

**MANAGEMENT OF OIL SPILLAGES FROM INLAND OIL TERMINALS IN  
INDUSTRIAL AREA OF NAIROBI CITY COUNTY, KENYA**

**BY**

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## DECLARATION

This Thesis is my original work and has not been presented for a degree in any other University.

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## **DEDICATION**

I dedicate this Thesis to God for His Grace and Mercy which have enabled me to finish the study.

I also dedicate the Thesis to my children Ryan and Jason without whose caring support it would not have been possible to complete this study, and to my Dad and Mum, whose love of reading, respect for education and hard work have motivated me to reach this far.

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## ABSTRACT

Oil spills are one of the major environmental threats to both humans, animals and the physical environment. Naturally, oil terminals are a safety hazard because they hold tons of this dangerous, highly flammable product. Various mitigation measures to curb oil spillages have been put in inland oil terminals in Kenya but, these spillages are still occurring. This study focused on inland oil terminals located in industrial area of Nairobi City County, Kenya. The main objective of this study was to examine the appropriateness of the existing mitigation measures in managing oil spillages from oil terminals in the industrial area of Nairobi City County, Kenya. The sub objectives were i) to identify causes of oil spillages in the terminals ii) To examine the preventive and management strategies put in place to address oil spillages in these terminals and, iii) To assess the policy, legal and institutional mechanism used to address oil spillages in these terminals. Data collection was collected from 12 September 2017 to 19 October 2017, through Key informant interviews by use of semi-structured questionnaires administered to the oil terminal representatives and relevant regulatory institutions. This data was analysed and presented in form of bar charts and descriptive methods. The study has identified that the leading cause of oil spillages in the oil terminals is lack of staff adherence to the oil products loading instructions, followed by mechanical faults, equipment failure and lack of induction to new staff involved in the loading procedures. The preventive and management strategies put in place to manage oil spillages in the oil terminals are: i) implementation of policy, legal and institutional mechanisms including Environment Management and Coordination Act (EMCA) of 1999 and its (Amendment) Act of 2015, Environmental (Impact Assessment and Audit) Regulations 2003, and (Amendment), 2016, National Environmental Policy of 2013 and Environmental Management and Coordination (Deposit Bonds) Regulations, 2014. ii) preventive engineering works including installation of automated valves and alarms in the terminals that stop any oil supply whenever a spill is detected in the system and iii) staff training and awareness creation on the safety procedures to observe while conducting loading procedures. However, these strategies have been analysed to be inappropriate in the management of oil spillages due to short comings in their implementation key being, lack of adherence by the workers to the laid down safety procedures in the terminals , poor maintenance schedules of oil terminals equipment leading to mechanical failures, lack of coordination in the institutions such as Ministry of Environment and Forestry, NEMA, NDOC and NCCG and, gaps in the existing legislation such as lack of adequate responsibility allocation to the implementation of the National Environmental Policy of 2013, and absence of relevant legislations including the Petroleum and Energy policies. This study concludes that the mitigation measures put in place to prevent and manage oil spillages in the inland oil terminals in industrial area of Nairobi City County are inappropriate and need improvement to improve their effectiveness when implemented in these terminals. The study has therefore proposed recommendations including i) the oil terminals partnering with institutions such as OSMAG, DOSHS and NDOC to conducting frequent refresher training to staff in the terminals on a need-based analysis. ii) conducting induction to new staff. iii) collaboration of the Cabinet Secretaries in the Ministry of Energy, Ministry of Petroleum and Mining, Ministry of Environment and Forestry and the Ministry of Devolution and Planning to streamline their roles and avoid overlap to enable for better implementation of the legislation and, to build on human and financial capacities in these institutions all geared towards preventing and managing oil spillages.

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## LIST OF ACRONYMS

API	American Petroleum Institute
CASELAP	Centre for Advanced Studies in Environmental Law and Policy
EIA	Environmental Impact Assessment
EHS	Environmental, Health and Safety
ERC	Energy Regulatory Commission
EPRA	Energy and Petroleum Regulatory Authority
ILO	International Labour Organisation
ITOPF	International Tanker Owners Pollution Federation
KPA	Kenya Ports Authority
Mg/l	Milligram per litre
MoE	Ministry of Energy
MoPM	Ministry of Petroleum and Mining
NDOC	National Disaster Operations Centre
NCCG	Nairobi City County Government
NEMA	National Environment Management Authority
NFPA/I	National Fire Protection Association
NOSDRA	National Oil Spill Detection and Response Agency
NOSRC	National Oil Spill Response Committee
OSMAG	Oil Spill Mutual Aid Group
THC	Total Hydrocarbons Content
PIEA	Petroleum Institute of East Africa
PPE	Personal Protective Equipment
UNEP	United Nations Environment Programme

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Background of the Study**

An oil spill can be defined as the release of oil into the environment (Lawson, 2012). When oil is spilled, it can be very detrimental to the physical, biological and social environment. Some of the effects of oil spillages include fire outbreaks when the oil comes into contact with ignitions that may claim human and animal lives, choking of plants by cutting off oxygen and preventing water absorption by the soils making them infertile. The persistency of oil spills in food chains due to lead components has resulted to long-term health effects to both humans and animal lives (Ogumor, 2013). There are two types of oil spills. Marine oil spills that occur on sea and terrestrial oil spills that occur on land (Overholt, 2016). This study focuses on Terrestrial oil spills and specifically on inland oil terminals.

Globally, oil spills have overtime impacted the environment negatively and, in some cases, have left permanent damages. For instance, the Gulf oil spill that occurred on 20 April 2010 was the largest in history where 500,000 tonnes of oil was released into the Gulf of Mexico and caused damage to the Louisiana coast fragile ecosystem. The effects of the spill resulted to the destruction of the Gulf coast region. Among the effects were destruction of its natural beauty, interference with oyster, shrimping and fishing industries which devastated the region's economy that depended on the seafood trade and tourism, among others. The spill cost about 200 million dollars to restore the natural environment that had been damaged by the spill (Michael, 2012).

In July 2013, a spill was experienced from a pipeline in Tioga North Dakota that contaminated a wheat field making it infertile. 840,000 gallons of crude oil was spilled and costed about 17.5 million dollars to clean it up (North Dakota, 2016).

Continentially, there has been a number of oil spills that have left the environment in a wanting situation. Castillo de Bellver oil spill that occurred in South Africa on 6 August 1983 off the Table Bay South Africa left 77,616,000 gallons of light crude oil spill into the water. An explosion causing fire left the oil carrying ship split into two spilling the oil in the water. The impacts included serious damage to fishing grounds and fish stocks, as well as rain with oil droplets from evaporation that fell on wheat growing and sheep grazing lands leading to poor wheat harvest and irritations to the animals. Due to the nature of the spill most of it was cornered offshore to Burguela Currents due to wind. Dispersants were used in the clean-up and the whole exercise costed about 153 million dollars (Samantha, 2013).

In Kenya, some of the past oil spill worst incidences include KenGen's oil spill that occurred in 2012 at Kipevu diesel power station, where at least 10,000 litres of oil was released and it spread into the sea soaking beaches and killing animals near the port of Mombasa (Ringa, 2012). Other oil spillages experienced in the past are associated with leaks by tankers at the Port in the coastal region. An example is the 1998 oil spill where 15,000 tons of oil gushed out of storage tanks at the Mombasa harbour causing acres of mangroves to be swept away by the spill, drying them up and leading to an ecological disaster (UNEP, 2010).

Oil terminals are industrial facilities for storage and distribution of largescale refined oil products. They play an important role in the oil industry sector as they are the link between the producers and the consumers and also allow for transportation of oil products closer to the end users or consumers (Kramer, 2019).

Industrial area in Nairobi City County is home to various oil terminal marketers. The oil terminals include Gulf Energy, VIVO Energy, Oilcom, KenolKobil, National Oil and Oilibya Terminals all located along Nanyuki road. Various fuel tank trucks belonging to these companies are used to transport fuel from them to their various retail outlets. It is estimated that more than 200 oil tankers pack along Nanyuki Road waiting refilling every single day (Mwangi, 2012). This is evident that the terminals engage in bulk storage and dispatch of oils every day. The area has experienced past oil spill incidences which have been fatal. The recent case is the Sinai fire disaster caused by an oil spill from Kenya Pipeline Company Nairobi Terminal that happened on 12 September 2011, leaving 100 people dead and around 160 badly injured with scars to date (Shileche, 2012).

Measures put in place to address oil spillages include enforcement of international and local Policy, Legal and Institutional mechanisms. The Environmental, Health and Safety (EHS) Guidelines for Crude Oil and Petroleum Product Terminals (World Bank, 2007) and, institutions such as the American Petroleum Institute (API) have given certain regulations which are to be observed by oil terminals in controlling and managing oil spillages. In Kenya, Environment Management and Coordination Act, 1999 and its (Amendment) Act of 2015, Energy Regulatory Commission (ERC) Guidelines for oil terminals developed in 2015 and 2016, National Environmental Policy 2013, National Land Use Policy 2017, the recent Environmental Management and Coordination (Deposit Bonds) Regulations, 2014, Petroleum Act 2019 and the Energy Act of 2019 are among the policies and legislations to be adopted when addressing oil spillages in the oil terminals.

Engineering measures have also been adopted globally and locally to address oil spillages. They include introduction of spill response equipment such as automated spill alert systems and erecting band walls around the tanks to act as containment chambers in case of spillages from the tanks. Other spill address measures include putting up berms or trenches to direct spilled oil to a designated collection point, use of sorbent materials to suck up the spilled oil and introducing bioremediation processes all geared towards reducing the impacts of the oil spillages when they occur. (Adelana et al, 2011).

Creating awareness among staff through training and staff induction has also been a way through which oil terminals have implemented in order to address oil spillages by reducing their occurrence and impacts (PIEA, 2016). Since environmental conservation strategies have been given priority globally, regionally and nationally, oil spill prevention and their management needs to be addressed so as to reduce their impacts (United Nations, 2019).

## **1.2 Statement of the problem**

Naturally, inland oil terminals are a safety hazard because they hold tones of dangerous, highly flammable products (ILO, 2004). Literature review indicates that various mitigation measures are available (Policy, legal and institutional measures as well as engineering works) to prevent and address oil spillages in the inland terminals located in industrial area of Nairobi City County. However, oil spills still occur in these terminals (Odhiambo, 2012).

This study examined the causes of oil spillages in these terminals, prevention and management strategies put in place to control oil spillages in the terminals and the policy ,legal and institutional mechanisms used to address oil spillages in oil terminals.

### **1.3 Research Questions**

The main question that guided the study was, how appropriate are the existing mitigation measures in managing oil spillages from oil terminals in industrial area of Nairobi City County, Kenya. The specific questions addressed in the study were as follows:

- i. What are the causes of spillages in these oil terminals?
- ii. What are the prevention and management strategies put in place to control oil spillages in these oil terminals?
- iii. What are the policy, legal and institutional mechanisms used to address oil spillages in these oil terminals?

### **1.4 Objectives of the Study**

The main objective of the study was to examine the appropriateness of the existing mitigation measures in managing oil spillages from oil terminals in the industrial area of Nairobi City County, Kenya. The specific objectives of the study were to:

- i. Identify the causes of oil spillages in these oil terminals.
- ii. Examine the prevention and management strategies put in place to address oil spillages in these oil terminals.
- iii. Assess the policy, legal and institutional mechanisms used to address oil spillages in these oil terminals.



### **1.5 Justification of the Study**

In the recent past, oil spillages have caused various impacts to both human beings and the physical environment (Bardroff, 2014). These impacts have left permanent scars to humans and in some cases claimed lives as indicated in Table 2-1. It is therefore necessary to ensure that oil is handled carefully to minimize spills as much as possible and where the spills occur, to ensure practical mitigation measures are put in place to address the spillages before they become detrimental.

This study intends to establish why despite the various mitigation measures that have been put in place in the oil terminals located in industrial area of Nairobi City County, oil spillages are still occurring in these terminals. In finding out this, the study will identify any challenges that impede implementation of the mitigation measures and recommend how these challenges can be addressed.

### **1.6 Significance of the Study**

Findings of this study are meant to benefit the oil marketers, since they will be able to address oil spillages and be able to make the terminals safer working places for both the workers and their customers. Proper management of the oil spillages will also enable them to efficiently account for the oil products and hence increase their profit margins. The Final Draft National Disaster Management Policy of Kenya October 2010 and the Draft National Energy and Petroleum Policy of 2015 are yet to be finalised and gazetted in Kenya.

Students who may wish to study further on oil spillage related studies will benefit from this document since it will contribute towards providing current data on oil spillages in the oil terminals in the industrial area of Nairobi City County.

The policy makers will be able to benefit from this study as a reference document. Specifically, the Ministry of Energy and Ministry of Petroleum and Mining through their Cabinet Secretaries are obliged to develop the National Energy Policy and The National Petroleum Policy respectively. This is a requirement as indicated in the Energy Act 2019 and the Petroleum Act of 2019.

There are various businesses and surrounding residential estates next to the oil terminals in industrial area. The businesses include banks, manufacturing companies and other local businesses. Making the oil terminals safer from spills will benefit surrounding communities living in various residential areas such as Buruburu Phase 4 and 5 and Slums in Viwandani (Jamaica, Sinai, Paradise) through providing a safe working and living environment.

### **1.7 Limitations to the study**

Out of the six (6) terminals and six (6) institutions contacted during the study, only five (5) terminals and six (6) institutions participated in the study. One oil terminal did not respond to the request to participate in the study even after several telephone calls made and physical follow ups. Data collection from Oilibya Nairobi terminal was therefore not collected. However, the data from the five (5) terminals was representative. The study also aimed to interview some of the workers especially in the terminals, but access was given only to the senior representatives from the oil terminals. Despite this challenge, the study compared the collected data with the existing literature review data and bridged the missing data that the study intended to achieve.

Some of the institutions also took time to respond to the meeting requests which resulted to a delay in their feedback that resulted to a prolonged data collection period than was earlier anticipated. This challenge had been factored in the beginning of the study and therefore the license from National Commission for Science, Technology and Innovation (NACOSTI) allowed

for data collection within a year (September 2017 to September 2018) from the date of issue of the license. This license enabled the researcher to be able to easily access the representatives from the terminals and institutions targeted, for any follow ups and clarifications on the data collection process.

Tight working schedules also meant that data could only be collected on leave days taken from work and other off duty hours. Where possible and agreed, the stakeholders were engaged through virtual communication methods such as emails and telephone calls and therefore during physical visits, the time spent to fill the questionnaires took the shortest time possible. This worked very well as it allowed the oil terminals and institutional representatives to attend to their other official duties and also allowed time for the researcher to visit other targeted stakeholders.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

A review of the various studies that have been done focusing on oil spillages at global, continental and national levels are provided for in this chapter. It describes the causes of oil spills and the associated impacts which justifies the need for this study. The preventive and management strategies put in place to control oil spillages and the associated challenges experienced in implementing these strategies have also been identified in this chapter. The theoretical and conceptual frameworks that guided this study are presented in the last sections of the chapter.

### **2.2 Causes and impacts of oil spillages**

#### **2.2.1 Causes of oil spillages**

Generally, oil spills are caused by accidental spills during storage, transportation and handling of the oil products. Sabotage and non-functional equipment have been associated with most oil spill incidences. A study conducted by Michel and Fingas in 2016 indicates that 30% to 50% of oil spills are either directly or indirectly caused by human error while equipment failure or malfunctioning of the equipment contributes 20% to 40% of all spills (Michel and Fingas, 2016).

Among the worst global oil spill cases, is the Gulf deep water horizon oil spill also referred to as the Gulf of Mexico oil spill of 2010. During the spill, 500, 000 tonnes of light crude oil from an oil well blowout was released into the US Gulf of Mexico (Mohit, 2018). Another major spill is the Kolva River oil spill of 1994 at Kolva River in Russia. The spill was caused by a poorly maintained pipeline which caused 84 million gallons of oil to be spilled. The Spill was as a result of a faulty pipeline which had been leaking for approximately eight months. The accumulated oil was being contained by a dyke, but it suddenly collapsed due to cold weather and millions of the

accumulated oil was released. The spilled oil spread across approximately 170 acres of streams, damaging fragile bogs and destroyed the neighbouring marshland (Zahra, 2013).

In Indonesia, a major oil spill occurred on 31 March 2018 in Borneo that affected a huge area and was flowing to the open ocean (Basten, 2018). The spill originated from a pipeline that was being managed by a government owned firm (Pertamina) in Balikpapan spreading 130 square kilometres and leading to a state of emergency declaration around the port of Borneo Island by the Indonesian Government. Five fishermen lost their lives during the spill clean-up exercise when a fire spark during clearing the oil by burning it off the water surface. In addition, the Irrawaddy dolphin which is an endangered species in Indonesia and listed under the protected species also lost its life as it was found dead on the coast near the spill site. Thousands of Balikpapan local residents complained about health issues from the toxic slick since the spill further affected the environment by contaminating 84 acres of mangrove forest (Basten, 2018).

Alkhldi et al, (2017) conducted a study on how human error contributed to accidents in the oil and gas industry in Bahrain. The study results indicated that 70% of all the accidents in the industry emanate from human error. The study recommends that the oil industry should designate a training team to determine the gaps and skill needs among the workers and spearhead the training of workers in order to reduce the human error contribution to oil spillages. The study also recommended that the oil industry should include innovation and adoption to new industry technology as key to its industry practices. This will build skills among its workers in the oil industry and at the same time reduce the number of times that human beings have to control the processes in the industry. Through this, the oil spillages will be reduced.

In Africa, terrestrial oil spills have been experienced in the past especially in Nigeria which is the biggest oil producer in the continent. Along the Niger Delta, oil exploration activities are diverse especially in Ogoniland and Bodo area. The major causes of oil spillages in these areas are pipeline corrosion, pipeline maintenance activities, equipment failure, sabotage and theft. In 2011, Nigeria recorded the worst oil spill. 40,000 barrels of crude oil was spilled in the Bonga Field located approximately 75 miles off the coast of the Niger Delta from a damaged export line. Various negative impacts including contamination of water causes used by the surrounding communities were associated with the spill (Vidal, 2011).

The Greenpeace Furor ABT Summer oil spill occurred in 1991 where more than 250,000 tonnes of laded oil spilled on the offshore coast of Angola. The ship carrying large amounts of oil exploded and all the oil spilled into the sea causing one of the worst spills in history. Five fatal cases were recorded in the incident but unlike other spills, there was a milder impact to the ecosystem since the spill happened at high seas (Shardar, 2016).

In Kenya, most oil spills emanate from faulty or punctured oil pipelines, faulty storage equipment, old equipment and human error. Some of the past oil spill worst incidences include KenGen's oil spill that occurred in 2012 at Kipevu diesel power station, where at least 10,000 litres of oil was released and it spread into the sea soaking beaches and killing animals near the port of Mombasa (Ringa, 2012). Other causes of oil spillages are leaks by tankers at the Port in the coastal region. An example is the 1998 oil spill where 15,000 tons of oil gushed out of storage tanks at the Mombasa harbour causing acres of mangroves to be swept away by the spill, drying them up and leading to an ecological disaster (UNEP, 2010).

In Ngara area, Nakuru County, millions of litres of the hazardous super petrol was spilled on 7 June 2012. The incident occurred when a government grader punctured a Kenya Pipeline Company (KPC) channel when conducting road repairs. Luckily, the Police responded immediately and cordoned off the area including the Nakuru-Eldoret highway to prevent people from scooping oil and therefore prevented associated risks of the spill such as fire outbreaks. Due to the quick response on the spill, there were no reports indicating damage to the environment or humans by the spill (Mureithi, 2012).

In Kibwezi area of Makueni County, 400,000 litres of petroleum spilled into a river and farm land on 27 June 2016 (Onyango, 2016). The spill put Kenya's capacity to tackle large scale oil spill threat on the spotlight to reclaim the already spilled petroleum. The Kenya Pipeline Company led clean-up exercise that took almost three months saw to it that about half (that is 200,000 litres of the oil products) were reclaimed and re-injected back into the Mombasa-Nairobi oil pipeline. The area residents of Kibwezi East found traces of oil products in the seasonal Thange River. An environmental assessment and mapping of the area revealed contamination from the spillage had extended more than 1 kilometre downstream and on the farm, it covered a width of 250 metres and a depth of 300 metres from the top soil. Experts and the government of Kenya opted for environment restoration as the cost effective and viable option although it took a longer duration.

In Muhoroni area Kisumu County, the Kenya Pipeline Company (KPC) on 30 September, 2017 experienced a complex fuel siphoning network that had been operating for three months on the line 6 of the Nakuru-Kisumu pipeline (Nyabundi, 2017). The KPC systems in place revealed leakages of up to 50,000 litres from the affected line. KPC's hydrogeological report indicated that the product was contained in good time and hence no catastrophic damages were reported.

The report further noted that the existing well and borehole in the area had not been contaminated and the air quality impact was negligible. The Company carried out an environmental clean-up of the area for nearly two months and reported the area safe for re-occupation (Nyabundi, 2017).

In the industrial area of Nairobi City County, a spill occurred on 12 September 2011. An equipment failure within the Kenya Pipeline Company storm drainage channel caused fuel to be released into Sinai slum village and the nearby Ngong River. This spill caused a fire disaster in Sinai village that left 100 people dead and around 160 badly injured with scars to date. The fire happened when the residents opted to collect the fuel and, in the process the fuel came into contact with some form of ignition from the residents. It is reported that the Company spent more than Kshs 103 million in addressing the incident to cater for lost fuel, collection and transportation of the spilled product, environmental restoration costs and other associated costs including lost man hours and public media expenses. This was exclusive of the costs that were used to compensate the families whose relatives died in the incident and others who got injured (Mayoyo, 2012).

### **2.2.2 Impacts associated with oil spills**

This sub-section covers some of the impacts associated with oil spillages. The section discusses impacts to economy, impacts to physical environment and on animals, and lastly, impacts on human beings.



### Impacts to the economy

Oil spills can be very costly when it comes to cleaning the spills and restoring the ecosystem. In the US, clean-up costs sum up to approximately 300 dollars per litre when an oil spill occurs. In addition, the total cost could add up to 900 dollars per litre spilled when environmental restoration activities and addressing socio economic effects are included in the budget (Michel and Fingas, 2016).

Dorsett (2010) studied the Exxon Valdez Oil Spill continued effects on the Alaskan economy. Surprisingly in this study, it was noted that the oil spill content in samples were still existing in the same quantity similar to the composition just after the spill. The study indicated that decomposition of the oil was hardly above 4% per year from the date of the spill. This meant that it could take centuries for the spill traces to decompose. Some of the spill effects included the loss of 14 members from a 36-member pod of killer whales. This impacted the economy that depended on the whales as a cause of tourism attraction. The study indicated that over 3.8 US billion Dollars was spent by Exxon to clean up the site. Some of the expenses incurred included compensating 11,000 residents affected by the spill and paying related enormous fines. Besides this, in 1994, Exxon was ordered by an Alaskan court to pay 5 billion US Dollars as a form of disciplinary charges to the company. This study, however, did not address the policy intervention aspect that would ensure that Exxon (the polluter) takes responsibility and be liable on the short and long term effects associated with the spill.

The Castillo de Bellver oil spill that occurred in South Africa on 6 August 1983 cost about 153 million US dollars to clean it up. In Angola the ABT Tanker ship oil spill that occurred on 28 May 1991 was grouped among the worst oil spills in Africa. The clean-up of the spill cost about

163 million US dollars. The tourism sector is also normally negatively affected especially when the oil spill happens in the coastal line where swimming, boating, angling and diving activities are disrupted due to oil contaminated shores. Fisheries and related resources also suffer due to physical contamination of fish stocks, impediment access to fishing sites as well as lost market confidence in the quality of seafood from the affected area. All these contribute to lost revenue in the fishing industry (ITOPF, 2015).

#### Impacts of oil spills on the physical environment and on animals

One of the major uses of Petroleum oils is fuels for locomotives and other uses (Bierkens and Geerts, 2014); however, they are becoming a worldwide threat to the environment due to their persistency in the environment, toxic nature and detrimental damage to ecosystems (Hentati et al., 2013). Gasoline, diesel fuel and lubricating or heating oil have polarity and soluble characteristics. When spilled on the environment, the organic chemicals of these petroleum products pass through the soil and groundwater systems causing serious pollution problems (Nwineewii and Abiye, 2015).

When oil spills get into marine habitats, they damage aquatic wildlife and their habitats by means of physical contact, ingestion, absorption and inhalation. The oil spills can cause harm to the aquatic ecosystem by choking them, altering their metabolic activity and other physical development. When species ingests these oils, it leads to damage of lungs, kidneys and the liver which may eventually lead to death (Schwarzenegger et al., 2015).

Terrestrial animals also share same fate when they come into contact with oil spills. Some of terrestrial animals rely on scent to find their young ones yet, their mothers fade away due to getting contaminated with the oils. As a result, the offspring are rejected and abandoned, and

eventually die. When ingested by animals, oil may cause poisoning of internal organs (lungs and liver), and in the long term may lead to their death. Soils also rely on microorganisms to assist in recycling nutrients to make them fertile. When microorganisms in the soils are killed and/or choked by oils, they render the soils infertile (Ogumor, 2013).

Lee (2011) conducted a study on the ecological and human health and economic impacts of oil spills near the Gulf of Mexico. The study was examining the short- and long-term effects of oil spills on the environment and human health. A review of published journals formed part of the secondary data collection procedures. The study results indicated that fatal marine death cases were caused by lack of oxygen in the waters which the aquatic organisms are dependent on for survival. This situation arises since the spilled oils cannot allow for oxygen penetration into the waters. This in turn causes loss of fishing grounds which are associated with economic impacts on the communities that depend on the fishing grounds for their survival.

Dermal complications and respiratory complications were also associated with effects from the oil spillages. The study also noted a reduction in animal population size for different species and, associated challenges when trying to recover to their original numbers before the spills. This indicated that some species were at risk of being endangered due to an inability to return to pre-spill population sizes. The study recommended that regulations should be created to prevent the natural behaviour or extinction of vital natural resources in the environment. However, it did not state the existing oil spill control mitigation strategies and the challenges being experienced in implementing the strategies as well as their mitigation measures.

Mei and Yin (2009) reviewed the studies on marine oil spills and their associated ecological damage. The study concluded that marine ecological damage caused by oil spills consist of destruction to marine resource value (direct value) and destruction to marine ecosystem service value (indirect value). These impacts results to a reduction in marine products economic value which in turn greatly affects the economy depended on it. This particular study did not propose any policy interventions that could be put in place to manage marine oil spillages and the possible mitigation measures that would possibly ensure quality and value from marine resources and at the same time, bring gain to oil owners and oil shipping businesses.

#### Impacts of oil spills on human beings

Oil spills cause contamination of underground streams which spread over wider regions beyond the original spill sites. This water when consumed by human beings, it has toxic components that may lead to their death or compromise their health status (Simeonov et al., 2010).

Toxic components in Petroleum Oils that contaminate the environment are Volatile Organic Compounds (VOCs) such as petrol (gasoline), Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and, Polycyclic Aromatic Hydrocarbons (PAHs) which all have harmful effects on living things as they affect the central nervous system (Simeonov et al., 2010). Trace metals like lead can be present in all types of petroleum releases and are usually monitored in most environmental programmes.

Lead in particular has serious health effects as it affects the development of the brain and nervous system. It also has a negative influence on both children and adults. For children, it reduces the physical growth and mental growth. The intelligent quotient (IQ) of children is also normally diminished, while pregnant women exposed to lead have higher rates of infertility,

miscarriage and still births (Ediin et al, 2015). These toxic components found in oil indicate that oil spills have negative effects to human health and hence need to be managed as much as possible.

In Kenya, oil spillages associated with claiming human lives includes the Sachangwan oil spill that occurred on 31 January 2009 along the Nakuru-Eldoret highway, and left approximately 140 people dead as they tried to siphon fuel from an overturned fuel tanker that eventually burst into flames (Mkawale, 2009). A recent case is the Karai oil spill that occurred on 11 December 2016 along the Nairobi- Nakuru Highway that left 40 people dead when an oil tanker lost control and slammed into oncoming traffic before bursting into flames (Mukoya, 2016). Table 2-1 gives a summary of some of the oil spillages that have occurred in Kenya that left lives lost and a number injured.

**Table 2-1: Past oil tanker fire disasters in Kenya**

<b>Date</b>	<b>Place</b>	<b>Casualties</b>
13 July 1998	Sidindi Ugenya	33 dead
31 January 2009	Sachangw'an in Nakuru	More than 140 dead and at least 238 injured
18 June 2009	Kapkokyek Kericho	4 dead, 47 injured
07 February 2010	Sachangw'an in Nakuru	2 dead, 1 Injured
21 June 2010	Ugunja trading centre in Ugenya	1 dead
20 September 2011	Suo, Busia	8 dead, 37 injured, 15 with severe 3rd degree burns
12 September 2011	Sinai in Nairobi	100 dead and 160 injured.
11 December 2016	Karai area along Nairobi Nakuru Highway	40 dead and other many injured

Source: Shileche (2012)

Sako (2017) examined the human physical and mental health effects from oil spills. The study was based on the lived experiences of villagers in Koluama, Nigeria. The participants included a random sample of 33 residents of Koluama. Data was collected via individual semi-structured interviews and 3 focus groups and analysed using interpretative analysis. Key results from the analysis included increased children's health issues, including asthma and other breathing problems as well as high death rates among the elderly in the area. The villagers, aware of the increase in mortality and illness in the area, also suffered from anxiety and depression.

The research findings demonstrated the perception of the participants, which indicated that the oil companies appeared not to be concerned about the lack of health care in the area; although illness increased in the area of the oil fields. The study did not recommend the policy interventions that can be placed to mandate the oil companies to ensure that their actions do not interfere with the environment, and health of surrounding communities.

Adekola et al., (2016) conducted a study along the Niger Delta Nigeria, to determine the health risks associated with oil spillages. The study was based on 69 interviews conducted in the Niger Delta region. The study noted that in Africa, communities face environmental challenges which result to conflicts and a lot of emerging issues raised regarding exploitation of oil products and the environmental and human health impacts that are related to the exploitation procedures. Key concern from the study was lack of an effective risk communication mechanism, and the impact it had on the public understanding of a risk which in this case was impacts associated with the oil spill.

The study identified lack of an effective risk communication mechanism to the public and its importance in case of emergencies such as oil spillages. The study also evaluated the health risk communication in the oil rich Niger Delta region of Nigeria. It was argued that the health of the local population was being compromised by risk incidences relating to oil and gas exploration activities, the effects of which are aggravated by inadequate communication of health risks to the public. The study suggested ways in which the communication processes can be improved in the Niger Delta especially on the health effects to human beings, so as to enable them participate in management of such impacts while at the same time co-exist with the oil exploration activities. The study however, did not propose a policy intervention to incorporate the risk communication strategy that will enable for risk communication to the public.

Atubi (2015) examined the effects of oil spills on human health in nine selected oil communities in Delta State, Nigeria. Questionnaires were administered to the household heads in the oil dwelling communities. From the clustered information collected, “Statistica’ software version 12.0 on windows was used to analyse the data. From the study, it was evident that oil spillages effects ranged from impacts on land including poor soil fertility or nutrient content which led to poor crop productivity. Pollution of rivers and streams was also noted which in turn affected fishing activities which was a subsistence up keep for the families. This really compromised their sources of food leading to a struggling livelihood upkeep in the region. This study recommended the passing into law of the government policy on zero flare so as to enable for its enforcement and updating of existing laws to accommodate international and environmentally friendly standards.

Oyebamiji and Mba (2014) researched on the effects of oil spillage on community development in the Niger delta region as well as related implications for the eradication of poverty and hunger in Nigeria. Questionnaires were used for data collection. Focus group discussions and observations were also among the methods employed to collect the data. Analysis of the data was done using percentages and weighted mean. Study results indicated that oil spillages had led to poverty in the community due to environmental degradation in the area.

The study recommended that oil companies, government and community members in the area to institute control measures on oil spillages currently impacting negatively the community. One of the recommendations from this study was that any company that breached the laid down environmental protection laws could be penalised by suspending their operations. However, no policy interventions that could be used to penalise and suspend the operations of these companies were proposed.

Olusiya (2009) conducted a study on socio-economic implications and environmental effects associated with oil spillage in some of the communities living along the Niger delta. The objectives of the study were to determine the quantity of oil spilled from pipelines, the area of coverage and assessing the effects of oil spillage on the people, soil and water. Laboratory water analysis from sampled rivers within the communities showed a higher concentration of up to 40,000mg/l per water sample of Total Hydrocarbon Content (THC) above the World Health Organization (WHO) permissible levels of 1mg/l per water sample. This was found to have contamination effects on the water sources being used by the community and in turn affected the socio-economic activities of the people.



The study recommended that spills should be contained as soon as they occur to prevent and manage any adverse effects that may emanate when they find their way into the environment. The study also recommended that the oil companies should adequately and promptly compensate the affected communities whenever their activities result to oil spillages that impact the communities and lastly the oil companies must involve the communities in the maintenance and monitoring of pipelines with the ultimate goal of improving the quality of life of members of rural communities. This study did not, however, propose the policy interventions that could mandate the oil companies to involve the communities in the proposed oil spill mitigation measures.

The above reviewed studies have all indicated that oil spillages have negative effects to the economy, physical environment including animals and human health. The gaps identified in the study clearly indicate that proposed mitigation measures to prevent/manage oil spills have been identified but have not been proposed into legal framework to spearhead their implementation. Without relevant policy and institutional arrangements, the proposed oil spill mitigation measures will lack a legal instrument for their implementation.

### **2.2.3 Prevention and management strategies to control oil spillages**

This section looks at the different prevention and management strategies that have been employed in the management of oil spillages. These strategies include policy, legal and institutional framework as well as engineering mechanisms.

#### **2.2.4 Policy, Legal and Institutional Mechanisms for Addressing Oil Spillages**

Policy, Legal and institutional frameworks have been put in place by various institutions. Worldwide, the World Bank group's, Environmental, Health and Safety (EHS) Guidelines for Crude Oil and Petroleum Product Terminals that are industry specific have been established reflecting good international industry practice. In order to address oil spills, the guidelines have recommended guidelines such as requirement for the development of a spill prevention and control plan, installation of leak detection systems, emergency shutdown systems in case of oil leakages and training of personnel and providing equipment to address and contain oil spillages (World Bank, 2007).

The American Petroleum Institute (API) standards are used widely in oil terminals when putting up their product storage tanks. API 650 is the adopted standard in these terminals that specifies the tank design, fabrication, welding, inspection and erection requirements all aimed at preventing leakages that would lead to oil spillages during the operational period of the tanks (American Petroleum Institute, 2013).

National Fire Protection Association (NFPA) 30 approved by the American National Standard on 18 July 2003 provides specifications on storage of flammable and combustible liquids. The standard requirement for terminals is to have fire fighting equipment and workers trained on how to use the equipment in case of a fire outbreak (National Fire Protection Agency, 2015).

In other countries such as Florida, the approach applied involves forming plans at National level, which are then adopted regionally and further localized to make them acceptable and practical in their application. Figure 2-1 shows the hierarchy of Florida's Contingency plan as part of the

measures put in place to manage oil spillages. This plan is also a good proposal in trying to manage oil spillages from the sea port oil harbour to the inland oil terminals.



Figure 2-1: Hierarchy of Florida's Contingency Plan for improving oil spills management

Source: Florida Commission on Oil Spill Response Coordination (2012)

In Africa, Nigeria is the largest oil explorer due to its rich oil wells. The Environmental Guidelines and Standards for the Petroleum Industry provide guidelines and standards for environmental quality controls. The Petroleum Refining Regulations of 1974 emphasize on provision of personal protective equipment (PPEs) for the workers while at the refinery. The Institutional framework in Nigeria includes the National Oil Spill Detection and Response Agency (NOSDRA) which was formed by the Federal Government of Nigeria in 2006, to implement the National Oil Spill Contingency Plan. Ministry of Environment and Department of Petroleum Resources which are tasked with ensuring enforcement of the laws and regulations within the oil exploration, production and distribution agencies (Awogbade et al, 2017). The Ecological Fund Office (EFO) was created in 2003 to be a viable funding source for the various environmental challenges facing the nation. It basically funds remediation programmes to address oil spillages in the oil and gas industry (Elenwo et al., 2014).

The National Environmental Standards and Regulations Enforcement Agency (NESREA) operates under NESREA Act of 2007 which authorises the Agency to ensure and maintain public health and welfare by prohibiting any party from discharging any hazardous substances into the environment, while the National Oil Spill Detection and Response Agency (NOSDRA) operates under the NOSDRA (Establishment) Act of 2006 to provide for the treatment of waste emanating from oil production and exploration.

In South Africa, Institutional bodies responsible for oil and petroleum management include the Petroleum Agency of South Africa and the National Energy Regulator of South Africa (NERSA) which are tasked with regulating petroleum activities and promoting sustainable development in the oil sector. The Petroleum Act of 2003 provides for the regulatory framework on procedures that should be followed during the construction and operation of petroleum pipelines in the oil industry as well as the loading and storing facilities. In addition, the National Environment Management Act of 1999 subject's various development activities to environmental authorisation. In November 2015, the Act was amended to include environmental requirements that relate to rehabilitation and restoration of the environment in areas where oil exploration and production is conducted. (Davidson and Oberholzer, 2017).

Oil spill management in Oloibiri, Niger Delta involves associating the government to provide effective capacity building at all levels on oil spill management and purchasing basic oil spill response equipment (Egwu, 2012). A study conducted along the Niger Delta recommended various measures for adoption and implementation. This included developing a National Spill Contingency Plan and adopting it for oil spill management at local levels, encouraging effective partnership between the public and private sector since they work towards a common set goal which is oil spill management.

Other corrective measures proposed for adoption included developing and updating the current laws and regulations to control oil spillages due to the new technologies being used in the oil industries, streamlining the various government departmental functions in controlling oil spillages to avoid duplicity of functions that makes it difficult to assign specific responsibilities to the departments and lastly, promoting capacity building strategies among staff in government departments dealing with oil spillages so as to prevent the government from being dependant on international assistance when oil spillages occur (Egwu, 2012).

The above are policy , legal and institutional efforts that have been put in place to worldwide to ensure that oil spills are being prevented and managed as a measure of contributing towards sustainable development.

Locally, various oil spill strategies have been adopted by oil companies. For instance, oil spill response arrangements by Kenya Ports Authority (KPA) under the KPA Act of 2014 included setting up of the National Oil Spill Response Committee (NOSRC). The members of this committee include private companies and parastatals involved in the oil refining and distribution and government agencies such as Kenya Wildlife Services, Kenya Marine and Fisheries Research Institute and the Fisheries Department dealing with wildlife maritime activities and environmental conservation (ITOPF, 2014).

NOSRC also developed a National Oil Spill Response Contingency Plan. In the plan, oil spills are divided into three tiers. Tier one spillages consist of up to 100 tonnes of oil and are expected to be dealt with primarily by the operators responsible, while Tier two spillages comprise of up to 1000 tonnes of oil and call for cooperative effort from various stakeholders to clean or remedy it up. Tier three incidents involve larger spills. For Tier three types of spills, NOSRC provides

“first aid” and calls for external assistance. The plan has identified the resources that are at risk, assessed their risk level of involvement and provides guidelines for shoreline clean up depending on type of contamination. It also provides a list of what needs to be done when an oil spill occurs in terms of lines of communication to ensure coordination of effort, responsibility for particular tasks, contractors, directory of equipment, suppliers, experts and maps of sensitive areas (ITOPF, 2018).

A study on Strategic Environmental and Social Assessment of the Petroleum Sector in Kenya was conducted by the Ministry of Energy and Petroleum in 2016. The aim of the study was to consult with the relevant stakeholders to collect views and draft strategic recommendations for Policies, Plans, and Programmes (PPP). These recommendations would guide environmental and socio-economic planning and decision making in the petroleum sector in the country. The plan recommended environmental, socio economic and health and safety recommendations that would contribute to sustainable development in the petroleum business sector in the country. Among the institutions identified in management of oil spillages and that are relevant to this study were the Ministry of Energy and Petroleum (separated to Ministry of Energy and Ministry of Petroleum and Mining), Energy Regulatory Commission now Energy and Petroleum Regulatory Authority, Ministry of Environment and Natural resources (renamed to Ministry of Environment and Forestry), National Environment Management Authority (NEMA).

As part of the identified mitigation measures, this study focuses on the policy and institutional mechanisms in addressing oil spillages in oil terminals of industrial area. The findings have been discussed in detail in Chapter Four.

Olufunmilola (2016) conducted a study on institutional framework for multi-stakeholder participation in oil and gas management in Nigeria. He sought to give perspectives on the multi-stakeholder dialogue approach. He noted that despite the natural resource wealth that existed in the Niger Delta, the surrounding communities around the area suffer greatly from social, economic and infrastructural underdevelopment. The results of the study indicated that the failure to respect the right of the Niger Delta communities and allow them to participate in the management of environmental effects that arose in the oil and gas exploration was one of the key resource exploitation challenges facing the region.

The study indicated that recognition of the Niger Delta peoples as stakeholders and allowing them to effectively participate in Nigeria's oil and gas management could enable them hold the oil exploration sector companies accountable for the effects from oil pollution and be able to address the human rights issues. The study, did not, however address the policy interventions to be put in place to ensure incorporation of community participation in the oil sector together with associated impacts when a spill occurs.

Atanda (2015) assessed the legal framework for oil pollution in Nigeria. He recommended that the government ought to take a firm stand on oil pollution by cautioning the companies involved. He emphasized on the need for the government to strengthen the existing bodies and agencies concerned with oil pollution management and prevention to ensure the adherence and enforcement of the existing laws. This study noted lack of enforcement of existing laws is a contributing factor to oil spillages and its associated impacts at the oil terminals located in the industrial area of Nairobi City County.

Amaka et al (2014) conducted a study on the Legal Framework governing the Control of Oil and Gas Pollution in various worldwide oil rich countries including Nigeria, Republic of Congo, Equitorial Guinea, Chad, Iraq, United Kingdom and Cameroon. The survey found that it was important to have a legal framework in place to ensure best practices in the oil field and there should be proper coordination of efforts to address any oil spill incident. The survey also revealed that some of the legal framework in controlling oil spillages are inefficient and defective due to lack of capacity for enforcement of extant laws, weak institutions and a deficient institutional structure.

The study also noted that these countries are afraid of adopting measures based on international environmental laws for fear of hurting their economies. The survey proposed incorporating all stakeholders and making it mandatory for them to be responsible for any environmental pollution caused by the oil spill incidences.

### **2.2.5 Training and awareness programs**

Companies in the oil sector in Kenya formed Oil Spill Mutual Aid Group (OSMAG) in 1996. The objective of the group was to bring together all the oil companies located or using the Mombasa port to effectively respond to oil spills to participate in management of oil spillages strategies such as periodic training of staff in the oil companies which is normally sponsored by OSMAG.

This group operates with and integrates its members' effort with relevant government parties and maintains these links with concerned international, regional, national, local and private organizations. The obligation of each member of the group is to develop an oil spill safety plan and to ensure maintenance of oil spill response equipment (ITOPF, 2013).



A study by Muthike indicate that Kenya has put in measures to address oil spillages but lacks the capacity to address large scale oil spillages. The study also notes that the Government has established equipment stockpile for addressing oil spillages in accordance with international requirements. Personnel from various oil companies have been trained to manage and address oil spillages but are inadequately trained when it comes to large scale oil spill incidences (Muthike, 2018).

### **2.2.6 Engineering works used to prevent oil spillages**

Some of the technical strategies being employed worldwide in managing oil spillages include erecting berms or trenches. These are built on the path of the oil spill flow using sand bags or soil so as to prevent the oil from spreading further. Manual recovery has also been used where suction hoses, pumps, vacuum trucks among others are used to recover spilled oil (API Energy, 2015). The oiled materials are normally collected in buckets and transferred to processing stations for proper disposal. Sorbent materials have overtime also been used to absorb spilled oil. These materials include peat moss, vermiculate and clay (API Energy, 2015). After absorbing the oil, they are normally collected and treated or disposed of as hazardous materials.

The above method is however applicable when dealing with small amounts of spills of up to 100 tonnes. The method can also be used after other response options have been used. Bioremediation has also been used for certain portions of oil which are biodegradable, where certain fertilizers are applied together with associated micro-organisms to assist in disintegrating the oil particles. This process, however, takes time and it is, therefore, recommended to be used with other clean up procedures (API Energy, 2015).

Bioremediation was authorised by Alaska Regional Response Team during the oil spill clean-up of Exxon Valdez restoration activities. This included bio stimulation and bioaugmentation. These methods were used along Prince William Sound shoreline and were found to accelerate the natural degradation and decomposition of the oil with no or low levels of toxicity or eutrophication (EPA,1999).

Adelana et al (2011) recognises that the use of biological remediation has been implemented in some areas of the Niger delta in detoxification and ecosystem restoration activities from oil spill effects. In the city of Egbema, Imo state of Nigeria, a study conducted to determine the macro floral communities present at the site of an oil spill indicate that these macro organisms had the ability to break down the oil hence decreasing the oils toxic conditions. From consultations, the communities in the city hoped to use these methods of bioremediation to improve the quality of drinking water, health and soil conditions of the surrounding environment. The study however does not address policy mechanisms for the management of the spillages along the Niger delta, or elsewhere.

In Kenya the engineering works employed in terminals to prevent and manage oil spillages include erecting band walls around the oil storage tanks to contain spillages from spreading into a large area in case of spillages. The tanks are also fitted with automated valves and alarms to alert and stop any leakages that may be sensed in the systems. (GIBB Africa, 2015).

### **2.3 Challenges experienced in applying the mitigation measures to manage oil spillages**

Various challenges have been experienced globally, continentally and nationally in applying the preventive and management strategies used to manage oil spillages as discussed in the below sections.

#### **2.3.1 Challenges faced worldwide**

Many challenges are experienced in the oil industry when trying to implement measures aimed at preventing and managing oil spillages. In Vancouver Canada, the Western Canada Marine Response Corporation (WCMRC) is responsible for the immediate response and federal and provincial authorities provide oversight and long-term management of the response in oil spillages and other emergencies. However, coordination issues in the event of oil spill emergencies normally arise due to lack of harmonisation between provincial oil spill policies and the federal unit. There is, therefore, need for clear stated responsibilities in institutional arrangements to address and manage oil spill incidences (Chang et al, 2014).

In other developing countries worldwide, lack of local capacity and institutional structure to respond to oil spillages has been noted to be one of the short comings in addressing oil spillages and the associated impacts. The countries tend to rely on external assistance from more developed countries which in the long run is too expensive for them. This has led to slow response and poor mitigation measures being implemented when oil spills occur (Pitkin, 2013).

#### **2.3.2 Challenges faced continentally**

In Ghana, the delay in implementing the legal framework for oil exploration has taken a toll on its citizens who experience the impacts of oil exploration. One such example is the 2001 cyanide oil spillage caused by Goldfields Ghana Limited which led to pollution of two rivers causing death of significant aquatic flora and fauna. Fishing from the two rivers was the main source of

food for the local community, who also relied on the two rivers as their sources of drinking water. The result was that the community experienced serious health issues arising from use of the polluted waters from the rivers.

In 2010, the Ghanaian government presented the Petroleum Exploration and Production Bill 2010 before parliament, but it was withdrawn in 2011 due to concerns raised by civil society indicating that it contained deficiencies that would render it ineffective. The fine-tuning process of the Bill took long to be finalized. The Bill sought to create opportunities for the private sector to participate and invest in the petroleum sector. It was also meant to strengthen the regulatory framework for a healthy competition among the exploiters. The Bill was passed into law on 4 August 2016, five years later (Bawa, 2016). Within the five years various environmental impacts and human impacts had been experienced due to the oil exploration activities.

Poor enactment or adherence to existing laws has also been a challenge in trying to control oil spillages and their related impacts. In Nigeria, the legislations to address impacts of oil spillages include Petroleum (Drilling and Production) Regulations 1969, Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN), National Enforcement Standards and Regulation Enforcement Agency Act (NESREA), among others. These laws have, however, not been able to address oil spillages due to lack of proper enforcement mechanisms (Atanda, 2015).

Lack of allocation of sufficient funds to address oil spillages in the national budget is also a limiting factor in addressing oil spillages. Some of the direct costs associated with oil spillages include clean-up costs and environmental remediation, emergency response costs, replacement of damaged equipment, among others (Sadhu, 2013). Lack of funds may slow down the above-

mentioned activities which will result to more losses from oil spills due to the unavailable or slow response to the spillages.

In addition, the process of application and accessing the Ecological Fund Office (EFO) funds is rigorous and cumbersome as discussed in section 2.3. Therefore, most institutions prefer not to adequately address any oil spillages caused and therefore causing environmental degradation and in worst cases impacts to the ecosystem and human health. (Elenwo et al., 2014).

## **2.4 Theoretical and Conceptual Framework of the Study**

This section of the study presents the theoretical and the conceptual frameworks of the study. The theoretical framework is presented first followed by the conceptual framework.

### **2.4.1 Theoretical Framework**

The theoretical framework that guided this study was based on the Contingency Planning and Crisis Preparedness Theory (Perry and Lindell, 2003). This theory emphasises the general importance of planning and preparing for a crisis. It entails good planning which is influenced by cross cutting factors. In this study, these factors include policy, legal and institutional framework, engineering works and awareness creation and education on oil spillage prevention and management strategies among workers. All these are geared towards the reduction and management of oil spillages in oil terminals in the industrial area of Nairobi City County.

In relation to this theory, on 18th January 2007, a spill occurred in a Cameroonian forest and there was great difficulty in containing the spill as a result of the absence of an oil spill contingency plan. The spill caused negative environmental and social impacts due to inability of the government and associated stakeholders to contain the spill since they lacked information on the emergency steps to take in case of such a disaster. The World Bank being a major

stakeholder in these oil exploring countries and lessons learnt from the Gulf of Mexico oil spill in 2010 spear headed the development of the national oil spill contingency plan in Cameroon for use in case of oil spill emergencies in future (Mteboh, 2010). In line with this, the researcher focused on the level of preparedness the oil terminals in industrial area are at and, determine the appropriateness in the management of oil spillages in the terminals and propose improvement recommendations.

#### **2.4.2 Conceptual Framework**

A conceptual framework has been defined as a hypothesized model that is used in identifying the concepts under a given study and their relationships (Mugenda, 2003). The independent variables that guided the study were engineering works adopted in the terminals and, employee awareness creation on the various preventive and management strategies that can be put in place in order to achieve a reduction in oil spillages. These independent variables are intervened by the various policy, legal and institutional framework at the national and international level, which have been put in place to ensure that there is a reduction in oil spillages in the oil terminals in industrial area of Nairobi City County Kenya.

The above mirrors the theoretical framework of the study on the level of preparedness that the terminals are employing currently and areas of improvement that the study recommends in order to achieve effective oil spill management in the terminals through reduced oil spillages. Figure 2-2 indicates the conceptual framework that guided the study

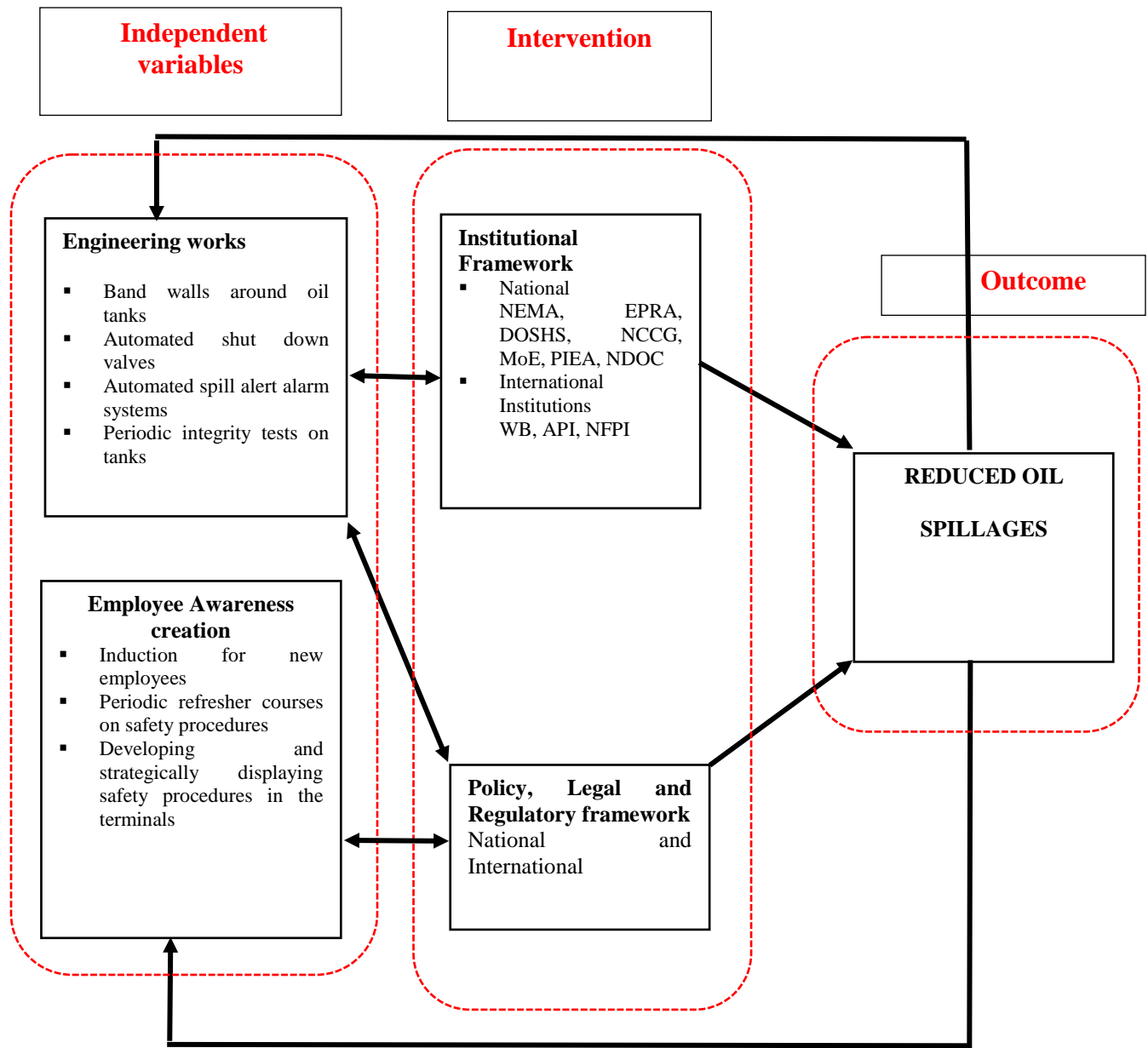


Figure 2-2: Factors contributing to effective management of Oil Spillages from Oil Terminals in Industrial Area of Nairobi City County

Source: Modified from the Contingency Planning and Crisis Preparedness Theory by Perry and Lindell (2003)

## **CHAPTER THREE: STUDY DESIGN AND METHODOLOGY**

### **3.1 Introduction**

This chapter provides details of the study site and describes the design used in the study. It also provides details on the procedures, data sources, collection procedures, data analysis and presentation aspects of the study.

### **3.2 Study Area**

The study focused on oil spillages in inland oil terminals. Nairobi is the Capital City of Kenya and the hub of various economic activities fuelled by the transportation industry. Due to this aspect, the city is a home to various inland oil terminals including Jomo Kenyatta International Airport Terminal, Wilson Airport Terminal and the Kenya Pipeline Corporation (KPC) Nairobi Terminal which is the largest inland oil terminal in Kenya. Due to KPC state mandate, the Nairobi Terminal is responsible for supplying fuel products to various oil companies whose terminals are located next to it in industrial area, Nairobi City County. In total there are six (6) oil terminals in industrial area of Nairobi City County, these are Gulf Energy, Oilcom, Kenol-Kobil, National Oil, VIVO Energy and Oilibya Nairobi Terminals. Based on this fact, the researcher found industrial area inland oil terminals to be ideal for the study since they were representative of all the other inland oil terminals in the Country. Figure 3-1 shows the map of the study site where the oil terminals are located.



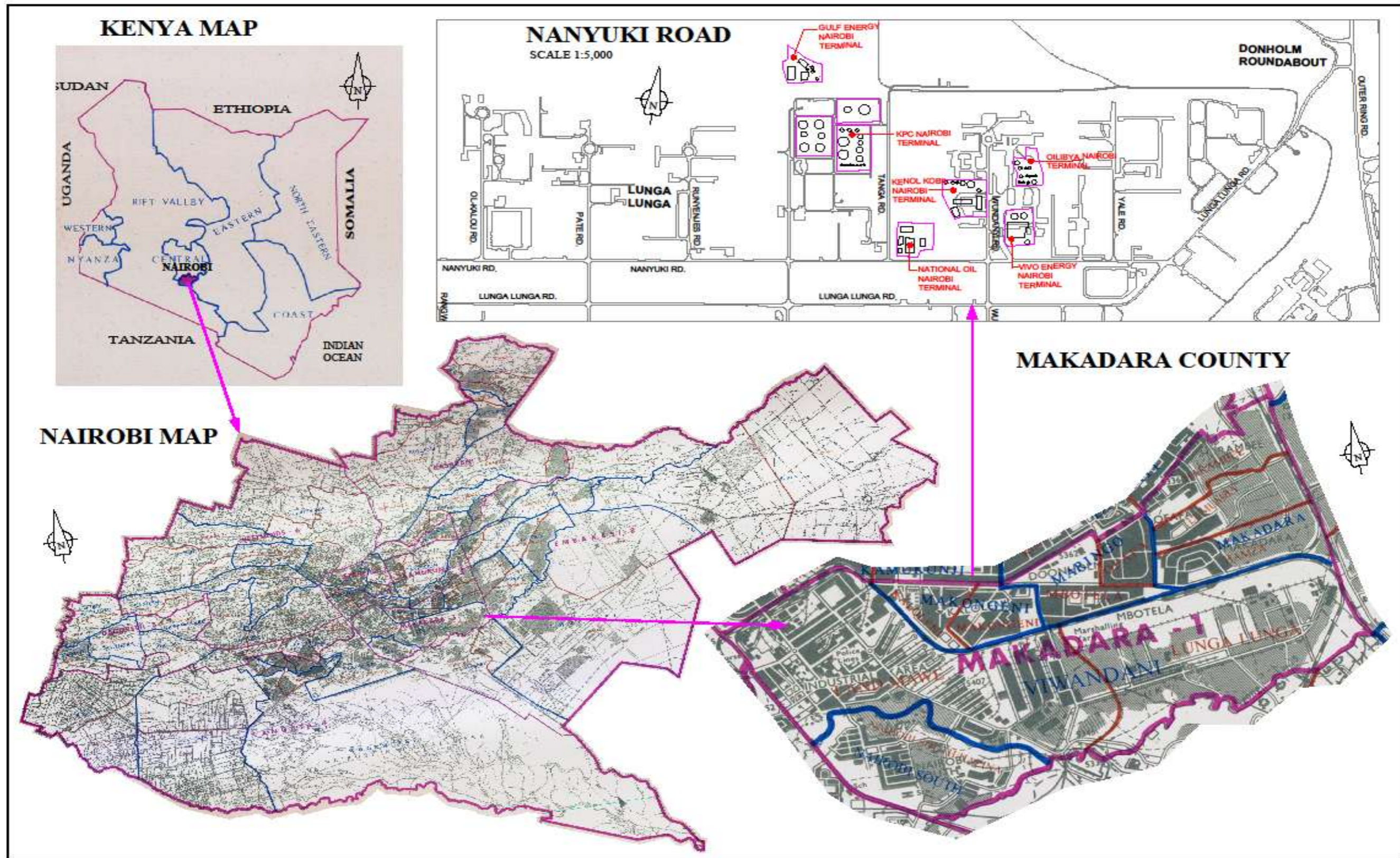


Figure 3-1: Map of Nairobi City County showing the location of the Terminals where the study was conducted

Source: Modified from Survey of Kenya 2002.

### **3.3 Geology and Topography**

Nairobi lies at an average altitude of 1650 masl (range 1500-1800 m) at the edge of the Athi Kapiti plain and the lower slopes of the Kikuyu and Aberdare escarpment. Land elevation increases from east to west. The geology of the area is dominated by volcanic rocks derived from volcanic activity associated with the formation of the Rift Valley. Among them, is the Kapiti phonolite which lies directly on rocks of the Basement Complex, the oldest rocks in the East Africa region. The lavas thin out in an easterly direction. As Nairobi is located close to the edges of the Rift Valley, it sometimes experiences tremors and minor earthquakes (GIBB Africa Ltd, 2015). The above contributes greatly and determines the type of soils in the study area site as discussed below.

### **3.4 Soils**

The soils of the Nairobi area are as a result of weathering of mainly volcanic rocks. The weathering process has produced red soils that reach more than 15m in thickness, and a number of subdivisions recognized in the area are classified according to drainage, climatic regions and slopes, and other soil categories including lithosols and regosols. (Saggerson,1991).

In the study area, the soil sub divisions that exist consist of black cotton soils which cover up to 2m from the ground. The soils are grey laterite with low to moderate strength and soil moisture tension ranging from 2386 to 6689 kPa. From 3m to 8m, there are moderately weathered brownish grey tuff, very low to moderate strength with soil moisture tension ranging from 1259 to 11534 kPa. From 8m to 11m its brownish grey agglomeratic tuff low to high in strength with soil moisture tension of 3314 to 28239 kPa. From 11m and beyond, its moderately weathered brownish grey tuff with horizontal and shear fractures with moderate to high strength and soil moisture tension of 5170 to 21604 kPa (Mathu et al, 2011). Due to the nature of these soils, they

can contain liquids for a longer period and therefore when oil spills occur, they can retain the oils for a long time posing a safety hazard when they come into contact with any form of ignition since this leads to a fire outbreak, as well as soil and underground water contamination.

### 3.5 Land use

The study site is an industrial area where most heavy industries such as food processing, oil storage and manufacturing industries are located. Other commercial activities include banking services and retail shops. According to Table 3-1, Commercial and industrial land use, totals to 4% of the total land use distribution in Nairobi City County (NIUPLAN, 2013). Table 3-1 below indicates the distribution of land use in Nairobi City County.

**Table 3-1: Land use distribution in Nairobi City County.**

Land Use	Area (sq. km)	Percentage
Residential	105.2	15.1%
Commercial	5.9	0.8%
Industrial	22.2	3.2%
Mixed Commercial & Industry	3.6	0.5%
Mixed Residential & Commercial	4.2	0.6%
Institutional	39.8	5.7%
No structures	0.3	0.0%
Open space	332.0	47.8%
Recreational	8.7	1.3%
Res slum	7.8	1.1%
Transportation	15.5	2.2%
Unknown	42.3	6.1%
Water	10.9	1.6%
Total	598.2	86.1%
National Park	96.9	13.9%
Grand total	695.1	100.0%

Source: JICA Study Team, 2013

The study area which are the oil terminals in industrial area fall under the Commercial and industrial land use in Nairobi City County.

### **3.6 Population**

The 2009 Kenya Population and Housing Census indicates that the total population of Kenya was approximately 38,610,000, and that of Nairobi City County was approximately 3,138,000, accounting for 8.1% of the total National population. The study area is located along Nanyuki road in Viwandani area of Makadara Sub County in Nairobi City County. According to the 2009 census, Makadara sub county had a population of 44,881 (GoK, 2009). With an expected growth rate of 3.8 % per annum population in Makadara Sub county is expected to have risen to 60,226 in 2018. The residential estates which form a larger part of the population include Buruburu Phase 4 and 5 and Slums in Viwandani area (Jamaica, Sinai, Paradise). These are the immediate population that will be affected by the impacts of oil spillages which can be fatal as discussed in chapter 2 of this thesis document.

### **3.7 Infrastructure**

The study area is served by two roads namely Nanyuki Road and Sekondi Road. The roads are normally characterised by heavy traffic congestions partly caused by petroleum tankers. Other infrastructural facilities available in the project area are railway siding and a public road (not classified) behind the study area. Sewer lines and water reticulation system managed by Nairobi Water and Sewerage Company as well as electrical lines managed by Kenya Power also serve the area. Telecommunication service providers in the area include Safaricom, Airtel, and Telkom Kenya networks (NIUPLAN, 2013). All these identified infrastructure and their operators can come in handy in case of a major oil spill that will require their attention in managing and preventing the impacts associated with the spills as discussed in chapter 2.

### **3.8 Study Design**

This study employed the descriptive research design (Murphy, 2018). The design was deemed appropriate for this study due to its ability to give an all-round approach for data collection that

gives a broader view of the information. Descriptive research design was ideal for this study because it ascertains and describes the characteristics of the variable of interest in a situation (Kothari, 2008). It also describes data collected over a period of time, in this case oil spills data was collected in the terminals for the past 5 years (2012 to 2017). Quantitative description of the data was achieved by describing the quantities of oil spilled in the terminals in the recent past.

### 3.9 Study Population

The research targeted representatives of the oil terminals in industrial area of Nairobi City County and representatives of Institutions involved in the management of oil spillages in the terminals as indicated in Table 3-2 and Table 3-3 respectively. The study was conducted between 12 September 2017 to 19 October 2017. The following Oil Terminals and Institutions were visited during the study.

**Table 3-2: Oil Terminal visited during the study**

<b>Oil Terminal</b>	<b>Person Interviewed</b>
Oilcom Nairobi Terminal	Operations Manager
VIVO Energy Nairobi Terminal	Terminal Manager
KenolKobil Nairobi Terminal	Depot/ Terminal Manager
Gulf Energy Nairobi Terminal	Terminal Manager
National Oil Nairobi Terminal	Environmental Health and Safety officer

Source: Field Data (2017)

**Table 3-3: Institutions visited during the study**

<b>Oil Terminal</b>	<b>Person Interviewed</b>
Energy Regulatory Commission (ERC)	Senior Technical Officer- Environment Health and Safety
National Environment Management Authority (NEMA)	Senior Compliance and Enforcement Officer (SCEO)
Petroleum Institute of East Africa (PIEA)	Research Analyst
Ministry of Environment and Forestry	Deputy Director in Policy and Director Environment Education and Awareness
Ministry of Energy and Ministry of Petroleum and Mining	Ministry Geophysicist Oil and Energy
National Disaster Operations Centre	Training Officer

Source: Field, Data (2017)

### **3.10 Sampling unit and Sampling procedure**

A sample is a subset of a population. While sampling is defined as the process of selecting a small part (sample) from the entire population to be studied (Cohen et al, 2007). It is therefore important in any research undertaking. In this study however, no sampling was done given that the number of respondents was small hence semi-structured interviews were conducted with the representatives of the oil terminals and the institutions.

### **3.11 Data Sources and Collection Procedures**

Semi-Structured questionnaires were designed to guide the Key Informant Interviews. They were administered to the oil terminal and institutional representatives in order to collect primary data see Appendix I and II for the copies of the questionnaires. Key Informant Interviews through the semi structured questionnaires was preferred in order to gather qualitative data, since it allowed

the researcher to ask a set of predetermined questions and also collect any other information not planned earlier but which proved relevant to the thesis topic of study (Zorn, 2010).

An introductory letter from the University of Nairobi and a research permit was obtained from National Commission for Science, Technology and Innovation (NACOSTI) before data was collected from the representatives of the Oil Terminals and Institutions. The questionnaires were personally delivered to them for filling and to guide the interviews. This was necessary to monitor the process, and to ensure that unintended people did not fill the questionnaire or were not interviewed. The questionnaires were filled, and assistance was sought where possible thus raising the reliability. The schedules of the meetings were done early in advance in order to allow for planning for the meetings.

Secondary data used in this study included that obtained in journals, library materials, past research studies and Internet searches. This data was collected through review of past studies on oil spillages and the existing International and National Policies, Standards, Acts and Institutional arrangements that focus on the management and handling of oil spillages.

### **3.12 Data Analysis and Presentation**

The process of data analysis involved review of responses from the Key Informant Interviews and a descriptive method was used to present the details of the data collected.

## CHAPTER FOUR: RESULTS AND DISCUSSIONS

### 4.1 Introduction

This chapter provides a detailed presentation of the study findings. The findings include the quantities of oils spilled in the terminals in the recent past, number of incidences of the oil spills in each terminal, causes of oil spills in the terminals, the mitigation measures being used by the management of oil terminals and institutions to manage the oil spillages in the terminals and the challenges experienced when implementing these mitigation measures.

### 4.2 Quantities, incidences and causes of oil spillages in in the recent past

#### 4.2.1 Quantities of oil spillage in the recent past

Figure 4-1 below indicates that during the recent years, the quantities of oil spillages were high in 2012 and tremendously reduced in 2013. There was a noticeable rise in 2014 and in 2015, with a reduction recorded in 2016. No spill was recorded in 2017.

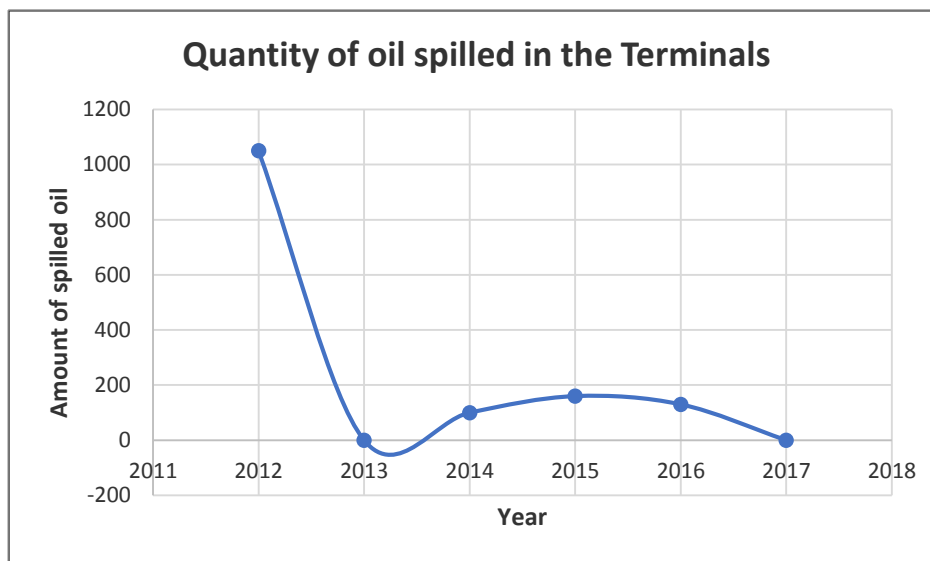


Figure 4-1: Amount of oil spilled in the inland oil terminals located in industrial area of Nairobi City County in the recent past

Source: Field Data (2017)



From the Key Informant Interviews, the reduction of spillage quantities from 2012 to 2013 were due to enforcement and creation of staff awareness on the safety procedures to be observed while at the terminal. This included confirmation of loading notes prior to loading any oil trucks, ensuring that the correct valves are opened when loading and closing the valves after loading procedure is complete in order to avoid any backflow that will lead to spillages.

Due to adaptation of improved technology, the terminals also reported improved engineering works such as installation of automated valves that close immediately, when they sense that the product recipient tank is full as well as automated alarms that go on immediately a spill is detected within the system. This enables for the staff to quickly address and stop any product flows before a spill occurs. Policy, Legal and institutional framework enforcement reported during the Key Informant Interviews of the oil terminals indicated that in order to obtain their annual operating licenses from Energy and Petroleum Regulatory Authority (EPRA) , the terminals were required to first obtain clearance from NEMA and other statutory bodies including DOSHS. According to Environmental (Impact Assessment and Audit) Regulations 2003, and (Amendment), 2016, the terminals are required to submit annual audit reports to NEMA on the preventive measures put in place to prevent oil spillages as well as record number of spillages that have occurred in the operating year and, how they were managed. This implied that the terminals had to put their operating procedures in order so as to ensure that their records on quantities of oil spillages are reduced. All these strategies contributed to the reduction in quantities of oil spillages from 2012 to 2013.

However, in 2014, the rise in quantities of spilled oil occurred due to some laxity in the implementation of the above-mentioned strategies as reported during data collection. The terminal representatives indicated that this rise was due to staff not adhering to the safety procedures set out in the terminals as discussed above. In some cases, the rise in oil spillages was due to new staff who had not been engaged in the loading activity previously being allowed to conduct the loading procedure and therefore were not aware of the safety procedures to observe while loading the products. There were also no records to indicate that all new staff that joined the terminals between 2014 and 2015 were being inducted on the safety procedures and this therefore contributed to the rise in oil spillages during the two years. Also, failure to service and maintain spill prevention automated equipment was reported to be one of the reasons behind the rise of the oil spill incidences since, the automated valves failed to shut down when spills were detected within the system causing oil spillages.

Due to the refresher causes that the terminals indicated that they resorted to be conducting to their staff, it is evident that this was implemented since there was a reduction in oil spillages in 2016 and no reportable spill was recorded in 2017. The EPRA Guidelines developed in 2015 and 2016 as discussed under policies in this section required the oil terminals to adhere to the safety operational guidelines prior to obtaining their annual operating licenses.

Muthike, 2018 conducted a study to determine the level of preparedness in which Kenya stands to respond to large oil spillages. Findings from the study indicate that personnel from the oil companies have been trained in oil spill preparedness and have gone through spill response exercises (Muthike, 2018). This is in agreement with this study since training of workers on oil spill prevention and management was one of the key preventive and management measures put in place in the terminals as reported during the study in addressing oil spillages.

#### 4.2.2 Oil spill incidences per Oil Terminal in Industrial Area of Nairobi City County

Figure 4-2 below indicates that in the recent past, KenolKobil and National Oil have experienced oil spill incidences in 4 years out of the 5 years of data collection. Gulf Energy followed closely by experiencing oil spill incidences in 3 years out of the 5 years of data collection. VIVO Energy and Oilcom recorded no oil spill incidences.

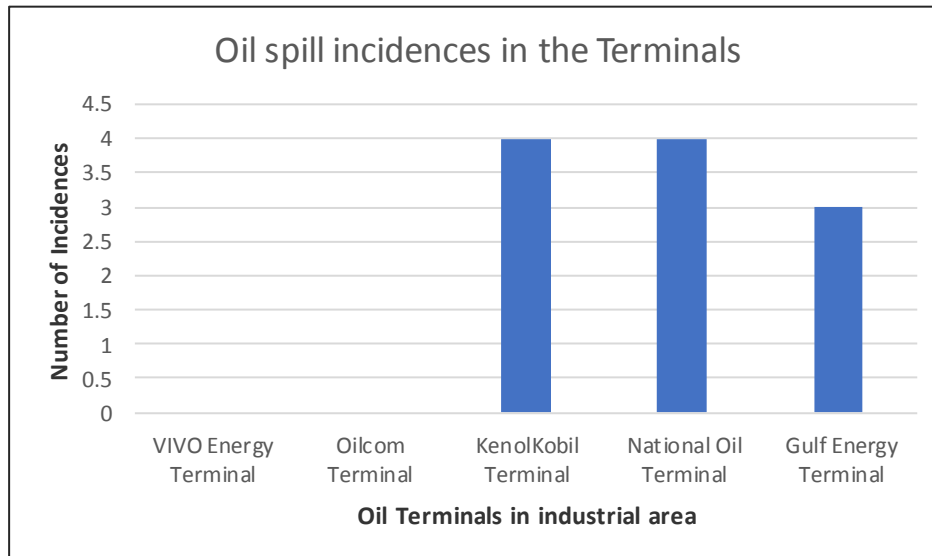


Figure 4-2: Oil spilled in the inland oil Terminals located in industrial area of Nairobi City County in the recent past

Source: Field Data (2017)

Key informant interviews indicate that refresher courses and staff induction has been encouraged in the terminals as a measure of preventing and managing oil spill incidences. However, the incidences in these terminals were as a result of staff who failed to observe these procedures. It is evident that KenolKobil, National oil and Gulf Energy terminals need to frequently conduct and remind the staff of their laid down procedures that are to be adhered to during the loading procedures. These procedures include cross checking the loading notes to ensure they match the

specified trucks and tank compartments, conducting integrity tests on the oil tankers before loading them, ensuring that the correct tank valves are opened during the loading process and, are also closed after loading procedure is complete to prevent any backflows which lead to spillages.

VIVO Energy and Oilcom Terminals reported not to have experienced any oil spillages however, they should also adopt the above discussed strategies since during the visit in the terminals, physical observations indicated that oil spillages have happened in the recent past.

Alkhldi et al, (2017) conducted a study on how human error contributed to accidents in the oil and gas industry in Bahrain. The study results indicated that 70% of all the accidents in the industry emanate from human error. The study recommends that the oil industry should designate a training team to determine the gaps and skill needs among the workers and spearhead the training of workers in order to reduce the human error contribution to oil spillages. The study also recommended that the oil industry should include innovation and adoption to new industry technology as key to its industry practices. This will build skills among its workers in the oil industry and at the same time reduce the number of times that human beings have to control the processes in the industry. Through this, the oil spillages will be reduced. The findings of this study agree with the findings and recommendations of the study by Alkhldi as discussed before which aim at reducing human error in the oil industry.

### 4.2.3 Causes of oil spillages in the Oil Terminals in the recent past

Figure 4-3 below indicates that lack of staff adherence to oil tank loading instructions are the leading causes of oil spillages in the terminals. This is followed by mechanical faults, equipment failure and lastly lack of induction to new staff involved in the oil tankers loading procedures.

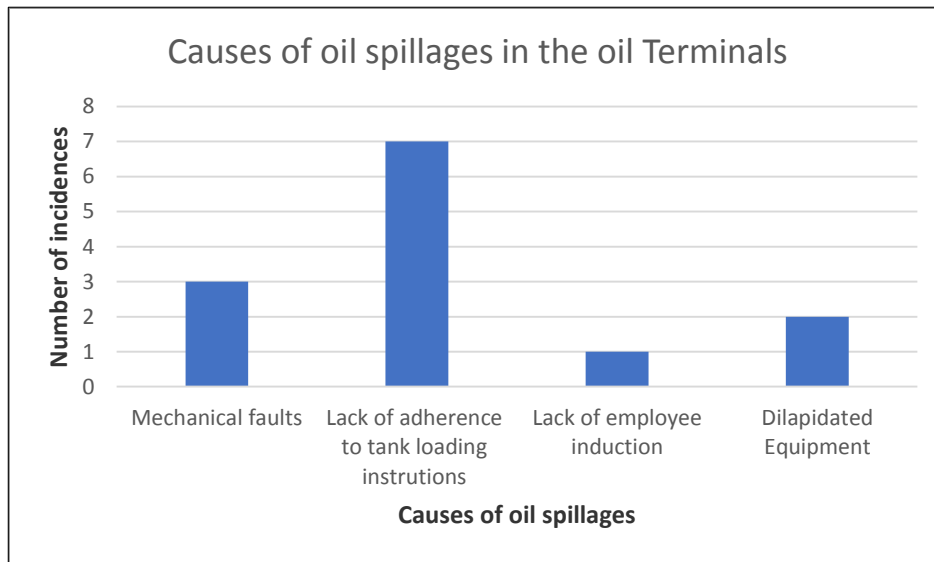


Figure 4-3: Causes of oil spills in the inland Terminals located in industrial area of Nairobi City County

Source: Field Data (2017)

From the Key informant interviews, lack of adherence to tank loading instructions includes mistakenly interchanging the loading arms assigned to different tank compartments with different capacities in the oil tankers. This causes oil spillages when the loading arm with a higher capacity is directed to feed in a tank compartment with a lower capacity. Failure of staff to open the right valve when loading the oil trucks have also contributed to oil spillages. This is

due to mistakenly opening valves in tank compartments with oil products instead of empty compartments meant to be filled, therefore leading to spillage of the oil products.

Mechanical faults were reported to be the second leading cause of oil spillages in the terminals. Lack of scheduled maintenance of oil handling equipment in the terminals, leads to mechanical faults which contribute to oil spillages in these oil terminals. These includes failure of automated valves and alarms which are supposed to stop oil supply procedure when they sense some spillages in the systems or alert the staff to stop any oil supply procedures until the detected spill or leakage is addressed.

Thirdly, dilapidated equipment or use of old equipment that are in a wanting state of replacement due to malfunctioning incidences and leakages. These includes retailers oil tankers with leaking points that need welding but since no integrity tests are conducted on the tankers prior to loading, there are loaded with oil products leading to leakages. Some product tanks are more than 30 years old. It was reported that these tanks have experienced leakages and need to be replaced with new product tanks.

Lastly, lack of induction to new staff has also contributed to oil spillages due to non familiarity with the loading procedures and the safety procedures to be observed, while undertaking the loading process.

The findings of this study are similar with a study conducted by Michel and Fingas in 2016 which indicates that 30% to 50% of oil spills are either directly or indirectly caused by human error while equipment failure or malfunctioning of the equipment contributes 20% to 40% of all spills (Michel and Fingas, 2016). It is noted that the study in the arctic was a maritime oil spill one while results from the oil terminals are terrestrial or inland oil spill studies but despite this,

human error still remains the leading cause of oil spillages in the oil industry. In this study case, it's the oil terminals located in industrial area of Nairobi City County.

#### **4.2.4 Prevention and management strategies put in place to control oil spillages**

The preventive and management strategies put in place by the oil terminals and institutions in managing oil spillages in the oil terminals include Policy, Legal and Institutional mechanisms, Engineering works, Education and awareness creation among staff as discussed below.

#### **4.2.5 Policy, Legal and Institutional mechanisms**

For better presentation of the policy, legal and institutional mechanism, the anchoring Legal instrument has been highlighted before the associated policies and lastly the institutional body in charge of its implementation.

#### **Constitution of Kenya 2010**

Various chapters in the Constitution of Kenya have highlighted the need to protect the environment from any harmful activities which in this case includes oil spillages, whose impacts are detrimental. For instance, Chapter 5 is on Land and Environment. Section 60 of the constitution advocates for all the citizens to use land and its resources in an effective and sustainable manner. Section 42 indicates that every person has the right to a clean and healthy environment. Section 69 indicates that state is obligated to protect the environment from any harmful activities or any activity that is likely to endanger the environment.

The inland oil terminals located in industrial area of Nairobi City County are therefore obliged to comply with the requirements of the Constitution of Kenya and ensure that oil spillages are prevented and managed in order to reduce their impacts to the environment.

## **Environment Management and Coordination Act (EMCA) of 1999 and its (Amendment) Act of 2015**

EMCA provides the main legal and institutional framework under which the environment in general is to be managed. EMCA is implemented by the guiding principle in section 42 of the Constitution of Kenya which states that every person has a right to a clean and healthy environment and can seek redress through the High court if this right has been, is likely to be or is being contravened.

Section 58 of the Act makes it a mandatory requirement for an EIA study to be carried out by proponents intending to implement projects specified in the Second Schedule of the Act. Such projects have a potential of causing significant impacts on the environment. Similarly, section 68 of the same Act requires operators of existing projects or undertakings to carry out Environmental Audits (EA) in order to determine the level of conformance with statements made during the EIA study. The oil terminals have been listed under the Second Schedule, high risk projects 11 (a) depots and refinery facilities for hydrocarbons. In relation to this study and in compliance to this Act, the oil terminals are required to be conducting Annual Audits in order to determine the level of preventive measures put in place in the management of the environment among them prevention and management of oil spillages. The study findings indicate that the terminals are aware of this Act and conduct their activities as per the requirements. This includes, conducting annual audits and submitting the reports to NEMA, prior to them obtaining the annual practising licenses from EPRA. Various policies and regulations are implemented through this act as discussed below.



### Environmental (Impact Assessment and Audit) Regulations 2003, and (Amendment), 2016

Regulation 3 states that “the Regulations should apply to all policies, plans, programmes, projects and activities specified in Part IV, Part V and the Second Schedule of the Act. As mentioned in EMCA Act, the inland oil terminals in industrial area have been listed under the Second Schedule, high risk projects 11 (a) depots and refinery facilities for hydrocarbons. They are therefore required to undergo Annual Audits as per the requirements and guidelines of these Regulations Part V on Environmental Audit and Monitoring.

### National Environmental Policy 2013

Formulated by the then Ministry of Environment, Water and Natural Resources in 2013, the goal of the policy is to provide better quality of life for present and future generations through sustainable management and use of the environment and natural resources.

Section 5.11.2 identifies inadequate capacity to deal with emergencies and incidences including storage and transportation of chemical products which includes oils, associated with oil spillages in the oil storage terminals. During the Key Informant interviews with the oil terminals representatives, the same inadequacy in capacity to deal with spillages was mentioned as one of the challenges that the oil terminals are experiencing in ensuring that their workers or staff are fully equipped with knowledge to address oil spillages in the event that they occur.

Section 5.9 recognises petroleum as one of the energy sources and recommends the development of a comprehensive petroleum policy guided by research and which shall emphasize on the precautionary principle. This research is an attempt to achieve this recommendation.

Section 9.2 Policy statement numbers 1 and 3 emphasise on the strengthening of capacities for environmental institutions so as to make them to be more effective in ensuring compliance and enforcement. Key informant interviews with the institutional representatives indicated that the institutional framework are limited by capacity in terms of human resources and financial resources, to enable them implement their roles fully in monitoring implementation of the law aimed at managing oil spillages in these oil terminals.

Section 9.3 on Environmental Compliance, Policy statement number 3 states that the Government shall provide economic incentives for establishments that adopt environmental friendly technologies. Economic incentives are used to encourage adherence to the laid-out rules or laws. The policy is however silent on the exact government arm that shall be in charge of promoting incentives. Proposed implementation strategies of the economic incentives to the inland oil terminals located in industrial area have formed part of the recommendations of this study.

#### Environmental Management and Coordination (Deposit Bonds) Regulations, 2014

These Regulations are applicable to activities such as industrial plants and others that are more likely to have adverse effected on the environment through their operations. The inland oil terminal in industrial area of Nairobi City County fall under this category.

The purpose of these regulations is to ensure good environmental practices, adequate remediation is achieved without adversely affecting economic viability of the industry, compliance with remediation obligations, availability of funds for remediation and sustainable development.

Depots for petroleum products have been mentioned in the First schedule section 2 (h) of these regulations to be among the facilities that shall attract deposit bonds. During the Key informant interviews, NEMA Senior Compliance and Enforcement Officer indicated that lack of funds to prevent and address oil spills has been identified as one of the challenges experienced by institutions and the terminals, when implementing mitigation measures aimed at addressing the oil spillages. The Officer indicated that when the terminals are mandated to contribute towards the deposit bonds, then this will ensure that they are covered financially when an oil spill emergency occurs.

Part VIII on Miscellaneous section 22 has stated the penalties to be imposed on any person found guilty of an offense with the regulations. The penalties have been stated to a fine of not more than three hundred and fifty thousand shillings or imprisonment of not more than eighteen months, or both. The regulations have not stated the minimum amounts to be charged or minimum period of imprisonment to be imposed. This can be an easy escape route for offenders of the regulations.

#### Technical guidelines on the management of used oil and oil sludge in Kenya, 2016

Published by NEMA, these guidelines seek to ensure effective and efficient collection and transportation systems for used oil. Targeted entities include government agencies, small generators, bulk generators of used oil and oil sludge, garages, used oil treatment plants, recycling and disposal facilities, and other interested stakeholders. The oil terminals fall under these categories and are required to adhere to these guidelines when disposing their wastes.

By adhering to these guidelines, the oil terminals can be able to monitor the quantities of hazardous wastes (wastes contaminated with oil products from the terminals). This can be used

as an indicator on how they are performing when it comes to spillages and will encourage improvement measures and reduced oil spillages while achieving reduced quantities of hazardous wastes generated from the terminals. These guidelines have however missed out on the penalties that should be imposed on anyone found contravening the requirements of these guidelines. This is an important aspect as it encourages the adherence to the guidelines by the used oil and oil sludge generators.

#### Environmental Management and Co-ordination (Waste Management) Regulations, 2006

Developed by NEMA in 2006, these regulations apply to all manner of wastes as categorised in the regulations. The inland oil terminals in industrial area Nairobi City County are prone to emit hazardous wastes from oil spillages which form part of the wastes as mentioned under the fourth schedule of these regulations.

Regulation 6 requires waste generators to segregate waste by separating hazardous waste from non-hazardous waste for appropriate disposal. Regulation 15 prohibits any industry from discharging or disposing of any untreated waste in any state into the environment. Regulation 17 (1) makes it an offence for any person to engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by NEMA. The inland oil terminals located in industrial area are therefore required to adhere to these regulations whenever they are disposing their wastes.

#### Environmental Management and Co-ordination (Water Quality) Regulations, 2006)

Developed in 2006 by NEMA, these regulations are applicable to all other water uses among them industrial waters as applicable to the oil terminals in industrial area. The fifth schedule provides standards for discharge into public drains as witnessed in these inland oil terminals.

As reported in Chapter 2, one of the slums in viwandani industrial area (Sinai) experienced the impacts of the accidental release of oil products from the KPC Nairobi Terminal on 12 September 2011. It became fatal and left over 100 people dead and around 160 badly injured with scars to date (Shileche, 2012).

The oil terminals are obliged to keep their waste water discharge into the public drain to within the stipulated standards so as not to discharge oil contaminated water into the environment through the public drain. This measure contributes towards a reduction of oil spillages in the terminals as an effort to comply with the regulations during the annual audits.

During the annual audits, various monitoring parameters are checked among them is the sampling of waste water discharged from the terminals to ensure that its content is within the stipulated water quality regulations of 2006. This is a measure that contributes towards ensuring that there is reduced oil spillages in the terminals. The institutional framework that will play a role in ensuring the above policies and acts are enforced in the terminals are as follows:

#### National Environment Management Authority

From consultations during the study, the National Environment Management Authority (NEMA) is involved in licensing of oil terminals after the terminals have demonstrated satisfactory oil spill management mechanisms. This includes requirement by the terminals to demonstrate that the Environmental and Social Impact Assessment (ESIA) licensing has been conducted and, effluent discharge licensing and monitoring operations to avoid oil spills through annual and control environmental Audits and inspections of the oil terminal facilities to ensure compliance with the relevant regulations. The control Audits are undertaken as a routine to confirm information submitted in the Environmental Audit Reports or the ground status in case of an oil

spill incident. NEMA also offers rapid response in case of oil spill incidents and coordination of the clean up by the relevant lead agencies and stakeholders.

NEMA indicated that there is inadequate technical capacity to offer thorough inspections when it comes to oil spill management in the oil terminals was a major challenge in the institution. In addition, lack of funds to enable them deliver their roles and weak inter-agency coordination in undertaking monitoring of operations in the oil terminals operations so as to ensure oil spillages do not occur are limiting factors to the institution when delegating its roles. Delays in finalisation of draft policies as indicated in Chapter two was also noted to impede their enforcement and therefore until they are finalised, NEMA indicated that they cannot penalise any oil terminal institutions based on the draft regulations.

#### Ministry of Environment and Natural Resources

The Ministry has been renamed to (Ministry of Environment and Forestry). From consultations conducted during the study, the Ministry supports NEMA in facilitating methods and strategies geared towards the management of oil spillages in oil terminals. This includes gazetting any regulations set by NEMA on oil spill management for example the Environmental Management and Coordination (Deposit Bonds) Regulations, 2014, and presenting any amendments to the laws and regulations to the Cabinet Secretary, for onward presentation to parliament before they are passed into law.

Data gathered from the Ministry indicated that the country lacks the capacity to address oil spillages and have to rely on international expertise to address the incidents when they occur. The institution also pointed out that its lack of representation at the County level has made it a challenge in terms of human resources to adequately monitor the various environmental threats

in the Counties, Nairobi being one of the Counties, whenever oil spill incidences occur they have to rely on feedback from the other institutions such as NEMA to inform them on the measures that have been taken to address the incidences and the improvement/recommendations that have been proposed. Lastly, the Ministry indicated that poor enforcement of the current legislation in addressing oil spillages combined with poor institutional coordination in implementing the legislation has aggravated the oil spill incidences in the oil terminals.

#### Nairobi City County Government (NCCG)

Through its Environmental and Enforcement department, NCCG is mandated to ensure that all environmental protection strategies are observed by various institutions within the County. During the Key Informant Interviews, the study found out that NCCG also participates in conducting fire drills and oil spill management training to the workers in the oil terminals. NCCG also conducts periodic sampling of the waste water discharges from the terminals to check and ensure that there are no traces of the oil products from the terminals that are beyond the stipulated water quality regulation of 2006 under EMCA. By this act, the terminals tend to adhere to the stated regulations all which contribute to prevention and management of oil spillages from the terminals.

#### **Land Act, 2012**

This is an act of Parliament to provide for the sustainable administration and management of land. Section 10(1) indicates guidelines for the management of public land by all public agencies, statutory bodies and state corporations in actual occupation or use. Part II Section 8 provides guidelines on management of public land by National Land Commission (NLC) on behalf of both National and County Governments. Among other duties the act gives mandate to

the commission to prevent environmental degradation and climate change. Oil spill management in the oil terminals in industrial area will contribute towards preventing environmental degradation. The National land policy is implemented through this act as discussed below.

### National Land Policy 2009

As published by the Ministry of Lands and Physical Planning, one of the guiding principles of the policy is to promote environmental conservation and preservation. Chapter 3 under section 3.4, Environmental Management Principles, indicates the policy advocates for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. These environmental degradation activities include soil erosion, air pollution, water and land pollution. The oil spillages in the oil terminals in industrial area of Nairobi City County can contribute to land pollution. There is therefore need to prevent and manage the spillages in order to ensure that land is not polluted.

Section 3.4.3.3 prohibits discharge of untreated wastes into the environment of which oil spillages form part of these untreated wastes. The study identifies that there are no penalties mentioned in the policy against anyone found contravening this policy. This policy is implemented through the Ministry of Lands and Physical Planning as discussed below.

### Ministry of Lands and Physical planning

The Ministry of Lands and Physical Planning is mandated to formulate and implement the land policy. Its mission is to ensure sustainable use of the land resource. This ministry is obligated to ensure that the oil terminals conduct annual NEMA audits in order to ensure that the land resource in these terminals is protected from land degradation activities such as oil spillages.



## **Energy Act 2019**

This is an act of Parliament to consolidate the laws relating to energy, to provide for National and County Government functions in relation to energy, to provide for the establishment, powers and functions of the energy sector entities among which is to regulate midstream and downstream petroleum activities. The act has highlighted various sections meant to address oil spillages that will be applicable to the oil terminals in industrial area of Nairobi City County. Among them are as follows.

Section 214 of the Act outlines requirements for reporting of accidents and incidents including oil spills to the Energy and Petroleum Regulatory Authority within 48 hours of the happening of the incident.

Section 4 mandates the Cabinet Secretary in charge to develop after every five years the National Energy Policy , which after every financial year and within three months shall give a report on how it has been implemented.

Under the fifth schedule item (B) (2(d), on the functions of the county governments, they have been designated to license and regulate the parking areas for petroleum tankers. This will go along way in contributing towards management of oil spillages in oil terminals located in industrial area. During the Key informant interviews, this was one of the challenges mentioned by the oil terminals in trying to control spillages around the terminals due to the siphoning of oil from the oil tankers parked outside the terminals. They felt that the situation could be controlled if the oil tankers had a designated parking area where there is monitoring and security that would discourage the siphoning activities.

## Final Draft of the National Energy and Petroleum Policy of 2015

As mentioned earlier, the Energy Act Mandates the Cabinet Secretary to develop a National Energy Policy after every five years. This draft National Energy and Petroleum Policy can be used as a guiding document in developing the policy. Section 6.8.5 on Disaster Preparedness, Prevention and Management has pointed out strategies that will be put in place to ensure readiness in addressing the disasters associated with petroleum products among them which are oil spills. Strategy Number 2 states that the Ministry of Energy and Petroleum will collaborate with National Disaster Operations Centre in spearheading response to petroleum associated disasters. However, the Ministry has since been split into the Ministry of Energy and Petroleum and Mining.

Strategy Number 6 advocates for the development of the Disaster preparedness, prevention and mitigation policy which shall benefit the oil terminals as a guiding tool when updating their oil spill preparedness and response strategy.

Strategy Number 7 states that the Ministry of Energy and Petroleum shall ensure compliance with all statutory requirements among which will include designation of parking lots for petroleum tankers. This aspect has already been covered under the Energy Act as discussed earlier.

## Energy and Petroleum Regulatory Authority (EPRA) Guidelines 2015 and 2016

### i. Operation and Maintenance of Petroleum Terminals November 2015

These guidelines have been developed to promote safety in oil terminals during installation and operational phases of these terminals. Section 18 highlights the steps and measures that should

be undertaken in case of oil spill in the terminal to curb its further spread. Some of the measures include soaking up the spilled oil with oil spill kits, soaked materials to be stored in impermeable containers for safe disposal as per the NEMA's Waste Management Regulations 2006 Part IV on disposal of hazardous wastes, testing of surface and subsurface soil and groundwater for product contamination and recommending for the necessary action to be taken.

From consultations with the oil terminal representatives, equipment failure is one of the causes of oil spills in the oil terminals. Section 24.6 of the guidelines on the causes of spills and leaks in terminals highlights various maintenance measures to be undertaken frequently on equipment to avoid cases of leaks and spillages.

ii. Pollution Incident Planning Guidelines for Petroleum Terminal June 2016

The document has provided Technical Guidance Notes/Guidelines on good practices for the development, implementation and sustenance of a Pollution Incident Response Plan for a Petroleum Terminal. Section 10.21, 10.25 and 10.26 requires for the installation of shut off valves which can be used to stop any spillages. Section 11 mentions the materials and equipment that can be used to contain spillages such as sand, absorbents, sealing devices and substances for damaged containers among others. Section 14 and 15 gives a guideline on how to develop a Pollution Incident Response Plan as well as the minimum contents that should be in the Plan. All these are relevant measures to be adopted in management of oil spillages from the terminals.

This study recognises that with new technology being embraced in development, the oil terminals will also embrace the same to improve their outputs and capital. With development and improved technology, new challenges in managing oil spillages may crop up. The guidance notes have not indicated the procedure to be followed by stakeholders whenever they need to

contribute to revisions of the guidance notes to accommodate the new challenges. The guidance notes should therefore propose a committee with a clear composition of participants and their roles, who will be mandated to review and update the documents to be in line with present and any new developments/technologies. These guidelines are implemented by EPRA.

#### Energy and Petroleum Regulatory Authority

Being a regulatory body, EPRA is mandated to conduct annual Audit inspections in the oil terminals to ensure that their operations are within the minimum requirements/standards in as far as environmental protection and health and safety at the terminals are concerned. The Authority is also responsible for the issuance of annual operating licenses to the oil terminals. Prior to the issuance of the licenses, they ensure that the oil terminals have demonstrated compliance with the institutions set guidelines (Operation and Maintenance of Petroleum Terminals November 2015 and Pollution Incident Planning Guidelines for Petroleum Terminals June 2016), the Energy Act, 2019, Petroleum Act, 2019 as well as the NEMA and DOSHS requirements, where they are required to Audit their terminals and submit their reports to these bodies for approvals. (GoK, 2016). EPRA therefore forms part of the key institutions whose role is key in prevention and management of oil spillages in the inland oil terminals located in industrial area of Nairobi City County.

During the Key informant interviews, EPRA indicated that there is lack of expertise in the country to deal with oil spill incidences. The researcher was informed that currently in the country, we don't have adequate oil spill response expertise (Muthike, 2018). EPRA also mentioned that lack of commitment from partner stakeholders in enforcing their roles in

managing oil spillages and promoting other safety procedures in the terminals has also been a challenge in the process of enforcing their role in management of oil spillages.

### Ministry of Energy

The Ministry of Energy functions include: energy policy and development, hydro power development, geothermal exploration and development, thermal power development, oil and gas exploration, oil & gas and minerals sector capacity development, rural electrification programme, petroleum products, import/export/marketing policy management, renewable energy promotion and development, energy regulation, security and conservation, and fossil fuels exploration and development.

In line with this study and as required by the Energy Act, the Cabinet Secretary is in charge of developing the National Energy Policy after every five years. The Ministry of Energy is in charge of cooperating with the Nairobi County Government to ensure that a designated and licensed parking area for petroleum tankers has been identified in industrial area which will contribute towards reduction of oil spillages within and around the oil terminals. This is as per the requirement of the fifth schedule item (B)(2(d) in the Energy Act.

### **Petroleum Act 2019**

This is an Act of Parliament to provide a framework for the contracting, exploration, development and production of petroleum, cessation of upstream petroleum operations, to give effect to relevant articles of the Constitution in so far as they apply to upstream petroleum operations, regulation of midstream and downstream petroleum operations and for connected purposes.

Section 5 of this Act indicates that the Cabinet Secretary shall develop and publish a National Policy on petroleum operations which shall be reviewed at least once in every five years, with the involvement of the relevant stakeholders. The Cabinet Secretary will also be required to publish within three months after every financial year a report on the policy implementation.

Section 63 of the Act requires that outlines requirements for reporting of accidents and incidents including oil spills to the Energy and Petroleum Regulatory Authority within 48 hours of the happening of the incident.

Section 75 of the Act requires the oil terminals to comply to local and international laws prior to receiving their annual operating licences. For the oil terminals in industrial area, this will include obtaining clearance from DOSHS, NEMA, NCCG among other institutional bodies. The oil terminals are required to comply to the legal framework in the Act and the Policies thereafter as a measure of preventing and managing oil spillages in the terminals.

#### Ministry of Petroleum and Mining

The Ministry's operations are guided by the Petroleum Act of 2019. During the study, data was collected from the then Ministry of Energy and Petroleum. However, and as mentioned before, this Ministry has since been split into two separate ministries namely: Ministry of Energy and Ministry of Petroleum and Mining. The Ministry of Petroleum and Mining has two state departments namely: State department for mining and State department for petroleum. The latter being created in 2015, is mandated to spearhead all petroleum operation programs in the country including policy formulation, review of legal and regulatory framework, monitoring and supervision of oil and gas exploration development and production activities. It is responsible to

ensure that the oil terminals in industrial area adhere to the Petroleum Act of 2019. Through this, oil spillages will be prevented and managed.

Data gathered during the study from the Ministry indicated that the country lacks the capacity to address oil spillages and have to rely on international expertise to address the incidences when they occur. The institution also indicated that there is poor institutional coordination in implementing laws aimed at addressing environmental disasters such as oil spillages.

#### Petroleum Institute of East Africa

From consultations during the study, Petroleum Institute of East Africa's (PIEA) role in oil spill management is to be a secretariat to the Committees of the oil terminals. Specifically, PIEA assists in organising for oil spill drills for the terminals and assesses the terminals' level of response as well as make recommendations on the improvement procedures to be implemented to deal with oil spillages. PIEA therefore forms part of the key institutions whose role will contribute towards prevention and management of oil spillages in the oil terminals located in industrial area of Nairobi City County.

However, during the Key informant interviews PIEA indicated that the government takes long to enforce safety measures around the terminals. A case example is the syphoning of fuel from packed oil tankers along Nanyuki road by the locals which poses danger to them and even the terminals in case of fire outbreaks as well as causing oil spillages around the terminals. A concern on lack of coordination and commitment between different stakeholders in the oil industry in enforcing the stated legislation meant to address oil spillages in the terminals was also an issue raised by the institutions that they felt needed to be addressed.

## Final Draft of the National Policy for Disaster Management, 2010

The Final Draft of the National Policy for Disaster Management in Kenya 2010 has listed oil spills to be one of the disasters that are being experienced in Kenya. Chapter 4 of the policy provides guidelines on Risk reduction and response functions. Specifically, section 4 emphasizes on awareness raising and education to the public on the general understanding of disaster risks and how to address them. Creating awareness among staff in the oil terminals has formed part of the independent variables in this study as a contribution towards achieving reduced oil spillages in the terminals. On its approval, the policy will among key institutions be implemented by the National Disaster Operation Centre.

### National Disaster Operation Centre (NDOC)

From consultations during the study, NDOC's role is to create awareness to the surrounding community about the possible dangers/hazards that may arise during activities such as oil exploration, development, production, storage and transportation of petroleum products. It also coordinates response to oil spills and gas leak incidents that may include fire outbreaks by ensuring that plans for evacuation and shelter for victims of any hazards in relation to oil spills are in place. This includes provision of basic commodities, ensuring relevant agencies are informed of the disaster response plans, preparation of disaster information media briefs to provide information on oil spill incidents, its effects on the surrounding community and what is being done to respond and mitigate the effects of the spills. Finally, it ensures that there is a data bank showing the likely responders to an oil spill or gas leak incidents. NDOC is one of the key stakeholders in creating safety procedures and strategies amongst workers in the inland oil terminals in industrial area.



From Key informant interviews, NDOC indicated that there is inadequate technical capacity especially in offering training to the terminals on prevention and management strategies meant to address oil spillages. The passing of the Final Draft of the National Policy for Disaster Management in Kenya 2010 into law by parliament should also be fast tracked to enable them to enforce the stated requirements. Overlap of roles with other institutions such as Kenya Maritime Authority was also noted as a challenge by NDOC which contributes to their non-participation during disaster incidences such as oil spillages.

### **The Occupational Safety and Health Act, 2007**

This is an Act of Parliament to provide for the safety, health and welfare of all workers and all persons lawfully present at workplaces in this case the oil terminals. It applies to all workplaces where any person is at work, whether temporarily or permanently. The purpose of this Act is to secure the safety, health and welfare of persons at work, and to protect persons other than persons at work against safety and health arising out of, or in connection with the activities of persons at work. It establishes codes of practices to be approved and issued by the DOSHS for practical guidance of the various provisions of the Act. The oil terminals are therefore required to comply with this Act at all times.

### **Directorate of Occupational Safety and Health Services (DOSHS)**

Its mandate is to ensure compliance with the provisions of the Occupational Safety and Health Act 2007 and promote safety and health of workers in the workplaces including the inland oil terminals in industrial area of Nairobi City County. It has various functions. The key functions applicable to the oil terminals are inspecting workplaces to ensure compliance with safety and health law, measurements of workplace pollutants for purposes of their control, training on

Occupational safety and health, first aid and fire safety and disseminating information on occupational safety and health to customers. By ensuring that the oil terminals comply to the above, this will contribute towards achieving a reduction in oil spillages.

#### Ministry of Labour and Social Protection

Its mission is to promote decent work, skills development and sustainable job creation. It has eight (8) objectives among them is to inculcate a safety and health culture in work places. The Ministry has been mandated by the government to promote health and safety at work. The Ministry therefore has a responsibility of ensuring that the oil terminals have been registered by DOSHS and are complying to the periodic safety audits as required by DOSHS. In line with this, the oil terminals are required to demonstrate the strategies that they have put in place to ensure that the terminals and the workers are prepared to address any oil spills emergencies, as well as the safety procedures put in place to prevent oil spillages. By complying to these requirements, the oil terminals will achieve a reduction of oil spills.

#### **The Kenya Roads Act, 2007**

The Kenya Roads Act No. 2 of 2007 is an act of parliament that provides for the establishment of the Kenya National Highways Authority (KeNHA), Kenya Rural Roads Authority (KeRRA), Kenya Urban Roads Authority (KURA) and provides for the powers and functions of the authorities and for connected purposes.

The various road authorities are in charge of maintaining their roads and in coordination with the Ministry of Transport, Infrastructure, Housing and Urban Development through the Traffic Act, ensure that their roads are well maintained with no emission of hazardous wastes on the roads. This will go a long way in ensuring that the oil tankers are well maintained with no leaking

points that would cause leakages at the oil terminals, when they are being loaded. In line with this study, Nanyuki road that leads to the oil terminals in industrial area is under the jurisdiction of KURA.

KURA is therefore mandated to work in collaboration with the oil terminals to ensure that there are no oil spillages emanating from the companies' oil tankers. This will encourage the companies to ensure that they frequently maintain their oil tankers to ensure that there are no leakages. By doing this, oil spillages caused by leaking oil tankers during the loading process in the terminals, will also be addressed.

### **The Traffic Act, Cap 403**

This Act empowers police officers to stop and remove from the road vehicles producing noxious emissions or to charge owners in a court of law. Under the traffic rules every motor vehicle shall be constructed, maintained and used such that no avoidable smoke or visible vapour is emitted. As explained before, this act will ensure that the oil tankers are well maintained with no leaking points that would cause leakages at the oil terminals, when they are being loaded.

### Integrated National Transport Policy, May 2009

The policy aims to develop, operate and maintain an efficient, cost effective, safe, secure and integrated transport system that links the transport policy with other sectoral policies, in order to achieve national and international development objectives in a socially, economically and environmentally sustainable manner.

The policy acknowledges that sustainable environmental policies have not been adequately incorporated in Kenyan road transport infrastructure management policies resulting in pollution and environmental degradation. Factors such as soil erosion, management of gravel pits and road run-off, noise pollution and gaseous emissions by road motor vehicles have not been adequately addressed. It goes ahead to propose that environmentally acceptable planning for development and maintenance of roads shall include environmental impact assessments (EIAs) including measures to be put in place when transporting of hazardous substances.

The owners of oil tankers loaded at the oil terminals need to adhere to this policy and ensure that the tankers are road worthy and in good state through regular checks and maintenance. This will contribute to reduction of oil spillages at the oil terminals in industrial area when they are being loaded as explained earlier.

### Ministry of Transport

The transport sector in Kenya encompasses a transport system comprising of road, rail, air and maritime. The sector is crucial in the promotion of socio-economic activities and development since an efficient and effective, transport system is a mainspring for rapid and sustained development in terms of national, regional and international integration, trade facilitation, poverty reduction and improvement of welfare of the citizen. The Ministry has five state Departments among them is the Transport department.

The transport department's objectives are to ensure that it promotes sustainable development and efficiency in the roads. The roads transport division is responsible for policy and regulations development on the road transport operations in the country. The Ministry's operations are

guided by the Traffic Act, Kenya Roads Act and the Integrated National Transport Policy. All this will contribute towards reduction of oil spillages in the terminals as discussed before.

#### Nairobi City County Government (NCCG)

As reported earlier, under the Energy Act of 2019 and Petroleum Act of 2019, in Nairobi County where the study site is located, NCCG have been mandated to ensure that they allocate spaces for parking for petroleum tankers. In industrial area, this will come in handy since the tankers will be regulated and any non-conformance will be corrected prior to entry into the terminals since the study noted that oil spillages are also caused by oil leaks from oil tankers with leaking tanks. Their regulation will contribute towards reduction of spillages in the terminals since the oil leaking points or haphazard oil siphoning activities from the tanks will have been controlled.

From a National comparison, the above findings on the roles of institutions that are involved in oil spill management in the oil terminals of industrial area Nairobi City County are in line with findings of study conducted by the then Ministry of Energy and Petroleum in 2016 on the environmental and socio-economic planning and decision making in the petroleum sector in the country. The aim of the study was to consult with the relevant stakeholders to collect views and draft strategic recommendations for Policies, Plans, and Programmes (PPP) in the petroleum sector.

Both studies have highlighted various institutions responsible in the oil sector among them NEMA, Ministry of Petroleum and Mining and the Ministry of Energy. The scope for this study was on inland oil terminals in industrial area of Nairobi City County while the study by the Ministry of Energy and Petroleum was conducted nationally and it covered both upstream, middle stream and downstream oil sector institutions.

These findings have indicated that lack of local capacity and institutional structure to respond to oil spillages was one of the short comings that the institutions experience in addressing oil spillages and the associated impacts. This results are similar to a study conducted in Nigeria which indicated that The study found that developing countries tended to rely on external assistance from more developed countries which in the long run was too expensive for them. This has led to slow response and poor mitigation measures being implemented when oil spills occur (Pitkin, 2013).

The findings from this study are also similar to those conducted in Ghana where the passing of the Petroleum Exploration and Production Bill drafted in 2010 took five years to be passed into law due to delayed concerns by civil societies. During the five-year period, various environmental impacts and human impacts had been experienced by the neighbouring community due to the oil exploration activities by Goldfields Ghana Limited (Bawa, 2016).

The findings also mirror those of a study carried out in Vancouver Canada, where the Western Canada Marine Response Corporation (WCMRC) responsible for the immediate response and federal and provincial authorities mandated to provide oversight and long-term management of the response in cases of non-compliance, normally have coordination issues when oil spills occur. This is because their roles are overlapping and therefore no clear stated responsibilities in institutional arrangements to address and manage oil spill incidences (Chang et al, 2014).

#### **4.3 Engineering works used to prevent oil spillages**

Key informant interviews findings indicate that engineering works form part of the measures that have been put in place to prevent and manage oil spillages in the terminals. These measures include developing band walls around the tanks for containment of spilled oil in case of leakages, fitting tanks and operating systems with automated alarms that automatically switches off oil

supply valves in case of any spillages, upgrading terminal equipment such as the loading pipes from underground piping system to above ground piping system for easier inspection and detection of any spillages and lastly, conducting integrity testing in oil tankers to identify and correct any leakages prior to loading the compartments with oil products. The oil storage tanks also go through periodic integrity tests as required by the API standards. This is in order to detect any leakages from the tanks and ensure that they are sealed prior to causing any leakages.

It was established that periodical permeability tests of tank band walls are done in order to avoid spillages of any leaked oils from the tanks' band walls. The oil terminals representatives also reported that KPC being the key product supplier has its valves fitted with High Level Alarms to stop supply in case of any leakage detection from the recipient oil terminals. Other measures in place include installation of independent tank valves so that they can be operated independently and, fitting their drainages with oil interceptors to contain any oils from escaping into public drains.

However, just like any other equipment, some of the equipment used have failed and therefore causing oil spillages. Use of faulty and old equipment including leaking tanks in oil tankers and faulty or non-functional valves in the tanks have all contributed to oil spillages in the terminals. This study finding is similar to a study conducted along the Niger Delta, in Ogoniland and Bodo area, where the study results indicated that the major causes of oil spillages in the region were oil pipeline corrosion, oil equipment failure and sabotage and theft (Vidal, 2011).

Feedback from consultations with the oil terminal representatives indicated that some of the equipment that they are required to install especially the automated valves and other mechanical equipment to detect and prevent oil spillages are very expensive to install. They have, however,

been allowed by their regulators such as EPRA to install the equipment in phases due to the high costs involved. Consultations during the study indicated that purchase and installation of an equipment meant to address oil spillages will at a minimum cost one million Kenyan Shillings (Kshs 1,000,000.00).

The findings are similar to those conducted in Canada where band walls around the tanks, installation of tank valves, and installation of emergency automated alarms are some of the measures used to manage oil spillages in oil terminals (Natasha, 2005).

#### **4.4 Education and awareness creation among staff in the oil terminals**

Education and awareness creation measures instituted by the oil terminals include worker requirement procedures laid out by these terminals as generated by the Quality Health Environment and Safety Officers (QHES) in the terminals of which each worker is expected to adhere to. They include product loading personnel being required to always counter check the loading notes/instructions prior to conducting the loading process and, periodic conducting of refresher training to the workers on prevention and management of oil spillages on a regular basis which is supposed to be done during weekly meetings. Other measures include encouraging workers to use Personal Protective Equipment (PPEs) while at the work stations, reporting of any spill incidences to Energy Regulatory Commission (ERC) now Energy and Petroleum Regulatory Authority (EPRA) within 48 hours to seek their assistance in containing and managing the spill and, strategically displaying a Spill Response Plan for use by the workers in case of the spill emergencies as required by the ERC Guidelines.



It is also mandatory for the product loaders to undergo training/safety induction and tests before being allowed to conduct loading processes. These study findings agree with studies conducted in Nigeria, for instance the Petroleum Refining Regulations of 1974 emphasize on sensitisation of workers on safety procedures to be followed while at work and provision of Personal Protective Equipment (PPEs) for the workers while at an oil refinery. Also, the Environmental Guidelines and Standards for the Petroleum Industry provide guidelines and standards for environmental quality controls while handling petroleum products both in upstream, middle stream and downstream levels (Awogbade et al, 2017).

During the Key informant interviews, the terminal representatives indicated that although refresher trainings are conducted frequently to the workers, most of them do not normally adhere to the set rules and safety procedures in the terminals. For example, loading trucks without counter checking the loading instructions was identified as one of the main causes of oil spills in the terminals and mistakenly interchanging the loading arms to assigned chambers in the oil tankers. This study finding is similar with a study conducted in Bahrain where human error constituted the greatest contributor of over 70% of all oil spill accidents in oil and gas industry (Alkhldi et al., 2017). The study indicated that emphasis should not only be placed on implementation of health and safety procedures in the workplaces but also on employee awareness of the importance of observing the measures for their own safety.

## **CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS**

### **5.1 Introduction**

This chapter summarises the findings of the study, presents the conclusion and makes appropriate recommendations. Suggestions for further study are provided in the last section of the chapter.

### **5.2 Summary of Findings**

The study has identified that the leading cause of oil spillages in the oil terminals is lack of staff adherence to the oil products loading instructions, followed by mechanical faults, equipment failure and lastly lack of induction to new staff involved in the loading procedures. The preventive and management strategies put in place to manage oil spillages in the oil terminals are implementation of policy, legal and institutional mechanisms, engineering works and awareness creation among workers on the safety procedures to observe while conducting loading procedures. However, these strategies need improvement measures in their implementation that will greatly contribute towards prevention and reduction of oil spillages in these terminals as discussed below.

### **5.3 Conclusion of the Study**

The leading cause of oil spillages in the oil terminals is lack of staff adherence to the oil tanks loading instructions, followed by mechanical faults, equipment failure and lastly lack of induction to new staff involved in the oil tankers loading procedures.

There preventive and management strategies put in place to address oil spillages are implementation of policy, legal and institutional mechanisms, engineering works and awareness creation among workers on the safety procedures to observe while conducting loading procedures.

The above strategies have been analysed to be inappropriate in the management of oil spillages in the terminals due to the following reasons: lack of adherence by the workers to the laid down safety procedures, poor maintenance schedules of oil terminals equipment leading to mechanical failures, lack of coordination in the institutions such as EPRA, NEMA and NCCG which are meant to work together in order to ensure that spillages are prevented and managed in the oil terminals, inadequate human and financial capacity in the institutions to support implementation of their roles in the terminals and lastly, gaps in the existing legislation such as lack of adequate responsibility allocation to the implementation of the National Environmental Policy of 2013, lack of implementable penalties in the Environmental Management and Coordination (Deposit Bonds) Regulations, 2014 and absence of key legislations to enable their implementation including Petroleum policy ,Energy policy and Final Draft of the National Policy for Disaster Management in Kenya 2010.

Therefore, this study concludes that the mitigation measures put in place to prevent and manage oil spillages in the inland oil terminals in industrial area of Nairobi City County are inappropriate and has proposed the following recommendations in order to improve their implementation and enable for oil spills to be controlled in the oil terminals.

#### **5.4 Recommendations of the Study**

From the findings and conclusion, several recommendations are suggested focusing on policy, legal and institutional mechanisms, engineering works and awareness creation amongst workers at the oil terminals as discussed below:

- 1 This study recommends that the maintenance schedules of the equipment in the terminals should be strictly observed in order to reduce the number of oil spill incidences caused by mechanical faults. National Environmental policy of 2013 in section 9.3 has recommended giving incentives to the institutions that record less or improved environmental management strategies. This study recommends that the Ministry of Petroleum and Mining should take lead in the implementation of incentives. In order to achieve this, the study recommends that the Ministry should work closely with the oil sector parastatals such as EPRA. This will enable them to identify terminals that have recorded improved oil spill statistics. The incentives could be awarded to these terminals through enforcing a tax relief on their annual returns or by allowing EPRA to award them a discounted annual operating license.
  
- 2 The National Land Policy of 2009 should be amended to include penalties on anyone found contravening the requirements of the policy. Technical guidelines on the management of used oil and oil sludge in Kenya, 2016 should also include penalties to be imposed on anyone found contravening the requirements of these guidelines. This will encourage the oil terminals to adhere to the regulations and hence contribute towards preventing and managing oil spillages. In line with this, the Environmental Management and Coordination (Deposit Bonds) Regulations, 2014, besides stating the fines to be imposed on anyone found contravening to the regulations, the regulations should also state the minimum and maximum periods of imprisonment. This will encourage adherence to its imposition in the oil terminals. It will come in handy to address financial challenges that are currently being experienced in the terminals when an accidental spill

occurs, since NEMA will be obliged to support the terminals when oil spills occur as per the deposit bond registered by the terminal.

- 3 The Government should fast track the finalisation and gazettment of the Final Draft of the National Policy for Disaster Management in Kenya 2010 to enable for its implementation. The Final Draft of the National Energy and Petroleum Policy of June 2015 should form part of the National Energy Policy and the National Petroleum Policy as required by the Energy Act of 2019 and Petroleum Act of 2019 respectively. This will enable for the strategies proposed as discussed in chapter 4, to be implemented in the inland oil terminals in industrial area and contribute to prevention and management of oil spillages in the terminals. For instance, Strategy Number 2 states that the Ministry of Energy and Petroleum will collaborate with National Disaster Operations Centre in spearheading response to petroleum associated disasters. However, since the Ministry has since been split into the Ministry of Energy and Ministry of Petroleum and Mining, this study recommends that the Ministry of Petroleum and Mining should take lead in this.
- 4 The Energy and Petroleum Regulatory Authority Guidelines 2015 and 2016 should be amended to include a proposed committee with a clear composition of participants and their roles, who will be mandated to review and update the guidelines to be in line with present and any new developments/technologies meant at addressing oil spillages. In addition, NDOC should be among the stakeholders to be consulted by the inland oil terminals in industrial area when preparing the emergency response plans that the terminals are required to develop as per the EPRA Guidelines. This is because they participate in responding to disasters such as oil spills and would best advice on

preventive and management measures to put in the emergency plans which will definitely contribute towards oil spill reduction.

- 5 The Cabinet Secretaries in the Ministry of Energy, Ministry of Petroleum and Mining, Ministry of Environment and Forestry among others as mentioned in Chapter 4 should ensure that the staff in the ministries are undertaking their roles as required by the relevant laws that contribute to the management of oil spillage in the terminals. These ministries can partner with the Ministry of Devolution and Planning to ensure that they build capacity at county levels in order to address the human resource inadequacy aspect as mentioned during the Key informant interviews. The Ministry of Devolution and Planning should liaise with the County Governments to ensure that these devolved government arms have been allocated funds from the County Budget to finance their operations. Lastly, the Cabinet Secretaries in these ministries should work together and streamline the roles of these ministries in order to avoid overlap as reported in the key informant interviews during the study.
- 6 This study recommends that all new employees or staff should be taken through an induction procedure. Records of this should be kept for future reference in determining causes of oil spillages especially caused by non-adherence to the laid down procedures by the workers. The oil terminals should conduct a need based analysis, on their workers in order to identify the areas that need emphasis during training when it comes to loading procedures and other safety procedures while in the terminals. The frequency of the training sessions should also be increased to ensure that the workers are fully aware of the safety procedures to observe while at the terminals and especially, during the loading

procedures. OSMAG, DOSHS and NDOC are the key stakeholder institutions that the terminals should consult and partner with when planning for these trainings.

- 7 In line with the above recommendations, the management in the terminals should enforce strict disciplinary actions and in worse cases dismissal to any worker found disobeying the laid down procedures especially while conducting loading processes in the oil terminals. This will encourage strict adherence to the laid down procedures which will contribute to the prevention and management of oil spillages.

### **5.5 Suggestions for further study**

The study focused on management of oil spillages in inland oil terminals located in industrial area of Nairobi City County. This study suggests that studies in relation to oil spillage management should be further explored including analysing the expertise technical competency in management of oil spillages in Kenya.

Management of oil spillages in retail outlets belonging to the various companies in the oil industry could also be researched on in order to ensure a wider coverage on management of oil spillages in the Kenya. This will in turn contribute to management of the oil spillages and the associated impacts.

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## **APPENDICES**

Appendix 1: Oil Terminal Questionnaire

Appendix II: Institutional Questionnaire

Appendix III: Letters of introduction from University of Nairobi