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Determine factors contributing to vulnerability of fishermen to these disasters

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ABSTRACT
Natural and technological hazards are common occurrences facing the fishing community throughout the world. Statistics show that fishermen on Lake Victoria particularly on the Kenyan side experience many natural and technological hazards including floods and storms.Vulnerability of fishermen to natural hazards is increasingly becoming a global concern. Consequently, fishermen have devised their own local coping mechanisms to the vulnerabilities posed by natural and technological hazards. However, in Kenya, little has been documented on the coping strategies employed by fishermen in relation to the existing natural and technological hazards. The overall objective of the study, therefore, was to assess the vulnerability of fishermen to natural and technological hazards on the Kenyan side of Lake Victoria. Specifically, the study sought to: establish natural and technological hazards affecting fishermen on the Kenyan side of Lake Victoria; examine factors contributing to vulnerability of fishermen to these hazards and to evaluate the effectiveness of coping strategies employed by fishermen in relation to the existing hazards. A cross-Sectional research design was employed. The study population was 40078 which comprised of fishermen, village elders, Beach Management Units (BMU) managers, Government officers. The researcher selected a sample of 625 respondents which included a sample size of 401 fishermen, and 84 key informants and 140 participants in focus group discussions. There were 14 focus group discussions each comprising of 10 participants.Cluster and random sampling techniques were used to select fishermenwith sub-counties being the basis of clustering before applying simple random techniques. Key informants were sampled purposively. Questionnaires were used to obtain data from fishermen, while interview schedules were used to obtain data from key informants. The study employed observation checklists. Content validity was established by expert judgment. Cronbach alpha coefficient was obtained to establish reliability of instruments. The data was coded and analyzed using descriptive statistics and presented using frequencies which was obtained to show distribution of responses. Spearman rho correlation analysis was conducted to establish the relationships between the study variables. Results were displayed using bar graphs, tables, pie charts and bar charts to present the data. The findings of the study revealed that fishermenon the Kenyan side of Lake Victoria were vulnerable to natural and technological hazards. The study recommended that more emphasis should be placed on community awareness/capacity building on metrological hazards in the Lake; mitigation and adaptation measures targeting disaster risk reduction in Lake Victoria should focus on addressing the safety of vessels particularly boats and perception of risk by the fishermen and any effort to address disaster risks at the lake should build on the local adaptations because on the overall they contributed to lake disaster risk reduction.

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OPERATIONAL DEFINITION OF TERMS

Due to different socio- economic orientations, terms vary in meanings depending on people and at different times. To reduce biasness in this study, terms were applied as stated below.

Coping strategies: It refers to specific efforts that fishermen employ to master, tolerate, reduce or minimize effects of natural and technological hazards.

Fishermen: This term is used in the study to refer to people who engages in fishing as an occupation on the Kenyan side of Lake Victoria.

Hazard: This term is used in the study to refer to potential damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic or environmental degradation.

Mitigation: The action taken to reduce the severity or natural and technological hazards by Fisherman

Natural hazard: Is a major adverse event resulting from natural process of the earth Examples floods earthquake, heavy wind, and heavy rain.

Preparedness: This is a state of readiness for any potential hazard or disaster.

Technological hazard: Are the consequences of technological or human hazards. Examples include transport accidents, the bad condition of the boats

Vulnerability of fishermen: Is the process of identifying, quantifying and prioritizing (or ranking) the vulnerabilities in the fishing industry.

Vulnerability: Conditions determined by physical, social, economic and environmental factors or Processes, which increase the susceptibility of a community to the impact of hazard.

I. INTRODUCTION

This chapter presents a detailed background of the study, statement of the problem, objectives of the study, research questions, and significance of the study, scope and limitation of the study.

1.1 Background of the study

Natural and technological hazards have the potential to cause negative impacts on the environment, property, poverty reduction and life. According to AFIPEK (2000), these hazards have adverse longer-term consequences on socio-economic development especially by causing significant budgetary pressures with both narrowly fiscal short-term impacts and wider long-term implications for development. Consequently trends in natural and technological hazards reveal several patterns of human suffering over the past several decades. Press (2003) observes that in order to reduce disaster risk, it is important to reduce exposure, and minimize the level of vulnerability.

Donald and Walker (2003), indicate that due to the increased global recognition of the utility of vulnerability assessments, efforts to conduct these assessments are becoming more and more common around the world especially the disaster-prone areas. Vulnerability assessment of fishermen in the coastal areas of California is a necessity. Asia's coastal community has been disproportionately affected, with more than 43% of all natural hazards and 70% of deaths occurring there over the last decade of the twentieth century. Edward, *et al*. (2009) indicate that fishermen in Bangladesh face increased frequency and severity of hurricanes, coupled with the greater penetration of saline water into coastal land due to thermal expansion of the warming oceans. Cold conditions and extreme wind and tidal forces along the rocky New England Coastline there have been a number of accidents in the last five years (Rodrigue, 2013).

According to Nakyonyi, (2011), vulnerability of African fishermen integrates many environmental concerns. In Lake Chad, fishermen are in danger of being struck by a disaster ranging from floods to warmer seas and higher bleaching. In Africa fishermen are extremely vulnerable to natural and technological hazards (Institute of Law and Environmental Governance (ILEG), Kenya, 2005). Vulnerability of fishermen to natural hazards is increasingly becoming a global concern especially in developing nations as its impact in one region can have an impact and risks in another region and vice versa, (Republic of Uganda, 2010).

According to Opere (2004), despite the socio-economic benefits of the fishing industry in Kenya, fishermen are always in danger of exposure to natural and technological hazards that cause severe damage of fishing boats, fishing equipment, supporting facilities and loss of life. In a report on Lake Victoria fisheries indicates that natural or technical hazards have become part of the daily experiences of the fishermen community (Raymond, 2012; Panapress, 2001).

Raymond (2012) indicates that most of the inhabitants of the Lake Victoria Basin (LVB) are among the poorest in the region despite abundant fisheries resources. Neshikura (2010) argues that fishermen in the Ganges-Brahmaputra River Delta are increasingly faced with natural hazards but with the help of local and international NGOs, they are able to restore their boats and cope with the situation. According to Abila (2005), social capital, human capital and the appropriateness and effectiveness of governance structures are elements of adaptive capacity in mitigating vulnerabilities.

Lake Victoria, with a surface area of 68,800 km² and an adjoining catchment of 184,000 km², is the world's second largest body of fresh water, and the largest in the developing world. Lake Victoria is relatively shallow reaching a maximum depth of about 80 m and an average depth of about 40 m (Raymond, 2012). Kenya controls 6 percent of the lake surface. Consequently Lake Victoria supports Africa's largest inland fishing industry. The high demand both locally and internationally for fish especially the Nile perch and tilapia has led to considerable increase in value of the fishing industry. Labour inflows into the fishery have increased along with growing demand. In 1983, there were an estimated 12,041 boats on the lake. By 2012, there were 51,712, and 153,066 fishermen (Raymond, 2012).

According to The National Lake Rescue Institute (2002), over 5000 people lose their lives annually in the lake and the high death rate makes the lake the most dangerous stretch of water in terms of fatalities per square kilometre because of economic losses associated with these accidents. There is need for vulnerability assessment of fishermen prompt and intervention for such emergency in the lake.

Statement of the problem

The enactment of the Lake Victoria Transport Act 2007 was expected to improve safety on the Lake reducing the number of maritime casualties hence boosting fishermen confidence on the Lake.

Despite the existing legislation, Lake Victoria has become a pool of dangerous water as fishermen are highly vulnerable to natural and technological hazards. A study by Omwega (2006) concluded that the second major cause of death among fishermen in Lake Victoria is by drowning which stands at 14.3%. According to Opere (2004), 5,000 people are killed every year on the lake, victims of erratic weather conditions and a mix of poor communications and lack of resources. The high death toll makes the lake arguably the most dangerous stretch of water in the world in terms of fatalities per square kilometre. In 2007 fishermen on a fishing expedition were trapped by the water hyacinth due to heavy rains followed by storms making the visibility and navigation of the fishermen difficult. There are many widows in Lake Victoria region due to the death of their husbands in fishing accidents, leaving them to support families in an area where jobs are few. According to McLaughlin (2008), fishermen have devised ways of coping with natural and technological hazards such aslarge waves by not going out to deep water, or mooring their boats with long ropes during small tsunamis.In Kenya little has been documented on the coping strategies employed by fishermen in relation to the hazards facing them.It is against this background that the research seeks to investigate the vulnerability assessment of fishermen to natural and technological hazards on the Kenyan side of Lake Victoria.Despite the insights offered in this literature, no research has critically assessed the vulnerability of fishermen to natural and technological hazards and coping strategies on Kenyan side of Lake Victoria hence the study seeks to fill this gap.

Research objectives

The general objective of this study was expected to assess the vulnerability factors of fishermen to natural and technological hazards on the Kenyan side of Lake Victoria. Theresearch was guided by the following specific objectives;

Justification of the study

Lake Victoria is prone to natural disasters such as severe floods and storms during heavy precipitation periods in the Eastern part of Africa. In addition to floods, traditional fishing equipment used by most fishermen in Lake Victoria are vulnerable to both natural and technological hazards. These problems are of serious concern and require active and aggressive measures to minimize the loss of human lives and property damage yet there is no research that has been done on vulnerability of fishermen to natural and technological hazards in Kenya. It is important therefore to carry out a research to shed more light not only on the causes of natural and technological hazards but also to provide methods that can be used to mitigate and eliminate vulnerabilities and coping strategies of the fishermen communities. These can then be formulated into policies for protection of fishing communities from hazards facing them during fishing activities.

Additionally the research findings, data and information generated will help people and relevant institutions to understand their various roles in matters of disaster preparedness and management.

Scope of the Study

The purpose of this research was to assess the vulnerability of fishermen to natural and technological hazards based on data collected from a sample of the population. The population of the study included fishermen and some key informants from the Kenyan side of Lake Victoria.

The research covered the Kenyan side of Lake Victoria based on the time frame within which the research was conducted (January 2014 to August 2015) and the Kenyan side had very little documentation on vulnerability assessment and coping strategies. The procedure of obtaining research permits from the three East Africa states limited the scope to the Kenyan side of Lake Victoria.

II. LITERATURE REVIEW

Introduction

This chapter presents the literature review on the objectives and the conceptual framework of this study. It contains relevant information from what other researchers and scholars have already done in order to be able to facilitate the study

Nature of fishing industry

The literature review under this Section is at three levels; global, regional and local.

Global perspective

Globally, the fishing industry is aimed at the delivery of fish and other seafood products for human consumption or as input factors in other industrial processes. According to Clay (2008), the world harvest of fish in 2005 consisted of 93.3 million tones captured by commercial fishing in wild fisheries, plus 48.1 million tons produced by fish farms.Due to cold conditions and extreme wind and tidal forces along the rocky New England Coastline

there have been a number of accidents in the last five years (Rodrigue, 2013). In addition, 1.3 million tons of aquatic plants were captured in wild fisheries and 14.8 million tons were produced by aquaculture. Directly or indirectly, the livelihoods of many people in the world depend on fisheries and aquaculture yet little focus has been put on the vulnerability of the key stakeholders in the industry who are fishermen on natural and technological hazards that affected them. This study seeks to explore the vulnerability of fishermen on these hazards.

In China, fishery industry has played a more important role in the country's agriculture and the national economy as indicated by the rapid and continuous growth of people living standard. Since the end of 1970s when China started to carry out the reform and open-door policies, fishery sector has developed rapidly and achieved great results. The fishery output was ranked first in the world for seven years in succession since 1990, making up one fourth of the world total. The development of fisheries has also helped to create job opportunities for the populations in China. As a result the government has always attached great importance to the application of the science and technology to fishery production (Ringbom, 2008). Despite the jobs and livelihoods that the fishing industry creates globally, most research is silent on how the same jobs and livelihoods are threatened by natural and technological hazards.Donald and Walker (2003), indicate that due to the increased global recognition of the utility of vulnerability assessments, efforts to conduct these assessments are becoming more and more common around the world especially the disaster-prone areas. This study seeks to assess the vulnerability of jobs and livelihoods of fishermen to natural and technological hazards.

Regional perspective

In Sub-SaharanAfrica 400 million people, depend on fish for most of their animal protein intake;this is because food security remains a serious problem in Africa. According to Yowa (2002), there have been many attempts to promote fishing as a means to address food security in Africa but with limited success. At face value, the fishing industry provides wages for its workers and nutritious food for its customers but it is a risky investment for fishermen. Fishing at sea is probably the most dangerous occupation in Africa. This is because over 24,000 fishermen die every year while using sea sites. Since many people are depending on the scarce marine resources, a lost vessel and a lost fisherman have a vital impact on the coastal community. However, despite Yowa (2002) pointing out how vulnerable fishing is to technological and natural hazards in Africa, he remains silent on the coping mechanisms employed by the fishing community in the region. This study seeks to evaluate the coping mechanisms employed by fishermen to natural and technological hazards in Lake Victoria.

Local perspective

In Kenya, inland fresh-water fisheries are the most important, with Lake Victoria dominating in fish production, contributing over 90% of the total fish landings in the period 1990-2008(Nakyonyi, 2011). Lake Victoria fishery is mainly a commercial fishery, with artisanal fishers, working from canoes propelled either manually or with outboard engines (Mark, 2013). Locally, most researchers have focused on the commercial value and technology employed by the fishing industry with little attention given to the technological and natural hazards facing the same industry. The study seeks to contribute to local literature of the vulnerability of the fisher community on these hazards.

Abila (2005) indicates that there are three main fish species in Lake Victoria. They include the Nile perch, Nile tilapia and *dagaa*. The Nile perch was introduced to Lake Victoria in the 1950s and 1960s and led to the huge boom in the fisheries in the 1990s, attracting investment, more fishers and the construction of processing plants. Around 75% of the Nile perch landed is exported, mainly to Europe, the US and the Middle East, making a significant contribution to employment, income, GDP and foreign exchange. Nile tilapia was also introduced to the lake in the 1950s and 1960s and mainly serves the domestic and regional markets, contributing to food security as well as income and employment. *Dagaa* (also known as *mukene* and *omena*) is a small sardine-like fish, most of which is dried and sold either for human consumption or for animal feed. *Dagaa* serves the local and domestic markets, but much is exported within the region, particularly the Democratic Republic of Congo, and even to Southern Africa. It's an important fish for the poor, as it is cheap and highly nutritious. Additionally before the introduction of Nile perch and Nile tilapia in the 1950s and 1960s, Lake Victoria had a multi-species fishery of over 500 endemic fish species.Nakyonyi(2011)indicates thatother important species included *Bagrus* (catfish), *Clarias*, and *syndontis, Schilbe*, *Protopterus* and *Labeo*. Abilaand Nakyonyifocus mainly on growth of fish species in Lake Victoria which has in turn resulted in increased fishing activities. The two authors however remain silent on the vulnerability issues of fishermen that have increased with fishing activities on the Lake on natural and technological hazards. This study seeks to fill this gap.

McLaughlin (2008) argues that efforts to manage the lake have been going on since the late 1800s. For much of the last 100 years, the management approach has been based on top-down enforcement of management measures, with little consultation with, or participation of, fishing communities. This has now changed. Co-management of the fisheries is now being implemented, bringing fishing communities together with government

to manage the fisheries – making decisions, collecting data, recommending policy and legislation and improving compliance. Most of the efforts by key stakeholders have focused on management of the lake for sustaining fishing activities but little attention has been on building the resilience of the fisher community. This study seeks to assess how the fisher community manages their exposure to natural and technological hazards in Lake Victoria.

The Lakes *Niloticus* (Nile perch) is the basis for L. Victoria's most important industry and underpinning subsistence lifestyle in rural portions in the riparian districts of Lake Victoria (AFIPEK, 2000). The harvest of Nile perch sold by the artisanal fishers contributes KES 8 billion annually to the sector. Within the membership of the fish association Nile perch forms the backbone of 50% of our membership who targets it both for domestic and export markets. This fish is of commercial interest due to its excellent physic-chemical properties and the method of fishing making it a prime fish for fillets both chilled and frozen. The by-products of Nile perch also feeds into a major industry dealing in skins, scales and other by products employing mainly women. Because of the magnitude of commercial fisheries for Nile perch, the fish industries have adopted a self-regulation mechanism to ensure that sustainability is adhered to amongst its member factories. A clear check and balance mechanism has been adopted by members and currently being implemented to ensure its sustainability both locally in Kenya and Regionally due to the shared and straddling Nile perch resource. Lake Victoria, which is the second largest fresh-water lake in the world, is also known to have high fish diversity. These other species include *Alestes,Barbus,Labeo, Synodontis, Schilbe, Protopterus, Clarius, Mormyrus* and *Haplochromis.* These fishes are of extreme high value and are sold as niche fishes in the domestic markets (Clay,2008). Much of the research on Lake Victoria has been on the importance of the various fish species and their corresponding economic value to the local and national economies. This study seeks to assess the exposure of the fisher community to hazards that are hampering their sustained economic benefits from the most economic fish species such as the Nile perch.

There has been a steady increase in fish production from Lake Victoria. The number of vessels and fishermen in Lake Victoria has been increasing gradually over the last 20 years there were over 15,000 boats, 3% of which were motorized while the rest manually propelled. According to environmental management program, the number of fishermen increased 129,305 to 175,890 fishing crafts from 42,483 to 52,479 and gillnets from 855,053 to 984,084 billion the year 2000 to 2002. Fishing in Lake Victoria is expected to continue to grow and expand, taking advantage of the lifting of EU ban to increase their exports to Europe and the discovery of new emerging markets for Kenyan fish products such as Israel and Dubai. Enhancement of quality standards in fish processing is also expected to stir growth in the sub sector by increasing demand for Kenyan fish (Raymond, 2012). Most authors have focused on the dramatic growth of the fishing industry in Lake Victoria particularly economically and even projected an increase in the same but they are silent on the levels of vulnerability to natural and technological hazards associated with the same. This study seeks to address this question.

The fishing industry provides direct employment and revenue to communities around the Lake. In addition, there are more other people employed in fisheries associated activities such as in processing and trading. According to Mark (2013), a wide diversity of stake holders is involved in the sector, ranging from wealthy investors in capital-intensive production and processing units to subsistence fishers. Division of labour often occurs on a gender basis, with men fishing and women processing and trading although this division is not always strict and may depend on cultural and religious traditions. In aquaculture, fish feeding and pond management are often the responsibility of women, particularly in Asia. Women and children may also be involved in small-scale fishing and men in processing and trade activities. However, despite the fact that the industry attracts people of varied social and economic backgrounds, little attention has been given to how vulnerability to natural and technological hazards affects the same. This study seeks to assess the vulnerability levels among the various stakeholders in the fishing community to these hazards and their coping mechanisms.

In the literature that has been reviewed it is evident that fishing can make substantial improvements to livelihood, foster economic growth and improve food security without compromising ecosystem services within the Lake region and in Kenya at large (Clay, 2008).

It is evident that fishing can make substantial improvements to livelihood, foster economic growth and improve food security without compromising ecosystem services within the Lake region and in Kenya (Clay, 2008). It is also indicated that there are problems facing fishermen and hindering the growth and development of the fishing industry. It is also indicated that there are problems facing fishermen and hindering the growth and development of the fishing industry. Despite the insights offered in this literature, no research has critically assessed the vulnerability of fishermen to natural and technological hazards on Kenyan side of Lake Victoria. The study aims at filling this gap by assessing the vulnerability of fishermen to natural and technological hazards, which has been

put in place by the fishermen to comply with these standards. This study seeks to assess whether the coping mechanisms employed by fishermen is in compliance with the safety standards under this Act.

In order to make certain that shipping is kept as safe as can be possible, it is critical that all ships must be fit in design, structure, condition and equipment to encounter the ordinary perils of the voyage; otherwise enormous consequences could result from the failure to do sorequi. The Lake Victoria Transport Act 2007

requiress vessels operating on the Lake to carry certificates of seaworthiness attesting to compliance with these technical requirements. When it comes to passenger vessels, particular emphasis should be paid to issues such as; demonstration of buoyancy in the case of a leak, situation of passenger spaces on decks, for example they should be situated aft of the collision bulk head, minimum thickness of bottom, 21 bilge and side plating of passenger vessels, basic requirements for subdivision of vessels, transverse bulk heads, intact stability and stability in the event of a leak, calculation of the number of passengers on the basis of free deck area, safety clearance, free board and drought marks, fire protection and fire fighting in passenger spaces (ILEG Kenya, 2011). Most of the safety measures in this Act are hardware in nature and as such do not building on local coping mechanisms which most fishermen on the lake employ. There are no assessments conducted to establish the indigenous knowledge applied by local fishermen to handle technological and natural hazards. This study seeks to fill this gap.

It is provided for in part 8 of the Lake Victoria Transport Act and part 10 of the Maritime Safety Regulations under the heading Safety of Navigation. Safety of navigation can be considered as `such conditions of conducting the ships at sea which ensure that ships are not endangered by collisions, stranding or storm damage. It follows therefore that adherence to the provisions of the Act and Regulations will enhance safety on the lake. Authorities should always inspect vessels before they sail for compliance with the requirements of the 22 Act, ensure that deck crew has the necessary qualifications and are conversant with safety equipment on the vessel. Law provides for safety obligations and avoidance of collisions, stability of vessels, compasses and navigation, navigation, lights and sound signals, notification of hazards to navigation, distress signals and equipment, load line certificates among others (Aisha, 2011). Despite all these safety provisions in the Act, no assessments have been conducted to establish the compliance and establish whether the same have increased resilience levels of the fishermen to technological and natural hazards.

According to Henrik (2008), these provisions are extensively based on those laid down in the International Regulations for Preventing Collisions at Sea COLREGs 1972, as amended

Technological hazards

Technological hazards is the failure of manmade systems, which occur accidentally or deliberately, that have the potential to cause significant loss of life, cause human suffering, and produce significant damage to structures. There is a wide range of hazards of technological origin that affect the fishing industry. These are an increasing source of risk to fishermen and their environment around the world. This is an effect of the globalization of production, an increase of industrialization and a certain level of risk connected with sea transportation and waste management. These risks are associated with the release of substances in accident condition or with the production of such substances under certain conditions as fire, substances which could affect fishermen health, fish, sea animals and plants (Abila, 2005). Little research has been done to assess the vulnerability of the fishing community to the technological hazards.

In a study conducted by Clay (2008), a hazard originating from technological includes accidents, dangerous procedures, infrastructure or specific human activities, that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Examples of technological hazards include industrial pollution, nuclear radiation in water bodies, toxic wastes, dam failures, sea transport accidents, fires, and chemical spills.

Globally, populations depending on fisheries and aquaculture for their livelihoods are threatened by technological hazards beyond their control. Most small-scale fishers and fish workers live in developing countries and they often face a multitude of problems that increase their vulnerability to hazards, such as pollution, environmental degradation, overexploitation of resources, high levels of accidents at sea and conflicts within industrial fishing operations. Many coastal communities are also particularly vulnerable to hazards resulting from poverty and food insecurity. The particular characteristics of the fisheries sector and the livelihood context of small-scale fishers and fish farmers and their communities need to be clearly understood in order to be able to provide adequate disaster response in an emergency situation and to help these people to be better prepared for and warned of potential future threats through preventive disaster risk management. Rated are highest in the small-scale fleet operating close to shore (Yowa, 2002). This study has adopted a seamless approach of establishing the hazards the fisher community faces, their vulnerability levels as well as their local adaptive mechanisms to counter the same.

Lake Victoria is historically important to the local communities for fisheries, agricultural and domestic water supply. In May 21, 1996 a tragedy occurred in Tanzania. About 500 people were feared drowned in a steamer disaster on Lake Victoria. The steamer, MV Bukoba, sank near Bukoba with 600 people on board; most of them were feared dead. Only 21 bodies were recovered by the Tuesday afternoon (Radio Tanzania) and latest about 120 people had been rescued that far (Rodrigue, 2013). The steamer was from Bukoba heading for Mwanza when it sank about 30 nautical miles from Mwanza. It developed some problems near Mwanza and almost sank before this tragedy occurred. The Bukoba resumed service between port Bell in Uganda, Kisumu in Kenya and Mwanza after the revival of East African cooperation. This sinking was the worst ever disaster in Lake Victoria.

26 people drowned when the boat they were travelling on from Lugala to Hama Island capsized, the boat was carrying 50 people loaded with 200 crates of beer, 190 sacks of maize flour and over 80 sacks of charcoal. Ugandan Radio Network Statistics indicates that there has been drastic increase in the number of deaths on the lake. According to Raymond(2012), 109 were killed in eight different accidents in Suba, while the neighboring district witnessed eight deaths in five boat accidents. In 2011, a number of tragedies occurred in Lake Victoria among them. A boat accident, after a motor boat in Kisumu to Remba Island lost control and rammed into a fishing boat, two fishermen in a boat perished, two others were rescued. A fisherman drowned in the Lake while fighting with his workmate (Yowa, 2002). Most focus by researchers has been on the risks associated with hazards on the Lake. Little attention has been given on how to address the risks and that what this study seeks to solve through assessment of vulnerability to these hazards.

Fishermen in the Lake suffer from among others hazardous safety and or security. 5000 people are estimated to drown annually in the Lake as a result of maritime accidents. (Mark, 2013) States that disaster frequently strike fishermen in the Lake Victoria. For example the passenger vessel M/V Bukoba capsized in 1996 with the loss of over 500 lives. The wagon ferry M/V Kabalega collided with a sister vessel MV/ Kaawa and sank in 2005. Cargo vessel MV Nyamageni sank in 2006. More recently, the following incidents have been reported; 18 Tanzanian school children drowned when their vessel flipped in strong winds on August 05, 2010. 28 people are feared dead after their ferry capsized in bad weather near Entebbe on July 21, 2011.

Nakyonyi (2011) says that this is a crisis and the need for improved safety standards cannot be overruled. The issue of disaster response is very critical in the prevention of extensive negative effects of disasters. This can be done through the development of comprehensive disaster emergency plans. Make sure that early warnings reach and are understood by the most vulnerable people; they need to know what to do, where to go, and how to protect themselves. Provide food to communities with emergency material such as water purification tablets, jerry cans, chain saws, lanterns, plastic sheeting, first aid suppliers and venerators (Owili, 2006). Dedicate vacated areas for specific uses (such as parks or football fields) when moving people out of flood plains. Build houses and infrastructure to withstand future disasters such as provide roofs with straps to protect against hurricanes, use steel reinforcements at the corners of a house to make it earthquake resistant. Provide disaster victims with cash support to purchase their own supplies, shelter rather than receive items in kind which might not be appropriate. Gender differences should also be considered when designing the response to disaster often affect men and women differently. Safety standards cannot be improved without a clear understanding of the vulnerability conditions as well as the local adaptive capacities. This study provides an avenue for improvements in the safety standards by building on local coping mechanisms.

In summary, the global trends in natural disaster occurrences and impacts suggest several important patterns of vulnerability among people and places, at the same time that they mask considerable geographic variation. Floods, windstorms, earthquakes and cyclones are the most common hazards events globally (Yowa, 2002). The reviewed studies reveal that 5000 people are estimated to drown annually in Lake Victoria as a result of maritime accidents. Even though a comprehensive analysis is given on how dangerous fishing in Lake Victoria and other parts of the world is, the studies fail to assess the hazards facing fishermen on the Kenyan side of Lake Victoria. Therefore the research seeks to evaluate both natural and technological hazards facing fishermen in Lake Victoria.

Vulnerability of fishermen to natural and technological hazards

In order to provide an academic basis of the second objective of the study, the researcher sought to review literature on vulnerability of fishermen to natural and technological hazards. For clarity literature on vulnerability to both hazards has been presented separately.

Vulnerability of fishermen to natural hazards

A research conducted by Republic of Uganda (2010) indicated that vulnerability of fishermen to natural hazards is increasingly a global concern especially in developing nations as its impact in one region can have an impact and risks in another region and vice versa. This is compounded by increasing vulnerabilities related to changing demographics, technological and socio-economic conditions, climate variability, competition for scarce resources and the impact of epidemics such as Aids. It all points to a future where disasters could increasingly threaten the world's economy and its population and sustainable development of developing countries. In the past two decades, on average more than 200 million. Global climate change is estimated to be one of the biggest environmental threats over the coming century Assessment Report recorded that global warming of 1.4ºC–5.8 ºC can be expected over the coming century (Press, 2003). The report concluded that an increase in temperature with adequate rain will cause certain vector-borne diseases. However the report does not spell out the levels of vulnerability and local coping mechanism employed by the fisher community.

Vulnerability of fishermen to technological hazards

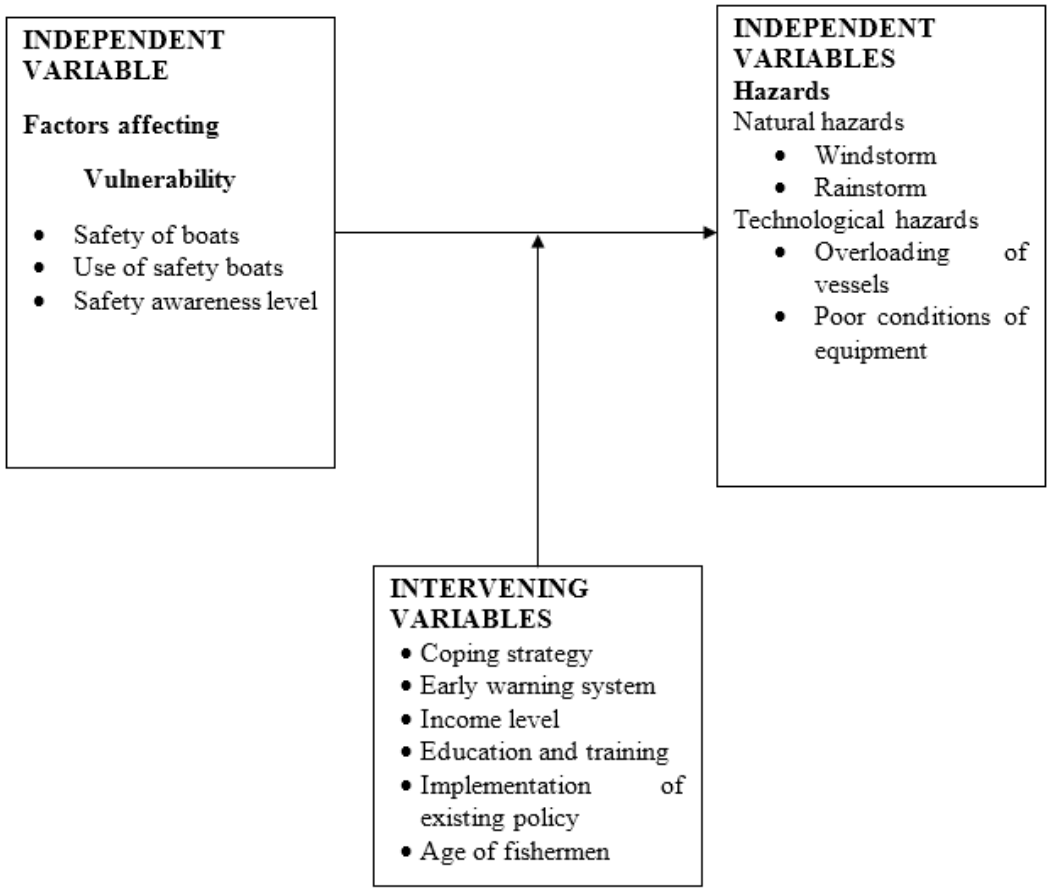
The world conference on disaster reduction in the fishing industry held from 18th to 22nd January 2005 in Kobe, Hyogo Japan, adopted a framework for action 2005-2015; for building the resilience of nations and fishing communities to disasters. The conference provided a unique opportunity to promote a strategic and systematic approach to reducing vulnerabilities and risks to hazards. It underscored the need for, and identified ways of, building the resilience of nations and communities to disasters (Gallopín, 2006). It was observed that disaster loss is on the rise with grave consequences for the survival, dignity and livelihood of individuals, particularly the poor and hard won development gains. It is against this background that this study seeks to assess the vulnerabilities and local capacities of the fishing community to the hazards that face them so as to provide a starting point for enhancing their safety by building on local resilience.

According to Byron (2003), poverty is a main cause of vulnerability in many parts of the world and there is a clear link between disaster risk and development. Over the last decade, an average of 44 people were killed per natural disaster in countries with a high human development index (United Nations Development Programme Human Development Index), while the average death toll in countries with a low index was 300 people per event. To reduce disaster risk, it is important to reduce exposure, keep people as far away from the hazard as possible and minimize the level of vulnerability. This can be achieved by removing the underlying causes of the vulnerability through, for example, poverty alleviation (Press, 2003). Vulnerability and exposure can also be reduced by preparedness and early warning mechanisms. This study seeks to specifically evaluate the factors of vulnerability affecting the fishing community in Lake Victoria.

Raymond (2012) indicates that most of the inhabitants of the Lake Victoria Basin (LVB) are farmers (average of 73% for Kenya). Despite the abundant land and fisheries resources the inhabitants of the lake region are among the poorest in the region. For instance an average of 41.3% of the LVB (Tanzania) live below the Basic Needs Poverty Line while those on the Kenya side are 39% and the Uganda side 34%. Other demographic aspects considered include gender especially the way men and women work together and the division of labour and how they share benefits from their contribution to production. Marital status is looked at in terms of the composition of households, whether polygamous or monogamous. The types of households do have implications on cultural values and beliefs. For instance polygamy is taken to be a sign of wealth and high social status in some communities. (Mark, 2013)Population density has been increasing at a tremendous rate in the LVB Tanzania side with the highest rate of population increase witnessed between 1988 and 2002 (152% increase in population density for Mwanza, 153% for Kagera, 157% for Shinyanga and 140% for Mara). The studies however do not demonstrate the link between some of the factors of vulnerability being highlighted with the natural and technological hazards in Lake Victoria.

Moreover this coincided with the time of the Nile Perch boom period and "Gold rush" period, where an influx of people flooded the lakeshore towns of Mwanza where there are more fish processing plants and fishing business is higher. Gold and diamond resources attracted people to Shinyanga and Mwanza regions during this period due to liberalization policies, which made these resources accessible by small scale as well as large scale mining companies. Occupational activities of LVB (Lake Victoria Basin) includes: fishing, farming, bee keeping, trading activities, quarrying and sand mining and mining of gold and other minerals (Gallopín, 2006). The studies do not demonstrate if their exist associations between vulnerability of fishermen to natural and technological hazards with other occupational activities within Lake Victoria.

Nakyonyi (2011) Populations depending on fisheries and aquaculture for their livelihoods are threatened not only by natural hazards but also by human-induced events and developments beyond their control. Most small-scale fishers and fish workers live in developing countries and they often face a multitude of problems that increase their vulnerability to hazards, such as pollution, environmental degradation, overexploitation of resources, high levels of accidents at sea and conflicts within industrial fishing operations. Many coastal communities are also particularly vulnerable to hazards resulting from poverty and food insecurity. The particular characteristics of the fisheries sector and the livelihood context of small-scale fishers and fish farmers and their communities need to be clearly understood in order to be able to provide adequate disaster response in an emergency situation and to help these people to be better prepared for and warned of potential future threats through preventive disaster risk management (DRM). Rated are highest in the small-scale fleet operating close to shore (Mark, 2013). Despite the information offered in this literature, the studies fail to explore the vulnerability of fishermen in Lake Victoria to natural and technological hazards. The study therefore seeks to establish the level of vulnerability of fishermen on the western side of Lake Victoria to natural and technological hazards.



Conceptual Framework
Source: Researcher (2014).

The framework allows the study to simplify level of vulnerability of fishermen into safety of boats, use of safety equipment and safety awareness level; Natural and technological hazards into floods, rainstorm, windstorm and carrying capacity against number of passengers; and ways of enhancing mitigation and preparedness of fishermen into policy implementation, income level, early warning system, education and training and age of fishermen.

The presence of the natural hazards (windstorm, rainstorm, etc.) and technological hazards (overloading of vessels and poor conditions of the equipment) directly affects the safety of the boats and its occupants. From the model framework, the presence of natural hazards and the use of poor equipment make fishermen vulnerable to disasters. Additionally, the lack of warning system, education and training, coping strategy, and low income levels makes the fishermen more vulnerable to disasters while fishing. For instance, the vessels involved mostly in lake disasters are traditionally made and this makes them unable to sustain severe floods and storms during heavy precipitation periods. Likewise, the lack of knowledge on the need for the use of modern equipment and the need for better income to buy the vessels has hindered most of the fishermen in improving their fishing vessels, hence making them vulnerable to disasters. This therefore results in the above model framework

Theoretical Framework

The study is based on the Cannon-Bard theory of emotion which explains how physiology influences emotions. It was actually a compilation of work from Walter Cannon (1871-1945) and Philip Bard (1898-1977). Their ideology was that we simultaneously experience emotions and physiological reactions. *Physiological reactions* are reactions such as muscle tension, sweating, and trembling. Essentially, their hypothesis is that emotions result when brain systems such as the thalamus signals response to a stimulus. Among other things, the thalamus influences *motor control, auditory/visual signals, and sending sensory signals*. The end result is the physiological reaction. For example, if you or someone you know has seen a spider, their reaction validates the Cannon-Bard theory. The spider is seen, the person is afraid, and at the same time they may scream or tremble.

Walter Cannon criticized the James-Lange theory, which hypothesized that emotion is not directly caused by the perception of an event, but by the body's response caused by the event. Through experimentation, Cannon

discovered that *emotion occurs even if the brain was not connected to information about body responses*. He also argued that body responses are similar. For example, the heart races whether you are excited or angry. Those are two different emotions. However, the body's reaction is the same. Philip Bard agreed with Cannon and together they concluded the experience of emotion does not depend on input from the body and how it responds. Again, the experience of emotions and physiological responses occur at the same time, but not because of physiological responses. Walter Cannon criticized the James-Lange theory, which hypothesized that emotion is not directly caused by the perception of an event, but by the body's response caused by the event. Through experimentation, Cannon discovered that *emotion occurs even if the brain was not connected to information about body responses*. He also argued that body responses are similar. For example, the heart races whether you are excited or angry. Those are two different emotions. However, the body's reaction is the same. Philip Bard agreed with Cannon and together they concluded the experience of emotion does not depend on input from the body and how it responds. Again, the experience of emotions and physiological responses occur at the same time, but not because of physiological responses.

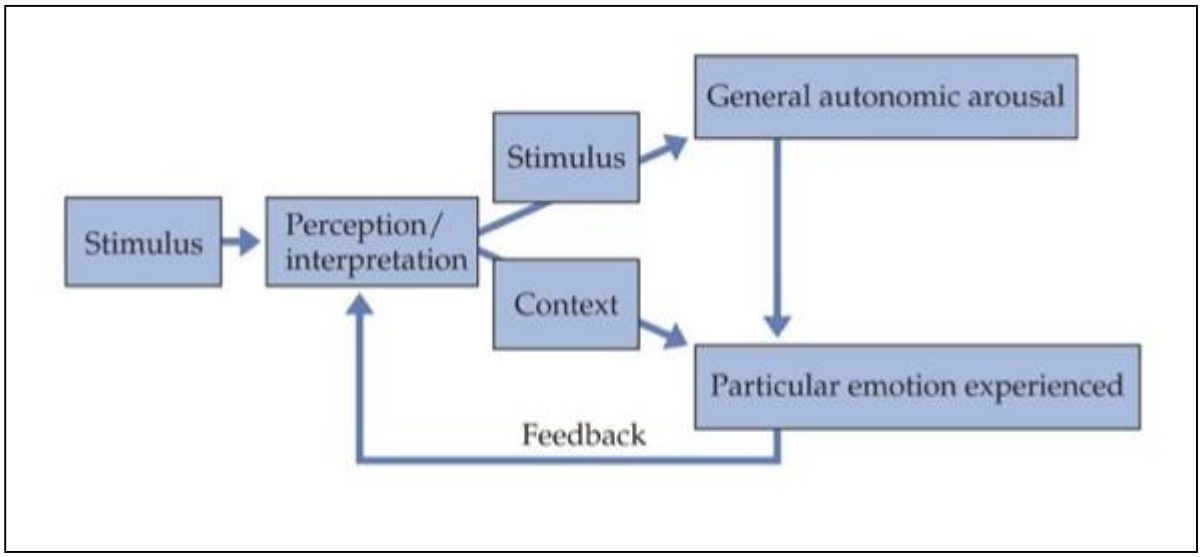


Figure 2.3: Illustration of the Cannon-Bard theory of emotion

All these theories however point out that human beings will react to any extreme events due to fear. This either calls for mitigation, preparedness, response as well as coping on the part of those affected. This study was therefore driven by these facts; hence the need to identify natural and technological hazards affecting fishermen, determine factors contributing to vulnerability of fishermen, and assess the effectiveness of coping strategies employed by fishermen in relation to existing hazards.

III. RESEARCH METHODOLOGY

Introduction

This chapter contains the research design to be used, target population of the study, the sampling design and sample size, data collection instrument, validity and reliability of the study, data analysis and presentation procedures.

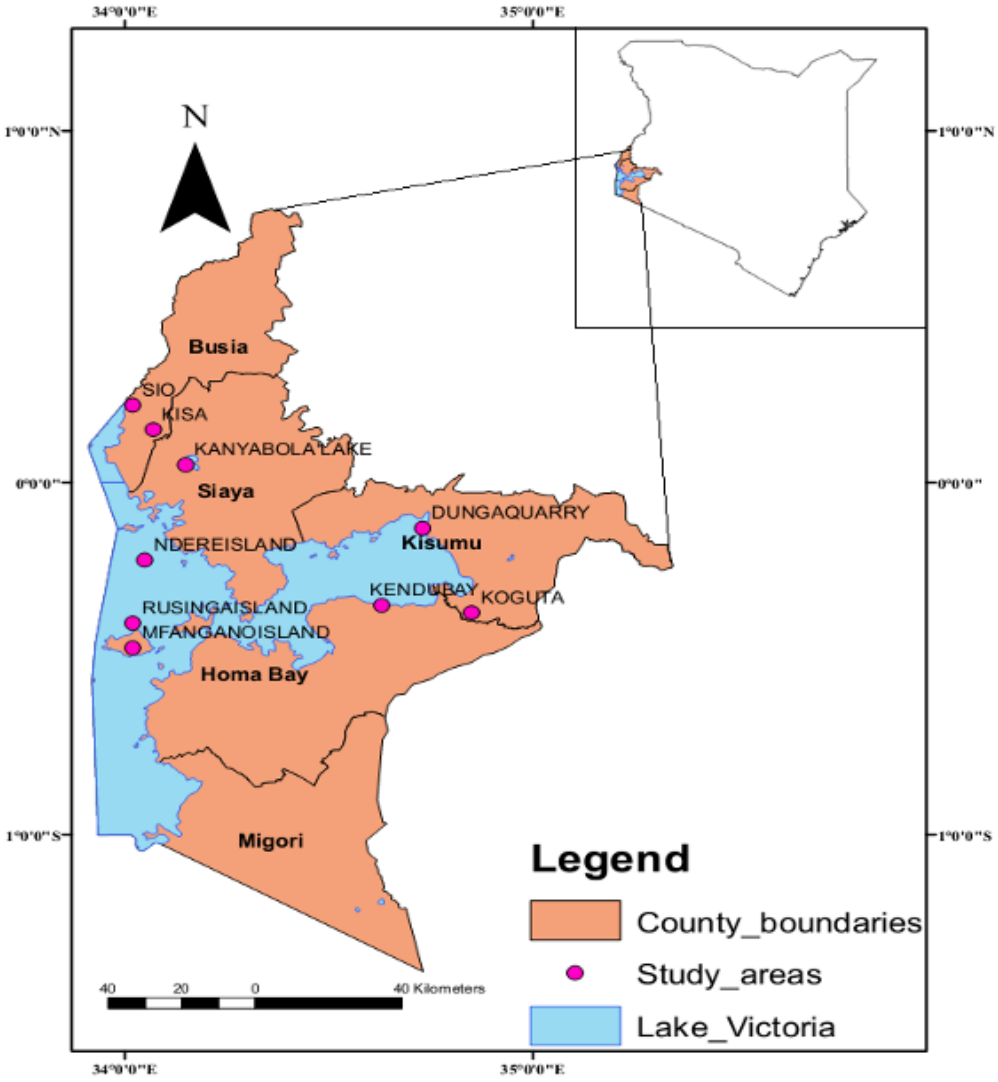
Study Area

Lake Victoria is the world's second largest fresh water lake by area. It is located in eastern central Africa, straddling the equator, and is shared between the nations of Uganda, Tanzania and Kenya. It is generally considered to be the source of River Nile, the world's longest river. By size Lake Vitoria is 250 miles (400km) long; 200 miles (320km) wide; by area, Lake Victoria is 26,828 miles^2 (69,485km^2). In terms of geographic coordinates the Lake extends between latitudes 0º30' N and 2º30' S and between longitudes 31º50' E 34º10' E, Surface altitude is 3,720 feet (1,135m), maximum depth: 265 feet (81m) - average 132 feet (40m) and the shoreline is 3,440 km (2,138mi).

Lake Victoria occupies a shallow depression in Africa and has a maximum Depth of 84m (276ft) and an average depth of 40m (130ft) its catchment area covers 184000km^2(710,040m^2).The Lake has a shoreline of 4,828km (400m). The lake receives most of its water from direct precipitation. Its largest influent is the Kagera

River, the mouth of which lies on the lake's western shore. The only river to leave the lake (flowing north) the White Nile (known as the "Victoria Nile"), leaves at Jinja, Uganda, on the lake's north shore. The lake is facing a serious threat, deadly weed that has wreaked havoc to urban water supply system, marine transport, and fishing activities. While there are other threats to the Lake such as overfishing and pollution of the Lake waters, the hyacinth has so far been the strangest phenomenon. The weed has from the early nineties blocked fish landing sites and communal water points along the lakeshore. Marine experts indicate that the weed would hamper rescue operations in the Lake in the event of a disaster.

The region is situated on the equator, leading to a hot and humid year-round climate and little annual rainfall of approximately 1,200 mm. Kisumu's average temperature is 83 degrees Fahrenheit. Peak temperatures reach into the high 80s and 90s, with low temperatures dropping into the 60s. Morning humidity levels around Kisumu are between 80 percent and 90 percent, with evening humidity percentage levels dropping into the 40s and 50s. Kisumu has two rainy seasons-from March through June, and November through December. Average rainfall is in the range of 258.0 to 816.0 mm per month.



Map of Lake Victoria, the Kenyan side
Source: Lake Victoria Biennial Fisheries (2012).
study designs is given in

Research Design

Source: Researcher (2014). StudyPopulation

Specific Objective	Measurable Variable/indicator	Research Design
To evaluate natural and technological hazards affecting fishermen on the Kenyan side of Lake Victoria.	**Hazard** • Windstorm • Rainstorm • Overloading of vessels • Poor conditions of vessels	• Cross-Sectional survey
To determine factors contributing to vulnerability of fishermen to these disasters.	• Safety of boats • Use of Safety equipment • Safety awareness level	• Cross-Sectional survey
To assess the effectiveness coping strategies of fishermen in Lake Victoria.	• Counseling services • Social amenities	• Evaluative survey

The target population was a group of people or study subjects who are similar in one or more ways and forms the subject of the study in a particular survey (Orodho, 2003). It can also refer to that population to which the researcher uses to generalize the results of the study.

In this regard, the study population for this study comprised of the key stakeholders in the fishing sector who are vulnerable to the natural and technological hazards. These include40,078 fishermen spread across the fourteen Sub-counties in along Lake Victoria on the Kenyan side. Key informants included 14 beach management unit managers, 14 police officers, 14 sub-county Health officers, 14 emergency Management officers, 14 Village 3.4

Sample size for fishermen and key respondent

Sub County	Registered beaches	Study population(N)	Procedure	Fishermen sample size Size (n_i)	Key informants
Samia	Sea port	543	543*401/40078	5	6
Funyala	Port Victoria	2,659	2659*401/40078	27	6
Kisumu East	Dunga	947	947*401/40078	9	6
Kisumu west	Ndere	844	844*401/40078	8	6
Kisumu North	Kanyawegi	582	582*401/40078	6	6
Nyando	Orongo	447	447*401/40078	4	6
Nyakach	Kusa	405	405*401/40078	4	6
Rachuonyo North	Karachuonyo	2,770	2770*401/40078	28	6
Homa –Town	Homa bay	470	470*401/40078	5	6
Mbita	Rusinga	8,008	8008*401/40078	80	6
Suba	Mfangano	5,103	5103*401/40078	51	6
Nyatike	Migingo	5,429	5429*401/40078	54	6
Bondo	Usenge	8,543	8543*401/40078	85	6
Rarieda	Misori	3,318	3318*401/40078	33	6
		40,078		401	84

Sampling Strategies

Category	Sub-County	Study Population (N_i)	Sample Size (n_i)	Sampling Method	Data collection instrument	Appendix number
Fishermen	Samia	543	5			
	Funyala	2,659	27			
	Kisumu East	947	9			
	Kisumu west	844	8			
	Kisumu North	582	6			
	Nyando	447	4	Systematc		I
					Questionnaire	
	Rachuonyo North	2,770	28	sampling		
	Homa –Town	470	5			
	Mbita	8,008	80			
	Suba	5,103	51			
	Nyatike	5,429	54			
	Bondo	8,543	85			
	Rarieda	3,318	33			
	Total (N)	**40,078**	**401**			
Key informants	BMU Managers	14	14			
	Police officers	14	14			
	MoH Emergency	14	14	Purposive	Interview	
	Management officers	14	14	Sampling	Guide	II
	Village elders	14	14			
	Red Cross	14	14		Interview	VIII
FGDs		14 x 10 (140)	14 x 10 (140)	Purposive	Guide	
	Grand Total (N)	**40302**	**625**			

Source: Researcher (2014).

The researcher will add 10% to sample size of fishermen with small samples. This is meant to increase representation in those areas.

Data collection instruments and procedures

The Section gives the data collection instruments and procedures that were employed in data collection. Data Collection Instruments

This study employed a number of tools including questionnaires, interview guidesand observation checklists. These tools were used to collect primary data from respondents.Secondary data were collectedfrom secondary sources such as reference books, journals, indexes, abstracts and government publications.

Questionnaires

Uma (2003) defines a questionnaire as a formulated written set of questions to which respondents record their answers within closely defined alternatives. Most variables in the questionnaire were closed with a few open-ended questions. This was meant to facilitate easy coding and analysis. These instruments were used to collect data from fishermen. The questionnaires were pre-tested on a pilot basis before data collection commenced (A sample questionnaire is given in Appendix I)

Interview guides

The study used interview guides to gather information from key informants and focus group discussions. The interviewer had a list of predetermined probing questions directed to respondents. These tools consisted of open ended questions, which gave the researcher a complete and detailed understanding of the issues under research. They also gave respondents freedom to respond in whatever way they wanted. The instrument was used to source data from BMUs, police officers, sub-county Health officers, emergency Management officers, Village elders and Red Cross officers (Appendices II-VII)

Observation checklists (Appendix X)
The researcher observed various variables of the study guided by an observation checklist. The researcher observedequipment used by fishermen while at work and other issues that will be relevant for this study. The information obtained was used to verify and confirm the information collect from questionnaires responses and interviews with key informants (Mugenda and Mugenda, 2003).

Data Collection Procedures
The researcher contracted a team of five trained research assistants who understand the local languages of the study population. The team worked under the leadership of the main researcher. The use of locally trained research assistants decreases the potential of bias. Therefore, research assistants assisted in administration of the instruments. The respondents gave enough time to respond to all the questions.

Validity and Reliability of the Instruments Validity
The researcher conducted validity and reliability tests to ensure the relevance of the content in the tools as well as ascertain the reliability of the same.

Validity
Orodho (2004) defines validity as "the degree to which an empirical or several measure of a concept accurately representing that concept. "In this study, expert judgment of content validity was employed. The decision to use expert judgment as a method of determining validity was guided by Kothari, (2001). Content validity of the instruments was determined by expert judgments as supported by Huck (2000). The content of interview results can be predicted through the questions asked. Therefore, the interview schedule was thoroughly revised to adhere to the standards expected in this study. A pre-test interview was carried out in one of the villages in Mbita area. In addition, the researcher ensured validity of the collected data by administering the interview schedules personally.Pre-testing wasconsidered important in this study because comments and suggestions by the respondents after pre-testing helped improve the quality of the questionnaire (Mugenda and Mugenda, 1999). Piloting revealed deficiencies in the questionnaire, for example, unclear instructions, insufficient writing space, vague questions and wrong numbering, thus improving the instruments. The responses from the questionnaires weree analyzed to check if the methods of data analysis are appropriate and suitable.

Reliability
Reliability on the other hand has been defined as "the degree to which a measuring procedure gives equivalent results over the number of repeated trials." Charles (1995) adheres to the notions that consistency with questionnaire items are answered or individual's scores remain relatively the same can be determined through the test- retest method at two different times. This attribute of the instrument is referred to as stability. Results should be similar for a stable measure. A high degree of stability indicates a high degree of reliability, which means the results are repeatable. On reliability of the research instruments, the questionnaire will be pre-tested.

Reliability analysis will be done using Cronbach's alpha. Composite reliability coefficients of items measuring variables will be recommended to be above threshold of Cronbach's alpha 0.70 for an instrument to be deemed reliable (Nunnery, 1978). To ensure reliability appropriate sampling procedures will be used in this study to ensure a representative sample. The questionnaires will be scrutinized by the supervisors of the research to judge the items on their appropriateness of the content, and to determine all the possible areas that need modification so as to achieve the objectives of the study.

Data Analysis and Presentation
Quantitative data was analyzed using descriptive statistics including frequencies, averages, and percentages and the results were presented through tables and figures. The researcher also conducted spearman rho correlation to establish the strength and direction of relationships between the variables. Qualitative data which was mainly collected by open ended questionswere first classified on the basis of common attributes then tallied to obtain statistical frequencies, tabulated and finally analyzed using descriptive statistics. According to Kothari (2010), this helps to collapse large volume of qualitative data in numerical form for ease of statistical interpretation.

Data analysis and presentation

Specific objective	Measurable variables/ Indicators	Research design	Data analysis
To evaluate natural and technological hazards affecting fishermen on the Kenyan side of Lake Victoria.	• Hazards • Windstorm • Rainstorm • Overloading of vessels • Poor conditions of vessels	Cross-Sectional Survey	• Descriptive • analysis • Correlation
To determine factors contributing to vulnerability of fishermen to these disasters.	• Safety of boats • Use of Safety equipment • Safety awareness level	Cross-Sectional Survey	• Descriptive analysis • Correlation • Chi-square
To assess the effectiveness of coping strategies of fishermen in Lake Victoria.	• Counseling services • Social amenities	Cross-Sectional Survey	• Descriptive analysis • Spearman rho correlation • Chi-square

Source: Research data (2014).

Limitations

The challenges involved matters such as language barrier and personnel constraints. This was because most fishermen are illiterate and could only communicate fluently in Tholuo and Abaluya. To overcome the challenge the researcher employed the services of a translator from the study areas. The study was only confined to Western and Nyanza provinces meaning the result may not be universal but only true of the area.

Ethical Considerations

The researcher obtained permission from the relevant institutions including Masinde Muliro University of Science and Technology school of graduate studies, government departments notably the office of the President and National Council of Science, Technology and Innovation (NACOSTI). The researchers reported to and briefed the local provincial administration officials of the intended study and requested for their cooperation. Confidentiality of information and anonymity of data recording was assured. Participants were also briefed on the nature of the study before the commencement of the interviews. Only those who voluntarily consent to participate in the study were interviewed.

Summary

The foregoing chapter describes the methodology used in this research. The study area encompasses Lake Victoria area which is the world's second largest fresh water lake. The Lake provides marine transport and a fishing ground for a large number of fishermen. Cross-Sectional survey design approach was used to determine the factors contributing to vulnerability of the fishermen to natural and technological hazards. The study population for this study comprised of the key stakeholders in the fishing sector who are vulnerable to the natural and technological hazards. The target sample size was obtained through the use of non-probability and probability sampling approaches. Data was then collected through the use of questionnaires, interview guides, and observation check lists. Validity and reliability of the data collection instruments used was the done to determine the accuracy in data collection. Data collection was then done with ethical consideration being observed then presented for analysis.

FACTORS CONTRIBUTING TO VULNERABILITY OF FISHERMEN TO NATURAL AND TECHNOLOGICAL HAZARDS

Introduction

This chapter presents the results for objective two; factors contributing to vulnerability of fishermen to natural and technological hazards affecting fishermen on the Kenyan side of Lake Victoria. The first Section consists of descriptive results while the second Section consists of the test statistics.

Vulnerability factors

The researcher sought to establish factors contributing to vulnerability of fisher men to technological and natural disasters.

Type of vessel involved in disaster

The study sought to establish the type of vessels that were involved in lake disasters and the results are displayed in figure 5.1below.

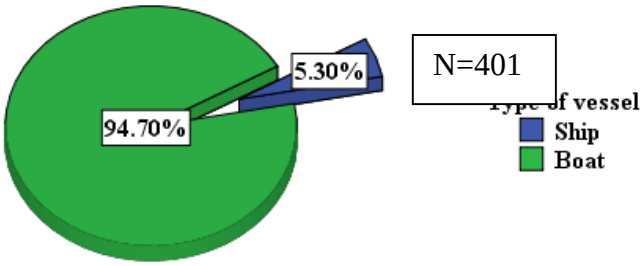


Figure 5.1: Type of vessel involved in disaster

Source: Field Data 2014.

From figure 5.1, most respondents (94.70%) indicated that boats were involved in disasters while (5.30%) indicated ships.

Plate 5.1: Boats along Homa-bay beach

Source: Field Data 2014.

According to Raymon & Hans, (2007), Fishers are highly dependent on fishing for their livelihood with little possibility of finding alternative employment. Their access to land is generally limited and their assets, in the form of boats and gear, are more exposed to natural hazards and hence more easily lost than land-based property.
According Raymond (2012), the Lake is also extensively used for transport and trade purposes. There are a few big ferries, transport boats and oil tankers, but most of the goods transported between landing sites is carried out by big, open, wooden motorized boats (between 4 and 10 tons).

Causes of lake disasters

Respondents were asZed to state the causes of lake disasters and they responded as illustrated in table 5.1.

Table 5.1: Cause of lake disasters

Cause of disaster	Frequency	Percent (%)
Weather	352	87.7
Lack of swimming knowledge	25	6.3
Lack of safety/ swimming gadgets	20	5.1
Hippos knocked the boat	4	0.9
Total	**401**	**100.0**

Source: Field Data 2014.

Results in Table 5.1 illustrate that most causes of lake disasters 352(87.7%) was associated with weather, 25(6.3%) was associated with lack of swimming knowledge, 20(5.1%) indicated lack of swimming gadgets while 4(0.9%) indicated hippos knocked the boats.A fisherman at Kendu- Bay beach commented by saying:

"The swimming gadgets are too expensive that we cannot afford, if they can loan us then it can be better".

Plate 5.2:A Fisherman fishing in company of the wife without a swimming gadget at Homa-Bay beach

Source: Field Data 2014.

Safety is one of the biggest problems affecting both users and operators and influencing their use of water transport. There are unique weather dynamics that continuously threaten air and marine navigation over the lake and its basin. The region around the lake has the highest occurrence of hailstorms and thunderstorms in the EAC region. The most important navigation hazards are storms, strong winds and strong waves.

The researcher further enquired the causes of lake disasters from the key informants. The results are displayed in Figure 5.2.

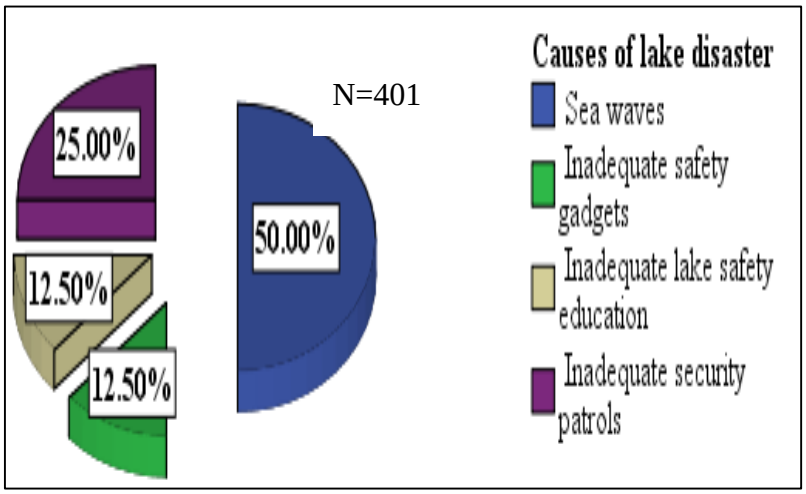


Figure 5.2: Key informant responses on causes of lake disasters

Source: Field Data 2014.

Figure 5.2 illustrates that most causes of lake disasters (50.0%) as perceived by key informants were sea waves, 25.0% inadequate security patrols while 12.50% indicated lake safety education and inadequate security patrols respectively.

Focus group discussions revealed that causes of lake disasters attack by hippos, bad weather, inadequate safety gadgets, low awareness on lake safety and drunkardness. Bad weather was ranked as the most common cause of lake disasters by FGDs.

Spearman's correlations on causes of lake disaster

The rankings from key informant interviews was compared with that of FGDs. This was summarized in Table 5.2

Cause of disaster	Key Informants	FGD ranking
Weather	1	1
Lack of swimming knowledge	2	3
Lack of safety/ swimming gadgets	3	2
Hippos knocked the boat	4	4
Sea waves	5	5
Inadequate safety education	6	7
Inadequate security patrols	7	6

Spearman's rank order correlation was carried out to establish whether the ranks were similar or different. The following results were obtained:

$r = 0.93 \pm 0.05$

The value or r is significant implying that the ranks are similar (in agreement). From the results, the main causes of disasters, in rank order were weather, lack of swimming knowledge and lack of safety/ swimming gadgets.

Vulnerability assessment to lake disasters in their locations

The study sought to further assess the vulnerability of respondents' lake disasters in their locations. The questions were measured on a Likert scale as shown in Table 5.3.

Table 5.3: Statements on vulnerability to lake disasters in their locations

Statement		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Disasters within Lake Victoria are common	F	0	21	26	28	326
	%	0	5	6.5	7.1	81.4
Many people have been involved in lake disaster	F	0	8	28	29	336
	%	0	1.9	7.0	7.3	83.8
Many people need help in relation to lake disasters	F	0	11	22	21	347
	%	0	2.8	5.5	5.2	86.5
Very little Lake disaster education has been carried out	F	0	10	20	45	317
	%	0	3.2	6.6	11.1	79.1
Women and children are majority victims of Lake disasters	F	0	37	43	77	343
	%	0	12.4	14.3	25.6	47.7
	%	0	3.1	4.7	3.7	88.5

Source: Field Data 2014.

Table 5.3illustrates that most respondents tended to agree with the statements on factors of vulnerability to lake disasters in their locations: lake disasters were common 326(81.4%); many people had been involved in lake disasters336(83.8%); many people needed help inrelation to lake disasters 347(86.5%); education on disasters was important for all the people 338(84.3%); very little Lake disaster education had been carried out in my location317(79.1%); women and children were the majority victims of Lake disasters 343(47.7%). Drowning was the most common form of Lake Disaster in my location 366(88.5%).

Pearson's correlations

The researcher conducted pearson's correlation between variables on vulnerability to technological and natural hazards in the lake with type of disaster (. The results are as indicated in Table 5.4.

Table 5.4: Vulnerability to technological and natural hazards with type of disaster

	Type of lake disaster

Type of vessel involved in lake disaster	r- Value	-0.046
	p- Value	0.490
Major lake disaster victims	r- Value	0.063
	p- Value	0.265
Frequency of lake disasters	r- Value	-0.067
	p- Value	0.239
Many people are involved in lake disasters	r- Value	-0.065
	p- Value	0.249
Many people need help	r- Value	0.046
	p- Value	0.412
Education on lake disasters is important	r- Value	0.014
	p- Value	0.810
Little on lake disaster has been carried out	r- Value	0.007
	p- Value	0.908
Women and children are majority of the victims	r- Value	0.063
	p- Value	0.265

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
Source: Field Data 2014.

From table 5.4, causes of lake disasters indicated a positive but weak correlation (0.387) with types of disasters. Cross tabulation results indicated that (90.4%) of lake disasters were caused by weather. This implies that when lake hazards and vulnerabilities increased, the types of lake disasters increased proportionately. Weather hazards were the most dominant cause of lake disasters. Increase in weather hazards meant increase in lake disasters.

Type of lake disasters recorded an insignificant negative correlation with type of vessel, frequency of lake disasters and number of people involved in the lake disasters. Cross tabulation results indicated that 94.3% of the lake disasters involved boats, with 85.2% resulting in drowning. 82.9% of the respondents indicated that drowning disasters were common on the lake.

The types of vessels involved in lake disaster decreased with an increase in the types of Lake Disasters. This implies that as lake disaster took toll, the types of vessels involved decreased. This can be attributed to the fact that, as the types of disasters increased, perception of risk increased and this in turn forced the fishermen to withdraw their vessels or improved their vessels so as to cope with the hazards.

As the types of lake disasters increased there was a corresponding decrease in the frequency of disasters. This could also be attributed to the fact that as disasters increased in frequency, there were interruptions in fishing and trading activities on the lake hence reducing the types of lake disasters.

Number of people involved in the lake disasters decreased with increase in the types of lake disasters. This implies the fishermen perception of risk increased with an increase in the types of lake disasters. Fishermen became more cautious and improved their local adaptations with increase in the types of lake disasters

Summary

This chapter gives a summary of the factors contributing to vulnerability of fishermen to natural and technological hazards affecting fishermen on the Kenyan side of Lake Victoria. The lack of the land makes fishermen highly dependent on fishing for their livelihood. Their access to land is generally limited and their assets, in the form of boats and gear, are more exposed to natural hazards and hence more easily lost than land-based property.The unique weather dynamics that continuously threaten air and marine navigation over the lake and its basin makes the fishers vulnerable to natural and technological hazards within the lake. Cross tabulation of the results indicates that most lake disasters were caused by weather. This implies that increase in weather hazards meant increase in lake disasters. Number of people involved in the lake disasters decreased with increase in the types of lake disasters. This implies fishermen became more cautious and improved their local adaptations with increase in the types of lake disasters

IV. Conclusion

Weather related disasters account for the highest number of disasters in Lake Victoria on the Kenyan side. Fishermen and business men remain the most vulnerable with many of them losing their lives. At least 44 cases of lake disasters happen every month. Most men than women got involved in lake disasters. Most people involved in lake disasters were in their productive ages of 21-40 years.Fishermen who fully relied on fishing for their livelihoods were more vulnerable than those who diversified their sources of income. The fate of lake disaster victims worsened with increase in age. Older fishermen were more at risk of worst consequences such as death during lake disasters as compared with the younger ones.

Type of vessels, weather, type of victims, and attitude were important factors of vulnerability to lake disasters. Boats were most vulnerable to disasters. Weather hazards accounted for most of the disasters in Lake

Victoria. Major victims of lake disasters were fishermen. The types of vessels involved in lake disaster decreased with an increase in the types of Lake Disasters. As the types of lake disasters increased there was a corresponding decrease in the frequency of disasters, number of people involved in the lake disasters. This implies the fishermen perception of risk increased with an increase in the types of lake disasters hence initiating coping mechanisms.

Local adaptations and coping mechanisms by the lake community werse important in adapting to technological and natural hazards on the lake. External assistance during lake disasters was minimal. Red Cross and members of the public were notable rescuers during disasters. Though the locals perceived their efforts were not effective, they greatly contributed to the overall risk reduction. Effectiveness of interventions improved with improvements in the rescuers. Negative attitude hampered implementation of effective mitigation measures.

Recommendations

Basing on the findings of the study, it was recommended that:

More emphasis should be placed on community awareness/capacity building on metrological hazards in the Lake. Emphasis should be placed on diversifying livelihoods to reduced exposure to lake disaster risks by the fishermen. Any interventions should focus on cushioning elderly fishermen to reduce their exposure to lake hazards.

Mitigation and adaptation measures targeting disaster risk reduction in Lake Victoria should focus on addressing the safety of vessels particularly boats and perception of risk by the fishermen.

Any effort to address disaster risks at the lake should build on the local adaptations because on the overall they contributed to lake disaster risk reduction.

Suggestions for further study

This study suggestsareas of further research in the following areas;

i. Influence on demographic indicators on vulnerability of fishermen to lake disasters
ii. The mediating role of risk perception in reducing vulnerability to lake disasters
iii. The scope of improving local adaptations and interventions by fishermen and external rescuers

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