UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
EAST ASIAN REGIONAL COORDINATING UNIT

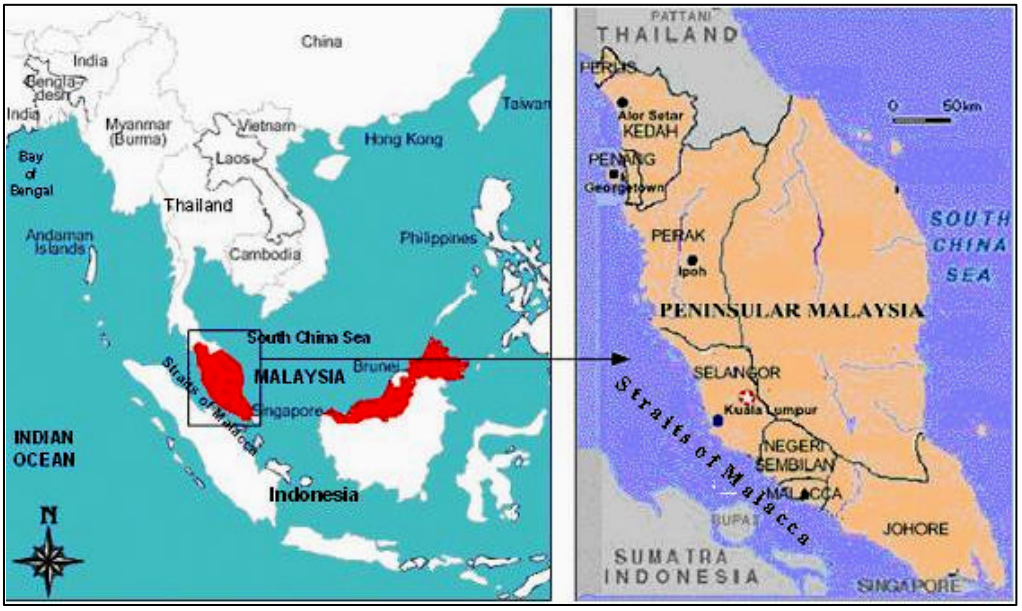
NATIONAL REPORT OF MALAYSIA

On the

Formulation of a Transboundary Diagnostic Analysis

And

Preliminary Framework of a Strategic Action Programme for the Bay of Bengal



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ACKNOWLEDGEMENT

The author wishes to express his sincere gratitude to the following individuals for providing valuable literature and spending time for an interview;

1. Y.B. Dato' Dr. Hashim Hassan	*Secretary-General II* *Ministry of Science, Technology and Environment, Putrajaya, Malaysia.*
2. Dr. Mohd Zahit b. Ali	*Director* *Conservation and Environment Division,* *Ministry of Science, Technology and Environment, Putrajaya, Malaysia*
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NATIONAL REPORT OF MALAYSIA ON THE BAY OF BENGAL LARGE MARINE ECOSYSTEM PROGRAMME

By
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1. INTRODUCTION

1.1 AIM OF REPORT

The aim of the national report is to review existing information on the use of, and threats to, the Malaysian coastal and marine resources off the Straits of Malacca and the adjacent waters of the Andaman Sea and the Indian Ocean. In the process, an attempt is made to identify, examine, and rank those threats that have transboundary effects on man and the environment and to determine information gaps that need to be addressed for integrated management of coastal and marine resources in the region.

1.2 MAJOR WATER-RELATED ENVIRONMENTAL PROBLEMS

The sources of water-related environmental problems in Malaysia are both land and sea-based pollution. The fouling of the water ecosystem, natural or man induced, cause delirious effects such as harm to living resources, hazards to human health, and a hindrance to economic processes.

Land-based Sources of Pollution

One of the main causes of water/river pollution is the rapid urbanisation on the West Coast, arising from the development of residential, commercial, and industrial sites, infrastructural facilities (ports and roads) as well as land reclamation in coastal waters. The

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destruction of rainforests and water catchments, and the subsequent erosion of soils together with the heavily silted run-offs, pollutes the rivers. These and other sources of land-based pollution are as follows:

- Sediment run-off
- Industrial waste
- Domestic waste
- Agricultural and animal waste
- Heavy metals

Sea-based Sources of Marine Pollution

Next to the Dover Straits in U.K., the Straits of Malacca is the world's second busiest international shipping lane. Over 15,000 vessels, large and small, utilize the straits waters daily. Shipping activities, discharges, and accidents are all threats to the marine environment. In general, the sea-based sources of marine pollution in the coastal waters off the West Coast of Peninsular Malaysia are:

- Shipping activities (operational discharge, deballasting, tank cleaning, bilge water and sludge)
- Small vessel discharge (barges and fishing vessels)
- Aquaculture development (prawn and fish culture)
- Domestic discharge from coastal population
- Land reclamation (for commercial/industrial centres)

1.2.1 Air-Related Environmental Problems

Though not directly a water related environmental problem, the haze in 1997 caused by Indonesia's shifting agriculture and slash-and-burn technique of jungle clearing was one of Asia's worst man-made catastrophe. The emission of smoke, soot, organic particles and

noxious gases such as nitrous oxides, sulphur oxides, dioxins, and other volatile compounds sent the air pollution index in neighbouring Southeast Asian countries beyond the very unhealthy (201-300) and, for some areas, above the hazardous (>500) level.

Haze is a phenomenon characterised by visibility impairment due to the scattering and absorption of light by particles and gases in the atmosphere. Its effect to the water environment is through:

- Emissions of sulphur dioxide (SO_2) and oxides of nitrogen ($N0_x$) and related particulate matter (sulphates and nitrates) that contribute to poor visibility and impact public health that in form is associated with breathing difficulties, damage to lung tissue, cancer and premature death.

- Acid rain, as emissions of SO2 and N0x in the atmosphere react with water, oxygen and oxidants to form acidic compounds. The acid rain raises the acid levels of lakes and streams making the water unsafe for some fish and other wildlife.

Indonesian haze has hit the region on a number of occasions in the 1980's and 1990's. The one in 1977 was the worst incurring an economic loss of US1.3 billion, from close-down of factories, curtailing of regional flights, drop in tour packages, to vessel accidents in the Straits of Malacca (www.icsea.org/sea-span).

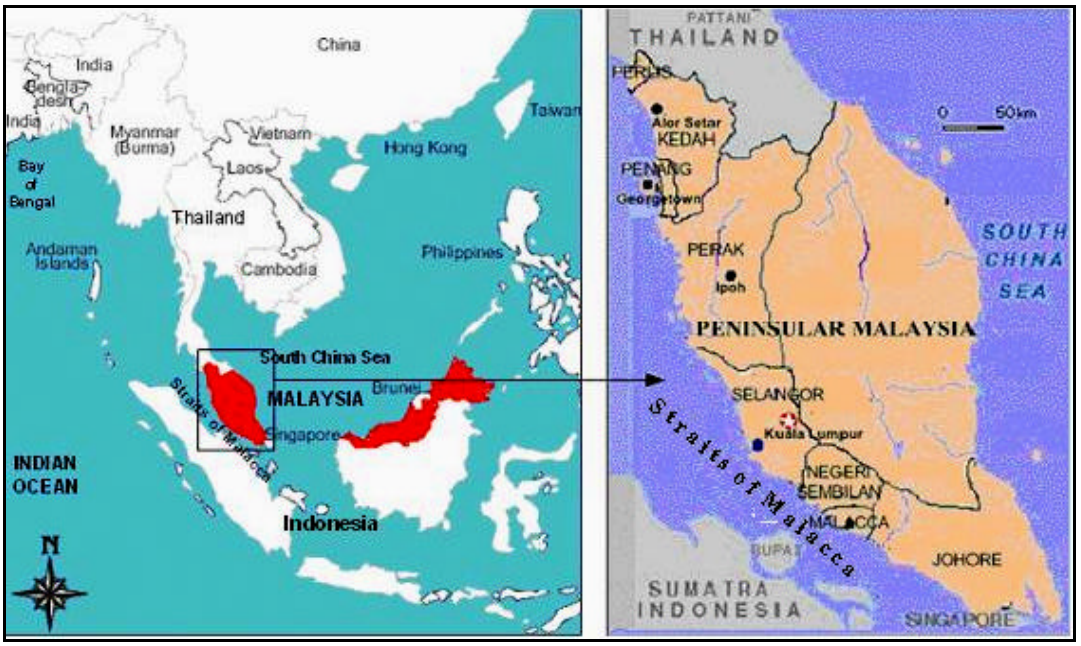
With Malaysian companies investing in a big way in palm plantations in Kalimantan and Sumatra and with palm oil prices expected to be bullish, the torching of forest lands in Indonesia could be on an industrial scale in the future. The monitoring, control, and management of Indonesian haze has to be on a regional basis among ASEAN members. Being hit by the ASEAN financial crisis, Indonesia is not in a position to adopt the polluter-pays principle.

1.3 COUNTRY BACKGROUND

General Geography

Malaysia is situated in the central part of South-East Asia and occupies a total land area of 330,434 square kilometres. The land mass comprises three main components: Peninsular Malaysia and the two states of Sabah and Sarawak, which occupy the coastal strip of northwest Borneo (Figure 1.1). Peninsular Malaysia is the largest of the three areas, covering 131,387 square kilometres.

Figure 1.1: Map of Study Area



Malaysia has a long coastline of 4,810 km. Her marine waters consist of a continental shelf of 148,307 km^2 and an Exclusive Economic Zone of 450,000 km^2.

Economic Setting

Malaysia consists of a federation of 11 states in Peninsular Malaysia and the states of Sabah and Sarawak in the north of Kalimantan. Kuala Lumpur, the national capital, Labuan

and Putra Jaya form the Federal territories. The multiracial population of Malaysia is composed of 58 percent bumiputra (Malays and indigenous people), 24 percent Chinese, and the remainder Indians and other minor groups (18 per cent). The population was about 22 million in 2002, with the majority (over 80 per cent) living in Peninsular Malaysia.

Under the Federal Constitution, both land and water are state matters, while public health and sanitation are concurrent matters on which both can legislate. To some extent, the federal and state jurisdiction overlaps in environmental management, whereby broad policies are formulated at the national level for implementation by the respective federal and state agencies at the ground level. This overlapping of roles and responsibilities at the implementing level can lead to unnecessary bureaucracy, agency rivalry and slow action.

In Peninsular Malaysia, the 11 states can be divided into two economic regions. The majority of the manufacturing industries, plantations, tin reserves, ports and populations are concentrated in the west coast states, while the east coast states are sparsely populated and relatively undeveloped.

The general data on the Malaysian economy are shown in Table 1.1. With a gross National Product (GNP) of RM310.8 billion and a GNP per capita of RM13,361 (US$3,516), Malaysia enjoys a reasonable standard of living with low poverty (9.6 per cent of households) and unemployment rates (3 per cent).

Since independence in 1957, the structure of the Malaysian economy progressed from a simple agriculture economy to one that is industrial and export-oriented economy. Subsequently, the share of agriculture dropped from 29 per cent in 1970 to 14 per cent in 2000, while the share of manufacturing jumped from 14 per cent in 1970 to27.8 per cent for the same period (Dept. of Statistics, 2002).

Table 1.1: General Economic Data, Malaysia (2000)

Area	329.758 sq km (incl. inland water) 330,417 sq km (Peninsular) 131,598 sq km (Sabah) 73,711 sq km (Sarawak) 124,449 sq km
Poverty rate	9.6% of households
GDP	RM339.4 billion
GNP	RM310.8 billion
GNP per capita	RM13,361
Current Account Balance	+RM31.2 billion
Exports / imports	RM373.3 bn / RM312.4 billion
CPI change	+1.5% (Q1 2001)
Employment	9.64 million Agriculture = 14.0% Mining = 00.5% Manufacturing = 27.8% Construction = 08.8% Services = 48.3%
Unemployment	3.0%
Water coverage	91% of population

Sources: Department of Statistics, Malaysia.

Table 1.2 shows the major export items of Malaysia in 2002, both in terms of value and share. Electrical and electronic, palm oil, petroleum, and wood-based industries contributed over 75 per cent to total export value.

In terms of export markets, Singapore, USA, and Japan were the main trading partners (Table 1.3). Together, these countries imported merchandise worth about RM27 billion and accounted almost 50 per cent of Malaysian exports.

Malaysian imports consist mainly of intermediate raw materials and equipment for her value-added manufacturing activities (Table 1.4). These include mainly electrical and electronic materials, machinery appliance and parts, metals and iron and steel products. Similar to export markets, her major import sources were from Japan, USA and Singapore (Table 1.5).

Study Area

Peninsular Malaysia comprises mainly of highlands, floodplains, and coastal zones. The mountain range, Banjaran Titiwangsa, which runs from north to south divides the west coast and east coast states of the Peninsular. Starting from the north, the west coast states that fringe the Straits of Malacca are Perlis, Kedah, Penang, Perak, Selangor, Negeri Sembilan, Malacca, and West Johore (Figure 1).

Most rivers on the west coast of Peninsular Malaysia such as Sg. Muda, Sg. Pinang, Sg. Perak, and Sg. Klang are short and steep. Open water bodies, natural wetlands, and man-made lakes such as dams, and ex-mining pools are mostly found in the Klang and Kinta Basins. These water bodies are used for power generation, flood control, national water supply, recreation, aquaculture and tourism.

Figure 1.1: Map of Study Area

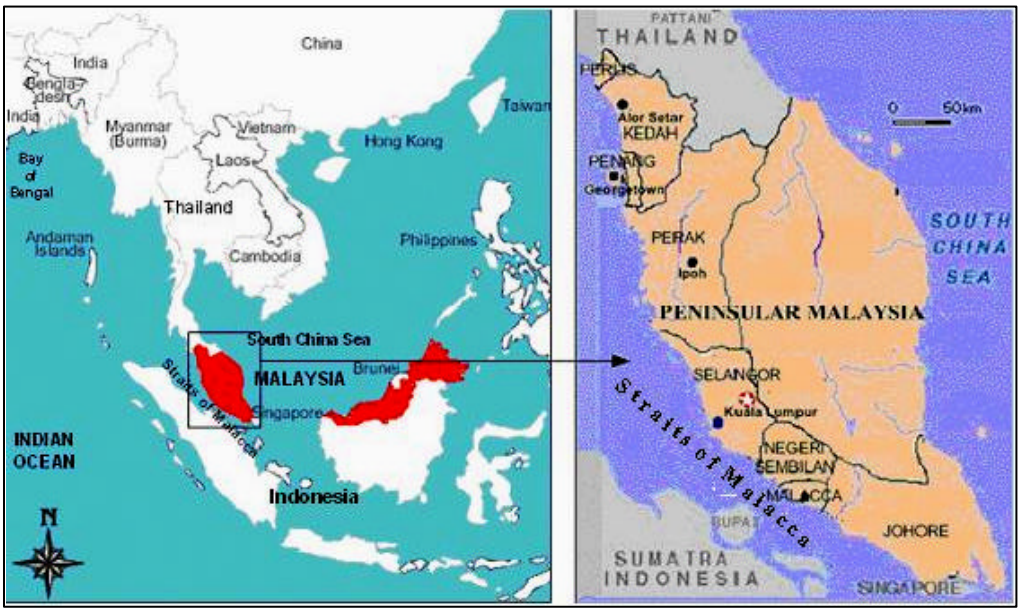


Table 1.2: Major Export Items, Malaysia (2002)

	Value (RM Million)	Share (%)
Electrical and electronic	197,986.6	55.9
Palm oil	17,193.2	4.9
Chemical	16,731.9	4.7
Crude petroleum	11,831.8	3.3
Machinery appliances & parts	11,150.5	3.1
LNG	10,451.4	2.9
Wood products	10,451.4	2.9
Textiles and clothing	8,408.3	2.4
Optical and scientific	8,157.3	2.3
Refined petroleum	6,790.1	1.9

Source: Department of Statistics, Malaysia.

Table 1.3: Major Export Markets by Country (2002)

	Value (RM Million	Share (%)
USA	71,501.9	20.2
Singapore	60,663.5	17.1
Japan	39,776.3	11.2
Hong Kong	20,169.3	5.7
China	19,965.8	5.6
Thailand	15,096.0	4.3
Taiwan	13,223.9	3.7
Netherlands	13,146.9	3.7
Korea Republic of	11,823.7	3.3
United Kingdom	8,353.1	2.4

Source: Department of Statistics, Malaysia.

Table 1.4: Major Import Items, Malaysia (2002)

	Value (RM Million)	Share (%)
Electrical & electronic	149,469.8	49.2
Machinery appliance & parts	26,659.2	8.8
Chemical	21,525.0	7.1
Manufactures of metal	11,004.7	3.6
Transport equipment	11,540.1	3.8
Iron and steel products	9,746.9	3.2
Optical and scientific	9,139.2	3.0
Refined petroleum	7,496.3	2.5
Crude petroleum	4,780.1	1.6
Textiles and clothing	4,319.9	1.4

Source: Department of Statistics, Malaysia.

Table 1.5: Major Import Sources by Country, 2002

	Value (RM Million)	Share (%)
Japan	53,909.6	17.8
USA	49,699.8	16.4
Singapore	36,316.1	12.0
China	23,474.4	7.7
Taiwan	16,803.5	5.6
Korea Republic of	16,079.4	5.3
Thailand	12,017.0	4.0
Germany	11,163.4	3.7
Philippines	9,862.8	3.2
Indonesia	9,688.0	3.2

Source: Department of Statistics, Malaysia.

Marine Environment

Covering both the continental shelf and exclusive economic zone, Malaysian maritime waters off the West Coast of Peninsular Malaysia is approximately 600 nautical miles long, semi-conical in shape, with widths of 220 nautical miles in the northwest and 8 nautical miles at the Riau Archipelago. A major portion of the waters lies within the continental shelf areas of 10 to 60m in depth. The deepest area (70m) is in the Andaman Sea at the northern tip of the Straits, while the shallowest is at the One Fathom Bank in the south.

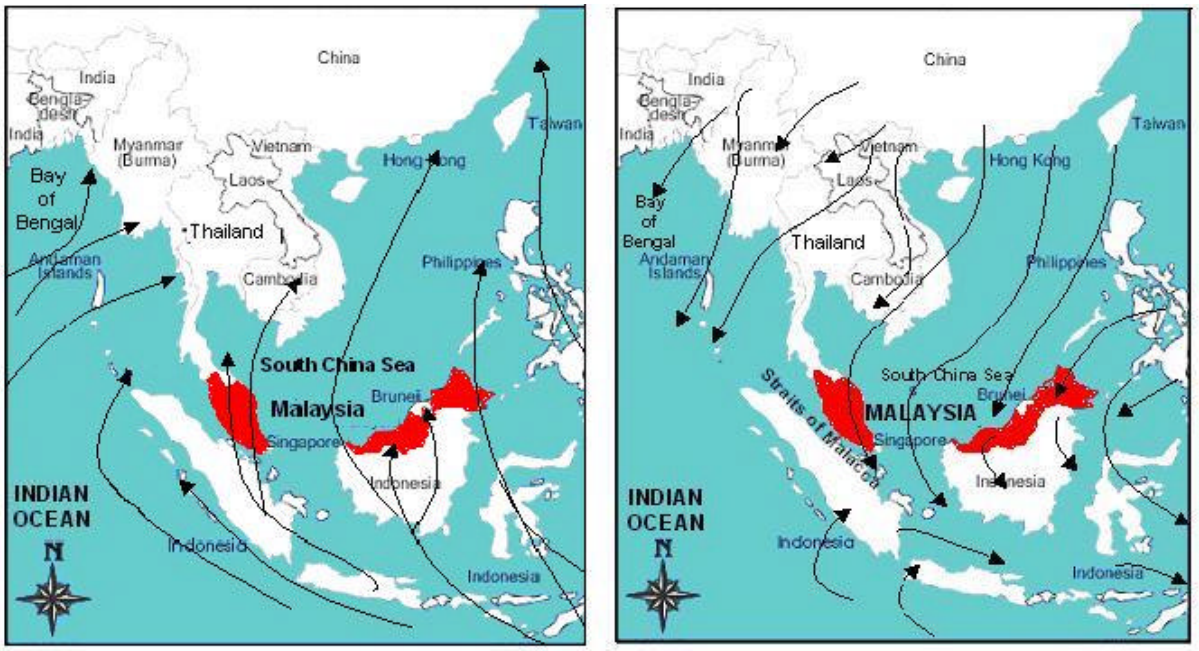
The current predominantly flows in a northwest direction with rates of 1 to 1.25 knots, although in some areas it may increase to 5 knots. The tidal range varies from 1.6 to 3.7 meters, with a much higher range inshore. For instance, Port Klang has experienced tides of up to 5 meters and with a tidal stream of over 4 knots.

The West Coast of Peninsular Malaysia has an equatorial climate, with an average annual rainfall of more than 2500mm and a daily temperature that ranges from a minimum of 25°C to a high of 33°C. The area is subjected to two rainy spells, the Southwest monsoon from June to September and the Northeast monsoon from November to March (Figure 1.2). During these periods, the marine waters may be rough enough to curtail fishing operations in the Straits.

The coastal zone along the Straits of Malacca is rich in mangroves, estuaries, coral reefs, sea-grass meadows and algae beds, mudflats, beaches and small island ecosystems. Each of these marine-based resources, with its unique habitat, supports a wealth of marine life, some not well explored nor documented.

Figure 1.2 Temporal Monsoons Affecting Peninsular Malaysia

I) South West Monsoon ***II) North East Monsoon***



Pollution Control and Management

The main legislation protecting the environment in Malaysia is the Environmental Quality Act (EQA), 1974. The legislation sets limits to allowable pollutant levels for both land and sea-based sources as well as for prescribed development activities as specified under the Environmental Impact Assessment Regulations (1987). There are other regulations to complement the Environment Quality Act, 1974, such as laws governing resource use (National Forestry Act, 1984, Fisheries Act, 1985, and Exclusive Economic Zone Act, 1984), vessel operation and conduct (The Merchant Shipping Ordinance, 1952), land use pattern (National Land Code, 1965, and Land Conservation Act, 1960), and other local government by-laws on earthworks, earth removal, mining, sanitation and solid waste disposal.

Thus, with respect to water resources, the most important legislation in Malaysia governing water quality management is the Environmental Quality Act (EQA), 1974. The objective of the EQA is basically twofold: pollution prevention, abatement and control as

well as environment enhancement. There are at least six sets of regulations under EQA, 1974, for control of water pollution and the environment, and these are:

- Environmental Quality (Prescribed Premises)(Crude Palm Oil Regulation, 1974)
- Environmental Quality (Prescribed Premises)(Law Natural Rubber) Regulation, 1979.
- Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979.
- Environmental Quality (Prescribed Premises)(Schedules Waste Treatment and Disposal Facilities), Regulations, 1989.
- Environmental Quality (Scheduled Wastes) Regulations, 1989.
- Environmental Quality (Prescribed Activities Environmental Impact Assessment) Order, 1987.

The above regulations stipulate the standards and procedures for handling the various types of domestic and industrial wastes.

Stakeholders and Water Resource Management

The conservation, use, and management of water resources, freshwater or marine, is everyone's concern. The general public, private sector, national and local governments, non-governmental organizations, and international agencies have a role and responsibility to ensure proper and sustainable use of water resources.

In Malaysia, the administration and management of water resources is carried out by Federal and various state government agencies. The Federal Government sets the policies and undertakes studies at the national level for overall planning and development purposes. Recently, the Federal Government initiated the National Water Resource Studies (till year 2050) and established the National Water Resource Council (1998) with the responsibility of streamlining water resource development and management activities of all states.

As mentioned earlier, the relationship between the states and Federal Government in terms of legislative and executive powers is governed by the Federal Constitution. Under the Constitution, land is a state matter and, hence, state governments have legislative powers over rivers, lakes, streams, aquifers, including turtles and riverine fishing. The key agencies that deal with the implementation, management and monitoring of water resources include the following: -

- **Department of Irrigation and Drainage** ***(under the Ministry of Agriculture)***
  Involves in development works, operations, and maintenance of water supply and infrastructures. Also, provides other technical services such as flood control, coastal pollution information, hydrological data collections, irrigation and river conservancy.

- **Department of Environment (DOE)** ***(under Ministry of Science, Technology and Environment)***
  Mission is to promote, ensure and sustain sound environmental management in the process of nation building. Has responsibility to ensure the water in rivers is clean by controlling and monitoring pollution. Also undertakes mitigated measures through implementation of the Environmental Impact Assessment (EIA) for projects.

- **State Water Departments**
  State agencies are responsible for water abstraction, treatment, and distribution to consumers and industrial users.

- **Local Authority**
  The local authorities indirectly influence the state of rivers and water resources through their overall development plans and land use decisions.

- **Department of Town and Country Planning** ***(Ministry of Local Government)***
  Controls land use patterns and pace of development as the Department gives the final approval to developers. Land-use zoning directly affects river and water resources.

- **Forestry Department**
  Responsibility to manage state gazetted forests, peat wetlands and mangrove forests as well as catchment areas and rivers within forests. It also controls logging activities through the selective management system (SMS).

Besides the state and federal agencies, some of the local community groups and NGOs that are active on environmental issues include: Friends of the Earth (Sahabat Alam Malaysia), World Wildlife Fund for Nature (Malaysia), Malaysian Institute of Marine Affairs (MIMA), Malaysian Nature Society, Malaysian Fisheries Society, Environmental Protection Society of Malaysia, Public Media Club, and various charity organizations.

Malaysia participates actively in the regional and international fora on environment and has good working relationships with a number of international organizations. Some of these linkages include United Nations Environmental Programme (UNEP), United Nations Conference on Environment and Development (UNCED), Food and Agriculture Organization (FAO), Coordinating Body on the Seas of Asia (COBSEA), UNESCO, GEF/UNDP/IMO, and PEMSEA.

2. DETAILED ANALYSIS OF MAJOR WATER-RELATED CONCERNS AND PRINCIPAL ISSUES

2.1 POLLUTION

Often associated with the flow of residuals, pollution can be defined as the presence of matter or energy that has undesired effects on the environment. Pollutants pose a risk to life support ecosystems and can be difficult to control. Water pollutants are many, if not more than their polluting sources.

2.1.1 Rivers

Rivers with their loads of municipal, industrial and agricultural wastes eventually end up discharging these at the estuaries and polluting the coastal marine waters. Under the previous Malaysian Water Quality Programme, a total of 116 rivers encompassing 892 sampling stations were monitored by the Dept. of Environment throughout the country. Assessment of water quality in these stations were measured in terms of biological and chemical characteristics and compared against the national water quality standards.

Table 2.1 shows the status and trend of river quality for the period 1988-1994. It can be seen from the water quality measured in terms of Biological Oxygen Demand (BOD) caused by organic decomposition, ammoniacal nitrogen (NH_3-N) emitted from sewage and animal waste, and suspended solids from soil erosion and sedimentation all registered negative overall trend (deteriorated) for the period 1988-1994. The overall water quality index, measured for its physical, chemical and biological characteristics in form of turbidity, salinity, temperature, pH, dissolved oxygen and electrical conductivity, also worsened for all 116 rivers over the same period.

Table 2.1: Status and Trend of River Water Quality, Malaysia, (1988-1994)*

Pollutants	Status in 1994			Overall Rate of Change (1988-1994)	
	Polluted	Slightly	Clean		
Biological Oxy. Demand (BOD)	13 (13%)	18 (15%)	83 (72%)	-0.88	Deteriorated
Suspended Solids (SS)	66 (57%)	16 (14%)	34 (29%)	-0.91	Deteriorated
Ammonia cal Nitrogen (NH_3-N)	36 (31%)	35 (30%)	45 (39%)	-1.72	Deteriorated
Overall Water Quality Index (WQI)	14 (12%)	64 (55%)	38 (33%)	-0.92	Deteriorated

* A total of 116 rivers were evaluated.
Source: Dept. of Environment Malaysia (1994).

From the table, suspended solids and ammoniacal nitrogen were the main pollutants accounting for 57 per cent and 36 per cent of the total polluted rivers respectively.

Since 1995, there were no documented statistics on river water assessment that was published by the DOE, as the Natural Water Quality Programme was contracted to a private company, Alam Sekitar Malaysia Sdn Bhd (ASMA). However, in 2000 the DOE resumed the data collection but the format was changed from river to basin-based reporting, depriving inter-period comparisons. This time around, the DOE covered 931 water-monitoring stations which were located within 120 river basins (DOE, 2001). Of these 931 monitoring stations, 489 (53%) were found to be clean, 303 (33%) slightly polluted, and 135 (15%) polluted. Even though the outcomes are not exactly comparable to those of 1994, because of sample size and location of stations, nonetheless the broad picture indicates a general improvement in water quality of the Malaysian rivers. This improvement could be due to several factors that include a slowdown of economic activities and property development due to the Asean

financial crisis, relocation of swine farms away from rivers, and the improved awareness of the general public on environmental pollution due to intensive public and NGO campaigns.

2.1.2 Sedimentation

The rapid pace of urbanization, indiscriminate destruction of rainforests and catchments for the establishment of new townships and industrial sites have resulted in the high sedimentation of rivers in the littoral states of the Straits of Malacca. Prior to urbanisation, rainwater gets absorbed by the vegetation, infiltrates the ground and takes time to get to the rivers. Without vegetation, the run offs are excessive, rapidly eroding both land surfaces and river banks. The heavy loads of sedimentation that empties into the rivers are a hazard to both human and aquatic life.

2.1.3 Industrial Waste

The common forms of industrial pollution are suspended particulate emissions that cause air pollution, BOD discharges that cause water pollution, and toxic waste discharges that affect all elements. Over 80 per cent of the total volume of industrial water discharge in Malaysia originate from four categories of manufacturing activities (1) food and beverage processing, (2) industrial chemicals and chemical products, (3) rubber products manufacturing and (4) textile and leather products (Table 2.2).

Rivers in the highly industrialized states of Penang, Perak, Selangor, Malacca and Johore were most affected by industrial waste.

Table 2.2: Distribution of Major Industrial Sources of Water Pollution, West Coast States (1993)

	Major Pollution Sources/Industries							
States	**Palm Oil**	**Raw Natural Rubber**	**Rubber Product**	**Food and Beverages**	**Textile & Leather**	**Paper**	**Chemicals**	**Total**
Selangor	31	8	252	174	92	87	194	838
Johor	67	39	32	199	203	43	76	659
Pulau Pinang	4	8	58	164	76	38	77	425
Perak	48	26	54	102	1	1	28	260
Kedah	4	28	47	55	33	23	18	208
Negeri Sembilan	13	20	43	25	14	11	21	147
Melaka	2	10	28	48	55	22	27	192
Perlis	0	2	8	3	2	0	15	30
Total States	**169**	**141**	**522**	**770**	**476**	**225**	**456**	**2759**
Contribution by Pollution Source	**6.13%**	**5.11%**	**18.92%**	**27.91%**	**17.25%**	**8.16%**	**16.53%**	**100.00%**
Total MALAYSIA	**287**	**18**	**597**	**1169**	**545**	**292**	**560**	**3468**
Contribution by Pollution Source (%)	8.28%	0.52%	17.21%	33.71%	15.72%	8.42%	16.15%	100.00%
Overall Contribution to Total Pollution	**79.56%**							

Source: Dept. of Environment Malaysia (1994).

2.1.4 Domestic Waste

Domestic or human waste affects the environment in at least three ways. When solid waste is burnt it pollutes the air, when sewage is inadequately treated it contaminates drinking water; and when sanitation is poor, it results in water and insect-borne diseases. Lack of proper sewage disposal and treatment systems result in the waste being discharged directly into the rivers and seas.

Table 2.3 shows the organic pollution load discharge according to sectors. In 1993, the pollution load measured in BOD from domestic sewage accounted for 67% of total BOD load, followed by agricultural and animal waste (22%), manufacturing industries (7%), and agro-based industries (2.7%). One interesting feature that needs investigation is the rapid increase in BOD loads from the other sectors over the years, resulting in a decline in the amount of domestic sewage from about 80 per cent in 1989 to 67 per cent in 1993.

Table 2.3: Malaysia: Organic Pollution Load Discharged According to Sector (1989 –1993)

Year	1989		1990		1991		1992		1993	
	1	2								
Sector	BOD Load	Population Equivalent	BOD Load	Population Equivalent	BOD Load	Population Equivalent	BOD Load	Population Equivalent	BOD Load	Population Equivalent
1. Agro-based Industries (Palm Oil & Raw Natural Rubber)	11	0.22	15	0.30	12	0.24	30	0.60	28	0.56
2. Manufacuturing Industries	21	0.42	25	0.50	25	0.50	27	0.54	77	1.54
3. Agriculture (Animal Husbandry)	60	1.20	65	1.30	65	1.30	211	4.20	230	4.60
4. Population (Sewage)	366	7.32	380	7.60	385	7.70	481	9.63	698	13.96
Total	**458**	**9.16**	**485**	**9.7**	**487**	**9.74**	**749**	**14.97**	**1033**	**20.66**

Source: Dept. of Environment Malaysia (1994).

2.1.5 Agricultural and Livestock Waste

As can be seen in Table 2.3, there has been a more than three fold increase in livestock waste over the years. Agricultural wastes from agro-based industries, such as wood, palm oil, and rubber processing mills were also on the increase. Johore, Selangor, and Perak collectively accounted 65.7 per cent of the total number of identified sources of pollution in the agro-based and manufacturing sector (DOE, 2001).

Livestock waste, pesticides, and fertilizers pollute our rivers and coastal waters. As coastal aquaculture systems are located mainly in sheltered coastal waters of the Straits of Malacca, these agricultural wastes, carrying bacteria and heavy metals, can be a health hazard if transmitted to the fish species cultured. There are very few studies on this causal link, although food poisoning incidences are often associated with cultured mussels and cockles.

2.1.6 Heavy Metals

The Department of Environment reported consistently much higher concentrations of heavy metals in rivers of the littoral states of the Straits of Malacca than in other parts of the country. Admittedly, this is due to extensive land use and industrialization, especially in Penang, Perak, Selangor and Malacca.

Penang has a large electronic industry and producing computer chips and semi-conductors generates a lot of wastewater, toxic chemicals and hazardous gases. In Malacca, the river alongside Alor Gajah Industrial Estate is polluted with heavy metals such as mercury, copper, and zinc that are higher than the permissible limits.

2.2 MARINE POLLUTION

The extent of marine pollution in the Straits of Malacca and adjacent waters depends mainly on the discharges of land-based activities from rivers, shipping operations, aquaculture effluents, domestic discharge from coastal population, land reclamation and from illegal dumping of waste.

2.2.1 Ports, Harbours and Marine Transport

Usually, cargo and oil ports are not major sources of pollution, except when shipping accidents, oil spills and groundings take place. With the busiest tanker traffic in the world, vessels that patronize the Straits, docked, berthed, anchored, laid-up, steaming or being serviced carry inherent risks where an accident can develop into an environmental catastrophe. Such risks are real but difficult to quantify as shipping statistics are difficult to compile. Although ships passing through are now required to report under the International Maritime Organization's Mandatory Ship Reporting System (1998) these, at times, do not

follow specific routes. Besides this, there are many cross traffic cargo vessels that service intra regional trade as well as thousands of licensed and unlicensed fishing vessels operating in the same sea space.

Table 2.4 presents an attempt to collate available statistics on the number of vessels that call on the major ports along the Straits for the period 2000-2002. Penang and Port Klang were the busiest ports and, in 2002, accounted over 85 percent of the traffic.

Table 2.4: Number of Vessel by Major Ports in the Straits of Malacca (2001-2002)

Port	2000	2001	2002
Penang	7,263	7,460	7,328
Port Klang	12,804	1,303	13,175
Sungai Udang	955	1,066	987
Port Dickson	1,185	1,152	908
Malacca	1,356	1,090	1,137
Tg. Bruas	461	462	423
TOTAL	**24,024**	**24,533**	**23,958**

Source: Compiled from Marine Department, Malaysia.

With thousands of large and small vessels plying the Straits a total of 476 accidents took place between 1978-1994 (Gunalan, 1999). Also, there were 18 major oil spill incidents (Table 2.5) due mainly to collision, grounding and human error.

Another source of marine pollution in the Straits is the non-accidental oil discharge as routine ship maintenance requires pumping out bilge water and, to a lesser extent, ballast water. Gunalan (1999) reported that vessel maintenance alone is capable of generating 888,000 tonnes of waste per year, consisting of 150,000 tonnes of oily bilge water sludge, 18 tonnes of solid waste and 720,000 tonnes of sewage. While a National Contingency Plan has been drawn up by the Malaysian government to control and mitigate oil spills in the Straits,

the threat of non-accidental oil discharge to the coastal marine environment has been overlooked.

Table 2.5: Oil Spill Incidents in Malaysia Waters Year (1975-1997)

Year	Name of Ship	Location	Cause	Type and Quantity of Oil Spill
1975	SHOWA MARU	The Straits of Singapore	Grounding	Crude oil 4000 tons
1975	TOLA SEA	The Straits of Singapore	Collision	Fuel oil 60 tons
1976	DIEGO SILANG	The Straits of Malacca	Collision	Crude oil 5500 tons
1976	MYSELLA	The Straits of Singapore	Grounding	Crude oil 2000 tons
1976	CITTA DI SAVONNA	The Straits of Singapore	Collision	Crude oil 1000 tons
1977	ASIAN	The Straits of Malacca	Collision	Fuel oil 60 tons
1978	ESSO MERSIA	The South China Sea	Collision	Fuel oil 505 tons
1979	FORTUNE	The South China Sea	Collision	Crude oil 10000 tons
1980	LIMA	The Straits of Singapore	Collision	Crude oil 700 tons
1981	MT OCEAN TREASURE	The Straits of Malacca	Human Error	Fuel oil 1050 tons
1984	BAYAN PLATFORM	The South China Sea	Human Error	Crude oil 700 tons
1986	BRIGHT DUKE/MV PANTAS	The Straits of Malacca	Collision	-
1987	MV STOLT ADV	The Straits of Singapore	Grounding	Crude oil 2000 tons
1987	ELHANI PLATFORM	The Straits of Singapore	Grounding	Crude oil 2329 tons
1988	GOLAR LIE	The Straits of Singapore	Grounding	-
1992	NAGASAKI SPIRIT	Near Medan, Indonesia	Collision	Crude oil 13000 tons
1997	EVOIKOS / ORADIN GLOBAL	The Straits of Singapore	Collision	Fuel oil 25000 tons
1997	AN TAI	The Straits of Malacca	Material Fatigue	Fuel oil 237 tons

Source: Marine Department, Malaysia.

2.2.2 Small Vessel Operation and Discharge

Besides the oil and petroleum tankers as well as large container carriers that ply the Straits of Malacca, another significant cause of marine pollution is from the fishing operations and, to a lesser extent, the cargo vessels that transport goods between neighbouring countries. About 13,000 vessels or 37% of Malaysian fishing vessels are operating from the shores of the littoral states along the Malacca Straits. The waste discharged from fishing vessels, villages and jetties, and the indiscriminate encroachment of trawlers into inshore waters pollute as well as destroy the breeding grounds of aquatic resources.

2.2.3 Aquaculture Effluents

With the levelling of fish landings, marine aquaculture is seen as an important alternative for fish production, especially along the sheltered coastal areas of the Straits of Malacca. Although the aquaculture industry is sensitive to water pollution, it is also a polluter to the marine environment (Chua, at. el., 1997). Semi and intensive culture of finfish and prawns has often been associated with eutrophication of coastal waters and the spread of disease. For example, aquaculture pollution from the intensive culture of groupers, sea-bass and snappers, is often caused by faeces and uneaten food, as well as nutrient discharges which reduce dissolved oxygen in the water and cause high BOD. The adverse effects of aquaculture effluents on water quality are seldom reported. In general, poor management of aquaculture effluents has resulted in the outbreak of fish diseases that often incur more financial losses to the farmers than the damage to the marine environment due to eutrophication..

However, of more pressing concern than aquaculture effluents is the destruction of the mangrove ecosystem in order to accommodate the rapid expansion in aqua farming.

2.2.4 Domestic Discharge from Coastal Population

The West Coast states are well developed and have the highest concentration of the Malaysian population. Table 2.6 shows that the West Coast has 58.62% of the national population despite having only 20.46% of the total land area. Penang, Selangor, Malacca, and Perlis have population densities that are multiples of the national average.

Table 2.6: Population by State - Malaysia (2000)

	Johor	Kedah	Melaka	Negeri Sembilan	Perak	Perlis	Pulau Pinang	Selangor	Total	MALAYSIA	% of Total Malaysia
AREA *Area in square kilometres*	18,987	9,425	1,652	6,644	21,005	795	1,031	7,960	**67,499**	**329,847**	20.46%
POPULATION SIZE AND COMPOSITION											
Total population	2,740,625	1,649,756	635,791	859,924	2,051,236	204,450	1,313,449	4,188,876	**13,644,107**	**23,274,690**	58.62%
Population density (per square kilometre)	144	175	385	129	98	257	1,274	526	***373.5****	**71**	
Urban population (%)	65.2	39.3	67.2	53.4	58.7	34.3	80.1	87.6	**486**	**62**	783.55%

**** Average***

Source: Department of Statistics, Malaysia, 2002

With the cities, towns, industrial sites, fishing ports and villages located in close proximities to river mouths and coastal waters, improper treatment of the sewage discharge seeps into the drainage system and pollutes the rivers and seas. Poor sanitation is also a source of water-borne diseases.

Domestic wastewater comprising of used water from toilets, bathrooms, laundry, kitchen and synthetic cleaning chemicals, if not properly treated, is toxic to humans, plants, and wildlife. Presently, the wastewater is collected by a system of sanitary sewers and treated at municipal plants before being discharged to rivers, but these are still inadequate even in urban centres (Keizrul Abdullah and Azuhan Muhamed, 1998).

2.2.5 Land Reclamation

Land reclamation for housing, infrastructure, and industrial purposes has an adverse impact on mangroves, cockle mudflats and fish stocks if not properly planned as it affects both the stability of the coastline and sustainability of capture and culture fisheries. For instance, land reclamation off Prai in Penang for industrial purposes, and subsequent discharges from factories, has threatened cockle farming at Kuala Juru because of high sedimentation and the incidence of heavy metals. It was reported that the heaviest concentration of mercury was near Nan Sing Textile factory, Kuala Juru, where the water contained 2.30ppm of mercury, 460 times the permissible level in the US.
(http://www.surforever.com/sam/a 2z/content3.

With 76 coastline reclamation projects covering 97,000 ha in the pipeline, particularly the large ones in Kedah, Penang, Perak and Selangor, there is an urgent need for a thorough EIA appraisal on the impact of land reclamation on the marine ecosystem.

2.3 FRESHWATER SHORTAGE AND DEGRADATION OF QUALITY

2.3.1 Surface Water

In Malaysia, rainfall is the only source of freshwater, especially during the wet monsoon seasons. The annual downpour amounts to above 900 billion m^3, of which 566 billion m^3 is in form of surface runoff, 360 billion m^3 is lost through evaporation, and 64 billion m^3 is trapped in aquifers (Govt. of Malaysia, 1982). The volume of groundwater resources stored in aquifers is estimated at 5000 billion m^3. Even though groundwater accounts for 90 per cent of total freshwater resources, 97 per cent of the national water supply for domestic, agricultural, and industrial use originates from surface runoffs.

Surface water resources are trapped mainly in dams or reservoirs at water catchment areas, chlorinated, and channelled through pipes to the end-users. Some rural folks living in squatter settlements and villages along riverbanks utilize surface runoffs directly from the rivers.

2.3.2 Surface Water Demand and Supply

The national demand for water is expected to grow at a rate of about 4 per cent annually, and projected to be almost 20 billion m^3 by 2020. Of this, 5.8 billion m^3 is for annual domestic and industrial water demand and the remainder for irrigation purposes (Keizrul, 1998). On a per day basis, consumption of water has increased from 7.6mn m^3 in 1995 to 10.4mn m^3 in 2000 (Mak, 2002).

With the present irrigated rice bowl areas in Kedah and Butterworth not expected to increase significantly in the future, the share of agricultural relative to domestic and industrial demand for water is expected to fall. On the , especially in Penang, Selangor and

Malacca, the domestic and commercial demand for water is expected to increase further given the current pace of urbanisation and industrial growth.

Table 2.7 illustrates the rapid growth in water demand for the states fringing the Straits of Malacca. Between 1980-2000, there was more than a three-fold increase in domestic and industrial water demand. With many catchments areas on the under intense pressure from land development activities, and the rapid rise in domestic and industrial demand from urban centres downstream, there have been frequent shortages and disruptions in water supply to the end users in recent years.

Table 2.7: Domestic and Industrial Water Demand, (1980-2000) (million m^3)

State	1980	1985	1990	2000
Perlis	7	9	16	37
Kedah	49	82	113	266
Penang	124	169	236	343
Perak	145	216	327	596
Selangor	470	658	787	1201
Negeri Sembilan	62	102	131	197
Malacca	30	43	61	112
Johore*	159	258	338	578
Total	**1,046**	**1,537**	**2,009**	**3,324**

* For the whole state
Source: Dept. of Irrigation and Drainage

On the supply side, the availability of water has also increased from 9.5mn m^3 per day in 1995 to 12.8mn m^3 in 2000. Under the Water Resource Master Plan (till 2050), an allocation of RM52 billion has been made for 62 water projects, including 47 dams. Recently, another RM 3.4 billion has been set aside under the 8^{th} Malaysia Plan (2001-2004) to fund ongoing projects, upgrade the distribution network, and repair existing infrastructure.

2.3.3 Groundwater

Groundwater resources are replenished by rainfall and through seepage from streams. Despite the abundance of groundwater, it only accounts for 3 per cent of total water use. The under utilization of groundwater resources is due to several factors and these include; the lack of information or maps to indicate their locations, perception that the supply is non-sustainable and harmful due to effluent seepages, and the lack of local expertise on groundwater technology. Furthermore, the present disposal of industrial and domestic waste in landfills in suburban areas poses a threat as the leachates can contaminate the groundwater with chemicals, heavy metals, and bacteria (*E. coli*).

Groundwater is extracted mainly through wells, especially in very rural areas for domestic use and irrigation. With water supply readily available to over 90 percent of the communities, planners previously gave little thought on groundwater development. Also, for practical reasons, investments in groundwater systems are expensive for urban dwellers because of the high capital outlays and operating costs. However, since the recent water crisis, the DOE has taken preliminary steps to determine the quality and distributions of groundwater through the national groundwater-monitoring programme in 1997. By 2001, the DOE had established 79 monitoring wells in Peninsular Malaysia and another 19 in Sarawak.

Samples taken were analysed for volatile organic components (VOC), pesticides, heavy metals, anions, bacteria, phenolic compounds, radioactivity, total hardness, total dissolved solids (TDS), pH, temperature, conductivity and dissolved oxygen. The groundwater status was determined by comparing against the National Guidelines for Raw Drinking Water Quality (1990). The results indicate iron, manganese, nitrates, and arsenic wastes (especially near landfills) contents in groundwater were significant (DOE 2003).

Much has still to be done for groundwater utilization as data on the distribution and relative abundance of groundwater resources, wells, and users are still scanty for macro planning.

2.3.4 Water Related Issues and Problems

Drought

In recent years, the water situation in the West Coast, especially Penang, Klang Valley, Negeri Sembilan and Malacca, has worsened. In1998, the prolonged drought caused by the El-Nino resulted in a water crisis and many parts of the country had to be rationed for water. Water demand from new growth centres such as the Kuala Lumpur International Airport and the Multimedia Super Corridor (MSC) further aggravated the drought effect causing frequent cutbacks in water supplies to neighbouring townships. This crisis has alerted the government of the need for prudent and integrated approach to water resource management so as to sustain commercial and industrial activities in order to achieve economic growth.

Floods

Floods occur due to the inability of streams and rivers to drain excess water from heavy downpours. About 29,000 km^2 or 9 per cent of the country's land area is flood-prone affecting the livelihood of 2.7 million people, both rural and urban dwellers. Even the aquaculture farms in coastal waters suffered high mortalities of fish, prawns and cockles from reduced salinity and heavy sedimentation due to sudden and excessive intrusions of freshwater from streams and rivers. Due to the freshwater intrusions, mussels culture in Malacca, cockles at Kuala Juru and prawn farms at Kuala Muda have incurred heavy financial losses.

In the urban centres, there has been a steady increase in the incidence of flash floods. The Klang Valley and Penang are two areas most susceptible to flash floods even after a short spell of heavy downpour, causing massive traffic jams that may last for hours. Flood mitigation measures, such as widening and deepening of drainage systems, are expensive but do not seem to be able to curb with the heavy downpours.

Water pollution

As with most Asean countries, man tend to be the main culprits to water pollution. Indiscriminate dumping of domestic and industrial wastes and the silting of rivers due to erosion caused by the destruction of forests and catchment areas pollute as well as reduce the carrying capacities of rivers. Water pollution reduces availability of good quality water, increases water treatment costs, and is also an ecological hazard affecting both human and aquatic life. Water pollution is a concern for all nations.

Management Issues

The management of national water resources, both from supply and demand perspectives, is not easy with an uneven distribution of residents, catchment areas, and differing financial capabilities of the states. As land is a state matter under the Malaysian Constitution, the powers of the federal agencies are limited at the ground level and this complicates the implementation of projects, particularly those that are of national interest. Malaysia has an abundance of sector-based regulations but not those that focus on the polluter-pays principle.

Exploration and Exploitation of Groundwater

With catchment areas gradually reduced for economic development and with an abundance of groundwater resources, efforts must be made to explore and map out the viable

locations for the exploitation of groundwater. Human capacity building and collaboration with countries such as Denmark, Germany and Holland, which have considerable experience in groundwater supply systems, can assist in our new focus for future water needs.

2.3.5 Sensitive and High Risk Areas

Most of the Straits of Malacca and coastal areas around densely populated urban and industrial centres can be considered sensitive and high-risk locations. These places pose direct and indirect threats to public health and aquatic resources as well as the sustainability of coastal biodiversity.

Starting from the north of the Malacca Straits, the Muda River has deteriorated from industrial and urban discharge due to rapid development at Sungai Petani, the state's new growth centre. Presently, the polluted river is threatening fish cage culture systems and the mangrove ecosystem downstream. Other rivers such as Sg. Pinang and Sg. Juru have also been degraded due to upstream economic growth, endangering the coastal life support systems affecting both aquaculture yields and fish landings.

In the central and southern regions, the high risk locations that are prone to flash floods, water pollution, and ecological damage, are Klang Valley, upper Kinta Valley, Linggi and Malacca Basins. Many urban rivers, lakes, and ponds that serve these areas are unfit for use as these are overloaded with non-point source (NPS) pollutants and storm water-generated waste.

The biggest danger to the marine and coastal resources, including the lives of fishermen, comes from the perpetual threat of oil spills and vessel accidents from ships that patronize the international straits. Such accidents are bound to damage marine life as well as life support systems such as mud flats, mangroves and coral reefs.

2.4 EXPLOITATION OF LIVING AQUATIC RESOURCES

The fishery sector is an important economic sector to the growing population as it continues to provide animal protein, employment and foreign exchange earnings.

In 2000, total fish production from marine capture, brackish/marine aquaculture and freshwater culture systems was 1.43 million tonnes valued over RM5.4 billion or about 1.6% of the GNP. Employment for the sector amounted to over 106,000 people or about 1.10% of the national total.

Marine captured fisheries contributed over 88% of the total fish production and provided 77.3% of employment in the sector. Overall, coastal fisheries is the major contributor to the sector with a production of 1.115 million tonnes or about 72% of total value of fish production.

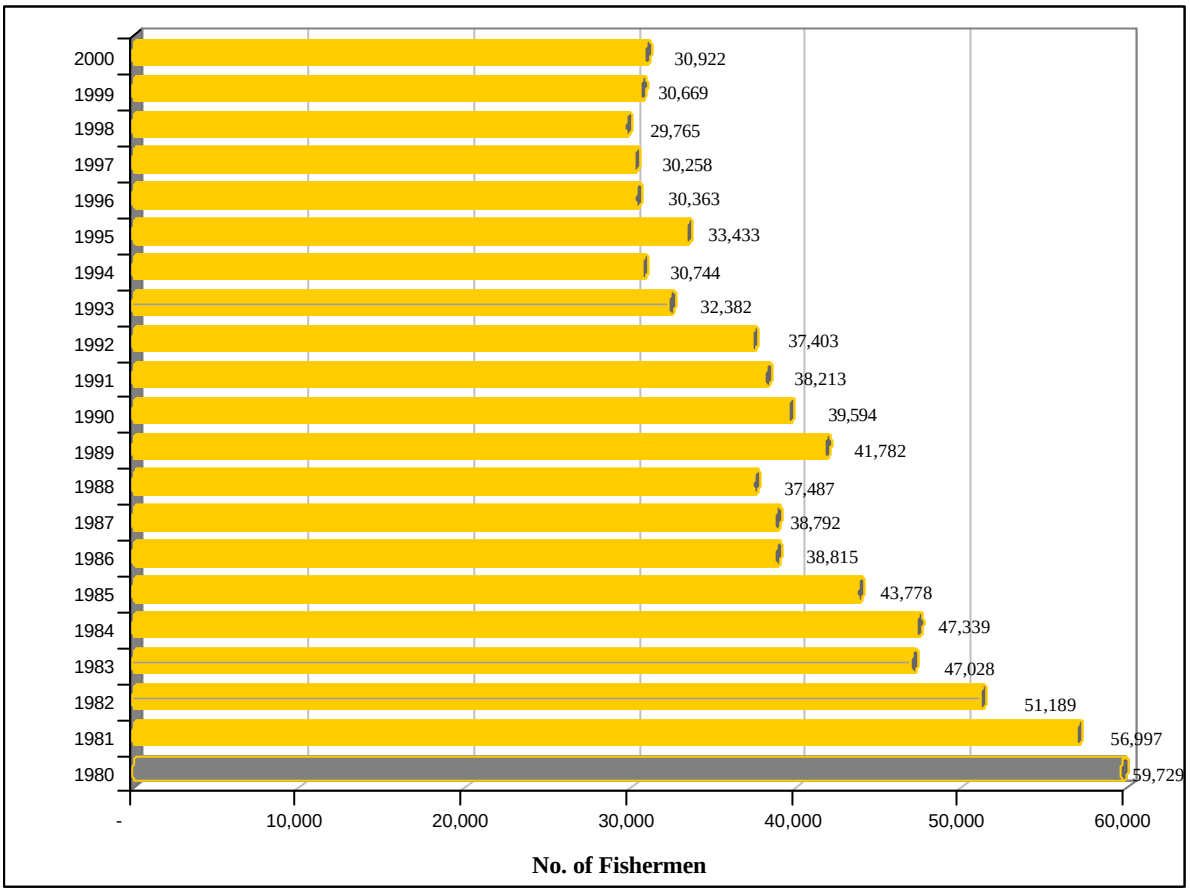
West Coast Marine Fishery

West Coast of Peninsular Malaysia remains the most productive fisheries region in Malaysia. In year 2000, the West Coast marine waters contributed 535,188 tonnes or 41.61% of Malaysia's total marine landings. It also dominates other regions in aquaculture production, contributing over 89% and 54% of the total fish production from brackish/marine aquaculture and freshwater culture systems respectively.

West Coast marine fishery employs some 31,000 fishermen (Figure 2.1) using around 13,095 vessels of which 98% were those licensed for inshore fishery and operating within 30 nautical miles from land. These vessels contributed 513,508 tonnes or 96% of the aggregate marine fish landing for the West Coast. Notice that there was a general decline in the number

of fishermen over time. In part, the gazetting of coastal waters for port activities such as the Klang and Malacca ports had displaced fishermen from vicinity villages (Ishak, 2000).

Figure 2.1: Number of Fisherman Working in Licensed Vessels West Coast Peninsular Malaysia, 2000



Source Annual Fisheries Statistics

In 2000, there were only 186 offshore fishing vessels operating in the West Coast. In spite all the government efforts to encourage fishermen to venture into deep-sea fishing, landings from this sector only contributed about 21,610 tonnes or 4 % of total fish production (Table 2.8). In 2003, the Fishery Development Authority (LKIM) bought five 80-tonner fishing vessels from Japan for the exploitation of skipjack tuna in the Indian Ocean . If successful, the venture may attract others to participate in deep-sea fisheries.

Table 2.8: Inshore Vs Offshore landing (tonnes), 1990-2000 West Coast Malaysia, 1990 - 2000

	INSHORE (< 30 n.m.)			OFFSHORE (= > 30 n/m.)			Total Landing (tonnes
	< 70 GRT No. of Vessels	Total Landing (tonnes)	% of Total Landing	= > 70 GRT (No. of Vessels)	Total Landing (tonnes)	% of Total Landing	
1990	16,801	494,842	96.94%	193	15,629	3.06%	510,471
1991	16,474	365,266	93.86%	185	23,897	6.14%	389,163
1992	15,693	452,604	95.49%	194	21,391	4.51%	473,995
1993	14,116	423,228	94.78%	190	23,287	5.22%	446,515
1994	13,269	439,564	95.49%	168	20,738	4.51%	460,302
1995	16,277	501,214	94.78%	172	27,604	5.22%	528,818
1996	14,509	485,980	94.21%	167	29,848	5.79%	515,828
1997	14,218	483,896	93.88%	154	31,533	6.12%	515,429
1998	14,048	521,334	94.58%	164	29,848	5.42%	551,182
1999	13,463	475,950	95.17%	163	24,131	4.83%	500,081
2000	12,909	513,508	95.96%	186	21,610	4.04%	535,118
1990-2000 Average		**468,853**	**95.01%**		**24,501**	**4.99%**	**100%**

Source Annual Fisheries Statistics

2.4.1 Living Freshwater Resources

Freshwater Aquaculture

The living freshwater resources cover fishing activities in ponds, cages, lakes, ex-mining pools, hydroelectricity impoundments, reservoirs and others. Inland fishing is done on a part-time basis and is supplemented by other agricultural pursuits. The contribution of inland fisheries is small, about 4.1% of total fish production in the West Coast.

The ornamental fish industry, which requires smaller establishment (tanks) and under controlled environment, has steadily gained importance. In 2000, the industry produced about 306 million aquarium fishes valued at RM72 million (Lim and Chuah, 2002).

Freshwater aquaculture is probably the most diversified in terms of species and culture systems. There are almost 20 species that are cultured using at least four different culture systems. The main culture systems by species are shown in Table 2.9.

Expansion of freshwater aquaculture industry has been slow, despite early optimism of its potential contribution to national fish production. The discharge of agricultural chemicals and pesticides to heavily silted rivers has limited the growth in the industry. In recent years, excavated ponds for recreational fishing is gaining popularity around urban centres.

Table 2.9: Freshwater Culture Systems by Species

Culture System		Intensive Culture	Semi-Intensive
Pond	Poly	*Chinese Carps*	*Carps*
	Mono	*Tilapia, Catfish, Prawns*	*Tilapia, Catfish, Snakehead, Goby, Prawns*
	Integrated	X	*Carps*
Cage	Poly	X	
	Mono	*Tilapia, Catfish*	*Tilapia, Catfish*
Tank	Mono	*Tilapia, Catfish*	X
Pen	Poly	X	*Carps*
	Mono	X	*Tilapia, Catfish*
	Integrated	X	*Tilapia, Catfish*

Note: X – seldom practised

Swamps and Water Bodies

Swamp forests act as carbon sinks and play an important role in regulating floods, as well as a source of water during droughts. These are also the home to diverse animals and plants besides being an important source of timber, fish and medicinal products. Land development, unabated logging and improved drainage, tend to dry out the top peat layers making them fire hazards and causing a loss in biodiversity.

Besides the swamps, mining for minerals, especially alluvial tin and sand, caused widespread degradation of areas with mineral deposits leaving behind sandy, barren and unfertile land, unattended water bodies, and silted waterways. Landslips, particularly of open-cast alluvium mines, also pose a hazard to life and property.

Paya Indah, covering 4000 hectares of degraded tin-mining land and bogged peat swamp forest, including the Kuala Langat Forest Reserve, has been gazetted in 1996 as the Malaysian Wetland Sanctuary. This is a high-profile environmental project and, with the Prime Minister as its patron, this initiative reflects Malaysia's continued commitment to Agenda 21 and Ramsar obligations.

Another government initiative is a RM20 million 5 year-project to promote the conservation and sustainable use of peat swamp forests in three sites in Pahang, Sabah and Sarawak (New Straits Time, 10/9/2003). This project funded by the United Nations Development Programme/Global Environment Facility (UNDP/GEF) in collaboration with the Danish International Development Agency (Danida) is intended to develop a model to be used in sustainable management and conservation of Malaysia's 3.3 million hectares of peat swamp forests.

However, present legislations governing the use of wetlands and mining are still inadequate due to the absence of clear guidelines, standards or benchmarks for sustainable utilization of the resource.

2.4.2 Living Marine Resources

2.4.2.1 Marine Capture Fisheries

The main marine species landed in Malaysia are classified under pelagics, demersal, crustacean/shellfish, mollusks/cephalopods and trash fish. Table 2.10 shows the amount and type of marine species caught by region in terms of tonnage. The West Coast region dominates for most species groups in Malaysia.

Table 2.10: Fish Species Landings by Location, Malaysia (2000)

Region	Demersal (tonnes)	Pelagics (tonnes)	Crustacean (tonnes)	Mollusks (tonnes)	Trash Fish & Others (tonnes)	Total (tonnes)	% of Total Malaysia
West Coast	75,680	126,987	67,211	47,635	217,605	535,118	41.62%
East Coast	55,032	196,822	7,797	25,447	113,677	398,775	31.02%
East Malaysia	103,886	105,673	34,710	15,353	92,181	351,803	27.36%
Total Malaysia	**234,598**	**429,482**	**109,718**	**88,435**	**423,463**	**1,285,696**	**100%**
% by Species Group	18.25%	33.40%	8.53%	6.88%	32.94%	100%	

Source: Annual Fisheries Statistics

Pelagic species dwell and feed on plankton and zooplankton near the water surface. Most of the pelagic species are transboundary and migrate along coastal and EEZ waters. Those of economic importance are the mackerels (*Rastrelliger*), scads (*Decapterus*), sardines (*Sardinella*), tunas (*Thunnaus, Auxis*), pomfrets (*Parastormateus*) and anchovy (*Encrasicholina*). These pelagic species are caught mainly by purse-seiners and trawlers. Pelagic species are difficult to manage as these are mainly shared stocks with neibouring coastal nations. Any conservation efforts or restrain on catch by one country will result in a gain for others. The optimal management of shared stocks is an area that requires collaborative effort among the littoral nations of the Bay of Bengal and the Andaman Sea.

Demersal fish resources are bottom-dwelling and often carnivorous. The marine species require light to hunt for food and are found in shallow waters, usually among mangroves rocks and reefs. Those of commercial value are threadfin bream (*Enmities*), bigeye (*Piracanthus*), barracuda (*Sphyraena*), red snapper (*Lutjanus*), and groupers. Demersal fishes are mainly caught by trawlers, traditional gear types, and hook and line. Attempts have been made by the Malaysian government to increase the productivity of fishery resources through the establishment of artificial reefs with the hope of creating a new breeding ground for marine fishes. A study by Zainuddin and Razak (2000) and recent evidence on the increase in marine landings on the West Coast suggest that artificial reefs can enhance fish productivity. However, a detail study on this is needed, to determine the extent of productivity increases as well as the fish species that are attracted to the artificial habitat.

Of concern to Malaysian fisheries, especially the West Coast fisheries, is the large amount of trash fish landed recently, over 200,000 tonnes or about 40% of total catch. Trash fish is an assortment of commercial and non-commercial species which are processed into fishmeal or other foods. The abundance of trash fish landings is an indicator that the West

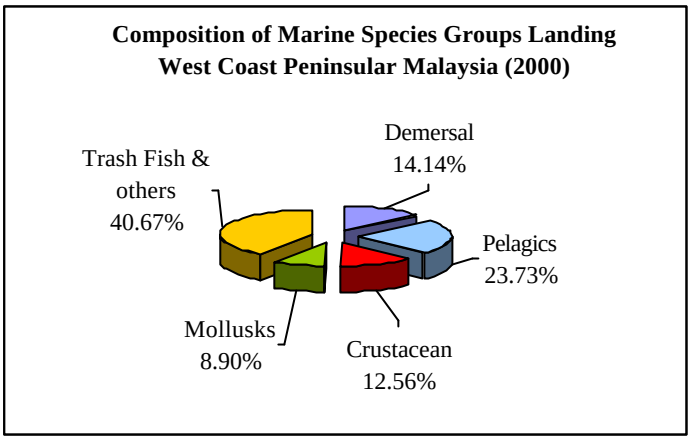
Coast fisheries has been over exploited, that is a level of fishing effort which produces a catch over the maximum sustainable yield (MSY).

The West Coast fisheries is also important for other marine species that are of commercial value such as prawns and mollusks. These species are both cultured and caught from the wild. In aggregate, West Coast prawns and mollusks landings contributed about 61% and 54% respectively of the national output. The increase in squid and cuttlefish landings recently is another phenomenon that can be linked to an over capitalized fishery.

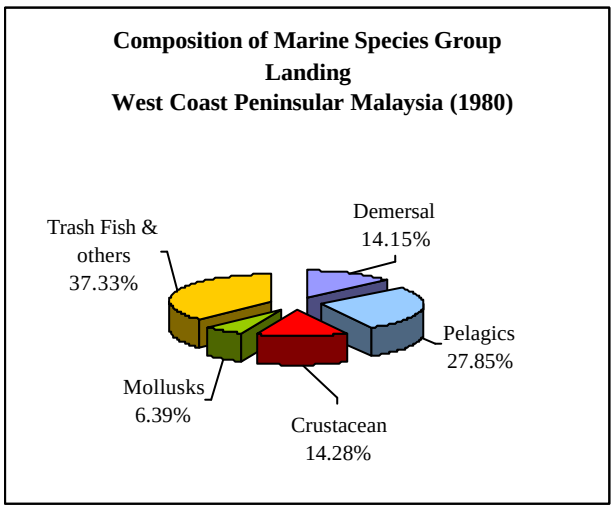
The general pattern in the species mix of landings over time is shown in Figure 2.2 (a to c). The ranking in terms of contribution by species group to total landing has been consistent over the three decades indicating that the fishery, though over exploited, has been relatively stable.

Figure 2.2: Composition of Marine Fish Species Group Landings West Coast Peninsular Malaysia

a)



b)



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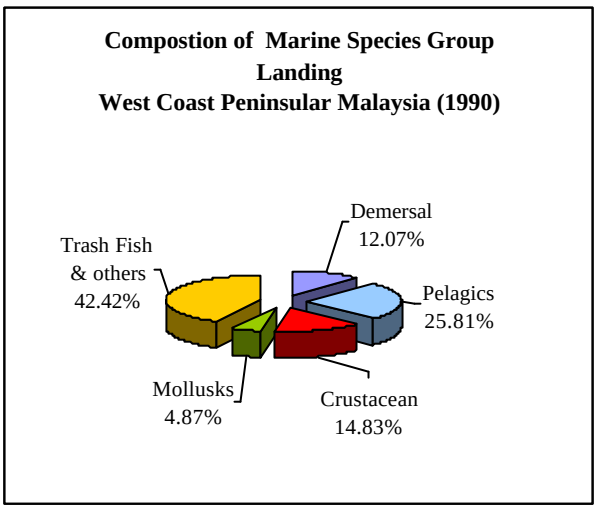


There has been a decline in the number of licensed fishing vessels over the years from 22,082 in 1980 to 13,095 in 2000 (Table 2.11). Most of the increase in landings in the West Coast was due to technological development, through the use of better fishing techniques, synthetic instead of fibre nets, large powered vessels and the rapid adaptation of trawl gear since the mid-1960's. Figure 2.3 shows the relative share of the gear groups. As expected, the mobile gear types, trawlers and purse-seiners landed the most, about 79% of the total catch.

One of the main problems in the West Coast fishery is the encroachment of trawlers into the coastal fishing grounds of traditional fishermen that has resulted in frequent conflicts between the two. Also, there are inter-country conflicts arising from the encroachment by Thai and Indonesian fishing boats into Malaysian waters, some have resulted in violence and even death (Ishak, 1994). The present trend in employing foreign fishermen, especially from Thailand to man offshore vessels has also created social problems resulting in hostility between the local and foreign fishermen.

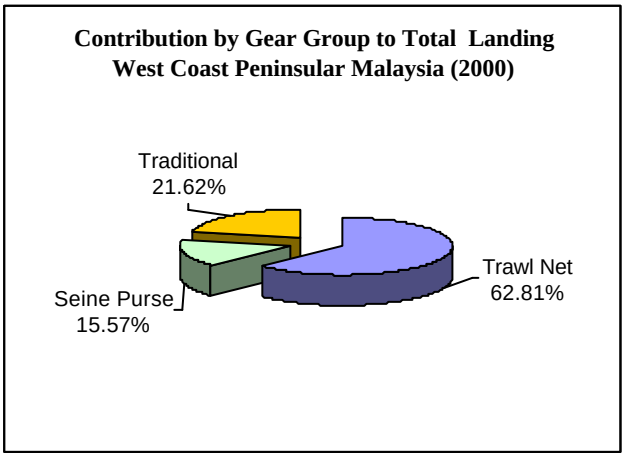
Besides the above, and of international concern, is piracy in the Straits of Malacca that is prevalent even in present times. For the first half of 2003, one quarter or 64 cases of piracy incidents worldwide occurred in Indonesian waters. Four ships were reported hijacked and 43 boarded while attempted attacks were made on 17 vessels (The Sun, 28 July 2003). Malaysia, with her better naval and marine capabilities to monitor her coastline had only five cases of piracy.

Table 2.11: Number of Licensed Fishing Vessels by Tonnage Class West Coast Malaysia (1980 – 2000)

Year	0 to 5 n. m.		Inboard - Powered				Total Vessels
			5 to 12 n.m.	12 to 30 n. m.	> 30 n.m.	TotaI Inboard-Powered	
	Non- powered	Outboard-Powered	< 40 tons	40 - 69.9 tons	70 tons & above		
1980	3,820	5,709	11,995	548	10	12,553	**22,082**
1981	2,948	6,428	11,865	592	15	12,472	**21,848**
1982	1,557	6,294	10,972	755	43	11,770	**19,621**
1983	1,308	6,181	9,600	754	52	10,406	**17,895**
1984	1,133	6,207	10,058	788	73	10,919	**18,259**
1985	979	5,707	9,120	770	120	10,010	**16,696**
1986	763	5,875	8,770	685	137	9,592	**16,230**
1987	653	5,462	8,945	628	152	9,725	**15,840**
1988	588	4,993	8,824	637	167	9,628	**15,209**
1989	664	6,281	9,578	621	193	10,392	**17,337**
1990	677	6,034	9,513	577	193	10,283	**16,994**
1991	626	5,838	9,415	595	185	10,195	**16,659**
1992	555	5,353	9,164	621	194	9,979	**15,887**
1993	407	4,456	8,623	630	190	9,443	**14,306**
1994	374	4,193	8,076	626	168	8,870	**13,437**
1995	438	7,260	7,959	620	172	8,751	**16,449**
1996	379	6,191	7,317	622	167	8,106	**14,676**
1997	352	6,194	7,026	646	154	7,826	**14,372**
1998	298	5,780	7,256	714	164	8,134	**14,212**
1999	182	5,260	7,272	749	163	8,184	**13,626**
2000	163	5,149	6,827	770	186	7,783	**13,095**
% of 2000 Total	*1.24%*	*39.32%*	*52.13%*	*5.88%*	*1.42%*	*59.43%*	*100%*

Source Annual Fisheries Statistics

Figure 2.3: Contribution by Gear Group to Total Landing West Coast Peninsular Malaysia (2000)



Marine/Brackish Aquaculture

Malaysia has a good potential to develop her aquaculture industry due to the abundance of sheltered marine waters, bays, lakes, mining pools and rivers as well as suitable climatic conditions for rearing fish. It has been estimated that a total 491,559 hectares of land and water bodies are suitable for aquaculture (Lim and Chuah, 2003).

Table 2.12 indicates the distribution of the potential areas for aquaculture by region in Malaysia, of which less than 10% has been utilized. Table 2.13 shows the number of culturists, and type of marine and brackish water output for the period 1980-2000. Cage culture of finfish (sea bass, groupers, and snappers) and pond culture of tiger prawns in mangrove areas has been increasing steadily over the years. In 2000, the value of aquaculture output was at RM403.7 million, almost doubling the previous period. Some of the main problems that limit the expansion of marine/brackish aquaculture are (i) *pollution from rivers*, (ii) *lack of breeding technology for new fish species* and (iii) *poaching*. The destruction of mangrove areas for brackish aquaculture is also of concern as these are important breeding and feeding grounds for the offshore fisheries.

Table2.12: Aquaculture Resource Potential in Malaysia

Resource Type	Suitable Area (ha)			
	Peninsular Malaysia	Sarawak	Sabah	Total Area
Open Coastal Waters (marine fish)	58,980	19,350	19,390	97,720
Lagoon Resources (seaweed)	x	x	102,413	102,413
Protected Coastal Waters (marine fish), mussels and oysters)	x	na	1,229	1,229
Mudflats (cockles)	8,330	na	na	8,330
Coastal Land (shrimp)	3,376	14,116	8,050	25,542
Freshwater Land Resources (freshwater fish)	60,000	na	51,178	111,178
Ex-Mining Pool (freshwater fish)	3,451	na	na	3,451
Lake/Reservoirs (freashwater fish)	25,496	116,000	na	141,496
Total	**159,633**	**146,466**	**182,260**	**491,359**

Source: Lim and Chuah (2003)

Table 2.13: Aquaculture Production from Brackish/Marine Aquaculture Systems West Coast Peninsular Malaysia (2000)

BrackishMarine Cages, Ponds, Cockles, Mussels, Oysters, Seaweed & Micellaneous							
	Culturist	Production (tonnes)					Total Wholesale Value
	(Nos.)	Cages	Ponds	Cockles	Mussels	Oysters	(RM '000)
1980	na	n.a.	n.a.	n.a.	n.a.	n.a.	na
1981	na	n.a.	n.a.	n.a.	n.a.	n.a.	na
1982	363	413	317	n.a.	n.a.	n.a.	4,392
1983	463	546	414	n.a.	n.a.	n.a.	12,438
1984	469	33	64	63,313	n.a.	n.a.	na
1985	547	373	158	44,684	n.a.	n.a.	20,569
1986	494	463	4,601	45,664	605	n.a.	27,155
1987	660	1,246	793	40,794	605	n.a.	40,376
1988	783	1,559	956	34,867	1,368	n.a.	45,238
1989	802	1,893	1,025	38,146	1,551	n.a.	54,644
1990	1,117	2,049	1,659	32,292	566	n.a.	50,885
1991	1,155	2,118	1,860	45,546	1,554	n.a.	72,087
1992	1,029	3,307	1,944	55,542	1,418	na	83,416
1993	1,100	5,414	3,525	16,590	1,179	5	146,886
1994	1,072	4,849	4,362	81,782	961	10	185,328
1995	1,312	4,850	4,568	99,658	761	12	190,818
1996	2,093	4,810	5,658	71,796	1,127	12	221,679
1997	1,895	5,237	5,975	58,400	1,751	13	235,937
1998	1,978	5,701	7,239	81,717	959	14	308,810
1999	1,987	6,184	7,833	79,885	1,302	21	224,114
2000	2,009	62,675	9,178	64,396	1,476	28	403,772

Note : n.a. – Not available

Ponds fish – *Baramundi, Grouper, Mangrove Snapper, Banana Prawn, Tiger Prawn, Mud Crab, Red Tilapia & miscellaneous*

Cages fish – *Baramundi, Grouper, Mangrove Snapper, Red Snapper, Tiger Prawn, Mud Crab, Berried Crab, Red Tilapia & miscellaneous*

Source Annual Fisheries Statistics

Marine Habitat

The Straits of Malacca is blessed with a myriad of ecosystems that host many species of resident and migratory wildlife which when coupled with extensive beaches and coral reefs, are attracting a growing number of tourists, both local and foreign. Among the important habitats found in the Straits of Malacca are mangroves, coral reefs, mudflats, and seagrass meadows.

Mangroves

Mangroves are important spawning, nursery, and feeding grounds for many marine crustaceans and fishes. The habitat plays a valuable role in the food chain, exporting out detritus and nutrients which form the food base for microorganisms, which in turn support the near shore fishes. Several mangrove areas and associated mudflats are also breeding, foraging, and transit sites for some resident and migratory shore birds. Tg. Piai (Johore) and Kg. Kuantan (Selangor) are popular ecotourism sites for watching birds and fireflies. Mangroves too play a protective ecological function by acting as a buffer against tidal erosion.

Even though only 17% of the total 640,000 hectares of mangrove forest are in Peninsular Malaysia, most of these are found in sheltered estuaries and deltas of rivers in the West Coast. The Larut-Matang area (40,711 hectares) in the north coast of Perak is the largest mangrove reserve, while others fringe the coastal borders of West Johore, Selangor and Kedah (Table 2.14). Small patches of mangrove are also found in the rocky shores of Pulau Langkawi, Pulau Pangkor, Port Dickson and the estuaries of Sg. Pulai. The common species of mangrove trees are *Rhizophora, Bruguiera, Ceriops, Avicennia, Sonn*eratia and *Xylocarpus*.

Table 2.14: Mangrove Reserves and State Land Mangroves in Peninsular Malaysia

State	Mangrove Forest Reserves[a]	Stateland Mangroves[b]	Total Mangroves
Perlis	0	100	100
Kedah	7,949	100	8,049
Penang	451	100	551
Perak	43,502	2,600	56,102
Selangor	15,090	4,000	19,909
Negeri Sembilan	233	0	233
Melaka	238	0	238
Johor	16,659	8,000	24,659
Pahang	2,483	450	2,933
Trengganu	1,295	0	1,295
Kelantan	0	20	20

Sources: [a] Annual Report of Forestry Department (1995)
[b] Chan and others (1993)

The principal threats to the mangrove ecosystem are: -

- Pollutant from rivers.
- Reclamation of land for development such as ports (Port Klang and Malacca Port), airports and industrial estates (Penang) and commercial centres (Malacca and Penang).
- Conversion of mangrove into aquaculture ponds for prawns and fish culture such as those those in Yan and Kuala Muda (Kedah) and Larut and Lumut areas (Perak).
- Coastal erosion due to tidal storms
- Inadequate legislation for mangrove conservation.
  Mangrove areas are partly gazetted as forest reserve (Federal Government) while the remainder is for state use. The absence of all-compassing legislation and institutional arrangement results in little attention paid to mangrove conservation or its use.

Coral Reefs

Coral reefs are important food, nesting, and nursery grounds for many commercial and aquarium species of fish, crustaceans, turtles, otters, dugongs, sea-cucumbers and other invertebrates. These are entirely living ecosystems comprising colonies of small coral polyps that live inside limestone cups and feed on plankton using their tentacles. Even though coral

reefs occupy less than 1% of the marine environment, they are the home of more than 25% of all known fish species *(www.wwfmalaysia.org/features/spaces/coral.htm)*.

Coral reef colonies are found around groups of islands off Pulau Langkawi, Pulau Pangkor, Pulau Sembilan and off the coast of Port Dickson. There is evidence that these habitats are being threatened or degraded due to sediments and pollutants from development activities on land, use of explosives to catch fish or to harvest corals, tourism-related activities and boat anchoring. Examples of these include the coral reefs at Pulau Giam near Pangkor Island (due to vessel traffic), Tanjung Tuan in Port Dickson (land reclamation) and Langkawi's Datai Bay (fishing and illegal harvest of corals).

Coral reef degradation could also be due to nature. Under currents, storms and starfish infestations can damage or destroy the habitat.

In order to conserve and protect the important coral reef areas, the Department of Fisheries has gazetted such places are marine parks. A marine park is essentially a sanctuary prohibiting the exploitation of any form of marine flora and fauna. On the West Coast, the four islands off Kedah have been gazetted as the Pulau Payar Marine Park, which today is a popular tourist destination.

Sea Grass Meadows

Unlike mangroves and coral reefs, sea grass meadows are hardly studied in Malaysia, even though the habitat is rich in food resources as well as important breeding and nursery grounds for many marine species. Sea grass meadows are located in shallow waters of 0.2 to 1.8 metres off the littoral states of the Straits of Malacca, from southwest Johore to Langkawi.

Arshad et.al (2001), in evaluating sub-tidal sea grass areas in southwest Johore, found a total of twenty fish species, mainly juveniles of *Ariidae* and *Dorosomatidae* families, that live in the meadows. Grunters, silver biddies, and scad, penaid prawns and portunid crabs were also in abundance. The dugong, a mammal protected under the World Conservation Union list of threatened animals, no longer frequent the meadows as in the past because of the heavy vessel traffic in the Straits of Malacca.

Land reclamation, industrial and domestic pollutants, sedimentation, sand mining, and oil spills constitute a threat to the habitat.

2.4.3 Impact of Man-based Activities on Freshwater and Marine Ecosystems

The impacts of men's activities on the freshwater and marine ecosystems are summarized in Table 2.15. These negative impacts are drawn from earlier discussions on the threats to each ecosystem.

Admittedly, it is impossible to quantify or attach a monetary value to these degradations for lack of empirical evidence. Thus, the ranking of the impacts on the basis of significant, moderate and non-significant will help to identify those critical man-based activities that need to be closely monitored and regulated. From the table, it can be seen that land reclamation, international shipping, industrial discharge, and urban development were the major causes to the degradation of marine and freshwater ecosystems.

As mentioned earlier, mother nature is also capable of habitat degradation. Heavy downpours and subsequent erosion of hills, land and river banks, floods, sedimentation, and sudden changes in marine salinity due to freshwater intrusions to the sea all nature-based and are damaging to all ecosystems.

Table 2.15: Summary of Adverse Impacts of Man-based Activities On Marine and Freshwater Ecosystems

Man-based Activities	Marine Ecosystems				Freshwater Ecosystems
	Mangrove	Seagrass Meadows	Coral Reefs	Mudflats	Rivers, Swamps, Water Bodies
1. Fishing Activities					
Capture	✓	✓	✓	NS	NS
Culture	✓	✓	NS	NS	NS
2. Agriculture	✓	NS	NS	NS	✓
3. Industrial Activity	✓	✓	NS	✓	✓
4. Urbanization	✓	✓	M	✓	✓
5. Sewage Disposal	✓	✓	NS	M	✓
6. Land Reclamation	✓	✓	✓	✓	✓
7. Mining	✓	✓	NS	M	✓
8. Logging	✓	✓	NS	✓	✓
9. Shipping Accidents	✓	✓	✓	✓	M

Note : ✓ = significant impact
M = moderate impact
NS = non-significnt impact

3. ANALYSIS OF SOCIO AND ECONOMIC COSTS OF IDENTIFIED WATER-RELATED PRINCIPAL ENVIROMENTAL ISSUES

The importance of biodiversity conservation in all ecosystems is important as these provide food, water, and opportunities for enhancing our wealth. There is a need to conserve, protect or even develop the biodiversity assets, although valuing the benefits is a complex task because of physical, ecological, and species interactions. However, the lack of proper management of life support habitats will lead to environmental problems that will incur high social and economic costs to society. Figure 3.1 provides an indication for a thorough appraisal of the socio economics costs of poor water resource management.

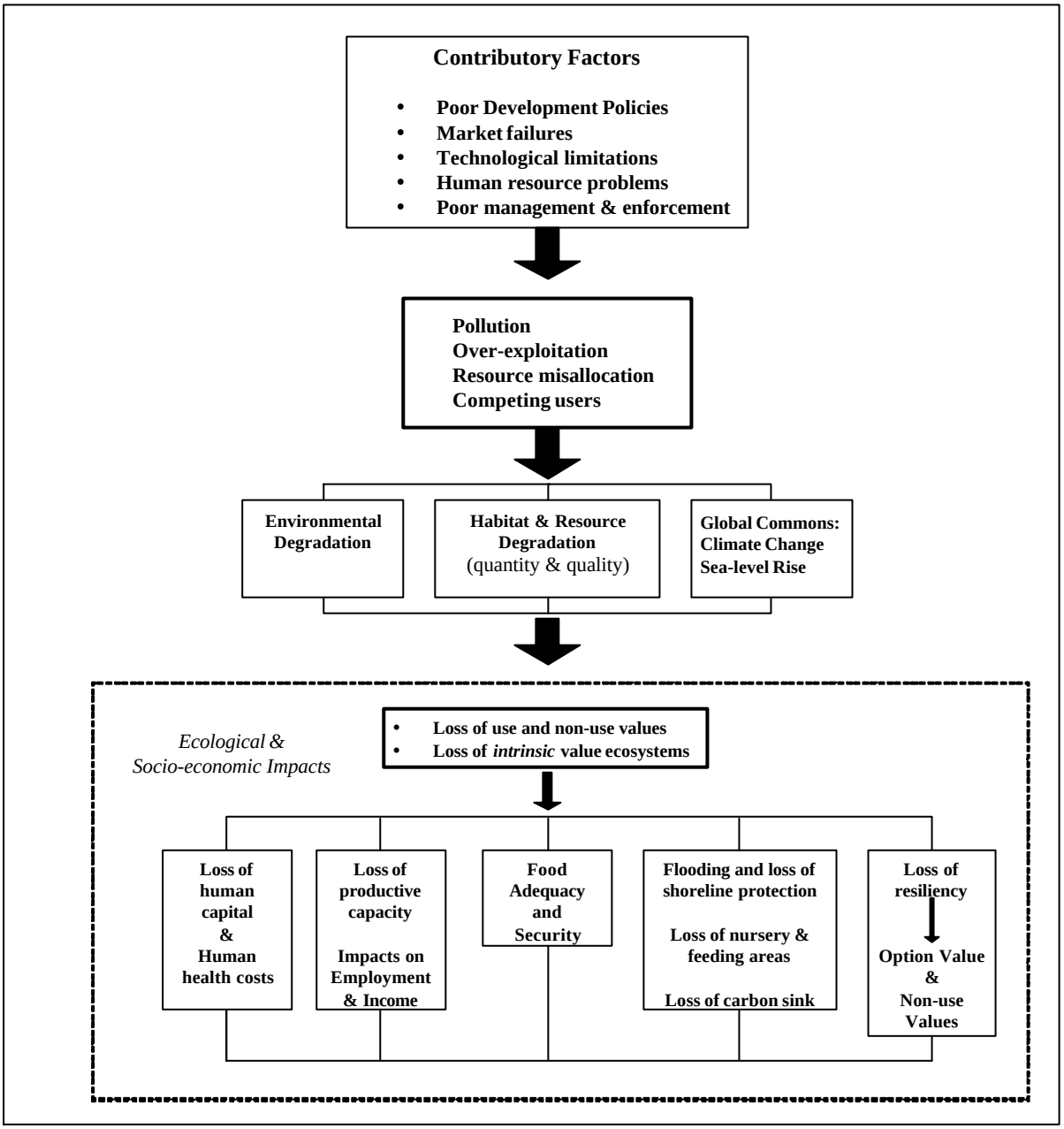
Some of the principal water-related environmental issues and socioeconomic costs discussed earlier can be summarized as follows: -

- Water related issues (pollution, rising costs of water supply, erosion, floods, droughts and management)
- Resource use issues (ecosystem degradation, resource exploitation, and man-based threats)
- Biodiversity issues (loss in biodiversity, aesthetic value and endangered species)

Water related issues are generally self-inflicted by society due to ill-conceived planning and management of projects and are most expensive to rectify. Poor sewage disposal systems, indiscriminate discharge of toxic materials from industries, erosion, siltation and floods arising from rapid runoffs in the urbanization process result in outbreak of water-borne diseases, destruction of valuable habitat and high capital expenditures to alleviate or overcome the problems. Establishment of embankments to curtail erosion and

improve drainage systems cost billions of Ringgit to the government. For the general public, the rising costs of safe water supply is of concern.

Figure 3.1: The Socio-Economic Costs of Water Resource Degradation



The link of marine habitat, as life support systems, to many commercial fishes of the West Coast has been well acknowledged. For lack of biological information, extrapolations on monetary values of these relationships are far from convincing. At times non-market valuation of an ecosystem is exaggerated to be multiple times that of actual value of the

marine resources harvested. Of more serious concern is the man-based activities that are threatening the very ecosystems that they depend upon for food and income. Over-exploitation of fishery resources and the destruction of marine ecosystems by coastal communities and others represent an economic loss for both present and future generations.

The compensation sought from polluters is also not easy to recover and may take years of arbitration. Even local polluters, especially the manufacturing industries, are rarely subjected to the polluter-pays principle for lack of clear guidelines and benchmarks. The same can be said of international users of the Straits of Malacca. Despite our adoption of the MARPOL resolutions, compensations for vessel accidents or oil spills to littoral states is seldom promptly honoured as the negotiation process is lengthy and involves international arbitration. In the meantime, the costs of vessel surveillance, safe passage and maintenance of an integrated oil spill contingency plan rest mainly on the Malaysian government that gets her financing from the general public.

The degradation of freshwater and marine ecosystems has resulted in loss of biodiversity and endangering some species of fish, plants, mammals, turtles and other wildlife. It also carries a social cost, since the aesthetic and recreational values of the habitat are lost for local and foreign tourists.

As a party to the Convention of International Trade of Endangered Species (CITES) and other organizations, Malaysia is concerned with any loss in biodiversity. Table 3.1 shows some of endangered species of water-based ecosystems and the causes for their high mortality, evidence obtained from research and documented literature.

Table 3.1: Endangered Marine Resources and Mortality Sources

Type of Ecosystem	Endangered Species	Cause for High Mortality
Freshwater Ecosystem	***Fish***	
• rivers, lakes, and swamps	*Tor tambroides* (Ikan Kelah) *Scleropages formusus* (Ikan Kelisa) *Hampala macrolepidota* (Ikan Sebarau) Source: Hanan (2002)	• Pollution • Illegal fishing techniques (explosives & poison) • Excessive sedimentation due to urbanization
Marine Ecosystem	***Fish***	
• rocks, reefs and mangroves	*Lactarius lactarius* *Sciaenids* (Jewfish) *Helsa species* Source: Abu Talib et. al, (2000)	• Overfishing • Vessel traffic • Environmental factors
	Turtles	
• coral reefs • coastal waters	*Eretmochelys imbricata* (Hawsbill turtle) Source: Tan et. al. (2002)	• Accidentally caught by fishing gears • Vessel traffic along the Straits • Land Reclamation activities
• seagrass meadows	***Mammals*** *Dugong* Source: Gan, S. L. (1999)	• Accidentally caught by fishing gears • Vessel traffic along the Straits • Degradation of grazing areas • Land Reclamation activities

4. ANALYSIS OF THE ROOT CAUSE OF INDENTIFIED WATER-RELATED ISSUES

The analysis of the main issues, causal chains, socio-economic impacts, and suggested remedies for water related problems are presented in Table 4.1. Poor land practices, enforcement limitations, rapid urban development, and lack of funds for investment in treatment technologies, presumably due to the ASEAN financial crisis (1997), have taken a toll on the aquatic environment, resulting in food contamination, land erosion, degradation of habitats and loss in biodiversity.

As the Straits of Malacca is the principal depository of land-based pollution via river systems, and coupled with the fouling of marine waters from oil spills and coastal land reclamation activities, the ultimate outcome is the degradation of critical habitats for fish, crustaceans, mollusks, mammals and other wildlife. The loss in productivity of the marine waters, income for fishermen, and aesthetic and recreational values of habitats for tourism are transboundary issues as the resources of the Straits of Malacca are shared by Singapore, Indonesia, Thailand and Malaysia. The economic losses to littoral states due to foreign vessel accidents or oil spills in the Straits can also be transboundary but have to be resolved through international arbitration.

Table 4.1 (a): Analysis of Root Causes and Socio-Economic Impacts of Water-Related Issues

Major Problem	Location	Source	Causal Chain		Socio-economic Impacts	Action
			Cause	Root Cause		
1. Degradation of Water Quality	Major towns (Alor Star, SG. Petani, Penang, Klang, Malacca, Muar, Ipoh, Kuala Juru	• Sewage related liquids and microbes	• Domestic wastewater (BOD), nutrients, low oxygen	• Insufficient treatment facilities • Financial constraints	• Health problems from microbial contamination	• Build central sewage system and treatment facilities • Invest in human resource development
	Major rivers (Sg. Juru, Sg. Pinang, Sg. Perak, Sg. Klang, Sg. Melaka, Sg. Muar)	• Agricultural, livestock, and industrial waste	• Untreated animal waste, fertilizers, pesticides, and chemicals	• Unclear policies, failure to treat industrial waste	• Eutrophication and loss of aquatic production • Human health problems from hazardous metals • Loss in biodiversity	• Enforce benchmarks and polluter-pays principle
2. Sedimentation and Solid Waste	All major rivers and deltas	• Logging • Urbanization • Land Reclamation • Mining • Dredging	• Soil erosion • Tailing Discharge	• Poor land use, practices and enforcement • Illegal logging • Direct dumping of municipal waste	• Destruction of property due to flash floods • Degradation of habitats • Loss of revenue from fisheries and tourism activities	• Review laws and adopt integrated river basin management • Minimize land reclamation projects • Stricter surveillance and enforcement of forest lands and industrial estates • Improve drainage systems
3. Heavy Metals	All major rivers, deltas, mudflats and coastal waters near industrialized sites	• Industrial discharge, city pipes, land fills, agricultural weedicides, and pesticides	• Heavy metals taken-in by marine resources, e.g. shellfish, cockles, fishes and other organisms	• Lack of treatment technologies • Financial constraints • Lack of enforcement	• Health hazard from contaminated seafood. • Destruction of coastal habitat and loss of revenue due to lower yield	• Introduce recycling or environmental-friendly treatment technologies • Provide tax incentives for cleansing technologies • Stricter enforcement and adopt polluter-pays principle.

Source:

Table 4.1 (b): Analysis of Root Causes and Socio-Economic Impacts of Water-Related Issues (con't)

Major Problem	Location	Source	Causal Chain		Socio-economic Impacts	Action
			Cause	Root Cause		
4. Degradation of Marine Waters	Coastal waters of littoral states	• Accidents, oil spills, operational and ballast water discharge	• Lack of oxygen to marine ecosystem due to the oil	• Accidents and leakage • Human error • Lack of enforcement on vessel sea-worthiness • Irresponsible attitudes	• High costs of clean-ups • Habitat damage and loss of income from loss of fishing and tourism • Loss in biodiversity	• Build central sewage system and treatment facilities • Invest in human resource development
	Langkawi , Prai, Port Klang, Malacca, Penang, Lumut	• Land Reclamation Activities	• Loss of benthic community, biological community composition and degradation of coastal habitats (mudflats, seagrass meadows and mangroves) • Conversion into urban centers, ports and industrial centers.	• Expensive urban land • Easy shipment • Infrastructure-building, e.g. roads to ease traffic congestion (Penang)	• Damages coastal habitat and reduces fishing incomes • Increase coastal erosion and sedimentation that affects other economic activities	• Discourage or ban coastal reclamation projects • Stricter monitoring of reclamation of activities so as to minimize ecological damage

Source:

5.0 REMEDIAL ACTIONS

5.1 WATER POLLUTION

At the national level, the strategy adopted by Malaysia to control pollution is the enactment of laws, the principal being the Environment Quality Act (EQA), 1974. The Act controls pollution from land-based and vessel-based sources while legislation of prescribed development activities is stipulated under the Environmental Impact Assessment Regulation, 1987.

At the state level, the legislation and prosecution of the various acts are done by both federal and state agencies. Pollution of inland waters by industries may also be prosecuted by state legislations such as the Waters Enactment, 1920, Mining Enactments, and even the rearing of pigs enactments that are adopted by Malacca, Negeri Sembilan and Johore state governments.

Under the Local Government Act, legislation for domestic wastewater is under the local municipal authorities. However, in 1993, due to the lack of sewerage infrastructure and poor maintenance of treatment plants by state municipalities, a private consortium (Indah Water Consortium) was commissioned by the Federal government to undertake all development and operations of municipal wastewater infrastructure. The privatisation of sewage system meant an additional cost to consumers who now have to pay the water bill plus an environmental cost. With treatment cost, at times, exceeding the water bill there was obvious outcry from the public and subsequent defiance to pay the charges. An amicable solution is yet to be found, and in the meantime Indah Water has to burden the expenses. Also, the separate billings for users by the local municipality and IWK reflect that the two agencies are not in the best of terms.

One major success of the EQA (1974) was the curtailing of effluents from rubber and palm oil mills, once the main culprits to river pollution. Also, the Dept. of Environment was effective in controlling organic discharge from pig farms into rivers, especially those located in Negeri Sembilan and Malacca.

Since 1985, the DOE began monitoring pollution in coastal waters. Presently, there are approximately 153 locations that are monitored for chemical and bacteria content

5.2 WATER SHORTAGE

For reasons mentioned earlier, urban areas with a high population density and experiencing rapid growth have frequent interruptions of treated water supply. Non-revenue water losses due to leaks in the distribution system and pilferages that are on the increase aggravate the shortage.

At the peak of the water crisis, more than 600,000 residents in central Selangor and Kuala Lumpur had to be rationed for water. Lorry tankers were used to transport water to residents and 10 mobile water treatment units from France were installed at disused mining pools to ease the water shortage. Penang had to source her supply from the Muda Dam in Kedah to meet her needs. This stopgap measures were still inadequate and new investments had to be made to ensure sustainable supplies of water to urban centres. These include:

- **Sungai Selangor Phase III Project** (RM2.4 billion)
  Expected to be operational in 2004, this project will supply 1,050 million litres per day of water to the state of Selangor. It involves the contruction of the Sungai Selangor Dam as well as water treatment plants for Rasa and Bukit Badong.

- **Pahang – Selangor Water Transfer Program** (RM3.8 billion)
  The project is aimed at transferring water from water sufficient states like Pahang to water deficient states. Via underground pipes, the

project is expected to transfer 2,400 million litres per day of raw water from Pahang to Selangor, Kuala Lumpur, and Negeri Sembilan.

5.3 PRIVATISATION OF WATER DEPARTMENTS AND PROJECTS

Following the National Water Resource Study in 1982, another move to ensure water adequacy in terms of both quantity and quality to the populace, a number of states have privatised their water departments (Selangor, Johore, Pahang, Kelantan and Negeri Sembilan). While the strategy reduces the financial burden and augments state control of water resources and projects, it attracted new players or stakeholders to the industry. With contracts running to billions of Ringgit, the industry has drawn in a number of new and listed companies, jockeying for influence and contracts.

Some of those that have won lucrative contracts include Gamuda which holds a 30 per cent in SPLASH (Selangor's water department that has been privatised and owns the concession) for the construction of Sungai Selangor Phase III Project and Perangsang Water Management (also state-linked) and Puncak Niaga which were earlier awarded contracts for the Phase 1 and Phase II Projects. Even a prominent businessman has his finger in the pie through a reverse take-over of a listed company and immediately acquiring the operation and management of 16 water treatment plants in Johore. In other states, a similar pattern of awarding of contracts was adopted, with state-owned entities collaborating with firms or influential dignitaries. The performances of these joint ventures have yet to be evaluated but the present trend in privatisation of state water departments clearly indicates that state authorities are not going to succumb easily to control or pressure from the central authority, i.e. the National Water Resource Council.

5.4 INTEGRATED RIVER BASIN MANAGEMENT (IRBM) APPROACH

Deforestation, dam construction, urbanization, industrial discharges, landfills, and indiscriminate dumping of wastes represent uncoordinated activities that pollute and undermine the natural capacity of rivers to carry their loads and excessive runoffs to the sea. Also, the planning, monitoring and enforcement of regulations for water resource management rests with a host of sector-based agencies as well as local and federal agencies, at times complementing and, on other occasions, they rival each other. Thus, environmental conservation, water resource development and management on an integrated and sustainable basis is an arduous task.

Recently, Malaysia has adopted the Integrated River Basin Management framework for sustainable river management. The approach takes a holistic perspective and looks into the whole river system from its headwaters through its middle course, associated lakes, and right down to where the river empties itself into the sea at the estuary. The framework also includes efforts for river restoration activities and protection of the flora and fauna.

The first pilot project was launched in 1997 by the Dept. of Environment (DOE) for the Sungai Trengganu River as a model for other states to emulate. In 1999, the Selangor State government enacted the Waters Management Enactment (1999) for the establishment of the Waters Management Authority for Selangor to carry out a four-year restoration programme covering six rivers. As expected Sungai Selangor was to serve as the pilot project for the IRBM system. In line with the Ramsar Convention, Malaysia has also incorporated wetland conservation and use into river basin management initiatives. However, the achievements of the IRBM projects are yet to be documented.

5.5 PUBLIC AWARENESS ON WATER CONSERVATION

With the consumption of water generally twice the population growth, our supply of water will be scare in the future. There is a need to create awareness among all water users on the need to avoid wastage and reduce pollution, so as to preserve our valuable resource for humans, terrestrial and aquatic life.

Some of the efforts taken by the government to inculcate responsible attitudes to water users include:

- Establishment of Environment Education and Information unit at the DOE in 1981 for public use,
- Incorporation of environmental science in the curriculum at all levels of education,
- Public campaigns, seminars, documentaries, advertising and other awareness programmes. Some of the prominent activities include Malaysian Environmental Week, World Environmental Celebrations (yearly), and Love Our River Campaign,
- Utilisation of NGOs such as Sahabat Alam Malaysia and World Wildlife Association to participate in the programmes, and
- Participation in the International Year for Freshwater (2003) organised by the United Nations in order to galvanise action on the critical water problems the world faces.

Although Malaysia has been active in local and international awareness programmes, there have been few attempts to evaluate their achievements to see if the messages delivered were short-lived, or ingrained in the users' minds.

5.6 COASTAL POLLUTION

While land-based sources of pollution have to be mitigated and regulated by the littoral states, marine-based sources have to be managed integrally by all stakeholders. In the case of the waters of the Straits of Malacca, bilateral, regional and international cooperation is needed to minimize the incidence of oil spills, vessel collisions, and the dumping of toxic wastes.

In the last two decades the Malaysian government has made serious efforts to regulate and manage the Straits with some international support. These efforts include a traffic separation scheme, a reporting system to ensure safety of navigation, and the development of an integrated oil spill contingency plan (National Oil Contingency Plan). The National Oil Contingency Plan is a collaborative effort between the public agencies (leadership provided by DOE) and the private sector (leadership by the National Oil Corporation, Petronas). Petronas coordinates the private sector efforts and resources, with funds from the Petroleum Industry of Malaysia Mutual Aid Group (PIMMAG) and the Japanese government.

Probably, the most significant effort at strengthening marine protection is the seeking of compensation for marine pollution. Malaysia has adopted the International Convention for the Prevention of Pollution from ships, 1973, and the Protocol of 1978 (MARPOL 73/78) which Malaysia ratified on 28 Jan 1997. This ratification provides Malaysia a control instrument for Malaysian flagged vessels while concurrently protects Malaysia from pollution by ships of other member countries through the polluter-pays principle.

While Malaysia is relatively advanced in her precautionary efforts to minimize accidents in the Straits of Malacca, her neighbour Sumatra is ill-equipped with facilities

and personnel to handle any crisis. Any mishap on Indonesian waters will incur ecological and economic losses to her neighbours.

5.7 INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

In an attempt to curtail ad hoc development of coastal areas as well as protect the marine ecosystem, an integrated management framework in managing coastal resources has been adopted (Ismail, 2003). Issues, problems, and challenges in managing coatal resources are complex, multidisciplinary, cross-boundary and cross-sectoral in nature. Thus, development options have to be viewed in as integrated, holistic, and sustainable manner in order to avoid multiple use conflicts.

By adopting the ICZM approach, environmental considerations are factored into policies, programmes, plans, and project formulation in a more comprehensive manner. The strategy, to move from a project to regional development, allows implementation, assessment, and monitoring of physical and ecological processes to be made in a broader perspective, so as to capture cumulative and synergic impacts of several concurrent developments. Among other things, ICZM helps overcome existing legislative and institutional problems that are fragmented, sometimes overlapped in function and not effectively geared towards a common goal. Environmental Impact Assessment (EIA) and a Shoreline Management Plan (SMP) are other inputs that enhance the ICZM approach.

6. CONSTRAINTS TO ACTION

6.1 INSTITUTIONAL PROBLEMS

As mentioned earlier, there are essentially two main authorities in water resource use and management, the federal and state governments. The Federal Constitution (1957) has bestowed state governments with powers to manage land, turtle and riverine fisheries, while the Federal government has authority over shipping, navigation, maritime and estuarine fisheries. This duality in water resource jurisdiction creates problem of leadership and authority for the conservation, planning and management of the national resource, as rivers transverse both jurisdictions as they meander from land to sea.

Water tariff is an important source of revenue for state governments. With huge investments tied to water-related projects, it is unlikely that state governments will succumb easily to the pressure or demands of the Federal Government, even with the formation of the National Water Council. However, during the National Water Council Meeting on 29th July 2003, the Prime Minister made it clear that for cost-effective management of national water resources, the Federal Government intends to take over the administration and management of the resource, including the states' powers. As an incentive, the Federal Government will assume all water supply debts and liabilities from the states. However, this will take time, as constitutional implications have to be ironed out before amendments can be made. In the meantime, trend towards integrated river basin and coastal zone management will reduce institutional conflicts.

6.2 LACK OF CAPACITY TO IMPLEMENT POLICIES AND ENFORCE REGULATIONS

The lack of trained personnel to implement policies on development matters and to enforce regulations is a pressing problem at the ground level. Local municipalities are usually small outfits, lack professional staff, and are often pre occupied with water bill collections and public complains.

Enforcement of regulations on water contamination and applying the polluter-pays principle is not easy. Benchmarks for allowable limits of toxic discharge are yet to be documented, as there are still knowledge gaps in determining the threshold contaminant levels. For instance, there is a need to establish a causal link of specific industries to the exact form and amount of pollutants they discharge and, subsequently, harmonizing these to permissible limits to prevailing water qualities before one can enforce the notion of polluter-pays for the damage.

Lack of capacity to enforce regulations can also be tied to financial constraints. Effective enforcement requires trained personnel who are backed with good logistical support and adequate financial resources to monitor the geographical spread of activities. However, state governments place a high priority on choice of development projects and, most of the time, environmental enforcement considerations are not factored in for a budget.

6.3 INADEQUATE CENTRAL SEWAGE SYSTEM AND TREATMENT FACILITIES

Prior to the ASEAN financial crisis, countries in the region enjoyed high growth rates. Along with the prosperity, there was the mushrooming of residential, commercial, and industrial estates, including rapid development of supporting infrastructures such as roads, ports and power plants. All of these developments together with growth in population and

immigrant labour have contributed significantly to the degradation of both freshwater and marine ecosystems.

There were also huge investments in water-related projects, with RM328 million spent on development of sewerage systems and another RM7.7 billion on water catchments. Even then, the sewerage system managed to serve only 52.7 % of the population (Seventh Malaysia Plan, 1996-2000) as growth in water consumption and wastewater discharge outpaced growth in sewage treatment facilities, thus aggravating the badly polluted rivers in the West Coast.

After the Financial Crisis, ASEAN countries as a whole not only lost their wealth but were also saddled with massive foreign debts. With the currency devaluation that subsequently inflated foreign debts, the federal and state governments made severe cuts on their development budgets including investments in water supply and treatment systems. Most water-related companies, also caught by the financial crisis due to heavy external borrowings, were either financially bust or were unable to continue their obligations for lack of financial resources. Obviously, the urban and high growth centres such as Kuala Lumpur, Shah Alam, Bangi, Klang, Penang, Sungai Petani, Malacca and Seremban suffered the most from water shortages, inadequate central sewage and wastewater treatment facilities. All these places are pollution 'hotspots' for the West Coast.

Even the National Sewage Company, Indah Water Konsortium (IWK), till today, has problems in meeting its loan obligations to creditors. As of 31 December 2002, IWK had spent RM246 million for refurbishing 3,019 sewage treatment plants and another RM59 million for upgrading works of plants and network pumping stations, against a total collection of only RM31 million from its 1.8 million customers (IWK Customer's Pamphlet, 2003). It had to draw down a substantial portion of funds for these investments from the

Ministry of Finance and Ministry of Housing and Local Government instead of commercial banks.

6.4 LACK OF PUBLIC AWARENESS

Water is essential for our lives, and yet in development planning and management we ignore other living things that also depend on clean water for their survival. The awareness to conserve the aquatic habitats and resources came about with the mandatory requirement for an Environmental Impact Assessment (1987) for large projects to complement the more specific Environmental Acts (Prescribed Premise) made earlier. Even then, during the boom periods, planners and developers paid little attention to the EIA requirement and it is usually the NGO's such as Friends of the Earth (Sahabat Alam), Malaysian Nature Society and Environmental Detection Society that applied the pressure for a thorough appraisal.

The frequency of fresh floods in urban centres, loss of public and private property, and the rising costs of food and water bills have generated greater awareness among the Malaysian public for prudent management of our water resources and the valuable ecosystems the resource supports. This awareness is reflected in the local press, especially on the recent public outcry on forest clearing activities in Cheras and the reluctance of residents in Semenyih to allow the Selangor State government to locate its municipal waste incinerator nearby for fear of cancerous emissions. Regular campaigns such as "Love Our River" done previously together with documentaries and advertisements in the mass media can educate the public of the responsibilities to conserve water and the consequences of pollution.

7. TRANSBOUNDARY ISSUES, KNOWLEDGE GAPS, AND RECENT DEVELOPMENTS

In the light of earlier discussions on the threats to the Malaysian coastal and marine resources in the Straits of Malacca, we can attempt to examine those that have transboundary effects, measures taken to mitigate them, and the knowledge gaps that need to be addressed or researched.

Generally, environmental concerns that are transboundary create pressure on the marine ecosystems, at times over large geographical areas. Transboundary issues arise because,

- Marine resources are mostly mobile (fish stocks, mammals, and turtles),
- Activities in the marine environment (such as shipping, fishing and movement of migratory wildlife) can act as carriers for contaminants and diseases, and
- Oceanic or marine currents act as a medium through which pollutants (from rivers or coastal hotspots) are carried and transmitted to other locations.

With current growth in economic and shipping activities expected to be sustained, the threat to further degradation of marine resources and ecosystems as well as its transboundary effects on other littoral states in the Straits of Malacca and the region has to be taken seriously. The concern, especially on transboundary issues, has attracted the attention of several international organisations and NGO's. PEMSEA (undated) identified the main transboundary issues, among others, to include pollution, introduction of alien species, over-exploitation, destructive fishing practices, and international trade.

Based on the text, the main transboundary issues for the West Coast marine resources, and in order of importance, arise from pollution, exploitation of living resources, coastal reclamation, external market forces, and use of destructive fishing methods.

7.1 POLLUTION

As discussed earlier, both land and marine based sources of pollution result in the destruction of coastal resources and marine habitats. Land based sources such as sediment run-off, industrial, domestic, agricultural and livestock wastes pollute the rivers that unload these to the Straits of Malacca. Based on the Water Quality Index, almost 50 percent of Malaysian rivers are polluted. In terms of BOD, sewerage, agriculture, livestock, and industries were the main contributers to water pollution.

Heavy Metal and Toxic Materials

Polluted rivers have transboundary effects in that heavy metals and toxic materials can be absorbed and stored by some marine life, especially cockles and mussels. Infected cockles or mussels can be a health hazard of transboundary dimension as these are exported to Thailand, Singapore, and East Malaysia.

It is also worth noting that cockles and mussels resources, whether reared or gathered, tend to be found in abundance in the West Coast and in close proximities to polluted areas such river mouths, mudflats and reclaimed industrial sites (Kuala Juru, Perak, Selangor and Malacca). For instance, Toshihiro (1999) found mercury content in Port Dickson to be 23ug/km, a level twice that of Kuala Trengganu on the East Coast. Also, Abu Talib et.al (2000) reported that samples collected from coastal waters in the Straits of Malacca had values of lead, copper, and cadmium exceeding the national standards.

E. Coli Bacteria

The presence of *E. Coli* in coastal waters which when transmitted to marine fishes, captured or cultured, poses another health problem. For instance, demersal fish species that are of high market value such as the sea bass and snappers are exported abroad, mainly to Singapore, Hong Kong, Taiwan and even Japan.

A survey by DOE (1995) reported that the main contaminants of coastal/marine water quality were oil and grease (84 per cent), total suspended solids (65 per cent) and *E. Coli* (37 per cent). As mentioned earlier, sewerage collection and treatment facilities for the densely populated urban centres on the West Coast are still inadequate. On a per day basis, about 645.43 tonnes of domestic waste were drained into the Malacca Straits, of which about 50 per cent were treated.

Erosion and Sedimentation

Heavy erosion and sedimentation by rivers destroy mangrove, seagrass beds and coral reefs, habitats of endemic and migratory wildlife. As discussed earlier, degradation of these ecosystems has led to the extinction of some species and reduced populations of those species still surviving. As most of the commercial fish species depend on these habitats to breed, any loss in juvenile population will affect the landings of both demersal and transboundary/shared stocks in the littoral states of the Straits. Sasekumar et. al (2000) provided some crude estimates of the value of the marine habitats based on economic benefits these systems support. However, more information such as species mix, their relative abundance, ecological interdependencies and life cycles are needed before meaningful estimates and conclusions can be drawn on the monetary value of marine ecosystems.

Oil Spills and Vessel Activities

Oil spills and compensation are transboundary issues that have been discussed and debated at local, regional and international fora. As one of the busiest international Straits in the world, thousands of vessels, ranging from large tankers, cargo vessels, tourist cruisers, fishing boats and even pirates patronise the channel daily. Transboundary issues that arise from shipping and transportation activities include oil spills, docking activities, and discharge from small vessels.

The biggest threat to the marine environment is that of oil spillage from tanker collision, grounding or human error (Aprilani, 1999). In spite of the serious efforts made over the last two decades to regulate and manage shipping activities through traffic separation scheme, safety in navigation, oil spills preparedness and response, and an integrated oil spill contingency plan, the Straits of Malacca is still the world's hotspot for oil spills, vessel accidents and piracy. Even with Malaysia's oil spill contingency plan, Indonesia's lack of support and enforcement capabilities is worrisome. Like the haze, any oil spills in Indonesian waters can have catastrophic effects on neighbouring resources and habitats because of the tidal currents.

Docking activities for transfer of cargo, sourcing of supplies (including water) and the pumping out of bilge and ballast water during maintenance can result in transmission of bacteria and other contaminants onto the vessels, while vessel discharge may introduce alien organisms to our waters. Although the threat of this transboundary issue is real, there has been little documented evidence on this.

7.2 EXPLOITATION OF MARINE RESOURCES

The exploitation of marine resources in fishing grounds that are shared with others, such as the Straits of Malacca and the Indian Ocean, will have transboundary issues. Over exploitation or conservation measures by one party will affect landings of another. The most obvious case is with pelagic species such as the mackerels (*Rastrelliger*), scads (*Atule, Alepes, Selar*) sardine (*Sardinella, Dussumieria*) and hardtail (*Megalaspis*) that migrate across territorial waters of Thailand, Malaysia, Thailand, and Singapore.

Here, over-exploitation by one will reduce landings of others. Conversely, catch restraint through conservation measures by any party will benefit the others. As fishery resources in the Straits are generally exploited beyond their maximum sustainable yields, it makes sense for the littoral states to collaborate to from a regional regime for optional management of the shared stocks. A prerequisite to this will be knowledge on the biological life cycles and migratory habits of each species but such information need to be collated collectively.

The exploitation of tuna species, especially the skipjack tuna, in the offshore waters of the Indian Ocean can also be subjected to regional management by the littoral states of the Bay of Bengal large marine ecosystem. Here again, sharing of information and catch quotas can result in sound management of the offshore fisheries.

The composition of trash fish which amounted to over 200,000 tonnes or about 40 per cent of total catch on the West Coast is of serious concern to resource managers and those that depend on the sea for a livelihood. Trash fish, composed of an assortment of juveniles of commercial and non-commercial fish species, represents an economic loss for Malaysia and other littoral states that share the same resource. Reasons for the significant

premature fish harvests are unclear, especially when the increase in trash fish landings is amidst declining number of fishing vessels.

In Malaysia, the Fisheries Act (1985) prohibits the use of poisons, electrical shocks, and explosives to catch fish, as these will indeed detrimentally affect the flora and fauna that share the same habitat. Such destructive methods result in loss bio diversity and size of parent stocks, including those that are transboundary. Despite the ban, there have been isolated cases that breach the regulations, such as the use of explosives to blast corals off Pulau Langkawi for the purpose of making tourists handicrafts.

7.3 COASTAL LAND RECLAMATION

Coastal land reclamation, including sand mining activities, destroys mangroves, seagrass beds, mudflats, adjacent shores and the ecological balance of aquatic life that depends on these ecosystems. If not properly planned, land reclamation for housing, infrastructure, and industrial purposes affects both the stability of the coastline and sustainability of capture and culture fisheries. As discussed earlier, these are issues of national and regional concerns. The degradation of marine habitats also represents a loss in biodiversity and recreational value for local and foreign tourists.

Hadibah (2001) expressed her concern on the mega reclamation projects that are in the pipeline especially those bodering the Straits of Malacca such as Perlis, Kedah, Penang, Perak and Selangor. These include Kedah's 110km coastline covering 20,000ha, the world's largest reclamation, at a cost of RM30 billion and Malacca's Coastal Reclamation Project covering 2,835 hectares. She called for a mandatory Macro-Environmental Impact Assessment and An Integrated Shoreline Management Plan, as well as close monitoring of these projects so as to minimise damage to the coastal environment. Again, there is a

dearth of information on the ecological and hydrography processes of the coastal environment to provide benchmarks for modelling runs and post-project impact assessments.

7.4 HIGH DEMAND FOR MARINE PRODUCTS

The local and world demand for high-value fish species and prawns provide short and long-term economic opportunities for coastal communities and investors to generate wealth. Marine products such as Penaied prawns, seabass, snappers, jellyfish and seaweeds are highly sought in the local (restaurants and hotels) and world markets (Singapore, Hong Kong, Japan, Europe and U.S.). The rising export demand for marine products provides incentives for conversion of mangroves and other wetland forests to ponds for the culture of prawns and fishes. The rapid expansion of aquaculture activities in mangrove areas, especially from recent participation by the corporate sector, has destroyed the spawning and breeding grounds for fish, prawns, and shellfish stocks, other life support habitats (seagrass beds mudflats), reduced biodiversity and visits by migratory shore birds, as well as threatened the survival of some wildlife species. Transboundary issues that arise from mangrove-based aquaculture include declining fish populations offshore, increased vulnerability of shorelines to tidal erosion, indirect destruction of other vicinity habitats due to sedimentation, and loss in aesthetic and recreational value of mangroves for tourism.

Changing trade regimes, under the World Trade Organization (WTO) and the General Agreement on Tariffs and Trade (GATT) have implications on transboundary trade in fish (World Fish Centre, 2002). Technical standards like Sanitary and Phytosanitary (SPS) measures, Hazard Analysis and Critical Control Point (HACCP) are being introduced by developed countries in place of tariffs and quota restrictions. Even though

improved hygienic requirements may curtail the spread of bacterial infection from contaminated marine exports, most exporting countries in the region expressed widespread apprehension as the technicalities may act as a barrier to trade.

Other transboundary issues that arise from the high global demand for marine products include the encroachment of foreign fishing vessels into Malaysian waters to search for fish (especially the Thai vessels), and the transboundary transaction of fish at sea between Malaysian and Indonesian vessels because of higher domestic fish prices.

7.5 KNOWLEDGE GAPS

From the review of previous research activities and documented literature, there exists considerable knowledge gaps on the complex physical, chemical and biological processes taking place in estuaries, marine habitats, coastal waters and the marine resources therein, so as to provide reliable empirical data for the valuation of these resources and, subsequently, the impact of man's development activities on these. Even the frequently researched mangrove habitat lacks reliable information on the composition and relative abundance of fish species and other flora and fauna, their biological cycles, and migratory habits, as well as the physical processes that link these to their parent stocks offshore.

Admittedly, Malaysia has made attempts to generate information on the marine ecosystem through fish resource surveys, research at marine-based centres in universities such as Universiti Putra Malaysia (Malacca Straits Research and Development Centre or MASDEC), Universiti Malaya (mangrove habitat) and Universiti Sains Malaysia (marine biological sciences), and the establishment of a central depository for Environment Statistics at the Statistics Department (Dept. of Statistics 1997). The research efforts include assessment of various living and non-living resources, tidal currents, suspended

materials, pollution, marine habitats, and shipping traffic. Some of the research apply modern technologies such as Remote Sensing and GIS (Ibrahim et. al., 2000). Unfortunately, the research activities reflect the interests of researchers or sponsors and lack a holistic approach to provide the information gaps that are needed for a reliable database of the marine environment for development planning and decision-making.

7.6 RECENT DEVELOPMENTS

There have been several developments of late that reflect Malaysia's strong commitment to protect her coastal waters and marine resources and that development in these areas are undertaken on an environmentally sound and sustainable manner. This is reflected in the recent formulation and endorsement of the National Policy on the Environment at the Meeting of Ministers (Ministry Science, Technology And Environment, 2002). The broad objectives of the Policy are to: -

- Achieve a healthy and productive environment for present and future generations,
- Conservation of the country's unique and diverse cultural and natural heritage with effective participation by all sectors of society, and
- Sustainable lifestyles and patterns of consumption and production

Among the Policy's eight guiding principles to harmonise economic development goals with environment imperatives that have direct, or indirect, impacts on transboundary issues are: -

- Integrate environmental dimensions in the planning and implementation of policies, objectives, and mandates of all sectors to protect the environment,
- Manage natural resource base and prevent degradation of the environment,
- Conserve natural ecosystems to ensure integrity of biodiversity and life support systems, and

- Participate actively and effectively in regional and global efforts towards environmental conservation and enhancement.

Malaysia's strong commitment to the global community on environmental and transboundary issues are reflected in her active and multilateral participation in a number of regional and international agencies. At the regional level, the Policy document states that Malaysia will fully cooperate with neighbouring countries on transboundary environmental issues and adopt practical measures to minimise the occurrence of transboundary pollution and industrial accidents. As for the international arena, Malaysia hopes to play a proactive role in addressing global environment issues such depletion of the ozone layer, climatic changes, transboundary pollution, hazardous chemicals and toxic waste management, and trade in endangered species.

In order to uphold the above commitments, there have been several in-house developments. Some of these include: -

- A National Policy in Biodiversity (1998) was formed to conserve, manage, and promote utilization of biological resources, with the Steering Committee under the chairmanship of Ministry of Science, Technology and Environment (MOSTE).

- Formulation of Soil and Conservation Act (under review) to address problems related to soil erosion, air and water pollution due to indiscriminate land clearing (MOSTE, 2000).

- National Coastal Zone Policy is being drawn up to protect coastal and marine resources, address issues of multiple use conflicts, and to streamline the legislative and administrative responsibilities of state and federal agencies.

- Establishment of Environmental Depository to institutionalise the compilation of environment statistics.

From the discussions and the continuous evolvement of management regimes and regulations, managing aquatic life and resources is more complex than terrestrial life. Our knowledge of coastal resources and marine life is indeed limited and the monetary value in

the loss of natural habitat and biodiversity is hard to gauge. Malaysia's commitment to safeguard her natural environment, in a way, was rewarded when Tg. Piai and Pulau Kukup, in Johore were included in Ramsar's prestigious list of Wetlands of International Importance in 2003.

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