OIL WASTE MANAGEMENT AND MARINE POLLUTION

A CASE STUDY OF KILINDINI HARBOUR,

MOMBASA, KENYA.

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MAY, 2010.

DECLARATION

I **MWALIKO JOHN MBITHI** hereby declare that the work contained in this dissertation entitled, **"OIL WASTE MANAGEMENT AND MARINE POLLUTION: A CASE STUDY OF KILINDINI HARBOUR"**, with the exception of the acknowledged references, ideas and concerns is my original work and it has never been submitted for fulfillment of the requirement of a degree award or other education qualification in any institution of learning.

Signed..... **Date**.....17TH SEPTEMBER 2010.....

MWALIKO JOHN MBITHI

APPROVAL

This research report entitled, **"OIL WASTE MANAGEMENT AND MARINE POLLUTION" a CASE STUDY OF KILINDINI HARBOUR",** is submitted to Kampala International University, School of Engineering and Applied Sciences with my approval as the Supervisor.

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Date:.....20/09/2010

DEDICATIONS

I dedicate this project to my parents; Mr.Welton Rueben Mwaliko and Mrs. Serah Ngina Mwaliko, who have been my fountain of strength and pillars of my firm virtues, my brother Captain Moses Muthama for all the financial and logistical support, my best friend Charity Wanjiku Njiiri who gave me a helping hand in writing this dissertation.

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I would also like to send my heartfelt congratulations to my friends David Kulwa, Peter Luena, Hashim Hatibu and C.J Maganga for their emotional back up that saw the successful completion of this project.

MAY GOD REWARD YOU ABUNDANTLY

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ACRONYMS

GESAMP - Group of Experts on the Scientific Aspects of Marine Environmental Protection.

IMO - International Maritime Organization.

UNEP - United Nation Environment Program.

KMFRI - Kenya Marine and Fisheries Research Institute

TEU's – Twenty foot container Equivalent Units.

NOSRC - National Oil Spill Response Committee

ABSTRACT

The study established the Problems of Marine Oil waste Management Processes at Kilindini Harbour at Mombasa Kenya guided by three objectives namely, to identify the procedures involved in the management of oil waste to final disposal, to identify the challenges in the managing of marine oil waste and to make recommendations on how oil waste management can be improved

The study was conducted under the view that most of the problems of marine oil waste management at Kilindini Harbour arose from rapid unplanned urbanisation, institutional shortcomings of KPA had led to deteriorated state in marine oil waste management and that the problems of marine oil waste management emanated from operational huddles in implementation of policies.

The study was both descriptive and analytical in nature where it based on primary and secondary data to establish the magnitude of the study. Primary data based on quantitative and qualitative data designs. Qualitative data designs included; interviews and observation. Quantitative data were gathered through questionnaires. A total of 80 respondents were involved in this study. A purposive sampling was employed to select the respondents around Kilindini Harbour.
Technical planning problems were found to be a deep root in the problem having emanated from long ago as the port operations grew. Financial inadequacies were also found to be a major problem to institutional efforts of KPA in the management of marine oil waste. The oil waste collectors were found to have a very poor culture in regards to oil waste disposal.

The study recommended better planning for the port development, sensitisation of all relevant stakeholders to influence good culture on marine oil waste disposal. In addition easing control and regulation of structural development around the harbor needed to be in harmony with policy on marine oil waste management. The study also recommends inclusion of private sector involvement into the management of marine oil waste. On labour problems the city authorities were advised to get better or modern technology and retrain its staff in order to reduce on expense of having to hire many employees.

CHAPTER ONE

INTRODUCTION

1.1 Background

Marine ecosystems are biomes dominated by species of flora and fauna abundant as the highest proportion of species in these regions. Aquatic zones are natural and are Distinguished by flora and fauna defined by relative abundance of various species in respect to a habitat in a given region (Aboudha., 2004).

This concept refers to the form of the plants and animal, species that are present and dominant in a given area. The term flora, in contrast, considers an area's plant life as a collection of particular species. An ecosystem is a functional ecological unit in which biological, physical and chemical components of the environment interact. The term focuses its attention on the complex interplay between plants and animals with a biotic factor within their habitats.

Marine Ecosystem management is the science of directing human activities to sustain marine resources, the desired diversity and productivity of terrestrial and aquatic ecosystem in the area. The essence of Marine ecosystem management lies in its systematic approach in multi scale spatial and temporal views (Mc Clanahan et-al., 2006).

Biodiversity is the abbreviation of "biological diversity", term for variety or diversity within the biological world. In its widest sense, biodiversity is virtually synonymous with "Life on Earth". There is a great concern that human activities have resulted to reduction of Marine biodiversity. This is through effects of oil pollution and other activities such as navigation and shipping activities, agricultural practices, and recreational activities which contribute to loss of biodiversity (Muthinga et-al., 1998).

"Species" is classified as a measure of abundance in an ecological diversity, given area or region. Normally it's determined by numbers and population size.

Conservation refers to sustainable use of natural resources, such as, water, plants, animals, and minerals. In economic terms, the natural resources of any area constitute its basic capital, and wasteful use of such resources constitutes to economic loss. From aesthetic and moral point of

view, conservation includes maintenance, conservation and management of all significant biomes. In certain cases, conservation may imply protection of the natural environment from various human activities.

1.2 Importance of marine environment

Marine aquatic zones are important environmental units which act and protect the environment in various ways such as reducing the water velocity thus controlling soil erosion. The usefulness of Marine ecosystem is usually under estimated and ignored where many individuals have a negative perception. It is important for us to note the crucial role played by marine ecosystems.

The Kenyan coast consists of a diverse marine environment including estuaries coastal ecosystems, mangroves, sea grass beds and intertidal reef platforms and coral reefs, which are vital for the diversity and reproduction of marine organisms. These ecosystems systems are regarded as some of Kenya's most valuable and some are protected by the six marine national parks and reserves. These coastal ecosystems make up the basis for the livelihood of the large coastal population, but do on the other hand face serious threats from the ever increasing human population pressure through tourism, industrial pollution, overfishing, destructive fishing, mangrove logging and other unsustainable use of marine resources. (McClanahan et al., 2006).

Modern scientific insights are needed to ensure that present changes will favour implementation of sustainable marine ecosystem management strategies for the benefit of Kenya Ports Authority's Kilindini Harbour and the entire marine ecosystem. Majority of individuals and organisations depend on various marine resources originating from marine environments for their survival.

Marine environments are the most threatened ecosystems in Kenya. Many conservation initiatives have been carried out to protect this ecosystem at national levels. There is need for protect aquatic zones due to the abundant biodiversity and productive potential they posses, where ocean waters acts as vital transport agent that opens up the East and Central Africa through navigational and other shipping activities and has other distinctive values to the environment such as it supports the tourist and hotel industry which is Kenya's highest foreign exchange earner.

1.3 Research problem

Generated marine oil waste spilled from sea-based activities continues to be the major marine pollutant in coastal and offshore waters. This is despite many successful regulatory initiatives at international and national levels, and the considerable efforts that are being made by the oil and shipping industries to reduce the number of accidents, reuse, and recycle oil wastes aboard ships. This study presents updated estimates of inputs of oil, as defined under the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 1973/1978) Convention that originates from shipping and other sea-based activities.

The oil waste management activities contradicts the International Maritime Organization (IMO) guidelines of oily wastes handling by privately owned oil waste management firms after the closure of the only port reception facility and as a result has detached themselves from the Kenya Ports Authority (KPA) organizations mission and vision.

1.4 Significance of the study

The purpose of the study examined the most effective oil waste management plan that best suited the dynamic business and marine environment for better results of the KPA organization.

The study also examined different situations that required alternative waste management approaches in dealing with the large quantities of volumes generated effectively.

1.5 General objective

The study aimed at assessing the oil waste management processes and the control of marine pollution generated by vessels in Kilindini Harbour, Kenya Ports Authority (KPA).

1.5.1 Specific objectives

i. To establish the procedures used in the management of oil waste to final disposal.

ii. Identify the challenges in the managing of marine oil waste.

1.6 Research questions

1. What are the major activities at the Kenya Ports Authority?
2. What are the major procedures involved in the management of marine oil waste?
3. What has to be done to reduce negative impacts of marine oil waste on the environment?

1.7 Limitations of the study

The study faced the following challenges;

1. The researcher was faced with the problem of uncooperative people. This is where the respondents did not want to give out the information and sometimes they turned to violence thinking that the researcher was spying on them.
2. The difficulty of getting to access the required respondents such as head of department and sections to give the required data limited the researcher in data collection.
3. Accessibility to certain areas of research such as libraries and archives.

1.8 Operational terms.

Fuel oil sludge - residual oil and other substance that collects at the bottom of ship bunker tanks.

Fuel oil - the heaviest grades of residual fuel used for marine and industrial purposes.

Operational discharge - a release of a material or chemical from a ship, whether legal or illegal. Legal operational discharges of oil from ships are regulated under the MARPOL Convention (Annex 1).

Reception facility - for oily residues and oily wastes, they are fixed installations and mobile or floating processing plants that exist at ports around the world to receive and treat oily waste and residues or slops from ships.

Sludge oil - as defined in MARPOL, is sludge from the fuel or lubricating oil separators, waste lubrication oil from main or auxiliary machinery, or oil waste from bilge water separators, oil filtering equipment or drip trays (IMO 2002).

Ship - "means a vessel of any type whatsoever operating in the marine environment and includes hydro-foil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms".

Sludge - Deposits, generally from the purification of fuel and lubrication oils, consisting of mixtures including oil, paraffin wax, sediments and other tank residues. Oil sludge is heavy oily material that collects at the bottom of oil tanks (fuel or cargo) on a ship.

CHAPTER TWO

LITRATURE REVIEW

2.1 Introduction

Throughout the world, pollution of the marine environment has been a problem that has led to the degradation of the marine environments and this has consequently led to the decline of the marine biodiversity in many countries. Effects of marine pollution on the environment have resulted to alteration of resources between different regions of the world that was once rich and abundant in biodiversity and has changed to such a pathetic state. Therefore the formulation of the oil waste management plan principally with the aim of the legislation is to "reduce the discharges of ship generated oil wasteand oily residues into the sea, thereby enhancing the protection of the Marine environment." reflecting the aims of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the protocol of 1978 relating there to International Convention for the Prevention of Pollution from Ships (Lethbridge., 1991).

Pollution of marine environment by petroleum products arises from tanker accidents, deballasting operations, tank washing, offshore production, and coastal refineries, municipal and industrial wastes. The latest estimate of oil and its products that finally reaches the marine environment by United Nations Environment Programme (UNEP 1992) indicates about 2.33 million tonnes per year. Almost 50 percent of this is contributed by land based activities. The oil production in the world over is 3452 million tonnes, out of which 2026 million tonnes are transported to different parts of the world. The biggest share is transported through marine environment, of which this 45 percent of the transporting vessels originating from Middle East countries and passes through Arabian Sea, Bay of Bengal and Indian Ocean. From this we may be able to assume the vulnerability of our seas and coastal environment to oil pollution (UNEP, 1992).

Operational discharges of oil into the marine environment by ships depend on several factors. These include: type and age of ship; level of maintenance of ship and engines; presence of oil-water separators and other equipment designed to curtail discharges of oil; practice of the LOT (load-on-top)principle; training and vigilance of the crew; level of shipping activity, which was lower in the 1990s than in previous decades13; and presence of adequate reception facilities.

Under the MARPOL Convention Annex 1, discharges of oil are strictly regulated. As from 1997, the maximum legal operational discharge of oil was reduced from100 parts of oil per million parts of water (i.e. ppm) to15 ppm per nautical mile (nm), beyond 50 nm off a coastline. Sludge and bilge oils are collected in the engine room sludge tanks and are taken to be the same source of oil for the estimations in this section. Due to the high cost of lubricating oil and the increasing refinement of marine engines, the numbers used in the 1990 report are overestimates based on today's practices (Carlin 2002). For an estimate of the bilge oil fraction, it has been assumed by Intertanko experts that this would be1% of the total amount contained in the sludge tanks. It is further noted under MARPOLAnnex VI, most of the fuel oil sludge produced goes to the ship's incinerator, and any remaining fuel oil sludge would be stored separately and discharged to port reception facilities.

2.2 Overview of marine ecosystem

The coastal marine environment is considered to be one of the most dynamic and biologically productive environments on the earth. In Kenya, it varies in nature from loose muddy to consolidated rocky cliffs. Therefore, the implementation of appropriate action for coastal or marine pollution management especially oil spills requires a combination of environmental, logistical and operational knowledge. Through this compilation the researcher has tried to bring out a comprehensive document on pollution of the marine environment by oils (McClanahan and Obura., 1997).

The Kenya coast is bathed by the northward-flowing warm waters of the East Africa Coastal Current, located between latitudes 1° and 5° S. With a narrow continental shelf, the coastal marine environments are dominated by coral reefs, sea grass beds and mangroves, with large expanses of sandy substrates where river inputs from Kenya's two largest rivers, the Tana and Athi Rivers, prevent the growth of coral reefs. The northern part of the coast is seasonally influenced by upwelling waters of the Somali Current, resulting in lower water temperatures for part of the year. The coast is made up of raised Pleistocene reefs on coastal plains and hills of sedimentary origin, which support native habitats, dominated by scrub bush and remnant pockets of the forests that used to cover East Africa and the Congo basin. The marine environment is characterized by warm tropical conditions varying at the surface between 25°C and 31°C throughout the year, stable salinity regimes, and moderately high nutrient levels from terrestrial

runoffs and groundwater. The semi-diurnal tidal regime varies from 1.5 to 4 m amplitude from neap to spring tides, creating extensive intertidal platform and rocky-shore communities exposed twice-daily during low tides. Fringing reef crests dominate the whole southern coast and parts of the northern coast towards Somalia, forming a natural barrier to the wave energy from the ocean.

Coral reefs form the dominant ecosystem along the majority of the Kenya coast, creating habitats for sea grasses and mangroves in the lagoons and creeks protected by the reef crests. Kenya's marine environment faces a number of threats from the growing coastal human population estimated at just fewer than three million in 2000. Extraction of fish and other resources from the narrow continental shelf, coral reef and mangrove ecosystems increases each year with inadequate monitoring and management structures to protect the resource bases. Coastal development in urban and tourist centres proceeds with little regard for environmental and social impacts. With a faltering economy, industrial development in Mombasa proceeds with few checks on pollution and other impacts. In 1998 Kenya's coral reefs suffered 50–80% mortality from the El Niño-related coral bleaching event that affected the entire Indian Ocean. The institutional, human resource and legal infrastructure for managing the coastal environment has in the past been low, however these are rapidly improving with the revitalization of national institutions and the passing in 1999 of an Environmental Management Coordination Act (EMCA). Marine Protected Areas (MPA) is the key tool currently used in management of marine ecosystems, and focus principally on coral reefs and biodiversity protection. New initiatives are underway to improve application of fisheries regulations, and to use Integrated Coastal Zone Management (ICZM) as a framework for protecting marine and coastal environments (NEMA., 2009).

Over 88% of Marine Protected Areas are less than 100 km with a median size of 5km^2. Only 4% of coral reefs occur in areas managed under the strictest International Union for the Conservation of Nature (IUCN) categories.41% are under management categories which allow for sustainable use and often permit activities which are destructive. Tropical shallow water habitats cover 6,037,100 km2 of the sea floor and support the livelihoods of one billion people world wide. Coral reefs alone support 25% of marine biological diversity and provide about US$30 billion in net benefits world wide.

At the World Summit for Sustainable Development, Kenyan government made a commitment to increasing the protection of the marine environment to halt the loss of marine biodiversity, especially in coral reefs and associated tropical shallow water habitats less than 20m deep, such as sea grasses and algal beds. In order to sustain marine biodiversity, research suggests 10-40% of the marine environment should be set aside as protected areas.

Almost 50% of the world's coral reefs are in the Indian ocean and South East Asia, but less than 15% of these are officially protected. 13% of the worlds coral reefs are found in the Great Barrier Reef Marine Park, Australia, which represents 72% of all protected coral reefs (Muthiga et-al., 1998)

2.3 Impacts of oil pollution on marine environment

The environmental impacts of spilt oil can be severe. The damage caused by a spill depends on location, volume type of oil spilt, weather conditions, season, and many other factors. Large spills cause widespread immediate impacts, and potential long-term damage to parts of affected ecosystems. However, chronic discharges such as from street runoff and improper oil disposal are also damaging. Cumulative chronic discharges far exceed major spills in volume. Cleanup operations remove some, but not all, oil from the environment; the oil that remains naturally degrades over time.

2.4 Effects of Oil on Coastal Habitats

Coastal areas are particularly susceptible to oil pollution. When a large spill drifts ashore, some of the oil may become trapped and remain for years. This is in contrast to the open sea where currents and diffusion rapidly reduce the concentration of oil. While shoreline impacts are very situation-specific, immediate effects of heavy oiling may be evident by the death of plants and animals due to smothering and toxicity. In some situations, oil may persist for many years, causing less apparent but harmful chronic effects. In **rocky shore areas**, stranded oil may coat the rocks and gradually harden by weathering into a tough tarry "skin." This oil is gradually removed by wave erosion, but pools of oil that collect form a skin of weathered oil and may remain for a long time. On **cobble and sandy beaches**, oil can sink more deeply into the sediments and can remain longer than on bare rocks. Tidal pumping and sediment grain size effect the rate of penetration. In muddy sediments, penetration is minimal. **Tidal flats** are broad

low-tide zones, usually containing rich plant, animal and bird communities. Oil may seep into the muddy bottoms and have long term impacts. **Salt Marshes** have a wide variety of plant and animal species. Oiling of such systems may reduce the population and growth rate of the marsh plants and dependent species (Obura., 2001).

The two principal causes of harm to wildlife are toxicity and coating. Oil is most toxic during the initial phases of a release, before the lighter components have dissipated. These more toxic portions are also usually more soluble in water putting fish and shellfish at risk. **Birds**: Birds are usually the most visible victims of an oil spill. Birds have a high likelihood of exposure, as they float on the water's surface with the oil. Oiled bird feathers no longer repel water, so oiled birds lose body heat rapidly, and may drown UNEP, 1998). Birds will also ingest any oil that adheres to their body through the activity of preening. This, combined with rapid loss of body heat due to loss of insulation may induce starvation. Oiled wildlife rehabilitation is possible, but survival rates vary based on the oil, species, time, and location. Usually only a fraction of oiled birds are captured for treatment. **Marine animals:** The most common marine mammals at risk in oil spills in Kenyan waters are dolphins, sharks turtles, whales and several other endangered or threatened species (UNEP, 1998). Effects include suffocation or respiratory damage by oil, loss of insulation, and poisoning. Most vulnerable are animals that have fur for insulation such as sea otters. **Fish:** Fish may be more resistant than other marine organisms to oil because their surfaces, including gills, are coated with oil repellent mucus, although larval fish, which may concentrate at the surface (with the oil), may be more vulnerable. Fish can be affected through the gills, by ingestion, or by eating oiled prey. **Shellfish:** A good deal of study has been done on the effects of oil on shellfish, both bottom dwelling (lobsters, crabs, etc.) and intertidal (clams, oysters, etc.) Species living in bays, estuaries and other shallow environments are at particular risk because oil coming ashore may become concentrated. In addition to the toxic effects, heavy oils can literally smother and immobilize some invertebrate species. Sub-lethal effects are also seen, including changes in growth, metabolism, reproduction and behaviors.

2.5 Effects of marine activities on Kilindini Harbour marine environment.

The various activities within and around the harbour water have various impacts which are socio-economic and ecological. These impacts are mild in some areas while adverse to some regions Vessels interact in many ways with the environment. They accidentally and intentionally release substances into the environment. When tanker vessel accidents spill large quantities of oil, they receive the attention of the world's media, politicians, and the general public. The damage to plants, fisheries, birds, and mammals can be considerable has increased steadily from 6,672,000 metric tonnes in 1988 to 8,127,000 metric tonnes in 1994

Ninety per cent of oil and refined products are transported by the sea. Accidents resulting in massive oil spills, with their images of soiled beaches and dying birds are newsworthy, accessible to the mass media, affect public opinion and mobilise policy-makers. However, such dramatic accidents occur only infrequently and represent only a small fraction of the pollution problem at sea. Routine tanker operations lead to the release of noxious ballast water and tank washing residues. Furthermore, fuel oil sludge, engine room wastes and foul bilge water, produced by all types of ships, also end up in the sea. The impact depends on the type of oil, amount spilled, weather conditions and dynamics of the area or the ecosystem. When crude oil reaches water, 16% is diluted, 22% is biodegraded into simpler substances by either sunlight or bacteria, and the remaining amount has negative impacts on the environment. The less dense components (~15%) eventually evaporate into the atmosphere. This petroleum then reacts to form greenhouse and acid gases similar to those from the combustion of oil. The heavier portions of crude oil coagulate into tar patties, a sticky oil and water mixture, and may either wash up on shore or sink to the bottom. The 28% that sinks to the bottom of the sea mixes with sediments, and can turn into a thick tar-like mass that destroys the habitat of many bottom-dwelling organisms and valuable spawning sites for fauna. Especially vulnerable are slow-moving shellfish such as clams, oysters and mussels.

These creatures can't escape from an oil slick. The tar-like clumps can also drift with tides and currents and pile up in high seas (~3%), or wash up on shores (~15%). If a spill occurs near a coastline, beached oil can leak into fresh groundwater reservoirs that often extend under beaches, contaminating local wells.

In many spills involving tankers some of the oil spilled initially catches fire, resulting in atmospheric emissions of gases that contribute to global warming and acid rain, as well as large quantities of toxic ash. The fate of sludge is more complex to determine, since synthetic oil has a longer life span in the natural environment, accumulates in the food chain and contains toxics such as dioxins and heavy metals that have dramatic effects on wildlife. Oil can harm the marine environment in three different ways: by poisoning after ingestion, by direct contact and by destroying habitats. Its impacts are deadlier on coasts than in open ocean, as more living organisms are affected. Marine mammals and birds can ingest a great deal of oil while attempting to clean them. Carnivorous animals and birds which eat the carcasses of other oiled creatures also end up ingesting potentially toxic amounts. Birds and marine mammals can also be killed by direct exposure to oil. It can cover a bird's feathers, making it impossible for it to fly, and so heavy it may simply sink rather than float. Oil also eliminates the ability of a bird's feathers and mammals' fur to keep them warm, leading to death by hypothermia.

Fish ingest large amounts of oil through their gills. If this does not kill them directly, it can inhibit their ability to reproduce, cause deterioration in their DNA and result in offspring which are deformed. Fish and shellfish metabolism often degrades oil components into other substances even more toxic for them are deformed. Fish and shellfish metabolisms often degrade oil components into other substances even more toxic for them.

2.5.1 Air Pollution

Although commercial vessels account for only two percent of the world's consumption of fossil fuels, they are a significant source of ocean air pollution. Vessel engines are the dirtiest combustion sources per ton of fuel consumed, producing 14 percent of the world's nitrogen emissions from fossil fuels and 16 percent of all sulfur emissions from petroleum (Spice, 1999). Gases from vessel power plants account for 60 percent of the sulfur dioxide found in the air over harbour areas (with busy shipping lanes) of the Kilindini Harbour (Capaldo et al., 1999).

Commercial vessels are also a significant source (5 to 30 percent) of sulfur dioxide pollution in coastal areas; 70 percent of ocean-going vessel emissions occur within 400 km of land (Capaldo et al., 1999).

2.5.2 Anti-Fouling Pollution (Tributyltin) TBT

Fouling is the unwanted growth of biological material, e.g., barnacles, algae or molluscs, on the water-immersed surface of a vessel. When vessel hulls are clean and smooth, i.e., free of fouling, they travel faster through water and consume less fuel. Fouling can be removed when a vessel is dry-docked, which occurs every two to five years.

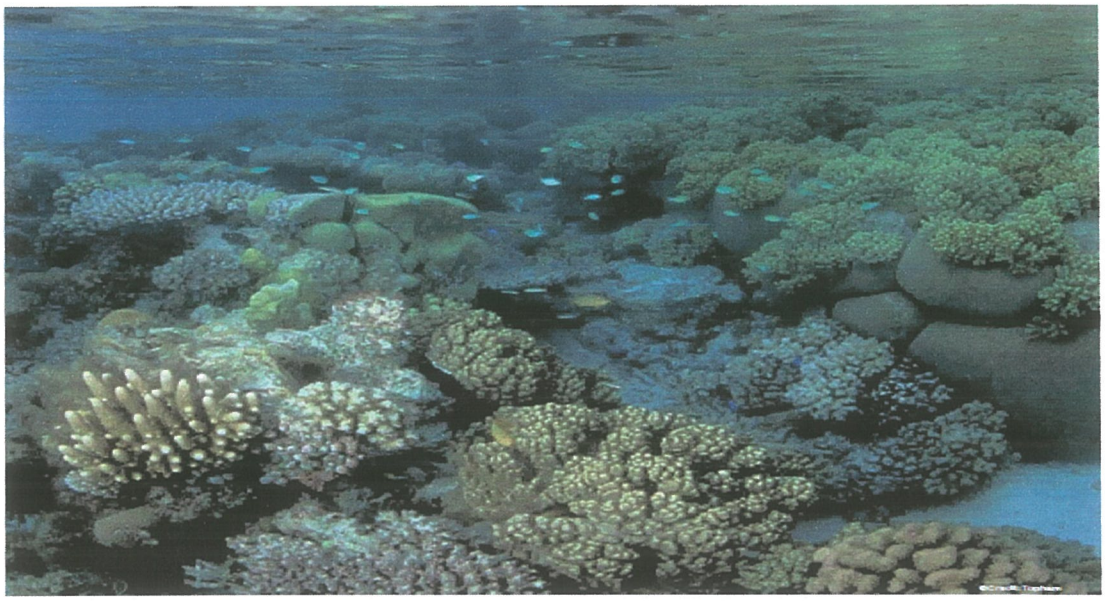

Plate 1: Marine coral life at the Kilindini Harbour shipping Channel

While anti-fouling TBT paints have been found to be effective in killing sea life attached to vessel hulls, they have also killed and caused genetic alterations in other sea life, e.g., shell deformations in oysters. In the 1970s TBT contamination was linked to the high mortality of oyster larvae. TBT is the most toxic substance ever deliberately introduced into the marine environment. Further, it persists in the marine environment. High concentrations of TBT have been found in the worlds coastal waters, especially in ports and harbors where boats and vessels are concentrated. As a consequence, a number of countries have introduced regulations to limit the use of TBT in anti-fouling paints. France, for example, prohibits the use of TBT anti-fouling paints on vessels less than 25 meters in length. In 1990 the IMO, Marine Environment Protection Committee (MEPC) adopted the resolution Measures to Control Potential Adverse Impacts Associated with Use of Tributyltin Compounds in Anti- Fouling Paints which recommends the elimination of TBT anti-fouling paint on non- aluminum hulled vessels of less than 25 meters in length.

2.5.3 Dredging

Dredging is the process of increasing the water depths of waterways by removing sediments from their ocean bottoms. The Kenya Ports Authority has been carrying out regular dredging activities along the Kilindini Harbour for deepening the navigation channel for smooth and safer shipping activities along the harbour waters. Currently the shipping channel is being dredged to a depth of 15 meters. The environmental effects of dredging include: turbidity, ecosystem, and spoil disposal effects.

When waterways are dredged, elevated suspended solids (or turbidity plume) emanate. The distance the plume moves from the point of origin is dependent upon waterway currents, the nature of the plume, the scope of dredging, and the preventive measures employed by the dredging contractor. Excessive turbidity can affect fish species by abrading sensitive epithelial tissues, clogging gills, and reducing light penetration. Light reduction further reduces the photosynthesis of phytoplankton, kills submerged vegetation, and reduces water oxygen. Also, sediments raised by dredging can bury plants away from the dredged site, thereby reducing their density. The reduction in plant density, in turn, can erode bottom sediments and increase silt.

Dredging not only removes plants, but also changes the physical, biological, and chemical structure of the ecosystem. The removal of bottom sediments frequently kills benthic organisms and disrupts their feeding habitat. The noise, turbulence, and obstructions from dredging operations themselves also disrupt organisms and their habitat. In some cases, it may take years for the re-colonization of organisms to occur.

Suspended sediments dredged from waterways are generally biologically and chemically active. Dredged spoils from harbor and port waterways that are in proximity to industrial and urban centers are often contaminated with pollutants such as heavy metals, organochlorine compounds, polyaromatic hydrocarbons, and petroleum hydrocarbons. Disposal sites for dredged spoils often have high levels of sediment buildup and oxygen depletion which create adverse conditions for biotic communities.

2.5.4 Ballast water disposal

A common and necessary practice to insure vessel stability is for vessels to take on and discharge ballast water. While in port, ballast water may be pumped into vessel cargo, or specially designed, tanks to compensate for variance in weight distributions as cargo is removed. When cargo is loaded, the ballast water is released in amounts according to the design of the vessel and the profile of how the vessel is loaded. A large containership, for example, may carry 15,000 tons of ballast water.

When vessels take on ballast water, aquatic life indigenous to that region is often found in the water. When the water is discharged in another region, the discharged aquatic life may then thrive and disrupt the local ecological system. When there are no natural predators, the non-indigenous aquatic life will alter or destroy the natural marine ecosystem. For example, the comb jelly, which was transported in ballast water from the U.S. to the Black and Azov Seas, almost wiped out the local anchovy fisheries. In 1999 the invasive specie, the green crab, was found in the U.S. waters of Washington State. Human health can also be at risk. The Asian strain of cholera bacterium was likely introduced into Latin American waters through the discharge of ballast water. Invasive species can also cause property damage. The zebra mussel, for example, introduced into the Great Lakes in the mid-1980s by vessels arriving from Europe, has caused $5 billion in damage to water pipes, boat hulls, and other surfaces in the Great Lakes (Loy, 1999).

2.6 Laws and policies on marine conservation and management in Kenya

Oil was the first of the recognized "marine pollutants" to be controlled and regulated. This started with the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, and many other specific international conventions, including The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto Marpol Convention (Carlin., 2002).

International legislation has also been improved following the Torrey Canyon spill of 1967 in U.K, and in the United States following the Exxon Valdez spill of 1989. As a result of cooperation between governments, industry and intergovernmental organizations, many positive changes have taken place in the oil and shipping industries to reduce oil inputs from routine operations, and to recover oil from small spills and large accidents.

Environmental policies formulated by the ministry of environment and natural resources which aims at creating good conditions of the marine environments, good fishing activities and mining activities thus improving the quality of life. All these are addressed in order to prevent degradation of marine environment in the coastal areas. The strategies include controlled fishing activities to minimise over fishing, navigational activities and other economic and social activities being undertaken in and outside marine environment.

NEMA 1999 under the state of environmental report states that, marine environments are meant to maintain good conditions of the biological diversity and good water quality; all these are addressed in order to prevent degradation of marine environment. The Environmental Management Coordination Act 1999, (EMCA) which was established through an act of parliament stipulates clear guidelines on the handling and reception of waste on the marine environment.

Ocean dumping and oil pollution are the major cause of concern to the environment. Uncontrolled maritime activities result to high pollution levels. It is also these high pollution levels that make marine waters vulnerable. Environmental laws calls for controlled levels of pollution through minimizing intended activities that cause pollution. Such laws and policies are not clearly elaborated within the bylaws of Mombasa Municipal council. Furthermore, majority of individuals within the district are not aware of existence of such bylaws. This is one of the reasons for slow management of marine environments within this region.

CHAPTER THREE
MATERIALS AND METHODS

3.1 Introduction

This chapter highlighted how data was collected and analysed for the purpose of the study. It mainly focused on general design of the study in relation to research design, it measured quantitatively. Sample size, tools of data collection, data analysis and limitations faced in the course of this study.

3.2 Study Area

Mombasa District is one of the 71 districts of Kenya. Mombasa has a old history as a harbour city. In Coast Province there are seven districts, Mombasa District being one of them. It is situated in the southeast of Coast Province. It is the smallest in size covering an area of 295 km^2 including 65 km^2 of inshore waters. The district lies between latitudes 3°56' and 4°10' south of the equator and longitudes 39°34' and 39°46' east (Appendix F). The district and the town are divided into four divisions namely: Mombasa – 14.1 km^2, Changamwe –54.5 km^2, Likoni–51.3 km^2 and Kisauni-109.7 km^2.

Mombasa District lies within the coast lowland, which rises gradually from the sea level in the east to slightly over 76 m above sea level in the mainland west (Banne and Sassi, 1980) The highest point is at Nguu Tatu hills in the mainland north that rises up to 100 m above sea level Kilindini Harbour is a large, natural deep-water inlet extending inland from Mombasa, Kenya (Jewell, 1987). It serves as the harbour for Mombasa, with a hinterland extending to Uganda and Southern Sudan.

3.3 Research design

Cross sectional study base on qualitative together with quantitative and quantitative analysis was employed. Quantitative techniques were used to formulate to numerical data. Qualitative techniques were also used to collect opinions about the phenomena being investigated.

3.4 Target population

This study targeted a population consisting of oil waste generators, oil waste collectors and oil waste managers. This population was targeted because of their involvement and management of marine oil waste. They also bear relevant experience and expertise in the provision of the services which include anti-pollution activities, as well as occupational health and safety.

3.5 Sample and sampling technique

The study population of the three areas of oil waste reception and the handling in KPA is estimated to be 6000. Participants in the study were drawn from a sample of 100 respondents (n=100). Oil waste managers interviewed were 20 (n=20), oil waste generators were 20 (n=20) and oil waste collectors was 20 (n=20). In total the number of respondents was sixty (N=60).

The formula used to calculate the sample size is $n = N/(1+ (N*e^2))$. Where **n**=desired sample size, N= Total population and **e** = estimate or probability of the population size which is 0.05 (constant).

Table 1: Showing summary of respondents

Participants	**Estimated population** (e)	**sample size** (n)
oil waste managers	20	20
oil waste managers	60	20
oil waste managers	20	20
Total	**100**	**60**

3.5.1Sample of the oil waste managers

The sample must be a representative as possible of the population from which it is drawn. This study considered 20 oil waste managers working with at Pollution Control Section of the KPA.

Out of the 20 managers, a representative sample size of 20 was considered (n = 20). From this sample, 20 were interviewed (n = 20). (See **table 1**). Systematic random sampling procedure, which is considered to have less bias and of reasonable time convenience, was used to select oil waste managers.

3.5.2 Sample of the oil waste collectors

Systematic random sampling procedure was used to select two (2) private oil waste firms incensed by KPA and NEMA. Out of these two firms, 10 participants were drawn from each, making a total of twenty (2 X 10) making a total of twenty oil waste collectors (n = 20) **(see table 1).** This method was used since only these workers were deemed to have crucial information essential to answer the research objectives.

3.5.3 Sample of the oil waste generators

Systematic random sampling procedure was used to select two (2) vessels docking at Kilindini Harbour and discharged their generated marine oil wastes. Of these two vessels, 10 participants were drawn from each, giving a total of 20 (n = 20) **(see table 1).** This method was used since only these areas deemed to be running activities that generate much waste within the harbor environment, and they might be appropriate in answering the research questions for this study.

3.6 Data collection instruments

Data was collected by use of designed research interviews and focused group discussions (FGD'S). Also in quantitative data was collected by using designed research questionnaires to the respondents. Thirdly data was sought through documentary review from different libraries reviewing literature related to the study

3.6.1 Interviews

In this part structured and in-depth structured and unstructured interviews was held with the target population. Interviews were held with twenty (20) respondents from different sections and areas. The interviews were guided by an interview schedule/guide that consisted of open ended questions to make the study fast. These interview guides were developed to guide the interview in order to facilitate data collection and the results helped to improve quality of the final results for the purposive technique. The interviews sought data on; managerial procedures, technical aspects of marine conservation, and other factors that affected the marine ecosystem at the KPA.

3.6.2 Focus group discussions

In this session two groups with ten (10) respondents from the different areas from marine operations department, marine engineering section (dockyard) and other relevant stakeholders in oil waste management within the KPA were chosen in the research. The research study used focus group discussion guide to collect data from the knowledgeable respondents. This was guided and controlled the interview in order to facilitate data collection. The FGDs performed the following functions; they examined the data derived from other data collection methods, devised the appropriate data presentation techniques, assessed the relevance of the data included in the final study findings and advised the researcher on the proper ways of conclusion, recommendation of study findings and the general report writing procedure

3.6.3 Questionnaire

Here a set of well purposively selected questions that examined topics related to the study. Both open ended and close ended questions which were set and distributed to the twenty respondents. These were presumed manageable due to limited resources and time. Questionnaires were employed because of the following reason; the different views held by different respondents were known and integrated into the study. They gave what really happened in the field of study.

3.7 Data analysis

The quantitative data generated through the questionnaires was analysed and transcribed during and after data collection manually to generate mean, rations and percentage according to the theme and code categories. This was used to establish the magnitude of the study problem. Further, the quantitative and qualitative data was presented in a descriptive form that involved diagrams like charts, graphs and tables.

Qualitative data generated through the description of emerging issues were analysed carefully to make respondent's opinion and views represented during report writing. The researcher also reviewed the notes written during the discussion. The data from questionnaires was first inspected and edited in order to discover items misunderstood, detect gaps and discard off data that never generated enough information. The responses from the questionnaires were also be coded; the total, mean, ratios and percentages were also generated.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents data analysis and presentation of the findings on oil waste management at Kilindini Harbour in Mombasa, Kenya. The data from questionnaires was first inspected and edited in order to discover items misunderstood, detect gaps and discard off data that never generated enough information then, data was analysed manually to generate mean ratios and percentage according to the theme and code categories. This enabled the presentation of quantitative data in descriptive form that involved frequencies and percentages presented in charts, graphs and tables.

The chapter is organized along the major research question except1 for the section that deals with demographic information of the respondents. Other sections are organized as follows; activities at KPA and effects of activities at the KPA.

4.2 Background information

The study considered demographic characteristics of three groups; oil waste managers, oil waste collectors and oil waste generators of Kilindini Harbour. The background information of the respondents included gender, working experience and level of training.

Table 2 below shows that overwhelming majority of respondents (95%) were males, and only (5%) were females. They were of different job designations; managers oil waste collectors and oil waste generators. Half of them (50%) had a working experience of above ten (10) years, 10% percent of the respondents had a working experience of less than five (5) years, (40%) had worked for more than five years. Base on the level of training; 42% of the respondents had basic training, 35% percent had tertiary training and 23 % percent had specialized training, this included managers of different sections in KPA.

Table 2: Percentages of employees by gender, working, experience and levels of training

Gender	**Frequency**	**Percent**
Male	57	95
Female	3	5
Working experience		
Less than (5) years	6	10
More than (5) years	24	40
Above 10 years	30	50
Level of training		
Basic training	25	42
Tertiary training	21	35
Specialised/highly skilled	14	23

4.3 Activities taking place at Kilindini Harbour

The port of Mombasa is a government parastatal that has principally been given the mandate of providing efficient and cost-effective port services like receiving storing and even transport. (Table 3). Of the cargo that is to be exported or that has been imported for transshipment and transit cargo.

4.3.1 Cargo Handling Activities

Cargo handling at the port of Mombasa has been the on the increase annually. The port has already registered a clear growth in throughput signified by the tonnage increase from 15.96 to 16.42 million tons between 2008 and 2009. That is a total of 4,232,305 tons of cargo compared to 4,202,795 tons registered in 2008. (Figure 1)

Plate 2: Vessel offloading Cargo at the Kilindini Harbour

Table 3: A table showing Cargo handling statistics 2008 – 2009

CARGO TYPE	JAN-JUNE 2009	% SHARE	JAN-JUNE 2008	% SHARE	CHANGE VOLUME	%CHANGE
DOMESTIC	5,476	68.3	5,387	69.8	89	1.7
TRANSIT	2,276	28.4	2,135	27.7	141	6.6
TRANSHIPMENT	267	3.3	193	2.5	74	38.4
TOTAL (TEU's)	8,019	100	7,715	100	304	3.9

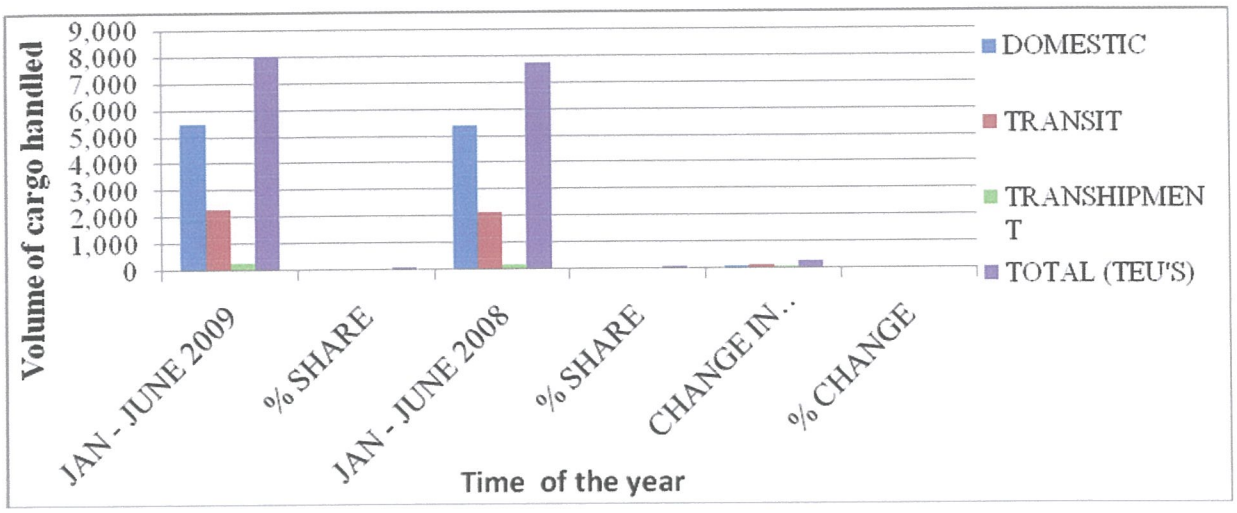

Figure 1: Total cargo movement at Kilindini Harbour

4.3.2 The volume of cargo handled.

The volume of cargo movement at the port has been significantly increasing annually. As per the graph, between 2008 and 2009 their was 304 metric tonne increase in volume. The domestic cargo had the largest share with a 68.3% of all the cargo handled, cargo that was on transit to neighbouring countries like Uganda, Rwanda, Burundi and Democratic Republic of Congo (DRC) was 28.4%. Cargo that was delivered on port to await transhipment to other sea port by vessels was at a minimum of 3.3%. These statistics reveal an overall increase in of volume of cargo delivered at the port.

4.4 Need for Port Waste Reception Facility as per IMO Regulation

The KPA has a Waste Management Plan (WMP) which has produced the following requirements set out by the International Convention for Marine Pollution of Ships, 1973 (previously referred to as MARPOL 73/78), concerning restrictions and control over ship generated waste.

The WMP of KPA addresses the following major aims:

- To reduce the harm inflicted upon the environment through illegal discharge of ship-generated oil wastes into the Indian Ocean.
- To provide an environmentally friendly management of ship-generated waste in the Kilindini Harbour.

- To provide a full-scale view of management of ship-generated wastes in the Kilindini Harbour, to assess the effectiveness, as well as the impacts on the environment.

- Increased oil waste collection from vessels docking at the Kilindini Harbour has led to the importance of establishment of a port waste reception facility especially during months of August, September, October and November since the Monsoon Season is over and this makes navigation better.

- The establishment of a port waste reception facility would help towards strengthening the economic status of the KPA and the country as a whole. The revenue generated would also in turn channel towards conservation and protection of marine environment.

The key task of the plan is to produce an economically expedient and market driven waste management model, which would successfully incorporate with the waste management policy.

In order to handle problems with oil waste which in growing amount pollute coastal waters and the open seas new established international institutions and legal mechanisms. In 1954, the first international convention for Prevention of Pollution of the sea by Oil (OILPOL 54) was adopted.

In 1973, OILPOL was superseded by the new Convention of MARPOL 73/74, the aim of which was to entirely prevent deliberate pollution of maritime environment with oil products and other hazardous substances. The Convention of MARPOL 73/74 and the protocol provided a general framework of principles from prevention of wastes, with six major annexes specifically describing the categories of ship- generated wastes and detailed requirements for waste management.

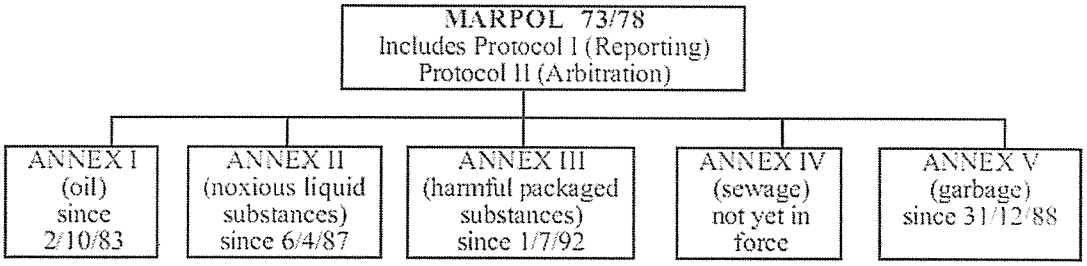

Figure 4.1 - Structure of MARPOL 73/78

Figure 2: Showing Annexes of Marpol Convention 73/79

4.4.1 Causes of oil spills

Most incidents are the result of a combination of actions and circumstances, all of which contribute in varying degrees to the final outcome. The following analysis explores the incidence of spills of different sizes in terms of the primary event or operation in progress at the time of the spill. These "causes" have been grouped into "Operations" and "Accidents". Spills for which the relevant information is not available or where the cause was not one of those given are listed under "Other/unknown".

It is apparent from the table that:

- Most spills from tankers result from routine operations such as loading, discharging and bunkering which normally occur in ports or at oil terminals.
- The majority of these operational spills are small, with some 91% involving quantities of less than 7 tonnes.
- Accidental causes such as collisions and groundings generally give rise to much larger spills, with at least 84% of incidents involving quantities in excess of 700 tonnes being attributed to such factors.

4.4.2 Potential shipping oil waste types

Table 4: Oil waste types for Kilindini Harbour

Waste Category	Waste Description	Reusable or Recyclable	Relevant MARPOL 73/78 Annex
Liquid	Oil waste	Yes	I
Liquid	fuel residues	Yes	I
Liquid	Oily mixtures containing chemicals	Possibly	I, II
Liquid	Tank wash water	Yes	I, II
Liquid	Sewage	No	IV
Liquid	Grey waters	No	IV
Liquid	Noxious liquids	No	II

4.5 Oil Waste Removal Statistics

The study reviewed the quantities of marine oil waste characteristics on monthly basis at KPA. These wastes were received from various vessels that docked at the port for on year. The wastes include bilge oils, fuel oil sludge and oily ballast from fuel tanks among others.

Table 5: Annual oil waste volumes for Kilindini Harbour

Month	Quantity(Metric Tonnes)
January	737.15
February	505.7
March	821.35
April	777.05
May	889.8
June	471.78
July	659.7
August	1000.3
September	969.26
October	943.01
November	1000.8
December	779.56
TOTAL	**9555.46**

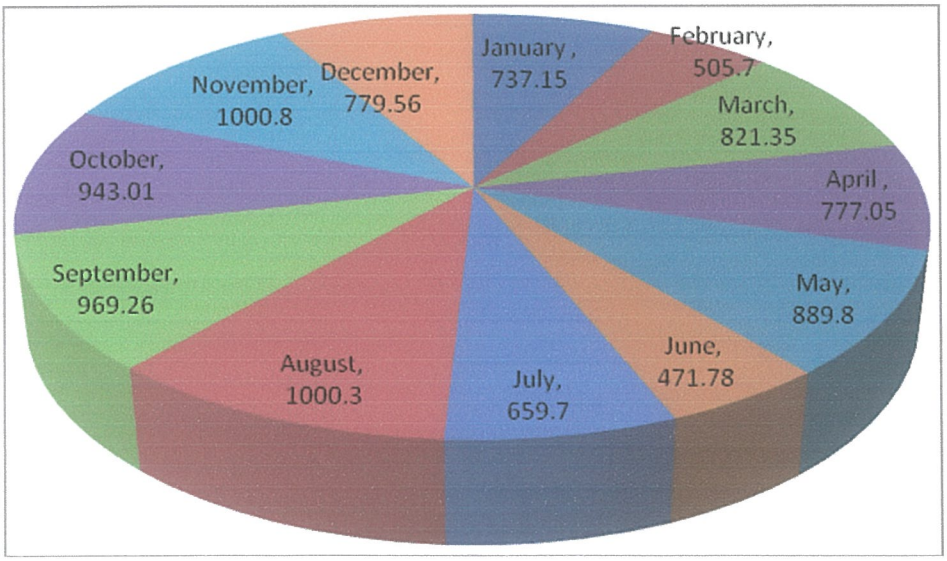

Figure 3: Oil waste removal volumes for Kilindini Harbour 2009.

4.5.1 Interpretation of findings on annual oil waste removal statistics characteristics

The research made a detailed study on oil waste removal statistic that comprises of a twelve month analysis. According to this statistics, the oil waste r emoved had an annual monthly average of about 796.2883 metric tonnes. The least quantity of oil waste to be handled was 4771.78 metric tonnes while the maximum was 1000.80 metric tonnes. The second half of the year (August – December) recorded above average oil waste removal from vessels. This was as a result of mordernisation activities currently undergoing at the port. Secondly the sharp increase in the oil waste handling from sea going vessels was attributed to the increased licensing of privately owned marine oil waste management firms. This provided a suitable data to analyze on the management of marine oil waste. This also meant that there was a substantial good record keeping both of electronic data and hard copy information that accessible at the KPA Pollution Control Section.

4.6 Challenges encountered waste oil management

Table 6: Showing challenges faced in oil waste management

Challenges	**Frequency (f)**	**Percent (%)**
Lack of waste reception facility	46	46
Corruption	32	32
Inadequacy of anti-pollution equipments	8	8
Financial and Administrational	14	14
Total	**100**	**100**

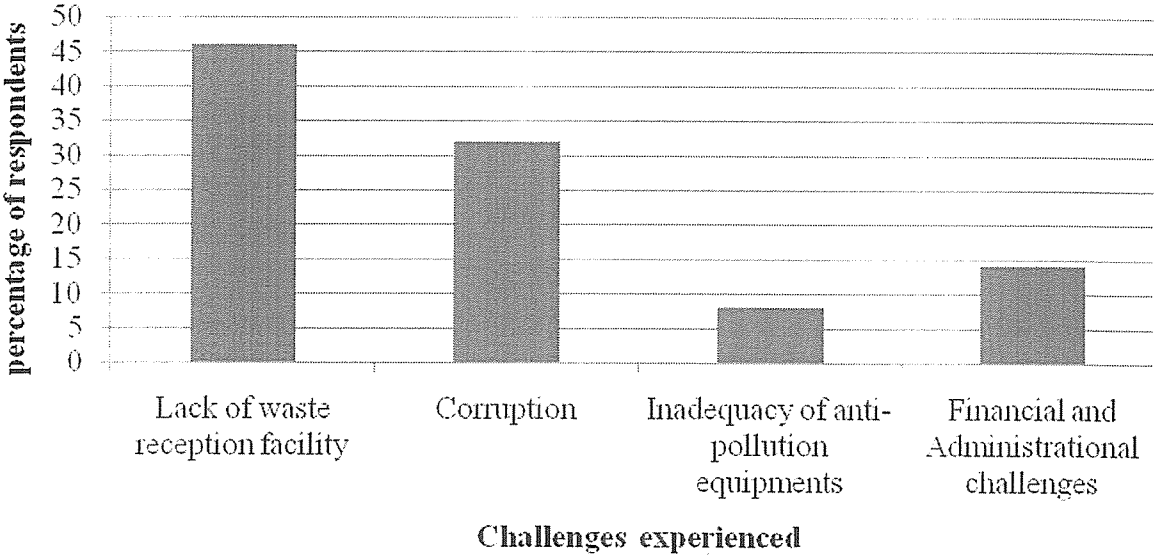

Figure 4: Challenges of oil waste management

Among the various challenges faced in the management of oil waste management was lack of a waste reception facility. 46% indicated that lack of a waste reception facility was hampering the management of the generated marine oil waste at the Kilindini Harbour and this was in contradiction to the IMO rules and regulations of port and harbours (Lethbridge., 1991).

Corruption was also endemic in the management of marine oil waste where 32% of the respondents attested to its existence. This was witnessed by the private waste oil collection firm officials whom complained of harassment by some KPA personnel especially in security section, Kenya Revenue Authority and NEMA officials before and after retrieval of waste of the oil waste from vessels.

Inadequacy of pollution control was a challenge that was being least experienced with 8% of the respondents saying more equipments that were effective and applicable on the Kenyan Indian Ocean waters. Still the pollution control section was lacking a credible anti-pollution vessel that was effective to work even in deep sea instead of reliance on tug boats (Simba III, and Nyangumi) for deep sea oil spill recovery processes was hectic since the same vessels have a busy shipping schedule.

Financial and Administrational challenges were also seen to hamper the marine oil waste management with 14% of the respondents having a first a hand experience. Waste oil managers principally directly affected since a lot of protocols had to be adhered to prior to deployment of pollution control equipments on oil spill sites.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter will dwell on the findings making conclusions and recommendations on whatever findings that were found by the research.

5.1.1 Summary

The study inquired into the problems of marine oil waste management case of Kilindini Harbour, basing on the specific objectives that included: identifying the procedures involved in oil waste management, to find out the impacts of pollutants to the marine environment and to identify the challenges faced in the management of marine oil waste at Kilindini Harbour and to make recommendations on how marine oil waste management can be improved. Chapter two contained literature review on basing on the specific objective to reveal prior authorities on, institutional problems like financial problems and operational huddles that affect the management of marine oil waste management at Kilindini Harbour.

The Kenya Ports Authority's Kilindini Harbour faces a number of challenges toward the collection and management of marine oil wastes. Currently the only oil waste management firm that was fully operational and licensed by both NEMA and IMO was shut down indefinitely due to unexplained circumstances. Currently oil waste management is undertaken by private oil waste firm that are licensed by NEMA and KPA

5.1.2 Financial and Administrational Challenges Facing the Marine Oil waste management at Kilindini Harbour.

The KPA comes across several huddles in its exercise of marine oil waste management at Kilindini Harbour. According to the findings the biggest problem is financing the collection and disposal of oil waste. Meaning that about 80% of the problems is money related.

Of the problems of administration, KPA claimed not to have so much problems in expertise and neither had problems in sustaining the right number of employees. On the problem of culture problems were found to be greater in making mariners abandon the poor culture of irresponsible disposal of generated marine oil waste. Financial problems to put in place against such habits by

the waste collectors also proved to be absent. Again proving that financial problems as a major setback.

5.1.3 Lack of waste reception facility

Independent waste disposal firms often operate without being part of the refining business. Although they are licensed by both NEMA and KPA, they operate contrary to the stipulated guidelines of the IMO (Lethbridge, 1991). They most often inflate cost to the ship and encourage ships to dump their waste in marine environments. In some cases refinery terminals have further profited from disposal of ships generated waste by significant charges for receipt of waste from the independent waste disposal businesses.

5.1.4 Corruption

The study revealed that some Independent waste disposal firms have complained of serious involvement of corrupt officials that hinder the proper management of marine oil wastes from vessels docking at the Kilindini Harbour. The private waste collection firms have claimed that officials from NEMA, Kenya Revenue Authority (KRA), and KPA among others openly demand for bribes to secure waste management handling from vessels. In addition, the oil waste collection firms have been forced to bribe the ship agents so that they can acquire boarding pass with is mandatory document that authorizes removal of oil wastes from vessels.

Corruption was also identified during the actual site of oil waste removal where the oil waste is pumped to oil waste tankers since occasional spills occur both on the ocean waters and on the adjacent land or both. Normally if a spill does occurs then a formal report has to be made to the harbour master or the chief pilot, the pollution control officer and NEMA officials so as to help in the conduction of anti- pollution activities and subsequent fines to be levied upon the polluter as per the "Polluter Pays Principle" of environmental management.

The study revealed out that the oil waste collectors occasionally do not have the required documentations as licenses, anti-pollution equipments, fire extinguishers, personal protection equipments and gadgets that enhance personal safety among others. This leads them vulnerable to accidents that may cause personal injury or spillage of oil waste to the marine environment, thus endangering their lives and those in the aquatic environment. This leads them to vulnerable positions that enhance bribe payment to NEMA, KPA and others relevant officials.

5.1.5 Inadequacy of anti-pollution equipments

Due to the negative impacts that oil has as a pollutant o the marine environment immediate action is always taken incase of an occurrence of a spill. The response team, being the pollution control personnel takes the required actions in handling the problems of Containment, Recovery, Dispersants and Storage.

Lack of booms that help in containing spilled oil waste is a problem. In a bid to avoid further pollution that results from wind and current action. Recovery of spilt oil in water is done by skimmers that have special disks that filter out oil from the sea water. Dispersants are chemicals that are used to disperse oil in water. They consist of two substances mainly a blend of surfactants consisting of emulsifiers and wetting agents and a solvent system, which acts as a carrier for the surfactants.

These chemicals are designed to emulsify the oil into the water column in the form of oil droplets small enough to remain under the surface and not reform as slick. This is possible by the characteristic of surfactant molecules forming a layer around every droplet of oil, making it impossible for the oil to coalesce once more. This process facilitates the mixing up of oil particles into the water, thus accelerating the process of biodegradation of the oil. Dispersants are applied using various types of spraying machines, ranging from single-man manually operated knapsack sprayers, to machine operated sprayers and spray booms. Dispersants however, have limitations of use since they can also cause considerable damage to the marine environment, especially on shallow areas. They are not applied where the depth of the water is less than 20 meters. This is the depth that covers near shore waters and offer great habitat for marine organisms as a result of the chemical implications of dispersants, their use in the cleaning process remains controversial. Lastly storage of the recovered oil from the water rather, the temporal storage of this oil in a bid to facilitate offshore transportation, or temporary storage of the oil before it is collected for disposal by the contracted companies. This is done in special tanks.

5.2 Conclusion

The study thus concluded that;

On technical planning problems, marine oil waste management at Kilindini Harbour efforts were greatly compromised by the absence of structural planning in some port areas of the harbour and failure by the authority to follow through with scrutiny upon privately owned wastes oil management firms should be enforced to make sure that marine oil waste management at Kilindini Harbour is planned for especially during establishment of port waste reception facility. Financial problem is one of the major problems in marine oil waste management at Kilindini Harbour.

The growth of the port berthing facilities was way to fast for the planning that was being carried out at Kilindini Harbour, in regards to structural development that improves cargo handling. This was the reason why the was a rise in cargo handling, this brought the problem of disposal and collection of the generated oil wastes since port reception facility was lacking and the available private oil waste collectors lacked tankers to provide the services at specific times.

The institutional challenges encountered by the city council were, first and fore most financial planning problems. The Kenya Ports Authority rarely allocates proper funding to the Pollution Control Section to purchase recent equipments to effectively combat marine pollution activities.

The Kenya Ports Authority also encountered labour problems i.e. skilled personnel. Pollution Control Section activities faces a shortage of qualified and trained personnel that was making the Pollution Control Section less effective, in addition proper maritime training, mechanical, environmental and other relevant courses should be initiated to the entire pollution control staff.

While in the field, the management of marine oil waste was being dragged behind by operational problem encountered and the most common were the culture of the private waste disposal firms and oil waste generators in oil waste management.

5.3 Recommendations

The research therefore suggests that the KPA management should lay aside personal interests, politics and get rid of improper and corrupt oil waste collectors, before its too late and replace them with better trained private firm who have the required facilities and resources to ensure proper collection and disposal with causing any significant negative impacts on the marine and the surrounding environments.

The Kilindini Harbour should also be zoned to ensure proper development of waterfront structure and facilities that would promote efficient service delivery to the clients. A port waste reception facility should be established as per the regulations of IMO and as stipulated in the MARPOL 73/78 Convention.

In order to cater for the shortage of funds in the management of marine oil waste in the Kilindini Harbour, the KPA should entice more private investments into the industry and concentrate on making the infrastructure of the industry smoother and more profitable for the players. This will leave the private oil waste firms at lesser expenses on the actual collection and disposal of marine oil waste.

The KPA needs to invest in better technology that is cheaper in the long run. Rather than use of booms and old knapsack sprayers that need huge numbers of labour to work. This would reduce the expenses by a great percentage. Through the purchase of a multi purpose sprayers that work on sea and land. The need for a fully equipped and efficient control vessel that is multi purpose in nature is needed to perform regular patrols along the Indian oceans coastline of Kenya territorial waters which is 20 nautical mile from the nearest sea shore.

The KPA should make an upgraded of its employees to make them competent in handling modern tools and equipment of oil waste management and subsequent recovery then invest in machinery that reduces on human capital and maximises on output. This will ease the stress of having to find experts who will seek more in pay unlike the retrained old work force and still solve the problems of labour shortages and incompetence's.

There should be mass sensitisation on the subject of marine oil waste management to make and motivate involvement of the people and to reduce on illegal dumping around the marine environment. This will make the cleaners work less tedious and also less involving giving time to clean and collect from more places around the harbor.

5.4 Areas of Further Study

In the course of the study, it became apparent that there would be need to explore more into other problems like, planning in third world port and harbours, the effects of poor oil waste management, and some further study on effective and efficient management of marine oil waste.

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APPENDICES

Appendix A: Questionnaire Scheduled

Dear Sir/Madam

I am a student of KAMAPLA INTERNATIONAL UNIVERSITY carrying a study on Marine oil waste management assessment in pollution control at Kilindini harbour at KPA. You are kindly requested to answer the following questions by providing the most relevant information and to the best of your knowledge on the issues sought by the questions below. This study is aimed at collecting information on assessing the effectiveness marine oil waste management at Kilindini harbour. The information being sought is purely for academic reasons and will be treated with the utmost confidentiality.

PART A: Oil Waste Collectors

1. Do you have an oil waste management plan? ..... (YES or NO). If YES is it effective? If NO, why?

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2. From your experience do marine oil waste generators handle marine waste properly? ..... (YES or NO) please give a brief explanation.

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.....

.....

3. How frequent do you collect the oil wastes from vessels/ crafts?

Daily..... Weekly..... Others..... if others, please specify

.....

.....

3. Where do you dispose collected oil wastes? .....

.....

.....

4. Are the disposal areas approved by NEMA? ..... (YES or NO)

5. What procedures/strategies do you employ in management of the oil wastes i.e. (waste separation, reduction, recycling etc)? .....

.....

.....

.....

6. Have you ever been bribed or given a bribe inorder to facilitate proper service delivery at the port in the marine oil waste management? ..... (YES/NO.)

7. What by-product may be realised from the proper management of oil wastes?

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8. What challenges do you face in managing marine oil wastes?

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.....

.....

9. What suggestions can you give to effectively manage marine oil wastes?

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.....

.....

Do you have the required operational equipments for the proper handling and managing of the generated marine oil wastes? ..... (YES/NO).

Thank you, for your cooperation!

Appendix B: Questionnaires Schedule

Dear sir/madam

I am a student of KAMAPLA INTERNATIONAL UNIVERSITY carrying a study on Marine oil waste management assessment in pollution control at Kilindini harbour at KPA. You are kindly requested to answer the following questions by providing the most relevant information and to the best of your knowledge on the issues sought by the questions below. This study is aimed at collecting information on assessing the effectiveness marine oil waste management at Kilindini harbour. The information being sought is purely for academic reasons and will be treated with the utmost confidentiality.

PART B: Oil Waste Generators.

1. Marine waste management is a major problem in many harbours and threatens aquatic ecosystems. What measures does your vessel/craft have in managing Marine oil waste?

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2. Do you think the above named strategies are effective in managing marine oil waste? ..... (YES or NO). If YES is it effective? If NO, why?s

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3. From your experience do marine oil wastecollectors employ effective marine oil waste management at Kilindini harbour? ..... (YES or NO). If YES is it effective? If NO, why?

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4. Do you have an oil waste management plan on board? ..... (YES or NO).

5 What facilities do you have on board that help in proper management of oil waste?

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5 What procedures/strategies do you employ in management of the waste i.e. (waste separation, reduction, recycling etc)? .....

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6 Do you have a standardised procedure for oil pollution management on board? ..... (YES or NO). Please explain your reasons in brief.

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7 What oil pollution equipment do you have on board?

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8 Do you conduct periodical inspection on board to ensure proper management of the generated oil wastes? ..... (YES or NO). How often do you conduct the inspections?

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9 What challenges do you face in managing marine oil wastes?

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10 What suggestions do you propose that may help in the marine oil waste management ?

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Thank you, for your cooperation!

Appendix C: Questionnaires Schedule

Dear Sir/Madam

I am a student of KAMAPLA INTERNATIONAL UNIVERSITY carrying a study on Marine oil waste management assessment in pollution control at Kilindini harbour at KPA. You are kindly requested to answer the following questions by providing the most relevant information and to the best of your knowledge on the issues sought by the questions below. This study is aimed at collecting information on assessing the effectiveness marine oil waste management at Kilindini harbour. The information being sought is purely for academic reasons and will be treated with the utmost confidentiality.

PART C: Oil Waste Managers

1. Do you have Marine oil waste management plan?

If YES is it effective? ..... If NO, why?

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2. What are the effects of oil wastes on harbour environment?

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3. Is your section equipped with trained personnel and equipments to manage marine oil wastes in aquatic environment? ..... (YES or NO) If YES is it effective? If NO, why?.....

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4. Have you ever been bribed or given a bribe inorder to facilitate proper service delivery at the port in the marine oil waste management? ..... (YES/NO.)

5. What are the challenges of managing oil waste in the marine environment?

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.....

6. What suggestions do you propose that may help in the management of marine oil waste management?

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Thank you, for your cooperation!

Appendix D. Interview Schedule

Dear Sir/madam

I am a student of KAMAPLA INTERNATIONAL UNIVERSITY carrying a study on Marine OIL waste management assessment in pollution control at Kilindini harbour at KPA. You are kindly requested to answer the following questions by providing the most relevant information and to the best of your knowledge on the issues sought by the questions below. This study is aimed at collecting information on assessing the effectiveness oil waste management at Kilindini harbour. The information being sought is purely for academic reasons and will be treated with the utmost confidentiality.

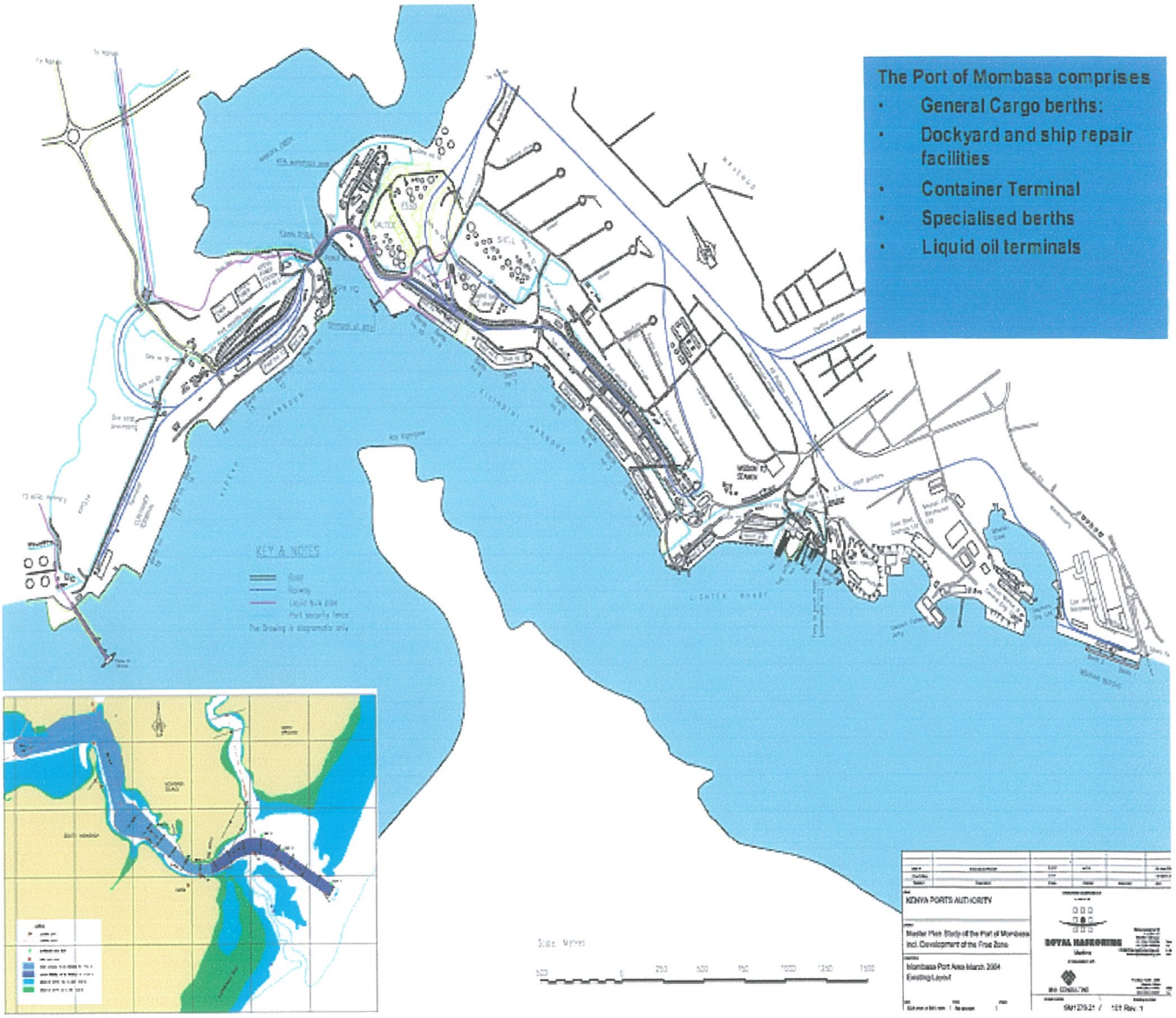
1. What means do you use to dispose off the collected marine oil wastes?
2. Would you say that your area of operation is planned (i.e. developed by structural plans)?
3. Has this in your opinion affected the management of oil waste in your area of operations?
4. Does your organization have proper pollution control equipments?
5. Are the staffs properly trained on the occupational health and safety courses, fire fighting skills and first aid etc?
6. What is the frequency of collecting oil waste from vessels?
7. Have you ever been bribed or given a bribe inorder to facilitate proper service delivery at the port in the marine oil waste management?
8. In your view are the private oil waste firms competent in handling the problems of marine oil wastes at the KPA?
9. What are some of the challenges faced in oil waste management at KPA?

Thank you, for your cooperation!

Appendix E. Tentative Work Schedule

It is anticipated that the research process shall take a period of six months to generate findings.

S/No	Activity	Date / Duration
1	Area surveys and pre-research study	July to August 2009
2	Writing and presentation of the research proposal to my supervisor	November 2009
3	Implementation of the research design. Activities to be carried out within this period include: • Questionnaire design • Set of interviewing questions • Observation from the field • Literature reviewing in libraries, internets, organizations to collect enough information on marine oil waste management.	January 2010
4	Data analysis	January 2010
5	Evaluation of the project	February 2010
6	Presentation and submission of the research report	May 2010



APPENDIX F: Map of Kilindini Harbour at Kenya Ports Authority, Mombasa.

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FACULTY OF SOCIAL SCIENCES

Date: 28/07/2009

To... Kenya Ports Authority

This is to introduce to you [illegible] who is a bonafide student of Kampala International University. He/she is working on a research project for a dissertation, which is a partial requirement for the award of a Degree. I here by, request you, in the name of the University, to accord him/her all the necessary assistance he/she may require for this work.

I have the pleasure of thanking you in advance for your cooperation!

Yours sincerely,

Dr. Mose Anyeda
Dean

APPENDIX G: University research approval letter

Kenya Ports Authority
P. O. Box 95009 - 80104 Mombasa, Kenya.
Tel: +254 - 41 - 2112999
Mobile: 0720 312211
0720 202424
0720 202525
0735 337941-4
Fax: +254 - 41 - 2311867
Website: www.kpa.co.ke

AHM/2/5/07

19th January, 2010

The Master,
M.V "_____"
MOMBASA

Dear Sir,

RE: RESEARCH QUESTIONNAIRE

The bearer Mr. John Mbithi is conducting research on Waste Oil Management in the Port of Mombasa. His finding will assist in the decision making process, for better services to Port users.

This is to kindly request your indulgence to enable Mr. John Mbithi compile these important information.

Yours Sincerely,

CHIEF PILOT
KENYA PORTS AUTHORITY
MOMBASA

Capt. M. Muthama
CHIEF PILOT

APPENDIX H: Research questionnaire format