UNIVERSITY OF NAIROBI

GENDER INFLUENCE ON CLIMATE CHANGE ADAPTATION BY THE FISHER COMMUNITY IN MBITA SUB-COUNTY, HOMA BAY COUNTY, KENYA

BY

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DECLARATION

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ABSTRACT

Increasingly there concern over the consequences of global warming on household food security and livelihoods of the world's 36 million fishers and the nearly 1.5 billion consumers who rely on fish for their dietary protein. There has been limited focus on the interaction between impacts of climate change on the fishing activities on inland and fresh waters like Lake Victoria and how the fishers are coping and adapting. This study focused on Mbita Sub-county on Lake Victoria shore whose local community's main livelihood activity is fishing. The overall objective of the study was to examine the influence of gender on the adaptation to impacts of climate change and variability among the fisher folks' in Mbita Sub County. The study used a constructivist epistemology and the mixed methods research design to achieve the said objectives. Both primary and secondary data were used to achieve the study objectives. The study targeted 13898 fishers out of whom 388 were selected as respondents. The primary data was collected using questionnaires; interview schedules for Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). Secondary data was collected through document review on relevant information fishers' livelihoods and climate change; time frame of Mbita Sub-county climate data for over the last 30 years (From 1987-2017) was central to the review. Analysis of data was completed by using computer supported software for quantitative data which was expressed in descriptive and inferential statistics. The findings showed that the majority of fishers' had clear perception of climate variability and change but only 46% had the scientific knowledge of the causes of Climate Change; the fishers' relied more on Indigenous Knowledge (IK) since as meteorological forecasts were too technical for them hence considered irrelevant. The study further found that the erratic changes in rainfall and temperature were the greatest stressors on fishing activities with the fishers agreeing to having seen a rise in the annual temperatures with statistical significant p-value = 0.02. There was gender discrimination in access and control of resources that supported adaptive activities thus making women more vulnerable to climate variability and change including climate hazards and disasters; Climate Change Adaptation (CCA) requires access and control of resources with access to and control of land, balanced meals, sources of power and workshops found to be significant to adaptation. The long rainy season from March to May was found to have an impact on infrastructure and weather related diseases which endangered the fishers' lives while the dry and hot season (January to February and September to October) resulted in insufficient fish catches. The fishers' coping strategies fishers showed that adaptation required the collaboration and consultation of entire Mbita community and County Government to address the environmental and conservative resource utility while streamlining gender issues. The study concluded that a lack of capital, information and limited alternative livelihood opportunities were the major constraints to adaptation of people living in the Lake Victoria region. This was amplified with a limitation of other employable professional skills outside the fisheries. The study recommended for consultation, development and implementation of adaptive strategies by the stakeholders, which can translate into flexible and sustainable adaptation livelihood activities. Future research should explore participatory action research on environmental factors that influence Climate Change Adaptation by comparing findings across other beaches.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AU- IBAR	African Union Inter Africa Bureau for Animal Resources
BMU	Beach Management Unit
CC/ CV	Climate Change/ Climate Variability
DFID	Department for International Development
FAO	Food and Agriculture Organization
CIDP	County Integrated Development Plan
FGDs	Focused Group Discussions
GoK	Government of Kenya
HCIDP	Homa Bay County Integrated Development Plan
HIV	Human Immunodeficiency Virus
ICIPE	International Centre of Insect Physiology and Ecology
IPCC	Intergovernmental Panel on Climate Change
KMD	Kenya Metrological Department
KNBS	Kenya National Bureau of Statistics
LVEMP	Lake Victoria Environmental Management Programme
LVFRP	Lake Victoria Fisheries Research Programme
LVFO	Lake Victoria Fisheries Organisation
PREPARED	Planning for Resilience in East Africa through Policy, Adaptation, Research, and Economic Development
SEDAWOG	Socio-economic Data Working Group of the Lake Victoria fisheries Research Project
SDGs	Sustainable Development Goals

SLA	Sustainable Livelihood Approach
SPSS	Statistical Packages for Social Science
SSA	Sub Saharan Africa
UNFCCC	United Nations Framework Convention on Climate Change
UNHABITAT	United Nations Programme for Human Settlements and Sustainable Urban Development
WESS	World Economic and Social Survey

DEFINITION OF KEY TERMS

Adaptation: Purposive modification/adjustments in routines to cope with emerging/impending phenomena; this could be in the ecological, social or economic system or anticipated seasonal changes in weather patterns with the purpose of minimizing the otherwise adverse effects by taking up any opportunities that may present.

Climate change: Climate change is understood from measurement of climatic variables which include temperatures and rainfall patterns, cumulative variability in temperature and rainfall patterns over a long period of time produce climate change or shift from known patterns which impact on livelihood activities hence the implication of change.

Climate variability: Refers to variations from seasonal expectations in the mean state and other statistics (such as standard deviation, occurrence of extremes, and others) of climate at all spatial and temporal scales beyond that of individual weather events.

Perception: This is a mind-map of conceptualizing what is happening and associating with some causality; the process by which we receive information or stimuli from our environment and transform it into psychological awareness.

Fishers: used to describe communities whose key livelihood depends on fish/fish products. Inclusive of men and women girls and boys who are involved in catching of fish, processing, selling and owns fishing gears and boats.

Livelihoods: Means of survival based on capabilities availability and accessibility of resources: those activities performed by people to earn a living relative to their skills and assets (material and social) to make a living.

Fisheries/Fishery: One or more stocks of fish or any operations based on such stocks which is a unit for conservation and management, taking into account geographical, scientific, technical, cultural, economic and recreational.

Access to resources: Ability to own/enjoy utility of essential resources as and when you are in need of them e.g. factors of production linked for livelihood activities (secure tenure of land, fisheries and forests).

ORGANIZATION OF THE THESIS

This thesis contains nine chapters that are choreographed to provide distinctive contributions in fulfilling the obligation of the research objectives.

Chapter One presents the background of the study. It sets out the context of the research, including the objectives, justification and the significance of research and general scope of the study.

Chapter Two presents the literature review of relevant documents on previous studies on gender, climate change and fisheries including relevant working papers and policy protocols on climate change and variability, gender and gender climate interactions with fisheries.

Chapter Three presents the methodological approach, the conceptual framework, and sampling, fieldwork, data collection and analysis used.

Chapter Four presents the results from Objective 1 on the fishers' perception and knowledge of climate change and variability in Mbita Sub County.

Chapter Five presents the results from Objective 2 on the effects of climate change on the fishing activities and livelihoods in Mbita Sub-County.

Chapter Six presents the results from Objective 3 of the influence of gender on access and control of fisher resources for climate adaptation in Mbita Sub County.

Chapter Seven presents the results from Objective 4 the influence of gender in the current coping and adaptation strategies of the fishers in Mbita Sub County

Chapter Eight presents the synthesis and discussion of the results

Chapter Nine presents the summary of findings conclusions and recommendations.

Annexes

CHAPTER ONE: INTRODUCTION

1.0 Introduction

This chapter provides the background of the study through review of relevant past literature which address climate change and adaptation relative to fisheries and gender groups. It includes the problem statement, justification and the significance of research and the general scope of the study.

1.1 Background

According to FAO (2011), gender refers to being masculine or feminine; it does not refer to being male or female but rather to the relations between men and women, both perceptual and material. Gender is not determined biologically but is a social construct. It is a central organizing principle of societies, and often governs the processes of production, reproduction, consumption and distribution. Climate change has been identified by researchers, development practitioners and governments as a threat and a hurdle to sustainable growth and development in the world (Nelson *et al*., 2009). It is observed that climate change and variability affect different gender groups differently and these effects are cascaded to how men and women adapt to extremes of climate change and climate variability in their livelihood activities.

Globally, over 2.9 billion people depend on fish for most of their protein intake (de Graaf, and Garibaldi 2014), and millions of people depend on fishing for their livelihoods (Allison *et al*., 2009; Badjeck *et al*., 2010). According to FAO (2012), in Sub Saharan Africa fisheries are a source of employment for around 10 million people and the main or only source of animal protein for over 20% of the population (Barange and Perry, 2010).

Fish is one of the most commercialized food commodities in the Lake Victoria basin region. It supports economic growth processes, contributing to food security and diversification of diets

and the implications of climate change for those who depend on fish for food or livelihood are difficult to ignore (Barange and Perry, 2010). Allison *et al*, (2009) observed that Climate change, is a new global stressor that is expected to exacerbate the impacts of the other stressors on fisheries and fishing livelihoods. Climate change poses significant threats to fisheries culminated by other concurrent pressures such as overfishing, habitat degradation, pollution, introduction of new species and so on (Brander, 2010).

According to FAO (2012), small scale fishers in the developing countries will be the most vulnerable to climate change and variability due to their high reliance on fisheries and their poor adaptive capacity. The IPCC (2014) supports this and stresses that climate change and variability will have a significant and long-term risk to fisheries in many tropical developing countries and particularly Sub Saharan African countries. This will ultimately undermine the benefits gained from the development of fisheries, which are significant as fisheries and aquaculture play important roles in food supply, income generation and nutrition of the communities that depend on them (FAO, 2012).

A number of studies have investigated the vulnerability and adaptive capacity of the fishery dependent community to climate change and variability but there has been little emphasis at the local scale on how the impacts of climate change and climate variability is affecting the lives and livelihoods of the majority of small-scale fisher folks, who make up more than 90% of the world's fishers and fish trade (Badjeck *et al*.2009). LVEMP (2011) concurs that little has been done to establish the influence of climatic elements on fishing activities especially in inland water masses like Lake Victoria despite the importance of fishing as a livelihood strategy in this region.

World Bank (2016) reported that the Lake Victoria Basin supports a population of over 40 million, providing a variety of economic and development opportunities from fisheries to

tourism. All these opportunities are under threat from a number of environmental problems including pollution of the lake, biodiversity loss, habitat destruction, soil erosion and now impacts of climate change and variability. Lake Victoria therefore provides the ideal circumstances against which to study the effects of climate variability on the fishing activities of the small scale fisher folks. The lake's shallowness, limited river inflow and large surface area relative to its volume make it highly vulnerable to climate variability (PREPARED, 2014). The changes in temperature and precipitation will likely to impact on fish production, species composition, distribution, safety and efficiency of fishing. These would have a significant effect on the livelihood activities of the fishing communities like those in Mbita Sub County. In this study the construct gender was measured through biological lenses that sees (maleness/femaleness) as planning tool of inclusions/exclusion in access, utility and control of fishing resources which are instrumental to adaptation..

1.2 Problem Statement

Climate change and variability has intensified and is expected to worsen in the future, affecting natural resources such as fisheries by influencing fishery production processes and fish yield, thereby affecting the livelihoods of fishers whose livelihoods depend on the fish. Most studies investigating vulnerability and adaptive capacity of the fisher communities to climate change and variability, have directed their analysis on marine and open water bodies documenting the trends and fluctuations in fish abundance and distribution (Badjeck *et al*., 2009)

It is documented that most inland fisheries are already under multiple stressors like over fishing and poor management practices, pollution, habitat alteration and now have their challenges further exacerbated by climate change impacts (Daw *et al*., 2008), yet very little analysis has

been done on inland lakes such as Lake Victoria to establish how the local fishers lives are impacted by a changing climate and how they are coping (Badjeck *et al*., 2009).

The Lake Victoria Basin supports a population of 40 million but over the last four decades the Lake Victoria region has faced a number of environmental problems which may jeopardize this situation. It is estimated that the lake's indigenous fish species have reduced by approximately 85% and over 70% of the forest cover in the catchment area. In addition, the water quality in the rivers flowing into the lake continues to carry increasing amounts of silt and nutrients, causing eutrophication, thus impacting on fish production, and efficiency of fishing and will have a significant effect on the livelihood activities of its fishing communities (FAO, 2012). The study therefore sought to examine the gender influence on climate change and climate variability awareness, access and control on fishing and livelihood resources and how these related to vulnerability and adaptation efforts of the studied fisher community. The study aimed at creating a transdisciplinary stakeholder participatory platform for discussing climate change/variability as an external force that affect community livelihoods so that the county governance and other developmental agencies including researchers and climate scientist could inform workable policies and programmes for building a more lasting resilience for the Mbita fisher community.

1.3 Study Objectives

In this section the overall and specific study objectives will be discussed in detail.

1.3.1 Overall Objective

The overall objective of this study was to examine the gender influence on climate change adaptation among the fisher community in Mbita Sub-County, Homa Bay County.

1.3.2 Specific Objectives

The specific objectives of this study included to:

i. Assess the fishers' perception and knowledge of climate change and variability in Mbita Sub-County.
ii. Establish the gendered effects of climate change and variability on the fishing activities and livelihoods in Mbita Sub-County.
iii. Determine the influence of gender on access and control of fisher resources for climate adaptation in Mbita Sub-County.
iv. Determine the influence of gender in the current coping and adaptation strategies of the fishers in Mbita Sub-County.

1.4 Research Questions

The study sought to find out how gender is used as a planning tool for allocation of resources and cultural power structures in accessing and coping with climate variability and change in Mbita Sub-county. The questions included:

i. What are the fishers' perception and knowledge of climate change/variability in Mbita Sub-County?
ii. What are the effects of climate change/variability on fishing and livelihood activities in Mbita Sub-County?
iii. How does gender influence access and control of fisher resources critical for adaptation to impacts of climate change/variability in Mbita Sub-County?
iv. How does gender influence the current coping and adaptation strategies of the fishers in Mbita Sub-County?

1.5 Justification and Significance of the Research

Fishing communities are more vulnerable to climate change impacts because they live close to the coast/lake in order to enjoy easy access to fishing grounds; they also depend on climate sensitive fisheries resources and their social position can often be defined as underprivileged (Daw et al 2009). Attention focused on fishing communities at this point in time was timely to focus attention on climate change adaptation debates as a concern for pursuit of sustainable development. Traditional cultures like that of Mbita Sub County Kenya, have used biological gender discriminatively in planning for access and control of resources; a state that influence levels of adaptation towards attainment of food security and livelihood security as roots to the achievement of SDGs goals especially goal number one ,two, six and twelve.

IPCC (2014) states that even though there is a growing acknowledgement of climate change as being a gender differentiated problem, there remains a lack of attention to the influence and dynamics of gendered social relations in climate change discourse and policy. The collection of such data about issues on impacts of CC/CV is essential to highlight the differences between men and women and to ensure that climate change adaptation measures are gender sensitive. Without the consultation of both men and women in the planning of adaptation interventions, the emerging adaptation measures may not be appropriate or sustainable.

Climate change is not manifesting itself in isolation but is rather synergistically interacting with multiple social, economic and political livelihood stressors. Despite these observation there is limited empirical analyses for understanding gender dynamics, climate change and livelihoods associations. This study contributed to empirical literature on the gender dynamics at play in the livelihoods of fishers' by showing how they are impacted by the perceived variability and how

the fishers are responding through coping and adaptation measures. This information may contribute to policy formulation on adaptation strategies that are complimentary to those which may already be employed by the fishers as well as identifying areas that need improvement.

Mbita is predominantly occupied by small scale fishing community. The importance of this study was to understand the local people's awareness on the impacts climate change and variability and their responses to these changes. This information may help in better understanding how they observe and understand the changes in the climate. The results of this study may be used to inform government, civil societies and other stakeholders engaging in future programs targeting integration of resource users' experiences and views in climate variability and change adaptation

1.6 Area of study

The study focused on Mbita Sub-County in Home Bay County, a small, rural town located along the shores of Lake Victoria, near the southwestern border of Kenya, located on a peninsula, with water on three (3) sides and surrounded by picturesque islands between latitudes 0^o 21' and 0^o 32' south and longitudes 34^o 04' and 34^o 24' east (CIDP, 2017).

The livelihoods of most of the residents depend on fisheries and rain fed small scale farming, practices that are highly vulnerable to environmental degradation and to the effects of climate change, which influences the rainfall and temperature patterns thereby affecting the lakes stored water. PREPARED (2014) observes that the temperature in the Lake Victoria Region is projected to increase by 3 to 4°C by the end of this century without much change in the rainfall regime, leading to a significant downward trend in the lake's water supply as a result of enhanced evaporation as well as increased water temperatures. This coupled with dwindling fish

stocks due to overfishing will increase the pressures on the fishers' livelihoods.

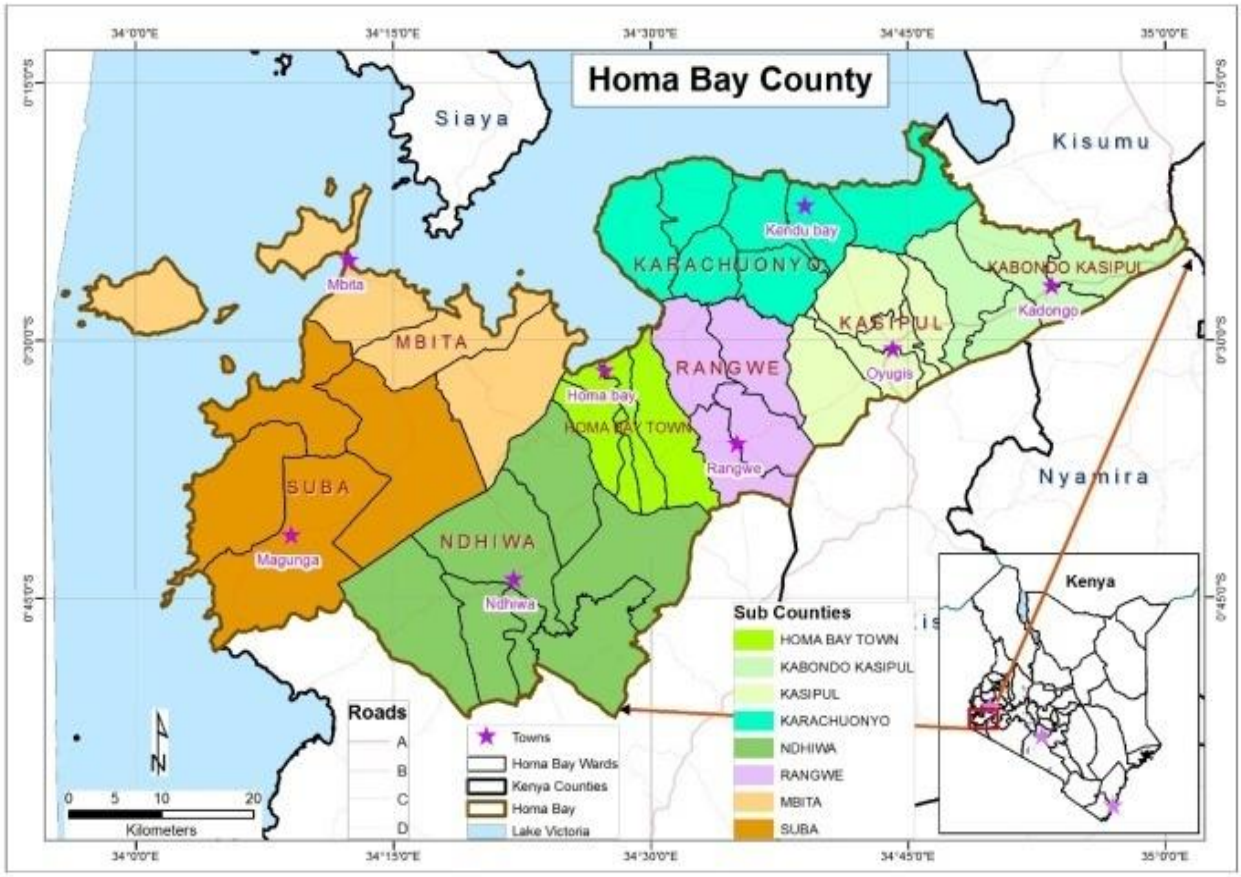

Figure 1.1: Map of Study Area; Source: CIDP 2017

1.7 Biophysical Setting

Under this section the climate, vegetation, land use**,** physiographic and drainage of the study area will be discussed in detail.

1.7.1 Climate

Mbita Sub-County experiences an inland equatorial type of climate which is modified by the effects of altitude and nearness to the lake making the temperatures lower than in an equatorial climate. It experiences two rainy seasons, the long rainy season between March to May and the

short rainy season from October and December. Mbita receives an annual rainfall ranging from 700 to 800 mm. It experiences wind speeds of about 4 m per second and have certain regularity due to the convection effect of the large water body of the lake that borders the often hot dry land. Temperature varies with altitude and proximity to the lake and tends to increase towards the lowland. Temperatures are highest between December and March with the hottest weather being experienced in February and the lowest in April and November (CIDP, 2017).

1.7.2 Vegetation

The vegetation in Mbita largely consists of *Acacia* woodland and bush land growing over the black cotton soils that cover most of the county apart from the hilly areas which have rock outcrops. There is also an assortment of species of indigenous species of trees as well as grass in open fields and homesteads and compounds (CIDP, 2017). The land does not have high agricultural potential hence concentration on fishing livelihoods.

1.7.3 Land Use and Resources

Mbita Sub County is strategically located at the mouth of a bay, allowing it a lot of different uses. It is the gateway to the islands of Mfangano and Rusinga, as well as to Ruma National Park lending itself to tourism. The water resources in Mbita include the rich Lake Victoria which is exploited significantly for fishing. Small pockets of urban and peri-urban development are located along transport routes such as the roads to Kendu, Rodi and Suba are used for trading and residential purposes (UN-Habitat 2010),

1.7.4 Physiographic and Drainage

Mbita is located on the lakeshore lowland, which ranges between 1143 to 1220 meters above sea level and comprises of a narrow stretch bordering Lake Victoria. It has hilly and sloping surfaces

forming the major terrain with the storm water flowing from the hilly sides to the town draining westwards to the lake except the areas of *Got Rabuor*, which drain into the *Arujo* stream which eventually drains into Lake Victoria (UN-Habitat 2010). The area is prone to top soil loss through erosion during rainy season.

1.7.5 Biophysical Vulnerabilities

According to (CIDP, 2017), the Mbita fisher population is food insecure as an estimated 80% of the Mbita households do not have enough food to meet their household needs sustainably. This food insecurity is linked to the low agricultural productivity due to the poor rocky soils, extreme weather and generalized poverty levels. Pollution is prevalent in and along the lake beaches with most of fish collection points not properly developed. The fishermen are still employing old methods of fishing and obsolete technology which results in poor catch and depletion of fish in the lake and this is magnified by the occasional infestation of the lake by the water hyacinth which inhibits movement within the lake by the fishers and even tourists. Future climatic projections show that temperatures in Mbita are projected to increase by about 0.4ºC. The moisture stress is projected to affect the already stressed fish stocks and ultimately affect the Mbita fishers' livelihoods (UN-Habitat 2010).

1.8 Socio-Economic Setting

Mbita Sub-County population is estimated at approximately 111,409 currently out of whom 54,942 are males and 56,467 are female. This is projected this to 131,667 people in 2020, translating to 67,106 males and 68,969 females (CIDP, 2017).Fishing is the core economic activity in Homa Bay County and in Mbita Sub County particularly, engaging upwards of 18,300 people. The Frame Survey (2016) of the county reported a catch of 12,000 tons valued at Ksh. 12 billion (UN-Habitat 2010). Homa Bay County has 151 docking beaches of these Mbita has the

largest number of 43 beaches. It is worth noting that very little in terms of crops are produced in Mbita although there exists potential for cotton growing (CIDP, 2017).

1.8.1 Political and Administrative Context

Mbita Sub County was curved out of Suba District in the year 2009 and has one constituency, Mbita. It lies on the shores of Lake Victoria and borders Suba District to the South and Homa Bay District to the East. It occupies an area of about 801 km^2 of which 428km^2 is land and 381km^2 water mass. The district is divided into 11 Locations, 27 Sub-locations and three Divisions namely; Mbita, Lambwe and Mfangano (CIDP, 2017).

1.8.2 Health Setting

Mbita Sub County has a total of 30 health facilities mainly community dispensaries and health centres with only one level 4 hospital for referral cases. The most prevalent ailments in Mbita are malaria followed by respiratory diseases, HIV/AIDS and waterborne infections like typhoid, diarrhoea and dysentery, which put the general public's health in danger since they are communicable and cause death. Sanitation related diseases remain a major challenge in Mbita since they keep recurring and at times come as outbreaks. They mainly result from drinking of unsafe water and food poisoning (CIDP, 2017).

1.8.3 Socio-economic Vulnerabilities:

According to UN Habitat (2010) Mbita Sub County is characterized by a rapidly growing population, high population density, falling food production, and low resilience to climate change. The combined effects of climate change and rapid population growth are increasing food insecurity, environmental degradation, and poverty levels in the county. Most of the roads are in Mbita are in very poor state leading to poor accessibility to the beaches due to bad state of

feeder and access road making transporting of fish products very difficult especially in the rainy seasons. Most of Mbita is off the grid making it difficult to establish cooling plants and cold storage for the fish especially along the beaches. This together with the inadequate fish harvest and handling facilities often lead to huge post-harvest losses (CIDP, 2017).

1.9 Scope of the Research

The study was conducted among the fishers of Mbita Sub County, Homa Bay County that mainly drew their livelihoods from fishing activities as a reference case for the fishery dependent communities along the Lake Victoria basin. The study focused mainly on the effect of rainfall and temperature on the fishers' livelihoods and how gender influenced their resource allocation and adaptation options. The study was piloted in March 2019. The field study to collect data was done between June and August 2019 and the study report compiled between September and February 2020.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

In this chapter the study reviewed relevant documents on previous studies on gender, climate change and fisheries including relevant working papers and policy protocols on climate change and variability, gender and gender climate interactions with fisheries as presented below.

2.1 Climate Variability and change

Climate variability is the "variation in the mean state and of other statistics (such as standard deviation and the occurrence of extremes) of the climate on all temporal and spatial scales beyond that of individual weather events" (IPCC, 2014). Indicators of climate variability include extended droughts, floods, cyclones and conditions that result from periodic *El Niño* and *La Niña* events. Climate variability reveals year to year variations of climatic elements such as temperature and rainfall (Amwata, 2013). Variability includes variation that may result from natural internal processes within the climate system (internal variability) or variations as a result of external or anthropogenic forces (Tasokwa, 2011).

IPCC, (2014) defines climate change as a "change in the state of the climate that can be identified (using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer". Thus climate change may simply be defined as the clear changes in the average weather patterns over more than three decades.

According to the IPCC (2014), climate change may be due to internal processes and or external forces. The internal influences may include changes in solar radiation and volcanism, occurring naturally and contribute to the total natural variability of the climate system. External changes

that trigger climate change can be traced to human activity with the initial trends observable from the era of industrial revolution in western societies (IPCC, 2014).

Climate change and variability have differential effects on male and females and there also exist differences on how they respond to the impacts of climate change and variability making disaggregated data by gender important to ensure that interventions cover the most vulnerable (Abeka *et al*., 2012).

2.2 Gender and Climate Change

Gender refers to the socially constructed roles, responsibilities and opportunities between male and females which are learned and vary widely across societies and cultures. Gender is a central organizing principle in traditional societies, and often governs the processes of production and reproduction, consumption and distribution of resources (FAO, 2015).

According to FAO (2011) climate change impacts men and women differently, largely due to their gender differentiated relative powers, roles and responsibilities at the household and community levels. Women tend to be overly burdened with household work and caring for children, the sick and the elderly. For example, during the Asian tsunami in 2004 (70 percent of the victims were women); many women and children were trapped inside their homes while most men were out in the open. Further, cultural and religious norms on respective gender roles sometimes limit women's abilities to make quick decisions in disaster situations and, in some cases, the clothes they wear and/or their responsibilities in caring for children could hamper their mobility in times of emergency.

Disparities in economic opportunities and access to productive resources also render women more vulnerable to climate change because they are often poorer, receive less education, and are

not involved in political, community and household decision-making processes that affect their lives. In poor communities, Women tend to be the poorer among the in terms of access and control to natural resources and that affect their livelihoods (World Bank 2012).

In the context of climate change and the fishers, this study conceives that gender affects the interaction with, perceptions and knowledge of climate change and variability, the access and control of resources, the vulnerability and effect of climate change and climate variability and the eventual coping strategies that the fishers take up to help them to manage climate-related risks to agriculture and food security (Jost *et al.* 2015).

Since culturally stereotyped roles inhibit women access to and control of resources, they are often more vulnerable to impacts of climate change than men. Most traditional economies are governed on a gendered division of labour. Enarson and Fordham (2001) observed that while women are the primary resource managers they have less access than men to resources such as land, credit, agricultural inputs, decision-making structures, technology, training and extension services that could help them to develop their adaptive capacity to avoid or minimize the adverse effects of extreme weather events (Denton, 2002).

2.3 Gender and Global Climate Change Politics

Globally gender and climate change issues have tended to remain in grey literature since the emergence of climate change as a serious environmental and developmental challenge. According to Denton (2002) gender was a 'latecomer' to the climate change debate with developmental agenda forwarded for its delayed start. This was in part due to the overwhelming emphasis that was put on mitigation to climate change impacts instead of adaptation, and due to

scientific and technocratic construction of adaptation to climate change that overlooked its social and political attributes (Mac Gregor 2010).

In 1988 the IPCC was established with the mandate to provide clear and scientific knowledge about climate change, its environmental and socioeconomic impacts. Its first scientific report in 1990 provided important information about climate change that became pivotal to the creation of UNFCCC (IPCC, 2013). Later focus and recognition of how gender influences climate change impacts led to its inclusion in international plans, programmatic policies after sustained pressure from several gender forums made it more evident that men and women experience life in different ways, based on socially constructed rules and expectations obliging the UNFCCC to fully include gender as a thematic area in its overall scope of work (Skinner, 2011).

2.4 Gendered Roles in Fisheries

In Sub Saharan Africa, men and women participate in different but complimentary activities in fisheries. The men's activities dominate mainly the extractive processes while the women are often responsible for post-harvest activities, which frequently earn narrower profit margin than that made by fish catchers (Béné and Merten, 2008). The fisheries are governed by a highly gendered labor and power distribution practices that involve restrictions on access to fishing grounds, unequal control over fisheries governance and unequal access to resources needed to engage in fishing. These barriers can result in fewer benefits accruing to the women even though their roles in fish trading and processing are greatly affected by fishery conditions (Nyukuri, 2016).

2.5 Effects of Climate Variability and Change on Fishery Resources

The intensification of climate variability and change will impact natural resources like fisheries that are sensitive to climate (Allison *et al*. 2005; IPCC, 2013). Fisheries are affected by decrease in average river runoff, shifts in precipitation and consequent change in the timing of peak river flows and changes in flood and drought frequency and intensity (Milly *et al*. 2005). Evidence of impacts of climate variability and change on fisheries resources has been observed with changes in fish species diversity, size and composition (Munday *et al*. 2008), species distribution (Perry *et al*. 2005) and reduced productivity (Allison *et al*. 2007). FAO (2010) has predicted that climate change will shift fisheries to smaller, faster growing, opportunistic less valuable species that can adapt fast to the changing environment. These will bring changes in aquatic productivity processes and fisheries production (Brander, 2010) that will ultimately affect the livelihoods of the people dependent on fishery resources.

In the context of fisheries, climate change impacts occur in light of multiple interacting existing stressors (e.g. poverty, change in markets, overexploitation and governance issues). For example, while poverty in fishing communities or other forms of marginalization reduces their ability to adapt and respond to climate change, increasing globalised fish markets are creating new vulnerabilities by causing market disruptions.

Assan and Kumar (2009) report that the effects of climate change will not be experienced equally by global economies or sectors. Africa and other developing countries are more likely to suffer the impacts of climate change because of their dependence on natural resources, including fisheries, high levels of poverty, limited levels of human and physical capital as well as poor infrastructure. This view is supported by Dulvy *et al*., 2010 who state that the situation will be

particularly more severe in Africa's small-scale fishing communities due to the risky nature of fishing, compounded by other social, economic, ecological and political constraints.

2.6 Effect of Climate Variability and Change on Fishers Livelihoods

Climate variability and change affects various livelihood assets, activities and outcomes (Balgis *et al*. 2005) of fisher communities who depend on the climate sensitive fisheries (Allison *et al*., 2005). For example, the recession of Lake Victoria water levels caused a decrease in fish catches affecting livelihoods of fisher communities around the lake (Rubaru *et al*., 2012). Impact of climate variability and change on availability of fish products, revenues, harvesting strategies, processing and marketing will disrupt most fishing operations in turn affecting the fisher communities' lives and livelihoods. Severe weather conditions damage assets and infrastructure such as landing sites, boats and gear and disruption of marketing systems and loss of lives (Rubaru *et al*., 2012).

Climate variability and change through rise in water levels, storm and flood frequency can impact on the human and social capital of a community. Badjeck *et al*., (2009) points out that different dimension of human capital, ranging from safety at sea to food security will also affected by climate variability, with the loss of lives will be the most dramatic impact of extreme climatic events affecting not only surviving household members but also potentially disrupting economic and social activities. Safety at sea and injuries are often associated with natural disasters linked to climatic stresses such as floods and hurricanes, reducing the physical capabilities of fisher folk to pursue their livelihoods. Additionally, loss of revenues can be the result of closure or reduction of fisheries activities during weather anomalies (Nagy *et al.,* 2006).

2.7 Fishers' Knowledge and Perception of Climate Change and Variability

Swai *et al.* (2012) state that knowledge is a background factor that influences a person's attitude toward a certain behavior and thus a clear perception and scientifically correct knowledge of the causes and impacts of climate change is imperative for successful adaption to the effects of a changing climate. MacGregor (2010) stated that if people are equipped with the knowledge of the changing weather patterns and understand that extreme weather events will occur more often, they will be able to debate the issues with their families and communities and discuss the risks and possible courses of actions to enable them adapt more effectively.

Nhemachena and Hassan (2007) observe that gender plays a role in perceptions of climate change and variability. They stated that generally, women have limited access to information due to traditional social barriers, so they are less likely to perceive changes in climate leading to differential exposure to climate shocks and adaptation than the men. Ospina (2011) conducted a similar study using a gender lens and found that availability, access to and dissemination of information and knowledge remains the most challenging aspects of communicating climate change information particularly to women who least go to community gatherings where information about climate change may be shared. He further reported that other related limitations to communicating climate change information included the abstract nature of climate change; limited qualified personnel; limited documentation; and limited access to information on climate change. In short there is a lack of useful information which is scripted in simple enough language responding to local needs and priorities of alternative livelihood options.

2.8 Effect of Climate Change on Fisheries and Fishing Livelihoods

Climate change and variability will affect the various livelihood assets, activities and outcomes of all fisher communities (Amwata *et al*., 2015). Raburu *et al*., (2012) in their study found that

recession of Lake Victoria water levels caused a decrease in fish catches, affecting livelihoods of fisher communities around the lake. They also observed that the extreme weather patterns caused loss of fishing days, posed danger to life and caused damage or loss of fishing equipment. Post harvest losses may also increase during intensified rainy periods, when outdoor drying of fish becomes difficult. This will disproportionately affect women who are chiefly responsible for this node of the value chain. Majaliwa (2009) observed that public health problems in the fishing communities will occur due to high precipitation, flooding and runoff all coming from climate change which affects activity level of the fishers. The fishers will thus be negatively impacted as most of them lack access to health care and education, and it will be important to enhance local adaptation strategies and its links with wider development initiatives to reduce their poverty and improve their resilience. Williams and Rota (2011) state that the degree to which households can adapt to change is however based upon multiple factors including their livelihood asset base, social class, religion, origin, gender, age, wealth, education, location, policies and institutions as exemplified by the sustainable livelihood concept (DFID, 2000).

2.9 Fisher Communities Access and Control of Resources

De Silver (2011) observed that resource access in fisheries in Africa is gendered and embedded in a complex and often intricate socioeconomic and cultural foundation that determines the participation of men and women in fishing activities. The roles in fish harvesting are founded in deep rooted gender stereotypes. Nwabeza (2013) studied gender roles in fisheries in Nigeria and found that the fishery activities are largely a male domain. The argument advanced was that women lack physical strength needed for the work and are not able to work as hard as men.

The ability of fishers to either cope, scale up or diversify in the light of climate change and other stressors in Lake Victoria will depend on the level of capital and management practices done by the fishermen (Mbaru, 2012). This notwithstanding,(Yongo, 2000) found that 65% of the population around Lake Victoria live below the poverty line with no savings or access to credit but the fishermen groups and societies provided some leverage to the fishermen who were not able to access sufficient capital for fishing. The fisher groups require capital for the purchase of boats, fishing equipment and payment of labourers (Chali *et al.,* 2014). The lack of capital leads to improvising by the fishermen which usually result into inefficiencies and more losses in most cases (Oloo, 2011).

2.10 Fisher Communities Coping and Adaptation Strategies

Climate change and variability is viewed to have its greatest impact on poor households because they have the lowest capacity to adapt to changes in climatic conditions (Salau *et al.*, 2012). The ability of individuals and communities to adapt to climate change depends on their vulnerability, exposure and adaptive capacity (Amwata *et al.*, 2015). In turn, this is related to their financial and social capital, such as social networks. Their exposure and vulnerability to climate change impacts is also related to the existing infrastructure and institutional framework, including government sponsored social safety programmes and on their ability to acquire assets, such as insurance, technologies, and knowledge (Bene, 2011).

Studies have illustrated that fishers adapt to the impacts of climate variability and change in various ways. When faced with declining yields, income and food security, fishers may seek alternative resources. For example, in West Africa, when coastal fisheries resources are scarce, fishers adopt alternative livelihood strategies including hunting for bush meat (Brashares *et al*, 2004). On the Lake Malawi area the fishers cope by diversifying into farming and pastoralism

while others migrated in response to the decrease in fish catches that followed the drop in lake levels (Njayaa, et *al.*, 2011).

On Lakes Kyoga and Albert in Uganda the fishers shifted from using gillnets to mosquito seine nets in the Mukene fishery (Ogutu-Ohwayo *et al.*, 2013).Despite variability in climate and vulnerability of the fisher-folk community in Mbita, limited systematic studies have been carried out to determine the impact of weather and climate variability on their fishing activities and how these communities are coping. This study therefore sought to establish the influence of gender on the adaptive strategies of the fishing community in Mbita Sub County Homa Bay County, Kenya.

Williams and Rota (2010) propose that adaptation responses to changes in the fisheries sector must center on boosting adaptive capacity and resilience of both communities and ecosystems on which they depend. They suggest adaptation should not focus on altering catch size and effort only but on building communities to adapt and allow taking advantage of new opportunities in coping with climate change consequences.

2.11 Barriers and or Constraints to Climate Change Adaptation

Barriers to adaptation are obstacles that affect adaptation and also impact the adaptive capacity of a system. This is because adaptive capacity determines how effective system can respond to stressors (Clarvis and Engle, 2015). The most commonly reported barriers are linked to the institutional and social dimensions of adaptation that are context specific across space, time and sector (Biesbroek *et al*., 2013) while Sikor and Lund, 2009 reported that access to capital, ownership/opportunity and authority to use capital for enhancing adaptive capacity tops the list of constraints to adaptation among rural communities.

CHAPTER THREE: DATA AND METHODS

3.0 INTRODUCTION

This chapter presents the methodological approaches and processes that were used to collect and analyze data. Thus it provides the conceptual framework, the study design, sampling framework, sampling process sample size data collection tools, data collection techniques and analysis and presentation.

3.1 Overview of the Methodological Approach

The study was anchored on Social Constructivism paradigm and related developmental theories. Gender refers to the characteristics of women, men, girls and boys that are socially constructed. This includes norms, behaviour and roles associated with being a woman, man, girl or boy, as well as relationships with each other. As a social construct, gender varies from society to society and can change over time as it is argued that reality is constructed and there could be multiple realities of same situation. Creswell (2011) posits that in interpretive framework, individuals seek to understand their world and develop their own particular meanings that correspond to their experience. Social constructivism has its origins in sociology and it views knowledge and truth as created by the interactions of individuals within a society.

Gender lenses are dynamics because socio-cultural values define their implied meaning from community to community. The gendered socio-cultural dimensions of vulnerability and adaptation to climate change can only be understood in context due to the contextual nature of these dimensions (Nielson and Reenberg, 2010).

Social Constructivism paradigm was deemed the best to guide this research given the believe that things that are generally viewed as natural or normal in society depending on the cultural values they espouse, such as understandings of gender, race, class, and

disability, are socially constructed, and consequently aren't an accurate reflection of reality everywhere but just of that particular one. In adopting this epistemology, considerations were that the interpretation, experiences of and responses to climate-related impacts were socially-constructed and differently perceived by different gender groups (Hulme, 2009).

The study also drew from The Sustainable Livelihoods Approach propounded by Robert Chambers in the mid 1980s to elaborate on the need to enhance the efficiency of development cooperation through emphasis on sustainable livelihoods. It seeks to bring together the assets, events and critical factors that affect household strategies' vulnerability or strength (Allison & Ellis 2001). It is particularly relevant to understanding climate change vulnerability as it provides a framework for analyzing the principal components (that make up livelihoods) and the contextual factors that influence them. They are closely linked to the elements that make a household or community more sensitive or exposed to climate change impacts and that affect their ability to cope with environmental change (Eakin & Luers 2006).

In its design, the study used the mixed methods research design. The rationale for mixed methods was that information needed to answer the research objective needed both qualitative and quantitative data to complement required information some of which was complex and called interactive sessions with the study population to tease out their reactions with climate change and variability. According to (Tashakkori and Teddlie, 2010), mixed methods used in combination are complementary to each other and allow for more complete analysis of the study variables.

This methodology has been used by several researchers in different African countries to study gender and climate change as follows:

i. Garutsa (2018) studied gender differentials in climate change adaptation among the Shona ethnic group in Marondera Rural District, Zimbabwe.
ii. Owusu (2016) studied gender vulnerability to climate change and livelihood security in Ghanian urban slums.
iii. Musinguzi (2015) studied Fishers' perception, adaptation and mitigation measures to cope with changes in climate variables around Lake Wamala, Uganda.

Gender analysis was used to help understand the relationships between men and women in biological terms linked to resource access and control. Assessing the relationship made it possible to determine men's and women's constraints and opportunities within the fishing community. The analysis was centered on access, which referred to a person's ability to use the necessary resources to be a fully active and productive by finding out who has access to and control over resources and services. It also looked at the knowledge and the perception of the fishers, referring to the types of knowledge that men and women possess; the beliefs that shaped their gender identities and behavior; and the different perceptions that guide people's understanding of their lives, depending on their gender identity. And lastly at the practices and participation of the fishers, referring to the fishers' behaviors and actions, what they actually do and how this varies by gender roles and responsibilities, also looking at the differences in the ways men and women engaged in activities.

3.2 Research Approach

The study adopted a transdisciplinary research approach where the effect of climate change on fisher community is viewed in a holistic way. The three complexities of transdisciplinarity (dynamic, social and generative complexity) were involved in the research process.

Transdisciplinary research had two parallel processes which were the research process and the change process. This approach investigated current situation and articulated perceived probable future situation. Transdisciplinary research supports participatory learning and knowledge integration with stakeholders in the centre of identification of prevailing phenomenon and possible mediations for reducing negative impacts. The approach aims at transformation of society through mutual learning, knowledge integration and by involving all the stakeholders with both the scientific and indigenous knowledge integrated to address the problem.

3.3 Conceptual Framework

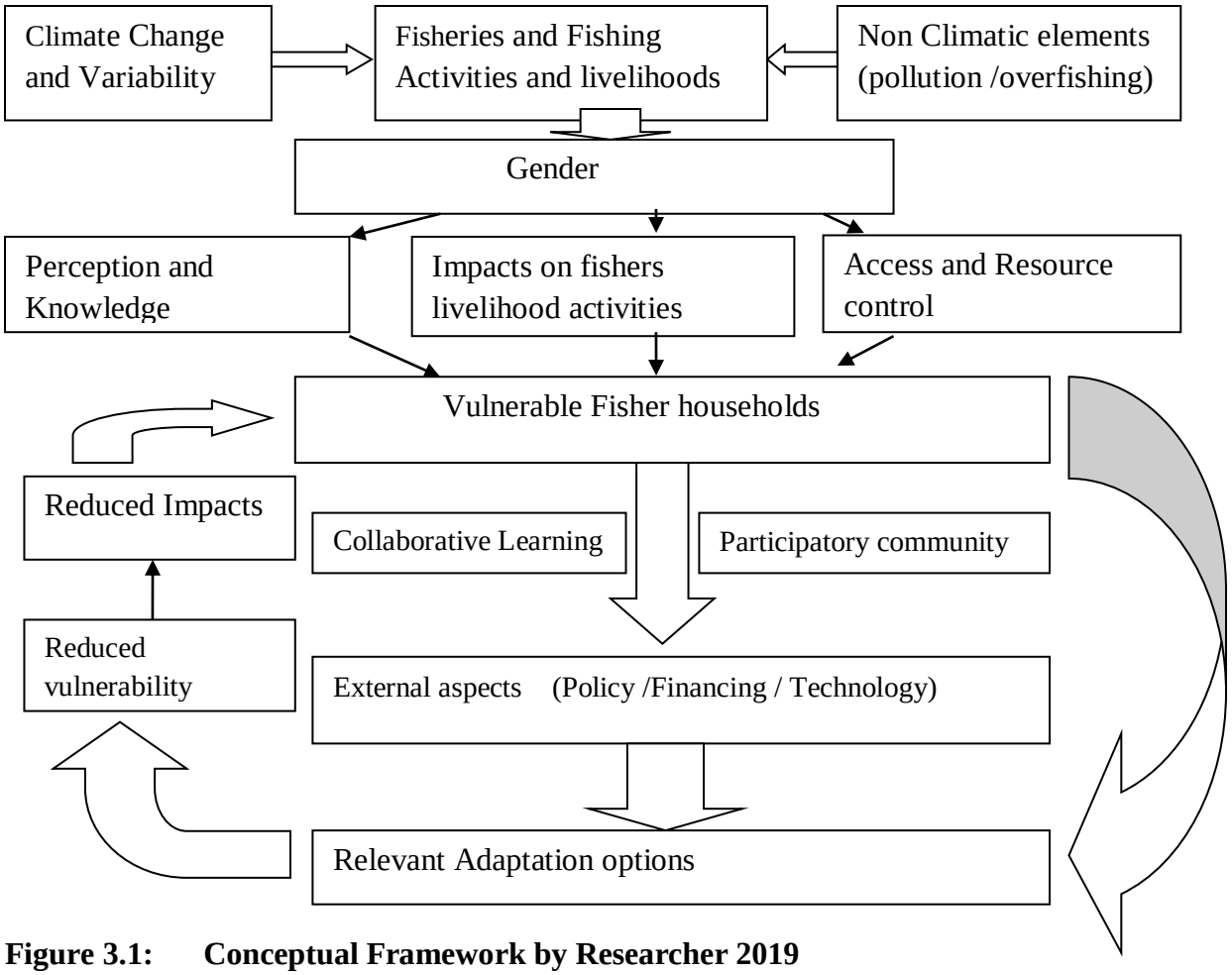

Figure 3.1: Conceptual Framework by Researcher 2019

Figure 3.1 above provides a holistic approach to comprehending the influence of gender on climate adaptation by the fishers in Mbita. It integrates the social constructivism research paradigm and the sustainable livelihoods together with the transdisplinary research methodology. It identifies the climatic and non-climatic elements which influence fish, fishing activities and fishing livelihoods ranging from the volumes of catches, varieties caught, the catching, processing and marketing of the fish. It shows the complexity of the dynamic interactions of gender and cultural belief systems which guide resources access and control. The cultural norms and values within the fisher community influence gender disparity on access/control of resources and ultimately the impacts of climate change/variability on the fisher community in Mbita. Navigating to sustainable livelihoods could be achieved through participatory action research processes that will bring together all the key stakeholders for the purpose consultative identification of livelihood challenges associated with climate change/variability and the crafting of plausible interventions for reducing the adverse effects. The reinforced collaborative learning likely to entrench transformative pathways owned by the affected people for reducing fishers' cyclic vulnerability to climate change and catalyzing positive shifts for attaining a more sustainable adaptive strategies .

3.4 Data collection tools, methods, processes, and techniques

This sub section presents the various methods used to achieve each of the study objectives

3.4.1 Objective 1 Assess the fishers' knowledge and perception to climate change and variability in Mbita Sub-County.

To achieve this objective, 10 perceptual statements on rainfall, temperature were asked and the fishers used a 5 point Likert scale to base their perceptions. 5 open ended questions were used to

test their knowledge of climate change/variability issues. The key informant interviews with the beach management unit officials, fishery and meteorological officers gave further insights into variability of temperature and rainfall in Mbita. This was compared to findings from the scientific climate data from ICIPE metrological station to triangulate/validate the fishers' perceptions of climate variability. The focus group discussions with the fishers allowed them to freely give their opinion on possible causes of the climate changes, visualize the future weather patterns and give thoughts on possible opportunities for the fishers coming from climate change.

3.4.2 Objective 2 Establish the gendered effects of climate change on the fishing activities and livelihoods in Mbita Sub-County.

To achieve this objective a list of 13 possible effects of climate variability to fishers' activities and livelihoods were presented from which they selected all relevant ones. The fishers were allowed to list any other effect they had experienced to make their responses more exhaustive. The focus group discussions and key informant interviews further threw light on how the fisher activities have been affected by the changes in climatic conditions and explicitly discussed the effect on their incomes and livelihoods. Fish catch data was sourced from the fisheries dept and from local BMU and fisheries officials to triangulate against fishers perception on the impact of climate variability on the fish catch for the last 10 years.

3.4.3. Objective 3 Determine the influence of gender on access and control of fisher resources for climate adaptation in Mbita Sub-County.

To achieve this objective ,the fishers were given 20 options of available resources to choose from .These fell under the 5 capital assets namely human, natural, financial physical and social capitals, which are deemed important for the fishers wellbeing, reduced vulnerability and their ensured sustainability .This allowed for a gendered resource analysis with the focus group

discussions and key informant interviews clarifying the subtle social and cultural influence of who controls and who accesses the available resources among the Mbita fishers.

3.4.5 Objective 4 Determine the influence of gender in the current coping and adaptation strategies of the fishers in Mbita Sub-County.

To achieve this objective, a list of 13 available options for coping and adaptation were presented to the fishers and on constraints/challenges to adaptation 7 options were given. The focus group discussion and the key informant interviews were used to discuss in greater details the coping and adaptation practices the fishers have put in place to help them cope, increase productivity, clarify any challenges encountered and illustrate any possible opportunities they thought could arise from the prevailing conditions.

3.5 Field Work Mapping and Data Collection

The section below discusses the target population the sample frame and data collection

3.5.1 Target Population and Sample Size

Table 3.1 below provides Mbita Sub-County with a total population of 13191 persons and their locational distribution. Stratification technique was used to select a study sample of 388 as shown from across four locations of Rusinga East, Rusinga West, Gembe East and Gembe West respectively inclusive of officials from Fisheries, Meteorological Departments officers and BMU leaders who were purposively selected, the remaining respondents systematic random sampling was used to pick every 10^{th} name to remove any bias in the target population and enhance objectivity for generalization.

Table 3.1 Mbita Sub-County locations population distribution

Location	Population	Percentage	Weight
Rusinga East	3299	25	97
Rusinga West	3708	28	109
Gembe East	1648	12.6	49
Gembe West	4536	34.4	133
Total	13191	100	388

Source: Records from Mbita District Fisheries Office 2016 Survey

Sample selection was backed with using Yamane's formula: Yamane (1967) which puts a 95% confidence level and p =0.05, size of the sample thus:-

$$n = N \div (1+Np^2)$$

.where, n = the desired sample size

N = Population sample

p = error term = 0.05

$$n = \frac{13,191}{1+13,191(0.05^2)} = 388.$$

3.6 Data Collection

Initial reconnaissance survey of the area was conducted prior to the commencement of the field work. This was done to meet the relevant stakeholders especially the communities and introduce

the study objectives. The researcher met key stakeholders such as the beach management unit administrators, fishery officers and meteorological officers. The pre-study session was very useful as it helped to familiarize the researcher with the local communities to gain their trust, sensitize and integrate members of the community into the research process. Prior to data collection the researcher piloted the instruments at Sango Rota beach on the shores of Lake Victoria. Four assistants were recruited locally among the fishers, one in each location of the study area for ease of access to fishers and in the administration of the questionnaires. The research assistants had previous experience but were additionally trained to enhance their interactions with respondents as they administered the questionnaires.

3.7 Data Sources

Data collection was actualized through use of questionnaires to collect quantitative data (Questionnaire sample annexed); interview guide to collect qualitative data from the key informants (Interview guide annexed) and focus group discussions (FGD guide annexed) to solicit qualitative data from respondents .

3.7.1 Primary Data

a) Household Survey

A formal survey was conducted using a standard questionnaire. The questionnaire was administered to the household heads and was designed to capture information on family characteristics (educational and marital status, family size, age, sex, major source of income) as well as other parameters such as local perception of climate change, their access to resources, effect of change/variability on their livelihood and coping methods to changes.

b) Focused Group Discussion (FGD)

Discussions were carried out with fishers to get information about the past and present condition of climate, impacts and adaptation strategies. A total of 8 focused group discussions were carried Rusinga East, Rusinga West, Gembe East and Gembe West, 2 in each one for men and one for women respectively. Each focused group consisted of 8-10 participants with the findings used to validate and triangulate the responses that came out of household survey. The researcher personally conducted the key informant interviews and the focus group discussions for uniformity in recording and interpretation of the qualitative information.

c) Key Informants Interview

Additional information was gathered from office holders with pertinent information for the study. They included the areas meteorological, fishery officers and the beach management unit leadership in the 4 sites. This information was used to triangulate/validate the views of respondents. The key informant interviews focused on climate pattern, access to resources, impacts of change on fishing, adaptation measures and possible opportunities arising from the changes.

3.7.2 Secondary Data

Secondary data was obtained from publications, reports and working papers relevant to climate change and climate change adaptation and climate variability to solicit information from respondents on their perceptions and knowledge climate change impacts on fisheries. Archived data about temperature and rainfall trends was also obtained from ICIPE Meteorological Station and fish catch data from Fisheries Department in Mbita.

3.8 Data Analysis and Presentation

Quantitative data collected through questionnaires was coded and analyzed using computer supported software (Statistical Package for Social Sciences) and presented in descriptive statistics, and was further regressed and presented in inferential statistics using the below.

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon} \quad \textbf{……..Eqn (1)}$$

Where **Y** = Adaptation

$\mathbf{X_1}$ = perception /knowledge of fishers

$\mathbf{X_2}$= effects of CC/CV on fishing activities and livelihoods

$\mathbf{X_3}$= access and control of fisher resources

$\mathbf{X_4}$= coping strategies/constraints

$\boldsymbol{\varepsilon}$ = Error Term

$\mathbf{B_1..\beta_4}$. = Coefficients of regression

Qualitative data which was sourced from the key informants interviews and focus group discussions provided in-depth discussion data which were analyzed thematically and presented in prose. The climate data on average annual rainfall and average annual minimum and maximum temperatures as from 1987 to 2017 was analysed to get climate variability trends within the period by trend analysis and Microsoft excel used to plot the trend charts. Pictures plates which showed diversified livelihood activities were incorporated alongside thematic narratives for easy visualization and understanding of dynamics of adaptation through livelihood diversification.

CHAPTER FOUR: RESULTS FROM OBJECTIVE ONE: FISHERS' KNOWLEDGE AND PERCEPTIONS ON CLIMATE VARIABILITY AND CHANGE IN MBITA SUB-COUNTY

4.0 Introduction

This chapter presents findings from the assessment of the fishers' perception and knowledge on the impacts of climate change and variability in Mbita Sub-County of Homa Bay County.

4.1 Socio-demographic Characteristics of the Respondents

Table 4.1 Socio-Demographic Characteristics of the Fishers in Mbita Sub-County

	Men N (%)	Women N (%)	Cumulative N (%)
Age category			
<19	6(2.9)	4(3.8)	10(3.2)
19-28	62(20.2)	36(34.2)	98(32)
29-38	76(25.8)	48(45.7)	124(40.5)
39-48	34(16.9)	17(16.1)	51(16.6)
49-58	17(8.4)	0(0.00)	17(5.6)
59+	6(2.9)	0(0.00)	6(1.9)
Marital status			
Single	55(26.8)	22(20.9)	77(25.1)
Married	80(39.8)	37(35.2)	118(38.5)
Divorced	15(7.4)	11(10.47)	26(8.5)
Separated	34(16.9)	23(21.9)	57(18.6)
Widow/er	15(7.4)	13(12.3)	28(9.2)
Education			
None	7(3.4)	4(3.8)	11(3.5)
Primary	93(46.2)	62(59)	155(50.6)
Secondary	84(41.7)	36(34.2)	120(39.2)
Tertiary	17(8.4)	3(2.9)	20(6.5)
Household(HH)			
Male headed	195		195(63.7)
Female headed		101	97(31.7)
Child headed	6 (2.9)	4(3.8)	10(4.6)
Parity			
0 – 3	112(55.7)	63(60)	175(57.1)
4 – 7	82(40.7)	41(39)	123(40.2)

*Figures in brackets are percentages

Table 4.1 above presents the socio-demographic characteristics of the fishers by gender, age, marital status, education, source of income, income per month and households' sizes.

The study found that the majority 65% of the fishers' respondents were male while 35% were female. On age distribution, only 3% of the respondents were <19years of age; 32% were between 19-28 years of age; 40% were between 29-38 years of age; 16% were 39-48 years of age; 5% were between 49-58 and 2% of them were 59+ years. The age group (29-38) years represented the most energetic and economically productive segments, who undertake the tedious activities of fishing, fish processing and vending fish and fish products as well as taking care of the young and old age groups. This finding is consistent with Odhiambo 2013 and Lwenya *et al.*, 2009 whose findings showed that the average age of fishers in Kenya was can be averaged at less than 35 years old.

On marital status, it was found that 25% of the fishers' were single made up of 27% of the males and 21% of the females; 39% of the respondents were married, 40% of them males and 36% females; 9% of the respondents were divorced 8% of the male and 10% of the females ; 19%of the sample were separated made up of 17% of the males and 22% of the females and 9% of the sample were widowed/widowers made up of 7% of the male and 12% of the females.

On education level of the sampled fishers, the study found that 4% of them had no education at all made of 4% of the male and 4% of the females; 51% of the respondents had primary education made up of 46% of the males and 59% of the females; 39% of the respondents had attained secondary education made up of 42% of the males and 34% of the females and finally 7% of the respondents had acquired some tertiary education of made up of 8% of the males and 3% of the females. These results were similar to those of Odhiambo (2013) who found that

(49%) of his sample had attained primary education; 42% attained secondary education; and 6% had tertiary/ college education while 3% of his sample no formal education.

The finding is also consistent with SEDAWOG II (1999) that found that more than half of fishers in Lake Victoria have at most primary level of education. Idrisa, *et al*, (2012) found that education plays an important role in creating awareness in fishing communities therefore educated people are better equipped to source information. Thus the profile of education of the sample mapped the trend of the levels to which information could reach the fishers.

On household's headship the study found that 64% were male headed; 32% female headed and only 4% child headed households. This finding is similar to that of Nzeadibe, *et al*, (2012) who found that 65% of the fisher households were male headed and 34% female in the Niger Delta region of Nigeria. Concerning household size, the study found that 57% of the sampled households of made up of 56% of the males and 60% of the females were living with between 0-3 people in their houses; 40% of the respondent made up of 40% of the males and 39% of the females were living with 4-7 people in their household only 3% of the respondent reported that they were living with 8+ people in the same household: of these 3% of the males and less than 1% of the female. This finding supports the earlier findings by Lwenya, *et al*, (2012) who found that in Kenya, on average, majority of fishers in Lake Victoria have four children per family and other dependents ranging between 4 to 12 people per fisher.

4.2 Livelihoods and Livelihood Activities

Table 4.2 Livelihoods and Livelihood activities

Source of livelihoods	Male N (%)	Female N (%)	Cumulative N (%)
Fishing	134(66.6)	70(66.6)	204(66.6)
Livestock	13(6.4)	4(3.8)	17(5.5)
Mixed cropping and fishing	48(23.8)	23(21.9)	71(23.2)
Other	6(2.9)	8(7.6)	14 (4.5)
Roles in fishing			
Boat owner/maker	19 (9.4)	8 (7.6)	27(8.8)
Fisherman/crew	137(68.1)	0 (0.)	137(44.7)
Fish marketer	26(12.9)	79(75.4)	105(34.3)
Years in fishing			
<5	43(21.3)	21(20)	64(20.9)
6 – 9	85(42.2)	49(46)	134 (43.7)
10 –14	38(18.9)	24(22.8)	62(20.2)
15 – 19	21(10.4)	8(7.6)	29(9.4)
20 +	14(6.9)	3(2.8)	17 (5.5)
Average monthly income			
0 to 4999	99(49)	62(59)	161(52.6)
5000 to 9999	56(27.8)	24(22.8)	80(26.1)
10000 to 14999	24(11.9)	9(8.5)	33(10.7)
15000 to 19999	9 (4.4)	7(6.6)	16(5.2)
20000+	13(6.4)	3(2.8)	16(5.2)
Social group member			
Church group	42(20.8)	69((65.7)	111 (36.2)
Credit group	63(31.3)	46(40.68)	109(35.6)
Fishers/BMU group	177(88.0)	89 (84.7)	266(86.9)
Men/women group	102(50.7)	61(58)	163(53.2)
Other	18(8.9)	6(5.7)	24(7)

*Figures in brackets are percentages

As presented in Table 4.2, the study found that 67% of the sampled fishers solely depended on fishing as their main source of livelihood made of 66% of the male and 66% of the females .The second most dominant source of income for the respondents was mixed cropping and fishing

accounting for 23% of the respondents made up of 24% of the males and 22% of the females. Livestock rearing was the third most dominant livelihood activity in which about 6% of the respondents were engaged in. Lastly 5% of the respondents made up of 3% of the males and 8% of the females were engaged in other activities like beauty salons, hotels, second hand clothes vending, water vending sand-mining, *boda boda* riding among others to make a living.

On establishing the years of experience of the respondents in fishing, 21% of the respondents made up of 21% of the males and 20% of the females reported they had been involved in fishing for less than 5 years. 44% of the respondent comprising of 85% of the males and 49% of the females reported they had been fishing for between 6-9 years, while 20% of the respondents made up of 19% of the males and 23% of the females had been in fisheries for between10-14 years; approximately 9% of the respondents made up of 10% of the males and 8% of the females reported they had been in the fishing industry for between 15-19 years and lastly the remaining 6% of the respondents made up of 7% of the males and 3% of the females stated that they had been in fishing for a period exceeding 20 years. These results were consistent with those of Odhiambo (2013) and Sidi (2015) who found out that most fishers had been in the fisheries for periods between 5-15 years.

On the roles taken in the fishing chain 10% of the males as opposed to 8% of the females reported that they were either boat owners or makers, 45% of the respondents reported they were either fishermen or boat crews and were all male, since fishing is culturally a male occupation. Further, it was found that about 68% of respondents who had direct fishing roles were males; while 34% of the respondents composed of 13% of the males and 75% of the females reported they were engaged in fish marketing.

On estimates of monthly incomes; about 53% of the respondents comprising of 49% of the males and 59% of the females reported they made between (0- 4999) Ksh a month from their fishing activities; about 26% of the respondents comprising of 28% of the male and 23% of the females reported they made between (5,000 – 9 ,999) Ksh a month ;11% of the sampled fishers in the distribution of 12% of the males and 9 % of the females made between (10, 000 – 14999) Ksh a month ; about 5% of the respondents comprising of 4 % of the males and 7% of the females reported they made between Ksh (15,000 – 19,999) a month while just about 5% of the respondents in distribution of 4% of the males 6% of the females reported making over Ksh20, 000 a month. This findings supports those of Omwega (2000) who found that that the average boat owner earned in the range of US$ 65 per month in Lake Victoria Kenya; and in a good week, fisher folk earned approximately Ksh.7,750, while in a bad week they earned Ksh.1, 822 a week. These findings confirm that a majority, about 53% of the respondents earned a fairly low income of between Ksh 0 to 4999 a month from their fishing activities and this could be a constraint to their being able to diversify their livelihoods and effectively adapt to the effects of climate variability/change in their fishing livelihoods.

On social groups and Information sharing, the study found that the fishers belonged to a variety of social groups with a majority, about 87% of the respondents comprising of 88% of the males and 85% of the females belonging to the Fishers/BMU this high enrollment is because it is a precondition for all fishers to be enrolled for better regulation and management of the fisheries. About 53% of the respondents comprising of 51% of the males and 58% of the females reported they belonged to gendered loans and savings groups through which they saved and gave each other unsecured loans and shared information relevant to their welfare and livelihood activities.

The study learned from the FGDs that other social groups the fishers had ranged from church, agriculture to social welfare groupings. About 36% of the respondents comprising of 21% of the males and 66% of the females were enrolled in church groups, 36% of the respondents comprising of 31% of the males and 40% of the females were in credit group and the remaining 7% of the respondents made of 9% of the males and 6% of the females were in other undefined welfare groupings. The finding on groupings was consistent with Weeratunge *et al*. (2014) who found that rural dwellers belonged to organizations that satisfied their innate need for belonging and affiliations that would assist them in solving their problems through collective efforts. This implies that information on fishing and climate change issues can be disseminated quickly to members of the different social networks whether economic or religious.

4.3 Fishers' Perception and Knowledge of Climate Variability/Change in Mbita

In this section the scientific climatic trends of Mbita will be analyzed and presented followed by the perception of the fishers to the climate trends and eventually their knowledge and forecasts of future climatic trends will be detailed.

4.3.1 Scientific Climatic Trends in Mbita Sub County between 1987 and 2017

In this section the monthly and annual trends of rainfall and temperature are presented below using graphical images constructed from 30 year period climatic raw data sourced from ICIPE Meteorological Station. This was a critical indicator for confirming the phenomenon of weather and climate change/ variability in the region.

4.3.2 Rainfall Variation in Mbita Sub County

In this subsection the monthly and annual rainfall trends of Mbita Sub County are presented and interpreted to explain scenarios of rainfall variability in the study area.

4.3.2.1 Monthly rainfall variation from 1987 to 2017

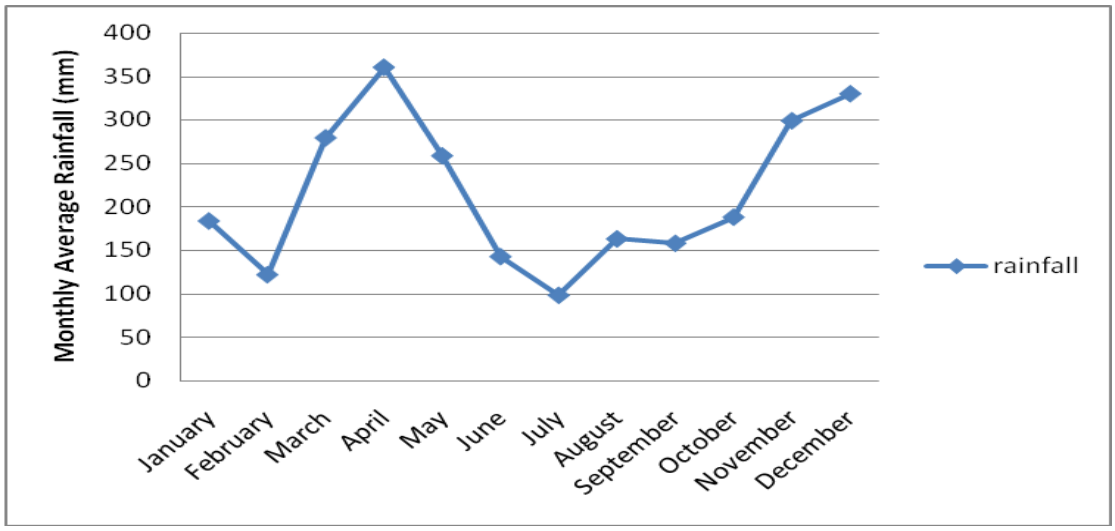

Figure 4.1: Average monthly rainfall pattern data for Mbita (From 1987 to 2017).
Source: Mbita ICIPE Meteorological Station

The rainfall data showed Mbita experiences two rainy seasons, the long rainy season between March to May and the short rainy season from October and December. Figure 4.1 shows that the month of April had the highest amount of rainfall over the years recording an average of 360 mm while July recorded the lowest rainfall over the years with an average of 98.4 mm.

4.3.2.2 Annual rainfall trends from 1987 to 2017 in Mbita Sub County

For the 30 years under consideration 1987 to 2017 showed a highly variable trend of rainfall as shown in Figure 4.2 There was an overall decrease in annual rainfall by 5.1 mm during the period (Table 4.3). From 1987 to 1988 the rain showed an increasing trend from 900-1000 and a rise between 1989- 1990 before a sharp fall in 1991 before leveling back in 1993. Thereafter the rainfall was highly variable with rises and falls in annual totals till 2017 as shown in Figure 4.2.

The irregularity in rainfall pattern from these records points a clear indication to weather and climate variability with some years like 1997, 2002 and 2006 have exceptionally high average rainfall of over 140 mm, while others have lower than 100 mm**.**

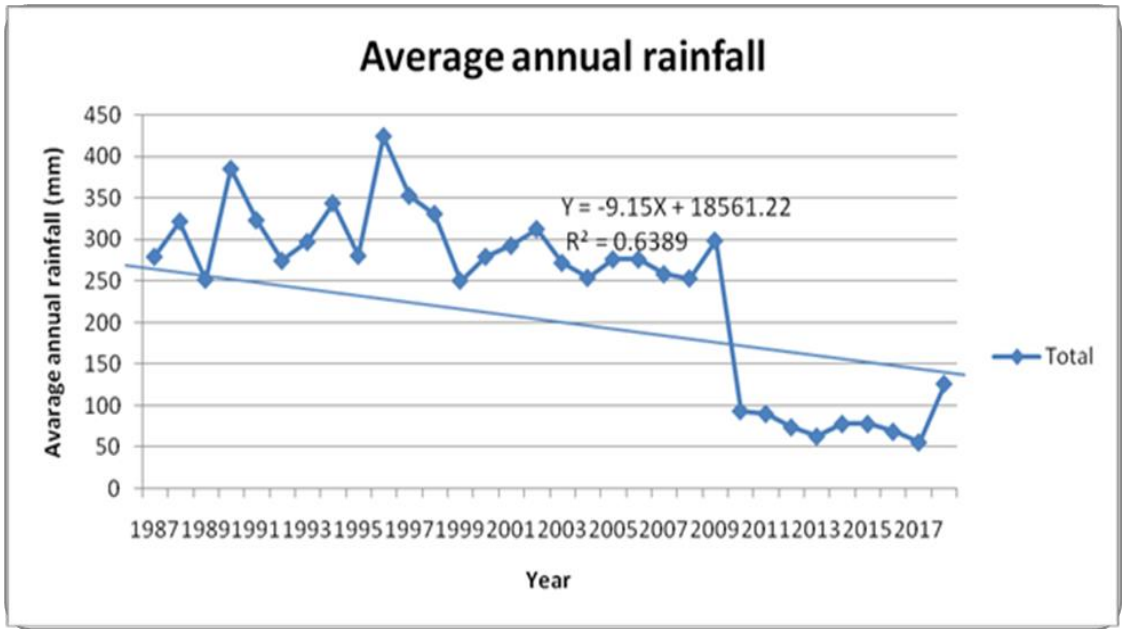

Figure 4.2: Average annual rainfall trends for Mbita: 1987-2017

Source: Mbita ICIPE Meteorological Station

Table 4.3: Analysis of rainfall data from 1987 to 2017

Rainfall	Monthly	Year
Mean(mm)	215.5	237.7
Standard deviation (mm)	86.7	107.4
Trend (mm /year or month)	0.01	0.02
Total change calculated from the trend(mm/30 years)	**-13.92**	**-5.1**

Source: Based on data from the Mbita ICIPE Meteorological station 1987-2017

Table 4.3 presents the statistical analysis in which the monthly average rainfall for this period under observation was 215.5 mm while the annual average rainfall was 237.7 mm. for the same period. The monthly mean rainfall over the 30 year period showed a decrease by 13.92 mm over

the period while the annual average rainfall showed a decrease of 5.1mm over the period. This was an indication that the area is already experiencing rainfall variability between the long and the short rainy seasons.

4.3.3 Monthly and Annual Temperature Variations in Mbita Sub County

In this subsection the average monthly and annual temperatures variation of Mbita Sub County are presented and interpreted to explain temperature variability in the study area.

4.3.3.1 Monthly temperature patterns

Monthly temperature recordings for the period 1987-2017 showed that the minimum temperatures over Mbita were fairly constant oscillating between 17 and 19°C throughout the year with July being the coolest month with the average temperatures of 17.8 °C as shown in Figure 4.3. The average maximum monthly temperatures however exhibited a bimodal pattern with high temperatures in January peaking in February and March before coming down in April through to August; then rising again in September to peak in October and November at temperature ranges of 29 °C to 30°C.

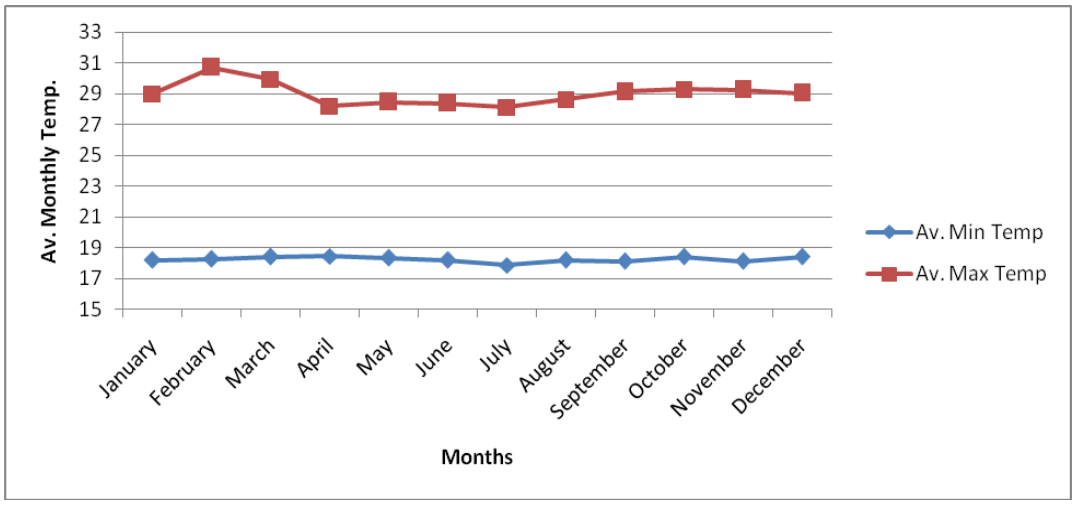

Figure 4.3: Average monthly temperature pattern for Mbita: 1987-2017

Source: Data from Mbita ICIPE Meteorological Station

4.3.3.2 Average Annual Temperature Trends in Mbita Sub County

The yearly temperature distribution over the thirty year period presents patterns of unstable cycles for both the maximum and minimum temperatures as per Figure 4.4. The maximum temperatures from 1987 to 2017 showed irregular cycles of rising and falling of temperatures as illustrated above while the minimum temperatures showed a gentler curve staying steady between 1987 till 1992 where there was a slight warming and a fall till 1997 where the temperatures were fairly consistent until 2012 where they have been rising consistently.

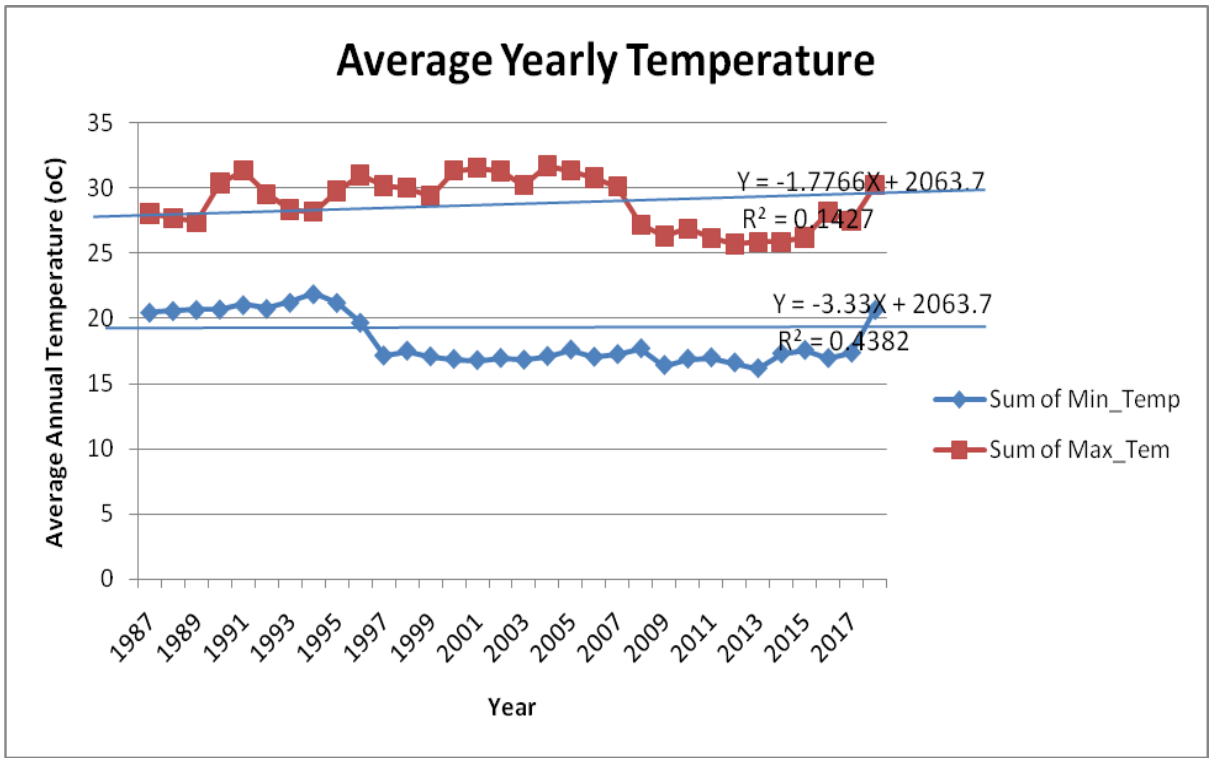

Figure 4.4: Yearly trend of temperature data for Mbita: 1987-2017

Source: Data from Mbita ICIPE Meteorological Station.

The temperature trends displayed in (Table 4.4) for Mbita between 1987 and 2018 shows a variable trend, for the monthly minimum temperatures had fallen by 0.17^0C while the maximum monthly averages went down by 0.68^0C. The minimum and maximum annual temperature showed a rise with the minimum annual temperatures having risen by around 0.89^0C and the

maximum annual temperatures by 0.60^0C. The warming trend in the area was however non-significant and indicated climate variability. This finding is consistent with Kenya Meteorological Department (KMD) report that appeared in (GOK, 2010) stating that the trend of minimum temperature from 1960 has been increasing by 0.8-2.0^0C, while the maximum temperature has been increasing by 0.1- 0.7^0C in the Lake Victoria region.

Table 4.4 Statistical Temperature Analysis in Mbita Sub-County

Temperatures	Monthly		Yearly	
	Min	**Max**	**Min**	**Mix**
Mean (^{O}C)	18.2	29.0	18.3	29.0
Standard deviation (^{O}C)	0.35	1.4	1.8	2.0
Trend (^{O}C/year or month)	0.01	0.04	0.974	0.09
Total Change calculated from the trend (^{o}C/30 years)*	**-0.17**	**-0.68**	**0.89**	**0.60**

Source: Based on data from the Mbita ICIPE Meteorological station 1987-2017

4.4 Perception of Temperature Variability by Fishers in Mbita Sub County

This subsection details the fishers perception of the variability in temperature over a period of 10 years .It is assumed that most fishers would easily recall with clarity if there were any changes in the temperatures within this span of time (See Appendix 4.5).

4.4.1 Fishers Observed Changes in Annual Temperatures over the last 10 years

The majority, 68% of the respondents made up of 69% of the male fishers and 65% the female fishers were of the opinion that there had been an increase in the annual temperatures in the

area, while about 3% of the respondents made up of 2% of the male and 4% of the females did not agree that there had been any increase , with about 30% of the respondents made up of 29% of the males and 30% of the females reported not knowing if there had been any increase .

While for decrease in the annual temperatures over the last 10 years, the majority of about 74% of the respondents made up of 73% of the male and 74% of the females did not think there had been a decrease in the annual temperatures , while just about 4% of the respondents made up of 4% of the male fishers and 4% of the women reported there had been a decrease in the annual temperatures, with about 22% of the fishers comprising of 22% of the male fishers and 23% of the female fishers reported not knowing if there had been any decrease in annual temperatures.

As to whether there had been change in temperature over the last 10 years, 68% of the respondents made up of 67% of the male fishers and 70% of the women disagreed with the observation that there had been no change in temps 8% of the respondents made up of 8% of the male fishers and 6% of the women were in agreement that there has been no change in temperature while 25% of the respondents made up of 26% of the male fishers and 23% of the female fishers reported not knowing if there had been any changes.

4.4.2 Fishers Observed Changes in Rainfall in the Last 10 Years

Responding to whether rainfall comes earlier than expected over the last 10 years 93% of the respondents made up of 91% of the men and 95% of the women disagreed with this statement, while 2% of the respondents made up of 3% of the male fishers and 1% of the women agreed that this was true, 5% of the sampled fishers, made up of 6% of the male fishers and 4% of the female fishers reported not knowing if this was the case or not.

Responding to whether the rainfall comes later than is expected over the last 10 years, 93% of the respondents made up of 93% of the male fishers and 92% of the females agreed with this statement while 3% of the respondents made up of 2% of the men and 3% of the women disagreed, with 5% of the respondents comprising of 4% of the male fishers and 5% of the females reported not knowing.

Responding to if the total amount of rainfall is less than usual over the last 10 years, 68% of the sampled fisher population made up of 70% of the male fishers and 65% of the female fishers thought this was true, while 5% of the fishers made up of 6% of the males and 6% of the female disagreed and 25% of the respondents comprising 23% of the male fishers and 30% of the female fishers reported not knowing.

Responding to whether the rains have become more erratic over the last 10 years, 89% of the sampled fishers made up of 91% of the males and 86% of the females affirmed that the rains have become more erratic, while 3% of the fishers made up of 2% of the men and 3% of the females disagreed with 8% of the fishers reported not knowing.

Responding to whether there has been any change in the rains over the last 10 years 85% of the respondents made up of 87% of the males an 80% of the females disagreed with this statement, while 6% of the respondents made up of 5% of the male and 6% of the female agreed that there was no change in rainfall and 10% of the respondents made of 7% of the male fishers and 13% of the female fishers reported not knowing if there had been change.

From the interactive FGD sessions the respondents demonstrated that they were fully aware that the climate is more variable and unpredictable with the rainfall becoming more inconsistent with unpredictable onset dates coupled with haphazard distribution, while the temperatures /were

becoming increasingly warmer. The fishers observed that extreme weather events such as droughts and floods are the most important climatic stressors with negative impacts on their households. Extremes of temperatures and occurrence of flash floods translated into declines in fish catch. Many fishers also stated that there were more unusual patterns with winds with more sudden storms arising over the lake, endangering their lives all which were evidence of the climate variability in the study area.

Table 4.5 Statistical Significance of Perception of the Fishers to Climate variability and Change in Mbita -

	Agree		Don't Know		Disagree		p-value
Perception	Male (Yes%)	Female (Yes%)	Male (Yes%)	Female (Yes%)	Male (Yes%)	Female (Yes%)	
Rise in annual temperature	70.6	65.7	29.4	30.5	0.0	3.8	0.021***
Lowering in annual temperature	6.6	11.4	22.3	21.9	71.1	66.7	0.345
Hotter during hot months	71.1	90.0	25.9	17.1	3.1	1.9	0.171
Hotter during cold months	62.4	50.5	32.5	36.2	5.1	13.3	0.020***
Rainfall comes earlier	5.1	1.0	10.3	9.5	84.6	89.5	0.176
Rainfall comes later	89.7	96.2	4.6	1.0	5.6	2.9	0.123
Total rain less than usual	62.4	64.8	30.9	29.5	6.7	5.7	0.9
Rain more erratic	83.8	84.8	13.7	12.4	2.5	2.9	0.939

Statistically the fishers agreed to having seen a rise in the annual temperatures due to climate change and the temperatures getting warmer during the cold months ,both with a significant p-value = 0.02. This is a clear indication that change in climate was causing rise in annual temperature according to the fishers in Mbita. This gave the indication that the fishers thought climate change/variability had led to hotter weather even during the cold months. Although climate change had some effects on all the other variables such as; lowering of annual temperature, hot weather during hot months, earlier rainfall, and later rainfall, total rain that is higher than the usual one, and a more erratic rain, the effects were not statistically significant registering a p-value < 0.05.

4.5 Fishers Knowledge of climate variability in Mbita

Responding to knowledge level on effects of climate change and variability, 132 (43%) of the respondents reported they had knowledge of climate change and its effects on fish catches. The remaining 174 (57%) of the respondents claimed no knowledge of this phenomenon. Statistically tested for its significance on the fishing activities the regression display shows a p-value of 0.017. It is notably significant yet only 43% of the fishers reported having knowledge of it; more male fishers were knowledgeable on climate change than the females, implicit of cultural bias of educating males over females thus empowering them to more knowledge access than women, as illustrated in Appendix V: Table 1).

Table 4.6 Statistical correlation of knowledge level of the fishers on climate change in Mbita Sub-County

Knowledge of climate change	Male(%Yes)	Female (% Yes)	p-value
	46.3	37.1	0.017****

****Significant at 5%

These findings are consistent with those of Nzeadike *et al*, (2011) who found that the level of scientific knowledge of the local communities of climate change was still low in the Niger Delta Region of Nigeria, however contrasting those of Musnguzi (2013) and of Aphunu and Nwabeze (2012) who found an increasingly high knowledge and perception of climate change among the fishers in their studies.

4.6 Comparison of scientific climate trends and fishers perceived trends

Understanding the perceptions of communities on climate change and relating it to meteorological evidence is important in planning adaptation strategies with rural communities. Comparing perceptions of fishers on rainfall changes with meteorological rainfall trend shows that perception on annual rainfall trend agrees with meteorological rainfall trend for the study area. 74% of the

respondents made up of 72% of the male and 81% of the female correctly listed the years 2015 and 2017 as the hottest they have experienced in the last 10 years and 2010 and 2012 as the coldest. The scientific data from ICIPE corroborated this as true with the 3 years having maximum temperatures ranging from 29 - 32°C annual averages. The fishers also correctly reported that the months of February, March, and November as the hottest months in every year, while July, August and September as the coldest months.

Accordingly, the fishers also reported, the wettest year ever experience in this region in the 10 years were 2004, 2006 and 2008 which all had over 2000 mm in annual rainfall and the driest as 2010 2012 and 2013. These were all correct except for 2010 which had an average rainfall of 616 mm but looked dry as the previous year had enhanced total annual rainfall of over 2369 mm as corroborated by the scientific data from ICIPE weather station in Mbita.

When asked about the changes they have observed during focus group discussions the fishers highlighted that temperature were getting warmer coupled by more frequencies of dry periods. They also reported that the rainfall amounts were decreasing, with an increase in midseason dry spells, rainfall was becoming patchy, and the onset of rainy/growing season increasingly unpredictable and in most cases starting later than normal. This was consistent with the climatic data as the fishers perceived that temperature has been warming in Mbita Sub-County in the last 30 years. This shows that the impact of global warming is already being felt even if at a small scale by people living in the rural areas like Mbita.

4.7 Fishers Perceived Causes of Climate Change/Variability in Mbita

From the FGDs the fishers perceived climate change to be caused by a range of factors which were broadly categorized into three clusters: in agreement with scientific understanding; in contradiction and those who didn't know the cause. Most respondents were in the 1st cluster which included

human activities and destruction of vegetation/trees while category; 2nd cluster of responses believers of super natural forces/God, seasonal changes and change in wind systems. The broader picture shows that these findings were consistent with those from household surveys. The finding was further consistent with causes as outlined in IPCC (2013) and Niang *et al*., (2014).

Characterizing perception by age, the older fishers viewed climate change/variability from the traditional lenses attributing the causes to their ancestors' emotions who were angry due to the current generation ignoring cultural norms and beliefs. They believed that the spirit of ancestors controlled the cosmos and brought in adverse changes in weather overtime leading to changes in climate as punishment to the modern society.

Contributing to observable human activities which brought climate change/variability the respondents explained that cutting of trees (deforestation) to create room for agriculture, settlement, habitation and industrialization were causes of climate change. Other causes cited included the burning of firewood and charcoal as the sole sources of cooking energy; pollution of water bodies in the area as well as sand mining along beaches and inside the lake.

4.8 Fishers sources of information on weather and climate

Responding to sources of climate change/variability information in the interactive FGD sessions the respondents stated they mainly relied on their personal experience and traditional systems to monitor and forecast the local weather and climatic conditions as they believed this was the most precise and accurate means. The change indicators included animals (frog, ant, crow, cowbird, fish); atmospheric and celestial and astrological bodies (the moon, sun, stars rainbow, clouds, and the wind, and lake conditions). Several indicators signal the start or end of a rainy or dry season. For instance as one participant indicated, '*The things around us shows us what will happen for example*

before the beginning of a season or end the sound of frogs in June indicates rain. Hot sun indicates rain, Ants carrying food shows heavy rains and a dark moon will show dry season is coming'

Other than their interpretation of natural phenomena, the fishers also stated that they sourced and received most weather related information from the radio. They mainly tuned into *Ekialo Kiona Suba Youth Radio, Sunset FM, Ramogi FM; and Rusinga FM*, all which informed them of what weather conditions to expect to help guide their fishing activities. Word of mouth came up strongly as channel of information among relatives and friends, besides some said they got information through workshops and public meetings/*baraazas,* convened by the local administration authorities. The finding was consistent with that of Tologbonse *et al* (2010) who found that the most important information source on climate change was through personal experience followed by radio and television. Responding to the distinction between ''climate change'' from ''weather'' patterns or events the respondents were able to share that ''climate change'' was associated with long-term changes while weather patterns were short term observed day to day.

4.9 Relevance and use of climate information to fishers in Mbita

Most of the fishers did not think that the information they received was beneficial to them as it did not explain to them the conditions to look for to know what changes to expect. They felt that the weather information was not tailored for their needs as the broadcasts were in expert language and were not relevant to their fishing activities. Asked what kind of information they would like to receive, the fishermen were interested in short-term forecast of wind direction and movement of water currents. Most fishers interviewed reported that the weather and climate information they received was not relevant to their operational decisions instead they relied on traditional methods and experiential understanding to guide their activities. A few who thought it was relevant reported they used the information to organize and make decisions on when to go fish and when not to

depending on the forecast. One respondent stated; "*The information on weather and climate is not directed to fishers, we only use it as a guide. To make it worse, most times even the predicted weather does not come to pass or happen so we rely on ourselves to understand the changes and plan how to deal with them*."

4.10 Fishers perception of future climate

From the FGDs the response on the projected perception of climate change/variability among the older fishers were pessimistic because they held the view that climate change/variability is a natural phenomenon beyond human control and therefore they have to be accepted as normal for they believed strongly that there is very little people can do about it. The majority of fisher respondents were in consensus that the weather patterns will only continue to worsen and become more and more erratic. The fishers predicted a decrease of forest cover due to increasing human pressure for settlement, agriculture and infrastructure which would ultimately drive deforestation and make the climatic changes even worse. Few fishers were however were optimistic that the trends could be reversed and even restored if the government became more aggressive in enforcing policies of no cutting of trees and ensuring afforestation and re-afforestation programmes.

CHAPTER FIVE: RESULTS FROM OBJECTIVE 2: INFLUENCE OF GENDER ON ACCESS AND CONTROL OF FISHER RESOURCES

5.0 Introduction

This chapter presents findings on objective two (2) of the study which sought to establish the influence of gender on the access and control of fisher resources and assets. The bar graphs below presents the access/control of the fishers resources, which are further illustrated by the descriptive statistics, refer **Appendix: Table 5.2).**

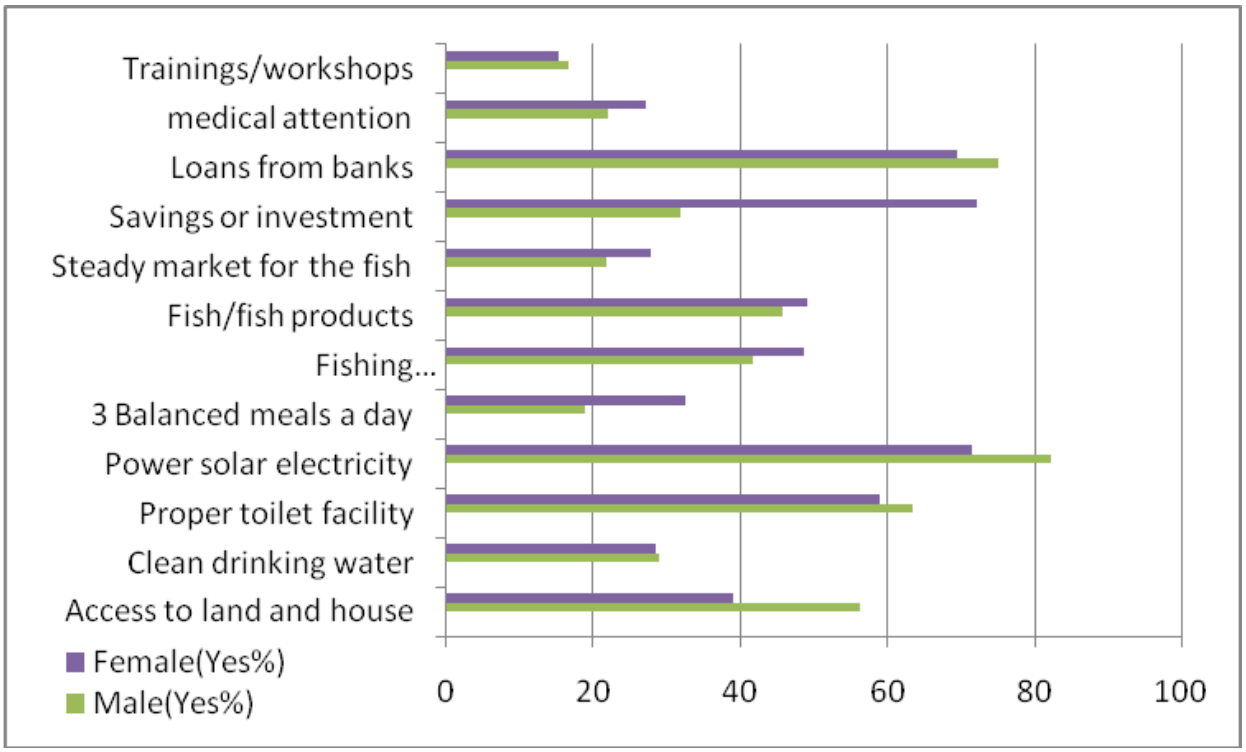

Figure 5.1: Accesses/Control of fisher resources

5.1 Accesses/Control of Fishing Equipment /Storage and Processing Equipment.

The study found that 135 (44%) of the respondents comprising of 42% males and 49% of the females reported they had access/control to fishing, storage and processing equipment. The men mainly owned boats, engines, nets and coolers while the women mainly owned drying nets and frying equipment. On the other hand, about 171 (56%) of the respondents comprising of 58% of the males and 51% of the females had no access to fishing/processing/storage equipment; they hired the

equipment they needed for their work from the people who had them while most of them were employed as casuals also called *jotich or jalwedo* by the boat owners as captains, whose duty it was to ensure equipment needed for the operations were both available and maintained. This finding was consistent with findings of (Muhoozi, 2002) who found that some fishers had resorted to the use of smaller-mesh-sized gillnets nets which were cheaper to purchase.

5.2 Access to Land/Housing

The study found that approximately 155 (51%) of the respondents comprising of 57% of the males and 39% of the females had access to land/house while close to 151 (49%) comprising of 43% males and 61% of the females did not own any land/housing. Of the men who owned land, the majority had pieces measuring less than 0.4 hectares and just 9% of them owned land more than 2.02 hectares. Of the 4% of the woman who reported they owned land, most were widows who had inherited it from their dead spouses. The FGD established that most of the fishers had rented houses in and around the landing beaches as they did not hail from the area but only came to earn a living from fishing activities. Most of the rented houses were semi-permanent with either mud or clay walls but with iron sheet roofing or purely built from iron sheet and termed as *Kaunda suit*. It was observed culture of the area support men having both access and control rights for land and the fishing equipment. The study clearly confirmed that men have express control over the land guarded by culture and women's access was only on behalf of significant others (children).

5.3 Access to Clean Drinking Water and Proper Sanitation

The study established that 88 (29%) of the respondents had access to clean drinking water in proportion of 58 male and 30 females; 218 (71%) of the respondents made up of 71% of the males and 71% of the females did not have access and had to fetch water from the lake for their use. This is a trend that is likely to expose the fishers to the danger of waterborne diseases. On access to

proper sanitation it was found that 190 (62%) of the respondents comprising 63% of the males and 59% of the females had proper sanitation facilities in the form of toilets while 116 (38%) of the respondents comprising of 36% of the males and 41% of the females did not have access, translating into high pollution of lake water.

5.4 Access to Solar Power /Electricity

The study found that close to 241 (79%) respondents comprising of 83% of the male and 71% of the females had access to power /solar/electricity while 65 (21%) of the respondents made of 17% of the male and 28% of the females did not have access to power. Access to electricity in Mbita is limited with a majority of the respondents' relying on solar power mainly solar lanterns which is cheaper and cleaner but still dependent on sunshine. The study established that solar light charging business was thriving in the area with over 3 solar companies running operations in the area.

5.5 Access to Fish and Fish Products

The study found that 74 (24%) of the respondents composed of 24% of the male and 25% of the female fishers had access to fish/fish products when they needed it; while the majority 232 (76%) of the respondents comprising of 76% of the males and 85% of the females did not have access. Those men who had access to the fish/fish products whenever they needed it were mainly the boat owners and captains because of their proximity to the means of production as well as their role in the extraction of fish from the water. The women access to fish was mediated by the male fishers and therefore restricted leading to "*jaboyaism*" an arrangement whereby male boat owners solicit sexual favours in order to give female fisher fish for sale among other strategies to guarantee them access to the fish. Fish harvesting is the prime and most important venture in fisheries the findings from this study imply that fishing (harvesting) is predominantly men's work.

The dominance of men in fishing was argued that it required a lot of time, energy and that it was a risky activity mainly done late at night or early morning. The patrilineal nature of the *Luo* tribe who were the majority of respondents always favored men on access to land and education. This puts men in better earnings and better investment in commercial fisheries. The pervasive male dominance over access to fish and financial resources requires women to be more strategic and innovative in order to gain access to those resources, leading to cases of women engaging in sexual relationships with fishermen in order to guarantee their access to fish.

These findings concur with Kamau and Ngugi (2013) who found that gender is a hierarchical tool in fisheries' operations which designates women to the low paying tasks. It is further corroborates Nwabeza, (2013) who in his Nigeria study reported that women formed the core of the industrial fisheries labour force through their involvement in the post-harvesting and processing with low earnings. These findings imply that access and control over fish resources in Mbita is entirely dependent on the cultural and socio- economic factors of the fishers. The findings reinforce those of (Mojola, 2011), which found that rigid gendered divisions of labour within the fisheries industry designates women's participation in fishing as culturally inappropriate, and therefore constrains women to undertake fish processing and mongering activities.

However, these findings contradict those of Overa (2005) who found that in Ghana the fisheries occupations are also distinctly gendered with men engaging in fishing and women engaging in fish processing, but the women are the providers of the financial inputs necessary for boat ownership and other entrepreneurial investments needed by fishermen and others working in the industry and Mafimisebi, *et al* (2015) who in their comparative study found that women dominated fish based livelihood activities in southwest Nigeria has seen some of the more wealthy and educated women

own motorized fishing boats and shared with the crew in the ratio of 3:1 (owner to crew) thus giving women more control in the fish industry.

5.6 Access to Steady Market

The study established that 73 (24%) of the respondents made up of 22% of the males and 28% of the females had access to a steady market while 233 (76%) made of 78% of the males and 72% of the females did not have access to steady market. This was explained by the fact that men serve a different markets mainly as agents for the Nile Perch, which is either sold to companies for filleting and processing for overseas markets or are gutted and "*mondo*": the gut removed before being sent to markets in Kisumu and Nairobi as market niches, with the women processing the fish that is not accepted by the industrial processors by smoking and deep frying to serve the local markets. Fish processing is a female-dominated activity which is critical for its marketing; women play a vital role in the processing work, particularly at the level of small-scale fish processing of fish that cannot be accepted by industrial processing. The women also processed the *Omena* by cleaning and sun drying. The study findings indicated that cultural beliefs were used to limit women to the post-harvest activities that included fish handling, processing within the value chain. These findings are consistent with Smile (2013) who found that women mainly smoked fish in central region of Ghana as a traditional role while the actual fishing was considered a men's role; the women's roles were post-harvest although, these activities which were less economically competitive.

In marketing, the women are the principal actors, mainly retailing low value/quality fish from the lakes in markets. This explains the fact that women process and vend smaller fish species mainly for local markets which are not steady and dependent on seasonal availability of those species. In fish marketing it was found that men's role as fishermen gave them an edge in leveraging on the

allocation of fish and price negotiation and distribution of the fish which female fish processors and mongers sell.

5.7 Access to Savings and Investment

The study found that 153 (50%) of respondents comprising of 32% of the males and 85% of the females had access to savings or investments while 153 (50%) comprising of 68% of the males and 25% of the females did not have access any saving/investment. FGD responses confirmed that those with access vested on savings and not investment on livestock, households, fishing equipment or transport in bicycles/motorcycles and a few in land .The majority of women had savings in their "*chamas"*.

5.8 Access to Credit/Loans from Banks or Electronic Money

The study found that about 254 (74%) of the respondents, comprising of 75% of the males and 72% of the females had access to credit facilities on the other hand 81 (26%) of the respondents made of 25% of the males and 28% of the females did not have access to credit. In the FGDs this inaccessibility to proper loans/financial resources was reported to be the main economic stressor that limited the fishers' ability to purchase new boats, motorize their boats, or even enable them to diversify their livelihoods. This gap seems to support the emergence of alternative financing in form micro fiancé institutions in the area offering unsecured loans for the lower segments of unbanked fisher population in Mbita. The finding was consistent with Mwaijande and Lugendo (2013) in their study of Tanzanian artisan fisher that found about 49% of their target was constrained in access to credit or loans and adapted into getting soft loans from their own merry go rounds. In support, Jacobi and Colombi (2013) observed that most financial institutions are cautious in extending credit to fishermen due to lack of collateral by artisanal fishermen in Lake Victoria region.

5.9 Access to Three (3) Balanced Meals a Day

The study established that approximately 72 (24%) of the respondents mainly boats and gears owners comprising of 19% of the males and 32% females had access to 3 meals a day although not all were balanced; while a majority 234 (77%) constituting of 81% of the males and 68% of the females had less than three (3) meals a day. From all the FGDs, the respondents attributed the inconsistency in the meals to hard economic times and the urge to adjust for survival. Respondents expressed that they often missed meals when they failed to catch fish because that was their main livelihood; those who did subsistence farming said that poor yield from the farms worsened the situation of missing meals.

5.10 Access to Roads and Communication

The study found 264 (86%) of the respondents comprising of 87% of the males and 84% of the females had access to television/radio/cell phone for communication and access to passable roads; while about 14% of the respondents comprising of 12% of the males and 16% of the females said that they had no access to either communication or passable roads. This was understandable because most parts of Lake Victoria shoreline is characterized by a poor road network, causing increased postharvest fish losses due to autolysis. Fish is highly perishable and with inadequate preservation gear and storage facilities, respondents reported losses which they incur due to handling the catches. A study by Yongo *et al.* (2005) had also found that proper boats and landing sites in remote areas reduced margins for fishers in post-harvest losses.

5.11 Access to Medical Attention

In response to access to medical attention whenever needed only 22% of the respondents made of 21% males and 27% females said they had access to medical attention while the majority 78% of the respondents made up of 76% of the male and 83% of the females did not. This in part explains

why fishers around Lake Victoria are vulnerable to waterborne diseases and other health related issues. The respondents acknowledged that malaria, typhoid, amoebae and cholera were among the priority diseases which they suffered from. The study established that the fishers and their families sought medical care reachable clinics, dispensaries but cases that were serious were referred to the district and county hospitals which were long distances away.

5.12 Access to Regular Weather Information

Only 24% of the respondents made up of 23% of the males and 25% of the females had access to regular weather change information among whom were beach leaders and boat owners, while the majority 77% comprising of 77% of the male and 75% of the females only watched the changing climatic trends as mapped on increase/decrease of fish catches. This is a handicap that should be addressed to enhance women's adaptive capacity for information is a source of awareness.

5.13 Access to Extension/ Trainings/Workshops

Only 16% of the respondents comprising 16% of the males and 15% of the females shared that they had access to extension/training and workshops. This implies that the fishers' livelihood activities were so labour intensive that they hardly had time to attend trainings and workshops. The majority 84% of the respondents comprising of 84% of the males and 85% of the females spent bulk of their time in livelihood fishing activities. While the fishery officers are supposed to offer extension services and also enforce fishing the laws, their number was too low to cover all the beaches. The study concluded that in order to fully enhance women's roles in fishery resource management, it is necessary to develop the capacity of women in different links of the value chain and to find ways to overcome and challenge institutional and socio-cultural barriers.

Table 5.1 Statistical significance to essential resources by different gender groups in Mbita Sub-County

Access and control	Male (Yes %)	Female (Yes %)	p-value
Access to land and house	56.4	39.1	0.004***
Clean drinking water	29.0	28.6	0.957
Proper toilet facility	63.0	59.1	0.453
Power solar electricity	82.0	71.0	0.030***
3 Balanced meals a day	18.9	32.6	0.004***
Fishing processing/storage equipment	41.7	48.6	0.214
Fish/fish products	45.8	49.2	0.988
Steady market for the fish	21.7	27.7	0.219
Savings or investment	31.9	72.3	0.058
Loans from banks	75.1	69.6	0.953
Medical attention	21.9	27.2	0.103
Trainings/workshop	16.5	15.2	0.000***

***** Significant at 5% level**

With reference to Table 5.1 above provides the statistical correlation of the gendered access and control of fisher resources is explained. It was found that 56% of the male respondents and 39% of the females had access and control to land and house making it statistically significant with a p-value of 0.004. Access to electricity/power was statistically significant with a p-value of 0.03 with 82% of the male and 71% of the females reporting access. Access to 3 balanced meals a day among the fishers was statistically significant with a p-value of 0.004 as only 18.9% of the male fishers compared to 32.6% of their female counterparts reported access. Access to trainings/workshops was also statistically significant with a p-value of 0.000 as only 16.5% of the male respondents compared to 15.2% of their female counterparts claimed they had access.

CHAPTER SIX: RESULTS FROM OBJECTIVE 3: EFFECTS OF CLIMATE CHANGE / VARIABILITY ON THE FISHING ACTIVITIES AND LIVELIHOODS OF MBITA FISHERS

6.0 Introduction

This chapter presents findings on objective three (3) which sought to determine the effects of climate change and variability on the fishing and livelihood activities of the fishers in Mbita Sub-County. The bar graphs below presents the effects of climate change/variability on the fishing activities/livelihoods, which are further illustrated by the descriptive statistics, refer (**Appendix: Table 6.2)**

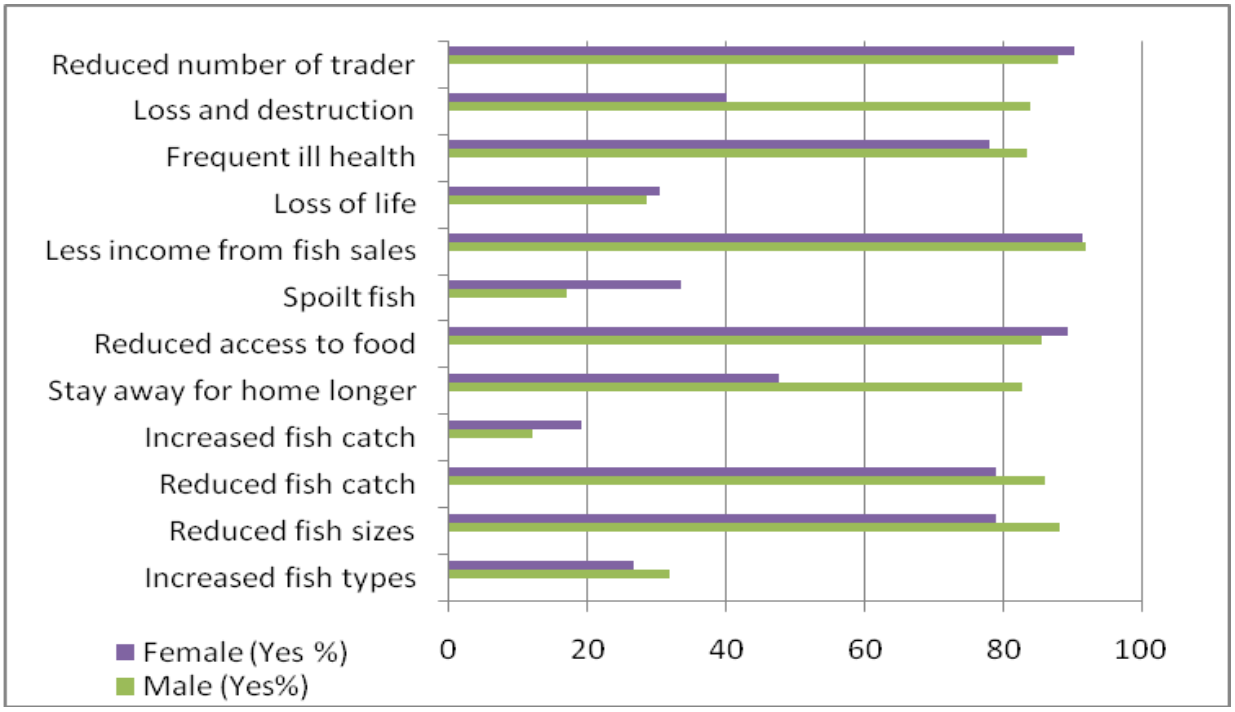

Figure 6.1: Effects of climate change/variability on the fishing activities/livelihoods

6.1 Increased Fish Types

About 214 (70%) of the respondents comprising of 68% of the males and 73% females fishers reported that there was no increase in fish types; 92 (30%) of the respondents comprising of 32% of the male and 26% of the female fishers however reported an increase in fish types especially the

wet seasons. The latter group reporting was consistent with Lake Victoria Frame Survey (2016) that reported an increase of small pelagics specifically *Omena* and Haplochromines locally known as *Fulu* the once dominant fish species in Lake Victoria with the increased rains.

6.2 Reduced Fish Sizes

The majority 260 (85%) of the respondents affirmed a reduction in fish sizes over time; these comprised of 88% of the male and 79% of the females. On the contrary 46 (15%) of the respondents comprised of 11% of the male and 21% of the females did not think there was any reduction in fish sizes. The observations of the 1st group is consistent with Kolding *et al,* (2019) that reported that climate variability caused reduction in fish sizes in all the major African Lakes and reservoirs, while Raburu *et al,* (2012) in their study found that recession of Lake Victoria water levels caused a decrease in fish catches.

6.3 Reduced Fish Volumes

A majority 264 (86%) of the respondents composed of 86% of the males and 86% females reported a reduction in fish catch resulting from climate variability. The reasons given were that more people were entering the fishing area resulting into final reduction each fisher could net in. The decreasing volumes of catches of the larger fish species like Tilapia and Nile Perch is comparable with the trends shown on the graph in Figure 6.1 ,while 42 (14%) of the respondents composed of 14% of the males and 13% of the females did not see any climate variability related in volume of fish catches. The finding is consistent with Odongkara *et al,* (2005) who found that because of accelerated fishing effort the catches were consistently showing a decline due to high fishing pressure leading to over-fishing.

6.4 Increased Fish Volumes

Only 14% of the respondents consisting of 11% of the males and 19% of the females confirmed that fish catches increased particularly the *Omena* and *Fulu* seasonally contrary to what 263 (86%) of the respondents 89% of the males and 81% of the females who claimed minimal increases, probably they were too engrossed in the daily fishing activity to bother associating the volume of catches with climate variability provided they were able to get what they needed. Figure 6.1 below constructed from raw data from raw data from Mbita Fisheries Office below was handy in authenticating what fishers reported with what was actually happening on the ground.

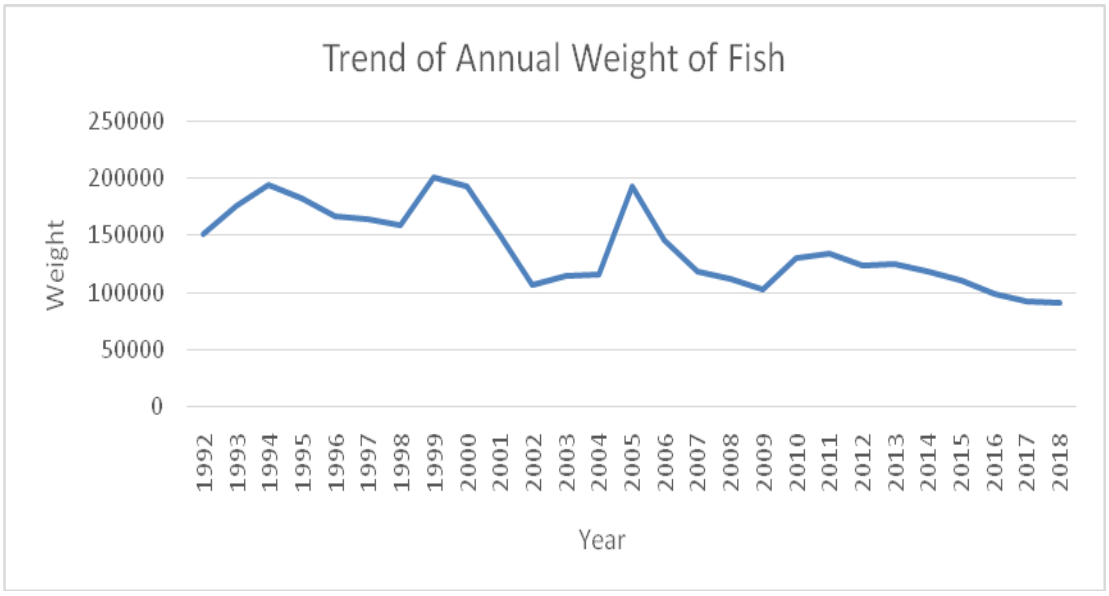

Figure 6.2: Fish Catch Volumes between 1992-2018

Source: Raw data from Mbita Fisheries Office 2019

According to the Lake Victoria Frame survey (2016) the total annual fish catches deduced from the average monthly total catches indicated that Nile Perch and Tilapia total catch estimates had decreased by 34%, from 251,063 to 165,084 tonnes and by 65% from 59,681 to 20,371 tonnes in 2014 and to 165,083 tonnes in 2015 respectively. *Omena* catch estimates increased by 11% from 509,598 tonnes in 2014 to 566,570 in 2015. Haplochromines catch estimates increased by 20%

from 73,556 to 88,794 tonnes in 2014 and 2015 respectively. The total lake wide catch had declined by 4.7% from 919,310 to 876,547 tonnes between the last two surveys.

6.5 Spent More Time Away From Home for Fishing/Marketing

The majority, 215 (70%) of the respondents comprising of 84% of the males and 43% of the females of the respondents reported that they stayed away from their homes longer to get the catch or for marketing. The fishermen associated this with overfishing and seasonal climate changes. On the other hand, 91 (30%) of the respondents made up of 18% of the males and 52% of the females were among the people who supplemented their fishing activities other livelihood activities like subsistence farming and other smaller trades.

6.6 Reduced Access to Food due to Lose of Revenue

The majority 265 (87%) of the respondents made up of 85% of the males and 90% of the females expressed that their access to food was reduced resulting from the fluctuating fish catch volumes and associated revenue. These represented the category of fishers who were wholly dependent on fishing livelihood and whose food security stability rested squarely on fish related incomes; 40 (13%) of the respondents comprising of 15% of the males and 10% of the females who did associate their reduction in fish revenue with their reduced access to food. The female headed fishers reported that in their households they were eating fewer meals and reducing the amount of food eaten per day as a close gap measure during the time their revenues from fish reduced in order to guarantee their survival.

6.7 Lack of Road Access and Storage Facilities.

23% of the respondents comprising 17% of the male and 23% of the females stated that road access and bad roads particularly during the rainy seasons delayed fish transportation to market causing fish to decompose, as fish and fish products are highly perishable commodities requiring the

shortest time between the landing and marketing, while 78% of the respondents comprising of 83% of the males and 67% of the females who mainly sold their small catches locally did not say anything about road challenges and fish spoilages however they agreed that when the roads were unreachable they sold their fish cheaply to traders who had refrigerated containers. This finding was consistent with Yongo *et al,* (2005) who reported that much of the Lake Victoria area is characterized by a poor road network, which greatly increases postharvest losses. The study observed that the fishers lacked refrigerated facilities that would facilitate fish storage to support competitive market prices so the fish was often sold cheaply to avoid spoilage. Thus 92% of the respondents comprising 92% of the males and 91% of the females said that they earned less income from fish catch/sales while 9% of the respondents did not.

6.8 Weather Related Loss of Lives

The majority 216 (71%) of the respondents comprising of 71% of the males and 70% of the females had lost relatives and friends from fishing accidents during stormy weather which often caused boats to capsize and drown often times the entire crew and catches they were carrying. This finding supports Westlund *et al,* (2007) who found that fishing had become an even more dangerous activity, given the more violent storms and winds affecting the fishers' safety, in particular with an increase in the risk of losing their lives and their means of fishing.

6.9 Health Issues in Relation to Dry and Wet Seasons

The majority 250 (82%) of respondents comprising of 84% of the male and 78% of the females, reported frequent sicknesses like malaria corresponding with mosquito increase in wet climatic scenarios and typhoid associated with unsafe drinking water at the beaches. In the focus group discussions the respondents decried the hazard the fishers faced were vast ranging from infections from water borne diseases coupled with the lack of hospitals that are away from the beaches and

villages. The finding supports earlier Abila (2000) who found that water borne ailments and HIV/AIDS related diseases were prevalent in the fishing communities and this was worsened since health facilities/hospitals were located far away from them.

6.10 Destruction of Fishing Boats and Equipment in Extreme Weather.

About 95 (31%) of the respondents composed of 16% of the males and 60% of the females, reported no loss/destruction to fishing gear/property. This could be attributed to the fact that they were crew members or fish traders. However 69% of the respondents comprising 79% of the males and 40% of the females reported they had lost or experienced destruction of fishing gear and boat. The plate shown below was taken of fishers who were carrying their boat to safer place ground during strong storms and waves to avoid the same as shown in Plate 6.1 below

Plate 6.1 Fishermen Carrying Boat to Higher Ground for Safety

Daw, *et al* (2009) had similar findings in their study ,which showed that climate variability had direct impacts on fisher livelihood including frequent ill health, damaged infrastructure, damaged gears, increased danger at the lake, loss/gain of navigation routes and flooding of fishing communities. Similarly Trotman (2002) found that extreme weather like tropical cyclones were damaging to the fisheries industries as they caused destruction on the fishing gear, fishing vessels and coral reefs which is a major setback to the fishing community due to reduced fish catch and by extension the general population.

6.11 Reduced Number of Fishers/Traders.

In terms of reduction in the number of fishers and traders, about 32 (11%) of the respondents comprised of 12% of the males and 8% of the females respondents reported they had noticed a decrease in fishers/traders mainly due to ill health, migration or diversification of livelihood activities. A majority however of 272 (89%) of the respondent comprising of 88% of the males and 92% of the females stated that the numbers had infact grown even larger because while some people migrated, others moved in to replace them. A key informant from the Department of Fisheries in Mbita observed that from 10 years of his experience he had observed that there were too many boats/fishermen on the lake over the last 10 years with marked increases yearly. This is consistent with Kinadjian (2012) whose findings in Lake Kariba study showed that since there were no real access controls to Lake Kariba fishery, the number of fishers have more than trebled in less than 10 years leading to overfishing and environmental degradation in the area. According to the fishers, the increase in fishing pressure due is catalyzed with high levels of unemployment of youths. Earlier study of reef fisheries by Mangi, *et al*, (2007) that found that Kenya unemployment situation is one of the socio-economic drivers of poverty and that the low agricultural productivity due to dry climate change is pushing people into fishing for a livelihood.

6.12 Effect on Overall Livelihoods

The majority 281 (92%) of respondents made of 93% of the males and 90% of the females responded that CC affected their livelihoods negatively as it interfered with health and means of earning. The majority of respondents explained that frequent fluctuations and reduction in fish sizes and catch were most likely to be caused by the changes in the climatic conditions of the Mbita area. SEDAWOG (2000) had similar findings and reported that climate variability interfered with fish supply as well as fishers as it posed a major problem to the local processors.

From the FGDs the respondents made it clear that the amount of rainfall positively influences the number of fishers as in high rainfall season many people went fishing due to increased fish in the Lake while during low rainfall or drought few people went fishing due to low yield of fish volumes and variety. The respondents explained high rainfall went hand in hand with high risk of life and higher fish yields. Adaptive measures for risk weather included staying away or venture into the waters for a short while only due to fear of injuries or loss of vessels during high rainfall but recorded low fish catches.

Similar findings were reported in O'Reilly *et al.,* (2003) who studied fish production in Lake Tanganyika. All the male respondents from the four beaches expressed they undergo psychological stress during extreme weather conditions. These psychological impacts were further compounded by lack of ownership of fishing equipment/high cost of replacing them or ill health which hindered the men's ability to support and provide for the family in times of need. These findings were consistent with (Badjeck *et al.* 2009; Crandall, 2009) that found that climate variability had direct impact on the fisher folks; strong winds led fishes losing their lives or having their boats submerged.

6.13 Other Insecurities Fishers Experienced due to Climate variability

During the interactive FGDs the male fishers mentioned that hippopotamus and crocodiles attacks were getting more regular, often damaging their boats/nets and causing loss of human life. This reporting was consistent with McGregor (2005) who reported that crocodiles and hippos are sources of harassment and economic problems for artisanal fishers as they damage nets, particularly in the summer months.

Table-6.1 Statistical correlation of effects of climate variability and change on the fishing activities and livelihoods in Mbita Sub-County

Fishing activities livelihood	Male(Yes)	Female (Yes %)	p-value
Increase in fish types	31.9	26.7	0.099
Reduction in fish sizes	88.1	79.1	0.001***
Reduction in fish catch	86.1	79.1	0.000***
Increase in fish catch	12.0	19.1	0.148
Stay away for home longer	82.9	47.7	0.004***
Reduction in access to food	85.6	89.5	0.06
Spoilt fish	17.0	33.4	0.444
Less income from fish sales	92.0	91.4	0.239
Loss of life	28.6	30.5	0.001***
Frequent ill health	83.5	78.0	0.165
Loss and destruction	84.0	40.0	0.000***
Reduction in a number of trader	88.0	90.4	0.076
No effect	6.9	10.5	0.276

***** Significant at 5% level**

Table 6.1 above provides the statistical correlation of effects of climate change on the fishing activities and livelihoods is explained. From the table it can be noted that the climate variability had a statistically significant effect on reduced fish sizes with a p-value of 0.001 which affected incomes with 86.1% of the male respondents and 79.1% of female respondents affirming this.

Reduction in fish catches which directly affected their overall earning thus reduced fish catch was also statistically significant with a p-value of 0.000.Staying out longer for fishing/marketing was also statistically significant with a p-value of 0.004, with 82.9% of the male respondents and 47.7% of their female counterparts reporting it. On whether the climate variability /change led to loss of life of the fishers, 28.6% of the male respondents and 30.5% of the female respondents concurred with making it statistically significant with a p-value of 0.001. Loss and destruction of life/property among the fishers was statistically significant with a p-value of 0.000as 84% of the male respondents and 40% of their female reported they were affected. However as much as the climate change had some effects on; increased fish types, increased fish catch, reduced access to food, spoilt fish, less income from fish sales, frequent ill health, reduced number of traders, and if it had no effects on the fishers; the effects were considered statistically insignificant (with *p-value >0.05*) although they still formed confluences of negative effects of climate variability on fishers in Mbita.

CHAPTER SEVEN: RESULTS FROM OBJECTIVE 4: ADAPTATION/CONSTRAINTS AND OPPORTUNITIES BROUGHT BY CLIMATE VARIABILITY AND CHANGE IN MBITA SUB COUNTY.

7.0 Introduction

This chapter presents findings to objective 4 which sought to establish the adaptation/constraints and opportunities brought by climate variability to the fisher community in Mbita .The bar graphs below presents the adaptation options of the fishers, which are further illustrated by the descriptive statistics, refer (**Appendix: Table 7.3)**.

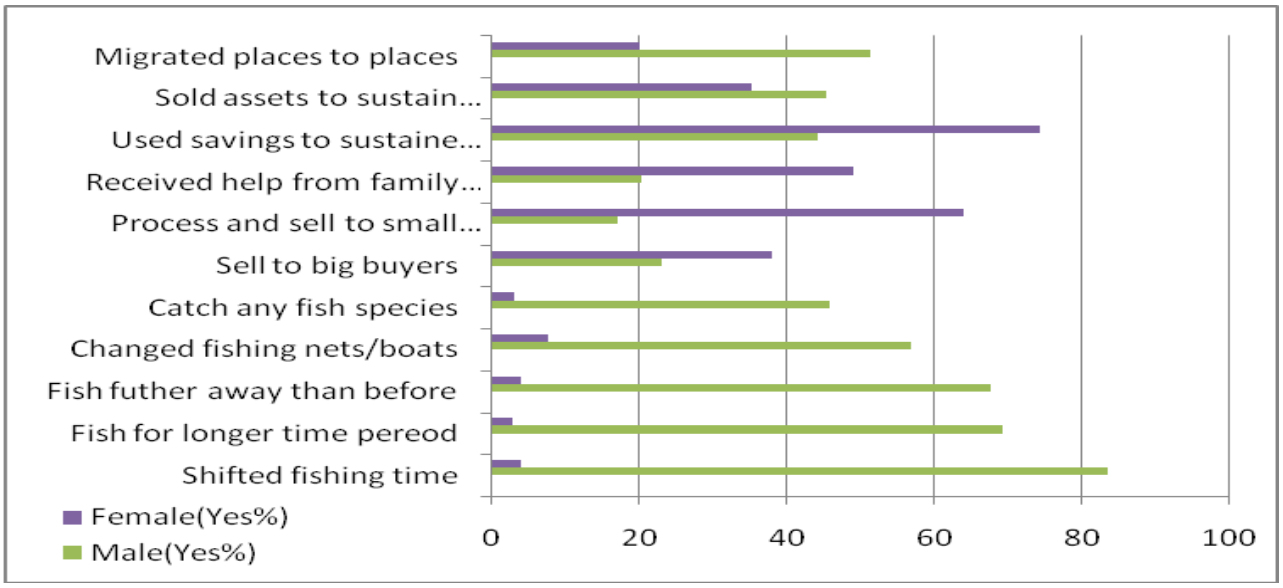

Figure 7.1: Adaptation options of the fishers to climate change/variability.

7.1 Adaptive Activities used by Fishers in Mbita Sub County

Since fishers are individuals of varying means, no common strategies for their coping were stated. Detailed below are some of the adaptive strategies employed by the fishers in Mbita Sub-County.

7.1.1 Changes in Fishing Timing, Distances Travelled and Migratory Fishing

The fishers stated that they carried out a wide range of adaptive activities and processes in order to cope with dwindling fish catches resulting from climate variability. Changing fishing time was cited

by 172 (56%) of the respondents comprising of 84% of the males and 4% of the females, while 134 (44%) of the respondents comprising of 17% of the males and 96% females did not make any adjustments their fishing routines. Responding to fishing for longer time as an adaptive activity 142 (47%) of the respondents comprising of 69% of the males and 3% of the females confirmed that they fished for longer to catch get some fish compared to a long time when there was plenty and fishing times thus shorter. 164 (53%) of the respondents comprising of 30% of the males and 97% of the females however reported they had not adjust their fishing time. This is because fishing is purely a male activity and the few females who reported using changing fishing timing and distances as an adaptive strategy were boat owners who were reporting on behalf of their crews.

Responding to going further into the lake as adaptive activity 140 (46%) of the respondents comprising of 68% of the males and 4% of the females explained that they went further into the lake to fish as the catches reduced as an adaptive activity, while 166 (54%) of the respondents comprising of 32% of the males and 96% of the females did not. The fishers fished further into the lake waters to better their chances of getting better fish catches that those who did not. This finding was implicit of the limited number of fishers who had strong enough boats to go out into the open waters for fishing. This finding was consistent with a study in Galicia in Spain by Allison and Ellis (2001) that found that in coastal artisanal fisheries, the fishermen used diverse pattern of fishing activities with respect to the species exploited, location of fishing grounds and gear used to deals with fluctuating environmental conditions.

Responding to migratory fishing from beach to beach in search of more fish 124 (41%) of respondents comprising of 51% of the males and 20% of the females reported they migrated from beach to beach following where fish was reportedly in abundance while 60% of the respondents comprising of 49% of males and 80% of the females stayed in their local beaches. This was

consistent with (Alston, 2013 and Muallileral, 2011) who observed that migratory fishing would provide time for fish stocks to rejuvenate hence migratory fishing was found to be a good coping strategy. From the FGD the study learned that in the past, both old and young men were the ones involved in migratory labour practices as a response to impacts of climate variations.

7.1.2 Change of Fishing Equipment /Gear

The changing of fishing nets and boats was an adaptive activity to which only 122 (40%) of the respondents made up of 57% of the males and 8% of the females had taken up. They said that they had acquired multiple gear, mainly boats, fishing nets, hooks and lines to enable them catch all kinds of fish; while the changing of boats was necessitated to cope particularly with the strong winds. In the FGD sessions the study learned that some of the fishers had come together to build bigger boats and acquired engines to power their boats and with some type of refrigeration to reduce postharvest losses due to fish spoilage hence it was an effective adaptive strategy despite its cost implications.

7.1.3 Selective Sales and Pre- Sale Processing

The respondents reported on selective sales as another adaptive activity to which 58 (28%) of the respondents comprising of 23% of the males and 38% of the females ascribed to. They said that they sold their fish mainly to big buyers which guaranteed them reliable market sustainably; while 220 (72%) of the respondents comprising of 77% of the males and 62% of the females did not have a specified customer target implying they had no specific clientele in mind so they sold to whoever came their way.

Processing of fish was found to another adaptive activity fishers practiced to add value to their products. It was found that 101 (33%) of the respondents comprising of 17% of the males and 64% of the females processed the fish and sold to small buyers; more women than men processed fish

before selling it, while 205 (67%) of the respondents comprising of 83% of the males and 35% of the females reported not processing the fish .Since fish processing is traditionally a female role we thus see a high percentage of men reported not processing fish as an adaptive strategy.

7.2 Other Adaptive Strategies.

The study found that there were other adaptive activities which fishers used in adverse climatic situations resulting in extreme fish reduction. Asked how else they adapted to climate adversities on fish production 167 (55%) respondents comprising of 44% of the males and 74% of the females explained that they sustained their households by using up their savings made during favourable times when fish catches are more abundant , while 139 (45%) of the respondents comprising of 56% of the males and 26% of the females reported that since they had no savings so they survived by turning to alternative sources which included asking for help from family members/relatives. A total of 165 (54%) of the respondents comprising of 63% of males and 36% of the females reported they relied on receiving assistance from their relatives and well wishers, while 141 (46%) of the respondents comprising of 37% of the males 64% of the females reported receiving no help from any of the relatives and resorted to any job available as casual laborers in any house/home chores.

Faced with extreme cases 104 (34%) of respondents comprising of 38% of the males and 25% of the females shared that they had sold their assets to sustain their livelihood in hard times, while 202 (66%) of the respondents comprising of 62% of the males and 75% of the females had found other ways and means to survive without selling their property.

From the interactive FGD sessions across the 4 beaches, the study learned that the fishers disposed of their belongings ranging from bicycles, house hold utensils like gas cylinders to poultry and small livestock to raise money for sustenance. During crop planting time the female fishers reported they would often worked for other people with farms in exchange for food items mainly maize and

beans. Others took credit from the many lenders not knowing how and when they would pay back and a fair number had turned to small scale businesses such as selling second hand clothes, sand harvesting, selling firewood and charcoal, a good number had diversified into running beer halls and hotels, selling vegetables and running stores for where it is collected until the buyers fetch them. Men on the other hand reported that they mainly sold livestock (particularly small livestock such as goats, sheep and poultry) during times of food shortage.

The findings were consistent with that of Eakin (2005) who that found that farmers in Mexico coped with food shortages by selling small livestock in order to acquire sufficient funds to purchase maize. The findings further support those of Mertz *et al*. (2010) who reported that keeping livestock, particularly small-scale livestock is a common coping strategy employed by the farmers and fishers as they can be disposed off quickly to solve short-term urgent problems.

The study also found a unique adaptive strategy in the fish trade of female fishers exchanging sex for fish with male fishermen to guarantee their access to fish supplies. This finding concurs with past studies by Béné and Merten (2008) which reported that in African fisheries economy sexual exchange for fish commodity is a common practice. It is also consistent with the findings of Mojola, (2011) that found that due to increasingly intense competition within the processing and retail segments of the fishing industry, as well as due to a declining fish population there was an increased incidences of fishermen and women mainly to engage in sexual exchange for the fish.

From FGDs the study found that most of the fishers had adopted multiple occupations/alternative livelihoods to deal with reduced fish catches and subsequent lower incomes. These included farming/livestock and poultry rearing, small businesses like running bars/hotels/selling second hand clothes, betting/selling harvesting sand, firewood and seeking formal employment in hotels.

Plates 7.1 - 7.4 show some micro-enterprises activities the fishers engage in as coping/adaptive measures.

Plate 7.1 Second hand cloth vending for alternative/supplementary livelihoods

Plate 7.2 Boda boda riding for adaptive/alternative livelihoods

Plate 7.3 Sand Harvesting for adaptive/alternative

Plate 7.4 Firewood for fish processing as an adaptive livelihoods.

The study found that majority of the coping/adaptation strategies used by the fishers were responsive as they are not coordinated by any other stakeholders other than the fishers themselves. Some of the strategies used by Mbita fishers could be considered maladaptation as some of them triggered environmental degradation through mining of sand both in the lake and around the lake, destruction of forest to provide firewood for processing the fish, using unauthorized fishing net to catch underweight fish among others. Shifting fishing sites, distances and frequency and the use of modern using boats were found to be climate smart options of adaptive fishing but had some cost implications and needed credit to allow also diversification. This finding supports the earlier

findings by Chali *et al*. (2014) whose study focused on Lake Kariba which reported that the lowered frequency of fishing and going further distances in the new fishing boats in Siavonga District were all climate smart adaptive options since there was less release of greenhouse gases from use of fossil fuels into the atmosphere.

The fishers suggested need for the renewal of the fishing policies that would close lake fishing for at least three months to allow fish breeding and growth. They suggested the encouragement of alternative economic activities like farming, but this could only work for fishers who owned land. Moreover the fishers decried inadequate institutional support and inappropriate policies and inaccessibility to natural resources by majority of the fishers.

Table 7.1 below presents the statistical correlation of the fishers' coping/adaptation strategies which were mainly gendered with the roles stereotyped on cultural approval of the local community.

Table 7.1 Determination of Statistical Significance of The Fishers Coping/ Adaptation Strategies in Mbita Sub-County.

Adaptation strategy	Male (Yes %)	Female (Yes %)	p-value
Shifted fishing time	83.5	3.8	0.000***
Fish for longer time period	69.2	2.8	0.000***
Fish further away than before	67.7	3.8	0.000***
Changed fishing nets/boats	56.7	7.6	0.000***
Catch any fish species	45.8	2.9	0.000***
Sell to big buyers	22.9	38.0	0.676
Process and sell to small buyers	17.0	63.8	0.000***
Received help from family members	20.1	48.9	0.000***
Used savings to sustain household	44.2	74.3	0.074
Sold assets to sustain livelihood	45.3	35.2	0.000***
Migrated places to places	51.2	20.0	0.001***

***** Significant at 5% level**

As detailed in the Table 7.1 above provides the statistical correlation of coping/adaptation strategies used. It was found that shifting of fishing time was practiced by 83.5% of male respondents and only 3.8% female respondents with a statistical significance of p-value of 0.000; confirming that only the males did the actual fishing. Fishing for a longer time as a coping/adaptation to climate variability strategy was adapted by 69.2% male respondents while only 2.8% female counterparts were into longer time fishing adaptation with a statistical significance of p-value of 0.000. On fishing further away than before was practiced by 67.7% of the male respondents while only 3.8% of their female counterparts who were boat owners practiced it giving a statistical significance of p-value of 0.000. On changing their fishing nets/boats; 56.7% male respondents practiced with only 7.6% of their female had making it statistically significant with a p-value of 0.000.When asked if they had resorted into catching any fish species as a coping and adaptation strategy; 45.8% of the male fishers respondents agreed with this while only 2.9% of their female counterparts agreed with this, this was statistically significant with a p-value of 0.000.

Processing and selling to small buyers as a coping and adaptation strategy was practiced by 63.8% of the female respondents while only 17% males practiced this with a statistical significance of p-value of 0.000. Receiving support from family members as a coping/adaptation strategy was reported by 20.12% of the male respondents 48.98% of their female counterparts with a statistical significance of p-value of 0.000; asset sale as an adaptation strategy practiced by 45.3% male respondents while 35.2% of female headed households said in extreme situations was statistically significant with a p-value of 0.000 and migratory fishing was used by 51.2% of the male respondents and 20% female respondents with a statistical significance of p-value of 0.001. Selling of big fish to big buyers and using of savings to sustain households by the fishers as ways of coping and adaptation strategies were not statistically significant at p-values > 0.05.

7.3 Adaptation Constraints.

In their bid to adapt to the variable climatic conditions, the fishers detailed the following constraints as classified below and as detailed in (**Appendix: Table 7.4)**

7.3.1 Limited Knowledge/Information on Climate Change Adaptation

Limited access to information on climate change and climate variability was cited by 250 (82%) of the respondents comprising of 83% of the males and 79% of the females, while 56 (18%) of the respondents comprising of 17% of the males and 21% of the females did not think that information on climate variability was a constraint to their fishing activities. From the FGD sessions and key informant interviews with the BMU officials, the study found that the fishers relied mainly on knowledge accumulated by the BMU officials, who informed the fisher community on pragmatic information on fishing and other relevant matters. As local institutions the Beach Management Units observed overtime that fishers do not depend on the flow of information from the climate managers but relied more on their traditional weather institutions. The lack of both access to information and knowledge and lack of public awareness about current climate vulnerability were cited as the main constraints to adaptation. The synthesis of this was anchored on lack of/ inadequate education of local leadership, financial limitation/ inability to set time aside to carry out all projected programmes due to absence of structured institutional arrangements. 256 (83%) of the respondents comprised of 86% of the males and 80% of the females expressed that the language used by meteorological department to forecast climatic changes was too technical for their understanding, while 50 (17%) of the respondents comprising of 15% of the males and 20% of the females raised no complaint about language; the latter group comprised of people who had above secondary level of education. This drives the observation that most of the fishers, for whatever reason are not highly educated.

7.3.2 Limited Credit and Technology for Adaptation

The study found that 248 (81%) of the respondents constituting 84% of the males and 79% of the females cited limited credit facilities as a constraint, while 19% of the respondents made up of 16% of the males and 21% of the females did not consider it a constraint. This implies that the majority of the fishers' financial access posed a major constraint to their adaptation. This was consistent with reporting in World Bank (2006) that implementation of adaptation measures faces globally financial barriers while in a related study, Adger *et al.*, (2009) found that although some adaptations may be technologically possible, they are constrained by economic and cultural barriers.

7.3.3 Lack of Structured Institutional Framework and Complexity of Adaptation

Further the study found that there was limited knowledge on adaptation because there was no structured platform for sharing of climate change information and even the indigenous knowledge which was already with the community and the beach leaders. The study found that 230 (75%) of the respondents comprising of 77% of the males and 72% of the females reported they had limited knowledge on adaptation. The finding were consistent with the work of Umunakwe (2011) who found poor extension services, limited access to improved crop varieties and high cost, lack of government policy on adaptation, prevent fishers from effectively adapting to the changing climate scenarios.

The study further found that respondents associated complexity of climate change adaptation with lack of established institutional frameworks to support information sharing for instance modern weather prediction requires access to and ability to own technological appliances. High cost of technology was cited by the majority, 263 (85%) of the respondents distributed into 88% of the males and 83% of the females, while 43 (15%) of the respondents comprising of 13% males

and17% of the females were able to access and own the technological appliances necessary for receiving meteorological information through media as reported in the FGDs.

Technological challenges were not limited to information sharing only but were inclusive of ability to purchase storage equipment for keeping fish wholesome for longer period to support selling at competitive prices. This finding was consistent with SEDAWOG, (1999) and Ngigi (2009) whose studies concluded that lack good storage equipment and poor transport facilities forced fishers to sell their fish at low prices thus end up with low profits. AU-IBAR (2016) had also reported that low compliance to fisheries laws and regulations and inadequate enforcement was a major challenge in the management of the fisheries by resource users.

This complexity was worsened by the reports from 174 (57%) of the respondents comprising of 68% of the males and 34% of the females cited lack/limited fishery extension service as a challenge to compliance with responsible fishing. Still connected to complexity of adaptation inadequate enforcement of policies and laws was reported by 191 (62%) of the respondents comprising of 87% of the males and 15% of the females.

7.3.4 Infrastructure and Marketing of Fish

The study found that operations of most of the fishers were concentrated around the beaches where some of them had temporary structures. The study found that 80 (26%) of the respondents composed of 27% of the males and 25% of the females reported on limited market for fish products as a constraint, while 226 (74%) of the respondents comprising of 73% of the males and 75% of the females operated at too low a level to note the instability in reaching customers. Linked to marketing of fish, lack of infrastructure in fishery operations was reported by 134 (45%) of the respondents comprising of 39% of the males and 53% of the females as a constraint to marketing of

fish, while 172 (56%) of the respondents comprising of 61% of the males and 47% of the females who dealt in small species sold at beach site did not think infrastructure was a problem.

From FGD sessions the study found that reliable market availability was serious problem is in some beaches especially where there were no agents or factory representatives to buy the fish from them. The result of this is that the fish is either given away to villagers at very low prices or given free to relatives in order to avoid spoilage. The roads leading the beaches were all either earth or *murram* making them impassable during the rainy season. This made the fish landed at such beaches to sell at very low prices. This finding was consistent with Abila (2000) who found that poor infrastructure and lack cold storage facilities contributed to post harvest losses in fish spoilage and low sale prices and continuation of living in poverty. Due to lack of cold storage driving low bargaining on the products, the fishers are vulnerable to buyers and owners of fishing gear.

7.4 Other Constraints to Adaptation

The study also confirmed from the interactive FGDs that cultural customs and beliefs which are not documented but were very closely adhered to by the fishers of Mbita made the females more vulnerable than the males to the extremes of climate change and climate variability. It was found that 118 (39%) of respondents distributed into 19% of the males and 75% of the females cited customs as a complexity in instituting adaptation as it created role barriers between men and women thus challenging complementarity in fishers activities however, 188 (61%) of the respondents comprised 81% of the males and 25% of the females did not have a problem with the cultural customs and beliefs which provided male superiority in all adaptive measures.

Table 7.2 Determination of statistical significance of adaptation constraints in Mbita Sub-County

Climate Change Constraints	Male(Yes	Female(Yes	p-value
Limited access to information on Climate	71.6	100	0.231
Climate change information is too technical	81.2	82.9	0.725
Limited credit facilities	76.1	89.6	0.005***
Limited market for fish products	19.8	38.1	0.001***
Limited Knowledge on adaptation	78.7	68.6	0.053
Complexity of instituting adaptation strategies	17.0	63.8	0.196
Limited/high cost of technology	87.8	82.9	0.235
Poor fishery extension service	64.5	41.9	0.000***
Cultural customs and beliefs.	30.5	53.3	0.000***
Lack of infrastructure in fishery operations	44.7	41.9	0.645
Inadequate enforcement of policies and laws	70.1	48.6	0.000***

***** Significant at 5% level**

As indicated in the Table 7.2 all the constraints listed were barriers to adaptation to changes experienced by the Mbita fishers in the study who represented the wider community. The following however were the most significant constraints to climate change adaptation by the fishers and had a gender bearing .Limited credit facilities at a p-value of 0.005, limited markets at p-value of 0.001, poor fisheries extension services at 0.0000, cultural customs at p-value of 0.000 and inadequate reinforcement policies at p-value of 0.000.

7.5 Opportunities Arising From Climate Variability and Change in Mbita Sub County

Despite the constraints cited the fishers were able to identify the following possible opportunities that that could come with the climate variability (refer to **Appendix: Table 7.5).**

7.5.1 Development and Implementation of Community Based Climate Change Resilience Strategies

210 (67%) of the respondents made up of 67% of the males and 72% of the females saw the changes in climate offered them an opportunity to develop and implement local community based resilience strategies. From the FGDs the fishers opined that the changes would allow for the strengthening of institutional capacities and the enhancement of good governance of the fisheries. It would allow for the mainstreaming of the authority of BMUs governance mechanisms to lead a more robust fisher community capable of facilitating collective action resilience strategies. This concurs with Cinner *et al*, (2018) findings that through community based arrangements institutions could be strengthened to enhance resilience and adaptive capacity. The fishers also reported that the central/county govt. and civil society organizations) all have a role to help communities to become better equipped to adapt to climate change. The development of fishing focused policies, programmes to capacitate the fishers' communities into active participation was given as an opportunity that should be explored. These views were consistent with U.N (2016) who emphasizes community based strategies are the core goal of building climate resilience without which adaptation to variability and change in climate will remain elusive, and that poverty and inequalities will likely increase .

7.5.2 The Integration of Knowledge

207 (67%) of the respondents made up of 60% of the male and 82% of the females saw the changes in climate as an opportunity for knowledge integration among the various stakeholders given that adaptation in the fisheries sector has been riddled with governance challenge. The changes allow the opportunity for relevant actors at different levels and sectors of government, civil society, academia and community organizations to engage in an interactive processes through which

pathways and policies can be defined and implemented, providing an opportunity to ensure easy access to climate change information and technology which is a key element in an effective response to climate change. The learning and research institutions are important in developing climate change knowledge and in the preparation and presentation of climate change information in a way that benefits local communities so need for synergies to develop and disseminate information, education, and communication materials on climate change and fisheries and the establish and improve early warning monitoring and surveillance systems to those who need them most, the fishers in this case.

There exists an opportunity for relevant authorities to partner with the local communities particularly in improving climatic data observation. The Kenya Meteorological Department (KMD), and relevant partners should enhance research and develop more accurate forecasts and develop and promote products and services by involving the community in data collection and sharing of their IK to produce and dissemination climate information the form of bulletins and periodic forecasts, extreme weather alerts, and relevant information this would enhance uptake as the community would see themselves as stakeholders and co-producers of knowledge.

7.5.3 Diversification and Expansion into the Utility of Fish/Fish Products

Only 145 (47%) of the respondents saw both diversification and expansion of fish related products as an opportunity. Of these 39% were male and 64% were female, while 53% of the respondents did not think so, of these 61% were male and 36% were female as the fish oil was already being used by artisanal processors to deep fry fish and its by-products because it was cheaper than other commercial fats and oils. From the FGDs the fishers pointed to the possible processing and use of Nile Perch skin into leather while some fishers stated it was already being exploited by some

fishers for dietary uses as is believed to have therapeutic value providing polyunsaturated fatty acids which are concentrated in fish oils and this could be commercialized.

7.5.4 Revitalization of Fisher Networks

251 (81%) of the respondents of these 89% were male and 70% were female saw the revitalization of their fishers cooperative as an opportunity. For around the world social organizations and fishers cooperatives have posted good results especially in improving fisher's status. Practical examples include fishing cooperatives in Japan, Netherlands and United Kingdom which have enhanced fisher's benefits embedded on the collective action theory enhanced management of the resource (Symes and Phillipson 2009). Such cooperation is very crucial for co-managing Lake Victoria (Odongkara. *et al,* 2005). The fishermen of Mbita need to initiate a cooperative union in order to strengthen their economic position and be able to participate in price determination and even gain entry into the lucrative export market. The fishers however will need more awareness and training about the running and operation of cooperative unions.

7.5.5 Other opportunities

From the interactive FGDs the fishers suggested that the changes in climate/weather offered an opportunity for the government both national and county to reorganize the fisheries and the fisher livelihoods to ensure their sustainability. The fishers felt that the changes in climate were a perfect opportunity for enhanced financial and structural support to help with diversification into non-fishery activities as it could successfully contribute to improved income, food security and employment for fisher communities. The fishers" adaptation measures of venturing out further into the lake and varying the time on fishing grounds could also improve their income and food security.

Given the growing demand and prices for fish an opportunity presents for promotion of aquaculture production in the lake area with the county and national government providing

enabling infrastructure and services for the small scale fishers, Undertake aquaculture value chain analysis, develop business plans , and demarcate suitable sites for the cages see Plate 7.5 below.

Plate 7.5 Fish cages in Mbita

Most young men saw the variability in climate as the opportunity for diversification to other economic activities particularly or tourism. They felt that the county government could tap into the location of the Ruma National Park and the vastness of the lake, the numerous islands and varied flora and fauna around the lake to draw large numbers of tourists both local and international if marketed properly.

The older fishermen felt the County Government of Homa Bay should instead focus more on developing the infrastructure around the lake by ensuring there was electricity to enable the fishers have cooling plants, and with the help of government enable the fisher co-operatives to own fish processing industries to add value to the fish to earn them much more income and making their livelihoods more sustainable.

CHAPTER EIGHT: SYNTHESIS AND DISCUSSIONS

8.0 Introduction

This chapter synthesizes the findings of the study by presenting the summary in sequential order starting from the 1st to the 4th objective to derive a high order discussion addressing the overall objectives of the study.

8.1 The 1st Objective of the study sought to determine levels of perception and knowledge of the Mbita fishers on climate variability/change.

The finding was that majority (68%) of the respondents had a clear perception of climate variability in the area with most fishers stating that the temperatures were warming up with longer dry spells. The rainfall was unreliable and erratic overtime, however only 46% of the fishers reported having scientific knowledge of CC/V.

Whereas the Mbita fishers' community received scientific weather information from local radio stations that relied on meteorological forecasts, they considered it irrelevant and relied on their own indigenous and personal interactive experiences with the wind patterns and the position of stars in the sky which supported traditional systems to monitor and forecast weather/climate and inform their activities.

8.2 The 2nd objective sought to establish the effect of climate variability /change on fishing activities and livelihoods of the Mbita fishers.

1) The study found that the fisheries in Mbita are characterized by cultural gender roles with men catching the fish with a few women slowly getting involved in the catching of fish but as owners of the boats most of the women were mainly involved in the post harvest activities of fish processing and trade.

2) It was also found that in wet season there was abundant fish in volume and species while in dry season fish reduced in volume, sizes and species for about 85% of the respondents; also wet season attracted increased number of fishermen, while during dry season smaller volume of fish was caught resulting into food insecurity due to less money from sales forcing households to survive by reducing food portions.
3) Wet weather was found to make the roads impassable resulting into fish spoilage for those who caught large fish and marketed it out of the county; for fishers who traded locally fish influx resulted into low fish prices.
4) The study found that climate variability had a negative impacts on the fishers health on majority, 81% respondents reported on weather-borne ailments like malaria and diarrhea corresponding with mosquito increase in wet scenarios and typhoid associated with unsafe drinking water at the beaches; all supporting related opportunistic infections from HIV/AIDS

8. 3 The 3rd objective sought to determine the influence of gender on access and control of fisher resources for climate adaptation in Mbita Sub-County.

On access to fishing equip /storage and processing equipment the study found that only 44 % of all the fishers had access to fishing equip /storage and processing equipment with the men mainly owning the boats, engines, nets and coolers while the women owned drying nets and frying equipment. These were proportionate to likely cash flow accessible to men and women respectively

On access to land/house the study found that men had both access and control rights for land while women headed households that were majority, had full access but not the control of land as power still rested with clan elders.

On access to access to the fish/fish products, the study found that only 24% of fishers mainly the boat owners had access to fish/fish products; the women's access was mediated by the male fishers creating condition of "*jaboyaism*".

The fishers had limited access to extension/ trainings/workshops as a result of their labour intensive livelihood activities coupled with the low number of fishery officers in Mbita who were to provide both extension and governance.

8. 4 The 4th objective sought to determine the influence of gender in the current coping and adaptation strategies of the fishers in Mbita Sub-County.

The study finding was that adaptation/coping strategies and activities in Mbita were culturally gender stereotyped in fishing activities and responsibilities giving men more adaptive options than women; fishermen adapted by changing fishing time/length and fishing gear and by migrating to other beaches, while women who depended on men for the fish they sold sought support from family members, used savings to sustain household and sold assets to sustain livelihood. Some of the fishers have been forced to seek alternative sources of livelihood such as small businesses, sand-mining, firewood cutting, farming, but some of these were not sustainable.

The study found that main constraints to adaptation include limited information, access to capital/credit with the low/reduced incomes being the most important barrier to diversification for households for the impoverished fisher households have no choice but to alleviate immediate pressures of hunger, illness, and daily living by relying solely on fishing leading the households into even higher dependence on the fishery even though stocks are becoming less available. Often, people in these households do not have the time, financial resources, education, or training necessary to seek alternative livelihoods.

The study further found that there was an opportunity in the development and implementation of community based climate change resilience strategies ,the integration of knowledge, in divesting and expansion into the utility of fish related products and for the government both national/county to reorganize the fisheries and the fisher livelihoods to ensure its sustainability .The fishers felt that there is an opportunity for enhanced financial and structural support to help in reducing particularly with diversification to non-fishery activities being an option that could be the most beneficial as it successfully contributes to improved income, food security and employment for fisher communities.

CHAPTER NINE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

9.0 Introduction

This chapter summarizes key findings of the study, presents the conclusions and recommendations for further research in climate change adaptation and actionable by stakeholders in fishery livelihoods.

9.1 Cross Cutting Issues

The study found that Mbita Sub County in the Lake Victoria basin is already experiencing weather and climate variability and the fishers perceive this correctly and are feeling its negative effects on their fishing and livelihood activities. The community uses gendered cultural values hence the effects of climate variability affect men and women differently. The study established that gender was a discriminative crosscutting tool anchored on local community's cultural traditions, allowing men more access and control of the key factors of production while designating women only to user rights of natural resources; making them more vulnerable to effects of climate change/ variability.

9.2 Summary of Findings and Conclusions

The 1st objective sought to determine the perception and knowledge of the fishers on climate variability/change. The finding was that fishers in Mbita Sub County were fully aware of climate variability and were already experiencing it, with negative impacts on their fish dependent livelihoods. The fishers in Mbita mainly rely on their indigenous knowledge to inform their fishing livelihoods as they don't understand the weather forecasts and doubt its reliability.

The 2nd objective sought to establish the effect of climate variability /change on fishing activities and livelihoods of the fishers. The finding was that climate variability affects the livelihoods of the Mbita fishing community negatively; the effects range from direct impacts on the fishers themselves such as loss of lives and livelihood and on their health, to destruction of fishing

equipments, long duration of fishing, reduced fish catch. The majority of the fishers reported decreases in income and food security when there were droughts or floods. Stormy weather prevented fishing operations while too much rain caused road blockages, damage to infrastructure (boats, houses, roads, gear), increase in human disease, and greater post-harvest losses of fish. The warmer weather however allowed for excellent conditions for sun drying which would likely lead to better food security as dried *omena* can be stored for weeks and excess fish could be consumed within the households and sold off for more income.

The 3rd objective sought to determine the influence of gender on access and control of fisher resources for climate adaptation in Mbita Sub-County. The findings were:-

1) The patrilineal nature of the *Luo* tribe, the majority of respondents favored men on access and control of resources, putting them in better earnings. The pervasive male dominance over access to fish and financial resources required the women to strategize and be innovative in order to gain access to fish resources.
2) The female fishers' who were the homemakers were more vulnerable to extreme weather changes and often faced food insecurity due to depressed incomes from their fishing activities.

The 4th objective sought to determine the influence of gender in the current coping and adaptation strategies of the fishers. The study found that community adaptive responses were spontaneous and reactive, unplanned and already showed negative outcomes on livelihoods. It was concluded that limited applicable adaptive alternatives was due to lack of capital,information and lack of structured development agenda by the county government .

Under the theme of constraints, the study found that lack of knowledge and resources led to uncontrolled fishing activities, resulting in the depletion of fish species. The study concluded that reinforcement of sustainable fishing practices on the Lake shore needed to be accompanied with

capacity building training for alternative employable livelihoods for boosting incomes of the community member.

9. 3 Recommendations

The reduction of impacts, vulnerability or risks, increase in adaptive capacity or resilience, and facilitating adaptation actions and processes to climate variability and change for the fishing communities would require multifaceted measures as recommended below.

For the National and County Government of Homa-Bay

- Need to raise awareness on gender equality issues for all stakeholders in the fisheries sector by creating an enabling policy and legislative environment that influences fishing policies with a gender perspective.

- Ensure that women have equal access to productive tools such as boats and gear so that they may have a greater stake and right to fisheries/ management and development strategies.

- Reducing exposure needs to be complemented with reducing sensitivity, increasing adaptive capacity and supporting adaptation processes through planned adaptation. In this case need to ensure improved livelihood outcomes of fishers by augmenting their livelihood assets and improving access to them, and helping to diversify livelihood strategies.

- Build the fisher community's human capital through education and skills development. This could particularly help to diversify livelihoods which in turn would help individuals and associated households to be less reliant on the climate sensitive fisheries.

- Promote community agency through improved governance, improved enforcement: Negative interactions among governing bodies and fishing communities can undermine

capacity for adaptive action. Improved communication among stakeholders and frequent meetings between fishers, governing bodies, and managers may advance adaptation.

For Climate Scientists and Research institutions

- Need for integration/harmonization of the scientific weather forecasts and fishers indigenous knowledge for improved weather forecasting. Warning and evacuation systems should be put in place to reduce the fishers' exposure to extreme events both in inland and in the lake.

- Local research institutions have a role to play in cascading climate change knowledge to locals as they work on collaborative projects and programme.

- Develop methodologies that improve the gathering of gender and socio-economic-disaggregated data in the fisheries sector, with particular attention given to the small-scale and subsistence fisheries sector.

For the Fisher organizations and associations.

- The reinvigoration of a fisher's organization in Mbita is a matter of priority to ensure sustainability of fishing livelihoods. A vibrant fisher's organization would strengthen their economic position ,allowing for modernisation of fishing technology (such as improved quality fishing boats), modernisation of fish drying technology (such as more use of solar tent driers) will also be required in future to adapt the fish drying process to increased variations in temperature and rainfall.

- Organize and build strength to better advocate for an equitable and just fisheries sector, with a greater role for women in fisheries resource management, including boat ownership.

Recommendation for Mitigation in the fisheries sector

- Mitigation options in the fisheries sector are very much at the early stages of investigation but policy options to contribute towards climate change mitigation could however include regulation and incentives related to promotion of fuel-efficient fishing methods ,Improvements in building design and handling practices to reduce energy requirements and increase energy efficiency e.g. through better insulation in ice plants, freezing plants, cold stores and chill stores and fuel use in the transportation of fish to markets.

9. 4 Recommendations for Further Research

Following the findings of the study, the following suggestions for further research are put forth for consideration;

1) This study was limited to Mbita Sub County in Homa Bay County; future research could replicate it to other regions along the Lake Victoria basin where fishing is the chief community economic and livelihood activity for the purpose of comparing the cultural interface on findings.

2) Studies on the influence of extreme climate events is expected to increase, with climate variability and change studies and their influence on livelihoods still in their infancy. More research is needed to determine the trends of effects of these events will have on fisheries productivity and livelihoods and propose strategies for promoting sustainable fisheries and climate smart communities.

9.4 Contribution of the Study to the Body of Knowledge.

This study established that Mbita community fishers are rather individualistic in their adaptive approaches to the effects of climate variability on their livelihood. The efforts were mainly reactive and not anchored on any planned policies since most of the fishers have no scientific knowledge of

climate change as a global environmental stressor. This call for policy address to improve capacity of communities to understand and enhance adaptation to climate change and associated stressors by providing practical sustainable livelihood activities which are considerate with needs of the Mbita fisher community.

The study established that both climate scientists and local community members are aware of climate variability and change but are however using divergent measures to address the problem, so both are losing on synergy. There is need for climate scientists and local community to work together and harmonize their forecasting to enable synergy to produce sustainable adaptation to climate change and climate variability overtime in Mbita.

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APPENDICES

Appendix I: Fishers' Questionnaire

This questionnaire is to help in gathering information on the gender influence on climate change adaptation in Mbita. The major aim is to identify the effects of changes in Rainfall, Temperature on Fishers livelihoods and how they are coping in Mbita Division. The responses you give are purely for academic work, in creating knowledge on the activities in the fishing industry.

Your responses will be treated with utmost confidentiality and cannot be traced back to you.

Date…….

Location……..

Section A: PERSONAL DETAILS AND SOCIO-ECONOMIC CHARACTERISTICS

1.1 Gender- 1(Male) ……; -2 (Female)……..

1.2 Age ……..years

1.3 Marital Status1(Single)……;2(Married)…;3(Divorced).....;4(Separated)…;5(Widow/er) …

1.4 Highest Level (HL) of Education …….Years of formal education.

1.5 Household (HH) Type

(Male headed)……; 2 (Female headed)……..3 (Child headed)……

1.6 How many persons live in your house on daily basis? .....people

1.7 Distribution of people living in your house by age

1(0-4 years)……2(5-9 years)…….. 3(9-14 years)……4(.more than 15 years)…….

1.8 What is the main source of livelihoods in your household?

1) Fishing……..2) Livestock …….3) Mixed crop and fishing ……4) other specify

1.9 If fishing is your main livelihoods, what activities do you carry out related to fishing?

1 (Boat Owner/Maker); ……..-2 (Fisherman/crew); ……. 3 (Fish marketer); ……..

4 (Net Maker)……5(other) specify …….

1.10 How many years have you been involved in fisheries? ..... years.

1.11 How much do you get weekly from fishing activities? Kshs……

1.12 Do you have any other source of income apart from fishing activities? 1) No…2) Yes……..

If yes, name the activity/ies) and the amount you receive from them monthly.

Activity	**Amount/ month**

1.13 Do you belong to any social group? 1) No…….. 2) Yes……..

If Yes tick all the group/s you belong to 1] church group…… [2] credit groups……..

[3] fishers groups…….. [4] women/men group…….. [5] social group……

Section B: Knowledge and Perception of Fishers towards temperature and rainfall changes

Use the code below to answer the following questions according to your level of agreement or disagreement: **Code: 1**–Strongly agree, **2**–Agree, **3**–I Don't Know **4-** Disagree, **5**–Strongly disagree

Observed changes in temperatures in the last 10 years?

1) There has been an increase in the annual temperatures.....
2) There has been a decrease in the annual temperatures…….
3) It is hotter during hot months…….
4) It is hotter during cold months…….....
5) There has been no change in temperature.....
6) Which is or are the hottest year(s) you have ever experience in this region? List the years…….
7) Which is or are the coldest year(s) you have ever experience in this region? List the years……

Observed changes in rainfall in the last 10 years?

8) The rainfall comes earlier than expected……..
9) The rainfall comes later than expected…….
10) The total rainfall is much higher than usual……..
11) The rains are more erratic.....
12) There is no change in rainfall ……
13) Which is or are the wettest year (s) you have ever experience in this region? List the years…….
14) Which is or are the driest year (s) you have ever experience in this region? List the years……

Knowledge of Climate change and variability

1) Have you heard about climate change and variability? Yes/No……
2) What is it in your own understanding?

……..

3) How has the changes in climate influenced your fishing activities?

……

4) From what sources did you hear about climate change? List any 3 sources

a)……b)……..c)……

5) What information was received in relation to change in climatic conditions?

……

6) Was the information received relevant to your fishing activities? 1) No…..2) Yes…….

7) If yes, how did you use the climate information to inform your fishing activities?

…….

Section C: Effects of weather and climate variability on fishers'activities and livelihoods.

What effects has weather and climate variability had on your fish related livelihood activities? (Please tick all the ones that apply)

1) Increased fish types…….
2) Reduced fish sizes…….
3) Reduced fish catch……..
4) Increased fish catch…….
5) Stay away for home longer for fishing/marketing……..
6) Reduced access to food due to loss of revenue from fishing …….
7) Spoilt fish catches due to lack of road access to market……
8) Less income from fish catch/sales…….
9) Loss of life of a relative /friend/ family member from fishing accident…….
10) Frequent ill health and sickness ……..
11) Loss and destruction of fishing boats/property……
12) Reduced number of fishers/traders ……..
13) No effect……
14) Others (specify)……..

Section D) Access and control of fisher resources and assets.

Did you have/use of any of the following resources in the last year? Answer (1=Yes, 0=No)

1) Do you own any fishing / processing/ storage equipment? .....

If yes, list them……..,……,……..

2) If no, where /how do you get the fishing equipment you need?
3) Do you own any land? If yes how big? .....
4) Do you own a house/home or is it rented? …….
5) Is it a permanent or semi permanent building? .....
6) Do you have access to clean drinking water? …….
7) Do you have access to a proper sanitation facility? …….
8) Do you have access to electricity/solar power? ……
9) Do you have access to the fish/fish products whenever you need it? ……..
10) Do you have access to a steady market for your fish? ……
11) Do you have any savings in cash or investment? ……
12) Do you have access to credit/loans whenever you need it? …….
13) Do you/family have access to 3 balanced meals every day? ……
14) Do you have access to medical attention whenever you/family need it? ……
15) Do you have access to trainings/workshops on fisheries/climate issues? ……

Section E: Climate Change Adaptation

What changes or adjustments in your fishing activities have you made due to changes in climate patterns? (Please tick all the ones that apply to you from the list below).

1) I have shifted my fishing times to allow me get enough fish ……
2) I fish for a longer time to catch enough amounts of fish …….
3) I fish further away into the lake to catch enough fish than before …….
4) I have changed my fishing /nets and boats ……
5) I catch/buy any fish species available ……
6) I only sell to big buyers……
7) I process and sell to small buyers…….
8) I have used my saving/taken credit to help sustain my business……
9) I have received help from family members to help sustain my livelihood……..
10) I have sold some of my assets to help sustain my livelihood……
11) I migrate from time to time to places/beaches with more fish…….
12) Any other please specify …….

Section F: Climate Change Adaptation Constraints/ Opportunities

What constraints have you had in relation to adaptation and fishing? (Please tick all the ones that apply to you from the list below).

1) Limited access to information on climate variability and change……
2) Climate change information is too technical to understand……..
3) Limited of credit facilities to make changes……..
4) Limited market for fish products……
5) Limited knowledge on adaptation measures……
6) Complex nature of instituting climate change adaptation strategies……
7) Limited/high cost of technology (better nets/boats etc)……
8) Poor fishery extension service delivery…….
9) Cultural norms, customs, and traditional beliefs ……..
10) Lack of infrastructure in fishery operations (transport/cooling plants/markets)……..
11) Inadequate understanding and enforcement of fishery policies and laws…….....
12) Other (specify)……

I foresee the following opportunities in relation to adaptation to climate variability in Mbita (Please tick as many as are applicable).

1) Enhanced climate information sharing between stakeholders' govt. and community……
2) Knowledge integration between stakeholders to enhance fishery sustainability……
3) Divest and expansion into the utility of related fish products e.g. lake flies for animal feed
4) Revitalization of fisher networks and cooperatives .....……
5) Others (specify)…….....

The End.

Appendix II: Fishers Focus Group Discussion Guide

This Guide is to help in gathering information on the gender influence on climate change adaptation in Mbita. The major aim is to identify the effects of changes in Rainfall, Temperature on Fishers livelihoods and how they are coping in Mbita Division. The responses you give are purely for academic purposes and creating knowledge around the activities in the fishing industry.

SECTION A: Perception and knowledge of climate variability/change

1. Have you noticed any changes in (i) the rainfall pattern and (ii) the temperature levels over the past ten years? Kindly describe the changes you have noticed?
2. Could you suggest some of the possible causes of these changes in the climatic conditions?
3. How do you visualize the weather patterns to be in the next (5years) from now
4. Do you think that climate change could be beneficial to the fishers in any way? If Yes, How? And if No Why?

Section B: Access to resources and effects on fishing livelihoods

5. What resources do you require in your fishing roles?
6. What resources do you own in your business? how do you access what you need but don't
7. Who does what/when and why in the fishing chain?
8. Do fishers do the same activities throughout the year (seasonal changes)? If not when are activities different and why?
9. Have any of these activities been affected by the changes in climatic conditions? If yes, how?
10. How have these changes affected your income /livelihood?
11. From where do you get weather information and how important is this information to your fishing activities?
12. How do you acquire fishing equipment?
13. How do you access credit/financing to enhance your fishing activities?

Section C: Adaptation Strategies

14. What practices have you put in place to help you cope with the current changes so as to increase your productivity in fishing/processing and marketing?
15. Have these practices been helpful? Please explain
16. What support (assets, skills and knowledge) do the fishers need to effectively adapt their livelihood to the changing climate?
17. Do you know of any government /fisheries strategies/ policies that have been introduced to help the fishers to cope with these changes? Explain
18. What do you think the government/fisheries dept can do to help fishers cope better to these changes

Appendix III: KII Interview Schedule

This guide is to help in gathering information on the gender influence on climate change adaptation in Mbita. The major aim is to identify the effects of changes in rainfall, temperature on fishers' livelihoods and how they are coping in Mbita Division.

INTERVIEW QUESTIONS for BMU/Fisheries personnel

1. How long have you worked for your organization and in what capacities in Mbita?
2. Have experienced any changes in the trends of rainfall and temperature in Mbita over the last10 or so years?
3. If yes, have these changes had any impacts on the fish and on the fishers' livelihoods? Explain.
4. With respect to gender, which groups of fishers are more vulnerable to these changes men/women? Could you suggest reasons?
5. Do you have any specific programmes to make the fishers aware of these changes? If yes kindly make suggestions.
6. How do fishers doing adjust to / adapt to these climatic changes?
7. What resources do you think the fishers need most to be able to adapt to a changing climate?
8. Are there constraints on the part of fishers in adapting to these changes? Make suggestions.
9. Do you think climate change could present any new opportunities for fishers in Mbita? If yes which ones?
10. Are there other problems facing the fishers in Mbita?
11. How does the government/and its development partners support the fishers in relation to coping/adapting to climate change?
12. What future plans are there to mitigate the effects of climate change among the fishers?

Questions for Metrological Officers

1. How long have you worked in Mbita?
2. Do you have up to date data for rainfall and temperature of Mbita for the last 30 so years?
3. What are some of the unusual trends have you noticed in the rainfall and in temperature in Mbita over the last 5 or so years?
4. Do you think the climate is changing if yes what do you think is causing the change?
5. How do you think these changes affect the fish and fishing operations in Mbita?
6. Do you disseminate up-to-date weather information to the fishers? If yes how?
7. Do you think the fishers have their own specific weather information for their activities? If yes what additional information do you think they need and who should provide it?
8. What constraints do you see that the fishers may have in adapting to climate change in this region
9. Can you suggest what you think the climatic trends will be in the next 5 or so years?
10. Are there any opportunities that climatic changes can bring to fishers in Mbita? If yes which ones.

Appendix IV: Tables of Descriptive Statistics

Table 4.5. Descriptive results of Mbita fishers' perception and knowledge to climate variability/change

Climatic Changes	**Strongly agree**		**Agree**		**Don't Know**		**Disagree**		**Strongly disagree**	
	Male N(%)	**Female N(%)**	**Male N(%)**	**Female N(%)**	**Male N(%)**	**Female N(%)**	**Male N(%)**	**Female N(%)**	**Male N(%)**	**Female N(%)**
1)Rise in temperature	54(26.8)	18(17.1)	85(42.2)	51(48.5)	58(28.8)	32(30.4)	4(1.9)	4(3.8)		
lowering in temperatures	2(0.6)	1(0.9)	7(3.4)	3(2.8)	44(21.8)	23(21.9)	120(59.7)	64(60.9)	28(13.9)	14(13.3)
2)Hotter in hot months	30(14.9)	19(18)	113(56.2)	67(63.8)	52(25.8)	17(16.1)	6(2.9)	2(1.9)		
3)Hotter in cold months	6(2.8)	7(6.6)	9(4.4)	4(3.8)	47(23.3)	18(17.1)	139(69.1)	76(72.3)		
4)No change in temp			17(8.4)	6 (5.7)	52(25.8)	24(22.8)	104 (51.7)	69(65.7)	28(13.9)	6(5.7)
5)Rainfall comes earlier	3(1.4)	1(0.9)	3(1.4)	0	12(5.9)	4(3.8)	122(60.6)	70(66)	61(30.3)	30(28.5)
6)Rainfall comes later	48(23.8)	21(20)	139(69.1)	76(72.3)	9(4.4)	5(4.7)	3(1.4)	3(2.8)	2(0.9)	
7) Rain less	33(16.4)	12(11.4)	108(53.7)	56(53)	47(23.3)	31(29.5)	9(4.4)	5(4.7)	4(1.9)	1(0.9)
8)Rain erratic	61(30.3)	30(28.5)	122(60.6)	60(57.1)	13(6.4)	12(11.4)	4(1.9)	1(0.9)	1(0.4)	2(1.9)
9)No rainfall change			11(5.4)	6(2.8)	15(7.4)	14(13)	146(72.6)	67(63.8)	29(14.4)	18(17.1)
Knowledge of CC	**Male N (%)**	**Female N(%)**	**Cumulative (%)**							
1) Know	93(46.3)	39(37.1)	132(43.1)							
2)Don't Know	108 (53.7)	66(62.8)	174(56.9)							

Table 5.2 Descriptive results for effects of weather and climate variability on fishers

Effects of livelihood	Male N (%)	Female N (%)	Cumulative N (%)
1) Increased fish types			
No	137(68.1)	77(73.3)	214(69.9)
Yes	64(31.9)	28(26.7)	92(30.1)
2) Reduced fish sizes			
No	24(11.9)	22(20.9)	46(15)
Yes	177(88.1)	83(79.1)	260(85)
3) Reduced fish catch			
No	28(13.9)	14(13.3)	42(13.7)
Yes	173(86.1)	91(86.7)	264(86.3)
4)Increased fish catch			
No	177(88)	85(80.9)	263(85.9)
Yes	24(12)	20(19.1)	43(14.1)
5) Stay away from home longer for fishing/marketing			
No	36(17.9)	55(52.30)	91(29.8)
Yes	169(82.9)	46(47.70)	215(70.2)
6) Reduced access to food due to lose of revenue			
No	29(14.4)	11(10.5)	40(13.4)
Yes	171(85.6)	94(89.5)	265(86.6)
7) Spoilt fish due to lack of road access			
No	167(83)	70(66.6)	237(77.5)
Yes	35(17)	24(33.4)	69(22.5)
8) Less income from fish catch/sales			
No	16(8)	9(8.6)	25(8.2)
Yes	185(92)	96(91.4)	281 (91.8)
9)Loss of life of a relative/friend/family member from fishing accident			
No	143(71.4)	73 (69.5)	216(70.6)
Yes	58(28.6)	32 (30.5)	90(29.4)
10) Frequent Ill health and sickness			
No	33(16.5)	23(22)	56(18.4)
Yes	168(83.5)	82(78)	250(81.6)
11)Loss /destruction of fishing boats/property			
No	32(16)	63(60)	95(31.1)
Yes	169(84)	42(40)	211(68.9)
12)Reduced number of fishers/traders			
Yes	24(12)	9(8.6)	32(11.2)
No	177(88)	95(90.4)	272(88.8)

Table 6.2 Descriptive results for fisher access and control of resources and assets

Access/control of resources			
1) Access to land/house	Male N (%)	Female N (%)	Cumulative N (%)
Yes	87(43.3)	41(39)	128(41.8)
No	114(56.2)	64(61)	178(58.2)
2) Clean drinking water			
Yes	58(28.9)	30(28.6)	88(28.7)
No	143(71.4)	75(71.4)	218(71.3)
3)Proper toilet facility			
Yes	128(63.7)	62(59)	190(62)
No	73(36.3)	43(41)	116(38)
4)Power solar/electricity.			
Yes	166(82.5)	75(71.4)	241(78.8)
No	35(17.5)	30(28.6)	65(21.2)
5)3 balanced meals a day			
Yes	38(18.9)	34(49.28)	72(23.5)
No	163(81.1)	71(30.74)	234(76.5)
6) Medical attention when you need it.			
Yes	48 (21.9)	18(27.27)	66(21.6)
No	153(78.1)	87(37.18)	240(78.4)
5) Fishing equip /storage/ processing equipment)			
Yes	84(41.7)	51(48.6)	135(44.1)
No	117(58 .3)	54(51.4)	171(55.9)
6) Steady market for the fish			
Yes	44(60.27)	29(27.7)	73(23.9)
No	157(66.22)	76(72.3)	233(76.1)
7) Savings or investment			
Yes	64(31.9)	89(72.3)	153(50)
No	137(68.1)	26 (27.5)	153(50)
8)Loans from banks or electronic money			
Yes	151(75.1)	73(69.6)	254(73.6)
No	49(24.9)	32(30.4)	81(26.4)
9)Access to radio/TV/cell			
Yes	176(87.6)	88 (83.8)	264(86.3)
No	25 (12.4)	17(16.2)	42(13.7)
10) Access to transport			
Yes	74 (26.9)	23 (22)	97(25.2)
No	147 (73.1)	82 (78)	229(74.8)

11) Access to regular weather information			
Yes	46(12 .9)	26 (24.8)	72 (23.5)
No	155(77.1)	79(75.2)	234(76.5)
12)Trainings/workshops on climate change			
Yes	33(16.5)	16(15.2)	49(16.1)
No	168(83.5)	89(84.8)	257(83.9)

Table 7.3 Descriptive results on fishers' adaptation strategies

Adaptation Strategy	**Male N (%)**	**Female N (%)**	**Cumulative N (%)**
1)Shifted my fishing times			
Yes	168(83.5)	4(3.8)	172(56.2)
No	33 (16.5)	101(96.1)	134(43.8)
2)Fish for longer time periods			
Yes	139(69.2)	3(2.8)	142(46.4)
No	62(30.8)	102(97.1)	164(53.6)
3)I fish further away than before			
Yes	136(67.7)	4(3.8)	140(45.7)
No	65(32.3)	101(96.1)	166(54.3)
4)Changed my fishing /nets and boats			
Yes	114 (56.7)	8 (7.6)	122(39.9)
No	87(43.3)	97(82.7)	184(60.1)
5)Catch any fish species			
Yes	92(45.8)	3(2.9)	95(31)
No	109(54.2)	102(97.1)	211(69)
6)Sell to big buyers			
Yes	46(22.9)	40(38)	86(28.1)
No	155(77.1)	65(61.9)	220(71.9)
7) Process and sell to small buyers			
Yes	34(17)	67(63.8)	101(33.1)
No	167(83.)	38(35.4)	205(66.9)
8)Used saving to sustain household			
Yes	89(44.2)	78(74.3)	167 (54.8)
No	112(55.8)	27(25.7)	139(45.2)
9)Sold assets sustain my livelihood			
Yes	110(54.7)	68(64.8)	178(58.2)
No	91 (45.3)	37(35.2)	128 (41.8)
10)Help to help sustain my livelihood			
Yes	127(63.1)	38(36.1)	165(53.9)
No	74 (36.9)	67(63.8)	141 (46.1)

11)Sold assets to sustain my livelihood			
Yes	78(37.9)	26(24.7)	104(33.9)
No	123(62.1)	79(75.2)	202 (66.1)
12) Migrate to places/beaches			
Yes	103(51.2)	21(20)	124(61.6)
No	98 (48.8)	84 (80)	182 (38.4)

Table 7.4 Descriptive results on fishers constraints to adaptation.

Adaptation Constraints	Male N (%)	Female N (%)	Cumulative N (%)
1)Limited access to information on CC			
Yes	167(83)	83(79)	250(81.6)
No	34(17)	22(21)	56(18.4)
2)Climate Change Information is too technical			
Yes	172(85.5)	84(80)	256(83.4)
No	29(14.5)	21(20)	50(16.6)
3)Limited credit facilities			
Yes	165(84)	83(79)	248(81)
No	36(16)	22(21)	58(19)
4)Limited market for fish products			
Yes	54(26.8)	26(24.8)	80(26)
No	147(73.2)	79(75.2)	226(74)
5)Limited knowledge on adaptation			
Yes	154(76.6)	76(72.3)	230(75.1)
No	47(23.4)	29(27.7)	76(24.9)
6)Complex nature of instituting adaptation			
Yes	142(70.6)	68(64.7)	210(68.6)
No	59(29.4)	37(35.3)	96(31.4)
7)Limited/high cost of technology			
Yes	176(87.5)	87(82.8)	263(84.9)
No	25(12.5)	18(17.2)	43(15.1)
8)Poor fishery extension service			
Yes	136(67.6)	38(34.2)	174(56.8)
No	65(32.4)	67(63.8)	132(43.2)
9) Cultural customs, and beliefs			
Yes	39(19.4)	79(75.3)	118(38.6)
No	162(80.6)	26 (24.7)	188(61.4)
10)Lack of infrastructure in fishery operations			
Yes	78(38.8)	56(53)	134(44.8)

No	123(61.2)	49(47)	172(56.2)
11) Inadequate enforcement of policies.			
Yes	175(87)	16(15.2)	191(62.4)
No	26(13)	89(84.8)	115(37.6)

Table 7.5 Descriptive results on possible opportunities

Opportunities	Male N(%)	Female N(%)	Cumulative N(100.00)
1)Develop and implement community-based resilience			
Yes	134(66.6)	76(72.3)	210(68.6)
No	67(33.4)	29(27.7)	96(31.4)
2)Knowledge integration			
Yes	121(60.1)	86(81.9)	207 (67.6)
No	80(39.9)	19(18.1)	99(32.4)
3)Divest and expansion into the utility of fish products			
Yes	78(38.8)	67(63.8)	145 (47.4)
No	123(61.2)	38(36.2)	161(52.6)
4)Revitalization of fisher networks			
Yes	178(88.5)	73(69.5)	251(81.1)
No	23 (21.5)	32(30.5)	55(17.9)