

EFFECTS OF LAKE VICTORIA WATER VESSEL ACCIDENTS ON THE SOCIO-
ECONOMIC DEVELOPMENT OF HOUSEHOLDS IN MBITA SUB-COUNTY,
HOMA BAY COUNTY, KENYA.

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A Thesis Submitted in Partial Fulfillment of the Requirement for the Award of Degree of
Master of Science in Disaster Management and Humanitarian Assistance of Masinde
Muliro University of Science and Technology

October, 2023

DECLARATION AND CERTIFICATION

DECLARATION BY THE CANDIDATE

This research thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

Signature.....

Date.....

CDM/G/01-58009/2016

CERTIFICATION BY THE SUPERVISORS

The undersigned certifies that they have read and hereby recommends for acceptance of Masinde Muliro University of Science and Technology a research proposal entitled **“Effects of Lake Victoria Water Vessel Accidents on the Socio-economic Development of households in Mbita sub-county, Homabay County, Kenya.”**

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DEDICATION

I dedicate this research work to my parents- James Maklago and Pamela Maklago for their encouragement, prayers and support. In addition, I would also love to dedicate this thesis to my family- wife Moleen Otunge and two daughters; Mary Faith Uduma and Rhian Amanda Uduma for their unconditional love and support throughout the period

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ABSTRACT

For a long time, in many regions across the world, water vessel accidents have been on the rise hence has disrupted the socio-economic activities of many people. Indeed, a lot of properties and lives have been lost during these unfortunate occurrences. Therefore, this study examined the impact of water vessel accidents on the livelihood of those living in Mbita Sub- County in the Lake Victoria basin of Kenya. The study was guided by the following objectives. To determine the prevalence of Lake Victoria water vessel accidents in Mbita Sub-County, Kenya; to examine the effects of Lake Victoria water vessel accidents on the socio-economic activities of the communities; and to evaluate the effectiveness of measures applied by the community and government agents to mitigate the impacts of water vessel accidents on the socio-economic in Mbita Sub-County, Kenya. The study employed a disaster impact model by Lindell, Wisner and Sustainable Livelihood Framework to analyze the impact of ship and boat accidents on the community's livelihood. Similarly, the research used survey research design in this study. The study used stratified sampling technique to select respondents for the study. The study sampled 384 household heads respondents drawn from all the five wards within Mbita sub-County. The study sampled household heads as main unit of analysis while key informants were drawn from KMA, ministry of interior officers, ministry of fisheries, victims of vessels accidents, and search and rescue team. Data collection tools included questionnaires, Interview guide and document analysis. Data was coded and then entered in the SPSS software and analyzed. The data collected was analyzed using descriptive statistics and quantitative results were presented in graphs, tables, frequencies and percentages. Similarly, qualitative data were cleaned and analyzed in themes. The result shows that for many years, water vessel accidents have been occurring in Lake Victoria. The frequency of the water vessel accidents cannot be determined or predicted; they sometimes occur frequently while at times you can even take three to four years before you hear of an accident in L. Victoria. As a result, the leading causes of these accidents are unfavorable weather conditions, mysterious happenings and lack of experience by sailors to navigate the Lake. According to Pearson, there was a correlation at a 0.01 significant level (2-tailed) between the effects of water vessel accidents and household level of income. Finally, this study revealed that the local community mitigates the impact of water vessel accidents through training, avoiding overloading, and improving the boat nature. The study concluded that water vessel accidents are common in Lake Victoria which mostly involve unpredictable capsizing of boats and rare capsizing waterbus. Water vessel accidents occur as a result of bad weather, mystery, crew errors and poor state of water vessels. The study also concluded that Water vessel accidents have resulted into psychological problems, poverty, social break-ups, hunger and dropping out of school due to inability to pay school fees. Finally, the study concluded that Water vessel accidents have resulted into psychological problems, poverty, social break-ups, hunger and dropping out of school due to inability to pay school fees while slow response during water vessel accidents was cited in addition to the government not offering any help

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ABBREVIATIONS AND ACRONYMS

BMUs	Beach Management Unit
FBOs	Faith-Based Organizations
FGDs	Focus Group Discussions
KMA	Kenya Maritime Authority
KMD	Kenya Meteorological Department
LVBC	Lake Victoria Basin Commission
NACOSTI	National Commission for Science Technology and Innovation
NGOs	Non-governmental Organizations
SAR	Search and Rescue
SDG	Sustainable Development Goal
SPSS	Statistical Package for Social Sciences
UNMA	Uganda National Meteorological Agency

OPERATIONAL DEFINITION OF SIGNIFICANT TERMS

Drowning: Refers to death caused by being underwater and not being able to breathe

E-navigation: Refers to harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment

Fisherfolks: Refers to people who engage and benefit directly from fishing in Lake Victoria. (Those who take part in the fishing activity as a livelihood occupation process and sell fish).

Households: Refers to persons living in and outside the same house in Mbita sub-county who share, contribute, or depend on its resources.

Livelihoods: Refers to socio-economic activities that people engage into for their survival during their life time. These livelihood activities sometimes are not similar but depend on the capability of an individual or the group of people.

Water vessel accidents: Refers to sudden or great misfortunes relating to Lake Victoria which in its occurrence causes drowning, injury or death of water vessel occupants, loss of property and water vessel wreckage.

Navigational aids: Refers to any sort of marker which aids the traveler in navigation for example.

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Generally, across the globe some oceans, lakes, seas and rivers have become too dangerous to many users for a long time (Onsongo, 2017). For instance, the Drake Passage which connect Pacific and Atlantic Oceans; the other dangerous places are the Bermuda triangle which is situated in the Atlantic Ocean, Michigan Triangle in Lake Michigan, Dragon's Triangle in the Pacific Ocean, Sargasso Sea in the middle of the North Atlantic Ocean.

More than 90% of international trade is achieved by the movements of seaborne cargoes due to the capability of ships in providing low-cost and efficient transportation (Valentine 2015). The 21st Century Maritime Silk Road (MSR), proposed by China in 2013, is a new type of trade corridor connecting China to the world following newly developed global political and trade patterns. At present, 80% of China's oil imports, 50% of natural gas and 42.6% of other seaborne cargoes' goods are transported through the MSR (Jiang et al. 2018). Clearly, along with the development of the 21st Century MSR, the demand for shipping transportation and international logistics is significantly increased. This increase results in heavier traffic along the corridor, which in return causes higher navigational safety and security concerns. Serious maritime accidents could cause casualties, economic loss, environmental pollution and traffic congestion and further affect trading cost and volume (Zhang et al. 2013). Despite the massive investment to improve the infrastructure

construction and development of the MSR in the past years, we have seen a large number of safety and security accidents occurred along the MSR. On April 22, 2014, a tanker was attacked by pirates in the Straits of Malacca (IMO, 2018).

The Human Factor Analysis and Classification System (HFACS) has been widely applied to enrich accident analysis with respect to human and wider organizational factors (Shappell and Wiegmann, 2012). Examples comprise general analysis (Celik and Cebi, 2009; Chen et al., 2013) and more specific ones, such as of machinery space fires and explosions (Schröder-Hinrichs et al. 2011), ship collisions (Chauvin et al., 2013), and, most recently, assessing the potential impact of unmanned vessels on safety (Wróbel et al., 2017). However, HFACS also rests on the Swiss cheese accident model and is used to label types of errors, problems, or poor decisions made by humans and organizations. However, HFACS remains inadequate for systemic causal analysis (Stringfellow, 2010).

According to Vouker (2014), marine accidents are events occurring in facilities which may potentially lead to injuries, destructions and even loss of lives. It encompasses accident in the sea or at port, quayside or anchorage, dockyards or shipyards etc. It is not necessarily only when the vessel or object involved in accident is sailing or stationary at the point and time of accident (MAIB, 2008). Nigeria is member of the International Maritime Organization (IMO) which is an agency of the United Nations (UN), tasked with the regulation of the safety operations and instrumentation in world maritime industry (Nnadi, 2014). Nigerian inland water ways is about ten thousand kilometers (10,000km) and extensive coast line of about eight hundred and fifty-two kilometers (852km). The

territorial sea is based on the United Nations Convention on the law of the sea of 1982 and extending twelve nautical miles into the open seas, from the shorelines of the country, falling fully within the country's exclusive economic zone (Nze, 2013; Nnadi, 2014). Nigerian coastal regions and internal waters runs extensive oil pipeline networks of over 7000km extending to the shores and numerous oil exploration and exploitation platforms.

This study has looked in the effects of ship and boat accidents on the economic development of the community living around Lake Victoria, Mbita Sub-County, Kenya. The study has given a critical understanding of the impacts of ship and boat accidents on the community's socio-economic; the main causes of these accidents and some of the ways to mitigate the vulnerability to those challenges associated with the occurrence of those accidents. On the other hand, the relevance of this study is to force concerned actors to critically study this phenomenon and provide ways to solve all the problems.

The shipping industry represents more than 90% of world trade in goods and as such is one of the drivers of the world economy (UNCTAD, 2018). The safety of ships at sea is the primary concern of all interested parties, whether carriers, shipper or port authorities. Lack of safety causes loss of life, environmental pollution, damage to cargo and vessels and should be avoided. In the last decade, there have been several catastrophic accidents, such as the sinking of the container ship SS El Faro and the cargo ship Cemfjord with the worst consequences - total loss and death (Hasanspahić, 2021). International Maritime Organisation (IMO) defines maritime accident as “any marine casualty or marine incident.

An accident does not include a deliberate act or omission, with the intention to cause harm to the safety of a ship, an individual or the environment”. (IMO, 2008). Accidents are usually caused by a chain of errors, often a combination of various factors (human, technological and meteorological, exceptionally by vis major).

In addition, Onsongo (2017), in Lake Natron in Tanganyika there is a channel where boats and ships have been involved in the mysterious accidents. Similarly, there are numerous boats and ships accidents that have taken place in Lake Victoria. Those accidents have taken place across the three countries that share Lake Victoria that is Kenya, Uganda and Tanzania. Moreover, these accidents have caused devastating effects on the household's income of the communities around.

According to Sumabe (2013), inland water transport just like any other mode of transport possess challenge to the users irrespective of the geographical positions but it is serious in the developing countries than developed which makes those living in developing countries more vulnerable to poverty after the occurrence of the accidents. However, for Hilling (1996) argues that some of the accidents that can be prevented continues to occur in some in water. This leaves many people and their livelihoods in a critical condition. Whenever, a ship or a boat accident occurs, the plight of the victims' family becomes worse, and at the same time they cannot stop using the means because there is option. Many scholars have indicated that in the recent past a lot of water vessel accidents have occurred in Lake Victoria on the Kenyan side. The occurrence has led to the destruction of property and loss of lives.

According to Living with Risk (2006), the number of susceptible to the water vessel

accidents in Lake Victoria annually is very high which is a worrying trend especially in the least developed country where poverty is very high. According to Raymon and Hans (2007), a significant number of those living along water body have their livelihood dependent on the fisheries, with very people have alternative sources of livelihood. All these attributes to the high level of poverty in those areas. Notwithstanding scholars such as Hilling (1999), boats manufactured from low technology and poor policies are the causes of high number of accidents in the least developed countries.

Generally, most of the vessels used in Lake Victoria are predominantly used for fishing, transportation of goods and people, and sand harvesting. On the other hand, landing sites for bigger ships are not many therefore they are not frequently used. Thus, there is a higher number of wooden boats which is used by many people because they are cheaply available and easy to construct. Their availability makes them used for economic activities such as fishing and transportation (Amore *et al.*, 2017). There is not going to be means of transport for those living in the Islands if the wooden boats are not used. This then require the owners to use a hard wood to make a good boat, repair them frequently and even use all the maritime safety precautions to avoid any kind disaster. This would help reduce vulnerability to ship and boat accidents which accounts for a more significant proportion of the 502 deaths per 100,000 drowning fatality rate of the Lake Victoria boat using population (Kabusingye *et al.*, 2016).

Ship and Boat accidents in Lake Victoria have resulted in death and injuries of fishers, high poverty levels, and loss of engines and fishing vessels (Odhiambo, 2013). School drop-out by children to feed their families following the demise of their parents they depended on,

psychological fear of using the lake and leaving behind helpless widows and hopeless orphans.

From the past studies, little assessment has been done on the impact of water vessel accidents at the household level, which is most vulnerable. Many researchers only tend to study the general causes of water vessel accidents in Lake Victoria (Kabusingye *et al.*, 2016). The study community's main challenge is that many people live with very many vulnerabilities where main social amenities and other livelihood strategies are minimal or missing therefore, subjecting people solely to fishing or lake transportation businesses. On a worse note, the profitability of these livelihood strategies is affected by the frequent occurrence of water vessel accidents in the area, which mostly has severe long-term impacts. Upon their occurrences, there is very little or no livelihood support initiative to the community from responsible institutions and agencies.

Research studies should transcend above the actual causes of water vessel accidents as a catastrophe that has a considerable potential of disrupting communities' household livelihoods. Studying intervention measures and susceptibility at the household level is very critical as households respond uniquely to water vessel accidents they experienced (Sumabe, 2013).

Regarding Lake Victoria water vessel accidents, this study focused on households who have lost valuable property or close members who contributed helpfully to the household's economy or whose members have ever experienced life-threatening emergencies in the lake. In addition, the study examined households who have lost meaningful properties

through maritime accidents if only such losses have significant devastating impacts on the economy of households. In pursuit of accurate information and for easy analysis of household livelihood examination, this study organized households into two main groups based on their level properties before suffering from a water vessel accident and after its occurrence. Against this background, this study investigated the effects of Lake Victoria ship and boat accidents on the socio-economic livelihood of households in the Mbita (Suba- North) sub-county.

1.2 Statement of the Problem

The Fisheries Management in February 2001 showed that Kenya's portion of Lake Victoria covers about 6% (4,080km²) of the total lake area and contains over 200 landing beaches and over 6,000 artisanal fishing crafts distributed with the highest number being in Mbita sub-county waters (Raymond, 2012).

At the moment, Lake Victoria's safety levels and standards have sunk to the lowest. There have been recurrent fatalities and casualties reported in Lake Victoria every time, which have greatly affected the lakeside communities, especially the fisher folks and other lake users. In 2010, Lake Victoria Basin Commission (LVBC) reported that about 5000 lives are lost in this lake every year, making it the most disastrous lake globally (Raymond, 2012). These deaths are spread across all three countries of Uganda, Tanzania and Kenya who share this lake. In the Kenya portion, these water vessel accidents have caused many losses of lives, casualties, poor health, poverty, hunger and malnutrition, destruction of the environment, loss of livelihoods, disruption of education, and even displacement of several community members in some cases.

Past studies on maritime incidents have focused on both safety and security risks, such as acts of piracy (Pristrom et al. 2013; Yang et al. 2013), ship hijackings (Pristrom et al. 2016), collisions (Wu et al. 2019), groundings (Uğurlu et al. 2016), and contacts, among others (Mullai and Paulsson 2011). The geographical regions explored concerning maritime incidents include the Western and Eastern Indian Ocean (Pristrom et al. 2016), Arctic waters (Baksh et al. 2018), Norwegian waters (Størkersen 2017), the Baltic Sea and Gulf of Finland (Mullai and Paulsson 2011), Greece (Nævestad et al. 2019), the UK (Akhtar and Utne 2014), the Turkish Straits (Uğurlu et al. 2016), and the Yangtze River in China (Zhang et al. 2013; Wu et al. 2015; Wang et al. 2019). Over the past five decades, reliable evaluations of maritime incidents at sea, in navigable waters, and at ports have been conducted (Luo and Shin 2016). The primary factors leading to maritime incidents generally include environmental influences, human behavior, vessel conditions, or a combination of these elements (Luo and Shin 2016; Wu et al. 2017; Wang et al. 2018). In the investigation of environmental influences, previous research has highlighted the natural or oceanographic surroundings as a significant factor impacting maritime incidents. Environmental variables (such as visibility, wind, light, sea conditions, and precipitation) and the timing of an incident are recorded upon its occurrence (Mullai and Paulsson 2011). Raiyan et al. (2017) used an event tree analysis combined with quantitative methods to assess how a single factor can lead to an accident, whether alone or in conjunction with others; their results showed that the probability of avoiding an accident was heavily influenced by visibility in both good and bad weather conditions. However, none of these studies focused on the effects of water vessels accidents on socio-economic development

thus knowledge gap. Also, most studies were conducted outside Kenya specifically, Mbita Sub County, area of the study, hence geographical gap.

Recent studies related to maritime collision incidents mainly focus on commercial ships (Puisa et al., 2018; Graziano et al., 2016; Antão et al., 2023; Wu et al., 2018). There is still a lack of research regarding accidents involving fishing vessels. There is an increasing fatality rate of 502 deaths per 100,000 population in Lake Victoria boat using the local community (Kabusingye *et al.*, 2016). More than half of the drowning events are reported during transportation across the lake and others during fishing activities. Kabusingye *et al.* (2016) attribute the water vessel accidents to factors such as unfavorable weather conditions, carrying the over-capacity, and the state of the boats frequently used in the lake. Disaster managers are presently forecasting a high rise in water vessel accidents involving ships in the Lake Victoria Kenyan portion in the future as a dredging machine that should dig an 80-meter-wide canal and 63 kilometres long from Kisumu to Mbita. To make it possible for bigger ships to access Lake Victoria was launched. Kevin Omollo reported in dailies, Standard newspaper, that Raila Odinga, the AU Infrastructure envoy launched the dredger meant to clean up the Lake Victoria water hyacinth and dig the canal that intends to make the water deeper.

The digging of the canal, once complete, might claim up more lives in the future for the significant number of lake navigators expected to use it. Yet, it remains unsafe like the other Lake Victoria transport channels (Omollo 2019, standard newspaper, Thursday, 19, January 2019). Covering nearly 70,000 square kilometers, Lake Victoria stands as Africa's

largest freshwater lake, extending across three nations and providing livelihoods for over 200,000 fishers. Most of these fishers operate from small vessels, which may not hold up well during severe storms.

The risk of drowning is already significant for these fishers, with up to 1,500 fatalities occurring on Lake Victoria each year, and around 1,000 of those deaths happening in adverse weather conditions. The research identified 141 drowning incidents among fishers across 43 landing sites in Mbita. Our findings indicate that the majority of drowning victims were males under the age of 40. Adverse weather elements, such as turbulent waters, strong winds, and heavy rainfall, were reported as the cause of 42% of the recent drowning incidents among fishers. While the boats were generally well-maintained, boat owners seldom provided navigation tools and life jackets, even though Kenyan laws mandate their use. This lack of safety gear contributed to the high drowning rates; 69% of the fishers who perished in storms were not wearing life jackets. a(Rasolofoson and Fiorella, 2023). These high rates of statistics and effects prompted the need to conduct this current study.

The economic performance of this sub-sector has consistently been weak and below anticipated levels due to marine hazards. This scenario incurs both economic and financial costs, which subsequently restricts the maritime transport sub-sector's potential contribution to Kenya's national output (GDP) (Nwokedi et al., 2014). Nwokoro and Nwokedi (2015) affirm that the failure to implement strategies for managing existing hazards has simultaneously jeopardized the maritime industry as a whole.

Lake Victoria would be a wonderful and busy place with much potential without these recurrent water vessel accidents on the navigators and lake users. It would be preferable for recreation, fishing, tourism, and the most preferred medium of transport in the Lake Victoria basin. However, unexpected abrupt attacks by wild animals inhabiting the lake, bad weather, and unmanageable capsizing of water transport vessels have all made it catastrophic. Lake Victoria water vessel accidents arising from harsh weather and unfavorable climate variability have directly impacted fisher folk's socio-economic livelihood. Against this backdrop, the study sought to investigate the effects of Lake Victoria water vessel accidents on the socio-economic livelihoods of households in Mbita Sub- County, Kenya.

1.3 Research Objectives

The general objective of this study was to examine the effects of Lake Victoria water vessel accidents on the socio-economic development of households in Mbita sub-county, Homabay County, Kenya.

1.3.1 Specific Objectives

Following are the specific objectives for this study:

- i. To determine the prevalence of Lake Victoria water vessel accidents in Mbita Sub-County, Kenya.
- ii. To examine the effects of Lake Victoria water vessel accidents on the socio-economic activities of households in Mbita Sub-County, Kenya.
- iii. To evaluate intervention measures being applied by residents and government agents to mitigate the socio-economic effects of water vessel accidents in Mbita

Sub-County, Kenya.

1.4 Research Questions

The study was guided by the following questions:

- i. What is the prevalence of Lake Victoria water vessel accidents in Mbita Sub-County, Kenya?
- ii. What are the effects of Lake Victoria water vessel accidents on the socio-economic development of households in Mbita Sub-County, Kenya?
- iii. What are the intervention measures being applied by residents and government agents to mitigate the socio-economic effects of water vessel accidents in Mbita Sub-County, Kenya.

1.5 Justification of the Study

Water vessel accidents have been on the rise in Lake Victoria's water, and many such incidents have gone unreported, unnoticed, and ignored. Of late, KMA and LVEF have tried implementing some assumed measures to bring about safety in Lake Victoria navigation. However, so far, there have been devastating socio-economic development raised by households on the effects of water vessel accidents in the Mbita sub-county. Below is provided both the academic and policy justification of the study.

1.5.1 Academic Justification

Areas around Lake Victoria- Kenya are mainly inhabited by small-scale fishery communities. It is generally rocky surface and dry area, which makes it unsuitable for agricultural activities for instance domestic animal rearing and farming. Fishing

expedition and transportation of commuters across Lake Victoria remain the most predominant economic activity. Literature from Odhiambo (2013) suggests that bad weather in Lake Victoria causes water vessel accidents that directly negatively impact the fisher folks involved.

In addition, it is projected that the work output will act as crucial inputs in designing sustainable mitigation measures to minimize Lake Victoria water vessel accidents and all their associated risks on livelihoods. Hence, it would contribute directly to the existing studies. Responding to the impacts of water vessel accidents on households requires a combined effort, which cuts across the disciplines and integrated response and community participation of those affected directly or indirectly. Knowledge of how households' livelihoods are affected is essential in addressing the problem of water vessel accidents while also indicating potentials for mitigation and healthy adaptation strategies.

Therefore, this study has offered contemporary insight on the assessment and estimation of the impacts of the Lake Victoria water vessel accident phenomenon on the Kenyan community's socio-economic development of households. It aims at providing new knowledge about the maritime phenomenon and how it can be mitigated, which has never been studied in the past. This study's findings may also be beneficial to academicians, politicians and administrators and stakeholders in understanding the effect of Lake Victoria water vessel accidents on the socio-economic development of households.

1.5.2 Policy Justification

The safety of Lake Victoria has been affected by many boats and ship accidents that have prompted the formation of KMA and LVBC by the Kenyan government and East African Community, respectively, to mitigate the socio-economic effects. According to Sumabe (2013), interventions to mitigate the impacts of boating accidents should target emergency response and address long- term development, such as putting trans-formative policies that govern navigation and assistance. Therefore, the findings of this study may assist policymakers in drafting, amending, and enforcing laws governing Lake Victoria safety navigation interventions and operations.

The study is very significant because it assessed and estimated the effects of water vessel accidents on the Kenyan community's socio-economic development. It revealed the dangers posed to Kenyan households by the Lake Victoria water vessel accidents that may need to be addressed by the government, Non-Governmental Organizations, policymakers, and the entire community and has proposed the significance of employing other sources of income. The methods by which people and communities react to weather and climate changes can also provide a critical understanding of how households that would be affected in the future might adapt and cope with the effects of weather and climate changes.

It is unbelievable that despite the increasing numbers and magnitude of water vessel accidents in the recent past, there is no impact assessment study on households' social and economic development has been undertaken in Lake Victoria. This has led to the absence of comprehensive data and information on water vessel accidents, resulting in ad-hoc responses during emergencies that are just but short-term. Additionally, this study has

attempted to develop recommendations and mitigation measures helpful in strengthening community resilience to the impacts of water vessel accidents.

1.6 Scope of the Study

The study was conducted in Mbita Sub County. The general objective of the study was to examine the effects of Lake Victoria water vessel accidents on the socio-economic development of households in Mbita sub-county, Homabay County, Kenya. The study was anchored on three specific objectives. The study was anchored on conceptual framework based on two models. The study adopted descriptive research design while the main unit of analysis was household heads. The main unit of analysis was household heads. Key respondents were sampled from person involved in the fishing industry, including fishers, fish traders (both men and women), security personnel such as chiefs, police officers, and County commandants, as well as fisheries officers, meteorological officers and beach managers. The study used purposive, simple random and snowball sampling techniques. Data was collected through use of interview guides, questionnaires, FGDs and Observation checklist. Both quantitative and qualitative data were analyzed descriptively and thematically respectively. Doing so was necessary for an in-depth analysis of water vessel accidents; the study considered the period between 1980 -2019. In this work, from 1980 provides an overview of over a thousand maritime casualty reports which have been reviewed in order to fully investigate and assess selected 213 marine accidents concerning the collision, grounding, and hull failure of ships, which occurred during the time period of 1980–2019, worldwide. The study ended 2019 as being the recent year of accident as per when the current study was being carried out. The study was carried out from September-December 2021.

1.7 Summary of Knowledge Gaps

Effects of Lake Victoria water vessel accidents study topic has received few attention before especially in Mbita Sub County where the focus of the study was. The most notable researchers in this field were (Kobusingye *et al.*, 2016), who, in their research survey finding of drowning among the lakeside fishing communities in Uganda, had many gaps in the literature review. As opposed to the qualitative research design was used in this study, Kobusingye *et al.* (2016) used a mixed-method cross-sectional study. This study also used a different locale, and sample size from that was never considered (Kobusingye *et al.*, 2016).

1.8 Chapter Summary

The chapter has presented into detailed background of the study; Statement of the problem; objectives of the study; research questions; significance and justification of the study, and the scope of the study. The next chapter discussed literature review.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter provides a brief history of some of the notable water vessel accidents, the literature on the study's objectives by identifying water vessel accidents. Their prevalence in Lake Victoria, examining effects of water vessel accidents, identifying vulnerable greatly affected, and lastly sheds light in evaluating intervention measures being applied by residents and government officers to reduce the socio-economic impacts of water vessel accidents. In addition, this chapter also highlighted the models that guided the study, namely: Disaster Impact Model by Lindell and the Bayesian Network Model of risk. It concluded by conceptual model and chapter summary.

2.1 Histology of Worldwide Notable water vessel accidents

Data relating to water vessel accidents can be traced back to the eighteenth century when HMS Birkenhead, a British ship, grounded in 1852 at South Africa Indian Ocean, resulting in 365 Casualties (Elinder & Erixson, 2012). In 1854, SS Arctic, a US-based ship due to collusion in Canada's North Atlantic Ocean, killed 227 and left 41 survivors. In 1862, SS Golden Gate, another US ship, caught up a fire in Mexico, Pacific Ocean on its six-voyage journey causing 206 casualty cases. Come 1873, the SS North fleet, a British-owned ship, experienced a collision with another ship at the English Channel in the United Kingdom. This disaster resulted in 206 casualties and 172 survivors during nine voyage days (Elinder & Erixson, 2012).

In the same year still, the world observed the RMS Atlantic slowly ground in Canada's

North Atlantic Ocean, leaving 538 casualties after the disaster. For the first time in world history, 1878 saw significant water vessel accidents occur in a river called River Thames in the United Kingdom due to a collision that involved SS Princess Alice that resulted in 697 casualties. Thirty-four years later in 1912, the renowned British-owned RMS Titanic that was termed 'unsinkable' collided with ice in Canada in the North Atlantic Ocean. Up to this moment, this remains the world's worst water vessel accidents that resulted in 1496 casualties and 712 survivors. Come 1915, and another British-owned RMS, Lusitania, sank due to a torpedo attack by a German U-boat at the United Kingdom in the North Atlantic Ocean, resulting in 1190 casualties (Elinder & Erixson, 2012).

In 1996, M/V Bukoba, a Tanzanian-based ferry, capsized in Tanzania's Lake Victoria. The water vessel accidents were caused by unlicensed navigational coxswains that led to the loss of over 500 lives (Nakyonyi, 2011). Nine years later, in 2005, a wagon ferry M/V Kabalegawasen route to Port Bell in Uganda collided with a sister vessel MV/ Kaawa, sailing in the opposite direction towards Mwanza in Tanzania sank southeast of the Ssesse Islands in Uganda's Lake Victoria. After a few months again in 2006, MV Nyamageni, a cargo vessel, left the Port of Bukoba for Mwanza in Tanzania before technicalities broke out and left 28 people dead in Lake Victoria (Nakyonyi, 2011).

More recently, Jason Burke, an editor of the Guardian Magazine, wrote that the MV Nyerere ferry capsized at Ukara Island in Tanzania on 21st September 2018, killing at least 166 passengers. The ferry was old, in poor condition, and had carried more passengers and goods than the required capacity. Humanitarian response during the capsizing was also

poor and delayed, which led to mass casualty incidents.

In Kenya, a 300-capacity ferry MV Mtongwe I, operating at the Mombasa Island to Mtongwe in the Likoni Channel in the Indian Ocean, capsized in 1994 and sank with approximately 400 passengers on board. At least 270 passengers died, and about 70 people aboard survived by swimming ashore or clinging to the few life aids on the ferry (Onsongo, 2017). The research study titled maritime commons also summarizes water vessel accidents worldwide between the years 1982 to 2016 in his research study titled maritime commons. It indicates that on 12th December 2008, a water vessel called B. Spacial capsized in Port Kisumu due to man overboard, killing one person. Later on, Elberon, Kirande, Mzee Adero, and Jerusalem water vessels capsized, leading to the death of seven people in Lake Victoria.

On 18th December 2012, a water vessel named Sara Dayo capsized in River Nyando, one of Lake Victoria's feeder rivers in Kenya, killing five people. Lake Victoria, Kenyan portion worst ever water vessel accidents happened on 1st December 2010 as a water Vessel named O. Nyomogi capsized in the Lake killing nineteen people on board at a go. Other saddening disasters in this Lake include the capsizing of Salome water vessel on 10th October 2010 that killed six people, Nyandiwa beach boat capsizing in 2012, and the 2013 International Medical Corps boats that capsized off Mfangano island due to lack of stability.

2.2 Water vessel accidents and their prevalence

Data-set information of ferry accidents kept by Inter-ferry and the Worldwide Ferry Association spans 232 accidents between 2000 and 2014 (Golden and Weisbrod, 2016). Robert P. (2017), under the Dangerous theme crossing of the Mediterranean Sea, examines the plight of the Europe-bound African migrants, who arrive daily from Ethiopia, Sudan, Nigeria, and the Gambia. Other countries across the sea from Agadez, Niger to the 1500 miles Tripoli in Italy to look for economic opportunities to alleviate the suffering of their families back in Africa.

The Europe-bound African migrants use small boats or rubber rafts to cross the harsh and dangerous Mediterranean Sea. Robert (2017), states that thousands of these migrants die yearly in the sea as about 300 people are jammed into a small boat, usually prone to motor failure and carriage of overweight within the water vessels. Another shocking scenario was when some 300 Europe-bound African migrants drowned in 2015 as an Italian navy sea rescue mission turned fatal. The people who had been initially traveling in a boat drowned near an Italian rescue ship when passengers panicked and tried to get off all at once.

According to Golden and Weisbrod (2016), efforts to monitor water vessel safety in the poor countries are handicapped by incomplete record-keeping in least developed countries and sparse or those accidents are not covered by main media or international news outlets. In most of those reported, media reports of water vessel accidents usually do not capture all the information such as the name of the vessel involved, information on the company or the owners of vessel or other information relating to the causes of the incident. Most surprising is, even the number of occupants of the ships is often not available because overcrowding is

very rampant, disturbingly common, and unrecorded. Robert (2017), under the Dangerous theme crossing of the Mediterranean Sea, examines the plight of the Europe-bound African migrants, who arrive daily from Ethiopia, Sudan, Nigeria, and the Gambia.

Other countries across the sea from Agadez, Niger to the 1500 miles Tripoli in Italy to look for economic opportunities to alleviate the suffering of their families back in Africa. The Europe-bound African migrants use small boats or rubber rafts to cross the harsh and dangerous Mediterranean Sea. Robert P. (2017) states that thousands of these migrants die yearly in the sea as about 300 people are jammed into a small boat, usually prone to motor failure and carriage of overweight within the water vessels.

Another shocking scenario was when some 300 Europe-bound African migrants drowned in 2015 as an Italian navy sea rescue mission turned fatal. The people who had been initially traveling in a boat drowned near an Italian rescue ship when passengers panicked and tried to get off all at once. Nakyonzi (2011) states that transport on Lake Victoria suffers from hazardous events, which reduce its safety standards. In 2010, Lake Victoria Basin Commission (LVBC) also gave the statistics of those who die in Lake Victoria annually to be 5,000 people.

Numerous scholars have examined the accidents that take place in various marine locations due to the majority of maritime accidents having links to specific geographical features. Through a geographical study, Wang et al. (2014) analysed the safety of shipping across the South China Sea and discovered that the environment's hazard level decreased over time from the north to the south. Wang and Yang (2018) highlighted that the kind and area of accidents,

as well as the ship type and age were the key factors impacting the accident severity of maritime transportation in China. Goerlandt et al. (2017) looked at the pattern of the sea ice conditions and atmospheric circumstances of different accident and operation types that occurred during winter nautical incidents in the Northern Baltic Sea between 2007 and 2013. Kum and Sahin (2011) investigated the underlying factors that led to the Arctic maritime accidents from 1993 to 2011 and made recommendations on how to avoid human error in Arctic waterways.

China marine Safety Administration accident report statistics show that, between 2013 and 2022, there were 806 marine accidents in China, with collision accidents accounting for 39.08% of these incidents (Feng et al., 2023). In contrast to the 12th Five-Year Plan period (2011–2015), China's 13th Five-Year Plan period (2016–2020) saw a significant increase of 21.6% in collision accidents between merchant and fishing vessels (CAMF) and a 36.2% increase in fatalities or missing persons related to such incidents, despite a 34.4% decrease in the overall number of maritime traffic accidents and a 25.5% decrease in deaths or missing persons (CMS, 2022).

Collisions between fishing and commerce vessels are also common in waters outside of China. For instance, South Korea and Japan deal with comparable circumstances (KIM et al., 2017; Lee et al., 2013; Shinoda et al., 2012). Additionally, CAMF has steadily grown to be one of the major incidents that the International Maritime Organization (IMO) is concerned about. Currently accessible on the official IMO website (IMO, 2022), the draft "Lessons Learned on Marine Casualties" compiles a total of 38 sample maritime collision accidents over time. Of these, 9 instances, or 24%, were related to CAMF. This suggests that these kinds of mishaps

happen in international waters somewhat frequently.

Laursen et al. (2008) “used inspection status (whether a ship has legal obligation to be inspected) as a significant contributing factor in studying fatal accidents occurring among fishing vessels in Denmark, because vessels of these two statuses presented an opposite trend of fatal accident rate from 1995 to 2005. Other studies of maritime fatal accidents have highlighted the role of human error, such as unsafe practice in towing and mooring operations (Roberts et al. 2014) and look-out failure leading to non-serious incidents (Weng and Li 2019). Eliopoulou et al. (2016) showed that the age of a ship increased the accident rate likelihood. Ship type has been identified as the primary contributing factor in grounding accidents (Youssef and Paik 2018). Ship length and visibility conditions have also been considered as contributing factors to shipping accidents, based on the data derived from Norway, as well as from country of registration data (Bye and Aalberg, 2018). Navigational areas or zones have long been recognised as important contributing factors for shipping accidents (Wu et al. 2015; Ventikos et al. 2017), and their significance was confirmed in a recent study of shipping accidents caused by adverse weather, in which navigational area was identified as the principal contributing factor (Ventikos et al. 2018)”.

Since the 1990s, earth-shaking water vessel accidents have happened with the introduction of modern big carrier water vessels like the capsizing of MV Bukoba and MV Nyangemi. Kobusingye *et al.* (2016), in their community-based survey on drowning among Lake Victoria fishing communities in Uganda, indicated that 38.9% of the fishing communities

had at “least one member of their family in a life-threatening emergency in Lake Victoria waters, which mainly occurred either during fishing or transportation”. “Of those family members involved in identified life-threatening emergencies in the Lake, more than two-thirds of them drowned, equating the drowning fatality rate in the Lake as 502 deaths per every 100,000 population in the Lake's boat using community”.

Onsongo (2017) summarizes water vessel accidents worldwide from 1982 to 2016 in his study titled maritime commons. In the study's histology of water vessel accidents, there are records of the frequent ship and boat water accidents worldwide, with particular emphasis given to Kenya. Most of the Lake Victoria water vessel accidents recorded in the study arose from engine failure, heavyweight crushing, ship wreckage, mechanical problems, ship drifting, man overboard, barrier failure, loss of stability coxswain, and pilot ladder failure.

2.3 Effects of Water vessel accidents on the Socio-economic Well-being of Households

Empirical evidence on the extent of human behavior during water vessel accidents is usually scanty (Frey& Torgler, 2011). However, an assessment of how Titanic ship sinking victims behaved offers a quasi-natural field experiment of other water vessel accidents behaviors under extreme conditions of life and death in the water. During such scenarios, self-interested reactions usually predominate, and social cohesion disappears.

According to (Frey& Torgler, 2011), passengers inside RMS Titanic panicked, tramped on each other, and lost concern for their fellow human beings on the ship. After the subsiding

of panic, passengers turned into looting and exploitation while the community rented with conflict. Psychological problems were also reported among several victims. LÍndal and Stefánsson (2011), in their study of the long-term psychological effect of fatal accidents at sea on survivors, cites the development of extensive Post Traumatic Stress Disorder (PTSD) in the survivors of the water vessel accidents.

According to Hetherington, Flin, and Mearns (2006), maritime operations are exceedingly risky, even with the significant economic rewards that come with commercial shipping. Some of the dangers and hazards that sailors usually confront include exposure to toxic substances, drowning, significant mechanical hazards (crush injuries), minor personal injuries (cuts, bumps, and slips), extreme weather events, fire and explosions, accidents, and groundings (Håvold, 2010). According to Håvold (2010), accidents at sea can have major and expensive consequences, such as destroying the pristine marine environment, losing precious cargo, and seriously injuring or killing seafarers. The environmental effects of marine accidents are frequently irreversible, even though monetary damages may be recouped through insurance claims (International marine Organization, 2012).

“The consequences of maritime accidents are equally severe for seafarers. With a reported average of 14.2 injuries per million working hours, seafarers are up to 27.8 times more likely to suffer work related fatal injuries compared to the general shore-based workforce (Håvold, 2010). These figures are striking given that it is believed that maritime injury and accident statistics are underreported (Lützhöft, Grech, & Porathe, 2011). During 2015-16 the total compensation costs to cover seafarer injury claims on Australian ships amounted to around \$11.6 million (Seacare, 2016). Worldwide figures show that in the last decade the frequencies

of ship accidents generally increased (Eleftheria, Apostolos, & Markos, 2016). In addition, the global financial crisis of 2008 has left in its aftermath a large segment of international vessels (The Economist, 2015), with some trading in Australian waters operating under severe financial stress, potentially impacting safety". The high number of recorded incidents and accidents at sea could be attributed to a number of factors. According to Bloor, Thomas, & Lane (2000), Hetherington, Flin, & Mearns (2006), Roberts & Marlow (2002), 2005, and Rodryguez (2007), the hostile natural environment is intrinsically riskier than land-based enterprises. According to Grech, Horberry, and Koester (2008), living at sea also entails enduring ship vibrations and lengthy, irregular working hours, which worsen health conditions and increase the likelihood of accidents and exhaustion. In addition to having little social interaction, the distant nature of the work environment can result in crew members being isolated for extended periods of time without much assistance, which can negatively impact their performance, health, and well-being (Oliver, Cheyne, Tomas, & Cox, 2002). "Demanding conditions under which seafarers work is evident in the maritime literature with human error seen as last action in a series of contributing factors that results in accidents at sea (Grech et al., 2008). Traditionally, safety research has focused on technical and engineering aspects of maritime operations, but more recently, research has focused on the role of organizational factors influencing safety, such as safety culture".

According to Uğurlu et al. (2015), "knowing the human factors in accidents is the key in maritime transport," as they found that human factors account for between 77 and 81% of maritime losses. Numerous theories about the role of human factors are used in the maritime

industry, including the Swiss Cheese model (Reason, 1990), the Human Factors Analysis and Classification System (HFACS) (Wiegmann and Shappell, 2001), the Fuzzy Fault Tree Analysis (FFTA) (Celik et al., 2010), and the Functional Resonance Analysis Method (FRAM) (Lee and Chung, 2018). According to Yildirim et al. (2019), HFACS is considered to be one of the best frameworks for analyzing marine accidents since it takes into account a variety of human elements and can express their topological features. Furthermore, its classification somewhat corresponds with”, “Human Element Common Terms” outlined in Resolution A.884 of the International Maritime Organization (IMO)(Laxe et al., 2012). Therefore, “the HFACS method is widely used in the field of maritime accidents (Ergai et al., 2016; Celik et al., 2010; Kandemir and Celik, 2021; Qiao et al., 2020; Shi et al., 2021; Ma et al., 2022a, Ma et al., 2024). Moreover, the classification structure of HFACS can be adjusted and expanded to adapt to different research backgrounds, such as: maritime accidents (HFACS-MA) (Chen et al., 2013), collisions (HFACS-Coll) (Chauvin et al., 2013), groundings (HFACS-Ground) (Mazaheri et al., 2015), passenger transportation accidents (HFACS-PV) (Uğurlu et al., 2018; Yildiz et al., 2021), and ship collision accidents between assisted ships and icebreakers in ice-covered waters” (HFACS- SIBCI) (Zhang et al., 2019).

Both small-scale and large- scale sea disaster survivors expressed that the water vessel accidents caused nightmares, loss of ability to care for others, trouble with sleep, shame, forgetfulness and concentration problems, and avoidance of things that remind them of the accident. Fisher folks and commuter boat crews who experience water vessel accidents at times quit their jobs. Sea water vessel accidents harm both the survivors and on-lookers

depending on the same livelihood. The study records that fatal North- Atlantic water vessel accidents made many seamen change their occupation by officers quitting their jobs.

According to World Health Organization (2014), at least 372,000 people drown every year in world waters, with a whopping 91% coming from low and middle-income nations where people stay or work around water with inadequate measures to prevent drowning-related deaths. In 2010, the Lake Victoria Basin Commission reported that about 10,000 lives are lost in Lake Victoria annually, with others unreported. This concurs with Bowman *et al.* (2006), which state that African injury data have historically come mainly from a hospital or mortuary databases while drowning deaths in sub-Saharan Africa mainly occur outside hospitals meaning most kinds of deaths are excluded.

Schilling (1971) states that deep sea fishing poses life threats to fishers mainly from developing countries who mainly use traditional fishing means such as wooden boats. During emergencies in deep-sea fishing, there are usually high resultant casualties on the involved fishermen. Sumabe (2013) reiterated that inland water transport has been hazardous just like other hazards in most developed countries, exposing many sources of income in danger.

An analysis of the impact of boating accidents on the livelihoods of five boating communities around Lake Volta in Ghana reveals that inland water Yangmei vessel

accidents cause poverty to the fishermen's households. The engagement in other livelihood activities for fear of drowning, lack of trust in relevant government departments, psychological problems, and in some cases dropping out of school by affected household children to care for their suffering household members.

Omwenga *et al.* (2000), in their research around Lake Victoria, Kenya, show that there are high levels of poverty with reduced income. The study also points out high cases of malnutrition amongst communities living around, low standards of living, and high infection from waterborne diseases. Odhiambo (2013) asserts that changes in Lake Victoria wind patterns, the occurrence of severe storms, changes in temperature, and the reduction of the lake level due to weather and extreme climate changes are likely to impact the maritime safety of fish folks.

Upon their occurrence, the above would typically significantly affect the livelihood activities of the neighboring fishing communities around the Lake. Lake Victoria weather and climate variability have had a direct negative impact on fisher folk's livelihood. Impacts are loss of income from fishing, abandonment of fishing for other economic activities, and loss or destruction of fishing equipment, including nets, boats, and paddles. Apart from those, the study also showed that fishers affected by water vessel accidents search for safe fishing grounds away from local fishing beaches and lose membership to fishing co-operative.

The conflict with other fish folks over safe fishing grounds and have reduced access to food due to lost revenue from fishing. Furthermore, the researcher concurs with other earlier research by emphasizing the high risk of malnutrition and under-nutrition by family members of household members affected by water vessel accidents because of reduced fish supply which is a source of protein to many people.

2.4 Intervention Measures being applied by Residents and Government Officers to Mitigate the Socio-economic Effects of water vessel accidents

Mangione (2014) states that the United States of America, more so in California and Mississippi, adopted educational campaigns on life jackets in 2007 to reduce the drowning fatalities, which stood at 71% of all reported fatalities between 1999 to 2011 in its waters. Some of life saving intervention measures for instances mass media promotions, radio advertising, marina events, signing of pledge cards, celebrity appearances, and a campaign tour boat staffed with 'ambassadors' that cruised the Delta educating the public, disseminating information, and giving away free inflatable life jackets.

In 2006 International Maritime Organization (IMO) approved and implemented the adoption of e-navigation in world waters. In line with e-navigation, Ramirez *et al.* (2013) developed a web and mobile-based emergency quick portal application in Albay that has helped reduce the impact of disasters by providing interaction between the affected citizens and emergency units. This application which was later named PINDOT (Provincial

Information Network on Disaster Occurrences and Threats), had been tested and proven in Albay province in the Philippines.

“At the Northern Sea Route (NSR) in the Arctic Ocean, Arctic Voyage Environmental Information System (VEIS) for sea ice, ocean, wave, and weather parameters” (Yang *et al.*, 2018). Through the projects ‘Development of Safe Voyage Planning System for Vessels Operating in Northern Sea Route’ and ‘Development of Ship-handling and Passenger Evacuation Support System,’ VEIS was developed to reduce water vessel accidents updating its users five times a day. Satellite-based Sea ice monitoring is also linked to produce dynamic information on sea ice, ocean, wave, and weather in near real-time using polar-orbit satellite remote sensing and numerical model-based prediction data.

In 2007, the East African Community achieved a significant lake safety milestone through the creation of the Lake Victoria Transport Act. The transport act served to address the maritime safety standards within four main perspectives: seaworthiness of ships, collision prevention, crewing standards, and the establishment of navigational aids. If fully implemented, the Act would curb water vessel accidents in Lake Victoria. Additionally, each county surrounding Lake Victoria in Kenya has prepared a disaster management policy that seeks to reduce dangers of the Lake.

Angela Oketch, the editor of 'The East African magazine,' reported on 9th May 2018 that Lake Victoria Basin Commission (LVBC) secured Ksh3.6 billion (\$35.8 million) from donors to improve the safety of Lake Victoria, which would mitigate recurrent water vessel

accidents. LVBC had dubbed the project "Multinational Lake Victoria Maritime Communications and Transport" was implemented by Kenya, Uganda, and Tanzania over four years at the cost of about \$36.58 million.

According to the reporter, the project was to be funded by African Development Bank and European Union Africa Infrastructure Fund at a loan of \$25.01 million and \$4.77 million, respectively. This was projected to give daily weather reports and alerts to people on the Lake through SMS and radio broadcasts, increase telephone coverage, and build a network of 22 rescue centers along Lake Victoria shore.

According to Nakyonzi (2011), the East African Community had created 30 navigational assistances in the form of visual marks in Lake Victoria. Additionally, the sailing directions within the Lake were revised in 1972. Lake Victoria Basin Commission has also implemented the 1956 navigational charts and nautical surveys created between 1900 and 1906. To some point, these measures have ensured the reduction of trans-border water vessel accidents of boats, ferries, and ships. Powell (2016) records that Kenya Meteorological Department in 2003 set up two buoys carrying floating automatic weather stations, which were anchored at the lake bed off Homa Hills at Winam Gulf and in the open Lake close to Rusinga Island. Buoy's primary purpose was to monitor Lake Victoria, Kenya sector currents and water temperature to warn fishers against sailing in harsh weather to reduce water vessel accidents.

The study asserts that Kenyan fishers around the Ugandan border occasionally request the daily mobile weather alerts issued by the Uganda National Meteorological Agency (UNMA) and make fishing expedition decisions based on the results received on their cell phones. Odhiambo (2013) analyses the coping and adaptive mechanism of the fishing community in Lake Victoria- Mbita Division due to overwhelming disasters experienced in the Lake. Some of the copying and adaptive measures they do are farming, small-scale business, boat repairing, fish mongering, operating boda-boda, and grazing animals for other people.

2.5 Conceptual framework

Three models guided the conceptual framework; Lindell's impact model and, as stated in Wisner *et al*'s, Access model and Sustainable livelihoods Frameworks. Lindell's impact model addressed vulnerability factors and the impact of Lake Victoria water vessel accidents on the socio-economic development of households. Access Model of risk by Wisner *et al* will address the identification of water vessel accidents, identify intervention measures in place for mitigation, and assist in recommending long-term solutions for the recurrent disaster. Sustainable livelihoods Framework model, the framework depicts stakeholders as operating in a Context of Vulnerability. In other words, the framework provides a checklist of important issues and sketches out the way these link to each other, while it draws special attention to core influences and processes and their multiple interactions in association to livelihoods.

2.5.1 Disaster Impact Model by Lindell

The model attests that humans have been tolerating numerous disasters, leading to their development and evolution. In recent decades, advancements have been more rapid than ever before. Therefore, humans find it necessary to develop ways to handle such disasters as they occur in their environment.

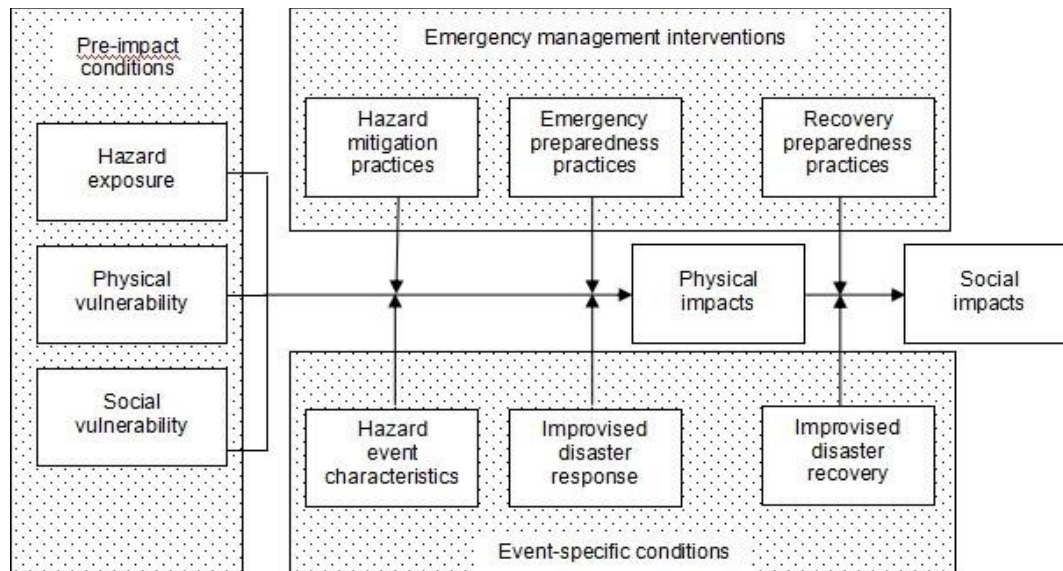


Figure 2.1 Lindell Disaster Impact Model

Source: Lindell and Prater (2003)

The process by which water vessel accidents produce socio-economic impacts amongst Homa bay county residents can be explained in the models proposed by Cutter (1996) and Lindell and Prater (2003). Specifically, Figure 2.1 indicates that the effects of a disaster are determined by three pre- impact conditions: hazard exposure, physical vulnerability, and social vulnerability amongst the population. Besides this, three event-specific conditions

affect the outcome: hazard event characteristics, improvised disaster responses, and improvised disaster recovery.

Two of the emergency-specific conditions, maritime emergency event characteristics and improvised disaster responses combine with the pre-impact mitigation practices to produce a disaster's physical impacts. The physical impacts, after that, combine with improvised disaster recovery and recovery preparedness practices to produce the disaster's social impacts. Local communities can engage in three types of emergency management interventions to reduce widespread disaster impacts. Physical impacts can be reduced by water vessel accidents mitigation practices and maritime emergency preparedness practices. In contrast, social impacts can be reduced by recovery preparedness practices and improved response measures. This model places many more specific social impacts, including psycho-social, demographic, economic, and political.

Physical vulnerability mainly rotates around the physiological response of the affected population during water vessel accidents exposure. The young, elderly, sick, and handicapped are usually most affected during its occurrence because of their inability to cope with the situation. In some instances, structural vulnerability sets in as maritime transport vessels also develop complexities leading to accidents. A case example is the Tanzanian MV Bukoba ferry released for a voyage despite its engineers warning that it was not safe and needed to be repaired. The result was it capsizing on its way to Mwanza, killing between 800-1000 passengers. Social vulnerability, too, in combination with physical

vulnerabilities during water vessel accidents, had a physical impact depending on how many people were in the vessel when it capsized.

Poor hazard mitigation practices, emergency preparedness practices, and improvised disaster response resulting from '*nyawawa*' and evil mermaids in the Lake affect response causing physical impacts. Physical disasters are not the end of the road. Poor recovery preparedness practices and improvised disaster recovery lead to social disasters like psycho-social, demographic, economic, and political impacts.

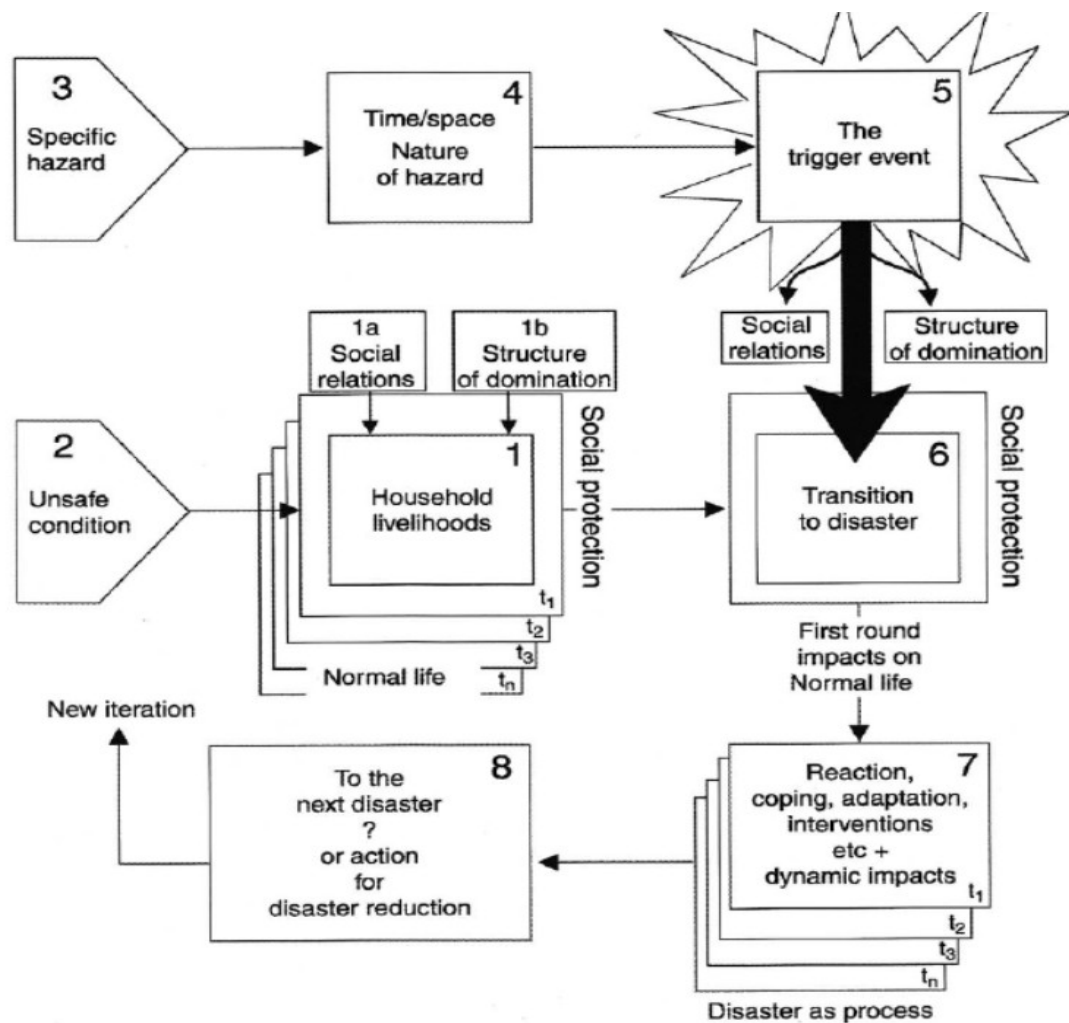


Figure 2.2 Wisner et al., Access Model

As stated in Wisner et al.'s (2004: 89), the access model is of the idea that disasters resulting from vulnerabilities significantly affect household livelihoods. We were having water vessel accidents as our study's specific hazard; the time in which maritime emergencies take to develop varies, with most being rapid on-set. On short notice, water vessel accidents occur when triggered by bad weather, leaking boats, attack by animals, or personal sail-men confrontation; the emergency is transformed into a disaster.

Water vessel accident triggers are met with unsafe conditions, which causes

vulnerability such as the absence of SAR responders, life jackets, and lack of emergency call center. After the disaster event has taken place, a transition from pre-disaster to post-disaster conditions takes place.

Disaster transition is the most challenging phase for the water vessel accidents-affected, often coupled with direct negative impacts on the household livelihoods. The affected families, later on, employ coping mechanisms and post-disaster interventions for resilience purposes. Depending on the copying mechanism or intervention received, water vessel accidents have dynamic impacts on the affected, which has a relationship with household livelihoods.

2.5.3 Sustainable Livelihoods Framework

The SLF (Figure 2.3) forms the core of the Sustainable Livelihoods Approach and serves as an instrument for the investigation of poor people's livelihoods, whilst visualizing the main factors of influence. Like all models, the SLF is a simplification and does not represent the full diversity and richness of livelihoods, which can only be understood by qualitative and participatory analysis at the local level. In its simplest form, the framework depicts stakeholders as operating in a Context of Vulnerability, within which they have access to certain Assets. These gain their meaning and value through the prevailing social, institutional and organizational environment (Transforming Structures and Processes). This context decisively influences the Livelihood Strategies that are open to people in pursuit of their self-defined beneficial Livelihood Outcomes (see Fig. 2.3). In other words, the framework provides a checklist of important issues and sketches out the way these link to each other, while it draws special attention to core influences and processes and their multiple interactions in association to livelihoods.

The Vulnerability Context forms the external environment in which people exist and

gain importance through direct impacts upon people's asset status (Devereux, 2001). It comprises Trends (i.e. demographic trends; resource trends; trends in governance), Shocks (i.e. human, livestock or crop health shocks; natural hazards, like floods or earthquakes; economic shocks; conflicts in form of national or international wars) and Seasonality (i.e. seasonality of prices, products or employment opportunities) and represents the part of the framework that lies furthest outside stakeholder's control. Not all trends and seasonality must be considered as negative; they can move in favourable directions, too. Trends in new technologies or seasonality of prices could be used as opportunities to secure livelihoods.

The livelihoods approach is concerned first and foremost with people. So an accurate and realistic understanding of people's strengths (here called "assets" or "capital") is crucial to analyze how they endeavor to convert their assets into positive livelihood outcomes (Bebbington, 1999). People require a range of assets to achieve their self-defined goals, whereas no single capital endowment is sufficient to yield the desired outcomes on its own. Since the importance of the single categories varies in association to the local context, the asset pentagon offers a tool to visualize these settings and to demonstrate dynamical changes over time through constantly shifting shapes of the pentagon. Assets are of special interest for empirical research in order to ascertain, if those, who were able to escape from poverty, started off with a particular combination of capital, and if such a combination would be transferable to other livelihood settings. Furthermore, it would be interesting to evaluate the potential for substitution between different capitals, for instance a replacement of a lack of financial capital – as is often the case in the reality of poor stakeholders – through a better endowment with social capital.

Transforming Structures and Processes represent the institutions, organizations,

policies and legislation that shape livelihoods. They are of central importance as they operate at all levels and effectively determine access, terms of exchange between different types of capital, and returns to any given livelihood strategy (Shankland, 2000; Keeley, 2001). Structures can be described as the hardware (private and public organizations) "that set and implement policy and legislation, deliver services, purchase, trade and perform all manner of other functions that affect livelihoods" (DFID, 2000). An absence of well working structures often constitutes an obstacle to sustainable development and makes simple asset creation difficult in case of adverse structures impeding access to apply a certain livelihood strategy. In contrast to other approaches, where scarcity and underdevelopment was thought to be a problem of people not having enough due to lacking capital endowments, the SLA analyses it as a problem of access and the possibility to control the available resources, that are often sufficiently at disposition (compare Sen, 1981). Complementary to structures, processes constitute the "software" determining the way in which structures and individuals operate and interact. There are many types of overlapping and conflicting processes operating at a variety of levels – and like software, they are crucial and complex. Important processes for livelihoods are for instance policies, legislation and institutions, but also culture and power relations. They may serve as incentives for people to make choices, they may be responsible for access to assets or they may enable stakeholders to transform and substitute one type of asset through another. Transforming structures and processes occupy a central position in the framework and directly feedback to the vulnerability context, while influencing and determining ecological or economic trends through political structures, while mitigating or enforcing effects of shocks or keeping seasonality under control through working market structures; or they can restrict people's choice of livelihood strategies (e.g. caste

system) and may thus be a direct impact on livelihood outcomes.

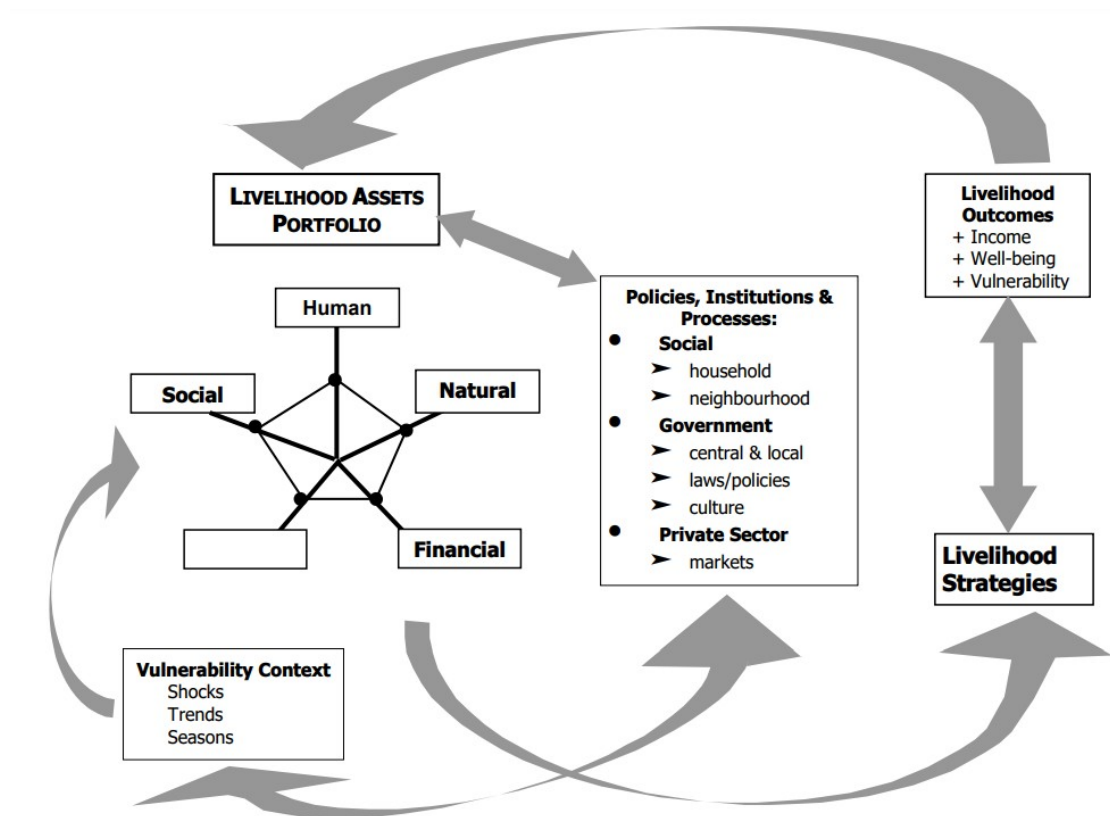


Figure 2.3: Sustainable Livelihoods Framework by Lowe and Schilderman, 2001)

When considering livelihood strategies and issues connected to the SLA in general it is important to recognize that people compete (for jobs, markets, natural resources, etc.), which makes it difficult for everyone to achieve simultaneous improvements in their livelihoods. The poor are themselves a very heterogeneous group, placing different priorities in a finite and therefore highly disputed environment. Compromises are often indispensable. An application of the SLA offers the advantage to be sensitive for such issues in a differentiated manner.

Livelihood outcomes are the achievements of livelihood strategies, such as more income (e.g. cash), increased well-being (e.g. non material goods, like self-esteem, health status, access to services, sense of inclusion), reduced vulnerability (e.g. better resilience through increase in asset status), improved food security (e.g. increase in

financial capital in order to buy food) and a more sustainable use of natural resources (e.g. appropriate property rights). Outcomes help us to understand the 'output' of the current configuration of factors within the livelihood framework, they demonstrate what motivates stakeholders to act as they do and what their priorities are. They might give us an idea of how people are likely to respond to new opportunities and which performance indicators should be used to assess support activity. Livelihood Outcomes directly influence the assets and change dynamically their level - the form of the pentagon -, offering a new starting point for other strategies and outcomes.

However, there are some limitations within the SLA. A differentiated livelihood analysis needs time, financial and human resources. Development projects often lack these conditions. The claim of being holistic inevitably delivers a flood of information hardly possible to cope with. Additionally, by improving the livelihoods of a specific group a negative effect may occur on livelihoods of others. This may lead to a normative dilemma on the decision about what to consider with priority. Reducing the livelihood perspective to a methodological tool contains the risk to look at the two things interchangeably. The SLF still is a simplification of the multidimensional reality of livelihoods.

2.6 Conceptual Model

For the guidance of this study, the study used the Sendai Framework for Disaster Risk Reduction 2015- 2030, which is the new world guideline for DRR. Disaster risk reduction is an integrated hazard monitoring system, forecasting and prediction, disaster risk assessment, communication, and preparedness activities and systems and processes that enable individuals, communities, governments, businesses. The others to take timely action to reduce (mitigation and preparedness) disaster risks in advance of hazardous events. This study addressed 4 Sustainable Development Goals (SDG)

forming the 2030 plan, which includes: SDG 1, which is poverty; SDG 9, which is industry, innovation, and infrastructure; SDG 11, which is sustainable communities; and SDG 17, which is a partnership for the goals.

Most water vessel accidents occur from natural causes such as bad weather and human-wildlife conflict. Therefore, it would not be entirely possible to eliminate these disasters but to reduce the level of risk by applying proper measures, which will lead to maritime safety within the Sendai framework in use.

Recent reports and studies indicate that the frequency and intensity of water vessel accidents have tremendously increased over the past years, rendering this less resilient population more vulnerable. Despite the increased intensity and magnitude of Lake Victoria's water vessel accidents, no comprehensive impact assessment study on the social and economic developments of the affected has ever been undertaken. Hence the response to Lake Victoria water vessel accidents has been reactive instead of proactive as contained in The Sendai Framework for Disaster Risk Reduction 2015-2030.

The study developed a conceptual model shown in Figure 2.4.

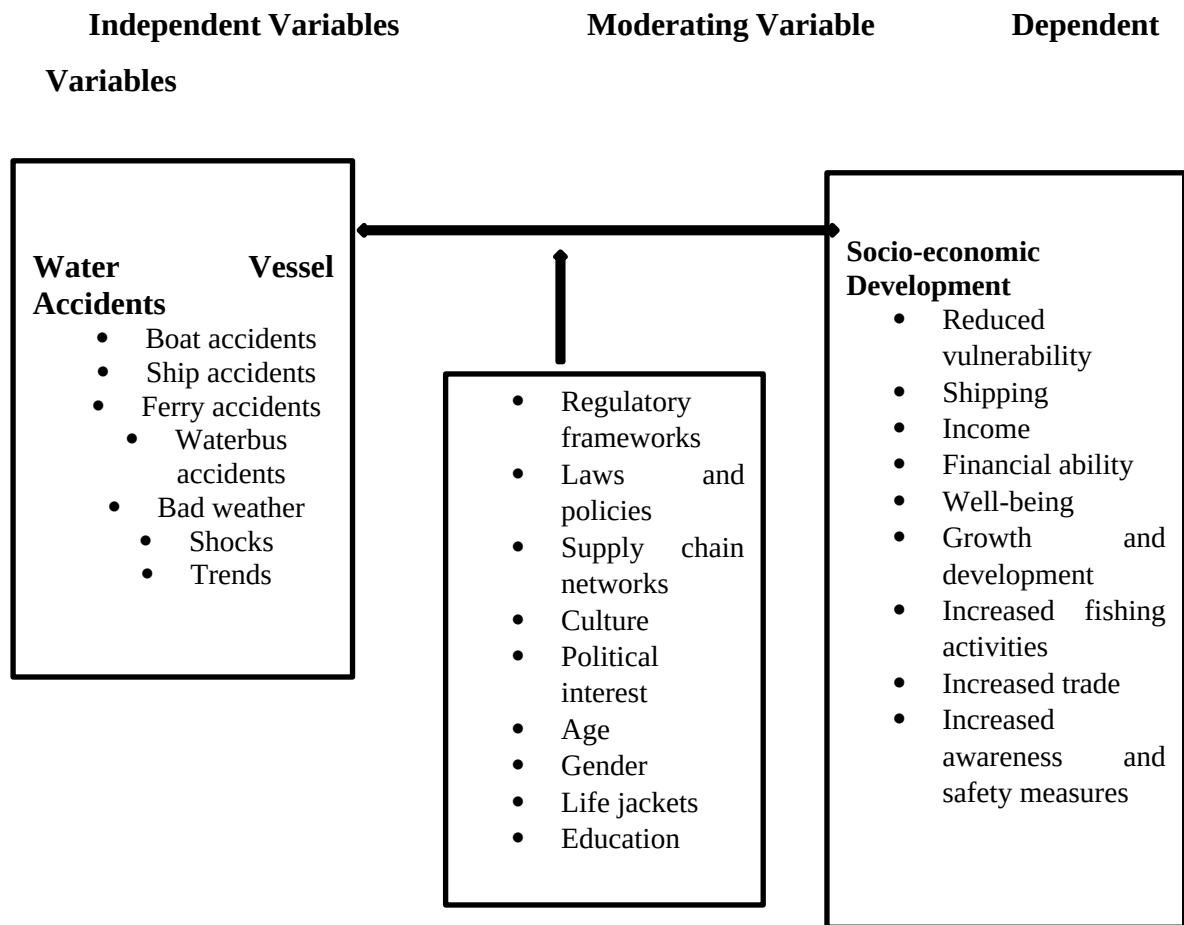


Figure 2.4 Conceptual model showing the interaction among variables

Source: Researcher 2023

Lake Victoria water vessel accidents result from bad weather that causes capsizing of water vessels such as water buses, ferries, boats, ships, speed boats, canoes, engine boats, common boats and rafts; attack by wild animals such as crocodiles and hippopotamuses. Other water vessel accidents also occur as a result of human errors, Amore *et al* (2017). After the occurrence of these water vessel accidents, we have silent particular variables known as intervening variables that either propels or hampers socio-economic development in Lake Victoria- Kenyan portion which is our study area.

These intervening variables include presence of life jackets; alcoholism; political

interests; search and rescue activities; strength of storms and water waves; age; gender; education; culture; communication; early warning communications; and financial compensation offered by the government also shape recovery process and outcomes.

In effect to Lake Victoria water vessel accidents in combination with any of the intervening variables, dependent variables, are produced which fully rely on the two variables i.e., independent and intervening variable.

The resultant socio-economic development effects include loss of lives, loss of property, loss of livelihoods, poverty, dropping out of school, destruction of the environment, minimized trade, low tourism activity, destruction of human capital or deterioration of the production capacity, dropping out of school, diseases, a settlement on shanties on lakeside fishing beaches and urban migration to source for jobs. Disasters in Lake Victoria water have been catastrophic in the lake basin region. This study will influence the exploration of the impacts of water vessel accidents on the socio-economic development of households' livelihoods.

2.7 Chapter Summary

This chapter has given a detailed literature review in identification of water vessel accidents, impact of water vessel accidents, the identification of potentially vulnerable groups and intervention measures applied by government agents or residents to mitigate the socio-economic impacts of water vessel accidents. Models like Lindell's impact model and Bayesian Network Model of risk have been used. This chapter also accentuates a conceptual model showing the interaction among variables. The study variables lead to the research methodology interrogation which is the subject of the next chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This particular chapter presented research methodologies and designs employed by the research in this study. The sub-sections of this chapter were research design, study area, study populations, sampling techniques, types of data, and techniques of data collection, data processing and analysis. It further described the reliability and validity of the instruments used in this study. Finally, it presented the piloting study, limitations and ethical considerations of the study.

3.1 Research Design

According to Strydom *et al.*, (2005), a research design is the set of procedures and methods employed in study while analyzing and measuring the variables of a specified research problem. The research design varies based on the purpose and, the nature of the study questions and the skills of the researcher and the availability of the resources (Strydom *et al.*, 2005). A method of descriptive research called descriptive survey research combines quantitative and qualitative data to produce accurate and pertinent information.

In this particular study, the researcher employed a descriptive research design that had both qualitative and quantitative methods. Descriptive was applied in this study because it shows the thing and then focuses on individuals' experiences and comprehending the structure of those lived encounter (Goodman, 2011). In addition, the study employed descriptive design since it encompasses description, in-depth, and the common characteristics of the phenomena that have occurred through the in-depth interviews data collection method.

3.2 Study Area

“Mbita Town is located on the shores of Lake Victoria in Homa Bay County, one of 47 counties in Kenya. It is a mostly rural area found between latitudes 0° 21’ and 0° 32’ south and longitudes 34° 04’ and 34° 24’ east. It is about 400 km west of Nairobi, the capital city of Kenya and it covers a total area of 163.28 km². Mbita is home to the International Centre for Insect Physiology and Ecology (ICIPE) research compound, Tom Mboya Mausoleum, Rusinga Island, Mfangano Island, Remba Island and several tourist attraction sites”.

This study was undertaken in Mbita Sub- County of the Kenyan side of Lake Victoria, among the households who have lost valuable property or close members who contributed helpfully to the household’s economy or whose members have ever experienced life-threatening emergencies in the lake. Mbita Sub- County was chosen because it is one of the key regions around Lake Victoria where households largely depend on the fishing activity and many commutes across the lake frequently. The Lake is believed to be the second-largest freshwater lake in the world and Africa's largest lake covering approximately 68,800 km². Kenya's portion of the lake is 6% which covers the open lake and the famous Winam Gulf. Of the 4,128km² occupied by Lake Victoria in Kenya, about 30 islands are either inhabited or instrumental for fishing activities and tourism activities. Lake Victoria has an average depth of 43m, and the most profound depths range from 83-100 meters.

Lake Victoria Kenyan portion stretches across five counties, namely Homa Bay, Siaya, Busia, Kisumu and Migori. These five counties have a projected total population of approximately 4,436,123, according to the 2008 Kenya Census statistics. According to KNBS & UNICEF (2017), over 40% of Kenyan households live below the absolute poverty line, with the highest poverty levels in rural areas. Kenya Integrated Household Budget Survey (2018) report indicates poor education, alarming children nutritional

status, little technological embracement, poverty, poor sanitation and waste management. It also reflects the poor housing and other living conditions of counties lying in the Lake Victoria basin.

Mbita Sub- County, the study area focus is located in the Western Part of Homa Bay County, which covers an area of 421km². Within it is contained a total population of 111,409 in 29,766 existing households (KNBS, 2019). Fishing is the primary source of livelihood and the chief economic activity in Mbita Sub-County (Suba North Constituency).

Fishing, domestic animal husbandry, small-scale business, and subsistence farming are the main sources of income for the populace. Although the times vary somewhat every year, there are typically two wet seasons: March to June and October to November. This sustainability study covers the following political administrative locations: Mfangano Ward, Kasgunga Ward, and Rusinga Ward. The primary source of income for Homa Bay County, which owns more than 80% of Kenya's Lake Victoria Beachfront, is fishing. More than 80% of people in Mbita Town are fisherman, making it a top fishing destination.

Since 2013, Homa Bay's County Government has prioritized the need to enhance the fishing industry through better market infrastructure, market connections, planned urban growth, and investment in fish value chain development. According to Allison et al. (2009), small-scale fishermen in the least developed nations are more vulnerable to water vessel accidents during fishing because of their over-reliance on the activity and poor adaptation techniques. With the exception of the primary road connecting Mbita and Homa Bay, the area's road systems are in terrible condition and are largely impassable during wet seasons. When traveling to islands,

lakeshore fishing grounds, and lakeside cities such as Luanda Kotieno, Asembo, and Sori, water transportation is the most popular option.

The Ndori–Luanda Kotieno sea route, which is served by the Mbita Ferries, which ply the narrow Nyanza Gulf between Luanda Kotieno on the Rarieda side in Siaya County of the lake and Mbita Town in Homa Bay County, provides excellent service to the area that includes "Kisumu, Siaya, Kisii, Migori, Nyamira and partly Kericho, some of the Counties that form Lake Region Economic Bloc, and the entire Suba region." The largest and newest boats, which can accommodate up to 30 motor vehicles and nearly 200 passengers on a single journey, were recently presented by the private company that owns and operates Mbita boats. This is a huge enhancement that would provide travelers easy access to the border the narrow channel". "It is anticipated that the boat service will boost regional economic activity by enabling businesspeople and dealers to access important wholesale and distribution stores in the area more quickly. Additionally, because the lake offers a unique chance to connect the region with the rest of East Africa, the investment opportunity in lake transportation is well-represented in the Homa Bay County Investment Booklet (Portfolio). Furthermore, the area will be open to commerce and economically significant investments in the fishing, agricultural, and tourism sectors thanks to the construction of new bitumen roads like Homa Bay – Mbita and the proposed Mbita – Sindo – Magunga – Nyandiwa ring road".

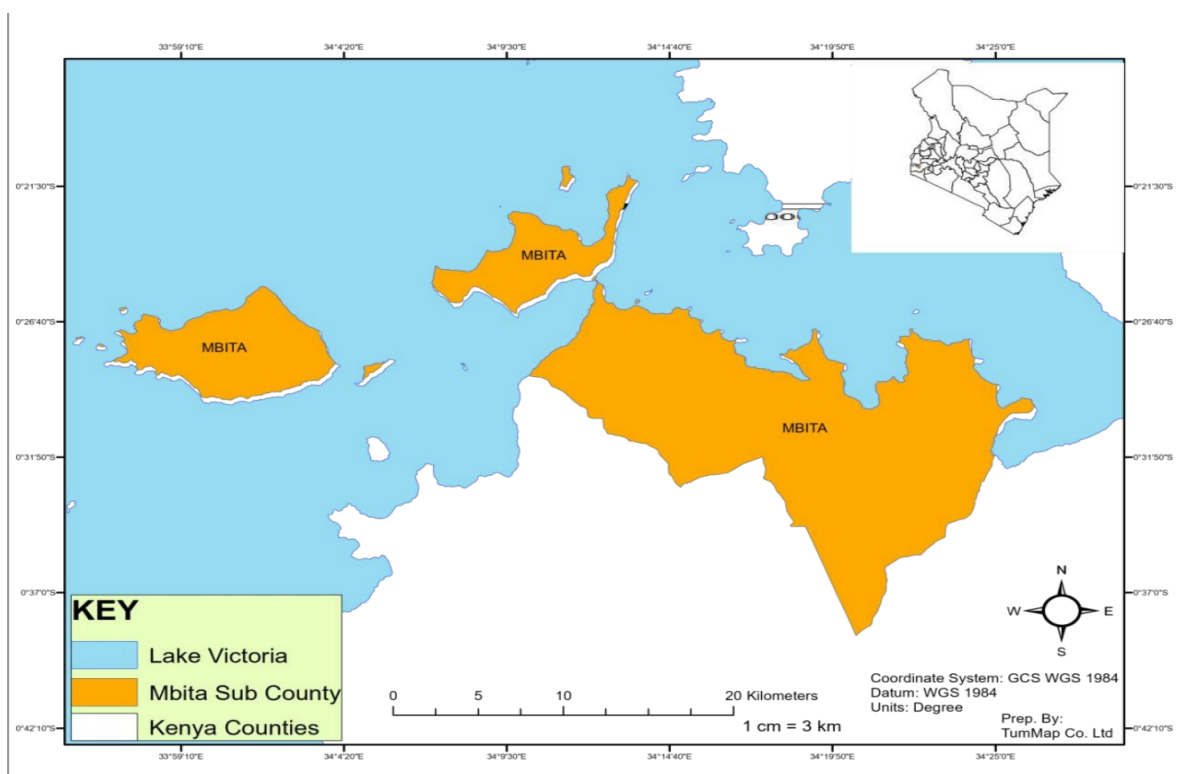
"To develop the Mbita-Sindo-Magunga road, which is anticipated to connect to another route from Ndhiwa to Sori Town in Nyatike district, the government has already inked a new contract with a Chinese road construction company. Tourists and visitors can drive easily along the lake with the option to branch off to places like Kisegi and Nyandiwa Hills, a rapidly expanding beach town, for unrestricted access. Mbita Town's close vicinity to Ruma National Park, Africa's sole home for the Roan Antelope, and the

presence of multiple prehistoric sites in Mbita and consequently the Suba region”.

Mbita Sub- County was selected for the study because water vessel accidents have become a recurrent phenomenon in lake since time immemorial, which has negatively impacted the community and has become a societal concern (Odhiambo, 2013). On several occasions, the Homa bay county government department of Disaster Management and Special Programs has had to divert resources from critical humanitarian development programs to respond to water vessel accidents in the Mbita North region on an ad- hoc basis.

From the 2019 population and census indicate that Mbita Sub-County has a total population of 124, 938 from the 29,766 existing households and a density of 264.72 people per square kilometers. The location of the study area is shown in Figure 3.1.

Figure 3.3 Showing Map of Mbita Sub- County the Study Area.



Source: Researcher 2021

3.3 Study Population

The target population consisted of the following groups of respondents; Household heads, Fishers and fish traders from Rusinga Island Ward, Gembe ward, Lambwe ward, Kasgunga ward and Mfangano ward, (men and women) , state security officers, 1 Sub-County Commissioner and sub county administrator (1), (3)Ward administrators, chiefs(3), assistant chiefs(3), beach mangers (5), Kenya Marine Offices (1), County Fishery department, victims of water vessel accidents, Search and Rescue teams (Red Cross) community members who included; women and youths who also formed part of the target population. Table 3.1 shows population per ward in the study area.

Table 3.1: Population per ward in the study area

Ward	Population	No of households
Gembe	16,498	4013
Rusinga Island	46,223	10,456
Mfangano	16,282	3,321
Kasgunga	27,574	7597
Lambwe	18,366	4379
Total	124, 938	29,766

Source: Researcher, 2022

3.4 Sampling Size and Sample Strategies

Sampling is an explanation as a description of strategies that the researcher used to select representative elements, subjects, or respondents from the target population (Oso and Onen, 2005). Both probability and non-probability sampling techniques was used.

Research quality in generalizations is affected by the quality of the selected sample.

According to Nesbary (2000), the larger the sample size, the greater the probability the sample will reflect the general population. It is however suggested that sample size alone does not constitute the ability to generalize. Patten (2004) suggests that sampling methods should be unbiased and every member of the target population should have an equal opportunity of being selected in the sample. This study employed a non-probability sampling technique to collect data which included purposive, convenience and snowball sampling.

KMA & LVBC staff members, frequent lake commuters, tourists, human rights activists, officers from Homa bay county government department of disaster management and special programs, disaster management committee members, opinion leaders and fisher folks were sampled purposively and randomly. Household members that have lost a member, property having significant implications on livelihoods together with those whose members have experienced emergency scenarios in the lake was sampled using the snowball sampling technique. Proportionate Sample distribution details per ward are contained in Table 3.2.

Mugenda and Mugenda (2003) argued that, when the study population is 10, 000 and above, a sample size of 384 is recommended. Wherefore, number of households in Mbita sub county is 29,766. The sample size for this study was determined using the

$$n = \frac{z^2 pq}{d^2}$$

following formula:

Where: n = the desired sample size (if the target population is greater than 10,000)

z = the standard normal deviation at the required confidence level

p = the proportion in the target population estimated to have characteristics being measured (q = 1 - p)

d = the level of statistical significance set

Therefore, n =
$$\frac{(1.96)^2(.50)(.50)}{(.05)^2} = 384 \text{ household heads}$$

Table 3.2: Proportionate Sampling of household heads per ward

Ward	No of Households	Proportionate sample
Gembe	4013	52
Rusinga Island	10,456	135
Mfangano	3,321	43
Kasungu	7597	98
Lambwe	4379	56
Total	29,766	384

Source: Researcher, 2022

3.5 Choice of Method and Research Techniques

As stated in the research design above, the study used the qualitative methods in collecting primary data. This is because my study sought meaning to water vessel accidents occurrences by explaining the “why” or “how” issues (Mikkelsen 1995).

According to Hesselberg (2012) qualitative research usage gives a Provides information on few items and attempts to locate all pre-existing variations regarding the topic under study. It additionally permits more for higher flexibility than the quantitative research method in following interesting leads into the issue being examined. Mikkelsen (1995) emphasizes that in all research methods are determined by questions to be answered. This study's assessment nature made the qualitative approach more pleasant than its counterpart or a mixed method.

Investigation of water vessel accidents' impact on various households requires a method that explored the totality of the situation and elicits thick and varied insights into the household's livelihoods; a purpose best achieved by a qualitative research approach. Therefore, this study's usage of the qualitative research method gave a deep understanding of what extent loss of significant property, concerned household members or experience of life-threatening emergency in the lake due to water vessel accidents affect households as they try to secure their livelihoods.

In addition, this study choice of qualitative research was attracted by its flexibility to allow for incorporation of new aspects that may act as additional leads, and valuable information to be investigated during research that may otherwise be lost if other research methods like quantitative were solely employed. Such provisions enriched the findings of this research study.

For the aim of achieving this study purpose; questionnaires, in-depth interviews, focus group discussion, and qualitative research techniques was employed in the investigation since all have immense contribution to the quality of this research study.

3.5.1 In-depth Interviews

The study employed in-depth interviews as the main research instrument for collecting qualitative data. The technique usually allows for intensive face to face or virtual interviews with an individual respondent to examine their understanding on a given theme, phenomenon or idea (Boyce, C. & P. Neale, 2006). This research study used a clear in-depth interview guide with questions that was semi-structured and open-ended. Further, the in-depth interview guide contained a list of all topics the study sought to cover in which questions were open-ended.

According to (Dunn 2010) an interview guide is made up of a list of themes a study would like to investigate in an interview. Its advantage is flexibility in which it allowed the interviewing conversation to flow naturally, with the researcher merely providing some direction to the discussion to cover all the issues at hand. Therefore, using in-depth interviews to investigate the impact of Lake Victoria water vessel accidents was quite advantageous as it provided more useful detailed information about the people's behavior and life after (Hammersley & Atkinson 2007; Dunn 2010). Employment of intensive individual in-depth interviews enabled the respondents to give a detailed information of their livelihood situations and reveal some important issues that would not be achieved if at all other interview techniques are applied. In carrying out in-depth interviews, a guide was designed and conducted on water vessel accidents in the study community where the opinions or views of both male and female-headed households were sought.

Moreover, the study undertook steps to interview water vessel accidents-affected households from the relative wealth divides, as well the direct victims from water vessel accidents that happened from way back in 1980. In total, thirty households were interviewed in the study area and all used in the analysis of the findings. Informants for

the study were selected through a purposive selection procedure. These study informants were identified by asking those in the study area whether they know of any household that has suffered from water vessel accidents within the study period.

Questions asked to the informants mainly involved post-disaster and pre-disaster household livelihood conditions which sought to expose household livelihood changes and vulnerability following the water vessel accidents. An In-depth interview guide also investigated water vessel accidents and their prevalence in Lake Victoria, vulnerable groups affected and intervention measures applied by residents and government officials to mitigate the socio-economic impacts of water vessel accidents.

3.5.2 Focus Group Discussion

Overseas Development Institute (2009) defines focus group discussion (FGD) as the manner to collect people from same backgrounds or experiences to discuss a specific theme. FGD respondents are moderated by the researcher or research assistant who highlights the topics for discussion and assist the participants in a natural set up for lively discussion.

This study's main aim of conducting FDG was to clarify and cross-check some of the responses obtained from the household in-depth interviews concerning their livelihoods. Focus Group Discussions were arranged on days or times not considered taboo by the participants like market days, Sabbaths and times of the day set aside for casting nets or fishing by the fish folks. FGDs was held in a number of selected lakeside fishing beaches so as not to disrupt the economic activities of the participants and was situated far from both the police station and chief's camp to make participants free of sharing experiences without fear.

Each FGD had ten participants both male and female attending the session with gender numbers varying on the acceptability of share the experience. A total of six FGDs were conducted, two of whom were women. Focus Group Discussion composition size varies according to various scholars. An example is (Mikkelsen, 1995) who puts the FDG required composition number from six to eight participants whilst (Cameron, 2010) recommends a range of between six to ten people. However, this study gave much concentration on the participants' ability to delve much into issues to be addressed by the study without having very few people who can't adequately address the research topic or very many who may be unmanageable.

Focus Group Discussion participants included 2 BMU chairmen, 1 LVBC staff, 1 KMA staff, 2 coxswains actively involved in the transportation of commuter and 4 fish folks. The study choice of the FGD composition is in line with (Cameron, 2010) who alludes that the importance of a FGD is viewed in the difference of processes and cultures that make up the globe socially, as the richness of the relationship between people and environment can be addressed and examined explicitly. FGD sessions were started by a thorough introduction, followed by discussions that lasted about one hour. During the discussions, general issues regarding water vessel accidents was asked alongside livelihood conditions in pre-disaster and post-disaster periods.

3.5.3 Key Informant Interviews

The key informant interviews were also done in this study using a checklist at both households and constituency levels. The main purpose of conducting key informant

interviews was to get primary data where FGDs was less feasible to conduct or employ. In most situations Key informant interviews are advantageous in that they are the cheapest method of accessing ideas in a bigger way and also permits for new and unexpected ideas and stories to come up (USAID, 1996).

The study sought to interview twenty key informants who are individuals acquainted with issues of study ranging from water vessel accidents to generally affected community household livelihood with the composition comprising of all critical players who have roles to play in the management of water vessel accidents. Examples of notable individuals or organizations at sub-county level that I sought to interview include the following:

- i. Churches
- ii. Mbita Sub- County Disaster Management Committee (Representative from Ministries of Water, Health, Gender and Social services, Agriculture, Education and Police)
- iii. Provincial administration and local authorities
- iv. Political leaders;

At the sub-county level, the interviewees were representatives of the general enlightened community and was relied on to give typical perceptions and perspectives on the study subject matter. Key informant interviews were done in venues organized by participants. It is significant to mention that these key informants are instrumental in this study in that they enriched the information and expound on the significant points that were not realized from the time of household in-depth interviews.

3.5.4 Observation

The study also employed an observation research technique. According to Hesselberg (2012), observation implies a way of data collection by observing and looking at the phenomenon. It further states that it is classified as a participatory study because the researcher may be forced to involve him/herself in the situations where his/her respondents are, at the same time taking notes and/or recording. Since this study deals directly with livelihood research, observing the activities in the lake, surrounding housing and settlements, livelihood activities, physical health of water vessel accidents victims as well as appearances of informants (though sometimes deceptive) gave me a first-hand impression about the relative vulnerability situation of households.

Further, the researcher traveled on boats and ships filled with commuters' crossing over the lake to observe their livelihood changes besides knowing boat operators and commuters' attitude towards safety measures like wearing life jackets. The observation was important for this study as it provided a visual impression, enable the addition or restructuring of the study being assessed.

3.5.5 Informal Interviews

Informal interviews were also employed by the study. (Cohen & Crabtree, 2006) states that informal interviewing is typically done as part of the process of observing a social setting of interest best used in the early stages of the development of an area of inquiry, where there is little literature describing the setting, experience, culture, or issue of interest. This study employed this during the traveling I conducted to observe boat operators' and passengers' attitudes' mitigative strategies.

Though considered as a minor research technique, informal interviews were provided

some foundation for developing and conducting more structured interviews. In addition, they were very productive in that they helped clarify some issues and reveal some critical information that a number of key informants in given offices are not allowed to share.

3.5.6 Document Analysis

According to Hammersley and Atkinson (2007), majority the segments of the society that we research on today are already studied by State, Ministries and other State Corporations. The results can be found in the form of written materials which include reports, memorandum and organizational charts. Therefore, this study obtained records relating to Multinational Lake Victoria Maritime Communications and Transport from Kenya Maritime Authority (KMA). From there, the study assessed the provision of daily weather reports and alerts to people on the lake (via text message and radio broadcasts), expansion of mobile phone coverage and building of the intended network of 22 rescue centers along Lake Victoria shore.

The study later assessed whether the 111-type number to report emergencies within the lake had been created and its impact in reducing water vessel accidents. KMA offices also provided the researcher with access to the Lake Victoria Transport Act of 2007 and other line legislation passed earlier to curb water vessel accidents menace.

Other information obtained from KMA database includes a list of all notable water vessel accidents that have occurred since 1980, the existence of navigational aids, navigational charts and nautical surveys, buoys carrying floating automatic weather stations.

Lastly, the study confirmed that the Kenyan government through KMA has adopted the donation of life jackets to fisher folks to enhance disaster mitigation. Although secondary data collected is important as it complements a few aspects of primary data, this study did not over dwell on it as secondary information is minimized due to some quality concerns and most of the data gathered does not reflect the reality on the group (Hammersley and Atkinson, 2007). Table 3.3 shows the summary of sampling distribution.

Table 3.3: Summary of Sample Size Distribution, sampling method, sample size and method of data collection

Population category	Target Population	Sample size determination	Sampling method	Sample size	Method of data collection
Household heads	29766	Fishers' Formular	- Simple random sampling	384	Questionnaires
Key Informants					
Security personnel	50	20%	Convenience	10	Interview
-Police officers			- Purposive		
Sub-County Commissioner	1	100%	- Simple Random sampling	1	Interview
Ward Administrators	5	100%	Census	5	Interview
Beach Managers	5	100%	- Census	5	Interview
Fishery Department officials	15	30%	-Purposive	5	Interview
Chiefs and assistant chiefs	10	100%	- Census	5	Interview
KMA officials					
Victims of water vessels accidents	200	10%	- Purposive	20	FGDs
Fishmongers, fishers	200	25%	-Snowballing		
			Purposive	50	FGDs

Source: Researcher. 2021

3.6 Data Processing and Analysis

The data was cleaned by the researcher using a process that involved listing the data, removing errors, examining extreme numbers, and making necessary edits to maintain consistency. A combination of qualitative and quantitative data were used by the researcher. The analysis of qualitative data involved the examination of measures of central tendency, frequency counts, and proportions. Before analysis, “both primary and secondary data from various sources was processed”. Quantitative data was edited, coded and entered in SPSS version 26 for analysis. While qualitative data was recorded thematically through verbatim.

The quantitative data was subjected to analysis through the utilization of descriptive statistics, specifically frequencies and percentages. The researcher presented the conclusions of the data in various visual formats, including frequency tables, pie charts, bar graphs, and narratives. Data analysis is the process of bringing order, structure and meaning to the mass of collected data by way of interpretation of the result Strydom, Fouche and Delport (2005). Most often it is difficult to explain raw data and find meaning- making the researcher to first describe and analyze the data and then interpret the results of the analysis.

According to Hammersley and Atkinson, (2007) analysis means the categorization, ordering, manipulating and summarizing data to obtain answers to research questions. The main purpose of the analysis is that it helps in keeping human bias away from research conclusions with the help of proper statistical treatment and reduces data into a consumable form so that the relations of research problems can be studied tested and conclusions are drawn.

For qualitative data analysis (Paton, 1990) suggests that there is no one kind of analysis but rather a variety of existing approaches relating to the different perspectives and purposes of researchers. To ensure accurate information, this study used a content analysis approach for both primary and secondary data.

3.7 Pilot Study

According to Peat *et al.* (2002), a pilot study is a ‘small study that the research may be engaged in to test his/ her research protocols, instruments, sample recruitment strategies, and other research techniques in preparation for the actual study. It involves pretesting of objectives to see if the idea is researchable and may be also used to determine the cost, time, and potential impact of the research before engaging on the actual study area (Teijlingen & Hundley, 2001).

Pilot study is one of the significant stages during the research project in that it in identifying loopholes, problematic areas and absurdity of the research instruments before to implementation during the full study (Teijlingen & Hundley, 2001). Additionally, a pilot study can also assist the research to familiarize with tools, protocols and terms and can help them decide between two competing study methods such as using in-depth interviews and informal interviews. This study’s pilot study was carried out at Usenge in Bondo sub-county because it has the same characteristics of the study area.

3.8 Reliability and Validity of Instruments

Results obtained from the study were validated for suitability with the support of two criteria such as reliability and validity of the research instruments.

3.8.1 Reliability of Instruments

Reliability refers to the measure of stability or consistency of the tools. Sandelowski (2000), presents it as the ability for a test or research findings to be repeatable. Reliability in this study was assisted by getting a proper definition of terms used and understanding of concepts to avoid ambiguities. Before going to the field to collect data, the researcher cross-checked, scrutinized and assessed the research instruments to make they are accurate, relevant and consistent with the topics of the study. In this study, the reliability of the research instruments was established using Cronbach Alpha Coefficient (CAC) analysis. The study therefore, obtained coefficient reliability of 0.78 showing higher reliability of the research instruments.

Employment of this enabled the researcher to establish whether the content in question items deals with and reflects the content and objectives of the study (Patton, 1990). For a qualitative study to establish reliability there was the need for appropriate checking procedures that ensured that the work is open to scrutiny by users of the research and each stage of the research was documented carefully, (Bradshaw & Stratford, 2010). This was done by first undertaking a review of the literature regarding water vessel accidents and household to assure these research users that the study was not conducted in a vacuum.

3.8.2 Validity of Instruments

Paton (1990) suggested that an instrument is valid if it measures what it is intended to measure and accurately achieves the purpose for which it was designed. Validity is a matter of degree and discussion should focus on how valid a test is, not whether it is valid or not. No test instrument is perfectly valid and researchers need some kind of assurance that the instrument used may result into inaccurate conclusions before

generalization (Wallen and Fraenkel, 2001).

In addition, Kothari (2009) states that to mostly the validity of the results depends upon the quality of the raw data collected which in turn also depends upon the research tools employed meaning valid and reliable research instruments translates into valid and reliable findings (Kothari, 2009). For enhancement of reliability, the researcher designed instruments with simple, clear, logical and comprehensive questions. Designed research instruments was then given to the supervisors at MMUST for review and advice. This enabled the researcher to check the wordings and content validity of the instruments for optimal data.

Being that the data collection method allowed the researcher to have an opportunity to ask probing questions and sought clarifications where it was necessary it was a true indication that the primary data to be collected was a fair reflection of the problem being studied.

3.9 Limitations and Delimitation of the Study

While conducting this study the researcher encountered various challenges which might include accessible regions like islands in the lake which may delay data collection. This was overcome by hiring fishing boats or motorcycles in areas having poor roads. Secondly, the researcher projected that some respondents would be unwilling to respond to interviews or FGDs due to secrecy, hence the researcher moved to interruption-free areas or postponed the interview.

3.10 Ethical Considerations

The researcher got an introduction letter from the Directorate of Postgraduate Studies of MMUST which was used to obtain authorization and permit from the National Commission of Science and Technology Innovation (NACOSTI), before conducting the

research. The researcher then moved to obtain a permit from the Deputy County Commissioner in Mbita Sub-County.

According to Gray (2009), the overarching principle of ethics in research is that the respondent must always have to give his/her informed consent. This study, therefore, ensured utmost respect for informants' freedom of participating in the study or declining to participate in the study and also of withdrawal from an interview at their wish. For a positive response, special attention was, therefore, be given to building cooperation over time and providing clear information before interview invitation. The respondents who accepted our invitation were assured of the information confidentiality to reduce their personal fears.

Since this study investigated households' livelihoods, examined the people's livelihoods, it subjected some respondents to painful memories of the water vessel accidents event as they recalled the last activities during the in-depth interview. This was coupled with emotional traumatic problems which the researcher controlled by consolation chipping in of words which may ignite laughter making the respondent forget with the bitter memories hence prevent them from shedding tears.

3.11 Chapter Summary

This chapter has given an overview of the research design, area of study, sampling size and sample strategies. It highlights the choice of method and research techniques, data processing and analysis, pilot study, reliability and validity of instruments. This chapter also provides the limitations of the study and ethical considerations.

CHAPTER FOUR:
DETERMINE THE PREVALENCE OF LAKE VICTORIA
WATER VESSEL ACCIDENTS IN MBITA SUB-COUNTY,
KENYA.

Introduction

This chapter begins with the presentation of key demographic information of respondents that gave insight on the effects of Lake Victoria water vessel accidents on the Socio-Economic Development of households, for instance, how old are you? your gender, marital status, the highest level of education, how long you have been in the fisheries sector, the main source of livelihood, average income from the main source of livelihoods and number of people per household. It then provides findings and discussion on the first objective of this study; to identify water vessel accidents and their prevalence within Lake Victoria in Kenya. This chapter ends with a summary.

4.1 Demographic Characteristics of Respondents

This section presents information on demographic characteristics of various categories of respondents that are significant for this study. The demographic characteristics that were examined were; Gender of the respondents, Age, Marital status, level of education, how long they have living along Lake Victoria and Source of livelihood.

4.1.1 Distribution of the respondents by Gender

This section presents the information concerning the gender of the respondents who participated in this study. Figure 4.1 below shows the findings on the gender of the respondents. The study revealed that majority 57% (219) of the respondents were female while 43% (165) were male.

The disparity in the percentages of gender distribution was because there are many jobs done in the post-harvesting stage of fisheries by women therefore the higher number. Additionally, most of the victims of the water vessel accidents are men thereby reducing their numbers in the beaches.

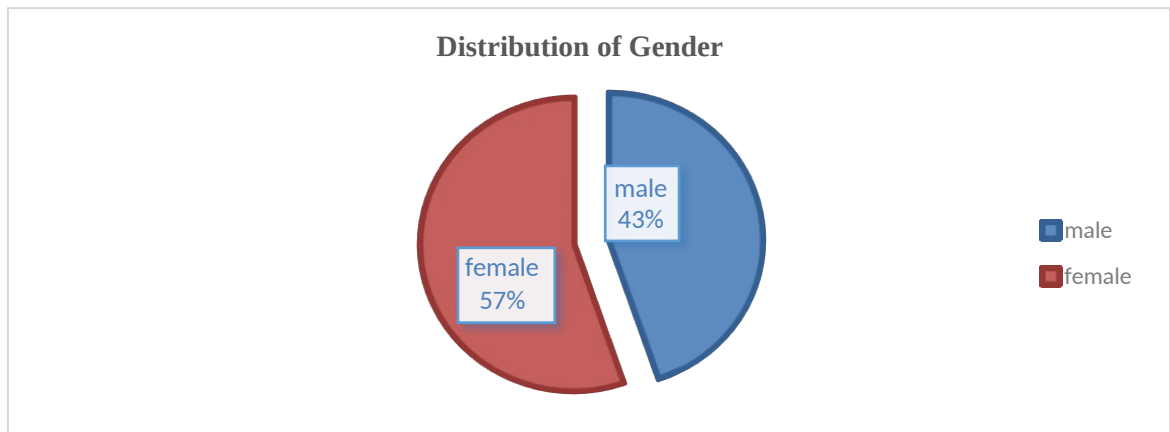


Figure 4.4 Distribution of respondents by gender N=384

Source Field Data, 2021

4.1.2 Distribution of the Respondents by Age

Respondents were asked to state their age brackets and the following is the presentation of the ages. The findings were presented in Table 4.1.

Table 4.1 Distributions of the Respondents by Age (N=384)

Age Distributions	Frequency	Percent
18-25 years	70	18.2
26-33 Years	79	20.6
34-41 Years	95	24.7
42-49 Years	84	21.8
50 Years and Above	56	14.6
Total	384	100.0

Source: Field Data 2021

The result in Table 4.1 above shows that majority 24.7% (95) of the respondents were in the age bracket 34-41 years followed by age bracket 42-49 at 21.8% (84). Those in the age bracket 26-33 were 20.6% (79) while those in the age bracket 18-25 years were 18.2% (70) and those in the age bracket 50 years above were 14.6% (56). This is due to complication in fisheries which requires people who have a lot of strength to the catching and transportation, processing and sale. That could be the reason why the majority of the respondents are people below 45 years of age.

This finding is consistent with a study conducted by Barrow et al, (2022) “in a different region, indicating similarities in the age distribution of fishermen. Regional differences in the age composition of the fishing workforce can be attributed to various factors, including economic opportunities, cultural traditions, regulatory policies, migration patterns, economic incentives, and technological advancements. These factors collectively influence the number of younger and older individuals engaged in fishing in different regions, highlighting the need for tailored approaches to address the unique challenges faced by fishermen in each area”.

4.1.3 Distributions of the respondents by marital status

The respondents were asked to indicate their marital status. Their responses as indicated in Fig 4.2

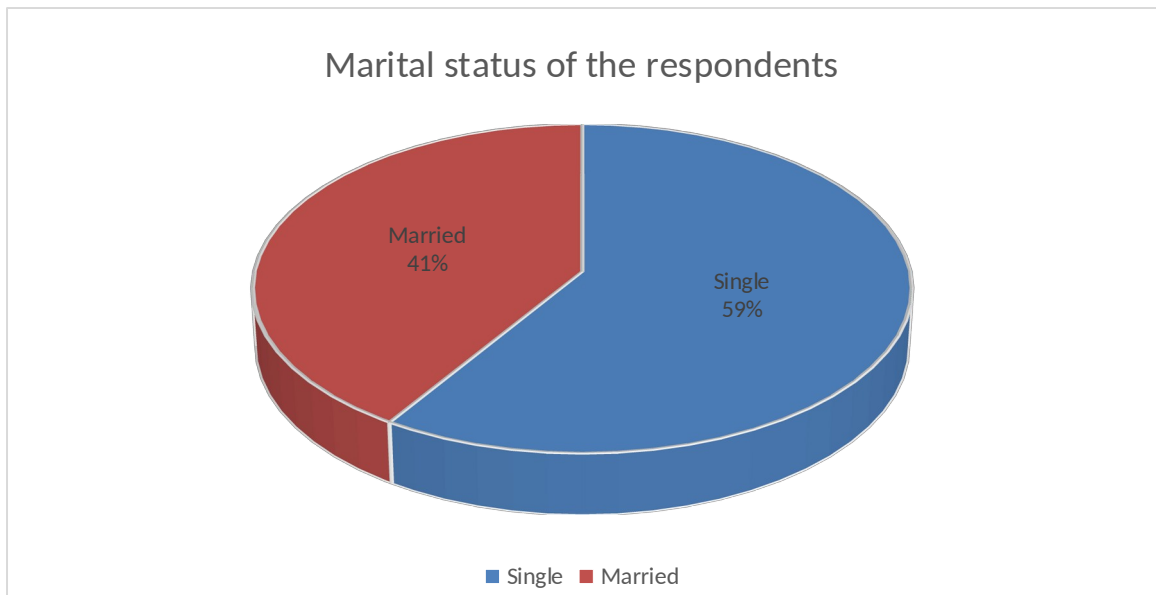


Figure 4.5 Distributions of the respondents by the marital status N=384

Source: Field Data, 2021

On the marital status of the respondents, the study revealed that the majority 59% (227) were single 41% (157) were married. The single respondents may be as a result of not yet married, divorced, widows or widowers. The other point relating to majority being single is the nature of fishing sector where people keep on migrating from beach A to beach B depending on where the catch is booming. The makes it difficult for the fishers to keep married, some tend to remain single for long times.

4.1.4 Distributions of the respondents by marital status for those who responded single.

The study further asked the respondents who stated that they were being single to explain why they are single. The responses are as presented in Figure 4.3.

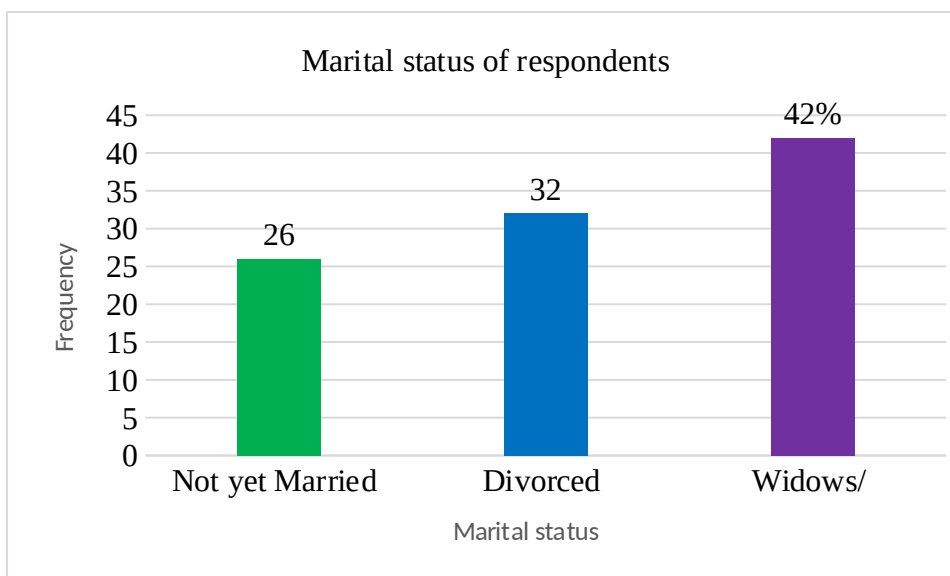


Figure 4.6 Distributions of the respondents by marital status for those who responded single N=384

Source: Field Data 2021

Of those who responded that their marital status as single, majority 42% (96) were widows/ widowers followed by those who divorced at 32% (73) and, those who were not yet married were 26% (58). Widows/ widowers were many as men are the main victims of boats and ships accidents because they are the ones who are crew members and again on the fact of the HIV/ AIDs prevalence in the area. Divorcees are also many due to the nature of life along the Lake where migration is the norm of the day and some have decided to remain single.

4.1.5 Distribution of the respondents by the highest level of education attained.

The study asked the respondents to state their highest level of education attained. Table 4.2 presents the findings.

Table 4.2 Distribution of the respondents by the highest level of education attained (N=384)

Highest level of education	Frequency	Percentage
Below Class Seven	134	35
Completed Class Eight	119	31
Completed Secondary Education	78	20
College/ University	53	14
Total	384	100.0

Source: Field Data 2021

Findings in the Table 4.2 above revealed that majority 35% (134) of respondents did not complete class Eight, they went up to class seven, 31% (119) of respondents completed class Eight. Another 20% (78) completed Secondary education and 14% (53) of respondents went up to College or University. Given these characteristics, they were expected to be of sound mind and body to understand the central theme of this investigation and to make meaningful contributions. Regarding education levels, the study findings align with previous research by Bhuyan et al, (2016) which emphasized a prevalent low level of education among fishermen, with a significant proportion having only primary or lower secondary education.

According to the study, “crew members' familial relationships continue to be very important in beach seine fisheries (Tietze et al., 2011, pp. 19–22). Beach seine crew members have low educational attainment and a high rate of illiteracy. One facet of poverty and vulnerability among beach seining participants is low reading and education levels, which impedes their career and geographic mobility as well as their political empowerment”.

A rise in fishermen's earnings is not directly caused by education. Because fisherman are not aware of the need to preserve and enhance children's education, “their level of poverty is impacted by their education. As to Pancasasti (2008), Velentina (2018), and Vibriyanti (2019), fishermen are more prone to depend on intermediaries to obtain loans. According to Putri et al. (2018), fishermen typically spend more on cigarette and gas purchases than they do on saving for schoolchildren's needs. Also, fishermen typically only have an elementary level education, and some of them never attend school at all”. A fisherman's perspective is influenced by the existence of varying educational levels. This supports the idea put forth by Bakir in Trianti (2007) that farmers with higher levels of education have a broader perspective and, naturally, will adopt innovations more quickly.

4.1.6 Duration in the fishing industry

The researcher asked the respondents to state how long they have been in the fishing industry. Table 4.3 present the findings.

Table 4.3 How long have you been in the fishing industry (N=384)

Numbers of Years	Frequency	Percent
Less than a year	59	15.0
Not more than 3 years	84	22.0
Five years	107	28.0
Many years	134	35.0
Total	384	100.0

Source: Field Data, 2021

Majority 35% (134) have been in fishing for many years followed by 28% (107) have been in the sector for five years, another 22% (84) have been in the industry for not more than three years and 15% (59) have been in the industry for some months.

Fishermen with the most experience will have even greater income levels, “according to the path analysis results between their experience and income level. According to study, fishermen typically have 30 years of expertise. As a result of this experience, fishermen may become more accustomed to the weather conditions at sea, have a large crew, have the necessary funds, and even begin to market directly to consumers due to the numerous connections”. The study's findings are consistent with those of Primyastanto et al. (2012), Abd. Rahim, and Dwi Hastuti (2016), as well as Ridha (2017).

On average, “fisherman have been using outboard motors for fishing for more than 13 years. The success of marine fish output will be influenced by fishermen's experience conducting fishing operations. Fishermen's production of marine fish will be influenced by the diversity of their capital, labor, and experience in the sea” (Dahen, 2016). Additionally, research by Dahen (2016) found that “the more diverse the capital, labor, and experience of fishermen in seawater, the more they will influence the amount of marine fish production caught, which in turn affects the amount of fishermen's income”.

Ariska & Prayitno (2019) have also demonstrated the impact of years spent at sea on earnings. According to them, the longer fishermen work, “the more money they make, therefore working longer is crucial to catching more fish. The longer the fishermen have been at sea, the more fish they can catch, and the more money Narayan will make”. Additionally, Wiyasa (2017) contends that “the number of years or periods of time spent

working have an impact on employee productivity. In general, offshore fishing, which is conducted for a longer period of time and is located further from the fishing target region, has a higher chance of producing more catches and undoubtedly offers greater income compared to nearshore fishing” (Trisnawati et al., 2013).

4.1.7 Number of Household members

The researcher asked respondents to state number of their household members. Figure 4.4 provides summary of the findings.

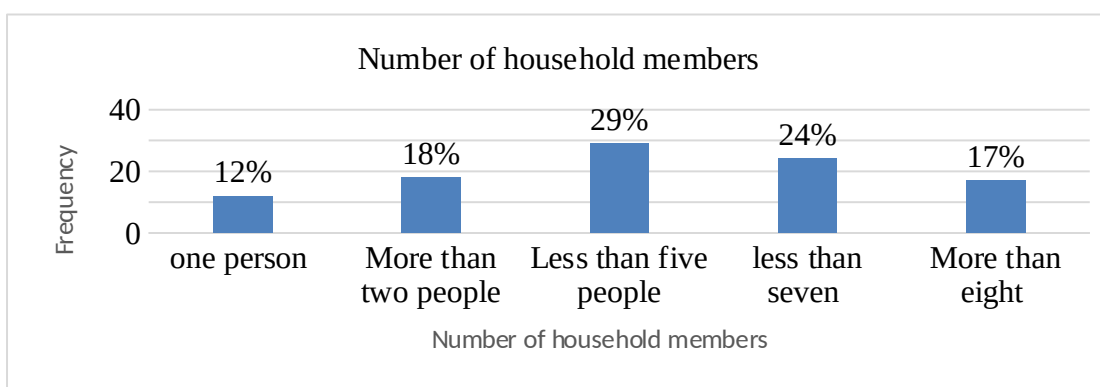


Figure 4.4 Number of Household Members (N= 384)

Source: Field Data, 2021

Majority of 29% (111) have less than five people in the household followed by 24% (93) with less than seven members in the household, 18% (68) more than two people in the household, 17% (65) having more than eight people in the household and 12% (47) represents those living alone.

4.1.8 Approximate daily Income of the respondents

Respondents were asked to indicate the approximate of income they get monthly. Table 4.4 presents the summary of the findings.

Table 4.4 Daily income of respondents

Income / Month	Frequency	Percentage
Less \$1/day	95	25
>\$1/day<\$3.75/day	127	33
>\$3.75/day<\$5/day	162	42
Total	384	100.00

Source: Field Data, 2021

The majority 42% (162) indicated that their daily income is >\$1/day <\$3.75/day followed by 33% (127) who indicated that their daily income >\$3.75/day <\$5/day and 25% (95) indicated that their daily income is <\$1/day.

From the World Bank, those who earn <1/day are living below the poverty line. So, the study findings revealed that the majority are living above the poverty line which is a result of livelihood diversification. This finding is in agreement with Omwenga *et al* (2000), that there are high levels of poverty with reduced income along with Lake Victoria. This is evident in the high number of cases of malnutrition amongst communities living around, low standards of living and high infection from waterborne diseases.

According to Rahmawati (2017), fishermen's revenue level is determined by whether they sell their seafood directly to the market or through intermediary brokers. According to Dahan's (2016) research, the income of Acehnese fisherman was determined by their capital, working hours, and job experience. According to Esa and Putra's (2016) research, however, fishermen's revenue in Bali Province's Batununggul village is unaffected by the sea's long-term experience, operational costs, or quantity. According to the findings of Rahim's (2017) study, the productivity of the capture industry and our kerosene had a positive impact on the income of motorboat fishermen along the South Sulawesi coast. Nevertheless, the gasoline prices, long overseas travel, and variations in the capture area had a negative impact.

The findings of the calculation regression have demonstrated the consistency with the theory proposed by Keynes in Mankiew (2013), according to which improvements in income will have an effect on public savings and consumption, which in turn will have an effect on public savings and accumulation capital, resulting in an increase in business capital. The hypothesis is backed by research by Bastian (2004), which shows that fishermen's income is beneficial and significant to improving the economy, community savings, community venture capital stock, and daily demands of the public.

If fishermen do not employ quality fishing gear, their capital-and season-based revenue will not function effectively. According to Putra et al. (2017), technology has a significant impact on catching. Fishing communities' fundamental requirements are increasingly being met by the more modern fishing gear they employ, which will increase fishermen's catch and impact their income.

Sastrohadiwiryo (2001) asserts that “length of service considers both the number of years of employment and the nature of the activity that has been or is regularly performed. As the amount of work increases, so will an individual's knowledge and abilities in the workplace to support attempts to optimize earnings. According to Iry & Rain (2020), a fisherman's fishing income increased with their length of employment. The theory of time allocation, as described by G. Becker (1994), shows that everyone has a certain amount of time for work and other pursuits”.

According to Putra (2019), “working hours at sea are positively correlated with changes in income, and the length of time at sea is the amount of time fisherman spend conducting one-day fishing operations at sea. In order to increase or produce more fish, fisherman must work longer hours because their earnings rise with the amount of time they spend fishing”. According to Ariska and Prayitno (2019), fisherman can produce more fish and earn more money if they work longer hours at sea.

4.2 Water vessel accidents occurrence in Lake Victoria

The study asked the respondents to mention if water vessel accidents do occur in Lake Victoria on the Kenyan side. The findings are presented in the Figure 4.5.

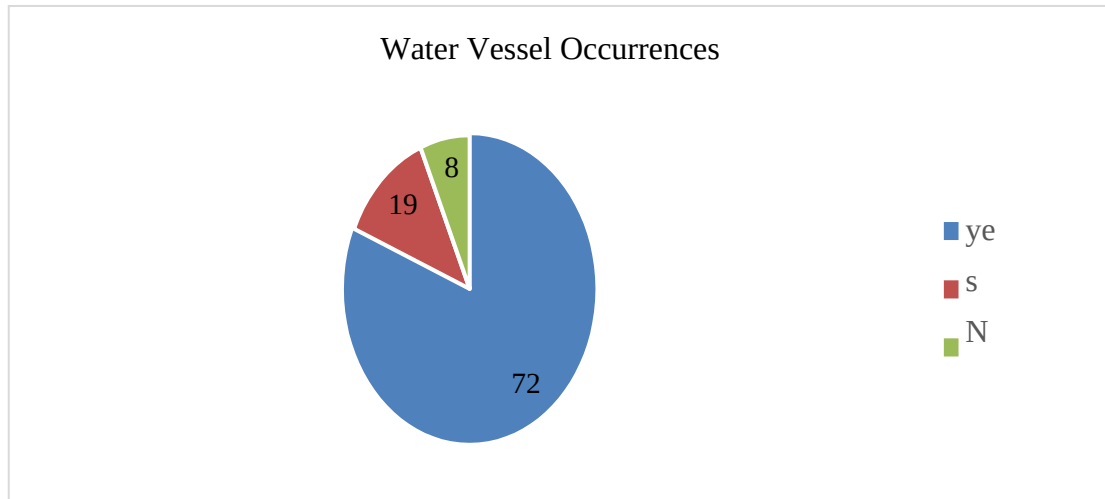


Figure 4.5 Water vessel accidents occurrences in Lake Victoria (N=384)

Source: Field Data, 2021

The findings revealed that water vessel accidents do occur in Lake Victoria with majority 73% (280) responding yes, 19% (72) said no while 08% (32) of the respondents said they are not aware of the occurrence of the water vessel accidents.

From the findings in Figure 4.5, it clear that water vessel accidents are frequent in Lake Victoria on the Kenyan side. During an In-depth interview in Mbita Town, respondent #03 stated that;

Since independence we have lost many people in Lake Victoria, some were crossing from Mfangano Island to Mbita for business, others are fishermen who drowned in water due to bad weather or the boat capsizing in the deep lake far from the mainland (In-depth interview #02 on 22/ 7/2020).

During focused group discussion in Rusinga Island elderly man FGD#7 stated that;

Many people have lost their lives in Lake Victoria since I came here in 1990s, the disasters do not occur every day or week but it is unpredicted. At times we can even take three months before you hear of any accident but during rainy seasons you can hear them even daily, sometimes with casualties or not (FGDs#07 on 26 July/ 2020).

The researcher further asked the respondents to identify some notable water vessel accidents in Lake Victoria on the Kenyan side. The respondents mentioned some disasters that they still remember update. During an interview with an elderly lady respondent #04, who has been in the fishing industry for sometimes now, she stated that.

The water vessel accidents that I remember is the one that claimed the lives of around 60 people somewhere between Mbita and Homa bay in 1994. The road connecting Mbita and Homa Bay town was terrible so people used motorboats as a means of transport or the ships but ships were too slow with strict time. So, on this day the motor-powered boat left Mbita town at around 8:30 after one hour they were approaching Homa Bay where the accident took place. Many people perished (Interview #04, 27/7/2020).

In focused group discussions, one respondent stated that.

The other incident of the water vessel accidents I remember is the one that happened around 2010 between Mbita and Mfangano Island where the people from one family died in the water. The boat they were traveling in was overloaded with building materials so they sunk in water. Some people were rescued, others swam to the nearby shore but these three brothers who contractors in one school in Mfangano, unfortunately, perished (FGDs #02 on 18/7/2020).

From those responses, there are indications that water vessel accidents have occurred on several occasions in Mbita Sub County. There are also some Maritime accidents where a boat capsizes and all the occupants are rescued or one perishes, at times accidents are caused by wildlife in water such as Hippos and crocodiles, and in some incidences, a crew member may accidentally fall in the water. These are common happenings along the Lake Victoria. The researcher asked respondents for a brief history of water vessel accidents in this community as they identify the notable disasters?

This study concurs with Robert (2017), *Dangerous Crossing of the Mediterranean Sea* examines the plight of the Europe-bound African migrants, who arrive daily from Ethiopia, Sudan, Nigeria, Gambia, and other countries who cross the sea from Agadez,

Niger to the 1500 miles Tripoli in Italy to look for economic opportunities to alleviate the suffering of their families back in Africa. Nakyonzi (2011) further confirms the findings that travelers on Lake Victoria suffer from hazardous events which reduce its safety standards. In 2010, Lake Victoria Basin Commission (LVBC) also gave the statistics of those who die in Lake Victoria annually to be 5,000 people. Since the 1990s to date, earth-shaking water vessel accidents have happened with the introduction of modern big carrier water vessels like the capsizing of MV Bukoba and MV Nyangemi.

Maritime accidents can result in loss of life, severe environmental damage, and financial loss (Adland et al., 2021). According to the European Maritime Safety Agency (EMSA, 2022), 2854 ships within the EU states were involved in accidents in 2021, of which 14 vessels were lost, 36 were fatalities, and 58 accidents involved marine pollution. In the period from 2014 to 2021, more than half of all maritime accidents took place in internal waters (port areas and others), and 44 % were “en route”, meaning in transit from point “A” to point “B”.

4.2.1 Frequency of water vessel accidents in Lake Victoria

The study asked the respondents to mention the frequency of water vessel accidents in Lake Victoria. The Table 4.5 is the presentation of the findings.

Table 4.5 Frequency of water vessel accidents in L. Victoria (N=384)

Water vessel accidents Occurrence	Frequency	Percent
Frequently	38	10
Rarely	53	14
Monthly	87	23
Unpredicted	206	53
Total	384	100.0

Source: Field Data, 2021

From Table 4.5 above majority 53% (206) responded that the frequency of the water vessel accidents in L. Victoria is unpredicted as they are accidents followed by 23% (87) who responded that they do occur monthly, 14% (53) responded that they rarely occur while 10% (38) responded that they do occur frequently. There were variances in the responses across which might be due to the background of the respondents. In focused group discussion, one respondent stated that.

The frequency of the water vessel accidents cannot be determined or predicted; they sometimes occur frequently while at times you can even take three to four years before you hear of an accident in L. Victoria. The accident major depends on some factors such as bad weather, state of the boat and just mere bad luck (Response from FGDs #06 on 02/08/2020).

Robert (2017), confirms the above field findings that thousands of these migrants die yearly in the sea as about 300 people are jammed into a small boat usually prone to motor failure and carriage of overweight within the water vessels. For instance, when some 300 Europe-bound African migrants drowned in 2015 as Italian navy sea rescue mission turned fatal.

Fishing for a living is a hazardous and stressful job. Commercial fishing in Alaska is still 29 times more dangerous than any other occupation in the United States, despite improvements over the years (Lazakis, Kurt, & Turan, 2015; Rezaee, Seiler, Pelot, &

Ghasemi, 2016; Syron et al., 2017). Over the 15-year period from 2000 to 2014, 179 people died as a result of fishing, with an average of 12 deaths annually (Syron et al., 2017). According to Sirin et al. (2017), drowning from falling overboard was the second most common cause of death, followed by vessel mishaps such sinking, capsizing, running aground, or fires that prompted crew to abandon ship (31%). In contrast to the 1980s and 1990s, when Alaska's crab fishery was the leading cause of injuries and fatalities, the salmon fishery is currently the state's deadliest catch (Case, Lincoln, & Lucas, 2018).

This study also supports the findings of Yip et al. (2015), who concluded that the two most common types of passenger vessel accidents are loss of maneuverability (30.0%, 18.6%, and 21.7% for ferry, ocean cruise, and river cruise vessels, respectively) and material failure (44.6%, 26.2%, and 32.5% for these types of vessels). Damage to the environment (17.9%) for ocean cruise ships and collision (15.7%) for river cruise ships are other common accident types.

A ferry involved in an accident is typically 22.9 years old and weighs 1,282 gross tons. An ocean cruise ship involved in an accident is typically 13.4 years old and weighs 54,369 gross tonnage. The averages for a river cruise ship are 22.1 years and 1,677 gross tonnage, respectively. Nearly all river cruise ships and ferries are registered under US flags. On the other hand, just 10.6% of ocean cruise ships are registered under US flags. The majority of passenger ships have steel hulls and are powered by diesel.



Plate (4. 1) Waterbus operating in Lake Victoria Capsizes

Source: Field Data, 2021

According to On Wuegbuchunam (2013), the number of marine accidents in Nigeria rises in tandem with the amount of oil prospecting and other maritime transportation activities throughout the Niger Delta and coastal regions. For instance, it is known that 552 people lost their lives in Nigerian inland waters as a result of boat and marine vessel collisions or capsizing between 2000 and 2009 (Dogarawa, 2012). Accordingly, an average of roughly 55 fatalities annually, excluding vessel and cargo losses, have been documented across Nigeria's inland and coastal waterways throughout the past ten years (Ekpo, 2012).

Maritime accidents are unexpected, unusual occurrences involving ships that regularly result in fatalities, serious injuries or property damage. These challenges have grown to be a major problem in the maritime industry (Jiang & Lu, 2020). Serious maritime accidents might result in deaths, economic loss, pollution, and traffic congestion, as well as an increase in trade costs and volume (Liu et al., 2021).

Eleftheria et al. (2016) analysed the frequency of ship accidents (normalised by yearly operational ships) of various kinds of vessels using a sample of 4,572 incidents worldwide. Bulk carriers, general cargo ships and other Ro-Ro cargo vessels were discovered to be the most prone to accidents. Fishing, liquefied natural gas (LNG), liquified petroleum gas (LPG) and reefer vessels were the least accident prone. The

study found that increasing ship age heightened the chance of accidents and discovered a favourable relationship between the age of vehicle carriers and bulk carriers and accident frequencies.

4.2.2 Causes of water vessel accidents in Lake Victoria

The study asked respondents to mention some of the causes of the water vessel accidents in Lake Victoria. Figure 4.6 presents the findings.

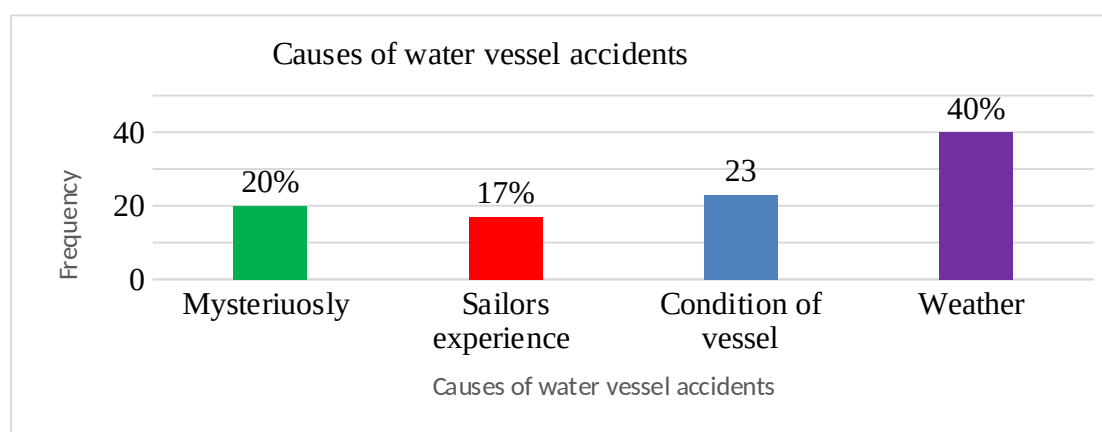


Figure 4.6 The causes of water vessel accidents in Lake Victoria (N=384).

Source: Field Data, 2021

From figure 4.6 the study revealed that 40% (152) responded that the main cause of water vessel accidents in Lake Victoria is bad weather conditions. Bad weather such as stormy waters, strong winds and others are the main causes of a water vessel accidents. 23% (87) responded mystery that water vessel accidents are the state or condition of the vessel for instance the size of the boat or ship where the small sized vessel cannot navigate strong waves easily and are prone to accidents.

The other 20% (78) said its cause is mysterious as it cannot be explained, it gets people unaware. Mystery or unknown cause of maritime is relating to some superstitious

argument and finally the knowledge and experience of the sailors and crews in terms of interpreting the weather, making right decisions and even swimming. Finally, 17% (67) of the respondents responded that sailors or crews' knowledge of the lake and currents may cause the disaster.

Lake Victoria has got many hidden secrets of which some cannot be shared due to fear of revenge on us. But the most common belief here is that we have evil spirits popularly known by locals as *nyawawa* which is solely responsible for the causes of many water vessel accidents, especially of twins (In-depth interview #2, on 13/08/2020).

The findings are confirmed by Robert (2017), The Europe-bound African migrants use small boats or rubber rafts to cross through the harsh and dangerous Mediterranean Sea. The size of the boat and nature can lead to fatality in the sea or lake. The finding is also concurring with the East Africa report on Monday July 04/2016 by LVBC, the deaths are caused by unstable boats, bad weather, overloading, lack of safety equipment and poor seamanship and now with stubborn weed, hyacinth water has blocked many waterways and landing sites, the latest cause of accidents.

The bulk of wrecked/stranded incidents happen on cargo ships, such as tankers, bulk carriers, and general cargo ships, according to Papanikolaou et al. (2015). The majority of wrecked/stranded incidents are caused by tugs and general cargo ships, accounting for 29% and 25% of all incidents, respectively. The lowest percentage is made up of fishing boats and containerships, each of which accounts for 4%. According to Shigunov and Papanikolaou (2014), the most common reason for wrecked or stranded instances is growing storms, which lead a ship to lie at anchor until it begins to drag. According to Papanikolaou et al. (2015), this reduces power and maneuverability for safe operation in bad weather. Wrecked and stranded occurrences can be caused by rotating tides. Because of the issue of draft, several ports worldwide only permit ships to enter during

high tide. Due to unforeseen tide changes, ships anchored at a port may experience this scenario. A ship's bottom hits the ocean floor when it is stranded or wrecked, resulting in structural damage. Similar to crashes, shipwrecks and strandings have also been caused by human error.

The issue of ship and fisherman safety is a matter of global concern (Putra et al., 2017). There are many international policies regarding safety at sea. The IMO states that human error causes 80% of accidents, and most of these errors can be attributed to management errors that cause pre-conditions for accidents (Purwangka et al., 2013). The three components of successful operations are fishing vessels, fishing equipment, and fishermen (Soeboer et al., 2018). Starting from calm waters to wavy waters, the potential for accidents is very large, including sinking ships, ship collisions, ships capsizing. Human error, natural factors and technical factors are the causes of these accidents (Putra et al., 2017). Working as a fisherman is work that is prone to accidents during fishing activities (Amrulloh et al., 2022). This accident can be caused by many factors, one of which is humans themselves who are not careful (human error). Fishing vessel crew accidents can be caused by five factors (Hendrawan, 2017), namely low crew awareness regarding work safety in shipping and fishing activities, low mastery of navigation and fishing safety competencies, ships not being equipped with safety equipment as they should be, human error and ship safety equipment, bad weather such as waves large and suffer from serious illnesses during shipping (Mansi et al., 2019). The findings are also supported by Golden and Weisbrod (2016), who found that major international news outlets rarely or never cover accidents, and that incomplete record-keeping in many developing nations hinders efforts to monitor water vessel safety in the developing world, particularly in Africa. Since there is no alarm in place in the event of a calamity, this could also result in catastrophes.

“The fact that cruise ships carry large and diverse groups of people means that their officers, staff and crew need a clear understanding of human responses in emergencies and an ability to deal with crowds. The areas directly related to human behavior and crowd control might include the ability of giving clear and reassuring order, dealing with passengers’ special needs and keeping order, reducing or avoiding panic” (Lois et al., 2004, p. 107). “Confusion is often caused by poor or ineffective communication between the various parties involved, such as the misunderstanding arising from a range of native languages among the crew. To a large extent, this type of error can be reduced by careful selection and adequate training of crew” (Lois et al., 2004, p. 108). The knowledge or experience and information flow among the crew of a cruise vessel may be inadequate for promoting cruise vessel safety.



Plate (4. 2) A sailor draws water from the boat as he pours it back into the lake due to the load on the boat and the water waves that let in water from behind

Source: Researcher, (2021)

The results supported Brander's (2007) claim that future fisheries production in both inland and marine systems will likely be significantly impacted by the frequency and severity of rainfall events. This study found that fish harvest for certain fish species was higher during periods of heavy rainfall, even though Brander (2007) did not explain

how rainfall frequency and intensity affected fish productivity.

Numerous sectors acknowledge that human mistake, commonly referred to as operator error, is a common source of mishaps and accidents. A number of errors can be included in it, such as errors of commission, where an operator performs an act incorrectly; errors of omission, where the act is forgotten or omitted; errors of timing, where the act is performed too early or too late; and errors of sequence, where the acts are performed in the wrong order (Latino 2007). According to conventional wisdom, which many writers have referenced, human error accounts for around 80% of maritime vessel accidents. Nevertheless, this figure has not been subjected to a thorough quantitative investigation, particularly for passenger vessels (Rothblum 2000).

In their analysis of 1079 maritime incidents, Paolo et al. (2021) revealed that exhaustion, stress, job pressure, and poor communication were frequently significant contributing causes to accidents in the round-the-clock shipping industry, where workers and ships are constantly pushed to their limits. The impact of human factors on maritime safety was examined by Fan et al. (2020) using a data-driven Bayesian Network (BN).

In order to meet their expenses and make a profit, many ferry operators purposefully overbook their vessels with people and cargo due to government regulations that enforce artificially low ticket rates (Lawson and Weisbrod 2005). It can be challenging to determine the exact number of people who are lost and to determine the overall number of dead and missing since operators frequently fail to document the names of passengers who board after a vessel's capacity has been reached. Accidents can be

caused by crowding, particularly when people cluster on the upper decks of a boat or flee to one side when they sense danger. If a ship is transporting hazardous or combustible materials, the risks can be considerably more acute. Improper stowing of heavy cargo cargoes can cause them to become unstable.

According to Asidu et al. (2018) and Mozumder et al. (2023), fish farmers and coastal communities are particularly affected by climate change, which has a negative influence on their livelihoods, fish availability and quality, and their housing, safety, and health. Due to low incomes, low production, small pond sizes, a lack of technological support, and ignorance of aquaculture operations, many small-scale fish farmers experience financial difficulties. According to data from the FAO (2020), tropical regions of Africa are most affected by climate change, with high temperatures that reduce aquaculture productivity. According to SSA climate trends, temperatures increased by about 0.7°C throughout the course of the 20th century, suggesting that all SSA regions will continue to see rising temperatures (Juana et al., 2013).

In the past, “the causes of marine accidents were mostly attributed to technological breakdown while the human element was neglected (Wayne et al., 2005). However, with continuous improvement in vessel design, technical infrastructure and global regulatory supervision, the frequency of technological failures has diminished and human factors have become more apparent determinant of marine accidents (Dogarawa, 2012; Cormier, 1994). (Rothblum et al., 2002) also identified some other human factors such as over-loading, excessive speeding, poor attention to weather conditions, fatigue, carelessness, calculated risk, improper loading, lack of training, cultural differences, incompetence and inadequate navigational aids. The shipping

industry cannot go on this way, with several deaths from accidents among seafarers every year. Thus, it may be argued that perhaps the cause of most marine accidents is related to human influence. The human factor plays a very vital role in the shipping industry. Ships require well trained and highly motivated crew in order to operate safely and efficiently”.

Further,” the findings are supported by Darbra and Casal, (2004) in their study on 471 cases of marine accidents that occurred from 1941- 2002 in Hong Kong observed that human factors accounted for about 57% of accidents which occurred while vessel was underway at sea and 43% of accidents occurred while berthing at ports. In like manner, the Canadian Transportation and Safety Board in 1994 reported that between the periods of 1995- 1996; 49% of marine vessel incidents were attributed to human factors, 35% due to technical factors while 16% were caused by environmental factors. Similarly, (Rothblum et al., 2002) reported that between 75 and 96% of marine vessel casualties are caused at least in part by some form of human error. Further empirical evidence also indicates that human error accounts for 84- 88% of tanker accidents, 79% of towing vessel groundings, 89- 96% of collisions, 75% of all collisions, 75% of fires and explosions” (Bryant, 1991).

4.2.3 Most vulnerable groups to the impacts of Lake Victoria water vessel accidents

The researcher asked respondents to indicate the groups of people who are vulnerable to the impacts of Lake Victoria water vessel accidents. Table 4.7 presents the most vulnerable groups to the impacts of L. Victoria water vessel accidents.

Table 4.7 Most vulnerable groups to the impacts of Lake Victoria water vessel accidents (N=384)

Vulnerable groups	Frequency	Percent
Fish mongers	68	18
Boat owners and family	114	30
Family members of Victims	160	42
BMU	42	10
Total	384	100.0

Source: Field Data, 2021

The findings revealed that the majority 42% (160) family members of Victims are the most vulnerable to the impacts of water vessel accidents followed by 30% (114) boat owners and their families are vulnerable. The findings further revealed that 18% (68) are Fish Mongers who are the most vulnerable victims while 10% (42) Beach Management Unit. In an interview, one of the respondents stated that.

Family members of the victims are the most vulnerable to the impacts of the water vessel accidents because they will have to pay the medical bill, incur funeral expenses and also will miss the support of the victims forever if dead. They may not be able to get their basic needs if the victim was the only provider to the family (Interview response #04 on 5/08/202).

In another Focused group discussion, one respondent said that;

Boat owners and their family members are the most vulnerable groups to the impacts of water vessel accidents because they lose their properties, investments and source of livelihoods. Some of

them borrowed loans in order to buy or make those boats and gears, so in case of accidents they lose a lot that can result in depression and other related diseases (FGDs #08 on 07/08/2020).

The finding is further confirmed by Kobusingye *et al* (2016) in a community-based survey on drowning among Lake Victoria fishing communities in Uganda indicated that 38.9% of the fishing communities had at least one member of their family in a life-threatening emergency in Lake Victoria waters which mostly occurred either during fishing or transportation. Of those family members involved in identified life-threatening emergencies in the lake, more than two-thirds of them drowned equating the drowning fatality rate in the lake as 502 deaths per every 100,000 population in the lake's boat using community.

In October 2012, “the passenger ship Lamma IV and the ferry Sea Smooth collided in Hong Kong, resulting in 92 injuries and 39 fatalities. In terms of the number of injuries sustained in Hong Kong, this catastrophe ranks as the deadliest vessel accident since 1971. 295 people, primarily high school students, perished in the April 2014 sinking of the ferry Sewol in Korea”.

More people are impacted by the death toll than just fisherman because it has an economic and social impact on their family and communities. When people believe they have little influence over their lives, they may accept their fate. Instead of pursuing education for their children and other self-improvement activities that require time, energy, money, and enough hope that delayed gratification becomes a viable behavior, they might be more inclined to choose life's pleasures and pay less attention to warnings about other risks like HIV. According to Asiki (2011), the villages surrounding Lake Victoria have some of the highest rates of HIV infection, poverty, illness, gender-based marginalization, violence, and illiteracy.

"An estimated 5,000 people per year die from severe weather on Lake Victoria," according to the recent study (Mary and Gomes, 2014). In addition to strong winds, waves, and lightning, unmaintained boats, a lack of life-saving gear, and a lack of navigational aids put fishermen at particular risk. Furthermore, storms of gale force can swiftly travel inland, destroying property, flora, and human populations, including medical facilities and schools" (Badjecka, 2010).

4.3 Chapter Summary

This chapter presented, analyzed and discussed the findings of the identification of water vessel accidents and their prevalence in Lake Victoria. In the beginning, this chapter described the social and demographic characteristics of the respondents and water vessel accidents occurrences in Lake Victoria. The study found out those water vessel accidents occurrences are present within Mbita sub-county and mostly happen unpredictably. The study established that most causes of water vessel accidents in Lake Victoria are bad weather, mystery, sailor errors and poor water vessel conditions. On the most vulnerable groups to the impact of Lake Victoria water vessel accidents, the research found out that the household members of the direct victims were most affected, together with boat owners and their families, fish mongers and the Beach Management Units which subscribed to the Lindell's disaster impact model which is a model tenet of study.

CHAPTER FIVE

THE EFFECTS OF LAKE VICTORIA WATER VESSEL ACCIDENTS ON SOCIO-ECONOMIC ACTIVITIES OF HOUSEHOLDS IN MBITA SUB- COUNTY

5.1 Introduction

The chapter investigates the effects of Lake Victoria water vessel accidents on the socio-economic development of the Households in Mbita Sub-County. The further chapter provides findings and discussions as well as a summary of key findings.

5.2 Economic Activities of the Respondents

5.2.1 Main economic activity of the respondents

The study asked respondents to state their main economic activities. The findings are shown in the Table 5.1 below.

Table 5. 1 Main economic activities of the respondents (N=384)

Main economic activity	Frequency	Percent
Fisheries	162	42
Crop farming	118	31
Juakali	64	17
Smallholder business	40	10
Total	384	100

Source: Field Data, 2021

The findings have revealed that the majority 42% (162) have fisheries as their economic activity followed by crop farming 31% (118), 17% (64) of the respondents had informal employment (Jua Kali) as their economic activity and 10% (40) were smallholder business people.

Most of the residents of Mbita Sub- County are depending on the fisheries as their main economic activity, fisheries have many departments from crews, boat owners, net menders, boat making or repairing, selling of fish gears and fish transportation, fish mongering and processing, and caging guards. There are those depending on the farming along the lakeshore for household survival and others in the formal employment in the study. In a focused group discussion with the community members of Rusinga East, one respondent narrated that.

Here in Rusinga almost everybody depends on fisheries as the main economic activity because there is no land to cultivate, the area also receives very little rainfall during long rainy season. Further, the area does not receive adequate rainfall for a proper production, therefore, we fully depend on fishing. Very few seek formal employment outside because it does not pay as much as how fishing would pay on good days (FGDs #7 on 12/8/2020).

In an in-depth interview with a community leader who had to this.

In this area we all fisherfolk, we depend on fishing activities, a child is born and the first thing they learn is how to catch fish. We have different people from different parts of the country here doing the business of fisheries, they are different jobs and many people have used the money got from the lake to educate their children up to the university level, others have used the return to build nice houses (In depth interview #5, on 13/ 08/2020).

Socio economic studies [Onyango et al, 2006] report that the fishers engage in other income generating activities to meet their daily needs and to subsidize on their income. The main activities that the fishers are involved in to supplement their income are farming of both cash and food crops, livestock keeping (cows, sheep, goats), petty businesses such as food kiosks, making of local brews, selling of clothing's and agricultural produce. This is true given that about 58% of the fishers have more than one source of income Luomba, [2007] The fishers income

is mostly spent on various activities but, a large proportion use their income on the basic needs such as; food, clothing's, shelter, medical services and education. Interestingly the crews mostly spend much of their money on entertainments such as alcoholism, sex with women, attending video shows and night disco at the landing sites.

Besides, farming and livestock keeping, food consumption is not a major problem within the fishing communities as Onyango et al [2006] reported that 80% of the fishers do not have problem of getting food and when asked on which fish they eat most, about 47% stated that they eat Nile perch most, Tilapia comes second (38.5%) and then Dagaa (12%).

5.2.2 Other Economic Activities

The study asked respondents to indicate other sources of Livelihood. Figure 5.1 below presents the findings.

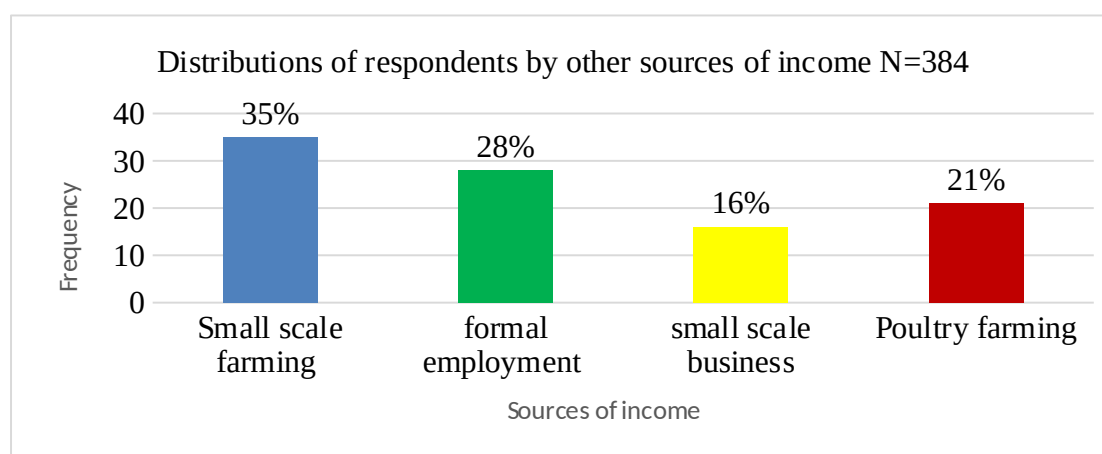


Figure 5.1 Distributions of respondents by other sources of income (N=384)

Source: Field Data, 2021

Figure 5.1 presents other economic activities that the respondents of the study area engage on apart from fisheries, majority 35% (136) engages in small scale farming

followed by 28% (108) of the respondents engage in small scale business such as shops, selling cereals and groceries; 21% (80) were engaged in poultry farming and 16 % (60) had formal employment as other sources of livelihood. These activities are used to supplement the main source of livelihood for the household. In an interview with a middle-aged respondent who said that.

The livelihood of most people in this place fully depends on fishing but due to the unpredictability of the catch, they depend on other sources of income to supplement their income. For example, I have seen people who started other businesses from fisheries and they are doing well. Some people are also involved in farming a long fishery due to the availability of water supply in the area (Interview in Mbita #07 on 14/ 08/2020).

The study is confirmed by Odhiambo (2010) by indicating that some of the copying and adaptive measures they do are farming, small scale business, boat repairing, fish mongering, operating *boda-boda* and grazing animals for other people.

On the other hand, the livestock kept are mostly cattle's, sheep's and goats however; there are some fishers who keep poultry as well Onyango et al (2006). The cattle is kept mainly for meat, milk, ploughing, and as social security and as safety nets or "banks" during difficulties, source of income for school fees, and for customary activities like marriages and specific activities during funeral. There is however no restriction on the number of livestock that one can keep Kibwage et al (2008) interestingly, some 6.5% of the fishers do not use their land for any activities. Within the fishing communities, ownership of land is not a problem as it has increased from 56% recorded by Onyango et al (2006) to 78%. However, only 18% have bought the land they occupy from the fisheries income, the others inherited from parents. These lands are used for cash and food crop production as well as livestock keeping.

Lake Victoria also has a vibrant fishery sector with over 500 fishing communities relying on it for their livelihoods (Bruno & Giacomo, 2016; Abutabenjeh & Jaradat,

2018). Lake Victoria has been historically exploited by industries such as oil exploration companies who have caused conflicts with local communities over resources allocation. Nevertheless, the lake has seen recent investment in infrastructure development by both indigenous firms and multinational companies that provide cleaner sources of energy including solar power systems.

According to Kholis et al. (2020), fishermen's income is the difference between their real earnings and fishing expenses, both annually and on each trip. In the context of fishing business income, it is the difference between the actual revenue and fishing expenses incurred by motorized and non-powered fisherman on each trip every fishing season. Fishermen's income is made up of their personal income, their family's income, and non-fishermen's income (Wahda, 2021). Wives and kids are examples of other working family members who provide non-fisherman income (PNN). Consistent with Azizah's (2015) assertion in Fitria Amir et al. (2019) that other fishermen's income comes from other sources, such as wives and children.

5.3 Mode of access most beaches

Respondents were asked how their beaches are accessed. The responses are summarized in the Figure 5.2.

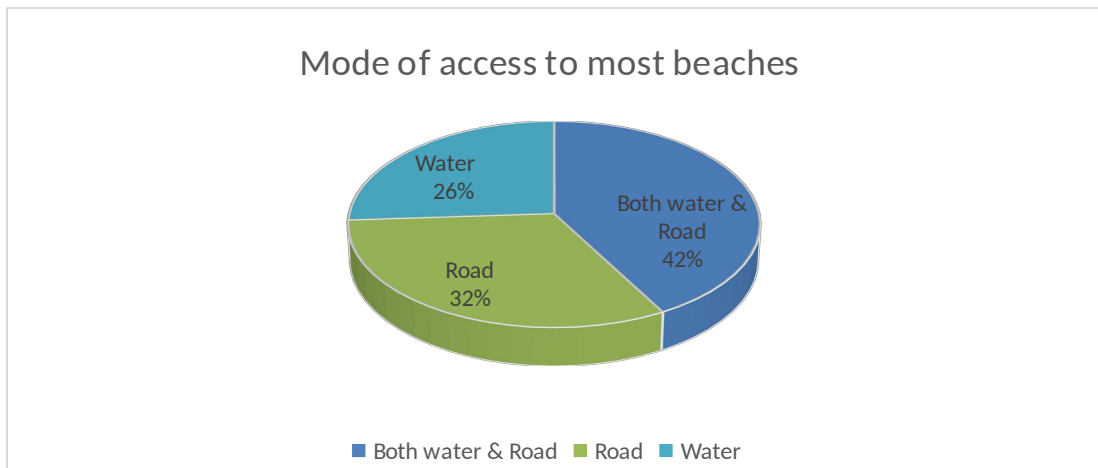


Figure 5.2 Mode of access most beaches (N=384)

Source: Field Data, 2021

The majority 42% (161) of the beaches are accessed through both water and road followed by 32% (123) of respondents indicated that their beaches are accessed through the road while 26% (100) of the respondents indicated that their beaches are accessed through the water. Accessibility depends fully on the nature of land whether it's main or island.

5.4 Effects of water vessels accident

The researcher sought to examine the effects of water vessels accidents on household/individuals and the community.

5.4.1 Effects of water vessels accident on households/individual

The researcher asked the respondents how water vessel accidents in Lake Victoria have affected them and the response is summarized in the Table 5.2.

Table 5. 2 Effect on household operations (N=384)

Effects of disaster to the household	Yes		No	
	Freq.	%	Freq.	%
Psychological effect	232	83%	48	17%
Not able to pay school/loss of livelihood sources	221	79%	59	21%
Feeding habits changed	224	80%	56	20%
No proper dressing or grooming	216	77%	64	23%
Relationship with relatives changed	238	85%	42	15%
Damage/loss of properties	256	91%	25	9%
Loss of lives	279	95%	14	5%

Source: Field Data, 2021

On the question of whether there are psychological effects after the accidents, majority of 83% (232) agreed while 17% (48) did not agree. On the question of whether the family could not pay school for the kids after the water vessel accidents, majority 79% (221) said yes while 21% (59) said no. On the question of whether feeding habits have changed since the demise of the family member, majority of 80% (224) said yes while 20% (56) said no, it has not changed. On the question of no proper dressing or grooming, majority of 77% (216) said yes while 23% (64) said no and finally, if in any case the relationship with other relatives have changed, 85% (238) said yes it has changed while 15% (42) said no it has not changed.

The findings have been confirmed by Frey& Torgler (2011) who argued that passengers inside RMS Titanic panicked, tramped on each other, and lost concern for their fellow human beings in the ship. Psychological problems were also reported among several victims. LÍndal and Stefánsson (2011) further confirmed that the above study in the long-term psychological effect of fatal accidents at sea on survivors cites development of extensive Post Traumatic Stress Disorder (PTSD) to the survivors of the maritime

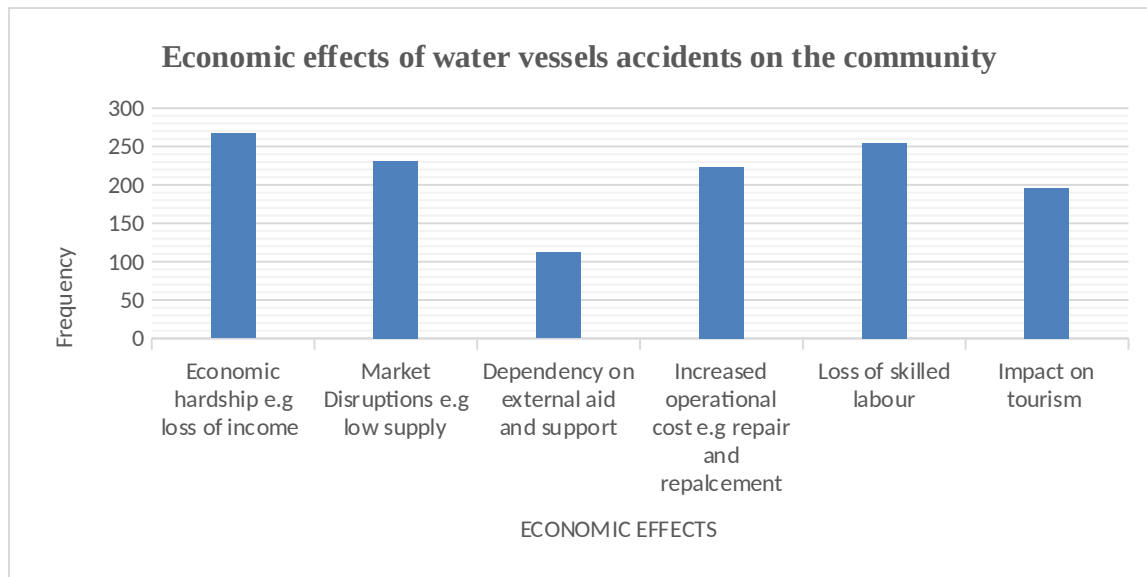
accidents.

The psychological wellbeing of fishermen is important because, not only are fatality rates high due to their dangerous occupation (Case et al., 2018; Syron et al., 2017), but depression and suicide are also rampant among seafarers (Carotenuto et al., 2013; Roberts, Jaremin, Chalasani, & Rodgers, 2010).

China marine Safety Administration accident report statistics show that, between 2013 and 2022, there were 806 marine accidents in China, with collision accidents accounting for 39.08% of these incidents (Feng et al., 2023). In contrast to the 12th Five-Year Plan period (2011–2015), China's 13th Five-Year Plan period (2016–2020) saw a significant increase of 21.6% in collision accidents between merchant and fishing vessels (CAMF) and a 36.2% increase in fatalities or missing persons related to such incidents, despite a 34.4% decrease in the overall number of maritime traffic accidents and a 25.5% decrease in deaths or missing persons (CMS, 2022).

5.4.2 Economic effects of water vessels accidents on the community

The study sought to investigate the economic effects of water vessels accidents on the community around the lake region. The findings are as presented in Figure 5.3.



Source: Field data, 2021

Figure 5.3: Economic Effects of water vessels accidents on the community.

The findings in Table 5.3 reveals that 267(69.5%) of respondents said economic hardship, loss of skilled labor was 254(66.1%), market disruption was 231(60.1%) while the least was dependency on external aid and support at 112(29.2%). These findings indicate that majority of respondents agreed that economic hardship and loss of skilled labour are the major economic effects of water vessels accidents on the community.

Talley (2002) analyzed individual ferry vessel accidents that were investigated by the U.S. Coast Guard between 1981 and 1991 and came to the conclusion that injuries from fire/explosion incidents are likely to be higher than those from material/equipment and grounding incidents. According to McIntire (2003), ferry accidents have resulted in injuries to passengers due to crew members' inattention, bad judgment, and negligence.

The factors influencing the severity of injuries and property damage in cruise ship accidents are examined by Talley et al. (2000). In this study, he estimated the property damage and injury severity equations for cruise-vessel accidents using specific data on

individual accidents over the 11-year period (1991-2001) that the US Coast Guard investigated. The estimation results indicate that the cost of damage to cruise vessels per gross ton is higher for accidents involving disintegration, collision, equipment failure, explosion, fire, flooding, and grounding than for other accidents and human-caused causes. Ocean cruises had higher accident injury severity than harbor/dinner cruise vessel accidents and human-caused incidents on rural waterways. Compared to harbor/dinner cruise vessel accidents and human-caused incidents, ocean cruises have more severe accident injuries. Compared to other accident types, explosion events had a higher unit damage cost of \$207.

On December 15, 2021, a boat sank in heavy weather off the coast of southern Malaysia, killing at least 11 Indonesian migrants and leaving 27 people missing (New Straits Times, 2021). The Eastern Star ship, a passenger ship, capsized in 2015, killing 442 passengers (Wang & Yang, 2018). All 32 crew members were killed when the Sanchi oil tanker collided with Hong Kong flagged cargo ship CF Crystal on January 6, 2018, while hauling 136 x 103 t of oil from Iran to South Korea. Accidents would cause a considerable amount of property damage and a significant number of fatalities. Maritime authorities, the shipping industry, and society are increasingly concerned about ship navigation safety.

According to Allianz Worldwide Corporate and Specialty (2022), there were 2,703 marine incidents and casualties reported in 2020, including the loss of 49 large ships on a global scale. The Global Integrated Shipping Information System (GISIS, 2023) estimates that between 2011 and 2022, there were roughly 3,821 maritime accidents. All the aforementioned maritime accidents caused fatalities, damage to property, and harm to the marine ecosystem (Ceyhun, 2014).

In the views of Nwokoro I. A., Nwokedi, T. C., (2015) accidents impose various “categories of economic costs which include: property damage cost (damage accident), injury and death cost (injury and death accident), cost imposed on economy as a result of accident induced pollution (spill/ pollution accident), cost of police services, court and insurance services, cost of safety measures implementation among others”.

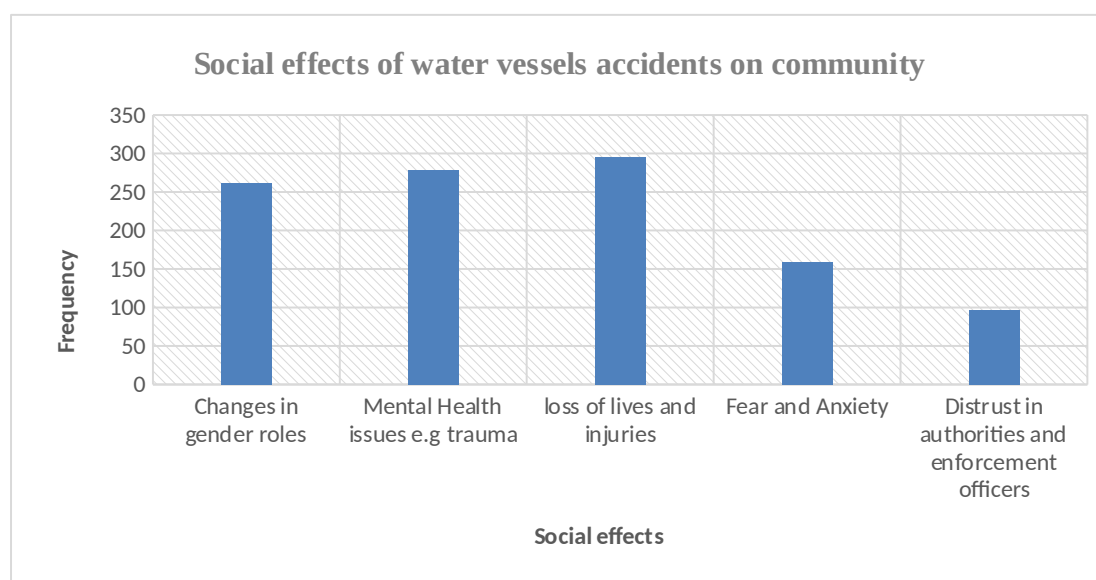
Humans, “the marine environment, and activities both on and off ships are all negatively impacted by marine accidents in varying ways and to varying degrees. Accidental consequences range from minor injuries to fatalities, as well as from negligible property and environmental damage to extremely serious harm”. According to Mullai and Paulsson (2011), p. 1590, “a significant portion of transportation expenses are related to accidents, including the cost of fatalities and injuries, property and environmental damage, prevention and mitigating measures, and insurance. Any kind of maritime mishap is a seafarer's worst nightmare. There are numerous and significant risks involved if it takes place in a narrow space, such as a strait or channel with high traffic”. However, “a significant maritime mishap becomes considerably more serious when, for example, water penetration occurs, potentially making the ship's damage stability worse if it is made worse by severe weather or a strong current”. Other incidents, however, cause oil spills, which make the problem more "environmental" (Akten & Gonencgil, 2002).

In accordance with article 9 section 7 of the Nairobi Convention on the Removal of Wrecks (WRC) 2007, “to which Nigeria is a signatory as of April 14, 2015, the government is responsible for removing the wrecks that have not completely disintegrated. The owners of the vessels typically bear the cost of doing so, and they have typically gone bankrupt due to a lack of employment in the profitable oil industry”

(Nigerian Tribune, 2016). The disposal of wrecks in Lagos alone is expected to cost at least 25 billion naira, according to Akoni et al. (2014).

5.4.3 Social effects of water vessels accidents on the community

The study sought further to understand the social effects of water vessels accidents on the community. The results are as shown in Figure 5. 4



Source: Field data, 2021

Fig 5.4: Social Effects of water vessels accidents on the community

The findings in Figure 5.4 shows that 295(76.8%) of respondents said loss of lives and injuries, 279(72.7%) said mental health issues such trauma, 261(68%) said changes in gender roles while the least was distrust in authorities and enforcement officers at 97(25.3%). Authorities and enforcement officers distrusted by the community include Kenya Maritime Authority (KMA), Kenya Coast Guard Service (KCGS), Homa bay county department of Disaster Management and Humanitarian Assistance and lastly Lake Victoria Basin Commission. These findings reveal that majority of respondents opined that loss of lives and injuries, mental health issues and changes in gender roles were the main social effects of water vessels accidents.

According to Carotenuto et al. (2013), Leszczyn´ska, Jez´ewska, & Jaremin (2008), MacLachlan, Cromie, Liston, Kavanagh, & Kay (2013), and Sliškovic´ (2017), “exposure to the occupational hazards of the marine sector, such as safety risks and bad weather, is naturally demanding and stressful. According to Johnson et al. (1998), stress is the psychological reaction to these risks and hazards and arises when there is a mismatch between the demands of the circumstance and a person's capacity to meet those expectations”.

Aside from the extreme and hazardous demands, fishing also involves a number of physical and psychological stressors, such as “confinement, isolation, boredom, monotony, social frictions, long hours, demanding and complex workloads, noise, sleep deprivation and disruptions, financial difficulties, limited access to medical evacuation, and being away from friends and family” (Carotenuto et al., 2013; MacLachlan et al., 2013; Palinkas, 2003; Pollnac, Monnereau, Poggie, Ruiz, & Westwood, 2011). Studies reveal that “these stressors have a detrimental effect on health and well-being and are associated with high rates of illness and death at work” (Johnson et al., 1998). Nevertheless, a lot of fishermen come back each year to fish another season.

In Nigerian seas, the number of fatalities from marine accidents continues to rise. According to Ukoji and Ukoji (2015), “boat and ferry accidents are the most common accident type that results in the greatest number of fatalities in Nigerian seas. In Nigeria, water-borne transportation has become a viable alternative to land-based transportation. Although Nigeria uses a lot of water for transportation, its safety is not given nearly as much consideration. Accidents involving boats and ferries are common, and the death rate is rising. Collisions and capsizing are the most frequent causes of accidents”.

According to research conducted by the Africa HSE Group in 2017, the majority of boats and ferries are overcrowded with people, which increases the risk of capsizing. “This is due to a lack of safety rules that monitor vessels that are overloaded. According to data from the National Inland Waterways Authority (NIWA) in 2013, 28 of Nigeria's 36 states use water for transportation. According to their figures, boat marine accidents claimed the lives of nearly 350 people in 2013. A total of 1607 people lost their life in 180 distinct boat and ferry accidents in Nigerian waterways between 2006 and 2015”(Ukoji & Ukoji, 2015).

The most recent boat catastrophe, which claimed over 50 lives in Kebbi State, Nigeria on September 14, 2017, “makes it clear that the number of deaths from marine accidents has not decreased (Vanguard, 2017). The number of fatalities from boat and ferry-related marine incidents in Nigerian interior waters between June 2006 and June 2015.

5.5 Household members involved in water vessel accidents

The researcher asked respondents whether any of their household members have been involved in water vessel accidents in Lake Victoria. Figure 5.5 presented the findings of the study.

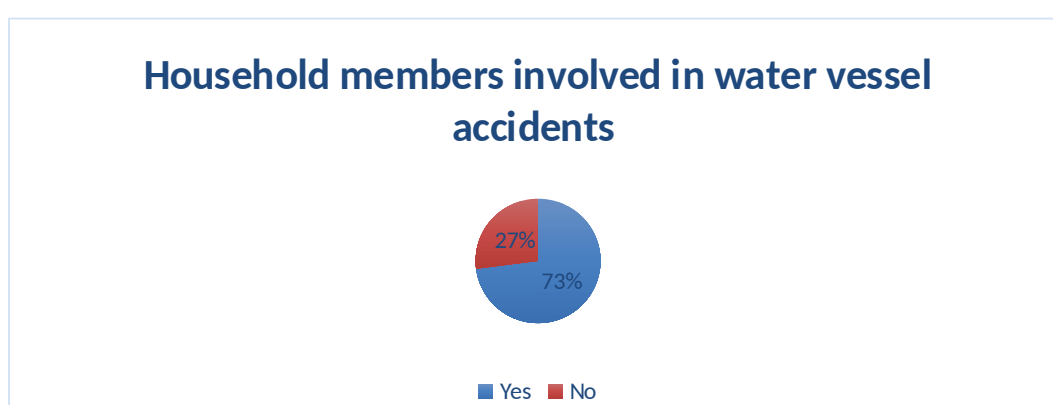


Figure 5.5 Household members involved in water vessel accidents (N=384)

Source: Field Data, 2021

Figure 5.5 shows that majority 73% (280) of the respondents have had household member involved in the Lake Victoria water vessel accidents while 27% (104) said no they have never any member involved in the Lake Victoria water vessel accidents. In an interview, BMU leader stated that;

We have lost many people in the last years in water vessel accidents, travelers as well as fishermen. Last year I lost a crew member in the deep lake, it took us three days before we recovered the body and some years back, I lost my nephew who was traveling to Siaya County (Interview #09, 16/08/2020).

In group discussion with members of the Litare beach, they all agreed that many people have lost their loved ones or people close to them in the past years. One lady narrated that.

I know many people in this group who have lost their loved ones but cannot talk due to pain they have undergone. I lost my brother last when they went fishing expedition, they were four people three people were rescued and he was not rescued. In another incident, my husband died when they were just transporting some building materials from Mbita to Ringiti. It was at night and nobody was there to rescue them. The family has suffered a lot since his demise (FGDs #07 on 29/8/2020).

The above findings have been confirmed by World Health Organization (2014), where 372,000 people drown every year in world waters with a whopping 91% coming from low and middle-income nations where people stay or work around water with inadequate measures to prevent drowning related deaths and also in line with Lake Victoria Basin Commission (2010) about 10,000 lives are lost in Lake Victoria annually with others that go unreported. The findings further in agreement with Bowman *et al* (2006) which state that African injury data have historically come mostly from a hospital or mortuary databases while drowning deaths in sub-Saharan Africa mostly occur outside hospitals meaning most kinds of deaths are excluded.

The finding above is further confirmed by Kobusingye *et al* (2016) in a community-based survey on drowning among Lake Victoria fishing communities in Uganda 38.9% of the fishing communities had at least one member of their family in a life-threatening emergency in Lake Victoria waters which mostly occurred either during fishing or transportation. Of those family members involved in identified life-threatening emergencies in the lake, more than two-thirds of them drowned equating the drowning fatality rate in the lake as 502 deaths per every 100,000 population in the lake's boat using community

5.6 Duration since last involvement in the water vessel accidents

From those 73% of respondents who said indicated they have had any members of the household involved in the Lake Victoria water vessel accidents; the researcher asked them to indicate how long it has taken since the member involved in the accidents.

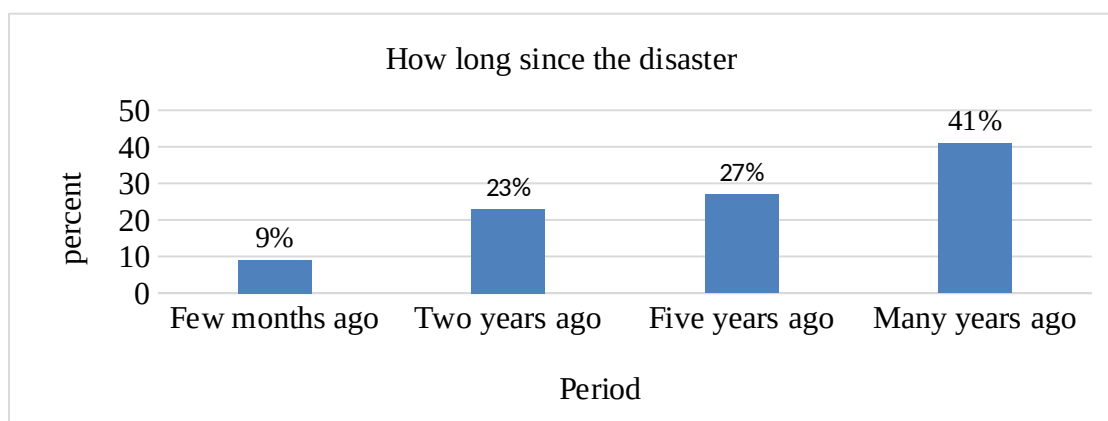


Figure 5.6 Duration since involvement in water vessel accidents (N=384)

Source: Field Data, 2021

The study revealed that the majority 41% (114) of the respondents said that it has taken

many years since their member of household was involved in the water vessel accidents followed by 27% (76) who responded that it has been five years since they witnessed water vessel accidents in their family. Another 23% (65) indicated that they last witnessed it two years ago while 9% (25) of the respondents indicated that they witnessed that in the last few months. In an in-depth interview with the chief of Rusinga who stated that.

“Water vessel accidents or accidents do not occur every day but after some years or months because people have become careful and some are well prepared with lifesaving jackets or floating items. It reduced the number of the accidents in this area. In the last few months, we had one or two deaths in the area because when it happens, it is reported to the area security teams who brief us on our weekly meetings (In-depth interview #05 on 11/ 08/2020).”

This finding is in line with Schilling (1971) assertion that deep sea fishing poses life threats to fishermen mainly from developing countries who mainly uses traditional means of fishing such as wooden boats, and during emergencies in deep sea fishing there are usually high resultant casualties on the involved fishermen.

5.7 Household livelihood changes due to water vessel accidents

The study asked the respondents if the water vessel accidents changed their household livelihood. The findings are presented in the Figure 5.7.

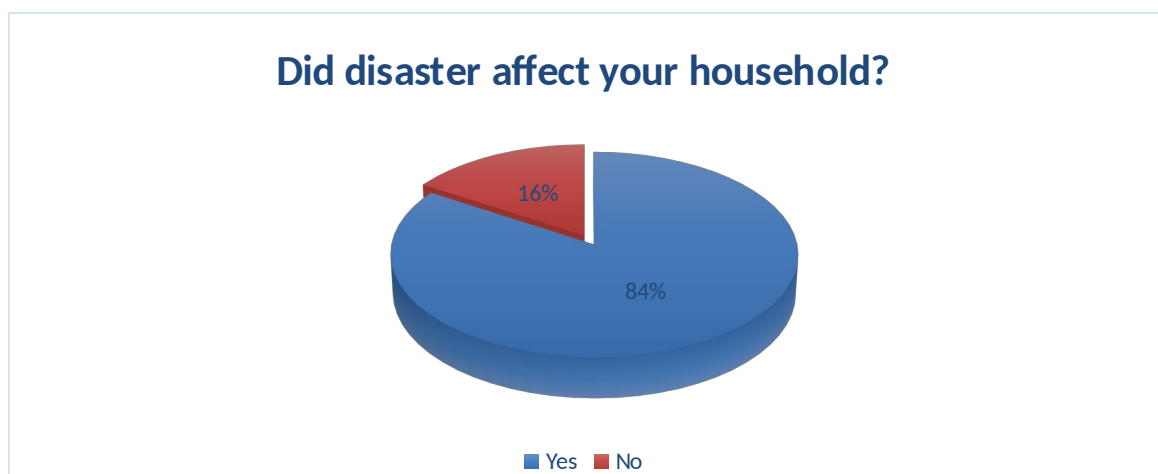


Figure 5.7 Household livelihood changes due to water vessel accidents (N=384)

Source: Field Data, 2021

From the Figure 5.7, the majority 84% (235) indicated that water vessel accidents changed their household livelihood in most cases people have suffered a lot while 16% (45) said the household did not change since the demise of the water vessel accidents. Change in the household livelihood is due to the fact that the main provider is the one that has lost his life and in situations that it has not changed could be related to having diversified livelihoods or the main provider is still alive.

This is confirmed by Sumabe (2013) who argued “that inland water transport is a hazard just like other hazards in most developed countries which puts many livelihoods at risk”. An analysis of the impact of boating accidents on the livelihoods of five boating communities around Lake Volta in Ghana reveals that inland water vessel accidents cause poverty to the fishermen households, engagement in other livelihood activities for fear of drowning, lack of trust in relevant government departments, psychological problems and in some cases dropping out of school by affected household children to care for their suffering household members. In an interview with a middle-aged man who said that.

“Livelihood for most families have changed since the water vessel accidents occurred. Some families have transferred their children to public schools or day secondary schools because the father who used to pay for these expenses is no longer there. I remember when we were in primary school, our dad died while they were fishing, therefore, my mother remained housewife with nothing. We had to stop going to school to provide for the family. Life was actually difficult (interview #08 on 16/ 08/2020).”

Waterway accidents may have detrimental effects on neighboring countries'

economic activity (Dolores et al. 2006), “marine and coastal ecosystems (Wells 2017), and even cause sociocultural disturbance (Miraglia 2002). Waterway transportation is therefore a high-risk system in addition to being a necessary component of international trade. Furthermore, there can be major severe ecological, economic, and societal repercussions from the unintentional or deliberate release of oil or other toxic liquids into the ocean” (Hassler 2011).

The Herald (1994) reported that the MV Mtongwe I was built to transport 300 people, “but it frequently carried more. It had consistently crossed the water between Mombasa Island and the South Coast in the Mtongwe Likoni area without incident. Numerous additional people were taken on board on that fatal day because they had an urgent need to cross the channel. The ferry capsized while being guided toward the mainland, about 40 meters from the Mtongwe coastline on the South coast of Likoni”. After a commission investigating the accident failed to assign blame, “the Kenya Ports Authority and Kenya Ferry Services agreed to take responsibility for the accident, stating that the deceased boarded the ferry knowing it was overloaded. Accordingly, they were held 30% responsible, and the two authorities agreed to take 70% of the blame” (Daily Nation, 2003).

5.8 Correlation between water vessel accidents and household level of income

The study sought to investigate the correlation between the household level of income and occurrences of water vessel accidents in Lake Victoria.

Table 5. 3 is the summary of the findings on the correlation (N=384)

		Level of income (Salary/ wag es per mont h)	Occurrences of water vessel accidents in Lake Victoria
Level of income (Salary/wages per month)	Pearson	1	.087'
	Correlation		
	Sig. (2-tailed)		.000
	N	384	384
Lake Victoria water vessel accidents.	Pearson	.087''	.1
	Correlation		
	Sig. (2-tailed)	.000	

**correlation is significant at the 0.01 level (2-tailed).

According to Pearson there is variance in values of collection between -1 and +1 and 0 indicates no correlation. The Pearson correlation shows .087, which means there is a correlation between the household income per month and water vessel accidents in Lake Victoria. The two variables are correlated though very weak. This indicates that when the household loses a person in a ship or boat accident the income of the household reduces significantly. When the 2-tailed significance value is .000 it means the study is highly correlated. Hence this study is highly significant.

The economic consequences of the effects of climate change can be both direct and indirect. First, fish producers may suffer large losses as a result of a major decline in aquaculture production brought on by climate change. According to Li et al. (2016), a decline in aquaculture output may result in changes to the cost and accessibility of aquaculture goods, which could have an impact on consumers. Nonetheless, it is important to remember that over half of the world's fish exports come from poor countries, including those in SSA (FAO, 2022). According to Williams and Rota (2011),

a drop in production results in a drop in net exports, which lowers foreign exchange earnings and the likelihood that poverty would be alleviated in these countries. As an example, a study by Asiedu et al. (2018) found that Ghanaian fish farms frequently encounter severe weather, unpredictable rains, floods, droughts, storms, and erosion.

5.9 Items lost or gained after water vessel accidents

The researcher asked if there are items that the family have lost or gained since the member of the family was involved in the water vessel accidents. The Table 5.4 is the summary of the findings.

Table 5. 4 Items lost or gained after water vessel accidents (N=384)

Items lost or gained after water vessel accidents	Gained		Lost		Total	
	Freq.	%	Freq.	%	Freq.	%
Boat	76	27%	204	73%	280	100
Poultry	100	36%	180	64%	280	100
Livestock	87	31%	193	69%	280	100
Bicycle/ Motor cycle	95	34%	185	66%	280	100
Radio	92	33%	188	67%	280	100

Source: Field Data, 2021

From Table 5.4 majority 73% (204) have lost a boat while 27% (76) have not lost, they have gained a boat, 64% (180) have lost poultry while majority of 36% (100) have gained poultry which was due to coping strategy. On the Livestock 69% (193) have lost the livestock while 31% (87) have gained, 66% (185) have lost motor cycle or bicycle due to maintenance and other expenses while 34% (95) have gained. Finally, 67% (188) have lost radio while 33% (92) have gained.

The safety of people and property, “as well as the marine environment, are severely harmed by total loss incidents. An estimated 15,738 people were killed in 3976 complete loss maritime incidents involving ships weighing more than 100 gross tons

worldwide between 1998 and July 2018, according to Lloyd's Register Intelligence Casualty Statistics” (2020).

Coastal nations and maritime associations have shown a great deal of interest in total-loss shipwrecks, “which have grown to be a significant service target for the global marine insurance sector (Liet al., 2009). The entire loss shipwreck is further separated into the constructive and real total loss based on the extent of cargo loss and the related ship repair and maintenance costs. In the event of a true total loss, the ship or its contents are either totally gone or have suffered such severe damage that they no longer function as they once did”. When a ship is in distress, “the degree of damage has not yet reached constructive total loss; but, the cost of salvage and repair, or one of them, will exceed the worth of the ship or the ship or cargoes after rescue, thus having no salvage value” (Rose, 2013).

The results of Jin's (2014) analysis of ship accident data from the U.S. Coast Guard from 2001 to 2008 indicated that “destabilization, foundering, daytime wind speed, ship age, and distance from shore were all positively correlated with the extent of damage to fishing vessels”. According to Aguilera et al. (2010), “oil spills substantially harm the growth of the marine economy, including fishing, and inflict major harm to marine biological resources”. Chen et al. (2018) developed an entropy-weight grey-correlation analysis model to investigate oil tanker spill incidents worldwide, “revealing that collisions and fires/explosions raise the likelihood of accidents. A major ship type that is involved in total loss accidents is the container ship”.

5.10 Chapter Summary

This chapter presents analyses and discusses the findings of the second objective of the study which investigates the effects of Lake Victoria water vessel accidents on the socio-economic development of households in Mbita sub-county. The chapter began by describing the social-demographic characteristics of the respondents in study, and discussing the likely implications on the effects of water vessel accidents. The study established that a majority of those living in Mbita sub-county practice fishing with most of them having been in the fishing industry for long over five years with water and road being the most common means of transport in the area.

It was also discovered Lake Victoria water vessel accidents have had a negative effect on the social and economic aspects on those whose household members had experienced water vessel accidents. Effects of water vessel accidents include psychological problems, inability to pay school fees, change in feeding habits, poor dressing or grooming and changes in the relationships with relatives. Despite the household members experiencing the disaster many years ago, the study also established that the water vessel accidents had impoverished the households as most had lost many household items such as boats and fishing nets, poultry, livestock, bicycle and radios since the disaster occurrence.

CHAPTER SIX

EVALUATION OF INTERVENTION MEASURES BEING APPLIED BY RESIDENTS AND GOVERNMENT TO MITIGATE THE SOCIO- ECONOMIC IMPACT OF WATER VESSEL ACCIDENTS

6.1 Introduction

The chapter evaluates intervention measures being applied by residents and Governments to mitigate the socio-economic impact of water vessel accidents in Mbita Sub-County. The further chapter provides findings and discussions as well as a summary of key findings.

6.2 Availability of stand by SAR team that responds to distress emergency calls in Lake Victoria

The study asked respondents if there is a stand by SAR team that responds to distress emergency calls in Lake Victoria. The findings are presented in the Figure 6.1 below.

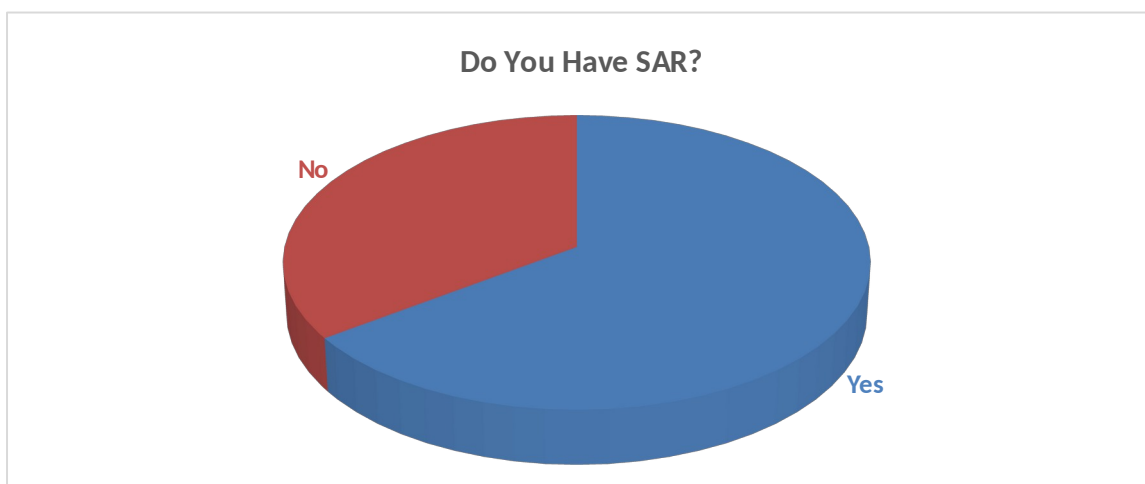


Figure 6.1 Availability of stand by SAR team that responds to distress emergency calls in Lake Victoria

Source: Field Data, 2021

The study revealed that majority 65% (250) indicated that there is a stand by SAR

team in Lake Victoria that responds to distress emergency call by the fishers and other lake user while 35% (134) are not aware of the existence of the SAR team in Lake Victoria. From the discussion with LVBC the researched realized that the team exists in Lake Victoria. One of the respondents stated that.

We have many stands by teams in Lake Victoria that responds within a short time to help fishers and other lake users in case of an emergency. They are very efficient and effective in handling the calls and signals to help but other fishers are also very alert whenever they sense a boat is not stable, they will run there and help unless it is at night when we they either don't or respond very late (Interview #18 on 19/08/2020).



Plate (6.1) Ongoing Search and Rescue Activity by BMU and Volunteers in response to a water vessel accident in Lake Victoria

Source: Field Data, 2021

Search and rescue (SAR) is one of the Canadian Coast Guard's (CCG) main duties. The vastness of Canada's coastal search and rescue area (~5.3 million km²), which includes both open ocean and vast inland waterways, makes the CCG's SAR program essential (Government of Canada 2019c). Every year, the CCG responds to about 6000 maritime accidents by efficiently utilizing SAR resources (Government of Canada 2019a).

A visual analytic process for risk assessment, asset allocation, and maritime response was proposed by Malik et al. (2012). The resultant visual analytic system, called Coast Guard Search and Rescue Visual Analytics (cgSARVA), was created to take advantage of the US Coast Guard's (USCG) database of past response operations, which covers Great Lakes activities from 2002 to 2011. By enabling visual interaction with historical SAR event data, cgSARVA helps USCG analysts better understand data quality issues and conduct data exploration and analysis more efficiently. The Station Optimization Process, which was started by the USCG, now includes cgSARVA (US Department of Homeland Security 2018).

6.2.1 Provision of day-to-day weather alerts to fisher folks and other lake users in Lake Victoria

Respondents were asked if they are provided with day-to-day weather alerts. The findings are presented in the Figure 6.2.

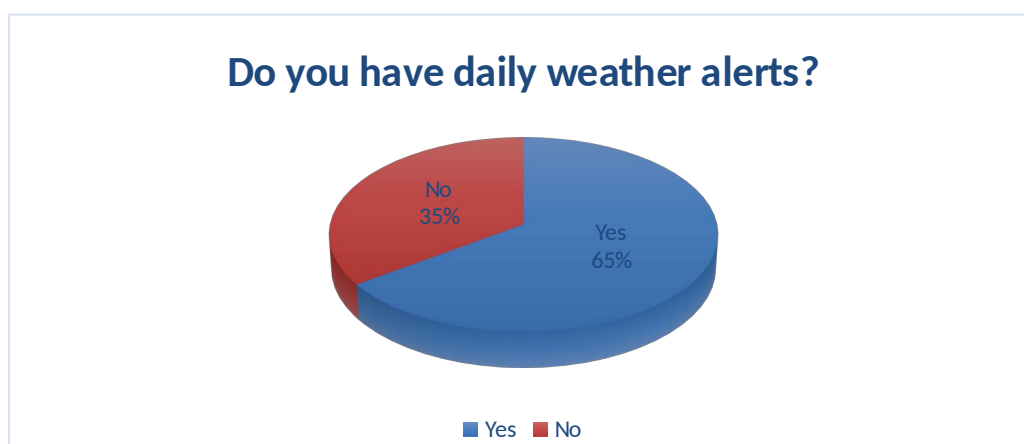


Figure 6.2 Provision of day-to-day weather alerts to fisher folks and other lake users in Lake Victoria (N=384)

Source: Field Data, 2021

The Presence of Most 35% (135) of respondents said they have not heard any weather

notifications, but 65% (249) said that fishermen and other lake users receive daily weather alerts. Fishermen can decide when and where to fish, whether to venture out onto the lake or seek cover in safe locations, by using meteorological information and warnings. Since many fishermen are the only source of income for big families, this boosts the standard of living in the towns surrounding the lake in addition to saving many lives.

There are weather alerts provided daily. There are weather alerts that do come for the fishers and other lake users. However, sometimes those weather alerts provided by LVBC are not that accurate so, some fishermen and Lake users ignore them and try to use traditional methods to predict the weather of the day (cf. interview #04 on 17/08/2020).

The findings concur with literature reviewed that LVBC dubbed “Multinational Lake Victoria Maritime Communications and Transport” is intended to provide regular weather reports and alerts to people on the lake (via text message and radio broadcasts), expand cellphone coverage and build a network of 22 rescue centers along Lake Victoria shore. So, there is weather alerts given to the Lake users across the three countries that share it. It has reduced fatalities and disasters to some extent.

Further, other respondents during FGDs stated that;

“Most of the time the community trusted in the early warning system, speaking to the validity of the warning message. In addition, authorities like the police were perceived as the responsible body that should issue the alerts. This is in agreement with the incident command operations that call for a clear chain of information flow”.

“The most common response action to a severe weather alert reported in this community was moving to a nearby island for safety and anchoring the boat. Although validation of this response was not tested as part of this study, the use of such indigenous/ local knowledge, if effective, may improve the effectiveness of response to an early warning system. As part of the warning dissemination, such information should be widely available so that there is organized response capacity in the

community”.

According to UNISDR (2006) and Sorensen and Sorensen (2007), this demonstrates the necessity of an efficient EWS that integrates risk knowledge, proper monitoring of the warning service, prompt distribution to the populations at risk, and improved community reaction capabilities. According to Anyah et al. (2006), the proposed severe weather now-casting early warning system uses lightning as a stand-in for severe weather, which is a reliable and scientific basis for early warning on the lake that frequently produces risks such strong winds, waves, and thunderstorms.

In collaboration with Earth Networks, the Uganda National Meteorological Administration, and other organizations, we suggest developing a Severe Weather Early Warning System (SWEWS) that uses lightning detection and other weather data to reduce the number of fatalities. SWEWS will be sent to fishermen and other workers near the lake via smartphone technology. The World Meteorological Organization, better known as the WMO, and the Grameen Foundation launched earlier SWEWS in this field in 2011–2012, but they tended to collapse when grant funds and staff left. A combination of factors, such as issues with information timeliness, sustainability, and delivery to end users, have caused the majority of these programs to cease operations. The region has seen the implementation of several projects that use various aspects of this concept, such as one that allows farmers to look for guidance on managing crops and livestock (Angelica V. O. and Richard H., 2010), as well as one that provides fisherman with weather information and market pricing (Byarugaba, 2014).

6.2.2 Presence of well-maintained and existing floating Navigational aids in Lake Victoria to guide sailors

The study asked respondents if they have well maintained and existing navigational aids in L. Victoria to guide sailors. The findings are presented in the Figure 6.3.

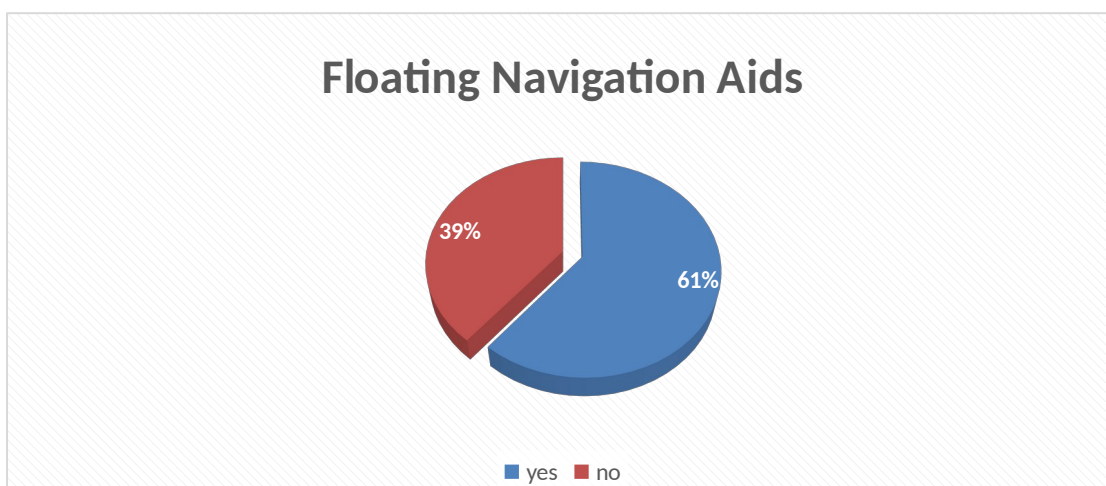


Figure 6.3: Presence of well-maintained and existing floating Navigational aids in Lake Victoria to guide sailors (N=384)

Source: Field Data, 2021

The majority 61% (234) agreed that there is a well maintained floating navigational aids in Lake Victoria to guide sailors while 39% (150) said there are no floating navigational aids in Lake Victoria. The contrast may be alluded to the fact that not everybody understands that there are some navigational aids because they are not frequent travelers in Lake Victoria or they are not keen to see those floating aids. The positive response is confirmed from the Interview with the LVBC member who said that.

We have, but not very many floating navigational aids in Lake Victoria, but the ones that are there are erected strategically to show sailors where to follow and also where there are many rocks that can interfere with the boats, canoes and ships. They can't be erected everywhere on the lake but specific points (Interview #09 on 25/

08/2020).

The findings are in line with the literature reviewed that in 2007, East Africa Community created Lake Victoria Transport Act, which addresses the maritime safety standards such as seaworthiness of ships, collision prevention, crewing standards together with the establishment of navigational aids. The Act would curb water vessel accidents in Lake Victoria. The act also requires every county surrounding Lake Victoria in Kenya has prepared a disaster management policy which seeks to improve the safety of the Lake. The findings are further supported by Nakyonzi (2011) that East African Community in the past had created 30 navigational aids in the form of visual marks in Lake Victoria which were later revised in 1972.

Lake Victoria Basin Commission has implemented the 1956 navigational charts and nautical surveys created between 1900 and 1906 which have reduced trans-border water vessel water vessel accidents of boats, ferries and ships. For example, two buoys carrying floating automatic weather stations which were anchored at the Lake bed off Homa Hills at Winam Gulf and in the open lake close to Rusinga Island erected by Kenya Meteorological Department in 2003 (Powell, 2016). These floating navigational aids are very important to lives of the Lake users as it has and will reduce most of the disasters.

6.2.3 Response to distress calls from fisher folks and other lake users trapped in water hyacinth in Lake Victoria

The study asked the respondents to mention how Kenya Maritime Authority and other emergency bodies responds to the distress calls from fishers and other lake users trapped in water hyacinth in Lake Victoria. The findings are presented in the Table 6.1.

Table 6. 1 Response to distress calls from fisher folks and other lake users trapped in

water hyacinth in Lake Victoria (N=384)

How do you respond to stress calls from lake users.	Freq.	Percent
Motor boats	181	47
Use choppers	105	27
Use divers	70	19
Clear hyacinth	28	7
Total	384	100.0

Source: Field Data, 2021

From the Table 6.1, majority 47% (181) mentioned that Lake Victoria Basin Commission and other emergency bodies use motor boats to respond, 27% (105) said they use choppers to respond in case there are people drowning in water, 19% (70) said the response is done using divers and 7% (28) said they clear water hyacinth to create way for those trapped. In the focused group discussion, all members agreed that.

The first people to respond are those who have motor boats, paddled boats or canoes will always come later. When people are trapped in the water hyacinth and the boat cannot move then they will use police choppers to rescue. In all water vessel accidents, we have seen here the community responds before any other emergency bodies (FGDs in Mfangano #06 on 11/08/2020).

In an interview with a community leader, he had this to say.

We use motors to disaster scene even if it is at the mid of the night to rescue people or those in the Lake at that time will ensure they rescue them before it's too late. It is our responsibility to rescue any kind of disaster in the lake. The Red Cross, KMA and Police are also there to help in the rescue mission until everyone is removed out of water dead or alive (Interview at Mbita town #011 on 15/ 08/ 2020).

In line with the research conducted by Keteregga and Sterner (2007), this study demonstrated that water hyacinth posed a significant risk to fishing and had a direct impact on fishing activity. As reported by the fishermen, the hyacinth infestation in Lake Victoria had several social and economic effects on fishing activities. Fishing activities are hampered by its fast growth rate, which has been shown to physically impede streams and water abstraction units. Along with producing a high number of long-lived seeds that can endure for a very long time, it also develops a weed population that doubles rather quickly. The highly productive open water surface is permanently covered by floating plants caused by the weed, which changes the food web and impacts biological diversity.

Similar outcomes were found when key informants were asked to discuss some of the ways that water hyacinth affects fishing during an interview. The following is a verbatim report of the results that were transcribed:

‘We experience loss of fishing gear, time wasting during fishing and difficulty in movement, and even sometimes prevent people from fishing’

According to Mailu (2001), hyacinth mats decreased individual fishermen's catch by covering fishing grounds, preventing them from accessing markets because of output loss, raising fishing expenses because of the time and effort required to clear waterways, requiring translocation, and resulting in net loss. In addition to these quotes, a few responders mentioned;

“The plant led to transport barriers on water thus hindering better access to fishing point”

Nonetheless, the Njiru et al. (2012) study discovered that hyacinth was more advantageous for fish growth and development. According to the majority of fisherman, the hyacinth mats ought to be left in places where they don't interfere with other

commercial operations. Regardless of the stance, long-term monitoring of the impact of water hyacinth on fisheries operations is essential to comprehending the relationships between hyacinth prevalence and fish population dynamics.

Mkumbo and Marshall (2014) estimate that the water hyacinth causes losses in transportation and fishing that amount to about US \$350 million annually. According to Mailu (2001), the water hyacinth has even more detrimental societal effects, such as decreased access to clean water and elevated mortality and disease risk. Over the last few decades, numerous management initiatives have been implemented to tackle this economic and environmental issue. Their efforts have mostly concentrated on eliminating the water hyacinth by chemical, physical, or biological methods, with little long-term success (Williams et al., 2005, Wilson et al., 2007).

6.2.4 Traditional measures that the community members put in place to mitigate water vessel accidents in Lake Victoria

Researcher asked respondents to mention some of the traditional measures that community members put in place to mitigate water vessel accidents in Lake Victoria. Table 6.2 below is the summary of the findings.

Table 6.2 Traditional measures used by the community to mitigate water vessel accidents in Lake Victoria (N=384)

Measures to mitigate water vessel accidents in Lake Victoria.	Freq.	Percent
Boat Naming	234	61.0
Use of celestial navigational techniques (using stars, moon)	72	19.0
Observation of Natural signs e.g	78	20.0

cloud formation, bird behaviors		
Beating of drums to chase away evil spirits	81	21.1
Charm (blessing of vessels	75	19.5
Assigning of experienced coxswains (madhars)	71	18.5
Designated routes	92	24

Source: Field Data, 2021

The majority of 61% (234) responded boat naming, 20% (78) said observation of natural signs while 19% (72) said use of celestial navigational techniques. Further, 19.5%(75) agreed use of charm, 18.5%(71) said assigning of experienced coxswains while 24%(92) said designated routes. The first measure that is taken to mitigate water vessel accidents is training or educating the lake users on what to do before you get in any boat or canoe. They are supposed to know how to sail the boat, put on life saving jackets, and under the guidance of an expert have followed that route at night or day time. Number two is knowing the capacity of the vessel, and finally to improve and repair the leaking or maintain the condition of the boat. From the focused group discussion, the following was agreed on.

In our beach, we don't allow visitors to lead the crew for fishing expeditions, they must first work under experts for a period of not less than two years then they were allowed to work in that area. Crews must be trained on weather observation and how to be alert all the time (FGD #01 on 28/07/2020).

In order to combat poverty, Syuryani (2017) investigated traditional fishermen households' coping mechanisms, which include actively increasing working hours and passively cutting back on expenditures throughout fishing seasons. According to Salmi's (2005) research, proactive measures to earn productive income, become a farmer, and labor for pay are examples of coping mechanisms for small-scale fishing.

In an interview with one beach leader who stated that.

Everyone who lives along the Lake is trained and taught dos and don'ts while in the lake. For example, when we were young, we were taught by our seniors how to swim, how to block leaking boats, how to catch fish using different methods. Finally, how balance on the boat to avoid capsizing of the boat (Interview #02 in Rusinga on 22/07/2020).

The findings of this study were confirmed by Mangione (2014) who stated that education campaigns adopted on the use of life jackets in 2007 in the United States of America more so in the state of California and Mississippi to reduce the drowning fatalities which stood at 71% of all reported fatalities between 1999 to 2011 in its waters. Education is very important as it creates awareness of the mitigation and also improves the understanding on the usage of the equipment recommended therefore it is applied as the traditional method to reduce Lake fatalities.

The level of knowledge of Cilicing fishermen regarding life safety is quite good because they often receive safety training and life safety equipment at sea. The level of knowledge of fishermen is influenced by experience and can increase a person's knowledge about something that is informational. With culture, someone with a good level of knowledge can meet their needs with the attitudes and beliefs they have. Some fishermen in Cilicing do not understand life safety at sea and existing procedures and only rely on minimal knowledge regarding safety.

There are several fishermen who rely on traditional knowledge about fishing safety

based on experience passed down from generation to generation from their ancestors and combining knowledge obtained through government outreach. Fishermen usually only look for signs from nature before going to the sea and do not bring the safety equipment they should carry it. According to the fisherman, if an accident occurs that causes the boat to capsize or sink, the fisherman can hold on to their boat and rely on jerry cans as an alternative buoy. This is based on the experience of fishermen when they have an accident and don't bring a life jacket, so the jerry can is an alternative so they don't drown.

Moreover, the jerry can has a cover so it doesn't sink and can help fishermen to stay afloat. Apart from jerry cans, cork can also be another choice for fishermen to avoid drowning because of the nature of cork which can also float in the sea. Knowledge of weather conditions before going to sea is also very important for fishermen. Because weather is a natural condition that is difficult to predict. Therefore, looking at natural signs and celestial bodies is something that is highly recommended for fishermen before going to sea to ensure the safety of their lives.

Fishermen in the Cilincing fishing village stated that they need to know the weather conditions before going to sea by looking at the sky, clouds and sea waves that occur on the beach. If the sky is cloudy, thick black clouds, especially accompanied by lightning, and the sea waves on the coast are very high, then it is very likely that the weather will be heavy rain accompanied by strong winds and big waves, and in these bad weather conditions fishermen will decide not to go to the sea.

In 2006, International Maritime Organization (IMO) approved the implementation the adoption of e- navigation in world waters. In line with e-navigation, Ramirez *et al* (2013) developed a web and mobile- based emergency quick portal application in Albay that

has helped reduce the impact of disasters by providing interaction between the affected citizens and emergency units. This has also reduced water vessel accidents but it is not mentioned in the findings, may be due lack of technological development in Lake Victoria. But the other two findings such as overloading and improving the conditions of the boat are captured with the education and training.

Everyone who fishes has to work on improving their ship husbandry skills because doing so will increase overall safety. For the purpose of documenting the findings of the pre-sailing system and machinery checks, among other equipment checks, it is imperative that a log be kept. Diving safety behavior needs to be encouraged and socialized. As a support system, the development of a diving community that is concerned with safety practices must become crucial (Kusnanto et al., 2020).

6.2.5 Other coping strategies that the community members employ during and after occurrence of water vessel accidents

The study asked the respondents to mention some of the coping strategies that community members employ during and after occurrence of water vessel accidents. The findings are presented in the Figure 6.4.

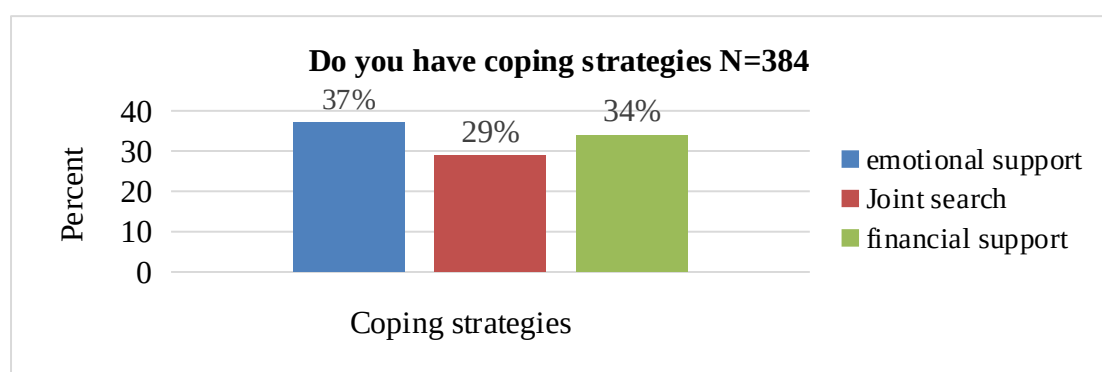


Figure 6.4 Copying strategies that the community members employ during and after occurrence of water vessel accidents.

Source: Field Data, 2021

Figure 6.4 shows that majority of 37% (142) respondents that emotional support given when a disaster takes place and even after the disaster, 34% (131) responded that the community give financial support to the affected families and 29% (111) responded that there are joint rescue operations during and after the disaster. From the group discussion all members agreed that.

When a disaster takes place, everyone in the village and the beach joins the rescue team and search until they find the lost person. The family members are also comforted to come to terms with what has taken place and there are also contributions that everyone must make in order to support the families and also any other program (FGDs #03 on 17/09/2020).

According to Omerkhil et al. (2020), the ability to adapt at the level of the fishing community is crucial for fostering community resilience and facilitating adaptation. The main justification stems from the challenges that fishermen face, including human pressure and climate change and variability (Seara et al., 2016). According to Moustahfid et al. (2020), fish stocks are known to naturally fluctuate in terms of temporal environmental variability, which presents numerous challenges for fishermen. These circumstances have compelled the fishermen to employ a variety of coping mechanisms in order to sustain their lives. Family coping refers to constructive behavioral reactions made by the family to address a problem or lessen the stress brought on by particular situations. Effective coping mechanisms are supposed to be used by families to help solve issues. In fishermen's families, sharing household duties is one type of internal coping mechanism. According to Mozumder et al. (2018), fishermen's livelihoods are demonstrated to be improved by internal coping mechanisms that incorporate the role of the family and their adaptability.

In an interview with one fish monger, she stated that;

We support those who are involved in water vessel accidents by offering counselling, psychological support and even through prayers. In case of fatalities, we contribute for the funeral expenses and any other bill. Everyone is expected to contribute for that. Some beaches have welfare offices where people contribute money every week. Others have self-help groups that help people when any calamity strikes (Interview #9 on 20/9/2020).

The findings do not concur with the findings of Odhiambo (2013) on the Coping and adaptive strategies of fishing community in Lake Victoria- Mbita Sub- County due to overwhelming disasters experienced in the lake. Some of the coping and adaptive measures they do are farming, small scale business, and boat repairing, fish mongering, operating boda-boda and grazing animals for other people. This is because most of the respondent looked at immediate response but his study looked at the overlying on the fishing to reduce poverty.

According to the Safety of Life at Sea (SOLAS) Convention, under regulation V/13, national authorities have an obligation to undertake to provide marine aids to navigation, and Vessel Traffic Services (VTS), “as the volume of traffic or the degree of risk justifies” (IALA 2016). Consequently, methods and tools for maritime waterway risk assessment and management have been developed, and guidelines for the use of specific tools have been adopted at the international level (IMO 2010).

International standards relating to fishermen's safety are “Standards of Training, Certification and Watch keeping for Fishing Vessel Personnel (STCW-F) 1995 (Adam, 2017; Zoolfakar et al., 2018), and Documents regarding Training and Certification Guidelines for Fishing Vessel Crew/ Document for Guidance on Training and Certification of Fishing Vessel Personnel FAO/ILO/IMO 2001” (FAO, 2007; Hasibuan

et al., 2020).

The following are safety assessment criteria for improving the safety of passenger ferry services: 1) safety equipment; 2) ship structure; 3) inspection of shipping documentation; 4) safety instruction; 5) communication and navigation; and 6) crew members' proficiency (rescue procedures and emergency response). According to Lu and Tseng (2012), the ability of crew members is the most crucial factor in improving ferry passenger safety, followed by safety gear. "Safety behavior, including safety compliance and safety participation, is positively correlated with safety training and emergency preparedness" (Lu and Yang, 2011, p. 339).

Likewise, avoidance may be helpful in instances when interpersonal conflict may be dangerous and avoiding the stressor is the safest course of action, even though it doesn't alter the stressor as much as problem-focused coping does (Riordan et al., 1991). On the other hand, appreciation involves highlighting and cherishing aspects of a circumstance or setting that leads to the establishment of a significant connection (Pavani et al., 2016). For example, valuing Alaska's stunning glaciers rather than complaining about the chilly, northerly wind. According to earlier studies, fishermen are more optimistic than a comparison group of land-based professionals, which supports the notion that appreciation is a significant coping mechanism in fishermen (Riordan et al., 1991).

According to Pavan et al. (2016), positive reappraisal involves cognitively reevaluating unpleasant situations by emphasizing their positive aspects, such as successful fishing during inclement weather. People can expand their thought-action inventory by employing these coping mechanisms, which results in the development of new methods for scenario assessment (Fredrickson, 2001; Pavani et al., 2016). These new methods are

then used to evaluate and manage upcoming difficulties. According to study, people are better able to handle stressful situations when they have a positive outlook and a sense of control (Smith, Barrett, & Sandal, 2018).

The IMO created the International Code for Ships Operating in Polar Waters, or the Polar Code, to improve ship safety and lessen the environmental impact on people in the isolated, dangerous, and potentially hostile polar waters (IMO, 2014). For a maximum of five days after a ship accident, ships operating in these seas must get ready for their own rescue, according the Polar Code. Nonetheless, Norwegian Coast Guard officials and University of Stavanger experts doubt if a ship's crew and passengers have the necessary knowledge and tools to accomplish it (Solberg et al., 2016). In polar waters, it is unlikely that passengers and crew members of commerce ships and cruise liners will have the same tools and abilities as professional rescue services, such as Coast Guard vessel crews and search and rescue helicopter teams.

6.2.6 Inspection of water vessel standards and crews in Lake Victoria

The study sought information from respondents if the government does inspection of water vessel standards and qualified crew members. The findings are presented on Figure 6.5.

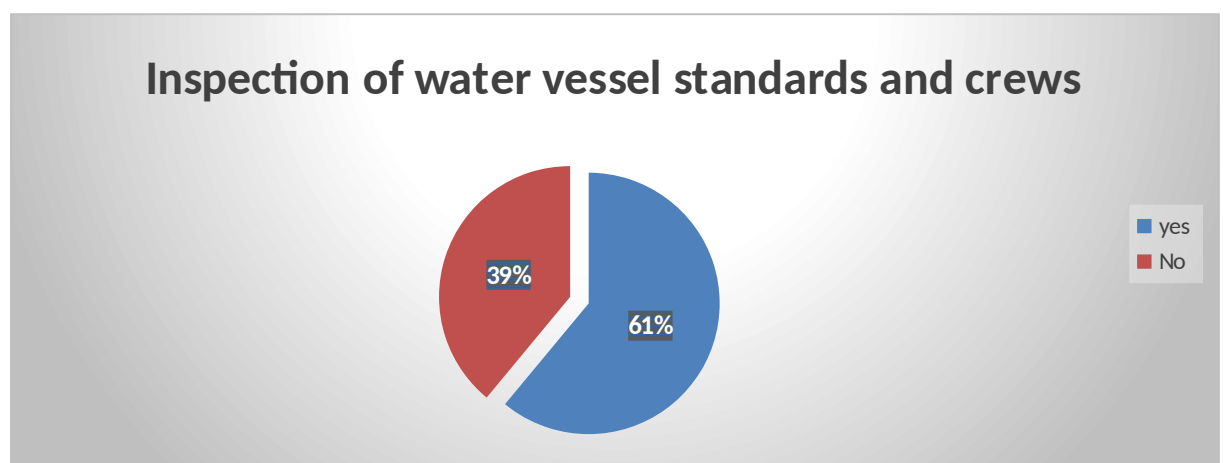


Figure 6.5 Inspection of water vessel standards and crews (N=384).

Source: Field data, 2021

The study revealed that a majority 52% (200) of respondents admitted the government through Kenya Maritime Authority and Lake Victoria Basin Commission after a duration of time inspects the water vessel standards in the docks and popular fishing beaches. Only 48% (184) of respondents reported that neither of them nor their water vessels have never been inspected. Ships are subject to inspections from different maritime stakeholders, such as port states, classification societies, shipowners, managers and operators. In addition, maritime risk analysis has, so far, not considered thoroughly the role of the inspection process in accident development. As a result, an improved understanding of the influence inspection methods would facilitate the implementation of effective measures for reducing accident probabilities or consequences.

One of the Beach Management Unit chairpersons reported:

Most water vessels plying Mbita to Luanda Kotieno route have been inspected and their crew members been found qualified. Kenya Maritime Authority officials usually make impromptu visits at Mbita point and does the inspection of the state of the water vessels and qualification of their crew members (Interview #10 on 21/9/2020).

This is in line with Onsongo (2017), who stated that thorough inspections are usually done to domestic water vessels to guarantee their safety. In the process of inspection, unqualified crew are pruned out. Wahlström et al. (2015) “argued that unmanned operations of vessels face many of the same challenges as those of aviation, subways, space stations, and other industries. The need for human understanding in local knowledge and object differentiation (e.g., differentiate between help-seekers and pirates), and the information overload and boredom, mishap during changeovers and

handoffs are a few examples”.

6.2.7 Numbers contacted for rescue during emergencies within Lake Victoria

The study sought information on which number they contact for rescue when they experience emergencies within Lake Victoria waters. Phone number contacted for rescue in Lake Victoria can determine the level of success of emergency response. The findings are presented in the Figure 6.6.

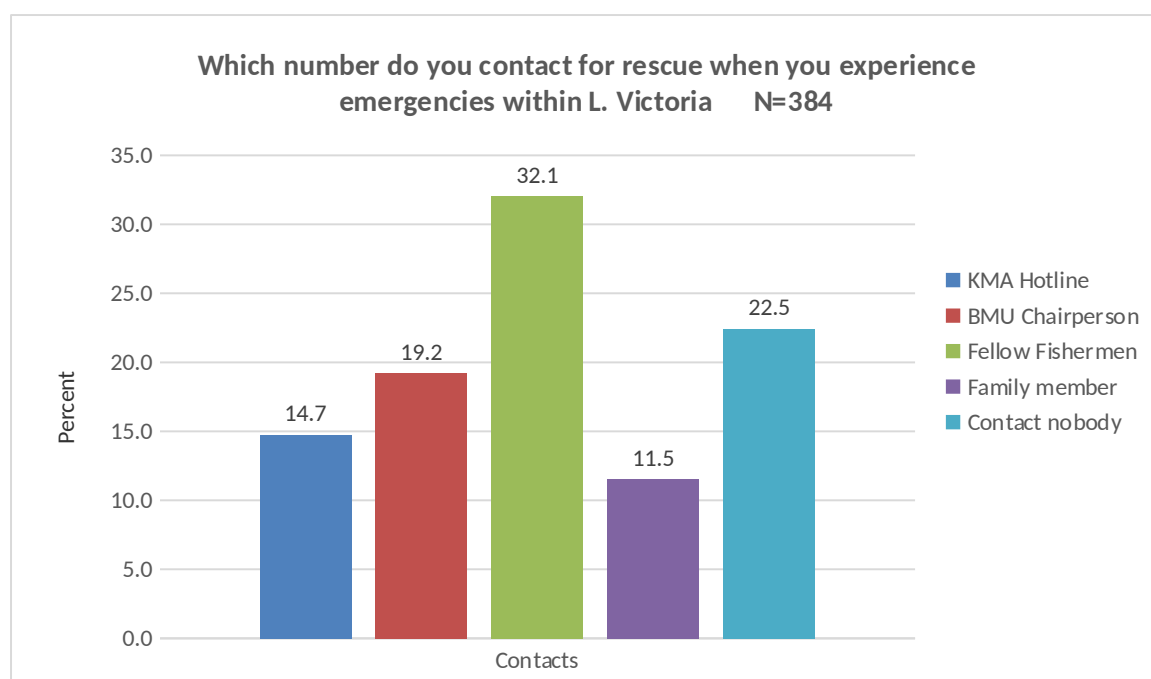


Figure 6.6: Phone number contacted for rescue during emergencies in Lake Victoria (N=384)

Source: Field Data, 2021

Out of 384 people who responded in this study, 32.1% (123) people reported that they contact fellow fishermen during emergencies in Lake Victoria. This was followed by 19.2% (74) who reported they contact Beach Management Units chairpersons and 14.7% (56) who reported they contact the Kenya Maritime Authority Hotline number. A

further 11.5% (44) of respondents indicated they contacted families during distress calls in the lake. However, 22.5% (86) of the respondents reported they contact nobody during emergencies within Lake Victoria.

Last year when we were sailing to the larger Chamaunga Island, you see over there to cut some firewood for sale in Mbita town, water started leaking into our boat which finally made us capsize. From my experience, the water vessel accidents brought us a lot of psychological fear and confusion that we could not remember to contact any number for rescue. With our phones in the pockets, we tightly held in the capsized boat whose parts remained afloat till other passer by fishermen came to our rescue Interview #15 on 24/9/2020).

6.2.8 Correlation between occurrence water vessel of accidents and copying strategies

The study sought to investigate the correlation between the effects of water vessel accidents and copying strategies put in put place. Table 6.3 shows the summary of the findings (N=384).

Table 6.3 Correlation between effects accidents occurrence and copying strategies

		The effects of occurrence of water vessel of accidents in Lake Victoria	Copying strategies
The effects of occurrence of water vessel of accidents in Lake Victoria Copying strategies	Pearson	1	.093
	Correlation		
	Sig. (2-tailed)		.000
	N	384	384
	Pearson	.093	1
	Correlation		
	Sig. (2-tailed)	.000	

N	384	384
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** Correlation is significant at the 0.01 level (2- tailed).

Source: Field Data, 2021

The table above shows that there is a correlation of .093 between effects of accidents occurrence and the copying strategies. The findings also shows that the correlation is not a strong one. It indicates that effects reduce with the application of copying strategies put in place to fight side effects of the accidents. With the 2-tailed significant at 0.01, there is a highly significant correlation between the effects of occurrences of water vessel accidents and copying strategies.

IMO (International Maritime Organization) says that human error accounts for 43.06% of fishing vessel accidents, natural factors 33.57%, and technical factors 23.35% (Malisan, 2013). Some factors that cause fishing vessel accidents include lack of crew awareness about work safety and fishing activities, lack of knowledge about shipping and fishing safety (Hassan & Mohamed, 2023), lack of necessary safety equipment, inadequate weather, such as large waves, and serious illness during the journey (Imron et al., 2017). Therefore, fishing vessel crews must prioritize their knowledge and skills regarding work safety, as well as safety equipment, vessel suitability, and navigation and safety system (Mukesh Krishnan et al., 2019). Knowledge and skills about work safety can help reduce the risk of early accidents and accidents that have already occurred, creating pre-conditions for accidents.

To maintain the long-term survival of small-scale fisheries, social and cultural challenges related to fish management must be resolved. With a variety of issues and strains, including financial strain, escalating operational expenses, fluctuating fuel prices, difficulties in hiring, diminishing fish populations, and the deterioration of marine environments (Prosperi et al., 2019). Small-scale fisherman have adopted a number of internal and exterior survival techniques in response to the unstable

environment they face. By fostering unity and group effort inside the community, cooperatives, or cooperative business groupings, it is carried out to establish a self-financing system (Mulyadi, 2007).

Fishermen's collaboration in providing capital to economic organizations will facilitate members' ability to meet their requirements. A "post-productive" activity model, which holds that institutions can accommodate the needs and problems of the community, primarily fishermen, is one study that demonstrates the significance of economic institutions as an external coping strategy developed from fishing communities (Salmi, 2015; Urquhart and Acott, 2013).

Through livelihood tactics, social interaction patterns also impact external coping mechanisms in the lives of fishermen. According to Paulus et al. (2019), livelihood strategies were used in fishing households. These included working a variety of jobs, even for low pay; using familial ties and exchanging returns to provide a sense of security and protection; and, as a last resort, leaving the area if there were no other options for income sources.

6.3 Chapter Summary

This chapter contains the presentation, analysis and discussion of findings of the third objective of the study was to investigate interventions being applied by residents and government agents to mitigate the socio-economic impacts of water vessel accidents in Kenya. The study found that there is a stand by search and rescue team in Lake Victoria. However, it was realized that there was a challenge in providing timely response especially at night when most problems are experienced. The study also established that that Kenya Meteorological Department also provides daily weather alerts to most selected lake users which the fishermen use to determine whether the lake is safe for

fishing or not. Additionally, it was also found that we have existing navigational aids to guide sailors and help them determine safe water routes.

Through the study, it was discovered that distress calls are hidden. During distress calls in Lake Victoria, response usually involves use of motor boats, lake choppers, divers or by clearing water hyacinth in which they are trapped. Traditional ways used by the local community to mitigate water vessel accidents in Lake Victoria includes public education or training, improving conditions of the lake and avoiding overloading of the boats. The study also found that the community has devised coping strategies that is employed by members during and after the occurrence of water vessel accidents which are conducting joint search, emotional support and financial support. Furthermore, the study established that we have Kenya Maritime Authority which does inspection of water vessels used in Lake Victoria together with the qualification of their crews.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a summary of key findings of the study, conclusions, recommendations and suggestions for further research. They are presented on the basis of the specific objectives and the corresponding research questions which were posed in pursuit of realizing the general objective of investigating effects of Lake Victoria water vessel accidents on the socio-economic development of house-holds in Kenya: A case study of Mbita Sub-County

7.1 Summary of Findings

The general objective of the study was to investigate effects of Lake Victoria water vessel accidents on the socio-economic development of households in Mbita sub-county, Homabay County, Kenya.

The summary of the study was informed by the objectives below:

- i. To determine the prevalence of Lake Victoria water vessel accidents in Mbita Sub-County, Kenya.
- ii. To examine the effects of Lake Victoria water vessel accidents on the socio-economic activities of households in Mbita Sub-County, Kenya.
- iii. To evaluate intervention measures being applied by residents and government agents to mitigate the socio-economic effects of water vessel accidents in Mbita Sub-County, Kenya.

7.1.1 Water vessel accidents and their Prevalence within Lake Victoria, Mbita Sub-County, Kenya

In respect to the first objective, the finding revealed that water vessel accidents do occur in Lake Victoria with majority 73% (280) responding yes, 19% (72) said no while 08% (32) of the respondents said they are not aware of the occurrence of the water vessel accidents. Water vessel accidents are frequent in the

The frequency of the water vessel accidents in L. Victoria is unpredictable. 53% (206) of respondents indicated that they unpredictably occur while 23% (87) and 14% (53) of the respondents indicated that they occur monthly and rarely respectively. The frequency of the water vessel accidents cannot be determined or predicted; they sometimes occur frequently while at times you can even take three to four years before you hear of an accident in L. Victoria.

On the causes of the water vessel accidents in Lake Victoria, the study revealed that 40% (152) responded that weather is the main cause of water vessel accidents in Lake Victoria, 20% (78) responded mystery that it is not known why it occurs, 23% (87) said the state of the vessel causes the water vessel accidents and finally, 17% (67) responded that sailors or crews' knowledge of the lake and currents may cause the disaster. Bad weather such as stormy waters, strong winds and others are the main causes of maritime accident. Mystery or unknown cause of maritime is relating to some superstitious argument and finally the knowledge and experience of the sailors and crews in terms of interpreting the weather, making right decisions and even swimming.

On who are the most vulnerable groups to the impacts of Lake Victoria water vessel accidents, the findings revealed that majority 42% (160) family members of Victims are the most vulnerable to the impacts of water vessel accidents followed by 30% (114) boats owners and their families are vulnerable. The findings further revealed that 18%

(68) are Fish Mongers who are the most vulnerable victims while 10% (42) Beach Management Unit.

7.1.2 Effects of Lake Victoria water vessel accidents on the socio-economic development of households in Mbita Sub-County, Kenya

In relation to second objective findings revealed that majority 42% (162) have fisheries as their economic activity followed by farming 31% (118), 17% (64) had informal employment (jua kali) as their main economic activity and 10% (40) are doing small business. On the other sources of Livelihoods, the study revealed that majority 35% (136) engages in small scale farming followed by 28% (108) small scale business such as shops, selling cereals and groceries; 16 % (60) in formal employment as other source of livelihood and 21% (80) in poultry farming. These activities are used to supplement the main source of livelihood.

On the number their household members, Majority 29% (111) have less than five people followed by 24% (93) with less than seven members, 18% (68) more than two people, 17% (65) having more than eight people, while 12% (47) represents those living alone. Findings on the approximate daily income revealed that majority 42% (162) earns >\$1/day<\$3.75/day followed by 33% (127) who earns >\$3.75/day <\$5/day daily and 25% (95) who earns <\$1/day.

On how beaches are accessed, Majority 42% (161) of the beaches are accessed through both water and road followed by 32% (123) of respondents indicated that their beaches are accessed through the road while 26% (100) of the respondents indicated that their beaches are accessed through water. On whether any of their household member been involved in water vessel accidents, Findings revealed that majority 73% (280) of the

respondents have had household member involved in the Lake Victoria water vessel accidents while 27% (104) said no they have never any member involved in the Lake Victoria water vessel accidents.

From those 73% respondents who said indicated they have had any members of the household involved in the Lake Victoria water vessel accidents. The study revealed that majority 41% (114) of the respondents said that it has taken many years since their member of household was involved in the water vessel accidents followed by 27% (76) who responded that it has been five years since they witnessed water vessel accidents in their family while 23% (65) indicated that they last witnessed it two years ago, and 9% (25) of the respondents indicated that they witnessed that in the last few months. On whether water vessel accidents changed their household livelihood majority 84% (323) indicated that water vessel accidents changed their household livelihood in most cases people have suffered a lot while 16% (61) said the household has not changed since the demise of the water vessel accidents.

On the effects of the Lake Victoria water vessel accidents to their household members, of 83% (232) agreed while 17% (48) did not agree with the psychological effects. The family could not pay school fees for the kids after the water vessel accidents majority 79% (221) said yes while 21% (59) said no. The feeding habits have changed since the demise of the family member majority of 80% (224) said yes while 20% (56) said no, it has not changed. On the question of no proper dressing or grooming majority of 77% (216) said yes while 23% (64) said no and finally if in any case the relationship with other relatives have changed 85% (238) said yes it has changed while 15% (42) said no it has not changed. Majority 73% (204) have lost a boat while 27% (76) have not

lost, 64% (180) have lost poultry while majority of 36% (100) have gained poultry which be due to coping strategy. On the Livestock 69% (193) have lost the livestock while 31% (87) have gained, 66% (185) have lost motor cycle or bicycle due to maintenance and other expenses while 34% (95) have gained. Finally, 67% (188) have lost radio while 33% (92) have gained.

7.1.3 Evaluate intervention measures being applied by residents and government agents to mitigate the socio-economic impacts of water vessel accidents in Mbita Sub-County, Kenya

On the third objective findings revealed that majority 65% (250) there is a stand by SAR team in Lake Victoria that responds to distress emergency call by the fishers and other lake user while 35% (134) are not aware of the existence of the SAR team in Lake Victoria. The study revealed there are daily alerts by majority 65% (250) responded that there are daily weather alerts provided to fishers and other lake users while 35% (134) have not heard any weather alerts. Majority 61% (234) agreed that there is a well maintained floating navigational aids in Lake Victoria to guide sailors while 39% (150) said there are no floating navigational aids in Lake Victoria.

Findings also revealed that majority 47% (181) Lake Victoria Basin Commission and other emergencies bodies use motor boats to respond, 19% (70) said they use divers to respond in case there are people drowning in water, 27% (105) said the response is done using choppers and 7% (28) said they clear water hyacinth to create way for those trapped. On the traditional measures that community members put in place to mitigate water vessel accidents in Lake Victoria Majority of 61% (234) responded education and training, 19% (72) said avoiding overloading while 20% (78) said improving the

conditions of the boat/ canoe.

The first measure that is taken to mitigate water vessel accidents is training or educating the lake users on what to do before you get in any boat or canoe. They are supposed to know how to sail the boat, put on life saving jackets, and under the guidance of an expert have followed that route at night or day time. Number two is knowing the capacity of the vessel, and finally to improve and repair the leaking or maintain the condition of the boat. Majority of 37% (142) responded that emotional support given when a disaster takes place and even after the disaster, 34% (131) responded that the community give financial support to the affected families and 29% (111) responded that there are joint rescue operations during and after the disaster.

7.2 Conclusions

Based on the findings and discussions from this research study, the following conclusions can be drawn: First, water vessel accidents are common in Lake Victoria which mostly involve unpredictable capsizing of boats and rare capsizing waterbus. Water vessel accidents occur as a result of bad weather, mystery, crew errors and poor state of water vessels. As compared to the period before the formation of Kenya Maritime Authority and Lake Victoria Basin Commission, water vessel accidents have presently reduced though are still a big hazard to Lake Victoria users.

Second, the negative effects of Lake Victoria water vessel accidents remain evident on the socio-economic development of households. Water vessel accidents have resulted into psychological problems, poverty, social break-ups, hunger and dropping out of school due to inability to pay school fees in Mbita Sub- County.

Finally, regarding the interventions being applied by residents and government agents to mitigate the socio-economic impacts of water vessel accidents in Kenya; the study discovered that the community has got acceptable traditional coping strategies employed during and after water vessel accidents to prevent them from suffering from the adverse effects.

The government in partnership with the Beach Management Units heads also participates in conducting search and rescue for those who have experienced water vessel accidents. The government responds to distress calls by clearing water hyacinth and through using motor boats, choppers and divers. However, slow response during water vessel accidents was cited in addition to the government not offering any help to cushion the affected families from suffering negative socio-economic effects resulting from the disasters.

7.3 Recommendations

Based on the research findings, the study herewith recommends the following policy considerations which, if implemented could play an important role in water vessel accidents management;

1. The findings showed that there is late response from the search and rescue teams during water vessel accidents occurrence. It is thus recommended that Lake Victoria Basin Commission, Kenya Maritime Authority and other stakeholders in the maritime industry develop a mobile portal using Geo-location that could help in prompt response during distress calls.
2. The findings of this study established that water vessel accidents have negatively affected the socio-economic livelihoods of households. It is, therefore, recommended that the government and other agencies should conduct water vessel accidents socio-economic impact assessments and do empowerment to

households whose members have suffered from water vessel accidents when rolling out economic stimulus projects such as economic diversification, training and sensitization.

3. The study revealed that the government has implemented a number of intervention measures to mitigate water vessel accidents in Lake Victoria. Thus, the study recommends that concerned government departments promotes local community-initiated mitigation measures so as to build community resilience.

7.4 Suggestions for further researchers

Drawing from this research study and need to build on the existing knowledge, the following suggestion is put forth for further research studies:

- i. Conduct research on the influence of beach management unit on the implementation safe fishing strategies among fishermen in Lake Victoria
- ii. Evaluate the types of water vessels accidents affecting fishermen in Lake Victoria
- iii. Assess the influence of globalization on the fishermen's sustainable livelihoods within Lake Victoria.

REFERENCES

- Abera MW (2018) Impact of Water Hyacinth, *Eichhornia crassipes* (Martius) (Pontederiaceae) in Lake Tana Ethiopia: A Review. Journal of Aquaculture, Research and Development
- Amore J., Were P., Okayo J., Adebe J. and Odinga M (2017). "Relationship between Technological hazards and Fishermen Vulnerability in Lake Victoria, Kenya." The IOSR Journal of Humanities and Social Science
- Angela Oketch, 2018. "\$36.6m raised for Lake Victoria safety project." The East African. May 9th
<https://www.theeastafrican.co.ke/scienceandhealth/-36-raised-for-Lake-Victoria-safety-project/3073694-4553020-ujq4xm/index.html>
- Anyah, R. O., F. H. Semazzi, and L. Xie (2006), Simulated physical mechanisms associated with climate variability over Lake Victoria Basin in East Africa. Monthly Weather Review, 134, 3588-3609.
- Areas. *Economic and Environmental Geology*, 46(3), 247-256.
- Asiki G, *HIV and syphilis prevalence and associated risk factors among fishing communities of Lake Victoria, Uganda*. Epidemiology Online, Volume 87, Issue 6., 2011.
- Asiki, G. (2011), HIV and syphilis prevalence and associated risk factors among fishing communities of Lake Victoria, Uganda. Epidemiology Online, Volume 87, Issue 6.
- Badjecka, M.C., E. H. A., Ashley S. Hallsd, N. K. Dulvy (2010), Impacts of climate variability and change on fishery-based livelihoods, Marine Policy, Volume 34, Issue 3, Pages 375 – 383.

- Beaman and Dillon (2009). *Do household definitions matter in survey design? Results from a randomized survey experiment in Mali*. International Food Policy Research Institute, Northwestern University
- Byarugaba GA. *Mobile Weather Alert and Advisories, Building Resilience through Innovation*. in *ICT4D Conference*. 2014.
- Byarugaba, G. A. (2014), *Mobile Weather Alert and Advisories, Building Resilience through Innovation*. In: *ICT4D Conference*.
- Cohen D, Crabtree B. "Qualitative Research Guidelines Project." July 2006. <http://www.qualres.org/HomeInfo-3631.html>
- Colin Dewey. (2014). Crafty Sailors, Unruly Seas: Margaret Cohen's Oceanic History of the Novel. *Criticism*,56(4), 861-870. doi:10.13110/criticism.56.4.0861
- Dunn, K. 2010. 'Doing' qualitative research in Human Geography. *Hay, I. (ed.). Qualitative research methods in Human Geography*. Oxford University Press, Ontario.
- Elinder, M., &Erixson, O. (2012). Gender, social norms, and survival in water vessel accidents. *Proceedings of the National Academy of Sciences of the United States of America*,109(33), 13220-13224. Retrieved from <http://www.jstor.org/stable/41700900>
- Frey, B., Savage, D., &Torgler, B. (2011). Behavior under Extreme Conditions: The "Titanic" Disaster. *The Journal o, 25conomic Perspectives*,25(1), 209-221. Retrieved from <http://www.jstor.org/stable/23049445>
- Gallopín, G.C, (2006). *Linkages between Vulnerability, Resilience and Adaptive Capacity*. Global Environmental Change
- Gans, L. (2006). Water Vessel Accidents. *Disaster Medicine*, 878-881.

- Golden, Abigail S & Weisbrod, Roberta E. 2016. Trends, Causal Analysis, and Recommendations from 14 Years of Ferry Accidents. *Journal of Public Transportation*, 19 (1): 17-27. DOI: <http://doi.org/10.5038/2375-0901.19.1.2>
- Goodman, V. D. (2011). *Chandos information professional series: Qualitative research and the modern library*. Retrieved from <https://ebookcentral.proquest.com>
- Gray, D. E. (2009). *Doing Research in the Real World*. (2nd, Ed.) London: SAGE Publications
- Hammersley, M. & P. Atkinson. 2007. *Ethnography*. Routledge, London.
- Hassan, N. H. S., & Mohamed, E. E. E. (2023). The Views and Knowledge of the Fishermen on the Impact of Lake Burullus Development on their Community. *Egyptian Journal of Aquatic Biology and Fisheries*, 27(1), 69–84. <https://doi.org/10.21608/ejabf.2023.281414>
- Heo, B., Yu, S., & Kim, S. (2013). Economic Impact Analysis of Disaster Mitigation Projects in Hazardous
- Hesselberg, J. 2012. *Fieldwork in developing countries. A short student guide*. ISS, UiO.
- Hong, Sun-Bae, “A study on the effects of e-navigation on reducing vessel accidents” (2015) World Maritime University Dissertations, 502
- Huysamen, G.K. 1993. *Methodology for the Social and Behavioral Sciences*. Halfway House, Pretoria: South Africa.
- Janjuha-Jivraj S, *The Sustainability of Social Capital Within Ethnic Networks*. *Journal of Business Ethics*, 2003. 47(1): p. 31-43.
- Janjuha-Jivraj, S. (2003), *The Sustainability of Social Capital Within Ethnic Networks*.

Journal of Business Ethics, 47, 31-43.

- Kassim, K. (2012). The Contribution of Lake Victoria Fisheries to The Economy of Tanzania; Economic Research Bureau, University of Dar Es Salaam Lake Victoria Basin Commission. "Lake Victoria Basin Community Annual Report July 2008- June 2009" Kisumu Kenya, LVBC 2010.
- Kisusu R.W., Onyango, P.O, Haule, T. &Salehe, M (2012). *Factors Influencing Involvement of Local Communities in The Fishing Industry in Lake Victoria, Tanzania: From Production to Marketing*
- Kothari, C. R. (2009). *Research Methodology: Methods and Techniques* (10th ed.). New Delhi: New Age International (P) Ltd.
- Lake Victoria Environmental Management Programme. (1997). Annual report. Kampala, Uganda.
- Lawal J., Dagarawa, (2012) "Marine Accidents in Northern Nigeria: Causes, Prevention and Management." The International Journal of Academic Research in Business and Social Sciences.
- Líndal, E. & J.G. Stefánsson. 2011. The long-term psychological effect of fatal accidents at sea on survivors: A cross-sectional study of North Atlantic seamen. *Social Psychiatric Epidemiology*, Vol. 46. 239-246.
- Mailu, A. M. (2001, October). Preliminary assessment of the social, economic, and environmental impacts of water hyacinth in the Lake Victoria basin and the status of control. Paper presented at the meeting of the Global Working Group for the Biological and Integrated Control of Water Hyacinth, Beijing, China.
- Mangione, T., & Chow, W. (2014). Changing life jacket wearing behavior: An evaluation of two approaches. *Journal of Public Health Policy*, 35(2),

204-218. Retrieved from <http://www.jstor.org/stable/43288018>

Marie-Caroline Badjecka EHA, Ashley S. Hallsd, Nicholas K. Dulvy, *Impacts of climate variability and change on fishery-based livelihoods, Marine Policy, Volume 34, Issue 3, Pages 375 – 383. 2010.*

Marples, D. R. (1988). The Environmental Impact. *The Social Impact of the Chernobyl Disaster*, 59-87. Matthewman, S. (2015). *Sociology and Disasters. Disasters, Risks and Revelation*, 11-34.

Mary and Gomes, *Lightning safety of under-privileged communities around Lake Victoria. Geomatics, Natural Hazards and Risk, 2014. (ahead-of-print): 1-17.*

Mary, A. H. and C. Gomes (2014), *Lightning safety of under-privileged communities around Lake Victoria. Geomatics, Natural Hazards and Risk, (ahead-of-print): 1-17.*

Mikkelsen, B. 1995. *Methods for development work and research: A guide for practitioners*. Sage, New Delhi. Molloy, M. S., Mulhern, J., & Gans, L. (2016). water vessel accidents. *Ciotton's Disaster Medicine*, 945-948.

Mkenda, A. (2001). *Fisheries resources and welfare in rural Zanzibar*. Unpublished doctoral dissertation, Göteborg University, Göteborg, Sweden.

Mugenda, M., & Mugenda, A.G. (2003). *Research Methods: Qualitative & Quantitative Approaches*. Nairobi: African Centre for Technology Studies (ACTS) Press.

Mukesh Krishnan, M. B., Saveetha, D., Arokiaraj Jovith, A., & Rajasekar, P. (2019). Fisherman navigation and safety system. *International Journal of Innovative Technology and Exploring Engineering*, 8(12), 5762–5766. <https://doi.org/10.35940/ijitee.L4011.1081219>

Nakyonyi, A. (2011). *Maritime Safety on Lake Victoria, Analysis of Legal and Regulatory Frame work*

- Ngenyam Bang, H. (2012). Disaster management in Cameroon: The Lake Nyos disaster experience. *Disaster Prevention and Management: An International Journal*, 21(4), 489-506.
- Odhiambo, T. (2013). "Effects of Weather and Climate Variability on Fishing Activities and Fishers' Adaptive Capacity in Mbita Division- Homa Bay County, Kenya; Department of Geography, Kenyatta University.
- Odongkara, K., B. Ntambi, H. Khisa, and B. Mbilingi (2006), Contribution of Lake Victoria Fisheries to economic growth, poverty reduction and development: literature review and data. Jinja Uganda: National Fisheries Resources Research Institute; Implementation of a Fisheries Management Plan.
- Odongkara; K, Ntambi; B, Khisa; H and Mbilingi B, *Contribution of Lake Victoria Fisheries to economic growth, poverty reduction and development: literature review and data*. 2006, National Fisheries Resources Research Institute; Implementation of a Fisheries Management Plan: Jinja Uganda.
- Olive Kobusingye, Nazarius Mbona Tumwesigye, Joseph Magoola, Lynn Atuyambe & Olakunle Olang (2016): *Drowning among the lakeside fishing communities in Uganda: results of a community survey*, *International Journal of Injury Control and Safety Promotion*, DOI: 10.1080/17457300.2016.1200629
- Omwenga R.N, R. Abila and C. Lwenya (2000) "Fishing and Poverty Levels Around Lake Victoria (Kenya) Kenya Marine and Fisheries Research Institute, Kisumu
- Onsongo, Selpha Kerubo, "Analysis of the domestic passenger ferry safety in Kenya" (2017). *World Maritime University Dissertations*. 552.

- Oso, W.Y., & Onen, D. (2005). *A general guide to writing research proposal and report*. Nairobi: Jomo Kenyatta Foundation.
- Paton, D. & D. Johnston. 2001. Disasters and communities: Vulnerability, resilience and preparedness. *Disaster Prevention and Management*, Vol. 10, No. 4. 270-277.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. (2nd ed.). California: Sage Publications, Inc.
- Powell, R. (2016). Proposal for a Daily Weather Forecast for Kenyan Fishermen on Lake Victoria; WISER Western Project. Final Version.
- Pratt, M. (1996). Useful Disasters: The Complexity of Response to Stress in a Tropical Lake Ecosystem, *Anthropologica*, 38(2), 125.
- Ramirez, Pondoyo, Laya, and Bahio (2013). *SagipPony: A web and mobile-based Philippine emergency quick response portal*
- Robert Press. (2017). Dangerous Crossings: Voices from the African Migration to Italy/Europe. *Africa Today*, 64(1), 3-27. doi:10.2979/africatoday.64.1.01
- Rymond, A. (2012). Lake Victoria Fisheries Reymond Organization
- Sandelowski, M. (2000). "Whatever happened to qualitative description?" *Research in nursing & health*, 23(4), 334-340
- Schilling, R. (1971). Hazards of Deep-Sea Fishing. *British Journal of Industrial Medicine*, 28(1), 27-35. Retrieved from <http://www.jstor.org/stable/27722586>
- Strydom, H., Fouche C. B. and Delport C.S.L (Third edition). 2005. Research at Grassroots for Social Sciences and Human Service Professions.
- Teijlgen, E. R., & Hundley, S. (2001). Social Research Update: The importance of pilot studies [online] <http://www.socsurvey.ac.uk/so.SRU35.pdf>.

Retrieved, 02.10.2018.

The First Homa Bay County Multisectoral AIDS Strategic Plan 2014/2015 – 2018/2019
(HBCAMSP- 1)

UN, *Global Assessment Report on Disaster Risk Reduction: Revealing Risk, Redefining Development: Summary and Main Findings*. 2011, United Nations.

USAID Center for Development Information and Evaluation (1996) *Conducting Key Informant Interviews Performance Monitoring & Evaluation TIPS*. Washington DC, USAID. Retrieved from http://pdf.usaid.gov/pdf_docs/PNABS541.pdf

Yanagisako, S.J. 1979. Family and household: The analysis of domestic groups. *Annual Review of Anthropology*, Vol. 8. 161-205.

Yang, C., Kim, K., Lim, H., Kim, C., Kim, M., & Hong, D. (2018). Voyage Environmental Information System (VEIS) for Safe Navigation Support in the Coastal Waters of the Arctic Ocean. *Journal of Coastal Research*, 561-565. Retrieved from <https://www.jstor.org/stable/26488280>

APPENDICES

APPENDIX 1

QUESTIONARE FOR FISHERFOLKS AND LAKE COMMUTERS

SECTION 1

1) What is your gender?

- A. Male B. Female

2) What is your age bracket?

- A. Less than 18 years
B. 18-25 years
C. 26-33 years
D. 34-41 years
E. 42-49 years
F. 50 years and Above

3) Are you married?

- A. Yes B. No

4) To the single, what is the state of being single?

- A. Not yet married
B. Divorced
C. Widow
D. Widowers

5) What is your highest level of education attained?

- A. Below class seven
B. Completed Class eight
C. Completed secondary education
D. College/ University

6) Do water vessel accidents occur in Lake Victoria Kenyan side?

- A. Yes B. No

- 7) How often do water vessel accidents occur in Lake Victoria
.....
- 8) In your opinion, what are the causes of water vessel accidents in Lake Victoria?
.....
- 9) Who are the most vulnerable groups to the impacts of Lake Victoria water vessel accidents?
.....

SECTION 2

- 1) What is your main economic activity?
.....
- 2) Other than the economic activity stated above, what are your other economic activities that you do for a living?
 - A. Small scale farming
 - B. Formal employment
 - C. Small scale business
 - D. Poultry keeping
- 3) How long have you been in the fishing industry?
 - A. Less than a year
 - B. Not more than 3 years
 - C. Five years
 - D. More than 5 years
- 4) How many household members do you have?
 - A. One
 - B. Two
 - C. Three
 - D. Four
 - E. Five
 - F. Six
 - G. Seven and Above

- 5) What is the approximate daily Income of the respondents?
 - A. Less \$1/day
 - B. >\$1/day<\$3.75/day
 - C. >\$3.75/day<\$5/day

- 6) How do you access most beaches?
 - A. Water
 - B. Road
 - C. Both water and road

- 7) Has any of your household member been involved in water vessel accidents?
 - A. Yes
 - B. No

- 8) If answer in 7 (above) is Yes, how long has it taken since he/she involved in water vessel accidents?
 - A. Few months ago
 - B. One year ago
 - C. Two years ago
 - D. Three years ago
 - E. Four years ago
 - F. Five years ago
 - G. Many years ago

- 9) Did the water vessel accidents change the household livelihood?
 - A. Yes
 - B. No

- 10) How did it affect the household operations?
 - A. Name social problems

.....
B. Name economic problems
.....
.....

11) As a household, which Items lost or gained after water vessel accidents?

- A. Boat
- B. Poultry
- C. Bicycle
- D. Livestock
- E. Radio

SECTION 3

12) Do you have a stand by SAR team that responds to distress emergency calls in Lake Victoria?

- A. Yes
- B. No

13) Are fisherfolks and other lake users provided with day-to-day weather alerts in Lake Victoria?

- A. Yes
- B. No

14) Do you have well maintained and existing floating Navigational aids in Lake Victoria to guide sailors?

- A. Yes
- B. No

15) How do you respond to distress calls from fisher folks and other lake users trapped in water hyacinth in Lake Victoria?

- A. Choppers
- B. Motor Boats
- C. Helicopters
- D. Clearing water hyacinth

- E. Use divers

16) Which are the main traditional measures that the community members put in place to mitigate water vessel accidents in Lake Victoria?

- A. Education/Training
- B. Avoiding overloading
- C. Improving conditions of the boat

17) What are the main coping strategies that the community members employ during and after occurrence of water vessel accidents?

.....
.....
.....

18) Do inspection of water vessel standards and crews do in Lake Victoria?

- A. Yes
- B. No

19) Which Number do you contact for rescue when you experience emergencies within Lake Victoria?

- A. KMA Hotline
- B. Beach Management Unit chairperson's
- C. Fellow fishermen
- D. Family members
- E. Contact nobody

APPENDIX 2
IN-DEPTH INTERVIEW GUIDE FOR COMMUNITY MEMBERS WHOSE
FAMILY MEMBERS HAVE BEEN AFFECTED BY WATER VESSEL ACC

1. Do water vessel accidents occur in Lake Victoria Kenyan side?
2. How often do water vessel accidents occur in Lake Victoria?
3. In your opinion, what are the causes of water vessel accidents in Lake Victoria?
4. Who are the most vulnerable groups to the impacts of Lake Victoria water vessel accidents?
5. What is your main economic activity?
6. Other than the economic activity stated above, what are your other economic activities that you do for a living?
7. How long have you been in the fishing industry?
8. How many household members do you have?
9. What is the approximate daily Income?
10. How do you access most beaches?
11. Has any of your household member been involved in water vessel accidents?
17. How long has it taken since he/she involved in water vessel accidents?
18. Did the water vessel accidents change the household livelihood?
19. How did it affect the household operations?
20. As a household, which items were lost or gained after water vessel accidents?
21. Do we have a stand by SAR team that responds to distress emergency calls in Lake Victoria?
22. Are fisherfolks and other lake users provided with day-to-day weather alerts in Lake Victoria?
23. Do you have well maintained and existing floating Navigational aids in Lake Victoria to guide sailors?

24. How do you respond to distress calls from fisher folks and other lake users trapped in water hyacinth in Lake Victoria?
25. Which are the main traditional measures that the community members put in place to mitigate water vessel accidents in Lake Victoria
26. What are the main coping strategies that the community members employ during and after occurrence of water vessel accidents?
27. Are inspection of water vessel standards and crews done in Lake Victoria?

Thank you very much for your cooperation

**APPENDIX 3: INTERVIEW GUIDE FOR KEY INFORMANTS, KMA
AND LVBC STAFFS**

1. Do water vessel accidents occur in Lake Victoria Kenyan side?
2. How often do water vessel accidents occur in Lake Victoria?
3. In your opinion, what are the causes of water vessel accidents in Lake Victoria?
4. Who are the most vulnerable groups to the impacts of Lake Victoria water vessel accidents?
5. Do you have a stand by SAR team that responds to distress emergency calls in Lake Victoria?
6. Are fisherfolks and other lake users provided with day-to-day weather alerts in Lake Victoria?
7. Do you have well maintained and existing floating Navigational aids in Lake Victoria to guide sailors?

8. How do you respond to distress calls from fisher folks and other lake users trapped in water hyacinth in Lake Victoria?
9. Which are the main traditional measures that the community members put in place to mitigate water vessel accidents in Lake Victoria?
10. What are the main coping strategies that the community members employ during and after occurrence of water vessel accidents?
11. Are inspection of water vessel standards and crews done in Lake Victoria?
12. Which Number do you contact for rescue when you experience emergencies within Lake Victoria?

Kindly, is there anything more I have not asked that you feel like sharing?

APPENDIX 4

FOCUS GROUP DISCUSSION GUIDE FOR FISHERFOLKS

1. What is your main economic activity?
2. Other than the economic activity stated above, what are your other economic activities that you do for a living?
3. How long have you been in the fishing industry?
4. How do you access most beaches?
5. Has any of your household members been involved in water vessel accidents?
6. How long has it taken since he/she involved in water vessel accidents?
7. Did the water vessel accidents change the household livelihood?
8. How did it affect the household operations?
 - A. Name social problems
 - B. Name economic problems
9. As a household, which Items lost or gained after water vessel accidents?
10. Do we have a stand by SAR team that responds to distress emergency calls in Lake Victoria?
11. Are fisherfolks and other lake users provided with day-to-day weather alerts in Lake Victoria?
12. Do we have well maintained and existing floating Navigational aids in Lake Victoria to guide sailors?
13. How do you respond to distress calls from fisher folks and other lake users trapped in water hyacinth in Lake Victoria?
14. Which are the main traditional measures that the community members put in place to mitigate water vessel accidents in Lake Victoria?
15. What are the main coping strategies that the community members employ

during and after occurrence of water vessel accidents?

16. Are inspection of water vessel standards and crews done in Lake Victoria?
17. Which Number do you contact for rescue when you experience emergencies within Lake Victoria?
18. Is there anything left that you feel you may want to share?

Thank you very much for your cooperation

APPENDIX 5
KMD WEATHER ALERT



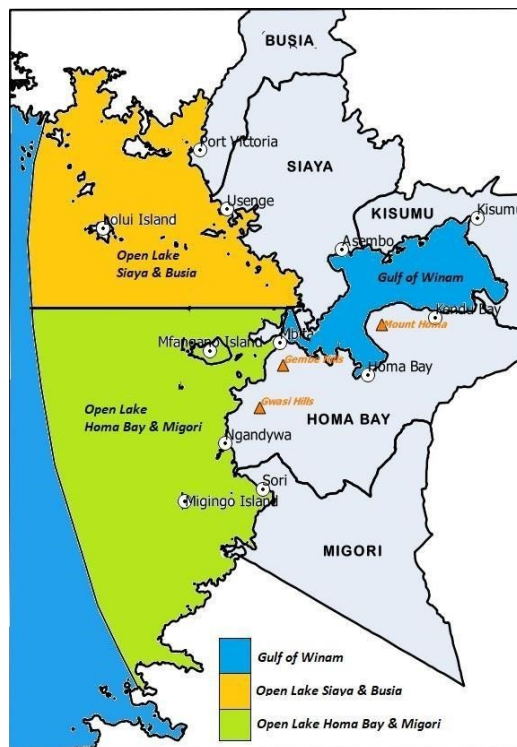
REPUBLIC OF KENYA

MINISTRY OF ENVIRONMENT AND FORESTRY

KENYA METEOROLOGICAL DEPARTMENT

24-HOUR FORECAST FOR FISHERMEN ON LAKE VICTORIA

Issued at: 22.00 EAT ON TUESDAY 22ND SEPTEMBER 2020



Period covered by forecast:

06.0 : Tuesday 22nd September 2020 to

06:00: Wednesday 23rd January 2020.

Highlights

Gulf of Winam

- Light wind blowing from the west expected in the afternoon.
- Light rains expected during the day.
- Small waves expected.

Open Lake – Homa Bay, Migori

- Light wind blowing from the southeast expected in the morning.
- Moderate rain expected in the morning.
- Small waves expected.
- **Open Lake – Siaya, Busia**

	• Light wind blowing from the southwest expected in the afternoon. • widespread thunder Rain expected in the afternoon. • Small waves expected.
--	--

Zone 1: Winam Gulf

Tuesday 22/09/2020	Wind strength /Direction	Wave height	Rainfall/ Cloud cover	Rainfall distribution	Visibilit y	Hazard s
Morning	 Light	 Small waves	 Light rains	 Few places	 Good	
Afternoon	 Light	 Small waves	 Isolated thunder rain	 Few places	 Good	
Night before midnight	 Light	 Small waves	 Night cloudy			

light after midnight	 Light	 No waves	 Night cloudy time			
-------------------------	--	---	--	--	--	--

Zone 2. Open Lake - Homa Bay, Migori

esday /09/2020	Wind strength /direction	Wave height	Rainfall/ Cloud cover	Rainfall distribution	Visibility	Hazards
orning	 Light	 Small waves	 Moderate rains	 Most places	 Poor	
ternoon	 Light	 Small waves	 Widespread thunder rain	 Several places	 Moderate	

ght fore dnight	 Light	 Small waves	 Isolated thunder rain	 Few places		
ght after dnight	 Light	 Small waves	 Night time cloudy			

Zone 3. Open Lake - Siaya, Busia

uesday	Wind strength	Wave height	Rainfall/Cloud	Rainfall	Visibility	Hazards
2/09/2020	/direction		cover	distribution		

Morning	 Light	 Small waves	 Moderate rain	 Most places	 Poor	
fternoon	 Light	 Small waves	 Widespread thunder rain	 Several places	 Good	
night before midnight	 Light	 No waves	 Isolated thunder rain	 Few places		
ight after midnight	 Light	 Small waves	 Night time cloudy			

Key to hazard warning colors

Green	No severe weather is expected
Amb er	Potentially dangerous weather is expected. Be prepared.
Red	Dangerous and potentially life-threatening weather conditions are expected. Take immediate action to ensure your safety.



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Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR•. 509099

Date: 13th June, 2019

Maklago Stephen Uduma,
CDM/G/01-58009/2016, P.O. Box
190-50100, KAKAMEGA.

Dear Mr. Uduma,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters proposal entitled "Effects of Lake Victoria Maritime Disasters on the Socio-economic Development of House-holds in Kenya: Case study of Mbita sub-county" and appointed the following as supervisors:

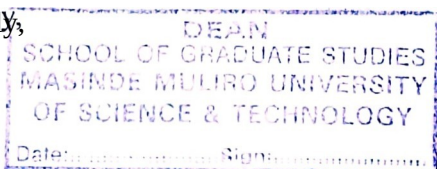
1. Dr. Kenneth Otieno
2. Dr. Richard Juma

You are required to submit through your supervisor(s) progress reports every three months to the Director of Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Disaster Management and Humanitarian Assistance Graduate Studies Committee; Chairman, Emergency Management Studies & Departmental Graduate Studies Committee. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your Master's thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge,

Yours Sincerely,



Dr. Consolata Ngala

DEPUTY DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES



Ref No: 190413

RESEARCH LICENSE



This is to Certify that Mr.. **STEPHEN MAKLAGO** of **Masinde Muliro University of Science and Technology**, has been licensed to **conduct research in Homabay on the topic: EFFECTS OF LAKE VICTORIA MARITIME DISASTERS ON THE SOCIO-ECONOMIC DEVELOPMENT OF HOUSE-HOLDS IN KENYA: CASE STUDY OF MBITA SUB-COUNTY** for the period **ending : 10/October/2020.**

License No: NACOSTI/P/19/1974

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NATIONAL COMMISSION FOR
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