



Coastal Community's Perception on Climate Change and Its Impacts: Analysis of Local Coastal Community of Winneba, Ghana

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Aims: The study assessed the perception of the coastal inhabitants of Winneba on climate change and its impacts.

Study Design: This study is descriptive in nature and employed both qualitative and quantitative approaches.

Place and Duration of Study: This research was conducted in Winneba, Ghana in February 2020.

Methodology: The survey method of research was employed in this study. An annual mean temperature timeseries data of Winneba from 1980- 2017 to supplement respondents' subjective views. In addition, community interactions were conducted to get personal information from the inhabitants about the impacts of climate change. 152 inhabitants were sampled through the convenience and the purposive sampling techniques. The convenience technique was used to select 148 respondents and 3 fishermen, and 1 fish seller selected purposively. This was done through questionnaire administration and interviews. Community's interactions centred on inhabitants' perception of climate change and its impacts.

Results: The study found that temperature in the Winneba community has increased. The study again found diverse views on the most serious impact of climate change in the community. While

some attributed it to rising temperatures, others attributed it to sea level rise and coastal erosion. The study also revealed that although many of the inhabitants lamented about rising temperatures as it disrupts their daily activities and cause diseases, sea level rise and erosion has also played a devastating role on the environment which needs to be addressed.

Conclusion: Local community perception and knowledge on climate change is important. Increased knowledge and awareness influence a community's choice of mitigation and adaptation to climate change impacts. A comprehensive policy framework on climate change awareness creation and education should, therefore, be implemented and made available to local coastal community members.

Keywords: Climate change; global warming; perception; community; Winneba; coastal zones.

1. INTRODUCTION

Coastal communities have long enjoyed many benefits from the coast: employment, food, and recreation. Many coasts serve as natural harbours which aid trade between and among countries. The beaches of these coasts attract tourists, as well as its wetlands and estuaries which serve as a habitat for aquatic lives. Globally, coastal communities have become susceptible to many possible threats including climate change, sea level rise, coastal resource degradation, saltwater intrusion, and coastal inundation. Many of these problems in Ghana, relate to sea level rise, increasing temperatures, decreasing rainfall, coastal erosion, poverty, and diseases [1]. These problems are currently being intensified by climate change, sea level rise and anthropogenic/human activities which trigger other effects along coastal areas [2,3,4].

In Ghana and Winneba in particular, climate change has added to the already existing environmental challenges such as land degradation and deforestation [5]. Over the years, Ghana's climate has become drier and unpredictable. This has a long-lasting effect on all sectors of the economy especially the fishing sector and the coastal environments. A study by Owusu and Wayhen revealed that, communities in the coastal savanna zones of Ghana are under the threat of climate change [6,7,8,9,10]. These changes have serious physical, economics and social impacts on the lives of people especially those found in the coastal zones whose source of livelihood depends on the usage of natural resources that are likely to be under the influence of its negative impacts [11]. The variabilities of climate change have been observed throughout the history of the earth. The variabilities of the climate results from natural occurrences such as atmospheric carbon dioxide variations, volcanic eruptions, nitrous oxide, among others. The evolution of industrialization however, has

diverted attention from these climate variabilities to a focus on anthropogenic/human activities as the main cause of greenhouse effect and the consequent warming of the earth in the past century [2,3,12,13,14]. Not only does this warming affect the earth but also it has a great impact on the oceans as well. Global ocean temperatures have increased. The increased ocean temperatures, however, have a negative impact on coastal resources [15,16,17].

The mitigation and adaptations to the risk involved ranges from the community to the national and international. The perceptions and views of communities with regards to climate change matters are very key to its mitigation. Public opinion is very necessary. This is because it serves as a foundation within which policies are designed. If the perception of a community differs from the policy makers, implementation of policies become difficult or may be misunderstood [18]. Local community's opinions enable scientific views of changes to be framed in a local context, provides a platform to 'ground truth' scientific research, allows for better local examination, expression and interpretation of global changes and provides improved foundations for decision-making and adaption measures. Some local communities' opinions have been used to understand and respond to feedback, which has addressed uncertainty and unpredictability in climate change's research [19-28]. The adaptation to climate change and its impacts is crucial especially among vulnerable coastal communities who are affected by the dire consequences. The perceptions of such communities determine how they design measures to mitigate with.

In Ghana, a lot more studies on Climate change have been conducted on food and agriculture especially in the wet-equatorial, moist-semi equatorial, and the dry continental climatic regions of the country. However, few studies on

climate change have been done on the dry-equatorial region. Many of these studies have also been conducted in the urbanized areas of the country such as Accra, Kumasi and Takoradi [29,30]. On the coastal zones, a lot more studies have been conducted on the Accra, Cape coast, and Sekondi-Takoradi coast. However, little or no studies on climate change have been conducted on the Winneba coast. This study assessed local coastal community's perception on climate change and its impacts.

1.1 Study Area

1.1.1 Location, population and culture

Winneba is a municipal town located in the Central Region of Ghana. It is located on latitude 5° 20' N and longitude 0° 37' W along the Gulf of Guinea. The geographical map of Winneba is shown on (Fig. 1). The total population of Winneba as of 2010 was 56,356 comprising 27,008 males and 29,348 females [31]. Winneba has majority of its population being economically active 56.2% [31]. Winneba has a lot of economic activities including fishing and farming. Winneba has the Aboakyir Festival (Deer hunting) as the most important festival in the municipality and the Central Region as a whole (<http://www.charlottesville.org>).

1.1.2 Climate

Winneba has a tropical climate and lies within the dry-equatorial climatic zone of Ghana [32]. Winneba receives low rainfall and long dry season of 5 months. There exist disparities in the amount and seasonal distribution of rainfall. Highest rainfall in Winneba is recorded between April and July. June is the month with intense rainfall. Minor rains also occur between September and November. The annual rainfall ranges between 400 millimetres to 500 millimetres [31]. Mean temperatures ranges from 22°C to 28°C. The variation in annual temperature is 3°C. January and June are the driest and the wettest month, respectively. The coldest and warmest months, however, are August and March, respectively.

1.1.3 Geomorphology

Winneba is low lying area with few isolated hills. The Ayensu and the Gyahadze rivers are the major rivers that drain Winneba. There exist diverse features along the coast. The coastal zone of Winneba is divided into three; eastern, western, and central portions. The eastern

portion is bordered by the Ayensu River with some isolated hills. The rocks found in the river area are quartz schists. The river is surrounded by the Winneba wetlands. Transport of sediments into the coast and the sea is great during rainy season when the river overflows its bank.

The western portion is bordered by the Muni-Pomadze Ramsar site which comprises the Muni Lagoon, the neighbouring flood plains, and the nearby sandy beach on the seafront. The catchment area of the Muni-Pomadze Ramsar is gentle undulating plain and is bordered to the north and north-east by the Yenku hills, a maximum height of 290 meters and in the south-west by the Egyasimanku hills, a maximum height of 205 meters. There exists a steep slope up to 20% grades along the face of the lagoon. The western portion of the coast is characterized by complex rocks from the Upper Brimian, which consists of extrusive and hyperbyssal rocks. The central part of this area is also characterized by lagoonal deposit of sand. The lagoon is situated behind a sandbar and its formation is due to the strong shore littoral drift of sand in west to east direction [33]. The surface area of the lagoon is about 3000 ha and is shallow, saline, and semi closed in nature. The vegetation found along the shoreline of the lagoon includes *Sesuvium portulacastrum*, *Paspalum virginicum* and *Sporolobus virginicus*. This is in continuous order up to the dune area. The vegetation in the floodplains (wetlands) also includes mangroves with *Typha australis* and *Ludwigia erecta* and other freshwater hydrophytes occurring further inland. The uplands areas have grassland, thickets and pockets of *Eucalyptus* and *Cassia* plantations [34].

The central portion consists mostly of a continuous sandy beach with few rocks. This portion is highly utilized by the inhabitants. It is used as a landing site for canoes, a waiting ground for fish buying, maintenance of fish nets by fishermen and a place for recreation. However, the erosion rate of this portion is very high due to swash and backwash actions of wave breaks. The swash action is very strong as it carries sea waters through waves and advances towards the coast. The sandy beach along the shoreline of this portion sometimes acts as a buffer and soaks sea water. The rocks found in this portion have similar characteristics as those in the western portion (The Ramsar site). Hyperbyssal rocks are found on this part. This is due to the resistive capacity of the rocks

which resist the swash actions of wave breaks. Nevertheless, continuous action will result in cracks along the rocks surfaces and increasing temperatures in the area, will result in the weathering [35]. These processes will breakdown the rocks (over 100 years), losing its resistive capacity and the incidence of erosion on the part.

2. MATERIALS AND METHODS

The study employed both primary and secondary data. Primary data were obtained from questionnaire administration and interviews. An annual mean temperature timeseries data of Winneba from 1980-2017 was obtained from the Ghana Meteorological Agency.

One hundred and forty-eight (148) questionnaires and four (4) interviews with a total

of one hundred and fifty (152) inhabitants were sampled for the study. The convenience sample technique was used to select respondents for the questionnaire administration and the participants for the interview were purposively selected based on the following criteria; lived in the area \geq ten (10) years, have knowledge about climatic conditions in the area and age \geq nineteen (19) years. Three (3) fishermen and one (1) fish seller were interviewed. These people were interviewed because they are found along the coast and have their activities directly linked to the sea. Primary data was analysed using Statistical Package for Service Solutions (SPSS v.16.0). This helped in generating frequency tables. The study used in-depth interview guide to gather qualitative data from fishermen and a fish seller in the area on the most visible impact of climate change and how the impacts of climate change are being felt.

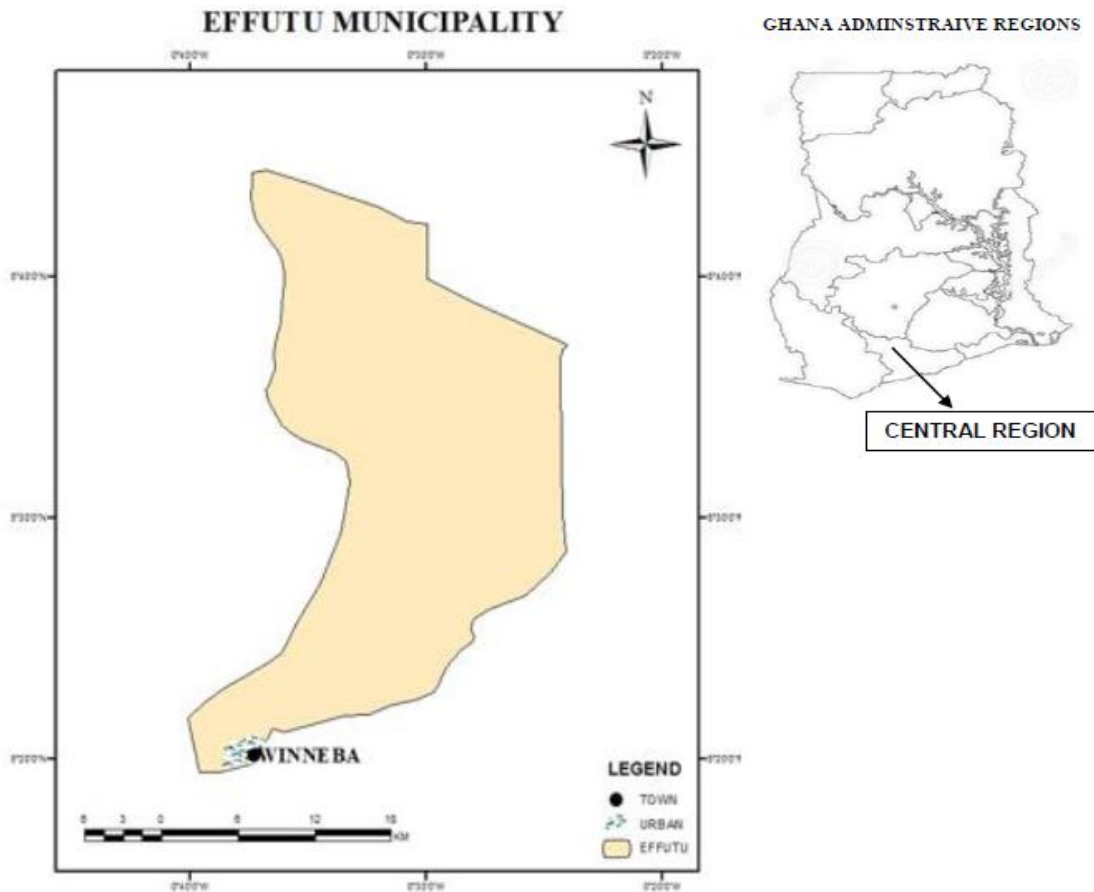


Fig. 1. Map of Winneba (Effutu) Municipality
 Source: Author's construct, 2020

The interview was conducted between an interviewer and a participant and it was conducted at a place where the participant was engaged, specifically, the participant home. At the instance where participants were at their duties at their workplace (Shore), interviews were conducted at point where the participants were free and devoid of any third party. The interview was conducted in the local dialect (Effutu) and in English Language. The English Language was used because there were respondents with diverse socioeconomic background. For anonymity sake, no names were assigned to the interviewee and did not include any personal traits. Questions relating to participant's perception on climate change were asked. Specific question included the most visible impact of climate change and how the impacts of climate change are being felt. The interviews from this study were tape recorded if and only when the interviewer and the participant agreed. This helped in the transcription stage of the interview as participants' responses were captured in their own words. The participants' personal views from the interviews conducted in February 2020 were presented in quotations.

3. RESULTS AND DISCUSSION

The results constitute the generalized views of the sample that was employed for the study. The perspectives of the respondents on the perception of climate change in the community are the raised categories from the data. The description of the administered questionnaires and interviews are grouped into three themes: climate change knowledge and awareness, current perception on climate change and impacts of climate change on the lives of inhabitants and supplemented with a physical climatological data.

3.1 Demographic Characteristics of Respondents

On the demographic characteristics of the respondents, majority of them were aged between 30-40 years at the time of the survey. More males participated in the survey than females, although the proportion of females in the Municipality outweighs that of the males. On the educational status of the respondents, majority of them had attained Primary/Junior High School education. This was followed by Secondary education and tertiary education. This implies that majority of the population in the Effutu Municipality are literate, however, majority

of the population end their education at the primary/Junior High School level with few who advance to the secondary and the tertiary level. Many of the respondents had stayed in the study community for 20 years and above. The study made sure respondents have a fair knowledge about the climate change incidence in the community. Most of the population are employed in trading and fishing while a few are teachers. Others especially, the males also engage themselves in other activities such as driving as presented in Table 1.

3.2 Climate Change Knowledge and Awareness

There was a consensus among the respondents as all (100%) of them indicated that they have heard about the issue of climate change. From Table 2, the respondents are aware of the climate change issue. The high knowledge and awareness level of the climate change issue can be attributed to the great efforts of some institutions and organizations such as the radio/tv/newspapers, schools, churches, nongovernmental organizations, among others. The media whether the print or electronic during morning news and just after their morning shows, provide the public with the state of the atmosphere. They provide information on how the atmosphere is today, how it will be tomorrow and how it had been some years back. They provide the public with information on the changes in our environment especially climate change and educate people on the adaptation mechanisms. For instance, a print media could devote a whole page to educate the public on the changing climate of the country. Schools have also developed curriculum modules on climate change which is taught at some levels of education. The various environmental Non-Governmental Organizations, as part of their corporate social responsibilities, also provide the public with information on the environment. Climate change and its impacts have attracted the concerns of many researchers worldwide. It is therefore no wonder why many people in the study area have become familiarized with the issue.

The study sought respondents' views on temperature level in the community for the past years as presented in Table 3. Many of the inhabitants believe that temperature levels in the community has increased for the past years. From the available annual mean temperature (Fig. 2), for the past years, temperature of the

community has been increasing however, annual mean changes are not so great. Temperature for the community has been increasing on a decreasing rate. For the past years, and per this data, the highest temperature 28.1°C was recorded in the years of 1998 and 2017.

Available data therefore supports respondents' views however, changes in annual values are not so great. The finding in in the above table is in consistent with a study by [4] on climate change which revealed that the earth temperatures have been increased due to climate change.

Table 1. Background information of respondents

Respondent types		Frequency	Percentage (%)
Age	19-29 years	46	31
	30-40 years	65	44
	41-51 years	29	20
	52-62 years	8	5
	Total	148	100
Sex	Male	90	61
	Female	58	39
	Total	148	100
Education	Primary/JHS	105	71
	Secondary	17	12
	Tertiary	23	16
	No formal education	3	2
	Total	148	100
Period of stay in community	10years	30	20
	15years	34	23
	20years and above	84	57
	Total	148	100
Occupation	Fishing	42	28
	Trading	46	31
	Farming	4	3
	Teaching	30	20
	Other	26	18
	Total	148	100

Source: Field survey, 2020

Table 2. Sources of information on climate change

	Frequency	Percentage (%)
Radio/TV/Newspaper	67	45
School	58	39
Church	2	1
NGO's	20	14
Other	1	1
Total	148	100

Source: Field survey, 2020

Table 3. Temperature levels in the community for the past years

Temperature levels for the past years	Frequency	Percentage (%)
Increased	142	96
Decreased	4	3
Constant	2	1
Total	148	100

Source: Field survey, 2020

3.3 Community Perception on Climate Change

The perceptions and views of communities with regards to climate change matters are very key to its mitigation. Public opinion is, therefore, very necessary. This is because it serves as a foundation within which policies are designed. The study found that, currently inhabitants of the community believe temperature levels has increased as presented in Table 4.

The above subjective views were compared with an annual mean temperature from 1980-2017 of the area as presented on Fig. 2. From Fig. 2, there has been a great change in climate of the area for the past 38 years. The annual mean differs yearly. From a critical look at the graph, it could be realized that temperature rises as the year moves ahead. The highest and lowest annual means were recorded in 1998, 2017 and 1993 with an annual mean value of 28.1°C and 25.1°C respectively. The climate when compared in yearly range could be realized that the highest annual mean values were recorded in the 1990's,

followed by that of the 2000's and the 1980's. Towards a changing climate, the community lived in somewhat safe climatic conditions in the 1980's. When compared with the last 10 years of the century, the climate of the area has been changing though at a decreasing rate. Changes in means over the wet and dry season are small and a co-efficient of determination ($R^2 = 0.4339$) shows a weak correlation.

In furtherance to this, the study sought the respondents' perception on the most serious problem facing the population of the 21st century and the community to be precise as presented in Table 5. From Table 5, global warming/climate change leads the most serious problem that confronts the 21st century population as perceived by the inhabitants. The changing nature of the environment especially climate change has serious impacts on the lives of people. All the problems facing the world today, could in one way or the other be attributed to climate change and its impacts. The changing environment through rising temperatures and decreasing rainfall affects crop yields.

Table 4. Respondents' current perception on temperature levels in the community

Current perception on temperature	Frequency	Percentage (%)
Increased	110	74
Decreased	12	8
Constant	26	18
Total	148	100

Source: Field survey, 2020.

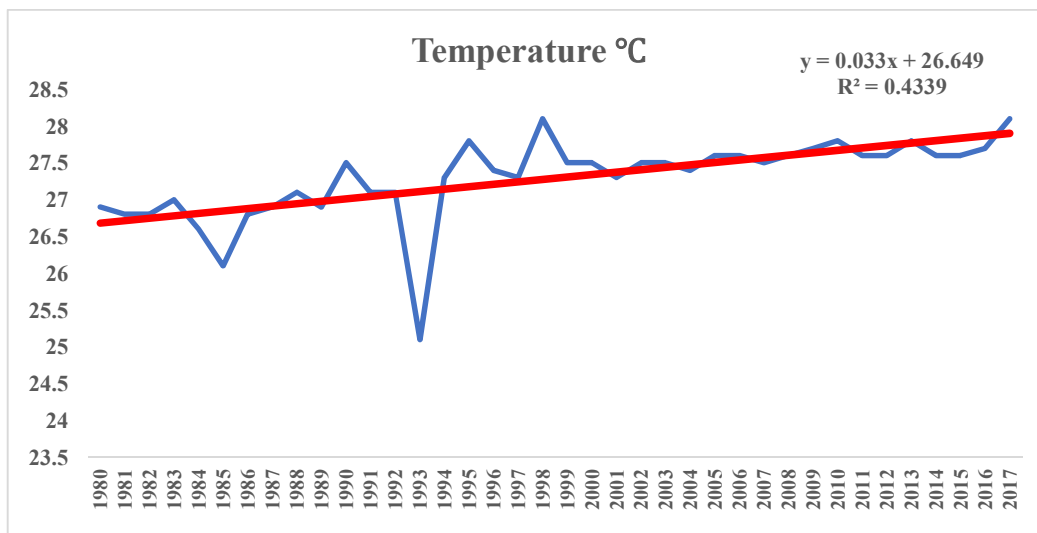


Fig. 2. Annual mean temperature of Winneba from 1980-2017

Source: Ghana Meteorological Agency

The warming of the earth provides heat which causes diseases such as skin rashes, malaria, among others. This causes harm to the health of people, reduces their productivity level, and renders them poor. Field observations shows that there is an evidence of poverty in the study community. The study area is found on the dry-equatorial climatic region of the country. It contains soils which do not support the growth of commercial cash crops such as cocoa, cashew among other. Crops such as maize which the soil supports, is also not cultivated on large scale. The climate change incidence through its changing trends in rainfall in the community affects the yields of crops and the security of foods. Informal conversations with the respondents also show that the unavailability of cultivated lands in the area, is the results of increased food prices which many of the people cannot afford. They again attributed the aridity of their lands to the changing climatic factors such as increasing temperatures.

The study again sought the respondents' views on causes of climate change impacts as presented in Table 6. From Table 6, inhabitants attributed the cause of climate change and its

impacts to both anthropogenic/human activities and natural variabilities. Records show that climate system differs naturally over a wide range of time scales. Generally, climate change before the industrial revolution in the 1700s were attributed solely to natural causes, such as changes in the sun's energy, volcanic eruptions, and natural changes in greenhouse gas concentrations. Current climate changes, however, cannot be attributed to natural causes alone. Research has revealed that natural causes of climate change do not explain most observed warming, especially warming since the mid-20th century. It is, however, particularly likely that human activities have been the central cause of climate change [3]. Harmful human activities began since the Industrial Revolution took place around 1750. Human activities contributed substantially during this period by adding carbon dioxide (CO₂) and other heat-trapping gases such as methane (CH₄), nitrous oxide (N₂O), chlorofluorocarbons (CFCs), hydro chlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and Sulphur hexafluoride (SF₆) into the atmosphere.

Table 5. Respondents' perception on the most serious problems facing 21st century population

Most serious problem facing 21st century population	Frequency	Percentage (%)
Global warming/climate change	45	30
Poverty	26	18
Food Insecurity	34	23
Diseases	43	29
Total	148	100

Source: Field survey, 2020

Table 6. Respondents' perception on the causes of climate change impacts

Causes		Frequency	Percentage (%)
Anthropogenic activities	Strongly Agree	28	19
	Agree	90	61
	Disagree	30	20
	Total	148	100
Natural Variability	Strongly Agree	10	7
	Agree	85	57
	Disagree	33	22
	Strongly Disagree	20	14
	Total	148	100
Both Anthropogenic and natural activities	Strongly Agree	120	81
	Agree	28	19
	Total	148	100

Source: Field survey, 2020

3.4 Impacts of Climate Change on the Lives of Inhabitants

Notwithstanding the above, the respondents were asked to indicate whether the changing climate impacts their lives as presented in Table 7. All the respondents 148(100%) reported that climate change impacts their lives greatly. Many of the inhabitants perceive rising temperature to be the most visible impact of climate change in the community. This is particularly so because many of the inhabitants that were sampled for the study were traders (shop keepers and petty traders) and fish sellers with low educational status. Since some of them stand in the sun to sell, they indicated rising temperature as the visible impact and failed to realize that impacts of sea level rise and coastal erosion.

The 2010 population and housing census data revealed that majority of the population of the Effutu Municipality has attained primary education [31]. Though these people are literate as they can read and write, they however lack the clear understanding of the climate change issue. The climate change issue goes beyond mere reasoning and its impacts requires critical analysis and observations. The few ones with tertiary education however recognized the dire impacts such as sea level rise, coastal erosion,

and flooding. The study however, found diverse views on this issue. Whilst fish sellers and petty traders attributed the most serious problem in the community to rising temperatures, the fishermen who stayed and have their activities along the coast attributed their problem to coastal erosion and sea level rise.

In an interview with some fishermen who are natives and have stayed in the study community for a very long time revealed that, the community's problem is coastal erosion and sea level rise as presented in the respondents' analysis in Table 8.

The respondents demonstrated how the most visible impacts of climate change (Table 7) are being felt as presented in Table 9. Since many of the inhabitants were traders and fish sellers, they indicated that rising temperatures distract their daily activities and diseases which affect their health and reduce their productivity and sales. Sea level rise has also caused saltwater intrusion into the wetlands in the area. Salt water has affected both surface and underground waters. The area's water table is just beneath the surface of the earth however when people dig wells in their homes, they cannot drink the water, nor can they use it for other domestic activities like washing. The salt content in the water makes it

Table 7. Respondents' views on the most visible impacts of climate change in the community

Most visible impacts of climate change in the community	Frequency	Percentage (%)
Sea Level Rise	39	26
Coastal Erosion	42	28
Rising Temperature	57	39
Other	10	7
Total	148	100

Source: Field survey, 2020

Table 8. Respondents' analysis

Participants	
A 38 year old fishermen	"My brother! Who said is temperature? Anyway, is true but I have stayed in this community for 38 years and our problem is not about the sun (temperature). Some years ago, the sea increased in volume and advanced into the land. The sea water passed these houses and entered town. The sea is eating (eroding) the land and I know one day we cannot stay here".
A 42 year old fishermen	"We have problem with the sea because it is approaching us (advancing) some people cannot see but some of us have seen that. The sea has increased in volume and we feel that on the sea when we go for fishing. Around 4:00pm thereof each day you will see that the intensity of the tidal waves becomes strong and extend waters close to the land. Due to this those who are not natives of this community are drove out from the sea around 4:00pm during occasions when they come here to swim".

Source: Field survey, 2020

Table 9. Respondents’ views on how climate change impacts are being felt in the community

How climate change impacts are being felt	Frequency	Percentage (%)
Distracts daily activities	64	43
Diseases	38	26
Pollution of water bodies	17	11
Distraction of the ecosystem	29	20
Total	148	100

Source: Field survey, 2020.

Table 10. Respondents’ analysis

Participants	
A 40 year old fish seller	“Brother, nowadays the sun (temperature) is too much. We sell under umbrellas, but the sun can pass through. In fact, there is too much heat. At times when we come to sell, it will look like the rain is coming to fall so we have to pack but it will not rain. Other times too it rains so we do not sell”.
A 42 year old fishermen	The weather (climate) has changed. The sun (temperature) is too much. I was born in this town and I have stayed here for 42 years. The sun (temperature) was not like that some years back. Even on the sea when I go for fish, I feel the sun’s heat (temperature). On days that I do not go for fish and I want to repair my net, I cannot sit on the canoe I have to move to the wooden structure over there”.

Source: Field survey, 2020

hard to lather with soap. The low-lying nature has made the area to become susceptible to erosion and flooding. Due to erosion, the area has been flooded many times.

In an interview with participants on the above issue, several responses were given as presented in the respondents’ analysis in Table 10.

4. CONCLUSION

The study assessed the perception of the inhabitants of the Winneba community on climate change and its impacts. The study revealed that the issue of climate change is not new to the inhabitants as almost all of them are aware however, the respondents lack in-depth understanding of the issue due to their low educational level. The inhabitants currently have a negative perception on climate change. The study found both anthropogenic/human activities and natural variabilities as the cause of climate change and its impacts in the area. The inhabitants again complained about the decreasing levels of rainfall in the community as against rising temperatures both at sea and on land. The study again found diverse views on the most visible impact of climate change in the community. While some attributed it to rising temperatures, others attributed it to rising sea level and coastal erosion. Although many of the

inhabitants lamented about rising temperatures as it distracts their daily activities and cause diseases, sea level rise and erosion has also played a devastating role on the environment which needs to be addressed.

The study recommends a comprehensive policy outline that will take into consideration the protection of coastal inhabitants under the under influence of climate change impacts. Also, an accurate policy framework that will contribute towards the mitigation of climate change impacts under study should be designed. For example, government, community members and other stakeholders should be more concerned about the impacts of climate change on the coastal zones. Also, there should be more researches on climate change impacts on coastal zones and more importantly the coastal zone of Winneba.

CONSENT AND ETHICAL APPROVAL

The University Research Ethics Committee, Department of Geography Education, University of Education, Winneba, provided the approval for this study. Regarding the declaration of University of Education, Winneba, participants received consent prior to the start of the interview process. Informed consent was obtained from all the participants who participated in the study.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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