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An action plan to address the protection of marine environment from risks posed by land-based and marine activities in Maputo Bay

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AN ACTION PLAN TO ADDRESS THE PROTECTION OF MARINE ENVIRONMENT FROM RISKS POSED BY LAND BASED AND MARITIME ACTIVITIES IN MAPUTO BAY

By

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DECLARATION

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

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

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ABSTRACT

Title Dissertation: **AN ACTION PLAN TO ADDRESS THE PROTECTION OF THE MARINE ENVIRONMENT FROM RISKS POSED BY LAND BASED AND MARITIME ACTIVITIES IN BAY.**

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The marine environment is an essential part of the global biosphere, the oceans cover almost the fourths of the earth's surface, contain over the 90 per cent of the world's water resources, and are home to many forms of marine life. The oceans are also environmentally susceptible to natural and human-related activities, such as climatic changes, sea level rise, dredge and fill activities, channelisation, sedimentation, sewage discharges and shoreline development, among many others. therefore there is an urgent need for immediate action, to stop further destruction of the marine environment caused by offshore and land based activities.

This dissertation is a study of the different sources of pollution in Maputo Bay focusing on shipping activities and land-based source of marine pollution. The purpose of this study is centred on the three main points

Firstly, the dissertation highlights the potential sources of pollution in Maputo Bay.

Secondly, it gives the comparative studies of the attention given to the marine environment, in order to reduce pollution caused by port activities in ports of Helsingborg and Maputo.

Thirdly, it provides a proposal for an action plan for the prevention and reduction of pollution in Maputo Bay.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviations

BOD	Biological Oxygen Demand
CEE	Comunidade Economica Europea
CLC	International Convention on Civil Liability for Oil Pollution damage, Brussels 1969, as amended by Protocols 1979 and 1984
COLREG	Convention on the International Regulation for Prevention of Collision at Sea 1972
Cr.	Chrome
DNMP	Direccao Nacional de Medicina Preventiva
EEZ	Exclusive Economic Zone
FAPACAR	Paper Factory
FUND	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Brussels 1971 as amended by Protocols 1976 and 1984
GESAMP	United Nations Group of Experts on the Scientific Aspects of the Marine Pollution.
GT	Gross Ton
IMO	International Maritime Organisation
INAHINA	National Institute of Hydrography and Navigation
INMARSAT 76	Convention on the International Maritime Satellite Organisation 1976
LC 72	Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 (London convention 72)
m/m	mass per mass
MABOR	Tire Factory

MACMAHON	Brewery Company
MARAD	Maritime Administration
MARPOL 73/78	International Convention for the prevention of Pollution from the Ships, 1978, as amended by the protocol of 1978 relating thereto.
MEMAC	Marine Emergency Mutual aid Centre
MEPC	Marine Environment Protection Committee
MER	Marine Engineers Reviews
MICOA	Ministry of Co-ordination of Environmental Affairs
MPN	Most Probably Number
N	Nitrogen
OECD	Organisation for Economic Co-operation and Development
Oil-Pol 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.
PETROMOC	Mozambican Parastatal State Oil Company
pH	Potential Hydrogen
ROPME	Regional Organisation For the Protection of the Marine Environment
SAFMAR	National Maritime safety Authority
SAR 79	International Convention on Maritime Search and Rescue 1779
SDR	Special Drawing Rights
SOLAS 78	International Convention for safety of Life at Sea, 1974 and its Protocol of 1978.

SS	Solid Suspended
STCW 95	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 78 as amended in 1995
TBT	Tributylin
TEXLON	Factory of Cotton Processing
Ton/yr.	Tonnes per Year
UK	United Kingdom
WHO	World Health Organisation
WMU	World Maritime University

CHAPTER I

INTRODUCTION

Maputo Bay is located in the southern part of the Republic of Mozambique, within the province of Maputo. The bay has a commercial port which serves Mozambique and its neighbouring countries, which are: Zimbabwe, Lesotho, Botswana and Swaziland. The port also serves the regions of Mpumalagana and Komatiport (Republic of South African); these regions will soon be linked by the Maputo corridor (highway), which is already in an advanced stage of construction. On completion of the road the vessel traffic in the port will increase because the two South African regions are industrialised.

The bay is surrounded by urban zones with the population being concentrated in three zones: Maputo, Matola and Machava. The population has been increasing very fast since 1980 (see Table 1).

Table 1: Total population in urban areas

YEAR	MACHAVA	MATOLA	MAPUTO	TOTAL
1980	89,973	189,335	470,692	750,000
1981	90,282	190,002	470,876	751,160
1982	92,452	192,372	477,876	762,700
1983	95,672	194,178	482,630	772,480
1984	97,912	195,526	531,797	825,235
1985	98,316	199,694	538,474	836,484
1986	103,787	201,686	546,554	852,027

1987	110,014	212,124	568,434	890,573
1988	116,615	212,949	582,805	912,369
1989	123,612	217,093	600,194	940,899
1990	138,028	283,125	655,457	1,076610
1991	147,223	290,253	750,786	1,188262
1992	191,390	295,133	986,162	1,472685

Source: (Planing centre, Ministry of Health 1993)

The table shows that since 1986 the population growth rate is higher in all zones.

Industries are located within the urban centres (Maputo, Matola and Machava) whereas agriculture is practised in the basins of the main rivers which flow into the bay. In chapter three there is a discussion as to how this activity affects the bay.

The objective of this dissertation is to study the problems of pollution in the bay and to draw up an action plan to reduce and prevent the pollution, and its impacts. The study focuses on land-based source pollution and will cover pollution caused by shipping activities.

The study is aimed at helping to address the problem of pollution of Maputo Bay using administrative and legal methods (conventions and regulations). It also draws from the experiences of the port of Helsingborg in Sweden, in addressing environmental issues.

This dissertation consists of seven chapters and a brief outline of each chapter is as follows:

Chapter one gives the geographical location of the bay, a brief discriptiom of the situation with industrial and agricultural activities, the Maputo population issue and the objective of the dissertation.

Chapter two defines marine pollution, describes the many sources of marine pollution and their effects on the marine environment and on human life.

Chapter three provides the discussion about the main sources of marine pollution of the bay, and provides the hydrological and biological characteristics of the bay.

In chapter four, a comparative study is made between port the of Helsingborg and Maputo Port. Particular attention is given to environmental issues in both ports and a discussion about reducing pollution in Maputo Port, based on the methods used in the port of Helsingborg.

Chapter five, gives the discussion of International conventions which deal with marine environment issues namely: MARPOL 73/78, OPRC-90, and LC Convention. For each convention a specific discussion is provided, and an evaluation of how it can be used to reduce or prevent pollution caused by shipping activities in the bay.

Chapter six gives details on how the Maputo maritime administrations handle marine issues in the bay. It further proposes an action plan for reduction and prevention of pollution in the bay.

Chapter seven, the last chapter, provides a brief summary and conclusions regarding the study.

The research method used was mainly based on a search and analyses of the literature covering the topic, as well as some data related to Maputo Bay and Maputo province. In addition field studies, and lecture handouts were also used.

CHAPTER II

MARINE ENVIRONMENT POLLUTION

2.1 INTRODUCTION

In discussing marine environment pollution, it is appropriate to focus on human activities that is likely to affect the marine environment. This chapter examines the major sources of marine pollution, and provide information on how pollution can affect marine living resources and human life.

The ocean and seas cover approximately 75% of the earth's surface and offer great hope for future seafood supplies. It is a common mistake to consider the oceans to have infinite capacity to assimilate waste materials without causing harm because of their vast size. Thus, it has often been referred to as the ultimate discharge of waste, through the introduction of waste into rivers or directly into the oceans, and when the waste is introduced into the oceans it does not become diluted evenly throughout the oceans, but instead the diluted contaminants tends to build up in the vicinity of the discharge point, becoming a part of the sea water and settling into the sediment. The points of discharge are usually located near the coastline, and due to these practices vast coastal zones become heavily polluted. The impact of marine pollution depends essentially on the types and quantities of the substances introduced into the oceans.

2.2 DEFINITION OF MARINE POLLUTION

Different definitions are given to marine pollution, but a common definition which is used for marine pollution is one by GESAMP. The United Nations Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) has defined marine pollution as: 'The introduction by man, directly or indirectly, of substances or energy into the marine environment, resulting in such deleterious effects as harm to living resources; hazards to Human life , hindrance to marine activities, including fishing impairment of quality for use of sea water, and reduction of amenities'.(Clark, R.B 1989. page 6)

Table 2: Example of pollutants introduced by mankind and nature at sea

CLASS OF POLLUTANT FOUND IN THE OCEAN	ORIGINATING FROM NATURAL CAUSES (SOURCES)	ORIGINATING FROM MANKIND' ACTIVITIES (SOURCE)
Petroleum hydrocarbons a) biogenic b) Petrogenic	Seeps (oil), (gas), (tars), rivers, runoff, volcanoes, gas hydrates, bacteria in water column, atmosphere.	Urban runoff (asphalt roads, crankcase oils, two-cycle engines), transportation, production, aerosols.
Particulate	Rivers, runoff, turbidity currents, nepheloid, layers, high biological production/bioturbation, atmosphere.	Farming, fisheries (i.e. trawling), runoff, dredging (harbours rivers channels), industrial and municipal effluents, drilling operations.
Heavy metals	Volcanoes, rivers, runoff, fissures faults, fractures, subduction zones, sediments, decomposition of organisms.	Industrial and municipal effluents.
Radioactive materials	Rivers, runoff, volcanoes, faults, fissures, fractures placer deposits, subduction zones, atmosphere.	Industrial and municipal effluents, nuclear power plants, nuclear weapons testing .
Nutrients	Rivers, runoff, bottom sediments brought to the surface by upwelling, biological recycling, atmosphere.	Municipal effluents, agricultural fertilisers and slurry mixtures
Thermal effects	Volcanoes, fissures, faults, fractures, subduction zones, supra-heated tropical lagoons/ estuaries.	Cooling tower discharges, ocean thermal energy conversion.
Brines	Salt domes, faults, fissures, fractures, shallow lagoons, rivers.	Industrial effluents including disposal of brine from salt dome storage cavities.
Biological oxygen demand (BOD)	red-tide, eutrophication, decomposition	Municipal and industrial effluents, cannery wastes.

Source: Marine Environmental Pollution, Dumping and mining (Richard A G)

Table 1, shows that pollutants introduced by mankind into the oceans are also introduced by natural causes for example, heavy metals. Natural sources introducing heavy metals into the sea are: rivers, runoff, volcanoes, faults, fissures, fractures placer deposits, subduction zones, and the atmosphere.

2.3 CAUSES OF MARINE POLLUTION

There are many causes of marine pollution, but human activities such as industry, mining, agriculture, sea transportation, and natural activities e.g. through natural accidents such as earthquakes, volcanic eruptions, natural seeps, and sediment erosion are more relevant. In the following section, the factors that cause marine pollution will be discussed.

2.4 SOURCES OF MARINE POLLUTANTS

Waste substances find their way to the oceans from different sources; the main sources of pollution are:

- Pollution from ships
- Domestic sewage
- Industrial wastes
- Oil spills.
- Solid wastes
- Antifouling paint
- Heat or thermal pollution
- Offshore oil exploration and production.
- Land based source of pollution
- Dredged spoils

2.4.1 MARINE POLLUTION FROM SHIPS

Vessels are major marine polluters. Ships loaded with huge amounts of toxic substances, such as crude oil, liquefied natural gas, pesticides, and industrial chemical products, may by accident or intentionally release these materials into the sea, thus polluting the marine environment. Other causes of pollution related to ships are solid wastes, garbage, and sewage which are produced in great quantities in passenger vessels. With the increase of tourism activities, the problem of sewage produced on board passenger vessels has become a major concern.

The discharge of ship's bilge water and waste oil from the machinery without complying with the requirements, of the MARPOL Convention is another way of polluting the oceans.

Table 3: Major accidental oil spill from ships since 1985

YEAR	SHIP'S NAME	LOCATION	SPILL SIZE	CAUSE/ EFFECTS
1985	Nova	South of Iran	70.000 tons	Vessel sank
1988	Odyssey	Off Nova Scotia, Canada	132.000 tons	Vessel sank
1989	Exxon Valdez	Alaska	70.000 tons	Grounding, caused grave environmental damage, led to the introduction of OPA .
1989	Kharg5	Northwest Africa	70.000 tons	Explosion then towed 1500 miles because no nearby nation would allow her near their coastline carrying crude oil
1991	ABT summer	Angola, Africa	260.000 tons	Vessel sank
1991	Agip abruzzo	Livimo, Italy	80.000 tons	Collided with ro/ro ferry Moby Prince, the two vessels caught fire, losses of life in Ro-Ro ferry , moderate oil pollution affected wide area.
1991	Haven	Genoa, Italy	144.000 ton	Fire and explosion, ship broken in three and sank. Most crude oil burnt but 10.000 tons and residue escaped.
1992	Aegean Sea	La Coruna, Spain	72.000 tons	Grounded and broken in two. wide spread environmental damage, 3.000 fishermen affected.
1993	Braer	Shetland Islands, UK	84.000 tons	Engine failure in bad weather, crude oil caused widespread damage to fishing grounds and farmland
1996	Sea Empress	Milford Haven, UK	65.000 tons	Grounding, bad weather entering port; damage to coastal areas and fishing grounds

Source: ITOPF

Table 3, Identifies ten major oil pollution incidents from tankers and the severe adverse impact in marine environment that occurred near the shoreline, since 1985.

2.4.2 DOMESTIC SEWAGE

Actually many people live closely to estuarine and coastal waters, increasing the potential harm that waste from these areas can cause to the oceans. The waste and domestic sewage reaches the ocean through direct disposal at sea or carried by rivers.

Domestic sewage discharged into the oceans without treatment causes serious problems in the marine environment because sewage needs high quantities of oxygen to be degradable: Therefore, when introduced in large quantities it can be a great menace to the marine environment. The sea area near where there are major concentrations of industries and population, suffer marked deoxygenating because of the high degree of organic pollution.

For example, the UK (United Kingdom) had serious pollution problems in the marine environment caused by sewage in 1970 when operators of sewage treatment plants went on strike. Untreated wastewater was dumped into the rivers, oceans and estuary, during a period of approximately eight days. In the next five weeks of this incident, oxygen concentration in the water was reduced due to the discharge of untreated sewage into the sea. This resulted in the death of many fish and a great decline in fauna densities. (Bishop, 1983).

2.4.3 INDUSTRIAL WASTES

Industrial wastes originating from a variety of manufacturing operations, located near the coastline or rivers are discharged daily into the sea, sometimes without any treatment. This includes wastes from: petroleum refining, metal finishing and plating, inorganic and organic chemical production.

These are discharged into the rivers or directly into seawater creating an excessive load of pollution on the water bodies and rendering their natural process of purification inoperative. Organic matters added in large quantities create a large demand for oxygen, and death may occur when marine life becomes deprived of oxygen. Furthermore, when these wastes come from chemical industries they cause serious damages due to chemical oxygen demand and poisonous effects. (Bostwich, 1978)

2.4.4 OIL SPILLS

Oil is a substance which is considered as a major marine pollutant because of its impact when introduced into the sea whether accidentally or intentionally. Oil can also be introduced into the oceans through natural seepage from the seabed.

Accidental discharges may occur during loading operations in ports, oil terminals and through breaks in pipelines during operations. Accidental discharges also include large losses of oil into the oceans from vessel collisions and vessel grounding. Intentional discharges consist in introduction of oil into the sea by tankwashing, deballasting, bilge pumping, and negligent discharge.(Smith 1979)

Main sources and figure of marine pollution.

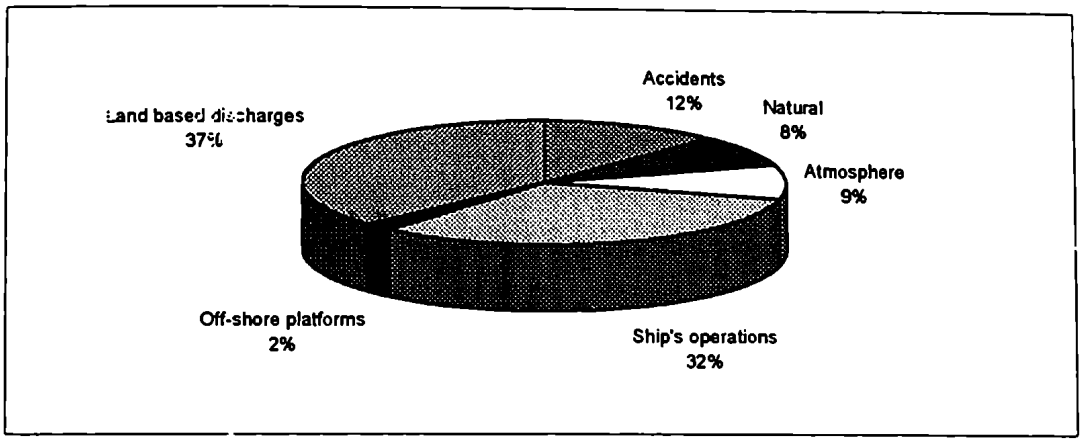


Figure 1(985)

Main source and figures of marine pollution

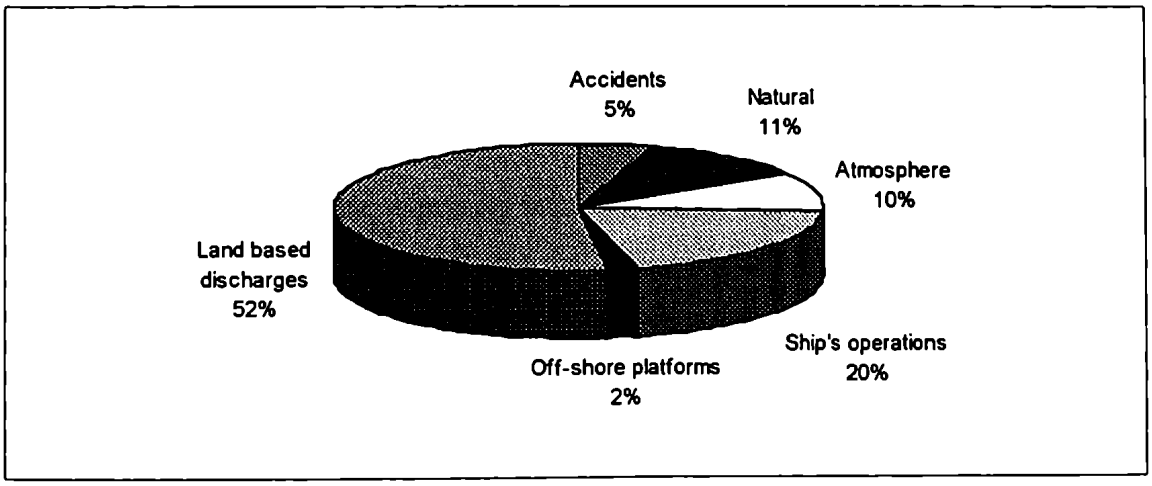


Figure 2 (1989)

Source: Pardo F. (1997) lecture notes, pollution of the sea, origin and main pollutants pp 10.

Figures 3 and 4, illustrate the impact of annex 1 of MARPOL 73/78 in the shipping activity, which entered into force in 1983. Figure 3 shows the percentages of oil introduced into sea from different sources in 1985 and, figure 4 shows the quantity of oil introduced into the sea in 1989. It should be noted that the quantity introduced by ships operation has reduced from roughly one third of the pollution to only one fifth.

2.4.5 SOLID WASTES

Solid wastes constitute essentially the following:

- Garbage: waste from cooking, handling, storage and serving food,
  Cartons, barrels, boxes, paper, and old furniture, which are all combustible, and the non combustible rubbish which is metal, tin cans, and glass.

- Trash from streets: litter, leaves, dirt, sweepings

- Construction wastes: gravel, concrete, scrap

- Demolition waste: brick, masonry, destroyed buildings

- Old fishing nets and other persistent plastic materials

The dumping of solid waste, especially industrial waste, into the sea has been going on for years because people thought that the oceans were such large bodies of water that they could absorb pollution of unlimited quantities and types. Dumping wastes at sea affects the marine life and the health of human beings through the food cycle.

2.4.6 ANTIFOULING PAINT

The use of antifouling paint on bottoms of ships has been considered a major source of heavy metal in the seawater and in sediments near docks and shipyards. Antifouling paints which contain copper, lead, zinc, and tin (Tributyltin (TBT)) are used to prevent growth of organisms which can greatly increase drag on the bottom of the ship. The paint is designed to be permanently toxic, to kill organisms that attach themselves to the bottom of the ships, these materials contributes to elevating the concentrations of heavy metals being founds in the vicinity of many docks.

Effects of TBT on the marine environment:

Tributyltin, commonly referred to as TBT has been used as an active ingredient in several formations of marine antifouling paint. Such paints have had widespread use on vessels of all types: ocean going transport vessels, naval ships, fishing boats and small pleasure craft. TBT is universally toxic and has been used as a fungicide, bactericide, insecticide and wood preservative. It is known to be harmful to a range of aquatic biota, including microalgae, fish, molluscs and crustaceans, invertebrate communities and seagrass beds.

The first evidence of the harmful effects of TBT on oysters came from Arcachon Bay on the west coast of France in the mid-1970s. Oyster culture and pleasure boating are traditional activities there, and TBT contamination from boats was linked to high mortalities of oyster larvae and such severe malformations of the shells of adults that they were unmarketable.

Another case related to TBT is the effect on female Dogwhelks, which develop a condition known as IMPOSEX due to TBT effects. Male characters, including a penis and vas deferens, became superimposed on the females' genitalia. In extreme cases, the vas deferens occludes the opening of the pallial oviduct, preventing the release of egg capsules and rendering the female effectively sterile. Due to the above mentioned factors, the use of TBT- based antifouling paints for ship bottoms has been recommended to be banned according to MEPC 41/10, MEPC 40/11. (MER, 1998 page 19).

2.4.7 HEAT OR THERMAL POLLUTION

Power plants, petroleum refineries, and steel mills, located near the coastline use huge of amounts of sea water for cooling purposes. The daily use of these amounts of water often increases the sea water temperature and reduces the capability to keep

dissolved oxygen in good concentrations in the seawater. As a result of the high water temperature, oxygen combines more rapidly with the organic waste. The consequence is a high rate of consumption of the dissolved oxygen. The rate of oxygen consumption becomes higher than the rate of oxygen transfer into the seawater, and can result in zero oxygen concentration which means death to the water body.

Warmer water also causes aquatic organisms to increase their respiration rates and consume more oxygen, hence increasing their susceptibility to disease, parasites and toxic chemicals. The discharge of heated water into shallow waters near the shore, or in lakes, may also disrupt spawning and kill juvenile fish. (Clark 1992 page 123)

2.4.8 OFFSHORE OIL EXPLORATION AND EXPLOITATION

High quantities of marine pollution originating from oil drilling operations can be intentional or accidental. Intentional pollution by oil is not very common because, any loss of oil and gas goes against the commercial interests of the operator. But there is much room for accidental pollution caused by blowouts, tanker spillage trough operation or collision when ships, come alongside the platforms. According to certain calculation, it was concluded that, out of 0.08 millions tons of oil that were released annually from offshore operations about 0.06 million tons were attributed to accidents (Evans, 1986)

Operational pollution involves mainly the discharge of oily water produced during drilling and the dumping of oil related debris but, also oil-based drillings muds, and chemical biocides used as coating substances to discourage sedentary marine species from attaching themselves to platforms.

Drilling operations are also responsible for pollution caused by substances other than oil discharged into the sea. These substances are inert elements or derivatives of

natural products and include garbage and sewage produced by the inhabitants of offshore installations. In addition to pollution caused by accidental or operational discharges into the marine environment is pollution by pipeline breaks (fractures) due to erosion, corrosion, heavy weather and collisions. (Kennedy, Linzi, Dennes 1992, 158)

2.4.9 LAND-BASED SOURCES OF MARINE POLLUTION.

The ocean remains under pressure from anthropogenic activities, although legal protection of the oceans has advanced further than for any other environment compartment. Only pollution originating from ships and trough ocean dumping has been reduced effectively, actually 70 per cent of the marine pollution comes from land-based source. It causes a real disaster in many coastal area, shallow waters, land-locked seas, in the contrast to the pollution in open oceans, the margins of the sea are affected by man almost everywhere. The main sources of pollution from land are:

- agricultural
- industry, and
- urban zones.

Agricultural practices that borders rivers and coastlines are, associated with over fertilisation and are a principal cause of ocean pollution. Inappropriate agricultural practices and deforestation, cause soil erosion which lead to a dramatic rise in sediment and nutrients. When these nutrients reach the sea they stimulate plant growth, just like they do on land. Plant growth, especially of algae may cause eutrophication. When the algae blooms develop rapidly and die, the water oxygen supply is depleted, resulting in death of the fish.

The use of pesticides (insecticides, fungicides, herbicides) in agricultural activity is another source of marine pollution. Pesticides when introduced on marine

environment it disturbs the reproductive process of fish and increases the mortality of the eggs and larvae at nearshore fisheries (Wayne1994)

The urban zones contribute to marine pollution through waste material, human and animal sewage and others wastes that flow from yards, and streets to the coastal water. The level of pollution from urban areas depends on the community education, culture, and municipal waste management. Bad management or lack of ideal urban waste management contribute negatively to seawater pollution. For instance, leaving food wastes in the open allows them to be washed into the sea by rain water through the city drainage system. The industries located in coastal cities or near rivers usually discharge their waste water into the sea or rivers without any treatment. thereby polluting the ocean environment.

2.4.10 DREDGED SPOILS

Dredging is very important for shipping, because dredging is done to increase the depth, to widen the channel, and to maintain or increase the depth of the harbour in order to handle big ships.

Dredged material from harbours and estuaries with intense shipping activities and heavy industries is more contaminated than in other areas where a low level of industrial and shipping activities takes place. Dumping of dredged material directly alters bottom configuration and biota and may disperse toxic or harmful chemicals around the disposal site, or may smother the benthic fauna in the areas (Bostwick.1985)

2.5.0 EFFECTS OF POLLUTANTS ON THE MARINE ENVIRONMENT, FAUNA AND FLORA.

Pollutants pose a potential hazard to the health of humans and other living organisms because the pollutants are: nondegradable, lethal, persistent in nature can be biologically magnified and otherwise cause detrimental cumulative effects. In the following paragraphs, the effects of some of the major marine pollutants on the marine environment and living organisms will be discussed in more detail

2.5.1 SEWAGE

The major problems associated with marine disposal of sewage are the potential for disease transmission by pathogenic bacteria in the waste, and the oversupply of plant nutrients which may lead to overstimulation of the plant growth and eutrophication. The oxygen consuming proprieties of substances within the sewage can cause depletion of oxygen levels in the sea and result in the death of marine life.

One of the serious consequences of sewage contamination of the seas is the potential for disease transmission by pathogenic organisms from discharge streams. Some of the pathogenic organisms are: Salmonella, Shigella, Leptospira, Entropathogenic Escherida Coli, Pastuerella, Vibrio, Mycobacterium, Human Enteric Virus, Cysts of Endamoeba Hystolytica, and Hookworm larvae. Many diseases caused by these organisms can be transmitted by fish products, as well as by direct contact. The principal means by which persons may be exposed to pathogens in the sea are by recreational immersion or through consuming seafood harvested from contaminated waters. (OCED 1991, pp 73)

Table 4: Disease in Humans which is caused by consumption of aquatic animal contaminated with different disease agent.

DISEASE AGENT	DISEASE IN HUMANS	PRINCIPAL AQUATIC ANIMAL INVOLVED	MODE OF TRANSMISSION TO HUMANS
bacterial: clostridium	diarrhoea, abdominal pain	fish or shellfish	ingestion of fish or shellfish that has not been properly refrigerated
clostridium botulinum	botulism	fermented, salted and smoked fish	ingestion of raw or improperly processed fish or shellfish
Salmonella	typhoid and paratyphoid fever	fish or shellfish	Ingestion of raw or insufficiently cooked fish or shellfish
Vibrio	Diarrhoea abdominal pain	fish or shellfish	Ingestion of raw or insufficiently cooked fish or shellfish
Viral: Virus of infectious, hepatitis	Infectious hepatitis	shellfish	Ingestion of raw or inadequately cooked contaminated shellfish
Parasitic: Nematodes	Enteritis	Cod, Herring, Mackeral	Ingestion of raw or partially cooked, pickled or smoked herring

Source: Thacher and Meith-Avcin, 1978

Table 4: show the diseases which humans may suffer from eating aquatic animal affected by bacterial, viral and parasitic organisms.

2.5.2 DREDGED SPOILS

The effects of dredged spoils on the marine environment depends on the types and quantities of materials dumped into the sea. For example, dredged spoils from harbour or port areas usually contain toxic compounds from industrial effluents. such as mercury or other materials. These are harmful to marine living resources and human life. Dumping mainly affects benthic organisms in the disposal site through smothering and physical disruption of their habitat.

Human beings can be affected by effects of dredged spoils, through consumption of contaminated seafood. The process of contamination of seafood is called biocumulation, which is the accumulation of contaminants in the tissues of organisms through any route, including respiration, ingestion, or direct contact with contaminated sediment or water.

Marine contamination from metals has, in the past caused a critical impact on human health. One of the most widely discussed examples of metal contamination is Japan's experience with MINIMATA disease, which resulted from the long-term ingestion of fish and shellfish contaminated with mercury compounds. These incidents occurred in the 1950s but continue to have negative repercussions even today in the form of continued health effects (OCED 1991)

2.5.3 SOLID WASTES

The effects of solid wastes depend on the varieties of waste dumped into the sea. Among the various types of solid wastes are plastics which are the most dangerous to marine living resources. Plastic is not a readily degradable material and therefore, remains for along time in the marine environment. Although plastic is not a toxic substance, it is harmful to marine living resources. For instance, fish have been discovered with plastic cups lodged in their stomach; turtles, marine mammals and

birds have been killed by ingesting plastic bags or becoming entangled in plastic sheeting. Fish and birds have been killed by the plastic rings used to secure six packs of canned drinks.

Ghost fishing is another menace to marine living resources caused by lost and dumped fishing nets into the sea. These nets remain floating in the sea continuously to catch or entangle marine life. The fish caught by these nets are not collected, and after a period of time they rot while the nets are still fishing. (O'sullivan 1998).

2.5.4 OIL

Petroleum and its components that have been released into the environment are eventually decomposed into simple compounds of their consistent elements by physico-chemical or biological agencies, with or without human assistance. They eventually become innocuous (inoffensive), but in the process, they may cause serious damage to plants and animals or their surroundings, and thus impede human exploitation of natural resources. The effects of oil pollution also vary widely according to the magnitude and type of the spillage, the nature of the locality and state of its biota.

Oil has a major negative impact on plants when the spillage occurs in places where many plants exist. The vegetation may die because plants exchange the gases involved in respiration and photosynthesis through small pores, mostly on the underside of their leaves, so when these sensitive parts of plants are covered by oil, they eventually die.

Damage to terrestrial animals will be confined mainly to those actually engulfed (covered) by the spill. Birds and small mammals may enter the polluted area to feed on insects or earthworms affected by the oil, and as a result they may become oiled or intoxicated themselves.

It is difficult to determine the number of birds killed by oil spills, because many sink without reaching the coast, where the corpses can be counted. For example, during the environmental disaster caused by oil spill from the tanker Amoco Cadiz, which grounded on the coastline of France it was estimated that, around 3,200 seabirds died. Further during the Exxon Valdez oil spill on the USA it is believed to have killed between 100,000 and 300,000 seabirds and 3.500 to 5.000 sea otters (Castro and Hubber 1997 page 383)

The discussion made in this chapter about major sources of marine pollution and its effects in marine resourcesand human life, demonstrates that, land based activities and offshore activities are the major sources of marine pollution. The following chapter will discuss marine environment issues in Maputo Bay.

CHAPTER III

MAPUTO BAY

3.1 BACKGROUND OF THE MARINE ENVIRONMENT OF MAPUTO BAY

This chapter discusses critical issues that cause pollution in the Bay, and provides a background of the marine environment of the Maputo Bay.

Maputo Bay is a lagoon with complex hydrographic characteristics, and a line of high dunes along the side with the Indian Ocean, which extends until Inhaca Island, and is located in between Ponta Macaneta and Ponta Malongana.

The opening of the bay is broad but restricted by an extensive series of sand banks through which some passages and natural channels are found. These channels allow vessels to enter the port area located inside of the bay.

The six principal rivers in southern Mozambique pass through Maputo Province and flow directly into Maputo Bay. These rivers have the following characteristics: The Incomati and Maputo river have high flow, while the Infulene, Tembe, Matola and Umbeluzi rivers have low flow. (INAHINA)

These rivers carry different types of residues, such as chemicals, organic and microbiological materials, which is the result of industrial, agricultural and domestic

activities. During the rainy season, the water coming in from the six rivers brings high quantities of pollutants.

The bay, which is naturally closed by a line of high dunes, law currents and a stable bottom. There is a natural tendency of the bay to be filled with sediments from the rivers, making the shore low and swampy.

In addition to the wastes or pollutants transported by the rivers in great quantities during the rainy season, the marine environment and natural resources in Maputo Bay have deteriorated rapidly since 1975, due to economic stagnation and weak government policy in relation to environmentally issues. This has resulted in harm to and degradation of the sensitive ecosystems. The combination of pollution from rivers, shipping activities, urban pollution, inefficient fishing activities, rapid population growth, and the lack of environmentally sound policies have worsened the degradation.

Although economic growth is necessary to raise living standards, poorly planned development increases pressure on natural resources. Mozambique is facing the challenge of ensuring that economic growth, especially in marine and agricultural activities, does not come at the cost of long term prosperity. The future of Maputo Bay demands the integration of environmental considerations, economical planning and social policy. Therefore, it is necessary to set a strategic programme for improvement of the marine environment and natural resources management.

3.2 PHYSICAL, HYDROLOGICAL AND BIOLOGICAL CHARACTERISTICS OF THE BAY

Maputo Bay usually has two high tides and two low tides during the day. There is a change between 4 to 6 meters in tide height with an average of 5 meters. Winds

affects the height and times of the tides, the variation depending substantially on the physiography of the considered area. In general, the winds affect the rising sea level in the direction where the wind blows. If the wind blows from the sea to the land, it causes a rise in the level of the sea, often with heights, higher than the previously mentioned 4 or 6 meters. The opposite may occur if the wind action is from the land to the sea. The circulation of the sea water by bay currents differ from region to region according to river flow.

In the bay there are three main species of marine mammals which are: The Bottlenose Dolphin (tursiops truncatus), the Indo-Pacific Humpback Dolphin (Sousa Chinesis) and the Dugong. All are found mainly in the eastern part of the bay. Another important marine species located in the bay is the sea turtle which can be found in great numbers within the bay.

Some of these species have been threatened by the local population, for example, the Dugong which is highly valued for its meat. Thus it is undoubtedly killed when accidentally or intentionally caught. In interviews with the local communities on the Inhaca Island, it was reported that certain parts of the Dugong are used for magic-medicinal purposes, hence, creating a huge demand for this species by the local communities for both food and medical purposes. (Lundin C G and Linden, 1995)

3.3 THE MAJOR MARINE ENVIRONMENTAL ACCIDENT IN MAPUTO BAY

The major marine environmental accident which occurred in this bay was the accidental spillage of about 3000 cubic metres of heavy fuel oil by the Greek oil tanker, "*Katina P*" in the channel in April of 1992. The spilled oil damaged the nearby mangroves, beaches and marine life and disturbed the socio-economic activities of the population living around the bay. The result of an environmental monitoring study

indicated that two years after the disaster, the mangrove forest was still badly affected by the spill.

The "*Katina P*" oil accident is the worst ecological disaster ever to have occurred on the south-eastern African coast. The lack of equipment and any framework mechanisms for emergency oil spills worsened the effects of the case. (MICOA 98)

3.4 MAIN SOURCES OF MARINE POLLUTION IN MAPUTO BAY

The main sources of marine pollution are

- shipping activities, and
- land based pollution.

3.4.1 SHIPPING

3.4.1.1 PORT ACTIVITIES

In Maputo Bay there are two quays: Maputo and Matola, both of which are used for commercial purposes. The potential pollutants in these quays from ships are: exhaust fumes discharged to the atmosphere, oily bilge water, oil sludge from the engine room, toilet sewage, garbage and galley waste, accidental oil discharge during tanker transfer operation, de-ballasting of cargo tanks, tank cleaning operations and spills during bunkering operations.
(DNMP 94)

Bunkering operations are one of the major sources of oil pollution in the bay. This is because the distribution of oil along the harbour is made through fixed old pipes and they leak during bunkering operations. The problem is associated with the lack of awareness for environmental issues by the employees of Parastatal Oil Company (PETROMOC). During their service, these employees intentionally discharge the remaining oil in tubes in to the port's waters.

3.4.1.2 DRY DOCKS

Maputo Bay used to have two dry docks, one graving dock and one floating dock. Unfortunately, the floating dock, which was located on the Catembe side of the bay, (Catembe is located on the opposite shoreline of the city of Maputo) sank in February of 1998 due to lack of maintenance.

The dry dock, located on the Maputo side, and which lies only a 1000 meters behind the Maputo Maritime Administration Is the major contributor of pollution in the bay due to its activities. Many ships enter the dock annually for maintenance purposes. The waste water produced during cleaning operations of the ballast tanks, bunker tanks, chain lockers, bilges and sewage facilities, is discharged into the bay without prior treatment. Added to this is the leaking of lubrication oils and paint. The use of antifouling paints, for protection of the bottom of ships, is another threat to the marine ecosystem in the bay, this is due to antifouling paints leaking from brush during painting of the ship's bottom.

3.4.1.3 DREDGING

Dredging activities cause major problems for the ecosystem of the bay. This activity is done to maintain the depth of the channel of the entrance as well as within the port area. However, due to uncontrolled disposal, harm is further done to the environment. There is no determined disposal site for the disposal of dredged material. The discharges are disposed of according to the effects of the currents, which means that during this activity the master dredging vessel discharges in a way so as to keep the dredged material from returning to the channel, without giving any consideration to the marine environment.

Besides pollution caused by the dumping of dredged material into the bay, the practice by national shipping companies of dumping old and damaged vessels in the bay also affects the environment.

In the bay area, several ships have grounded along the shoreline and some have sunk in the bay. For example, there are dredge vessels such as the '*Buzi*' and the '*Comandante Hertz*', the passenger vessel '*Africa*', motor vessels such as the '*Save*', the '*Inharrime*' and the '*Licungo*', the tanker '*Luabo*' and others. these were dumped in the 1970s, are all still in the bay.

3.4.2. LAND-BASED SOURCES OF POLLUTION

Land based sources of pollution pose a major threat to the marine environment in the bay. Land based pollution comes from industrial activities, agriculture and urbanisation.

3.4.2.1 INDUSTRIAL ACTIVITIES

Industrial activities in Maputo Province are spreading in three principal areas, namely Maputo, Matola and Machava, where 126 operational factories are located. The principal rivers in these areas are Matola, Maputo, and Infulene which receive huge amounts of the industrial waste water.

The biggest factories which discharge high quantities of waste into the rivers that enter into the bay are: PETROMOC (Mozambique state oil company), Uniao de Cortumes (leather tannery), TEXLON (cotton processing), FAPACAR (paper factor) and MACMAHON (brewery) and MABOR (tire factory).

3.4.2.2 COMPANIES THAT CONTRIBUTE TO POLLUTION

TEXLON, is located on the Matola river at a distance about 8 kilometres upstream from its mouth. This factory uses approximately 12,000 tonnes of caustic soda annually. Other chemicals used include acids, detergents, amides and dyes. The only treatment done to the waste before discharging it into the river is sedimentation. The Tannery (Uniao de Cortumes) is also located on the Matola River. Waste water from this factory is discharged directly into the river without any treatment.

There are three factories located adjacent to the Infulene River (in fact a stream) which flows north-south and ends into the bay; a paper factory (FAPACAR), a brewery (MACMAHON) and tire factory (MABOR). residues from all three factories are untreated prior to being discharged into the Infulene River. daily waste and emissions discharged from the FAPACAR factory are shown in table 5. Daily waste loads from MACMAHON are shown in table 6. Water quality parameters for the Infulene River at two sites downstream of the MACMAHON (at the site where the discharge canal enter the river and 200 Mts. downstream this site) are given in table 7.

3.4.2.2.1 OIL COMPANY

An oil refinery, owned by PETROMOC, is located in the Matola area, close to the bay. Although the refinery was mothballed in 1984, the refinery is actually used to store and further distribute imported petroleum products. Before the distribution, petroleum products are cleaned through a huge oil separator. The oil and water waste produced during this process is discharged directly into the bay.

Table 5: Waste emissions discharged daily into the Infulene River from FAPACAR (paper factory)

PARAMETER	AMOUNT
Waste water production	1220m3/day
Suspended solids	570kg/day (467mg/l)
BOD	260kg/day (213 mg/l)
COD	940 KG/day (771 mg/l)

Table 6: Daily waste loads discharged by the MACMAHON (brewery)

PARAMETER	AMOUNT(KG/DAY)
total suspended solids	311
BOD	590
COD	1135

Table 7: Water quality downstream of the MACMAHON (brewery)

PARAMETER	SITE A- DISCHARGE CANAL	SITE B- 200 METER DOWNSTREAM OF DISCHARGE CANAL
pH	7.7	7.5
Electrical conductivity (mmho/cm)	3.045	1.704
suspended solids (mg/l)	129	65
BOD (mg/l)	119	22
COD (mg/l)	376	44

Source of table 5,6,7 (Lundin C G and Linden 1996)

TABLE 8: WATER CONSUMPTION, PRODUCTION, ESTIMATED LOADS, BY COMPANIES LOCATED IN THE MATOLA RIVER
REFINERY (PETROMOC)
Volume of water consumed: unknown. Production: 600,000 (ton/yr) estimated loads (ton/y): BOD 76.9; ss 22.7; oil 292; N 8.0; phenol 1.482; S 0.780; Cr 0.294
TEXLON (cotton processing)
Volume of water consumed: 420,000 m3/yr Estimated loads (ton/yr): BOD 43.1; ss 6.6.
UNIAO DE CORTUMES (Leather tannery)
Volumes of water consumed: 60,000 m3/yr Production: 1950 ton of hides/yr Estimated loads: (ton/yr): BOD 132.8; ss 202.8; oil 112.8; N 23.4; S 5879 Cr 8354; phenol 1493,

Source: Evaristo and Hauenguene 1995

3.4.2.3 URBAN AREA

From urban areas, domestic and industrial sewage and waste water are the major sources of pollution to the bay. Around the bay there are 17 outfalls which allow rain water, liquid waste from septic tanks and hospital liquid waste, to be discharged into the bay untreated.

The existing sewerage system in Maputo, covering less than 40% of the city is connected with the only treatment plant, which is regarded as substandard. The plant

is located along the Infulene River, which serves as stabilisation pond. This treatment plant treats less than 50% of Maputo's sewage, and the remainder enters septic tanks which are connected into the city drainage system, allowing waste water from these septic tanks to flow untreated into the bay. (MICOA 96)

3.4.2.4 ORGANIC POLLUTION OF THE BAY

The organic pollution is caused mainly by the residual effluent from a municipal rain water drainage channel, which is frequently contaminated by different pollutants because of the poor drainage system of the city. In 1996, a system of evaluating the pollution status of the bay was made. Samples of water were analysed in terms of MPN (most probably number) of faecal and total coliform. Table 9 is a classification range used to judge the quality of the water concerning organic pollution.

Table 9: Table of classification of water quality in terms of biological contamination

MPN/100ml(total colif)	Quality of water	Degree of contamination
0-100	Excellent	1
101-500	Good	2
501-1000	Mediocre	3
>1000	Contaminated	4

Source: MICOA 96 (WHO 77)

According to the evaluation made from 1985 to 1996, based on table 9 it can be concluded that the level of pollution of the bay has evolved from a good situation in 1985 to mediocre situation in 1996, as shown in figure 3.

Level of total coliform in Maputo Bay

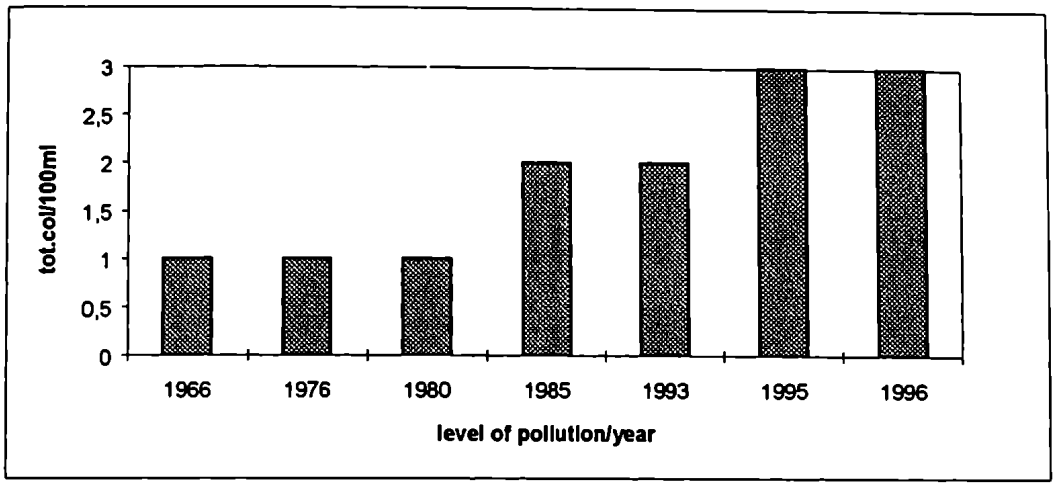


Figure 3. Source: MICOA 96

COLIFORM RATES IN BATHING AREA

The evaluation of the level of pollution in the bathing area in Maputo Bay in 1996, using the European Union evaluation (Table 10) according to the Norm 76/160/CEE (bathing water in the European Union: council directive 76/160/CEE) is as shown, below.

Table 10. Classification of water quality in terms of faecal coliforms as per Norm 76/1600/CEE.

MPN/100 ml(faecal colif)	Quality of the water	Level of contamination
up to 100	Good	1
100-2000	Acceptable	2
>2000	Not acceptable	3

Source: MICOA 96

Faecal coliform in the bathing areas (1996)

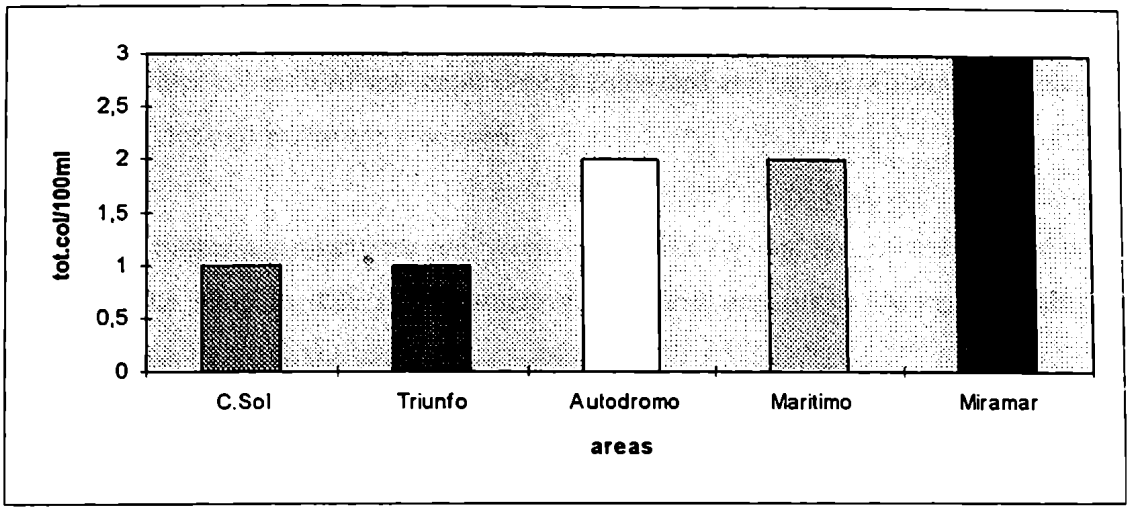


Figure 4. Source: MICOA 96

According to the total of faecal coliform in the bay, using the method of the European Union (figure 4) Norm 76/160/CEE, it can be observed that only the Costa do Sol and Triunfo areas had a good level in 1996

3.4.2.5 AGRICULTURAL POLLUTION

Agriculture is a significant source of pollution of the bay; agriculture is practised in the basins of the six rivers, which flow to the Maputo Bay. Therefore, any agricultural chemicals used in the basins of these rivers end up in the bay transported by the river currents.

Along the Infulene River. rice and vegetable are produced. Umbeluzi, which is an international river arising from the Kingdom of Swaziland, flows through Maputo Province in the Boane district along the Umbeluzi border. In the neighbouring country of the Kingdom of Swaziland, sugar cane is produced, and on the Mozambican side the same crop is produced in addition to citrus.

Incomate, another international river, which arises in South Africa, flows across Moamba, Magude and Manhica districts in Mozambique and end in Maputo Bay. Along this river in South Africa, sugar cane is cultivated and on the Mozambican side, sugar cane, rice and maize are produced.

In all these basins agrochemicals are heavily used. The type of agrochemicals used in farms on the Maputo side are insecticides and fertilisers, which during the rainy season are washed into the bay.

In 1987, in order to reduce the negative effects, Mozambique published a pesticide act, The Act states that all pesticides used in Mozambique should be registered, but unfortunately there is no enforcement and, therefore, no data available on the agrochemicals used. (Evaristo and Hauengue, 1995)

In relation to the level of pollution caused by oil in the bay, there have been no academic studies done so far. One indication of pollution in the bay is the presence of spillages, which are often floating around the bay. Another indication of oil pollution came from interviews with the local fishermen. During the interviews, this community reported that the total amount of fish caught daily has dramatically been reduced in the last five years.

In order to prevent or reduce pollution in the Bay it can be seen that there is an urgent need to create mechanism to control humans activities which affects the marine environment of the Bay. In light, the following chapter will focus on a comparative study between Maputo Port and Port of Helsingborg concerning the environmental issues.

CHAPTER IV

COMPARISON BETWEEN MAPUTO PORT AND THE PORT OF HELSINGBORG ON ENVIRONMENTAL ISSUES

4.1 INTRODUCTION

As early stated in chapter 3, this chapter will focus on a comparative study between Port of Helsingborg and Maputo Port about environmental issues in the port area.

The ports of the world play and serve important national, regional, and global roles in carrying out waterborne trade and commerce. This intra-and inter-national commerce is essential to the national economies of the port countries, as well as countries that rely on the transportation services they provide.

Port operations are not only essential elements of many national economies, but also provide a fundamental bases for commercial, legal and political relationships between states. Port operations are especially important for many developing countries that rely heavily on maritime commerce to sustain their economic growth and development. Most ports are located in enclosed waters. and have universal problems with relation to prevention of pollution of the environment. Most relevant are problems regarding to:

- Air pollution
- Oil waste pollution
- Solid waste pollution

The main objective of this chapter is to carry out a comparative study between the port of Helsingborg, Sweden and the Maputo Port, Mozambique. While the study will consider environmental issues in both ports, it will go further to give suggestions on how the methods being used in the port of Helsingborg, can be used to solve/reduce the environmental problems in Maputo Port.

The study seeks to ensure that development does not diminish the environment, but rather allow environment and development to progress hand in hand. Therefore the Maputo port authorities, who are involved in port operations, must pursue their economic aims with due concern for the protection of the environment.

4.2 POLLUTION CAUSED BY MAPUTO PORT ACTIVITIES IN THE BAY

4.2.1 AIR POLLUTION

Air pollution in the port of Maputo port is caused by exhaust from engines from ships when they are alongside the harbour quay and while at anchorage. Because the majority of ships which regularly come to this port use fuel oil with a high content of sulphur, sulphur dioxide air pollution results in the port area. The use of forklifts powered by diesel oil with high sulphur contents, during cargo services adds to the amount of pollution caused by ship engine emissions in port. Another source of air pollution in Maputo Bay is the coal terminals. This Bay has two coal terminals, one located in Maputo quay, and the other in Matola quay. Both used for loading purposes.

In Maputo, mineral coal loading operations are performed by huge electrical machines with a capacity to lift a full wagon. The machine lifts the wagon until a certain height and then turns the wagon up-side-down, discharging the coal into the ship's hold. The wind constantly blowing, spreads the mineral coal dust throughout the port area,

including into the port waters, thus polluting the environment. The same problem occurs in Matola quay although, conveyor belts are used during loading operations.

The mineral coal dust has adverse effects on marine living species as well as on human life. Because coal is a carbon compound that was formed from vegetation millions of years ago, when the dust is introduced in the human body through breathing, it causes serious health damages. One of the illness it causes is black lung disease which is medically knows as coal worker's pneumoconiosis.

The signs of black lung disease are:

- Difficulty in breathing
- Focal emphasema
- Heart failure
- Increased risk of rheumatoid arthritis, with some forms of black lung disease (i. e Caplan's syndrome)

Coal dust contamination of the marine environment occurs around coal loading and storage terminals. Molecular studies on the effects of mineral coal dust exposure of juvenile Chinook salmon have also revealed physiological defects. According to the result of laboratories experiment done by, Department of Fisheries and Oceans, 4160 Marine drive, west Vancouver, V7V 1N6, Canada. in term of molecular study on the sublethal physiological effect of coal dust, come to the conclusion that the coal dust can affect cellular metabolism of juvenile Chinook salmon. (Campbell & Devlin, 1997).

4.2.2 OIL WASTE:

Oil waste produced on board, when the ships are alongside the quays, is discharged into the bay as reception facilities and treatment plants are scarce in Maputo port. This practice increases the rate of water pollution within the bay. However, although

port regulations prohibit the discharge of this waste, port authority cannot enforce this law because there are not port reception facilities, to assist the ships with the waste when they are located in the harbour.

4.2.3 SOLID WASTE:

Solid waste from the galley, crew cabins and from the engine rooms is also discharged into the sea. As already mentioned, there are no port reception facilities at the port, hence this solid waste is discharged into the sea too. Some ships have a fixed drum at the stern of the ship, in which solid wastes are disposed of, during day light, and discharged into the sea at night time.

Another source of solid waste is generated during ship maintenance. Solid wastes produced during deck scraping are usually released into the sea. Because a ship needs to have a waste bin for disposal of waste, authorities or their agents have to submit written requests from them. This leads to an increment to the harbour fee, and as a result most ships, during deck maintenance, do not ask for a waste bin. And the waste is eventually disposed of into the bay.

4.2.4 SEWAGE

Sewage and waste water from national and foreign vessels are also usually discharged into the bay without treatment. Most of the national ships are not equipped with holding tanks (slop tanks); hence the ship's sewage system allows direct discharge of sewage and waste water into the sea.

In relation to foreign ships, although some are equipped with holding tanks, they generally negligently discharge untreated sewage and waste water into the bay. This is because the port does not have sewage collection services, and no enforcement of port regulations which prohibit the discharge of waste into the port area.

Other producers of sewage sludge in the bay are the local fishermen. According to the division of port terminals, there is a quay reserved for them where there are sanitary facilities provided by the port, but the facilities have become dilapidated. In this place, therefore, a sewage sludge may be seen floating, because the, small fishing boats do not have onboard any sanitary facilities, and the fishermen do not want to use the dilapidated ones. Hence, when nature calls they relieve themselves over the edge of the wooden boats, directly into the bay.

4.2.5 BUNKERING:

In the port installations there is a fixed iron pipe system for bunkering services, as stated in the chapter 3. Due to poor maintenance, the pipe has many holes, which allow the leakage of oil during bunkering operations. In addition, the carelessness observed during this service both on-shore and on-board, by personnel, results in many tank overflows and hose disconnection during bunkering. All these factors result in pollution of the bay.

4.3 PORT OF HELSINGBORG, SWEDEN.

4.3.1 GEOGRAPHIC LOCATION

The port of Helsingborg is located close to the southern tip of Sweden overlooking the busy waters of the Öresund and faces the Danish harbour of Helsingör.

Helsingborg's geographical position makes it an important city for shipping trade. The port of Helsingborg is one of Sweden's most modern full service ports, serving all types of vessels, carrying all types of cargo. This port provides a link between Sweden and Denmark and the mainland European continent. The port is divided up into 4 harbours: bulk harbour, the southern harbour, the west harbour and the north harbour.

4.3.2 ENVIRONMENTAL PROBLEMS AND THEIR SOLUTIONS

Ships and ferries use the port of Helsingborg for cargo and passenger services. Port activities cause disturbance to the surrounding vicinity. In order to minimise this problem, the port authority has implemented an outdoor environmental policy, which deals with the following areas:

- Conducting the business in such a way so as to minimise disturbances to the surrounding area
- Encouraging shipping companies to use the best fuel in order to reduce exhaust emissions
- Working for the introduction of a protection zone around the port and its activities
- Conducting business with the an aim of ensuring the long-term fulfilment of local health committee requirements, together with the customers and those others who use the port. The port authorities contribute to a better environment for the people of Helsingborg in the following areas:

  The air
  Oil waste
  Solid waste, and others areas

4.3.2.1 THE AIR

Cargo vessel and ferry traffic in the Helsingborg region, generate air pollution due to the constant exhaust of fumes into the atmosphere. These fumes contain such substances as sulphur oxides, nitric oxides and hydrocarbons. Land traffic, forklifts and lorries contribute to the air pollution too. Concentrated exhaust fumes cause pungent smells in the air.

In order to reduce air pollution, port authorities in Helsingborg have set in place the following measures to be taken in the port areas;

- ships; all vessels and ferries are encouraged through reduction of port fees, to use only low sulphur bunker oil in and around the port area. Emphasis on this requirement is placed more on ferry traffic as it is more frequent.

- Shipping companies: Shipping companies are encouraged to install catalytic converters in exhaust systems of vessels.

- In-terminal transport: Transport services in these places use the electrical trucks as much as possible with the objective of reducing smoke emissions. For instance, if it is impossible to use an electrical vehicles, then they use vehicles powered by high grade diesel-oil, to obtain a more environment-friendly fuel.

4.3.2.2 OIL WASTE

Water contamination by oil only occurs when humans intentionally, negligently or accidentally release oil into the sea. Usually ships are reported for emptying their tanks in open sea, to the maritime authority.

When oil is released into the marine environment, it can cause great harm to both flora and fauna. In case of large spills, clean-up operations can become very costly, and when the nature is once disturbed, it takes long time for the initial conditions to be restored.

In order to solve the problems caused by oil waste, the port authority in Helsingborg, with an objective to reduce waste oil pollution in port area, encourages the ships to use special stations for oil-contaminated water. This service and assistance is provided

free of charge, which means that the proper disposal of waste oil from ship engine rooms can be encouraged or required without negative consequences for the vessels.

4.3.2.3 SOLID WASTE

Dumping unsorted rubbish in Sweden, costs a lot of money and creates a refuse mountain which the port has to reduce. In Helsingborg there are waste segregation systems for solid waste, in order to reduce this quantity of refuse. The port authorities make the utmost effort to keep the port and terminals clean, because solid waste within the port area, creates an unhygienic, unsafe and unpleasant working environment

To prevent and reduce waste in port area, the port of Helsingborg has a waste recycling station where refuse can be sorted into the following groups:

- Wood
- Plastic
- Paper and cardboard
- Other waste

Hazardous waste can also be dealt with. All waste products have to be marked according to port guidelines.

Just as oil waste, ships are not permitted to release toilet waste directly into the sea near the coast, but may leave such waste at the facility provided by the port, free of charge. (Port of Helsingborg, 1997)

4.3.3 BUNKERING

Bunkers in the port of Helsingborg are delivered through bunkering vehicles and vessels. During bunkering operations the following regulations have to be observed,

with the objective of guaranteeing a safety and environment protection. During bunkering operations the entities involved most meet the following requirements:

1. Notification

1.1 An advance notification of intended bunkering should be made to the Helsingborg Port Control.

1.2 The advance notification should contain:

- the name of receiving ship,
- the name of bunkering vessel,
- the time and location of the bunkering,
- the oil quality, and
- the name of the company delivering the bunkers.

2 Distribution of responsibility

2.1 The person on board a receiving ship who is responsible for the bunkering has to prior to the bunkering operations appoint a safety guard who, if necessary, can order the pumping to be stopped.

2.2 The person on board a receiving ship who is responsible for the bunkering and the master of a bunkering vessel or the driver of a bunkering vehicle are responsible, within their respective area of responsibility, for taking all necessary steps to prevent the release of bunkers into the water or onto the shore.

3 Before the bunkering operation commences

3.1 All scuppers on the receiving ship and bunkering vessel that are affected by the bunkering must be closed.

3.2 The tank goose-necks shall be equipped with suitable means of protection against overflowing.

3.3 The master of tank bunkering vessel or the driver of the bunkering vehicle, must be informed about the maximum pumping pressure allowed and the quantity to be filled in each tank of the receiving ship.

3.4 The hose from the bunkering vessel or the bunkering vehicle, must be securely connected to the manifold on board the receiving ship.

3.5 Only a hose that has been approved for this purpose and tested during the last twelve months may be used.

3.6 Checks should be carried out on all valves that are in use to ensure they are set to fill the right tanks.

3.7 Safe communication, preferably by means of radio, shall be established between the receiving ship and the bunkering vessel, or the bunkering vehicle.

4.0 Bunker transfers

4.1 Hose connections shall continuously be checked regarding leakage.

4.2 A safety guard who is experienced in the operation onboard the receiving ship shall be in attendance during the entire bunkering operation. This person have to stay in such a place that he can immediately an interruption in the pumping should this be called for, due to overfilling or otherwise.

4.3 Safe communication to ensure safety shall be maintained during the entire bunkering operation between the bunkering vessel or the bunkering vehicle and the receiving ship.

4.4 The oil level in the tanks of the receiving ship must be carefully checked. The greatest caution shall be exercised during "topping up".

5.0 After completion of the operation

5.1 Before the hose is blown with air the responsible officer must ensure that there is space enough to receive its contents in the tank that was being filled

5.2 The hose of the bunkering vessel or the bunkering vehicle must be disconnected in such a way that oil is not spilled. A drip tray must be used. The hose must be blinded before being brought back to the bunkering vessel or ashore to the bunkering vehicle.

5.3 Actions in the case of oil spills

In the case oil is spilled the following actions must immediately be taken:

- The pumping shall be stopped
- The valves onboard the bunkering vessel or the bunkering vehicle and the receiving ship must immediately be closed.
- The Helsingborg Port Control and Helsingborg Fire Brigade must be alerted.

(Bye-Laws for the port of helsingborg 1994)

4.4 MEASURES TO AVOID/ REDUCE DUST POLLUTION

Bulk cargo which produces dust during cargo operations such as mineral coal, grain, fertilisers, cement and clinker are handled trough a Siwertell system in order to reduce and prevent dust pollution.

The Siwertell systems are available for multi-purpose use in a wide range of bulk commodities such as grain, fertilisers, derivatives, cement, clinkers, chemicals and coal. This system can be used in ships of any size. The basic design criteria are the same for unloaders; Totally enclosed conveying system, low weight, high efficiency and ease of maintenance. The system is also equipped with a telescopic loading spout specially developed to prevent the escape of dust. The loading operation is controlled automatically and dust is collected and returned to the ship's hold. There should be no

dust emission or spillage even if a powdery material like cement is handled. (BMH-Marine A B Sweden)

4.5 APPLICABILITY OF METHODS USED IN THE PORT OF HELSINGBORG TO REDUCE/AVOID POLLUTION IN MAPUTO PORT.

All measures used in the port Helsingborg Port to reduce, prevent and, control pollution in port are applicable to Maputo Port, but problems will arise in the final treatment of waste which will be collected from ships at port. This is because Maputo province have no effective installations for waste water, sewage or solid waste treatment plant; consequently, waste management is a difficult problem to solve.

In relation to air pollution caused by mineral coal dust and ship and vehicles exhaust emissions, the port authority has to encourage ships which call at the port to use environmental friendly fuel oil in port area. this could be done through the reduction of fees paid as port duties to ships which choose to comply. For the forklifts, the port has to replace the existing ones with those that are electrically powered. In case of financial difficulty precluding replacement, the port needs to use environmental friendly diesel oil in its vehicles and forklifts.

Coal terminals have to replace the present cargo loading system with a closed loading system(Siwertell) which is used in many European ports for all bulk cargo, to eliminate dust generates during the loading operations.

The comparative study made between both ports, demonstrates that the attention given to the marine environment in the port of Helsingborg during port activities can be used in Maputo port to handle environmental issues. The next chapter will focus on International Conventions which deals with the marine environment. Basically it will look at environmental issues handled in the Maputo Bay.

CHAPTER V

INTERNATIONAL CONVENTIONS

5.1 INTRODUCTION OF INTERNATIONAL CONVENTIONS

The port of Mozambique can benefit from the International conventions regarding pollution prevention. In the early 1950s, the international community realised the need to introduce regulations for control and prevention of marine pollution caused by non environmentally friendly marine activities. In 1954 the OIL-POL Convention was adopted with the objective of prevent operational pollution from ships.

Ports are one of principal elements in shipping activities and usually they are located in bays, or in semi-enclosed waters to provide a natural shelter against bad weather and strong winds. Thus, this ecologically sensitive area suffers the adverse impacts of pollution from ships' activities and from cargo operations.

Since the introduction of OIL-POL 54, With the prime objective of reducing and controlling the adverse impacts on the marine environment caused by shipping activities, International conventions have been adopted to address these problems. Some of these are:

- International Convention for the Prevention of Pollution from Ships 73/78 (MARPOL 73/78),
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC-90)

- Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 (London Convention 72)

The next section will discuss how these conventions can have positive impacts on resolving environmental issues in Maputo Bay, if they are incorporated into the Mozambican marine environmental legislation.

5.2 MARPOL 73/78:

In the 1970s the international community realised that the OIL-POL Convention 54 was inadequate to control the pollution produced by ships. As a result, MARPOL 73 was formulated, which is more comprehensive than Oil-Pol Convention 54.

Due to economical implications related to implementing this convention (the economical problems are caused by the provisions of reception facilities and waste treatment plants, which are a key element for ports that must comply with this convention), the original convention never entered into force, because the number of states who were willing to give their consent to be bound by it was insufficient. As a result, a protocol to this convention was adopted in 1978. The protocol incorporating the provisions of the 1973 Convention entered into force, and is generally referred to as MARPOL 73/78. The MARPOL Convention contains two protocols and six annexes. Annexes I and II are compulsory while the others are optional.

- Annex I, provides Regulations for the Prevention of Pollution by Oil

- Annex II deals with regulation for the control of pollution by noxious liquid substances in bulk

- Annex III, deals with regulations for the prevention of pollution by harmful substances carried by sea in packaged forms or in freight containers, portable tanks or road and rail wagons

- Annex IV deals with regulations of pollution by sewage from ships

- Annex V deals with regulations for the prevention of pollution by garbage from Ships

- Annex VI deals with air pollution.

Table11: MARPOL ANNEXES AND THE DATE ENTERING INTO FORCE

ANNEX	DATE ENTERED INTO FORCE
Annex I	2 October 1983
Annex II	6 April 1987
Annex V	31 December 1988
Annex III	1 July 1992
Annex IV	not yet
Annex VI	not yet

The ratification and implementation of the MARPOL Convention in Mozambique will have a positive impact on Maputo Bay, because the Maputo-MARAD, which is the institution that is responsible for control and prevention of pollution in the bay will then have up-to-date regulation to prevent and reduce pollution caused by shipping activities in the bay.

This Convention will have a positive impact on controlling the causes of pollution in the bay, excluding land-based sources of pollution, which are regulated by the national

legislation. According to the pollutants which affects the Bay the following material and regulations will have to be put in place:

5.2.1 RECEPTION FACILITIES

The function of reception facilities is to collect all kinds of waste generated by ship operations, including those generated during cargo handling, dock services and ship's maintenance.

In accordance to the requirements listed in the MARPOL Convention, states that are parties to the convention have to ensure the provision of reception facilities at their ports, according to the needs of ships using their ports, terminals or repair ports. The capacity and number of these facilities will depend on the type of waste and terminal in which the ship will be located.

5.2.2 CONTROL OF DISCHARGE OF WASTE INTO THE SEA ACCORDING TO MARPOL 73/78

5.2.2.1 OIL MIXTURE

The liquid waste which pollutes the Maputo Bay comes from ship's bilge water, urban areas, the dry dock, and from industries located nearby.

By implementing the requirements of this convention, will reduce pollution caused by shipping activities, because Annex I Chapter II, Regulation 9, (which deals with requirements for control of operational pollution from ships), prohibits the discharges into the sea of oil or oily mixtures from ships. Incorporating and enforcing this regulation in the laws which rules the Bay, ships will not be allow to discharge oil mixture into the bay, this thus will reduce pollution.

5.2.2.2 DISCHARGE OF SEWAGE

Discharge of sewage into the sea is regulated by Annex IV, Regulation 8, which provides the condition to be observed during the discharge of sewage. Ships are allowed to discharge sewage into the sea, but before discharge, sewage must have been disinfected and comminuted in accordance to the requirements and system approved by the administration. The vessel has also to be in a distance of not less than 4 nautical miles from the shoreline. Non-disinfected sewage can be discharged 12 mile distance away from the shoreline. If the discharging of stored sewage in holding tanks, the discharge has to be made in a moderate way and the vessel has to be en route with a speeds of not less than four knots.

Ships which are equipped with approved sewage treatment plants they are allowed to discharge sewage into sea but have to comply with the country's sewage discharges legislation if they are located within territorial waters.

5.2.2.3 DISPOSAL OF GARBAGE

Annex V of the MARPOL Convention prohibits the discharge into sea and in special area of all kinds of plastic substances But disposal is allowed of certain types of garbage. The annex also provides the following regulation to control garbage disposal at sea.

Regulation 3, deals with disposal of garbage outside special areas
Regulation 4, provides special requirements for disposal of garbage
Regulation 5, provides guidelines for disposal of garbage within special areas
Regulation 6, provides exceptions to compliance with regulation, which among other measures, it allows ships to discharge garbage in whatever place, without compliance of this regulation, as a safety measure. (IMO, 1991 page 441-446)

5.2.3 ANNEX VI

Annex VI of the MARPOL Convention was adopted in 1997. It deals with air pollution caused by emission of nitrogen oxides and sulphur emission from ship exhausts.

According to regulations incorporated into this annex, the governments should ensure the use and provisions of adequate reception facilities in its repair yards for the collection of ozone depletion substances and equipment containing such substances when removed from ships. Reception facilities for the collection of exhaust gas cleaning residues should also be provided. In addition to the provision for reception facilities, this Annex regulates the use of fuel oil in marine diesel engines. The fuel oil must be free from inorganic acid and, should not contain substances which are harmful to personnel and contributes to additional air pollution. The sulphur content should not exceed 4.5% m/m (mass per mass), and should not affect the performance of engines and other machinery.

Incorporation of Annex VI into Mozambican law would to regulate pollution in the bay and would considerably reduce harmful smoke emissions from ship's engines. Furthermore it will be mandatory for the Mozambican Oil Company to supply environmental friendly fuel oil to ships which call at the ports of Mozambique.

Besides the provisions to reduce/control pollution, this convention also allows the parties to apply penalties to violators of the rules, and promotes technical co-operation among them.

'The penalties specified under the law of a party pursuant to the present article shall be adequate in severity to discourage violations of the present convention and shall be equally severe irrespective of where the violations occur'. (IMO 1997)

MARPOL Convention, Article 17 deals with promotion of technical co-operation among the parties to the convention. According to this Article all parties have to provide support for those parties which request technical assistance for:

- Training of scientific and technical personnel for reception and monitoring.

- The facilitation of other measures and arrangements to prevent or mitigate pollution of the marine environment by ships, and

- The encouragement of research.

5.3 CONVENTION ON THE PREVENTION OF MARINE POLLUTION BY DUMPING OF WASTES AND OTHER MATTER 1972

The need for an international convention to control the dumping of waste at sea was first recognised in 1971 at the first meeting of the preparatory committee for the United Nations Conference on the Human Environment in Stockholm. As a result of the ideas expressed at that meeting, the convention was written and was finalised in 1972. Originally known as the London Dumping Convention, it has been in force since 30th October of 1975 when 15 Nations ratified. The convention with its amendments of 1978,1980 and 1993, controls marine pollution from dumping and incineration at sea.

The London Convention prohibits the dumping of some substances including plastics and mercury and allows the regulated dumping of other substances. This Convention does not cover operational discharge from ships, for example, ballast water and oily bilge water, and excludes the disposal of waste related to the exploitation and offshore processing of seabed resources. For example, pollution caused by the oil and gas

industry. Offshore platforms is not covered, as well as the discharge from land-based sources, such as sewage pumped directly into the sea from a city's sewerage system.

The main rules of the Convention are described in Article IV which contains a general prohibition against dumping of any waste or other matter in whatever form or condition except as otherwise specified. The regulation expresses a complete prohibition of the dumping of substances listed in its annex I which is commonly referred to as the black list. The referred substances are: Organohalogenic compounds, mercury and mercury compounds, cadmium and cadmium compounds, persistent plastics and other persistent synthetic material, (for example netting ropes, which may float or may remain in suspension in the sea which may prejudice, fishing, navigation or other legitimate uses of the sea), crude oil and its waste, refined petroleum products, high-level radioactive wastes, etc. (IMO 1991)

According to this Convention to dump substances listed in Annex II (called the grey list) requires a special permit, which means permission is granted specifically on application in advance and in accordance with Annex II and III. of the convention. The requirements of LC 72, annex II, apply to the dumping of wastes containing significant amounts of: Arsenic, lead, copper, zinc and their compounds, organosilicon compounds, cyanides, fluorides and pesticides and their by-products not covered in Annex I. A special permit for such dumping has to be issued.

According to LC/72, Annex II, significant amounts mean:
Pesticides and their by-products not covered by annex I and lead and lead compounds: have to be 0.05 per cent or more by weight. All others substances in annex II, paragraph 'A' have to be 0.1 per cent or more by weight. More details in relation to obtaining dumping permission can be found in the LC 72 Annex II.

Implementing this convention will enable Maputo-MARAD to control the disposal of dredged material produced from the channel and maintenance of port area. The

channel which allows vessels to enter into Maputo Port is a dredged channel which suffers from high bottom erosion due to water of the rivers which flow into Maputo Bay. The effects are high in the rainy season, and therefore to maintain the depth of the channel and port area, dredging activities are constantly necessary.

As has been stated in chapter 3, there is no control in dumping and there are no selected dumping sites for dredged material. Furthermore, the bay is heavily polluted by waste from dry dock, where anti fouling paint (TBT) is still used. Waste from the urban area, industrial activity and from rivers which are overloaded with agricultural chemicals (pesticides and fertilisers), also come into the bay. This means that material (waste) from all the Bay contain substances which are prohibited to be dumped e.g. heavy metal and wastes with chemicals compound, or need special permits for dumping into the sea, but all are dumped into the bay.

Ratification and incorporation of this Convention into the national legislation will enable the local authorities to have a legal instrument to reduce and control pollution caused by dredging activities. In addition, by following the requirements of these regulations, national shipping companies will need to stop the dumping of old and damaged ships in the Bay.

5.4 INTERNATIONAL CONVENTION ON OIL POLLUTION PREPAREDNESS, RESPONSE AND CO-OPERATION, 1990 (OPRC-90)

In 1989, as a result of several oil spill incidents, including the Exxon Valdez, the International Maritime Organisation (IMO) through, its Marine Environment Protection Committee(MEPC) developed an International Convention on Oil Pollution Preparedness and Response. In November 1990, 90 IMO members states adopted the agreed text for the convention at an IMO Conference. The condition set the Convention to enter into force was adoption by 15 member states, and this was

achieved in may 1994. The OPRC 90 came into force on 13 May 1995, when 21 countries had accepted the convention.

5.4.1 THE KEY FEATURES OF THE CONVENTION

- This convention requires co-operation between the Government and the industry, on drawing up oil spill response contingency plans. National contingency plans have to include at least, a minimum level of equipment to combat spills and training of relevant personnel.

- It stresses the importance of preparedness to combat oil pollution incidents and prompt action to minimise the damage such incidents may cause. Ships, offshore installations, ports and terminals are required to have an oil pollution emergency plan in place and any incidents involving oil and other discharges must be reported without delay to the competent national authority.

- This convention promotes international co-operation between governments to enhance existing capabilities concerning oil pollution preparedness and response. Governments who are parties to the convention are obliged to co-operate in response to an incident, for example, by enabling equipment and personnel to move across national boundaries. by promoting co-operation in research activities and by providing of technical services.

Incorporating OPRC-90 into Mozambican legislation, which regulates activities of the Bay, will enable the authority which deals with pollution matters to establish a legal framework that may enable them to work with neighbouring ports to control and combat pollution. Under this regulation port authorities and other users need to have at least a minimum amount of equipment for pollution control. Further, these will be

mandatory training in pollution control/combating for the staff working in the port area.

Another important aspect of OPRC-90 Convention is the requirement of the national Contingency Plan to be put in place for the benefit of Maputo Bay and the country in general. In spite of the bad accident experienced in 1992 by the grounding and oil spill caused by the Greek tanker the *Katina P*, the Bay is still without a contingency plan to deal with marine pollution.

The bay is not only threatened by vessels which call at the port, but also under the menace posed by the VLCCs (very large crude carriers) which daily pass through Mozambique's exclusive economic zone (EEZ), coming from the Middle-East loaded with thousands of tons of crude oil, and heading to south.

5.5. NATIONAL LEGISLATION

The constitution of Mozambique has basic provisions for environment control. Although, specific legislation dealing with the protection of the marine and coastal environment is at a very early stage of development, there are few effective controls or performance standards. The enforcement of these few provisions is hampered by the absence of environmental monitoring and the needed associated skills, as is the case in other fields of Mozambique's economic and social activities. The environmental legislation in force is dated prior to 1975. In fact, Article 79 of the first constitution approved in 1975, it indicates that, '...any law or its provision adopted prior to independence will remain valid as long as it does not harm the interest and policy of the Republic of Mozambique...'. Therefore, some of the legislation published during the Portuguese administration is, still valid and in force, such as the pollution controls based on Oil-Pol 54, the very first of the conventions that addressed marine pollution problems. This is the only marine pollution legislation in the country, published in 1973, which provides any controls oil pollution from ships. It is obsolete and without

relevance to major oil spill control. Furthermore, this regulation does not deal with prevention and reduction of marine pollution caused by other substances than oil from ships.

5.5.1 IMPLEMENTATION OF INTERNATIONAL CONVENTION

Mozambique has ratified a reasonable number of international conventions which deal with maritime matters, but unfortunately, Mozambique has not ratified those which deal comprehensively with the marine environment. Those deem most important; MARPOL-73/78, LC-72 and OPRC-90, which have just been discussed.

The International conventions that Mozambique has ratified are:

- IMO Convention 48 (International Maritime Organisation Convention 1948)
- SOLAS 74/78 (International Convention for the Safety life at Sea, 1974 and its Protocol of 1978)
- Load Line Convention 66 (International Convention on Load Lines 1966)
- International Tonnage Convention 69 (International Convention on Tonnage Measurement of Ships 1969)
- COLREG 72 (The Convention on the International Regulation for Prevention of Collision at Sea 1972)
- STCW 78/95 (International Convention on the Standards of Training, Certification and Watchkeeping for Seafarers, 1978 as amended in 1995)
- SAR 79 (International Convention on Maritime Search and Rescue 1979)
- INMARSART 76 (Convention onthe International Maritime Satellite Organisation 1976)
- CLC Convention 69 (International Convention on Civil Liability for Oil Pollution Damage, Brussels 1969, as amended by Protocols 1979 and 1984)

- FUND Convention 77 (International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Brussels 1971 as amended by Protocols 1976 and 1984) (MMTC 97)

Among all the conventions ratified, only the STCW 78/95 Convention has been incorporated in the national legislation.

Table 12: Conventions ratified by Republic of Mozambique

Convention	Ratification	Incorporation in National Legislation
IMO 48	YES	NO
SOLAS 74	YES	NO
LL 68	YES	NO
Tonnage Convention 69	YES	NO
COLREG 78	YES	NO
STCW 78/95	YES	YES
SAR 79	YES	NO
INMARSAT	YES	NO
CLC Convention 69	YES	NO
FUND Convention 77	YES	NO

Amount the International conventions ratified , CLC 69 and FUND 76 basically deals with marine environment. However, these convention does not contains relevant measures for protection, but provides measures to be followed in case of marine pollution. If these conventions are incorporated in the national legislation it will benefit both Mozambique and the citizens. Because 'CLC 69 Convention contain three essential elements; strict liability, higher limits of liability and compulsory liability insurance. This convention applies exclusively to oil pollution damage, and the preventive measures so taken to minimise the damage caused on the territorial sea and in the Exclusive Economic zone of contracting state (Article II of the CLC). The convention also holds the owner of ships to be liable for any pollution damage caused

by oil which has escaped from the ship as result of an incident (article III of the CLC) in waters of a contracting State.

Value and record of paying compensation

CLC Governs the strict liability of shipowners for oil pollution damage and creates a system of compulsory liability insurance. This is stipulated under article III of the Convention ("... The owner of a ship at the time of an incident ... shall be liable for any damage caused by oil which has escaped or bee discharged.. .") The owner carrying more than 2,000 metric tons of persistent oil as cargo and bunker is therefore obliged to maintain insurance to cover its oil pollution damage liability, up to the limitation amount, which is underwritten by the shipowner's P&I club. Tankers are consequently require to carry a certificate on board, issued by the flag state attesting the insurer. The aforementioned three factors regarding the strict liability, higher limits of liability and compulsory liability insurance, coupled with the legitimacy of a direct action against the insurer greatly improves the position of the victims of oil pollution.

Limitation of liability

The owner of a tanker has strict liability for pollution damage caused by oil spilled from a tanker as a result of an incident. the owner has an exemption from liability under the following conditions:

When pollution is caused due to:

-an act of war or grave natural disaster;

-sabotage by a third party, or

-negligence on the part of public authorities in maintaining lights or other navigational aids.

Under certain condition, the owner can limit the liability to the following amounts:

- for a ship < 500 GT, 3 million SDR (approximately US $4.3 million)
- for a ship between 5000 and 140,000 GT, 3 million SDR + 420 SDR

-for a ship > 140,000 GT, 59.7 million SDR (approximately US$ 85.8 million).

The money payable by the shipowner, as indicated above, is distributed to the claimants in proportion to their respective proven claims. For these purposes, a claim by the shipowner for recovery of these expense of preventive measures ranks equally with other claims against this fund.

FUND Convention 77

The Fund Convention supplement the CLC. The main function of the Fund is to provide supplementary compensation to those who cannot obtain full compensation for oil pollution damage under the CLC, and only those States that have become party to the CLC can become members of the IOPC Fund. this compensation regime is by the cargo owners and has nothing to do with the shipowner.

The maximum compensation payable for a particular incident is 135 million SDR (approximately US$ 194 million). this sum includes the sum actually paid by the shipowner (or his insurer) under the applicable CLC.

The claim should be made within three years of the date on which the damage occurred. In some instances the damage might occur at a much later date. In such a case, claim must in any case be brought within six years of the date of the incident'. (Sampson 1998)

The review done in this chapter about implementation of international conventions, which deals with Maritime environment in Mozambique, the discussion conclude that Mozambique has to incorporate in its national legislation all conventions already ratified, and should ratify and incorporate in the national legislation all international conventions discussed in this chapter. The next chapter will be a discussion about Maputo-MARAD (maritime administration).

CHAPTER VI

MAPUTO MARAD AND PROPOSAL OF ACTION PLAN

The main aim of this chapter is to provide a background of Maputo-MARAD(maritime administration), details information about the activities and responsibilities of Maputo MARAD will be provided and in the last section of this chapter will be a proposal of action plan to deal with environmental issues in the bay.

The Maritime Administration in Mozambique is subordinate to the National Maritime Safety Authority (SAFMAR), which is under the Ministry of Transport and Communications. There is a MARAD office located at every Mozambican port to control maritime activities.

MARAD was created in 1975 to replace the Portuguese institution Capitania dos Portos de Mocambique, which was the in charge of Maritime activities. Before 1975 these offices, were headed by Portuguese military marine officers, but the Portuguese left the country in 1975, when Mozambique regained independence. With the objective of controlling marine activities, unskilled individuals were then used to manage this sector as the Portuguese had not trained the locals for management jobs.

The government of Mozambique trained personnel and in 1989 the Government through the Ministry of Transport and Communications, replaced the untrained Maritime Administrators with qualified merchant marine officers. These officers had been trained at the Mozambique Nautical School, and others at the Russian maritime academies. However, they did not result in good perform their duties enough due to the following reasons:

1. The legislation used to control marine pollution was still not up-to-date and therefore lacked adequate clauses to deal with marine environmental issues.

2. The port lacked the infrastructure, such as reception facilities for solid waste, treatment plants for liquid waste and support personnel to give assistance to the maritime administrators.

3 Most of them were old, untrained, and poorly paid due to the policies of the former colonial regime which had marginalized and excluded the natives from education opportunities and hence managerial and technical positions of employment which was their. From these styles inherited from the colonial bosses, the civil personnel still tend to be heavily bureaucratic.

6.1 ORGANISATION

The departments and duties of the Maputo-MARAD are as follows:

- The Marine Surveillance Departments have the following responsibilities

  Supervise piloting in the ports

  Supervise and co-ordinate pollution prevention and response at sea

  Supervise and co-ordinate surveillance in the bay and along the coast, according to its jurisdiction

- The Maritime Safety Department has the following responsibilities:

  Surveying non SOLAS vessels.

  Registration of non SOLAS vessels.

  Participation in casualty investigations.

  Registration and certification of ratings.

- The Finance and Administration Department has the following responsibilities

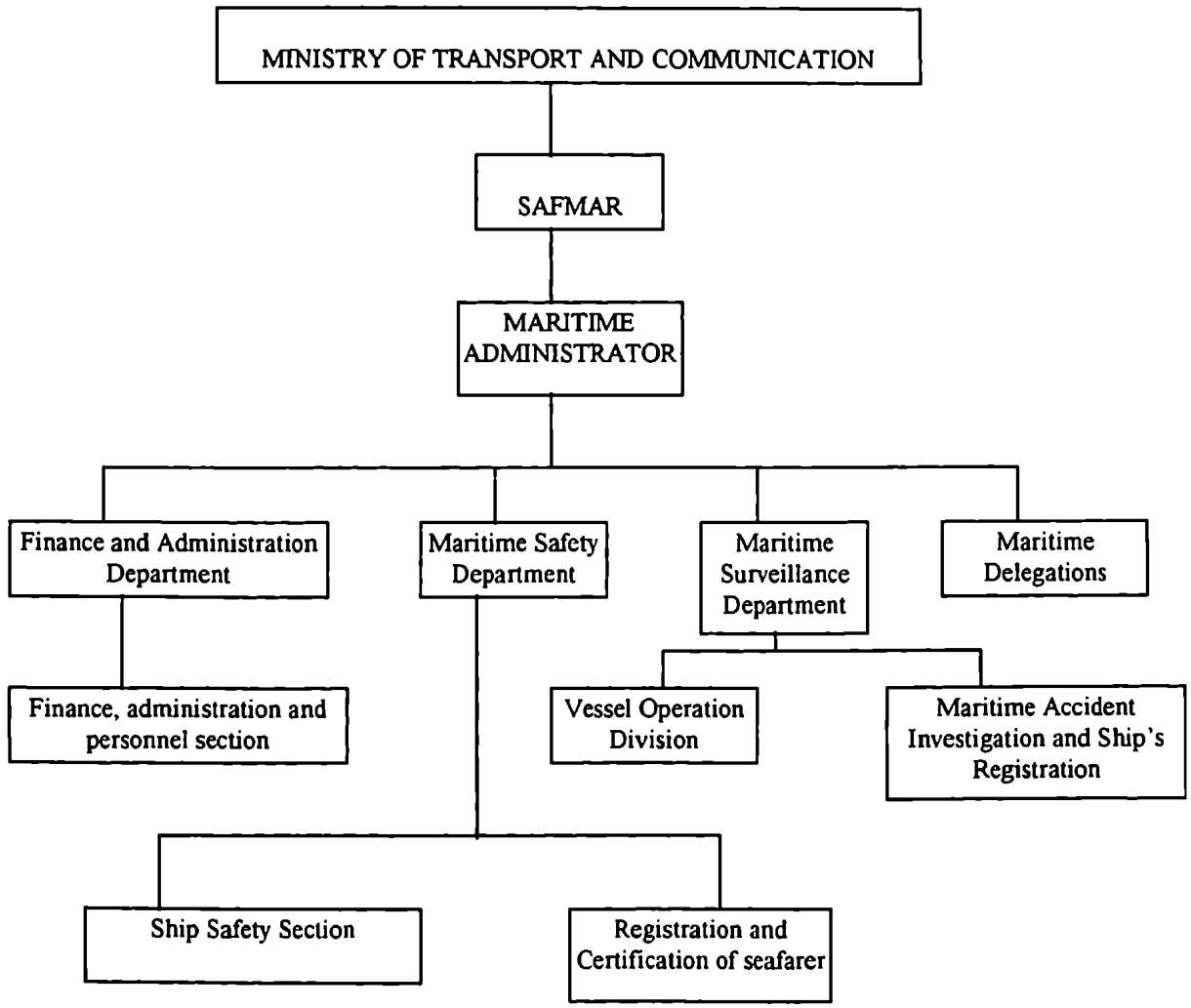
  Performing secretarial work

Development and managing budget and accounts for the entire administration

Performing administrative work, including handling salaries of all employees.

The registration and certification of SOLAS vessels and registration and certification of merchant marine officers, in Mozambique are the responsibility of SAFMAR (Maritime Safety Authority)

6.2 STRUCTURE OF MAPUTO MARITIME ADMINISTRATION



Source: MTC 92 Report concerning assistance to Mozambique in establishing a maritime safety Authority

The main duties of the maritime delegation is to control maritime activities in the regions (zones) where maritime administrations are not, but maritime activities takes place such as, fishing, recreational activities and passenger transportation by small wood boat.

6.3 MARITIME SURVEILLANCE DEPARTMENT

This is the sector of MARAD which is in charge of pollution issues caused by shipping activities in the bay. This sector actually faces great difficult in performing its duties because, the department is still run by the old guard, and as explained earlier, some of the personnel are advanced in age with low levels of education; hence lacking knowledge marine environmental issues. Another problem is the lack of boats for surveillance operations in the bay and lack of equipment for combating pollution in case of a maritime accident.

6.4 PROPOSAL FOR AN ACTION PLAN

The objective of this action plan is to foster opportunities for the government, industries, local communities and environmental groups, to work together in preventing and reducing the sources of marine pollution. The implementation of this action plan should lead to the improvement of water quality and natural resources of the bay, and this would guarantee the bay sustainable use:

- Recreational activities.
- Human consumption of fish, shellfish and other aquatic life
- Shipping activities

The action plan consists of the proposal of leadership, problem identification, vision statement, external involvement, strategic actions items and framework.

a) LEADERSHIP

The Maputo-MARAD, has to be a leader in order to co-ordinate the implementation of the action plan.

b) PROBLEM IDENTIFICATION

The main problems which have to be addressed under this action plan is pollution of the Bay caused by shipping activities and land-based sources of pollution which have already been discussed in detail in chapter 4. The following operations were seen to be the main sources of pollution at the bay:

- Dredging activities
- Docking services
- Ship operations
- Cargo operations
- Agriculture activities in the basin of the rivers which flow into the bay
- Industrial activities and urban zones.

c) VISION STATEMENT

- The Maputo-MARAD should serve the Maputo residents by providing leadership to protect, restore and sustain the environment of the Bay and coastline for present and future generations. This they would do by improving water quality and natural resources, reducing and preventing pollution in the bay, and working in partnership with all other appropriate entities to prevent, minimise and control the release of waste substances into the bay.
- The goal should be "Zero pollution"

d) EXTERNAL INVOLVEMENT AND PARTNERSHIPS

The leadership must promote pollution reduction, prevention and achieve the aim of the action plan through:

- Establishing partnerships and initiating teamwork with individuals, environmental organisations, industries, other ministries and neighbouring countries, especially the Republic of South Africa and the Kingdom of Swaziland.

- Providing more direct public involvement by consultation and through public meetings and workshops.

- Playing a positive role in resolving conflicts related to environmental issues

e) STRATEGIC ACTION ITEMS

1. Plan to control pollution caused by land based activities

- The government in its fiscal policy needs to prioritise a formation (creation) of companies for waste treatment, or needs encourage national and foreign investors to build companies of this nature.

- Industrial activities, hospitals and urban zones, have to revise their waste disposal methods practices with the aim to minimise and eventually eliminate harmful waste discharged into the Bay.

- The Mozambican Government has to approach the neighbouring countries, the Republic of South Africa and the Kingdom of Swaziland, with the objective of developing and implementing plans for reduction/control of pollution caused by agricultural activities by applying a the precautionary principle.

- The government has to enforce the Fertiliser Act which have already been established.
- The government has to apply and enforce polluter pays principle

- The Maputo Municipality Authority should stop the connection of housing, hospital, and industry septic tanks with the urban drainage system.

  The Maputo Authority needs to educate and inform the local community about environmental matters, using the existing means of communications: radio, television and newspapers. The school educational programmes should include environmental education.

- The local authorities needs has to develop programmes for informing and educating the basin farmers about the adverse impact of agrochemicals in the marine environment.

2 Plan to control pollution caused by shipping activities.

- The government should establish and enforce up-to-date maritime legislation which deals with environmental issues based on the discussed International Conventions in Chapter 5; these are MARPOL 73/78, LC 72 and OPRC-90.

- The government should ensure the provision of reception facilities for solid wastes along the harbour free of charge to vessels; the port authority needs improve solid waste collection services in port area.

- SAFMAR needs to develop a reform programme to restructure the Maputo-MARAD

- Maputo-MARAD, in co-ordination with the port authority, environmental groups, MICOA (Ministry of co-ordination of environment affairs) and the Municipalities should allocate disposal sites for dredged material. In the case of clean dredged material, these should be used for beach replacement, which has been damaged by erosion.

- When ships are alongside the harbour quays, they need to be powered by shore side electricity instead of using generator which use high sulphur content of diesel oil. In order to reduce air pollution in port area due to ship emissions (exhaust fumes)

- SAFMAR needs to co-ordinate the development of a contingency plan to deal with environmental matters in the bay.

- SAFMAR needs to create a permanent body to deal with the implementation of global conventions related to environmental issues.

- The Port Authority needs replace the diesel oil powered forklifts with electrical powered ones, or if this is impossible replace ensure environmental friendly diesel oil is used.

- The coal terminals, should to be improved by changing the present loading system with an enclosed, Siwertall, loading system.

6.4.1 FRAME WORK

To accomplish the proposed action plan, the following organisation should be put in place in Maputo MARAD.

a) LEADERSHIP

Maputo-MARAD's main duties will be to co-ordinate and control the implementation of this action plan.

b) EXECUTIVE BODY

The executive body for implementing the Action Plan. should contain representatives from the local industries, schools and universities, leaders of municipalities and legal representatives.

The representatives of the industries should ensure the revision of waste disposal from industrial activities. further, they should promote industrial development based on "clean and green growth"

Representatives of schools and universities, should ensure the implementation of environmental educational programmes. The universities on the other hand should participate in research programmes and scientific studies on the environmental issues facing the Bay .

Representatives of municipalities should carry out informal educational programmes about environmental issues for the citizens of Maputo

The legal representation should be composed of maritime experts and lawyers. The main duties should be to deal with legal matters related to implementing the action plan, ensuring legislative jurisdiction and authority.

The review done in this chapter shows the main problems which Maputo MARAD faces which are the lack of trained personnel and up-to-date legal instrument to handle environmental issues in the bay, and furthermore the lack of equipment to be use in case of environmental accident. The last chapter provides the summary and conclusion this dissertation.

CHAPTER VII

SUMMARY AND CONCLUSION

The main objective of this dissertation is to develop an action plan to address pollution issues caused by shipping and land-based activities in the Bay of Maputo.

During the development of this dissertation the focus was mainly on activities which are considered to be major sources of marine pollution in the bay. They are: as follows;

a) Agricultural practices in the basins of the rivers which flow into the bay.
Pollution caused by agricultural activities comes from fertilisers and pesticides used by farmers with farms in the basin which ends up in the Bay through transportation by river currents.

b) Industrial activities which take place nearby the rivers discharge directly untreated liquid waste water into rivers which then flow into the bay.

c) Urban areas. Major organic pollution originates from sewage and liquid waste which is discharged into the bay without prior treatment.

d) Shipping activities are among the major sources of pollution. Ships calling at Maputo Port cause pollution by

- discharging exhaust fumes into the atmosphere from engine rooms.
- introduce oil into the bay during bunkering operations.
- discharging oily bilge water and oil sludge from the engine room into the Bay.
- discharging garbage and galley waste into the Bay.
- the discharge of sewage into the Bay.

Dredging activities are another source of pollution due to the discharge of dredged material without giving any consideration to the ecology of the Bay.

The comparative study made between Maputo Port and the Port of Helsingborg, which concentrated on the marine environment impacts during port operations in both ports. The study demonstrated that Maputo Port has been polluting the port area due to carelessness during cargo operations and bunkering services. The use of non-environmental friendly fuel oil in ships which are alongside the quay is another source of pollution in the port area.

This study show, that the Maputo-MARAD, which is the entity in charge of environmental issues for the bay, faces the following problems:

- Lack of trained staff
- Lack of equipment to be used in case of environmental incidents
- Lack of up-to-date legal regulations to handle environmental issues.

Chapter seven of this dissertation contains a proposal for an action plan to address the environmental issues in the bay. It is recommended that the Mozambican Government implement this proposed action plan to reduce/prevent pollution in the Bay of Maputo.

BIBLIOGRAPHY

Archer, A B (1992) 'Land-based sources of pollution coastal and marine pollution in CARICOM countries'. *Industry and environment*, vol. 15, no. 1-2, pp 23-28.

Babcock International (1998a). *BMH: Siwertell Ships unloads/loaders.* Bjuv, Sweden: Consilium CMH Babcock.

Babcock International (1998b). *BMH Global Competence: local* Buxtechude Germany: Babcock Materials Handling Division GMBH

Babcock International (1998c). *Siwertell Ships Loaders.* Advertisement brochure Bjuv, Sweden: Babcok Materials Handling (BMH).

Bishop, P L (1983). *Marine pollution and its control.* (Mcgraw- Hill series in water resources and environmental engineering: New York: Mcgraw-Hill).

Borup, M B and Middlebrooks, E J (1987). *Pollution control in petrochemical industry.* Chelsea, Mich: Lewis Publishers.

Bostwick, H K (1985). *Neashore waste disposal.* New York: Wiley.

Bostwick, K H, Dana, R K and Kilho, P (1981). *Ocean dumping of industrial waste.* New York: Plenum Press.

Cairns, W J (1992). *North sea oil and the environment, development oil and gas resources, environmental impacts and responses.* London: New York, Elsevier Applied Science.

Campbell, P M, and Devling, R H (1997). The response of juvenile clinook salmon to coal exposure. *Aquatic toxicology*, vol. 38, no 1-3, pp 1-15

Castro, H M (1997). *Marine biology.* 2nd ed. Wasshigton, D.C.: WM. C. Brown Publishers.

Clark, R B (1989). *Marine pollution* 2nd ed. Oxford, New York: Clarendon Press.

Clingan, T A and Law of the sea Institute (1988). *The law of the sea. what lies ahead?*. Honolulu: Law of the sea Institute, William S. Richardson School.

Dicks, B (1989). *Ecological Impacts of the oil industry.* Chichester: Wiley

Direccao Nacional de Medicina Preventiva (1994). *inquerito sobre a poluicao da Baia de maputo.* Maputo: Ministério para Cordenacao de accao ambiental. (MICOA)

Geyer, R A (1980-1981). *Marine environmental pollution* Amsterdam: New York. Elsevier Scientific

Gray, N F (1992). *Biology of wastewater treatment.* Oxford: Oxford University, Press.

IMO (1991a). *OPRC-90 Convention.* London: IMO

IMO (1991b). *London Dumping Convention 1972.* London: IMO

IMO (1991c). *MARPOL 73,78.* London: IMO

Johnson, R (1976). *Marine pollution.* London, New York: Academic press.

Kenned, J, Linzi, P and Dennes, P (1992). an operator's approach to environmental management. *Offshore Safety protection of Life and the Environment, 20-21 May 1992, London.* London: Marine Management(Hoildings), pp 149-148.

Lundin, Gustaf and Olof L (1997). *Integrated coastal zone management in Mozambique*. Maputo: World Bank

MER (1998). Antifouling: *The effect of Tributylitin on the marine environment, MER,* August, pp 19-22.

MICOA (1894). *Environmental impact study of "Katina P" oil spill-terminal report.* Maputo. Ministério para Cordenacao de Accao Ambiental (MICOA).

MICOA (1993). *Second phase of the environmental impact of the katina p oil spill.* Maputo: MICOA

O'Sullivan, J (1998). *Chronic pollution*. Lecture notes. World Maritime University, Malmö Sweden.

OECD (1998). *The state of the environment.* Paris: The Organisation for Economic Co-operation and Development.

Pardo, F (1997). *pollution of the sea, origin and main pollutants.* Lecture notes: World Maritime University. Malmö, Sweden.

Port of Helsingborg (1994). *Bye-Laws for the Port of Helsingborg.* Helsingborg, Sweden: Port of Helsingborg.

Port of Helsingborg(1997). *The green port guide.* Helsingborg, Sweden: Cyclus Print.

Pritchard, S Z (1987). *Oil pollution control London.* Wolfeboro: N.H., Croom Helm.

Ryding, S O (1992). *Environmental management handbook.* Bocaraton, Fla: Lewis Publishers.

Sampson, T (1998). *Frame work guidelines to facilitate and co-ordinate marine emergency response activities with the ROPME region through MEMAC Report* World Maritime University, Malmö Sweden

Shaheen, E I (1992). *Technology of environmental pollution control.* 2nd ed. Tulsa, Okla: Pennwell Books.

Society of Naval Architects of Japan (1995). *Marienv'95: international conference on technologies for marine environment preservation, Tokyo, Japan 24-29 September 1995.* Tokyo, Japan: Society of Naval Architects of Japan.

Soule, D F and Wassh, D (1983). *Waste disposal in the oceans: minimising impact, maximising benefits.* Boulder, Colo: Westview Press.

Squires, D F (1983). *The ocean dumping quandary.* Albany: State University of New York Press.

Tippie, V K and Kester, D R (1982). *Impact of marine pollution on the society.* New York: Praeger.

Vesilind, P A (1990). *Environmental pollution and control.* 3rd ed. Boston: Butterworth-Heinemann.

Wardley, S J (1979). *The prevention of oil pollution.* London: Graham and Trotman

William, J C (1992). *North sea oil and development: Developing oil and gas resources, environmental impacts resources.* London: Elsevier Applied Science.