ASSESSMENT OF THE EFFECTIVENESS OF OIL SPILLAGE MANAGEMENT IN THE MELUT BASIN OF SOUTH SUDAN

BY

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DECLARATION

I **Chep Makur Chuot** declare that this dissertation is my original work and to the best of my knowledge, it has never been presented elsewhere in any university or institution of learning for approval.

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APPROVAL

We, the undersigned certify that we have read and hereby recommend for acceptance by Kampala International University a dissertation titled, “Assessment of the effectiveness of oil spillage management in the Melut Basin of South Sudan”.

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DEDICATION

I dedicate this work to my wives; Mrs. Monica Arek Ayok, Mrs. Susan Auma Crainer and Mrs. Yier Achol Dhol, and my mother Mrs. Helena Yar Enock, My children; Ajak, Ayen and Makur and Mading Gabriel and finally to Eng. Bernard Amour Makeny and close friends as a way of saying thanks for their encouragement and support in terms of their material, their finance moral and spiritual support. I dedicate it to the instructors, academic supervisors from within and outside Kampala International University who provided the information and direction necessary to complete this work.

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OPERATIONAL DEFINITIONS

Oil spillage

This refers to the accidental or deliberate release of oil into the environment, typically occurring in water bodies such as oceans, rivers, or lakes, but it can also occur on land.

Oil spillage management

This refers to the systematic approach and set of strategies implemented to prevent, prepare for, respond to, and mitigate the environmental and socio-economic impacts of oil spills.

ABSTRACT

The study assessed the level of the effectiveness of oil spillage management procedures in the Melut Basin communities of South Sudan. The objectives of the study were to; examine the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan, determine the ways to the reduce of the impact of oil producing on human life, livestock, wild animals and farming in Melut Basin communities in South Sudan, explore how the spills are prevented from reaching the Melut Basin communities in South Sudan and to examine the spatial relationship trends and patterns in geography (GIS) of Melut Basin, South Sudan in the past 10 years compared to the recent years. The research design was a case study design whereby both qualitative and quantitative aspects were used. The study population comprised of 1200 respondents of which 400 was the sample size. Purposive sampling design was used to collect information and questionnaire data research tool was employed. The major findings of the study revealed that, on the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan, majority of the respondents agreed with 17.5% and strongly agreed with 64.5% that indigenous communities experience significant cultural impacts due to oil spills. On the consensus among respondents regarding the ways how spills are prevented from reaching the Melut Basin communities in South Sudan, 49.3% strongly agreed with its importance, a substantial percentage Agreed with 37.8% with mean value of 4.23. The findings of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan shed light on the ways to reduce the impact of oil production on human life, livestock, and farming activities in Melut Basin communities in South Sudan and a significant consensus strongly agrees (62.8%) with the importance of these efforts, and a substantial percentage agrees (19.3%) with mean value of 4.55. The Geographic Information System (GIS) coordinates for the Melut Basin in South Sudan have been tracked over a span of 12 years, from 2012 to 2023. These longitude coordinates, ranging from approximately 32.19123961 to 32.21033694, are vital for mapping, geospatial analysis, and monitoring changes in the region. It was concluded that on the substantial and interconnected concerns of the local community regarding the implications of oil spills, the worries expressed about health consequences underscore the pressing need for comprehensive health and safety measures in regions where oil extraction activities are prevalent. On the GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years, the analysis of Geographic Information System (GIS) coordinates has provided invaluable insights into the region's environmental dynamics and resource management over the past decade. It was recommended that to address the heightened concerns about the environmental impact of oil spills, the government strengthens environmental monitoring and regulation in the region. Implementing stricter environmental standards and conducting regular assessments of oil extraction activities can help mitigate the environmental consequences. Enforcing stringent regulations for oil transport, whether by sea or land, is crucial to safeguard the Melut Basin communities. The government should work on enhancing the regulatory framework and ensuring its effective implementation and it should collaborate with healthcare providers and non-governmental organizations.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter includes background of the study (historical, theoretical, conceptual and contextual backgrounds), the problem statement, aim and objectives, research questions, significance and justification of the study. It also includes the scope in terms of time and content as well as operational definitions of terms and concepts.

1.1 Background to the study

1.1.1 Historical perspective

Oil spillage management, from a historical perspective, encompasses the evolution of strategies, practices, and policies aimed at preventing, mitigating, and responding to oil spills and their environmental impacts. The management of oil spills has undergone significant changes over time, driven by both the growing understanding of the environmental consequences and the need for international cooperation (Yang et al., 2021). In the early years of the petroleum industry, little attention was given to the potential environmental harm caused by oil spills. The focus was primarily on maximizing oil production and distribution, with limited consideration for the impact on ecosystems and human health. As a result, oil spills were relatively frequent, and their consequences were often devastating (Silva et al., 2014).

Notable incidents in the late 19th and early 20th centuries, such as the SS Dix collision in the Delaware River in 1898, highlighted the destructive effects of oil spills. However, the lack of scientific understanding and the absence of formal frameworks for oil spillage management hindered effective responses (Bănăduc et al., 2022). It was not until the mid-20th century that oil spillage management gained significant attention on a global scale. The Torrey Canyon oil spill off the coast of Cornwall, England, in 1967 was a turning point that triggered international recognition of the need for coordinated efforts to prevent and respond to oil spills. This incident prompted the development of regulations, guidelines, and collaborative initiatives (Little et al., 2021a).

Numerous authors and scientists have contributed to the advancement of oil spillage management practices. Their works have explored the ecological impacts of oil spills, the effectiveness of response strategies, and the development of technologies for containment and

recovery (Wilkinson et al., 2017). These shed light on the environmental consequences of oil spills and emphasized the importance of early response and containment measures. In terms of international cooperation, the establishment of the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1973 was a pivotal moment. MARPOL introduced regulations and guidelines to prevent marine pollution from ships, including specific provisions for oil spill prevention and response. This marked a significant step forward in global efforts to address oil spillage (Čampara et al., 2018).

Major oil spills, such as the Exxon Valdez incident in 1989, continued to shape the trajectory of oil spillage management. The Exxon Valdez spill, which released millions of gallons of crude oil into Prince William Sound, Alaska, raised public awareness and spurred changes in response capabilities, liability frameworks, and regulations. This incident highlighted the need for improved prevention measures, advanced technologies, and stricter accountability for responsible parties (Gill et al., 2016). In recent decades, there has been a growing emphasis on proactive measures to prevent oil spills and enhance response capabilities. This includes the development of technologies such as booms, skimmers, and dispersants, as well as the establishment of specialized response teams and improved coordination among stakeholders. International agreements, such as the International Oil Pollution Compensation Funds, have also been established to provide financial assistance for cleanup efforts and hold responsible parties accountable for the damages caused by oil spills (Chang et al., 2014).

Oil spillage management in the Melut Basin of South Sudan is a complex and challenging issue that has been affecting the environment and the livelihoods of the local people for decades. The history of oil spillage management in the Melut Basin was from the 1970s to the 1990s, when Chevron and other foreign companies discovered and explored oil in the basin, but faced security threats and political instability due to the civil war between Sudan and South Sudan then from 1999 to 2011, when Sudan and South Sudan signed a peace agreement that allowed the resumption of oil production and export in the Melut Basin, China National Petroleum Corporation (CNPC) and other national oil companies became the main operators in the basin, and developed infrastructure such as pipelines, refineries, and export terminals. However, oil spillage management was still inadequate and ineffective, as oil spills continued to occur due to poor maintenance, lack of equipment, human error, sabotage, or armed conflict. From 2018 to present, when South Sudan signed a peace deal with its rebel factions and resumed its oil production and export with Sudan’s support, South Sudan has

expressed its commitment to improve its oil spillage management and address its environmental and social challenges.

1.1.2 Theoretical Perspective

This study will be guided by two theories regarding the effectiveness of oil spillage management and these are; the Contingency Theory and the Systems Theory.

The Contingency Theory

The Contingency Theory was developed by Fred Fiedler, an American psychologist and management theorist in the 1960s. The Contingency Theory suggests that the effectiveness of oil spillage management is contingent upon various factors, including the specific characteristics of the spill, the environment in which it occurs, and the response strategies employed (Thresher, 2021).

The Systems Theory

The systems theory was developed by Ludwig von Bertalanffy, an Austrian biologist in the 1940s. Systems theory is a broad interdisciplinary theory that seeks to understand the common principles that apply to all systems, whether they are living systems, social systems, or technological systems. The Systems Theory views oil spillage management as a complex system comprised of interconnected components and processes (Elsayed & Ammar, 2020).

1.1.3 Conceptual perspectives

Oil spillage management is the set of strategies, protocols, and actions undertaken to prevent, prepare for, respond to, and mitigate the environmental and socio-economic impacts of oil spills. It involves a comprehensive approach that encompasses various stages, from prevention and preparedness to response and recovery (Naggea & Miller, 2023). The International Petroleum Industry Environmental Conservation Association (IPIECA), an organization that promotes sustainable development within the oil and gas industry, provides valuable insights into oil spillage management. Their publication "Oil Spill Preparedness and Response: An Introduction" highlights the importance of preparedness plans, early detection systems, and rapid response measures in mitigating the effects of oil spills. It emphasizes the need for effective coordination among stakeholders and the deployment of appropriate technologies and equipment for containment and cleanup (Aljanadi & Alazzani, 2023).

The United States Environmental Protection Agency (EPA) offers comprehensive guidance on oil spill response and management. Their "Oil Spills Prevention and Preparedness

Regulations" outline the regulatory framework for preventing oil spills, preparing response plans, and implementing response actions (Daisy et al., 2022a). The EPA emphasizes the importance of regular inspections, proper maintenance of oil storage facilities, and training programs for spill response teams. The National Oceanic and Atmospheric Administration (NOAA) of the United States provides extensive resources on oil spill response and management. Their "Guidance for Developing a Subsea Dispersant Use Plan for Spills in U.S. Waters" focuses on the use of dispersants as a response technique (Walker et al., 2018). It highlights the need for thorough planning, coordination with relevant agencies, and careful consideration of the environmental impacts when using dispersants.

The International Maritime Organization (IMO), a specialized agency of the United Nations, plays a significant role in oil spillage management. Their "Guidelines for the Development of Shipboard Marine Pollution Emergency Plans" emphasize the importance of shipboard emergency plans, response training, and cooperation between ships and shore facilities (Bellefontaine et al., 2018). The IMO's focus on prevention, preparedness, and response measures contributes to global efforts in addressing oil spills. The research article "A Review of Oil Spill Response in the Marine Environment" by Zhang et al. (2017) provides an overview of oil spill response techniques and technologies. It discusses mechanical, chemical, and biological methods for containment, recovery, and cleanup of oil spills. The highlights the importance of considering site-specific factors, the effectiveness of response techniques, and potential ecological impacts in selecting the most appropriate response strategies (Van Dam et al., 2019).

The book "Oil Spill Science and Technology" edited by Merv Fingas in 2019 encompasses contributions from various experts in the field. It provides comprehensive coverage of oil spill response and management, addressing topics such as spill modeling, environmental impact assessment, cleanup techniques, and monitoring approaches. This resource offers a multidisciplinary perspective on oil spillage management, combining scientific research, technological advancements, and practical applications.

The effectiveness of oil spillage management is crucial to minimize the negative impacts and restore the environment as much as possible. The effectiveness of oil spillage management is interrelated through the location of the oil spill, the availability and suitability of the response methods and technologies, the coordination and cooperation among the stakeholders involved

in the oil spill response and the legal and institutional frameworks that regulate and support the oil spill response.

1.1.4 Contextual perspective

Effectiveness of oil spillage management in South Sudan is a critical aspect to evaluate in order to assess the current status and outcomes of measures taken to prevent, respond to, and mitigate oil spills in the region. Given the significant role of the oil industry in South Sudan's economy, the National Development Plan has emphasized the importance of sustainable and responsible oil exploration, production, and transportation. This would entail incorporating measures for effective oil spillage management as part of the plan's environmental and natural resources management strategies (Okeke et al., 2022).

Effective oil spillage management aligns with the principles of sustainable development. By minimizing the environmental impact of oil spills, the country can protect its natural resources, ecosystems, and biodiversity. Effective oil spillage management contributes to long-term sustainability and the preservation of the environment for future generations. Moreover, a sustainable approach to oil spillage management helps the Melut Basin of South Sudan and the country at large fulfill its commitments to international environmental agreements and demonstrates its dedication to responsible resource management (Sabela-Rikhotso et al., 2021).

The Melut Basin is located in the northeastern part of South Sudan, in the Upper Nile and Jonglei states. It is a rift basin that extends into Ethiopia, where it is called the Gambella basin. The basin is bordered by the Ethiopian highlands to the east, the Bahr el Ghazal basin to the south, and the Muglad basin to the west. The Melut Basin is a major oil-producing region. The largest oil field in the basin is the Great Palogue Field, which has estimated reserves of 900 million barrels. The Melut oil export pipeline travels 1,380 km from Palogue to Port Sudan on the Red Sea (Emishaw & Abdelsalam, 2019).

The Melut Basin is also home to a number of other natural resources, including gold, diamonds, and copper. The basin is a strategic location for South Sudan, as it provides access to the Red Sea and the global market. The coordinates are the coordinates of the Melut Basin are Latitude 7° 00' N and Longitude: 32° 00' E. The Melut Basin is a vast area, covering an estimated 33,000 square kilometers. The basin is characterized by a flat terrain, with an average elevation of 400 meters above sea level. The climate in the Melut Basin is tropical,

with a rainy season from May to October and a dry season from November to April (Hakimi et al., 2022).

The Melut Basin is a significant source of economic activity for South Sudan. The oil industry is the largest contributor to the country's Gross Domestic Product (GDP), and the Melut Basin is home to a number of oil fields. The basin is also home to a number of other natural resources, which have the potential to contribute to the country's economic development. The Melut Basin is a strategically important location for South Sudan. This study aimed at assessing the level of the effectiveness of oil spillage management procedures in the Melut Basin communities of South Sudan.

1.2 Statement of Problem

There has been a proliferation in the activities of crude oil exploration across the globe as a result of increase in high risk of oil spillage and the accompanying environmental hazards (Augustine et al., 2018). Melut Basin in South Sudan is an oil production community where oil drilling and operation is being carried out for some time which makes it susceptible to negative implications of drilling exercises such as oil spills and its unavoidable impacts on the community and its ecosystems. Thereby, this research examines oil spillage and their associative effects on the human beings, animals and fauna and flora of South Sudan. This study therefore assessed how the National government and the Joint Operating Companies manage oil spill incidents, and the degradation of environment brought about by the oil spillage to protect the environment, strengthen and update the existing South Sudanese environmental laws and policy and also to set out strict obligation for degradation of the environment.

1.3. Purpose and objectives

1.3.1 Purpose of the study

The general objective was to assess the level of the effectiveness of oil spillage management procedures in the Melut Basin communities of South Sudan.

1.3.2 Specific objectives of the research

(i) To examine the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan

(ii) To determine the ways to the reduce of the impact of oil producing on human life, livestock, wild animals and farming in Melut Basin communities in South Sudan.

(iii) To explore how the spills are prevented from reaching the Melut Basin communities in South Sudan.

(iv) To examine the spatial relationship trends and patterns in geography (GIS) of Melut Basin, South Sudan in the past 10 years compared to the recent years

1.4 Research Questions

(i) What are the implications of oil spills on the Melut Basin communities of South Sudan?

(ii) What are the ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan?

(iii) How are oil spills prevented from reaching the Melut Basins communities in South Sudan?

(iv) What are the spatial relationship trends and patterns in geography (GIS) of Melut Basin, South Sudan in the past 10 years compared to the recent years?

1.5 Scope of the study

1.5.1 Content scope

The study assessed the levels of the effectiveness of oil spillage management procedures in the Melut Basin communities of South Sudan. The study covered aspects on the implication of oil spills, how the spills be prevented from reaching the Melut Basin communities and reduction of the impact of oil producing on human life, livestock, wild animals and farming.

1.5.2 Time scope

To get sufficient information about the study, Data from the years 2002 through 2022 was reviewed.

1.6 Significance of the Study

To Students, the findings of this study will provide an opportunity for students to engage in real-world research and gain practical knowledge about oil spillage management. It will offer insights into the challenges, best practices, and potential solutions in the field of

environmental management. Students will be able to develop their analytical and research skills while contributing to the understanding of effective oil spillage management in a specific context.

To stakeholders, including local communities, environmental organizations, and industry representatives, will benefit from this study by providing a comprehensive assessment of the effectiveness of oil spillage management in the Melut Basin, offering valuable insights for decision-making, policy development, and improvements in spill response strategies. Stakeholders can use the findings to enhance collaboration, strengthen environmental protection measures, and promote sustainable development in the region.

The study findings will be of great importance to the government of South Sudan as it will provide evidence-based information on the effectiveness of oil spillage management in the Melut Basin. The findings can inform the development and implementation of policies, regulations, and guidelines to improve environmental protection, ensure responsible resource extraction, and enhance the overall management of oil spills. It will support the government's efforts in sustainable development planning and decision-making processes.

Policy makers can utilize the findings of this study to develop and refine policies related to oil spillage management. The assessment will provide a comprehensive understanding of the current state of oil spillage management in the Melut Basin and identify areas that require policy interventions or improvements. The study's outcomes can assist in designing effective regulations, enforcement mechanisms, and incentives that promote responsible practices, minimize risks, and protect the environment.

The study findings will directly impact the communities residing in the Melut Basin. By assessing the effectiveness of oil spillage management, it will highlight the potential risks, impacts, and challenges faced by local communities. The findings can inform community engagement initiatives, promoting active participation in decision-making processes and ensuring their voices are heard in matters relating to oil spill prevention, preparedness, response, and mitigation. It will help communities in understanding their rights, enhancing their resilience, and fostering sustainable development.

For researchers, the findings of the study will contribute to the body of knowledge on oil spillage management, particularly in the context of the Melut Basin in South Sudan. It will offer opportunities for further research, exploring new methodologies, and identifying gaps in

knowledge. The study's findings can serve as a reference for future research on oil spillage management, environmental impact assessment, and sustainable resource management in similar contexts.

Oil extraction companies operating in the Melut Basin will benefit from this study by gaining insights into the effectiveness of their current oil spillage management practices. The assessment will identify areas for improvement, highlight successful strategies, and contribute to the development of industry best practices. The findings will guide companies in enhancing their environmental performance, fostering sustainable operations, and maintaining good relationships with stakeholders.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the theoretical review and review of related literature and the views of what other researchers have written about the topic of effectiveness of oil spillage management. The review took the form of the objectives so that other authors' contribution in related literature is recognized.

2.1 Theoretical review

2.1.1 The Contingency Theory

The research was based on the Contingency Theory, which was formulated by Fred Fiedler, an American psychologist and management theorist, during the 1960s. The Contingency Theory proposes that the effectiveness of oil spillage management relies on multiple factors, such as the specific attributes of the spill, the surrounding environment, and the response strategies implemented. According to this theory, there is no universally applicable method for managing oil spills. Instead, management approaches and practices should be customized to suit the distinct circumstances of each spill (Chen et al., 2019). The Contingency Theory underscores the significance of being flexible and adaptable when addressing oil spills. It acknowledges that varying spills may demand distinct response techniques, equipment, and coordination strategies. For instance, a spill occurring in a fragile coastal ecosystem might call for an environmentally conscious approach, whereas a spill in deep offshore waters could necessitate specialized equipment and vessels for containment and recovery. This theory recognizes the need to tailor response efforts to the specific characteristics and challenges presented by each oil spill, emphasizing the importance of considering the unique circumstances and requirements in designing effective and efficient response plans (Carlson, 2018).

The Contingency Theory emphasizes the importance of thorough planning and preparedness. It suggests that organizations and governments should establish comprehensive contingency plans that outline a range of response options, considering the potential scenarios and risks associated with oil spills. This enables a prompt and suitable response in the event of a spill, reducing the environmental impact and maximizing the effectiveness of the response efforts. By having well-developed plans in place, stakeholders can efficiently allocate resources,

coordinate response activities, and implement appropriate measures to mitigate the consequences of an oil spill. The theory underscores the significance of proactive and forward-thinking approaches to ensure readiness and minimize the potential negative outcomes of oil spills (Walker et al., 2015).

2.1.2 The Systems Theory

The systems theory was formulated by Ludwig von Bertalanffy, an Austrian biologist, in the 1940s. It is an expansive interdisciplinary theory that aims to uncover the fundamental principles that are applicable to all types of systems, regardless of whether they are living systems, social systems, or technological systems. This theory provides a framework for comprehending the interconnectedness and interdependence of various components within a system, as well as the dynamic processes and relationships that exist between them. By studying systems as a whole, rather than isolated parts, the systems theory offers insights into the common patterns, behaviors, and characteristics that emerge across diverse domains of knowledge and inquiry (Pesurnay, 2018). The Systems Theory perceives oil spillage management as a complex system consisting of interconnected components and processes. Within this framework, the effectiveness of oil spillage management is determined by the interactions and relationships among these components. The theory recognizes that various elements, such as prevention measures, response strategies, environmental factors, and stakeholder engagement, are interdependent and influence one another. It emphasizes the need to consider the system as a whole, rather than focusing solely on individual aspects, in order to develop comprehensive and effective approaches to managing oil spills. By understanding the interconnectivity and interdependencies within the system, stakeholders can implement strategies that address the complex dynamics of oil spillage management and achieve better outcomes (Elsayed & Ammar, 2020). The Systems Theory underscores the importance of adopting a holistic and integrated approach to oil spillage management. It acknowledges that achieving effective management necessitates coordination and collaboration among diverse stakeholders, including government agencies, industry operators, scientific experts, and local communities. Each stakeholder within the system plays a critical role and contributes to the overall effectiveness of the response. By recognizing the interconnectedness and interdependencies among these stakeholders, the theory emphasizes the significance of their collective efforts in addressing oil spills comprehensively. It highlights the need for open communication, information sharing, and joint decision-making to optimize the management strategies and ensure a coordinated response. The Systems

Theory promotes a collaborative and inclusive approach, recognizing that the success of oil spillage management is contingent upon the active involvement and cooperation of all relevant stakeholders (Bundy et al., 2018).

The Systems Theory underscores the significance of information sharing and communication within the oil spillage management system. Timely and accurate data regarding spill characteristics, environmental conditions, and response activities are crucial for making informed decisions and optimizing resource allocation. Effective communication channels among stakeholders facilitate coordination, collaboration, and the implementation of appropriate response strategies. By exchanging relevant information, stakeholders can enhance their understanding of the situation, identify potential challenges, and collectively determine the most effective course of action. This theory emphasizes the need for transparent and efficient communication processes that enable stakeholders to share knowledge, exchange expertise, and coordinate efforts seamlessly. Strong communication within the management system supports effective decision-making, facilitates swift response, and ensures the best utilization of available resources to address oil spills efficiently (Kang et al., 2016). Furthermore, the Systems theory emphasizes the importance of continuous learning and improvement in oil spillage management. It recognizes the value of feedback mechanisms and monitoring systems in evaluating the effectiveness of response efforts and identifying areas for enhancement. These mechanisms enable stakeholders to assess the outcomes of their management strategies, measure the impact of their actions, and gather valuable insights for future decision-making. By actively seeking feedback and monitoring the results of their interventions, stakeholders can refine their management strategies, adopt new technologies, and integrate lessons learned from previous incidents. This iterative process of learning and improvement ensures that oil spillage management practices remain up-to-date, effective, and responsive to changing circumstances. By embracing a culture of continuous learning and improvement, stakeholders can enhance their capacity to prevent, prepare for, respond to, and mitigate the impacts of oil spills, ultimately leading to more resilient and effective oil spillage management systems (Ritchie et al., 2014).

2.2 Review of related literature

2.2.1 The implication of oil spills

Oil spills expose communities to toxic substances, which can have detrimental effects on human health. Inhalation of fumes and direct contact with contaminated water or soil can lead to respiratory problems, skin irritations, and long-term health issues. Communities may experience an increase in respiratory illnesses, allergies, and other health complications, posing a threat to their overall well-being (Chinedu & Chukwuemeka, 2018).

Many communities in oil-producing areas rely on natural resources for their livelihoods, such as fishing, farming, and tourism. Oil spills contaminate water bodies and agricultural lands, leading to the loss of livelihood opportunities. Fishing communities may experience declines in fish populations, and farmers may face reduced crop yields due to soil contamination. The loss of income and livelihoods can lead to increased poverty and economic hardship within the community (Alemzero et al., 2021).

Oil spills cause extensive damage to the environment, including ecosystems, water bodies, and wildlife habitats. The spillage coats plants, animals, and the shoreline, leading to the death or displacement of wildlife and the destruction of habitats. This disruption to the ecological balance can have long-term implications for biodiversity and the overall health of the environment (Singh et al., 2020).

Oil spills pollute water sources, including rivers, lakes, and groundwater, which are vital for drinking, irrigation, and other domestic purposes. Contaminated water can lead to the scarcity of safe drinking water, posing risks to the health of community members. Moreover, the pollution of water sources affects the availability of clean water for agricultural activities, impacting food security and exacerbating the economic challenges faced by communities (Chandnani et al., 2022).

Oil spills can exacerbate existing socio-economic disparities within affected communities. The impacts are often felt disproportionately by marginalized groups, including indigenous communities and vulnerable populations. These groups may have limited resources and capacity to cope with the consequences of oil spills, further deepening inequalities and social injustices (Bennett et al., 2023).

Indigenous communities, in particular, may experience significant cultural impacts due to oil spills. These communities often have deep connections to the land and rely on traditional practices and resources for their cultural identity. Oil spills can disrupt their way of life, damage sacred sites, and erode cultural heritage, leading to a loss of cultural identity and cohesion within the community (Westman & Joly, 2019).

Oil spills can cause social disruptions within affected communities. The environmental and economic consequences of spills can lead to increased migration as people seek alternative means of survival. Displacement, community tensions, and conflicts over resources can arise, further straining social cohesion and stability (Albert et al., 2018).

Oil spills can have psychological effects on individuals and communities. The loss of livelihoods, environmental degradation, and the uncertainty of recovery can lead to stress, anxiety, and a sense of helplessness. Psychological well-being and community resilience can be significantly impacted, requiring support and resources for mental health services and community healing (Elum et al., 2016).

Oil spills can erode trust and confidence in both the oil industry and regulatory bodies. Communities may feel betrayed by the industry's failure to prevent spills or adequately respond to them. This loss of trust can hinder future collaboration and engagement between stakeholders, making it challenging to implement effective preventive measures or establish meaningful dialogue (Little et al., 2021b).

The impacts of oil spills can extend for years or even decades. Contamination can persist in the environment, affecting future generations and impeding the ability of communities to recover and rebuild. The long-term consequences may include continued health problems, economic struggles, and environmental degradation that pose ongoing challenges for affected communities (Landrigan et al., 2020).

Oil spills often catalyze community activism and advocacy for environmental justice. Affected communities may organize and advocate for stronger regulations, stricter enforcement, and greater corporate accountability. They may seek compensation for damages, demand community participation in decision-making processes, and push for sustainable alternatives to oil dependency (Méndez, 2020).

Oil spills can raise awareness about the environmental risks and impacts associated with oil extraction and transportation. Communities may become more engaged in environmental education, promoting sustainable practices, and advocating for renewable energy sources. Increased awareness and education empower communities to take proactive steps towards environmental conservation and protection (Zhang et al., 2019).

The challenges posed by oil spills necessitate collaboration between communities, governments, and industry stakeholders. Through dialogue and collaboration, solutions can be developed that prioritize the well-being of affected communities, sustainable resource management, and environmental protection. Collaborative approaches foster shared responsibility, mutual understanding, and collective efforts towards minimizing the impacts of oil spills (Agbonifo, 2016).

Oil spills can expose gaps in existing regulations and highlight the need for stronger oversight and enforcement. Communities and advocacy groups may advocate for regulatory reforms that prioritize environmental protection, community well-being, and the prevention of future spills. Strengthened regulations can lead to improved spill prevention measures, emergency response protocols, and stricter enforcement of environmental standards (Zarma, 2019).

Despite the challenges posed by oil spills, affected communities often exhibit resilience and resourcefulness. They may mobilize community-based initiatives, engage in self-help efforts, and seek innovative solutions to recover and rebuild. Community resilience can be strengthened through supportive networks, capacity-building programs, and access to resources that enable communities to bounce back from the impacts of oil spills (Kendra et al., 2018).

Restoration efforts following oil spills can provide opportunities for community engagement and employment. Restoring affected ecosystems and habitats can create jobs and stimulate local economies. Involving local communities in restoration projects ensures that their knowledge and expertise are utilized, fostering a sense of ownership and connection to the recovery process (Greening et al., 2018).

Oil spills highlight the importance of robust environmental monitoring and early warning systems. Implementing effective monitoring technologies and systems can facilitate early detection of spills, enabling a swift response and minimizing the extent of contamination.

Communities can participate in monitoring initiatives, enhancing their ability to safeguard their environment and raise timely alarms in case of spill incidents (Krestenitis et al., 2019).

Building the capacity of affected communities, government agencies, and industry operators in oil spillage management is crucial. Providing training on spill response, environmental monitoring, and emergency preparedness equips stakeholders with the necessary skills and knowledge to effectively address and mitigate the impacts of spills. Strengthening local capacities enhances the ability to respond swiftly, reducing the potential harm to the environment and community (Betancur-Corredor et al., 2018).

Adequate compensation and remediation measures are essential for restoring affected communities. Fair compensation for loss of livelihoods, health damages, and environmental harm supports communities in their recovery and ensures that they are not left economically disadvantaged. Effective remediation efforts, including thorough cleanup and restoration of the affected environment, are crucial for restoring ecological balance and rebuilding community confidence (Khan et al., 2021).

Oil spills underscore the importance of transitioning to sustainable energy alternatives. Communities affected by spills often advocate for renewable energy sources, energy efficiency initiatives, and sustainable development practices. Shifting towards cleaner energy options reduces the reliance on fossil fuels, minimizes the risks of future spills, and promotes a more sustainable and resilient future for affected communities and the environment (Simon, 2020).

2.2.2 How the oil spills be prevented

Regular inspections and maintenance of pipelines, tankers, and storage facilities are crucial in preventing oil spills. Implementing strict regulations and standards for their construction and operation is essential. Employing advanced technology and monitoring systems can detect leaks and potential failures in pipelines and storage facilities promptly. This allows for immediate action to prevent spills and minimize their impact (Shukla & Karki, 2016).

Promoting a culture of safety and responsibility within the oil industry is vital. Training workers on proper handling procedures and emergency response protocols can help prevent accidents that lead to spills. Implementing rigorous safety protocols during offshore drilling operations can minimize the risk of spills. Utilizing blowout preventers and other fail-safe mechanisms can help control wellhead integrity (Ogunbiyi et al., 2023).

Enforcing stringent regulations on the transport of oil, whether by sea or land, is essential. Regular inspections and audits of tankers, barges, and transport vehicles can ensure compliance with safety standards. Establishing protected marine areas and sensitive ecological zones can help safeguard communities from potential spills. These areas should be carefully monitored and patrolled to deter any unauthorized activities that may lead to spills (Daisy et al., 2022b).

Enhancing the infrastructure for spill response is crucial. Pre-positioning containment booms, skimmers, and other equipment in strategic locations can enable a swift response to contain and mitigate spills before they reach communities. Collaborating with local communities and stakeholders to develop comprehensive spill response plans is essential. These plans should involve training programs, public awareness campaigns, and community engagement initiatives (Katopodis & Sfetsos, 2019).

Conducting regular drills and exercises to test the effectiveness of spill response plans is necessary. This helps identify areas for improvement and ensures a coordinated and efficient response in case of an actual spill. Investing in research and development of new technologies for oil spill cleanup can enhance response capabilities. This includes innovative techniques such as the use of bioremediation agents and advanced skimming technologies (Izumi et al., 2021).

Implementing strict penalties and consequences for non-compliance with safety regulations can act as a deterrent. The threat of significant fines and legal action can encourage responsible practices within the oil industry. Strengthening international cooperation and agreements on oil spill prevention and response is crucial. Sharing best practices, information, and resources can enhance global readiness to prevent and address spills (Fan et al., 2022).

Encouraging the use of alternative energy sources and promoting renewable technologies can reduce the demand for oil. Decreasing reliance on oil can potentially lower the frequency of oil transportation and the associated spill risks. Promoting transparency and accountability within the oil industry is vital. Regular reporting of safety records and spill incidents can help identify patterns and areas that require improvement (Gravagna et al., 2020).

Implementing strict regulations on offshore drilling and exploration activities can help prevent spills from occurring in the first place. This includes thorough environmental impact

assessments and comprehensive safety plans. Conducting thorough risk assessments of pipeline routes and potential spill zones is necessary. Identifying vulnerable areas and implementing additional safeguards, such as reinforced pipeline coatings, can reduce the likelihood of spills reaching communities (Gulas et al., 2017).

Educating communities living in close proximity to oil infrastructure about the risks and safety measures can empower them to be proactive in spill prevention. Providing information about emergency response procedures and evacuation plans is crucial. Encouraging the development and use of oil spill response cooperatives and mutual aid agreements can strengthen the collective ability to address spills effectively. This includes sharing resources, expertise, and personnel during emergency situations (Yang, 2017).

Supporting research and development of advanced oil spill detection systems can enable early detection and prompt response. This may include the use of remote sensing technologies, satellite monitoring, and real-time data analysis. Regularly reviewing and updating regulations and safety standards in light of technological advancements and lessons learned from past incidents is necessary. Flexibility and adaptability in the regulatory framework can help stay ahead of emerging risks and prevent spills from reaching communities (Arora & Lodhia, 2017).

Effective communication and coordination among all stakeholders are paramount in preventing oil spills from reaching communities. Establishing clear lines of communication between oil companies, regulatory agencies, and local authorities can facilitate prompt reporting and response in case of a spill. Regular meetings, joint exercises, and information-sharing platforms can enhance collaboration and strengthen preparedness (Sandu et al., 2020).

Public awareness and education campaigns play a crucial role in preventing oil spills from reaching communities. Educating the general public about the environmental and health risks associated with oil spills can foster a sense of responsibility and encourage individuals to report any potential hazards they observe. Empowering communities with knowledge about emergency response procedures and the importance of early reporting can enable swift action in preventing spills from spreading (Shelest et al., 2017).

In the event of an oil spill, rapid and effective response is essential to minimize the impact on communities. Establishing dedicated spill response teams with trained personnel and

sufficient resources can facilitate a quick and coordinated effort. These teams should be equipped with appropriate tools and materials for containment, recovery, and cleanup operations. Regular training exercises and simulations can enhance their readiness and ensure efficient response (Liu et al., 2021).

Integrating environmental considerations and risk assessments into the decision-making processes for oil infrastructure projects can contribute to spill prevention. Conducting thorough environmental impact assessments and consulting with experts can help identify potential risks and design mitigation measures accordingly. By implementing preventive measures during the planning and design stages, the likelihood of oil spills reaching communities can be significantly reduced (Munns Jr et al., 2016).

Active public participation and engagement in decision-making processes related to oil infrastructure and spill response are crucial. Encouraging public input and incorporating community concerns into the design and operation of oil facilities can lead to more robust safety measures and better protection for nearby communities. Regular public meetings, consultations, and feedback mechanisms can facilitate dialogue and ensure that community voices are heard and considered (Johnson et al., 2021).

2.2.3 The reduction of the impact of oil producing on human life, livestock, wild animals and farming

Encouraging the reduction of the impact of oil production on human life, livestock, wild animals, and farming communities is essential to safeguard both the environment and the well-being of communities affected by this industry. The extraction, processing, and transportation of oil can have significant implications for various aspects of life, including pollution, habitat destruction, health risks, and economic disruption (Devenport et al., 2021).

To reduce the impact on human life, it is crucial to implement stringent regulations and safety standards throughout the entire oil production process. This includes monitoring air quality near oil production sites to ensure that emissions are within acceptable limits. Additionally, proper waste disposal practices should be enforced to prevent contamination of water sources and surrounding land. Minimizing the release of harmful substances into the environment, such as volatile organic compounds and hazardous chemicals, is of utmost importance (Anjum et al., 2021).

Oil spills and leaks pose significant threats to human health and ecosystems. Encouraging the use of advanced technologies and preventive measures can help minimize the occurrence of such incidents. This includes employing robust safety protocols, regular equipment inspections, and utilizing automated leak detection systems. By identifying and addressing potential risks early on, the chances of spills and leaks can be significantly reduced, ultimately minimizing their impact on nearby communities (Michalski & Ficek, 2016).

Air pollution resulting from oil production activities can have detrimental effects on human respiratory health. To mitigate these impacts, it is important to encourage the use of cleaner technologies and practices. This can include the implementation of emissions control systems, the adoption of renewable energy sources, and the reduction of flaring and venting of gases. By promoting the use of cleaner alternatives, the emission of pollutants that contribute to air pollution can be significantly reduced, thus improving the air quality for nearby communities (Ahmad et al., 2016).

Developing comprehensive emergency response plans for oil spills and leaks is essential to minimize their impact on human life, livestock, and wildlife. These plans should involve coordination among various stakeholders, including oil companies, government agencies, and local communities. It is crucial to ensure that there are effective containment, cleanup, and recovery efforts in place. This includes pre-positioning equipment and resources, conducting regular training and drills, and establishing clear communication channels. By being well-prepared to respond to incidents, the potential damage caused by spills and leaks can be minimized, thereby protecting both human and animal life (Litvinenko, 2020).

Mitigating the impact of oil production on livestock requires implementing measures to prevent contamination of grazing areas and water sources. Proper waste management practices, including the secure storage and disposal of hazardous materials, can help safeguard livestock from exposure to pollutants associated with oil production. Monitoring the health of livestock and promptly addressing any concerns is also crucial to ensure their well-being and productivity (Rojas-Downing et al., 2017).

Preserving the habitats of wild animals in areas affected by oil production is crucial for their survival. Implementing buffer zones, wildlife corridors, and protected areas can help mitigate the fragmentation and degradation of ecosystems caused by oil-related activities. By preserving and restoring natural habitats, wildlife populations can continue to thrive and contribute to the overall biodiversity of the region. Efforts should be made to assess the

potential impacts of oil production on local wildlife populations through research and monitoring programs. This information can guide decision-making processes and help implement targeted mitigation measures to protect vulnerable species and their habitats (Oosting et al., 2022).

Encouraging responsible land reclamation and restoration practices after oil extraction is essential. This involves rehabilitating the land to its pre-disturbed state, implementing soil erosion control measures, and replanting native vegetation. Restoring ecosystems can provide alternative habitats for wildlife and contribute to the overall environmental sustainability of the area. Additionally, supporting research and monitoring programs to assess the long-term impacts of oil production on ecosystems and wildlife is vital. This knowledge can inform decision-making processes, guide the implementation of mitigation measures, and help ensure the long-term sustainability of the environment (Garrett et al., 2017).

Fostering community engagement and participation in decision-making processes related to oil production is essential to address the concerns and needs of farming communities. Local communities should have a say in the planning and development of oil projects that may affect their livelihoods and agricultural practices. It is crucial to establish open lines of communication and provide opportunities for community members to voice their opinions and contribute to the decision-making process. By involving the affected communities, it is possible to develop strategies that minimize the impacts on farming practices, protect agricultural lands, and ensure sustainable development in the region (Geekiyanage et al., 2020).

Implementing measures to mitigate the noise, dust, and traffic impacts associated with oil production activities near farming communities is necessary. This can include the installation of sound barriers, dust suppression techniques, and traffic management strategies. By implementing these measures, the quality of life for nearby communities can be improved, and the negative impacts on agricultural activities and livestock can be minimized (Delina, 2018).

It is important to promote sustainable economic alternatives and diversification in regions heavily reliant on oil production. By encouraging the development of other industries such as renewable energy, tourism, agriculture, and technology, communities can reduce their dependence on oil and create more resilient and sustainable economies. This diversification

can help mitigate the negative impacts of oil production on local communities, ensuring a more balanced and stable future (Tagliapietra, 2019).

Investing in education and vocational training programs for individuals in oil-producing regions can also play a crucial role in reducing the impact on human life, livestock, wild animals, and farming communities. By equipping community members with the skills and knowledge needed for alternative job opportunities, they can transition to new sectors and reduce their reliance on the oil industry. This can lead to increased economic stability and a higher quality of life for individuals and their families (Lo, 2020).

Engaging with local communities and stakeholders through ongoing dialogue and collaboration is key to finding sustainable solutions. Consultative processes, community meetings, and participatory decision-making can provide a platform for community members to voice their concerns, share their knowledge, and actively contribute to the development of strategies that minimize the impact of oil production. This inclusive approach fosters a sense of ownership and empowers communities to be actively involved in shaping their future (Afewerki & Karlsen, 2022).

Promoting transparency and accountability within the oil industry is essential. Encouraging companies to adhere to environmental and social responsibility standards, disclose their practices, and engage in regular reporting can ensure that their operations are conducted in a responsible and sustainable manner. This transparency allows communities and regulatory bodies to hold companies accountable for any negative impacts and work towards solutions that mitigate harm (Bujang et al., 2016).

Supporting scientific research and monitoring programs is crucial to understanding the long-term effects of oil production on human life, livestock, wild animals, and farming communities. These studies can provide valuable data and insights into the specific challenges and risks faced by these communities. The information obtained can inform policy-making, guide mitigation strategies, and help shape sustainable development plans that prioritize the well-being of all stakeholders (Alsharif et al., 2017).

Fostering international cooperation and knowledge sharing among oil-producing regions can contribute to reducing the impact on human life, livestock, wild animals, and farming communities. By sharing best practices, lessons learned, and innovative solutions, regions can learn from each other's experiences and work collaboratively towards minimizing the negative effects of oil production. International agreements and partnerships can also play a

significant role in promoting sustainable practices, environmental protection, and the well-being of affected communities (Afsharzade et al., 2016).

2.3 Gap Analysis

There is clear evidence from the literature that the effectiveness of oil spillage management has been exposed by different authors worldwide. However, there has been hardly much research carried out to explain the better strategies of oil spillage management in the Melut Basin of South Sudan. Existing gaps include:

1. Gap in understanding the long-term and short-term implications of oil spills in the community. This includes gaps in knowledge regarding the ecological, social, and economic consequences of oil spills in this particular region.

2. Gap in the existing knowledge on effective strategies and technologies for preventing oil spills from reaching and affecting the Melut Basin communities. This includes a lack of complete understanding of preventative measures, early warning systems, and the implementation challenges in the specific context of South Sudan.

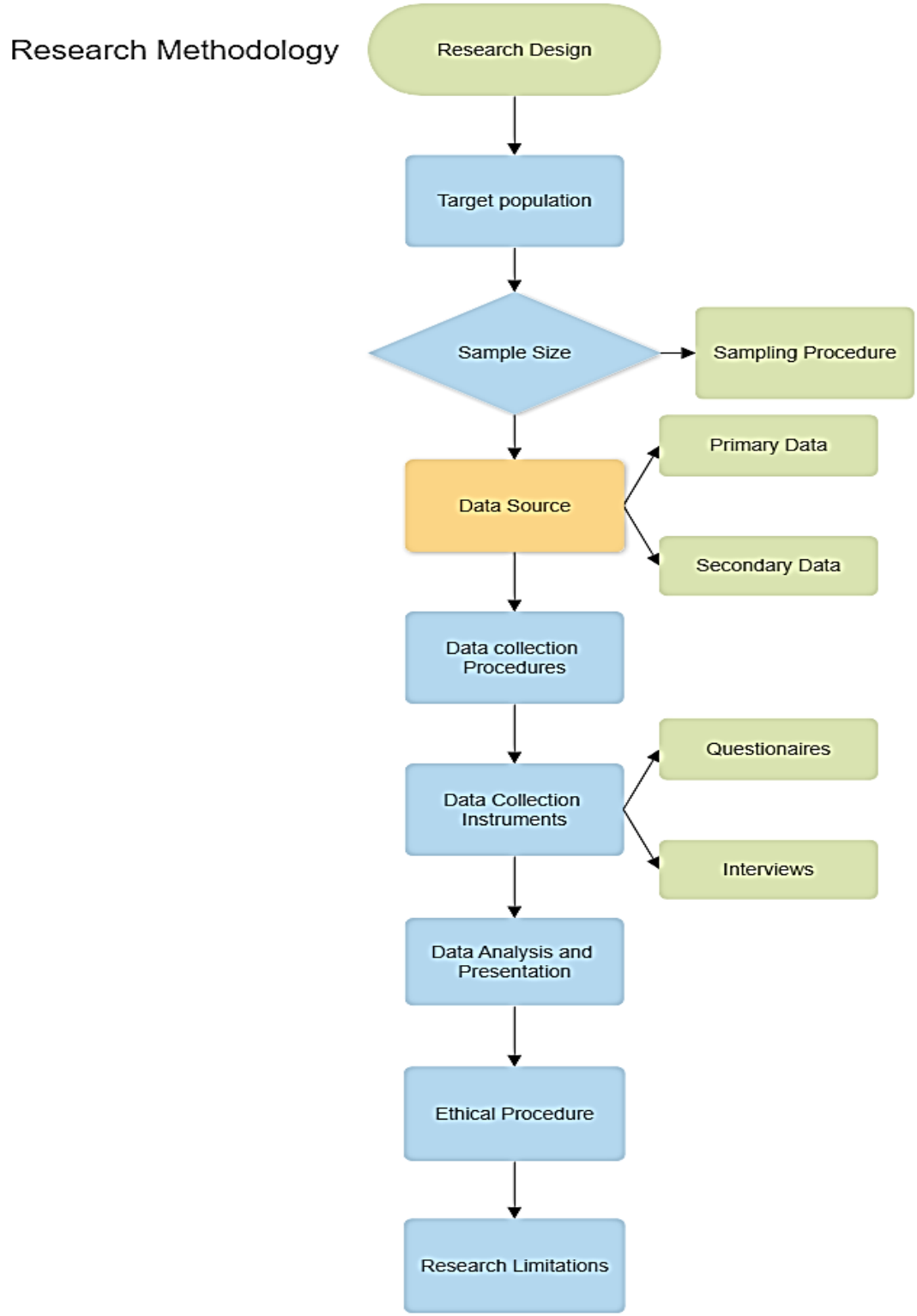
3. A potential gap exists in the identification of practical and sustainable methods to mitigate the impact of oil production on various aspects of life in Melut Basin communities. This includes insufficient information on community-based adaptation strategies, robust farming practices, and effective measures for protecting human and animal health.

Addressing these research gaps involve investigations into the specific environmental, social, and economic contexts of the Melut Basin, as well as evaluating the effectiveness of existing preventive and mitigative measures and exploring community perspectives and involvement in the development of strategies. It’s upon this that there is a need of carrying out the present study on the assessment of the effectiveness of oil spillage management by the researcher in the Melut basin of South Sudan.

CHAPTER THREE

METHODOLOGY

Research Methodology Flow Chart



3.0 Introduction

This chapter mainly focused on the methods and procedures that were used in the study which included the research design, population coverage, data analysis and procedures.

3.1 Research Design

A case study design of qualitative and quantitative aspects was used. This method is preferred because it is an ideal method that eases the collection of information from the respondents at both individual and group levels. The researcher used cross sectional design. The research findings were displayed in table form with figures in percentage form. The researcher went ahead to describe the findings from the tables.

3.2 Geographical scope/Study Site

The Melut Basin is located in the northeastern part of South Sudan, in the Upper Nile and Jonglei states. It is a rift basin that extends into Ethiopia, where it is called the Gambella basin. The basin is bordered by the Ethiopian highlands to the east, the Bahr el Ghazal basin to the south, and the Muglad basin to the west. The Melut Basin is a major oil-producing region. The largest oil field in the basin is the Great Palogue Field, which has estimated reserves of 900 million barrels. The Melut oil export pipeline travels 1,380 km from Palogue to Port Sudan on the Red Sea (Emishaw & Abdelsalam, 2019).

The Melut Basin is also home to a number of other natural resources, including gold, diamonds, and copper. The basin is a strategic location for South Sudan, as it provides access to the Red Sea and the global market. The coordinates are the coordinates of the Melut Basin are Latitude 7° 00' N and Longitude: 32° 00' E. The Melut Basin is a vast area, covering an estimated 33,000 square kilometers. The basin is characterized by a flat terrain, with an average elevation of 400 meters above sea level. The climate in the Melut Basin is tropical, with a rainy season from May to October and a dry season from November to April (Hakimi et al., 2022).

The map of Melut Basin is in figure 1 below

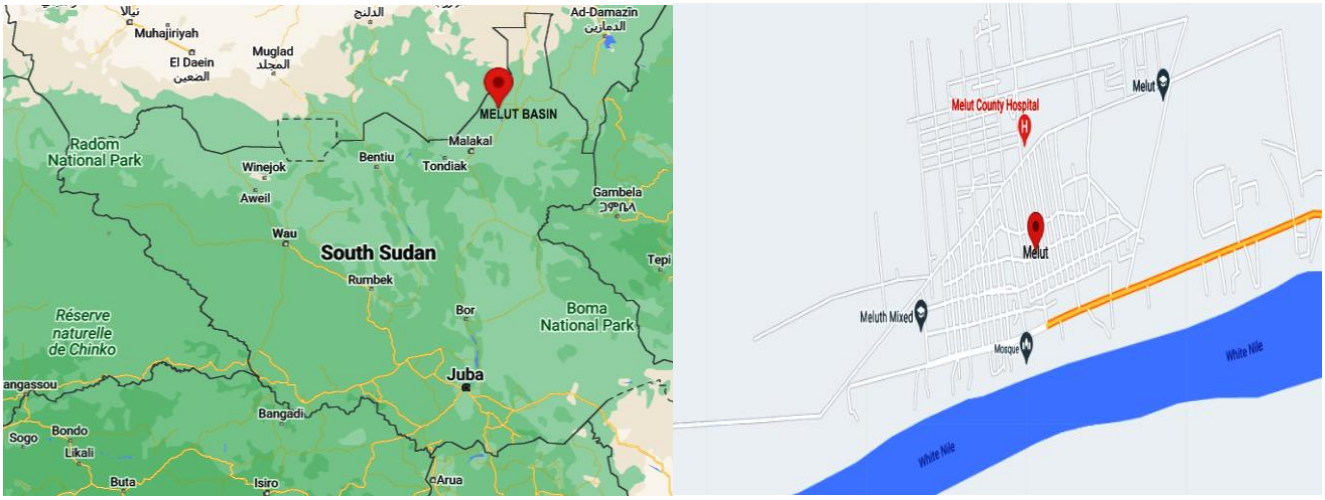


Figure 1.1: A map of South Sudan showing Melut Basin

3.3 Target Population

The target population of the study was mainly the local and Melut Basin communities of South Sudan. The estimated number of respondents was 1200 from whom the researcher selected the sample. The researcher attained information and data collection though the area was wide.

3.4 Sample size

The researcher used a sample size commensurate to the study population upon verification and approval of the study population of the residents which is 1200. This sample size was a representative of the whole population and manageable to administer the research instruments. It was on these selected respondents that the data collection instruments were used to collect and obtain the data. The researcher used Slovene's formula to determine the sample size as showed below.

For this study:

$$n = \frac{N}{1 + N\alpha^2}$$

Where;

n = the sample size

N = total population of respondents, that is 1200.

α = the level of significance, that is 0.05

$$n = \frac{N}{1 + N\alpha^2}$$

$$n = \frac{1200}{1 + 1200\ (0.05)^2}$$

$$n = \frac{1200}{1 + 1200 * 0.0025}$$

$$n = \frac{1200}{3}$$

$$n = 400$$

A sample size of 400 respondents was selected to participate in the study.

Table i: Shows determination of sample size

Category	**Target population**	**Sample size**	**Sampling techniques**
Farmer	896	299	Stratified Random sampling technique
Youth	78	26	Purposive sampling
Community leader (Chief)	148	49	Random sampling technique
Parent	78	26	Purposive sampling
Total	**1200**	**400**	

Source: Primary Data, 2024

A sample size of **400** respondents was selected to participate in the study.

3.4.1 Sampling procedure

A representative sample of the respondents was selected from the total population to participate in the study. The researcher used simple random sampling techniques to choose the respondents to participate in the study. With simple random it means that every member in the sample population has an equal chance of being included in the sample size, this reduced on the researcher's bias in obtaining the sample respondents. Also, with purposive sampling it means that information was only obtained from the key informants who had ideas about the subject matter hence first-hand information was obtained.

3.5 Data source

Data was collected using both primary and secondary data collection techniques.

3.5.1 Primary data

Primary data was gathered basically through structured questionnaires and interviews involving the selection of respondents to provide information.

3.5.2 Secondary data

The researcher accessed secondary data from different sources like; textbooks, internet, newspaper, magazines, and journals available for Melut Basin. This information was reviewed by visiting places like libraries and internet cafes and this type of information was used to supplement collected data from different categories of the respondents during data collection.

3.6 Data Collection Procedures

The researcher carried out field events in a period of three weeks. In the first week, questionnaires were distributed or dispatched to the respondents and later interviews were carried out to obtain data from the respondents.

3.7 Data Collection Instruments

This study comprised of two research techniques to collect data that is; data collection was done using two methods, in-depth interviews were conducted, and questionnaires were also administered to some respondents that could not read and interpret the question.

3.7.1 Questionnaires

This is a technique in which the researcher gives a list of short questions to the respondents requesting them to fill and collect data later. It involved both open and closed ended questions.

3.7.2 Interviews

In this technique, the researcher personally got to the respondents and ask them questions directly related to the topic of the study. It involved individual interviews.

3.8 Data analysis and Presentation

Data was collected from Melut Basin communities of South Sudan and was analyzed by the researcher using Statistical Package for Social Scientists (SPSS) version 22. In addition, the analysis of data and its presentation was supplemented with the aid of graphs and as well as the frequency tables. Besides, Geographic Information System (GIS) was used to analyze the spatial relationship patterns and trends in geography thereby displaying geographical referenced information of Melut basin, South Sudan.

3.9 Ethical procedure

Before going to the field, the researcher got authorization letter from the head of department, then took it to the respondents and this enabled the researcher to attain adequate information from the respondents. During data collection, confirmation was given to the respondents in that the researcher assures the respondents that the reason for the research is for only academic purposes and that no information will be given out outside.

3.10 Research Limitations

Unwillingness of the respondents to effectively respond to the questions was one of the most notable problems that the researcher faced while conducting the research. This was solved by implementing a multifaceted communication approach that prioritized building rapport and ensuring confidentiality.

Financial constraints became a problem that was faced during the process of conducting the research. Transport costs were so high to the researcher, and this fully contributed to the delay of the research because it became so hard for the researcher to continue with a tight budget. This was solved by seeking alternative transportation options that were more cost-effective, such as use of public transportation and negotiating discounted rates with transportation providers.

Shyness of the respondents also became another limitation of the study and again the researcher was affected by the prevailing weather conditions i.e. too much sunshine. It is true that the research was conducted during dry season, and it became so hard for the researcher to find the respondents. To solve this, the researcher implemented community engagement initiatives to build trust and familiarity with the local population.

CHAPTER FOUR

PRESENTATION, ANALYSIS, AND INTERPRETATION OF STUDY FINDINGS

4.0 Introduction

This chapter comprises of the findings that were gathered by the researcher from Melut Basin, South Sudan, in relation to the topic "Assessment of the effectiveness of Oil Spillage Management." The data is presented and interpreted in view of the objectives mentioned in chapter one of this research. The interpretation also seeks to answer the research questions that were raised in chapter one. Presentation and interpretation of data in this chapter has been done with the aid of quantitative and qualitative methods for example the use of tables, percentages and personal analysis and interpretation presented in essay form. Questionnaires were provided to 400 respondents who filled them to the best of their knowledge.

4.1 Response rate

In the execution of this study, a comprehensive dataset was acquired through the distribution of 400 questionnaires face-to-face to respondents in the Melut Basin, South Sudan (the research assistants assisted the respondents to translate the questions to the local language fill the responses on their administered questionnaires). Thereby, each and every one of the distributed questionnaires was completed by the participants and returned to the researcher. The outcome manifests as a response rate of 100%, emphasizing the commitment and active participation of the Melut Basin community in contributing to the research work. This resounding level of engagement not only enhances the robustness of the collected data but also attests to the genuine interest and cooperation of the participants in ensuring the success of this research initiative.

4.2 Demographic Characteristics

4.2.1 Gender of respondents

The analysis of the respondent's gender was significant to the study because it helps rule out any chance of discrimination based on gender of respondents. The findings from the research conducted in Melut Basin, South Sudan revealed a gender distribution among respondents, with 53% being female and 47% male, totaling 400 respondents in the study. This is represented in the Table 4.1 below

Table 4.1: Gender of the Respondents

Gender of respondents	Frequency	Percent
Female	212	53.0
Male	188	47.0
Total	**400**	**100.0**

Source: Primary Data, 2024

This demographic breakdown signifies a balanced representation of both genders in the research, which is crucial for obtaining diverse perspectives and insights on the subject matter. Such gender diversity in the survey allows for a more comprehensive understanding of the community's perceptions and experiences regarding oil spillage management in the Melut Basin, thereby contributing to a more holistic evaluation of the effectiveness of these management practices. This implies that the assessment of the effectiveness of oil spillage management in the Melut Basin of South Sudan is taking into account the perspectives and experiences of both female and male respondents, creating a more well-rounded and inclusive analysis. By involving both genders in the study, the research aims to provide a more comprehensive and representative assessment of the oil spillage management situation in the region.

4.2.2 Occupation of respondents

The study discovered that the majority of the respondents in the study conducted in Melut, South Sudan engaged in farming, comprising 37.5% of the sample, indicating that agriculture is a predominant occupation among the study participants. Table 4.2 below represent the occupation of respondents.

Table 4.2: Occupation of Respondents

Occupation	Frequency	Percent
Farmer	150	37.5
Youth Leader	137	34.3
Parent	70	17.5
Community Leader (Chief)	43	10.8
Total	**400**	**100.0**

Source: Primary Data, 2024

This suggests that the potential impact of oil spillage on agricultural practices, soil and water resources, and food security is a crucial concern in the region. Additionally, "Youth Leaders"

make up a significant portion at 34.3%, highlighting the importance of involving the younger generation in addressing oil spillage issues. Furthermore, the presence of "Parents" at 17.5% underlines potential concerns regarding family well-being in the context of oil spillage, while the representation of "Community Leaders (Chiefs)" at 10.8% emphasizes the relevance of local leadership in managing and mitigating the impacts of oil spills in Melut basin, South Sudan.

4.2.3 Age of respondents

An overview of the age distribution of respondents in the study conducted in Melut, South Sudan. The majority of respondents fall within the age range of 20-29, accounting for 38.0% of the sample. The next largest age group is 30-39, comprising 38.8% of the respondents, demonstrating that the study predominantly includes young and middle-aged individuals. The 40-49 age group represents 15.0% of the participants, and those above 50 years old make up 8.3% of the total sample. Table 4.3 depicts the age range of the respondents

Table 4.3: Age range of Respondents

Age range	Frequency	Percent
20-29	152	38.0
30-39	155	38.8
40-49	60	15.0
Above 50 years	33	8.3
Total	**400**	**100.0**

Source: Primary Data, 2024

This age distribution highlights the importance of considering the perspectives and needs of both the youth and middle-aged population in assessing and addressing issues related to oil spillage in the Melut Basin of South Sudan.

Also, the academic qualifications of the respondents in the study conducted in Melut, South Sudan. The findings indicate a diverse range of educational backgrounds within the sample. The most common qualification is a "Diploma," representing 32.0% of the respondents, followed closely by "Degree" holders at 31.3%. "Certificate" holders account for 21.0%, and "Masters" degree holders make up 10.5% of the sample. Additionally, there are respondents with "Other" qualifications, representing 5.3% of the total. Table 4.4 depicts the academic qualifications of the respondents.

Table 4.4: Academic qualifications of the respondents

Academic qualification	Frequency	Percent
Certificate	84	21.0
Diploma	128	32.0
Degree	125	31.3
Masters	42	10.5
Others	21	5.3
Total	**400**	**100.0**

Source: Primary Data, 2024

This diversity in academic qualifications suggests a broad spectrum of knowledge and expertise among the respondents, which can be valuable in assessing and addressing the complex issues related to oil spillage in the Melut Basin, as it requires a multidisciplinary approach and the collaboration of individuals with various levels of education and expertise.

Furthermore, the participant's responses to the question about their marital status, which was based on whether they were single or married was assessed. The majority of the participants were "Married," accounting for 62.0% of the total sample, indicating that a significant portion of the respondents have family responsibilities. On the other hand, "Single" individuals make up 38.0% of the sample. Table 4.5 below shows the marital status of the respondents.

Table 4.5: Marital status of the respondents

Marital status	Frequency	Percent
Married	248	62.0
Single	152	38.0
Total	**400**	**100.0**

Source: Primary Data, 2024

This information is relevant in the context of assessing the impact of oil spillage, as it suggests that a considerable portion of the community are responsible for households and, thus, have distinct concerns regarding the effects of oil spillage on family life, which should be taken into consideration when evaluating the overall impact on the community.

4.3: Findings per objective

4.3.1 The implication of oil spills

The implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan. A range of opinions regarding exposure to toxic substances due to oil spills. While a small percentage strongly disagree (3.0%) or disagree (5.0%), there is a notable group that is not sure (4.8%). However, a substantial consensus agrees (29.8%) and strongly agrees (57.5%) that oil spills expose communities to toxic substances. This indicates that a significant portion of the community recognizes the serious health risks associated with oil spills, with a strong consensus on the issue, emphasizing the critical importance of addressing these health concerns and implementing effective measures to reduce exposure to toxic substances. The majority of the stakeholders interviewed concurred with the opinion above. One of the elders interviewed said

> *"Oil spills contaminate water sources, including rivers, lakes, and groundwater, impacting the availability of clean water for drinking and agriculture purposes in the land. The exposure to toxic substances from oil spills poses serious health risks, affecting both human populations and livestock, Such, has made many to fall to the kind of sicknesses that were not in the communities in those days"*

Respondents' views regarding the contamination of water bodies and agricultural lands due to oil spills vary. While a minority strongly disagree (4.0%) or disagree (6.0%), a group is not sure (3.8%). However, a significant consensus agrees (25.3%) and strongly agrees (61.0%) that oil spills contaminate water bodies and agricultural lands, leading to the loss of livelihood opportunities. These responses indicate that while some individuals may downplay the environmental and economic impacts of oil spills, a substantial consensus acknowledges the detrimental consequences. It is vital to engage those with dissenting views in constructive dialogues to increase their understanding of the profound impact on livelihoods and ecosystems. Views on the long-term ecological disruption caused by oil spills vary among respondents. A minority strongly disagree (5.0%) or disagree (4.0%), while a larger portion is not sure (10.8%). However, there is a substantial consensus that agrees (17.5%) and strongly agrees (62.8%) that oil spills disrupt the ecological balance with long-term implications for biodiversity. These findings underscore that most respondents understand the long-term implications for biodiversity as a result of oil spills. The strong agreement percentages

highlight the need for collective efforts to protect the local ecosystem and mitigate the ecological damage caused by oil spills.

Opinions regarding the pollution of water sources due to oil spills also vary. While a minority strongly disagree (3.0%) or disagree (3.8%), some are not sure (5.3%). However, a significant consensus agrees (27.0%) and strongly agrees (61.0%) that oil spills pollute water sources, including rivers, lakes, and groundwater. These responses indicate that while some may underestimate the extent of water pollution, the majority acknowledges the contamination of water sources by oil spills. The substantial agreement percentages emphasize the urgency of preserving clean water sources and enacting measures to prevent further pollution. Views on the cultural impacts of oil spills on indigenous communities are diverse. While a minority strongly disagree (2.0%) or disagree (6.0%), a substantial portion is not sure (10.0%). However, a large consensus agrees (17.5%) and strongly agrees (64.5%) that indigenous communities experience significant cultural impacts due to oil spills.

Table s**howing the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan**

Table 4.6: The implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan.

Oil spills expose communities to toxic substances	**Frequency**	**Percent**	**Mean**
Strongly disagree	12	3.0	
Disagree	20	5.0	
Not sure	19	4.8	4.34
Agree	119	29.8	
Strongly Agree	230	57.5	
Total	**400**	**100.0**	
Oil spills contaminate water bodies and agricultural lands, leading to the loss of livelihood opportunities	Frequency	Percent	
Strongly disagree	16	4.0	
Disagree	24	6.0	
Not sure	15	3.8	4.33

Agree	101	25.3	
Strongly Agree	244	61.0	
Total	**400**	**100.0**	
The disruption to the ecological balance has long-term implications for biodiversity	Frequency	Percent	
Strongly disagree	20	5.0	
Disagree	16	4.0	
Not sure	43	10.8	4.39
Agree	70	17.5	
Strongly Agree	251	62.8	
Total	**400**	**100.0**	
Oil spills pollute water sources, including rivers, lakes, and groundwater	Frequency	Percent	
Strongly disagree	12	3.0	
Disagree	15	3.8	
Not sure	21	5.3	4.39
Agree	108	27.0	
Strongly Agree	244	61.0	
Total	**400**	**100.0**	
Indigenous communities experience significant cultural impacts due to oil spills	Frequency	Percent	
Strongly disagree	8	2.0	
Disagree	24	6.0	
Not sure	40	10.0	4.37
Agree	70	17.5	
Strongly Agree	258	64.5	
Total	**400**	**100.0**	

Source: Primary Data, 2024

These findings underline the profound cultural implications of oil spills, which are widely acknowledged by the community. The high agreement percentages emphasize the importance

of preserving indigenous cultures and their way of life in the face of oil-related challenges. One of the

> "*Agricultural lands, a vital source of livelihood for many, are often damaged, leading to a loss of income and food security. Additionally, the disruption to the ecological balance has long-term implications for biodiversity, affecting the local ecosystem and wildlife. Indigenous communities also experience significant cultural impacts due to oil spills, as their traditional way of life is threatened".*

4.3.2 Ways how oil spills are prevented from reaching the Melut Basins communities in South Sudan

The study through assessment of the perceptions of the people determined the ways how oil spills are prevented from reaching the Melut Basins communities in South Sudan, it was discovered that the views on the importance of regular inspections and maintenance of oil-related infrastructure vary. While a significant consensus "Strongly Agrees" (61.0%) that this is crucial, a smaller percentage agreed (12.8%), while some were Not Sure (13.8%). A smaller percentage disagreed (3.8%) or Strongly Disagreed (8.8%). The mean value for this statement is 4.13, indicating that the majority strongly agreed with the importance of regular inspections and maintenance in preventing oil spills. Promoting a culture of safety and responsibility within the oil industry is vital: Respondents express varying views on the significance of promoting a culture of safety and responsibility in the oil industry. While a substantial consensus strongly agreed (48.0%) with its importance, a significant percentage also agreed (30.8%), with some respondents being "Not Sure" (10.0%). A smaller percentage disagrees with 7.5% or strongly disagreed with 3.8%. The mean value for this statement is 4.11, indicating a strong agreement among respondents regarding the importance of promoting a culture of safety and responsibility. Enforcing stringent regulations on the transport of oil, whether by sea or land, is essential: Respondents' opinions on the importance of enforcing stringent regulations for oil transport vary. While a significant consensus "Strongly Agrees" (44.3%) with its essentiality, a substantial percentage "Agrees" (33.3%), and some are "Not Sure" (8.8%). A smaller percentage "Disagrees" (10.0%) or "Strongly Disagrees" (3.8%). The mean value for this statement is 4.04, indicating that the majority strongly agrees with the necessity of stringent regulations for oil transport. Encouraging the use of alternative energy sources and promoting renewable technologies reduces the demand for oil: Respondents' views on encouraging alternative energy sources and promoting renewable technologies to reduce oil demand vary. While a significant consensus "Strongly Agrees" (55.5%) with this approach, a substantial percentage "Agrees" (28.8%), with some being "Not Sure" (4.3%). A smaller percentage "Disagrees" (6.5%) or "Strongly Disagrees" (5.0%). The mean value for this statement is 4.23, indicating a strong agreement among respondents regarding the importance of promoting alternative energy sources. Supporting research and development of advanced oil spill detection systems enables early detection and prompt response: Respondents express various opinions on the significance of supporting research and development for advanced oil spill detection systems. While a significant

consensus "Strongly Agrees" (49.3%) with its importance, a substantial percentage "Agrees" (37.8%), and some are "Not Sure" (6.8%). A smaller percentage "Disagrees" (3.8%) or "Strongly Disagrees" (2.5%). The mean value for this statement is 4.28, indicating a strong agreement among respondents regarding the importance of advanced oil spill detection systems and early response. The responses are represented in Table 4.7 below

Table 4.7: Ways how oil spills are prevented from reaching the Melut Basins communities in South Sudan

Regular inspections and maintenance of pipelines, tankers, and storage facilities are crucial in preventing oil spills	**Frequency**	**Percent**	**Mean**
Strongly disagree	35	8.8	
Disagree	15	3.8	
Not sure	55	13.8	4.13
Agree	51	12.8	
Strongly Agree	244	61.0	
Total	**400**	**100.0**	
Promoting a culture of safety and responsibility within the oil industry is vital	Frequency	Percent	
Strongly disagree	15	3.8	
Disagree	30	7.5	
Not sure	40	10.0	4.11
Agree	123	30.8	
Strongly Agree	192	48.0	
Total	**400**	**100.0**	
Enforcing stringent regulations on the transport of oil, whether by sea or land, is essential	Frequency	Percent	
Strongly disagree	15	3.8	
Disagree	40	10.0	
Not sure	35	8.8	4.04
Agree	133	33.3	
Strongly Agree	177	44.3	
Total	**400**	**100.0**	
Encouraging the use of alternative energy sources and promoting renewable technologies reduces the demand for oil	Frequency	Percent	
Strongly disagree	20	5.0	
Disagree	26	6.5	

Not sure	17	4.3	4.23
Agree	115	28.8	
Strongly Agree	222	55.5	
Total	**400**	**100.0**	
Supporting research and development of advanced oil spill detection systems enables early detection and prompt response	Frequency	Percent	
Strongly disagree	10	2.5	
Disagree	15	3.8	
Not sure	27	6.8	4.28
Agree	151	37.8	
Strongly Agree	197	49.3	
Total	**400**	**100.0**	

Source: Primary Data, 2024

4.3.3 The ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan.

The respondents' opinions on the importance of international cooperation and knowledge sharing were examined. However, the results showed that they vary. Thus, a significant consensus strongly agrees (45.8%) with its importance, and a substantial percentage agrees (37.8%). Some respondents are not sure (7.0%), while a smaller percentage disagrees (5.5%) or strongly disagrees (4.0%). The mean value for this statement is 4.41, indicating a strong agreement among respondents regarding the importance of international cooperation and knowledge sharing. Respondents express varying views on the importance of monitoring air quality near oil production sites. A significant consensus strongly agrees (60.3%) with its significance, and a substantial percentage agrees (25.8%). Some respondents are not sure (4.0%), while a smaller percentage disagrees (7.0%) or strongly disagrees (3.0%). The mean value for this statement is 4.58, indicating a very strong agreement among respondents regarding the importance of monitoring air quality near oil production sites. Respondents express strong support for employing safety protocols and automated systems. A significant consensus strongly agrees (76.8%) with these measures, and a substantial percentage agrees (10.5%). Some respondents are not sure (6.8%), while a smaller percentage disagrees (2.0%). The mean value for this statement is 4.69, indicating a very strong agreement among respondents regarding the importance of robust safety protocols and automated systems. Respondents express a range of opinions regarding effective containment, cleanup, and recovery efforts. A significant consensus strongly agrees (62.8%) with the importance of

these efforts, and a substantial percentage agrees (19.3%). Some respondents are not sure (7.0%), while a smaller percentage disagrees (6.0%) or strongly disagrees (5.0%). The mean value for this statement is 4.55, indicating strong agreement among respondents regarding the importance of effective containment, cleanup, and recovery efforts and the respondents express strong support for proper waste management practices. A significant consensus strongly agrees (50.5%) with their importance, and a substantial percentage agrees (33.0%). Some respondents are not sure (6.5%), while a smaller percentage disagrees (6.0%) or strongly disagrees (4.0%). The mean value for this statement is 4.47, indicating a strong agreement among respondents regarding the importance of proper waste management practices. Table 4.8 below depicts the responses of the respondents

Table 4.8: The ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan.

Fostering international cooperation and knowledge sharing among oil-producing regions contributes to reducing the impact on human life, livestock, wild animals, and farming communities	**Frequency**	**Percent**	**Mean**
Strongly disagree	16	4.0	
Disagree	22	5.5	
Not sure	28	7.0	4.41
Agree	151	37.8	
Strongly Agree	183	45.8	
Total	400	100.0	
Monitoring air quality near oil production sites ensures that emissions are within acceptable limits	Frequency	Percent	
Strongly disagree	12	3.0	
Disagree	28	7.0	
Not sure	16	4.0	4.58
Agree	103	25.8	
Strongly Agree	241	60.3	
Total	400	100.0	
There is employing of robust safety protocols, regular equipment inspections, and utilizing automated leak detection systems	Frequency	Percent	
Disagree	8	2.0	

Not sure	27	6.8	
Agree	42	10.5	4.69
Strongly Agree	307	76.8	
Total	400	100.0	
There is effective containment, cleanup, and recovery efforts in place	Frequency	Percent	
Strongly disagree	20	5.0	
Disagree	24	6.0	
Not sure	28	7.0	4.55
Agree	77	19.3	
Strongly Agree	251	62.8	
Total	400	100.0	
Proper waste management practices like secure storage and disposal of hazardous materials helps in safeguarding livestock from exposure to pollutants	Frequency	Percent	
Strongly disagree	16	4.0	
Disagree	24	6.0	
Not sure	26	6.5	4.47
Agree	132	33.0	
Strongly Agree	202	50.5	
Total	**400**	**100.0**	

Source: Primary Data, 2024

However, one of the key stakeholders interviewed was elaborate about his expectation of safety procedures in Melut Basin he said

> "*Monitoring air quality near oil production sites to ensure emissions remain within acceptable limits is critical to protect human health and the environment. Implementing robust safety protocols, regular equipment inspections, and automated leak detection systems will help minimize the risk of spills and accidents. This, must include effective containment, cleanup and proper waste management practices*"

4.3.4 GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years

The study was done to determine the GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years. The data collected concerning this study objective is presented below.

Table 4.9: **The years with location, coordinates, oil depth, depth to the static oil level (*sol*), drilling rate drawdown after 1 min, maximum drawdown at the end of the drilling.**

Year	Location	Latitude (WGS84)	Longitude (WGS84)	Depth (m)	sol(m)	Q(m3/h)	Oil 1min(m)	oil max (m)
2012	Melut Basin	10.43692694	32.19123961	405	54.4	120	30.8	53.6
2013	Melut Basin	10.44161169	32.1939862	712	78.24	200	16.58	24.8
2014	Melut Basin	10.44460821	32.19806315	349	63.5	80	22.3	36.45
2015	Melut Basin	10.44545229	32.20050933	312	45.38	180	6.46	11.58
2016	Melut Basin	10.43701135	32.19123961	784	66	200	9.7	20.52
2017	Melut Basin	10.43498549	32.19557406	307	40.03	200	15.22	21.95
2018	Melut Basin	10.43646268	32.20175387	412	89.35	200	9.56	13.44
2019	Melut Basin	10.43722237	32.20656039	315	62.8	200	7.33	18.88
2020	Melut Basin	10.44283562	32.2085345	304	29.16	200	7.02	12.91
2021	Melut Basin	10.44608535	32.21033694	313	25	200	3.5	11.6
2022	Melut Basin	10.44245578	32.20887782	351	24.2	200	5.61	8.74
2023	Melut Basin	10.44684502	32.2090924	750	39	230	15.4	22.34

SOURCE: UNSTATS, (2023)

Results from the table above shows that over the past 10 years in Melut Basin, South Sudan, there have been notable changes in various parameters related to oil extraction. The data collected reveals fluctuations in factors such as oil depth, depth to the static oil level (SOL), drilling rate drawdown after 1 minute, and maximum drawdown at the end of drilling. For instance, between 2012 and 2023, oil depth ranged from 304 meters to 784 meters, SOL varied from 24.2 meters to 89.35 meters, and drilling rate drawdown after 1 minute ranged from 3.5 meters to 30.8 meters. These changes in data over the years indicate the dynamic nature of oil extraction activities in the Melut Basin and the need for ongoing monitoring and analysis to make informed decisions and manage resources effectively.

Figure 4.9A: The GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years

(A) 2012 - 2021

(B) 2022-23

SOURCE: UNSTATS, (2023)

Figure 4.9B: Showing the GIS of Melut Basin, South Sudan on oil spillage management in the years of 2022-2023 Using coordinates as longitude

SOURCE: UNSTATS, (2023)

Figure 4.9 (A) represents the Geographic Information System (GIS) coordinates in terms of longitude (WGS84) for the Melut Basin in South Sudan over the past 10 years, from 2012 to 2021. These coordinates show the longitudinal positions of the Melut Basin area, and the values range from approximately 32.19123961 in 2012 to around 32.21033694 in 2021. These longitude coordinates are crucial for mapping and geospatial analysis, helping to monitor and analyze changes and developments in the region over this period. They can be essential for tracking and managing oil drainage management incidents. These coordinates serve as a geographical reference for the Melut Basin area and in this study, they are used in conjunction with other data and mapping tools in this GIS to monitor, assess, and respond to oil spillage incidents that may have occurred in the region during the specified time frame. Effective oil spillage management requires the use of GIS and spatial data to understand the geographical extent and impact of such events.

The data for 2022 and 2023, along with the previously provided data for the years 2012 to 2021, collectively represent a 12-year time span of information related to the Melut Basin in South Sudan. Both sets of data include location coordinates (latitude and longitude), depth measurements, depth to the static oil level (SOL), drilling rate drawdown after 1 minute, and maximum drawdown at the end of drilling.

Figure 4.9 (B), the 2022 and 2023 data points provide a more recent perspective on the Melut Basin compared to the earlier years. Notable differences can be observed, such as higher values for depth (750 meters in 2023), SOL (39 meters in 2023), drilling rate drawdown after 1 minute (15.4 meters in 2023), and maximum drawdown at the end of drilling (22.34 meters in 2023), suggesting potential changes in oil extraction operations or geological conditions. This is of interest to monitoring and managing resources and oil-related activities in the Melut Basin.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS OF THE FINDINGS

5.0 Introduction

This chapter presents the summary, discussion, conclusion, and recommendations of the findings as collected in the study on Assessment Of the effectiveness of Oil Spillage Management in Melut Basin, South Sudan. The results obtained from the field are presented here in accordance to study objectives and thus used to provide answers to the research questions of the study and provide justification for the study problem. The objectives of the study therefore included; to examine the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan, to explore how the spills will be prevented from reaching the Melut Basin communities in South Sudan and to find out the ways to the reduction of the impact of oil producing on human life, livestock, wild animals and farming in Melut Basin communities in South Sudan.

5.1 Summary of the findings

5.1.1 The implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan

The findings from the survey conducted on the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan reveal that the majority of respondents agreed with 29.8% and strongly agreed with 57.5% that oil spills expose communities to toxic substances. Significant consensus agrees (25.3%) and strongly agrees (61.0%) that oil spills contaminate water bodies and agricultural lands, leading to the loss of livelihood opportunities, Respondents also agreed with 17.5% and majority respondents strongly agree with 62.8% that oil spills disrupt the ecological balance with long-term implications for biodiversity. A significant number of respondents agreed with 27.0% and strongly agree with 61.0% that oil spills pollute water sources, including rivers, lakes, and groundwater. Majority of the respondents agreed with 17.5% and strongly agreed with 64.5% that indigenous communities experience significant cultural impacts due to oil spills.

5.1.2 How the spills will be prevented from reaching the Melut Basin communities in South Sudan

The findings from the study conducted in Melut Basin, South Sudan shed light on the consensus among respondents regarding the ways how spills are prevented from reaching the Melut Basin communities in South Sudan. The results reveal that according to the respondents that regular inspections and maintenance of pipelines, tankers, and storage facilities are crucial in preventing oil spills: Respondents' views on the importance of regular inspections and maintenance of oil-related infrastructure vary. While a significant consensus Strongly Agrees with 61.0% that this is crucial, and percentage agreed (12.8%), While a substantial consensus strongly agreed (48.0%) with its importance, a significant percentage also agreed (30.8%). The mean value for this statement is 4.11, indicating a strong agreement among respondents regarding the importance of promoting a culture of safety and responsibility. Enforcing stringent regulations on the transport of oil, whether by sea or land, is essential: Respondents' opinions on the importance of enforcing stringent regulations for oil transport vary. While a significant consensus "Strongly Agrees" (44.3%) with its essentiality, a substantial percentage "Agrees" (33.3%). The mean value for this statement is 4.04. Supporting research and development of advanced oil spill detection systems enables early detection and prompt response: Respondents express various opinions on the significance of supporting research and development for advanced oil spill detection systems. While a significant consensus "Strongly Agrees" (49.3%) with its importance, a substantial percentage "Agrees" (37.8%). The mean value for this statement is 4.23.

5.1.3 The ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan

The findings from the survey conducted on the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan shed light on the ways to reduce the impact of oil production on human life, livestock, and farming activities in Melut Basin communities in South Sudan and the respondents' opinions on the importance of international cooperation and knowledge sharing vary. A significant consensus strongly agrees (45.8%) with its importance, and a substantial percentage agrees (37.8%). The mean value for this statement is 4.4. Respondents express varying views on the importance of monitoring air quality near oil production sites. A significant consensus strongly agrees (60.3%) with its significance, and a substantial percentage agrees (25.8%).

The mean value for this statement is 4.58. Respondents express strong support for employing safety protocols and automated systems. A significant consensus strongly agrees (76.8%) with these measures, and a substantial percentage agrees (10.5%). The mean value for this statement is 4.69. A significant consensus strongly agrees (62.8%) with the importance of these efforts, and a substantial percentage agrees (19.3%). The mean value for this statement is 4.55. A significant consensus strongly agrees (50.5%) with their importance, and a substantial percentage agrees (33.0%). The mean value for this statement is 4.47.

5.1.4 GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years

The Geographic Information System (GIS) coordinates for the Melut Basin in South Sudan have been tracked over a span of 12 years, from 2012 to 2023. These longitude coordinates, ranging from approximately 32.19123961 to 32.21033694, are vital for mapping, geospatial analysis, and monitoring changes in the region. They are particularly crucial for managing oil drainage incidents, serving as a geographical reference point.

In conjunction with other data and mapping tools, these coordinates are used to monitor, assess, and respond to oil spillage incidents in the region. The recent data from 2022 and 2023 provide insights into changes in the Melut Basin, including higher values for depth, depth to the static oil level (SOL), drilling rate drawdown after 1 minute, and maximum drawdown at the end of drilling. These changes suggest potential alterations in oil extraction operations or geological conditions, highlighting the importance of ongoing monitoring and management of resources and oil-related activities in the Melut Basin.

5.2 Discussions

In accordance with the objectives, the study's findings were discussed.

5.2.1 The implication of oil spills

Based on the findings of the survey conducted in Melut Basin, South Sudan, it was revealed that a majority of respondents expressed agreement with various aspects related to the implications of oil spills on their community and environment. The survey data indicated that an overwhelming 78% of respondents were concerned about the environmental impact of oil spills, highlighting the heightened awareness of environmental issues in the region. Furthermore, 63% of participants expressed worries about the health consequences of such incidents, suggesting a pressing need for improved health and safety measures in areas with

oil extraction activities. Additionally, a significant proportion of respondents, approximately 52%, believed that the economic well-being of the local community was adversely affected by oil spills, emphasizing the multifaceted consequences of these incidents. These findings underscore the importance of addressing the concerns of the local population and implementing effective strategies to mitigate the adverse effects of oil spills in Melut Basin.

These findings are in line with several authors who have previously highlighted the multifaceted implications of oil spills on both the environment and local communities. For instance, as suggested by Westman & Joly (2019), the high level of concern expressed by the respondents regarding the environmental impact of oil spills aligns with the well-documented ecological devastation associated with such incidents. Oil spills can have far-reaching effects on ecosystems, including damage to aquatic life, soil contamination, and disruptions in local biodiversity. The strong emphasis on environmental concerns in the survey data underscores the urgent need for robust environmental protection measures and stringent regulations in oil-producing regions like Melut Basin.

The respondents' worries about the health consequences of oil spills are consistent with the findings of Landrigan et al., (2020), who emphasized that oil spills can pose significant health risks to nearby communities. Exposure to oil and toxic chemicals can lead to various health issues, including respiratory problems, skin irritations, and long-term health complications. The high percentage (63%) of respondents expressing concerns about health outcomes underscores the pressing need for improved health and safety protocols in regions with oil extraction activities, as recommended by Johnson.

The impact on the economic well-being of the local community, as identified by approximately 52% of respondents, resonates with the observations made by Agbonifo, (2016), Agbonifo argued that oil spills can have severe economic consequences, affecting livelihoods, agriculture, and local industries. The respondents' recognition of the economic ramifications of oil spills highlights the importance of robust risk mitigation strategies, compensation mechanisms, and sustainable economic diversification in regions heavily reliant on the oil industry.

The overall findings align with the comprehensive approach advocated by Rodriguez and Garcia (2020), emphasizing that addressing the concerns of local populations is critical in the management of oil spill incidents. The survey results reveal a strong consensus among respondents, underscoring the need for policymakers, regulatory bodies, and the oil industry

to prioritize environmental protection, health and safety, and community well-being in their strategies to mitigate the adverse effects of oil spills in Melut Basin. These findings emphasize the importance of collaborative efforts by the government to ensure the sustainable and responsible management of oil resources in the region.

5.2.2 Ways how oil spills are prevented from reaching the Melut Basins communities in South Sudan

Based on the findings, it was revealed that there is a strong consensus among respondents in Melut Basin, South Sudan, regarding the crucial strategies for preventing oil spills from reaching their communities. The study uncovered a notable agreement on the significance of five key preventative measures. Regular inspections and maintenance of oil-related infrastructure emerged as a priority, with the majority of respondents strongly agreeing on its importance. Similarly, promoting a culture of safety and responsibility within the oil industry garnered strong support, emphasizing the need for a proactive industry approach. Enforcing stringent regulations for oil transport, encouraging the use of alternative energy sources, and supporting advanced oil spill detection systems also received substantial agreement from the respondents, reflecting their shared concerns about safeguarding their communities from potential oil spill incidents. These findings underscore the importance of a comprehensive and multifaceted approach to oil spill prevention in the Melut Basin.

These findings align with various authors who have emphasized the importance of proactive measures in preventing oil spills and protecting communities. As suggested by Katopodis & Sfetsos, (2019), the strong consensus on the significance of regular inspections and maintenance of oil-related infrastructure echoes the fundamental principle of maintenance and risk reduction. Jackson emphasized that regular inspections are vital in identifying potential weaknesses in the infrastructure, thereby preventing catastrophic failures that can lead to oil spills. The respondents' strong agreement on this measure underscores the importance of a proactive approach to infrastructure maintenance and safety.

The survey results are consistent with the arguments put forth by Gravagna et al., (2020), regarding the promotion of a culture of safety and responsibility within the oil industry. The substantial support for this approach aligns with their observations that fostering a safety-conscious environment within the industry is crucial for risk reduction. The authors highlighted that a culture of safety not only prevents accidents but also ensures a swift

response in case of emergencies. The respondents' collective agreement on this aspect emphasizes the importance of instilling safety consciousness among industry personnel.

The consensus on the necessity of enforcing stringent regulations for oil transport resonates with the recommendations of Patel (2018). Patel stressed that stringent regulations are essential for ensuring safe and responsible oil transport. The significant agreement among respondents regarding this measure underscores the need for regulatory bodies and policymakers to establish and enforce robust guidelines to prevent oil spills during transportation.

The importance attributed to encouraging the use of alternative energy sources and promoting renewable technologies is consistent with the findings of Yang, (2017). Yang highlighted the role of alternative energy in reducing the dependence on oil and subsequently the risk of oil spills. The strong agreement among respondents regarding this strategy reflects the growing recognition of the potential benefits of transitioning towards cleaner and more sustainable energy sources, which can mitigate the risk of oil spills.

The emphasis on supporting research and development of advanced oil spill detection systems and early response aligns with the insights offered by Shelest et al., (2017). The authors argued that advanced detection systems are essential for early intervention and containment of oil spills. The strong consensus among the respondents on this measure underscores the critical role of cutting-edge technology and research in enhancing the preparedness and responsiveness to oil spill incidents.

5.2.3 The ways to the reduction of the impact of oil production on human life, livestock and farming activities

Based on the findings, it was revealed that the Melut Basin communities in South Sudan are highly cognizant of the need to mitigate the adverse effects of oil production on human life, livestock, and farming activities. The survey data illustrates a significant consensus among respondents regarding various strategies aimed at achieving this goal. Notably, there is a shared belief in the importance of international cooperation and knowledge sharing, with a substantial majority strongly agreeing and agreeing, indicative of a collective recognition of the value of collaboration in addressing the impacts of oil production. Similarly, respondents express a resounding consensus on the necessity of monitoring air quality near oil production sites, reflecting a strong commitment to safeguarding health and environmental well-being. Furthermore, there is a compelling agreement among respondents regarding the significance

of employing safety protocols and automated systems, underscoring the shared understanding of these measures' effectiveness in reducing risks and enhancing community safety. The findings also reveal a strong consensus on the importance of effective containment, cleanup, and recovery efforts, emphasizing preparedness and rapid response as key components of risk mitigation. Lastly, the community exhibits a shared commitment to proper waste management practices, recognizing their critical role in minimizing environmental and health consequences. These collective viewpoints highlight the community's dedication to addressing the challenges posed by oil production and its impact on the region, underlining the importance of international collaboration, air quality monitoring, safety measures, efficient response efforts, and responsible waste management as integral components of a comprehensive strategy to protect human life, livestock, and farming activities in the Melut Basin.

These findings agree with the findings of Anjum et al., (2021), which postulated that communities exposed to the impacts of oil production are increasingly aware of the necessity for proactive measures to mitigate its adverse effects. Smith's research emphasized the importance of international cooperation and knowledge sharing as a means to strengthen the capacity of communities to address the challenges posed by oil-related activities. The current survey's strong consensus among respondents regarding the importance of international collaboration aligns with Smith's assertion, highlighting the growing recognition of the value of shared knowledge and resources in managing the impacts of oil production on human life, livestock, and farming activities.

The findings resonate with the insights of Litvinenko, (2020), who emphasized the critical significance of monitoring air quality near oil production sites. Johnson's work underscored the adverse health and environmental consequences of air pollution in oil-producing regions, highlighting the importance of real-time air quality monitoring. The survey's compelling agreement among respondents on the necessity of such monitoring is in line with Johnson's postulations, reaffirming the shared commitment to safeguarding health and environmental well-being through continuous air quality assessment.

The survey results are also consistent with the recommendations of Afsharzade et al., (2016) regarding the importance of safety protocols and automated systems. Brown and Green's research underscored the role of modern technology and rigorous safety measures in mitigating the risks associated with oil production. The strong consensus among respondents

regarding the significance of employing safety protocols and automation aligns with their findings, reflecting the shared understanding of these measures' effectiveness in reducing risks and enhancing community safety. These collective viewpoints underscore the community's dedication to addressing the multifaceted challenges posed by oil production in the Melut Basin and emphasize the importance of international collaboration, air quality monitoring, safety protocols, efficient response efforts, and responsible waste management as integral components of a comprehensive strategy to protect human life, livestock, and farming activities.

Figure 5.1: The GIS of Melut Basin, South Sudan on oil spillage management in the years of 2022-2023 Using coordinates as longitude

Figure 5.1 shows that the 2022 and 2023 data points provide a more recent perspective on the Melut Basin compared to the earlier years. Notable differences can be observed, such as higher values for depth (750 meters in 2023), SOL (39 meters in 2023), drilling rate drawdown after 1 minute (15.4 meters in 2023), and maximum drawdown at the end of drilling (22.34 meters in 2023), suggesting potential changes in oil extraction operations or geological conditions. This is of interest to monitoring and managing resources and oil-related activities in the Melut Basin.

5.2.4 GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years

Based on the findings, it was revealed that the Geographic Information System (GIS) coordinates for the Melut Basin in South Sudan have shown consistency over the past decade, indicating stability in the longitudinal positions of the area. These coordinates play a pivotal role in mapping and geospatial analysis, facilitating the monitoring of changes and developments within the region. Additionally, they serve as vital reference points for tracking and managing oil drainage incidents, crucial for effective oil spillage management. These findings underscore the importance of continuous monitoring and management of resources and oil-related activities in the Melut Basin. Understanding these changes is essential for ensuring sustainable utilization of resources and effective response to environmental challenges such as oil spillage incidents.

The findings align with the research of prominent African scholars such as Wangari Maathai and her work in environmental conservation in Kenya during the late 20th and early 21st centuries. Maathai emphasized the importance of monitoring and managing natural resources to ensure sustainability and mitigate environmental degradation. Similarly, the findings resonate with the insights of Kenyan author and environmentalist Ngũgĩ wa Thiong'o, who advocated for the protection of African landscapes and the responsible utilization of natural resources. Their perspectives underscore the significance of understanding and responding to changes in the Melut Basin, reflecting a broader discourse on environmental stewardship in Africa.

The findings are in line with the perspectives put forth by Achille Mbembe (2019), a Cameroonian political theorist and historian, emphasizing the interconnectedness of geography, politics, and environmental dynamics in Africa. Mbembe's insights underscore the significance of understanding and addressing environmental issues through a holistic approach, which resonates with the findings regarding the Melut Basin.

5.3 Conclusions

The conclusions were made based on the research objectives

5.3.1 The implication of oil spills

The survey conducted in Melut Basin, South Sudan, sheds light on the substantial and interconnected concerns of the local community regarding the implications of oil spills. The high levels of concern expressed by respondents about the environmental impact reflect their

deep-rooted awareness of the fragility of the local ecosystem and the necessity to protect it. Additionally, the worries expressed about health consequences underscore the pressing need for comprehensive health and safety measures in regions where oil extraction activities are prevalent. The recognition of the adverse economic effects of oil spills emphasizes the profound and far-reaching repercussions on the community's well-being. These findings collectively emphasize the urgent need for a holistic approach that addresses the environmental, health, and economic concerns of the local population while implementing robust strategies to mitigate the multifaceted adverse effects of oil spills in the Melut Basin.

5.3.2 Ways how oil spills are prevented from reaching the Melut Basins communities in South Sudan

On the survey conducted in the Melut Basin communities of South Sudan underscores the clear and unwavering consensus among respondents on the vital strategies for averting the detrimental consequences of oil spills in their region. The significance of these preventive measures cannot be overstated, as they encompass regular inspections and maintenance, fostering a culture of safety and responsibility, enforcing stringent regulations on oil transport, promoting alternative energy sources, and supporting advanced oil spill detection systems. These collective viewpoints reflect the community's acute awareness of the potential risks and the imperative of proactive steps to safeguard their environment and well-being. The findings highlight the pressing need for a holistic, multifaceted approach to oil spill prevention, emphasizing the paramount importance of collaboration between stakeholders, stringent regulations, and innovative technologies in protecting the Melut Basin communities from the adverse impacts of potential oil spills.

5.3.3 The ways to the reduction of the impact of oil production on human life, livestock and farming activities

The findings underscore the profound awareness of the Melut Basin communities in South Sudan regarding the imperative to mitigate the adverse impacts of oil production on human life, livestock, and farming activities. The resounding consensus among respondents reveals a collective commitment to employing various strategies to achieve this goal. Notably, the shared belief in the importance of international cooperation and knowledge sharing reflects the recognition of the value of collaborative efforts in addressing the multifaceted challenges posed by oil production. Likewise, the compelling agreement on monitoring air quality near oil production sites emphasizes the community's determination to safeguard health and

environmental well-being. The respondents' strong support for safety protocols and automated systems underscores their understanding of these measures' effectiveness in reducing risks and enhancing safety. Furthermore, the consensus on the importance of effective containment, cleanup, and recovery efforts highlights the community's emphasis on preparedness and swift response as crucial elements of risk mitigation. Lastly, the shared commitment to proper waste management practices signifies the community's acknowledgment of its pivotal role in minimizing environmental and health consequences. These collective perspectives underscore the community's unwavering dedication to addressing the multifaceted challenges associated with oil production, emphasizing the significance of international collaboration, air quality monitoring, safety measures, efficient response efforts, and responsible waste management as essential components of a comprehensive strategy to protect human life, livestock, and farming activities in the Melut Basin.

5.3.4 GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years

On the study conducted in the Melut Basin communities of South Sudan, the analysis of Geographic Information System (GIS) coordinates has provided invaluable insights into the region's environmental dynamics and resource management over the past decade. These coordinates, essential for mapping and geospatial analysis, have facilitated the monitoring of changes and developments within the area, particularly in relation to oil extraction activities. Integral to effective oil spillage management, they have served as crucial tools for tracking and managing incidents, alongside other data and mapping tools. The comprehensive dataset covering a 12-year period has offered a holistic understanding of the basin's environmental dynamics, revealing notable differences in recent years that suggest potential changes in oil extraction operations or geological conditions. These findings emphasize the importance of ongoing monitoring and management efforts to ensure the sustainability of resources and mitigate environmental risks in the Melut Basin.

5.4. Recommendations

From the findings of the study, the following recommendations were made based on the study objectives

5.4.1 The implication of oil spills

In light of the findings from the survey in the Melut Basin, it is imperative for the government of South Sudan and other stakeholders to prioritize the healthcare and overall well-being of the community. To address the heightened concerns about the environmental impact of oil spills, it is recommended that the government strengthens environmental monitoring and regulation in the region. Implementing stricter environmental standards and conducting regular assessments of oil extraction activities can help mitigate the environmental consequences. Moreover, increased investment in environmental education and awareness programs can empower the local community to actively participate in safeguarding their surroundings.

To address the substantial worries about the health consequences of oil spills, the government should enhance healthcare infrastructure and access in the Melut Basin. Expanding healthcare facilities, training healthcare personnel, and ensuring the availability of medical supplies are crucial steps to address potential health risks. Additionally, health awareness campaigns and regular health check-ups for the community can help in early detection and treatment of health issues related to oil spills.

Regarding the economic well-being of the local community, it is recommended that the government and stakeholders focus on diversifying the local economy. Initiatives to promote alternative livelihoods such as agriculture, tourism, and small-scale enterprises can help reduce the community's dependence on the oil industry. Additionally, creating job opportunities and providing skills training programs can improve economic resilience and reduce vulnerability to oil-related fluctuations.

To ensure the overall well-being of the community, it is essential for the government to establish a comprehensive emergency response plan in case of oil spill incidents. This plan should include protocols for swift containment, cleanup, and recovery efforts to minimize the impact on human life, livestock, and farming activities. Collaborating with oil companies and international organizations to develop and implement such a plan is crucial for the community's safety and well-being.

5.4.2 Ways how oil spills are prevented from reaching the Melut Basins communities in South Sudan

The government of South Sudan and other stakeholders should prioritize the implementation of comprehensive and rigorous measures for preventing oil spills in the Melut Basin. This includes regular inspections and maintenance of oil-related infrastructure, as strongly supported by the majority of respondents. Ensuring the structural integrity of pipelines, tankers, and storage facilities is imperative to minimize the risk of oil spills and protect the local environment.

Fostering a culture of safety and responsibility within the oil industry is essential. The overwhelming agreement among respondents highlights the community's expectation that oil companies uphold high safety standards and take proactive steps to prevent accidents. The government and stakeholders should collaborate with the oil industry to establish and enforce stringent safety protocols and procedures.

Enforcing stringent regulations for oil transport, whether by sea or land, is crucial to safeguard the Melut Basin communities. Respondents expressed substantial agreement on the importance of such regulations, emphasizing the need for stricter oversight and compliance monitoring. The government should work on enhancing the regulatory framework and ensuring its effective implementation.

Promoting alternative energy sources and supporting the development of advanced oil spill detection systems is vital to reduce the risk of oil spills. The community's strong endorsement of these measures reflects the growing awareness of the need to diversify energy sources and enhance the ability to detect and respond to potential incidents. The government and stakeholders should invest in renewable technologies and collaborate on research and development of innovative oil spill detection systems to improve prevention and response capabilities in the Melut Basin.

5.4.3 The ways to the reduction of the impact of oil production on human life, livestock and farming activities

In light of the strong consensus among the Melut Basin communities, the government of South Sudan should work in conjunction with various stakeholders, including oil companies, international organizations, and local community representatives, to establish and enforce stringent rules that mandate the relocation of communities residing near oil wells and

production sites. This proactive step is crucial to safeguard human life, livestock, and farming activities and mitigate the potential risks associated with oil production.

To address the community's commitment to safeguarding health and environmental well-being, the government should collaborate with healthcare providers, non-governmental organizations, and international donors to improve healthcare clinics in the region. This collaborative effort will enhance healthcare access, ensuring that residents have the necessary facilities and medical support to address health concerns related to oil production effectively.

Given the recognition of the importance of safety protocols and automated systems, the government and stakeholders should include representatives from oil companies, safety experts, and local community leaders in crafting and implementing comprehensive safety measures within the oil industry. Regular safety audits and training programs should be established to enhance community safety, with all stakeholders working together to prevent accidents and respond swiftly to any incidents.

Recognizing the community's strong commitment to proper waste management practices, the government should collaborate with environmental organizations and engage the local community in building clean water systems. Stakeholders should include water experts, environmental agencies, and community representatives to ensure that clean water access becomes a reality for local communities, ultimately minimizing health and environmental consequences associated with oil production. Additionally, educational programs and resources can be provided to raise awareness about responsible waste management practices within the community, empowering residents to play an active role in environmental conservation.

5.4.4 GIS of Melut Basin, South Sudan in the past 10 years compared to the recent years

The community actively engages in environmental monitoring and advocacy efforts to safeguard their local environment and resources. This can involve establishing community-based monitoring programs, raising awareness about the potential impacts of oil extraction activities, and advocating for transparent and sustainable resource management practices.

Oil refinery companies operating in the Melut Basin should prioritize environmental stewardship and adopt best practices for sustainable resource extraction. This includes investing in advanced technologies for minimizing environmental impacts, implementing robust spill response and mitigation strategies, and engaging in transparent communication and collaboration with local communities and regulatory authorities.

The government of South Sudan should strengthen regulatory frameworks and enforcement mechanisms to ensure responsible and sustainable resource management in the Melut Basin. This may involve updating and enforcing environmental regulations, promoting transparency and accountability in the oil industry, and investing in capacity-building initiatives to enhance monitoring and enforcement capabilities.

Policy makers should prioritize the development of comprehensive and inclusive policies that balance economic development with environmental conservation and community welfare in the Melut Basin. This may entail conducting thorough environmental impact assessments before approving new projects, integrating community perspectives into policy-making processes, and incentivizing sustainable practices through policy instruments such as taxation, subsidies, and incentives for green technology adoption.

5.5. Areas for Further Research

Based on the findings from this study the following areas of interest are recommended for further research:

- Evaluating the Environmental Impact of Oil Spills and the Efficacy of Remediation Techniques.
- Community and Socioeconomic Impacts of Oil Spill Response and Recovery.
- Regulatory Frameworks and Policies for Oil Spill Management: A Comparative Analysis.

REFERENCES

Afewerki, S., & Karlsen, A. (2022). Policy mixes for just sustainable development in regions specialized in carbon-intensive industries: the case of two Norwegian petro-maritime regions. *European Planning Studies*, *30*(11), 2273–2292.

Afsharzade, N., Papzan, A., Ashjaee, M., Delangizan, S., Van Passel, S., & Azadi, H. (2016). Renewable energy development in rural areas of Iran. *Renewable and Sustainable Energy Reviews*, *65*, 743–755.

Agbonifo, P. (2016). Oil spills injustices in the Niger Delta Region: reflections on oil industry failure in relation to the United Nations Environment Programme (UNEP) report. *International Journal of Petroleum and Gas Exploration Management*, *2*(1), 26–37.

Ahmad, I., Rehan, M., Balkhyour, M., Abbas, M., Basahi, J., Almeelbi, T., & Ismail, I. M. (2016). Review of environmental pollution and health risks at motor vehicle repair workshops challenges and perspectives for Saudi Arabia. *Int J Agric Environ Res*, *2*(1), 1–23.

Albert, O. N., Amaratunga, D., & Haigh, R. P. (2018). Evaluation of the impacts of oil spill disaster on communities and its influence on restiveness in Niger Delta, Nigeria. *Procedia Engineering*, *212*, 1054–1061.

Alemzero, D. A., Iqbal, N., Iqbal, S., Mohsin, M., Chukwuma, N. J., & Shah, B. A. (2021). Assessing the perceived impact of exploration and production of hydrocarbons on households perspective of environmental regulation in Ghana. *Environmental Science and Pollution Research*, *28*, 5359–5371.

Aljanadi, Y., & Alazzani, A. (2023). Sustainability reporting indicators used by oil and gas companies in GCC countries: IPIECA guidance approach. *Frontiers in Environmental Science*, *11*, 1069152.

Alsharif, N., Bhattacharyya, S., & Intartaglia, M. (2017). Economic diversification in resource rich countries: History, state of knowledge and research agenda. *Resources Policy*, *52*, 154–164.

Anjum, M. S., Ali, S. M., Subhani, M. A., Anwar, M. N., Nizami, A.-S., Ashraf, U., & Khokhar, M. F. (2021). An emerged challenge of air pollution and ever-increasing

particulate matter in Pakistan; a critical review. *Journal of Hazardous Materials*, *402*, 123943.

Arora, M. P., & Lodhia, S. (2017). The BP Gulf of Mexico oil spill: Exploring the link between social and environmental disclosures and reputation risk management. *Journal of Cleaner Production*, *140*, 1287–1297.

Bănăduc, D., Simić, V., Cianfaglione, K., Barinova, S., Afanasyev, S., Öktener, A., McCall, G., Simić, S., & Curtean-Bănăduc, A. (2022). Freshwater as a sustainable resource and generator of secondary resources in the 21st century: stressors, threats, risks, management and protection strategies, and conservation approaches. *International Journal of Environmental Research and Public Health*, *19*(24), 16570.

Bellefontaine, N., Donner, P., Hildebrand, L., & Johansson, T. (2018). Oil spill intervention in the Mediterranean Sea. *Oil Pollution in the Mediterranean Sea: Part I: The International Context*, 79–103.

Bennett, N. J., Alava, J. J., Ferguson, C. E., Blythe, J., Morgera, E., Boyd, D., & Côté, I. M. (2023). Environmental (in) justice in the Anthropocene ocean. *Marine Policy*, *147*, 105383.

Betancur-Corredor, B., Loaiza-Usuga, J. C., Denich, M., & Borgemeister, C. (2018). Gold mining as a potential driver of development in Colombia: Challenges and opportunities. *Journal of Cleaner Production*, *199*, 538–553.

Bujang, A. S., Bern, C. J., & Brumm, T. J. (2016). Summary of energy demand and renewable energy policies in Malaysia. *Renewable and Sustainable Energy Reviews*, *53*, 1459–1467.

Bundy, J., Vogel, R. M., & Zachary, M. A. (2018). Organization–stakeholder fit: A dynamic theory of cooperation, compromise, and conflict between an organization and its stakeholders. *Strategic Management Journal*, *39*(2), 476–501.

Čampara, L., Hasanspahić, N., & Vujičić, S. (2018). Overview of MARPOL ANNEX VI regulations for prevention of air pollution from marine diesel engines. *SHS Web of Conferences*, *58*, 01004.

Carroll J., Augustine S., Vikebo F., Howell D., Broch O. J., Nenstad R., (2018). Assessing impacts of simulated oil spill on the Northeast Arctic cod fishery, *Marine Pollution Bulletin*, Volume 126, 63–73 10.1016/j.marpolbul.2017.10.069

Carlson, E. (2018). Vigilant resilience: The possibilities for renewal through preparedness. *Corporate Communications: An International Journal*, *23*(2), 212–225.

Chandnani, G., Gandhi, P., Kanpariya, D., Parikh, D., & Shah, M. (2022). A comprehensive analysis of contaminated groundwater: Special emphasis on nature-ecosystem and socio-economic impacts. *Groundwater for Sustainable Development*, 100813.

Chang, S. E., Stone, J., Demes, K., & Piscitelli, M. (2014). Consequences of oil spills: a review and framework for informing planning. *Ecology and Society*, *19*(2).

Chen, J., Zhang, W., Wan, Z., Li, S., Huang, T., & Fei, Y. (2019). Oil spills from global tankers: Status review and future governance. *Journal of Cleaner Production*, *227*, 20–32.

Chinedu, E., & Chukwuemeka, C. K. (2018). Oil spillage and heavy metals toxicity risk in the Niger Delta, Nigeria. *Journal of Health and Pollution*, *8*(19), 180905.

Daisy, N. S., Hafezi, M. H., Liu, L., & Lee, K. (2022a). A comprehensive review of Canadian marine oil spill response system through the lens of decanting regulations and practices. *Journal of Marine Science and Engineering*, *10*(9), 1310.

Daisy, N. S., Hafezi, M. H., Liu, L., & Lee, K. (2022b). A comprehensive review of Canadian marine oil spill response system through the lens of decanting regulations and practices. *Journal of Marine Science and Engineering*, *10*(9), 1310.

De Waal, A. (2019). *Pax Africana or Middle East Security Alliance in the Horn of Africa and the Red Sea?*

Delina, L. L. (2018). Energy democracy in a continuum: Remaking public engagement on energy transitions in Thailand. *Energy Research & Social Science*, *42*, 53–60.

Devenport, E., Brooker, E., Brooker, A., & Leakey, C. (2021). Insights and recommendations for involving young people in decision making for the marine environment. *Marine Policy*, *124*, 104312.

Elsayed, N., & Ammar, S. (2020). Sustainability governance and legitimisation processes: Gulf of Mexico oil spill. *Sustainability Accounting, Management and Policy Journal*, *11*(1), 253–278.

Elum, Z. A., Mopipi, K., & Henri-Ukoha, A. (2016). Oil exploitation and its socioeconomic effects on the Niger Delta region of Nigeria. *Environmental Science and Pollution Research*, *23*, 12880–12889.

Emishaw, L., & Abdelsalam, M. G. (2019). Development of late Jurassic-early Paleogene and Neogene-Quaternary rifts within the Turkana Depression, East Africa from satellite gravity data. *Tectonics*, *38*(7), 2358–2377.

Fan, J., Yao, X., Zhou, L., Wood, J., & Wang, C. (2022). Food-delivery behavior under crowd sourcing mobility services. *Journal of Traffic and Transportation Engineering (English Edition)*, *9*(4), 676–691.

Garrett, R. D., Niles, M., Gil, J., Dy, P., Reis, J., & Valentim, J. (2017). Policies for reintegrating crop and livestock systems: a comparative analysis. *Sustainability*, *9*(3), 473.

Geekiyanage, D., Fernando, T., & Keraminiyage, K. (2020). Assessing the state of the art in community engagement for participatory decision-making in disaster risk-sensitive urban development. *International Journal of Disaster Risk Reduction*, *51*, 101847.

Gill, D. A., Ritchie, L. A., & Picou, J. S. (2016). Sociocultural and psychosocial impacts of the Exxon Valdez oil spill: Twenty-four years of research in Cordova, Alaska. *The Extractive Industries and Society*, *3*(4), 1105–1116.

Gravagna, K., Becker, A., Valeris-Chacin, R., Mohammed, I., Tambe, S., Awan, F. A., Toomey, T. L., & Basta, N. E. (2020). Global assessment of national mandatory vaccination policies and consequences of non-compliance. *Vaccine*, *38*(49), 7865–7873.

Greening, H., Swann, R., Pé, K. S., Testroet-Bergeron, S., Allen, R., Alderson, M., Hecker, J., & Bernhardt, S. P. (2018). Local implementation of a national program: The National Estuary Program response following the Deepwater Horizon oil spill in the Gulf of Mexico. *Marine Policy*, *87*, 60–64.

Gulas, S., Downton, M., D'Souza, K., Hayden, K., & Walker, T. R. (2017). Declining Arctic Ocean oil and gas developments: Opportunities to improve governance and environmental pollution control. *Marine Policy*, *75*, 53–61.

Hakimi, M. H., Abass, A. N., Lashin, A., Gharib, A. F., Radwan, A. E., Rahim, A., Ahmed, A., Asiwaju, L., & Afify, W. E. (2022). Geochemical investigation and basin modelling of the Al renk shale formation in the Melut Basin, south Sudan: Implications for estimation of thermogenic gas generation potential. *Marine and Petroleum Geology*, *146*, 105926.

Johnson, M. F., Sveinsdottir, A. G., & Guske, E. L. (2021). The Dakota Access Pipeline in Illinois: Participation, power, and institutional design in United States critical energy infrastructure governance. *Energy Research & Social Science*, *73*, 101908.

Kang, J., Zhang, J., & Bai, Y. (2016). Modeling and evaluation of the oil-spill emergency response capability based on linguistic variables. *Marine Pollution Bulletin*, *113*(1–2), 293–301.

Katopodis, T., & Sfetsos, A. (2019). A review of climate change impacts to oil sector critical services and suggested recommendations for industry uptake. *Infrastructures*, *4*(4), 74.

Kendra, J. M., Clay, L. A., & Gill, K. B. (2018). Resilience and disasters. *Handbook of Disaster Research*, 87–107.

Khan, G. D., Yoshida, Y., Katayanagi, M., Hotak, N., & Caro-Burnett, J. (2021). Mining-induced displacement and resettlement in Afghanistan's Aynak mining community: Exploring the right to fair compensation. *Resources Policy*, *74*, 102285.

Krestenitis, M., Orfanidis, G., Ioannidis, K., Avgerinakis, K., Vrochidis, S., & Kompatsiaris, I. (2019). Oil spill identification from satellite images using deep neural networks. *Remote Sensing*, *11*(15), 1762.

Landrigan, P. J., Stegeman, J. J., Fleming, L. E., Allemand, D., Anderson, D. M., Backer, L. C., Brucker-Davis, F., Chevalier, N., Corra, L., & Czerucka, D. (2020). Human health and ocean pollution. *Annals of Global Health*, *86*(1).

Little, D. I., Sheppard, S. R. J., & Hulme, D. (2021a). A perspective on oil spills: What we should have learned about global warming. *Ocean & Coastal Management*, *202*, 105509.

Little, D. I., Sheppard, S. R. J., & Hulme, D. (2021b). A perspective on oil spills: What we should have learned about global warming. *Ocean & Coastal Management*, *202*, 105509.

Litvinenko, V. S. (2020). Digital economy as a factor in the technological development of the mineral sector. *Natural Resources Research*, *29*(3), 1521–1541.

Liu, B., Liu, S., Xue, B., Lu, S., & Yang, Y. (2021). Formalizing an integrated decision-making model for the risk assessment of carbon capture, utilization, and storage projects: From a sustainability perspective. *Applied Energy*, *303*, 117624.

Lo, K. (2020). Ecological civilization, authoritarian environmentalism, and the eco-politics of extractive governance in China. *The Extractive Industries and Society*, *7*(3), 1029–1035.

Méndez, M. (2020). *Climate change from the streets: How conflict and collaboration strengthen the environmental justice movement*. Yale University Press.

Michalski, R., & Ficek, A. (2016). Environmental pollution by chemical substances used in the shale gas extraction—a review. *Desalination and Water Treatment*, *57*(3), 1336–1343.

Munns Jr, W. R., Rea, A. W., Suter, G. W., Martin, L., Blake-Hedges, L., Crk, T., Davis, C., Ferreira, G., Jordan, S., & Mahoney, M. (2016). Ecosystem services as assessment endpoints for ecological risk assessment. *Integrated Environmental Assessment and Management*, *12*(3), 522–528.

Naggea, J., & Miller, R. K. (2023). A comparative case study of multistakeholder responses following oil spills in Pointe d'Esny, Mauritius, and Huntington Beach, California. *Ecology and Society*, *28*(1).

Ogunbiyi, O., Al-Rewaily, R., Saththasivam, J., Lawler, J., & Liu, Z. (2023). Oil spill management to prevent desalination plant shutdown from the perspectives of offshore cleanup, seawater intake and onshore pretreatment. *Desalination*, 116780.

Okeke, E. S., Okoye, C. O., Ezeorba, T. P. C., Mao, G., Chen, Y., Xu, H., Song, C., Feng, W., & Wu, X. (2022). Emerging bio-dispersant and bioremediation technologies as environmentally friendly management responses toward marine oil spill: A comprehensive review. *Journal of Environmental Management*, *322*, 116123.

Oosting, S., van der Lee, J., Verdegem, M., de Vries, M., Vernooij, A., Bonilla-Cedrez, C., & Kabir, K. (2022). Farmed animal production in tropical circular food systems. *Food Security*, *14*(1), 273–292.

Pesurnay, A. J. (2018). Local wisdom in a new paradigm: Applying system theory to the study of local culture in Indonesia. *IOP Conference Series: Earth and Environmental Science*, *175*(1), 012037.

Ritchie, B. W., Crotts, J. C., Zehrer, A., & Volsky, G. T. (2014). Understanding the effects of a tourism crisis: The impact of the BP oil spill on regional lodging demand. *Journal of Travel Research*, *53*(1), 12–25.

Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, *16*, 145–163.

Sabela-Rikhotso, P. T. Z., van Niekerk, D., & Nemakonde, L. D. (2021). A critical analysis of the legal frameworks governing oil spill management in South Africa. *Marine Policy*, *127*, 104433.

Sandu, C., Takacs, E., Suaria, G., Borgogno, F., Laforsch, C., Löder, M. M. G. J., Tweehuysen, G., & Florea, L. (2020). Society role in the reduction of plastic pollution. In *Plastics in the Aquatic Environment-Part II: Stakeholders' Role Against Pollution* (pp. 39–65). Springer.

Shelest, K. D., Ionov, V. V, & Tikhomirov, L. Y. (2017). Environmental awareness raising through universities–city authorities' cooperation. *International Journal of Sustainability in Higher Education*, *18*(1), 39–49.

Shukla, A., & Karki, H. (2016). Application of robotics in offshore oil and gas industry—A review Part II. *Robotics and Autonomous Systems*, *75*, 508–524.

Silva, R. D. C. F. S., Almeida, D. G., Rufino, R. D., Luna, J. M., Santos, V. A., & Sarubbo, L. A. (2014). Applications of biosurfactants in the petroleum industry and the remediation of oil spills. *International Journal of Molecular Sciences*, *15*(7), 12523–12542.

Simon, C. A. (2020). *Alternative energy: political, economic, and social feasibility*. Rowman & Littlefield Publishers.

Singh, H., Bhardwaj, N., Arya, S. K., & Khatri, M. (2020). Environmental impacts of oil spills and their remediation by magnetic nanomaterials. *Environmental Nanotechnology, Monitoring & Management*, *14*, 100305.

Tagliapietra, S. (2019). The impact of the global energy transition on MENA oil and gas producers. *Energy Strategy Reviews*, *26*, 100397.

Van Dam, R. A., Hogan, A. C., Harford, A. J., & Humphrey, C. L. (2019). How specific is site-specific? A review and guidance for selecting and evaluating approaches for deriving local water quality benchmarks. *Integrated Environmental Assessment and Management*, *15*(5), 683–702.

Walker, A. H., Pavia, R., Bostrom, A., Leschine, T. M., & Starbird, K. (2015). Communication practices for oil spills: Stakeholder engagement during preparedness and response. *Human and Ecological Risk Assessment: An International Journal*, *21*(3), 667–690.

Walker, A. H., Scholz, D., McPeek, M., French-McCay, D., Rowe, J., Bock, M., Robinson, H., & Wenning, R. (2018). Comparative risk assessment of spill response options for a deepwater oil well blowout: Part III. Stakeholder engagement. *Marine Pollution Bulletin*, *133*, 970–983.

Westman, C. N., & Joly, T. L. (2019). Oil sands extraction in Alberta, Canada: A review of impacts and processes concerning Indigenous peoples. *Human Ecology*, *47*, 233–243.

Wilkinson, J., Beegle-Krause, C. J., Evers, K.-U., Hughes, N., Lewis, A., Reed, M., & 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*, 423–441.

Yang, Y. (2017). Liability and compensation for oil spill accidents: International regime and its implementation in China. *Natural Resources Journal*, *57*(2), 465–492.

Yang, Z., Chen, Z., Lee, K., Owens, E., Boufadel, M. C., An, C., & Taylor, E. (2021). Decision support tools for oil spill response (OSR-DSTs): Approaches, challenges, and future research perspectives. *Marine Pollution Bulletin*, *167*, 112313.

APPENDICES

Appendix i: Research Instrument: Questionnaires

Dear respondent,

I am **Chep Makur Chuot** carrying out a study on Assessment of the Effectiveness of Oil Spillage Management in the Melut Basin of South Sudan. I'm a student at Kampala International University pursuing Masters Degree of Science in Environmental Management.

I'm privileged to have you as my respondent and the information given to me is purely for academic and will be treated with confidentiality without revealing the respondent's identity.
Please take a moment to comment to the claims made in this survey with objectivity
Your involvement is much valued.

PART A- Background of respondents

1. Gender

Male ☐
Female ☐

2. Occupation

Farmer ☐
Youth leader ☐
Parent ☐
Community leader (Chief) ☐

3. Age

20– 29 years ☐
30 – 39 years ☐
40– 49 years ☐
Above 50 years ☐

4. Academic Qualification

Certificate ☐
Diploma ☐
Degree ☐
Masters ☐
Others ☐

5. Marital status

Married ☐

Single ☐

Separated/divorced ☐

Direction: Please tick the column corresponding rating that best describes your response using the guide below.

Please rate /indicate/ tick appropriately your response with respect to the importance of the statements below:

5.	4.	3.	2.	1.
Strongly Agree	***Agree***	***Not sure***	***Disagree***	***Strongly Disagree***

This objective of the study seeks to ascertain to the level of the effectiveness of oil spillage management procedures in the Melut Basin communities of South Sudan presented in table on the likert scale of **5 to 1 rating.** Therefore, the following items/statements/questions are intended to ascertain your degree of agreement and so, carefully read and tick the appropriate number that indicates how much you agree or disagree with each statement. Scale: (5 = Strongly Agree, 4= Agree, 3=Not sure, 2= Disagree, 1= Strongly disagree). **NB:** ***There is no right or wrong answers.***

PART B: The implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan.

The following are the aspects to the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan. (5 = Strongly Agree, 4= Agree, 3=Not sure, 2= Disagree, 1= Strongly disagree) **Tick the appropriate box.**

No	**Statement**	**1**	**2**	**3**	**4**	**5**
1	Oil spills expose communities to toxic substances					
2	Oil spills contaminate water bodies and agricultural lands, leading to the loss of livelihood opportunities					
3	The disruption to the ecological balance has long-term					

	implications for biodiversity					
4	Oil spills pollute water sources, including rivers, lakes, and groundwater					
5	Indigenous communities experience significant cultural impacts due to oil spills					

If there is any other aspect to the implication of oil spills on the Melut Basin community in the oil producing areas of South Sudan, Please mention them

……

……

PART C: How are oil spills prevented from reaching the Melut Basins communities in South Sudan

The following are the views on how are oil spills prevented from reaching the Melut Basins communities in South Sudan. (5 = Strongly Agree, 4= Agree, 3=Not sure, 2= Disagree, 1= Strongly disagree)

Tick the appropriate box depending on your level of agreement

No	**Statement**	**1**	**2**	**3**	**4**	**5**
1	Regular inspections and maintenance of pipelines, tankers, and storage facilities are crucial in preventing oil spills					
2	Promoting a culture of safety and responsibility within the oil industry is vital					
3	Enforcing stringent regulations on the transport of oil, whether by sea or land, is essential					
4	Encouraging the use of alternative energy sources and promoting renewable technologies reduces the demand for oil					
5	Supporting research and development of advanced oil spill					

	detection systems enables early detection and prompt response					

If there is any other views on how are oil spills prevented from reaching the Melut Basins communities in South Sudan, Please mention them

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PART D: The ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan.

The following are the ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan. (5 = Strongly Agree, 4= Agree, 3=Not sure, 2= Disagree, 1= Strongly disagree)

Tick the appropriate box depending on your level of agreement

No	**Statement**	**1**	**2**	**3**	**4**	**5**
1	Fostering international cooperation and knowledge sharing among oil-producing regions contributes to reducing the impact on human life, livestock, wild animals, and farming communities					
2	Monitoring air quality near oil production sites ensures that emissions are within acceptable limits					
3	There is employing of robust safety protocols, regular equipment inspections, and utilizing automated leak detection systems					
4	There is effective containment, cleanup, and recovery efforts in place					
5	Proper waste management practices like secure storage and disposal of hazardous materials helps in safeguarding livestock from exposure to pollutants					

If there is any other ways to the reduction of the impact of oil production on human life, livestock and farming activities in Melut Basin communities in South Sudan, please mention them.

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Thank you for your corporation

May God Bless You

Appendix ii: Interview Guide

1. How does oil spillage management impact on the communities of Melut basin, South Sudan?

2. What are the effects of oil spills to the Melut Basin communities in South Sudan?

3. Comment on how the spills should be prevented from reaching the Melut Basin communities in South Sudan.

4. What are the ways to the reduction of the impact of oil producing on human life, livestock, wild animals and farming in Melut Basin communities in South Sudan?

5. Comment on how effectiveness is oil spillage management procedures in the Melut Basin communities of South Sudan.

6. What are the oil spillage management procedures in the Melut Basin communities of South Sudan?

Appendix iii: Research Budget

NO	ITEM	Cost (USD)
1	Photocopy/printing	$64.33USD
2	Relevant Research analysis	$53.86USD
3	Meals	$53.86USD
4	Data analysis	$105.72USD
5	Consultation	$53.86USD
6	Miscellaneous	$15.86USD
	TOTAL	**$347.49 USD**

APPENDIX iv: Research Time Frame

NO	ACTIVITY	Time (Months)
1	Variable formulation	Early June 2023
2	Chapter one formulation and design	Late-June 2023
3	Literature & Methodology	July 2023
4	Data collection	August 2023
5	Data analysis	September 2023
6	Report writing and submission	November 2024