

The Effects of Oil Spillage on The Environment A Case of Thange Village in Makueni
County Kenya

by

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APPROVAL

EFFECTS OF OIL SPILLAGE ON THE ENVIRONMENT: A CASE OF THANGE VILLAGE IN MAKUENI COUNTY, KENYA

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DECLARATION

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I declare that this thesis is my original work and has not been submitted to another college or university for academic credit.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACGSF	Agricultural Credit Guarantee Scheme Fund
AUVs	Autonomous Underwater Vehicles
BP	British Petroleum
BTEX	Benzene, Toluene, Ethyl Benzene and Xylenes
CEC	County Executive Committee Member
CSR	Corporate Social Responsibility
DU-ERB	Daystar University Ethics Review Board
FGDs	Focus Group Discussions
GPS	Global Positioning System
HNS	Hazardous and Noxious Substances
IOGP	International Association of Oil & Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
KI	Key Informants
KII	Key Informant Interviews
KSHS	Kenya Shillings
KNBS	Kenya National Bureau of Statistics
KPC	Kenya Pipeline Company
MESMA	Multi Endmember Spectral Mixture Analysis
MPP	Marginal Physical Product
NACOSTI	National Commissions for Science, Technology and Innovation
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
OPRC	Oil Pollution Preparedness Convention
PAHs	Polycyclic Aromatic Hydrocarbons

PH	Potential Hydrogen
SBOIL	South Baltic Oil Spill Response
SPSS	Statistical Package for the Social Sciences
TPH	Total Petroleum Hydrocarbon
WHO	World Health Organization

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ABSTRACT

This study assessed effects of oil spillage on the environment in Thange village, Makueni County. The objectives were to investigate the effects of oil spillage on land, water, flora and fauna, and explore the mitigation challenges in addressing environmental effects of oil spillage. Contingency planning and crisis preparedness theory informed the study. Descriptive design was used; an interview schedule was administered to 95 household heads, an in-depth interview guide administered to four key informants and three focus group discussions moderated with 8 participants each. Ethical procedures and research protocols were adhered to, maintaining standards of research practice. Descriptive statistical procedures analyzed the quantitative data using SPSS Version 26 statistical package and qualitative data analyzed using content and thematic analysis. Quantitative data was presented in tables, while qualitative data was presented in prose and verbatim. Acidity in soil was the most cited effect of the oil spill on land; lack of access to clean water the most cited effect on water; agricultural produce loss the most cited effect on flora and fauna; lack of communication and coordination among agencies managing the oil spill, the major challenge in mitigation efforts. The research recommends the formation of a task force comprised of government and private sector agencies to manage the oil spills effects. Scientific and latest best practices towards the cleanup of soil at Thange village; provision of alternative long-term community water sources; creation of short-term alternative livelihood sources to enable the communities to cope with the spill's effects on their sustenance.

CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

Introduction

The environment can be termed as the totality of all living space which includes land, water and all organisms existing within it that depend on it for their existence (Akinwumi, Oyebisi, & Salami, 2013). Garg, Pandel, and Tyagi (2014) describe degradation of the environment as its degeneration by depleting natural resources such as soil, water, and air along with wildlife extinction and destruction of ecosystems. This change is as a result of several factors such as air, soil and water pollution, unsustainable fishing and agricultural practices and deforestation, global warming and mineral extraction activities (Garg et al., 2014; Akinuwimi et al., 2013). Human activities also contribute to noise, thermal, industrial and light pollution (Marsh, 2016).

Some of the human activities that contribute to pollution include unsustainable agricultural practices which affect land productivity, loss of forest cover and watershed reduction through forest degradation, oil spillage and poor waste disposal that contaminates both land and groundwater sources, dam sedimentation and air pollution from exhaust and waste discharge (Croitoru & Sarraf, 2010). This study focused on oil spillage and its effects on the environment.

This study focused on oil spillage, a form of environmental pollution that occurs in the duration of storage, extraction, or oil transportation. Spillage results in various environmental degradation such as pollution of air, water sources and soils, disruption of ecosystems and degradation of forest cover (Aigbedion & Iyayi, 2007). Environmental damage caused by oil spillage pollution has long lasting effects on the lives of community members and animals living in or relying on the polluted environment.

Oil spillage is a global problem that needs urgent attention because of its far-reaching effects on the environment that maintains the eco-system balancing (Michel & Fingas, 2016). Hence, this study informed by this understanding and its focus will be conduct an assessment of oil spill effects on the environment. The study used Thange village in Makueni County as a point of reference.

This chapter provides a background of oil spills and the effects of these events on the environment from a global, regional, and local perspective. The chapter also presents the local context of oil spills and the environment in the research problem, from which research objectives and questions are derived. The chapter also includes the significance, scope, justification, limitation and delimitation, assumptions and definitions of terms of the study.

Background to the Study

Since the industrial revolution, worldwide increase in industrial development has driven the demand for oil as a valuable fuel resource (Leeuwen & Tulder, 2006). Oil as a mineral resource is a driving force in global industrialization due to its demand, pricing instability, high capital involvement in running oil industries and the subsequent profit generation for oil-producing countries and industry players (Karl, 2007).

Oil production has had various consequences globally in oil producing countries and oil spillage is at the forefront of these consequences. Oil spillage result in various environmental degradation such as: pollution of air, water sources, soils, and disruption of ecosystems and degradation of forest cover (Aigbedion & Iyayi, 2007). The environmental damage caused by oil spillage pollution has long lasting effects on the lives of community members and animals living in or relying on the polluted environment. This is manifested by emergence of health issues, displacement of people, loss of income, and changes in living standards of the communities (Pyagbara, 2007).

The Exxon Valdez oil spill from a tanker accident in Alaska's Bligh Reef is considered to be one of the world's worst environmental oil pollution catastrophes (Dorset, 2010). Approximately, forty to forty five percent of oil mass spilled into seven hundred and eighty-seven kilometers of the Prince William Sound beach in 1989 and another eleven percent was transported and contaminated one thousand two hundred and three kilometers of the Alaska Gulf shoreline (Xia & Boufadel, 2010). Brazil experienced a thick crude oil spill that affected the Northeastern tropical coast in Brazil in 2019. This spill affected forty marine areas under protection and a set of unique less explored coastal ecosystems that consisted of coral beds, sandy beaches, rocky shores, mangroves, sea grass beds, estuarine systems, and coral reefs were affected (Campos-Silva, Brum, & de Oliveira, 2020).

In Africa, some of the environmental impacts of oil spills in Nigeria have been vegetation loss, withering of plant covers that seemed sprayed with herbicides and losing their colour as well as poor performance, and the mortality of fish and other faunal organisms (Ugochukwu & Ertel, 2008). In South Sudan, the greatest threat of oil spills to the environment has been the spillages of hydrocarbons that flow from oil production tends and activities to have relations to the petrochemical industry illegal disposal of oil products (Kuany, Zhou, Abdelhafez, & Abdelhafeez, 2019).

Owing to the effects of oil spills on the environment, there are different interventions undertaken by the governments of the day, oil companies, and non-profit companies. The interventions to oil spills have been categorized into different groupings by different authors. For instance, Lee (2011) distinguished oil spills interventions between human and mechanical interventions. Udoh and Ekanem (2011) distinguished oil spills interventions into government and other agencies' interventions. While Ishak, Johari, Mazlan, and Ismail (2018) found that management practices such as emergency

plans were the best response to oil spills and the emergency plan cover cooperation among all units and departments to provide support for the response teams effectively.

Balogun and Kareem (2013) found that compensation that is paid by government and oil companies are not enough to meet the needs of livelihoods of the affected communities in the long-term. Osuagwu and Olaifa (2018) revealed that the occurrence of oil spills among a variety of environmental factors that affected agricultural output negatively more so in fishing. In Nigeria, the agricultural interventions have also failed to enhance fish production such as the Agricultural Credit Guarantee Scheme Fund (ACGSF). Ivshina et al. (2015) agree that a major intervention at oil spills has been to implement skimmer pumps in wells that are underground to do away with any of the free product that can be recovered to reduce the continuous source of contamination.

These challenges facing mitigation of oil spills implementation, and this has been documented in the general literature and some of these are highlighted in this background. One of the challenges cited by the World Wildlife Federation (2007) is weather conditions as the arctic habitat has posed specific challenges to oil spill reactive technologies and techniques. In some situation, arctic conditions can enhance favourable spill response but, in several cases, the arctic habitat can lessen on how effective how oil spill control and recovery equipment and methods.

Moroni, Pieri, and Tampucci (2019) noted that significant pollution situations are maintained by special contractors for undertaking remedy and interventional actions, small ones are managed at least in the first phases majorly by using local remedy and monitoring resources. The optimization and orchestration in the utilisation of such resources also presents some challenges in the continuous management of smaller pollution events. Ishak, Johari, Mazlan, & Ismail, (2018) identified eight management approaches towards oil spill response and preparedness included assignment of

competent staff, response framework, complying with laws of the maritime, situational awareness, emergency plans, event management systems, preparedness program, and event inspection of the facilities and equipment.

Mulako (2019) listed delay of implanting legal framework in oil exploration, poor enactment, or adherence to existing laws on oil spillages, lack of allocation of sufficient funds, lack of capacity and institutional structure, and coordination of intervention measures as challenges to oil spillage interventions in Africa. Osuagwu and Olaifa (2018) identify small-scale interventions for environment conservation often failed due to low participation of the community. Where participation was present, adherence to the goals and regulations of this intervention was a challenge to achieve its objectives.

Kenya has experienced several oil spillages cases; the first was caused by an oil tanker explosion in Sachangwan Town Center, Nakuru County on 31st January 2009 (Mkawale, 2009). An oil leak from the Mombasa Nairobi Pipeline occurred on 12th September 2011 and subsequent explosion in Sinai Slum, Nairobi County (Mayoyo, 2012). This was followed by another tanker explosion in Kimende along the Nairobi-Nakuru Highway in 2016 (Michira, 2016).

The malfunctioning of the Mombasa-Nairobi Pipeline has also caused several spillages incidents; the first at the Nairobi Industrial Area Joint Depot on 19th April 2016 (Odhiambo, 2016). Another spill occurred in Miasenyi and Majengo Mapya villages in Taita Taveta County on 17th December 2016 (Mnyamwezi, 2017), followed by a leak in Kiboko Natural Springs on 29th April 2019 (Maundu, 2019) and Mariakani in September 2020 (Okoth, 2020). This was followed by an oil tanker explosion in Gem on July 2021 (Matete, 2021). The environmental damage of soil, water bodies, flora and fauna caused by oil spillage have long lasting effects on the lives of communities living in or relying

on the polluted areas and this is manifested by the emergence of health issues, conflict, and displacement, loss of income, and alteration of living standards (Karl, 2007).

Kenya joined the global oil extraction and shipping industry in 2019 once drilling commenced at its wells in Turkana County by Tullow Oil. The country's oil extraction is in its first stages, it is projected to be fully operational at a higher capacity as the industry develops the necessary infrastructure (Onyango & Nanok, 2017). According to the Ministry of Planning and National Development & National Economic and Social Council, Kenya is in the early stages of oil extraction, the country acknowledges the importance of energy as one of the enablers of infrastructural development.

There was need therefore, to understand effects of oil spillage on the environment and how disruption caused by oil spillage was managed. Additionally, if care is not taken, Kenya's recent discovery of oil, its extraction and shipping are likely to contribute to the rise of oil spillage. Hence, there is need for further investigation in this area.

Statement of the Problem

There have been global incidences of oil spills over time as revealed in the study's background. However, the nature of oil spills in Kenya has been characterized by tankers spilling oil on the ground surface and from spills that have occurred underground from major pipelines from the Mombasa port to Nairobi. Most oil spills that have occurred from these pipelines have affected the natural environment and an impact of these oil spills have been felt by the communities that live near and along this pipeline affecting their livelihoods as most of these communities rely on natural resources for their livelihoods.

The occurrence of oil spillage is not a new phenomenon in Kenya but the response and mitigation to these catastrophic events has not been as anticipated from the different stakeholders in the industry (Mulako, 2019). The government and private stakeholders

have a function to play in replying to these situations and this is a subject that required more empirical and academic research to identify and map the effects of oil spills on the natural environment from the flora and fauna, air, soil, and water by focusing on Thange village oil spill experience. Therefore, this study explored the response interventions that have been executed by government and private stakeholders in the oil industry and environment sector to mitigate effects of oil spillage. The study further examined challenges faced in mitigating the effects of oil spillage on the environment to recommend strategies that could be adopted to reduce incidents of further oil spills and consequent effects on the natural environment.

Purpose of the Study

The purpose of this study was to assess effects of oil spillage on the environment using Thange Village, Makueni County, Kenya as a case of reference.

Objectives of the Study

The study objectives were to:

1. Investigate the effects of oil spillage on land in Thange Village.
2. Investigate the effects of oil spillage on water in Thange Village.
3. Investigate the effects of oil spillage on flora and fauna in Thange Village.
4. Examine the constraints faced in mitigating the effects of oil spillage in Thange Village.

Research Questions

The research answered the following questions:

1. What are the effects of oil spillage on land at Thange Village?
2. What are the effects of oil spillage on water at Thange Village?
3. What are the effects of oil spillage on flora and fauna at Thange Village?

4. What constraints were faced in mitigating oil spill effects in Thange Village?

Justification for the Study

There has been an increase in oil spillage in the country that calls upon researchers to look into the oil spill effects on the environment and recommend on the best appropriate methods that can be adopted to prevent damage. Research into oil spillage and how to deal with its impacts on the environment and affected communities need to be undertaken to complement policies in the oil sector to respond and prevent effectively to oil spill disasters in the future.

Notwithstanding the different concerns and settings that have been experienced internationally on the effects of the oil sector on the sustainability of the environment, little detailed information indicating the effects has been documented about Thange oil spillage. There are more complainants than the compensation that is undertaken, if any, which in most instance is not enough to restore the livelihoods of the affected community to normal (Ngunjiri, 2017).

No relevant body has been put in place to investigate the effects of the oil spillage on the environment and recommendations from this study contributed to the creation of a body that is mandated to respond to oil spillage disasters that involves collaboration and coordination of the different authorities and agencies that are engaged in responding to oil spills.

Significance of the Study

The study provided insights and a better understanding on the effects of environmental pollution occasioned by oil spillage on communities to academic institutions, policy makers, stakeholders involved in the oil extraction industry, health care providers and community members.

The study also provided insight on oil spillage effects from the community members' perspective and provide them with the opportunity to contribute to mitigation measures for possible future spillage incidents.

The study suggested measures that may be taken to address environmental concerns in Kenya's petroleum industry that may be used to mitigate spillage cases. Lastly, environmental issues from oil spillage were identified from the study that may contribute to the existing information on various types of pollution effects in Kenya.

Assumptions of the Study

The assumptions of this study were realised, and everything worked well because

1. The respondents sampled from the study population and those selected for the Key Informant Interviews (KIIs) agreed to participate in the study.
2. The Covid-19 pandemic curve flattened during the data collection exercise, allowing the researcher to conduct the KIIs and focus group discussions (FGs) with identified respondents.
3. The study acquired ethical approval from the Daystar University Ethics Review Board (DU-ERB) and a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI).
4. The outcome of the research is significant to stakeholders in the oil industry and will help them to make necessary amendments and adopt strategies that could be used to prepare, manage, and respond to future oil spill events.

Scope of Study

The scope of this study was limited to Thange village in Makueni County, Kenya as one of the forty-seven counties located in the Southeastern part of the country (Makueni County, 2013). Thange where the oil spill occurred is located in Kibwezi Sub-

County, Makueni County approximately 14 Kms South-East of Kibwezi Town and 1.4 Kms North-East of Thange Centre located on Mombasa Highway. The Thange community is found within the Thange River Basin which starts at the source of the spillage near the river and it runs in the north-east direction following the river basin for approximately 4km up to the area near Nzavoni (Panafcon, 2016). The study focused on oil spillage effect on environment and the challenges faced in addressing this problem.

Limitations and Delimitations of the Study

The researcher did not encounter any language barrier as participants were fluent in either Kiswahili or English and there were no challenges in understanding the questions in the interview schedule.

Some participants expected some form of remuneration from the researcher for their participation in the study and did not want to divulge information vital to the study unless they were rewarded for it. They accepted to participate in the study once the researcher persuaded and reassured the respondents that the research is meant for academic reasons and that data provided from the study would be held in confidence. Besides, the researcher engaged the local leaders who assured the community of the importance of this research in sustaining the ecological environment at Thange.

The community was not fatigued from constant interviewing by outsiders investigating the oil spillage incident and therefore had no issues with participating in the study. The researcher ensured that the interviews did not interfere with the day-to-day activities of the respondents by making prior notification before the interviews so that the respondents were not caught unawares. They were also informed that the study is for academic research purposes and information provided was to be treated confidentially. Officials from KPC and Makueni County Government did not want to be involved in the study or want to divulge any information regarding the spillage incident. The researcher

assured key informants that this study was purely academic, and confidentiality was upheld at all stages of the research for those who agreed to participate.

Definition of Terms

Environment: This can be termed as the totality of all living space which includes land, water and all organisms existing within it that depend on it for their existence (Akinwumi et al., 2013). In this study, environment refers to the physical surroundings and organisms where the pollution occurs.

Environmental Degradation: This refers to the disturbance or change on a habitat to be undesirable or damaging (Garg et al., 2014). In this study, environmental degradation refers to the extent to which changes have been made to alter the physical and biological quality of the environment to harmful extents.

Household Head: In this study, this will be the major decision maker in home, this will include the father or mother in the event that it is a nuclear family (Posel, 2001). Considerations will also be made for decision makers in child and female headed households. In instances where the parents are not available, the head will be considered to be the eldest sibling who is 18 years and above, able to read or write and is legally considered to be an adult.

Oil: A liquid product of petroleum which may be in a liquid crude or refined form (Kadafa, 2012). In this study, it refers to crude or processed petroleum product either being transported by tankers or the Kenya Pipeline Company pipelines.

Oil Spillage: This is the release of liquid petroleum or spills of crude or petroleum products that have been refined such as diesel, gasoline, and their by-products to the natural environment due to human activity (Oyebamiji, Adekola, Mba, & Igwe, 2014). In this study, oil spillage will mean the disposal of pollutants or contaminants linked to

processing of crude oil which seeps into the ground which then adversely affects land and water quality.

Pollution: A state of water, air, flora and fauna and soil being made impure beyond acceptable limits by the presence of oil from spillage making it harmful for use (Pyagbara, 2007). The study looks at oil spillage as a form of pollution and its contributions to the degeneration of the environment and the consequent impacts.

Summary

This chapter provided a background on the resultant effects of oil spills from major oil spill events that have occurred around the globe. The study was then situated into the problem in Kenya with the transportation and exploration of oil which have contributed to an increased frequency of oil spill which have affected communities and the response to these disaster events. The objectives of the study were presented along with the corresponding research questions. The chapter also includes the significance, scope, justification, limitation and delimitation, assumptions and definitions of terms of the study.

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CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter deals with review of related literature for the study. The literature review is organized as follows: theoretical framework, general literature, the empirical review of literature, conceptual framework, discussions, and chapter summary.

Theoretical Framework

This refers to a system that is a summary of theories and concepts which are designed from knowledge that has been published and tested and is then produced to help a researcher to have a background on theories and a foundation for analysis and interpretation of data and the meaning of research (Kivunja, 2018). A theoretical framework for the study is important as it links an investigator to the present knowledge. Guided by the relevant theory, the researcher has a foundation for the formulation of the research objectives, research questions and choice of research methods (Kivunja, 2018). Through a theoretical framework, an investigator can see the main variables that contribute to a study area and to assess how these variables are different and at which situations.

Contingency planning and Crisis Preparedness Theory

The contingency planning and crisis preparedness theory is associated with Perry and Lindell (2003) and emphasizes the significance of preparing and planning for a crisis where good planning is influenced by a variety of factors. These factors include institutional and legal framework, awareness and knowledge on the different disasters, having the available resources, and suitable management strategies that can be used to

respond to disasters, in this case oil spill disasters. Perry and Lindell's contingency planning and crisis preparedness theory outlines four guidelines that can be used to respond effectively to disasters (Eriksson, & McConnell, 2011).

The first tenet of this theory is emergency planning should be tailored for inter-firm coordination and that response to emergency should be conducted in several departments and also at several governmental levels. The second principle for contingency planning and preparedness is that there is a need for specific knowledge of the risk and of responses from humans. This specific knowledge of risk is present via assessing hazards and analyzing vulnerability (Mulako, 2019).

Third, planners are able to identify the reality of the situation where an operation in a disaster occurs by focusing on the main tenets of response, clearly articulating priorities and reducing the operational information thereby restricting flexibility. In the end, it is significant knowledge that disasters lead to variant changes in the environment and that it is impossible to cover all actions that might arise in terms of a future disaster event (Mulako, 2019).

Adopting the above guidelines on disaster response to the Thange oil spill, there is a need for the different government and private agencies engaged in oil spill disaster response to have a coordinated effort and requires communication and partnership between the different agencies. Disaster response managers in oil spills should recognize the need for being flexible and thus should adopt to the situations of disaster and not stick to rigid response strategies as every oil spill disaster is unique. The response guidelines also point to the need for research and risk assessment on the vulnerabilities and likely risks of oil spills occurring and thus being adequately prepared to respond.

General Literature Review

The degradation of quantity and quality of natural resources is defined as environmental pollution (Garg et al., 2014). Some human activities that contribute to pollution include unsustainable agricultural practices, deforestation and watershed reduction, oil spillage and poor waste disposal that contaminate land, flora and fauna, and groundwater sources (Croitoru & Sarraf, 2010). Environmental degradation is a matter of emergency for all human beings in the past decades as it protects persons from reaching their basic needs of security and physiological safety (El- Hagggar, 2007; Shrinkhal, 2019).

The natural resources depletion of water, soil, and air where persons are less likely to access to clean water, food, and good air quality. Moreover, the extended disruption of natural ecosystems and spread of disease does not give a safe setting for persons to live owing to increased risk in natural disasters and disease breakouts; therefore, security and safety needs are also frustrated (El- Hagggar, 2007). The two foundational needs are deficiency needs; if a deficiency happens in any way, a person can be able to eliminate it. Thus, persons are hesitant to experience any energy toward social, economic, political, or cultural reform until their basic needs and sustained and fulfilled. (El- Hagggar, 2007).

According to Simiyu (2009), environmental degradation has already been rampant in Kenya, but modern recognition of the issue by the independent watchdogs and scientific community has led to the Kenya recognizing the major environmental problems. Water diminution and contamination from causes of human and also natural processes is a major issue with everything else reducing beside them (El- Hagggar, 2007).

The significant environmental matters that are popular in Kenya include soil erosion from wind and flowing water; salinization of soil from irrigation, along with

pollution, biodiversity diminution, deforestation, landslides, desertification of protected areas, and habitat loss and its effect on health of the environment (Fitzgerald, 2015; Ndeve, 2018). The production of natural resources into the commercial streams will be important to examine and identify these hazards producing environmental processes in more specificity so as to lessen their more harmful effects (Muthike, 2018).

The environmental damage from these sources in Kenya has received enough legal attention and the formation of the National Environmental Management Authority (NEMA) has contributed to the development of testing mechanisms to solve some of these environmental issues. The 5 pillars of the environment have been created as a foundation from which to remedial activities and manage protection. These pillars are the creation of policies and laws, natural resource management which is community-based, environmental data and other evaluations, formation of environmental organisations, and impact assessments (Institute of Economic Affairs, 2016).

Globally oil spillage has contributed to environmental degradation. Oil spillage and its effects have been experienced globally in various incidents with the most notable being the Exxon Valdez oil spill caused by tanker accident in the Bligh Reef in Alaska in 1989. Dorsett (2010) explains that the spill caused deaths of marine life from the time of the spill through to three years after its occurrence. Another large disaster of oil spilling happened in the Gulf of Mexico when an oil well accidentally released oil into the marine gulf in April 2010 (Dorsett, 2010). The spillage exceeded the amount of oil that was spilled in the Exxon Valdez in 1989 with an estimated excess of 205.8 million gallons. The spillage saw the pollution of the Gulf of Mexico with the ensuing clean-up efforts successfully removing 33.6 million gallons from the affected area, leaving a remaining 172.2 million gallons in the Gulf (Leeuwen & Tulder, 2006).

In the Middle East, conflict fueled by oil as a resource has also contributed to environmental degradation from this mineral resource (Croitoru & Sarraf, 2010). Conflict in Lebanon spanning a period of a little over a month in July, 2006 contributed to the destruction of Lebanon's fragile environment when an oil plant in Jiyeh was bombed. This led to the spillage of close to fifteen thousand tons of oil into the Mediterranean Sea and the disaster was further exacerbated by fires and oil burning which degraded air quality (Croitoru & Sarraf, 2010).

In Africa, the effects of spillage are highlighted by the oil industry's activities in the Niger Delta. The Niger Delta is a region with a diverse ecosystem that makes up twelve percent of the total surface of Nigeria with a thirty million population who heavily rely upon it for their livelihoods (Akinwumi, Diwa & Obianigwe, 2013). Soil and water pollution in the Niger Delta by oil spills and gas flaring have affected farming and fishing practiced by the communities in the region, the health of the population as well as degradation of the affected ecosystems (Achebe, Nneke, & Anisiji, 2012). Osuagwu and Olaifa (2018) add that access to clean drinking water; food production and fishing have also been affected by the scorching of soil from gas flaring and acid rain resulting from pollutant emissions.

The continent of Africa is experiencing with the most degradation of the environment with more than seventy percent of its population is dependent on natural resources and land meaning that they are directly dependent on natural environment and land for its wellbeing and livelihoods (Fitzgerald, 2015). Fast growth of the population, social inequalities, and poverty has led to watershed degradation (Tacoli, 2009). The Savannah landscapes give ecological and economic services that sustain livelihoods that are at risk from issues of vegetation cover decrease, soil erosion and wood land cover depletion (Nyssen, Frankl, Zenebe, Poesen, & Deckers, 2015). In Kenya, environmental

degradation is pronounced by fast growth of the population, changes in land use, increasing levels of poverty, and deforestation to the increase of farmlands and exploitation of forests due to fuel wood, charcoal burning, medicinal herbs, fodder, construction material contributing to food crises and watershed/land degradation (Government of Kenya, 2013).

The Institute of Economic Affairs (2016) reported that oil consumption in Kenya covers twenty one percent of its entire energy needs. Oil is a key factor of the overall economic performance of the country (Osoro, Muturi & Ngugi, 2015) as it is a significant influence on investment and consumption patterns through its direct effect on the country's exchange and interest rates. In an effort to enhance its oil sector competitiveness and reduce the imported oil costs to levels that are manageable, Kenya has entered into partnerships with big gas and oil companies, expanded and increased oil exploration (Nanok, & Onyango, 2017).

The contamination of food crops, water, land, air from oil spills have been trace metals and hydrocarbon as seen in general literature, empirical literature and the conceptual framework. These have had significant impacts on people in a manner that is not always acknowledged (Abdibattayeva & Su, 2019). Panafcon (2016) study implied that impacts of oil spill on food crops and water may consist of concentrations of copper, zinc, iron, manganese, cadmium, lead, hydrocarbons, and nickel. Moreover, the presence of these metals in food and water can be seen as harmless as they help the body in metabolism and play a role in meeting the recommended everyday requirement while lead, hydrocarbons, cadmium, and nickel have some potential to be toxic to human health (Kumar, Kumar, Singh, & Kumar, 2019).

The World Health Organization (WHO) considers cadmium to be a continuous toxin due to the ability of the human body to excrete a small amount if ingested in a day

and although it is carcinogenic its toxicity affects the liver, bones, and kidneys and is more severe to post-menopausal women as normochromic anemia, renal dysfunction, osteomalacia, and osteoporosis. Oil spills have contributed to the lessening of quality and quantity of food that is available to households in communities (Ejiba, Onya & Adams, 2016). This may have resulted in more than twenty four percent increase in malnutrition among children and hours of hunger pangs in communities in the Niger Delta (Ejiba et al., 2016). These situations were said to be exacerbated in areas within oil spillage; and by the fact there is no presence of relief actions which lead to the community members feeling no assistance was forthcoming from the oil companies and the government (Ordinioha & Sawyer, 2008; Yakubu, 2017).

The damage from oil spill may extend or be limited on a small area or encompass and extensive in a large area. In such settings, it is imperative for stakeholders to know what to expect and the appropriate actions to be taken when oil spills occur. This view is supported by Legborsi (2007) discussion on the severe effects of oil production and exploration among Nigeria's Ogoni people finding that activities in the large oil fields resulted in poor health of these communities and also to their livestock through pollution by effluent discharge into surrounding areas, gas flares, and oil spills

Causes of Oil Spillage

According to Salako, Sholeye and Ayankoya, (2012), oil spills in Africa are as a result of oxidation of storage tanks and pipes, sabotage, or lack of safety protocols during production of oil operations and oil tankers accidents. Moreover, few oil spills are as a result of engineering, machine failure, failure to control oil wells, and poor care in unloading and loading of oil vessels.

Kenya has experienced several oil spillages cases prior to the incident at Thange in 2015 as a result of various causes. The first incident occurred in Sachangwan Town

center, Nakuru County in 2009 after an oil tanker explosion (Mkawale, 2009). This was followed by an oil leak from the Mombasa Nairobi Pipeline on September 2011 and subsequent explosion in Sinai Slum, Nairobi County in the same year (Mayoyo, 2012).

Due to malfunctioning of the Mombasa Nairobi Pipeline, another incident occurred at the Nairobi Industrial Area Joint Depot on April 2016 (Odhiambo, 2016), followed by a tanker explosion in Kimende along the Nairobi-Nakuru Highway on December 2016 (Michira, 2016). The next spillage from the pipeline occurred in December 2016 at Miasenyi and Majengo Mapya villages in Taita Taveta County (Mnyamwezi, 2017) followed by leaks at Kiboko Natural Springs on April 2019 (Maundu, 2019), a spill in Mariakani on September 2020 (Okoth, 2020) and tanker explosion in Siaya in 2021 (Matete, 2021).

Literature has shown that majority of oil spills in Africa were attributed to third party activities due to vandalism of pipelines and illegal extraction and this does not lead to any compensation to affected communities as a response designed to discourage sabotage of pipelines and extraction sites (Akinwumi, et al., 2013; Ejiba et al., 2016). In perspective, the long term and acute effects of oil spill exposure it is not fair for community members to face these crises alone and the least that they are entitled to are immediate and long term relief and treatment which is a guaranteed for individuals exposed to toxic materials.

Effects of Oil Spillage on the Environment

Oil spillage effects are diverse affecting different aspect of the environment. Environmental components that can be potentially affected include land, water resources, air, fauna and flora and the human health. These effects are explained in detail in the subsequent sections.

Effects on Land

Soil is a critical part of the natural environment and is a basic medium for most human and biological activities such as agriculture (Schmidt et al., 2011). There are many areas that damage can happen as farmers lose crops and arable and grazing land due to the non-biodegradable materials in the soils. The popular obvious and immediate oil spill effects on land has been reducing the capacity of production for the soil affected (Ite, Ibok, Ite & Petters, 2013). The removal of soil that is productive from the local community results in severe socio-economic effects as well as habitat consequences for fauna and flora (Pearce & Moran, 2013). Soil settling pollutants can harm vegetation growth and success of organisms living in the soil thereby leading to higher chances of erosion as pollutants are localized and affect a narrow band of soil (Panafcon, 2016).

Effects on Water Resources

Whenever oil spillage occurs, it intersects and infiltrates into a drainage pattern, altering the local hydrology by modification of the natural hydrological environment (Akinwumi & Salami, 2013). Rivers and streams are polluted by oil spills and lead to severe effects on water habitats by spreading over surfaces stopping oxygen getting to animals and plants living in the water. This is supported by Nwilo and Badejo (2005) who are of the view that the spillage is harmful to aquatic and insects fauna such as crayfish and crabs, disrupting the food chain, preventing plants process of photosynthesizing and taking a longer duration to remediate or recover.

Fishing and agriculture which are practiced along areas with wetlands or water bodies as the people's sources of income are also affected because of oil spills. Many affected residents especially in the worst affected areas may not recover from the loss of their livelihood and income from the effects of oil spillage (Akinwumi & Salami, 2013). The unpredictable, rapidly entering into severe properties of oil usually damages large areas of vegetation near drainage basins (Adelana, Adeosun, Adesina, & Ojuroye, 2011).

The physicochemical features of water are critical as they can indirectly or directly affect quality and consequent matching for the distribution and production of aquatic life and fish (Moses, 2010). The degree of heavy toxic metals on estuarine organisms also affects the physicochemical mix of the ecosystems (Yarhere, 2010; Adelana et al., 2011).

Effects on Fauna and Flora

The Kenya National Bureau of Statistics (2016) reported that tourism and wildlife accounted for eighty-four billion Kenya shillings in the 2015/2016 financial year. Wildlife also has a significant part of the ecological part that is critical for networked web of life supporting systems. Significant effects of oil spill can consist of destruction of protected terrestrial wildlife ecosystems (Baumüller, Donnelly, Vines, & Weimer 2011; Panafcon, 2016). This was the case with the oil spill in Mauritius from the MV Wakashio ship into the Mahébourg lagoon as the spill happened near two protected marine habitats in the Blue Bay Marine Park Reserve (Kadhka, 2020).

Selected biological features such as species and habitats depth make some fauna and flora have a higher chance to be exposed to oil spill effects than others (Chang, Stone, Demes, & Piscitelli, 2014). Bird species and marine mammal which must often go through air-water interface to breathe are more vulnerable to oil exposure (Lu, Yuan, Mikkelsen, Ohm, Stange, & Holand, 2017), although pelagic fish species have small exposure to oil (Helm, Costa, De Bruyn, O'Shea, Wells & Williams, 2015). In oil spill disasters where the oil is floating has the largest exposure will result in the intertidal zone where falling and rising tides bring species in direct contact with the large amount of oil spilled (Chang, et al., 2014).

Toxic pathways in various species are diverse and some illustration can consist of oil ingestion, cardiac dysfunction, collection of contaminants in tissues, huge mortality of larvae and eggs, effects on immune performance, also in fish, loss of insulation and

buoyancy for birds and inhalation of vapours (Aguilera et al. 2010; Judson et al., 2010; Major & Wang 2012). Affected flora and fauna species will differ in their response to oil spillage due to the genetic variance in their morphological and physiological traits (Chang et al., 2014).

Effects on Air

Oil spills have also been found to have an effect on the quality of air. Gros et al. (2014) reported that in the beginning hours of releasing oil at sea; crude oil hydrocarbons collect fast into water and air. According to Chang et al. (2014), bird and marine mammal species which have to go through air-water interface to breathe are more susceptible to oil exposure. Oil spills also result in Volatile Organic Compounds (VOCs) that evaporate and then become airborne in hours causing multitude of residents near the vicinity of oil spill to be removed for serious health signs. The inhalation of serious chemicals is common occurrence among those species of wildlife that need to breathe air (Chang et al., 2014).

Hoang, Pham, and Nguyen (2018) agree that physical overwhelming in a long duration and toxic parts owing to disasters of oil spills not only impacted serious marine plants and creatures' life and other animals but also polluted the air and reduced the human beings health. In case of oil spills that have happened in open water such as large areas on the surface of seawater, ice or snow, in-situ or thermal burning techniques that were only used due to emission of several pollution components into marine and air environment threatening marine life and other resources (Hoang et al., 2018). In earlier oil spills where quality of air was checked following burning, concentration of toxic gases which fall to the background levels outside almost three kilometers from a burn (Azwell, 2013).

Mitigation Measures

In the study, mitigation measures are the efforts/initiatives that have been made in order to reduce or regulate the adverse effects of oil spillage. These measures may be implemented by the government or other agencies.

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Surveillance and Monitoring

The adequate response needs a comprehension of the extent, location, thickness and movement of oil spills. Governments have created event command, a standard emergency management firm structure which used monitoring and surveillance data to make priority the direct and response cleanup resources and to provide data for site protection (Fingas & Brown, 2017).

In developed nations, in-water surveillance from Autonomous Underwater Vehicles (AUVs) and vessels of different sizes is used for checking a subsea spill (International Petroleum Industry Environmental Conservation Association [IPIECA] & International Association of Oil & Gas Producers [IOGP], 2017). Instruments are employed from attached AUVs or vessels to collect and sample sub-surface information and these technologies have the ability to map and detect oil under, on or within sea ice (Wilkinson, Beegle-Krause, Evers, Hughes, Lewis & Wadhams, 2017).

In countries such as Malaysia and South Africa, their government's Department of Environmental Affairs use aircraft for surveillance in order to control marine pollution from oil spillage along the coastlines (Fingas & Brown, 2017). These strategies of response such as in-situ burning, or chemical agents have been placed to change oil from one area of the environment to another such as from water surface to atmosphere and change its chemical and physical features.

Waste Management

Waste associated and handling activities are constant to all response actions except from natural recovery. Dependent on the oil spill size, response actions can produce huge volumes of waste such as contaminated debris, contaminated soils, personal protection equipment, used sorbents and booms, personal protection equipment

– that should be stored transported, decontaminated, handled, and/or disposed of properly (Beegle-Krause et al., 2017).

The procedures that comply with federal and state regulations are present for the transfer or storage of all solid, petroleum, or hazardous wastes created in the process of cleanup and recovery activities to reduce the reintroduction of waste into the environment. Staging areas, vessels, and transport to landfills, open burning, refineries, or incineration (Beegle-Krause, et al., 2018).

Oil Spill Response Contingency Plan

The major element to respond to specific oil spill disasters is the presence of a contingency plan which has been tested and that has related oil spill vulnerabilities with the capacity to respond taking into concern the environmental impacts (Muthike, 2018). Additionally, the plan should consist of settings matched with response capability and strategy that consist of a protocol for outside help through a leveled approach. The contingency plan should be cabala and deliverable of responding to the worst-case setting (Knol & Arbo, 2014; Muthike, 2018).

Alaska had existing legislation that shaped its policies regarding oil spills. This changed following the Exxon Valdez Oil spill's magnitude of environmental effects which prompted the government to come up with additional legislation that strengthened Alaska's oil spill response program (Bureau of Ocean Energy Management, 2019). This focused on state authorities' involvement in oil spill prevention, response, and cleanup.

In 2015, the Alaskan government evaluated Alaska's existing oil spill response planning structure and began the process for its development, which resulted in the Alaska Regional Contingency Plan in 2018. This contingency plan was unveiled in an effort to streamline and enhance responder efficiency in consistency with the

requirements of the National Contingency Plan (Bureau of Ocean Energy Management, 2019).

Incident Management system

An oil spill response can be successful consist of an effective incident management system with other partners engaged into the programme thus ensuring good practices and strategies are put into place in the event of an oil spill (IPIECA-IOPG, 2015). The effective incident management system consists of establishing control and command to response activities. It incorporates mix of different organisations within the firm structure promoting response that is efficient (IMO, 2010; Muthike, 2018). Notably, a team approach mainly consisting of experts from different organizations is more effective than individual organization structure for all the networks involved (Kurtz, 2008).

Most research has been done on oil spill response and preparedness that are effective (Chilvers et al., 2016; De Wolf, 2013; Ha, 2018; Manzer Communications, 2016). According to IPIECA-IOPG (2015), a successful response to oil spill should have an incident management system; robust stakeholder participation knowledgeable with strategies and tactics to oil spill response, and a comprehension of leveled response by response stakeholders and decision making that is ethical. It is critical that despite strong preparedness oil spills they may still happen. The major factor is containment of oil spills and reducing the economic and social environmental impact.

Oil Spill Response Communities

Owing to the difficulty of these operations there is a requirement to include priorities and expectations from all major stakeholders in an industry including local communities, government agencies, and oil firms to work together in attain the common

objective of responding and managing oil spills (Nanok, & Onyango 2017; Muthike 2018). Basically, there is a requirement for local communities and government agencies to partner in effective decision making and communication and policies on response techniques and to set objectives that are attainable (International Petroleum Industry Environmental Conservation Association, 2015).

Nonetheless, there was no inclusion for mechanisms for support and mutual agreements among government and industry agencies and various levels of preparedness. The available literature shows that firm networks should create the foundation on which oil spill preparedness is undertaken (Kurtz, 2008). Therefore, there is a requirement to engage communities in preparedness and response to oil spills activities (Knol & Arbo, 2014).

Response Techniques

So as to respond to oil spills effectively, different oil spill response techniques have been employed internationally and these include bioremediation, in-situ burning, mechanical, and chemical methods. Emerging technologies are always developed such as the South Baltic Oil Spill Response (SBOIL). SBOIL was first introduced in research by Biobind – an environment friendly technology for responding to oil spills (Nilsson, Dalaklis, Larsson, & Pålsson, 2018). The oil spill approach employed is matched by the conditions of the environment, impact on marine organisms, and type of oil. Importantly, as it is evident from the literature, response ability to an oil spill response is more integrated to preparedness and effectiveness to oil spills response approaches (Wang, Liu, Yu, & Zheng, 2018).

Oil Spill Response Training

Oil spill response training is the foundation of making sure that a well-prepared team is able to face an incident of an oil spill. In this setting, the utilization of crisis

simulations when conducting drills providing a chance to practice emergency operation skills (Kurtz, 2008; International Maritime Organization, 2010). Training simulations also assist in knowing the constraints facing the actual incident and propose what strategies to adopt to overcome these constraints. Moreover, it leads to the connections through communication that resulted into creating stronger team bonds (Kurtz, 2008; International Maritime Organization, 2010).

Preparedness to oil spills is limited to the inside operations of the organisations. The first response organizations and other networks should be effectively trained through simulation of crisis as it provides chances to practice skills in oil spill response. This training creates trust among firms' networks thereby enhancing communication. Majority of the research also cited that the inefficiency of back up resources in many firms (Kurtz, 2008).

The past oil spill events show that volunteers have a critical role to play such as in the Prestige and the Amoco Cadiz events in Europe. In these instances, some work has been done by coastal communities in France, Portugal, and Spain which resulted in the damage of the environment (Muthike, 2018). There is more evidence that supports the perception that there is a requirement of volunteers to undergo consistent training exercises and sessions for efficiency and professionalism in operation (International Petroleum Industry Environmental Conservation Association, 2015).

Effective Communication

The response to coming oil spills need to be proactive to contribute to the communication of reporting and media. This response should give the media with factual information and enhance the degree with which information is transmitted to influence articles and themes in the print media (Chilvers et al., 2016). The unavailability of senior crisis communication professionals to operate in close contact with senior management of

a specific firm to communicate to media may result to crisis reputation thus tainting the firm's public image as an irresponsible corporate actor.

A report by the GPO-Oil Commission showed evidence that the Deep-Water Horizon recommended the significance of strong crisis communication plan that is related to a well-trained team to meet demand during a crisis (GPO-Oil Commission, 2011). It is critical for firms to recruit senior communication employees so as to provide advice on the content to be communicated to the media and how it should be transmitted (Manzer Communications, 2016).

In a crisis, there is a need for stakeholders to have all the information, connected, and safe to action employed to fix the situation. This is attainable by regular and timely communication and reporting that is honest, during, before, and after response to an oil spill event. There is a need to report honest on what is not known and what is known so as to attain credibility. The communication before a response is critical as it protects the image of the firm (De Wolf, 2013).

Tiered Oil Spill Response Approach

The most important approach in avoiding vulnerabilities linked with any operations. The chances of environmental effects are linked with oil spill settings can be attained through the tiered approach of response and preparedness. This approach calls for integration of oil shipping, port, industries, government agencies, and stakeholders for partnership and cooperation. There are three levels based on the level of response and preparedness is global, regional, or local (International Petroleum Industry Environmental Conservation Association, 2015).

Leveled response ability is determined during the planning phase of oil spill management (IPIECA-IOGP, 2015). The first level covers the operator's resource to respond to an oil spill within their area of operation. The second level is huge than the

level one and needs more resources to respond to oil spill effectively. Level three calls for global assistance to improve the efforts of levels one and two resources (International Petroleum Industry Environmental Conservation Association, 2015). The resources needed in an oil spill event are dependent on the type of location, oil spill, volume, and season (International Tanker Owners Pollution Federation, 2017).

New Zealand has had instances of marine oil spills which the country has considered to be small in volume. This has prompted the country to adopt the tiered oil spill response approach headed by the Oil Pollution Advisory Committee (OPAC) (New Zealand Maritime, 2018). This committee is made up of both private sector and government actors and it addresses all matters related to oil spills in New Zealand. The tiered response approach has been used to manage any occurrence of oil spills and also effectively plan on how to manage significant spills with greater environmental effects if they occur (Maritime New Zealand, 2018).

Empirical Literature Review

This section looks into empirical studies reflecting on the environmental effects of oil spillage and the challenges faced in implementation of intervention measures for oil spillage effects. In each of the sections, every effort was made to include empirical literature from a global, regional, and local perspective.

Effects of Oil Spillage

Pegg and Zabbey (2013) did an investigation on the oil spill effects on conventional livelihood systems in Nigeria from the Trans-Niger pipeline oil disaster that occurred in the 2008–2009 time period. In collecting data for this study, empirical data on the water quality of Bodo Creek before and after the 2008 spills was accessed. The study also used personal experience and accounts of the local community whose livelihoods

were associated with shellfish or fish harvesting along with important global, NGO, and academic material to support the findings. The study found that community development had suffered disastrously from the extractive industries as the community suffered from destruction of waterways and mangrove forests and killing of fish and shellfish population. This resulted in the loss of thousands in employment and uncompensated personal property destruction (Pegg & Zabbey, 2013). The study was limited to coastal and marine impacts of oil spillage whilst the present study focuses on the effects of oil spillage on land.

Ogeleka, Tudararo-Aherobo, and Okieimen (2017) evaluated ecological effects of oil spills in the Niger Delta where there was no remediation or clean-up exercise was undertaken one year after the disaster. The study found that there were ecological effects noticeable after a year following clean-ups as there were oil sediments in the water indicating that the clean-up activities were not effective and was unable to restore the environment to its original state. This study was limited to laboratory testing of the effects of oil spills and water which are not in the scope of this study. The researcher aims to examine the effects of oil spill on water sources from the personal testimonies of the respondents.

Ipingbemi (2009) examined oil spill effects on the socio-economic aspect of people living in the Niger Delta by gathering information from secondary and primary sources where three hundred and two respondents were administered with soil samples and literature review from published sources were used. The study found that the vegetation suffered from herbicidal effects due to the oil spill and the plants had withered as if sprayed with herbicides and plants had lost their coloration too.

Mohamadi, Liu, and Xie (2016) undertook an investigation into an oil spill on vegetation using Multi Endmember Spectral Mixture Analysis (MESMA) to determine

the number of vegetation by percentage present before and after an oil spill using Landsat images from 2011-2012 with a total of one hundred and sixty three documented oil spills. The results showed that seventy three percent of oil spill areas had experienced loss of vegetation. The study was limited to scientific analysis of direct impacts of oil spills on vegetation while the present study aims to identify the direct effects of oil spill on flora and fauna; the study also aims to find out the indirect effects of oil spillage on vegetation cover.

Oil Spill Intervention Measures

In Spain, Pérez-Pereira, Tinajero, Rodríguez, Peralbo, and Sabucedo (2012) took a look at the impact of huge oil spill disaster on the behaviour of children and adolescents in the classroom and their academic achievement in the Spain using an ecological perspective. The findings revealed that there are limited effects of the oil spill on academic achievement and classroom behaviour. However, some protective factors that had been undertaken by the authorities were found to have been effective in reducing the amount of impact of the oil spills on classroom behaviour thus indicative that the intervention was effective in the children and adolescents adapting to the disaster.

Balogun and Kareem (2013) did a research whose objective was to undertake an early exploration into the constraints of oil spills in Nigeria. Several findings were established, the compensation paid to communities by the government and oil companies was not enough to meet the livelihoods of the affected members of the community in the long-term. The findings showed that government does not usually intervene immediately to save the oil spill victims in some communities. In addition, low response of interventions from the government shows the amount of negligence to the challenges facing oil production communities. The study concluded government intervention levels does not match the effects of oil spills.

Ekpo, Obot, and David (2018) conducted a review on the oil spill impact on surviving aquatic resources in the Niger Delta. One of the objectives of this review was to identify some of the interventions that the government undertook to address the occurrence of these events. The Federal Government of Nigeria's (FGN) reaction to the need for community compensation and development for the negative impact of oil extraction has been via creation of new bodies and small increase in revenues from oil being allocated to the region.

Ivshina et al. (2015) researched aimed to summarize emerging knowledge on technology and research gaps that were needed for creating effective decision-making methods to be used in oil spill events. The majority of oil exploration is happening deeper into the ocean, and this makes the oil spill effects even much greater and higher. The study makes recommendations for significant intervention at oil spills should focus on installing skimmer pumps in wells underground to remove as much of the oil that can be recovered to reduce the present source of contamination. The recovery of concentrated hydrocarbon amounts, and crude oil is challenging owing to low water solubility.

Osuagwu and Olaifa (2018) assessed the oil spill effect on production of fish in Nigeria from a period of 1981-2015 which found that oil spill and production had a negative effect on production of fish. The study also found that interventions based on agricultural production had also failed to enhance communities' affected livelihoods such as the Agricultural Credit Guarantee Scheme Fund (ACGSF). The study focused on the government interventions that the Nigeria government made in addressing the effects of oil spills on the fishing industry in the delta. The present study aims to focus on government interventions on oil spills on land, water sources and flora and fauna.

Challenges that Hinder Effective Intervention of Oil Spillage Effects

Ishak et al. (2018) case study found that there existed positive and statistically significant correlation between the management practices and response to oil spills. The most effective management practices are the emergency plan which focuses on the cooperation among all units and departments to support the response team adequately. This study was conducted in a coastal oil spill context unlike the present study which focuses on terrestrial oil spills. Moreover, the study explored the response and preparedness to oil spills and this study is focused on the response to oil spills.

Moroni et al. (2019) explored the existing solutions, best practices and current challenges. They begin by noting that in recent times, there has been greater media attention to large oil spills in contrast to micro and small oil spills are less noticed or reported in the media but are noticed by local communities and authorities who are indirectly or directly affected by these events. However, small oil spills represent the vast majority of oil pollution events. One of the constraints of dealing with micro and small oil spills is they are on a less spatial scale and are less detectable when using remote sensing. The study found that comparison, cross-correlation, and gathering of multiple sources of data may not be effectively conducted manually by stakeholders and authorities in charge of the intervention and remediation operations.

Carlan, Heaver, Sys, and Vanelslander (2016) examined the nature of governance issues affecting spill response in ports and to examine the systems used to achieve effective response in leading ports in Antwerp. The study adopted several strategies, one of which was using a desk research approach to present the legal international framework under which the oil spill response is treated. Second, experts in the study were involved using semi-structured interviews and the study was able to see that the constraints of interventions towards oil spills were finance, corporate social responsibility (CSR), equipment, planning, communication, training, political will, and regulatory framework

Issa and Vempatti (2018) reviewed the different chemical, natural, and mechanical methods of remediation used in cleanups and give a different comparison of these for ability to use them in future events. One of the easiest designs to remove oils from water is using a suction tool which can suction or pump out the oil from water surface. However, a challenge of this technology includes its limitation to application to more contamination sites, storage of recovered oil is limited, and higher proportion of water is in the end collected and it should be emptied to increase the accessible oil storage ability. The study concludes that there are several remediation and cleanup methods and these can be grouped into biological, chemical, mechanical, and natural.

Ishak et al. (2018) assessed the relationship between response and preparedness on oil spills and the management approaches adopted in Malaysia. The objectives of the study were to assess the association response and management practice to oil spills and evaluating the association between preparedness and management practices to oil spills. The study found that management practices such as an emergency plan was the best responses to oil spills and emergency plan focuses on the cooperation among all units and departments to ensure effective support is provided to the response team.

In Kenya, Mulako (2019) assessed the management of oil spillages from inland oil terminals in Industrial Area of Nairobi City County. The data for the research was gathered using semi-structured questionnaires and KIIs that were administered to regulatory institutions and oil terminal representatives. The study listed delay of implanting legal framework in oil exploration, poor enactment, or adherence to existing laws on oil spillages, lack of allocation of sufficient funds, lack of capacity and institutional structure, and coordination of intervention measures as challenges to oil spillage interventions in Kenya.

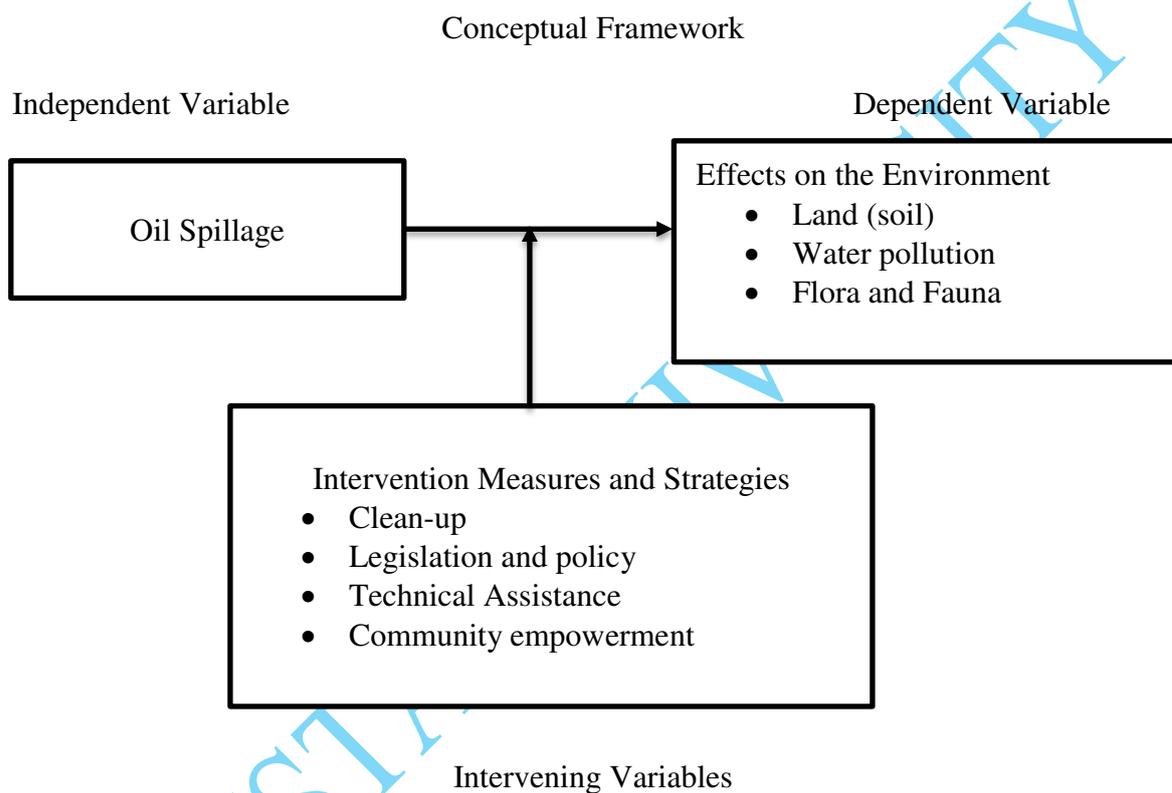


Figure 2.1: Conceptual Framework
Source: Author (2021)

Discussion

Figure 2.1 shows the study's conceptual framework where the independent variable is oils spillage indicated on the left-hand side and the dependent variables being the effects of the spillage on water, soil, flora and fauna on the right. The intervening variables are shown in the lower middle section of the diagram. The intervening variables include policy and legislative framework and disaster response mechanism for dealing

with ecological disaster such as oil spills and emergency response which can affect the extent to which the government and other agencies can intervene and to what degree the communities have been strengthened in terms of reducing vulnerability in the event of spills.

Summary

A review of oil spill preparedness in Kenya shows that the country has made significant progress towards implementation of the provisions of the International Convention on Oil Pollution Preparedness (OPRC) Convention and the (Hazardous and Noxious Substances by Sea Convention (HNS) Protocol. Measures taken include adopting a national system addressing oil pollution preparedness and response (Ministry of Energy and Petroleum, (2015).

However, it is important to note that the risk of oil spillage pollution is high due to the growth of the oil industry and coupled with crude oil export through the Port of Mombasa in the future. Given the oil spillage incidents that have occurred in Kenya, there is a need to build capacity in anticipation of similar oil spills and their effects on the environment. Importantly, no regulation directly addresses the issue of oil spill preparedness in the country to ensure that it accords fully with international best practices. This thesis aimed to provide solutions to existing gaps to improve oil spill preparedness in Kenya using the spillage incident at Thange as a case study.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

Research can be defined as “an activity that involves finding out, in a more or less systematic way, things you did not know” (Walliman & Walliman, 2011, p.7). On its part, “Methodology is the philosophical framework within which the research is conducted or the foundation upon which the research is based” (Brown, 2006, p. 42). Research methodology therefore is a section of research describing research methods and designs in detail to be used in the study, justifying the choice of their use by explaining the advantages and disadvantages of each method and design while considering their practical applicability in the research (Queirós, Faria & Almeida, 2017).

In light of this, this chapter describes the research design, population, target population, sample and sampling techniques, data collection instruments, types of data, data collection procedures, pretesting, data analysis plan, ethical consideration and summary.

Research Design

A plan that is adopted into research that explains the types and sources of information that pertain to the subject under study is referred to as a research design (Briggs, Coleman & Morrison, 2012). A research design is an approach that explains how data will be analysed and gathered and also shows the techniques and procedures to be used in analyzing the data (Creswell, 2013). There are three research designs that one can select, ranging from mixed methods, qualitative or quantitative and each has its own techniques and procedures that match them uniquely (Creswell, 2013). This study adopted a descriptive design where both quantitative and qualitative data were utilized.

According to Omair (2015) descriptive research designs collect information at a defined period of time with the aim of providing a description of the current situation or finding out what conditions can be determined or compared to determine the relationship between events. Cohen and Manion (2012) explain that descriptive research designs are not aimed at fact-finding alone but also towards formulation of important solutions and knowledge to significant problems. This implies that descriptive research is aimed at systematically and accurately describing a population, phenomenon, or situation by answering the how, what, where and when questions. The current research will help in formulating solutions and knowledge on the effects of oil spills to the environment. Thus, this design was adequate for gaining quantitative and qualitative data in terms of the evaluation of oil spill effects on the environment in Thange.

Population

According to the 2019 population census, Makueni County has a population of 987,653, from 884,527 in 2009 (Kenya National Bureau of Statistics [KNBS], 2019). The 2019 population census shows that Kibwezi Sub-County in Makueni County, where Thange is located has the highest population of 197,000 people (KNBS, 2019).

Target Population

Based on the 2019 Kenya Population and Housing Census, Kinyambu Sub-location where the affected Thange community is located has a population of approximately 9,807 people and 2,723 households (KNBS, 2019). Therefore, the study target population was 9,807 people translating to 2,723 households at Thange village (KNBS, 2019).

Sample Size

Not all households in Thange were covered as the size of the sample was arrived at by considering Alreck and Settle's (2013) assertion that an optimum sample is one that meets the requirement of representativeness, efficiency, reliability and flexibility. According to Israel (2013), with a confidence interval of +/-10% and a confidence level of 95 % using the formula below, a sample size of 96 households was used for the study.

$$n = \frac{N}{1+N(e)^2}$$

Where:

n = sample size,

N = target population

e = desired level of precision 10% (standard value of 0.1)

Therefore:

$$n = 2,723 / 1 + 2,723 (0.1)^2$$

$$n = 96$$

Thus, from a sample size of 96 household heads, 95 respondents were reached from the 2,723 household heads. Additionally, the study targeted 6 Key Informants (KIs) consisting of one KPC official, one NEMA County official, one Makueni County Executive Committee Member (CEC) of the Department of Agriculture, Irrigation, Livestock and Fisheries Development, one healthcare provider, a chairperson of truck drivers' association in Makueni, and one community leader concerned with environmental conservation in Thange. Out of these KIs, only four were reached in the data collection.

To enrich the study, three Focus Group Discussions (FGDs), one of female respondents, another of male respondents and another with both male and female each

with 8 participants were convened. The number is determined based on Kasomo (2015) assertion that focus groups are usually comprised of six to eight participants. These groups were essential in providing information and perspectives on different community and gender experiences during oil spillage.

Sampling Techniques

Out of the 2,723, the study sampled 96 household heads in Thange village through systematic random sampling technique. The first step of conducting a systematic random sampling technique is identifying an interval by dividing the population by the sample size ($2,723/96$) which results in an interval of 28. The researcher then selected 29 as a random starting point and then select every 29th household in the sample until the desired sample size was achieved based on Israel's (2013) systematic sampling formula described below.

$$K = \frac{N}{n}$$

Where: K = sampling interval

N = target population

n = sample size

Therefore:

$$K = 2,723 / 96$$

$$K = 29$$

Interview schedules were administered to representatives of household heads during the actual data collection. These included the father or mother in a nuclear family. In case the household head was not available, the researcher made an appointment to return and administer the interview schedule.

In addition to the 96 respondents, purposive sampling was used to select 6 key informants (KIs); one KPC official, one NEMA County official, one Makueni CEC of Department of Agriculture, Irrigation, Livestock and Fisheries Development, one healthcare provider, a chairperson of truck drivers' association in Makueni and one community leader in Thange. Purposive sampling was opted to sample KIs who have important information and are knowledgeable on the effects of oil spillage on the environment. The interview with the KIs was carried out by the principal researcher to get in-depth information through probing based on the quantitative findings.

Similarly, the principal researcher moderated three FGDs; one with male participants; another other comprising of female participants while the third group had both male and female participants. The researcher used these group criteria to eliminate subjective bias and enable the participants to freely share their personal experiences on the effects of the oil spill. Each group comprised of eight participants. These groups were essential in providing information on the community experiences during oil spillage. The 24 FGD participants were Thange Village residents who had a first-hand account of the oil spillage and were not part of the household survey and were over the age of 18years.

The participants were selected through the assistance of local area administrators such as Chief, the Chairman of the affected households and village elders. The researcher organized the FGDs in the afternoon when participants were likely to be available. FGDs are important because oil spillage affects all cadres of the society in various ways and therefore a response system will equally call for efforts of everyone based on their views and spillage effects experienced.

Data Collection Instruments

This study used a semi-structured interview schedule for primary respondents, an in-depth interview guide for the KIIs and an FGD guide for FGD participants. The study

found it necessary to use the three instruments for purposes of triangulation to facilitate cross checking of the reliability of the data collected in order to gather reliable data. According to Kombo and Tromp (2016), using different methods of collecting data allows a researcher to solve a problem with various methods that have existing weaknesses as well as complimenting others to enhance the accuracy of results.

Kumar (2011) points out that an interview schedule is a research tool comprising of a sequence of questions for gathering data from respondents. The benefits of using interview schedules over other forms of surveys are that they are economical, user friendly to the interviewer, and often have homogenous answers for ease of data compilation and analysis (Creswell, 2011; Kasomo, 2015; Kombo & Tromp, 2016).

A semi-structured interview schedule was appropriate for this study because it enabled the researcher to gather data from 95 primary respondents. Besides, the interview schedule relates to this study because it was able to gather both qualitative and quantitative data that the researcher is interested in. A Likert Scale was used to gather data on the various indicators such as land, water, fauna and flora and mitigation challenges. Open-ended questions were used to gather information on the mitigation and coping mechanisms adopted by different stakeholders.

An in-depth interview guide was used to gather data from key informants. An in-depth interview guide is essentially a structured discussion where the researcher asks the questions, and the respondent provides answers (Merriam Webster Dictionary, 2016). In-depth interview guide questions are open-ended meant to elicit unexpected answers not originally anticipated (Creswell, 2011). The importance of using this instrument in the study was to collect rich information from respondents by allowing them to give their own experiences with the effects of oil spillage on the environment. The KIs may have information or knowledge on these effects and are expected to provide rich and insightful

data. In this case, the tool was used to collect in-depth information on interventions by the government and other agencies that were undertaken after the oil spillage event.

A focus group discussion is a technique of data collection used to collect from participants in a group setting. In this discussion, participants are asked about their insights, views and attitudes towards a product, service, concept or phenomena (Harding, 2013). Focus groups usually have six to eight participants who are asked questions in an interactive setting where the participants are free to talk with each other (Kasomo, 2015). The researcher used this method to eliminate subjective bias and get an in-depth view of the problem.

The study had three FGDs comprising of eight participants aged 18 years and above. Recruitment of the FGD participants was restricted to Thange village and was not part of the 95 primary respondents. The FGD guide had questions that expressed the objectives of the study, and the idea was to have conversations and contributions amongst the participants on these areas. This tool was instrumental in gathering divergent views on the effects of oil spillage on the environment from the group participants during the discussions.

Types of Data

The information acquired in the course of a research to solve a problem is referred to as data and can be categorized as either primary or secondary data (Kasomo, 2015). Primary data was obtained directly from the field through an interview schedule and focus group discussions, while secondary data was obtained through review of existing literature relevant to the study. This data can further be classified as qualitative and quantitative data. Quantitative data is in number form whilst qualitative data is best described by words, and in this study, it was derived from the interview schedules. Qualitative data can be grouped into categories based on their physical properties or

attributes of the object and is interpreted as written or spoken narrations rather than numbers (Kombo & Tromp, 2016). In this study, qualitative data was obtained through KIIs, FGDs and the open-ended sections of the interview schedule.

Data Collection Procedures

The researcher acquired several documents before collecting data. Approval was sought from the Daystar University Department of Development Studies, the Daystar University Ethics Review Board (DU-ERB), the National Commission for Science, Technology, and Innovation (NACOSTI), and the local administrators in the study area. Once the approvals were given, the researcher then embarked on data collection for the study.

The interview schedule was administered to respondents (household heads) by five trained research assistants who were residents of Thange Village, under the supervision of the principal researcher. The interview schedule was distributed to household heads. Through the local administration, the researcher provided prior notice to the households on the days that the interview schedule was to be administered to ensure that respondents were available. The interview schedule was then directly administered to household heads in the study area to ensure that data was collected comprehensively. Where the male household head, who is ideally the husband, was not present, the researcher approached the wife to be the respondent in the study.

The 95 primary respondents were the first contact of data collection for the study through the interview schedules. After obtaining all permissions to collect data, the researcher listed the number of households in Thange village which was used to create a sampling frame for the systematic random sampling technique to be used.

The individual in-depth interview sessions with KIs were conducted with NEMA officials, a healthcare provider at ABC Thange Dispensary, the community leader and

truck drivers' chairman. These interviews were performed at convenient times for the KIs based on prior appointments with each one of them. With their permission, conversation with each KI during the interviews was taken down in a transcript.

The FGDs participants were selected based on gender segregation to ensure that their opinions are captured separately and not influenced or dominated by the other gender. This composition of the groups was also important because oil spillage affects all cadre of the society and it provided insights on various effects of the spillage in the community. FGDs were moderated by the principal researcher using a focus discussion guide with open-ended questions that prompted discussions that enabled the researcher to obtain views and responses related to the study based on the participants understanding and experiences. The research assistants assisted in the recording of the proceedings. Recorded data was transcribed and processed to facilitate data analysis. Data collected from the KIs and FGDs provided qualitative data that enriched the quantitative data collected from primary respondents through interview schedules.

Pretesting

A pre-test of the study was required to identify how to shape the field exercise of research (Creswell, 2011). The aim of the pre-test is to check if the instrument items were unambiguous and clear to respondents and the issues that may arise as they respond to the questions. Pretesting aids a researcher to recognize problem areas in the tools of data collection to be used in the study, reduce measurement error, determine if respondents are understanding questions properly or not, and confirm that the order of questions is not influencing how the respondents answer them (Hilton, 2015).

The pre-testing was conducted at Kiboko area in Makeni County. Kiboko is similar to Thange in that it is also a drainage basin, and the area may have had similar

characteristics of an environment effects from oil spillage along the KPC pipeline experienced in March 30th 2019. Based on the assertion by Connely (2014), an ideal pretest sample size should be 10 % of the sample size for main study. Thus, a pre-test was conducted with 10 household heads from the Kiboko community. The researcher selected the household heads through consultations with the area local public administrators who were familiar with households affected by oil spillage.

The researcher, with the help of RAs administered the interview schedule to 10 the sampled household heads. This training included the need to observe ethical principles of respecting the respondents, asking for verbal consent, and keeping the information given confidential and anonymous. The pre-test of the key informant interview guide was done with one informant from NEMA, Makueni office who was referred to the researcher by the County Director and three members of the community.

In this test, the researcher evaluated four criteria that Hurst et al. (2015) proposed for validating qualitative methods of data collection such as the in-depth interview guide and FDG guide. These are; evaluating the competency of the interviewee in terms of their competency, estimating the time length of the interview session to determine the periods of respondent fatigue. Third, the principal researcher read and practiced improving their skills on qualitative interviewing and leading an FGD session to enhance standards for data collection. Lastly, the fidelity and feasibility of transcription and translation was done by practicing the translation of and transcription of recorded interview sessions.

Data Analysis Plan

The data collected for the purpose of the study was analyzed qualitatively and quantitatively. Quantitative data that was obtained through the interview schedule was coded into Statistical Package for Social Sciences (SPSS) programme (Version 26) to produce frequencies, means and percentages as guided by the study objectives. This data

included the counts and numbers showing effects of oil spillage and the challenges in mitigation measures. The interview schedule was validated by making sure that it was correctly filled, edited, and then coded before being subjected to analysis.

Data from in-depth interviews with KIs and focus group discussions constituting of qualitative data in word and phrases were transcribed and then categorized into the emerging themes matched with the research variables. This involved audio recording data from FGDs, and oral interviews was transcribed then cleaned and sorted for completeness. The data was classified and coded as per the emerging themes which the researcher then gave interpretations.

The researcher selected quotes that were most representative, descriptive and holistic of the research findings. The structure of the presentation was based on the theme emerging from the information which was supported with narratives and quotes to show support or inform the quantitative findings.

Ethical Considerations

The researcher sought an introduction letter from the Department of Development studies, Daystar University for identification as a bonafide student who is out to conduct research. Clearance was sought from the Daystar University Ethics Review Board (DU-ERB) and once approval was granted, the researcher obtained a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI).

After this, the researcher sought permission from the local administrators to carry out the research in the study area. The nature and purpose of the study was explained to the respondents and their consent sought for them to participate. As their participation in the research was voluntary, the respondents were required to fill in the informed consent form that incorporates their rights. The researcher informed the respondents that the

research tool used did not have any questions that may infringe on their privacy hence no form of harm can be caused to them. In addition, there are no financial or any other physical benefits that came from participating in this study and this was made clear to the respondents.

The researcher assured the respondents of their anonymity and confidentiality. Respondents were not required to disclose their identity in the FDGs and KIIs. The researcher considered any individuals with emotional, cultural, and physical barriers which needed simple language and communication to enhance comprehension. Lastly, respondents were informed that they can voluntarily withdraw from the study if and when they chose to do so.

The respondents were sought for their verbal consent in the beginning of any activity of sharing information. The interview schedule had a consent form where the respondents were explained on their rights, obligations, and role in data collection. This consent was recorded during the key informant interviews and the FDGs. Thus, respondents were required to give verbal consent before the start of data collection.

The information from the respondents was only accessible to the data collectors and the data analyst. Confidentiality was enhanced by having the data under lock and key and giving instructions to the data collectors and analyst not to share any information from the study be it hard or soft copy. Data was stored on the investigator's laptop and was only shared with the data analyst using a memory stick.

Summary

In this chapter, explanations on the methods and strategies that were used to prepare and conduct this research are given. The sampling methods used were systematic random sampling and purposive sampling while the tools of data collection were an

interview schedule, in-depth interview guide and an FGD guide. To test for suitability of the tools of data collection, the instruments were subjected to pre-testing in Kiboko community to enhance necessary adjustments before being administered to actual respondents of the study.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

Introduction

This chapter presents the findings of the study. The findings are presented in two parts indicating the quantitative data presented in tables and the qualitative information presented in prose and verbatim text to support statistical presentations. The sections of this chapter include the response rate, the demographic information, effects of oil spillage on land, water, flora and fauna; and the constraints faced in mitigating the effects of oil spillage in Thange Village.

Analysis and Interpretation

Response Rate

The sample size for the study was 96 respondents who were targeted for the interview schedules. Out of these, the researcher was able to reach 95 respondents from different villages that included 21.1 % in Nzavoni, 18.9 % from Kyausini, 17.9 % from Ngomano, 12.6 % from Thange while 10.5 % were from Kavumie and Mwanza villages. Mbulutini village accounted for 7.4 % while 1.1 % was from Kwa Moki Village.

Table 4.1: Study Response Rate and Their Corresponding Villages

Village	Frequency	Percent
Thange	12	12.6
Kavumie	10	10.5

Mwanza	10	10.5
Kyausini	18	18.9
Nzavoni	20	21.1
Ngomano	17	17.9
Mbulutini	7	7.4
Kwa Moki	1	1.1
Total	95	100.0

Therefore, the response rate for the study was 98.9 % as shown in Table 4.1. The achievement of a high response rate was as a result of the rapport created between the researcher and the community that developed a sense of trust during the data collection process.

Demographic Information

The aim of gathering demographic data from respondents was to get a better understanding of the profile of respondents and this was also important as the study can be able to generalize the findings to the defined characteristics.

Respondents' Gender

In terms of respondents' gender distribution, the findings showed that there were 58 (61.1%) female respondents while male were 37 (38.9%) as shown in Table 4.2. This implies that there was fair gender representation of the respondents who participated in this study.

Table 4.2: Gender Distribution Among Respondents

Gender	Frequency	Percent
Male	37	38.9
Female	58	61.1
Total	95	100.0

Respondents' Marital Status

The results show that 69 (72.6%) of the respondents were married, followed by those who were widowed at 19 (20.0 %), those divorced/separated were 4 (4.2%), while 3 (3.2%) represented those who were single as illustrated in Table 4.3. From this finding, it

is clear that the respondents' marital status was well spread out, representing all the sections of society.

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Table 4.3: Marital Status Distribution

Marital	Frequency	Percent
Single	3	3.2
Divorced/separated	4	4.2
Married	69	72.6
Widowed/Widower	19	20.0
Total	95	100.0

Respondents' Highest Level of Education

The distribution of education levels among the respondents shows that 53 (55.8 %) had primary level of education, followed by 22 (23.2 %) respondents with no formal education and 17 (17.9 %) with secondary level of education. Respondents holding diploma, undergraduate, and postgraduate level each was 1 (1.1 %) as shown in Table 4.4. It is evident from the findings that 92 (79%) of all the respondents had primary level or no education at all. This finding implies that primary education is the most pursued level of education among the sample respondents who may not have opportunities to further their education.

Table 4.4: Education Distribution Among Respondents

Education	Frequency	Percent
No formal education	22	23.2
Primary level	53	55.8
Secondary level	17	17.9
Diploma	1	1.1
Undergraduate level	1	1.1
Postgraduate level	1	1.1
Total	95	100.0

Respondents' Occupation

In regard to respondents' occupation, Table 4.5 shows that 38 (40 %) were in self-employment and farming respectively, livestock and farming registered 12 (12.6 %) respondents, 4 (4.2 %) were in the public sector while businessmen and women accounted for 2 (2.1 %) and 1 (1.1 %) respectively. This finding reflects a characteristic of a rural area.

Table 4.5: Occupation Distribution Among Respondents

Occupation	Frequency	Percent
Public sector	4	4.2
Self-employed	38	40.0
Farmer	38	40.0
Livestock and farming	12	12.6
Business man	1	1.1
Business lady	2	2.1
Total	95	100.0

Respondents' Level of Income

The respondents were asked to indicate their monthly income and the findings showed that 26 (27.4 %) had an income of less than Kshs. 10,000, 36 (37.9 %) an income of between Kshs. 10,000 – 20,000 and 18 (18.9 %) of respondents had an income of between Kshs. 20,000 – 30,000 per month. The findings show that respondents earning more than Kshs. 50,000 accounted for only 2 (2.1 %), while those earning less than Kshs 20,000 amounted to 62 (65.3%) as shown in Table 4.6. The finding implies that the area is a low-income rural setting, and this may have shaped the response to the oil spill by the responsible agencies.

Table 4.6: Income Distribution Among Respondents

Income	Frequency	Percent
Less than 10,000	26	27.4
10,000-20,000	36	37.9
20,000-30,000	18	18.9
30,000-40,000	9	9.5
40,000-50,000	4	4.2
Above 50,000	2	2.1
Total	95	100.0

The demographic findings show that there were more female respondents than male, respondents attributed this to the fact that male household heads usually go to work and leave their spouses to manage the home. the respondents' marital status was well spread through the married, widowed, divorced/separated and single categories, representing all sections of the society. The respondents with a primary level of education

were the larger share of the respondents followed by those with no formal education as some of the sample respondents may not have opportunities to further their education. In terms of occupation, farming and self-employment were prominent among the sample with more of the sample earning between Kshs. 10,000 – 20,000, implying a low-income area.

Effects of oil spillage on land

The first objective of the study was to examine the effects of oil spillage on land and the respondents were asked to indicate their level of agreement with statements that reflected the expected effects of oil spills on land as derived from the literature review. As shown in Table 4.7, the overall mean score was 4.11 and the standard deviation was 0.831 which means that the responses were closer to this mean. This finding suggests that respondents agreed that the oil spillage had an effect on land. Specifically, respondents agreed that the oil spill contributed to decline in soil fertility as shown by a mean score of 4.18, acidity in soil at 4.40, while reduced farmland had a mean score of 4.23.

Table 4.7: Oil Spillage Effects on Land

Statements	1 (Very Little)	2 (Little)	3 (Moderate)	4 (Strong)	5 (Very Strong)	Mean	Std. Deviation
Decline in soil fertility	1.1%	4.2%	7.4%	50.5%	36.8%	4.18	0.825
Increase in surface run off	2.1%	5.3%	21.1%	56.8%	14.7%	3.77	0.844
Acidity in soil	0%	2.1%	10.5%	32.6%	54.7%	4.40	0.764
Increase in soil erosion	2.1%	5.3%	9.5%	60.0%	23.2%	3.97	0.856
Reduced farming land	1.1%	3.2%	12.6%	37.9%	45.3%	4.23	0.869
Overall mean score						4.11	0.831

The results imply that the oil spill increased soil acidity at Thange, which in turn reduced the ability to support vegetation which is crucial for the sustenance of this community which depends on crop and livestock farming. This affected the agricultural

production in the area as this was supported by a female FGD participant who remarked that;

Farmers' livelihoods were greatly affected by the spill as they could not successfully practice agriculture as they did before the spill. Makueni County Department of Agriculture put a ban on the sale of food produce, livestock products and water use from Thange throughout the county due to fears of contamination and spread of health risks. This reduced the value of land in terms of farming meaning less dependence on farming threatening the livelihoods of households.

This reduced the productivity of land which threatened the community's means of subsistence as was alluded by a key informant;

Farms neighboring the spill point were contaminated due to refined oil product that percolated to the underground water sources which dried up crops and trees. Deep rooted trees, for example mango trees were the most affected. This was evidenced by their drying up soon after the spillage.

A male FGD participant explained further stating that;

There was an experience in decline in soil fertility changing Thange from being a breadbasket of Makueni County to not practicing agriculture from the spill contamination which reduced the sizes of arable land. The contaminated soil resulted in fruit trees around the spill site drying up.

On effects of oil spill on land, the findings show respondents agreement that there was a decline in soil fertility, reduced farming land, and acidity on soil. Soil tests were carried out after the oil spill to investigate the presence of Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAHs), Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX) and heavy metals in the contaminated area. and identified the presence of hydrocarbons in the contaminated soil (Panafcon, 2016). The lab analysis results of the tested soil samples showed the presence of hydrocarbons in the soil, which altered the soil acidity (Panafcon, 2016). The findings show acidity in soil had the largest mean score showing that this factor also resulted in the decline in soil fertility and decline in the size of land for farming.

Effects of oil spillage on water

The second objective of the study was to investigate on the effects of oil spills on water. Respondents were asked to respond to 7 statements referring to the experienced effects of oil spillage on water sources in Thange village. Table 4.8 show an overall mean score of 4.14 and standard deviation of 0.813 indicating that respondents confirmed that water sources were affected by the oil spill. One of the effects that were experienced was having unclean drinking water. The responses showed a mean score of 4.62 and a 0.622 standard deviation. The respondents also agreed that pollution of rivers occurred ($M = 4.54$, $SD = 0.712$), in addition to the contamination of wells ($M = 4.36$, $SD = 0.771$), while the discoloration/filming of water was also observed ($M = 4.04$, $SD = 0.824$).

Table 4.8: Oil Spillage Effects on Water

Statements	1 (Very Little)	2 (Little)	3 (Moderate)	4 (Strong)	5 (Very Strong)	Mean	Std. Deviation
Sedimentation of rivers and water pans	1.1%	3.2%	13.7%	60.0%	22.1%	3.99	0.765
Pollution of rivers	1.1%	0%	6.3%	29.5%	63.2%	4.54	0.712
Pollution of wells	1.1%	1.1%	8.4%	40.0%	49.5%	4.36	0.771
Drying of rivers	7.4%	17.9%	13.7%	37.9%	23.2%	3.52	1.237
Discoloration/filming of water	1.1%	3.2%	15.8%	50.5%	29.5%	4.04	0.824
Hardening of water	0%	3.2%	21.1%	51.6%	24.2%	3.97	0.764
Unclean drinking water	0%	1.1%	4.2%	26.3%	68.4%	4.62	0.622
Overall mean score						4.14	0.813

The findings indicate that oils spillage effects on water resulted in lack of access to drinking water. This is because the residents of this village get drinking water from the river and surrounding shallow wells (Panafcon, 2016). The pollution of rivers was also listed as a consequence of the oil spill along with contamination of water wells which members of the community had dug in the area. Groundwater tests were conducted in Thange Village, and the analyzed samples results showed the presence of petroleum products (Panafcon, 2016). A female FGD participant commenting on water pollution pointed out that;

Wells in Thange area were contaminated by the spill creating challenges in accessing clean drinking water. Oil fumes were also emitted from the wells. Filming and discoloration of water along the river was noticeable after the spill prior to clean-up efforts. The soak pits near the river left by Enviroserv after the cleanup exercise still show evidence of filming, water discoloration and oil fumes.

In order to access safe drinking water, the community had to resort to other alternatives as indicated by a male FGD participant that;

Affected households resorted to buying drinking and farming water which was previously freely accessible from the river prior to the spillage. Schools and households unable to afford to buy water walk longer distances upstream to fetch water or fetch it from areas they consider less polluted downstream.

In conducting the clean-up exercise at Thange, Enviroserv (K) Limited was contracted by KPC to perform the cleanup exercise, which involved creating soak pits alongside the river from which the spilled oil would be collected. In terms of effects of oil spill on the water, the findings show there was unclean water, pollution of Thange River, pollution of wells, and the discoloration or filming of water.

Effects of oil spillage on flora and fauna

The study aimed at investigating the effects of oil spill on flora and fauna where respondents were asked to respond with 6 statements related to these effects. Table 4.9 reveals that an overall mean score of 4.19 and standard deviation of 0.745 implying respondents' agreement that oil spill affected flora and fauna in the area.

Table 4.9: Oil Spillage Effects on Flora and Fauna

Statements	1 (Very Little)	2 (Little)	3 (Moderate)	4 (Strong)	5 (Very Strong)	Mean	Std. Deviation
Reduction of forest /vegetation cover	0%	1.1%	11.6%	57.9%	29.5%	4.16	0.657
Death of animals	0%	1.1%	6.3%	32.6%	60.0%	4.52	0.666
Reduced grazing lands		1.1%	11.6%	57.9%	29.5%	4.16	0.657
Destruction of protected habitats	8.4%	10.5%	16.8%	47.4%	16.8%	3.54	1.147
Poor aesthetics	0%	0%	9.5%	55.8%	34.7%	4.25	0.618
Loss of agricultural produce	0%	2.1%	7.4%	23.2%	67.4%	4.56	0.725

Overall mean score	4.19	0.745
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From the findings, the respondents agreed with most of the statements on effects of the oil spill on loss of agricultural produce ($M = 4.56$, $SD = 0.725$), death of animals ($M = 4.52$, $SD = 0.666$), poor aesthetics ($M = 4.25$, $SD = 0.618$), reduced grazing area ($M = 4.16$, $SD = 0.657$), and reduction of vegetation cover ($M = 4.16$, $SD = 0.657$). These findings indicate that there was a higher level of agreement with the mean scores in statements on effects on flora and fauna by respondents on grazing livestock and the reduced population of small animals in this habitat. This view was supported by a male FGD participant;

Polluted river and wells, which were sources of drinking water for human beings and wildlife in the area, resulted in the loss of livestock, wildlife, vegetation and crops. Polluted water downstream could not be used for farming and livestock rearing. Moreover, there is noticeable reduced numbers of monkeys, porcupines, butterflies, that used to be found in the area.

In conclusion, the effects of oil spill experienced were the loss of agricultural produce, death of animals in the habitat, reduced vegetation and tree cover.

Challenges Facing Mitigation of Oil Spillage

Following the oil spill at Thange, there were various stakeholders who were engaged in the mitigation efforts. It was crucial for the study to find out the efforts undertaken by these stakeholders. The respondents were presented with a list of challenges faced when addressing oil spill as derived from the literature and which were refined after the pre-test of this study.

Lack of communication and coordination among departments and agencies responsible for managing oil spill disaster events was one of the statements that respondents agreed to as indicated by a mean score of 4.32 and 0.762 standard deviation.

There are various stakeholders engaged in oil spillage disasters including government agencies, KPC and private agencies.

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Table 4.10: Thange Oil Spill Mitigation Challenges

Mitigation challenges	1 (Strongly Disagree)	2 (Disagree)	3 (Moderately Agree)	4 (Agree)	5 (Strongly Agree)	Mean	Std. Deviation
Lack of political will to manage oil spills	4.2%	0%	8.4%	43.2%	44.2%	4.23	0.928
Inadequate regulatory framework for oil spills interventions	3.2%	12.6%	11.6%	53.7%	18.9%	3.73	1.015
Lack of CSR from stakeholders in dealing with oil spills	0%	7.4%	17.9%	35.8%	38.9%	4.06	0.932
Planning on how to deal with the spills	33.7%	41.1%	11.6%	10.5%	3.2%	2.08	1.078
Agencies responsible have the necessary equipment	5.3%	3.2%	15.8%	52.6%	23.2%	3.85	0.989
Lack of communication and coordination among agencies	1.1%	2.1%	5.3%	47.4%	44.2%	4.32	0.762
Agencies lack training required to deal with oil spills	6.3%	2.1%	11.6%	44.2%	35.8%	4.03	1.052
Overall mean score						3.75	0.965

These include those who provide social support and emergency distribution of services and goods as well as those who are involved in cleaning the oil spill. It is notable that lack of communication and coordination hamper such efforts. According to a Female FGD participant;

There was poor communication between KPC and the affected households. The community felt KPC was inaccessible as their officers handling the spill were based in Nairobi.

The finding showed that respondents agreed that lack of political will to direct efforts towards dealing with oil spill disasters was a challenge as shown by a mean score of 4.23 and standard deviation of 0.928. The government is responsible for regulation of the oil industry and is also responsible for enforcing existing regulations for oil companies. This finding was supported by a key informant statement that;

Political interests among various actors and interference disrupted the compensation and clean-up process. The environmental effects of oil spills are long-term as recovery and restoration are a lengthy process. This poses a challenge in the provision of permanent alternative sources of clean water for affected areas. Compensation is also a challenge as the effects are varied and may escalate over time if the compensation is not provided immediately.

The study findings show respondents noted that there was no goodwill by political leaders to act on the oil spillage effects. The respondents also agreed that there was lack of corporate social responsibility (CSR) from the oil company responsible and stakeholders in dealing with the oil spill as shown by a mean score of 4.06 and a standard deviation of 0.932, thus implying that KPC did not take responsibility for the disaster to the concerns of Thange community. Lack of political will in supporting mitigation of oil spill's effects was also supported by a statement from a male FGD participant;

A taskforce was formed comprising of the governor, Ministry of Energy and Petroleum, Ministry of Health, member of national assembly, MCA's office, area administration, community leadership, senator's office, NEMA and WARMA. This was tasked to deal with environmental effects of the spill, but it was disbanded by the governor.

The Thange River Community Basin wrote a petition to the Senate on the response to Thange oil spill citing the abolishment of the Thange River Environmental task force prematurely and indefinitely under unclear circumstances. The community formed the Thange River Community Basin to address the issues that were facing the mitigation of the oil spill. According to a female FGD participant;

After the taskforce was disbanded by the governor, we came together as affected community members in Thange. The community members formed the Thange River Basin Residents Association and through the office of the senator, petitioned KPC and parliament to assist the affected households.

Regarding the challenges facing mitigation of oil spill at Thange, the findings show respondents perceived that lack of political will was the most significant factor, followed by poor and lack of communication and coordination among stakeholders, inadequate CSR practices, and inadequate training of agencies engaged in the mitigation activities.

The poor communication, coordination, and mandate of the agencies involved was a major factor that affected the mitigation processes and activities.

Summary of Key Findings

The findings showed that acidity in soil was the most cited effect of the oil spill on land in Thange showing that acidity of soil resulted in a reduction in crop productivity, and it affected the vegetation that livestock fed on. The effects of the spill on land also reduced the size of remaining arable land for farming affecting agricultural production in Thange Village.

In terms of effects of oil spill on water, lack of access to clean water was the most cited among respondents as the oil spillage had contaminated respondents' drinking water. The river and wells used as water sources in the area were contaminated by the oil spill, forcing the residents to find alternative water sources for drinking and household use.

The flora and fauna at Thange Village was affected negatively as there was loss of agricultural produce and reduced numbers of small mammals that were previously noticeable. Thange village is a rural area and communities depend on livestock production and crop cultivation and this source of income was threatened as the production of these sources of livelihood was reduced due to the oil spill.

The major mitigation challenge to the spill was lack of communication and coordination among different departments and agencies responsible for managing oil spill disaster events in Thange village and indeed across the country. This was coupled with the lack of political will by leadership to direct efforts towards dealing with the effects of the oil spill.

Summary

In this chapter, the effects of the oil spill on land, water and flora and fauna are outlined based on the study's findings from the administered household interview schedules, key informant interviews and focus group discussions. The most cited effect of oil spillage on land was increased soil acidity, lack of access to clean water as the effect on water, loss of agricultural produce was cited as the effect on flora and fauna and lack of communication and coordination cited as the challenge to managing the oil spill's effects.

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CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Introduction

In this chapter, the reader is presented with the discussion on the major findings from the study which is done by comparing the results with previous studies in the literature review. The conclusions of the study are also presented and recommendations from the study presented along the study objectives. The areas for further research are also presented.

Discussions of Key Findings

Effects of oil spillage on land

The findings show the oil spill resulted in an increase in soil acidity as indicated by 54.7% of the respondents and the analyzed soil sample test results done after the spill which contributed to the decline of soil fertility. This finding support earlier studies that found that oil spills affect the potential hydrogen (PH) levels in the soil. For instance, Oyem and Oyem's (2013) study in Nigeria comparing oil samples from a site near an oil spill and another from an area that had not experienced any oil spill found that there were elevated PH levels at the spill site. The high amounts of PH acts indirectly on plant growth by affecting availability of nutrients, the presence of toxins and the growth of soil microorganisms. These conditions generally imply low soil fertility, which in turn implies low agricultural productivity and reduced source of livelihood in the affected areas as has been witnessed at Thange.

The rise in acidity in soils means that there was a decline in soil fertility as shown by 36.8% of the respondents, reinforcing studies done earlier. A study conducted in Nigeria by Ugboma (2014) assessed the effects of oil spillage on soil fertility and found

that oil spillage has effects on soil fertility, and this resulted in poor crop productivity in the area. This reduced fertility on land exposed to oil spills as lower value of organic matter observed in oil polluted plots implies a deteriorating effect of spillage on the soil. This decline in soil fertility reduces soil fertility, germination rate, normal growth of crops and resistance to pests and diseases.

The effects of oil spill on soil established by these studies mean that they had reduced the amount of land that could be used for food production, an outcome that was also cited by the respondents and supported by Ojimba (2014) report on the economic effects of crude oil spillages on crop farms in Nigeria. This study found evidence that crude oil spillages reduced the farmland available for cropping in the state. This reduction in farmland had caused untold economic hardship to the crop farmers affected and this hardship is continuous. This finding was evident at Thange as years after the oil spill farmers have not been able to achieve the level of crop production since the land that was exposed to the oil spill does not yield any crops. This evidence is also present in other earlier studies.

One such study was conducted in Nigeria by Ojimba (2012), it aimed to determine the effects of crude oil pollution on crop production. The pollution reduced the size of land available for farming thus affecting the output and also having a negative effect on crop output. In another investigation into effects of oil spills, Osuagwu and Olaifa (2018) found that there was a reduction of farm size thereby reducing the marginal physical product (MPP) while those firms that had not experienced oil spill pollution had increased their output. The findings provided conformation that oil spills resulted in soil acidity resulting in declining fertility of soils.

Effects of Oil Spillage on Water

The respondents depend on the seasonal Thange River as their source of water and during drought periods, the wells they have dug adjacent to the river. It was indicated by 68.4% of the respondents that the major effect of the oil spillage on water was unclean drinking water because of the pollution of river as supported by 63.2% of the respondents and contamination of wells by 49.5% of the respondents sample. This finding supports the study by Mulako (2019) that reported that an environmental assessment and mapping of an oil spill at a terminal found that the oil spill had reached as far as one kilometer downstream on farms covering a depth of 300 meters from the topsoil and 250 meters wide.

Downstream effects of oil spills have been supported in other studies, for example, a study conducted in Canada that aimed at modelling oil spills in rivers. Kvočka, Žagar, and Banovec (2021) found that in contrast to oil spills that occur offshore, those ones in small and medium rivers had more negative effects on the environment owing to greater spatial distribution and small dilution which had a high chance for formation of oil droplets and interaction with living plants and animals. The harmful potential of oil spill to rivers was associated to the movement of the river which was mostly downstream. In this case, Thange oil spill occurred downstream which means the oil was spread from one point to another along farming lands in the community. Surface water samples collected from Thange River were tested for contamination and confirmed the presence of hydrocarbon contamination up to 2km downstream of the river (Panafcon, 2016).

Most rural communities such as the one sampled for this study depend on rivers, wells and boreholes for their drinking water. This means that any contamination of rivers will affect the water from the boreholes and wells. The results showed that respondents' major problem was accessing clean drinking water and this is supported by past studies on oil spill effects on communities. One such study was done by Balogun and Kareem

(2013) established that drinking water sources were reduced due to pollution of underground and surface water in areas where drinking water was sourced underground. The study concluded that the reliance of communities on ground water was affected by the oil spill and this resulted in scarcity of water in the event of an oil spill in the area.

Effects of Oil Spillage on Flora and Fauna

The output from the analysis indicated that loss of agricultural produce in Thange village was the most cited effect of oil spill by 67.4% of the respondents. The oil spill occurred during the rainy season when respondents had crops on their land which means crops for that season were destroyed. Research by Inoni, Omotor, and Adun (2014) on the effect of oil spillage on crop yield and farm income established that oil spill had a reduction effect on yield of crops, productivity of land, and also income from farms. A similar claim is presented by Uquetan et al. (2017) found that height of plants and seedling germination were affected by high levels of pollution. The study explained that with these conditions the land would not make significant yield for farmers until remediation processes were carried out on the land.

There is evidence that whenever oil spills occur, they cause destruction on flora and fauna. At Thange, where this study was carried out, 60% of the respondents confirmed that it led the death of livestock as they fed on vegetation along the river and drank water that had been contaminated. Similar studies done elsewhere seem to confirm the same, Batista et al. (2013) research on poisoning by crude oil in sheep and goats in Brazil that found a total of fourteen sheep and goats died or were euthanized in two days of an oil spill occurring near a farm. Furthermore, Murray, Poulsen, and Murra (2013) found that immediate health effects of oil spills were body weight loss, internal bleeding, increased mortality rates, dehydration, brain lesions, and organ function disruption.

The same is reiterated in a study by Osuagwu and Olaifa (2018) which suggested oil spills and oil production had a negative effect on production of fish concluding that long run effects of oil spills with a lessening of fish death and yield of crops. However, not all studies on oil spill support the claim that has effects on the health of animals. Getter, Taylor, and Macgregor-Skinner (2000) found there were no reported livestock deaths that were linked to the oil spill but indirect losses of livestock were reported for compensation purposes. Animal health monitoring conducted by veterinarians revealed that the number of illnesses was not different from earlier years showing that little to any oil spill effects on livestock.

Constraints Faced in Mitigating the Oil Spill Effects

The study sought to determine the constraints facing mitigation of oil spill effects and one of the findings from 44.2% of the respondents was the lack of communication and coordination among departments and agencies responsible for managing oil spill disaster events. The effects of communication in mitigation of oil spills are an important component and several studies have shown that it is integral to have coordination and communication between the different stakeholders engaged in such efforts.

According to Ishak et al. (2018), emergency plans require cooperation across all units and departments to support effective response from teams. However, this remains a challenge for most response teams in oil spill events. For instance, Carlan et al. (2016) agreed that communication was a challenge for parties engaged in effective response of oil spills. In Kenya, Mulako (2019) found that there was poor coordination of intervention measures in oil spillage interventions in Kenya.

There is a lack of political will to direct efforts towards dealing with oil spill disasters from the views of 44.2% of the study respondents. There is a lot of attention from politicians and leaders after the occurrence of an oil spill, but this attention reduces

over time and there are less political actions towards mitigating these oil spills in Kenya. This is a global phenomenon as the findings agree with other research that has found political will and participation in intervention measures to have been low. In Korea, Chun, Oh, and Kim (2020) found that the public sees oil spills as one off events that do not need more attention and as oil spills happen they tend to have or receive more political and media attention; they do not maintain on the agenda of policy in the long run.

This finding is also supported by the findings of Cheong (2011) as political fallout is also factors affecting governments in dealing with the Hebei-Spirit oil spill. In a study conducted in Nigeria, Oguchukwu and Akerele (2020) found that lack of political will and non-governmental activities and factors that have benefited financially from the oil disaster events so as to pursue or motivate corporate or personal interest and goals. The study concluded that clean-up responses to come to fruition, there must be strong political will void of profiteering motives.

The respondents of this research (38.9%) indicated that there was a lack of corporate social responsibility (CSR) from oil manufacturing companies and stakeholders in dealing with oil spills. CSR is a managerial concept that recommends environmental and social policy practices. Carlan et al. (2016) examined the nature of governance issues affecting spill response in ports and to examine the systems used to achieve effective response and found that challenges of oil spill interventions included CSR into a company's planning and operations. In another research, Duttagupta, Islam, Hosseinabad, and Zaman (2021) found that British Petroleum's (BP) investment in community development is very low compared to the investment in community development of Shell and Total which clearly indicates that BP's CSR strategies are not sustainable. Environmental protection and social wellbeing aspects are not balanced. In their study,

Ahmadian and Khosrowpour (2017) found that it was apparent that implementation of CSR is often extremely difficult for oil and gas companies.

In an analysis on CSR and oil spill prevention, Frynas (2012) found support that showed that oil spill prevention has been enhanced in recent times; however, it is less known to what extent does CSR have in contributing to these improvements. The literature that exists has not shown evidence of a correlation between oil spill reduction and CSR. In Kenya, Cheruiyot and Tarus (2016) report that CSR is a variable that has been operationalized weakly and defined poorly and can be further explained that CSR is the “humanistic orientation” of organizations in Kenya. This means that a poor definition of CSR in firms will result in poor implementation of response to an oil spill which was one of the feelings from the respondents that companies had no adequate response or preventive strategies for future disasters.

The findings show that respondents felt that there was inadequate planning on how to deal with oil spills as they disagreed that this was a challenge. Ishak et al. (2018) found that there existed positive and statistically significant correlation between the management practices and response to oil spills and concluded that emergency plan was the best response to oil spills. This finding holds true as there are strategies, guidelines, and actions that have been elaborated in addressing oil spills in Kenya. This was supported by the findings of Mulako (2019) who found that there was poor enactment or adherence to existing laws on oil spillages and this was a challenge to oil spillage interventions in Kenya. These findings suggest that there was poor implementation of response to oil spills such as the one that occurred in Thange. The findings imply that although there is adequate planning on addressing oil spills; implementation of these plans was not adequate and did not effectively address the oil spill at Thange.

Perry and Lindell (2003) proposed the contingency planning and crisis preparedness theory that emphasizes the significance of preparing and planning for a crisis where good planning is influenced by a variety of factors. The findings imply that the mitigation efforts did not match the proposed theory which elaborates that there are four principles to achieving effective mitigation of disasters. These includes emergency planning, accurate knowledge of the threat and of likely human responses, realities of the setting and considering flexible disaster responses, and acknowledging that all disasters create dynamic changing environments.

Conclusion

The study concludes that increased soil acidity which was a result of the oil spill on land in Thange, this in turn affected the vegetation used for livestock feed and reduced crop productivity.

In terms of effects of oil spill on water, the study concludes that lack of access to clean water was the most cited among respondents. This is because the oil spill had contaminated the river and wells which were the water sources used for respondents' drinking and farming water.

The study concludes that loss of agricultural produce and vegetation cover was the most visible effect of the oil spill on flora and fauna. The residents had to destroy the contaminated crops in their farms as they could not be consumed or sold.

In terms of mitigation challenges, the study concludes that lack of communication and coordination among departments and agencies responsible for managing the oil spill incident was a constraint of mitigating the Thange oil spill.

Recommendations

The findings showed that acidity in soil was the most cited effect of the oil spill on land in Thange. This change in soil acidity affected the growth of vegetation that livestock fed on and resulted in a decrease in crop productivity. There is need for scientific and latest best practices towards the cleanup of soil at Thange village to remediate or reduce the petroleum contamination in the soil. These efforts should be conducted by several competent agencies that have a proven track record of cleanup activities.

In terms of effects of oil spill on water, inability access clean water was the most cited among respondents. This was because the oil spillage had contaminated respondents' drinking water sources which are Thange River and wells dug in the area. The study recommends for authorities and stakeholders to drill boreholes in uncontaminated sites and find alternative long-term sources of water for the community as the cleanup process for drinking water may take a long time.

The flora and fauna at Thange Village was affected negatively as there was loss of agricultural produce. Thange village is a rural area and communities depend on livestock rearing and crop cultivation and this source of income was threatened as the production of these sources of livelihood was reduced due to the oil spill. There is need for creation and promotion of alternative sources of livelihood in the short-term to enable the communities to cope with the effects of oil spill on their sustenance and these activities can be supported by the county and national governments along with non-governmental organizations (NGOs) engaged in community development.

In terms of mitigation challenges, lack of communication and coordination among different departments and agencies responsible for managing oil spill disaster events at Thange village. It is recommended that there should be concerted efforts among the

stakeholders in planning, clean up implementation, compensation of affected property owners and completion of the cleanup process. This calls for guidelines and action plans to detail the roles and expectations of each stakeholder in the event of an oil spill. In doing so, the study recommends adoption of four tenets of the contingency planning and crisis preparedness theory.

Recommendations for Further Research

There is need for further research on the effects of oil spill on animals since much of the research done in this area has focused on marine animals and not domestic animals and non-marine wildlife. The present study focused on the effects of oil spills on the environment; however, there is need for further research into the cleanup interventions that are undertaken and their effectiveness on countering the effects of oil spills on land, water, flora and fauna. The findings found that there are mixed results on oil spill effects livestock and there is need for further study to establish effects of oil spills on livestock.

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REFERENCES

- Abdibattayeva, M., & Su, X. (2019). Soil degradation due to pollution by oil and oil products and the development of a way to prevent them. *Eurasian Journal of Ecology*, 59(2), 24-38.
- Achebe, C.H., Nneke, U.C., & Anisiji, O. E. (2012). Analysis of oil pipeline failures in the oil and gas industries in the Niger delta area of Nigeria. *Proceedings of the International Multi Conference of Engineers and Computer Scientists*, 1274–129.
- Adelana, S. O., Adeosun. T. A., Adesina, A. O., & Ojuroye, M .O. (2011). Environmental pollution and remediation: challenges and management of oil Spillage in the Nigerian coastal areas. *American Journal of Scientific and Industrial Research* 2(6), 834-845.
- Ahmadian, A., & Khosrowpour, S. (2017). Corporate Social Responsibility: Past, Present, and Success Strategy for the Future. *Journal of Service Science*, 10(1), 1-12.
- Aigbedion, I. N., & Iyayi, S. E. (2007). Environmental effect of mineral exploitation in Nigeria. *International Journal of Physical Sciences*, Vol. 2 (2), pp. 033-038, February, 2007.
- Akinwumi, I. I., Diwa, D., Obianigwe, N. (2013). Effects of crude oil contamination on the index properties, strength and permeability of lateritic clay. *International Journal of Applied Sciences and Engineering Research*, Vol. 3, Issue 4, 2014
- Akinwumi, I. O., Oyebisi, T. O., & Salami, A. T. (2013). Environmental degradation in Nigeria: implications and policy issues—a viewpoint. *International Journal of Environmental Studies*, 58(5), 585-595.
- Alreck, P. L., & Settle, R.B. (2013). *The Survey Research Handbook*. (3rd Edn). New York, NY: McGraw Hill Irwin.
- Amnesty International (2011). *The true tragedy: delays and failures in tackling oil spills in the Niger Delta*. London: Amnesty International Limited.
- Azwell, T. (2013). *Oil spill remediation and restoration: the fate and consequences of oil on the environment*. University of California, Berkeley.
- Balogun, S. O., & Kareem, B. (2013). The Effects of Oil Spillage on Aquatic Environment in Ilaje Community, Nigeria. *International Journal of Engineering Innovation and Management*, 3, 19-29.
- Batista, J. S., Câmara, A. C. L., Almeida, R. D., Olinda, R.G., Silva, T. M. F., & Soto-Blanco, B. (2013). Poisoning by crude oil in sheep and goats. *Journal of Veterinary Medicine*, 164(11), 517-520.
- Baumüller, H., Donnelly, E., Vines, A., & Weimer, M. (2011). *The effects of oil companies' activities on health, environment and development in Sub Saharan Africa*. London: Directorate-General for External Policies of the European Union

- Briggs, A.R., Morrison, M., & Coleman, M. (2012). *Research methods in educational leadership and management*. Thousand Oaks, CA: Sage Publications.
- Brown, R. B. (2006), *Doing Your Dissertation in Business and Management: The Reality of Research and Writing*. Sage Publications.
- Bureau of Ocean Energy Management (2019). Oil spill preparedness, prevention, and response on the Alaska OCS. Alaska OCS Region.
- Campos-Silva, J.V., Brum, H., & de Oliveira, E.G. (2020). Brazil oil spill response: Government inaction. *Science*, 367(6474), 155-156.
- Carlan, V., Heaver, T., Sys, C., Vanelslander T. (2016). *Oil spill response in/and around the North-west European ports – Final Report*. University of Antwerp. Antwerp, Belgium.
- Chang, S., Stone, J., Demes K., & Piscitelli, M. (2014). Consequences of oil spills: A review and framework for informing planning. *Journal of Ecology and Society*, 19(2), 457-472.
- Cheong, S.-M. (2011). A social assessment of the Hebei-Spirit oil spill. *GeoJournal*, 76, 539-549.
- Cheruiyot, T. K., & Tarus, D. K. (2016). Corporate Social Responsibility in Kenya: Reflections and Implications. CSR, Sustainability, Ethics & Governance, in: Stephen Vertigans & Samuel O. Idowu & René Schmidpeter (ed.), *Corporate Social Responsibility in Sub-Saharan Africa, edition 1*, chapter 0, pages 87-110, Springer
- Chilvers, B.L., Finlayson, G., Ashwell, D., Low, S.I., Morgan, K.J., & Pearson, H.E. (2016). Is the way an oil spill response is reported in the media important for the final perception of the clean-up? *Marine Pollution Bulletin*, 104(1), 257-261
- Chun, J., Oh, J-H., & Kim, C-K. (2020). Oil Spill Response Policies to Bridge the Perception Gap between the Government and the Public: A Social Big Data Analysis. *Journal of Marine Science and Engineering*, 8(5).
- Connelly, L. M. (2014). Ethical considerations in research studies. *Medsurg Nursing*, 23(1), 54-5.
- Creswell, J.W. (2011). *Research Design: Qualitative, Quantitative and Mixed Approaches*. (3rd Edn). New Delhi: Sage Publications.
- Creswell, J.W. (2013). *Qualitative, Inquiry and research design: Choosing among five approaches*. (3rd Edn). Nebraska, Lincoln: Sage Publications.
- Croitoru, L., & Sarraf, M. (2010). *The cost of environmental degradation: case studies from the Middle East and North Africa*. Washington DC: World Bank Publications
- De Wolf, D. (2013). Crisis communication failures: The BP case study. *International Journal of Advances in Management and Economics*, 2(2), 48-56.

- Dorsett, M. (2010). Exxon Valdez oil spill continued effects on the Alaskan economy. United States: Richmond: *The research journal for Colonial Academic Alliance*, 1(7), 1-16.
- Duttagupta, A., Islam, M., Hosseinabad, E. R., & Zaman, M. A. U. (2021). Corporate Social Responsibility and Sustainability: A Perspective from the Oil and Gas Industry. *Journal of Nature, Science & Technology*, 2, 22-29.
- Ejiba, I.V., Onya, S.C., & Adams, O.K. (2016). Impact of oil pollution on livelihood: evidence from the Niger Delta region of Nigeria. *Journal of Scientific Research and Reports*, 12(5), 1-12.
- Ekpo, I.E., Obot, O.I., & David, G.S. (2018). Impact of oil spill on living aquatic resources of the Niger Delta region: A review. *Journal of Wetlands and Waste Management*, 2(1), 48-57.
- El- Haggag, M.S (2007). *Sustainable Industrial Design and Waste Management Cradle-to-cradle for Sustainable Development*. Cambridge, UK: Academic Press.
- Eriksson, K., & McConnell, A. (2011). Contingency planning for crisis management: Recipe for success or political fantasy? *Policy and Society*, 30(2), 89-99.
- Fingas, M., & Brown, C.E. (2017). A Review of Oil Spill Remote Sensing. *Sensors* 18(1). doi: //doi.org/10.3390/s18010091
- Fitzgerald, K.H. (2015). The silent killer: habitat loss and the role of African protected areas to conserve biodiversity. In *Protecting the Wild* (pp. 170-188). Washington, DC. Island Press.
- Frynas, J. G. (2012). Corporate social responsibility or government regulation? Evidence on oil spill prevention. *Ecology and Society*, 17(4),
- Garg, N., Pandel, R., & Tyagi, S. (2014). Environmental degradation: causes and consequences. *European Researcher*, 81(8/2), 1491-1498.
- Getter, C. D., Taylor, E., & Macgregor-Skinner, G. (2000). Managing Agricultural Resources during Oil Spills. Case of the OSSA II Pipeline Spill in Bolivia, 2000. Retrieved from <https://archive.epa.gov/emergencies/content/fss/web/pdf/getterpaper.pdf>
- Government of Kenya (2013). *Makueni First County integrated development plan 2013-2017*. Government Printer, Nairobi, Kenya.
- Ha, M. (2018). *Modeling for the allocation of oil spill recovery capacity considering environmental and economic factors*. doi://doi.org/10.1016/j.marpolbul.2017.11.006
- Harding, J. (2013). *Qualitative Data Analysis from Start to Finish*. London, UK: SAGE Publishers

- Helm, R.C., Costa, D.P., DeBruyn, T.D., O'Shea, T.J., Wells, R.S., & Williams, T.M. (2015). Overview of effects of oil spills on marine mammals. *In Handbook of Oil Spill Science and Technology* (pp. 455-475). Hoboken, NJ: Wiley-Blackwell.
- Hilton, C. (2015). The importance of pretesting questionnaires: a field research example of cognitive pretesting the Exercise referral Quality of Life Scale (ER-QLS). *International Journal of Social Research Methodology*, 1-14. doi.10.1080/13645579.2015.1091640.
- Hoang, T. A. (2018) An investigation of remediation and recovery of oil spill and toxic heavy metal from maritime pollution by a new absorbent material, *Journal of Marine Engineering & Technology*, 20:3, 159-169,
- Inoni, O. E., Omotor, D. G., & Adun, F. N. (2014). The Effect of Oil Spillage on Crop Yield and Farm Income in Delta State, Nigeria. *Journal of Central European Agriculture*, 7(1), 41-48.
- Institute of Economic Affairs. (2016). *Situational analysis of energy industry, Policy and strategy for Kenya*. Nairobi: Institute of Economic Affairs.
- International Maritime Organization (2010). *Manual on oil spill risk evaluation and assessment of response preparedness*. Retrieved from <https://vp.imo.org/Customer/Subscriptions/IMOVega/res/pdf/MANOILSPILLMAN.pdf>
- International Petroleum Industry Environmental Conservation Association and IOGP (2017). *In-Water Surveillance of Oil Spills at Sea*. London, UK: International Association of Oil & Gas Producers
- International Tanker Owners Pollution Federation (2017). *Oil tanker spill statistics*. Retrieved from <http://www.itopf.com/knowledge-resources/data-statistics/statistics/>
- Ipingbemi, O. (2009). Socio-economic implications and environmental effects of oil spillage in some communities in the Niger delta. *Journal of Integrative Environmental Sciences*, 6(1), 7–23.
- Ishak, I.C., Johari, A.A., Mazlan, N., & Ismail, S.B. (2018). The correlation between management approaches towards oil spill preparedness and response: A case study in Lumut, Perak, Malaysia. *AIP Conference Proceedings*, 1, 1-10.
- Israel, G.D. (2013). *Determining Sample Size*. University of Florida. Gainesville, Florida.
- Issa, N., & Vempatti, S. (2018). Oil spills in the Arabian Gulf: A case study and environmental review. *Environment and Natural Resources Research*, 8(1), 144-153.
- Ite, A.E., Ibok, U.J., Ite, M.U., & Petters, S.W. (2013). Petroleum exploration and production: Past and present environmental issues in the Nigeria's Niger Delta. *American Journal of Environmental Protection*, 1(4), 78-90.

- Ivshina, I. B., Kuyukina, M. S., Krivoruchko, A. V., Elkin, A. A., Makarov, S. O., Philip, J. C. (2015). Oil spill problems and sustainable response strategies through new technologies. *Environmental Science: Processes & Impacts*, 17(7), 1201–1219.
- Judson, R.S., Martin, M.T., Reif, D.M., Houck, K.A., Knudsen, T.B., Dix, D.J., (2010). Analysis of eight oil spill dispersants using rapid, in vitro tests for endocrine and other biological activity. *Environmental Science and Technology*, 44, 5979-5985
- Kadafa, A. (2012). Oil exploration and spillage in the Niger Delta of Nigeria. *Civil and Environmental Research*, 2(3), 38-51.
- Kadhaka, N. (2020, 13 August). *Why the Mauritius oil spill is so serious*. The British Broadcasting Corporation.
- Karl, T.L. (2007). *Oil-Led Development: Social, Political, and Economic Consequences*. Encyclopedia of Energy, Vol. 4. San Diego: Elsevier.
- Kasomo, D. (2015). *Research methods in humanities and education*. Nairobi: The Jomo Kenyatta Foundation
- Keating, K., Becker, S. S., Davis, I.F., Chandler, T., Slack, T., & Beedasy, J. (2020). Families Coping with Financial Loss Following the Deepwater Horizon Oil Spill. *Family relations: Interdisciplinary journal of applied family science*, 69(5), 887-906.
- Kenya National Bureau of Statistics (2019). *2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County*. Nairobi: The Kenya National Bureau of Statistics.
- Kirigha, M. (2017, January 27). *Taita-Taveta residents have raised an alarm over the impact caused by oil spillage in the area*. The Standard Newspaper, a Standard Media Group Publication.
- Kivunja, C. (2018). Distinguishing between Theory, Theoretical Framework, and Conceptual Framework: A Systematic Review of Lessons from the Field. *International Journal of Higher Education*, 7(6), 44-53.
- Knol, M., & Arbo, P. (2014). *Oil spill response in the arctic: Norwegian experiences and future perspectives*. *Marine Policy*, 50, 171-177
- Kombo, D., & Tromp, D. (2016). *Proposal and thesis writing. An introduction*. Nairobi: Paulines Publications Africa.
- Kothari, C., & Garg, G. (2016). *Research methodology. Methods and techniques* (3rd ed.). New Delhi: New Age International (P) Limited Publishers.
- Kuany, P.B.G., Zhou, X., Abdelhafez, A.A., & Abdelhafeez, I.A. (2019). Wailing of the people of South Sudan from oil contamination (overview of oil production and effects on people health). *International Journal of Scientific and Research Publications*, 9(5), 463-469.

- Kumar, V., Kumar, R., Singh, J., & Kumar, P. (Eds.). (2019). *Contaminants in Agriculture and Environment: Health Risks and Remediation*. In: *Contaminants in Agriculture and Environment: Health Risks and Remediation*. Haridwar, India. Agro Environ Media,
- Kurtz, R.S. (2008). Coastal oil spill preparedness and response: The Morris J. Berman Incident. *Review of Policy Research*, 25(5), 473-486.
- Kvočka, D., Žagar, D., & Banovec, P. (2021). A Review of River Oil Spill Modeling. *Water*, 13(1610).
- Lee, H. (2011). *Impacts of Oil Spills: Ecological, Human Health and Economic*. Unpublished paper. The University of Texas at Austin. Austin, Texas.
- Leeuwen, L., & Tulder, R. (2006). Case study: An oil-stained legacy of Greenpeace do Brasil versus Petrobras S.A. Netherlands: *The journal for International Business-Society Management*, 1, 1-15.
- Legborsi, S. P. (2007). *The adverse impact of oil pollution on the environment and wellbeing of a local indigenous community: The experience of the Ogoni people of Nigeria*. New York. United Nations Department of Economic and Social Affairs.
- Lu, J., Yuan, F., Mikkelsen, J.D., Ohm, C., Stange, E., & Holand, M. (2017). Modelling the transport of oil after a proposed oil spill accident in Barents Sea and its environmental impact on Alke species. *In IOP Conference Series: Earth and Environmental Science*, 82(1),
- Major, D.N., & Wang, H. (2012). How public health impact is addressed: a retrospective view on three different oil spills. *Toxicological and Environmental Chemistry*, 94, 442-467.
- Manzer Communications. (2016). *Deep water horizon: A look back at a first-rate PR disaster*. Retrieved from <https://manzercommunications.com/2016/09/26/deepwater-horizon-a-look-back-at-a-first-rate-pr-disaster/>
- Marsh, A. (2016). *Environmental degradation; types, causes and impacts (environmental remediation technologies, regulations and safety)*. United Kingdom: Nova Science Publications Incorporated.
- Matende, F. (2021). *Oil tanker overturns on Kisumu-Nairobi highway*. The Star Newspaper.
- Maundu, P. (2019). *Oil spill threatens to pollute water sources in Makueni*. The Daily Nation Newspaper, a Nation Media Group Publication.
- Mayoyo, P. (2012, March 18). *Established: Cause of Sinai fire tragedy*. The Standard Newspaper, a Standard Media Group Publication.
- Michel, J., & Fingas, M. (2016). Oil Spills: Causes, Consequences, Prevention, and Countermeasures. *In Fossil Fuels. Current Status and Future Directions*. World Scientific: Singapore.

- Michira, M. (2016, April 20). *Another oil spillage in Nairobi revives horrors of Sinai fire tragedy*. The Sunday Nation Newspaper, a Nation Media Group Publication
- Ministry of Energy and Petroleum. (2015). *National Energy and Petroleum Policy - final draft – June 2015*. Nairobi: Ministry of Energy and Petroleum.
- Ministry of Planning and National Development, & the National Economic and Social Council (NESC), (2007). *Kenya: Vision 2030*. Nairobi: Government of the Republic of Kenya, Ministry of Planning and National Development and National Economic and Social Council (NESC), Office of the President.
- Mkawale, S. (2009, February 1). *Over 100 dead in Nakuru oil tanker accident*. The Standard Newspaper, a Standard Media Group Publication.
- Mnyamwezi, R. (2017, January 28). *Oil spill is killing us, Taita-Taveta residents tell Governor Mruttu*. The Standard Newspaper, a Standard Media Group Publication.
- Mohamadi, B., Liu, F., & Xie, Z. (2016). Oil spill influence on vegetation in Nigeria and its determinants. *Polish Journal of Environmental Studies*, 25(6), 2533-2540.
- Moroni, D., Pieri, G., & Tampucci, M. (2019). Environmental Decision Support Systems for Monitoring Small Scale Oil Spills: Existing Solutions, Best Practices and Current Challenges. *Journal of Marine Science and Engineering Review*, 3(9), 1-17.
- Mulako, V.A. (2019). *Management of oil spillages from inland oil terminals in industrial area of Nairobi City County, Kenya*. Unpublished research project. University of Nairobi. Nairobi. Kenya.
- Murray, M. L., Poulsen, S. M., & Murra, B. R. (2013). Decontaminating Terrestrial Oil Spills: A Comparative Assessment of Dog Fur, Human Hair, Peat Moss and Polypropylene Sorbents. *Environments*, 7(7), 2-13.
- Muthike, S. (2018). *Assessment of Kenya's Capacity to Effectively Prepare for and Respond to Oil Spill Incidents*. Unpublished Dissertation. World Maritime University Dissertations. Malmö, Sweden.
- Mutua, K. (2015, November 8). *Families suffer in oil spill aftermath*. The Sunday Nation Newspaper, a Nation Media Group Publication.
- Nanok, J., & Onyango, C. (2017). A Socio-Economic and Environmental Analysis of the Effects of Oil Exploration on the Local Community in Lokichar, Turkana County, Kenya. *International Journal of Management, Economics and Social Sciences*, 6(3), 144-156.
- New Zealand Maritime (2018). *New Zealand Marine Oil Spill Readiness and Response Strategy 2018 – 2022*. Maritime New Zealand.
- Ngene, S., Tota-Maharaj, K., Eke, P., & Hills, C. (2016). Environmental and Economic Impacts of Crude Oil and Natural Gas Production in Developing Countries. *International Journal of Economy, Energy and Environment*, 1(3), 64-73.

- Ngunjiri, J. (2017). *KPC pays fees for 227 Kibwezi needy students*. The Business Daily Newspaper, a Nation Media Group Publication.
- Nilsson, H., Dalaklis, D., Larsson, J., & Pålsson, J. (2018). *Maritime education and training activities: Improving oil spill response in the south Baltic Sea region*. 12th International Technology, Education and Development Conference. Valencia, Spain. 5-7th March. doi: 10.21125/inted.2018.0418
- Nwilo, P. C., & Badejo, O. T. (2005). Oil Spill Problems and Management in the Niger Delta. *International Oil Spill Conference Proceedings*, 5(1), 567-570.
- Nyssen, J., Frankl, A., Zenebe, A., Poesen, J., & Deckers, J. (2015) Environmental conservation for food production and sustainable livelihood in tropical Africa. *Land Degradation and Development*, 26(7), 629-631.
- O'Mathúna, D. P., Dranseik, V., & Gordijn, B. (Eds.). (2018). *Conceptualizing and Assessing Disasters: An Introduction*. [Springer ebook]. Retrieved from <https://www.springer.com/gp/book/9783319927213>
- Odhiambo, A. (2016, April 20). *Safety scare after Nairobi Industrial Area oil spillage*. The Business Daily Africa Newspaper, a Nation Media Group Publication.
- Ogeleka, D.E., Tudararo-Aherobo, L.E., & Okieimen, F.E. (2017). Ecological effects of oil spill on water and sediment from two riverine communities in Warri, Nigeria. *International Journal of Biological and Chemical Sciences*, 11(1), 453-461.
- Oguchukwu, T. O., & Akerele, E. W. (2020). Political Profiteering and Oil Spillage in Ogoni-Land: Why The “Clean-Up” Has Become a Mantra in Niger Delta. *Research and Reviews Journal of Social Sciences*, 6(3), 50-56.
- Ojimba, T. P. (2014). Determining the effects of crude oil pollution on crop production using stochastic trans log production function in Rivers State, Nigeria. *Journal of Development and Agricultural Economics*, 4(13), 346-360.
- Ojimba, T. P. (2014). Economic Effects of Crude Oil Spillages on Crop Farms in Rivers State, Nigeria. *Global Journal of Pure and Applied Sciences*, 17(2), 131-136.
- Okoth, E. (2020, September 24). *KPC loses fuel in Mombasa-Nairobi pipeline leakage*. The Business Daily, a Nation Media Group Publication.
- Ordinoha B, & Sawyer W. (2008). Food insecurity, malnutrition and crude oil spillage in a rural community in Bayelsa State, south-south Nigeria. *Nigerian journal of Medicine*, 17, 304–309.
- Osoro, A., Muturi, W.M., & Ngugi, P.K. (2015). Determinant Affecting Performance of Supply Chain Systems in the Petroleum Industries in Kenya. *International Journal of Scientific and Research Publications*, 5(10), 45-57.
- Osuagwu E.S, Olaiifa, E. (2018). *Effects of oil spills on fish production in the Niger Delta*. *PLoS ONE* 13(10).

- Oyebamiji, M., Adekola, M., & Igwe, C. (2014). Effects of oil spillage on community development in the Niger Delta region: implications for the eradication of poverty and hunger in Nigeria. Toronto: *The World Journal for Social Science*, 1(1), 27-36.
- Oyem, I. L. R., & Oyem, I. L. (2013). Effects of Crude Oil Spillage on Soil Physico-Chemical Properties in Ugborodo Community. *International Journal of Modern Engineering Research*, 3(6), 3336-3342.
- Panafcon Limited Consultants. (2016). *Environmental and social economic impact assessment study on Thange River Basin*. Nairobi: Panafcon Limited Consultants
- Pearce, D., & Moran, D. (2013). *The economic value of biodiversity*. London, UK: Routledge.
- Pegg, S., & Zabbey, N. (2013). Oil and water: the Bodo spills and the destruction of traditional livelihood structures in the Niger Delta. *Community Development Journal*, 48(3), 391– 405.
- Perry, R. W., & Lindell, M. K. (2003). Preparedness for Emergency Response: Guidelines for the Emergency Planning Process. *Disasters*, 27(4), 336-350.
- Peterson, C.H., Rice, S.D., Short, J.W., Esler, D., Bodkin, J.L., Irons, D.B. (2003). Long-term ecosystem response to the Exxon Valdez oil spill. *Science*, 302(5653), 2082-2086.
- Posel, D. (2001). Who are the heads of household, what do they do, and is the concept of headship useful? An analysis of headship in South Africa. *Development Southern Africa*, 18(5), 651-670.
- Queirós, A., Faria, D., & Almeida, F. (2017). Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies*, 3(9), 369-387.
- Salako, A., Sholeye, O., & Ayankoya, S. (2012). Oil spills and community health: Implications for resource limited settings. *Journal of Toxicology and Environmental Health Sciences*, 4(9), 145-150.
- Schmidt, M.W., Torn, M.S., Abiven, S., Dittmar, T., Guggenberger, G.,... Nannipieri, P. (2011). *Persistence of soil organic matter as an ecosystem property*. *Nature*, 478(7367), 49-56.
- Shrinkhal, R. (2019). *Phytomanagement of Polluted Sites Market Opportunities in Sustainable Phytoremediation*. Amsterdam, Netherlands. Elsevier.
- Simiyu, B.B. (2009). *National competitiveness of Kenya and its oil cluster*. Unpublished Dissertation. Strathmore University. Nairobi. Kenya.
- Tacoli, C. (2009). Crisis or adaptation? Migration and climate change in a context of high mobility. *Environment and urbanization*, 21(2), 513-525.

- Udoh, J.C., & Ekanem, E.M. (2011). GIS based risk assessment of oil spill in the coastal areas of Akwa Ibom State, Nigeria. *African Journal of Environmental Science and Technology*, 5(3), 205-211.
- Ugboma, P. P. (2014). Effects of Oil Spillage on Soil Fertility in Udu Local Government Area in Delta State. *AFRREV STECH: An International Journal of Science and Technology*, 3(3), 47-56.
- Ugochukwu, C.N.C., & Ertel, J. (2008). Negative impacts of oil exploration on biodiversity management in the Niger De area of Nigeria. *Impact Assessment and Project Appraisal*, 26(2), 139-147.
- United Nations Development Program (2015). *The sustainable development goals*. New York: United Nations Development Program.
- United Nations Environment Programme (2011) Environmental Assessment of Ogoniland. Nairobi, Kenya: United Nations Environment Programme.
- Uquetan U. I., Osang J. E., Egor, A. O., Essoka, P. A., Alozie, S., & Bawan A. M. (2017). A Case Study of the Effects of Oil Pollution on Soil Properties and Growth of Tree Crops in Cross River State, Nigeria. *International Research Journal of Pure and Applied Physics*, 5(2), 19-28.
- Wang, Y., Liu, X., Yu, X., & Zheng, X. (2018). Assessing response capabilities for responding to ship-related oil spills in the Chinese Bohai Sea. *International Journal of Disaster Risk Reduction*, 28, pp 251-257
- Wilkinson, J., Beegle-Krause, C.J., Evers, K.U., Hughes, N., Lewis, A., ... Wadhams, P. (2017). Oil Spill Response Capabilities and Technologies for Ice-Covered Arctic Marine Waters: A Review of Recent Developments and Established Practices. *Ambio*, 46(3), 423-441.
- World Health Organization (2019). *Facing the facts: The impact of chronic disease in Nigeria*. Geneva: WHO; 2005. [Last accessed on June 2019]. Available from: http://www.who.int/chap/chronic_disease_report/en/
- Xia, Y., & Boufadel, M.C. (2010). Lessons from the Exxon Valdez Oil Spill disaster in Alaska. *Disaster Advances*, 3(4), 270-273.
- Yakubu, O. (2017). Addressing environmental health problems in Ogoniland through Implementation of United Nations environment program recommendations: environmental management strategies. *Environments*, 4(2). doi.org/10.3390/environments4020028
- Yarhere, M. (2010). Impact of oil exploration on fisher folks' livelihood and safety of fisheries industry in Nigeria. Proceedings of Fisheries Society of Nigeria (Fison) 25th-29th October, 2010. Ascon, Badagry.

APPENDICES

Appendix A: Consent Form

My name is Elsie Ng'endo Wambugu, I am a Master of Arts Student at Daystar University. As part of my course work, am required to conduct a research and write a thesis. I am carrying out a study on “The Effects of Oil Spillage on the Environment: A Case of Thange Village in Makueni County, Kenya”. The information provided here will enable me meet the degree requirements as this is purely an academic research.

Your participation in the research is completely voluntary and you can withdraw from the study at any time. There is no penalty for refusing to take part in the study. Your views and contribution will be treated with respect and confidentiality and will not be shared with other parties.

There is no compensation provided for participating in this research. However, you may find it interesting to talk about the issues addressed in the research and it may be beneficial to the field, your community and to individuals who have experienced similar issues in regards to oil spillage.

I have read/been read to the contents of this consent and all my questions have been answered satisfactorily. I therefore, give my verbal consent to be interviewed in the study.

Name _____

Signature: _____

Appendix B: Interview Schedule

Interview schedule code:

My name is Elsie Ng'endo Wambugu, I am a Master of Arts Student at Daystar University. As part of my coursework, I am required to conduct a research and write a thesis. I am therefore carrying out a study on "The Effects of Oil Spillage on the Environment: A Case of Thange Village in Makueni County, Kenya." The information provided here will enable me to meet the degree requirements as this is purely an academic research. Your views and contribution will be treated with respect and confidentiality.

Date of survey: _____

SECTION A: Demographic Data

1. Village _____
2. Gender:
 1. Male ()
 2. Female ()
3. Marital status
 1. Single ()
 2. Divorced/Separated ()
 3. Married ()
 4. Widowed/Widower ()
4. Educational level

1. No formal education ()	2. Primary Level ()
3. Secondary ()	4. Diploma ()
5. Undergraduate Level ()	6. Post-graduate Level ()
5. Respondent's occupation/source of income

1. Public sector ()	3. Self-employed ()
2. Private sector ()	4 Other (<i>Specify</i>)
6. Monthly income (tick where your income level applies)
 1. Less than 10,000 ()
 2. 10,000-20,000 ()
 3. 20,000-30,000 ()
 4. 30,000-40,000 ()
 5. 40,000-50,000 ()

6. Above 50,000 ()

SECTION B: Effects of Oil Spillage on the Environment

7. What effects did the oil spill have on soil resources are concerned? On scale of 1 – 5 rate the severity of the disturbance (1- very little, 2-little, 3-moderate, 4- strong, 5- very strong)

Bio-physical changes on soil resource	Level of severity				
	1	2	3	4	5
Decline in soil fertility					
Increase in surface run off					
Acidity in soil					
Increase in soil erosion					
Reduced farming land					

8. What effects did the oil spill have on the environment far as water resources are concerned? On scale of 1 – 5 rate the severity of the disturbance (1- very little, 2-little, 3-moderate, 4- strong, 5- very strong)

Bio-physical changes on water resources	Level of severity				
	1	2	3	4	5
Sedimentation of rivers and water pans					
Pollution of rivers					
Pollution of wells					
Drying of rivers					
Discoloration/filming of water					
Hardening of water					
Unclean drinking water					

9. What effects did the oil spill have on the environment as far as flora and fauna are concerned? On scale of 1 – 5 rate the severity of the disturbance (1- very little, 2-little, 3-moderate, 4- strong, 5- very strong)

Effects on fauna and flora	Level of severity				
	1	2	3	4	5
Reduction of forest /vegetation cover					
Death of animals					
Reduced grazing lands					
Destruction of protected habitats					
Poor aesthetics					
Loss of agricultural produce					

10. What effects did the oil spill have on the air environment? On scale of 1 – 5, Where: Strongly Disagree – 1, Disagree – 2, moderately agree, – 3, Agree– 4, Strongly Agree – 5

Air pollution	Level of agreement				
	1	2	3	4	5
The oil spill contributed to degraded air quality affecting breathing among the community					
The people living in the vicinity of the oil spill were evacuated for acute health symptoms due to inhaling polluted air					
Oil spills pollute components into air threatening the survival of livestock and animals					
The burning of oil spills has damaged the quality of air for vegetation					
Airborne pollutants from smoke plumes from burning oil created an oil mist that covered vegetation					

SECTION C: Intervention Measures

11. On scale of 1 – 5, Where: Strongly Disagree – 1, Disagree – 2, moderately agree, – 3, Agree– 4, Strongly Agree – 5. Please indicate your level of agreement with the following statements on intervention measures undertaken by government and private agencies.

Intervention Measures	Level of agreement				
	1	2	3	4	5
The compensations paid by oil companies and government are sufficient to sustain the means of livelihood and losses					
The government intervened immediately to rescue the victims of oil spillage in Thange Village					
There was a low frequency of government intervention to oil spillage cases in Thange					
The government and private companies have supported community development initiatives after the oil spill at Thange village					
There have been regular inspection of the equipment and facilities after the oil spill at Thange					

SECTION D: Challenges faced in implementing intervention measures

12. On scale of 1 – 5, Where: Strongly Disagree – 1, Disagree – 2, moderately agree, – 3, Agree– 4, Strongly Agree – 5. Please indicate your level of agreement with the following statements on challenges faced in implementing intervention measures.

Challenges facing intervention measures implementation	Level of agreement				
	1	2	3	4	5
There is a lack of political will to direct efforts towards dealing with oil spill disasters					

There is no adequate regulatory framework that guides implementation of oil spill interventions					
There is a lack of Corporate social responsibility from oil manufacturing companies and stakeholders in dealing with oil spills					
Planning					
The departments and agencies responsible for managing oil spills do not have the necessary equipment to do the job					
There is a lack of communication and coordination among departments and agencies responsible for managing oil spill disaster events					
The staff of departments and agencies mandated to intervene during oil spills do not have the required training					

SECTION E: Strategies to be adopted

13. Which strategies could be taken into consideration to deal with these challenges and effectively deal with the effects of oil spillage on the environment?

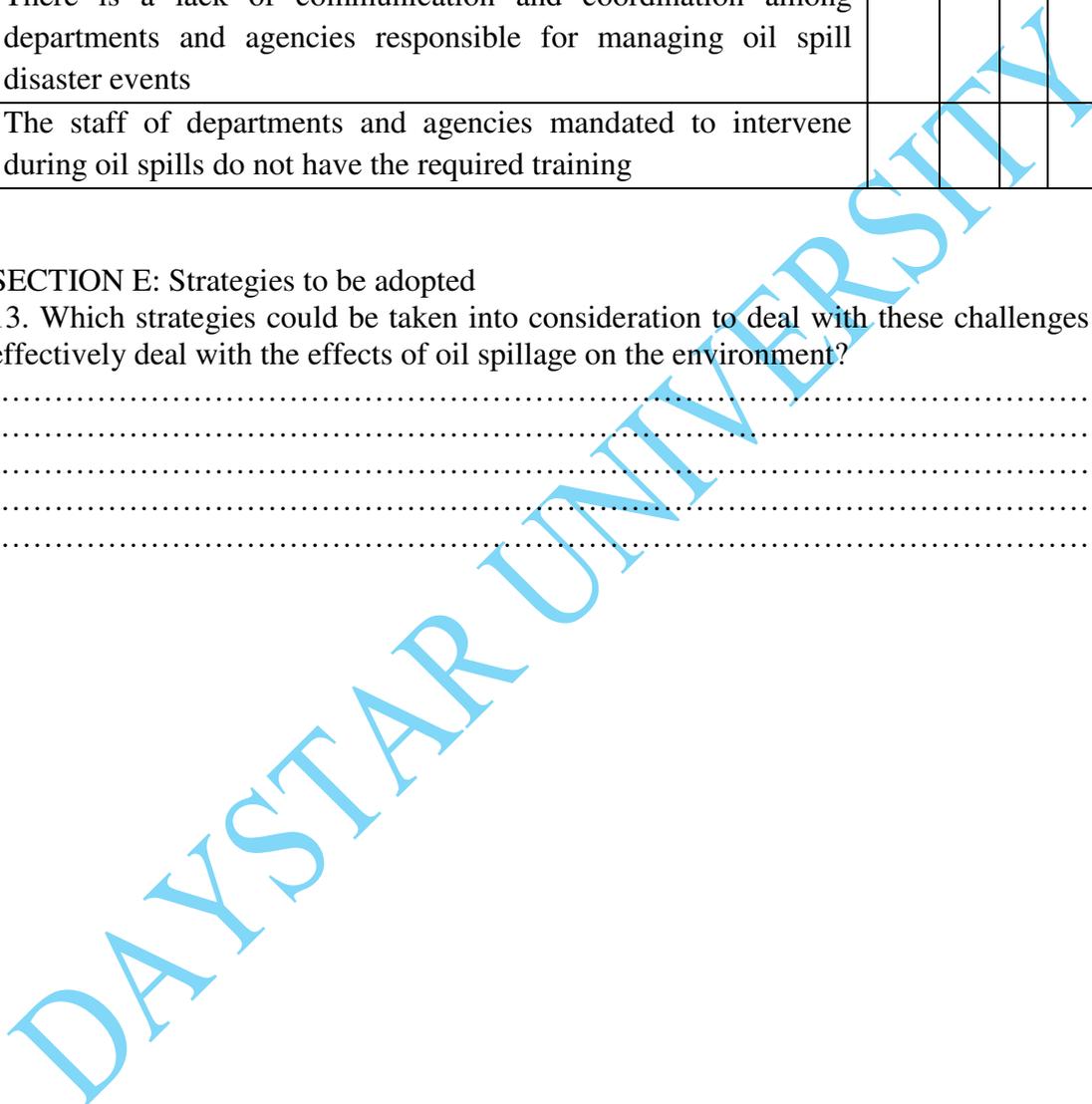
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Appendix C: In-depth Interview Guide

1. How has the oil spill affected to the land in terms of?
 - i. Decline in soil fertility
 - ii. Acidity in soil
 - iii. Reduction of farming land
2. How has the oil spill affected water sources in terms of?
 - i. Pollution of rivers
 - ii. Pollution of wells
 - iii. Discoloration/filming of water
 - iv. Unclean drinking water
3. How has the oil spill affected flora and fauna in terms of?
 - i. Reduction of forest /vegetation cover
 - ii. Death of animals
 - iii. Reduced grazing lands
 - iv. Poor aesthetics
 - v. Loss of agricultural produce
4. What are some of the challenges facing mitigation of oil spill at Thange?

Probing themes;

 - i. Communication and coordination among departments and agencies
 - ii. Corporate social responsibility from oil manufacturing companies and stakeholders
 - iii. Political will
 - iv. Training of staff to deal with oil spill disasters

Appendix D: Focus Group Discussion Guide

1. How did the spillage incident affect Thange's environment?

In terms of;

- i. Land
- ii. Water sources
- iii. Flora and fauna

2. Which government agencies were involved in dealing with the effects of the oil spill on Thange's environment?

3. What are some of the intervention measures adopted by the government to address the effect of the oil spill on Thange's environment?

4. What other agencies other than the government were involved in addressing the effects of the oil spill on Thange's environment?

5. What measures or actions did the community take in order to deal with the environmental effects from the oil spillage?

6. What are some of the challenges that were experienced by the different agencies and community members when dealing with the effects of the spillage on the environment in Thange?

7. How would you describe the coping that the community has used to deal with the effects of the oil spill?

8. What recommendations can you make to the authorities and the oil industry on strategies/mechanisms they should make to address the issue of oil spillage on the environment?

Appendix E: Researcher's Letter of Introduction

2nd July 2021

National Commission for Science, Technology and Innovation
P. O. Box 30623, 00100
Nairobi
KENYA

Dear Sir/Madam,

RE: ELSIE WAMBUGU

The above named is a student in the Master of Arts, Community Development at Daystar University Nairobi Campus. She is about to complete her coursework for the master's program and is required to do research as part of her final requirements.

The topic of study is '*Assessing the Effects of Oil Spillage On The Environment: A Case Of Thange Village In Makueni County, Kenya.*' Her proposal has been passed and approved by the Department of Development studies and Daystar University Ethics Review Board.

She is hereby authorized by the University to carry out her study by collecting data from the field. She requires your authorization to facilitate the same.

Thank you in advance for your willing to give this opportunity. We are truly grateful for your partnership in this, and for your organization's contribution in the education of Daystar University students.

If you have any queries, please do not hesitate to contact me.

Yours faithfully,



Dr. Philemon Yugi
HOD, Development Studies

Ref:hd/ministry letter



Appendix F: Ethical Clearance

VERDICT: APPROVAL WITH COMMENTS

Daystar University Ethics Review Board

Our Ref: **DU-ERB/14/06/2021/000525**

Date: 14th June 2021

To: Elsie Ng'endo Wambugu

Dear Elsie,

RE: ASSESSING THE EFFECTS OF OIL SPILLAGE ON THE ENVIRONMENT: A CASE OF THANGE VILLAGE IN MAKUENI COUNTY, KENYA

Reference is made to your ERB application reference no. 260421-01 dated 26th April 2021 in which you requested for ethical approval of your proposal by Daystar University Ethics Review Board.

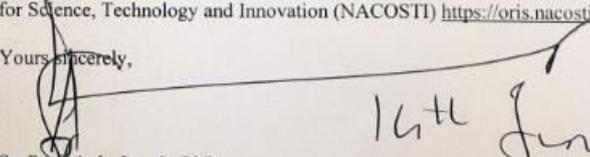
We are pleased to inform you that ethical review has been done and the **verdict is to revise to the satisfaction of your Supervisors before proceeding to the next stage**. As guidance, ensure that the attached comments are addressed. Please be advised that it is an offence to proceed to collect data without addressing the concerns of Ethics Review board. Your application approval number is **DU-ERB-000525**. The approval period for the research is between **14th June 2021 to 13th June 2022** after which the ethical approval lapses. Should you wish to continue with the research after the lapse you will be required to apply for an extension from DU-ERB at half the review charges.

This approval is subject to compliance with the following requirements.

- Only approved documents including (informed consents, study instruments, MTA) will be used.
- All changes including (amendments, deviations, and violations) are submitted for review and approval by Daystar University Ethics Review Board.
- Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to Daystar University Ethics Review Board within 72 hours of notification.
- Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to Daystar University Ethics Review Board within 72 hours.
- Clearance for export of biological specimens must be obtained from relevant institutions.
- Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- Submission of a signed one page executive summary report and a closure report within 90 days upon completion of the study to Daystar University Ethics Review Board via email [duerb@daystar.ac.ke].

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://oris.nacosti.go.ke> and other clearances needed.

Yours sincerely,



Sr. Prof. A. L. Lando PhD
Chair, Daystar University Ethics Review Board

Encl. Review Report



DAYSTAR UNIVERSITY
ETHICS REVIEW BOARD
14 JUN 2021
P. O. Box 44400 – 00100,
NAIROBI

Appendix G: Research Permit


REPUBLIC OF KENYA

Ref No: **267552** Date of Issue: **12/July/2021**

RESEARCH LICENSE



This is to Certify that Ms.. Elsie Ng'endo Wambugu of Daystar University, has been licensed to conduct research in Makueni on the topic: Assessing the effects of oil spillage on the environment; a case of Thange Village in Makueni County, Kenya. for the period ending : 12/July/2022.

License No: **NACOSTI/P/21/11700**

267552
Applicant Identification Number

Wambugu
Director General
**NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
INNOVATION**

Verification QR Code



**NOTE: This is a computer generated License. To verify the authenticity of this document,
Scan the QR Code using QR scanner application.**



Appendix H: Turnitin Report

Elsie Ng'endo Thesis - 2nd Nov. 2021

ORIGINALITY REPORT

15%

SIMILARITY INDEX

13%

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