THE IMPACT OF CLIMATE CHANGE ON ECONOMIC SECURITY IN THE GREAT LAKES REGION: THE CASE OF KENYA 2010-2020

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DECLARATION

This report is my own original work and has not been submitted for examination in any other University for attainment of postgraduate qualification.

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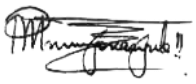
Signature: 

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ABBREVIATIONS & ACRONYMES

AU	**-**African Union
CH_4	-Methane
CO_2	-Carbon Dioxide
DRC	-Democratic Republic of Congo
EAC	**-**East African Community
GBM	-Green Belt Movement
GDP	**-**Gross Domestic Product
GHG	**-**Greenhouse Gas
GLR	-Great Lakes Region
HFC	**-**Hydro fluorocarbons
ILO	**-**International Labor Organization
IPCC	**-**Intergovernmental Panel on Climate Change
N_20	**-**Nitrous Oxide
UN	**-**United Nations
UNDESA	-United Nations Department of Economic & Social Affairs
UNFCCC	**-**United Nations Framework Convention on Climate Change.
US	**-**United States
USA	**-** United States of America
WB	**-** World Bank

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ABSTRACT

The world today is more vulnerable to environmental risks than it was two hundred years ago. Increasing evidence points to the fact that the planet has been moving from the safe operating space and it is now at a global crisis point. Manifesting this through floods, droughts and other climate extremes, we are now more than ever at a risk of crossing tipping points that shift the planet to a potentially catastrophic breakdown. While much research has been published about climate change science, not much has been published about the relationship between climate change and their implications to society and especially in developing countries. This study analyzed the impact of climate change on economic security in the great lakes region with a view to increase the understanding of this interaction. This research draws from a collection of societal aspects that were formerly ignored such as the environment, the economy, the military and the political environment. The main argument this study made is that the planetary boundaries that allowed and supported humanity and the biomes are all deeply connected. However, some are core boundaries that heavily impact on other aspects of planetary success and sustainability such that when one boundary is crossed, it generates tipping points that heavily amplify other societal risks that have serious existential implications. Climate and biodiversity are core boundaries and using global warming and erratic rainfall as key variables that I used to measure the correlation between climate boundaries and the economic aspect of security, this research has found that human activities and natural processes have heavily burdened these planetary boundaries to a great extent with irrefutably negative consequences.

CHAPTER ONE

1.0 BACKGROUND TO THE STUDY

Climate can be said to the long term prevailing weather condition in a particular geographical area. This is a global phenomenon that impacts all forms of living and non living organisms in the biosphere. Climate change on the other hand can be defined as a permanent deviation of weather patterns due to both natural and anthropogenic processes (UNFCCC, 2007). For instance, while seasons change throughout the year, inhabitants of the northern hemisphere experience seasons that include warmer winters and spring temperatures. The southern hemisphere on the other hand experience droughts and floods as some of the consequences of a changing climate (UNFCCC, 2007).

The United Nations Intergovernmental Panel on Climate Change (IPCC, 2007), a panel composed of scientists from different countries commissioned to provide a current logical view of the changing climatic scene, its impacts, risks and how to deal with it confirmed that there is indeed a correlation involving anthropogenic activities and changing climate (IPCC, 2007). The panel noted that Greenhouse Gases (GHG) have a huge impact on the climate system. These gases work by locking thermal energy released through natural and anthropogenic processes into the earth's atmosphere close to the earth's surface without allowing it to escape into space. This keeps the earth's temperature in habitable levels of around 14 degrees Celsius (IPCC, 2007). For example, radiation from the sun, metabolic processes such as photosynthesis by plants and gaseous exchange by animals are some of the ways greenhouse gases are released into the atmosphere. Anthropogenic causes of green-house gases include the burning of fossil fuels.

However, the report indicated that although GHGs have natural and manmade origins, Increasing GHSs such as Carbon Dioxide (Co_2), Methane (CH_4), Nitrous Oxide (N_2O) and Hydrofluorocarbons (HFCs), increases the amount of thermal energy disseminated through radiation into the earth's atmosphere resulting in the overheating of the earth. This effect is warmer temperatures in the atmosphere that trigger extreme climate changes such as floods, droughts and heat waves (IPCC, 2007). Consequently, this impacts people, plants and animals in the ecosystem negatively (IPPC, 2007).

There was further consensus that countries have a mandate to restore ecological balance for current and future generations. One of the agreements was to ease the effects of global warming through reduction of greenhouse gases concentration in the atmosphere to a point that will stop precarious interference with the environmental system (IPPC, 2018). A most inclusive report presented at the sixth Global Environmental Outlook in Nairobi in March 2019 warned that the planet is warming very fast and that if adequate measures are not put in place, it will be hard to prevent global temperatures from rising above the average by 1.50 degrees Celsius during this century. Further, the IPCC noted that in the later part of this century, arid and semi-arid areas in Africa are anticipated to increase with about 5 per cent to 8 per cent. Floods and other high impact climate extremes such as heat waves, drought and rising sea levels will make some areas become increasingly marginal and a likely result will be possible displacement of people (IPCC, 2007)

Not only do environmental hazards such as climate change have negative impacts on life and society, they also disrupt the economic aspect of a state. The economy is fundamental to a country's security. For instance, without collection of taxes from its citizens, a state would be unable to fund its military operations, lack funds to invest in infrastructure and be unable to provide adequate healthcare for its people. Additionally, a states industrial prowess such as infrastructure provides jobs for its citizens, creates wealth and raises a nation's status internationally. This is essential because, without jobs, the quality of people's lives deteriorates to a point where society itself disintegrates.

Scientists from the National Research Council of America believe that environmental hazards make up one of the most severe disruptors of business and supply chain continuity and economic output and growth across the globe (Council, 2008). They argue that global warming causes alterations in weather that affects human welfare. For example, sea level rise results from melting ice caps and increased precipitation give way to altered ecosystems and this increases costs with significant impacts on forestry, agriculture, fishing and wildlife populations (Adams, 1989).

In the Great Lakes Region, the long rains usually experienced in March, April and May have been observed to be decreasing and are significantly distorted with some areas receiving more than usual rainfall amounts while some areas are becoming drier over the last 10 years(RoK, 2016). Where agriculture is extensive for example in Africa, the food security is

greatly under threat as drought periods have become more frequent (Svetlana, Luke, & Riccardo, 2016).

Experts argue that more than half the global population is vulnerable and more than half a billion people are facing severe threats from various forms of meteorological disasters and other climate threats including floods, droughts, landslides and tropical cyclones(GHF, 2009).They warn that it is increasingly becoming imperative to give attention to the security implications of climate change because more people are being exposed to conditions of varying weather patterns of erratic rainfall patters and increasing hot weather. For instance Africa is finding itself in the eye of the climate change storm due to implications of gradual exposure to hazards such as storms, floods and drought. For example, the risk of inundation is raising population migration and other pressures such as an increase in food insecurity, rising poverty levels and vector borne diseases like as cholera, (IPCC, 2012).

In highly populated areas such as urban towns and slums, climate extremes such as floods have a significant negative impact on the people living on these areas than in areas with a few people. This is because more people would require a lot of emergency food aid, clean drinking water and health care that can quickly overwhelm the existing facilities available. At the same time, poor infrastructure especially in rural areas exposes more people to the dangers of possibly losing their lives because inaccessibility as a result of bad roads may prevent people from reaching hospitals that are very far. This also impedes rescue services in case of a disaster.

The IPCC report of 2012 indicates that changing climate leads to varying rates of occurrence, amount, areas covered and instances of weather extremes and climatic occurrences which sometimes results in unprecedented outcomes (IPCC, 2012). Unlike most traditional security threats, climate change triggers multiple effects at different regions and often at the same time. The report also indicated that as more people become exposed to these conditions they will experience various problems such as health and higher poverty levels. The situation is especially serious for marginalized and already vulnerable areas such as in Africa and areas with high aridity. In conditions of drought or flooding, human populations are placed at risk of food insecurity, displacement and high prevalence of disease (IPPC, 2018).

In a study carried out by Sarah Wild (2015) to find out why the African continent is vulnerable to climate change, she observed that the continents geographical predisposition of being a tropical country and the general climate variance raises its vulnerability level in experiencing negative climate scenario. For instance, because Africa sits in the tropics, a generally hot climate region, increasing temperatures expose the continent to adverse climate risk such as droughts and diseases that negatively affect human security in a great way (Wild, 2015). Research also indicates that the global implications of climate change are ominous and particularly so to economies of developing countries. For instance, although emission of carbon dioxide, a key greenhouse gas from Africa accounts for about 3.6 per cent of the global emissions, the consequences of worldwide emissions largely affect emerging economies such as Africa and Latin America.

At the same time, African countries largely depend on natural resources and are therefore extremely susceptible to climate fluctuations and change. Global warming and erratic rainfall patterns often manifest as extreme droughts and flooding which put significant pressure on the viability of the region's development. For developing countries like Kenya and many of the Great Lakes countries, adverse global climatic conditions largely contribute to the negative incomes (Thurlow, Zhu, & Diao, 2008). Expansion in farming remains unstable despite improvements in policy frameworks due to climate conditions and especially rainfall variability. Climate fluctuation is also feared to undermine the efforts to ease poverty given that majority of the poor populace are heavily dependent on farming incomes.

In Kenya for example, realization of sustainable development is uncertain due to recent climate related events affecting the country negatively. The country has in the recent past experienced abnormally hot temperatures and erratic rainfall patterns (RoK, 2016). These manifestations of climate change make up a significant threat to Kenya's natural, economic and manmade systems, on which the nation's economic development and future security depends. Overcoming climate unpredictability therefore poses a major challenge to maintaining agricultural growth, reducing poverty and achieving the millennium development goals. It also amplifies apprehension over potentially negative impacts from climate change.

Gender weaknesses also magnify the problem of climate change further. According to a report on Women and Poverty, statistics from different parts of the world indicate that over 50% of women population is extremely poor (United Nations, 2017). Further, their plight is

accentuated by many factors such as race, income disparities in some parts of the world, cultural practices, ethnicity and age. For example, when natural calamities and extreme weather events take place, women and men are affected differently. One case is when a husband dies and he was the sole bread winner, the widow is automatically thrown into extreme poverty. In Kenya, for instance, women and youth contribute 70% of agricultural labour, but many barriers such lack of access to supportive services exist. For instance, women are many times the caregivers in their households and their time is not paid for. As such, when calamity strikes, they become more affected than men at the household level. These gender disparities become more complicated for women and youth when environmental calamities such as extreme weather destroy their source of income (GOK, 2018)

Women also make up more than 50% of the people who are affected by water stresses worldwide. In many developing economies, women are responsible for water management at the domestic and community level. Records indicate that about more than eight hours a day are used travelling for ten and fifteen kilometers to each trip and transport between twenty to forty litres of water every day. Furthermore, natural calamities and extreme weather predispose women and children to a greater extent of losing their lives. According to a report on the impacts of floods on women (Action Aid, 2014), majority of those who lost their lives were women and children simply because they could not swim and were exposed to more social dangers such as rape, violence and starvation than men. As a result, infant mortality, early marriages of the girls and young women who survived, sexual assault, prostitution and trafficking of women and girls increased (Action Aid, 2014).

Gender roles also predispose women to the negative impacts of environmental hazards. According to a report from the Women and Environment Development Organization (WEDO, 2021), men, especially in rural areas, do not play the role of getting or carrying water. Their relation with water has more to do with agricultural work and with the storage of water. This gender based imbalances have significant negative impacts on the daily lives of women. For example, carrying many litres of water not only causes them physical disorders but also makes it impossible for them to make time for education, income generation, politics and recreation. Long-term and persistent drought also impacts women more acutely. Tens of thousands of at women and girls risk their lives as they migrate across traditional tribal and political boundaries in search of food and water in countries worst affected by drought, such

as Djibouti, Ethiopia, Somalia and Kenya. In addition, this migration worsens existing competition for available resources further over grazing land, water for animals and domestic use. This may provoke tensions among the neighboring clans raising fears of conflict.

Therefore, this study is an urgent necessity to provide insight into preparedness because the environment plays a key role in engendering and giving life, the economic aspect cannot be ignored.

1.1 STATEMENT OF THE PROBLEM

Scientific reports indicate that the climate system has changed significantly. Components of climate such as green house gases have risen and are having serious implications to all countries simultaneously. Experts warn that if combustion and high pollution actions that increase the level of harmful gases in the atmosphere are not reduced, overall temperatures will continue to rise with deleterious implications. Climate change is also causing extreme floods and droughts across many parts of the world.

These risks not only harm the environment but also pose threats to human health, safety through climate extremes such as floods and droughts. For instance, due to flooding and droughts, the agricultural sector in Africa suffers most due to reduced yields and poor crop output. This has multiple implications on the societies due to its implications to food security, job losses and disease prevalence. Besides stress to humans, the impacts of climate changes are leading to increased loss of biodiversity and changing ecosystems. At the same time, the pace at which these threats are spreading across the world is accelerating and what is worrying is that majority of those affected are citizens who are at a more extreme risk of economic, environmental, health, personal, food, community and political insecurities such as women and children.

Ironically, climate change risks are not widely known nor fully recognized. There is no doubt that environmental threats have existential significance to some aspects of natural and societal systems. When natural resources are not available, fundamental aspects of security are at risk. Therefore, a viable environmental system is essential without which life and the entire ecosystem would disintegrate. This research sought to analyze the interaction of climate change with the economic sector of the region and its implications to economic security of the Great Lakes Region.

1.2 RESEARCH QUESTIONS

1. How does global warming affect economic security in the Great Lakes Region?
2. How does an erratic rainfall pattern influence economic Security in the Great Lakes Region?

1.3 OBJECTIVES

The overall objective was to sharpen the understanding of the impacts and challenges of un-arrested global warming and erratic rainfall and how these variables affect the global economy.

1.4 SPECIFIC OBJECTIVES

1. To examine how global warming affects economic security in the Great Lakes Region of Africa.

2. To examine how erratic rainfall influences economic security in the African Great Lakes.

1.5 JUSTIFICATION

1.5.1 POLICY JUSTIFICATION

Climate change plays a major role in the efforts of Africa in realizing the vision of economic growth and a sustainable development pathway. Recognizing where physical weaknesses and exposures to climatic changes combine with other aspects of vulnerability is an important area for policy significance. Scientific evidence shows that climate change is increasingly affecting negatively key societal systems that are important to the success of the continent and the achievement of the vision 2030 goals. For example, global warming and erratic rainfall patterns have given way to declining trends in crop yields; a key component of the region's Gross Domestic Product (GDP), energy needs, infrastructure such as roads and buildings are destroyed during cycles of extreme weather, the health sector and also the trading environment.

With information on the implications of climate on the region's economy, and which part of the economy are most vulnerable, the results of this study will be of great use to policy makers because they can be used to come up with measures that reduce vulnerability as climate evolves. While economic security is aimed at achieving a country's interests by maximizing on the opportunities it has, elimination of threats and vulnerabilities arising from a changing climate is very important because of the economic considerations and financial requirements that are required to achieve this objective. It can generate information important in the development of sound and far sighted economic policies that stimulate trade and prosperity in the face of a changing climate. At the same time, while the information can help in creating and innovation of better adaptation and mitigation strategies.

1.5.2 ACADEMIC JUSTIFICATION

Global warming and erratic rainfall have a debilitating impact on the social, political and economic aspects in society. They are fluid in nature and this has the potential to cause a complete environmental breakdown in the world. Not much literature has been provided about the interaction of environment and other security indicators such the economy and the society. For instance, although Hill and Mejia (2017) studied the effects of climate change on crop yields in Uganda, their study did not show how crop yields affected the economic

position in the region. This shows that there is need for literature that is inclusive of both production and productivity impacts of climate change on other areas of society. This information will be helpful for students and academicians who will be dealing with similar quests in their academic journeys.

1.6 SCOPE

Due to the nature of the climate crisis coupled with other problems such as biodiversity loss, refugee crisis, poverty and diseases such as the recent Covid-19 pandemic ravaging the world and driving the point home that there is a catastrophic breakdown in the natural systems and their function. The failure of international politics including diplomacy to provide solutions to the above predicament provide a glaring hole that more studies and research are needed to show the extent to which climate change affects all aspects of society. The goal of this research study is to show the economic consequences of climate change. It analyzes the conditions that climate change produces that expose economies to risks. While these conditions are many, this study gives attention to global warming and erratic rainfall as components that generate risks to the economies of the Great Lakes region of Africa from 2011-2021.

CHAPTER TWO

2.0 LITERATURE REVIEW

INTRODUCTION

International relations has seen security definition evolve through complex interactions of various social, political and economic aspects of human life. Even the basic form of security at individual level depends on the ability of the person to harness the utility of housing, education and nutrition. National security however depends on a range of domestic and foreign measures to ensure safety of citizens and institutions.

Drawing from the work of various international relations scholars and experts, this section provides an understanding of security in a time of evolving threats such as climate change. This section discusses the link climate change has with economic sectors of a country and what these variables mean economic security. According to the IPCC, climate change is a significant matter that threatens societal security by undermining livelihoods, compromises cultural identities, increases migration that citizens would somewhat rather avoid and also complicates the capability of states to provide the necessary security for its people because of the difficulties states have in adapting, responding and recovering from climate shocks (IPCC, 2012).

2.1 EVOLUTION OF SECURITY

Security has undergone significant evolutionary processes across various contexts. Until the 19th century, scholars and early thinkers sought to explain the meaning of security through various prisms and lenses. Thucydides the ancient Greek historian of the Peloponnesian war expressed fear over the future of Sparta was at risk due to the growing power of the Athenians in 5th century BC. For Thucydides, security meant the ability to defeat a state such as Athens through war. He acknowledged that the more power an actor has, the more he prevails and emerges as a dominant force (Walt, 2010). Political theorist Niccolo Machiavelli who lived in the 16th century AD while writing his most prominent volume the Prince, portrays that a leader needs to do whatever is necessary to protect his position from men who threaten him and his realm (Walt, 2010).

A century later, Thomas Hobbes, in the Leviathan built on Machiavelli's principles arguing that the natural state of the world is always in a state of war where there is constant fear of conflict and death (Lloyd & Sussane, 2018). Hobbes argued that man is basically forced by a need for self guarding and because there is no leviathan to hold man in awe, people would exist in a world that is constantly at war as each person struggles to protect themselves. Essentially, life would be lonely, poor, cruel, violent and short. While total instinct for self preservation may be opposite to our wishes for freedom, it is the only thing that assures security (Hobbes, 1651).

Late 19th and early 20th century and the emergence of the state system appeared to bring control to the Hobbesian world of conflict and chaos. The rise of rational thought dominated security although human natural characteristics of self preservation and competitiveness were evident through leadership styles and decision making. Jean Jacques Rousseau one of the founders of rational thought based his philosophy on the behavior of individuals and applied this principle on states. According to Jean Jacques Rousseau, there are two aspects of insecurity among states; interdependence and inequality. As states become more dependent on one another, this creates suspicion and incompatibility and unequal allocation of resources which are drivers of insecurity (Walt, 2010).

E. H. Carr, echoed the same sentiments by Jean Jacques Rousseau that the lack of security in the world is caused by differences in resources and government structures, differences in ideologies and the hunger for power (Walt, 2010). For Kenneth Waltz, a proponent of the neorealist school of thought argued that states have no choice but to act selfishly so that they can survive in the anarchic environment. To him, power comes second after achieving national security in an anarchic world (Waltz, 2010).To Waltz, insecurity may arise from fear of other states which pushes them to cooperate with others or maintain the status quo. Critical of this proposition, offensive realists such john Mearsheimer dispute this arguing that this is likely to encourage states to seek power so as to deter external threats (Mearsheimer, 2001).

On the other hand, a softer approach than realism saw the rise of liberalism. Inspired by theorists such as Emmanuel Kant and Hugo Grotius, liberalism argues that self preservation is critical and should be a common goal. Emmanuel Kant contends that it is essential for states to cooperate with each other to avoid conflict (Baylis, Smith, & Owens, 2017). Hugo

on the other hand believes in the role of institutions to protect the rights of owners of products and their properties and that free trade fosters cooperation and security among states (Miller, 2014).

However, these traditional theories of understanding threats such as realism, liberalism, neorealism and neoliberal institutional have been used to explain climate politics though from a narrow vantage point, they have been used in identifying and mapping the extent to which cooperation is possible and which benefits these links bring. Realism for instance looks at climate change from the point of power and self interests. Though the neorealist perspective contends that power is the main factor in international relations, currently the United States dominates the international system. However, the United States does not fully support climate change negotiations as was seen when the then President Donald Trump wanted to pull out of the 2015 Paris Agreement to combat climate change.

More positively, the role of Neoliberal Institutionalism cannot be ignored in climate change discourse. To a larger extent, the gains climate change has received has been as a result of institutions such as the United Nations Environmental Program (UNEP), The United Nations Framework Convention on Climate Change (UNFCC).and institutional frameworks such as the Paris Agreement. However, for developing countries which have not developed their countries to match the more advanced countries, there is a common agreement that responsibility of climate change problems should not be equal.

In addition constructivism, a modern school of thought contributes immensely to the security debate. Constructivism argues that national security is a phenomenon of social construction brought about by aspects of social environments such as identity, norms and aspects of culture. For instance, in defining anarchy, Alexander Wendt argues that the anarchic nature of the global system is socially constructed, therefore Wendt opines that national security interests should also be socially constructed (Wendt, 1992). According to Wendt, the interaction of states through norms and identities shapes security outcomes. For example, what is considered normal in one region may be considered a threat in another region.

On the other hand, critical constructivism examines the ways in which threats are perceived and the referent objects. Barry Buzan, Ole Weaver and Jaap de wilde, supporters of this

school of thought argue that the referent object goes beyond the state and that security definition should be enlarged to incorporate issues of societal, environmental and of economic nature (Buzan, Weaver, & Wild, Security: A New Framework for Analysis. , 1998). To them insecurities and uncertainties may arise from any of this sector and if ignored, they may cause existential risks to the survival of man and the state. Today the nature of security has expanded so much such as from environmental hazards that may have catastrophic effects to the rise of fundamentalism as a driver of terrorism and violence.

In understanding the potential impact climate change has on the economy, various experts have operationalized the concept of vulnerability to climate change. The fourth Assessment report by the IPCC (2012) defines vulnerability as the degree to which a system is predisposed to suffer diminished capacity of coping with adverse effects of climate including climate susceptibility and extremes. According to the IPCC (2012), Vulnerability is a function of the nature, extent and speed of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity (IPCC, 2012). Risk on the other hand is a situation that involves the probability that one will be exposed to change. Vulnerability is therefore a part of risk and risk is seen as a function of both exposure to physical hazards and vulnerability (IPCC, 2012).

This research will draw mostly upon the theory of constructivism due to the nature of the problem we have currently and that is climate change. While threats in the traditional sense were conceived using a military symmetrical perspective, today threats are more of an asymmetrical nature that may result from the environment itself, land and forest degradation, eco threats from terrorist groups, resources, water and food scarcities. Because of the convergence of these vulnerabilities and threats, there is need for new thinking that encompasses all these aspects and is able to harness the instruments of power to mitigate, adapt and prevent the negative impacts of climate change.

Economic security refers to a situation of stability whereby one is able to maximize on material wealthand being in a position to and the ability to lower one's exposure to threats and vulnerabilities. However, climate change distorts this ability and capacity to manage uncertainties arising from the climate change domain. This study aims to highlight the magnitude of the implications of exposure to climate vulnerabilities and risks across the economic spectrum whereby vulnerabilities and risks are linked or overlap with diverse

systems of physical, socio economic and political aspects of society.

2.2 LINK BETWEEN THE ENVIRONMENT AND SECURITY

Climate change involves much more than the weather disparities experienced in different regions and geographical areas. It can bring with it many kinds of changes in the natural systems that have created a myriad of environmental, political, economic and social disruptions over centuries and millennia. Experts contend that climate change introduces conditions that produce risks and uncertainties across a wide range of societal aspects. One way in which these conditions come about according to (Buzan, Weaver, & Wild, 1998) is that the environment encompasses wide fields of uncertainties to security that range from survival of species to minimizing these risks.

According to the (IPCC, 2012), is that the world exists within planetary boundaries that are all deeply connected, but within these boundaries there are core planetary boundaries which heavily impact on others. These planetary boundaries keep the planet in a state that allows humanity and the biomes to prosper. Other scientists such as (Buzan, Weaver, & Wild, 1998) and local experts on weather phenomena agree. However, when planetary boundaries including the core boundaries such as climate and biodiversity are affected negatively, environmental risks arise. For instance, the climate mechanism can trigger feedbacks where small gradual changes in one component of the system can trigger unprecedented events such as earthquakes, floods and droughts among other climate extremes (Treut, et al., 2007)

Even as planetary boundaries are all deeply connected (IPCC, 2012), (Buzan, Weaver, & Willde, 1998) and (Trenberth, 2011) increasing evidence points to the fact that the planet is speedily moving from the safe operating space and it is now at a global crisis point where droughts, floods, landslides and other climate extremes dominate the weather conditions (IPCC, 2012), (RoK, 2016) and (GHF, 2009). Researchers indicate that we are now more than ever at a risk of crossing tipping points that may shift the planet to potentially catastrophic levels. One theory put across for this changing landscape is that the evolution of the climate system is influenced by its own internal dynamics and external factors that influence how climate manifests. The external factors may arise from natural causes such as volcanic activity and solar variations that cause changes in atmospheric composition and anthropogenic activities.

Today, the human hand print plays a huge role in climate change and can be blamed for much of the global environmental concerns being experienced (IPCC, 2019). For example, although global warming occurs naturally, where average temperatures of the earth increase, the increased pace of the warming and increase of greenhouse gases in the atmosphere are directly linked to human activities. According to the IPCC, the average temperature of the earth has increased by 0.8^0 compared to the nineteenth century. This is largely as a result of the high population growth rate that leads to unsustainable human consumption patterns which adds on the greenhouse gas concentrations. These consumption patterns are driven by among many factors such as globalization and human processing practices. At the speed of current carbon dioxide emissions, scientists expect an increase of between 1.50 and 5.30 celsius in average temperatures by the year 2100.

A lot of evidence shows that social economic systems are catastrophically undermining the natural environment. For example, according to the IPCC (2019) special report on climate change and land use, between 2007 and 2016, twenty three percent of the total anthropogenic green house gases came from unsustainable agricultural practices, forestry and other poor land use activities. Other major reports have brought attention to the convergent crisis such as increasing extinction rates (IPBES, 19), looming water crisis (UNESCO, 19) and the increasing global hunger (FAO, 19) all these resulting in health issues and deaths. For instance, the current global Covid-19 Pandemic has pointed to vulnerabilities that arise when agricultural practices are pushed further into the forest which interferes with the wildlife systems and hence these areas become breeding grounds for the emergence and reemergence of zoonotic diseases (ILRI).

Furthermore, because drought cycles are usually followed by extreme rainfall and flooding events, climate scientists predict that natural ecosystems will be further affected thus increasing the probabilities of extinction, alien invasion and spread of pandemics (Goodman, 2017). Climate change can affect the way diseases spread across geographical areas. First, climate can alter the life cycles of disease carrying insects such as mosquitoes by changing the insect's adaptive capacity to withstand extreme climate changes and cause further and more infections. Floods may be harmful to the minorities' population mainly living in poor over crowded urban settlement where drainage and sanitation services are constrained. As a result, outbreaks of waterborne diseases increase and may cause many deaths. The World

Health Organization estimates that in the next thirty years, climate change extremes will kill more than two hundred and fifty million people through disease spread such as malaria, cholera and dengue fever.

Therefore, unlike ancient security concerns that involve actions of a single country against another and mostly involving ignition of military elements in security conceptualization, climate change as a modern threat brings multiple persistent conditions globally that impact life negatively (Buzan, Weaver, & Wild, 1998), (IPCC, 2012), (IPCC, 2019), (UNESCO, 19) For example, climate changes in nature when they occur, they impact all countries at the same time. At the moment, polar ice shields are melting and the sea is rising among countries with coastal beaches. The implication this brings is that for most of the populations living along coastlines, migration will be inevitable. As a result humanitarian problems and tensions will begin to emerge.

On the biosphere, scientists warn that due to climate change, the ecosystems and the life that depends on them are at risk (IPCC, 2019). Today, biodiversity loss in among the most urgent and to slow down or stop these losses, bold management of resources must be implemented. For instance, the African continent is home to most species of plants, birds, marine and land animals. (Myers, 1997). These species inhabit the richest diverse biological ecosystems such as savannahs in East Africa, tropical forests, coral reef marine and fresh water habitats such as the Lake Victoria, wetlands and montane ecosystems. But due to a change in climate, these ecosystems and the life that depends on them are threatened (Myers, 1997). Myers argues that not only are floods washing away plants and animals, the effects of hot temperatures on the nesting and feeding hubs of marine life are causing their decline in large numbers. In addition, the risk of alien species is making aquaculture highly unsustainable (Myers, 1997).

In Kenya Conservationists at the Government run Kenya Wildlife Service for Lake Baringo fear that there is an ecological disaster looming if and when Lake Bogoria and Lake Baringo merge due to persistent flooding (Komen, 2020). This is because Lake Baringo is a freshwater lake while Lake Bogoria is an alkaline lake. Because of this, the birds, fish, hippopotamuses and crocodiles and the many lives that depend on the lakes are at risk (Komen, 2020). Furthermore, the government risks losing revenue from tourism, fishing and agriculture.

In addition, in the human security domain evidence points to the fact that although climate plays a critical role in ecosystem services that many communities rely on for their needs, extreme climatic events are causing unprecedented levels of uncertainty thereby exposing them to risks (IPCC (2012), (IPCC, 2012), (Suleri, 2012). One of the ways climate change impacts human security is associated with food security (IPCC, 2012), (Suleri, 2012), according to the IPCC, a food secure country is whereby all citizens are able to access enough healthy food in order to maintain a healthy life. However, human health declines when people are unable to access food because of various reasons such as price hikes, natural causes that prevent production or supply of food in the market as well government restrictions. This can be detrimental to the state both at the micro and macro levels.

Not only is climate change influencing the scope to which a region exhibits its weather patterns, scientists contend that it is undeniably apparent that the negative effects of climate change are heavily impacting the atmosphere and the life that depends on it (United Nations (2016), Wild (2015), Myers (1997) and Komen (2020). At international and local levels, climate threatens and exposes many areas to new and hostile stress factors. For example, extreme weather has the potential to create prolonged natural and humanitarian catastrophes on an exponential level that can go beyond comprehension. For example, where societal demands are larger than the ability of the government to cope, political instability, displacement and conflict often follow.

In addition, sustained climate change is said to seriously exacerbate already vulnerable societies in developing countries such as Asia and Africa and scientists are calling for urgent and effective interventions. The IPCC (2001, 2012), (Bushby, Smith, White, & Strange, 2013) and (Odingo, 2007) assert that this vulnerability is in part driven by the continent's geographical predisposition where the physical effects of climate change are likely to be most severe on the planet. For instance, (Basher & Briceno, 2005) contend that due to the lack of capacity of many African governments in coping with disasters, climate change seems to add on to the problems experienced such as poor economies, poor health care systems, weak education systems, lack of infrastructure and bad governance practices.

Global poverty also increases as the climate changes further worsening conditions in vulnerable areas. In Africa for example, scientists indicate that the continent is more

defenseless against the effects of drought that include reduced agricultural outputs, heat waves, water scarcities and livestock death (Mutanga, 2013) (IPCC, 2012), (GOK, 2018). They contend that, when climate changes, resources such as water and food become constrained sometimes to a point where they are not available. People may lose their crops, for example through floods for people who depend on agriculture. Sometimes the roads may become impassable causing their perishable food crops to rot before they reach the intended consumer. These impacts may constrain the government's available resources sometimes to a point where it is unable to cope.

The Great Lakes region of Africa is a commercial, transportation and communication hub of East Africa. It has experienced moderate economic growth over the past five years in areas such as education. Although the region has many countries such as Kenya which are attractive to investors and the ninth largest economy in Africa with a Gross National Income per capita of US dollars 1,380. Close to forty five per cent of the population live below the poverty line of about a dollar a day with female households reporting higher poverty rates. Fifty four per cent of rural and sixty three per cent of women in towns and young girls are estimated to live below a dollar a day which makes them more susceptible to the effects of climate change (GOK, 2018).

According to the World Bank (2016), the continent has recorded increasing water scarcity because of increased use and need from the rising population and industrial use. This problem is not only making the management of the resource more difficult but it is also interfering with the social life of the people. It is also increasing the likelihood of conflict and war. The report found that water stress will cost sub-Saharan countries a whooping six per cent of their gross domestic products because of expensive energy needs and agricultural systems due to increasing human populations. In addition, potential hydro scarcities will not only hurt the economy but reverberate far and beyond into food, urban and environmental systems. The convergence of this, the report noted that water stress acts as a threat multiplier and could potentially lead to war. For instance, the conflict between Kenya and Ethiopia is as a result of declining water levels at the border (World-Bank, 2016).

Further warning from scientists and researchers reports that the influence of climate on weather outcomes have confirmed that increased atmospheric heat leads to differences in rainfall amounts received IPCC (2012), Trenberth (2011), Coles and Back (2013), and

Orindi and Murray (Orindi & Murray, 2005). For instance, Orindi and Murray reported that increased temperatures on the African continent will worsen the weather including increased incidences of floods and droughts while Coles and Back indicated that in Australia, some regions are receiving very high rainfall after cycles of extensive heat while others receive very low amounts of rainfall. Across these studies however, there is a wide range of uncertainty generated by atmospheric temperatures.

The United Nations (2014) has reported that climate changes such global warming is predicted to increase the number of environmental refugees because of disasters such as flooding, droughts, landslides, melting glaciers and ocean acidification. This is a huge security concern because climate extremes usually amplify other security problems such as conflicts over natural resources. The report indicates that migration in Africa has been on an upward trend because of the continent's strategic position in the tropics (United-Nations, 2016). For example, between 2010 and 2015 about 2.9 million people were lost through migratory practices. One reason for this situation has been blamed to flooding (Wild, 2015).

The increasing relevance of traditional challenges that could develop because of climate and environmental changes are among others droughts and flooding (Goodman, 2017). While traditional security challenges require the input of military activities in conventional engagements, the climate change domain requires the security forces to prevent conflicts that are largely driven by environmental changes. Although droughts and floods have occurred since the beginning of time, it is projected that the ongoing climate crisis will increase their occurrence and frequency (IPPC, 2018), (Goodman, 2017). The intergovernmental Panel on Climate Change (IPCC), estimates that because of increasing global temperatures, there will be expansion of areas experiencing droughts and floods. As a result of this increase this will have a disastrous effect to farmers around the globe.

According to the United Nations Environmental Program, there exists a triangular relationship between people, the environment and the economy that is more direct in Africa than it is in the developed world. This is because that relationship is masked by technology and industrialization. In addition, this symbiotic relationship between the environment, crops and animals has been recognized as a critical component of environmental sustainability. However, the insatiable demand for natural resources to drive consumer demand has led to environmental degradation making large parts of the world unfit for human habitation. Not

only that, coastal flooding is expected to further complicate the lives of many people who live along coastlines. As a result, the degradation of many ecosystems is likely to be exceeded by generation due to a combination of climate change, coupled by extremes such as floods, droughts and ocean acidification including other anthropogenic activities.

2.3 LINK BEWEEN THE ENVIRONMENT AND ECONOMIC SECURITY

Although climate change and its extremes seem to overlap and affect many societal aspects, the economic sector is mostly caught between because of its significance to provision of funds to economic processes. It is also the basis of a country's security in that it ensures a level of safety that includes internal and external stability necessary for normal state as well and international functions (Litvinenko, 2013). Although there is no absolute economic security, a country's geographical location, natural resources, industrial and agricultural potential, the level of social development and the quality of its institutions affect a country's economic capabilities. The more a country is able to maximize gains and utilities of these resources, the higher its security capability (Litvinenko, 2013), (Tamosiuniene & Munteanu, 2015) and (Gregoriva & Fesina, 2013). In fact, Dhonte and Kapur think that a secure economic environment is perhaps a very important factor for promoting investment in developing countries (Dhonte & Kapur, 1997).

However, Economic implications associated with negative global climate risks and uncertainties have shown upsetting trends to the business environment. According to the World Economic Forum's (2019) Regional Risk for Doing Business Report, environmental factors feature among the top risks not only presenting in terms of various physical threats but also in the form of economic hazards of to the future of the international society. Some studies indicate that some economic activities are enhanced by good climate such as agricultural activities while others are undermined by poor climate and weather related events. For an individual, economic security is reflected by his stable income and other sources that uphold a level of a comfortable lifestyle and in the expected future.

Physical threats manifest as extreme weather conditions such as floods, droughts, wildfires, tropical storms among others. They present various risks to the security of a business with some reports from various parts of the world indicating that natural calamities and extreme weather events are among the highest risks faced by businesses today (WEF, 2019), (CRED, 19) (Ajowopi, 2017), (Bushby, 2008). For instance in North America, natural disasters and extreme weather have had a significant impact in the business world in the recent past. For example, water stress, world fires, floods and tropical threats rank higher for businesses than in other sectors. In 2018, North America and East Asia accounted for fifty per cent of the

global natural disasters. It was reported that these disasters claimed over eighty per cent of the total global deaths and a further fifty six billion dollars in terms of cost with fifty million livelihoods affected by climate related changes (WEF, 2019).

The report further indicated that although the Asia Pacific regions bears the most brunt in terms of loss of life, its large and highly vulnerable population make the region especially susceptible to economic losses when a natural catastrophe or an extreme weather event occurs (WEF, 2019). These problems have been compounded by the industrialization and unplanned urbanization which have led to environmental degradation which weakens the region's natural defenses against climate disasters. The report further claimed that if left unchecked, the growing frequency of climate events runs the risk of eroding East Asia and the Pacific's economic competitiveness (WEF, 2019).

In Africa and most of the East African region, the World Economic Forum report (WEF, 2019) indicated that extreme weather events and natural catastrophes topped the list of problems faced by small and micro enterprises. Problems such as desertification and water crisis, additional costs of energy and power as well inflationary costs due to climate vulnerabilities has continued to increase with changing climate. A study by the United Nations Environmental Program found that climate change increases the cost of capital in developing countries (UNEP, 2018). The study showed that in the past decade, developing countries sampled endured forty billion dollars in additional interest of payments on government debt alone (UNEP, 2018) (Fanjul, 2020).

Additionally, economic costs incurred are also a huge burden to states. For instance, a study carried out to provide knowledge on economic value of Kenya's Environmental resources, it was found that while forests in Kenya contribute to over one hundred million dollars per year to the national economy, the economic costs of land degradation were in excess on seventy million dollars per annum between 1992 and 1997 (Ndugire & Bokea, 1998) and (Harding & Devissher, 2009) meaning that these losses could otherwise be avoided with proper management and planning or resources.

Supply and demand of commodities is also affected by rainfall patterns through changes in yields. For example, while adequate rainfall supports harvests and raises people's income, drought also reduces supply especially in the agricultural sector. (Hill & Mejia, 2017) carried

out a study to examine the impacts of increasing temperatures on crops for example soybean and corn production in china, it was found increased temperatures had a negative impact on the production of these crops countrywide (Hill & Mejia, 2017). The study indicated that at certain temperatures, these crops did well and then started decreasing at thresholds of 29 degrees Celsius for corn and 30 degrees Celsius for soybeans (Chen, Chen, & Xu, 2016). In the fishing industry, there has been a decline in the lake's fisheries due to overfishing and the degradation of the environment from anthropogenic activities (Kassenga, 1997).

Similar studies carried out in America indicated that corn was seen to do well at 29 degrees Celsius, 30 degrees Celsius for Soybeans and 32 degrees Celsius for cotton. In Uganda between 2005 and 2011, a ten per cent decline in water because of lower amounts of rainfall saw crop yields reduce by between fourteen and twenty per cent (Hill & Mejia, 2017). In Kenya, livestock farming in arid and semi-arid regions is highly vulnerable to distorted rainfall patterns. Drought in these areas increases domestic animals morbidity and death because of lack of pasture, infection intolerance and poor support infrastructure such as marketing channels (RoK, 2016).

The World Trade Organization (WTO) opines that economic dependency on primary products that are vulnerable to climate variations exposes countries to poor economic growth and development (WTO, 2014). For instance in sub-Saharan Africa where primary sector dependence is high, the market share in the global manufacturing trade is usually low. This is because primary products fetch low prices on the world markets compared to finished products. According to the United Nations (2016) report, in an instance where natural environmental calamities such as floods and drought take place, export incomes fall thereby reducing a country's terms of trade. Similar results by Gregoriva and Fesina, (Hill & Mejia, 2017) as well as the Economist report of (2015)indicated that for farmers and industries that depend on agricultural output as a means of income generation, production shocks due to weather disruptions can affect how much income can be generated (Collier, Cornwar, & Venables, 2008) (Ajowopi, 2017).

Although The Great Lakes Region of Africa is rich in diverse natural resources and also has great potential in other areas such as tourism because of its rich geographical landscape with diverse natural tourist attractions and potential for rain fed agriculture. Observed changes from research indicate that the continent will have to endure increasing negative impacts

arising from climate changes such as extreme temperature or global warming, intense precipitation, rising sea levels as well as but not limited to diminishing resources. For instance, the United Nations reported that among other factors such as competition for resources, increasing population pressures and climate change, the convergence of these stresses put a lot of pressure on the accessibility and utilization of natural resources such as land, water and ecosystems (UnitedNations, 2013).

Reports indicate that because of reduced natural resources, the lives of many people who depend on these resources are at risk. For instance, while studying the impacts of climate change in Sri Lanka, Nazran Baba reported that because of reducing fish stocks, fishing along the coastline had been negatively affected. Likewise, Dunne (2007), (GOK, 2013) (GOK, 2018) noted that poverty levels had increased among people who depend on fishing in Migingo island and in Kenya as a result of reduced natural resources such as fish. In Kenya, the fishing industry supports directly and indirectly about thirty million inhabitants with jobs with fishing being the pivot of economic activities and generates about four billion shillings in revenue annually (Gitonga & Achoki, 2004).

Poverty in the world is also increasingly becoming concentrated in developing countries such as in Africa and among households engaged in primary industries such as agriculture. For instance, uncertain weather and climate extremes negatively affects famers. For example during drought periods, lower yields increases demand of food crops causing the prices to spike. The effect of this is that higher consumption prices impact negatively on income and this can influence farmer's ability to escape poverty such as was seen in the Russian droughts of 2010. When crop prices rise, vulnerable people can be pushed further into poverty because a large proportion of their budget is spent to buy foodstuff the rest of the population (Ivanic, Will, & Zaman, 2012). This can also magnify other societal problems such as lack of funds to access healthcare.

Because of poverty, the problem of youth unemployment in Africa and in the region becomes a cause of great insecurity. The rise of fundamentalism luring young people into terrorism and crime is a monster that needs more efforts to tackle. In Kenya for example, according to the International Labor Organization (ILO), Kenya's youth unemployment rate has shown little to no positive development and as at 2016, it stood at a shocking twenty two per cent. Not only that, over twenty percent of the Kenyan population is comprised of young people who majority of them are unemployed (AFIDEP, 2017). Hallegate and others investigated a

total of 52 countries to get a global picture of how climate change affects poverty levels. They found that eighty five per cent of the populations analyzed live in countries where drought is prevalent and around sixty per cent are exposed to river floods (Hallegate, et al., 2016).

While economic security is one aspect of human security according to the United Nations that is greatly affected by climate change, other aspects of human security that undermine sustainable development and suffer more under climate change scenarios are food, health, personal, community security and political security. One way in which climate change connects with security is its effect on food security. According to the 2019 Global Hunger Index (GHI), climate disasters that have increased rapidly in the last three decades have caused harm to low income families and their access to food. Experts predict that this trend is not likely to go away soon as hotter temperatures are expected to increase (GHI, 2019) and (Nelson, et al., 2016).

This paints a grim picture of the need to reduce global hunger. This is because; while floods may cut access to good quality food, the prices of most food products seem to be going up during times of extreme weather. Food production is also affected as farmers report poor crop yields. Furthermore, farming around the world contributes about 30% percent of greenhouse gas emissions. These losses therefore worsen climate change without improving food situation or nutrition. Therefore, ending hunger and under nutrition in a changing climate demands large scale action that will not only support human capital in terms of reduced fatalities as a result of malnutrition and other nutrition related complications.

The prevalence of diseases and other medical issues seem to be worsening as climate warms and extremes experienced. Health experts warn that human health is at risk because many infections are temperature dependent. For example, health scientists indicate that changes in climate can and does alter the transmission of communicable infections like cholera, and other vector borne diseases like Malaria. When this happens, more people become susceptible to infections. In addition, weather extremes for example flooding and storms can cause destruction of water storage centers or lead to break down to sewer lines which on the flip side increases the prevalence of diseases. This scenario has been established in Kenya, Uganda, Ethiopia, Tanzania and Rwanda (Ajowopi, 2017). Likewise, case studies from the effects of environmental changes in East African highlands indicate that vectors are changing

their prevalence rates as temperature and rainfall shifts by either re-emerging or emerging from areas they were previously not found (Afrane, Githeko, & Yan, 2012).

The health aspect in many developing countries is more complicated because it cuts across issues such as availability of safe drinking water, safe environment for living in, affordable health care and maternal support, HIV Aids prevention and other diseases such as pandemics. For example, the Covid 19 pandemic that emerged from China in December 2019 is tipping the world into a dangerous volatile phase. First, the global economic environment is on a declining trend that experts fear could be worse than the great depression. With travel restrictions and supply chain disruptions, marked dynamics will mean that price of many commodities will be affected upwards. In addition, many negative implications are following such as unemployment and food insecurity. These stresses may quickly escalate into mass unrests and eventually conflict. In Kenya for example, over one and a half million people have lost their jobs in the tourism sector as of September 2020 due to Covid 19 containment measures such as travel restrictions and social distancing measures to reduce the spread of Covid 19 pandemic.

Presently, the lack of an international framework to deal with a global pandemic is not helping the situation even as most of the developed countries have suffered severe spread of the pandemic. While worldwide, over two million people have been lost to the pandemic, many more vulnerabilities arise. For example almost all schools around the world are closed and even in as much as many schools are turning to technology to bridge the gap, majority of the children in developing countries are at home. Not only that, although crime has generally gone down according to the government of Kenya report, organized criminals are already exploiting this pandemic through exploitation of other spaces such as cyber space. It has been reported that since Covid 19 began, cyber crime and other abuses such as domestic violence have spiked.

Scientists conclude that the spread of diseases under conditions of a changing climate will continue worsening including those of animal and plant health. For example, the spread of emerging and re emerging diseases such as yellow fever and many communicable diseases like cholera carry significant threats to human health. The IPCC projects that in current global environment, endemic morbidities and mortalities due to communicable diseases associated with climatic and weather changes are expected to increase as the climate changes.

Furthermore, the shortage of health care workers globally is a cause for concern. According to the World Health Organization (2020) report on nurses worldwide, it showed that the continuous migration of nurses from low and middle income countries to high income countries has left many nations in Africa in dire need of health care workers even as their demand in more developed countries continues to rise.

Furthermore, while all people are at risk of failing health, poor people suffer more. For instance, infections such as malaria and diarrhea are largely magnified by hot and wet weather patterns and since most of poor people are uninsured, health expenses are regressive, from lost incomes and high consumptive prices and this pushes an estimated one hundred million people into poverty per year (World-Bank, 2018). The vulnerable such as women and children can be exposed to irreversible effects that could affect their earning power and lead to cycles of poverty (World-Bank, 2018). Additionally poor people may not be able to get social support from and may have a more limited security to guarantee loans from financial institutions (World-Bank, 2018).

Social stress is another key indicator of economic insecurity and climate change seems to magnify this problem. It has been found that climate change is exacerbated by local environmental hazards such as pollution and urbanization. According to (Fisher & Knutti, 2015), about seventy five per cent of the moderate hot extremes over land and eighteen percent of moderate rainfall extremes are as a result of global warming due to anthropogenic actions. As a result, climate shocks such as heat waves which are not so common today are predicted to increase by the year 2100 if nothing is done to stop the trend. The 2013 record temperatures in Australia could be an indication of what is likely to happen (Lewis & Karoly, 2013). The implications can be devastating to societal sections of the population that are highly vulnerable such as children, women, the elderly and refugees.

As a result of risk exposures and vulnerability, global warming and its negative impacts affect military operations and critical infrastructure in a great way. For example, sea level rise and other natural disasters increase the number of people being forced to move from their homes close to the shores and move on higher ground. This puts additional pressure to the government to provide housing, drainage and basic infrastructure necessary to accommodate the migrants (King, 2014). For example, when hurricane Sandy hit the U.S. in 2012, an estimate of the disaster indicates that 1.8 million buildings were destroyed. Losses in the

economy were above US$ 65 billion including all major sectors with tourism being hardest hit industry, with thousands of job cuts and losses exceeding US$ 1 billion (Liverman & Glasmeier, 2014). In the Lake Victoria Basin, tourism has also been hampered by climate change. For example, deforestation and severe anthropogenic activity at the Mau Forest has reduced the water levels such that wild beasts' population considered as the World's Eighth Wonder have reduced.

Pollution and Ocean acidification is mainly caused by carbon dioxide gas in the atmosphere which also dissolves in the oceans (IPCC, 2007). This leads to a lowering of the waters Ph making the ocean more acidic. In the past, ocean acidification occurred at a much slower pace but now it is occurring much faster due to anthropogenic increase of carbon dioxide in the atmosphere. As a result fresh water organisms are severely stressed and are unable to survive. When this happens, it is feared that this degradation of ocean habitats is destroying many marine food supplies around the globe. Consequently, this irregular challenge presented by loss of these major food chains could induce massive movements of environmental refugees that may cascade into full blown conflicts.

Many researchers today consider climate change a cumulative and non linear irregular challenge (Buzan B. , 2009), (Goodman, 2017), (IPCC, 2012), (Gray C. , 22). Its evolution is said to be a chaotic scenario as well as its consequences. For instance the collapse of fishing industries across the globe due to ocean acidification and other impurities could trigger conflicts locally as well as with neighboring countries because many environmental refugees move from their seaside homes in search of other sources of livelihoods. Experts warn that this movement of people in large volumes presents serious challenges to the economic and security resources of the states that receive the migrating populations.

Climate changes are also feared to have extensive disruptive abilities that may cancel out a country's ability to respond or adapt to climate change (IPCC, 2012). For instance, environmental catastrophies have potential to cause mass destruction effects that could induce both natural and human systems failure resulting in global calamities. For example, sea level rise has been reported consistently as more ice melts from the Polar Regions due to global warming (IPCC, 2007). Experts warn that melting ice is happening much faster and it may be approaching catastrophic levels. In the Great Lakes Region, the coastal region of Mombasa is having inundation effects as water pushes inwards from the sea (GOK, 2018).

Therefore, disaster management and planning should encompass reducing vulnerabilities while building resilience.

2.4 BARRIERS AND LIMITATIONS IN DEALING WITH CLIMATE CHANGE

The climate change debate has dominated much of the 20th and 21st environmental concerns. The first ever conference on environmental issues, The Stockholm Conference, 1972 took stock of anthropogenic impacts on the environment and asked for a shared view and outlook to encourage and guide the global community to safeguard and improve the environment for the benefit of all. Major outcomes of the conference included a call for all states to make resources available to protect and recover the environment; it identified science and technology as an important tool for addressing environmental challenges.

Furthermore developments in reducing and managing the impacts of a changing climate in the 20th century included the Kyoto Protocol of 1998. It noted the role of greenhouse gas in global warming and called for sustainable practices that reduce greenhouse gas emissions. Some of these practices include forest management practices, sustainable agricultural practices such as crop rotation and different crop mixes, energy efficiency and utilization of environmental friendly technologies.

However, dealing with climate change impacts has been hampered by many challenges arising locally as well as globally and especially so in developing countries. One of the challenges that limit most developing countries in the ability to prevent and reduce the impacts of climate changes is the costs associated with extreme weather implications. The consequences are usually very expensive to the economies in terms of prevention and response. Associated costs for instance according to the Kenya National Climate Change Action Plan 2018-2022, climate change contributes to massive loss of life and biodiversity. In addition, it multiplies risks in other sectors of the economy such as health and social welfare. Because the countries are still at the infancy state and much of their capital is still in the primary industry, budgetary constraints hinder them from fully investing in climate change.

This is further explained by the structural differences existing at the international level. While

climate change is both caused by natural and human factors, more than eighty percent of the anthropogenic effects of adverse climate extremes have been attributed to have been as a result of the actions of developed nations during their industrial ages and processes. To make the matters works, the heaviest of these consequences continue to be felt more by the developing nations (Maikasuwa, 2013). In addition, in developed countries, governance for adapting to climate change is component of the work done at village level. It merges with laid policies to control natural resource use, the laying of protective mechanisms and methods of tax receipts. Developing countries however have an unstructured plan of climate mitigation, usually done by well-wishers, the government and nongovernmental organizations.

Challenges in governance structures and political institutions that provide regulations that deal with climate related stresses are not as effective as in providing frameworks that work in dealing with the problem of climate. In Kenya for example, the undesirable impacts of climate change are complicated by human activities and inaction that degrade the environment such as corruption, illegal encroachments, deforestation and livestock feeding. According to the Green Belt Movement, the number of forests in the country has declined significantly from 12 per cent to 2 per cent today since 1960. There is consequently a need for ground-breaking that enforce environmental support strategies and practices.

For instance, poor environmental conservation and preservation of the Mau Forest in Kenya, a source of most rivers in the region has now taken a political twist that results in further deforestation and riparian land degradation. Spanning 900km^2, it is an indigenous forest in East Africa that provides critical ecosystem services not only for Kenya but also for the entire region. The Kenya government and the United Nations Environmental Program (UNEP) based in Nairobi claim that the forest plays a significant role in Kenya's tea, tourism and energy sectors. Therefore, destruction would have significant cultural, social and serious environmental and economic implications. (RoK, 2009).

The region is fraught with elected politicians who lack political goodwill to protect the environment. Some take institutional incentives for inaction or they may fuel conflict. This action exposes many vulnerable people in the region to poverty and other social ills. In the 2019 Bill and Melinda Gates foundation's third annual Goalkeepers Data Report that tracks health, development and inequality data around the world, gender inequality remains a big challenge that is magnified by climate changes. The foundation opines that for girls all over the world, their lives are harder and much harder if they are born in a poorer country.

According to the report, females receive less education and they do more unpaid work than their male counterparts. This means that while a boy's world will enlarge and be full of opportunities, a girl's world will contract (Gates, 2019).

Post colonial problems can be blamed for the inability of African states to achieve industrial status. Many countries including the Great Lakes Countries of Africa took over from rulers whose policies did not match the local needs of the people. For example, in Kenya, lack of political inclusion has been linked to a lot of political unrest and has been used as a reason to spread ethnic division by politicians. Secondly, reliance on natural resources weakens developing countries further because an abundance of these resources allows countries to become rent seeking economies, this fact allows complacency to creep in with lower motivation to develop the bigger economy as would governments of states that lack natural resources. The poorer governments are forced to give public goods in order to raise taxes and run other government functions (Otoabasi, 2013).

Furthermore, climate change issues lack proper conceptual and theoretical tools of analysis. For instance, until now, global governance structures have not reached consensus on the mitigation policies and there is a standoff over the impossibility of reconciling the needs of developed countries and emerging economies. During the United Nations Framework Convention on Climate Change (UNFCCC) Conference in Durban South Africa in 2011, parties agreed to postpone the decisions about what to do after the Kyoto Protocol expires. For President Yoweri Museveni of Uganda, greenhouse gas emissions are an act of aggression by the developed world against the developing world. At the 2007 UN Security Council debate on the impact of climate change, the Namibian representative Kaire Mbuende called greenhouse gas emissions tantamount to low intensity biological or chemical warfare.

For example, for the past two decades, the challenge by the Ugandan's over the sovereignty of Migingo Island has fuelled tensions in communities living on the island and due to declining fish population in the lake and a larger human population residing at the lake, the tensions may break out as full conflicts. On the one hand, Uganda claims that the island is within its borders while Kenya claims the same. Experts warn that there may also be spillover effects transcending borders and expanding the geographic range of conflicts. Such risks are exacerbated when accompanied by weak governance and rapid population growth (Dunne, 2007).

Adaptation measures are sometimes mixed with ongoing development and poverty reducing agendas. Although some progress made at the village level, for example, by municipalities, its control measures to trim down emissions have evolved slowly. This has been complicated by the fact that some climate negotiations put significant emphasis on the role of market tools to regulate and create incentives for decreased greenhouse gas pollution (Aldy & Stavins, 2009). The focal point is on carbon only, and on markets as key tools for change such as advocating for green economies.

These policies do not deal with the fundamental causes of climate change which are rooted in ideas of expansion and growth that have made consumption the most important measure of a good economy and of people's individual perceptions of well-being. Furthermore, these market solutions do not propose new institutions needed to close up the major governance gaps required to manage unavoidable climate change impacts. In the case of developing countries, the management of these policy mechanisms is in the hands of global development institutions such as the World Bank, which are mainstreaming matters related to climate into their ongoing programs and, thus, perpetuating existing neoliberal, market-based solutions to both issues. (All, 2013).

Although the region has seen notable efforts to save the environment spearheaded by the first ever Kenyan Nobel Laureate, The late Wangari Mathai (1940 – 2011), who not only increased the awareness and capability of countryside communities to act against climate changes as well as increase consciousness countrywide on the responsibility of local communities and forests in tackling negative climate changes. Evidence indicated on the IPPC Climate Change Report of 2014 indicated that bio systems globally and in most oceans were being affected by recent climate changes, melting glaciers and reduced agricultural output has been documented.

Therefore, identifying strategic choices and options that are available and affordable to all concerned in the international system to address the issue of climate change are needed. If there is lack of a defined policy framework, climate changes will continue to bring confusion and the opportunity will be distorted. Technology and all inclusive evolutionary developments in the area of climate change are required.

2.5 THEORETICAL FRAMEWORK

Climate is a critical aspect of the environment that generates multiple non linear, long term changes to the earth's climate system. Through natural and anthropogenic triggers, these changes increase risks and vulnerabilities across global security sectors in many ways. These sectors range from societal, environmental, economic, military and political issues. The impacts and possible consequences are extremely serious and critical and it is therefore important to take prudent actions in order to maintain security.

This study adopts two approaches in dealing with climate change. A rational approach and a constructivist approach. First, the rational approach identifies the climate system as a non renewable natural resource. As such, if nothing is done and warming continues, the atmosphere's ability to absorb harmful greenhouse gases from the atmosphere will be eroded with a potential to have unpredictable risks of possibly catastrophic magnitudes. Therefore, because climate change poses an existential threat to both biological and societal systems, I argue that a rational approach that looks at the short term benefits of prevention and mitigation costs as well as the long term gains of climate protection and adaption. All these, in my view require resource allocation and collective responsibility from the individual level up to the international level.

Second, this study argues that constructivist approach proposed by Barry Buzan to unravel and help understand how climate change interacts with these sectors and what this means for the great lakes region is important. The constructivist approach allows us to think socially rather than individually. According to Buzan (1998), the concept of security is much more multifaceted and complex. While traditional views of security such as realism were justified as derivatives of power, Buzan argues that this perspective is founded in a narrow manner and that there was need to incorporate aspects that were necessary for security but were ignored previously.

Buzan offers a broader framework of analysis incorporating the societal, economic, political, military and environmental dimensions. According to this multifaceted framework, all five security dimensions need to be addressed in tandem in order to provide a just and sustainable secure world. For example, Buzan acknowledges that the economy plays a critical role within the security domain and should be considered from the wider macroeconomic viewpoint that

addresses budgetary allocations and constraints. At the micro economic level, he perceives the focus should be on ensuring general economic conditions of the people and support of other components of security.

Although Buzan agrees with neorealist tenets such as anarchy and strong economic states, this constructivist approach of broadening the security agenda not only allows one to understand the broad nature of security but also to break down aspects that contributes to or affects security, from the individual security to the main referent body which is the state. The assumption this study holds is that climate change or the environment encompasses a wide array of uncertainties to security that range from survival of species to minimizing the impacts of climate change. Unlike traditional approaches that implied the ignition of military capacities for protection, global threats today such as climate change demand multi sum ignitions involving many states.

By adopting a multifaceted approach while analyzing security concerns brought about by climate change, this study shows that climate change as a modern threat may commence multiple persistent conditions that pose significant threats to the state although they may be originating from anywhere in the globe. With challenges such as climate change, material strength is not enough to ensure safety, there is a demand for collective actions and exchanges that are open and dedicated to solving environmental problems.

2.6 DEFINITIONS AND OPERATIONALIZATION OF KEY CONCEPTS

Climate Change: A permanent deviation of weather patterns due to both natural and anthropogenic processes (UNFCCC, 2007).

Global Warming: According to the IPCC, g*lobal warming* is a long-term rise in the average temperature of the Earth's *climate*system (IPCC, The Fifth Report on Climate Change, 2013).

Erratic Rainfall Patterns: An Increase or decrease in the amount of rainfall

(IPCC, The Fifth Report on Climate Change, 2013) **Security:** The pursuit of freedom from threats (Buzan, Weaver, & Wild).

Resilience: The ability of system or an entity to withstand shock or disturbances without losing its identity.

Vulnerability: The degree to which a system is susceptible to and unable to cope with adverse effects of climate change including climate variability and extremes.

Risk: A situation that involves the probability that one will be exposed to change.

Strategy: A plan of action that organizes efforts to achieve objectives.

Economic Security: Maximizing the production potential to lower a state's exposure to threats and vulnerabilities (Corneliu & Tamosiuniene, 2015)

2.7 RESEARCH HYPOTHESIS

This study intends to test the following hypothesis:

1. Global warming negatively impacts economic security of the Great Lakes Region.

2. Erratic rainfall patterns negatively affect economic security of the Great Lakes Region.

CHAPTER THREE

3.1 RESEARCH METHODOLOGY

This section outlines the procedures and methods adopted to achieve the objectives of this study. They take into account the study site, the study population, sampling techniques used, target population, methods of collecting data, research design and methods of data analysis used.

3.2 THE STUDY SITE

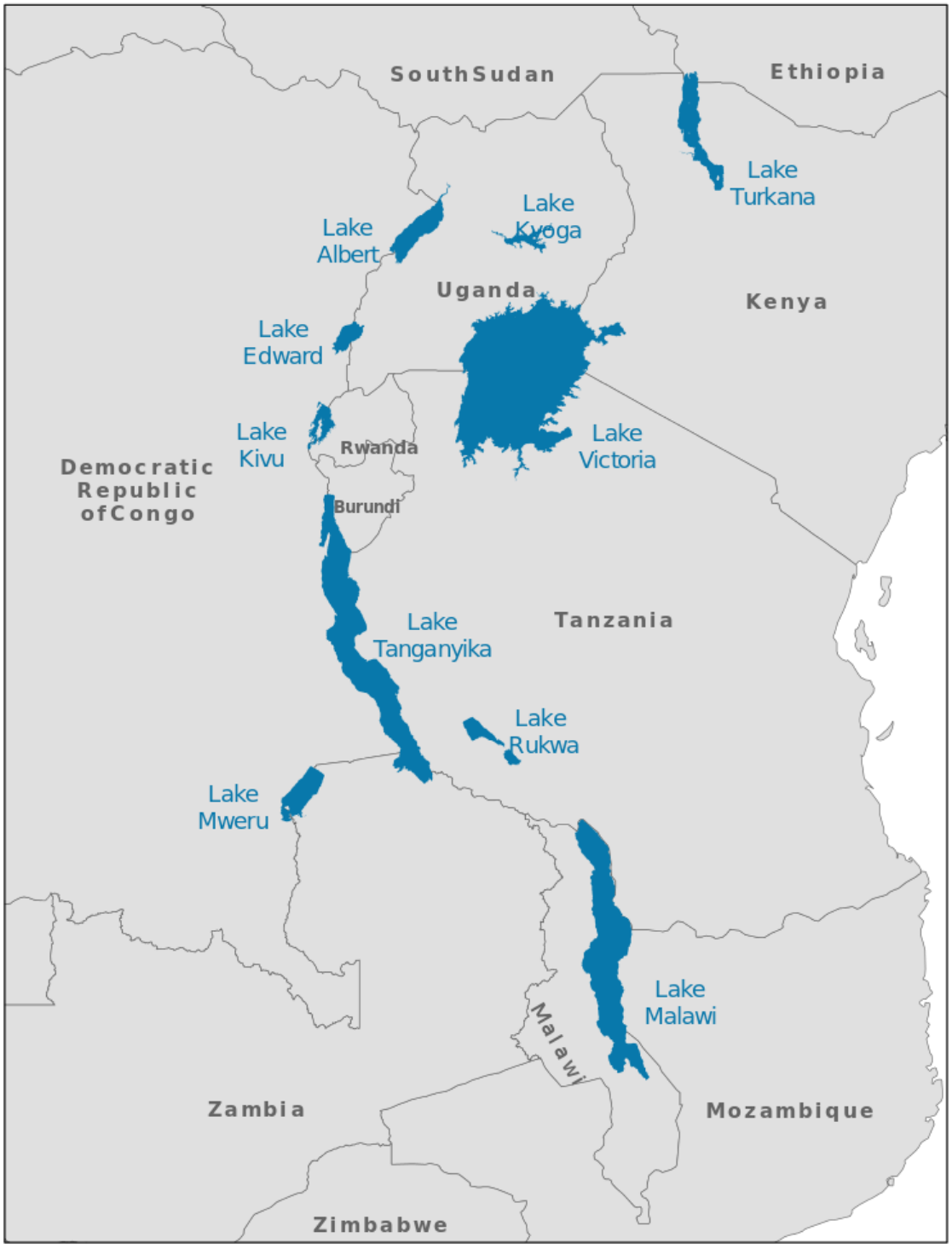
The Great Lakes of Africa (Swahili: *Maziwa Makuu*) are a series of lakes constituting the part of the Rift Valley lakes in and around the East African Rift. The focus on the Great Lakes of Africa is of a key strategic importance in the region's security agenda because first, the great lakes form a rich base of the region's geophysical resources that include a vast natural and diverse ecosystem. These ecosystems play a key role in the region's growth and development. For instance, the availability of fresh water, plant and forest ecosystems together with the rich minerals, renewable and non renewable resources sustain many people in the region, yet, their sustainability is not assured. Secondly, the great lakes region plays a huge role in the welfare and livelihoods of the people and lastly however, while the region is vital for the survival of the economies throughout the world, it faces a very big threat from the ever growing population as well as from global climate changes.

They are Lake Victoria, the second-largest fresh water lake in the world by area, Lake Tanganyika, the world's second-largest freshwater lake by volume and depth, and Lake Malawi, the world's eighth-largest fresh water lake by area. Collectively, they contain 31,000 km^3 (7400 cu mi) of water which constitutes about 25% of the planet's unfrozen surface fresh water. The Great Lakes region of Africa covers eleven countries that pass though seven countries including Burundi, the Democratic Republic of the Congo, Kenya, Malawi, Rwanda, Tanzania, and Uganda. It includes the seven most important lakes and river basin in Africa. These lakes and river basins are also the richest in fish species comprising of

half of the fish diversity in Africa and ten per cent of the global total (Holland & Darwall, 2011).

The site of this study will be in Kenya, one of the countries in East Africa and the Greater Lakes Region of the Continent with an area of 582,650 sq kilometers. the great lakes counties of Africa share similar ecosystem covers that include a rich resource base in both land and water resources and include a rich mineral base and many of the world's endemic species in forest ecosystems. The Great Lakes Countries of Africa also share similar economic and political challenges.

Figure1. Great Lakes of Africa.



3. 3 Research Design

This study employed descriptive research design. This enabled the study to explore the relationship between the global warming, erratic rainfall and economic security in Kenya. A

small representative sample typical of an agricultural middle income country will be used to represent the whole of the African Great Lakes Region.

3.4 Target Population

The entire population consisted of respondents from Kenya, one of the countries in the Great Lakes Region of Africa. Kenya is a middle income that depends highly on climate dependent industries for its economic development and sustainability and therefore the issue of climate change is relevant. This study involved businessmen and women, policymakers, experts and general citizens.

3.5 Sample Techniques and Sample Size

Sampling is the process of isolating a section of a target population to use as a representative of the entire population under study. This research used simple random, judgmental and snowballing techniques. The sample size included categories of four types of respondents, namely policymakers, experts in weather science, businessmen and women and citizens. Simple random was used to identify the local residents, judgmental sampling was used to identify key persons of interest who have knowledge of specific information required such as policymakers and experts. Snowballing was used to locate businessmen. Both male and female respondents were included.

Sampling Board

Respondents	**Sample Size**
	Kenya
Policymakers	2
Weather men	2
Businessmen	30
Businesswomen	30
Local Citizens	50
Total	114

3.6 Data Collection Instruments and Procedures

3.6.1 Methods of Data Collection

This study used both primary and secondary data. Primary data was collected using structured questionnaires (attached as appendix 1) and interviews from respondents (Attached as appendix 2). Some questions provided choices similar to the Likert Scale type questionnaire. The significance of questionnaires in data collection is that it is becomes easier to organize the opinion and arguments of respondents while allowing the researcher to be objective in his quest. Although it saves time and the researcher can guide the respondents in understanding the questions because many rural populations may not be able to read or write, some respondents can delay in returning their filled questionnaires and this may end up delaying the study further.

Some of the issues that were difficult to understand were clarified while those respondents who could not read or write were translated to and their answers recorded by the researcher. Secondary data was collected from published information across various fields. It included previously published studies and expert reports from relevant authorities. All questionnaires were collected on the spot be the researcher.

3.7 Data Analysis and Presentation

In responding to the research questions, qualitative data was analyzed using a descriptive statistics by use of a scientific computer software program called Statistical Package for Social Sciences (SPSS). This was done in order to determine the general trends in the data that either support or reject the hypothesis. The findings generated by this study were presented using tables.

3.9 Ethical Considerations

This study is in conformity with the University of Nairobi's research ethics guidelines. The rights of participants of this study were protected at all levels of the research and they were assured of the same and allowed to cancel their participation at any level. They were also furnished with the details and importance of this research to the student and to research in general before commencement. Where there was language barrier, it was overcome by use of

translator. Because of this, they were comfortable in taking part of the study. In addition, the data collected was used purposely for this study and no other use. Permission to conduct field studies on this research was given by Chairman, Department of Political Science and Public Administration of the University of Nairobi. (Letter of approval is attached as Appendix 3).

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.0 INTRODUCTION

The main objective of this study was to analyze the implications of climate change on the great lakes region of Africa and what these implications mean to the economic security of the region. This chapter outlines the findings of this study and their meaning to academia and policy. Although climate is a system that involves the interaction of many variables, this study opted to use two primary variables; that is erratic rainfall and global warming. This study further looked at how other socio economic variables such as economic performance indicators, health as well as security related with the primary variables above to further consolidate the goals of the study.

4.1 DEMOGRAPHIC VARIABLES

The study on the impacts of climate change on economic security in the great lakes region of Africa was done in Kenya using a sample population from the same country. The sample size involved a total of 110 respondents comprising of businessmen and women, policy makers, weathermen and local citizens as shown on figure 2. The samples were picked through random sampling for local residents; judgmental sampling was used to identify key persons of interest who have knowledge of specific information required such as policymakers and experts. Snowballing was used to locate businessmen. Both male and female respondents were included.

The gender distribution of the participants in this study is shown in table 1 whereby 51% of the respondents were male while 49% were female. One advantage of field research is that for this particular study, a 100% of the targeted population participated in the study.

Table 1: Gender Distribution

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	56	50.9	50.9	50.9
	Female	54	49.1	49.1	100.0
	Total	110	100.0	100.0	

In addition, the study drew participants from various occupations that included farmers, business men and women, jua kali artisans and formal employees. The table and chart below shows the frequency distribution of the occupational status of the participants in this study.

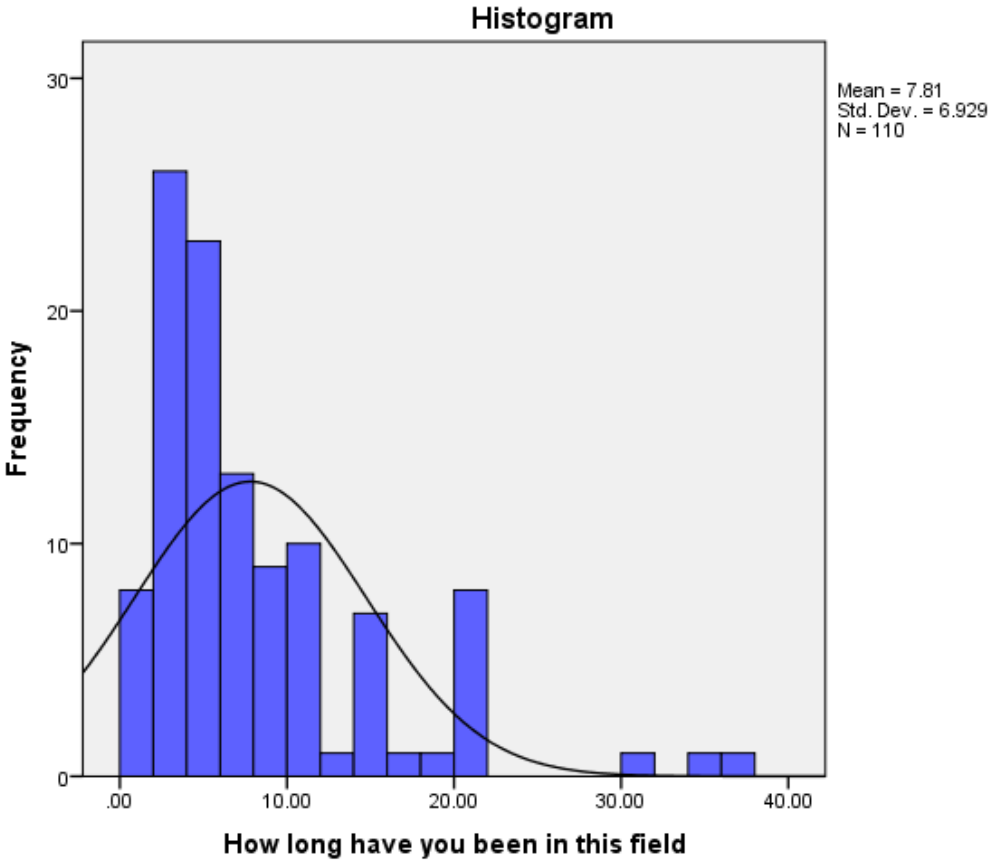
Table 2: Occupational Status of the Participants.

What is Your Occupation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farming	13	11.8	11.8	11.8
	Business	40	36.4	36.4	48.2
	Jua Kali	19	17.3	17.3	65.5
	Formal Employment	38	34.5	34.5	100.0
	Total	110	100.0	100.0	

The table shows that all participants were involved in various employment activities with farmers representing 12% of the study respondents while businessmen and women were 36%, jua kali artisans were 17% while those in formal employment were 35%. Also, all of the participants indicated that they had been involved in their occupation between 1 and 36 years as shown in the histogram below. Majority participants had been in their occupation for over three years.

Figure 3: Duration of Occupation



4.2 Descriptive Variables

The strategic direction in the twenty first century should include actions directed to mitigate and aid in adaptation to climate change. Many governments have often undermined the implications of environmental hazards despite their potential to cause destruction on a planetary scale. Therefore this new landscape of threats emanating from nontraditional state centric definitions requires reorienting the strategic direction. By quantifying the implications of climate to national security, this study will increase the understanding of the climate change threat to help in making new priorities that will guide actions that are aimed at reducing and c the coping with environmental changes.

This study hypothesized that global warming negatively impacts the economy and that erratic rainfall also negatively affects the economic security of the great lakes region. Thus in order to test and quantify the hypothesis, a questionnaire was developed with an aim to analyze the extent to which global warming and erratic rainfall affected the great lakes regions. The questionnaire also aimed to test how the participants cope with these challenges and what other vulnerabilities accompanied climate change as shown on the table below.

Table 1, Survey questions on knowledge and implications of climate change

Questions
Do you think global mean temperature has risen or it is the same
Do you think climate change affects your income
How does it affect your income
Have you encountered threatening situations due to climate extremes such as floods or destroyed infrastructure such as roads
Has your property, assets or business stock been destroyed as a result of extreme weather

Table 2; Survey questions on coping capabilities and the threat of other vulnerabilities.

Questions
On a scale of 1-5, how does climate change threaten your personal well being
On a scale of 1-5, what concerns you most (Poverty, Health, violence and Insecurity and Migration)

A more detailed questionnaire is attached as Appendix 1.

4.3 THE RESULTS OF THE STUDY

The climate system is a complex structure that involves the interaction of the earth's components involving the biosphere, geosphere, hydrosphere and the atmosphere. Specifically, the geosphere includes all land surfaces, the hydrosphere includes all the water bodies and the atmosphere includes the air (Treut, et al., 2007). For example, **c**limate controls the distribution of plants and other geographical features on the earth's surface. Regions close to the tropics are generally warmer while regions further away from the tropics and more cooler. Vegetation in turn influences climate through the process of photosynthesis. These complicated interactions between the earth's components can generate tipping points in the climate system where small gradual changes in one component of the system can lead to abrupt climate changes such as storms and hurricanes in different localities (Treut, et al., 2007).

One such tipping point is the green house effect. Although valuable to the biosphere, it is brought about by greenhouse gases which absorb heat energy released into the atmosphere through various human and biological processes from the earth's surface and reradiate it back into the earth surface. This maintains the planet's temperature at a level suitable for the maintenance and development of life. Carbon dioxide, methane and water vapour are the most significant greenhouse gasses which have a profound effect on the energy budget of the earth's system despite making up a fraction of all atmospheric gases. However, greenhouse gases have changed considerably throughout earth's history and these changes drive various

climatic processes across a wide range of timescales (Jackson, 2020) such as global warming.

In this view, the study aimed to find out if the participants were aware of climate changes such as global warming and erratic rainfall and what these events meant for their livelihoods. This question was based on the assumption that as more evaporation occurs due to increased heat and drought, more water vapor in the atmosphere leads to increased rainfall in some areas causing extensive rainfall that includes floods and storms. Chart 1 and figure 2 respectively showed that a total of 91% of the participants acknowledge that the global mean temperature had risen and that 73% of the respondents believed that erratic rainfall and global warming affects their income.

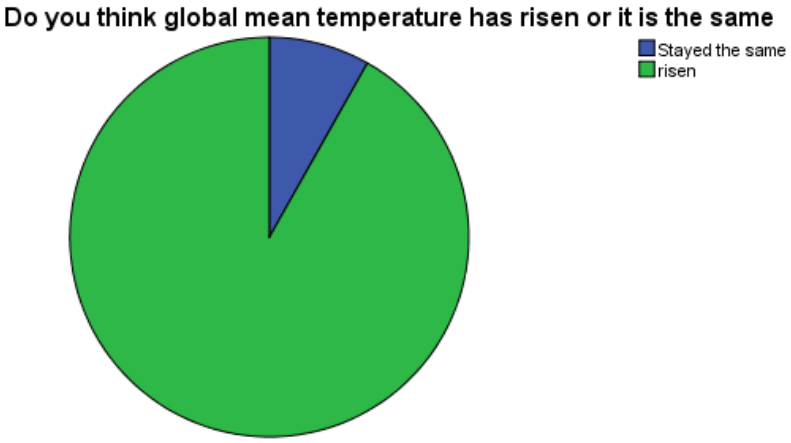
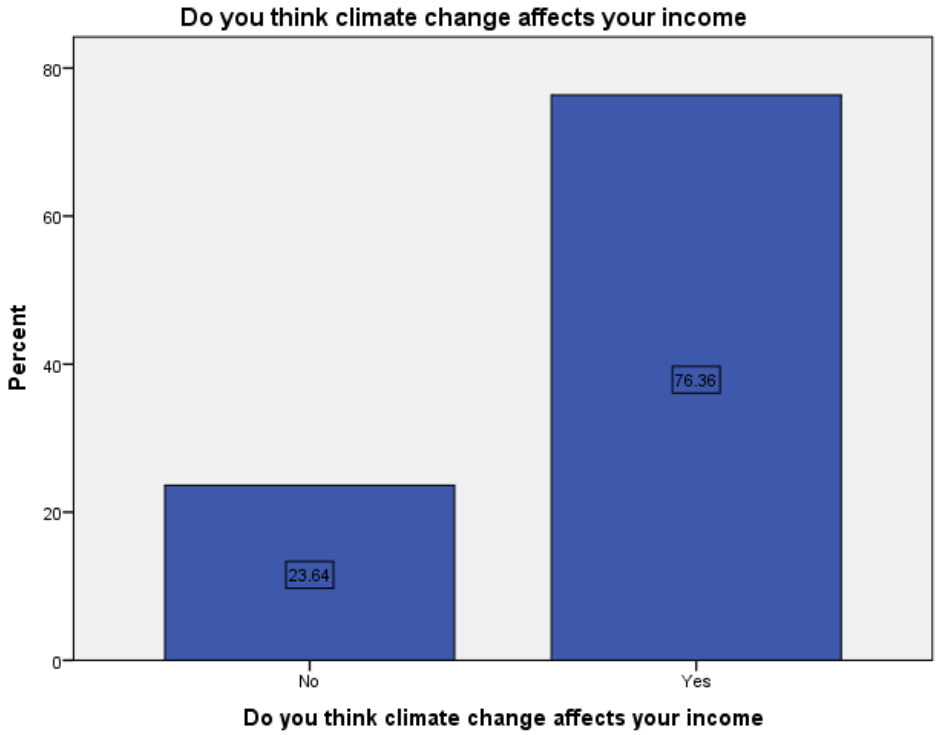


Figure 4.



26% of the respondents indicated that their source of income was not affected by climate variability.

Figure 5.

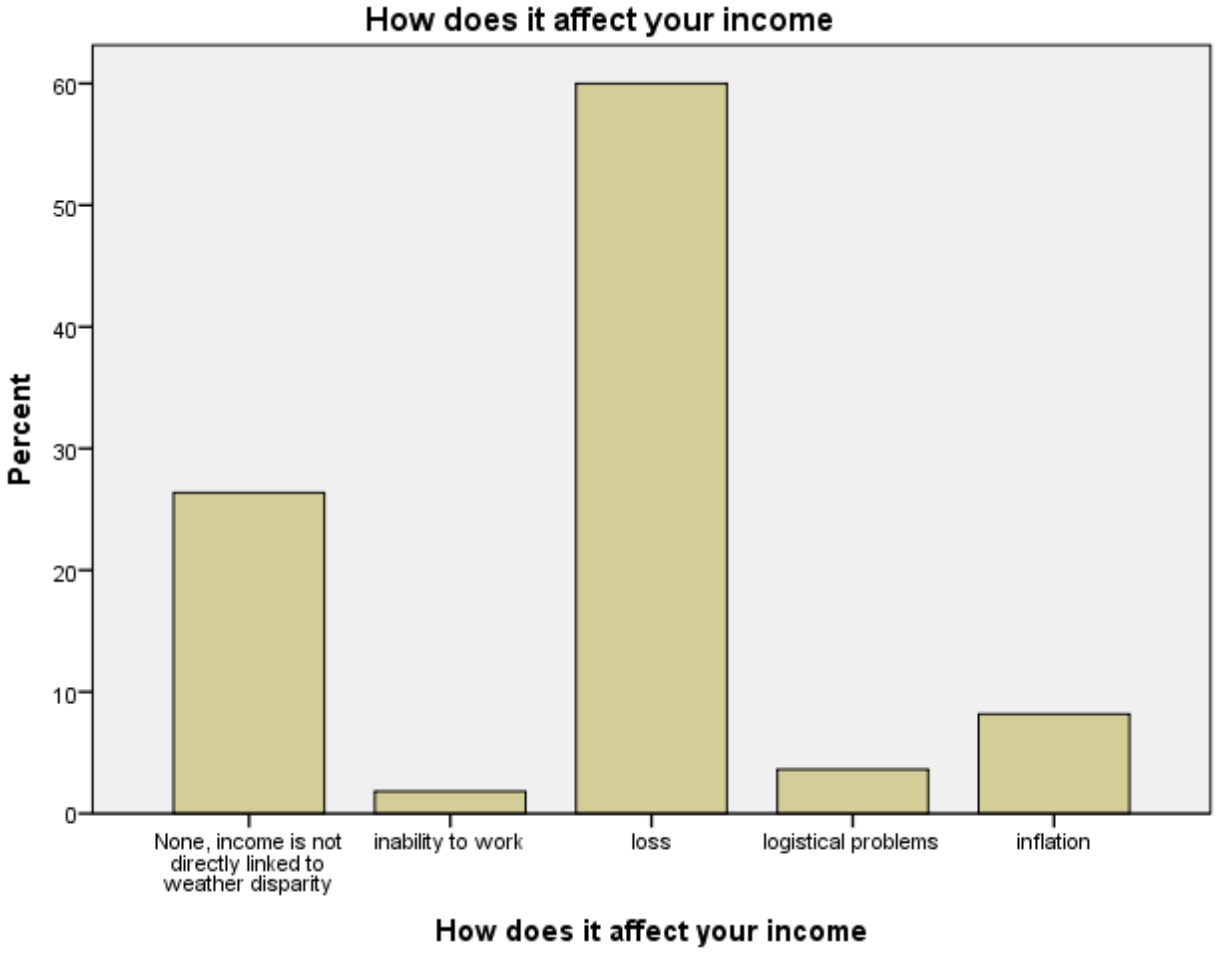
When asked how these changes affect their income, 60% of the participants indicated that they suffered various losses as a result. 4% had logistical problems and 8% indicated that they suffered inflationary costs. 26% decried that their income was not affected by climate disparities as shown on the figures below. This was intended to measure the extent climate changes impacted their livelihoods as indicated by the table and the graph below.

Table 3.

How does it affect your income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None, income is not directly linked to weather disparity	29	26.4	26.4	26.4
	inability to work	2	1.8	1.8	28.2
	loss	66	60.0	60.0	88.2
	logistical problems	4	3.6	3.6	91.8
	inflation	9	8.2	8.2	100.0
	Total	110	100.0	100.0	

Figure 6



When asked if weather disparities had caused some physical damages, a cumulative total of 67% indicated that weather variability had destroyed property, assets and their business stock as shown in figure

Table 4.

Has weather variability destroyed your property, assets or business stock

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	35	31.8	31.8	31.8
	Yes - destroyed property, assets or business stock	63	57.3	57.3	89.1
	yes	12	10.9	10.9	100.0
	Total	110	100.0	100.0	

While all participants expressed various vulnerabilities at a personal level, 72% indicated that they had encountered threatening situations such as floods, 38.2% indicated that this occurrence affected them on moderate level while a cumulative total of 52% reported that climate change threatened their well being. In addition 67% of the respondents indicated that they had gone to a hospital during a period of extreme weather.

Table 5.

Have you encountered threatening situations due to climate extremes such as floods or destruction of infrastructure such as roads

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	30	27.3	27.3	27.3
	yes - destruction of roads, poor drainage, business disruptions, power outages	80	72.7	72.7	100.0
	Total	110	100.0	100.0	

Figure 7.

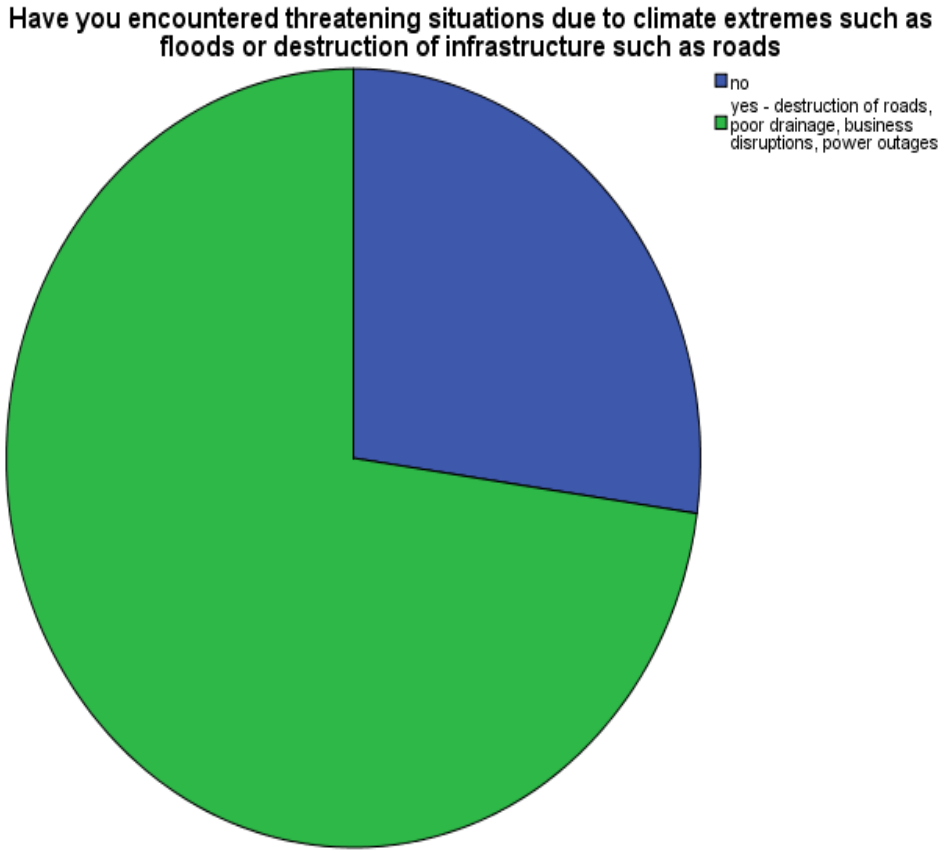
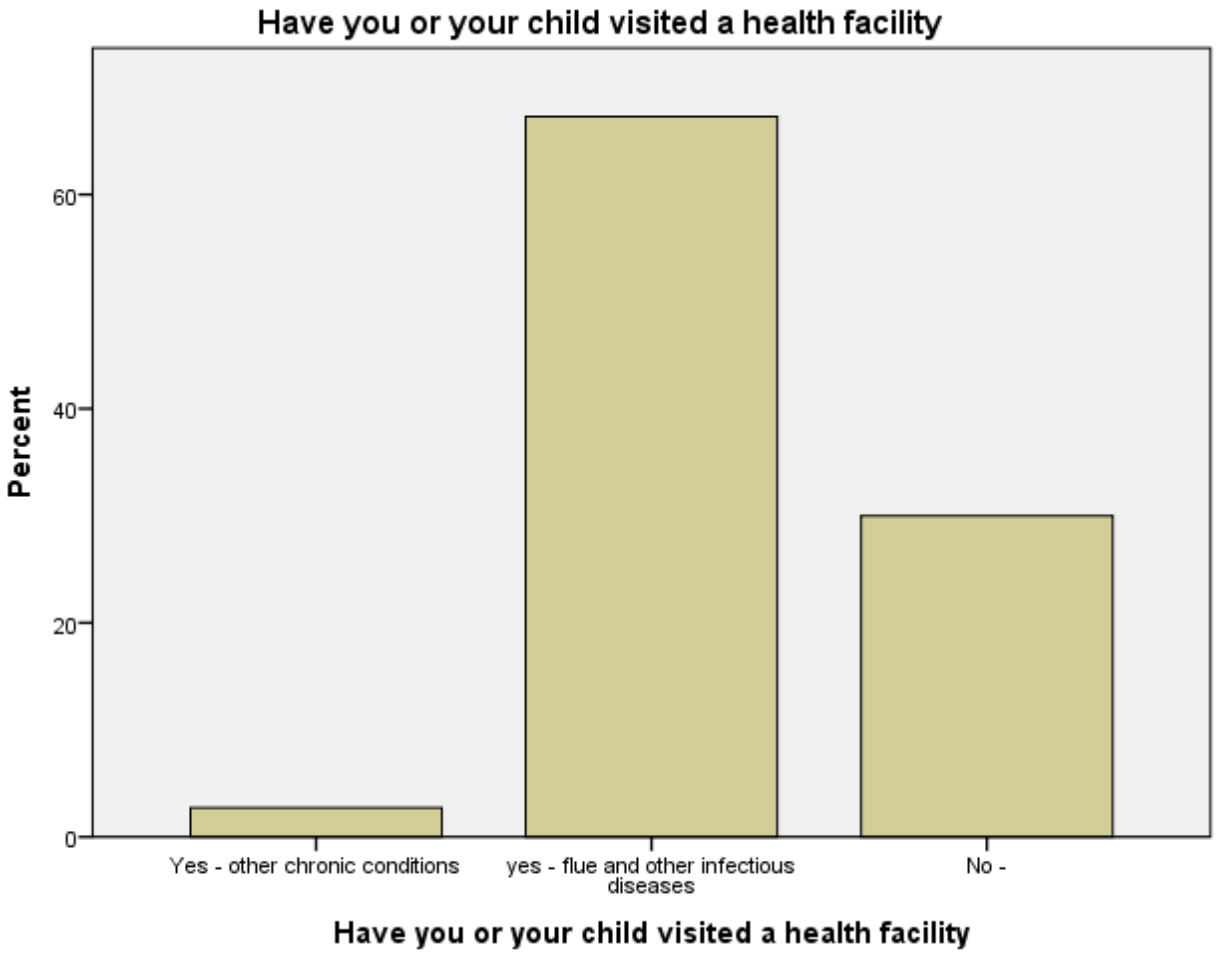


Table 6.

Have you or your child visited a health facility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes - other chronic conditions	3	2.7	2.7	2.7
	yes - flue and other infectious diseases	74	67.3	67.3	70.0
	No -	33	30.0	30.0	100.0
	Total	110	100.0	100.0	

Figure 8.



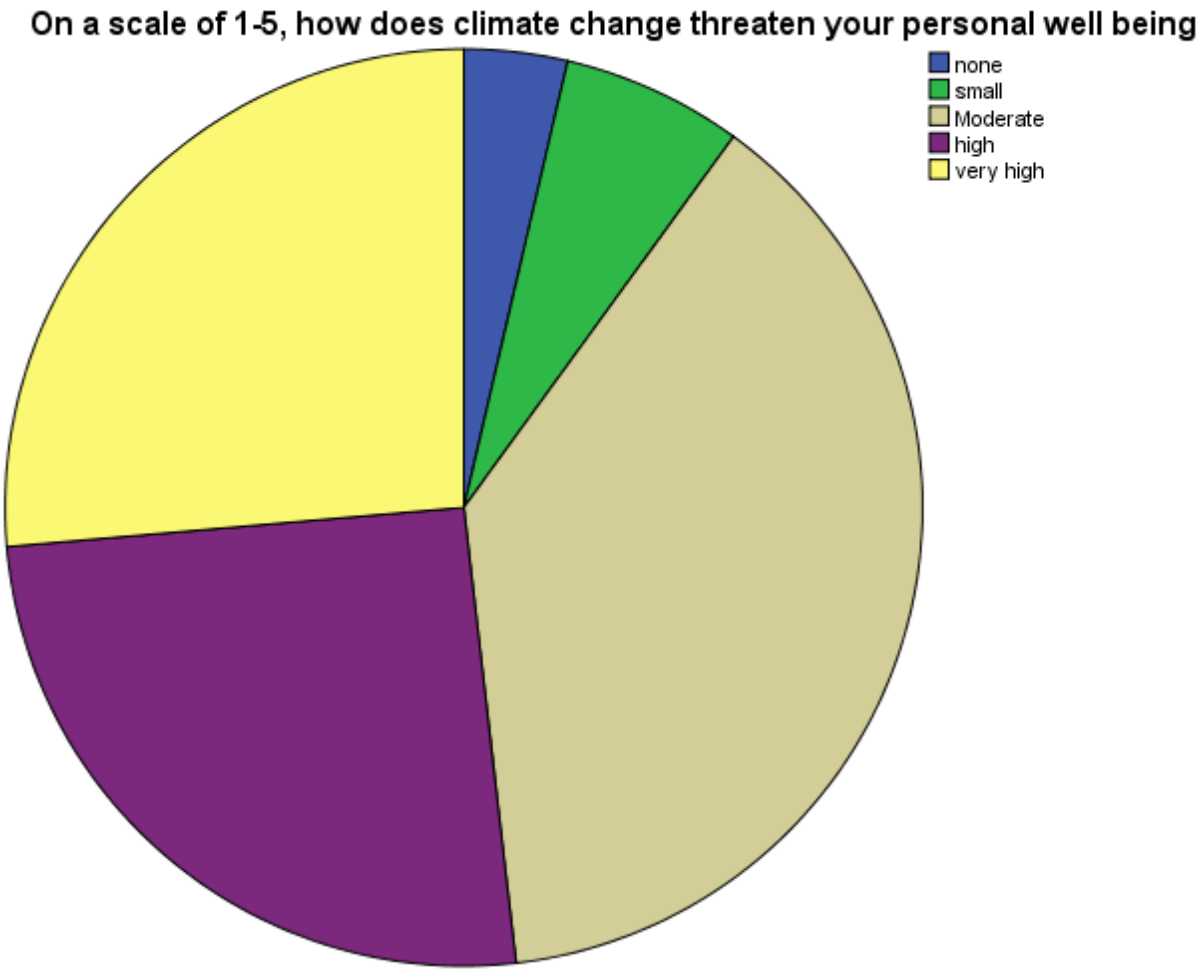
The respondents also indicated besides financial constraints, climate changes affected their well being in various ways as shown on the table and chart below.

Table 7.

On a scale of 1-5, how does climate change threaten your personal well being

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	none	4	3.6	3.6	3.6
	small	7	6.4	6.4	10.0
	Moderate	42	38.2	38.2	48.2
	high	28	25.5	25.5	73.6
	very high	29	26.4	26.4	100.0
	Total	110	100.0	100.0	

Figure 9



4.3 DISCUSSION

4.3.1 PHYSICAL EFFECTS

One of the main objectives of this study was to examine the effects of global warming and erratic rainfall on the economies of the Great Lakes region, with a focus on Kenya. This is from the backdrop of mounting climate concerns and their implications to modern society. Climate risk not only harms the environment but also aggravates economic problems in the region with irrefutably apparent effects. At the same time, the pace at which these threats are spreading across the world is accelerating and what is worrying is that majority of those affected will be citizens who are at a more extreme risk of economic, environmental, health, personal, food, community and political insecurities such as women and children.

Environmental Measurement of economic security provides a wholesome way to determine if security objectives are achieved and the findings of this study demonstrate that global warming and erratic rainfall negatively impacts the economies of the great lakes region. One key indicator used in this study was the measurement of income and income trends. As was seen earlier, the region is frought with increasing cycles of drought and erratic rainfall mainly floods and these have an important role in most of the productive industries in the region. 76% of the participants indicated that climate change affects their income negatively during cycles of extreme weather. These findings are similar to the IPCC's fifth assessment report (IPCC, 2019) which reported that drought and severe floods are the causes of significant negative incomes in the region.

These findings are also consistent with the production reports from Kenya Agricultural Production Report of 2018 which compared production percentages. According to the report, the agricultural sector grew by a mere 16% in 2017 compared to 47% in 2016. This was attributed to long dry spells such as the drought period that was declared a national disaster in Kenya in February 2017 and supply disruptions when it rained. (Thurlow, Zhu, & Diao, 2008) also found that for developing countries like Kenya and many of the Great Lakes countries, adverse global climatic conditions largely contribute to the negative incomes (Thurlow, Zhu, & Diao, 2008) (UNEP, 2018), and (Fanjul, 2020). Similar findings (Chen, Chen, & Xu, 2016), (Ajowopi, 2017) and (Hill & Mejia, 2017) show that indeed weather disparities have a direct correlation with production

The interviewees also noted that climate change is here with us and its consequences are severe and if left unchecked, they will cost the Kenyan economy billions of shillings and the region at large. They noted that one of the problems affecting many businesses and mostly those in the agricultural sector is the inability to cope with adverse climate changes. They indicated that for most local businesses, the situations were beyond their control in terms of adaptation or mitigation actions as the businesses were either sole proprietorships or small microenterprises. For instance, responses from interviewees in the study area indicated that floods and wash away crops and animals, droughts kill many animals worth billions of shillings. Report findings from a study that aimed to analyze the impact of drought to people living in arid and semi arid regions in Kenya, the findings indicated that for households particularly those which depended on pastoralism, climate variability was devastating due to income lost when livestock and other animals perished because of lack of water and fodder

(Migration, 2016).

The Great Lakes Region is highly dependent on rainfall for its mostly agro industries and export markets, a negative climate event usually means that the Kenyan market which also includes cash crop exports such as tea, coffee and others face various demand and supply shortfalls (WHO, 2014) (Chen, Chen, & Xu, 2016), (RoK, 2016). Many of the commodity prices are negatively affected thus culminating in massive food insecurity both locally and internationally and at the same time collide with other pressures such as environmental degradation, high rates of unemployment, insecurity and crime as well as other global population pressures. Because other research do not focus on regional short term to medium term impacts assessments, by quantifying the performance of the economy in conditions outside of the norm, we can anticipate and plan for the longer term.

These findings and other research findings also show that climate change cuts across many other complex human systems. In the Kenyan context, 4.8 million were affected by the 2014-2018 drought period experienced in the region. When it was declared an emergency, 23 counties in the country were already affected. 3.4 million people were food insecure and an estimated 500000 people did not have access to water (2018). An estimated 482,882 children mainly from the 23 arid and semi arid areas required treatment for malnutrition. In addition, school attendance dropped in these counties showing that many of the communities impacted by extreme weather are unable to cope.

Climate change also contributes to massive loss of life and biodiversity loss. As was seen on the literature review section that although the continent harbors most of the world's land, marine and forest diversity, current climate scenarios are making it more and more difficult for the survival and sustainability of plant and animal species. The interviewees reported that current ecological loss may be compared to past natural events such as volcanic eruptions but one difference to note is that while in the past climate changes were driven by mostly natural factors such as volcanicity, today's problems are human driven. These actions change the ecosystems and distort the natural interconnectedness leading to severe biodiversity loss that puts the communities and animals that depend on these ecosystems at risk.

In Europe for instance, more than seventy thousand people lost their lives as a result

cardiovascular and respiratory of a heat wave in 2003 while others suffer from myriad a of pollution related ailments that exacerbate illnesses. For example, asthma affects around 300 million people in the world and therefore increasing temperature levels are expected to aggravate this burden. In Africa, since the March 2020 long rains season started, over 1.3 million people have been affected by floods with at least 481, 000 displaced (WHO, 2018). The findings of this research are also similar to reports from the United Nations (2019)that noted that global warming increases the likelihood of increased refugees as a result of , flooding, landslides and other natural calamities. These vulnerabilities also increase the likelihood of tensions degenerating into full conflicts. The expert interviewees explained that in Kenya for instance, competition for resources does raise tension in the communities and neighboring countries as people move from one region to another looking for water and fodder for their animals.

For instance, global warming is a natural climatic change phenomenon characterized by an increase in average temperatures of the earth. This modification in the weather balances is directly linked to the increase in greenhouse gases in the atmosphere, worsening the green house effect. According to the IPCC, the average temperature of the earth has increased by 0.8^0 compared to the nineteenth century. If the pace of current carbon dioxide emissions continues, scientists predict an increase of between 1.50 and 5.30 celsius in average temperatures by the year 2100. If no action is taken, it would cause a myriad of negative consequences to humanity and the biosphere. For example, the fifth IPCC assessment report of 2014 indicates that for the period of1901 to 2010, sea level rose by an average of 19 centimeters globally. It is anticipated that by 2100 the sea will be between 15 and nineteen centimeters higher than it is now and will put over ninety two million people at risk (IPCC, Special Report on Climate Change and Land, 2019).

The majority participants indicated that the adverse effects of climate change affected their wellbeing in various ways. They also noted that besides the direct physical impacts of climate change such as floods and drought, many people were afraid of sinking into poverty, migration among others. This report was confirmed by the interviewees who said that the region is vulnerable because of its high dependence on climate sectors such as agriculture and tourism. A similar report was submitted by the World Economic Forum Regional Risk for doing Business (2019) in America and Asia Pacific and in Sub Saharan Africa confirmed that environmental factors such natural disasters, threats from floods and storms among others

featured among the top business risks. These findings clearly demonstrate that there is need for serious adaptation methods and strategies.

While migration was found to be a cause of concern in this study, similar findings have established that migration of people and especially vulnerable groups in Kenya is linked to climate change as reported by the International Organization for Migration (2016). The report also indicated that one of the reasons why people moved was because of dependence on climate for their livelihoods such as agriculture hence people are pushed to move to urban areas. Because of environmental degradation and competition for land and water, vulnerable people such as children, women and the elderly are more exposed to other climate risks such as poor health and malnutrition.

4.3.2 INDIRECT EFFECTS OF EXTREME WEATHER

Local businesses mainly small micro enterprises are the biggest sources of employment and support about 70% of the population in the study area. These findings indicate that in addition to the direct physical implications of extreme climate changes, they are also the biggest casualties of the adverse effects of climate change. These indirect effects also weaken a country's economy further. The findings of this study display a connection between climate variability and business performance. While rainfall sometimes means good harvests and profits, supply disruptions due to transport failure and other logistical problems have been found. Similar findings by the World Economic Forum (2019) on the risk for doing business found that in Kenya, in addition climate change, unemployment, illegal trade, terrorism, data fraud and food insecurity were among the top fears faced by investors.

Small and micro businesses are mostly vulnerable to climate risk through revenue loss and expenditure loss culminating in severe business failure and unemployment. Many people for example who live close to forest areas depend on the forest for wood, and income derived from timber sales and agriculture. However, when there is crop failure, many people turn to illicit trade such as illegal logging which in turn destroys tress that act as carbon sinks and climate regulators. According to the experts and from literature in this study (Hill & Mejia, 2017), , aside from cutting tress which increases global temperatures, the vice also accounts for the reduced forest cover and a threat to the animals and plants occupying these

ecosystems. These extensive fragmentation and degradation of the forests have put more and more animals and plant species on the verge of extinction.

Besides revenue losses, most of our critical infrastructure is at risk from climate extremes.72% of the participants in this study had encountered destroyed infrastructure ranging from damaged roads and drainage, business interruptions due to power outages and other communication huddles. Today, many businesses depend on internet communication meaning that if internet infrastructure such as cables are destroyed or damaged, this could have many serious implications and costs of maintenance and repairs. In addition, sea level rise could potentially cause loss of most of coastal towns today. Marine life could also be lost if floods continue.

Involuntary migration is also a consequence of climate volatility in the region. While some people are forced to move due to floods that sweep away their homes and properties, others move to urban towns to look for employment or put up small businesses. For instance, in many parts of the the Great Lakes regions arid and semi arid regions, climate change and associated climate inconsistencies, lack of water and land degradation now merge as issues driving involuntary movement of people (GEF, 2014). Both local and global migration contributes negatively to the climate system largely through increased emission of greenhouse gases mainly from manufacturing, transportation and industrial processes.

Among other vulnerabilities expressed in this study are violence and insecurity. This has been found to negatively influence the environmental conservation and their outcomes. Regardless of the source, violence for example through civil conflicts often result in direct and indirect environmental damage and present a multitude of risks for human health, livelihoods and the ecosystem. For example, conflicts may prevent the supply of natural resource extraction because it makes some areas in accessible. The ones mostly affected are forests and marine commerce. On the other hand, resources that fetch high prices on the world market such as minerals, oil products can be used by the fighters as sources of their finance (GEF, 2014).

The Global Environment Fund noted that at least eighteen civil wars since 1990 have been illegally using natural resources for financial gain. Illegal wildlife trade, drug trafficking arms and human trafficking has also been used by the combatants for gain. Following armed conflict, land, timber and minerals are often in high demand as resources for recovery and reconstruction. If not managed equitably, to support livelihoods, jobs and basic services, then

renewal of conflict is likely. Even where natural resources play no role or only a minor role as a source of conflict, the threat of violence or insecurity at the sub national level can undermine the feasibility of any economic enterprise (GEF, 2014). While some conflicts may be directly as a result of natural resources, other factors add on to the cause of conflict ranging from social, cultural to religious reasons. In other occasions, even where violent conflicts are not frequent, protracted environmental trends often act as stressors on countryside livelihoods and increase the natural resource dependent communities to social, economic and environmental shocks.

In Kenya for example, drought is a major cause of conflict affecting about 4.8 million people, (GOK, 2018). According to the National Climate Change Action Plan of Kenya (2018), droughts have destroyed livelihoods, triggered local conflicts over scarce resources and eroded the ability of communities to cope. Drought also causes changes in migratory patterns of animals and increases human and wildlife conflict. Of the respondents who took part in this study, a cumulative total of 37.3% indicated that one of their highest concerns is violence, insecurity and migration.

The tourism sector is a critical component of the region's as well as Kenya's economy. It is also the most volatile as a result of climate change and environmental disasters. In terms of revenue lost, the government loses duty and tax in terms of current revenue but also in terms of future costs due to the degradation of valuable natural resources. For example, illegal practices such as illegal logging and hunting wild game for their hides and horns contributes to degradation of natural habitats and also denies the government the much needed revenue. While cheap timber and rhino horns are sold in the black market, cheap timber contributes to lower timber prices in the world markets. There is therefore need for tougher and stringent measures to stop these actions in order to save the region's rich biodiversity.

Climate has also been reported by previous research as a significant driver of disease prevalence and occurrence. This study agrees with this claim and although climate changes such as warming may present some good news in some localities such as reduced winter mortalities in temperate climates and increased food production in tropical regions, the overall impacts of a changing climate are overwhelmingly negative. Climate changes affect many of the social and environmental determinants of health. They include; clean air, safe drinking water and enough food and secure shelter. Extremely hot temperatures contribute

directly to death from cardiovascular and respiratory diseases generally among the old people and young people.

Floods and extreme precipitation increases infectious disease occurrence. For example, excess rainfall creates breeding grounds for disease carrying insects such as mosquitoes. With protracted exposure, this is likely to lengthen the transmission seasons or even alter their geographic range. Malaria is strongly influenced by climate transmitted by anopheles mosquitoes. The disease kills over 400000 people every year mainly children less than 5 years old in certain African countries. The aedes mosquito vector of dengue is also highly sensitive to climate conditions and studies suggest that climate change is likely to continue to increase exposure to dengue. In addition, variable weather conditions are likely to decrease the production of food and increase food insecurity in many developing countries. Consequently, this will enhance the prevalence of nutrition based illnesses such as malnutrition and under nutrition. According to World Health Organization statistics, hunger and malnutrition causes 3.1 million deaths per year (WHO, 2018).

The Kenya government prioritizes health as a strategic sector in its national development agenda. However, the disease burden placed by pandemics and other health related concerns hamper these efforts. For instance the current Corona virus pandemic of 2019 has had unprecedented impacts on the health, social and economic sectors of the society and although the region has proven resilient and resourceful in dealing with the pandemic, it had severe implications on businesses and many sectors such as the transport and tourism sectors globally. The curfews and transport restrictions have had millions of people losing their jobs and incomes.

According to the World Health Organization, the number of global reported natural calamities has tripled since the 1960s and every year these disasters result in over 60000 deaths mainly in the developing countries. It is feared that rising sea levels and extreme weather events such as floods will destroy homes, hospitals, disable transport networks and other essential services as well as heighten the risk of a range of health effects from mental disorders to communicable diseases. For instance, lack of clean drinking water can increase the risk of diseases such as cholera and other communicable diseases which kill over 500000 children less than 5 years every year and with hundreds of thousands displaced, experts worry about the implications as the world battles the corona virus pandemic.

The consequences of climate change cascade quickly and largely affect the vulnerable people in society who include pregnant women, young children, the elderly, disabled and the poor. As a function of sensitivity to change and adaptive capacity to adjust or cope, the elderly are particularly vulnerable because they are frequently immune compromised and require medical care or other medical related costs due to underlying causes, their health worsens as a result of weather related extremes such as prolonged cold seasons. For the poor, inability to meet the costs of additional health burdens costs such as increased costs of drugs, high cost of medical care and dietary needs further add to the pressures. For countries with weak health infrastructure mostly in developing countries, they will be the least able to cope without assistance to prepare and respond to medical emergencies. Health concerns was the highest risk indicated by respondents at 34.5st % in this study while 67.3% indicated that they had visited a health facility as a result of an infectious disease.

CHAPTER FIVE

SUMMARY: CONCLUSSION AND RECOMMENDATION

5.0 INTRODUCTION

This chapter presents the summary of findings, conclusion and recommendation of this study.

5.1 SUMMARY AND CONCLUSSION

The aim of this study was to analyze the impacts of climate change to the economies of the Great Lakes Region of Africa. This study was anchored on the rationale that scientists have confirmed that climate change poses significant existential threats to the natural and social systems. As such, the aim of this study was to find out the extent to which these threats put to the economies of the Great Lakes Region. Accordingly, this research tested two hypothesis, first, that global warming negatively impacts economic security of the Great Lakes Region; second, that erratic rainfall patterns negatively affect the economic security of the Great Lakes Region.

The study was a descriptive study that relied on survey and empirical evidence. The study revealed that the economy in the Great Lakes is affected by climate change and variability in various ways. It showed that all sectors of the economy which include the primary, secondary and the tertiary sectors of the economy show encouraging trends whenever climate was favorable and discouraging trends in performance when the climate and weather was unfavorable.

The study revealed that the primary sector is significantly negatively affected during seasons of extreme heat and also during episodes of erratic and extreme rainfall. During drought and seasons of extreme heat, the study revealed that there is a lot of land degradation as a result of soil erosion especially in areas where pastoralist communities live. Food scarcities and lack of grazing land is rampant. During flooding, even though some crops that do well during seasons when there is adequate supply of water, this study revealed that the harvested crops may not reach maturity as they are swept away by the flood waters or may not get to the consumers because many road are washed away or are impassable by motor vehicles.

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In the secondary sector, the results of this study reveal that climate extremes including global warming and erratic rainfall affected the secondary sector in the following ways; frequent power blackouts due to broken power lines as well as power rationing due to reduced supply of electricity from hydro power plants, reduced production as a result of lacking raw materials for the industries and lack of water. Additionally, there was greater damage to the infrastructure and supply and demand disruptions.

This study also revealed that disruptions were experienced in the tertiary sector to a great extent. Supply and demand chain disruptions from extreme weather events such as floods and droughts. the study also found that trends in the housing sector reported overstretching as people migrated looking for better jobs or means of earning their up keep. Sanitation problems also became a problem due to lack of water during droughts and floods also brought a host of sanitary challenges including the spread of communicable diseases such as cholera, typhoid and malaria. As a result, the health burden became a source of stress to the government as well as the local citizens.

The study findings also suggest that small changes and dispersed activities may also lead to surprise environmental effects. These surprises may bring about consequences that are deemed unlikely and therefore suffer from often being overlooked. For example, recently the increases in environmental surprises have ranged from the emergence of new communicable diseases such as Covid 19. The World Bank says the Covid – 19 coupled with locust swarms which ravaged many countries in Eastern Africa has led to reduced agricultural productivity, massive job losses and weakened supply chains. This shows that there is need for better planning and putting in place strategic measures that help to deal with the most unlikely events.

Economic survival therefore will depend on the vigorous action to address climate linked environmental extremes such as floods and droughts. For instance, the countries in the Great Lakes region depend on hydro electric power for most of its industries and economy. Challenges in energy supply such as power blackouts, power rationing and natural disasters all bring leakages in the energy sector and must be addressed. In addition, ill timed responses by the governments has often worsened the problems.

5.2 RECOMMENDATIONS

1. Climate science is unequivocal about climate change. As such this study recommends that bold policies including economic, social and political policies are needed for short term benefits of climate prevention and mitigation and long term policies of climate protection. For instance, this study advocates for a bold international agreement that reduces green house gas emissions to zero.

2. This study recommends for investments in infrastructure that is more resilient to climate disruptions and extremes such as drainage controls, bridges and better roads.

3. This study therefore recommends that policy targets small business people in climate proofing their business. This may be done through reducing the cost of insurance policies that protect them against loss during times of extreme weather; extension services that educate and inform the business sector in all areas of need; as well as cheaper financial options from banks and micro finance institutions.

4. This study recommends that sharing knowledge about the implications of climate change to the community, policy makers and other stakeholders is important.

5. This study recommends that there is need for serious reorganization, planning and investing in various corrective, reductive and mitigating measures to deal with environmental problems and surprises. For example, today, countries are on the verge of failing to provide the basic public goods such as healthcare due to the Covid 19 pandemic. Previous research has also underemphasized social and economic vulnerabilities to climate change in assessments and policy. More evidence on such linkages is important so that insights into how different facets of vulnerability interact and evolve over time are easily understood.

6. The wellbeing of the earth system and all its inhabitants is of upmost importance. It is therefore important to balance the rise in population growth and available resources. This is because population growth is an underlying threat due to increased consumption of and energy and materials. For instance, there is a need for improved

production of food and distribution processes that eliminate waste from the environment. For example, at policy level, mothers should be encouraged to breast feed their infants to eliminate the need for processed formula milk that comes along with other wastes during the production process. Thus it is critical to reduce population growth while simultaneously improving the health, education and opportunities that enhance economic security.

5. 3 LIMITATIONS

1. One of the limitations of this study is the focus on only two variables that is global warming and rainfall. Therefore more inclusive research that involves many variables would greatly benefit the study of climate and its implications to societal systems.
2. Another limitation in carrying out this study was the anxieties brought about by the Covid-19 pandemic. Although I observed all protocols in preventing the spread by wearing face masks and frequent hand sanitization, some people were reluctant to be interviewed.
3. Lack of funds to cover all the eleven countries of the Great Lakes Region of Africa to collect data was painfully felt.

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APPENDIX A - QUESTIONNAIRE

Policymakers and Experts in Climate Change

1. Do you believe that climate change is real and posses an existential threat to the environment and national security at large?

   ……..
   ……..
   ……..

2. If so, what measures do you support for tackling climate change issues highlighted below?

   a) Environmental Pollution

      ……
      ……
      ……

   b) Energy Security

      ……
      ……
      ……

   c) Health Security

      ……
      ……
      ……

   d) Economic Security

      ……
      ……
      ……

   e) Water Security

      ……
      ……
      ……

   f) Food Security

      ……
      ……
      ……

3. Does government policy encourage climate research, innovations and information sharing to all citizens on matters of climate change?
   …….

…….
…….
…….

4. If so, please enumerate them below
   ……
   ……
   ……
   ……
   ……
   ……
   ……
   ……

5. Do your plans involve short term and long term solutions that you intend to use to tackle climate change?

…….
…….
…….

6. What are your plans in tackling green house gas emissions?

…….
…….
…….

Others

1. Which country do you come from?

   Kenya…….
   Uganda ……..
   Tanzania ……
   DRC ……
   Rwanda ……..
   Burundi ……..

2. Gender?

   Male …….
   Female ……..

3. What is your main source of income?
   a) Farming …….
   b) Business ……..
   c) Fishing…….
   d) Industry ……..
4. Does climate change pose a threat to your income generation activities?
   Yes…….
   No. …….

5. If so please explain how under the following headings
   i) Global Warming

   …….

   …….

   …….

   …….

   ii) Erratic Rainfall patterns

   …….

   …….

   …….

   …….

6. Are you able to cope with these threats?
   Yes…….…….
   No…….…….
7. If yes please explain how you are dealing with these challenges
   …….
   …….
   …….
   …….
8. If not, please explain why you are unable to

…….

…….

…….

…….

9. On a scale of 1 to 5, does climate change threaten your personal well being?

   1 2 3 4 5

   i) Has it affected your job output?
   ii) Has it destroyed your property or assets?
   For example car, home etc..
   iii) Has it affected your health?
   iv) Violence or threatsbecause of climate
   related issues?

10. On a scale of 1-5, what concerns you most?

    i) Poverty
    ii) Health
    iii) Violence & Insecurity
    iv) Migration

11. Are you aware of initiatives to reduce the effects of climate change?
    Yes……

    No ……

12. On a personal level, what are you doing to reduce climate change?

…….

…….

…….

…….

APPENDIX B – RESEARCH PERMIT

University of Nairobi
COLLEGE OF HUMANITIES AND SOCIAL SCIENCES
Department of Political Science & Public Administration

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P.O. Box 30197
Nairobi, Kenya

February 5, 2020

From: Chairman,
Department of Political Science and Public Administration

To: WHOM IT MAY CONCERN

AUTHORIZATION TO CONDUCT FIELD RESEARCH

This is to confirm that Ms. Jean Muthoni of registration number C50/76328/2014 is a bonafide student pursuing Master of Arts in International Relations at the Department of Political Science and Public Administration, University of Nairobi. She is researching on "The Impact of Climate Change on the Great Lakes Region of Africa, A Case Study of Kenya".

She has successfully completed the first part of her studies (Course Work) and has been authorized to undertake the final part of her studies (Field Research). It is upon this background that I request you to assist her collect relevant data for her studies.

The information collected shall be used purely for academic purposes.

In case of further clarification feel free to contact the undersigned.

Thanking you sincerely for support.

Yours,

Professor Fred Jonyo,
Chairman,
Department of Political Science and Public Administration,
UNIVERSITY OF NAIROBI