

**ENSIGN COLLEGE OF PUBLIC HEALTH, KPONG, EASTERN REGION,
GHANA**

**PERCEPTION OF CLIMATE CHANGE AND ITS IMPACTS: A STUDY AMONG
FISHERMEN IN FIVE FISHING COMMUNITIES IN THE ASUOGYAMAN DISTRICT
OF GHANA**

BY

NNENNA EKE UMEH

147100006

**A thesis submitted to the Department of Community health in the Faculty of Public health
in partial fulfillment of the requirement for the degree of**

MASTER OF PUBLIC HEALTH

May, 2016

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Supervisor: Dr. Frank Baiden

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DECLARATION

I hereby declare except for reference to other people’s work which I have duly cited, this project submitted to the School of Graduate Studies, Kwame Nkrumah University of Science and Technology, Kumasi, are the results of my own investigation and has not been presented elsewhere for any other degree elsewhere.

Nnenna Eke Umeh

(147100006)

Signature

Date

Certified by

Frank Baiden

(Supervisor)

Signature

Date

Certified by

Dr. Christopher Tetteh

(Dean)

Signature

Date

DEDICATION

This work is dedicated to my beloved husband Mr. Patrick Umeh.

ACKNOWLEDGEMENT

My greatest appreciation goes to the Almighty God who has seen me through the program

My love and gratitude goes to my beloved husband and best friend, Mr Patrick Umeh who has been more than supportive and has been there throughout the program.

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ABBREVIATIONS

VRA – Volta River Authority

ATL – Akosombo Textile Limited

IPCC – Intergovernmental Panel on Climate Change

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ABSTRACT

Climate change is any change in weather conditions over time due to natural variability or human activities. It has been described as the biggest health threat of the 21st century. Its effects are generally observed especially on fisheries but are often ignored and are termed as of no serious consequences. This study explored the knowledge, perception and impacts of climate change and adaptation measures to reduce the effects of these changes.

A mixed approach was used in the study. For the qualitative study, five (5) focus group discussions with an average of seven (7) participants and one (1) in-depth interview were conducted. Interview guide was used to lead discussions and interview. The quantitative study involved 166 participants aged 35 years and above with at least 10 years of fishing experience from the 5 target communities. Close-ended questionnaires were administered by researcher and assistants to get participants' view about the subject.

The results showed that although most participants have observed changes in weather conditions their understanding of the concept, perceptions and causes of these changes differ. Majority of respondents have observed a decrease in rainfall, fish catch, level of river, sea level and turbulence of the river. They have also observed an increase in temperature and pollution. It was also predicted that these conditions may worsen and many people will stop fishing. Bilharzia, eye and skin diseases were common diseases among these fishermen. Deforestation and activities of the Akosombo dam were the major causes of climate change identified by participants. Participants also stated that they have adopted different methods to reduce the effects of these changes including change in fishing time, use of special traps and nets, periodic removal of sea weeds and aquaculture.

It was evident that climate change, its causes and its impact is not well understood by the fisherfolks of the study area. It could translate to misinformed attitudes and behaviors that may have adverse effects on the environment as well as climate.

CHAPTER ONE

INTRODUCTION

This chapter gives a background of the study, problem statement, study objectives and justification of the study.

1.1 Background Information

The Intergovernmental Panel on Climate Change (IPCC, 2007) defines climate change as statistically significant variations in weather conditions that persist for an extended period, typically decades or longer. It includes shifts in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in global mean surface temperature.

Ozor (2009) defined climate change as any change in climate over time, whether due to natural variability or as a result of human activity. It has been described as one of the most threatening change that affects the natural environment which will significantly affect human and the ecosystem (McMichael *et al*, 2008). It has been dubbed the biggest global health threat of the 21st century (Costello *et al*, 2009).

In recent years numerous long-term changes in physical forces have been observed at global, regional and basin scales as a result of climate and other anthropogenic changes. Impacts of these on biological processes supporting fish and fisheries production in marine and freshwater ecosystems have already been observed and may be used as proxies to estimate further global climate change impacts. These physical factors include atmospheric circulation, intensity and variability patterns, ocean currents and mixing, stratification, hydrological cycles and seasonal patterns (Manuel *et al*, 2009).

The Intergovernmental Panel on Climate Change (IPCC) (2007) indicates that human activities (such as transportation, industrial activity, land-use change, and daily consumer choices) are the primary factors affecting changes to the earth's climate (e.g., altered surface temperatures, precipitation changes, sea-level rise, and changes in the frequency and magnitude of extreme weather events). It results in for example changes in the range and transmission of infectious diseases, food insecurity, health impacts of air pollution and temperature stress, reduced access to safe water and related psychosocial impacts (Myers et al, 2009).

Climate change is expected to influence crop and livestock production, hydrologic balances, input supplies and other components of agricultural systems however, the nature of these biophysical effects and the human responses to them are complex and uncertain. (Apata et al 2009).

Fisheries will also be exposed to a diverse range of direct and indirect climate impacts, including displacement and migration of human populations; impacts on coastal communities and infrastructure due to sea level rise; and changes in the frequency, distribution or intensity of tropical storms. (Daw T. et al 2009).

Barange and Perry (2010) established that some 43.5 million people work directly in the sector, with the great majority in developing countries. Adding those that participate in the processing, marketing, distribution and supply will increase this estimation to nearly 200 million livelihoods. In sub-Saharan Africa, fisheries are a source of employment for about 10 million people with 20% of the population having it as its main or only source of animal protein. Hence, climate change impacts on the sector will have adverse economically, nutritional and health effects on the affected regions. Portner and Peck (2010), suggested that organismal-level physiological changes will occur in response to changing environmental variable such as temperature,

dissolved oxygen and ocean carbon dioxide levels; individual-level behavioral changes may occur such as avoidance of unfavorable conditions and if possible, movement into suitable areas; population-level changes may be observed via changes in the balance between rates of mortality, growth and reproduction; and ecosystem-level changes in productivity and food web interactions.

In addition, with increasing evidence of the impacts of climate change on the aquatic ecosystems and its significant resultant impacts on food security and livelihoods, the sector remain a neglected area in climate adaptation policies (Badjeck et al, 2010).

Generally, poorer and less empowered countries and individuals especially in sub-Saharan Africa are more vulnerable to climate impacts, and the vulnerability of fisheries is likely to be higher where they already suffer from overexploitation or overcapacity (Daw T. et al 2009).

1.2 Problem Statement

Fishery as an agricultural sector plays a vital role in the health and economic status of people. Garcia and Rosenberg (2010) stated that fishery resources are an important source of proteins, vitamins and micronutrients especially for many low-income populations. The sector offers employment to several millions of people around the world. Essam and Zenebe (2013) argued that the benefits gained from the sector are often ignored and continued to lack sufficient attention by decision makers in both adaptation to climate change and food security policy formulation mainly because over half of the fish produced in sub-Saharan Africa are from small-scale fishermen and are not accounted for the national statistics, thus their contribution to the economy and food security remain invisible. Temperature, sea level, rainfall, etc. are climatic conditions that affect fishing activities. Changes in these climatic conditions have not been favorable to the fishing sector. It is ideal for fishermen and decision makers to understand the

impacts of climate change to enable them develop mitigation and adaptation strategies that sustain fish catch and improved protection in fisheries. The increasing temperature as a result of climate change is affecting fishing activities in both marine and fresh water fisheries. The waters are increasingly polluted and unsafe for most fishermen due to increasing human activities which could cause diseases and other health implications. Fish catch has reduced greatly over the years. Also the concept of climate change is not well known and understood especially among uneducated people and most fisherfolks fall under this category. Although these climatic changes are being observed, they are considered unimportant or a duty of the government to deal with its impacts hence affected communities are left vulnerable to its effects. This study therefore seeks to understand the knowledge and perception of climate change among fishermen and consciously or unconsciously instituted adaptation measures.

1.3 Rationale of study

Climate change has been observed and talked about for so many years but the concept is not commonly known especially among even educated people. Its impacts are generally observed but are either ignored or seen as having no consequences especially on health and may be responded to by consciously or unconsciously instituting adaptation measures. The impacts of climate change on fishing and its potential health implications cannot be overemphasized. A good knowledge and perception of climate change by people who work in the fishing sector is important if effective adaptation measures will be put in place.

Hence this study can improve awareness of climate change among fishermen and also help the policy makers in the public health sector institute policies and adaptation measures to reduce the effects of these changes.

1.4 General Objective: To assess the knowledge and perception of climate change of fishermen and the impacts on their activities.

1.5 Specific Objectives

- To assess the proportion of fishermen who understand and have observed change in weather conditions.
- To identify consciously and unconsciously instituted adaptation measures to reduce the impact of climate change by fishermen.
- To determine the health implications of climate change on fisheries.

1.6 Research Questions

The research questions are based on the objectives of the study.

- What are the perceptions of various climatic conditions among fishermen?
- What is the proportion of fishermen who know about climate change?
- What adaptation measures have been consciously or unconsciously instituted by fishermen to reduced effects of climate change on their activities?
- What are the health implications?

1.7 Profile of Study Area

This study was carried out in five (5) communities located along the Volta river in the Asuogyaman district. These communities include: South Senchi; Dzidzokope, Adome (Small London), Abume and Kpedzi. These communities are from 3 of the sub districts namely: Senchi, Atimpoku and Akosombo sub-districts. They are rural fishing communities where about 60 to 80% of the men are fishermen.

The Asuogyaman district is one of the 26 district in the Eastern region of Ghana with an estimated total population of 106,545. The district is divided into 6 sub districts which has

122 communities with 27 health facilities. The district shares boundary with Kwahu Afram plains North district on the north; on the south with North Tongu district; on the west with Upper and Lower Manya Krobo districts; and on the east with South Dayi and Ho West districts.

1.8 Organization of the Report

The report is organized into six chapters.

Chapter one contains the background of the study, the statement of the problem, rationale of the study, study objectives, profile of study area and organization of report.

In chapter two, relevant literature to the work is reviewed. The literature review is organized and presented according to the objectives of the study.

Chapter three contains the study methods and design, data collection techniques and tools, study population, study variables, sampling techniques and size, data handling and analysis, ethical consideration, limitations and assumptions of the study.

Chapter four contains the results and interpretations of data.

Chapter five discusses the findings of the research

Chapter six has the conclusions and recommendations made.

The bibliographic follows these chapters.

CHAPTER TWO

LITERATURE REVIEW

The literature review is based on the problem statement and objectives of this study. It looks at work that has been previously done on perceptions of climate change, impacts of climate change on fishing activities, potential health implications and adaptation measures identified and implemented.

2.1 Perception and Knowledge of Climate Change

Climate Change has been perceived by many to mean different things usually based on their interactions with the environment. Farmers especially the uneducated ones perceive it as lack of rainfall, some fishermen say it is the reduction of their fish catch, some group of the general public sees it to be the cause of excessive heat in the atmosphere and others perceive it as a distant problem that doesn't affect them.

Personal experiences are thought to be a key driver of risks perceptions of climate change. Existing research indicates that environmental views and perceptions of climate change can be related to individuals' physical surroundings and experiences (Spence *et al*, 2011). A survey conducted by David Maddison (2007) on perception of climate change among agriculturalists in 11 African countries revealed that significant numbers of farmers believed that temperatures have already increased and that precipitation has declined. Those with the greatest experience of farming were more likely to notice climate change.

Adeleke and Balogun (2013) established that fisherfolks have significant difference in perceptions and attitudes towards increase or decrease or occurrences in rainfall, temperature, sea level rise and wind speed, direction, duration and time as a factor of climate change.

2.2 Impacts of Climate Change on fishing activities

Fishing and aquaculture play significant role in human activities such as food supply, income generation, food security and employment for many men and women. Climate change has had devastating effects on the sector leading to poor production and increased health implication for farmers. In most African countries, climate change is threatening the fishing activities in the regions with increase in water surface temperature, sea level rise and ocean acidification. The type and amount of fish catch has decreased greatly leaving countries, especially developing countries; that depend on these activities to suffer low food supplies, fewer fisheries and aquaculture related jobs and increased food security risk.

Ficke *et al* (2007) discussed the potential impacts of global climate change on freshwater fisheries. They argued that general effects of climate change on freshwater systems will likely be increased water temperatures, decreased dissolved oxygen levels and increased toxicity of pollutants. This could alter food webs and change habitat availability and quality. Fish communities may change as range shifts will likely occur on the species level, not a community level. Impacted fisheries may make it difficult for developing countries to meet their food demand and developed countries may experience economic losses.

Tubiello (2008) also noted three major pathways through which climate change will affect fisheries and aquaculture, as well as dependent communities and their economic activities as; physical and chemical changes in oceans and fresh waters, including increase in water temperature and changes in salinity among others; change in fish production, catch composition and species distribution resulting from a complex interplay of ecological changes; and physical changes to coasts, estuaries, wetlands, lakes and rivers caused by changing weather patterns, weather-driven natural disasters and sea-level rise.

Essam and Zenebe (2013) also classified the impacts of climate change on fish stock in sub-Saharan Africa as physical changes (includes sea surface temperature rise, sea level rise, changes in salinity and ocean acidification) and biological changes (includes changes in primary production and fish stock distribution). They argued that these could affect both food production and food security in the region.

2.3 Health Implications of Climate change

It has been suggested that climate change will influence human health and disease in a number of ways. It is postulated that some existing health threats will intensify while new threats will emerge. (Figure 2.1)

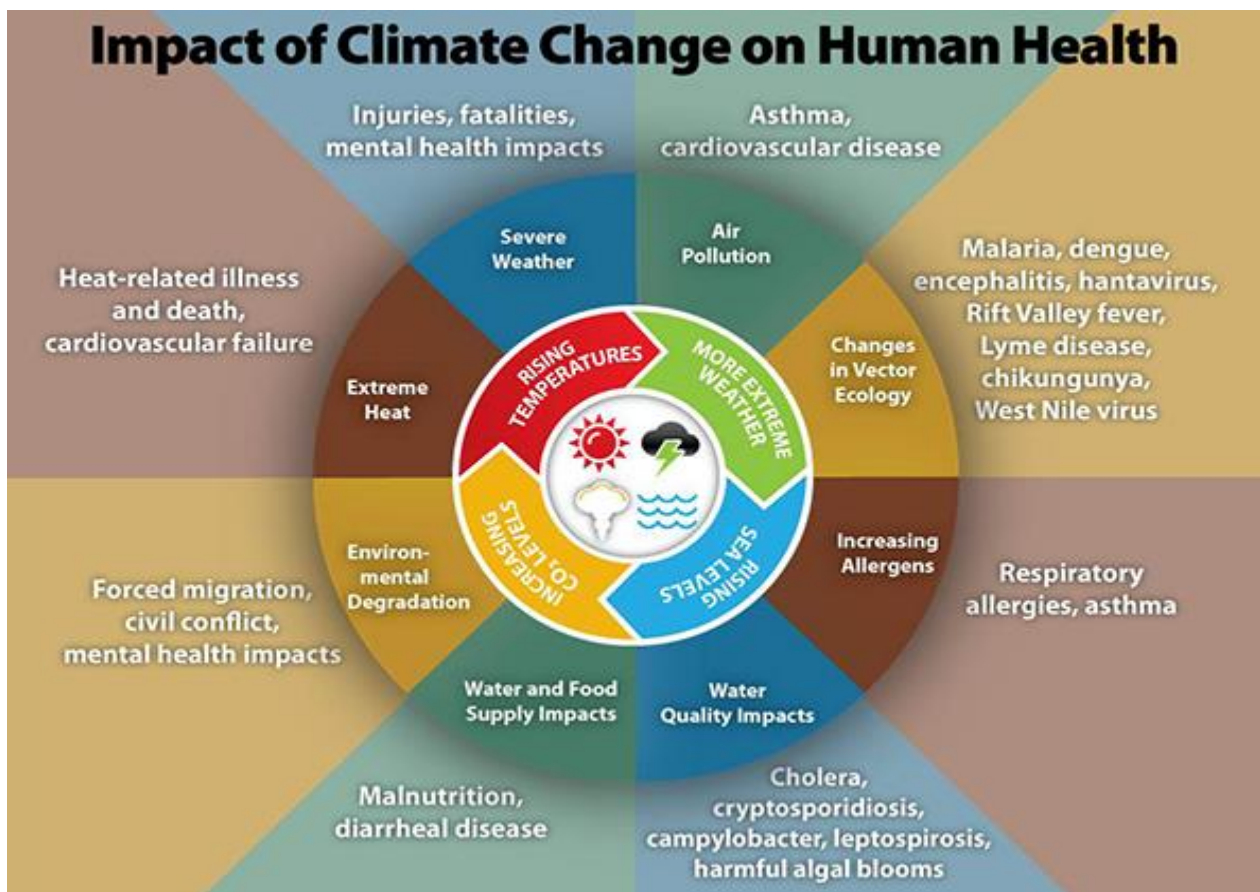


Figure 2.1: Impacts of Climate change on human health

The potential health effects of climate change can be classified into direct and indirect effects.

DIRECT EFFECTS

Thermal factors

Changing hygro-thermal conditions can be expected to influence human health and well-being in proportion to the degree of heat stress. The human body could cope effectively with a moderate rise in ambient temperature. However severe heat stress can result in deterioration in health including heat illness, with effects ranging from mild reversible cardiovascular disturbances to severe tissue damage and death.

Extreme Heat

Extreme high temperature contributes directly to deaths from cardiovascular and respiratory diseases especially among elderly people. For example, in the heat wave of summer 2003 in Europe, more than 70,000 excess deaths were recorded (Robine et al, 2008). High temperatures also raise the levels of ozone and other air pollutants that exacerbate cardiovascular and respiratory disease. Pollen and other aeroallergen levels are also higher in extreme heat. These can trigger asthma, which also affects around 300 million people. Ongoing temperature increases are expected to increase this burden.

Effects of ultraviolet radiation on human beings

Current recorded measurements indicate that there has been a significant decline in the stratospheric ozone concentrations. The health effects occurring largely as a result of increases in biologically effective UVR are expected to consist of: increases in non-melanoma skin cancer (NMSC) and malignant melanoma skin cancer (MM); increases in eye diseases, primarily cataract and possible alterations in the immune response.

Air Pollution

Atmospheric concentrations of pollutants are influenced by a variety of factors such as topography, wind speed, wind direction, precipitation and weather patterns. Apart from the effects of global climatic changes, air pollution is expected to increase throughout the world because of extending industrialization. Most man-made air pollutants come from the combustion, complete or incomplete, of fossil fuels used for generation of heat and power. However, fossil fuels contain compounds of sulphur that can cause irritation of the respiratory tract, leading to adverse effects of health. Also, the resulting acid rain is the subject of current concern because of its effects on forests and aquatic biota.

Natural disasters and variable rainfall patterns

Globally, the number of reported weather-related natural disasters has more than tripled since the 1960s. Rising sea levels and increasingly extreme weather events will destroy homes, medical facility and other essential services. More than half of the world's population lives within 60km of the sea. People may be forced to move which in turn heightens the risk of a range of health effects from mental disorders to communicable diseases. Increasingly variable rainfall patterns are likely to affect the supply of fresh water. A lack of safe water can compromise hygiene and increase the risk of diarrheal disease which kills approximately 760,000 children aged under 5 a year. Water scarcity leads to famine and drought. Floods are also increasing in frequency and intensity which contaminate freshwater supplies, heighten the risk of waterborne diseases and create breeding grounds for disease-carrying vectors such as mosquitoes (Daw *et al* 2009).

INDIRECT EFFECTS

Food and Nutrition

Even in the absence of large, overall, long-term changes in the global climate, there may be an increase in the frequency and intensity of short to medium term climatic changes. These will modify the nutritional requirements of the exposed individuals and affect agriculture and hence food production and consumption.

Nutritional requirements

The human body requires nutrients, minerals, vitamins and water for growth and development, tissue maintenance and physical and mental well-being. Energy requirements generally increase with colder conditions, higher activity levels and reduced body insulation. There is a relationship between latitude and human energy requirement, it being lowest in hot, humid climate and highest in cold, dry climates. Nutritional requirements will change because of a change in temperature.

Food Production

Both short and long term variations in climate will continue to be important determinants affecting agricultural, livestock and fish production. A direct effect of ultraviolet radiation on biota, including marine organisms and plants, could also adversely affect agriculture, food and fisheries. The adequacy of food supplies could be affected in four principal ways:

1. Spatial shifts in the agro-climatic zones suited to the growth of specific crops
2. Changes in crop yields, livestock output and fisheries productivity
3. Reduction in the quantity of water available for irrigation
4. Loss of land through sea level rise

Rising temperatures and variable precipitation are likely to decrease the production of staple foods in many of the poorest regions. This will increase the prevalence of malnutrition and undernutrition. Changing climatic conditions may also result in a new spectrum of plant pathogens and pests that have a major effect on food production.

Patterns of infection

- Communicable diseases

The impact of climatic changes on communicable diseases are based on 2 mechanisms

1. Through a modification of the ecology of vectors of a series of diseases,
2. Through a direct modification of human-related risk factors, the most important of which, in this context, are the availability and quality of water for drinking, cooking, sanitation and irrigation.

- Vector-borne diseases

Climatic conditions strongly affect water-borne-diseases and diseases that are transmitted by vectors such as insects, snails and other cold-blooded animals. Changes in climate are likely to lengthen the transmission seasons of important vector-borne diseases and alter their geographical range.

The occurrence of vector-borne diseases is largely determined by:

3. The abundance of vectors and intermediate and reservoir hosts
4. The prevalence of disease-causing parasites and pathogens suitably adapted to the vectors, the human and animal host and the local environmental conditions especially temperature and humidity.
5. The resilience and behaviour of the human population which must be in dynamic equilibrium with vector-borne parasites and pathogens.

For example, Malaria is strongly influenced by climate, malaria kills almost 600,000 people every year mainly African children under 5 years old. The *Aedes* mosquito vector of dengue is also highly sensitive to climate conditions and studies suggest that climate change is likely to continue to increase exposure to dengue. Other vector-borne diseases that could be affected by climate change include: Lymphatic filariases, Onchocerciasis, Schistosomiasis, Leishmaniasis, Dracunculiasis, African trypanosomiasis, etc.

Cardwell and Elliot (2013) tried to make the links between climate change and health. Few participants recognized the role of the environment in the context of either individual or community health. 77% of participants mentioned health effects as possible impacts of global environmental change. The results support recent calls for reframing the impact of climate change from an environmental to a public health issue in order to increase public engagement in adaptive and mitigative behaviour change.

Aquatic foods are known to have high nutritional quality, contributing 20 percent or more of average per capita animal protein intake for more than 1.5 billion people, mostly from developing countries. The sector has particular significance for small island States and communities, who depend on fisheries and aquaculture for at least 50% of their animal protein (Kevern *et al* 2009).

2.4 Adaptation to climate change

Adaptation to climate change was defined by Daw *et al* (2009) as an adjustment in ecological, social and economic systems in response to observed or expected changes in climate stimuli and their effects and the impacts in order to alleviate adverse impacts of change, or take advantage of new opportunities. Fishery resources are known to be highly sensitive to marine environmental changes. Though they had always coped with these changes, future climate changes will likely

be so extreme that it may be difficult for them to cope with. Therefore, identification of proper adaptation strategies is a high priority for the fishery sector (Daw *et al* 2009).

The vulnerability of fisheries and fishing communities depends on their exposure and sensitivity to change, but also on the ability of individuals or systems to anticipate and adapt. Brooks *et al*, (2005) indicated that the most vulnerable nations to climate change impacts are those situated in sub-Saharan Africa and those that have recently experienced conflict. Also adaptive capacity is associated predominantly with governance, civil and political rights and literacy. David Maddison, (2007) also observed that although experienced farmers are more likely to perceive climate change, it is formally educated farmers who are more likely to respond by making at least one adaptation.

Adger *et al*, (2005) argued that elements of effectiveness, efficiency, equity and legitimacy are important in judging the formulation and success of adaptation measures. Adaptation to climate impacts includes reactive or anticipatory actions by individuals or public institutions. These range from abandoning fisheries altogether for alternative occupations, to developing insurance and warning systems and changing fishing operations. (Daw *et al* 2009).

CHAPTER THREE

METHODOLOGY

The methodology discusses, study design, study population, the data collection techniques and tools, the sample size and sampling techniques, data handling and data analysis, pre-testing of data collection tool, ethical issues, the limitations and assumptions of the study.

3.1 Study Methods

A mixed method was used for the study.

3.1.1 Qualitative Study

This study was carried out first to get the general view of fishermen on the subject area. This is because climate change is basically a new concept in the study area of interest.

Five (5) focus group discussions were conducted with 7 to 8 fishermen in each group.

One (1) in-depth interview with an assembly man who is also fisherman was conducted.

Tools: Individuals completed an informed consent form before participating in the study.

Interview guide and a focus group discussion guide were used for data collection. Conversations and discussion were recorded with an audio recorder.

3.1.2 Quantitative Study

3.1.2.1 Study Design

A cross-sectional study (survey) was conducted. This was carried out in 3 weeks (February 17th – March 3rd 2016).

3.1.2.2 Sampling technique and sample size

The study targeted to interview 200 fishermen but a total of 166 fishermen were recruited into the study. This was due to time and financial constraint; and language barriers. The targeted sample size was based on the assumption that awareness of climate change will be 50% (to

achieve maximum variance in the absence of prior data) among a total fisher population of 10,000. This size will enable the true level of awareness to be determined at 95% confidence level. Probability proportional to size (PPS) sampling was employed to determine the number of fishermen to target in each community. A convenient sampling was used to select participants.

3.1.2.3 Data Collection and Tools

A close-ended questionnaire was developed from information gotten from the qualitative study and a standardized WHO recommended questionnaire and used for data collection. Responses were recorded directly into the questionnaires. Questionnaires were administered by interviews at the home of participants. These interviews were conducted by the researcher and trained community volunteers in the communities. The research assistants (community volunteers) are secondary school graduates who could read and write English Language and were fluent with the local language (Ewe). Informed consent forms were completed by individual before recruitment into the study.

Pretesting

The pre-testing of questionnaire was carried out in the Atimpoku community; this community had similar characteristics with the 5 selected communities. After the pretest, the questionnaire did not need any modifications.

Data Analysis

Data entry was done using Microsoft Access. Analysis was done using STATA. Test of associations was considered significant when the p-value is <0.05 .

3.2 Study Population

We set out to interview fishermen aged 40 years and above with at least 15 years fishing experience. This was based on the assumption that they have experienced and observed changes in climate over time. The age criterion was reduced to ≥ 35 years of age because the older folks made up a small percentage of the population of the community and many of them had stopped fishing. The younger folks met the criteria of the number of years of fishing experience and had started fishing while they were young with their fathers. Also this was done to enable us get the desired sample size.

3.3 Ethical consideration

Ethical approval was sought and obtained from the Ethics Review Committee of the Ensign College of Public health and Ghana Health Service (GHS). Administrative permission was sought from the Asuogyaman district. Permission to conduct study was sought from the community leader and other stakeholders in the communities. Informed consent was obtained from each participant before the questionnaire was administered.

3.4 Limitations of Study

The time for the study was short hence some fishermen could not be reached.

Resources limited the scope of the study by reducing the variables to be studied and also the projected number of trained field staff that could be used for the research.

Language barrier was a problem as interpreters were employed by the researcher to conduct the study. This could have led to a misunderstanding and misinterpretation of words.

The data collection technique relies on verbal reports of behavior practiced, which has the tendency for the questionnaire to over-report good or bad behavioral practices as the respondent try to please the interviewer. This could limit the validity of the study.

3.5 Assumptions

These are some of the assumptions made during the study

It was assumed that the participants answered the questions in the questionnaire honestly.

It was assumed that the fishermen had not heard about climate change but had observed changes in weather conditions.

CHAPTER FOUR

RESULTS

This chapter highlights the results from the quantitative and qualitative analysis.

4.1 QUALITATIVE

4.1.1 Knowledge about climate change

The knowledge of participants about climate change differs. Some understand it to mean change in weather conditions over time. Some view it to be changes in the environment that has led to a great reduction in their catch. Others are of the opinion that the seasons have changed

“What I know is that formerly when it is June or July you know that the rains are coming. From October, you start experiencing harmattan but now weather conditions have changed. Now, sometimes in the month of June and July, the weather becomes dry then somewhere in December, we experience rainfall. The seasons are no longer the way it used to be”.

“Fishing is something we have done all these years. When we were children we used to have bountiful harvests but now it has reduced drastically due to changes in environmental conditions”.

4.1.2 Observed Changes in climate and its impacts on fishing activities

Various climate changes were observed by the fishermen. These changes were commonly mentioned in all focus group discussions and the in-depth interview. These changes include:

Changes in rainfall patterns and a reduction in rainfall

Most participants have observed that rainfall patterns have changed and there is a great reduction in both amount and frequency of rainfall.

“Rainfall patterns have also changed. Instead of rain to fall at intervals, it delays and cause damage to things”.

“Rainfall is irregular; it doesn’t follow any pattern unlike the way it used to be”

The fishermen have also observed that when there is enough rainfall their catch is good. The reduction in rainfall has also been observed to be their greatest challenge. Rainfall is believed to cool the river and increase its volume hence making it easier to find the fishes.

“Anytime it rains heavily, we get a good catch but if it doesn’t rain, we don’t get anything, which is our biggest challenge”.

A great rise in temperature

Most participants observed that there is a great rise in temperature. The increase in temperature is believed to also contribute to a reduced fish catch as fishes need a lower temperature to thrive. It is also believed that the rise in temperature drives the fishes to the depths of the river or makes them hide under weeds hence making it difficult for the fishermen to get to them.

“The fishes cannot stand the hot sun so they go deep in to the river”.

Another effect of this temperature rise as believed by the fishermen is that some of the fishes that were caught from the river are no longer present. They believe that the fishes have migrated as the temperature of the river is no longer conducive.

“Some fishes like mud fish are no longer in the river. The water is now too hot”

A decrease in water level and current

The water level as well as water current is believed to have reduced greatly. The water was observed to be fast flowing but now its current has reduced hence it is slow flowing. The water current is believed to be associated with the type of fishes that are found in the river. Due to this reduction in water current, some fishes are believed to have migrated to more favorable places.

“The bottom of the river used to be covered by sand, stone, mud or gravel which serves as habitats for different fishes. Alga are now seen to grow on the muddy areas hence we can no longer find these fishes in the river”.

Schistosomiasis (Bilharzia) is associated with slow flowing water bodies. It was commonly mentioned as a disease that affects them.

“Inability to urinate well i.e. Bilharzia is a disease that affects us”

“It gives us skin diseases, eye itch and Bilharzia”

Increase in environmental pollution

The amount of pollution is said to have increased greatly. It is said that formerly the bottom of the river was covered by either sand, stone, gravel or mud and these muddy places are now covered with algae due to the increased pollution of the river.

“As human activities continue to increase, the amount of pollution has greatly increased”.

The pollution is observed to cause several diseases including skin and eye diseases. “There are black substances that affect our skin”

4.1.3 Reasons for observed changes

Deforestation

This is believed to be the major reason for the reduction in rainfall and the rise in temperature.

“In my opinion, cutting down of trees along the river banks is the biggest cause. In the western region the river banks has a lot of trees and they have a lot of rainfall”.

There is a common practice of cutting trees for building house, firewood and charcoal used in cooking or sold for money.

“Although this is a VRA afforestation area, some people still cut the trees for building houses and for firewood and charcoal used in cooking”

Trees that grew by the banks of the river are believed to provide shade for both the villagers and the fishes.

“In the past, we used to have a lot of trees along the river side and it gave us shade and made the environment cold. The fishes also come to the banks of the river because of the shade”.

Activities of nearby factories

The construction and activities of the dam is believed to have reduced the water current and therefore causing the growth of weeds on the river. These weeds serve as hiding places for the fishes. *“Before the Kpong dam, the water was flowing faster”.*

The activities of the dams and the Akosombo textile factory are believed to be the main reason for the pollution of the river. Most believe that these industries dispose their waste into the river.

“The river is polluted by VRA oscillation pond and waste from the Akosombo textile factory”.

“The two dams surrounding us pollute the river with chemicals. We believe waste water from the hospital also pollute the river”.

Most do not believe that their activities as villagers pollute the river. It was mention that pits that are dug to get mud for building houses are filled with domestic waste. Also there are pit latrines available in the communities. Some fishermen admitted that some of their activities such as domestic waste disposal, urinating and defecating in the river as well as bathing and washing could contribute to the pollution but not to a significant point. It was argued that when the river was fast-flowing the waste was carried away but because it is now slow-flowing, these wastes are left which leads to the increase in pollution.

“Formerly, when the water current was swift the weeds never developed because the water carries the waste”

Spiritual Dimension

Some fishermen believe that the reduction in their catch is because of the numerous sins committed by the people hence they are receiving the punishment for them. Some believe that they are wicked than their forefathers, hence their fathers had bountiful harvest and they do not.

“I believe that it is our sins that have caused these problems for us”.

4.1.4 Adaptation

Some adaptation measures that are now being adopted by the fishermen to improve their catch include

The construction of fish ponds on the river is an adaptation measure used by a few fishermen who can afford to buy fish feed. Fishes are trapped in cages constructed with nets and are fed with feeds.

The use of weedicides was identified by a few fishermen as an adaptation measure. Most believe that this intervention measure should be done by the government.

“Government can intervene by spraying the weeds so that we can increase our catch”

Some fishermen hang stones on weeds as a way of getting rid of the weeds.

Special kinds of feeds are also prepared by some fishermen and are placed in fishing traps to attract fishes.

Some fishermen have adopted the use deep diving approach to setting fishing traps.

“I dive into the water to set traps because of the weeds. If you don’t dive and you set your trap, it’ll go and land on these weeds and you won’t catch anything”

4.2 QUANTITATIVE

4.2.1 Demographics

This section presents the demographic characteristics of the study participants.

Table 4.1 Sociodemographic characteristics of respondents

Variable		Frequency	Percentage
Sex	Male	165	99.4
	Female	1	0.6
Ethnicity	Ga/Adamgbe	5	3.01
	Akan	1	0.6
	Ewe	160	96.39
	Others	0	0
Highest educational level	None	48	28.92
	Primary	54	32.53
	Secondary or higher	64	38.55
Religion	Christian	124	74.7
	Muslim	2	1.2
	Traditionalist	22	13.25
	Others	18	10.84
Marital status	Married	142	85.54
	Unmarried	12	7.23
	Divorced	9	5.42
	Widowed	3	1.81
	Others	0	0

The respondents were nearly all males. Only one woman participated in the study. They were also nearly all Ewes. Less than 5% of them were of other ethnic groups. About a third of them had had no formal education. Another third (33%) and 39% respectively had had some primary

and secondary education. Most (75%) of the respondents were Christians and married (86%).
(Table 4.1)

The mean age of the respondents was 50.1 years (standard deviation 10.6). The median age was 48 years (interquartile range of 13). The youngest participant was aged 35 while the oldest was 86 years. The mean years of experience in fishing was 30 years (standard deviation 11.9yrs).

4.2.2 Climate change Perception

This section presents the observations made by study participants of various climatic conditions over the past 10 – 20 years.

Table 4.2 Observation of respondents on some climatic conditions

Variable		Frequency	Percentage
Amount of rainfall	Increase	4	2.41
	Decrease	159	95.78
	No change	3	1.81
Amount of fish catch	Increase	0	0
	Decrease	166	100
	No change	0	0
Level or size of the lake/river	Increase	21	12.65
	Decrease	136	81.93
	No change	9	5.42
Turbulence at the lake	Increase	25	15.06
	Decrease	114	68.67
	No change	27	16.27
Amount of pollution	Increase	150	90.36
	Decrease	13	7.83
	No change	3	1.81
Weeds	Increase	133	80.12
	Decrease	22	13.25
	No change	11	6.63
Sea level	Increase	19	11.45
	Decrease	142	85.54
	No change	5	3.01
Temperature	Increase	164	98.8
	Decrease	2	1.2
	No change	0	0

Participants had interesting perception on the changes in weather conditions over the years. During the rains they observed significant increase in fish catch. A greater percentage (97%) of respondents believes there is a great reduction in amount of rainfall. All (100%) of the participants have observed a great reduction in the amount of fish catch. Most participants (82%) have observed a decrease in the size and level of the river as well as its turbulence. These changes they say have further reduced their productivity. Majority (90%) of participants have also observed an increase in pollution of the river, the lithosphere and the atmosphere. Majority indicated that the weeds have increased and it affecting their fishing activities. 80% have observed an increase in the amount of sea weeds growing on the river and 86% believe have observed a decrease in sea level and about 99% have observed an increase in both atmospheric temperature and water temperature. (Table 4.2)

4.2.3 Foreseen future consequences of climate change

This section presents predictions made by participants of various climatic conditions in the next 20 years.

Table 4.3 Predictions of respondents on future consequences of climate change

Variable		Frequency	Percentage
Amount of fish catch	Increase	14	8.43
	Decrease	140	84.34
	No change	1	0.6
	Don't know	11	6.63
Size/Level of the river	Increase	16	9.64
	Decrease	99	59.64
	No change	40	24.1
	Don't know	11	6.63
No. of people involved in fishing	Increase	61	36.75
	Decrease	96	57.83
	No change	2	1.2
	Don't know	7	4.22
Turbulence during fishing	Increase	27	16.27
	Decrease	74	44.58
	No change	36	21.69
	Don't know	29	17.47
No. of people getting eye diseases	Increase	112	67.47
	Decrease	24	14.46
	No change	5	3.01
	Don't know	25	15.06
No. of people getting skin diseases	Increase	138	83.13
	Decrease	10	6.02
	No change	4	2.41
	Don't know	14	8.43
Amount of money people make from fishing	Increase	37	22.29
	Decrease	124	74.7
	No change	1	0.6
	Don't know	4	2.41

Participants foresee further decline in their fishing activities as a result of climate change. The larger number of them believes the amount of money people make from fishing will reduce greatly in the near future. 84% and 60% believe that the amount of fish catch and level/size of the river respectively will continue to decline. They also foresee more people getting eye and skin diseases as the waters continues to be polluted. Many of them indicated that despite these future threats, they will continue to fish since there are no jobs from government to help them migrate to some other things. (Table 4.3)

4.2.4 Contributors to reduction in fish catch

This section presents the opinion of participants of some factors influencing climate change.

Table 4.4 Respondents view on contributors to reduction in fish catch

Variable		Frequency	Percentage
Domestic waste disposal into the lake	Yes	125	75.3
	No	35	21.08
	Don't know	6	3.61
Use of chemical in fishing	Yes	131	78.92
	No	21	12.65
	Don't know	14	8.43
Using small nets to catch young fishes	Yes	93	56.02
	No	56	33.73
	Don't know	17	10.24
Activities of the dams	Yes	134	80.72
	No	22	13.25
	Don't know	10	6.02
Fish ponds located in the lake	Yes	58	34.94
	No	82	49.4
	Don't know	26	15.66

Participants expressed their perceptions on the causes of climate change. 75% were of the view that dumping refuse in the river or lake contributes to reduced fish catch. Most frowned at the idea of using chemical in fishing. They believe that the chemical pollutes the water making it unsafe for the fishes to thrive. 79% strongly believe it is a major contributor of reduced fish catch. 56% says using smaller nets to catch young fishes reduces their fish catch in the long run because when most of the fishes are caught young they do not grow to become adults and reproduce. Most respondents agree that activities of the dams were a serious contributing factor to the reduction in fish catch. 81% believes it is a factor. Fish ponds located at the lake were also considered by 35% of the respondents as a contributing factor but 49% did not see it as such (Table 4.4).

4.2.5 Adaptation to the effects of climate change

This section presents the proportions of fishermen who employ some adaptation measures to increase their fish catch.

Table 4.5 Adaptation measures

Variable		Frequency	Percentage
Fishing at night	Yes	103	62.05
	No	50	30.12
	Don't know	13	7.83
Use of speed boats instead of canoes	Yes	3	1.81
	No	153	92.17
	Don't know	10	6.02
People will use smaller nets	Yes	27	16.27
	No	127	76.51
	Don't know	12	7.23
Periodic removal of sea weeds	Yes	86	51.81
	No	79	47.59
	Don't know	1	0.6
Aquaculture	Yes	34	20.61
	No	124	75.15
	Don't know	7	4.24

In order to increase their chances of catching fishes, participants adopt different measures in their fishing activities. 62% of fishermen recruited now fish at night to increase their catch. This is because the temperature is cool at night and fishes are believed to swim at the surface and can be caught easily. Up to 92% use canoes to fish. About 6% use both canoe and speed boats. About half of the participants (52%) periodically go to the river to remove the weeds. Over 75% of

them did not consider use of smaller nets and aquaculture as measure for adaptation. Only about 21% use this adaptation measure (Table 4.5)

4.2.6 Response to effects of climate change

This section presents the opinion of participants on some behavioral changes that would occur if climate change leads to reduced fish catch.

Table 4.6 Behavioural changes to address the effects of climate change

Variable		Frequency	Percentage
People will stop polluting the river with waste	Yes	130	78.79
	No	28	16.97
	Don't know	7	4.24
People will stop using chemicals for fishing	Yes	132	80
	No	24	14.55
	Don't know	9	5.45
People will stop using small nets to catch young fishes	Yes	95	57.58
	No	59	35.76
	Don't know	11	6.67
People will stop fishing and move to other vocations	Yes	103	62.42
	No	51	30.91
	Don't know	11	6.67

The respondents say fishermen will stop some human activities that contribute to climate change if they knew they were the causes of the decreased catch. About 80% will stop polluting the river with waste and desist from using chemical in their fishing activities. A little over half of them at 58% will stop using smaller nets to catch young fishes whereas 62% will leave fishing to some other vocations (Table 4.6).

CHAPTER FIVE

DISCUSSION

This chapter contains a discussion of the results from the analysis of the data. It compares findings to previous work done on the subject area.

This research has used both quantitative and qualitative methods to explore the perception of fishermen living in the Asuogyaman district in the Eastern region of Ghana about climate change and its impacts on their activities.

5.1 Knowledge and Perceptions of climate change

A major finding of the study is that although many fishermen had heard about climate change, their understanding of its definition, cause and mitigation differed markedly. Some understand climate change to mean changes in weather conditions over time. Some are of the opinion that it is the changes in the environment that has led to a great reduction in their fish catch. Others understand it to mean changes in seasonal patterns. Most participants who had not heard about climate change had observed changes in climate. Some misconceptions of the notion of climate change have been reported in other studies in sub-Saharan Africa (Spence et al 2011, and Maddison 2007).

Another finding is the perception that rainfall patterns have changed and rainfall have greatly decreased. Maddison (2007) also reported that there has been a great reduction in rainfall. This change is believed to be the greatest factor that affects fishing activities. It is believed that when there is sufficient rainfall, there is always good harvest. This was also reported by (Zarien, 2010;

Meynecke et al 2006). Deforestation was identified as a major cause of the great reduction in rainfall as wood is used for building houses and for firewood and charcoal.

Most fishermen have also observed a great increase in temperature (Maddison 2007). A rise in temperature was observed to be associated with the reduction in fish catch. This agrees with the study of Adeleke and Balogun (2013) and where they reported that fisherfolks believe that temperature is inversely related to fish catch. Also, study conducted by (Sunanda et al, 2013) agreed that ocean warming is greatly affecting fish catch and thereby threatening worldwide food security. Adel and Magdy (2012) argued that according to World Fish Centre, a rise in the temperature of inland water may reduce the wild fish stock by harming water quality. This supports the observation of participants that some fishes hide under sea weeds or can no longer be caught from the river due to the rise in temperature as fishes need a favorable temperature to thrive. Williams and Rota (2010) also pointed out that all marine and aquatic invertebrates (molluscs, crustaceans, worms etc.) and fish are poikilotherms; their internal temperature varies directly with that of their environment. This makes them very sensitive to changes in the temperature of their surrounding environment. When changes do occur they move to areas where the external temperature allows them to regain their preferred internal temperature.

An increase in environmental pollution was observed by most respondents and believed to be responsible for the growth of weeds where fishes go to hide making it difficult for the fishermen to reach them. This increase is believed to be caused by activities of factories around them that dispose their waste directly into the river. There is the belief that the activities of the villagers do not contribute significantly to this increase in pollution. Such misconceptions have the potential to make it difficult to mobilize support for local action towards reducing activities that contribute to climate change and the mitigating factors.

The study also showed that there is a great decrease in the river level and current. This has been identified to contribute greatly to diseases in the water such as Bilharzia (Schistosomiasis) which is associated with slow-flowing water body. It was attributed to the construction of the Akosombo and Kpong dams. Chitselo (2000) stated that about 200 million people are infected with the disease, mostly in Africa and the construction of water schemes to meet power and agricultural requirement for development has led to increasing transmission. Also, Steimann et al (2006) reported that the development and management of water resources is an important risk factor for the disease.

5.2 Foreseen future consequences

Majority of respondents agree that climatic conditions would continue to change if current environmental conditions persist.

Most fishermen believe that fish catch will continue to reduce as temperature continues to rise and rainfall continues to decline. Temperature and rainfall are important environmental factors that influence fish catch.

A great reduction in fish catch is the most difficult impact of climate change to the fishermen. Fishing is the only source of livelihood for many of them. According to a study by (FAO, 2008), over 520 million people depend on fisheries and aquaculture for a source of livelihood. A World Bank research further supports this idea with its indicated that 98% of these people are in developing countries (World Bank 2010). Inability to catch enough fishes to sell and support their families results in poor health and poverty among people in fishing communities. They are unable to provide the basic needs of their families and this has resulted to most people considering fishing as a vocation for the poor and deprived. Studies by Daw et al (2009) and

Smith et al (2005) have also reported that small-scale fisheries have been marginalized and poorly recognized in terms of contribution to food security and poverty reduction. More than half of participants have the opinion that the number of people who will be involved in fishing will reduce as many of them will stop fishing and look for other source of livelihood. As the number of people who fish continue to reduce, it has serious implications for the fishery sector and the economy of the country. It will increase the level of unemployment.

Furthermore, Ghana's food security will be threatened in the near future as fish catch from small-scale fishing further decreases.

5.3 Adaptation

Adaptation has been identified as an important mitigation measure to the effects of climate change. Moser and Estrom (2010) suggested that the adaptation process should include understanding the problem, planning adaptation actions, and managing the implementation of the selected option(s). The fishermen in the study area adopted different measures for coping with the adverse effects of climate change to increase their catch.

Many have changed their time of fishing. About 62% of them now fish at night. A few of them (21%) who could afford to have fish ponds on the river where small fishes are trapped and given feeds to mature. Also, the weeds are periodically removed by 52% of participants. Other measures that were identified to remove the weeds are the use of weedicides or hanging small stones on weeds.

An adaptation measure that has been suggested by previous studies (Williams and Rota, 2010) also adopted by fishermen but was not regarded as such is the combination of fishing with other sources of livelihood including farming, rearing of domestic animals, etc.

Although these adaptation measures are used, they may not be as effective in reducing the impacts of climate change on fishing activities.

5.4 Health Implications of Climate change

Spectrums of health events are postulated to have a relationship with climate change. This postulated effects formed the basis of questions posed to the respondents in this study. The findings in this study are fairly consistent with the anticipated effects of climate change. These views have been expressed in a population with limited understanding of the theoretical concepts of the topic. This suggests that even though the community members do not have a local word for climate change, they are well aware of the dangers of climate change.

Diseases such as Schistosomiasis, eye diseases and skin diseases were mentioned by the fishermen to affect them. In their article (Sabin et al 2015) showed that nearly 240 million people are infected with diseases from fishing such as Schistosomiasis in as much as 78 countries, with a vast majority of burden occurring in Africa. Nearly all participants of this study expressed concerns which confirm the findings cited above. Although the diseases contracted by these fishermen are not entirely attributed to their fishing activities, the predominance of certain eye and skin disease causes severe threat to fisheries and aquaculture. Complications of these diseases could lead to prostate and bladder cancer, blindness and other severe forms of skin diseases in the long term.

An exposure to high temperature is known to cause several diseases including cardiovascular and respiratory diseases (FAO, 2008). For example, in the heat wave of summer 2003 in Europe, more than 70,000 excess deaths were recorded (Robine et al, 2008). High temperatures were also reported to raise the levels of ozone and other air pollutants that exacerbate cardiovascular and

respiratory disease. Pollen and other aeroallergen levels are also higher in extreme heat. These can trigger asthma, which also affects around 300 million people. Ongoing temperature increases are expected to increase this burden (Castello et al, 2009).

Ghana as a developing country where most individuals depend on aquatic foods for their protein needs; a reduction in fishing activities will reduce the availability of these food and increase prices which will affect nutritional status in the long run. Fisheries have been described as the most important animal protein in the world (Hill 2004). Even in small quantities, fish can have a positive effect on nutritional status by providing essential amino acids that are deficient in staple foods such as rice or cassava. (Williams and Rota, 2010)

Adel and Magdy (2012) argued that climate change will undermine the ability of developing countries to attain millennium development goals and achieve sustainable development.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The importance of fisheries in both the agricultural sector and economy of a nation cannot be overemphasized. It is a sector that is affected greatly by the changes in climate. A good knowledge and understanding of climate change impact on this sector is necessary to mitigate its effects. It was evident that climate change, its causes and its impact is not is not well understood by the fisherfolks of the study area. It could translate to misinformed attitudes and behaviors that may have adverse effects on the environment as well as climate. It was also evident that fisherfolks have observed several changes in climatic conditions especially in rainfall, temperature, water current and pollution and have adopted consciously and unconsciously various adaptation measures to cope with consequences of climate change.

6.2 Recommendations

Campaigns on the reality of climate change, causes and consequences should be carried out among fisherfolks especially about how their activities also contribute to these changes as there is the belief that their activities do not contribute to climate change.

Policies to promote better adaptation measures to mitigate the effects of these changes

Policies to regulate the activities of fishermen with regards to methods of fishing as some use chemicals or use small nets to fish in order to preserve water quality and species diversity.

Funds should be made available and accessible to fishermen for them to purchase the current technologies to reduce the impacts of their activities on the environment.

Weather forecasts for the fishermen to determine the best time to go for fishing.

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APPENDIX 1

INFORMED CONSENT FORM

Study Title: Impacts of climate change on fishing activities and potential health implications: a study among fishermen in fishing communities of Asuogyaman district of Ghana.

Introduction

I am a student of Ensign College of Public Health and as part of my project work; I am conducting a study about the impacts of climate change on fishing activities and its potential health implications. There is concern that climate change may be impacting on the lives of people who live in coastal towns or whose livelihoods depend on the sea and other water bodies.

This participant information leaflet explains the research study you are being asked to join. Please take all the time you need to read it carefully or listen carefully as it is being read and explained to you. You may ask the research team questions about anything you do not understand at any time. You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.

Why you are asked to participate

You are being asked to take part in this study because you are a fisherman in one of the fishing communities of Ghana. Specifically, we are interested in talking to fishermen from 40 years and above.

Procedure

If you agree to be part of the study, a trained project staff will ask you a series of survey questions alone for approximately 10 to 15 minutes. Your responses will be recorded on paper and later entered into a computer database by study staff. The questions will only begin after you have agreed to be in the study and have signed the consent form. As a

participant, if you agree to participate in this study, data from your responses may be used as part of study.

Risks and Benefits

We anticipate minimal or no risk to you. There is no direct benefit to you for being in the study; however, study outcomes may lead to better understanding of health implications of climate change especially to fishermen.

Confidentiality

All data will be re-identified and will be kept private. Your identifiable data such as name or date of birth will not be used in documents, reports, or publications related to this research. All survey forms and consent forms shall be well handled and properly disposed of after data entry and analysis. When typing your survey responses into the computer, all data will be entered without any information that will make it possible for your identity to be known. The information you provide will be kept strictly confidential and will be available only to persons related to the study (investigator, study staff and other professionals who may be evaluating the study).

Withdrawal

You can choose not to take part and you can quit at any time. There will be no negative consequences if you choose not to participate in the study. Please note however, that some of the information that may have been obtained from you without identifiers, before you chose to withdraw, may be used in analysis reports and publications.

Contact

This study has been approved by the Institutional Ethics Committee of Ensign College of Public Health. If you have any concern about the conduct of this study, your welfare or your rights as a research participant or if you wish to ask questions, or need further explanations later, you may contact Mrs. Nnenna Umeh (Tel: 0268031138), my supervisor Dr. Frank Baiden (Tel: 0204591181) or the administrator of the ethics board at the Ensign College of Public Health that has approved the conduct of this study, Mr Patrick Kuma (Tel: 0245762229)

Do you have any questions?

CONSENT DECLARATION

"I have read the information given above, or the information above has been read to me. I have been given a chance to ask questions concerning this study; questions have been answered to my satisfaction. I now voluntarily agree to participate in this study knowing that I have the right to withdraw at anytime"

Name of Participant _____

Signature or thumbprint of Participant _____

Date:

Name of Investigator _____

Signature of Investigator _____

Date:

APPENDIX 2

IMPACTS OF CLIMATE CHANGE ON FISHING ACTIVITIES AND POTENTIAL HEALTH IMPLICATIONS QUESTIONNAIRE, 2016

Name.....House No:_____

SECTION A: DEMOGRAPHICS

- A1** Age: _____ yrs
- A2** Sex 1. Male 2. Female
- A3** Ethnicity 1. Ga/Adangme 2. Akan 3. Ewe
 Other:_____
- A4** Highest educ. Level 1. None 2. Primary 3. Secondary or higher
- A5** Religion 1. Christian 2. Muslim 3. Traditionalist
 4. Other:
- A6** Marital status 1. Married 2. Unmarried 3. Divorced
 4. Widower 5. Other
- A7** Total no. of children _____
- A8** No. of children less than 18yrs of age _____
- A9** No. of children less than 12yrs of age _____
- A10** For how many years have you been fishing?: _____ yrs
- A11** Do you have other sources of income? Yes No

SECTION B: KNOWLEDGE ABOUT CLIMATE CHANGE

- B1.** Have you heard about Climate change? Yes No
- B1b.** If Yes, what do you understand by climate change: _____
-

SECTION C: CLIMATE CHANGE PERCEPTION

Over the past 10-20yrs, how have you observed changes in the following?

C1. Amount of rainfall	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change
C2. Amount of fish catch	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change
C3. Level or size of the lake/river	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change

C4. Turbulence at the lake	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change
C5. Amount of pollution	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change
C6. Sea weeds	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change
C7 Sea level	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change
C8 Temperature	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change

SECTION D: FORESEEN FUTURE CONSEQUENCES OF CLIMATE CHANGE

In the next 20yrs how do you foresee the following events/activities in this community/waterbody?

D1. Amount of fish catch	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know
D2. Size/Level of the river	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know
D3. No. of people involved in fishing	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know
D4. Turbulence during fishing	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know
D5. No. of people getting eye diseases	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know
D6. No. of people getting skin diseases	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know
D7. Amount of money people make from fishing	<input type="checkbox"/>	1. Increase	<input type="checkbox"/>	2. Decrease	<input type="checkbox"/>	3. No change	<input type="checkbox"/>	4. Don't know

SECTION E: CLIMATE CHANGE – CONTRIBUTORS & ADAPTATION

Do you think the following activities contribute to climate change?

E1. Domestic waste disposal into the lake	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E2. Use of chemical in fishing	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E3. Using small nets to catch young fishes	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E4. Activities of the dams	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E5. Fish ponds located in the lake	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know

Which of the following adaptation measures do you employ to reduce the effects of these changes?

E6. Fishing at night	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E7. Use of speed boats instead of canoes	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E8. People will use smaller nets	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E9. Periodic removal of sea weeds	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E10. Aquaculture	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know

Do you think the following will happen if climate change leads to reduced fish catch?

E11. People will stop polluting the sea with waste	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E12. People will stop using chemicals for fishing	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E13. People will stop using small nets to catch young fishes	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know
E14. People will stop fishing and move to other vocations	<input type="checkbox"/>	1. Yes	<input type="checkbox"/>	2. No	<input type="checkbox"/>	3. Don't know