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**EXAMINING CLIMATE CHANGE EFFECTS ON THE YOUTH IN ARTISANAL
FISHING: A CASE STUDY OF GHANA**

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DECLARATION

Except for all quoted references and acknowledged sources, I, Sakina Korkor Akunor, hereby declare that this work is my original research conducted under the supervision of Dr. Mrs. Afua Boatemaa Yakohene. This work has not been presented in any form to any institution for another award.



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4 JULY, 2022 **4 JULY, 2022**
DATE..... DATE.....

INTEGRI PROCEDAMUS

DEDICATION

This dissertation is dedicated to My sister, Dr. Harriet Safia Akunor, my Mum, Mrs. Marian Amoasi Akunor, my brother, Sheik Abdul Basit Akunor, and my grandmother Mrs. Cecilia Opoku, and my husband Mr. Sheriff Dodoo for their constant support, love, patience, and prayers.



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EVERYONE, WE DID IT!!!!



LIST OF ABBREVIATIONS

IPCC	Intergovernmental Panel on Climate Change
GHGs	Greenhouse Gases
SDG	Sustainable Development Goal
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
CHS	The Commission on Human Security
MOFAD	Ministry of Fisheries and Aquaculture Development
SSA	Sub-Saharan Africa
MDGs	Millennium Development Goals
UV	Ultra-Violet Radiation
FAO	Food and Agriculture Organisation
MELR	Employment and Labor Relations
ITCZ	Inter-Tropical Convergence Zone
ENSO	El Nino Southern Oscillation
EJF	Environmental Justice Foundation
NGO	Non-Governmental Organization
SSFs	Small-Scale Fisheries sector
GNI	Gross National Income
FC	Fisheries Commission

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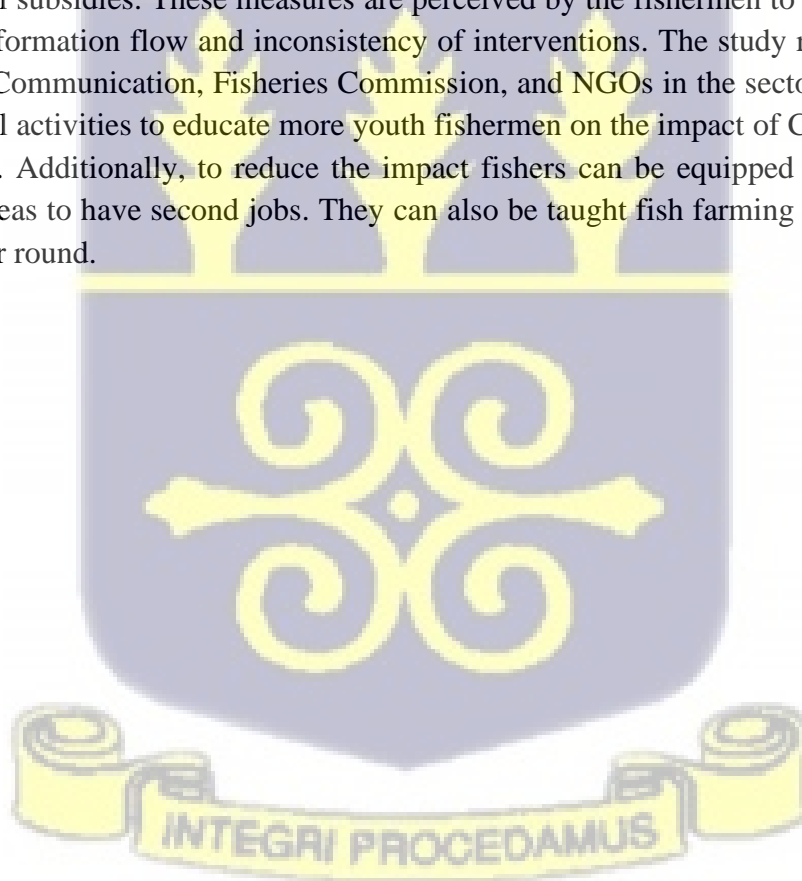
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ABSTRACT

The fisheries sector is significant for the development of a state. It sustains the livelihood of millions of people and provides food security and income security. However, Climate Change threatens the livelihood of many people in this sector. Focusing on the youth in artisanal fishing, this study uses Emisano, a town in the Central region of Ghana as a case study. This research sought to examine the vulnerability of the Ghanaian youth to Climate Change and what they perceive of Climate Change; examined the influence of Climate Change on the socio-economic livelihoods of the youth involved in artisanal fisheries; and assessed the effectiveness of measures being employed by the government and NGOs to mitigate the effects of Climate Change. The research employed the qualitative research design using primary (interviews) and secondary data sources. The research found that Climate Change presents a myriad of challenges to artisanal fishermen including low fish catch, revenue loss, food insecurity, and worse of it all death. Artisanal fishermen must adapt to these challenges to sustain their livelihoods. However, this study found that most of the measures they employ were not sustainable. We also found that state and non-state actors have put measures such as sensitization activities, access to loans, giving out of fishnets, and fuel subsidies. These measures are perceived by the fishermen to be ineffective due to inadequate information flow and inconsistency of interventions. The study recommended that the Ministry of Communication, Fisheries Commission, and NGOs in the sector should organize more educational activities to educate more youth fishermen on the impact of Climate Change on artisanal fishing. Additionally, to reduce the impact fishers can be equipped with employment skills in other areas to have second jobs. They can also be taught fish farming to help the fishers have fish all year round.



CHAPTER ONE

INTRODUCTION

1.0 Background to the Research Problem

Climate Change has become a huge rolling mass that is stripping the earth of its relevant resources. It is a global phenomenon with dire consequences on global development and imposes great concern on the international system. It presents serious continental and global risks which demand quick solutions. The climate of the world is changing steadily, and research shows that anthropogenic activities are to blame for the change. These activities are human activities that are causing enormous emissions of greenhouse gases that are causing global warming (National Research Council (U.S.), 2001). However, natural variabilities or biological factors like volcanoes, the Milankovitch cycles, and changes in the sun are also altering the climate of the earth (British Geological Survey, 2022).

The Intergovernmental Panel on Climate Change (IPCC) defines “Climate Change as any change in climate over time, whether because of natural variability or because of human activity” (Metz et al., 2001). Ever since the commencement of the industrial revolution in the mid-18th century, the continent is facing enormous accumulations of GHGs in the atmosphere (Metz, 2020). Industrial activities together with other human activities such as the burning of non-renewable energy (coal and gas), deforestation, farming, and livestock rearing are increasing the emission of GHGs in the atmosphere and exacerbating climate change (Campaign Against Climate Change, 2020). These GHGs are carbon dioxide, water vapor, methane, nitrous oxide, ozone, and carbon chlorofluorocarbon. Anthropogenic activities release these gases into the atmosphere in larger

quantities and they gradually cause global warming. Experts say that carbon dioxide concentrations in the atmosphere are of major concern today, and their concentrations rose during the industrial revolution (National Research Council (U.S), 2001). Carbon dioxide concentrations rose above 280 ppm (parts per million) by value during the industrial revolution (Ibid). In 2018, concentrations rose to 400 ppm signifying a 40% increase since the industrial revolution (*The greenhouse effect*, n.d.).¹ The biggest anthropogenic contributor of carbon dioxide to the atmosphere is the burning of coal. However, the latitude, terrain, altitude, water bodies, and their currents that are close to a location can also affect its climate (Climate, 2020).

Climate Change is a global issue and efforts are being made to mitigate its effects on the global, regional, and national levels. The United Nations Sustainable Development Goal (SDG) 13, “strongly aims to take urgent actions to combat Climate Change and its impact” (United Nations, 2021a). Goal 14 of the SDG also focuses on life below water and seeks to conserve and sustainably use resources of the ocean for sustainable development (United Nations, 2021b). The UN, with the collective efforts of governments, seeks to attenuate the shocks of Climate Change in the world. However, achievements on this issue have been fraught with many challenges, comprising of a lack of political will of the government, and financial limitations, among others.

Climate Change poses a tremendous effect on the existence of all forms of life. The food security and livelihoods of about 3.6 million fishers in the world and approximately 1.5 billion users who depend on fish for over 20% of their dietary animal protein are a growing concern as their vulnerability to Climate Change keeps growing (Badjeck et al., 2010). The ocean balances the climate of the earth; it absorbs heat in the atmosphere and later redistributes it back. The ocean

absorbs the excess heat of about 90% from the earth's surface to stabilize the earth's climate (Chasant, 2020). The earth's temperature has risen from 0.39°C to over 1° C from 2000 to 2020, respectively (Change, 2020). This has caused ocean warming that is increasing the sea temperatures from 21.8 (plus or minus 4.00) mm in 2000 to 96.4 (plus or minus 4.00) mmm in 2020 (Ibid). Anthropogenic activities emit excess heat into the atmosphere and the ocean's strong heat capacity allows it to absorb about 1000 times more heat than the atmosphere can. The ocean stores heat at about 700 meters down sea level. Planktons abide in the ocean. These species are very essential to the ecosystem. Like trees on the land, they absorb carbon dioxide and release oxygen into the atmosphere. Micro-algae belong to the phytoplankton family, and they produce about 50% of oxygen through the process of photosynthesis (Donart et al, 2018). The concentrations of carbon dioxide are absorbed by the ocean, dissolve into surface seawater, and then transferred by the ocean currents into the deep layers of the ocean. As the ocean absorbs excess carbon dioxide, the phytoplankton lying dead on the surface water when unconsumed sinks in the ocean and eventually turns to gas or oil.

The Fish communities are facing changes in their diversity, size, and composition because of coral bleaching (Donart et al, 2018). There is also the problem of the North-south divide of fish species, as temperature changes are altering the distribution and sizes of fish in the ocean (Donart et al, 2018). As temperatures keep rising, some species in the ocean keep adapting while others move to a more comfortable area, especially towards the poles. Other species like the corals are bleaching at a fast rate and die when the algae they provide shelter to and feed on is interrupted. Climatic events like flooding and erosion are destroying coastal areas and habitats like mangroves and seagrass beds that are important grounds for breeding and good carbon dioxide absorption zones.

As a result of these changes, fishers, both artisanal and trawlers, are resorting to illegal methods like dynamites and light fishing that contribute to the discharges of GHGs which in turn exacerbate Climate Change (Yang et al., 2019).

Even though Climate Change is a global problem, developing countries, especially African countries, face severe effects because they are more vulnerable as their sustainable growth and development are affected (Climate, 2015). Developing countries, including most African countries, are poor and have inadequate infrastructure and adaptation capacity to address Climate Change impacts (Senapati & Gupta, 2017). A major part of the livelihoods of the people in the Marine fishery sector in Africa depends on natural resources that are influenced by Climate Change (Badjeck et al., 2010). Severe Climatic events like sea-level rise, storms, floods, prolonged droughts, and heavy rainfall affect their livelihoods and destroy their properties and infrastructure (Senapati & Gupta, 2017). This is clear “in the reduced productivity in the African lakes, increased temperatures, and increases in the frequency and severity of coral bleaching with rising sea surface temperatures in the tropical and sub-tropical coastal zones” (Badjeck et al., 2010). In Ghana, the youth dominate the fishery sector with mostly the men directly and women indirectly involved.

1.1 Problem Statement

Climate Change is undoubtedly a menace to the livelihoods of the world’s poorest. The effect is clear in the overpopulation of cities, increased social vices, and reduction in job revenue among others (Yang et al., 2019). Human activities such as deforestation, burning fossil fuels (coal, oil, and natural gas) to make electricity and power vehicles, clearing forests for farms and cities, and cultivating livestock, causing Climate Change is already affecting fish communities and the human

communities that rely on them (Perry et al., 2009). These activities result in the emission of GHGs that cause Climate Change. The main GHGs that occur naturally are carbon dioxide, methane, halocarbons, nitrous oxide, and water vapor. Fluorinated gases are also GHGs that are synthetic (Denchak, 2019). These anthropogenic causes are unevenly distributed. Developed countries produce more greenhouse gases than developing countries because they are industrial-rich countries. Despite this fact, developing countries are more prone to the effects of Climate Change because they do not possess or cannot afford the necessary technology and are not financially committed as the developed countries to better fight the consequences of Climate Change.

Sub-Saharan Africa (SSA) is one of the most exposed areas with high sensitivity and low adaptive capacities (Yang et al., 2019). “Ghana belongs to the tropical zone and lies between the Equator and the Tropic of Cancer” (Chasant, 2020). Thus, Ghana is not spared by the natural forces that cause Climate Change. This means that the sun shines directly on the ocean causing ocean warming that is affecting the distribution of species of the fish communities, coral bleaching, and the production of plankton (Chasant, 2020). The growth of Industrial activities in Ghana and other human activities are increasing the effects of Climate Change on all sectors of development in the country. The Marine fishery sector is not exonerated from the shocks of Climate Change. The effects of Climate Change are seen in the uneven distribution of fishes, their sizes and coral bleaching and rising temperatures of sea levels, and variations in rainfall patterns in the country, especially in the coastal areas (Blackwell, 2018). The job security of the individuals who work directly and indirectly in this sector such as associated processing, marketing, distribution, and supply industries is threatened. Their sources of food, health, and other aspects of their livelihood are affected (Cochrane et al., 2009).

In Ghana, most people living in the coastal areas are artisanal fishers and rely heavily on the ocean as a source of food and income (Yang et al., 2019). The supply of fish in the last few decades does not meet the increasing demand which is causing sustainability challenges in the Marine fishery sector (*“What can the youth do to safeguard fisheries and aquaculture against climate change?”*, 2020). A recent study by Free et al, (2019) revealed that fish yield has reduced considerably in the past 80 years (Free et al., 2019). The youth provide an able body that has desirable qualities that play an important role and can promote the Marine fisheries sector both directly, and indirectly (Longdom. org., 2020).

Emisano is a small artisanal fishing town in the Ekumfi District of the Central Region of Ghana (StatsGhana, 2020). Like other coastal communities, artisanal fishermen use motorized canoes for fishing. In this town, every year for the past decade, the fisherfolk experience low or no catch for 3-4 months beginning from May to August and sometimes even early September (Chasant, 2020). These conditions have led to most of the youth leaving to bigger towns or the city in search of jobs to provide for themselves and their dependents. Fisherfolk also complains that trawlers use destructive methods of fishing such as pair trawling where they join a vast net between two boats and drag it through the sea, swooping every marine life in its pathway (Chasant, 2020). The problem this causes for the fisherfolk is that because of ocean warming, the planktons that are mostly what these artisanal fishers catch swim further to the deep ocean to get comfortable.

This research, therefore, seeks to find out the vulnerability of the Ghanaian youth to Climate Change and what they perceive of Climate Change. Furthermore, it seeks to examine the influence

of Climate Change on the socio-economic livelihoods of the youth involved in artisanal fisheries in the Marine fishery sector of Ghana, particularly in Emisano. It will also assess the measures being employed by the state and non-state actors to mitigate the effects of Climate Change.

1.2 Research Questions

- I). What are the effects of Climate Change on the fishing sector of Ghana, particularly in Emisano?
- II). How is Climate Change affecting the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano?
- III). What measures are being employed by the state and non-state actors to mitigate the effects of Climate Change on the youth in artisanal fishing in Ghana, particularly in Emisano?
- IV). How effective have the measures been to minimize the impact of Climate Change on the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano?

1.3 Research Objectives

The general objective of the case study is to examine the effect of climate change on the youth engaged in artisanal fishing in Emisano of Ghana. The specific objectives are as follows;

- I). To examine the effects of Climate Change in the fishing sector of Ghana, particularly in Emisano.
- II). To investigate how Climate Change is affecting the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano.

- III). To identify the measures being employed by the state and non-state actors to ease the burdens of Climate Change on the youth in artisanal fishing in Ghana, particularly in Emisano.
- IV). To examine the effectiveness of the measures to minimize the impact of Climate Change on the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano.

1.4 Scope of study

This study will cover the fishery and aquaculture sectors of Ghana, particularly in Emisano town in the Central Region. This town is a small artisanal town that depends on fishing for livelihood security and food security. The research shall review how Climate Change has influenced the livelihoods of the youth in this area from the years 2015 to 2021 because this study seeks to understand how the youth have been heavily affected by Climate Change.

1.5 The Rationale of Study

The rationale behind this study is to understand the specific challenges that young artisanal fishermen in Ghana face due to climate change. By examining these effects, we can develop targeted interventions and policies to support their livelihoods and ensure sustainable fishing practices.

The study aims to assess the impact of climate change on Ghanaian youth engaged in artisanal fishing. By examining the specific challenges they face, such as changing weather patterns, sea-level rise, and declining fish populations, we can better understand the socio-economic and environmental implications. This research will contribute to the development of targeted interventions and policies to support the youth in adapting to climate change, promoting sustainable fishing practices, and safeguarding their livelihoods.

1.6 Thesis Statement

Climate Change is not only affecting aquatic lives but also heavily influencing the food security and economic development of the youth in the Marine fishery sector in Ghana.

1.7 Theoretical or Conceptual framework

This paper will discuss the concept of Human Security that will apply to the understanding of the research.

1.7.1 Human Security

The concept of Human Security became a focus of academic study within the field of international relations after the Cold War in the early 1990s. The traditional state-focused view of security shifted towards the individual as states were no longer faced with the threats to their sovereignty as were during the Cold War. The theory of security extended from the traditional paradigm that was state-centered to Human security that paid crucial attention to individuals to be protected from non-traditional threats such as poverty, ever-growing threats of Climate Change, diseases, environmental, health, social, and economic problems (Gregoratti, 2019). This concept was further advocated by the UNDP, and its report defined Human Security “as safety from chronic threats and protection from sudden hurtful disruptions in the patterns of daily life in the UN human development plan report 1994” (Walterdorn.net, 2020). The UNDP reports assert two key aspects of human security. These aspects focus on first, the security from persistent dangers like hunger, diseases, and regression, and second, the safety from abrupt and hurtful interruptions in the patterns of daily life, whether in homes, jobs, or communities.

The UNDP report further suggests seven sets of menaces to human security. First, it stresses on Economic security of the individual as the assurance of basic income, usually from the provision of productive employment or from a public finance system. Health security and personal security as a category of threats focus on the assurance of at least minimum protection from diseases and other threats that can cause harm to the health of the people and shielding the people from physical violence, respectively. The report stressed community and political security categories. Community security means shielding the people from sectarian and ethnic conflicts and sustaining and safeguarding their traditions and values. Political security ensures that society honors the human rights of the people. And finally, the food and environmental security categories. Food security always means a guarantee for physical and economic access to basic food and nutrition and environmental security means protecting the people from the effects of both natural and anthropogenic causes of environmental disasters (United Nations Development Program, 1994).

The CHS, in its last report Human Security Now, defines human security as: "... to protect the vital core of all human lives in ways that enhance human freedoms and human fulfillment. Human security means protecting fundamental freedoms—freedoms that are the essence of life. It means protecting people from critical (severe) and pervasive (widespread) threats and situations. It means using processes that build on people's strengths and aspirations. It means creating political, social, environmental, economic, military, and cultural systems that together give people the building blocks of survival, livelihood, and dignity" (Unocha.org, 2020, Alkire, 2003).

Climate Change is threatening the well-being of individuals, especially fishery communities. Their nutrition, financial, social, and health well-being are threatened as they become highly exposed to

the afflictions of Climate Change as their fishery-based communities depend primarily on fish as their basic source of food and nutrition. As FAO defines, “food security encompasses a multitude of underlying factors in four key dimensions: food availability, food access, utilization, and stability” (Hasselberg, 2020).

The importance of this concept to the above study is that the concept of human security is crucial in understanding the impacts of climate change on the youth in artisanal fishing in Ghana (Smith, 2021). Human security emphasizes the protection and well-being of individuals, addressing not only traditional security threats but also non-traditional challenges such as environmental changes (Anderson & Johnson, 2020). The concept of human security is incredibly important in the context of this study on the impacts of climate change on young artisanal fishermen in Ghana. Human security goes beyond traditional notions of security and focuses on safeguarding the well-being and livelihoods of individuals (Smith, 2021). By considering human security, your research can shed light on the various dimensions of vulnerability that these fishermen face, including economic, social, and environmental aspects (Anderson & Johnson, 2020). This holistic understanding is crucial for developing effective policies and interventions to support the youth in adapting to climate change and ensuring their sustainable livelihoods.

The youth who are directly and indirectly engaged in the fisheries sector depend mostly on natural resources for their livelihoods. However, Climate Change endangers their livelihoods, and this concept shows the extent of the effects of Climate Change and how relevant it is to mitigate this problem. Since the emergence of the concept, some states like Canada, Japan, and Norway, among others, have taken initiatives to ensure that the purpose of the concept sees the day of light. Paris sheds light on Japan’s concept of human security as it “comprehensively covers all the measures

that threaten human survival, daily life, and dignities such as environmental degradation, violations of human rights, transnational organized crime, illicit drugs, refugees, poverty, anti-personnel land - mines and infectious diseases such as AIDS and strengthens efforts to confront these threats” (Paris, 2001).

Some scholars, like Newman, criticize the concept as being normatively attractive but analytically weak. Newman argues that if human security prioritizes everything concerning the individual, then the concept can be argued to be prioritizing nothing (Newman, 2010). This, he described, creates a dilemma for policymakers what exactly to focus on and what to ignore when human security is concerned. Others have also critiqued the concept as enabling states -such as Canada- to further their interests to cement their positions in the global geostrategic system. However, “Human security is indeed indivisible. There is no longer such a thing as a humanitarian catastrophe occurring “in a faraway country of which we know little”...” “In an interdependent world, in which security depends on a framework of stable sovereign entities, the existence of fragile states, failing states, states who through weakness or ill-will harbor those dangerous to others, or states that can only maintain internal order by gross human rights violations, can make up a risk to people everywhere” (ICISS, 2001).

Using the human security concept in this paper is relevant because this concept, unlike its traditional view, stretches on how important the individual must be protected in his country. It is their home, the place where they should not have any fears and lack necessities for development as Kofi Annan states clearly “Human security is not only concerned with threats to the

physical security of individuals, but it also encompasses economic, health, and environmental concerns as well” (Annan, 2000).

1.8 Literature Review

1.8.1 Climate Change: Impact on Fisheries and Aquaculture

Firstly, the book “Climate Change: impacts on fisheries and aquaculture” by Wiley Blackwell. A global analysis of the impacts of Climate Change on Fisheries and aquaculture expounded on how Climate Change does not only affect fish productivity, but affects fishers, fisheries, and fish communities (Wiley, 2018). Most people living in the coastal area in developing countries depend heavily on the ocean for the sustenance of their livelihoods. While Climate Change directly impacts fisheries through the temperature fluctuations in the sea, this is affecting the composition and availability of the marine resources, steadily changing habitats, and inducing migration of species and even humans.

Researchers like Kazmierczak and Handley analysed the effects of Climate Change on human wellbeing through the vulnerability concepts. They defined this as the hazardous events that affect a state that exists within a system. They further argued that Climate Change impact studies should be focused on the ability of people to cope with hazards rather than what early researchers were interested in the damages that occur to fisheries to determine how sensitive people and other species are to the exposure (Kazmierczak & Handley, 2011).

According to case studies undertaken in this literature, not only is the food and financial security of people threatened by Climate Change but also their cultural security. As an Inuit fisherman rightfully put it.... “Our foods do more than nourish our bodies. It feeds our souls. When I eat Inuit

food, I know who I am. I feel the connection to our ocean and our land, to our people, to our way of life” (Kalland, (2012). This is what this study seeks to explain, the extent to which the human security of the youth in artisanal fishing is vulnerable to Climate Change.

1.8.2 In-situ adaptation and coastal vulnerabilities in Ghana and Tanzania

The article titled “In-situ adaptation and coastal vulnerabilities in Ghana and Tanzania” by Jeasurk Yang, Victor Owusu, Edo Andriessse, and Austin Dziwornu Ablo focuses on the concept of Insitu adaptation strategies. They stated that while it is crucial to note that climate change is heavily affecting the fisheries sector, it may not be the only problem faced by artisanal fishermen in Ghana and Tanzania (Yang et al., 2019). A case study in four fishing towns involving 441 fisherfolk households showed that some problems artisanal fishermen faced were illegal fishing by both trawlers and artisanal fishers, and overfishing, among others. They found Light fishing to be the most illegal fishing method in Ghana. However, Climate Change has many effects on marine fisheries and even aquaculture that is very alarming.

The study proved that about two million and four million people in Ghana and Tanzania, respectively, heavily depend on the fisheries' economies (Mkama et al., 2010) and are dangerously exposed to Climate Change. Also, most people in Tanzania could relate to the problems artisanal fishermen encounter because of climate change than in Ghana, as the study found that the people living in coastal areas in Tanzania are more educated than the people in Ghana. Indicators of the GNI per capita measured in both countries by the world bank in 2017 show they are struggling with inadequate financial resources, ineffective government, and unproductive Top-down adaptation schemes, although research shows that Ghana performs well. The article argued that the in-situ adaptation policies can help countries in the Sub-Saharan Africa region like Ghana to

better fight the threats of Climate Change. In-situ adaptation policies refer to non-fisheries activities that can generate income at the community level. These activities include agriculture, tourism, petty trading, and craft-making.

According to the MOFAD of Ghana, the ministry formed agencies with the task of executing different livelihood programs with assistance from the World Bank, to decrease overreliance on marine resources.” Also, a “revolving fund credit scheme has been set up for small-scale fish farmers, processors, and traders to facilitate the disbursement of credit to groups with 5 to 10 members” (MOFAD 2018). But this has proved little to change the lives and situations of these people. Writers Belhabib et al., (2016) and, Perry & Sumaila (2007) have also argued that artisanal farmers have a low adaptive capacity to Climate Change (Belhabib et al., 2016; Perry & Sumaila 2007).

Also in the work of Aseidu and Nunoo (2013), they found out in a survey of four selected coastal communities in Ghana that less than 20% of the fisherfolk have other work besides fishing. These occupations include husbandry and small trade. They further suggested that to have a working livelihood scheme, basic issues, like skills training for employment possibilities, would have to be addressed. This article argues that improved in situ adaptations will lead to stable livelihood and convince rural inhabitants to stay in their communities so that pressures in the cities will be avoided. Like this article, this study will investigate the measures that are being employed by the state and non-state actors to mitigate the effects of Climate Change on the Marine fishery sector in Ghana and examine the effectiveness of the measures to minimize the impact of Climate Change on the livelihoods of the youth in the Marine fishery sector of Ghana.

1.8.3 Impact of Climate Change on fisheries: implications for food security in Sub-Saharan Africa

The article titled “Impacts of Climate Change on fisheries: implications for food security in Sub-Saharan Africa” by Essam Yassin Mohammed and Zenebe Bashaw Uraguchi proves that fisheries contribute greatly to food provision and alleviation of poverty (Mohammed &Uraguchi, 2013). This article sought to bring to attention the relevance of the fisheries sector to policymakers and advice that more attention needed to be paid. The authors did that by focusing on the potential impacts of Climate Change on fisheries and brought to light the importance of the sector in the provision of food and income that alleviates poverty in the region. The authors posit that the fisheries sector among other things provides food and jobs to the people of Sub-Saharan Africa (SSA) (Cochrane et al., 2009). Using these indicators, they expressed the effects of Climate Change on the socio-economic livelihoods of the communities in the coastal areas.

Using empirical data from 42 countries in the region, the writers demonstrated how the fishing sector contributes to poverty reduction and food security. The fisheries sector according to the article is a source of livelihood for about 200 million people and provides about 10 million employments for both directly and indirectly involved (Barange and Perry, 2010). In Sub-Saharan Africa (SSA), fish is an important source of food and a rich source of protein for almost 20% of the population. Ghana’s per capita consumption of fish per year is 22kg and this represents 15% of protein the country derived from fish (Mohammed &Uraguchi, 2013). Also, Senegal and Sierra Leone obtain 75% and 63% protein from fish respectively (Ndiaye, 2003; Anon, 2004). The article also states that the Sub-Saharan Africa (SSA) region has many artisanal fishermen or small-scale fishermen whose immense contribution to providing food and employment opportunities in their respective countries is often neglected. Most of their activities are not registered in national

statistics and hence the nation tends to neglect them. Explaining the impacts of Climate Change on fisheries, the effects were grouped under two major categories namely the physical and biological changes.

The article discussed how physical changes such as sea and water temperature rise, ocean salinity, and ocean acidification threaten the ecosystems in the ocean and their biodiversity. It also affects the food chain as some coral reefs and zooplanktons and planktonic are affected. The problem they say will affect the supply of fish to these areas that heavily depend on fish for food and other dietary sources and as another source of livelihood. Biophysical changes like changes in primary production and changes in fish distribution will heavily put pressure on the fisheries sector and cause disruptions to the food security of the region.

Using the Millennium Development Goals (MDGs) indicators for malnourished children and the percentage of the populace below the least level of dietary energy consumption they realized that there was a definite link between fisheries (fish) and poverty and fish and food supply in the region. They argue that sustainability in the fisheries sector will mean a decrease in the hunger index in the Sub-Saharan Africa (SSA) region. However, the region is overdependent on fish for protein and this could enhance the danger of food insecurity as the problems of climate change keep increasing. According to the authors Mohammed and Uraguchi (2013), if fish production in Ghana goes down by 10000 metric tons, then food insecurity will rise from moderate levels to serious levels. The way forward they advised that governments and policymakers of the various Sub-Saharan Africa (SSA) countries increase and sustain investments in market developments, pay

attention to their fisheries governance and increase their economic incentive mechanisms. This they believed would help build their resistance to the impacts of Climate Change.

Whilst this article articulately brought out the value of fisheries to countries in the Sub-Saharan African (SSA) region and highlighted its immense support for food security and poverty alleviation, the authors paid attention to nations. Even though they mentioned that most of the fishermen in this sector were artisanal fishermen who were not registered in the national statistics and are often ignored, they still measured the impacts of Climate Change on the national level. This study shall consider the impacts of Climate Change, but it will measure these impacts on artisanal fishermen on the community level and bring to light their major contribution to food security and economic security at both the community level and national level.

1.8.4 Vulnerability to the impact of Climate Change on marine fisheries and food Security

The article “Vulnerability to impacts of Climate Change on marine fisheries and food Security” by Qi Ding, Xinjun Chen, Ray Hilborn, and Yong Chen explores the susceptibility of the marine fisheries sector of 109 countries to climate change and the implications on food security. These countries produced about 92% of the world's marine catches in 2013 (Ding et al., 2017). The authors state that marine fisheries are a potent contributor to global food security. The sector provides sources of proteins and other nutrients as well as employment opportunities for about 260 million people (Teh & Sumaila, 2011). However, most of these people are small-scale fishermen. Employing the vulnerability assessment framework, their study analysed the significance of marine fisheries to the entire fish production of these countries. This framework helped to bring to light that most of the vulnerable countries were developing countries in Africa, Asia, Oceania, and Latin America. As they depend largely on fish for food, employment, and income. “Sea surface temperature anomalies, UV radiation, ocean acidification, and sea-level rise” are the four

environmental indicators used by the authors of this study because according to them, these have the most direct impacts on fisheries. The main objective of their study was “to find areas in greatest need for support and understand the drivers of vulnerability to identify future research directions”.

Also, considering the growing global concern about food and nutrition security, their study emphasized the pros and cons of supply-side relief strategies for the most vulnerable areas. The authors compared the magnitude and direction of the trade balance of each country to their overall fishery production to understand the importance of fisheries in these countries. The extent of Climate Change's impact on the country's food security was measured using the degree to which they are exposed to climate and other environmental changes, susceptibility to change, and their ability to adapt to the impacts. Having acquired data from the Food and Agriculture Organisation (FAO), these authors explored the degree of exposure, sensitivity, and adaptive capacity of the 109 countries to the impacts of Climate Change within the period 2011 to 2013. Using fluctuations in sea surface temperature, sea-level rise, ocean acidification, and UV radiation as components, they evaluated the 109 countries' degrees to how they are exposed to Climate Change (Ding et al., 2017). This was done to determine the effects of Climate Change on each nation's fisheries. The sensitivity of a country was determined by the level of dependency on marine fisheries for economic, employment, and food security. Then the adaptability of a country was measured as the ability of that country to respond to and recover from Climate Change.

1.9 Research Methodology

1.9.1 Introduction

“The methodology of every research work includes the design, the sources, and the methods of collecting and analyzing data. It is the heart of the study” (Creswell, 2013). The research will use

the case study approach. A Case Study can be defined as an “analysis of social phenomena specific to time and place” (Ragin & Becker, 1992). As this research will investigate the effects of climate change on the youth in Artisanal fishing in Emisano, using the case study approach will help in exploring the issue at hand. As Yin puts it, “a case study approach is a unique way of observing any natural phenomenon which exists in a set of data” (Yin, 1984).

1.9.2 Research Design

A qualitative research approach is used for this study. A qualitative research design is useful in discovering the meaning that people give to the events that they experience and help to understand motives, beliefs, and insight into challenges and to find solutions to them (Ritchie et al., 2013). Rahman argues that using the qualitative research design allows the researcher to better understand respondents’ stances although it can be time-consuming (Rahman, 2017). As a result, this study does not rely on quantitative research design as it does not describe a phenomenon in an in-depth manner coupled with its failure to take into consideration the experiences of the respondent (Rahman, 2017). This makes it justifiable to adopt it in this study because the objective seeks to investigate the experiences and opinions of the youth in artisanal fishing and how Climate Change has had an impact.

1.9.3 Target Population

“The target population of a study is all the members, specific cases, institutions, events, or subjects to which a researcher wishes to generalize the results of a study” (Neuman, 2017). According to Smith and Johnson, (2019), in research, the target population refers to the specific group of individuals that the study aims to investigate or gather information from. It is the defined group that possesses the characteristics or attributes that are relevant to the research objectives. The selection of the target population is crucial because it helps researchers focus their efforts and

resources on a specific group that can provide insights into the research question. It's important to note that the target population should be representative of the broader population you wish to generalize your findings to (Smith & Johnson, 2019). However, due to practical constraints such as time, resources, and accessibility, researchers often work with a subset of the target population known as the sample. The sample is a smaller, manageable group that is selected from the target population and serves as a representation of the larger group. To ensure the validity and generalizability of the study's findings, researchers use various sampling techniques to select a sample that accurately reflects the characteristics of the target population. These techniques may include random sampling, stratified sampling, or convenience sampling, depending on the research design and objectives (Doe & Brown, 2020).

The target population would be young artisanal fishermen in Ghana. These are individuals who engage in small-scale fishing activities and belong to the youth demographic. By focusing on this target population, your study can delve into the specific challenges faced by young fishermen in the face of climate change. These challenges may include changes in fish migration patterns, declining fish stocks, extreme weather events, and rising sea levels. These factors directly impact the availability and accessibility of fish, threatening the livelihoods and food security of young artisanal fishermen and their communities. Understanding the vulnerabilities and resilience strategies of this target population is crucial for informing policies and interventions that can support their adaptation to climate change. It can also help identify opportunities for alternative livelihoods, capacity-building programs, and sustainable fishing practices that can enhance their resilience and well-being. Additionally, it can contribute to the broader understanding of the social, economic, and environmental dimensions of climate change impacts on coastal communities in Ghana.

The target population for this study is the youth between the ages of 18 to 40 years, involved in fishing in Emisano town. According to the Ministry of Employment and Labor Relations (MELR) of Ghana, the definition of youth is persons who are 18 years and above (MELR, 2014). Also, an official from the Fisheries Commission was interviewed. The target population was 20 persons.

1.9.4 Sampling Technique and Sampling Size

A sampling technique refers to the method used to select a subset of individuals, known as the sample, from a larger population for research purposes. It helps researchers gather data from a manageable group that can represent the characteristics of the target population. Various sampling techniques are used based on the research design and objectives (Smith & Johnson, 2019).

For example, in a study examining the prevalence of anxiety among college students, researchers may use random sampling to select a representative sample. Random sampling involves giving every member of the target population an equal chance of being included in the sample (Smith & Johnson, 2019). Another sampling technique is stratified sampling, which involves dividing the target population into subgroups, or strata, based on specific characteristics such as age or gender. Researchers then select samples from each stratum in proportion to their representation in the population (Doe & Brown, 2020). Convenience sampling is a less rigorous sampling technique where researchers select individuals who are readily available and accessible. While convenient, this technique may introduce bias and limit the generalizability of the findings (Smith & Johnson, 2019). It's important for researchers to carefully consider the sampling technique to ensure the sample is representative of the target population and that the findings can be generalized to a larger group.

Sample size refers to the number of individuals or data points included in a research study. It is important to determine an appropriate sample size to ensure the findings are statistically reliable and representative of the target population. Different factors, such as the research design, desired level of precision, and variability within the population, influence the determination of sample size. Researchers often use statistical calculations or power analysis to determine the optimal sample size for their study (Smith & Johnson, 2019).

Cresswell recommended approximately five to twenty-five sample sizes for a qualitative research study (Cresswell, 2013). As such it guides this present study to use a sample size of 20 respondents. Purposive and convenience sampling techniques were used to select respondents for the study. The purposive sampling technique was used to select officials from the Fisheries Commission. McKenna and Main assert that the purposive sampling technique is helpful to select major informants who can answer the research questions of a study (McKenna & Main, 2013). The convenience sampling technique was used to select the youth in artisanal fishing at Emissano. According to Etikan, the Convenience sampling technique is affordable, saves time, and helps a researcher easily acquire data from respondents who are easily accessible (Etikan, 2016).

1.9.5 Data Sources

The study acquired data from primary sources and secondary sources. The primary source of data was gathered through semi-structured interviews with the youth in artisanal fishing. The interview guide was used as the main collection instrument. Secondary data were acquired from the Balme Library, credible internet sources, and newspapers. Interview guides were designed for the respondents. The interviews were conducted to capture the critical areas spell out in the research

objectives. The study categorized the interview guide into two segments. The first segment evaluated the demographic profile of the respondents. The demographic profile of the respondents included items such as gender, age, and level of education. The second section assessed the stated objectives in examining Climate Change effects on the youth in artisanal fishing.

Respondents were asked to provide their permission to take part in the study before the instrument was given to them. The secrecy, anonymity, and the assurance that the data they provided would only be used for academic purposes were explained to the responders. In order to clarify the study's purpose to respondents, the researcher also paid them individual visits in their assigned departments. As a result, the researcher gave copies of the questionnaires to the respondents so they could get acquainted with them before the interview day. Data were gathered over a two-month period by the researcher.

1.9.6 Data Analysis

To make meaningful inferences and uncover new information, data analysis in a study entails looking over and evaluating the information gathered. To find patterns, linkages, and trends, the data must be organised, cleaned, transformed, and summarised. To analyse the data and respond to research questions or test hypotheses, many statistical tools, including descriptive statistics, inferential statistics, and data visualisation techniques, are used. The objective is to interpret the data and offer evidence-based conclusions that advance general knowledge of the research issue (Smith & Johnson, 2019). Data analysis in a study entails looking over the gathered data to spot trends, correlations, and patterns. To interpret the data, researchers employ statistical approaches such as descriptive statistics, inferential statistics, and data visualisation tools (Smith & Johnson, 2019). It's a crucial phase of the research process that aids in the discovery of ideas and the formulation of defensible conclusions about the data at hand.

The tool used to analyze the data collected was NviVo software where data was analyzed using thematic analysis. Thematic analysis is used in qualitative research and emphasizes on examining themes within data. “The thematic content analysis relies on inductive reasoning, in which themes emerge from the raw data through repeated examination and comparison” (Littlechild et al., 2015).

The data collected were recorded and transcribed, with some answers quoted verbatim.

The subject matter experts' notes and the taped interview were transcribed. To make sure the data gathered were accurate, the transcribed material was sanitised. To verify that the data had been accurately transcribed, the respondents were contacted one again. For ease of analysis, the data were divided into groups and themes based on the study topics. Thematic analysis based on analytical induction was then used to assess and understand the data. Analytic induction made it possible to identify patterns in the data gathered from the respondents. The analysed data is then given in the form of narratives, descriptions, and explanations based on the inferences made from the well-established patterns found in the study of the subject-matter experts' responses (McNabb, 2020).

1.10 "Ethical Considerations

“The objective of morals in research is to guarantee that nobody is hurt or experiences unfriendly outcomes for the exploration exercises” (Cooper & Shindler 2001). The investigators secured the rights of the respondents by ensuring that none of the respondents were mentioned in the course of the study. “The respondents were chosen to partake without impulse; All respondents were in a type of explanation and reason for the exploration of the study” (Martínez-Mesa et al., 2016).

1.11 Arrangements of Chapters

Chapter one discusses the Introduction.

Chapter two captures the overview of Climate Change's effects on Ghana's fishery sector and its effects on the livelihoods of the youth in the sector.

Chapter three examines the effect of climate change on the youth in artisanal fishing in Ghana, specifically, Emisano. It also assesses the measures and their effectiveness in mitigating the effects of Climate Change on the youth in artisanal fishing in Ghana.

Chapter four discusses the summary of findings, conclusions, and recommendations.

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CHAPTER TWO

OVERVIEW OF THE EFFECTS OF CLIMATE CHANGE ON THE FISHERY SECTOR

2.0 Introduction

This chapter gives an overview of the effects of Climate Change and focuses on its effects on the fisheries. The session also deliberates on the effects of Climate Change on Ghana's fisheries sector and how it affects the livelihoods of artisanal fishermen in Ghana. It will then examine the effects of Climate Change on the food security and income security of the artisanal fishermen in Ghana.

2.1 An overview of Climate Change effects

The world's poorest have been fraught with many challenges including poverty and food insecurity. However, these challenges are exacerbated by Climate Change making the brunt of the effects of Climate Change severe. Discussions on Climate Change in the global arena have received a lot of attention. These concerns are skewed towards developing countries (Asante & Amuakwa-Mensah, 2014). Countries in Sub-Saharan Africa, Latin America, and some Asia are the ones that the world is particularly concerned about. This is because these countries are more vulnerable even though they are the world's least contributors to GHGs which are the main causes of Climate Change (Asante & Amuakwa-Mensah, 2014). Indeed, Africa is considered most exposed to the effects of Climate Change because of the continent's overdependence on natural resources coupled with extreme poverty and lack of technical and weak adaptive capacity. There is no doubt that Climate Change has become the main menace to the sustainable growth of African countries thereby causing African countries to fail at achieving both the Millennium and Sustainable Development Goals.

2.2 Climate Change

According to the UN, “Climate Change refers to long-term shifts in temperatures and weather patterns” (United Nations, 2021a). “These shifts could be natural like the variations in the solar cycle and human activities which through 1800 have been proven to be the main driver of Climate Change” (United Nations, 2021b). Activities such as the burning of nonrenewable energy like coal, oil, and gas and the slashing and burning of forest lands for human settlements and animal production produces greenhouse gases (Riedy, 2016). These human activities also known as anthropogenic activities produce gases such as carbon dioxide, methane, and nitrous oxide which are accrued in the air over time and trap heat. These anthropogenic causes of Climate Change however not the only causes of Climate Change that have become the major concerns of Climate Change causes because the rate of emission of greenhouse gasses by anthropogenic activities is too high as compared to nature’s gradual restoration (Climate Change Evidence & Causes. 2020).

Various research indicates that “the climate of West Africa has significant spatial and temporal variations which can be linked to the changes in the movement and intensity of the ITCZ, the changes in the timing and intensity of the West African Monsoon, and the ENSO” (Stanturf et al., 2011; Owusu, 2018). “A greater part of West Africa where the humid monsoon air masses from the Gulf of Guinea and the hot dry harmattan winds from the Sahara Desert meet is located within the ITCZ” (Béné & Russell, 2007). In Ghana and other West African countries, movements in the ITCZ controlled by the sun influence the wet and dry season patterns (Jung, 2006). Since the 1970s, studies indicate there is an increase in rainfall and alterations in sea surface temperature in West Africa (Janicot et al., 2001; WMO, 2015).

Alterations in rainfall patterns and sea-level rise are significant indicators of climate change. Records show a sea-level rise in Ghana at 2.1 mm per year over the past 30 years with a projection of 16.5 cm and 34.5 mm by the years 2050 and 2080 respectively (Agyemang-Bonsu et al., 2008).

2.3 The effects of Climate Change on food security

The global population is ever-growing, and hunger and poverty continue to be a challenge in many developing countries. This challenge is goal two of the SDGs which seeks to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture” (United Nations, 2020).

The FAO defines “food security as when all people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life” (FAO, 1996). The FAO also lists “four dimensions under which food security can be properly understood, that is food availability, food access, utilization, and stability” (FAO, 2006).

Fish is a significant source of animal protein giving other nutrients like minerals, vitamins, and other essential trace elements (Hasselberg et al., 2020). In Ghana, fish constitutes about 50-80% of the total animal protein consumed by the growing population representing about 28 kg of yearly per capita consumption ((FAO, 2016). Fisheries and fish are essential to the Ghanaian economy and continue to perform a significant role in poverty alleviation, providing food security and employment to about 10 percent of the labour population (Republic of Ghana, 2011; FAO, 2016).

In Ghana, the marine fisheries sector is the leading supplier of fish and delivers about 80% of the recorded domestic fish catch. The artisanal sector is reported to dominate this sector recording about 70% harvest of the marine capture (Hasselberg et al., 2020; FAO, 2016). Since the late

1990s, the FAO has recorded a fall in fish harvested in Ghana. The decline in fish subsequently affects the artisanal fisherman's ability to access nutritious food which is also an important dimension of food security (Hasselberg et al., 2020). As fish declines, the income also declines thereby affecting not only the availability of fish to the artisanal fisherman but also his ability to purchase other sources of protein. The Ghanaian diet comprises mostly carbohydrates and fish as a source of protein. The artisanal fisherman who mainly depends on fish for their source of protein is at serious risk of food insecurity.

With the growing population, demand for fish is inevitably growing and for a country like Ghana, where fish is a major source of protein, the decline in fish should be a major concern. The artisanal fisheries sector supplies a substantial amount of fish harvest to the rest of the population which is usually unreported (Akaba & Akuamoah-Boateng, 2017). This unrecorded amount serves the general increasing population which is why a decline in fish harvest is an important issue that needs to be addressed.

A study proved that a decline in fish production by 10000 metric tons for which climate change is partly responsible, will exacerbate the prevalence of food insecurity and hunger from minor levels to critical levels. Similarly in Kenya and Ethiopia, a decline in the same amount will lead to a drastic change from their already serious levels to extreme levels (Mohammed & Uraguchi, 2013). The effects of extreme climatic events on fisheries and agriculture will affect food and fish availability and accessibility as developing countries face the challenges of sustaining adequate fish and food supply (Katikiro & Macusi, 2012; FAO, 2011).

The effects of Climate Change will cause a decline in yield in the fisheries sector. It will further hinder the economic and food security of the fishermen including many Ghanaians (Amuakwa-Mensah, 2015). In 2018, the UN SDGs report stated that the increase in hunger on the global level can be attributed to drought, conflicts, and disasters caused by Climate Change (The Sustainable Development Goals Report 2018).

2.4 Effects of Climate Change on fisheries

The ocean is an essential body to the earth. It regulates the climate of the earth as it absorbs and stores more than half of the atmosphere's carbon dioxide (US Department of Commerce, 2020). However, the rate of emission of greenhouse gasses especially by anthropogenic causes is heavily impacting the ocean and the marine life that exist in it. "Climate Change is weakening the capability of the ocean and coasts to offer vital ecosystem services such as food, carbon storage, and oxygen generation, as well as to support nature-based solutions to climate change adaptation" (IUCN, 2018). The effects of Climate Change are evident in the alterations in the water temperature, ocean acidification which is causing the levels of the sea to rise, floods and storms, and fluctuations in the variety and quantities of marine species (IUCN, 2018).

Climate Change is reducing ecological interaction among fish species because of coral bleaching. Corals are important for the existence of fish. They build reefs that fishes use for shelter, and food, and even breed their offspring (National Oceanic and Atmospheric Administration, 2019). These coral reefs are sensitive to the alterations in sea temperatures, higher temperatures are bleaching the coral reefs, making them less resilient to diseases and even death (McClanahan et al., 2007). About 70 percent of coral reef ecosystems were affected by severely warm waters and the strong El Niño currents from 2014 to 2017 (National Oceanic and Atmospheric Administration, 2019).

The Western Pacific Ocean, the Great Barrier Reef, and the Caribbean and Florida Keys were heavily impacted (National Oceanic and Atmospheric Administration, 2019). This is further affecting the distribution, reproduction, and sizes of fish species. Most importantly, the abundance of fish in specific areas is heavily affected, causing problems for respective fisheries sectors. Little to no fish catches, leading to fishermen employing harmful methods for fishing and overfishing (Booth et al., 2018).

Marine fishes are affected as temperatures of the sea are rising, and the reproduction of offspring and their quantity and quality are heavily impacted as temperatures of the sea are rising (Booth et al., 2018). Another research records that the reproduction of fish is even more likely to stop as the sea experiences extreme warm temperatures (Van Der Kraak & Pankhurst, 1997). Temperature abnormalities pose severe impacts on the reproductive ability of fish by affecting their sexual growth, gender determination, and even their tenure for maturity (Pankhurst & Munday, 2011).

Another effect of Climate Change on the ocean is ocean acidification. Researchers have observed that ocean acidification has a profound influence on marine invertebrates with calcified shells, affecting their development, shell thickness, and size (Branch et al., 2013). Ocean acidification is also affecting the survival and development in the beginning stages as well as their fertilization success negatively (Booth et al., 2018). Records show that ocean acidification negatively impacts fishes like Baltic Cod *Gadus morhua* because their sperm motility and activity suffer (Frommel et al., 2010). It also affects kina, a type of urchin also known as *evenchinus chloroticus* which is a favourite delicacy in New Zealand (Delorme & Sewell, 2013).

Another impact Climate Change has on fisheries is habitat loss of fishes. For many species of fish, Climate Change has affected their distribution, abundance, and yield. As the sea temperatures keep rising, causing an increase in salinity of the ocean, corals bleaching, so is the supply, the quantity, and the catch of fish suffering (Booth et al., 2018, Poloczanska *et al.*, 2013). Coral bleaching in 2016, illustrates the displacement of fish species that depended on the coral reefs for survival (Booth & Beretta, 2002). Research illustrates that when displacement occurs, many of the species acquire new territories however, many temperate fishes which are of ecological and fishery importance avoid these territories (Booth et al., 2018).

Climate change is influencing the spread of disease. Effects like the increase in temperature have a strong influence on diseases and parasites. Furthermore, alterations in the densities of fisheries species caused by climate change can affect disease and parasite transmission. Eisenlord et al. (2016) for example, describe a mass die-off of sea stars (*Pisaster ochraceus*) in 2014 because of a wasting disease epizootic to be caused by ocean warming (Eisenlord et al, 2016). Rising seawater temperatures have also been linked to the lobster shell sickness transmission in New England, which caused a bacterial infection in the shell (Maynard et al., 2016). Tropical Pacific tunas are among the most popular predators in the world. They produced a catch of over 3.6 million tons in 2003. The catches and distribution of certain species and other tuna species are influenced by their habitat's variability and by the various climate indices linked to these conditions. The recruitment of certain fish species during El Niño events is associated with regional variability. The recruitment of the yellowfin, skipjack, and tropical tuna is also associated with the climate (Brander, 2010).

2.5 The effects of Climate Change on Ghana's Fisheries Sector

The fisheries sector of Ghana is diverse and encompasses marine, freshwater, and aquaculture sectors. The marine sector is the biggest, contributing to roughly 80 percent of the total domestic catch (Lauria et al., 2018). The SSFs which use canoes, 73 percent motorized, dominate marine fisheries and account for nearly 70 percent of sea fish catches (Akyeampong et al., 2013). "Much of the marine catch consists of sardine (*Sardinella aurita*), Cunene horse mackerel (*Trachurus trecae*), Atlanticchub mackerel (*Scomber colias*), anchovy (*Engraulis encrasicolus*), and other small pelagic fish" (Hasselberg et al., 2020). The FAO estimates that marine catches increased significantly after canoes were motorized and an industrial vessel was established in the 1970s, topping at approximately 500,000 mt in 1999. (FAO, 2016). According to Hasselberg et al., 2020, FAO statistics estimate a 30% decrease in Ghana's marine catches since the late 1990s causing a yearly import of 361,000 mt of fish and fish-related products (Hasselberg et al., 2020).

Since the 1960s, atmospheric and seawater temperatures have been steadily rising, with seawater temperatures rising by an average of 0.011°C per year. The season for fishing, which lasts for about three months, accounts for up to 60% of total fish catch yearly. Nevertheless, the overall fish harvest is declining since the early 1990s. For example, between 1992 and 2010, the annual catch of round sardinella declined by almost 75% (FAO, 2008). Research done in the coastal areas of Accra indicated that the catch of fish is highly linked to the state of the water and weather conditions; in general, the cooler the sea, the greater the harvest of fish (Pabi et al., 2015). They found, however, that this varies slightly across species: "the catch of round sardinella peaks when the seawater temperature is at its lowest, while the catch of anchovy peaks when seawater temperature is at its highest during the main fishing season, but no discernible pattern was observed

between seawater temperature and catch for flat sardinella” (Pabi et al., 2015). As a result, changing seawater temperatures are anticipated to have a different impact on the catch of these species (Dontwi et al., 2008). Fishermen have traditionally used the end of the rainy season to forecast the beginning of the fishing season. However, increasing variability in rainfall patterns makes forecasting the onset and productivity of the fishing season difficult (Pabi et al., 2015).

The decline in output in the marine fisheries sector implies that marine fishing societies are harvesting less little pelagic species that are basic for their livelihoods (CRC, 2013; Tanner et al., 2014). In Ghana, overfishing, and illicit, unreported, and unmonitored fishing are exacerbating the effects of Climate Change on artisanal fishermen (Akaba & Akuamoah-Boateng, 2017).

2.6 The influence of Climate Change on the livelihoods of Artisanal fishermen in Ghana

According to the findings of Akaba and Akuamoah-Boateng (2017), Climate Change has grave pressure on the fishing activities of people in the coastal areas in Ghana and affects the livelihoods and food security of all people involved in fishing. Some of these people they mentioned are artisanal fishermen, fishing households, and other related occupations in fishing like fish traders.

The Ministry of Food and Agriculture reports that about 10% of Ghana’s population accounting for around two million Ghanaians depend on fishing and related activities for their livelihoods. Environmental Justice Foundation (EJF) recorded in 2018 that in West Africa, Ghana contributes 11 percent of all artisanal canoes, and the small-scale fishing industry employs about 80 percent of all fishers in the country (Pabi, Codjoe, Sah and Appeaning Addo, 2015). Climate Change effects like degradation of the coastal and marine ecosystems are also putting pressure on the

physical, economic, and food security of local communities. Artisanal fishermen are unable to predict the climate these days and they complain that their activities are affected by the change in climate (Simpson, 2021).

According to Gnimadi et al, (2006), there is a strong relationship between fishermen's livelihood and the outputs from fishing activities. For this reason, Climate Change affects the sizes and reproduction of fishes and even the disruptions in weather patterns are detrimental to the livelihoods of fishermen. Challenges artisanal fishermen in Ghana are facing are a reduction in loss of income, falling into debt, and severe food and nutrition insecurity (Freduah et al., 2017; Pabi, Codjoe, Sah and Appeaning Addo, 2015). For lack of freezers for the storage of fish, most women involved in fishing preserve their fish by smoking or drying. However, the weather disruptions are making it difficult for these women to achieve that particular goal. They are at risk of losing most of their fish. Close to 80% of fish landed in Ghana is smoked, sun-dried, or fried as a means of preserving (Mensah, 2012).

2.7 Climate Change effects on Income Security

Fisheries are significant in alleviating poverty by providing economic security to the people involved directly or indirectly. It is a significant source of income for people affiliated with the sector albeit the challenges they face in this sector. Climate Change is one of the challenges that this sector faces and the effects do not only affect food security but also loss of employment consequently affecting the income acquisition of fishermen and other related jobs in fisheries (climate change report, 2011). Apart from low catch resulting in low income for the fisherman, there is also revenue loss. The livelihoods of fishermen are linked to the yields and produce from fishing and so fluctuations in fish catch will affect the livelihood of the fisherman (Massamba et

al., 2005). Islam et al (2013) also described fishing as “a high-risk livelihood activity” “because of the unpredictable nature of the resources and the harsh environment of the sea and perishability of the product” (MRAG 2011, p. 3; Islam et al., 2013).

Globally, the fisheries sector feeds about 1.5 billion people while employing about 520 million people (Badjeck et al., 2010). The effects of Climate Change on the income of artisanal fishermen are crucial as it consequently affects the food security of the fisherman. The fisherman is at risk of losing the physical assets that are used in the production of fish such as their canoes, nets, and even their landing sites due to storms and other severe weather conditions. The loss of revenue and income can be a result of low fish catch when the fishermen have gone to sea with the fuel they have bought with their already limited funds and due to the closure of fishing activities because of severe weather anomalies (Badjeck et al., 2010).

In Ghana, according to the FAO, the marine fisheries sector employs about 135,000 fishers while about 500,000 people are also employed in related jobs (FAO, 2016). Fisheries households depend majorly on fisheries as a source of food and income. low fish catch and other effects of Climate Change affect their livelihood. With no alternative jobs, a reduction in incomes and loss of revenue will affect their purchasing power to buy food even when they are no food (Hasselberg et al., 2020).

2.8 Conclusion

The chapter presented an overview of Climate Change and its effects on fisheries in the global, African, and Ghanaian contexts. The study shows that Climate Change is a world problem, and the fisheries sector is not spared by its effects. It also shows that Climate Change does not only

affect the fish in the sea but also the livelihoods of the artisanal fishermen and other related activities in fishing. The chapter gave an in-depth discussion on the effects of Climate Change on the livelihoods of the artisanal fishermen focusing on two categories of human security, food security, and income security.



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CHAPTER THREE

AN EXAMINATION OF THE EFFECTS OF CLIMATE CHANGE ON THE YOUTH IN ARTISANAL FISHING IN EMISANO

3.0 Introduction

This section explores the effects of climate change on the youth in artisanal fishing in Ghana, specifically Emisano. It will also discuss measures taken to mitigate the ramifications of the problem on the youth in this sector and the effectiveness of the policies. To address the objectives of the study, the research evaluates information collected from the youth in Artisanal fishing in Emisano and the Fisheries Commission through interviews. The responses from the study participants were gathered at the individual level, and the study participants were mainly fishermen. The findings presented within this chapter of this research comprise the profile of the interviewees and interview details. Subsequently, the themes were identified from the NviVo software.

3.1 Fishing as a source of livelihood in Emisano

Emisano is a small coastal town in the Central region of Ghana surrounded by a lagoon called Emisa. People cross the lagoon to the sea using canoes that are peddled by mostly children who enjoy this and collect a small fee at the end of every ride. This town covers a total area of 0.33 km², with about 82 acres of land. It is in the southern part of Ekumfi District bounded to the north by Suprudo and to the east by Asaafa towns. The total population of Emisano is 1887 comprising 868 males and 1019 females. The main economic activity recorded in this town is fishing. Men in this town go fishing using motorized Canoes and nets and the women buy them from the shore and

take them to other towns to sell them either fresh or after processing them frying or grilling (Local Assembly, Ekumfi district).

3.1.1 Profile of Interviewees and Interview Details

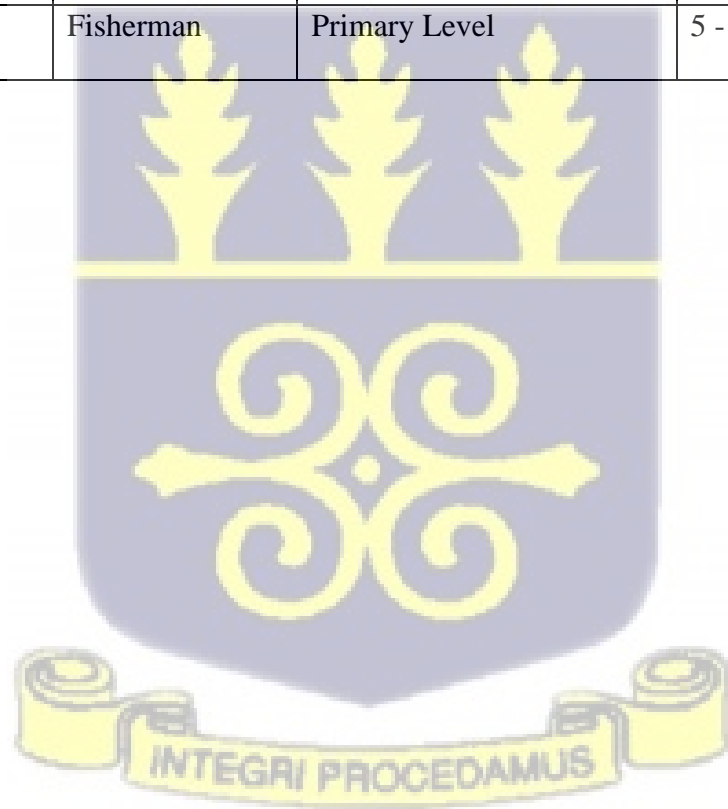
This session encompasses information regarding the individual respondent of the study and some details of the interview. This included the profile of the interviewees, and include information like age, gender, occupation, level of education, and years of experience of the participants. A detailed description of their profile information is provided in Table 1.



Table 1 Profile of Interviewees and Interview Details

Respondent	Age	Gender	Occupation	Level of Education	Years of Experience	Interview Mode/venue
R1	48	Male	Fisherman	Not been to school	10 and above years	Online
R2	35	Male	fisherman	Primary Level	10 and above years	Online
R3	22	Male	Fisherman	Primary Level	5 - 10 years	Online
R4	18	Male	fisherman	Primary Level	0 - 5 years	Online
R5	32	Male	Fisherman	Primary Level	10 and above years	Online
R6	29	Male	fisherman	Primary Level	10 and above years	Online
R7	37	Male	fisherman	Primary Level	10 and above years	Online
R8	20	Male	Fisherman	Primary Level	10 and above years	Online
R9	40	Male	fisherman	Primary Level	10 and above years	Online
R10	21	Male	Fisherman	Not been to school	10 and above years	Online
R11	30	Male	fisherman	Primary Level	10 and above years	Online
R12	40	Male	fisherman	Primary Level	10 and above years	Online
R13	23	Male	Fisherman	Primary Level	5 - 10 years	Online

R14	22	Male	fisherman	Primary Level	0 - 5 years	Online
R15	34	Male	Fisherman	Primary Level	10 and above years	Online
R16	24	Male	fisherman	Primary Level	5 - 10 years	Online
R17	39	Male	Fisherman	Primary Level	10 and above years	Online
R18	28	Male	Fisherman	Primary Level	10 and above years	Online
R19	33	Male	Fisherman	Primary Level	10 and above years	Online
R20	30	Male	Fisherman	Primary Level	5 - 10 years	Online



3.2 To Examine the Effects of Climate Change in the Fishing Sector of Ghana, Particularly in Emisano

The first of the goals of the study seeks to review the effects of Climate Change in the fishing sector of Ghana, particularly in Emisano. But to fully comprehend the effects of Climate Change on the people, the study first seeks to assess the respondent's perspectives and susceptibility to the influence of climate change on the fishing sector of Ghana.

3.2.1 Artisanal fishermen's perception and vulnerability to Climate Change effects

The livelihoods of about 36 million fishermen globally are vulnerable to Climate Change (Badjeck et al., 2010). Vulnerability defined by Kelly and Adger (2000) "is the capability of a system, social group, or individual to deal with, recover from, or adapt to any external stress placed on their livelihoods and well-being" (Kelly & Adger, 2000). "Vulnerability to Climate Change can also be defined as the extent to which a system, social group, or individual is posed to and unable to meet the negative effects of Climate Change. It depends on the nature, extent, and rate of climate alteration and variation to which a system is opened, its responsiveness, and its adaptive capacity" (Parry et al., 2007).

Knowing the perception of people affected by a phenomenon is significant to finding the solution. Doris and Morris (2001) expound that "the perspective of the indigenous people, the way they think and behave relating to Climate Change, as well as their values and aspirations have a significant role in addressing Climate Change". And for this, the first of the objectives of the study seeks to assess the respondent's perspectives on the effect of climate change on the fishing sector of Ghana.

First, to assess the respondent's perspectives on the effect of climate change on the fishing sector of Ghana, the participants were inquired about **their perception of what climate change is**. From the interviews conducted there was evidence that some of the participants who were interviewed did not have a fair idea of what climate change is all about. Some of the interviewees voiced their opinions by simply saying *"I don't know about climate change"* R10, and another stated that *"I have no idea"* R1. However, others did know about climate change. They shared their opinions in several ways, but mostly some major themes emerged from their views. This included, "change in sea level", "high temperatures", and "change in fish location". Some expressed their view by saying *"Climate change has affected the sea level and flow"* R2. Another interviewee made it known that what he knows about climate change is that it has affected the sea level, and this has resulted in the difficulty to get bounty catch - *"climate changes have affected sea level and fishes are difficult to locate"* R14.

Subsequently, the respondents of this survey were asked to **share their perception of the role of climate change on their fish catch**. Most participants agreed that the effect of climate change has led to a low catch of fish. Some expressed their views by saying; *"Climate change has affected the sea level and flow which has caused low fish catch"* R2. Another interviewee also stated that. *"It does not rain like before, so we do not get fish when we go fishing."* R11. These statements were further reaffirmed by R19 and R14 by simply stating that *"it has caused low fish catch"*.

The observed responses imply that climate change has changed the sea level, reallocation of fish, increase temperature, and led to low fish catch.

3.3 To investigate how Climate Change is affecting the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano

Subsequently, to extensively get an in-depth knowledge of the effect of climate change on the fishing sector of Ghana using the two categories of Human Security, the respondents were asked to share their views on how climate change is affecting their livelihood. Béné et al (2007) assert that most artisanal fishermen in developing countries particularly in Africa and Asia are in remote rural areas and have limited alternative sources of income and employment (Béné et al, 2007).

3.3.1 Climate Change effects on Artisanal fishermen's food security

FAO (2003) defines food security as the economic and physical access to sufficient and safe food. Food security exists when all individuals generally have physical or monetary access to adequate, protected, and nutritious food to meet their dietary requirements and food desires for a functioning and sound life (FAO, 2003). Fisheries support the livelihoods of fishermen and help to sustain their livelihood by providing them with food security (Muringai et al., 2019). When the respondents were asked if their access to sufficient and safe food has been affected by low fish catch, R3 said *“Yes it does because I have no money to buy food”* and R5 said, *“Even though it does, it doesn't affect me much, but I am sure it does affect my kids since they won't get what they want always”*.

All other respondents answered with a simple *“Yes”* without wanting to go into details.

3.3.2 Climate Change effects on Artisanal fishermen's income security

Consequently, the income of these fishermen is indeed affected directly and indirectly, and these artisanal fishermen showed no hesitance in sharing their difficulties. Some of the participants shared their grievances by saying, *“yes my finances have been affected”* R1. This was also confirmed by R17 who said that *“It has affected my income”*.

However, particularly to low catch of fish, some of the respondents share how low catch fish of climate change is affecting their livelihood by stating that; *“the problem is that we are losing revenue when we go and don’t get fish”* R5. Another mentioned that *“low catch due to the sudden change in weather, so we can’t get enough fish to sell”* R13. Furthermore, some of the respondents were of the view that low catch fish affected their income by saying, *“income is good with high fish catch and low with low fish catch”* R2. Furthermore, with the change in sea level and change in fish location, artisanal fishermen’s livelihoods are being affected in various ways. This was expressed by the respondents as; *“Fuel! I have to buy too much fuel to search for fish on the sea”* R18.

3.4 To examine the measures being employed by the state and non-state actors to mitigate the effects of Climate Change on the youth in artisanal fishing in Ghana, particularly in Emisano

Adaptation in the context of this study is defined as adjustments artisanal fishermen, government, and non-governmental institutions make during challenges they face due to Climate Change that will help to mitigate the effects and avail themselves of new opportunities. These adjustments come in the form of diversifying livelihoods to maintain their fishery-based livelihood, choosing a different source of livelihood, improving the methods they use in fishing, and policies that can help mitigate the effects of Climate Change (Daw et al, 2009).

According to Ankrah (2018), “adaptation to climate change in coastal areas may include a variety of strategies from local inhabitants and policy actions from the government that addresses multiple sectors and not just fish capture”. I got very useful information through interviews with the artisanal fishermen in Emisano and an official from the Fisheries Commission.

3.4.1 The artisanal fisherman's adaptive measures against Climate Change

When the respondents were asked what they do to adapt to the problems they face, some stated that they leave the town to look for other sources of livelihood during periods of low catch? R3 said, *"I migrate to Accra to join meager jobs"*. R18 also stated, *"I migrate to Kumasi or other places where we can get jobs"*.

Some engage in other jobs during the lean seasons. They simply said *"farming"* R1, *"I work as a repairer also, and it helps me earn something during those times"* R7, *"Repairing phones helps me a lot during the lean seasons"* R19. R12 and R17 mentioned that they had jobs even though they didn't state the specific jobs. They said, *"having a side job helps me"* and *"I focus on my other job to earn something"* respectively.

Other adaptive measures some of the respondents stated were savings, seeking help from family members, and reducing the expenditure on utilities to help them get by. Some respondents, however, resort to doing nothing to avoid the terrible conditions as they stated *"Nothing"* R16 and R20 and *"I avoid fishing during terrible conditions"* R15.

3.4.2 Adaptive measures by state and non-state actors to mitigate the effects of Climate Change

In an educative conversation with an official from the Fisheries Commission of Ghana, issues on Climate Change and fisheries were examined. The focus of the conversation was adaptation policies the Fisheries Commission has in place to lessen the effects of Climate Change on artisanal fishermen in the country including Emisano.

Although the official did not place much emphasis on Emisano, the official said - *“Broader sensitization of the phenomenon for them to understand that what they are seeing does not pertain to them alone, it is a global issue. So, individuals, groups of people, communities, nations are adapting through various means”*. When I mentioned the ban placed on fishing every year from July to August, she replied that *“that was not Climate Change-related. it is more of restocking or allowing the fishes to grow or spawn enough”* I asked her if she thought educating them was just enough, and she said *“Even with the severe effects of Climate Change like the rising of the sea level which is causing people to lose their homes and lives, people still do not want to move. They say this is the home where they were born. Others too will start requesting compensation. For now, that is what we can do because the issue of Climate Change is complicated and there is no straight solution to this problem but a gradual one”*.

She further gave an example of the Ankobra town in the Western Region of Ghana where the town is surrounded by the Ankobrah river and the sea. The folks stay in the town even during high tides when the sea water floods the town and refuses to move. The town folks claim that the village is not only their source of livelihood but also, they feel a sense of belonging as it is their home. To her, there is not much they can do but educate them on why they are facing such challenges and allow them to adapt in their way.

I asked if they partner with non-governmental institutions to help these people. She confirmed that they do collaborate with any agency interested in fisheries and Climate Change. However, she said it was mostly research.

The respondents of this survey were also asked for their opinion on the measures employed by the state and non-state actors to help alleviate the effects of climate change on the fishing sector in Ghana. The respondents were of the view that there have been some measures or strategies intended to alleviate the adverse effect of climate change on artisanal fishermen. From the respondents' answers, some themes run were identified – access to loans, subsidies on fuel prices, and distribution of fishnets.

The respondents shared their views by stating, *“recently one of the NGOs came around to share fishing nets for us, educated us on the trends of climate change and also gave us some money as well” R10*. Further, *R1* stated that *“the government needs to do things to help us, and there have started with the subsidies of fuel prices for us the fishermen”*.

These were some of the responses given out by the participant. However, among these measures, there was more awareness of the government's efforts to ensure they have access to loans to sustain their business. They expressed their views as, *“one of the policies which I know that the government has put in place is that we can go loan, which we use to support our business” R4*. In addition, *R16* added that *“first when we go for loans from the banks, it is difficult for us, but now we can get some loans from the bank, which is good although that is not that big”*.



3.5 The efficiency of the measures to mitigate the effects of Climate Change

When I asked the official from the Fisheries Commission if the policy of sensitization was enough, she replied *“Yes, for us it is working. The artisanal fishermen are still staying in their towns and adapting in their way because we make them understand that the dwindling fish stock is because of Climate Change and hence they do not go the extra to do things that will exacerbate the effects”*.

Lastly, the respondents were also asked for their opinion in terms of the effectiveness of the measures implemented by the state and NGOs to help minimize the effect of climate change on the livelihoods of artisanal fishermen. The interviewees were of the view that the measures and policies implemented by the state and NGOs were not effective to help minimize the effect of climate change on the livelihoods of the artisanal fishermen. The respondents describe that, although the current measures have helped to take off some burden on them, it is only just a small aspect of their fishing life. Therefore, they do not deem the measures to be very effective in minimizing the effect of climate change on their livelihood.

These were how the respondents shared their views, *“as for me I don’t see any measure by the government, because when there is something for us you would even hear about it”* R20. Subsequently, one of the respondents said, *the measures are not effective to me, there only come and just show off one time, and that is all there don’t come back”* R8. In addition, R17 added, *“I wish the government can do more to help us during this time because these measures and policies by the government or the NGOs are not effective and not helping at all”*.

These responses show a lack of adequate communication on intended interventions and consistency of the interventions. Hence, the perceived ineffectiveness on the part of some fishermen.

3.6 In all, the major themes deduced from the collected data are represented in a tabular form below:

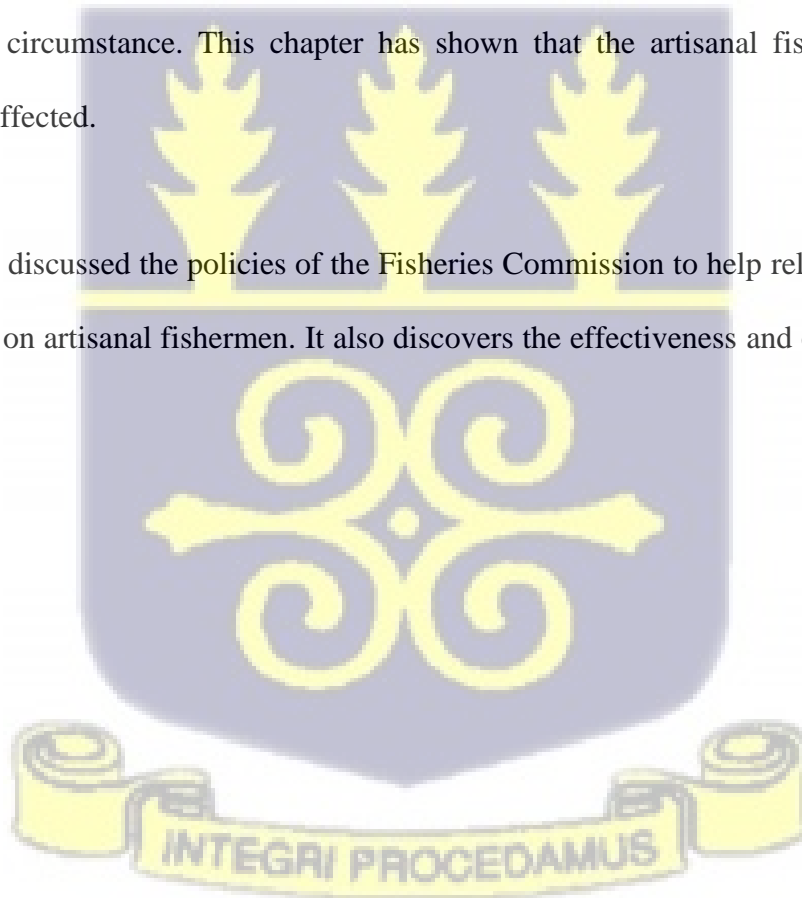
Construct	Theme
Effect of climate change	<ul style="list-style-type: none"> • Change in sea level • Change in the location of fish • Low catch fish
Effect on livelihood	<ul style="list-style-type: none"> • More expenses • Low revenue • Financial constraint
Adaptive measures by fishermen	<ul style="list-style-type: none"> • Migration • Resort to other jobs • Refusal to move to other towns
Measures by state and non-state actors	<ul style="list-style-type: none"> • Sensitization programmes • Access to loans • Subsidies on fuel prices • Distribution of fishnet
Effectiveness of measures	<ul style="list-style-type: none"> • Inadequate communication on intended interventions • Inconsistent interventions.

3.7 Conclusion

This chapter discussed findings on the effects of Climate Change on the youth in Artisanal fishing in Emisano. Using interviews with the youth in fishing in Emisano, this chapter established that Climate Change is indeed affecting the livelihood of artisanal fishermen directly and indirectly. Critical analysis showed that the livelihoods of all the respondents have been affected by Climate Change effects in diverse ways.

However, these artisanal fishermen have developed ways by which they can keep their lives going. Food security is not only food that is not available, but also when one can no longer get what they prefer due to a circumstance. This chapter has shown that the artisanal fishermen and their dependents are affected.

The chapter also discussed the policies of the Fisheries Commission to help relieve the effects of Climate Change on artisanal fishermen. It also discovers the effectiveness and otherwise of these measures.



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Interview with an official from the FC of Ghana.

Interview with the Artisanal fishermen at Emisano.



CHAPTER FOUR

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

4.0 Introduction

The section expounds on the summary of all the findings and the conclusion of the study. It also presents some recommendations that were reached using the findings of the study.

4.1 Summary of Findings

Focusing on the objectives of the research and the responses collected from the interviewees, the data shows that climate change has an impact on the youth in artisanal fishing and the fishing industry in Ghana.

4.1.1 The consequences of Climate Change on the fishing sector of Ghana

The study identified several effects of Climate Change. It was made known that Climate Change is a universal issue that the world's poorest must endure the most. Fisheries are a source of livelihood and Climate Change's effects on the sector is has both direct and indirect effects on the livelihood of artisanal fishermen.

The study shows that Climate Change has led to changes in sea level, changes in the locations of fish within the sea, and resulted in low fish catch. Which all have a consequential effect on the livelihood of the artisanal fishermen. The study shows that in Ghana, fish contributes about 50-80% of the whole animal protein consumed. Fisheries and fish are also significant to the growth of the Ghanaian economy and help to alleviate poverty by providing food and employment opportunities to about 10% of the labour population. However, Climate Change is exacerbating the already prevailing issues of food security and income security.

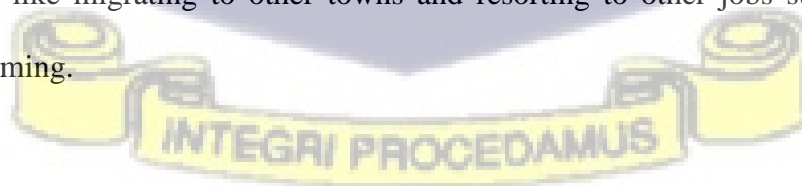
4.1.2 The effects of Climate Change on the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano

Using the responses from the interviews with the youth in fishing in Emisano, this study established that indeed the Climate crisis is affecting the livelihood of artisanal fishermen directly and indirectly. Critical analysis showed that the livelihoods of all the respondents have been affected by Climate Change effects in different ways.

The study found that the fishermen did not have knowledge about Climate Change but are aware of the weather changes and associated that with the challenges they face in their occupation. One of the Climate Change effects on the livelihood of the artisanal fishermen was that they must now spend more money buying fuel, and the adverse effect of the low catch fish has reduced their revenue if not all, leading to financial constraints for the fishermen.

Also, the study showed that the food security of the youth fishermen in Emisano are affected by Climate change. Low fish catch alone does not mean that their food security is threatened but also because they cannot get what they prefer to eat even due to financial constraints.

The research also found that these artisanal fishermen develop ways to adapt to the impacts of Climate Change like migrating to other towns and resorting to other jobs such as cell phone repairing and farming.



4.1.3 Examining the measures being employed by the state and non-state actors to ease Climate Change effects on the youth in artisanal fishing in Ghana, particularly in Emisano

The challenges artisanal fishermen face have prompted the intervention of the state and non-state actors to put out measures to help minimize the consequences of climate change on the livelihood of the youth in artisanal fishing in Ghana such as access to loans, subsidies on fuel prices, and distribution of fishnet. However, the fisheries commission is focusing on a broader sensitization of Climate Change and partnering with NGOs to research the effects of Climate Change.

4.2 Examining the effectiveness of the measures

From the responses of the respondents, the measures employed by the state and NGOs are not effective. They stated that although the state and non-state actors have deployed some measures to ease the problem of the impacts of Climate Change, it is usually a one-time effort.

4.3 Conclusion

The overall aim of the case study is to examine the effect of climate change on the youth in artisanal fishing in Emisano of Ghana. To achieve the objective of the study, 20 people were sampled for the case study. The findings of the literature review and case study analyses showed that the study's goal was met. Based on the information collected from the respondents the following conclusion were made.



Firstly, the study was able to conclude that low catch fish, change in sea level and change in fish location were the major effect of climate change on the fishing sectors. With the effect of climate change on the artisanal fishermen's livelihood, it was noted that the hostile effect of climate change

has resulted in food insecurity, fishermen spending more on fuel, low revenue or income, and financial constraints. Further, the study was able to conclude that state and non-state actors have implemented some measures such as education, subsidies on fuel prices, access to loans, and distribution of fishnet, to help curtail the climate change burden on the youth in artisanal fishing in Ghana. However, according to responses from the participants, it was concluded that these measures were not effective to help the artisanal fishermen.

4.4 Recommendations

The subsequent recommendations were made based on the results of the study and are seen as a measure that would, to a larger extent, help the artisanal fishermen with the Climate Changes.

- i. It was revealed during the interview that some of the youth artisanal fishermen do not have a fair idea of what climate change is all about, therefore, the Ministry of Communication, Fisheries Commission, and other NGOs organize more educational activities to educate the youth in artisanal fishing in all areas of Ghana.
- ii. It was evident from the interview that low catch fish was one of the effects of climate change which impacted the livelihood of the youth artisanal fishermen. As a result, the fishermen can be equipped with employment skills in other areas to have second jobs. They also are taught fish farming to help the fishermen have fished all year round.
- iii. Lastly, since the measures adopted by the government and NGOs are not effective to minimize the shocks of climate change on the livelihood of the youth artisanal fishermen, the state and NGOs can survey and act on what the youth artisanal fishermen need to help them minimize the effect of climate change for their wellbeing.

4.5 Limitations and Direction for Future Study

The study in nature was cross-sectional and only used youth in artisanal fishing in Emisano of Ghana. Future studies, therefore, can be conducted in another context to assess the effect of climate change on the fishing sector to improve awareness of climate change in the fishing sector to inform policy and interventions. Further, future studies should be expanded to other sectors like the agricultural sector to confirm or disconfirm the findings of the research. Lastly, this study was qualitative, as a result, other studies can develop a model from this study by conducting quantitative studies, to help improve the generalization of this study.



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Interviews

Interview with the Artisanal fishermen at Emisano

Interview with an official from the Fisheries Commission of Ghana.



APPENDICES

Appendix 1: Youth in Artisanal fishing in Emisano

Examining Climate Change Effects on the Youth in Artisanal Fishing: A Case Study of Ghana questionnaire

Age

Your answer

Gender

Male

Female

Occupation

Your answer

Level of Education

Primary Level

Senior High school Level

Tertiary Level

Do you have an alternative job?

Yes

No

How long have you been a fisherman/ fishmonger?

0 - 5 years

5 - 10 years

10 - above years

How can you describe fish catch for the past 6 years?

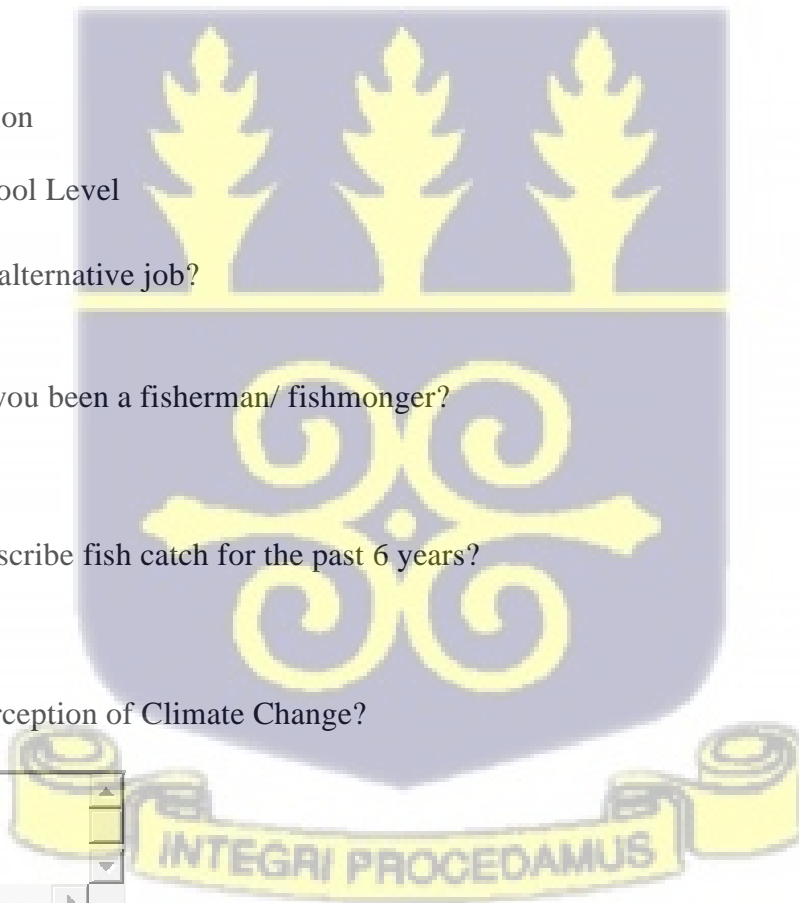
Low

High

Normal

What is your perception of Climate Change?

Your answer



What is your perception of the role of climate change on fish catch?

Your answer

What are the challenges you face with this occupation?

Your answer

Do you attribute your income situation to high/ low fish catch?

Your answer

Does low/ high fish catch affect your feeding situation?

Your answer

What is your household's biggest expense?

Your answer

What are some of the things you do to adapt to the problems you face now?

Your answer

Are you aware of any adaptation policies from the government and nongovernment agencies?

Yes

No

What are some of the adaptation policies you know of?

Your answer

Have the adaptation policies helped you?

Yes



No
I do not know

Appendix 2: Fisheries Commision

- I). What are the effects of Climate Change on the fishing sector of Ghana, particularly in Emisano?
- II). How is Climate Change affecting the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano?
- III). What measures are being employed by the state and non-state actors to mitigate the effects of Climate Change on the youth in artisanal fishing in Ghana, particularly in Emisano?
- IV). How effective have the measures been to minimize the impact of Climate Change on the livelihoods of the youth in artisanal fishing in Ghana, particularly in Emisano?

¹ *The greenhouse effect*. (n.d.). British Geological Survey. Retrieved May 17, 2021, from <https://www.bgs.ac.uk/discovering-geology/climate-change/how-does-the-greenhouse-effect-work/>

