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World Maritime University
Malmö, Sweden

**CONSIDERATIONS FOR THE
CONTROL OF MARINE POLLUTION
IN PAKISTAN**

By

RAHIM UDDIN

Pakistan

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

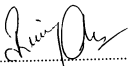
**GENERAL MARITIME ADMINISTRATION AND ENVIRONMENT
PROTECTION**

Class of 1997

DECLARATION

I certify that all the material in this dissertation that is not my own has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the WMU.


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ABSTRACT

Title of Dissertation: Considerations For Marine Pollution Control in Pakistan

Degree: MSc

The dissertation is a study of the state of the marine environment and pollution control set-up in Pakistan.

The principle features of Pakistan marine environment are highlighted with the evaluation of pollution in different areas. The areas of extensive marine pollution are pointed out. The importance of the endangered wetland habitats is highlighted. The hazards associated with marine pollution are examined. The main sources of marine pollution are investigated. The measures to control marine pollution are collated.

The development of legal documents for marine environment protection is scrutinised. The current global control of marine pollution is discussed and compared to that of Pakistan. The importance of some important IMO conventions is briefly evaluated. The current national policy and legislation for marine environment protection in Pakistan are investigated. The roles of national environmental organizations are examined. The significance of the current national environment laws is highlighted. The present set-up for a possible marine oil spill in Pakistan is examined.

The concluding chapters set out proposals to improve the present set-up of marine pollution control in Pakistan and the roles of other organizations, related to marine environment protection, are collated. A number of recommendations are made concerning the refined measures to control marine pollution.

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LIST OF ABBREVIATIONS

BOD	Bio-Chemical Oxygen Demand
CLC 69	The International Convention on Civil Liability for Oil Pollution Damages, 1969
COD	Chemical Oxygen demand
DDT	Dichloro-Diphenyl-Trichloroethane
DWT	Dead Weight Tonnage
ECO	Economic Co-operation Organization of Asian Countries
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EU	European Union
GDP	Gross Domestic Product
GESAMP	United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution
GMDSS	Global Maritime Distress and Safety System
GT	Gross Tonnage
HNS 96	The International Convention on the Liability and Compensation for damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea 1996
IAEA	International Atomic Energy Agency (United Nations)
IBC	International Code for the Construction and Equipment of ships Carrying Dangerous Chemicals in Bulk
IMCO	Intergovernmental Maritime Consultative Organisation
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
ISM	International Safety Management Code
ISO	International Organization for Standardisation
IUCN	International Union for the Conservation of Nature
KANUUP	Karachi Nuclear Power Plant
KMC	Karachi Municipal Corporation
LBMP	Land-Based Marine Pollution
LC 72	International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972
LITE	Landhi Industrial and Trading Estate
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973/1978
MEPC	Marine Environment Protection Committee: IMO
MEUFW	Ministry For Environment, Urban Affairs, Forestry & Wildlife
MPCC	Marine Pollution Control Centre (Karachi Port)
NEQS	National Environmental Quality Standards (Pakistan)
NIO	National Institute of Oceanography (Pakistan)
NOSC	National On-Scene Commander

OILPOL 54	International Convention for the Prevention of Pollution of the Sea by Oil, 1954
OPRC 90	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990
OSC	On-Scene Commander
PAH	Poly-Nuclear Aromatic Hydrocarbons
PCB	Poly Chlorinated Biphenols
PEPA	Pakistan Environment Protection Agency
PEPC	Pakistan Environment Protection Council
PMA	Pakistan Marine Academy
PPM	Parts Per Million
SAR 79	International Convention on Maritime Search & Rescue, 1979
SITE	Southern Industrial & Trading Estate (Pakistan)
SITREP	Situation Report
SOLAS 74	International Convention for the Safety of Life at Sea, 1974
SOP	Standard Operating Procedure
STCW 78	International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978
UN	United Nations
UNCED	United Nations Conference on Environment & Development, Rio de Janeiro, 1992
UNCHE	United Nations Conference on Human Environment, Stockholm, 1972
UNCLOS	United Nations Conference on Law of the Sea Convention
UNEP	United Nations Environment Program

CHAPTER I

INTRODUCTION

How long do we want the oceans to survive? Twenty-five years, fifty years, a century? This is a question no other generation has had to consider... Ocean systems are in disarray. High-tech fishing fleets diminish the fish supply and drive species to extinction. We fill sea with oil, nuclear waste, toxic chemicals, and sewage, which makes fish sick and the people who eat fish even sicker. We add so much carbon dioxide to the air that the globe heats up, causing the sea to rise. Soon flooding tides will drown low lands and coastal cities.

(Simon, 1984)

Oceans have always been a source of great attraction for humankind. For aeons humans thought the oceans to be the source of divine food. During the ages of developed civilisations, the oceans provided a gateway to the unknown worlds.

The quest to explore the world, fostered the idea of trading exotic goods between the continents. With the advent of trade by sea, one of the foremost sources of marine pollution came into the picture. Essentially, the primordial sea trade was not as sophisticated and risk free as of today. Ships had little chance to avoid a disaster if they lost their way or met a storm at sea. The sinking of ships at sea not only caused the foremost greatest loss of life and property in the history of transportation, it also resulted in the earliest kind of marine pollution. However, the amount of pollution was negligible and nature itself could easily take care of the minute damage to the marine environment.

The oceans of the world have never been sailed by such a large number of ships as of the current century. The ships are now made of iron and steel instead of naturally

degradable wood. Moreover, they carry goods that are mostly unnatural and fabricated. Some of these trading goods are extremely hazardous. When introduced to the marine environment, either intentionally or accidentally, they cause huge harm and in several cases irreparable damage.

The boom period of sea trade can be related to the industrial revolution of the current century. To foster sea trade, most industries located their shops near a port or on the coastline. The waste from these industries was indiscriminately dumped or discharged into the marine environment. But it took time for the pollution from these industries to attract the attention of governments.

The industrial revolution of this century attracted a mass of people to shift from farms to the cities in search of job opportunities. Many modern megacities like New York, Tokyo, Bombay and Karachi are examples of such mass migration of people. Few cities were able to plan and control the mounting problem of domestic wastes from the large population in the coastal cities. In most cases, especially in the third world, the city planning to accommodate such a large number of people was extremely insufficient. The domestic waste from these cities was aimlessly dumped or discharged into the sea. In many instances, it took a great deal of time until the governments realised the damage being caused by the dumping of domestic wastes into the sea.

Air emissions from coastal industries and the colossal number of vehicles in cities have given rise to atmospheric pollution in the shape of greenhouse gases. Global warming is causing the sea-level to rise which is disastrous for low lying countries. Atmospheric pollution also results in trans-boundary pollution.

A closer look at the sources of pollution will reveal that mankind is the only source of pollution on this planet. The inference is that if pollution is caused by mankind then he should be responsible to prevent it. This idea plays the pivotal role in the studies related to this dissertation.

The main theme of the dissertation is to study the state of marine pollution and its control in Pakistan. The dissertation comprises of eight chapters including the introductory and conclusive chapters. Nearly all chapters focus on the marine environment in Pakistan.

The Chapter II presents a brief description of the principal features of the Pakistan marine environment. It includes the topographical and ecological study of the area. The chapter particularly points out the marine pollution originating from the city of Karachi. The major sources of pollution from the city's domestic and industrial sources are considered. The exceptional vulnerability of the wetlands, at the eastern edge of the coast, is highlighted. The basic features and the sources of pollution in the EEZ are also discussed briefly.

Chapter III identifies the major marine pollutants and examines their adverse effects. The chapter addresses the pollutants in general and does not specifically focus on Pakistan. The chapter also includes some recommendations for the physical control of marine pollutants.

Chapter IV is a discussion of the international legal control of marine pollution. This chapter focuses on the IMO and UN conventions related to marine environment protection. The legal control on various major sources of marine pollution is discussed. Special emphasis is given to the LC 72 and MARPOL 73/78 due to their relevancy to this dissertation. Some of the regional agreements for marine pollution control are also discussed briefly.

The Chapter V is a study of the national environmental policy and legislation in Pakistan. The chapter briefly points out the salient features of the current environment legislation and its effectiveness. The roles of national agencies and organizations for marine environment protection and pollution control are also scrutinised.

Chapter VI evaluates the oil spill response strategy in Pakistan. This chapter highlights the principal features of the present contingency plan and investigates its effectiveness.

Chapter VII is a set of proposals for the improving control of marine pollution in Pakistan. This chapter sets out the proposals in the three main categories i.e. legislation, prevention, and clean-up. The chapter also investigates the potential roles of the related ministries and organizations which can be helpful in improving the present state of the marine environment.

Finally Chapter VIII collates the main conclusions drawn from the study and sets out some of the vital recommendations based on the inferences.

CHAPTER II

PRINCIPLE FEATURES OF THE PAKISTAN MARINE ENVIRONMENT

2.1. INTRODUCTION

Pakistan is located in south Asia and extends from the Arabian Sea to the mountain ranges of Hindu Kush in the north. The total land area is over 3,25,000 sq. miles. Pakistan shares its total international boundary of 3,631 miles with four neighbours: Iran, Afghanistan, China and India. Geographically Pakistan is divided into three main regions: the north highlands, the river Indus plane and Balochistan plateau. Except for the northern highlands the weather of the region is generally dry and hot. There are seasonal monsoon showers over several parts of the country during the summer (Akhtar, 1993).

Pakistan has a population of over 132.2 million. The adult literacy rate is below 35%. More than 80% of the population inhabits the rural areas. Infant mortality is relatively high. Except for a few large cities most part of the country is largely under-developed.

2.2. PHYSICAL FEATURES OF COASTAL ZONE

The coast of Pakistan is mostly an isolated desert region with an extreme climate and difficult terrain. The coastline extends for over 990 km in length and inland for as much as 129-161 km. It is a region of low uplifted mountains and platforms, separated by scalloped bays, wide sandy plains, salt marshes and lagoons, plus the large Indus Delta near the Indian border in the east. Several of the platforms represent the uplifted terraces and fault blocks, such as Ormara and Ras Malan, which have sheer cliffs more than 305 m high. It is also a region undergoing dramatic geological changes; there have been at least 30 recorded earthquakes in the last 40 years. In addition, the

occasional Arabian Sea cyclones cause considerable erosion and flooding of the coastal plain during the seasonal Monsoon. The total stretch of Pakistan coastal zone can be divided into four main regions.

2.2.1. Indus Delta

The Indus Delta makes up nearly 153 km or 15.5% of the total length of the coastline. The region is mostly flat, consisting of large tidal channels and creeks (NIO, 1994). The Delta covers an area of approximately 4,827 km². The climate is inhospitable for living conditions. It is extremely hot in summer and cool in winter and unhealthy during floods. Climatically, this region can be categorised as a true desert, with less than 203 mm of rainfall during the monsoon season. However, the delta remains inundated with the water from the River Indus. Physically the delta region undergoes continuous changes almost each year during the floods.

2.2.2. Karachi Region

The Karachi region extends over 135 km between the Karachi Steel Mills near Ghara Creek to the Cape Monze in the west. It houses several small uninhabited islands, plus the large Island of Manora at the mouth of the port entrance. There are also a number of sandy beaches along the coast. The Malir River flows along the east side of the city and is heavily polluted with industrial discharges. The Lyari River, which flows from the south-west end of the city is another repository of the massive aquatic pollution.

Karachi is the largest city of Pakistan and the only immense concentration of human population along the Pakistani Coast. According to the last census in 1981 the city inhabits over 5.11 million but under recent estimates Karachi has already become a megacity. Karachi has extreme characteristics related to its desert coastal environment. Temperatures in spring and fall remain high, particularly away from the coast. The climate along the coast is heavily humid, but the mid-afternoon sea breeze cools off the somewhat unbearable climate. The residential areas have increasingly expanded seawards to take advantage of the cooling sea-breeze.

The city of Karachi can be pointed out as the outstanding polluting source along the entire coastline. Over 10 million people, living in less than a 135 km stretch of coastline, bring about a host of domestic and environmental problems at an unprecedented scale. The country's largest concentration of vehicles in the city with their harmful emissions is another peril to the local environment. In addition, a host of large industrial discharges adds to the worst conditions. Water supply to the city is an increasingly pressing problem on the other hand flooding of the city is a common feature during heavy downpours in summer. A terrible stench is given off by the mud flats on the south and east side of the city during low tide and in the hot season, probably because untreated sewage is discharged directly into the sea, which is later distributed by the tides.

2.2.3. Lasbela Region

The Lasbela region is a triangular shape valley situated in the west of the Karachi region. It extends 260 km westwards from Cape Monze to Ras Malan and inland 129 km. It includes the triangular shaped Lasbela plain and the foothill regions of the low mountains in the north. The central part of the valley consists of a flat plain composed of silts and fine clays brought down by the Porali River and its tributaries. The valley is sparsely populated by the local tribal people, whose lifestyle has barely changed over the last several centuries, except for the introduction of a few modern farm machines plus trucks, buses and several power driven-boats.

The coastal plain consists of a series of beach ridges. An inner shoreline can be followed as a wide arc around the inner side of the Lagoon of Miani Khor. The only mini-harbours along the Lasbela coast are the small fishing villages of Somiani and Damb.

2.2.4. Makran Coast

The Coast of Makran is the larger part of the Pakistan Coastline. This region, lying between Ras Malan and the Iranian border consists of long stretches of sand shores backed by the valleys or wide coastal plains. These low-lying areas are interrupted in

a number of places by low mountains and bold headlands that form hammerhead peninsulas backed by hills and mountains.

The Makran Ranges are mainly composed of poorly indurated sandstone clay and mud. Severe erosion of the poorly indurated bedrock results in a bizarre badlands type of topography with large cap-crowned pillars and pedestals that rise abruptly above jagged ridges and ravine-ridden lower hills of clay and mudstone. This landscape is unique in its structure in the world.

Except for a few Makrani fishing settlements the Makran is a very sparsely settled coastal region. There are no more than 28 permanent fishing villages of different sizes along the entire Pakistan Coast. The exact population along the coast can only be estimated, as no accurate census has been taken so far.

2.3. STATE OF MARINE POLLUTION

The coastal area of Pakistan can be divided into six zones to study the state of marine pollution.

2.3.1. The Manora Channel

This area includes the Karachi harbour and the navigating channel. It spreads over an area of 7.17 km². The Channel is narrow and easily silted. Under an estimation, over 456,000 m³ of silt is removed annually by the dredging operations. The channel receives domestic wastes from the small fisherman villages on the islands of Manora Baba and Bhit; oil pollution from Karachi Port and Shipping activities, and waste from Karachi shipyard (Karachi Coastline Case, 1997).

The Lyari river discharges large quantities of industrial and domestic wastes on the northern back waters of the channel. The river carries a large variety of pollutants including trace metals, sewage, pathogens, silt, oil products, detergents, animal remains, garbage and numerous toxic effluents from industrial area. The industrial waste originates in the Karachi industrial area, locally known as SITE (Southern Industrial and Trading Estate), where hundreds of small and large industries of food

products, metallurgy, chemicals, coal etc. have been operating for decades, with little environmental concerns.

A small but extremely crowded fish harbour is located at the north-west back waters of the Manora Channel. The fish harbour contributes a large quantity of garbage from the adjacent fish market and oil residues from trawler operations, which cross the navigational channel in hundreds everyday. There is also a growing number of luxury boats in the few elite boat clubs of the city. The significant pollution from these vessels includes garbage and sewage plus minor oil spills. Pollution from these boats remains unregulated so far and needs immediate attention.

2.3.2. Karachi City

Karachi is the financial capital of Pakistan and has the highest number of literate people in the country. It serves as the central point for all international sea trade. The city accounts for almost half of the government's revenue and contributes 20% of the nation's GDP. The Karachi's industrial area is one of the largest in the country. The city houses the Pakistan's largest deep sea port, handling bulk cargo, containers and crude oil.

2.3.2.1. Karachi Port

Oil is one of the major cargoes imported at the Karachi Port. Besides the fact that Pakistan has ratified all Annexes of MARPOL 73/78, reception facilities for none of the annexed substances are adequate; specially for oily wastes. Oil transportation from port to destinations also results in a large quantity of small oil spills both at port and during passage. The port is inadequately equipped with modern port machinery. A large part of cargo handling is still labour-intensive that frequently results in mishandling and accidental spillage. The port also attracts many industries to set up shop nearby in order to expedite exports and cut transportation costs; thereby adding to the pollution. Constant dredging operations in the port are also having an adverse impact on the marine environment.

Pakistan has ratified LC 72 (London Dumping Convention). The guidelines provided in the Annex 2 of the London Dumping Convention for the dumping of dredged spoils requires that dredged spoils should be clean of harmful substances that are usually present in the harbour seabed. However, dredging practice in Pakistani ports is still unsophisticated. Old dredgers with grabbing arms are still used to maintain the required depth in ports. The single new suction dredger 'Mahmud-ul-Hassan' cannot operate effectively in the port because of the immense littering of the harbour seabed. 'Mahmud-ul-Hassan' is expected to have testing equipment to meet Annex 2 (LC 72) requirements, however, old dredgers operating in the port areas may not be able to meet this requirement.

Trade activities in the port of Karachi are expected to rise steadily. At present Pakistan's total sea-borne trade is estimated to be 32 million tons per year and is expected to maintain a steady growth rate of about 4.5% annually. Moreover, Pakistan stands committed to provide a deep sea water port for the land-locked countries of Central Asia. In consequence the steady push for increasing the capacity of the port facilities is likely to occur soon and pollution problems can rise to more than ever before.

2.3.2.2. The Industrial Area

It is estimated that over 1000 small and large industries are operating in various parts of Karachi. Most of these industries are located in Sindh Industrial and Trading State (SITE) and Landhi Industrial Trading State (LITE), plus the west wharf and Korangi industrial areas. The major products from these industries include metal manufacturing, chemicals, oil and grease, coal refining, textiles, rubber, paper and food products. SITE is located at the banks of Lyari River in the north of Karachi. The river gathers a large variety of toxic wastes and effluents from these industries. The effluents are mostly in the following forms:

- dissolved solid;
- organic matter;
- nitrogen and its compounds; and
- phosphate and its compounds.

It will not be wrong to state that concept of waste recycling, treatment, and proper disposal is nearly absent in the industrial sector of Pakistan. Even the highly polluted wastes are being discharged irrationally into water bodies, or soil and in the air. In fact, industrial waste treatment systems are virtually non-existent in the country and those existing in a few industries, either fail to meet the standards or are virtually non-operational. With scarce national government policies on environment controls, the industries are able to dispose of the waste in the cheapest way that usually ends up in the marine environment.

2.3.2.3. Metropolitan Area

The city produces huge quantities of domestic waste including garbage and sewage. A large part of the garbage waste is frequently recycled; however, the rest of the garbage is disposed of inappropriately; usually by dumping or burning. There has been a steady increase in the number of shanty towns ever since the country's independence 50 years ago. Karachi Municipal Corporation (KMC) is fighting a losing battle against the massive amount of domestic waste produced by the under-planned expansion of the city. The city's ever-increasing numbers of vehicles, often with run-down engine conditions, contribute massively to air pollution. The air pollution is carried over long distances including the coastal areas.

2.3.3. Karachi Beach Area

Karachi beach area extends northwards from Manora Channel until the coast of Balochistan. Mangrove forests are the principle feature of this area which extends until the eastward boundary. City's several popular tourist beaches are located in this area. Thousands of beach huts are indiscriminately constructed throughout the beaches. Most of these huts are poorly maintained and frequently collapse under the rough Monsoon conditions on the beach. This results in the fall of construction debris and waste directly into the marine environment. Garbage thrown by the tourists also causes pollution since its recovery routine by KMC (Karachi Municipal Corporation) is uncertain and inadequate. Therefore, garbage usually ends up in the sea.

Karachi Nuclear Power Plant (KANUUP) is located along the coastline on the Karachi beach area. KANUUP is a 137 megawatt heavy water power plant (Ahmed, 1977). The plant can be associated with pollution problems like stack gases, liquid wastes and heated water.

Ships at anchorage, waiting to enter Karachi port; sometimes for weeks, also cause pollution on beaches. The illegal dumping of wastes from anchored ships accumulate on the beaches that are the breeding grounds for endangered species of turtles and birds. The Gadani ship-breaking yard near the western boundary, contributes pollution in the form of metal scraps and bilge oil in this area. The mechanism of ship breaking is unsophisticated and usually involves beaching of the ill-fated ship. This frequently results in the oil spills from ship storage tanks and grease spillage directly into the beach environment.

2.3.4. Tidal Creek Area

The tidal creek area is located along the eastern metropolitan boundaries of Karachi city. It houses a number of large and small creeks including Gizri, Korangi and Phitti. The pollution in these creeks is contributed to by the Malir River which carries heavy pollutants from domestic and industrial wastes. Karachi Steel Mill, the largest in country; is located in this area. The mill uses sea water for the cooling processes which requires the discharge of liquid waste from machinery spaces (Ahmed, 1977). Qasim Port (a secondary port for handling bulk cargo, mainly iron ore for steel mill) is also located in this area. The port is relatively new when compared to the 19th century port of Karachi, but nevertheless the ship activities generate considerable pollution. Future development plans pose significant hazards to the sensitive wetland environment around the port.

2.3.5. Indus River Delta

This is located east of the Tidal Creek area and extends to the eastern border of Pakistan with the Indian territory. The area houses the world's fifth largest mangrove forest (Ahmed, 1977). This area is particularly sensitive because of the estuaries and the wetland habitats. Estuaries are the breeding grounds for a large variety of shrimps

and fish whereas wetlands are very productive in bio-diversity. The nutrient rich, murky waters of the Indus River, cause heavy eutrophication; thereby adversely affecting the shrimp and fish population in the delta region. River Indus has a large course of about 2,500 miles and passes through several densely populated urban areas; gathering large quantities of toxic waste from agriculture and several industrial activities.

2.3.6. Balochistan Coast

The Balochistan coast starts from the westward boundary of the Karachi beach area and extends to the westwards border of Pakistan with Iran. It includes the coastal areas of Lasbela and Makran. The continental shelf on the Lasbela-Makran coast is 350 miles long and 25 miles broad and occupies an area of 8,750 sq. Miles (NIO, 1993). The pollution along the coast is minimal largely due to the low population and absence of any industrial activities. The only pollution from the small cities and towns along the coast is in the form of domestic waste and limited fishing activities. The coast also receives some trans-boundary pollution from the oil shipment across the Gulf to far east.

2.3.7. Exclusive Economic Zone (EEZ)

Pakistan received its share of EEZ of nearly 110,000 sq. NM under the provisions of UNCLOS III 1982. The Pakistan EEZ has boundaries with India in the east and Iran in the west. The area is under-exploited and so far, out of any major pollution problems. It is rich in resources with reasonable fish stocks and high potential for offshore oil or gas and mineral explorations. The number of transiting ships is low because the international route for ships heading east falls at the outer limits of the EEZ.

The main pollution problem in the EEZ, arises from the ship's illegal discharges of oily wastes and garbage. Due to the spiralling demand of oil in the region, the tanker traffic has increased; thereby increasing the possibility of oil spill accidents. Accidents involving large oil spills in the EEZ can damage the coastal region of Pakistan and also result in the trans-boundary pollution.

2.4. SUMMARY

Pakistan coast is mainly a barren and geologically active area. However, the presence of wetlands, mangrove forests and estuaries in the east, renders the coastline, rich in biodiversity. The amount of pollution, as a whole, is presently below the level of concerns. However, the metropolitan city of Karachi is considered to be the main source of the marine pollution in this area. The sensitive wetlands lie mainly in the eastern side of Karachi. Pollution from the city is directly effecting the mangroves and wetland habitats in this area. The development of Qasim Port in this area, can also adversely affect, the natural environment of the most bio-productive wetlands.

CHAPTER III

POLLUTANTS IN MARINE ENVIRONMENT

"In publications, in conferences, in international units, matters are generally divided into air pollution, land pollution and water pollution. In fact, there is only one pollution because every single thing, every single chemical whether in the air or on land will end up in the ocean."

(Jacques Casteu, 1971)

3.1. INTRODUCTION

The popular conception of pollution is "the wrong amount of the wrong thing in the wrong place at the wrong time." Yet another simple description of pollution would be that "pollution occurs when there is a change in one or more parameters, such as that the environment has been degraded." A more practicable definition is stated by the GESAMP (United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution) in 1982. The statement is:

"Introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities."

The definition is now widely accepted in international marine pollution control regulations.

3.2. MARINE POLLUTANTS

There are at least five main categories of marine pollutants that need to be regularised. These sources are briefly discussed in the following section.

3.2.1. Land-based Sources

Pollution from land-based sources refers to wastes or energy transferred to the sea through water or atmosphere from land-based activities. This includes domestic and industrial wastes and river run-off etc.

3.2.2 Vessel Generated Pollution

This type of pollution is caused by ship activities in ports and at open sea. These activities include the operational and accidental discharge of oil and other cargoes in the sea environment.

3.2.3. Dumping at Sea

This type of pollution is caused by the dumping or incineration of industrial or municipal wastes at sea. This also includes the dumping of material from dredging activities.

3.2.4. Seabed Activities

This type of pollution is caused by the release of harmful substances into the sea environment arising from the exploration, exploitation and processing of seabed minerals.

3.2.5. Pollution Through the Atmosphere

Although this type of pollution can be associated with land-based sources it is important to categorise it separately since it provides a very large portion of the total marine pollution. It is mainly caused by the release of harmful substances into the atmosphere as a result of man's activities on land or onboard a vessel or aircraft and which enters the sea environment. The main sources of marine pollution are shown in Figure 1.

SOURCES OF MARINE POLLUTION

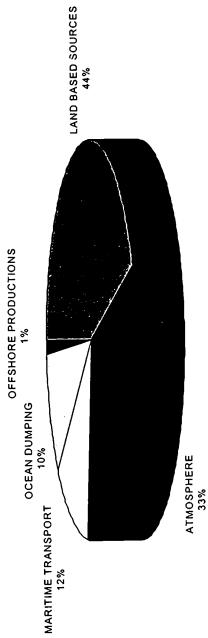


Figure. 1

Source: IMO (1982), *The London Dumping Convention: The First Decade and Beyond*. London: IMO.

3.3. MAJOR MARINE POLLUTANTS

Marine pollutants can merely be an eyesore or they can be extremely harmful. The degree of harm a pollutant can cause, largely depends on its concentration in the marine environment i.e., some pollutants in very small quantities can do more damage than others in large quantities. Some of the common pollutants with their adverse affects on the natural environment and human activities will be discussed in the following section in order to emphasise the importance for the control on their discharges.

3.3.1. Toxic Substances

Toxic substances are used or produced in many industrial processes. Materials used (such as chlorine) in small quantities may be harmless but in large quantities they may be destructive. The toxic substances are considered to be the most destructive to the marine environment. Most common toxic substances include acids and bases, halogenated hydrocarbons, petroleum products and chemicals. However, halogenated or chlorinated hydrocarbons have provoked the greatest concerns with their effects on the marine environment. The most common of these are the pesticides, such as DDT (Dichloro-Diphenyl-Trichloroethane) and PCBs (Poly Chlorinated Biphenols), used in electrical equipment. Both DDT and PCBs are identical in many ways. In particular, both are highly toxic, persistent and bioaccumulated. Because of these properties, a small concentration of chlorinated hydrocarbons in the marine environment can lead to the much greater accumulation in the high levels of food chain. They tend to collect in the fatty tissues of fish, animals and birds, with adverse affects on life and reproductive cycles. They are also very stable compounds that do not deteriorate easily even over a long period (Clark, 1992).

Acids and bases discharged into the marine environment can disturb the natural ecological balance system. The normal ocean water is slightly basic i.e. alkaline, the balance being maintained by a complex chemical reaction. If a large amount of acid

or base is introduced into the system this balance will be upset and an important element of the environment will be affected. The sources of acidic or basic material are primarily industrial effluents and sometimes accidental discharges during sea and coastal transportation.

3.3.2. Petroleum Products

Petroleum products may be classed as a toxic organic, but given time they are biodegradable. Petroleum products are complex organic material, containing a large number of separate compounds that also affect the biosphere. These substances find their way into the oceans through oil spills, ports and other industrial activities, disposal of automobile lubricants and unburned hydrocarbons emitted into the atmosphere as internal combustion exhaust, and then finding their way into the marine environment through rain.

Crude oil is the major source of petroleum product transported in heavy quantities around the world. The total global production of crude oil is presently about 3 thousand million tonnes annually and approximately half of it is transported by sea. Recent estimates indicate that nearly 3 million tons of oil enters the marine environment during transportation. This amount is besides the nearly 250,000 tons of natural seeps from seabed oil reserves. Tanker accidents over past decades have shown that oil spills cause immense damage to the coastal environment. The most obvious damages are fouling of beaches and wetlands, bird and animal deaths, and reduction in fishing stocks. Oil on combustion produces a variety of Poly-Nuclear Aromatic Hydrocarbons (PAHs), which are known to be carcinogenic. Some scientist believed that PAHs could bioaccumulate like PCBs in the marine environment. This fear has proved to be unfounded however, PAHs are still considered to be harmful for mare environment. The bioaccumulation of PAHs in marine ecosystem may lead to the reproductive failures in some animal species (Carl, 1997).

An estimated annual input of oil to the marine environment is shown in the Table 1.

ANNUAL INPUTS OF OIL TO THE MARINE ENVIRONMENT

SOURCE	ANNUAL INPUT (in million tons)
Offshore productions	0.05
Routine ship operations	1.05
Ship accidents	0.42
Atmosphere	0.3
Land-based sources	1.23
Ocean dumping	0.02
Natural sources	0.25
Total	3.32

Table 1

Source: IMO (1982). *The London Dumping Convention: The First Decade and Beyond*. London, UK: IMO.

3.3.3. Sewage

Sewage contains a wide variety of inorganic (i.e., nutrients and trace metals) and organic compounds. There are also suspended solids originating from human excrement, inorganic grit, and a variety of garbage. Sewage water readily contains large quantities of pathogenic organisms. Pathogens are living organisms that can cause sickness or biological imbalance in either plants or animals within the oceans or in human beings.

In most developing countries sewage is not separated from industrial discharges, which creates additional problems. Moreover, proper sewage treatment facilities are uncommon in many developing countries.

3.3.4. Metals

Metals are found in sea water at natural concentrations. Many of them are vital for living organisms. However, some of them are extremely toxic if found above the natural limits. Metals can be divided into three main categories in relation to their biological effects:

- 1) light metals (e.g. sodium, calcium, potassium); abundantly found in natural marine environment and useful for marine organisms;
- 2) transitional metals (e.g. iron, copper, cobalt, and manganese) which are toxic only in high concentrations;
- 3) heavy metals (e.g. mercury, lead, tin, selenium, and arsenic) which are harmful in any concentration.

Most of the metals are bioaccumulated in the food chain causing a number of diseases in marine animals and humans. The important sources of metal input into marine environment are untreated industrial and domestic wastes.

3.3.5. Garbage

Garbage can be defined as the product which is no more useful for any human activity and therefore is separated for disposal. Garbage is a growing global problem. Ironically industrialised countries produce much larger amount of garbage than the developing countries. Moreover, a large constituent of garbage is readily recycled in developing countries, whereas in industrialised countries most of the garbage ends up in incinerators or landfills.

An estimation of garbage produced around the world is shown in the Table 2.

**ESTIMATED GARBAGE PRODUCED IN SOME MAJOR CITIES AROUND
THE WORLD**

CITY	GARBAGE PRODUCED (In Pounds)
New York	4
Tokyo	3
Paris	2.4
Hamburg	1.9
Hong Kong (China)	1.9
Singapore	1.9
Stockholm	1.9
Rome	1.5
Jakarta	1.3
Cairo	1.1
Calcutta	1.1

Table 2

Source. Steger, Will and Bowermaster, Jon (1990). *Saving the Earth*. New York, USA: Alfred A. Knopf, Inc.

United States is the largest producer of garbage (Steger et al., 1990). Some most common items in the composition of garbage (United States) are shown graphically in Figure 2.

TYPICAL GARBAGE COMPOSITION (UNITED STATES)

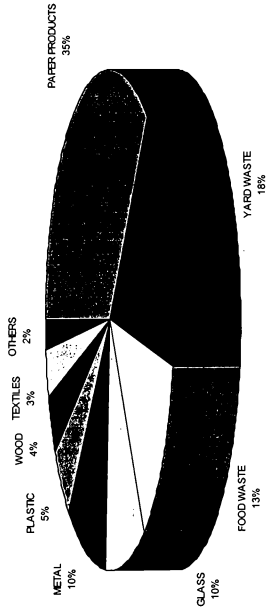


Figure. 2

Source: Steger, Will and Bowermaster, Jon (1990). *Saving the Earth*. New York, USA: Alfred A. Knopf, Inc.

Solid waste is a growing urban problem, which is usually seen in colossal proportions in the large cities. Oceans have been long favoured as an inexpensive and easy dumping site to get rid of almost every kind of garbage. It is alarming to note that a garbage in the marine environment can take decades and in several instances, centuries to decompose. The decomposing rate of some garbage items is shown in Table 3.

PERIOD TO DECOMPOSE FOR SOME GARBAGE ITEMS

TYPE OF GARBAGE	PERIOD OF DECOMPOSING
Bus ticket	2-4 weeks
Cotton cloth	1-5 months
Rope	3-14 months year
Woollen cloth	1 year
Painted wood	13 years
Tin can	100 year
Aluminium can	200-500 years
Plastic bottle	450 years
Glass Bottle	unknown

Table 3

Source: Prekezes, Christian (1997). *Environmental Training of Seafarers*. Presentation. HELMEPA, Greece. Visiting Lecturer at World Maritime University, Malmö, Sweden.

Garbage if not contaminated of toxic substances is relatively less harmful than other pollutants. However, garbage is a serious hazard for many marine animals including mammals and birds. Plastic is essentially the worst form of garbage that can float on water surface and mistaken by marine animals as a source of food. The swallowed plastic can make the animal sick and in most cases result in the animal's death.

3.3.6. Sediments

Sediments are always present, in the ocean environment, with the maximum amounts in river run-off and estuaries. The suspended sediments have a mark affect on marine plant growth, since they cause reduction in the light penetration; thereby, decreasing photosynthetic activity at greater depths. As the sediments are deposited on the bottom they will cover up bottom dwelling organisms (benthos) such as corals and oysters, and may even smother them under extreme circumstances. The land-based sediments from industries, river run-off, etc. may also contain large quantities of harmful substances.

3.3.7. Nutrients

Nutrients, commonly called fertilisers, are usually compounds of nitrogen and phosphorus and exist in the natural environment at all times. However, the activities of human being have added to the natural quantity. The excess of nutrients results in the overgrowth of micro organisms and plants. This causes a drop in the amount of oxygen available in the area. Nutrients are normally found in the domestic sewage, effluents and agriculture run off.

3.3.8. Radioactivity

Radioactivity in sea water is mainly caused through the discharge of radioactive materials by nuclear power plants and from other activities related with radioactive substances. Interestingly, when coal is burnt it also emits minor radioactive particles into the atmosphere which are then washed into the sea by rain. Other sources are the use of nuclear fuel, naturally occurring radioactivity and weapon testing in military activities.

3.3.9. Excess Heat

Excess heat, when introduced into the marine environment can change the ambient conditions that may be detrimental to the organism present. The primary sources of such excess heat are fossil-fuelled or nuclear power generating plants near the coast.

3.3.10. Brine

When brine is introduced into the marine environment it can cause damage to the organisms acclimatised to the particular salinity environment. Brine is mainly the by-product of desalination plants.

3.3.11. Fresh Water

Fresh water, when introduced in excessive amounts in a small area like an estuary can change the salinity and contents of other minerals. This change may be brought about by storm water, fresh water drains, water diversion arrangements from dams and effluents of some industrial processes.

3.3.12. Aesthetic Considerations

Materials unpleasant to look at, or of offensive odour such as tar balls and colouring agents could be repulsive as well as harmful to the marine life. Although in some cases these materials may present no long-term threat to the ecology of an area.

Aesthetically unpleasant areas often generate intense public reactions and hence are often only important from the public point of view rather than the actual environmental damage they cause.

3.4. CONTROLLING POLLUTION (PHYSICAL MEASURES)

With increasing population and the demand for energy and development, pollution has steadily made its way from land to the sea. As regards to the pollutants, the obvious control strategy would be to completely prevent their introduction into the marine environment. Though, this can be done theoretically only, by not producing the pollutant or by restructuring the process so that the pollutant is no longer a by-product. Some practicable and possible methods of controlling the major pollutants are briefly discussed in the following section of this chapter.

3.4.1. Industrial Pollutants

4.3.1.1. Oil Pollution

Oil at sea is one of the most significant of all types of marine pollution. Oil spills at sea attract the world-wide media attention and entail a large scale protest by the general public. However, oil pollution is not exactly that harmful as it is often believed. Oil is a naturally occurring substance, and is biodegradable over a certain period of time, depending on the type, amount and the surrounding conditions.

Since the turn of the century oil has become an important marine cargo. During the last few decades there have been several major oil tanker accidents resulting in significant spills and environmental damage. Other important sources of oil pollution are the Shipping and the port operations. IMO conventions like MARPOL 73/78 and LC 72 have provided for a significant reduction in uncontrolled discharges of oil into the sea environment during the recent decades.

Oil is not only a biggest eyesore in the sea environment, it also damages marine life and coastal ecosystems. Mangroves, marshes, beaches and coral reefs are exceptionally vulnerable to the oil pollution. The extent of environmental damage in the open sea is uncertain and it is widely accepted that the best course of action for an oil spill is to allow natural processes to deal with it. However, if the oil slick threatens the coastal areas then more protective measures are mandatory. Additional care has to be taken while using dispersants, as they mostly cause more damage than good.

When oil is introduced into the sea environment in significant quantities, it spreads as slick. Oil tends to be dispersed by waves and is emulsified by the absorption of water to change its texture to chocolate mousse. Oil also undergoes other physical reactions like evaporation, dispersion, sinking, etc.

Oil pollution in Pakistan is presently not threatening when compared to other sources. Tanker traffic is limited and the number of significant oil spills have been negligible during the recent past. However, the operational discharge of oil is nevertheless

noticeable. A high hope to minimise this practice is emerging with Pakistan's recent ratification of MARPOL 73/78.

3.4.1.2. Industrial Activities

Most industries use water as an integral part of cooling systems. Consequently, industrial effluents may contain large quantities of harmful wastes. These wastes may contain leached material from cooling plants, considerable amounts of heavy and light metals plus heat. However, the most harmful effluents originate from the pesticide, insecticide and fertiliser plants whose effluent discharge often proves to be extremely harmful for the marine environment.

Industries can be forced to limit their harmful effluents to the bare minimum or according to the prescribed standards usually known as National Emissions Quality Standards (NEQS). However, all these restrictions on discharges lead to an increase in the cost of the products, eventually to be borne by the tax payer. Governments and the public will have to decide as to what extent they are willing to pay to save the environment.

3.4.1.3. Pesticides and Herbicides

Pakistan is an agricultural country, it imports and produces a large quantity of pesticides and herbicides. These chemicals are used all over the country in virtually unlimited quantities and readily make their way through streams and river run-off to the sea.

An effective way to reduce this type of pollution will be to implement stringent and affective control on both the production and use of pesticides. A legislation defining the limitation on the use of pesticides will also be useful.

3.4.1.4. Radioactive Pollution

Radioactive pollution is caused by nuclear armament tests, power-generating nuclear plants and sea disposal of packaged nuclear wastes. Many European Union (EU)

countries have ceased to dispose of nuclear waste into the sea environment totally, they retain it on land which is a more effective way of nuclear waste disposal.

KANUPP (Karachi Nuclear Power Plant) presently poses no major threat as a source of nuclear pollution to the sea environment in Pakistan. However, the government must make a decision regarding the environmental and the economic feasibility of the plant in the future.

3.4.2. Domestic Wastes

3.4.2.1. Sewage

Sewage is relatively less harmful to the marine environment than other pollutants. The problem of sewage can easily be tackled by means of the sewage treatment plants. The process at treatment plants involves the primary and secondary treatment of sewage. The residual solids or sludge left behind by the treatment plant have limited use in agriculture due to large concentrations of metals. However, these can be safely used for construction work. Such residues can also be thrown into the sea but at selected safe areas after the removal of harmful substances.

3.4.2.2. Garbage

Garbage is one of the increasing pollution problems around the world. The problem is more acute in industrialised countries, where the generation of domestic waste is far higher than that of developing countries. Garbage or domestic waste largely constitutes paper products, food residues, clothing items and plastics. Plastic products are the biggest pollution problem when compared to other wastes since they are not easily biodegradable.

According to the American National Academy of Sciences, the world's merchant fleet dumps nearly 6.6 million tons of trash (including a large amount of plastic products) into the sea per year. Commercial fishermen are also large contributors of fatal plastic pollution. Drifting or Ghost nets prove to be death traps for large marine mammals that get caught and in a futile struggle to free themselves either suffocate or starve to

death. Small boat operators and tourists also contribute a large quantity of plastics directly or indirectly into the sea.

Pakistan is also suffering from the increasing garbage pollution. Cellophane bags are one of the largest residues in garbage throughout the country, since most other waste products are recycled.

Key steps in reducing plastic pollution in Pakistan would be a more stringent control of the type of plastic products. Additionally, waste treatment plants should be established in suitable numbers all over the country.

3.4.3. Shipping Activities

3.4.3.1. Dredging

Dredging is a constant process in Pakistani ports as the sea tide brings along a large quantity of sediments that can reduce the desired mandatory depth of busy port channels. Dredging can cause a major hazard to the marine environment, since sediments lying at the channel bottom often contain high concentrations of industrial pollution and can find their way to the surface layers of the water column during the dredging operations.

Sedimentation can be controlled by cutting off the source of sediment supply to the areas in a number of ways. One is to alter the natural landscape by artificial infrastructure so that no erosion takes place. Another is to build settling tanks to decrease the velocity of the streams and give the sediments a chance to settle. Third is to change the natural circulatory patterns by building training walls in selected estuary areas so that sediments are deposited in an area where they do not do any damage. In regions that are relatively shallow and narrow, high speed vessels can churn up the bottom and the resultant waves produced often tend to erode the banks and thus reduce the depth of the channel. Both these can be controlled by limiting the speed and the number of vessels using the channel.

Dredging is constantly practised in all major ports of Pakistan. The 990 km coastline witnesses one of the highest variations of diurnal tides. Sedimentation is unquestionably a problem in maintaining the desired depth of the channel. The above described methods to minimise dredging are undoubtedly costly and perhaps unpragmatic to achieve in Pakistan; however, an affective monitoring of the dredged spoils for any pollution contents could prove very fruitful before allowing to be dumped. No dumping should be permitted before the pollution contents are removed from the dredged material.

3.4.3.2. Anti-fouling Paints

The hulls of ships and boats are painted with anti-fouling paints in order to reduce the growth of marine creatures which affect the speed of the vessel. Anti-fouling paints are designed to leach a toxin to kill any sea creature coming close to the ship hull. The new anti-fouling paints contain toxins within the layer of original paint so that only those organisms coming very near to the hull are affected. However, the problem remains that ships' bottoms are routinely scrapped and sand blasted. These scrapings and sandblasted material are concentrated toxins and when escaped or released into the sea environment can cause considerable damage.

To minimise this type of pollution the scrapings of the ship bottom must be retained and treated before being disposed. A compromise in the use of anti-fouling paint is necessary and the studies to produce environment friendly deterrents for sea organisms should be undertaken.

3.4.3.3. Exotic Species in Ballast Water

One of the most recently identified marine pollution problem is associated with the transfer of marine organisms from one part to another part of the world in ships ballast water. These minute marine organisms, usually referred to as exotic species, are carried in the ships' ballast tanks to places where they may find an extremely hospitable environment to multiply in huge numbers. These alien species can cause damage to port or harbour structures and adversely affect the ecosystem of the host environment.

Currently there is not much work completed to reduce this type of marine pollution. However, in the absence of a more scientific means of control, exchange of ballast water in deep ocean areas or open seas, before arriving in the port of call, can currently offer a suitable means of limiting this emerging problem.

3.5. SUMMARY

The problem of marine pollutants has increased steadily over the past decades. Some pollutants are merely an eyesore but most of them are extremely hazardous to the marine environment. Some pollutants are very persistent and can bioaccumulate, resulting in diseases or birth defects in animals, at higher level of food chain. The more noticeable pollution like garbage is going to be one of the most concerning problem in the next century. The industrial activities are producing ever increasing amounts of marine pollutants in constant pursuit of development. The marine pollution is a controllable problem today, however, it essentially requires timely attention. The treatment of wastes before disposal is practised in most of the industrialised countries. However, for a developing country like Pakistan, waste treatment is currently more a luxury than a need.

CHAPTER IV

MARINE POLLUTION AND INTERNATIONAL CONVENTIONS

4.1. DEVELOPMENT OF LEGAL DOCUMENTS

The global concern over marine pollution appears to have originated in the first decade after World War I. Oil spills from the war stricken ships caused heavy damage to the unprotected coastline of many warring countries. In the following years of the war one of the foremost attempts to control and regulate oil spills from ships were made. The earliest convention relating to oil pollution was adopted in 1926 by the International Maritime Conference in Washington. The Convention catered for oil pollution related to ships, however, the Convention was not ratified by any nation.

4.1.1. OILPOL 1954

In 1954 the International Convention for the Prevention of Pollution of the Sea by Oil was adopted. OILPOL 1954 as it is commonly known, was a milestone in the developing trend to make the marine environment pollution free. It was later superseded by MARPOL 73/78.

4.1.2. International Maritime Organisation

Soon after the adoption of OILPOL 1954, the Intergovernmental Maritime Consultative Organisation (IMCO) was formed in 1958 as a specialised agency of the United Nations, under the Convention on the Inter-governmental Maritime Consultative Organisation 1959. The main purpose of the organisation was to provide machinery for co-operation among governments in the field of maritime laws to facilitate maritime safety and marine environment protection. The organisation was later renamed the International Maritime Organisation (IMO) on 22 May 1992. It currently has 155 Member States (IMO, 1997).

4.2. The United Nations and the Environment

The United Nations Conference on Human Environment (UNCHE 1972), held in Stockholm was attended by the heads of 113 states. Marine pollution was one aspect of the declaration, which served the global environmental issues and problems, such as de-forestation, desertification and global warming. The declaration contains 26 principles, covering all aspects of environmental problems, but principle 7 especially addresses marine pollution:

“States shall take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, damage amenities or to interfere with other legitimate uses of the sea.”

The UNCHE 1972 provided the international community with the necessary directional impetus to manage the environment. It also helped strengthen the political will of nations to pursue the environmentally friendly projects and their development. The famed Earth Summit or United Nations Conference on Environment and Development (UNCED), held in 1992 followed the guidelines of UNCHE 1972. Earth Summit 92 was unique in a sense that it set out unprecedented environmental issues to be adopted by the global community. The main outcomes of the UNCED 92 were:

- the Rio declaration on Environment and Development;
- the framework Convention on the Climate Change;
- the Convention on Biological Diversity;
- Agenda 21, including provisions on implementation, financial resources and mechanisms, transfer of environmentally sound technology, co-operation and capacity building as well as international arrangements among the countries;
- a Statement of principles on the management, conservation and sustainable development of all types of forests;
- a Statement of intention to deal with the problems of desertification;
- an Agreement on the establishment of the United Nations Commission for Sustainable Development; and

- a Decision to convene UN Conferences on Straddling and Highly Migratory Stocks in the High Seas, on the sustainable development of small islands; on integrated coastal management (Brubaker, 1993).

All the outcomes have some marine dimension however, Chapter 17, of the Agenda 21 directly addresses the marine environment issues. The implementations of these outcomes interact with the implementation and progressive development of the Law of the Sea.

In June 1997, another UNCED took place at New York, which reviewed the general achievements of UNCED 92 and drew the attention of many leading nations. However, it lacked the significance of the Rio Conference 92.

4.2.1. UNCLOS I and II

The first and second United Nations Law of the Sea Conferences took place in 1958 and 1960. The conferences considered the question of marine pollution, yet only superficially. The four conventions concluded by the first and second United Nations Law of the Sea Conferences are :

- Geneva Convention on the Territorial Sea and Contiguous Zone, 1958.
- Geneva Convention on the High Seas, 1958.
- Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas, 1958.
- Geneva Convention on the Continental Shelf, 1958.

4.2.2. UNCLOS III, 1982

This Convention was the result of the most ambitious attempt by the United Nations to reform international law. The Third United Nations Law of the Sea Conference (UNCLOS III) is one of the best chronicled international conferences to present the most widely accepted international marine laws (UNCLOS III, 1982). Pakistan is a party to the Convention. The principle features of UNCLOS III are:

- new jurisdiction for coastal states in 12 mile Territorial Seas; 24 mile Contiguous zones, 200 miles Exclusive Economic Zone; Archipelagic waters and especially environmentally endangered waters; and
- extensive new provisions for the protection of the marine environment in Part XII of the Convention which gives coastal states the powers to protect the marine environment in their jurisdiction.

4.3. DUMPING OF SUBSTANCES AT SEA

Seas were considered the last destination of all the wastes produced by man. The practice of dumping wastes in the sea is primitive, though it was only observed with increased concern during the industrial and shipping development of the current century. The sea provided a problem free waste disposal ground for industries which could not dispose off their hazardous wastes on land. Dredging spoils from the channels and the ports were also readily disposed off in the sea. The increasing amount and level of toxic substances in the marine environment served as impetus to the global attention to control the unregulated dumping of toxic substances.

4.3.1. London Dumping Convention (LC 72)

One of the earliest conventions addressing dumping of wastes in marine environment is LC 72 (London Dumping Convention). The Convention has a global character and represents a positive step towards the international control and prevention of marine pollution (IMO, 1982). It prohibits the dumping of certain hazardous materials, unless a subsequent authenticated permit is awarded by the controlling party state. On June 1997, 77 states had ratified the Convention. Pakistan also became party to the Convention recently but has not ratified the 1978 amendments.

4.3.2. Main Requirements

The general requirements are set out in the Article I and II of the Convention. Article I, states:

“Contracting Parties shall individually and collectively promote the effective control of all sources of pollution of the marine environment, and pledge themselves especially to take all practicable steps to prevent the pollution of

the sea by dumping of waste and other matter that is liable to create hazard to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.”

Similarly Article II states:

“Contracting Parties shall, as provided for in the following Articles, take effective measures individually, according to their scientific, technical and economic capabilities, and collectively to prevent marine pollution caused by dumping and shall harmonise their policies in this regard.”

Article III defines the area of application of the Convention and what is meant by dumping, including various other terms used subsequently in relation to the act of dumping and licensing of dumping.

4.3.3. Constraints on Dumping

Basic provisions of the Convention are provided in Article IV, which contains a general prohibition against dumping of any wastes or other matter in whatever form or condition except as otherwise specified. The second part of Article IV expresses restrictions on the dumping of substances, while the dumping of the substances listed in Annex I or the ‘Black List’ is completely prohibited. A ‘Special permit’ to dump the substances listed in Annex II or ‘Grey List’ is required, and a ‘General permit’ is needed before dumping of all other substances not listed in the two Annexes. Under Article V safety of life at sea takes precedence over the dumping restrictions and under Article VI Contracting Parties are obliged to designate an authority to award permits, keep records and monitor the condition of the sea. Article IX further presents the need of regional co-operation, particularly in the fields of monitoring and scientific research.

4.3.3.1. Annexed Substances

The three Annexes to the article contain the list of substances in order of restrictions.

4.3.3.1.1. Black List Substances (Annex I)

The Annex I contains the list of substances which are not allowed to be dumped in any quantity. The substances included, are considered most hazardous or toxic if

introduced into the marine environment. Examples are metals, persistent plastics, radioactive wastes, and crude oil.

4.3.3.1.2. Grey List Substances Annex II

Annex II contains the list of substances which are considered to be less harmful than 'Black List' substances. The 'Grey List' substances are allowed to be dumped in control quantity and outside the specified areas. A 'special permit' is issued by the designated authority of the flag or coastal state for allowing the dumping. Examples of Annex II substances are; wastes containing significant amounts of heavy metals, large quantities of acids or bases, and containers or metal scraps.

4.3.3.1.3. White List Substances Annex III

All substances or materials not mentioned in Annex I or II to the Convention fall in the 'White list' category. These substances require only a 'General permit' prior to their dumping. Strictly speaking, there is no list of substances or other materials in this category; instead, a list of factors to evaluate whether or not a permit to dump at sea should be issued, is contained in Annex III to the Convention. More specifically, the purpose of Annex III can be observed as follows:

- to decide whether an application for sea disposal should be pursued in the light of the availability of land-based disposal or treatment methods;
- to select a sea disposal site, including the choice and collection of relevant scientific data to assess the potential hazards to human health, harm to living resources and marine life, damage to amenities or interference with other legitimate uses of the sea;
- to choose appropriate disposal methods and conditions; and
- to develop an appropriate monitoring program.

4.4. LAND-BASED MARINE POLLUTION

Land-based marine pollution or LBMP is one of the earliest type in all categories of marine pollution. It can be traced back to the history of mankind when it first dwelled along the coasts for fishing and other resources of the sea. It is not very long ago when this source has been identified as the biggest contributor to the marine pollution. In

fact, it was not until 1960s when the LBMP began to attract international concern. At the 1972 UN conference on the Human Environment, for the first time, LBMP appeared as an important source of marine pollution in an international instrument. Since then at least one global convention UNCLOS III (1982) directly contains provisions to cover this source of marine pollution.

4.4.1. UNCLOS III 1982

Article 207 of UNCLOS III provide the guidelines for the state in relation with the LBMP. The Article states:

“States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources, including rivers, estuaries, pipelines and outfall structures, taking into account internationally agreed rules, standards and recommended practices and procedures...”

4.4.2. Obligations under International Law

It is the duty of every state under international law, to prevent polluting other states' boundaries under the “no harm principle”. The basis of this rule, appear to originate from the Roman Law maxim which interprets it as: “Use your own property so as not to ignore that of others”. The applicability of this rudimentary rule on environment protection has been re-stated in several major soft law instruments, such as the declaration of the ‘Human Environment’, Stockholm 1972 and declaration of ‘Earth Summit’, Rio 1992 (Qing-Nan, 1987).

Principle 21 of the 1972 Stockholm Conference on Human Environment declares that States have, in accordance with the charter of the UN and the principle of international law:

“The sovereign right to exploit their own resources pursuant to their own environmental policies and the responsibilities to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of are beyond the limits of national jurisdiction.”

This principle was re-defined in 1992 in UNCED at Rio. The fundamental principle is reflected in all sea-conventions. For example, Article 194 (2) of the 1982 law of the Sea Convention imposes on the Contracting Parties the obligation to:

“Take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this convention.”

This rule is applicable to LBMP when such pollution produces adverse trans-frontier effects. Although the development of international law on LBMP has been limited, impressive achievements have been achieved at the regional level. Every regional framework convention on the protection of the marine environment has a general provision on the LBMP. The four main regional agreements contain detailed provisions on this particular type of pollution. By the end of 1983 at least six framework conventions had been adopted in six regions of the world which are:

- The Mediterranean (Barcelona Convention 1976)
- The Gulf Region (Kuwait Convention 1978)
- The West and Central African Region (Abidjan Convention 1981)
- The South-East Pacific Region (Lima Convention 1981)
- The Red Sea and Gulf of Aden Region (Jeddah Convention 1982)
- The wider Caribbean Region (Cartagena Convention 1983)

In these framework conventions, excepting the Lima Convention, there is always an article on LBMP. The statements of the articles are slightly different but the purpose is identical. For example Article 6 of Kuwait Convention state that:

“The Contracting States shall take all appropriate measures to prevent, abate and combat pollution caused by discharges from land reaching the Sea Area whether waterborne, air-borne, or directly from the coast including out falls and pipelines.”

Regarding the general obligation, these articles require Contracting Parties to take all appropriate measures against pollution from land-based sources. Importantly, there are no explanations as to what “the measures” will be. However, by using the modifier “all”, they tend to include all possibilities, including measures both technical and legal. Four other regional framework conventions which contain detailed provisions in this field are as follows:

- **The Helsinki Convention.** The Convention on the Protection of the Marine Environment of the Baltic Sea area was signed on 22 March 1974. The member states are Denmark, the Federal Republic of Germany, Poland, Russia, Finland and Sweden. Article 6 of the Convention directly concern with the prevention, reduction and control of pollution from land-based sources, which is 80% of the marine pollution in the Baltic Sea. The Convention has already come into force.
- **Paris Convention.** The Convention for the prevention of Marine Pollution from Land-based Sources was signed on 4 June 1974 by the states bordering the North Sea and the Northern Atlantic. This was the first Convention specifically concerning LBMP control.
- **The Protocol on LBMP to the Barcelona Convention.** The protocol provides further development of the states’ responsibility to control LBMP. It was signed by 13 states and came into force in 1983.
- **The Protocol on LBMP to the Lima Convention.** The protocol was signed by Chile, Colombia, Ecuador, Panama and Peru on 12 November 1981. It specifically concerns the prevention of pollution from land-based sources.

4.5. POLLUTION FROM SEABED ACTIVITIES

The increasing use of the oceans and the accelerating demand for marine energy resources necessitate the deployment of offshore marine explorations and seabed activities. Although pollution from these offshore activities is somewhat minimal, it is nevertheless acute. The water that surrounds the offshore installations provides a perfect site for disposal of wastes. Marine pollution is therefore the most immediate repercussion of the seabed or offshore activities.

One of the greatest pollution hazards from seabed activities originates from oil drilling. Although, the operational pollution during these activities is below the level of concerns; however, the accidental blow outs and tanker collisions pose a considerable risk. Earlier estimates suggest that out of a total of 0.08 million tons of oil that were released annually from offshore operations, about 0.06 million was attributed to accidents (Gavouneli, 1995).

Recently, an increasing risk has emerged with the drilling operations of the minerals. Mine drilling occurs with a large amount of waste materials introduced in the surrounding marine environment. The material largely constitutes sediments that are biologically inert and adversely affect the marine ecosystem in the immediate surroundings of the offshore installation.

4.5.1. Conventional Regulations Covering Offshore Activities

Although pollution from seabed activities is an expanding field, the covering rules for it are still very few. One obvious reason is that most of the seabed activities take place on the continental shelf, under the jurisdiction of the coastal state.

4.5.2. Law of the Sea Convention

In the absence of any specific international treaty, the only valid rules covering offshore activities are those of the Geneva Convention on the Continental Shelf 1958, namely Articles 5 and 7, plus Article 24 of the High Seas Convention, which states:

“Every State shall draw up regulations to prevent pollution of the seas. resulting from the exploitation and exploration of the seabed and its subsoil, taking into account existing treaty provisions on the subject.”

In the 1982 Law of the Sea Convention, the general obligation of all states is provided in Articles 208 and 209, namely for adoption and enforcement of regulations to prevent, reduce and control pollution arising from seabed activities.

4.5.3. Regional Conventions

As the presence of offshore installations is more likely to be in the coastal waters, the associated pollution problems can be better addressed by the regional agreements.

The series of Conventions concluded under the auspices of UNEP (United Nations Environment Program) Regional Sea Program, set out a commonly adopted general obligation for the parties to take appropriate measures to prevent and control pollution arising from the exploration and exploitation of their seabed mineral resources. This obligation is described in Article 8 of the Abidjan Convention; in Article 4(c) of the Lima Convention; in Article VII of Jeddah Convention; in Article 8 of the Cartagena de Indias Convention; and in Article 8 of the Nairobi Convention. However, the root of all the stated obligations can be traced back to Article 7 of the Mediterranean Convention which provides for the adoption of a specific Protocol on the subject. Article 3 of the same Protocol state:

“The Parties shall take, individually or through bilateral or multi-lateral co-operation, all appropriate measures to prevent, abate, combat and control pollution in the Protocol Area resulting from activities, inter alia by ensuring that the best available techniques, environmentally effective and economically appropriate, are used for this purpose.”

There are special provisions for the operational discharges of the offshore installations that generally take into account the “internationally accepted standards”. For example, the operational discharges by the offshore installations are same as that of MARPOL 73/78 for ‘clean ballast water’.

4.5.4. Supplementary Offshore Regulations

Although most marine pollution conventions devote at least one article to the pollution arising from activities of exploration and exploitation of the seabed and its subsoil, regulations applicable to offshore installation can also be found in a number of conventional instruments dealing with other forms of pollution. For example, pollution from offshore installations is frequently included in the land-based sources.

Article 3(c)(iii) of the 1974 Paris Convention for the Prevention of Marine Pollution from Land-based Sources includes in its definition of land:

“Man-made structures placed under the jurisdiction of the Contracting Party within the limits of the area to which the present convention applies.”

Similarly the Montreal Guidelines on the Protection of the Marine Environment against Pollution from Land-based Sources also mention:

“Sources of marine pollution from activities conducted on offshore fixed or mobile facilities within the limits of national jurisdiction, save to extent that these sources are generated by appropriate international agreements.”

The regulations for the offshore installation had a late start. For long years, maritime nations were pre-occupied with the immense polluting capabilities of ships and consistently failed to acknowledge the contribution of offshore installation in the marine pollution. However, the new regulatory documents to cover offshore installation discharges are being developed on the same framework as of any other source of marine pollution.

4.6. POLLUTION THROUGH THE ATMOSPHERE

Pollution through atmosphere is relatively less acute when compared to other sources; however, it is increasing at an alarming rate. The substantial concerns from atmospheric pollution are the climate change (global warming), acid rain, depletion of ozone layer, hazards to human health and species extinction in some parts of the world. The causes of air pollution are widespread, such as massive urban population and its associated problems, industrialisation, transportation, and farm animal manure.

4.6.1. Global Control

The legal documents for air pollution are limited and still not widely implemented around the world. One of the most significant global conventions in this context is the Convention on the Long-range Trans-boundary Air Pollution, Geneva 1979. The Convention provides the guidelines to minimise air pollution and urges the Contracting Parties to co-operate with one another in achieving the set goals (Brubaker, 1993). Other important conventions in this context are:

- Convention for the Protection of the Ozone Layer, Vienna 1985;
- IAEA- Convention on the Early Notification of a Nuclear Accident, Vienna 1986;
- the framework Convention on Climate Change, Rio 1992.

The pollution through atmosphere is mostly invisible, yet there is no doubt that its results are destructive. Studies show that extinction of many frog species in the tropical rain forests of South America can be attributed to the acid rains. The widening hole in the ozone layer is directly responsible for skin cancer in humans. Similarly, global warming by the green house gases can cause a rise in the sea-level; inundating the low-lying countries like Bangladesh and Maldives. It is very important to control the air pollution since it can carry pollutants over vast distances and can cause many environmental problems that are still unknown to scientists.

4.7. VESSEL-SOURCE POLLUTION

The biggest concern from vessel-source pollution comes from oil tanker accidents. However, most of the oil pollution comes from the operational discharges of ships. The chemical cargo carried onboard ships, poses a more serious threat to the marine environment than oil in the case of an accident. Unlike oil, chemicals are usually very persistent and extremely toxic to marine organisms. The ships also generate other wastes like sewage, garbage, sludge and exhaust gases.

4.7.1. MARPOL 73/78

Ship-borne pollution was first addressed more seriously in the early 1950's, however, at that times oil was thought to be the only serious problem for the marine environment. The adoption of OILPOL in 1954 was a direct result of those prevailing concerns.

Since, vessel-source pollution has been significant and more obvious, the maritime community continued to address it sincerely in the following decades. MARPOL 73/78 which is considered to be one of the most meaningful convention in the context, was adopted in the wake of the 'Torrey Canyon' disaster in 1967. MARPOL 73/78 is the most comprehensive and ambitious international treaty covering ship-source

marine pollution. It came into force in 1983 and superseded OILPOL 1954. MARPOL 73/78 is currently ratified by 100 maritime nations. Pakistan became a party to the Convention in 1995, a rather late ratification. However, it ratified all the 5 Annexes to the Convention.

Unlike OILPOL 1954, MARPOL 73/78 does not only deal with the oil, but with all forms of ship-generated wastes. The Convention currently has five Annexes with the sixth Annex in draft format (air pollution by vessels). Most of the technical measures are included in the Annexes which deal with different types of wastes generated onboard ships.

4.7.2. Annex I (Oil)

This Annex covers the operational discharge of oil by vessels at sea. The oil discharge criteria contained in OILPOL 1954 are the same in Annex I, however, the total amount of oil which can be discharged into the sea is halved for new tankers to 1/30,000 of the previous cargo. The conditions for operational discharges are clearly defined for all vessels.

Parties to the Convention must ensure that adequate reception facilities are provided at their ports for the oily residues from ships. Under regulation 5, an international Oil Pollution Prevention Certificate must be issued to tankers of 150 GT. and above after being surveyed. All tankers and other ships must carry and maintain an 'Oil Record Book', in which all operations involving oil are to be recorded (IMO, 1997).

4.7.3. Annex II (Liquid Noxious Substances Carried in Bulk)

This Annex contains detailed requirements for the discharge criteria and measures for the control of pollution by liquid noxious substances carried in bulk. The substances are divided into four categories as A, B, C and D, according to the hazards they pose to the marine environment. Nearly 250 substances have been listed in the Appendix to the Convention.

Like Annex I, there are restrictions on the discharge of residues for the substances of Annex II. Parties to Convention are obliged to issue detailed requirements for the design, construction and operation of chemical tankers which contain at least all provisions of the IBC i.e. International Code for the Construction and Equipment of ships Carrying Dangerous Chemicals in Bulk. Operations involving substances to which Annex II applies, must be recorded in a 'Cargo Record Book', which can be inspected by the authorities of any Party to the Convention.

4.7.4. Annex III (Harmful Substances in Packaged Forms)

This Annex applies to all ships carrying harmful substances in packaged forms. The Annex requires the issuing of packaging labels, documentation, quantity limitations, exceptions and measures for preventing or minimising pollution by harmful substances. In order to favour the implementation of these requirements, the International Maritime Dangerous Goods (IMDG) Code was amended to cover pollution aspects.

4.7.5. Annex IV (Sewage)

Annex IV is not enforced and currently ratified by 65 countries. It is applicable to all ships irrespective of size and tonnage. Under this Annex, ships are not permitted to discharge sewage within four miles of the nearest land, unless they have an approved treatment plant in operation. Between 4 and 12 miles from land, sewage must be comminuted and disinfected before discharge. Contracting Parties are obliged to issue An 'International Sewage Pollution Prevention Certificate' after surveys of the ships. The Government of each Party is also obliged to provide reception facilities at ports and terminals for the reception of sewage.

4.7.6. Annex V (Garbage)

The Annex This Annex entered into force on 31 December 1988. It is ratified by 83 countries. It is also applicable to all ships irrespective of size and tonnage.

4.7.7. Annex VI (Air Emissions by Ships: Future Annex)

This Annex is still not included in the main text of MARPOL 73/78. However, it has been approved by the MEPC (Marine Environment Protection Committee, IMO) in draft format. The exhaust emissions of ships usually contain significant contents of SO_x, NO_x, and CO_x. These gases are the prime contributors to the atmospheric pollution problems. The future Annex of MARPOL 73/78 is expected to provide an effective control against the small but significant amount of ozone depleting gases from ship emissions.

4.7.8. Impact of MARPOL 73/78

There is little doubt about the effectiveness of the MARPOL 73/78. It was estimated that within 10 years of its implementation, oil pollution by ships had been reduced by almost 50 percent (Sampson, 1996). The studies carried out by the National Research Council Marine Board of United States credited MARPOL 73/78 with having "a substantial positive impact in decreasing the amount of oil that enters the sea." The impact of MARPOL 73/78 is expected to be even greater in the years to come. One reason is the economics: with successive increases in the price of oil the ships will be further obliged to follow MARPOL 73/78 guidelines.

The provision of adequate reception facilities for wastes is crucial to the successful implementation of MARPOL 73/78. Currently, they are required by four of the five Annexes (Annex III is the exception) and the intention is that ships will be able to retain their wastes onboard until they reach the port.

Although reception facilities are mandatory, in some cases they are still not existing. In some countries facilities are provided but at a very high cost; giving a disincentive to ships to discharge at ports. Ironically, many big oil exporting States e.g. Saudi Arabia and Kuwait have avoided the ratification of the MARPOL 73/78. One reason is that it will oblige them to provide reception facilities for oily wastes entailing a huge cost.

The role of MARPOL 73/78 in limiting the amount of waste to be discharged at sea is unquestionably monumental. However, if the ports fail to provide the reception

facilities the captain of the ship has to dispose of the wastes in some other way. The temptation is to do this illegally.

Despite the impediments, the next few years, present a bright prospect for MARPOL 73/78 role in further decreasing the amount of ship-source pollution. However, the success of the Convention still depends on the Governments, ship operators, vessels and the crews that sail in them. It is hoped that during the next few years, all international shipping conventions, including MARPOL 73/78, will be much more effectively implemented than in the past. Other measures developed by the International Maritime Organisation are intended to achieve this, for example, by emphasising the responsibilities of management and also monitoring the record of individual Governments in putting the convention into effect. A more effective implementation of Port State Control measures is also being encouraged.

4.8. RELATED IMO CONVENTIONS

Many of IMO conventions are not directly related to the marine pollution but their impact on the marine environment is nevertheless significant. Some of these important IMO conventions are briefly discussed in the following section (Gold, 1985).

4.8.1. SOLAS 74

The International Convention for the Safety of Life at Sea (SOLAS 74) in its successive forms is regarded as the most important of all IMO instruments. The convention was initially adopted in the wake of the sinking of the legendary cruise ship, 'Titanic' in 1914. The latest version was adopted in 1974, however, there are a series of amendments adopted after that. The fact that safety of life take precedence over the environment considerations in the time of crises, makes this convention extremely important as regards to improve safety standards so there are minimum possible compromises taken on environment during an accident.

Some important Codes which are mandatory under the convention are:

- IMDG (International Maritime Dangerous Goods) Code.
- GMDSS (Global Maritime Distress and Safety System) Code.

- International Grain Code
- ISM (International Safety Management) Code.

The SOLAS 74 has one of the largest group of party States among all the IMO conventions. The total ratification on 01 June 1997 was 125. Pakistan has ratified the SOLAS 74 and its 1978 Protocol, however, it has not ratified the Protocol of 1988 as yet.

4.8.2. STCW 78

The International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW), 1978 is the first to establish the basic requirements for the training and certification of the seafarers. The importance of the instrument is related to the improved safety standards and pollution prevention measures which are attributed to the better training of seafarers.

STCW 78 is also one of the most ratified conventions of IMO. The current strength of the members as per 01 June 1997 is 127. Pakistan ratified the convention on 10 April 1985.

4.8.3. SAR 79

International Convention on Maritime Search and Rescue (SAR) 1979 is the first of its kind to provide separate and comprehensive guidelines for the conduct of search and rescue (SAR) operations at global/regional scale. The Convention encourages the co-operation between the States for the establishment of a regional or international SAR plan.

The member States undertake to establish necessary arrangements for maintaining constant distress watch in their area of responsibility. The States are also required to ensure that arrangements are made for the provision of adequate SAR facilities. Pakistan is a member of this convention. The present member strength is 57.

4.8.4. OPRC 90

International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 1990 is another important IMO instrument to provide for the oil pollution combating measures at global or regional scale. The party States are required to establish methods to combat the oil pollution incident at their national or regional level. The ships of the member States are required to carry a shipboard oil pollution emergency plan. Parties to the convention are required to provide assistance to other States in event of a major disaster.

The convention came in to force on 13 May 1995 and the number of member States is currently 30. Pakistan became a member to the convention on 21 January 1993.

4.8.5. CLC 69

The International Convention on Civil Liability for Oil Pollution Damages (CLC) 1969 came in to force on 19 June 1975. The Convention was formulated to settle the issue of the ship owner's liability for damages suffered by the affected State or persons, in the event of an accident involving oil pollution. The convention puts the liability of such environmental damages on ship owner.

The convention applies to all sea going ships. The number of party States to the convention is 98. Pakistan is not a party to CLC 69.

4.8.6. FUND 71

The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damages, 1971, came in to force on 16 October 1978. The purpose of the convention is to provide compensation for the pollution damages in conjunction to the CLC 69. The basic idea behind the convention is to give relief to the ship owners in respect of additional financial burden imposed on them by the CLC 69.

Present strength of the member States is 74. Pakistan has not ratified the convention.

4.8.7. HNS 96

The International Convention on the Liability and Compensation for damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by Sea, 1996, is one of the latest IMO conventions. The instrument was adopted in order to provide for the compensation scheme for the victims of accidents involving HNS e.g. chemicals.

The Convention introduces strict liability on the ship owner for a HNS pollution incident. It is currently not ratified by any State.

4.8.8. INTERVENTION 1969

The need for this Convention was seriously felt in the following years of the grounding of 'Torrey Canyon' in 1967. The pollution caused by the oil spill raised the issue of the powers of coastal state to intervene when a serious threat was posed to its coastline. The Convention gives the coastal states limited rights to take preventive actions on the high seas against vessels which can present grave and imminent danger to the coastline. The Convention, for the first time furnished a real departure from the traditional international legal principle of non-interference on the high seas. Pakistan has ratified the Convention and its 1973 Protocol. On 01 June 1997 the total number of countries who ratified the Convention was 70.

4.9. SUMMARY

Marine pollution has always been a matter of concern in the recent history of Shipping. Though, it has only been noticed with greater attentions during the past few decades. Both United Nations and IMO have played pivotal roles in developing the international regulations to protect marine environment. It will not be wrong to state that nearly all major sources of marine pollution are given the adequate legal cover by UN and IMO. It is true to say that marine environment is still being polluted but with the advent of IMO and UN conventions, the amount of pollution has essentially reduced. However, the global interests in protecting the marine environment still need higher impetus.

CHAPTER V

ENVIRONMENT PROTECTION IN PAKISTAN

5.1. ENVIRONMENTAL LAW AND POLICY

Environmental protection awareness was a late start in Pakistan. There had been several attempts to check the increasing pollution in the country but none was more significant than the Pakistan Environment Protection Ordinance of 1983. Although now repealed by the Pakistan Environmental Protection Act 1995, this Ordinance was the first comprehensive attempt at a Government level to recognise environment pollution as a serious problem and provided a framework of policy actions to prevent it. The Ordinance extends to the whole of Pakistan including the territorial waters, EEZ, and historic waters (meaning such limits of waters adjacent to the land territory of Pakistan as are for the time being specified by notification under section 7 of the Territorial Waters and Maritime Zones Act, 1976).

5.1.1. Principle Features of Pakistan Environment Protection Ordinance (1983)

Under the Ordinance, Pakistan Environment Protection Council (PEPC) was established with President of Pakistan as the chairman of the Council. The Council was made responsible for the following functions:

- a) ensure enforcement of this Ordinance;
- b) establish comprehensive national environmental policy;
- c) give appropriate direction to conserve the renewable and expandable resources;
- d) ensure that environmental considerations are inter-weaved into National Development Plans and Policies;
- e) ensure enforcement of the 'National Environmental Quality Standards'; and

5.1.2. Establishment of Pakistan Environmental Protection Agency

Under the Ordinance, Pakistan Environment Protection Agency (PEPA) was formed to work under the directions of the PEPC. The PEPA was given the following responsibilities:

- a) administer this Ordinance and the rules and regulations;
- b) prepare national environmental policy for approval of the PEPC;
- c) publish an annual report on the state of environment;
- d) establish NEQS (National Environmental Quality Standards) as and when deemed necessary;
- e) co-ordinate environmental policies and programs nationally and internationally;
- f) establish systems of surveys, surveillance, monitoring, measurement, examination and inspection to combat environmental pollution;
- g) take measures to promote the development of science and technology which will contribute to the prevention of environmental pollution, such as the consolidation of survey and research system, the promotion of research and development, the dissemination of the results of such research work and development work, and the education and training of research experts and other governmental functionaries;
- h) provide information and education to the public on environmental matters and to recommend to the Council the introduction of environmental information in the syllabi of educational institutions; and
- i) co-ordinate and consolidate implementation of measures to control pollution with Provincial Governments and other Governmental agencies.

5.1.3. Additional Duties

In addition to the main functions described above, the PEPA was also eligible to:

- a) request any Government agency to furnish any information or data relevant to the functions of the PEPA;
- b) with the approval of the Federal Government, initiate requests for foreign assistance in support of the objectives of this ordinance and enter into arrangements with foreign agencies or organisations for the exchange of material or information and participate in international seminar or meetings;

- c) establish and maintain laboratories to conduct research in various aspects of environment and provide grants to institutions for specific projects;
- d) delegate any of its powers under this Ordinance and the regulations to any Government agency;
- e) identify the needs for legislation in the environmental field;
- f) at the request of the Federal Government or a Provincial Government or any Government agency, provide advice and assistance in the environmental matters; and
- g) perform any other function which the Council may assign to it.

5.1.4. Environmental Impact Statement (EIS)

Every proponent of a project, the construction or completion of which is likely to adversely affect the environment shall file with the PEPA at the time of planning, a detailed environmental impact statement including information on:

- a) the impact on the environment of the proposed industrial activity;
- b) the treatment works of the proposed project;
- c) the un-avoidable adverse environmental effects of the proposed project; and
- d) the steps proposed to be taken by the project proponent to minimise adverse environmental effects.

The PEPA is also entitled to prescribe guidelines for the preparation of EIS, approve or recommend to the Federal Government the necessity to modify or reject the submitted EIS, if in the interest of environmental objectives. The Agency is also to provide assistance to local councils, local authorities or Government agencies to implement schemes for the proper disposal of urban and industrial wastes in line with the approved procedures prescribed by the Agency.

5.2. THE PAKISTAN ENVIRONMENTAL PROTECTION ACT (1995)

The Pakistan Environmental Protection Act was enacted in 1995 and it repealed the Pakistan Environmental Protection Ordinance, 1983. The Act contains revised provisions to address the subject of environment protection, pollution prevention and sustainable development. The Act extends to the whole of Pakistan and its Territorial waters, Exclusive Economic Zone and historic waters.

5.2.1. Important Features of the Act

- i. The Act covers air, water, soil, marine and noise pollution (including motor vehicular pollution), waste disposal and handling of hazardous substances.
- ii. Comprehensive and revised definitions of environment and pollution control subjects are included.
- iii. Pakistan Environment Protection Council (PEPC) has been made responsible for the development and approval of environmental policies within the framework of the existing national conservation strategy.
- iv. Discharges or emissions in excess of the NEQS or more stringent standards established by Pakistan Environment Protection Agency (PEPA) have been prohibited.
- v. Two stages of environmental screening process has been introduced. The small proposed projects are required to file an initial Environmental Examination and an additional comprehensive Environmental Impact Assessment report for large projects.
- vi. Import of hazardous waste has been prohibited.
- vii. Control on handling hazardous wastes has been made more stringent.
- viii. To ensure compliance with NEQS, PEPA has been empowered to direct installation of pollution control devices in motor vehicles.
- ix. PEPA has been empowered to issue an environmental protection order to deal with an actual or potential adverse environmental effect in violation of the provisions of the Act.
- x. Environmental Tribunals have been constituted with exclusive jurisdiction to try serious offences under the Act. Relatively minor offences pertaining to littering/waste disposal, pollution by motor vehicles, and violation of rules and regulations etc. will be tried by authorised magistrates.

5.2.2. The Pakistan Environmental Protection Council

Under this Act the PEPC, was re-structured on the same lines as that of Pakistan Environmental Ordinance 1983. However, there are some changes in the organisation and functions. The Council consists of:

- i. the Prime Minister of Pakistan . . .Chairperson
- ii. Minister of Environment and Urban

affairs Division	..Vice-Chairperson
iii. Chief Ministers of Provinces	..Members
Ministers in charge for the subject of Environment in the Provinces	..Members
iv. team of experts (not exceeding 30) as the Federal Government may appoint, of which at least ten shall be non-official	..Members
v. the Secretary to the Government of Pakistan, Environment and Urban Affairs Division	..Secretary

5.2.3. Functions of the Council

The functions of the Council are:

- a) ensure enforcement of this Act;
- b) establish or adopt comprehensive national environmental policies and ensure their implementation within the framework of a national conservation strategy as may be approved by the Federal Government from time to time;
- c) approve National Environmental Quality Standards (NEQS);
- d) give appropriate direction to conserve biodiversity and renewable and non-renewable resources and ensure improved efficiency in their use and management;
- e) ensure that environmental considerations and concerns of sustainable development are incorporated into national development plans and policies;
- f) consider the annual national environment reports and give appropriate directions thereon; and
- g) give directions to any person requiring him to stop any contravention of the provisions of this Act by such person or to take such measures as may be necessary for carrying out the purposes of this Act.

In addition to the above the Council may also, either itself or on the request of the Federal or Provincial Government or any Government Agency, direct the Federal Agency to prepare, submit, promote or implement projects for the protection, conservation, rehabilitation and improvement of the living environment, the

prevention and control of pollution, and the sustainable development of the resources or to undertake research in any specified aspect of the environment.

5.2.4. The Pakistan Environment Protection Agency

The functions of the PEPA under the Act are more or less unchanged. The Federal Agency plays a key role in matters pertaining to environment and pollution prevention. The re-defined responsibilities of the PEPA are:

- a) administer and implement this Act and regulations;
- b) prepare, in co-ordination with the appropriate Government Agency, national environmental policies for approval of the Council;
- c) take all necessary measures for the implementation of the national environmental policies approved by the Council;
- d) prepare and publish an Annual National Report on the state of the environment;
- e) prepare or revise, and with the approval of the Council, establish the National Environmental Quality Standards;
- f) ensure the enforcement of National Environmental Quality Standards approved by the Council;
- g) co-ordinate environmental policies and programs at local and international levels;
- h) establish systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation, research and inspection to prevent pollution and to implement the Act and the rules and regulations;.
- i) designate one or more laboratories for conducting tests and analysis for the purpose of this Act;
- j) identify the needs for legislation in the field;
- k) provide advice and assistance in environmental matters to Governmental and non-governmental agencies;
- l) assist local councils, local authorities or other Government Agencies and persons to implement schemes for the proper disposal of wastes in line with the standards established by the Federal Agency;
- m) provide information and guidance to the public on environmental matters;
- n) recommend environmental courses, topics, literature and books for incorporation in the syllabi of educational institutions;

- o) promote public education and awareness of environmental issues;
- p) lay down safeguards for the prevention of accidents which may cause pollution, collaborate in the preparation of contingency plans for such accidents; and co-ordinate implementation of such plans;
- q) take all necessary measures for the protection, conservation, rehabilitation, and improvement of the living environment, the prevention and control of pollution, and the promotion of sustainable development; and perform any function which the Council may assign to it.

5.2.5. Additional Duties

In addition to the duties mentioned above, the Federal Agency may also:

- a) undertake inquiries or investigations into environmental issues suo moto or upon complaint from any agency or person;
- b) request any person to furnish any information or data relevant to the functions of the Federal Agency;
- c) with the approval of the Federal Government, initiate requests for foreign assistance in support of the purposes of this Act and enter into arrangements with foreign agencies or organisations for the exchange of material or information and participate in international seminars or meetings;
- d) recommend to the Federal Government the adoption of economic and financial programs, schemes or measures such as incentives, subsidies, tax exemption, depreciation allowances, and differential duties, taxes and other levies for achieving environmental objectives and goals and purposes of this Act in a cost-effective manner and for raising funds for environmental purposes;
- e) establish and maintain laboratories to help it perform its functions under this Act and to conduct research in various aspects of the environment and provide grants to the institutions for specific projects.

5.2.6. Provincial Environmental Protection Agencies

Under the provisions of the Act, each Provincial Government has established an Agency to be called the Environmental Protection Agency of the particular province, in order to perform functions as may be delegated by the PEPC and Pakistan

Environment Protection Agency. The duties and responsibilities of the provincial agencies are in line with the duties described for the Federal Agency.

5.3. COMPARISON

The Pakistan Environment Protection Ordinance 1983 (henceforth referred as 1983 Ordinance) and Pakistan Environment Protection Act 1995 (henceforth referred as 1995 Act) are almost identical, however, the latter is more comprehensive and modernised than the former. The 1983 Ordinance was one of the foremost legal attempts, at a national level, to consider environment damage as an offence. It lacks the details and subject variety of the 1995 Act, however, it has acted as a milestone for the future environmental legislation. A lot of work at federal level followed the 1983 Ordinance. Such as the establishment of the PEPC and the PEPA is attributed to the 1983 Ordinance. Under 1995 Act, the PEPC and the PEPA were re-structured to meet the developing requirements. The 1995 Act provided the prohibitory and regulatory provisions which are absent in the 1983 Ordinance. The 1995 Act also defines the imposed penalties on offences and identifies the establishment of environmental tribunals.

5.4. RELATED NATIONAL MARINE POLLUTION LEGISLATION

Following is a list of the Pakistan national laws and regulations that are related to marine pollution control:

- i. Admiralty Jurisdiction of High Courts Ordinance (1980)
- ii. Canal and Drainage Act (1983)
- iii. City of Karachi Municipal Act (1918)
- iv. Cantonment Lands Act (1924)
- v. Dangerous Cargoes Act (1953)
- vi. Exclusive Economic Zones (Regulations of Fishing) Act (1975)
- vii. Exclusive Fishery Zone (Regulations of Fishing) Act (1975)
- viii. Factories Act (1934)
- ix. Fisheries Act (1879)
- x. Korangi Fisheries Harbour Ordinance (1982)
- xi. Merchant Shipping Act (1923)

xii. The Ports Act (1908)

xiii. Territorial Waters and Marine Zones Act (1976)

5.5. MARINE POLLUTION CONTROL SET-UP

The key player in the marine pollution control is the Directorate of Ports and Shipping, under the Ministry of Communications. The Directorate is overall in charge of monitoring, controlling and cleaning up of any marine pollution especially arising from Shipping or port activities. The task of pollution control is sub-divided into two main areas. The first is ports and the other is the area outside ports i.e. coastal areas and EEZ. The responsibility of pollution control in port areas, including navigational channels lies upon the port authorities, whereas the area excluding ports jurisdiction is the responsibility of the Maritime Security Agency. The other non-governmental agencies as IUCN (International Union for the Conservation of Nature, Karachi office) assist in the provision of scientific studies involved in marine environment protection and pollution control.

5.5.1. Port Authorities

Pakistan has only two major ports, namely Karachi and Qasim. The two ports lie less than 100 km apart. The former is a historic port and dominates the major bulk of cargo handling including oil, bulk and containers. The latter basically deals with bulk cargo handling. Unlike Karachi, Qasim is a modern and recently built port. The pollution in Qasim Port is presently below the level of concern, however, it is a historical problem in Karachi Port. The pollution in the Karachi harbour area has long attracted the attention of the environmental agencies and significant studies have been carried out in this respect, though no concrete steps were taken to prevent it.

Both major ports have shown significant interest in the pollution control measures in their jurisdiction. The ports have reasonable contingency plans for oil spill control and management. In addition the ports carry out routine pollution abatement measures in their jurisdiction. Some of these measures are briefly discussed in the following section.

5.5.2. Marine Pollution Control Centre

The port authorities have recently shown a significant improvement in the pollution control measures. One substantial measure is the establishment of the Marine Pollution Control Centre (MPCC) in each port. The main functions of the MPCC are:

- a) abatement of harbour pollution including clean-up of harbour and to identify the pollutants and the polluters;
- b) monitoring of harbour water quality;
- c) implementation of port's oil spill contingency plan;
- d) inspection of ships for enforcement of rules and regulations relating to ships wastes covered by MARPOL 73/78 Annexes I, II, III, and V;
- e) evaluation and formulation of the requirements related to the Port Reception Facilities and to ensure that the ships generated waste is properly landed, collected, treated and disposed off; and
- f) adoption of measures to develop public awareness towards pollution control program.

The pollution combating equipment with MPCC includes a limited length of oil containment booms, few skimmers, suction pumps, storage tanks, dispersants and a water sample testing laboratory (Usmani, 1997).

5.6. MARITIME SECURITY AGENCY

The Maritime Security Agency was instituted in 1987 as a nascent paramilitary organisation in order to enforce national laws and interests in the EEZ. The agency is responsible for the control of marine pollution outside the ports' jurisdiction.

5.6.1. Roles of Maritime Security Agency

The key roles in relation to marine environment protection are described as below (Maritime Security Agency Act, 1994):

- i) Prevent unauthorised exploitation of any economic resources by any person, agency, vessel or device within the Maritime Zones.
- ii) Protect Pakistan fishing vessels and crew against any threat, intrusions or interference within the Maritime Zones.

- iii) Enforce the National and International laws, agreements and conventions on and under the water in the Maritime Zones.
- iv) Assist and co-ordinate search and rescue for the vessels, property and lives in distress and render such assistance which may be necessary in any emergency in the Maritime Zones and on high seas.
- v) Assist other departments and agencies of the Government to maintain and preserve the quality of marine life and to prevent and control the effects of marine disasters including marine pollution in and around the ports, harbours, coastal areas, estuaries and other areas of maritime zones.
- vi) Assist and co-ordinate with national and international agencies in hydrographic and oceanographic research, navigation, weather reporting and other scientific activities in the maritime zones.
- vii) Assist other departments and agencies of the Government in safeguarding and protecting artificial islands, offshore terminals, installations and other structures and devices in the maritime zones.
- viii) Provide assistance for petroleum exploration and production in the maritime zones.
- ix) Render assistance to other agencies in the acquisition of mineral exploration, seismic studies and assessment data in the maritime zones.
- x) Co-operate and provide assistance to customs, coast guards and other departments, agencies and authorities in maritime zones in the discharge of their duties and functions.
- xi) Perform such other functions as may be assigned to it by the Government, from time to time, to protect maritime interests of Pakistan.

A block scheme of the marine environmental protection set up in Pakistan is shown in the Figure 3

5.7. SUMMARY

The 1983 Ordinance was a milestone in setting the pattern for the succeeding legal documents on the subject of environment protection. The 1995 Act followed the guidelines established by the 1983 Ordinance. Substantial improvements were

incorporated in the 1995 Act, in order to meet the current environmental problems. The role of the PEPC and the PEPA has been significant in this respect but a more momentous impetus is necessary to pace up with the development in the pollution prevention. Marine environment protection needs more cover in the new 1995 Act. The enforcement of national laws in the marine environment fall upon more than one agency and administration. However, port authorities can play a significant role in reducing the amount of pollution by Shipping activities. The provision of appropriate reception facilities and the effective implementation of ports state control can prevent many incidents of intentional and accidental pollution. The main role of Maritime Security Agency remains to enforce national laws in EEZ, outside ports' jurisdiction.

MARINE ENVIRONMENT PROTECTION & POLLUTION CONTROL SET-UP IN PAKISTAN

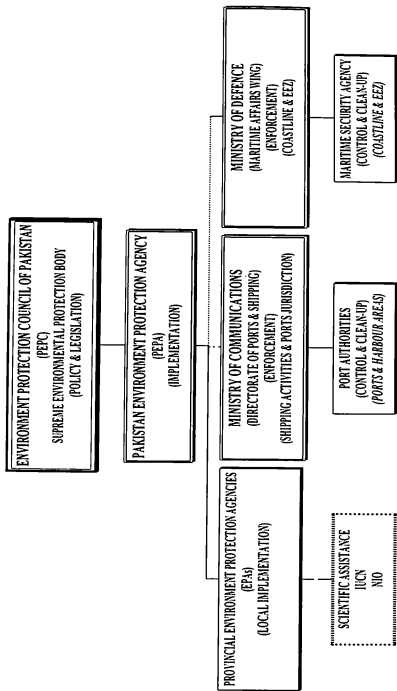


Figure 3

CHAPTER VI

MARINE OIL SPILL RESPONSE IN PAKISTAN

6.1. INTRODUCTION

Oil demand has increased steadily over the last decades. Oil is an essential running fuel for the millions of vehicles around the world. Oil is also used in many industrial processes both as fuel and lubricants. Besides its many advantages, the spilled oil can prove to be extremely harmful for the marine environment.

Oil is one of the largest cargo handled in the port of Karachi. Under development plans, a new oil handling facility will also be built in Port Qasim. Oil is also shipped in heavy quantities from Gulf to far eastern countries. Oil trade has grown steadily over past several years and so has the risk of an accidental oil spill near Pakistani coast.

6.2. RISKS

A major oil spill off the coast of Pakistan can severely damage various natural and man-made resources. Some of these can be classified as:

- tourist and recreational beaches;
- mangrove forests and estuaries;
- marine flora and fauna;
- fish stocks
- birds, sea mammals; and
- wetland and mudflat habitat

Pakistan coast can be divided into two distinct categories: wetland habitat in east and sandy beaches on the western coast. The ecological damage to wetland in case of an oil spill is relatively higher than that of sandy beaches. The wetlands are rich in biodiversity and house endangered mangrove forests. The flushing of sea water in diurnal tides is weak and any pollution brought in by tide tends to accumulate in the crowded wetland plants which are also the breeding grounds for the fish, shrimps, crabs, birds, insects and other endangered animals. An oil reaching this sensitive area can result in an ecological disaster.

Sandy beaches near Karachi, attract millions of tourists every year from all corners of Pakistan and some foreign countries. The beaches are also the breeding grounds of highly endangered species of sea-turtles and birds. There are thousands of beach huts along these beaches which are constructed in close proximity of tidal range. A few vital industries like Karachi Nuclear Power Plant (KANUPP) and Steel Mill, are operating near the shore and use sea water as a source of machinery coolant. Ships calling on ports need to ballast or de-ballast their tanks for operational requirements. In addition human health in coastal cities is also at risk from the tainting and contamination of sea-food.

6.3. PRINCIPLE FEATURES OF EXISTING CONTINGENCY PLAN

When Pakistan ratified the OPRC 90 in 1993. It seemed that efforts to prepare and enforce an effective National Contingency Plans will be accelerated. However, there were no positive impetus and the hastily prepared National Contingency Plan for oil spills remains un-enforced till to date. The contingency plan was prepared in 1993 by Maritime Security Agency in line with the national policy to protect the Pakistan coastline and the 110,000 sq. NM of EEZ against oil spills. The plan was designed to cater for a medium size oil spill i.e. up to 10,000 tons. The need of international assistance was mentioned, however, not clearly in case of a major oil spill incident. It is pertinent to note that an average tanker size calling Karachi port is less than

100,000 DWT, mainly due to the limitation of the depth in the channel. However, it is common for Super Tankers from Gulf to transit within or near the outward boundaries of Pakistani EEZ.

6.3.1. Area of Responsibility

The plan divided the coast in two main categories: port areas and EEZ including coastline outside ports jurisdiction. The port authorities were made responsible for the clean-up in ports and navigational channels for an oil spill of up to 100 tons. Maritime Security Agency was given the clean-up responsibility of areas outside the ports' jurisdiction. A central controlling station was proposed to be set up at Karachi under the control of the Agency, to cater for an oil spill up to 1000 tons. Secondary National Bases were to be located in coastal towns of Gwadar, Pasni and Ormara with a capacity to handle an oil spill of 100 tons each. It is not clear why this limit was set and what happens for a spill over this capacity. However, the contingency plan indicates that subsequent regional or international assistance during a major oil spill will be requested.

6.3.2. Oil Spill Control Regions

Under the contingency plan the coastline is divided into three main zones in order to boost the efficiency. A brief description of the characteristics of the area is also provided.

6.3.2.1. Zone A

The area from the westward territorial boundaries of Pakistan with Iran to Ras Ormara or at the westwards boundaries of Ormara city. The nature of the coast is mostly rocky separated by occasional sandy patches. The coastal cities Jiwani and Gwadar, are located in this zone. The elements for the priority protection are the coastline near the cities and the Gwadar fishing port.

6.3.2.2. Zone B

The area extends from Ras Ormara to the Cape-Monze at the westwards boundaries of the Karachi city. The coast is mainly rocky with sandy beaches near the westward boundary of Karachi city. The population like in case of 'Zone A' is limited. The cities of Pasni and Ormara are located in this zone. A naval harbour is currently under development in the vicinity of Ormara city. The areas to be prioritised for protection are the beaches near the cities, Pasni fish harbour, Ormara fishing bay settlements and the naval harbour.

6.3.2.3. Zone C

The zone extends from Cape-Monze to the eastern territorial boundary of Pakistan with India. The zone is one of the most important area in order of priority for protection. It contains tourist beaches, two major ports, the country's largest city of Karachi, several major industries near the shoreline, wetlands, and estuaries near the Indus Delta in east. It is difficult to prioritise a single length of coastline in this zone. However, the top priority areas could be the wetlands and estuaries of Indus Delta because of the extreme sensitivity of these fragile ecosystems to the oil pollution.

6.3.3. Response Policy

It was recommended in the plan that both major ports i.e. Karachi and Qasim would prepare the local contingency plan for the respective ports. These plans would support the national contingency plan in the times of crises.

The clean-up and recovery equipment would be transported by small tender ships e.g. tugs, inshore tankers and others. The three secondary bases at Gwadar, Pasni and Ormara will be stocked adequately for oil spill control in their respective zones. The use of aircraft in reconnaissance and dispersant spray was also indicated in the plan, however, the policy and methods of spray is not mentioned.

6.3.4. Oil Spill Risk Areas

Oil spill risk areas were highlighted in the plan for assessing the degree of threat posed to the coastline. The areas are divided under the considerations of varied weather conditions of Arabian Sea during the year. The areas are shown as distances from coastline in the Table 4.

OIL SPILL RISK AREAS

	Distance from Coastline	Distance from Coastline
• Area	April-September	October-March
• Red	50 NM	30 NM
• Blue	100 NM	50 NM
• Green	Beyond 100 NM	Beyond 50 NM

Table 4

Source: Directorate of Marine Pollution Control (1994). *Contingency Plan*. Official Document. Maritime Security Agency, Karachi, Pakistan.

6.3.5. Standard Operating Procedure (SOP)

The salient features of the standard operating procedure during an oil spill threat for various areas are described in the following section.

6.3.5.1. Area Green

- i. The plan will be activated at Maritime Security Agency Control Centre.
- ii. Air/surface monitoring of the spilled oil will be carried out once in 48 hours.
- iii. The relevant agencies and authorities (mentioned in the Annexes A, B, or C to the plan) will be informed by quickest available means.
- iv. The oil spill control equipment will be mustered for transport and deployment.
- v. Press release would be made if necessary.
- vi. Area warning will be issued to ships.

vii. Ministry of Defence will be informed of the latest situation.

6.3.5.2. Area Blue

- i. All actions would be taken as per 'Area Green' except aerial/surface surveillance would be carried out once every 24 hours.
- ii. The requirement of vessels or equipment will be placed to different co-ordinating agencies e.g. port authorities and zone control centres.
- iii. The equipment will be transported to the site of incident and made ready for deployment.
- iv. The supporting vessels and aircraft would be brought in readiness state.

6.3.5.3. Area Red

- i. All agencies/authorities (mentioned in the Annexes A, B, or C to the plan) will be informed of the latest situation.
- ii. Aerial/surface monitoring will be increased to twice per day.
- iii. The equipment will be deployed at the affected area.
- iv. Booms will be deployed according to the deployment strategy mentioned in the plan.
- v. International assistance will be sought for oil spills beyond the national capabilities (the addresses of sister organisation in neighbouring countries are mentioned in the Annex K to the plan).

6.3.5.4. Oil Booms Deployment Plan

The available booms will be deployed in different zones depending upon the varied nature and properties of the affected coast. The areas to be prioritised for protection are mentioned briefly in the deployment plan. The policy and methods of boom deployment is not indicated in the plan.

6.3.5.5. Trapping Sites

Three trapping sites were selected in Zone 'A' and one in Zone 'B'. The sites provided enough storage capacity which could be further supplemented by digging pits on beaches if needed. The coast around the selected sites is sandy, thereby providing less obstruction for the oil recovery operation.

6.3.5.6. Reporting Procedure

A standard reporting procedure for reporting the oil spill was established. The sources of information were also appended in the Annex 'A' to the plan.

6.4. Development of the Plan

The plan meets most of the basic requirements of the standard guidelines but there are some vital elements and pieces of information that are not clearly described. Some of these unclear or missing elements are pointed out in the following section (IMO, 1995).

6.4.1. Policy.

- The purpose and the main objectives of the plan needs to be clearly defined;
- the responsibility for implementation and development of the plan must be given to a suitable agency e.g. Maritime Security Agency;
- standard definitions for legal proceedings and claim preparations should be described in the plan;
- the sources for the funding of the plan should be indicated;
- mechanism for invoking the plan should be clearly defined;
- co-operation with oil industry and Ministry of Petroleum needs to be integrated in the plan;
- the use of computer based spill response programs is vital for the training and accurate oil spill response;
- a tiered response from different levels is necessary for an effective response;

- the custodian authority for development and amendments for the plan should be clearly defined;
- the coast should be mapped according to the sensitivity;
- the areas of high spill risk should be pointed out;
- the fate of the oil in different weather conditions should be calculated;

6.4.2. Response Strategy.

- NOSC (National On Scene Commander) and OSC (On Scene Commanders) should be designated;
- a national technical commission for scientific assistance should be designated;
- SOP for the discovery, alarming, evaluation, and invocation of oil spill should be established;
- the policy for the use of dispersants, containment, in situ burning, recovery and disposal should be established; and
- the roles of supportive agencies and authorities e.g. municipality, fire brigade, during shoreline clean-up should be defined.

6.4.3. Reporting and Communications

- SOP for reporting oil spill by ships, aircraft, and other sources should be established;
- the SOPs for formal invocation and revocation reports by the designated authority, and Situation Reports (SITREP); and
- policy on procedures for public relations/news reports should be clarified.

6.4.4. Regional and International Co-operation.

- The mechanism and criteria to seek regional or international help in case of a spill should be scrutinised and thoroughly worked out.

6.4.5. Training.

- Overseas training of key officials at reputed and experienced spill response organizations should be incorporated;
- training of response teams;
- computer based training programs for spill and crises management should also be incorporated; and
- periodical simulation exercises of the response teams should be authorised.

6.5. SUMMARY

The existing contingency plan was designed for a moderate oil spill i.e. up to 10,000 tons. The area of responsibility in the plan is not complicated to manage, because of its natural landscape and limited domestic and industrial activities. The current contingency plan was a modest attempt in the development of a nascent national contingency plan. It follows the guidelines of the IMO but needs to have major modifications to meet the current developments in this field. The plan was prepared with the ambitions to control a moderate sized spill and minimise the damages. It is uncomplicated and reasonably suited for local climatic conditions; however, it is still not enforced.

CHAPTER VII

PROPOSALS FOR IMPROVED MARINE POLLUTION CONTROL IN PAKISTAN

7.1. INTRODUCTION

The last two chapters of this paper addressed the aspect of marine environment protection in Pakistan. The government's interest in this respect was appreciated in these chapters. However, there are several shortcomings in the present set-up and they need to be overcome soon in order to prevent any further deterioration. This chapter proposes some achievable goals to improve the current set-up for marine environment protection.

7.2. NATIONAL LEGISLATION

The Pakistan Environment Protection Act 1995 fails to address the problem of marine environment protection in due detail. It is primarily a legal document for the protection of the environment as a whole. The marine environment essentially differs from the land; it includes the sea, wetlands, estuaries and coastal areas. Marine environment is far more sensitive to pollution when compared to other areas. Moreover, there is a bright future prospect for the exploration of sea-bed resources in Pakistan EEZ.

7.2.1. Need of Separate Marine Environment Protection Legislation

There can be a separate or a supplementary legal document, addressing primarily the marine environment. The legal document should be comprehensive and uncomplicated. It should define different levels of environmental infractions and

impose the penalties accordingly. The ratified IMO conventions e.g. LC 72 and MARPOL 73/78 should be adopted in national legislation with some possible additional regulations specific for Pakistani marine environment. The pollution from land-based sources should be regulated. The air emissions from vehicles and industries should also be given the legal cover.

In principle, any marine environment protection legislation should include:

- regular and effective reporting system for the state of marine environment;
- freedom of the EPAs (Environment Protection Agencies) to publish information in relation to the state of marine environment;
- the conduct of studies and investigations of environmental infractions; and
- the clarification of different levels of infractions and the penalties.

7.2.2. Pakistan Environment Protection Council (PEPC)

The Pakistan Environment Protection Council (PEPC) is the highest environmental policy making body in Pakistan. It has broad responsibilities for environment protection and sustainable development in the country's territory. The implementation of the environmental legislation is the foremost responsibility of the PEPC.

It is vital that the PEPC should promptly concentrate on the subject in order to prevent any further deterioration of the marine environment. The PEPC should be made the approving authority for the EIA (Environmental Impact Assessment) of the large projects.

7.2.3. Pakistan Environment Protection Agency (PEPA)

The PEPA is the second largest governing body, for the environment protection in Pakistan. The main function of the PEPA is to administer and implement the environmental act and regulations. The PEPA should be the approving authority for the EIA of small and moderate size projects. It should establish guidelines and procedures for the conduct of EIA by the provincial (EPAs). The PEPA should become a part of international network of environment protection agencies and organizations.

In order to optimise the efficiency, the PEPA can appoint a technical commission, specialised for the subject of marine environment protection.

7.2.4. The Provincial Environmental Protection Agencies

In many countries the legislative mechanism to control marine pollution is achieved with the help of EPAs. The EPAs in Pakistan should also be given more freedom to operate independently and with increased authority. EPAs should be able to freely collect and publish information in case of any violations of environmental law.

The EPAs should be given authority to conduct proposals for projects and the final approval of the EIAs should lie with the PEPA or the PEPC.

A uniform environmental protection approach should be ensured in all provincial EPAs. This is more important for EPAs of the littoral provinces of Sindh and Balochistan.

7.2.5. Ministry for Environment, Urban Affairs, Forestry and Wildlife (MEUFW)

The Ministry For Environment, Urban Affairs, Forestry And Wildlife (MEUFW) is the most suitable authority for the administration of the environment in Pakistan. At

present, the Ministry's focus is on urban development projects and the forests' conservation. However, its role in the protection of the marine environment is not clear.

The Pakistan Environment Protection Act 1995 does not clearly describe any significant role of MEUFW, in relation to the protection of the marine environment. However, in this respect, some important roles for MEUFW can be:

- assisting the PEPC in the promotion of marine resource management and sustainable development of coastal areas;
- the co-ordination of implementing national and international environmental laws;
- the preparation and implementation of national policies for marine environment protection;
- the development of national marine environment protection legislation;
- acting as an expert advisor to the PEPC on the subject of marine ecosystems;
- the promotion of general public awareness in marine environment conservation issues; and
- research on policy, administration and other related issues.

MEUFW may partner the PEPA, as appropriate in exercising the above functions.

7.3. POLLUTION PREVENTION

The concept of pollution prevention is most important in all environmental protection measures. It is a widely accepted and inexpensive method of pollution control around the world. Pollution can be compared with land mines; easy to install but extremely costly to remove safely. Similarly for pollution, the costs of clean-up are exceptionally high when compared to the preventive costs. The US Environment Protection Agency defines pollution prevention as,

“The use of materials, processes or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that the use

of hazardous materials, energy, water or other resources and other practices that protect natural resources through conservation or more efficient use.”

The preventive concept promotes the causes of both resource and waste management. Under this concept, the suggested order of environment management options can be:

- i. Waste reduction at source.
- ii. Waste recycling, re-use or reclamation.
- iii. Waste treatment.
- iv. Proper disposal e.g. landfills.

7.3.1. Industrial Processes

The Ministry of Industries and Development can play a key role in environmental administration of the industries. The industries should be forced to use green (unharmful to environment) products in the industrial processes in order to reduce the amount of pollution produced. The use of waste treatment plants should be mandatory for large industries. A centralised waste treatment facility should be provided for small scale industries. Heavy penalties should be imposed on the illegal waste discharges. The imports of all hazardous wastes should be monitored and supervised for appropriate handling.

7.3.1.1. Polluter Pays Principle

The principle of 'polluter pays' is widely accepted around the world and can be effectively implemented in Pakistan. The principle maintains that the agent responsible for the pollution should be financially liable for the costs of clean-up. The principle is suitable for industries where the source of pollution can be traced.

7.3.1.2. ISO 9000 and 14000 Series

ISO 9000 and 14000 series are the offspring of the International Organization for Standardisation (ISO), based in Geneva, Switzerland (ISO, 1997). The Organization

sets out standards for improving the production processes in industries. It is pertinent to note that ISO 9000 and ISO 14000 series are not standards for the products but for quality assurance in designing, developing, producing, installing and servicing.

The ISO 14000 series is more important in the context of environment protection because it assures the production of environmentally sound industrial goods. Among other ISO standards, ISO 14001 is the most prominent and a fully fledged international environment management system (EMS). Most of the European Union (EU) countries have already adopted the ISO 14001. The standard is becoming equally popular among developing countries. ISO 14001 is a new concept for Pakistan but its implementation can bring about a reliable system to produce environmentally sound products.

7.3.2. Shipping Activities

The Shipping activities in Pakistan are the most visible source of marine pollution. The cargo handling operations in Pakistani ports are relatively unsophisticated and in some cases unsafe. The mishandling of cargo by human labours results in several spillage incidents. Similarly, the overboard cargoes are rarely recovered from seabed in port.

7.3.2.1 Flag and Port State Control

The port authorities can play key role in the reduction of marine pollution by Shipping activities. The implementation of flag state and port state control can be extremely effective. The provision of appropriate reception facilities for ships' wastes is also vital in this context.

7.3.2.2. ISM Code

The International Safety Management (ISM) Code for the safe operations of ships and for pollution prevention is made compulsory under SOLAS 74. The Code will come into force on July 1998. The Code is applicable to all ships. The Code is a vital

requirement for the enhanced maritime safety and environment protection. Pakistan is a party to SOLAS 74 and all Pakistani flag ships are required to comply with ISM Code by the due date.

7.3.2.3 Maritime Training

The STCW 78 (International Convention of Training, Certification and watch keeping for Seafarers) provides essential training requirements of all the seafarers. The training standards at the Pakistan Marine Academy (PMA, Karachi) should be in line with the STCW 78. The Academy should adopt ISO 9002 which is more suitable for training institutes. The Academy should also provide training to officers from Navy, Coast Guard and Maritime Security Agency in environment protection discipline.

7.4. POLLUTION CLEAN-UP

The clean-up of pollution is the most complicated and cost extensive part of all environment protection measures. The costs and human efforts involved in a pollution clean-up program increase exponentially with time. It is a common practice in Pakistan to ignore the piling up of pollution until it becomes hazardous to human health. The clean-up programs are usually undertaken during the times of crises.

7.4.1. Role of City Municipalities

Most of Pakistani cities have inappropriate sewage management systems. The largest city of Karachi near the coast also lacks a good sewage and drainage system. The city does not have any storm water collection facility. Moreover, the concept of separate drainage for industrial and domestic discharges is virtually absent. The city houses a large number of car service stations. The waste water from these service stations is indiscriminately mixed with the domestic sewage. The rain water carries the scattered pollution from the roads and the open garbage piles and usually gets stranded in the streets. In most cases the rain water directly ends up in the sea.

It is a foremost requirement that the sewage systems of the cities should be refurbished, especially in the coastal cities like Karachi. The facility of separate drainage systems for industrial and domestic discharges should be provided. It is also important that city authorities effectively control the illegal expansion of shanty towns in the cities and simultaneously improvise on the present ageing sewage system. The waste treatment plant for domestic wastes is also an important responsibility of the city municipalities.

The European Union has a separate legislation for the control of urban and industrial waste water discharges. Similarly, a separate or supplementary legislation for Pakistan can also be formulated.

7.4.2. Role of Maritime Security Agency

The roles of the Maritime Security Agency are similar to those of the Coast Guard in many countries. The Maritime Security Agency is the only authorised force to do the clean-up of an oil spill in the Pakistan EEZ. The force suffers heavily from the limitation of resources to combat a possible oil spill in Pakistan EEZ.

It is extremely important that the force should be equipped with essential and sufficient oil combating resources. The training of key personnel of the force is equally important. It is pertinent to note that if an oil disaster occurs in the Pakistan EEZ, there is no qualified National On-Scene Commander (NOSC) to fulfil the essential requirement of the contingency plan.

Another appropriate suggestion in this context will be to sign a contract with an experienced and well-equipped country in the field of oil and chemical pollution combating. A regional approach to collectively tackle the marine accidental spills is also equally essential. It is also very important to prepare a contingency plan for a chemical spill in marine environment in line with the IMO guidelines.

7.5. SUMMARY

The proposed set-up to protect the marine environment can be divided into three main categories i.e. legal control, prevention at source and clean-up. Legal control can never alone protect the marine environment; it must be incorporated with preventive and clean-up measures. The concept of prevention is the most appropriate option to protect the marine environment. It is inexpensive and simple when compared to clean-up measures. The clean-up measures are complex and cost extensive. They need more trained people and costly resources. The concept of pollution prevention is vital for a country like Pakistan. The cost of pollution clean-up becomes exponentially high with time so it is important that the government takes action in due time before it is too late.

OIL SPILL CONTINGENCY PLANNING FOR PAKISTAN

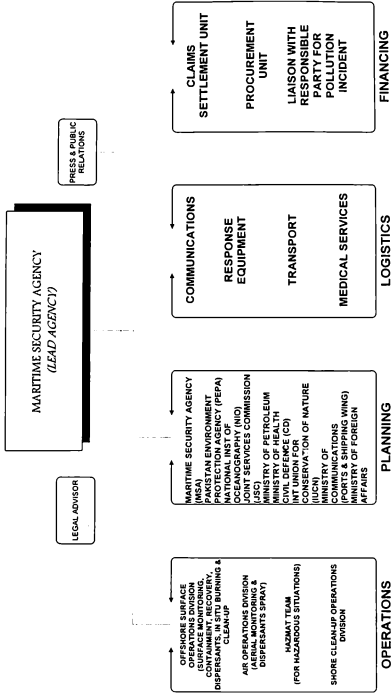


Figure 4

CHAPTER VIII

CONCLUSIONS & RECOMMENDATIONS

"If the present trend continues, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to the disruption than the world we live in now. Serious stresses involving pollution, resources, and environment are clearly visible ahead. Despite greater internal output, the world's people will be poorer in many ways than they are today."

(Global 2000 Report to the President of US 1980, p.1.)

8.1. MARINE ENVIRONMENT IN PAKISTAN

The subject of Pakistan marine environment was addressed in Chapter II of this paper. The main conclusion derived from the chapter can be that presently, the amount of marine pollution along the Pakistani coast and in the EEZ is below the level of concern. However, the city of Karachi and its surroundings are thought to be exceptionally polluted areas throughout the coastline.

In view of above, some important recommendations are made:

- The pollution originating from the city of Karachi should be checked and in this respect the following actions are recommended:
 - limiting the expansion of shanty towns in the city;
 - refurbishing the city's ageing sewage system;
 - constructing separate lines for domestic and industrial discharges;
 - constructing a storm water collection system;
 - the littering of tourist beaches should be effectively controlled;
 - vehicle service stations should be able to dispose of waste water and oil residues properly;

- the facilities for waste recycling and incineration should be provided by the government; and
- Integrated Coastal Management is vital for the sustainable development of the coast.

8.2. POLLUTANTS IN THE MARINE ENVIRONMENT

The Marine pollutants were discussed in chapter III of this paper. The main conclusions drawn from the chapter are that pollutants are extremely harmful to the marine environment. In some cases they are persistent and can poison the food chain. It was also concluded that the largest source of marine pollution, is land-based. Shipping activities contribute but little, when compared to the quantity of land-based sources of pollution.

In this context some of the steps that can be taken to minimise marine pollution are:

- the industrial and domestic discharges into the marine environment should be effectively regulated;
- pollution from ships should be controlled by flag and port state implementation;
- appropriate reception facilities for ship wastes should be provided in all ports;
- public media can be used to propagate the cause of pollution reduction among people;
- alternative solutions for the use of pesticides in agriculture should be attempted; and
- the sensitive environment of wetlands and mangroves should be given additional attention to safeguard them from pollution.

8.3. GLOBAL CONTROL OF THE MARINE POLLUTION

The legal control of marine pollution at the global level was discussed in chapter III. The prime conclusions derived from the chapter are that all major sources of marine pollution are adequately covered in international legal documents. It can also be concluded that ship source of marine pollution has attracted global attention more than any other source. It was also noted that Pakistan has not ratified some of the important IMO Conventions and is not an active member of UNEP Regional Sea Programs.

In this context some of the recommended points are:

- Pakistan should ratify the following IMO Convention:
 - CLC 69, CLC Prot. 92;
 - LC Prot. 96;
 - MARPOL 73/78 Annex VI (*future Annex*, Air emissions from ships);
 - FUND 71, Prot. 92; and
 - SALVAGE 89
 - HNS 96
- the ratified conventions should be timely integrated in national laws;
- Pakistan should participate more in the IMO proceedings; and
- Pakistan should also actively participate in the UNEP regional sea programs.

8.4. LEGAL CONTROL & ENVIRONMENT PROTECTION IN PAKISTAN

The legal control of environment protection in Pakistan was dealt with in chapter V of this paper. The main conclusion drawn from the chapter is that the current legal documents for environment protection in Pakistan are generic in nature and the subject of marine environment needs to be covered more. It can also be concluded that the role of the Pakistan Environment Protection Council (PEPC) and Pakistan Environment Protection Agency (PEPA) are more oriented towards industrial development and the subjects of marine environment are not sufficiently blended in their roles.

The recommended points to fill the shortcomings are:

- the effective implementation and enforcement of environment laws is the foremost requirement of environment protection in Pakistan;
- a supplementary legal document to cover the subject of the marine environment should be prepared;
- the roles of PEPC and PEPA should be elaborated for marine environment protection; and
- co-ordination among the scattered environmental agencies should be encouraged.

8.5. OIL SPILL CONTINGENCY PLAN FOR PAKISTAN

Oil spill response set-up was discussed in Chapter VII of this paper. The main conclusion drawn from the chapter can be that Pakistan is presently ill equipped to fight a major oil spill. The current contingency plan is still un-enforced and needs major amendments before its implementation. It was also concluded that the potential threat of an oil spill is currently not considered with due interest in Pakistan.

In this context, some of the recommendations are:

- the threat of a potential oil spill should be taken more seriously;
- a revised contingency plan should be prepared to cater for the current developments in oil spill response;
- a team of experts in oil spill response planning is necessary during the preparation phase of the contingency plan;
- the proper training of the oil spill response team should be undertaken;
- the much needed equipment for fighting a major oil spill should be purchased and maintained;
- the ports should ensure the effective flag and port state control of ships; and
- regional co-operation in fighting oil spills can be very helpful.

8.6. FINAL WORDS

The Pakistani coastal area and EEZ are still underdeveloped. In relation to environment protection this is a plus point. However, the prospect of future development along the coast and in the EEZ is expected. Many landlocked Central Asian countries are beginning to view Pakistan as a conduit to ship out their exports in the near future. This project can increase the maritime activities in Pakistan.

It will go a long way if the steps to protect the marine environment are taken before such development takes place. The government is now faced with the complex problem of encouraging the upswing in development, to foster economic growth while at the same time attempting to contain the environmental damage that ensues with these opportunities.

There are no short cuts in the environment protection process. The role of the government does not end with the formulation of the laws. The main challenge is to implement the laws effectively. It is still not too late for the protection of the marine environment in Pakistan. A timely endeavour in this respect can eliminate or at least, minimise, the destruction of this fragile asset.

As Gourlays (1988, p.v.) quotes of Stanely Clinton Davis,

“With the seas, as with other global resources, mankind must learn a new approach, and learn it quickly. If he does not, future generations will pay a heavy price. The pollution of the Sea is not principally a scientific or an economic problem. It is a political problem...”

(Gourlay, 1988, p.v.)

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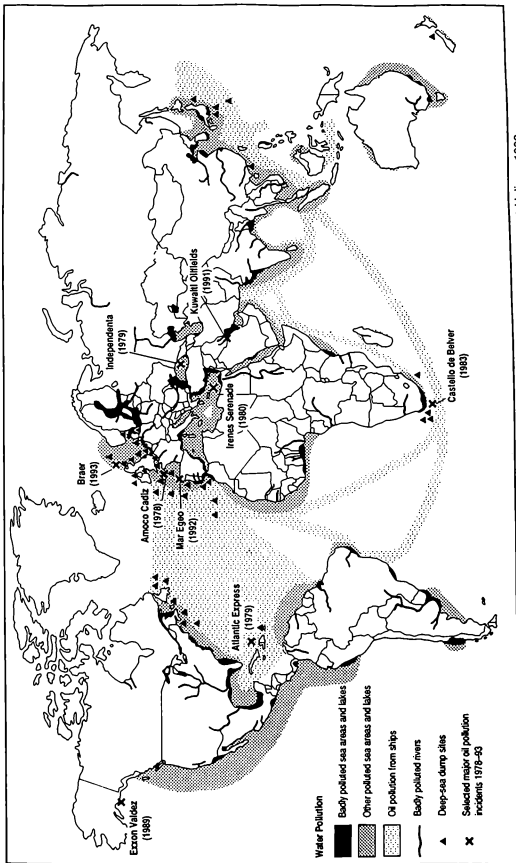
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APPENDIX 1

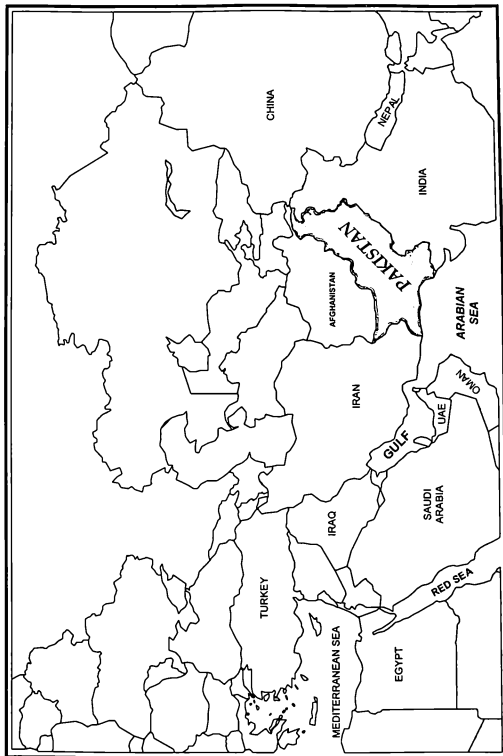
MARINE POLLUTION (GLOBAL)



Sources: *Environment Atlas*, George Philip, 1992; *World Environment Atlas*, Bartholomew, 1991; *Atlas of the Environment*, Helicon, 1992

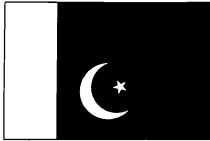
Appendix 2

GEOGRAPHICAL POSITION (PAKISTAN)

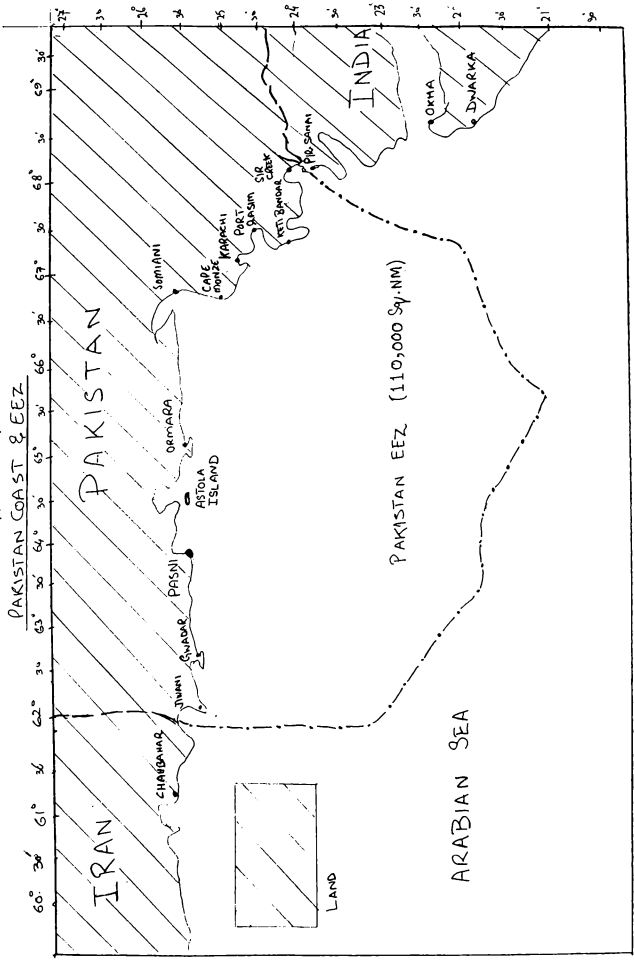


MAP OF PAKISTAN

Flag: Green & White

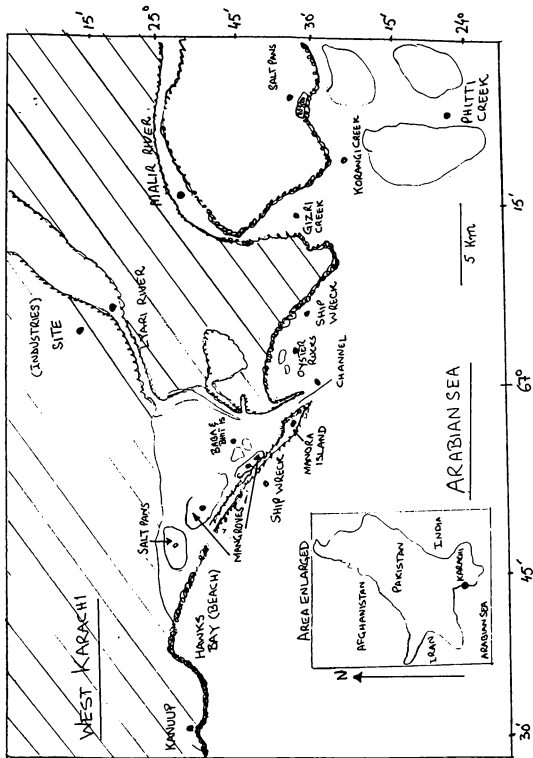


APPENDIX 7
PAKISTAN COAST & EEZ



APPENDIX 5

MAP OF KARACHI AREA



URBAN
AREA

Appendix 6
STATUS OF IMO CONVENTIONS (REGIONAL)

IMO CONVENTIONS	PAKISTAN	INDIA	IRAN	MALDIVES	SRI LANKA	OMAN
IMO CONVENTION 47	X	X	X	X	X	X
IMO (Amend) 91	-	X	-	-	-	-
IMO (Amend) 93	-	X	-	-	-	-
SOLAS 74	X	X	X	X	X	X
SOLAS (Protcl) 78	X	X	-	-	-	X
SOLAS (Protcl) 88	X	-	-	-	-	X
LOAD LINES 66	X	X	X	X	X	X
LOAD LINES (Protcl) 88	-	-	-	-	-	X
TONNAGE 69	X	X	X	X	X	X
COLREG 72	X	X	X	X	X	X
CSC 72	X	X	-	-	-	-
CSC (Amend) 93	-	-	-	-	-	-
SFV (Protcl) 93	-	-	-	-	-	-
STCW 78	X	X	-	X	X	X
STCW-F 95	-	-	-	-	-	-
SAR 79	X	-	X	-	-	X
STP (Agr) 71	-	X	-	-	X	-
STP (Protcl)	-	X	-	-	X	-
INMARSATARSAT 76	X	X	X	-	X	X
INMARSAT (Amend) 89	-	X	-	-	-	-
INMARSAT (Amend) 94	-	-	-	-	-	-
INMARSAT OA 76	X	X	X	-	X	X
INMARSAT OA (Amend) 89	-	X	-	-	-	-
INMARSAT OA (Amend) 94	-	-	-	-	-	-
FACILITATION 65	-	X	X	-	-	-
MARPOL 73/78	X	X	-	-	-	X
MARPOL Annex III	X	-	-	-	-	X
MARPOL Annex IV	X	-	-	-	-	X
MARPOL Annex V	X	-	-	-	-	X
LC 72	X	-	-	-	-	X
LC (Amend) 78	-	-	-	-	-	-
INTERVENTION 69	X	-	-	-	X	X
INTERVENTION (Protcl) 73	X	-	-	-	-	X
CLC 69	-	X	-	X	X	-
CLC (Protcl) 76	-	X	-	X	-	-
CLC (Protcl) 92	-	-	-	-	-	-
FUND 71	-	X	-	X	X	-
FUND (Protcl) 76	-	X	-	-	-	-
FUND (Protcl) 92	-	-	-	-	-	-
NUCLEAR 71	-	-	-	-	-	-
PAL 74	-	-	-	-	-	-
PAL (Protcl) 76	-	-	-	-	-	-
PAL (Protcl) 90	-	-	-	-	-	-
LLMC 76	-	-	-	-	-	-
LLMC (Protcl) 96	-	-	-	-	-	-
SUA 88	-	-	-	-	-	-
SUA (Protcl) 88	-	-	-	-	-	-
SALVAGE 89	-	X	-	-	-	-
OPRC 90	X	-	X	-	-	X
HNS 96	-	-	-	-	-	-
Total ratifications until June 1996	20	23	10	9	13	20

Source: IMO Homepage (1997)

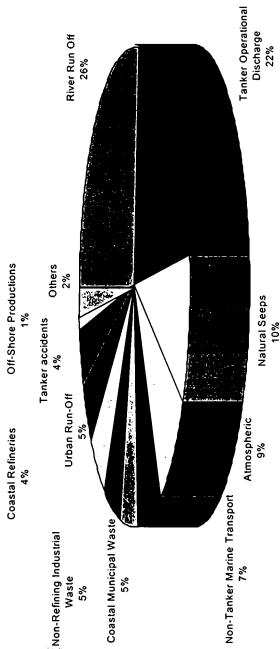
Appendix 7
RATIFICATION OF IMO CONVENTIONS BY PAKISTAN
 (As on 01 JUNE 1997)

IMO CONVENTIONS	DATE OF RATIFICATION
IMO CONVENTION	21-11-58
SOLAS 74	10-04-85
SOLAS PROTOCOL	10-04-85
LL 66	05-12-68
TONNAGE 69	17-10-94
COLREG 72	14-12-77
CSC 72	10-04-85
STCW 78	10-04-85
SAR 79	11-11-85
INMARSAT C 76	06-02-85
INMARSAT OA 76	Signed
MARPOL ANNEX I/II	22-11-94
MARPOL ANNEX III	22-11-94
MARPOL ANNEX IV	22-11-94
MARPOL ANNEX V	22-11-94
LC 72	09-03-95
INTERVENTION 69	13-01-95
INTERVENTION PROTOCOL 73	13-01-95
OPRC 90	21-07-93

Source: IMO Homepage (1997)

Appendix 8

SOURCES OF OIL POLLUTION TO THE MARINE ENVIRONMENT



Source: Steger, Will and Bowermaster, Jon (1990). *Saving the Earth*. New York, USA: Alfred A. Knopf, Inc.

