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## **MASTER'S THESIS**

University of The Gambia

**TOPIC:**

# **INTEGRATION OF CLIMATE CHANGE EDUCATION IN THE NATIONAL CURRICULUM OF THE GAMBIA**

By

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**Thesis submitted in Partial Fulfillment of the requirement for the Award  
of Master of Science in Climate Change and Education**

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**Date of Thesis Defense:** 1st March, 2018. Law Faculty, Kanifing.

# TABLE OF CONTENT

DECLARATION OF AUTHORSHIP.....	4
DEDICATION .....	5
ACKNOWLEDGEMENT .....	6
ABSTRACT.....	7
List of figures.....	9
List of Tables .....	10
1.1 Introduction.....	11
1.1.2 Problem Statement .....	15
1.1.3 Purpose of the study.....	15
1.1.4 Justification .....	16
1.1.5 Research Objectives.....	17
1.2 The Context, The Gambia.....	18
1.2.1 The Gambia, Geography and Climate.....	18
1.2.3 Population Growth .....	20
1.2.4 Population distribution by Sex by Local Government Area .....	21
1.2.5 Education system of the Gambia .....	22
1.2.6 Education Policy on Climate Change .....	23
1.2.7 Curriculum Audit on climate change .....	24
2.1 Literature Review.....	25
2.1.1 Climate change concept .....	25
2.1.2 Climate Change Education.....	27
2.1.3 Climate Change Teaching and learning approach .....	32
2.1.4 Climate change Themes for Integration in the Curriculum .....	34
2.1.5 The meaning and definition of climate change.....	34
2.1.6 The causes of Climate Change.....	35
2.1.8 Mitigation of Climate Change.....	37
2.1.9 Adaptation to Climate Change.....	37
2.2 Climate Change Education in The Gambia.....	38
2.3 Curriculum .....	39

2.3.1 Curriculum integration.....	41
2.3.2 Curriculum Adaptation .....	41
2.3.3 Curriculum Enrichment.....	44
3.1 Methodology .....	45
3.1.1 Content Analysis of Curricula.....	46
3.1.2 Sampling Technique .....	46
3.1.3 Population Growth in Kanifing.....	48
3.1.4 Population Growth in Kerewan.....	48
3.2 Administration of questionnaires .....	49
4.1 Results and Discussion .....	50
4.2 The result of the analysis of data collected .....	51
4.3 Discussion of the Results .....	60
4.4 Discussion on responses to the appropriate methods for climate change education:.....	62
5.1 Conclusion and Recommendations.....	64
5.2 Limitations and how to advance the study.....	67
References.....	68
Appendix I: Research Questionnaire for data collection .....	72
Appendix II: Climate Change Themes and Topics for integration .....	83
Appendix III: Curriculum Audit .....	86
Appendix IV: Data Compilation and Analysis .....	93

## **DECLARATION OF AUTHORSHIP**

I, Olalekan Oluwatobi Owa, hereby declare that this Master's thesis is my own work, and that I have written it independently.

I did not use any outside support except for the quoted literature and other sources mentioned in the paper.

I clearly marked and separately listed all of the literature and all of the sources which I employed when producing this work, either literally or in content.

I am aware that the violation of this regulation will lead to failure of the thesis.

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## DEDICATION

I dedicate this work to my friends, family and acquaintances both in The Gambia and abroad.  
Your support has made it possible for me to soar high in my academic pursuit in The Gambia.

## **ACKNOWLEDGEMENT**

I appreciate God for His support, guidance and protection, my family and friends, the WASCAL network in The Gambia and in other West African countries for the assistance rendered to me in my research work. God bless you all.

My sincere appreciation goes to the Federal Ministry of Education and Research (BMBF) and West African Science Centre on Climate Change and Adapted Land Use (WASCAL) for providing the scholarship and financial support for this program

## ABSTRACT

The study was conducted to integrate climate change education in the school curriculum of The Gambia. It included a curriculum audit of two subject areas, Social and Environmental Science (SES) and General Science, in the Upper Basic School. Research questions were developed and answered by the study. Quantitative research method was the approach employed for the study.. A 14-item structured questionnaire was developed and used for data collection. Weighted mean was used to answer the research questions while standard deviation was used to validate the mean. To answer the research questions, each item was assigned real limit number as follows; strongly agree-4.50-5.00, agree-3.50-4.49, strongly disagree- 2.50-3.49, Disagree- 1.50-2.49, Don't know- 1.00-1.49. Any item with a weighted grand mean ( $X_G$ ) of 3.50 and above was considered as "agree" while any item whose weighted grand mean is below 3.50 was considered as "disagree". The standard deviation was used to determine the closeness of the respondents from the mean and to each other and otherwise. The findings revealed that there are gaps in the curriculum of the Upper Basic School respecting climate change education which should be filled based on the suggestions raised. It also revealed the necessary climate change themes for integration in the school curriculum of The Gambia. Of all the 14-items included in the questionnaire, 12-items were appropriate for teaching the theme, Meaning of climate change, 13-items for teaching Causes and Mitigation of climate change impacts, while all were appropriate for teaching climate change Impacts and Adaptation to climate change. There was no significant difference ( $P > 0.05$ ) between the mean responses of educators and teachers on the appropriate methods for teaching climate change topics. The study recommended that the suggestions raised in the curriculum audit and the climate change themes identified be incorporated into the school

curriculum. That all the items considered appropriate be used to teach climate change education after integration in the Social and Environmental Science and General Science of the Upper Basic School Curriculum, especially in The Gambia.

### **Keywords**

Climate Change, Teaching Methods, Curriculum, Integration, Upper Basic School.



## List of figures

Figure 1:	Population size and growth	18
Figure 2:	Percentage Change in Population by Local Government Area	20
Figure 3:	Population distribution by Sex by LGA	21
Figure 4:	Local Government areas in The Gambia	46
Figure 5:	Rating of methods appropriate for teaching climate change issues	53
Figure 6:	Rating of methods for teaching causes of Climate Change	55
Figure 7:	Mean ratings of the appropriate methods for teaching climate change impacts	59

## List of Tables

Table 1:	Number of school, enrolment and teachers by region	48
Table 2:	Climate change content found in Social and Environmental Science, Grade 9.	50
Table 3:	Climate change content found in Science, Grade7.	51
Table 4:	Rating of the most appropriate method for teaching the meaning of climate change	52
Table 5:	Rating of the most appropriate method for teaching causes of climate change.	55
Table 6:	Rating of the most appropriate method for teaching the impacts of climate change	58
Table 7:	Suggested Action Plan for Integrating Climate Change in the Curriculum	66

## CHAPTER ONE

### 1.1 Introduction

As climate change continues to attract attention globally, disseminating information about the phenomenon is crucial in every country especially in the developing world today. This is so in order to develop and promote the use of appropriate adaptation and mitigation techniques and strategies at various levels of education and the society towards containing the phenomenon while at the same time ensuring sustainable development. As observed by IPCC (2014), climate change is accelerating with growing impacts on the various sectors of the economy in many parts of the world.

In the Gambia, the impacts of climate change are obvious in many aspects of the economy of the country. For instance, increasing reported cases of malaria, diarrhea and acute respiratory infections (including pneumonia) has been shown to be connected with the changing weather and climate conditions (The Gambia's Second National Communication 2012). Malaria incidences reach the peak during the rainy season (July to October) and about 1,000 infant deaths are recorded every year. Malaria also accounts for 4% of infant deaths and one quarter in children aged five years and below. Diarrhea, though has a seasonal pattern, has a high incidence as a result of inappropriate water handling practices and poor environmental sanitation worsened by uncontrolled runoff and flooding. Acute respiratory infections (including pneumonia) have become the second leading causes of death especially among infants and young children. In a study conducted by the British Medical Research Council (MRC), it was established that 14% of under-five death were caused by acute respiratory infection (see The Gambia's SNC, 2012).

The impact of climate change is manifest also in the coastal areas of the country. There has been increased beach erosion associated with sea level rise which is linked to the changing climate of the region. The erstwhile nesting grounds for green turtles and numerous habitats have been submerged. If Sea Level Rise continues, there will be loss of more mangroves and salt marsh vegetation in the present-day coastal wetlands (The Gambia's SNC, 2012).

In Ghana, some 1,998 kilometers away, climate change is reported to have impacted the energy sector and affected industrial production (Ghana's First National Communication 2000). There are already indications of the susceptibility of the energy sector in the Gambia to climate change, especially the effect of the highly variable precipitation patterns on hydropower production.

Export earnings in Ghana suffered a setback via crop losses and the regular dependence of the nation on hydroelectric power resulting from the occurrence of drought in the latter part of the eighteenth century (1980-1983). The failure of the hydrologic source of electricity during the drought led to the improvement of petroleum fired thermal plants now considered as a major alternative source of electricity in Ghana. Decrease in precipitation and higher temperatures, both climate change conditions, in different areas are most likely to cause a decline in biomass production resulting from water stress on the woody plants and land degradation. The likelihood of further threats to biomass availability was identified, as a result of changing ecological zones, insufficient water for irrigation, and outbreak of pests and diseases, all resulting in reduced agricultural productivity (Ghana's First National Communication 2000).

In a pattern similar to that of Ghana, Climate change has also impacted Nigeria in many ways. The coastal zones and low lying islands in the country, which are already experiencing increased frequencies and severities of floods and erosion, could potentially suffer more damages with

further sea level rise. In the same vein, the Sudan and the Sahel areas, which are already experiencing serious water stresses, will also be impacted ( Adesina *et al.* (2008).

In Mozambique, climate change impacts that have been experienced include the 1997, 1998 and 2000 floods which led to loss of life and properties in many areas (Etim and Okey, 2015). In a like manner, most parts of arid and semi-arid Africa have experienced increase in the degree of inter-annual rainfall variability due to climate change impacts (Etim and Okey, 2015).

In other parts of the world, climate change has had significant impacts too. For example, the European heat wave of 2003 had a magnitude which was more than double the expected amount after comparing the climate model output with and without anthropogenic forces. This can be attributed to human induced climate change, (Patz, *et al.* 2005).

In The Gambia, public awareness and sensitization campaigns were conducted at all levels in the course of implementing the various studies that contributed to the development of the Initial National Communication. Stakeholder's consultation was conducted to promote public awareness on climate change and also develop National Climate Change Action Plan.

There are also initiatives underway to disseminate information on climate change. Among these are the involvements of stakeholders and the Print Media as well as Radio Programs held by the National Climate Change (NCC). The print and electronic media are both represented in the NCC and they help to propagate information on Climate Change.

Among the activities planned to enhance public awareness are creation of a Newsletter and Website for wider dissemination of information to the general public, production of materials

meant to sensitize the public on Climate Change and translation of the materials into the different local languages (Gambia First National Communication).

Though, making climate change part and parcel of a society through awareness creation in mass media is important, it should be complemented with the use of the formal education system especially to “catch them young”. As was observed in The Gambia First National Communication, Climate and Climate Change issues are absent in the educational system. Environmental issues are treated under the Social and Environmental Studies (SES) segment of the school curriculum but weather and climate topics are treated to a shallow depth. There is need therefore to put climate change issues right into The Gambia educational system.

Education remains a vital tool for promoting sustainable development and improving the capacity of the people in addressing the impacts of climate variability and change in the environment (UNESCO, 2012). With human resource being the most important asset of any country (Tasquier *et al.*, 2014), formal education can be used as a means to help individuals and societies reach their highest potential (UNESCO, 2012). Therefore, for attitudinal and behavioral change, issues relating to climate change need to be taught to the youth at various levels of education to enhance an understanding of critical concepts (UNESCO, 2010). The curriculum content and teaching materials could be designed in such a way as to impart necessary knowledge, skills and attitudes in students and make them be in a position to effectively address climate change challenges in the various sectors of the country’s economy.

### **1.1.2 Problem Statement**

Considering the rate at which anthropogenic activities continue to aggravate climate variability and change, it is imperative to increase the understanding of its impacts, causes as well as relevant adaptation and mitigation measures particularly among young people. The impact is already severe and is unfortunately magnifying, requiring that all human activities are pursued in a manner that they are climate friendly. It is also required that everyone is able to take informed decisions in coping with climate risks such as anticipating floods and avoiding or minimizing their impacts. To achieve this scale of intervention in a sustainable manner, activities and programs must be systemic i.e. they should be made an integral part of the way of life of a society or country. One way by which this can be achieved is by infusing pertinent climate change issues into the national education system. According to a 2009 international comparative study on climate change education and sustainable development in ten countries, climate change education has only peripheral status in educational research and practice, and when it is addressed it is only within science education (Læssøe *et al.*, 2009).

For Gambia to develop the critical mass of educated individuals to turn around its capacities to respond to the challenges of Climate Change there is a need to strategically integrate climate education into the curricula in schools and colleges. This is the focus of this study.

### **1.1.3 Purpose of the study**

There is a need to address the problem of climate change from the grassroots through the various strata of the society. One of the ways by which this can be done is through its inclusion in the curricula at all level levels of education. This will help to create appropriate knowledge in the

individuals on the causes, impacts and potential threats in the future. If nothing is done, the vulnerability of populations to the impacts of climate change in the various countries especially the developing ones will increase dangerously. The purpose is to explore how the idea of infusing climate issues into the education system can be pursued in the Gambia. This is towards scaling up youth capacity for climate actions through the formal education system.

#### **1.1.4 Justification**

An important element of the climate change response is to get young people involved in such a way that taking appropriate climate action becomes a part of their life. This can be best achieved by making climate issues part of their normal educational development. It has been observed that children have a tendency to develop greater environmental and ecological interest between the ages of 8 to 14 years (Lorenzoni *et al.*, 2007). Pupils in the basic and secondary school fall within this age range and so can be targeted for climate education.

Targeting pupils in this age bracket will help to develop climate champions for effective war against the challenges posed by climate change. In order to do this effectively, it is crucial to look into how the intervention will take place in a manner that will produce optimum results. This will involve examining the existing curricula to determine what need to be injected, improved or removed to have in place the most suitable contents for climate education. It also involves determining when certain things can be best taught to young people in the school system. These are the basic issues that this study attempts to look at towards climate-proofing The Gambia against actual and anticipated adverse effects of climate change.



### **1.1.5 Research Objectives**

The research is meant to achieve the following objectives:

1. Integrate in the school curricula of The Gambia, relevant Climate Change themes
2. To determine the extent to which climate-related education is presently being taught in Upper Basic (lower secondary) schools in the Gambia.
3. To identify suitable teaching methods for conveying climate change information to students.

## **1.2 The Context, The Gambia**

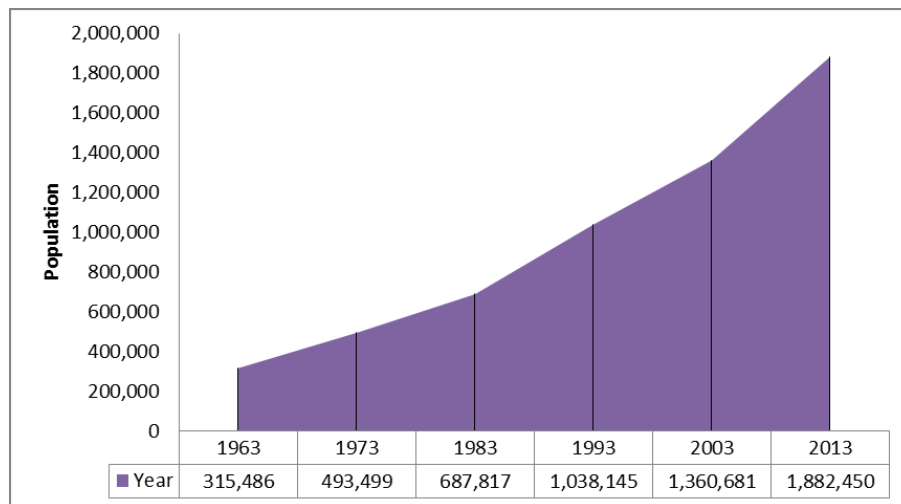
### **1.2.1 The Gambia, Geography and Climate**

The Gambia, the smallest country in Africa, is located between latitudes 13 and 14 degrees North and longitudes 17 and 12 degrees West. It has a total area of about 11,300 km<sup>2</sup> out of which 10,000 km<sup>2</sup> is occupied by land and 1300km<sup>2</sup> is water. It also has a contiguous zone of 18 nautical miles and an exclusive economic zone (EEZ) of 200 nautical miles. Its perimeter stretches for 740 km and marks its landward extension from the Republic of Senegal. An 80km long open coastline is visible on its western boundary, measured across the 11km-wide mouth of the River Gambia estuary. The country sits on the flood plain of the Gambia River and is edged by savanna and low hills. The country's highest elevation is 53 meters above sea level. The country's climate is Sahelian, which has a long dry season (November to May the following year) and a short wet season (June to October). The average temperature range in The Gambia is between 18<sup>0</sup>C and 30<sup>0</sup>C during the dry season and 23<sup>0</sup>C and 33<sup>0</sup>C during the wet season. There has been a rising trend in the temperatures to an extent of 0.5<sup>0</sup>C/decade as revealed by temperature measurement since 1940s. Consequently, the lowest mean temperature was recorded in 1947 to be 25.8<sup>0</sup>C while the highest mean temperature is 28.2<sup>0</sup>C was recorded in the year 2000. Average relative humidity (RH) values are 68% in coastal areas, 41% in the hinterland, and generally above 77% across the country during the wet season. Nonetheless, RH has also been declining since the 1940s, with annual average of 75% in 1945 which decreased to a little over 55% in 2002.

### 1.2.2 Population size of the Gambia

The Gambia has a population of 1,882,450 (National Population and Housing Census 2003). The figure indicated a 38.3% (521,769 persons) increase over the population count in 2003. Generally, the provisional census indicated that Gambian population has grown since the initiation of a complete census in 1963, from one-third of a million in 1963 to 1.4 million people in 2003 to 1.9 million people in 2013 (GBoS, 2013). With the challengingly harsh conditions of the global economic climate coupled with greater environmental problems, the rate at which the population is increasing will pose developmental concerns.

**Figure 1: Population size and growth**

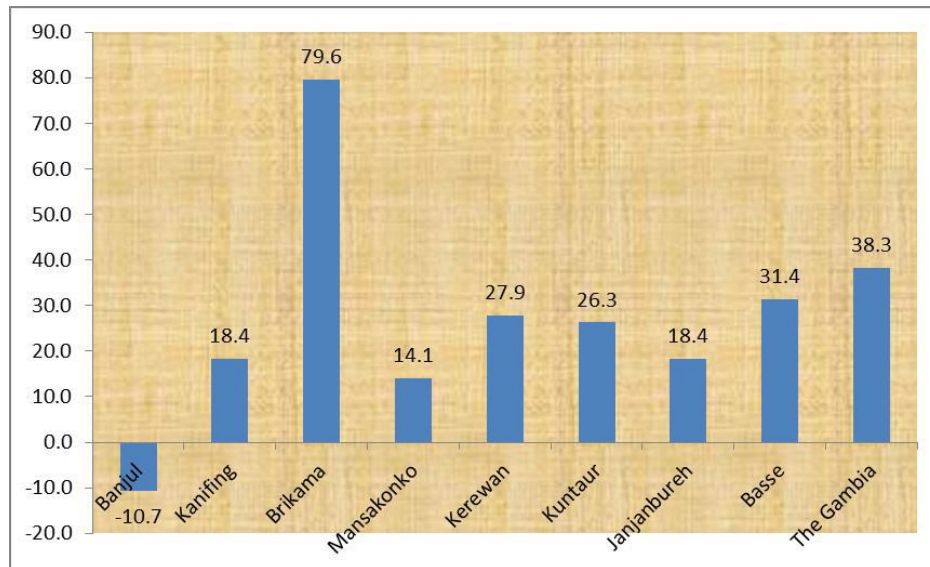


Source: Adapted and modified from the Gambia Population and Housing Census, GBoS 2013

### **1.2.3 Population Growth**

The population of The Gambia has been growing on the average at the rate of 3.3 per cent per annum between 2003 and 2013. With this growth rate, the population is expected to double by 2034. There has been a substantial increase in the growth rate over the past decade when comparing the current rate to the observed annual growth rate of 2.7 per cent over the 1993-2003 inter-censal period. Generally, the population of the Gambia has risen by 38.3% within the census duration - 2003-2013. However, Banjul's population declined by 10.7% during the period. Brikama recorded the largest increase in population. Other local government areas where significant increases were recorded include Basse (31.4 per cent) closely followed by Kerewan and Kuntaur with 27.9 per cent and 26.3 per cent respectively

**Figure 2: Percentage Change in Population by Local Government Area**

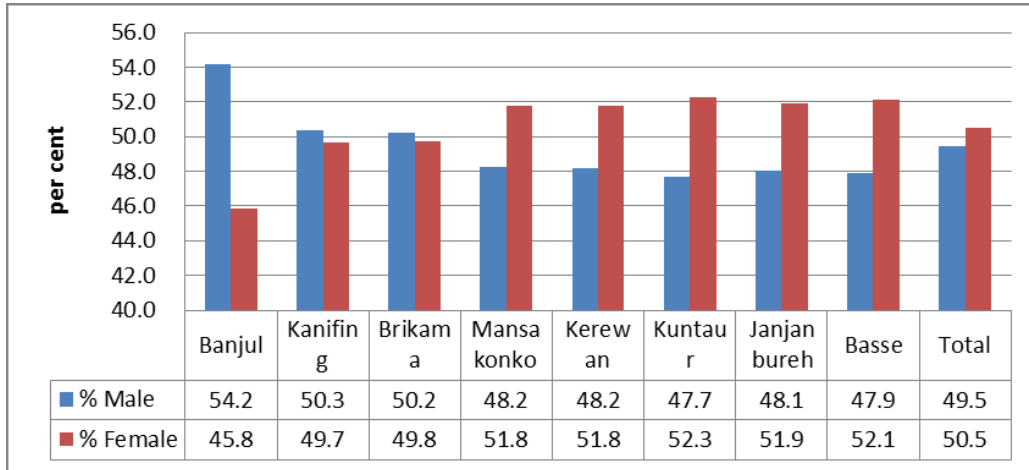


Source: Adapted and modified from the Gambia Population and Housing Census GBoS 2013

#### 1.2.4 Population distribution by Sex by Local Government Area

Generally, the provisional result of the 2013 population census indicated a greater population of females than males in the country. The results revealed that there are 50.5 per cent of females and 49.5% males in the population counted. Further information derived from the findings included the fact that there are more males than females in LGAs that are predominantly urban while females than males are present in the ones that are predominantly rural.

**Figure 3: Population distribution by Sex by LGA**



Source: Adapted and modified from the Gambia Population and Housing Census, GBoS 2013

The drastic population increase poses a potential threat to the environment with increased impact of climate due to low adaptive capacity

### 1.2.5 Education system of the Gambia

The Gambian education system is composed of the following; Nursery, primary school and basic cycle, lower secondary school and basic cycle schools and upper secondary schools and tertiary institutions. The nursery can either be public or private and Mandrassa. It is meant for the early development of the child and age range of its members varies from 3-6 years. The primary schools and Basic cycle schools could also be government, private, grant-aided and Mandrassa. It is to give the children lower basic education and the age range is from 7-12 years. The lower

secondary schools and Basic cycle schools consist of government, private, grant-aided and Mandrassa. It gives the children the opportunity to receive upper basic education and the age range includes children of 13-15years. Upper secondary schools include government, private, grant-aided and Mandrassa as well as Skill Centers (Public and private). It is an avenue where children can derive secondary education as well as technical and vocational education and training. Age range is from 16-18years.

Finally, the tertiary institutions are composed of University of the Gambia, Gambia technical Training institute, Management development Institute, The Gambian College (Public), and other private skill centers. They afford a higher education learning opportunities and the legal age range is from 19-125 years (Jammeh, 2015).

### **1.2.6 Education Policy on Climate Change**

The government of The Gambia has developed a number of policies which allowed the integration of environmental education in the school curricula, with legal provisions for environmental planning, management and decision making. With the support of MoBSE, environmental education and innovative approaches were promoted in schools. With the emergence of new environmental issues requiring the intervention of the education sector, MoBSE has partnered with other institution to train trainers on a comprehensive training manual on environmental education under the Program for Regional Environmental Education (PREE). To prepare youth for the effect of climate change and engage them for a positive response to the debilitating effect of climate change, a partnership need to be formed between the education sector and the relevant stakeholders to move environmental education forward including its integration in the school curricula. The partnership will also identify educational contents and

methods related to the unfolding environmental issues so as to include them in the curricula of all types of education and at all levels. In addition, there are plans for the facilitation of the universities and other training institutions by the Ministry of Higher Education, Research, Science and Technology to promote and give training courses in the area of natural resource management and other courses relevant for environmental development (Education Policy, 2016).

### **1.2.7 Curriculum Audit on climate change**

Curriculum audit was carried out for upper basic schools and senior secondary schools for several subjects including Social and Environmental Science, General Science (Lower Basic), Geography, Economics, English Language and General Science (Senior Secondary School). The gaps in curriculum in relation to the climate change themes for integration were identified and suggestions were made.



## CHAPTER TWO

### 2.1 Literature Review

#### 2.1.1 Climate change concept

Climate is the average weather condition over an extended period of time, for at least 30 years. It is statistical information, a synthesis of weather variation in a specific area for a specified interval of at least 30years. Climate plays a key role in reforming natural ecosystem, human economies and cultures. The fact that climate is changing with disruptive impacts is witnessed in recent times more obviously than in the last 2,000 years. The presence of carbon dioxide and other Greenhouse gases which trap heat in an increased amount in the atmosphere has warmed the earth and is causing other far-reaching impacts. Among these are melting of snow and ice, more intense heat events, sea-level rise, fires, droughts, and more intense storms, rainfall and flood. These trends, with their continual occurrence, pose substantial threats to human health, forests, agriculture, fresh water availability, coastline and other important resources relevant for a sustainable economy, environment and life quality (Amanchukwu, *et al.*, 2015). Consequently, it is imperative to reduce human caused greenhouse gas emission (GHGs) to checkmate the trend in climate change and reduce the chances of causing damages beyond human capacity to address. Most of the temperature increase observed since the middle of the 20<sup>th</sup> century was caused by increased concentrations of greenhouse gases resulting from human activities such as fossil fuel burning and deforestation (Owolabi *et al.*, 2012).

The urgency to address climate change issues was expressed in a world summit in New York, where Ban Ki-Moon, the UN secretary General intimated world leaders that the world's glaciers are melting faster than climate change negotiation(Amanchukwu, *et al.*, 2015). When the sun

emits rays of light unto the earth's surface, part of the heat is absorbed by the earth, another part is reflected into the atmosphere and a third part is sent out in form of infra-red rays. The clouds and water vapour suppress these rays, thereby stabilizing the earth's temperature under normal conditions (Amanchukwu, *et al.*, 2015). Greenhouse gases absorb these terrestrial radiations and re-emit them back to the earth, thereby causing a general increase in temperature known as global warming. Climate change refers to average weather variation resulting directly or indirectly from human activities coupled with natural events which changes the composition of the atmosphere (Ikehi *et al.*, 2014). According to (IPCC, 2007) , “climate change is a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the variability of its properties, and that persists for an extended period, typically decades or longer”. It is an alteration in climate over a time period owing to naturally occurring variability or human activity. The UN Framework Convention on Climate Change (UNFCCC) refers to “climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time period” (Ikehi *et al.*, 2014). Causes of climate change include increased concentration of greenhouse gases in the atmosphere, activities such as cutting down of trees, burning of fossil fuel, and others (Ikehi *et al.*, 2014).

Climate Change is as a result of alteration in the atmosphere which is above natural climate variations and occurs due to human activities. It therefore means that if human beings shift to a more environmentally sustainable way of living, the situation can be transformed. There are different factors which lead to changes in climatic condition among which are oceanic circulation, solar radiations in varying degrees, biotic processes, volcanic eruption, and human-induced changes in the natural world. Global warming is caused by these human-induced effects

which are often described by the term ‘climate change’. Global warming refers to the increase in the average temperature of the Earth’s air and oceans (those close to the surface) since the mid-20<sup>th</sup> (Owolabi *et al.*, 2012).

One main challenge with regards to climate change issues is that no single solution can address them. Several possibilities for addressing them have to be explored. One of these types of technologies is CO<sub>2</sub> capture and storage. This collects CO<sub>2</sub> from industries, power generation, natural gas production as well as refineries and injects them into the ground. The CO<sub>2</sub> is first separated and captured. This is compressed to a density comparable to that of a light liquid. After compression, it is injected into a suitable reservoir under the earth. This makes it possible to keep beneath the earth’s surface some of the CO<sub>2</sub> produced as a result of human activities. This of course has its own challenges. One of this is that it raises the cost of energy production and is unattractive especially in developing economies.

### **2.1.2 Climate Change Education**

“Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs, and habits.” (www.wikipedia.org). It is a major tool for engendering sustainable development in any country and its role in building understanding of natural phenomenon, as well as bringing a comprehension of scientific concepts through the discoveries, theories and genius of key individuals cannot be overemphasized (Smawfield *et al.*, 2013). According to Lorenzoni, Nicholson-Cole, & Whitmarsh ( 2007), children have a tendency to develop environmental and ecological interest related to moral and social understanding between the ages of 8 to 14 years. Students in the basic and secondary school fall within this age range and thus need a climate change integrated curriculum.

For the various aspects embedded in climate change to be well treated, education needs to play an important role, using a multi-disciplinary approach to disseminate information on the subject. There is a call to address climate change by considering its environmental, economic and social dimensions (UNESCO, 2013 ). Since climate change concept cannot be fully covered in any particular subject if sustainability concepts are to come into play, it is important to use a holistic approach. Therefore, it is important to take a step further from biophysical science to social sciences for the full weight of climate change threats to be understood by learners (UNESCO, 2013).

Climate change, being an environmental issue should be taught in a way that enables learners gain an understanding of their relationships with the immediate environment. An understanding of such relationship will create in the individual an awareness of what the environment is and how to reasonably exploit the environment for sustainable development (Dolapo, 2013; Jeje and Adesina 1998).

Children in the developing countries are very vulnerable to climate change impacts due to low awareness level and coping capacity (IPCC, 2007). Quality and focused education is needed to respond to the varying needs of the children - both the highly marginalized group as well as those exposed to high climate change risk (Ikehi *et al.*, 2014).

To avert the devastating consequences of climate change which today's youth are likely to face in the future, there is need to address the issue now as a matter of urgency (Gico *et al.*, 2011).

As opined by Chikaire *et al.*, (in Ikehi *et al.* 2014), educating the school children about climate change is paramount in producing future policy makers that will be willing to contribute their own quota to the rural sector.

To integrate climate change in the national curriculum of The Gambia, there is need to follow certain approaches. First is to conduct a situational analysis in order to determine the need for integration of a specific body of knowledge into the existing framework.

An observation on situational analysis by Henry *et al.*, (2012), suggests that the treatment of climate change issues in the social science subjects is with limited information and connection to agricultural production. For example, in the integration of climate change in the agricultural science curriculum, elementary topics on climate and its elements such as rainfall, temperature and wind are treated. However, consideration is not given to the impact of climate change on food security despite its pressing need. There is thus a need for complete integration of climate change and its related topics. It is not just training in basic climate science that is necessary.

Specific steps to integrate climate change in the school curriculum were taken in Benin and Seychelles, both African Countries. In Benin, a national Climate Change and Development-Adapting by Reducing Vulnerability (CC DARE) project focused on the integration of climate change impacts and adaptation strategies into the curriculum for Primary and Secondary Education. It involved developing a strategy for integrating climate change concerns into the curricula of primary and secondary schools as well as the design of school teaching materials on climate change impacts and adaptation strategies. These have already been tested on schools, teachers and students selected in collaboration with and spearheaded by the Ministry of Education of Benin. Dissemination of draft curriculum and teaching materials to stakeholders of the school education system took place in two seminars organized in October 2009. The succeeding step is the presentation of the materials to the Ministry of Education for adoption and implementation. It is to enable other institutions and countries to learn and replicate them in their education systems (UNEP/UNDP, CC DARE, 2013).

In Seychelles the Ministry of Education in partnership with Climate Change and Development-Adapting by Reducing Vulnerability (CC DARE) is working to demonstrate Rain Water Harvesting techniques at schools, which represents a potent option. The activity started in early 2010 and involved rain water collection from schools' roofs intended for domestic use such as the school gardening, cleaning of washrooms and other facilities. A pilot project which has run for more than one year covered only two schools. More schools and new elements are added with replications and expansion resulting from the CC DARE projects. The Ministry of Education collaborating with the National Climate Change Committee members is involved in the execution and implementation of the project. Implementation of activities is done by the committees in charge of the environmental projects in the schools. The project's ability to enhance and extend programs on water conservation sensitization in schools for teachers and pupils makes it relevant. There are now plans for the inclusion of Water Harvesting in the school curriculum to kick-start the integration of climate change adaptation measures and technology. Through partnership with the Water and Sewage Division of the Public Utility Cooperation, sensitization materials on water treatment and management will be provided (UNEP/UNDP, CC DARE, 2013).

In Kenya, the need to provide adequate climate change information as well as extended period of data to researchers, planners, policy makers and general public has been recognized. This concerns climate change impacts, adaptation and mitigation measures. One of the measures recommended is curricula review to allow for an integration of climate change issues into the Kenyan education system. Therefore, an action plan was developed specifically for this. Content analysis and interviews were used to determine the level of education integration into the Kenyan

education system. Due to the limitation of time and resources for completing the exercise, a purposeful sample of universities was used.

An analysis of policy documents which involved a desk review of major education policy document since Independence as well as content analysis of curricula were carried out. The content analysis involved the review of appropriate curricula and syllabi from primary to tertiary level excluding universities. Added to the content analysis of selected universities' course outlines, six education experts were interviewed on climate change issues with regards to: knowledge, skills and attitudes that should be taught in universities on climate change issues; subjects that could carry information on weather pattern in the curricular of the various institution; appropriate level of education to teach climate change topics in Kenyan education system; available online teaching and learning resources on climate change; available partnerships with other relevant institutions that deal with issues related climate change and the best approach for integrating climate change.

The findings based on the interviews and desk top reviews revealed the following information; Themes related to agriculture, geological and natural resources management, and environmental resources should accommodate subjects related to climate change; suggestions were also made for the integration of climate change in subjects such as agribusiness, agroforestry, environmental sustainability, development studies and natural resources management; conservation and water management were also considered.

The analysis of other suggestions revealed that 50% of the respondents supported environmental science and environmental studies while 16% suggested geography, metrology, human health, and agro-forestry and soil science. About a third (33%) suggested climate change to become a

stand-alone subject while 17% suggested environmental protection, waste management and disaster preparedness. Everyone suggested all levels for teaching climate change. The findings revealed that there are no online teaching and learning materials.

Approaches favored for integrating climate change include introducing new courses at tertiary institution, introducing mandatory common units at the universities and post school institution learning of climate change as stand-alone courses. Another suggestion revealed the review of present curricula in the learning institution should include climate change contents.

The findings of the research revealed the following steps as necessary in integrating climate change into the education curricula: formulating into the national policy the decision to integrate climate change issues, identifying climate change experts, designing of curricula, development of climate change contents for the curricula, development and design of curriculum support materials, validating and approval of curriculum, training and preparation of teachers, and finally, the piloting and implementation of the curriculum on a national scale (Kenyan, National Climate Change Action Plan, 2012).

### **2.1.3 Climate Change Teaching and learning approach**

Participatory learning approach was advocated by (UNESCO, 2013) which involves several techniques such as congruence and role modeling, strength in diversity, fluctuating group size and membership, whole persons learning and so on. For instance, congruence and role modeling support the idea of emphasizing values which are central to climate change education for sustainable development. Learner engagement and empowerment are seen as a way to raise



participation to a higher level. For reinforcement of the main messages, demonstration of the values and ways of relating are necessary. Open dialogue as well as entertaining a range of perspectives is beneficial. A combination of the different types of learning approaches was seen as an important strength in diversity technique. Previous investigation (UNESCO, 2013) showed that group work and the need to develop the ability to work as a team is helpful in the exchange of relevant ideas. Affective (emotional) form of learning was seen to be as important as cognitive order of learning which cannot on its own bring the necessary transformation in learners. Among the affective forms of learning identified are guided visualization of the future, learning through role play, drama, simulation and contemplative art, among others.

UNICEF (2012) reports that environmental projects should uphold the fundamental principles that are child-based, child-involving and environmentally protective like all other activities. Emphasis should be placed on child rights and equity. Experiential and project-centered learning methods were the main methodology promoted by child-centered learning and teaching. The study showed that when gardening is done with children, their ecological consciousness is promoted. Environmental projects are an intrinsic part of child-friendly school project which is included even without the prominence of climate change globally. These projects can be designed to deliberately include excluded children from the traditional backgrounds and not only to enhance inclusiveness. Children from rich diverse background add meaningful contributions to environmental education projects.

In the findings presented by (UNICEF, 2012), the involvement of school children in climate change was advocated, especially those from marginalized communities. It supported child-based approaches, which allow conduct of research and communication of findings and ideas by students. Research has shown that the involvement of children in environmental issues within

their communities have occurred worldwide. For example, children from Philippines and El Salvador participated in child-championed disaster risk reduction and adaptation activities at various levels. In Kenya, children also affirmed their concerns on climate change through school-organized mediums where various pressing issues were discussed. These ranged from inaccessibility to water and irrigation facilities, insecure livelihood to being incapable to halt environmental degradation.

#### **2.1.4 Climate change Themes for Integration in the Curriculum**

Based on the review of literatures, the climate change themes favored for integration in the curriculum in Nigeria are; the meaning and the definition of climate change, the causes of climate change, the impacts of climate change in the various aspects of the society, Mitigating climate change and adapting to climate change impacts. Part of the meaning of climate change favored includes the concept of climate change and the meaning and importance of climate change.

#### **2.1.5 The meaning and definition of climate change**

Climate is the average weather condition over an extended period of time, for at least 30 years. It is statistical information, a synthesis of weather variation in a specific area for a specified interval of at least 30years. The word ‘climate’ is the average weather pattern of a place. It comprises of temperature pattern, precipitation, humidity, wind, as well as seasons (Amanchukwu, *et al.*, 2015). Climate change refers to average weather variation resulting

directly or indirectly from human activities coupled with natural events which changes the composition of the atmosphere (Ikehi *et al.*, 2014). According to (IPCC, 2007) , “climate change is a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the variability of its properties, and that persists for an extended period, typically decades or longer”. Climate Change is as a result of alteration in the atmosphere which is above natural climate variations and occurs due to human activities It therefore means that if human beings shift to a more environmentally sustainable way of living, the situation can be transformed (Amanchukwu, *et al.*, 2015).

### **2.1.6 The causes of Climate Change**

The two major categories attributed to the causes of climate change include, man-made and natural causes. The man-made causes of climate change include, pollution from various human activities such industrial processes as well as agricultural activities, deforestation, bush burning, desertification, burning of fossil fuels like coals, oil, and gas. All these have direct influence on the atmospheric condition. The carbon contained in fuels is emitted in carbon dioxide (CO<sub>2</sub>). All of these releases from human activities contribute to climate change. Processes like variation in solar radiation, Earth’s orbit deviations, mountain building, continental drift, and changes in the concentration of greenhouse gases contribute significantly to shaping the climate and are referred to as climate forcing. When greenhouse gas increases in concentration in the atmosphere, there are changes in temperature, precipitation, sea level, and in frequency of occurrence of extreme events (Owolabi *et al.*, 2012). Climate change could also be attributed to variations in solar

radiation, oceanic circulation, biotic processes, volcanic eruption, (all oceanic processes) and man-made alterations of the natural world.

### **2.1.7 Impacts of Climate Change**

Some impacts of climate change include of its effect on food production because crop performances at various stages of development depend basically on climatic conditions such as temperature and rainfall patterns. In this context climate change can bring about increase or decrease in food production. Climate change can also lead to is greater intensity of tropical cyclones with higher wind speed leading to more intense damage. This is because these disturbances are associated with temperature of the air and sea. There could be increased incidence of flooding as being recorded in many areas today due to changing rainfall patterns and depth of glacier melting in the Spring and Summer.

A widespread deglaciation of Greenland and West Antarctic ice sheets could amount to enormous rise in sea-level, this implies major changes in coastlines and ecosystem and submergence of low-lying areas with the greatest impact in river deltas (IPCC, 2007). Relocating people will be challenging while economic activity and infrastructure would attract high cost.

There is an expected contribution of 4-6m or more to sea-level when a partial deglaciation of the Greenland ice sheet and possibly the West Antarctic ice sheet occurs ( medium confidence) over a period of time, which is a range of centuries to millennia for a global average temperature increase of 1-4°C (relative to 1990-2000). In addition, climate change can potentially affect all aspects of life including schooling as many children are absent from school during extreme climatic events, especially in remote areas with no limited means of transportation.

### **2.1.8 Mitigation of Climate Change**

This refers to reducing greenhouse gas concentration in the atmosphere and one way in which this is CO<sub>2</sub> capture and storage. This collects CO<sub>2</sub> from industries, power generation, natural gas production as well as refineries and injects them into the ground. The CO<sub>2</sub> is first separated and captured. This is compressed to a density comparable to that of a light liquid. After compression, it is injected into a suitable reservoir under the earth. This makes it possible to keep beneath the earth's surface some of the CO<sub>2</sub> produced as a result of human activities.

Efficient waste management can also help in mitigating climate change. For example, poor handling and disposing of waste destroy the ecosystem, degrades the environment and threatens public health (UNEP, 2007). Wastes are also an importance source of greenhouse gas emissions into the atmosphere. A good waste management practice include separation of valued waste such as scrap metal, plastics and cardboards at disposal sites, on transit and at transfer point. These can be sold to groups and artisans who have the skills to convert them into goods such as bags, hats, necklaces, baskets, door rugs and so on (Okot-Okumu, 2011). Another approach is generation of energy from waste products such as the Cows to Kilowatts project in Ibadan, Nigeria, which involved the generation of 0.5MW of electricity daily. It treats abattoir waste and provides domestic energy and organic fertilizer simultaneously (Assembly, 2014).

### **2.1.9 Adaptation to Climate Change**

Adaptation to climate change includes taking steps to cope with the adverse impacts of climate change. Some potent adaptation options that may be handy in many developing countries include relocating and resettling affected people, realigning transportation routes and nodes, constructing dykes, barrages, storm barriers for surge and channels for diverting storm, adopting a new

livelihood, among others options. The measures taken to respond to drought and desertification could include minimizing forest and woodland destructive activities as well as restoration of forests and woodland already degraded (Nigeria First National Communication).

In Seychelles, the Ministry of Education in partnership with CC DARE is working to demonstrate Rain Water Harvesting techniques at schools, which represents a good option. The activity started in early 2010 and involved rain water collection from schools' roofs intended for domestic use such as the school gardening, cleaning of washrooms and other facilities (UNEP/UNDP, CC DARE, 2013).

## **2.2 Climate Change Education in The Gambia**

Education, training and public awareness are all essential in developing and promoting broad-based support for climate action in a country. The first step is to mainstream climate change in the education curricula. Therefore, as already stated in the Intended Nationally Determined Contribution (INDC) of The Gambia, government intends to prioritize basic or primary education and expand access to secondary, higher and tertiary education while emphasizing climate change. In addition to the development and integration of new Basic Education curriculum, which integrates climate change and other environmental issues, teachers and trainers training was also initiated for the new curriculum (GCCA support project, 2016).

The intervention is expected to build on the environmental education and communication strategy of the National Environment Agency, which champions inclusion of environmental education in the formal education system (GCCA support project, 2016).

### **2.3 Curriculum**

There are different definitions of curriculum, based on the various perspectives of educators and philosophers, the following definitions represent some of the views expressed.

Curriculum can therefore be defined as a deliberately and systematically planned body of knowledge, skills and attitudes which are grouped into subject topics and taught to learners in schools (Ikehi et al., 2014).

Curriculum can be defined in educational terms, it therefore follows that an educational curriculum could be said to give a liberating experience. One way to view the curriculum is to consider it as “hidden”. By “hidden” curriculum, what is meant are those things which pupils learnt at school due to the organization and planning of the school’s work and through the materials provided but are not really included in the planning and consciousness of those in charge of school arrangement (Kelly, 2009). Again, curriculum could be planned and received. Planned curriculum referred to the blueprint in syllabuses and prospectus while actual or received curriculum refers to what is realized in terms of pupil’s experience (Kelly, 2009). Another perspective in which the curriculum is viewed is “formal” and “informal” curriculum. “Formal” curriculum means the formal activities that have been allocated specific teaching time

on the time-table of the school while the informal activities that go on outside the school hours, at weekends and during holidays such as sports, clubs, societies and so on , are meant as “informal” curriculum. They are also referred to as ‘extracurricular’ activities and should be seen as an appendage to the curriculum itself (Kelly, 2009).

“Curriculum is the subject contents which learners and teachers must cover in order to achieve set goals and objectives”, Ikehi *et al.* (2014). Chakeredza *et al.*, (2009). has also described it as “...the document used as instructional guide in formal institutions”, “it is a deliberately and systematically planned attempt to change the behavior of young and inexperienced to enable them gain the insight that helps them solve problems for a better society” (Offorma in Ikehi *et al.*, 2014) and the list of subject topics taught in schools is what is generally referred to as curriculum.

For the purpose of this study; curriculum is defined as the document used as instructional guide in formal institutions”,Chakeredza *et al.*, (2009). However, there is need for curriculum makers to base their work on policies on education and global trends that afford better learning opportunities with improved educational programs. According to (Dolapo (2013), there is need for curriculum developers to base their work on National Policy on Education, and other relevant policies especially on education and human capital development.

A study conducted by UNESCO (2007) indicated that efforts are being made to greatly expand educational opportunities for all, children, youths and adults by 2015. There is need to reexamine the curriculum to develop it and make it all-inclusive due to advancement in science, technology, and drastic environmental changes (Dolapo, 2013).

### **Curriculum integration, enrichment and adaptation**



### **2.3.1 Curriculum integration**

Integration refers to the incorporation of something into another in order to improve it (Ikehi *et al.* 2014). In this study, integration is the inclusion of climate change education in the social and environmental science as well as general science curriculum of the basic and secondary schools. This is to help the students to understand the basic concepts of climate change, its impacts, its causes as well as the necessary adaptation and mitigations measures. Before an appreciable impact of education on climate change could be felt, inclusion of climate change in the curriculum of the basic and secondary school education is necessary. This will make them aware of the various climate change issues and how to combat its impacts (Ikehi *et al.*, 2014). Several educators have argued that the definition of curriculum integration, one of the contested definitions is interwoven, cross-disciplinary curriculum (Czemiak *et al.*, 1999). Another definition given by Beane (1995) is that it starts with "problems, issues and concerns posed by life itself". He added that an integrated curriculum must have social meaning. Again, Beane (1996) attributed four characteristics to integration (a) curriculum revolved around problems and issues that have personal and social relevance in the real world (b) use of relevant knowledge in the context of topics without respect for subject lines (c) knowledge geared towards studying a prevailing problem instead of being for a test or grade level outcome, and (d) Emphasizing projects and activities with actual application of knowledge and problem solving.

### **2.3.2 Curriculum Adaptation**

Curriculum adaptation is an essential element in curriculum reform and introducing a new concept such as climate change into the curriculum, calls for adaptation in its use by the teachers. Curriculum adaptation is a main process in teachers' use of curriculum materials which cannot be used blindly or without adaptation. Teachers make adaptations to curricular lessons in

response to a number of factors like their own understandings of a lesson, the perceived abilities of their students, and constraints of time, materials, and other resources (Drake & Sherin, 2006).

Drake and Sherin (2006) investigated the influence of teachers' knowledge of the subject matter, pedagogical skills and belief on the implementation of curricula reform. They observed that knowledge plays a crucial role in the implementation practices of different teachers if one compares the practices of those with little knowledge with others of deep and flexible knowledge.

A study was conducted by Drake & Sherin, (2006) on curriculum adaptation and teacher narrative in the context of mathematics education reform in a medium- sized urban school in the United States of America. They looked at the connection between the identities of various teachers and their adaptation styles. It was discovered that the adaptation styles of the teachers have a link with their identities as learners and teachers of mathematics.

An observation was made multiple times of two teachers teaching mathematics in the course of the school year. A larger part of the observations was audiotaped or videotaped and transcribed, and field notes were taken. Interviews were also conducted before and after the lessons about their goals and the questions which arose in the process. Those interviews were audiotaped and transcribed. The teachers also participated in professional development sessions which were centered on the curriculum. The two teachers were joined by others teachers in their school who also piloted the curriculum but only the two teachers being focused on attended all the professional session. The topic of discussion in the briefings held varied from development of mathematics discourse and adaptation in the use of curriculum in a Mathematics classroom. All the briefings were videotaped and transcribed. Eventually, a mathematics story interviews were held for both teachers who participated in the study where they described their past experiences

in teaching and learning mathematics. The experiences shared included their vicissitudes in their various encounters with mathematics.

The study was able to identify various types of adaptations through the analysis of the transcript used by the teachers by directly comparing the pre- and post-transcripts of the lessons. These were the enacted lessons and the description written on lesson in the teacher's guide of the curriculum. Among the types of adaptation identified are omitting, adding, substituting a large portion or an entire activity, the changing of terminology, the order of activities, materials used, and other types. Three of which are structural or activity-level types while the other ten were found within the curricula activities. Every observation of the two teachers was then coded according to the adaptation types and an account giving the summary of the adaptation types was written. The study by Drake & Sherin, (2006) built on an earlier study by (Drake *et al.*, 2001) in which different types of mathematics story told by teachers with differing identities as learner and teacher of mathematics were spotted. Their narratives differ in structure and definite beliefs in their stories were taken into consideration by Drake and Sherin (2006) in their work. In connection to their study, Drake and Sherin (2006) looked at the models of curriculum use by each of the teachers from the perspective of themes identified in their mathematics story. The areas in which mathematics story themes assisted in explaining the models were noted. They included prior experience with mathematics, perception of self as a mathematics learner in the present time and influences from family. All of which affected their patterns of adaptation one way or the other.

Though the study conducted helped to identify different curriculum models used by the teachers and their adaptation patterns as connected to their narratives, it failed to ascertain vital

information. These include the sample population out of which the sample size was drawn to show the representativeness of the sample as well as other relevant variables (such as the prevailing culture in the school and classroom, language, especially in the bilingual class ( Drake & Sherin, 2006), and a host of other factors which could have affected the outcome.

### **2.3.3 Curriculum Enrichment**

Curriculum enrichment is an improved curriculum which aims at lowering the achievement inadequacy observed in students while controlling children who lack the needed self-mastery required for involved learning (Gest *et al.*, 2015).

By enriching both the curriculum and program delivery services, a learning experiences relevant to the learning abilities of specific students results (Schiever & Maker, 1997) in (Beecher & Sweeny, 2008). There is a tendency for enriched curriculum to be in a greater detail than regular curriculum and could go beyond the traditional school day (Schiever & Maker, 1997) in (Beecher & Sweeny, 2008) .

In a study conducted by Beecher & Sweeny, (2008) on how the achievement gap can be closed with enriched curriculum and differentiated one, a connection was made between enrichment approach and improved student achievement. Theories of enrichment or differentiation were brought into practice in an elementary school which previously practiced remedial model. It depicted a higher level of achievement with regards to student performance and a decline in achievement gap between rich and poor and differing ethnic groups. Considering the fact that engaging students' needs, interests and choices improves learning, enrichment and differentiation were chosen for a better learning environment. A significant amount of time was also devoted to teacher training due to the important roles they play in the success of the initiative. An

arrangement was made to give the needed training and guidance which would enable them to integrate new concepts and innovation into their lessons (Beecher & Sweeny, 2008).

## **Chapter Three**

### **Methodology**

#### **3.1 Methodology**

This chapter deals with the strategies adopted in carrying out the study. It described the process of data gathering and analyses as well as the procedure for infusing climate change education into the school curricula.

It also considered the analysis of Policy Documents and other relevant materials such as the curriculum framework and syllabuses for subjects like Geography, Agricultural Science, Economics and English Language. The process was carried out to know the aspects of climate change yet to be included in the curriculum and suggest the introduction of suitable climate change themes into the relevant subjects.

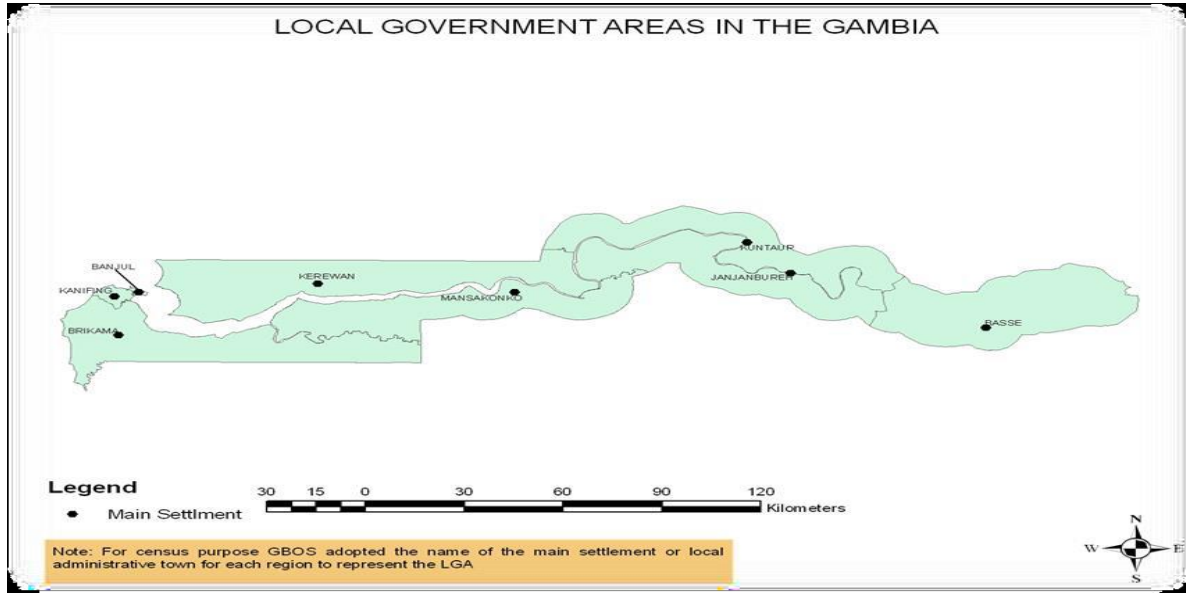
### **3.1.1 Content Analysis of Curricula**

A review of the curriculum framework and the teacher's guide for the basic schools in order to integrate a new subject was carried out. A list of climate change themes was developed and used for the curriculum auditing. During the audit, consideration was given to each of the themes of the selected subjects (Geography, General Science, Social and Environmental Science, Economics and English Language). Decisions were made on the appropriate themes in the syllabuses for the inclusion of climate change topics, and then a list was developed. The list showed an outline of climate change themes found in the syllabuses of the various subjects and the various gaps as well as suggestions for the inclusion of specific themes.

### **3.1.2 Sampling Technique**

Quantitative methods were employed in the research. Purposive sampling was used to select schools in Region 1(Kanifing) and 3(Farafenni) which participated in an environmental program held prior the research. Kanifing, an urban area and a semi-urban area, Farafenni were the study areas for the research.

Figure 4: Local Government areas in The Gambia



Source: Adapted and modified from the Gambia Population and Housing Census, GBOS 2013

As a small-scale research, the sample is not a representative one, but instead, based on those who are well placed to respond to the questions. Therefore, as stated before, the school participated in environmental education programme are those sampled in Regions 1 and 3. In Region 5 a semi-urban settlement (Farafenni) is the study areas for the research for easy access and the cosmopolitan nature of the settlement where all socio-ethnic characteristics are represented.

In terms of school population, the following table shows the number of school, enrolment and teachers by region

**Table 1: Number of school, enrolment and teachers by region**

Regions	Lower Basic	Upper Basic	SSS
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	No. of Schools	Enrolment	No. of teachers	No. of Schools	Enrolment	No. of teachers	No. of Schools	Enrolment	No. of teachers
Region 1	121	64,751	1,886	72	27,713	1,161	45	20,226	840
Region 2	246	102,274	2,788	103	34,368	1,072	49	16,761	680
Region 3	137	32,381	922	43	9,158	309	19	4,465	168
Region 4	82	14,693	451	23	3,989	151	6	1,467	65
Region 5	135	26,825	747	38	6,617	245	8	4,493	145
Region 6	140	34,015	660	46	5,546	216	7	1,701	73
Total	861	274,939	7,454	325	87,391	3,154	134	49,113	1,971

### **3.1.3 Population Growth in Kanifing**

The population in Kanifing increased by 18.4% from 2003 to 2013 according to the provisional results of the 2013 population census, with a population sex distribution of 50.3% male and 49.7% female. The 2013 census also revealed a rise in population density from 4,271.8 persons per square kilometer in 2003 to 5,057.5 persons per square kilometer in 2013 while the number of households increased from 49,016 in 2003 to 67,119 in 2013

### **3.1.4 Population Growth in Kerewan**

The population in Kerewan increased by 27.9% from 2003 to 2013 according to the provisional results of the 2013 population census, with a population sex distribution of 48.2% male and 51.8% female. The 2013 census also revealed a rise in population density from 76.6 persons per square kilometer in 2003 to 98.0 persons per square kilometer in 2013 and an increase in household number from 18,242 in 2003 to 22,407 in 2013.



### **3.2 Administration of questionnaires**

Questionnaires were designed and pre-tested before conducting the research. The corrections received from the pre-testing were incorporated before administering them to the respondents.

The questionnaires were administered to selected respondents to obtain information on the teaching methods that are appropriate for climate change education. A list of teaching methods was developed from the literature and included in the questionnaire. The Likert scale was used to rate the suitability of the various methods and a general comment session was used to obtain opinions from the respondents on the topic treated. The questionnaires were administered to teachers and educators at the Ministry of Basic and Secondary Education (MoSBE). In all, 150 questionnaires were administered, 100 to teachers in schools selected based on their participation in an environmental program previously held while 50 were administered to educators at MoSBE. The questionnaires were retrieved and analyzed. The Statistical Package for Social Sciences (SPSS) was used to capture the data from the questionnaire electronically. SPSS was also used in the analysis of the data.

## Chapter Four

### 4.1 Results and Discussion

The result of the curriculum audit and analysis of the questionnaires administered to both educators and teachers are presented below

4.1.1 The result of the curriculum audit of Social and Environmental Science for Upper Basic School.

**Table 2: Climate change content found in Social and Environmental Science, Grade 9.**

Theme of SES	Unit and Page	CC Theme found		Gaps/Suggestions
		Theme	Units of CC Theme	
1	1, pg. 5, 14	Climate change concept	The climate system	Land surface, hydrosphere.

Table 1.1 shows the result of the curriculum audit of Social and Environmental Science for Upper Basic School, Grade 9. The climate change theme found is climate change concept, while the climate system was the theme unit found.

### 4.1.2: Curriculum audit of Science for Upper Basic School, Grade 7

**Table 3: Climate change content found in Science, Grade7.**

Theme of Science	Unit and Page	CC Theme found		Gaps/ Suggestions
		Theme	Units of CC Theme	
2	1, pg. 29	Climate change concept	The climate parameters	
3	1, pgs. 54-57	Causes of climate change	Gases causing climate change	Water vapour, CO <sub>2</sub> not well explained (could be improved upon)
4	1, pgs. 67-68, 74-75	Climate change concept	The basic science of climate change	The atmosphere not elaborate (could be improved upon)

Table 2 reveals the curriculum audit of Science for Upper Basic School, Grade 7

Climate change themes found include Climate Change concept and Causes of climate change.

The theme units are the climate parameters, gases causing climate change and the basic science of climate change. A list of all the tables has been attached to the appendix III.

#### 4.2 The result of the analysis of data collected

Table 4: Rating of the most appropriate method for teaching the meaning of climate change.

S/N	Item statement on the method	X <sub>E</sub>	X <sub>T</sub>	SD <sub>E</sub>	SD <sub>T</sub>	X <sub>G</sub>	SD <sub>G</sub>
1	Teacher-centered	3.1200	3.3418	1.1299	1.03634	3.2885	1.05824
2	Child-centered	4.4400	4.3924	2.71181	.83846	4.4038	.80676
3	Resource-based learning	4.4000	4.2658	.86603	.91580	4.2981	.90178
4	Lecture method	3.1600	3.5696	1.28062	1.26778	3.4712	1.27680
5	Demonstration method	4.4000	4.4051	.64550	.70745	4.4038	.69000
6	Discussion method	4.6000	4.4430	.50000	.71157	4.4808	.66800
7	Field trip, excursion	4.5200	4.4810	.96264	.86024	4.4904	.88125
8	Role play/modeling/drama	4.3200	3.9747	.98826	1.02500	4.0577	1.02234
9	Project work or activity	4.3600	3.9747	.90738	1.10911	4.0673	1.07274
10	Experimental/exploration	4.4800	4.1899	.58595	.96178	4.2596	.89220
11	Student participation	4.6400	4.3797	.70000	.88149	4.4423	.84563
12	Audio visual Video/picture	4.6400	4.4177	.63770	.85646	4.4712	.81201
13	Brainstorming	4.0400	4.1013	.61101	1.03273	4.0865	.94623
14	Combination of different methods.	4.3200	4.0506	1.02956	1.06095	4.1154	1.05488

N= 104 (25 Educators and 79 Teachers)

Rating: 1=Field trip, excursion and site seeing 2=Discussion method 3=Audio visual Video/picture show 4=Student participation in community environmental project \*5=Child-centered 6=Demonstration method \*7=Resource-based learning 8=Experimental/exploration 9=Combination of different methods 10=Brainstorming 11=Project work or activity 12=Role play/modeling/drama 13=Lecture method \*14=Teacher-centered.

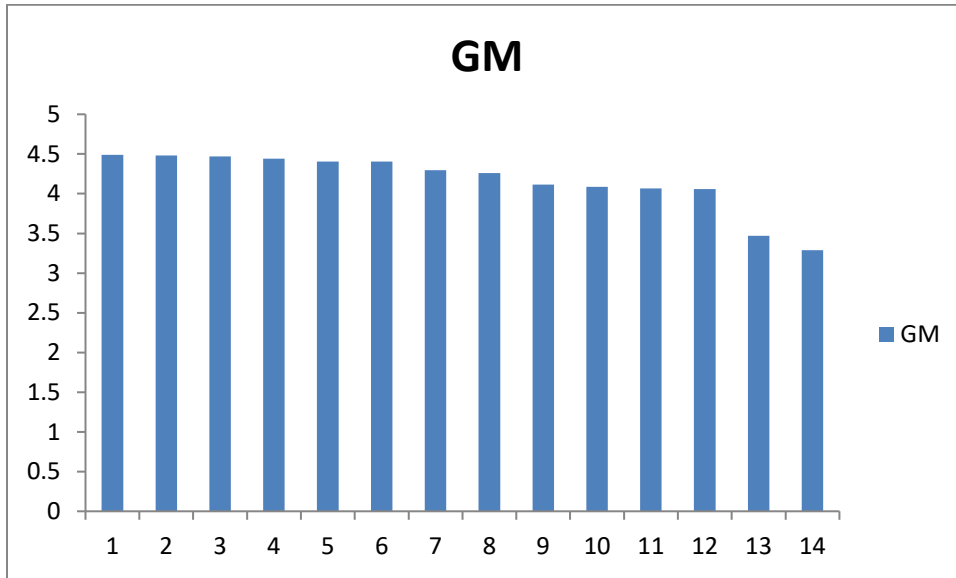
(Asterisk indicates general teaching methods)

Table 2.1 shows the mean rating of respondents (Educators and Teachers) on the most appropriate method for teaching the meaning of climate change. Weighted mean was used to answer the research questions. Standard deviation was used to validate the mean. To answer the research questions, each item was assigned real limit number as follows; strongly agree-4.50-5.00, agree-3.50-4.49, strongly disagree- 2.50-3.49, Disagree- 1.50-2.49, Don't know- 1.00-1.49. Any item with a weighted grand mean ( $X_G$ ) of 3.50 and above was considered as "agree" while any item whose weighted grand mean is below 3.50 was considered as "disagree". The standard deviation was used to determine the closeness of the respondents from the mean and to each other and otherwise. From Table 2, the weighted grand mean of both the educators and teachers ranged from 3.2885 to 4.4904. The items whose weighted grand mean was below 3.50 include teacher-centered method and lecture method. All other methods had their weighted grand mean above 3.50.

The results thus indicate that the most appropriate method for teaching the meaning of climate change include; Child-centered, resource-based learning, Demonstration method, Discussion method, Field trip, excursion and site seeing, Role play/modeling/drama, Project work or activity, Experimental/exploration and research for knowledge construction, Student participation in community, Audio visual Video/picture show, Brainstorming, Combination of different methods. The p-value of above 0.05 for all the items indicated no significant difference between the responses of the educators and teachers.

The ratings of all the above- listed methods based on their grand means as shown in table 2.1 reveals the following:

Figure 5: Rating of methods appropriate for teaching climate change issues



Rating: 1=Field trip, excursion and site seeing 2=Discussion method 3=Audio visual Video/picture show 4=Student participation in community environmental project \*5=Child-centered 6=Demonstration method \*7=Resource-based learning 8=Experimental/exploration 9=Combination of different methods 10=Brainstorming 11=Project work or activity 12=Role play/modeling/drama 13=Lecture method \*14=Teacher-centered.

(Asterisk indicates general teaching methods)

Table 5: Rating of the most appropriate method for teaching causes of climate change.

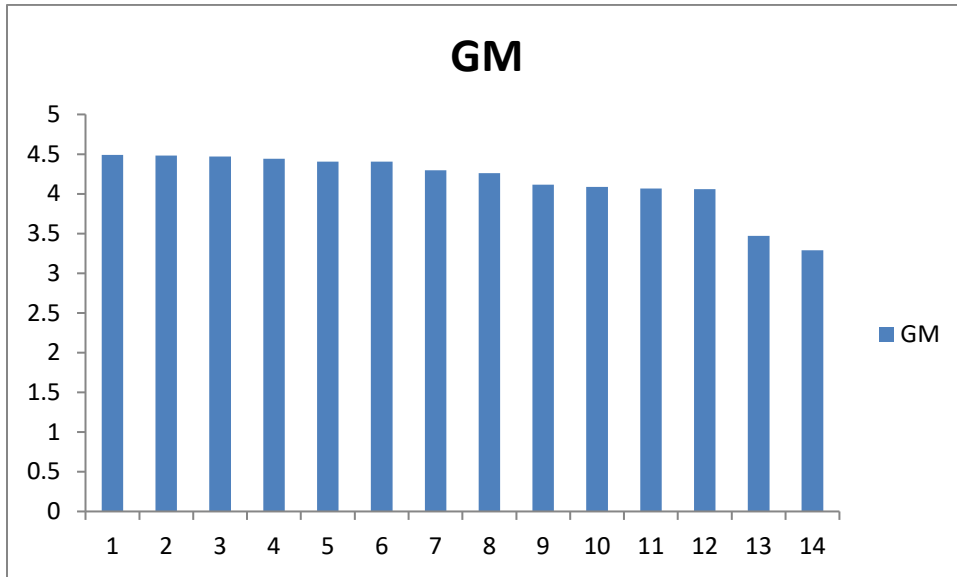
S/N	Item statement on the method	$X_E$	$SD_E$	$X_T$	$SD_T$	$X_G$	$SD_G$	t-cal	p-value

1	Teacher-centered	3.5200	1.15902	3.1899	1.11028	3.2692	1.12544	1.282	.203
2	Child-centered	4.6400	.48990	4.3418	.88992	4.4135	.81979	1.597	.113
3	Resource-based learning	4.4000	.86603	4.2278	.79983	4.2692	.81528	.919	.360
4	Lecture method	3.3200	1.10755	3.6835	1.11567	3.5962	1.11929	-1.422	.158
5	Demonstration method	4.3200	.74833	4.3797	.62642	4.3654	.65445	-.396	.693
6	Discussion method	4.4800	.65320	4.3418	.78260	4.3750	.75283	.799	.426
7	Field trip, excursion and site seeing	4.6000	.57735	4.3544	1.06263	4.4135	.97154	1.103	.273
8	Role play/modeling/drama	4.3600	.75719	3.9114	1.10000	4.0192	1.04260	1.899	.060
9	Project work or activity based learning	4.5600	.50662	3.8481	1.09882	4.0192	1.03324	3.128	.002
10	Experimental/exploration and research for knowledge construction	4.5600	.50662	4.0886	1.01514	4.2019	.93870	2.230	.028
11	Student participation in community Environmental project	4.4400	.82057	4.3165	.76030	4.3462	.77296	.695	.489
12	Audio visual Video/picture show	4.5200	.65320	4.3291	.87298	4.3750	.82659	1.006	.317
13	Brainstorming	4.0400	.88882	3.9114	1.10000	3.9423	1.05045	.532	.596
14	Combination of different methods	4.4800	1.00499	4.1013	.87112	4.1923	.91457	1.825	.071

N= 104 (25 Educators and 79 Teachers).

Rating: \*1= Child-centered 2= Field trip, excursion and site seeing 3=Discussion method 4= Audio visual Video/picture show  
5=Demonstration method 6= Student participation in community environmental project \*7= Resource-based learning 8=  
Experimental/exploration and research for knowledge construction 9= Combination of different methods 10= Role play/modeling/drama  
11= Project work or activity 12= Brainstorming 13= Lecture method \*14= Teacher-centered (Asterisk indicates general teaching methods).

Figure 6: Rating of methods for teaching causes of Climate Change



Rating: \*1= Child-centered 2= Field trip, excursion and site seeing 3=Discussion method 4= Audio visual Video/picture show  
 5=Demonstration method 6= Student participation in community environmental project \*7= Resource-based learning 8=  
 Experimental/exploration and research for knowledge construction 9= Combination of different methods 10= Role play/modeling/drama 11=  
 Project work or activity 12= Brainstorming 13= Lecture method \*14= Teacher-centered (Asterisk indicates general teaching methods).



Table 4 and Figure 5 show the mean rating of respondents (Educators and Teachers) on the most appropriate method for teaching the causes of climate change. Based on the assigned real limit value for the items, a weighted grand mean ( $X_G$ ) of 3.50 and above was considered as “agree” while weighted grand mean of below 3.50 was considered as “disagree”.

The range of the weighted grand mean of both the teachers and educators is 3.2692 to 4.3750 and items whose weighted grand mean were above 3.50 include the following; Child-centered, Resource-based learning, Lecture method, Demonstration method, Discussion method, Field trip, excursion and site seeing, Role play/modeling/drama Project work or activity based learning, Experimental/exploration and research for knowledge construction, Student participation in community environmental project, Audio visual/ Video/picture show, Brainstorming, Combination of different methods. The p-value of above 0.05 for all the items indicated no significant difference between the responses of the educators and teachers.

Table 6: Rating of the most appropriate method for teaching the impacts of climate change.

S/N	Item statement on the method	$X_E$	$SD_E$	$X_T$	$SD_T$	$X_G$	$SD_G$	t-cal	P-value
1	Teacher-centered	3.4000	.95743	3.5443	1.10706	3.5096	1.07030	-.586	.559
2	Child-centered	4.6400	.48990	4.2532	.94011	4.3462	.86764	1.970	.052
3	Resource-based learning	4.4800	.77028	4.3291	.67409	4.3654	.69754	.942	.348
4	Lecture method	3.4000	1.11803	3.7089	1.07598	3.6346	1.08885	-1.239	.218
5	Demonstration method	4.2800	.89069	4.2911	.81888	4.2885	.83227	-.058	.954

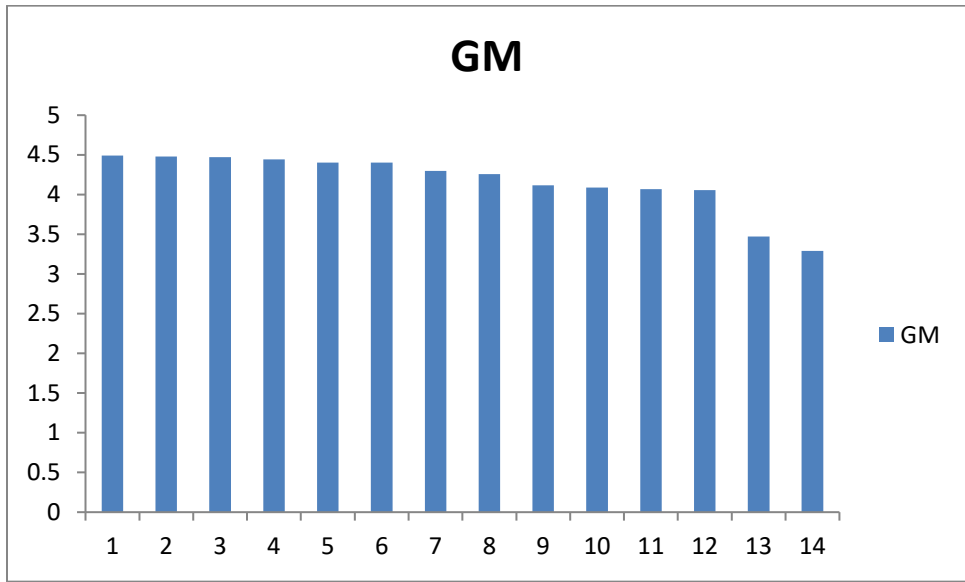
6	Discussion method	4.4400	.58310	4.4177	.76137	4.4231	.71993	.134	.894
7	Field trip, excursion and site seeing	4.6800	.47610	4.4177	.74434	4.4808	.69646	1.655	.101
8	Role play/modeling/drama	4.3200	.85245	4.0253	1.02500	4.0962	.99043	1.301	.196
9	Project work or activity based learning	4.4000	.70711	3.9494	1.09660	4.0577	1.03179	1.928	.057
10	Experimental/exploration and research for knowledge construction	4.4800	.65320	4.2152	.85741	4.2788	.81796	1.418	.159
11	Student participation in community environmental project	4.5600	.71181	4.3291	.85817	4.3846	.82800	1.218	.226
12	Audio visual Video/picture show	4.5600	.65064	4.4177	.81031	4.4519	.77434	.799	.426
13	Brainstorming	4.0000	.70711	3.7848	1.27773	3.8365	1.16678	.802	.424
14	Combination of different methods	3.9200	1.07703	4.0127	.99349	3.9904	1.00962	-.398	.691

N= 104 (25 Educators and 79 Teachers).

**R:** 1=Field trip, excursion and 2=Audio visual Video/picture show 3=Discussion method 4=Student participation in community \*5=Resource-based learning \*6=Child-centered 7=Demonstration method 8=Experimental/exploration and 9=Role play/modeling/drama 10=Project work or activity 11=Combination of different methods 12=Brainstorming 13=Lecture method \*14=Teacher-centered

(Asterisk indicates general teaching methods)

Figure 7: Mean ratings of the appropriate methods for teaching climate change impacts



R: 1=Field trip, excursion and 2=Audio visual Video/picture show 3=Discussion method 4=Student participation in community \*5=Resource-based learning \*6=Child-centered 7=Demonstration method 8=Experimental/exploration and 9=Role play/modeling/drama 10=Project work or activity 11=Combination of different methods 12=Brainstorming 13=Lecture method \*14=Teacher-centered

From the above table, the weighted grand mean of the items ranged from 3.5096 to 4.4519, indicating that all the items were agreed upon by both teachers and educators as being apt for teaching the impacts of climate change.

The methods appropriate for teaching the impacts of climate change are; Teacher-centered, Child-centered, Resource-based learning, Lecture method, Demonstration method, Discussion method, Field trip, excursion and site seeing, Role play/modeling/drama Project work or activity based learning, Experimental/exploration and research for knowledge construction, Student participation in community environmental project, Audio visual Video/picture show,

Brainstorming, Combination of different methods. The P-value of above 0.05 for all the items indicated no significant difference between the responses of the educators and teachers.

### **4.3 Discussion of the Results**

The result of the curriculum audit of Social and Environmental Science for Upper Basic School, Grade 7- 9 revealed the following;

**Grade 7:** The themes on climate change found include, Climate change concept and the impacts of CC, the themes units include the following, the climate system, changes in precipitation pattern and impacts on agriculture.

**Grade 8:** The themes on climate change found include, Climate change concept and the causes of climate change while the theme units are definition of related concept, the climate system, the climate parameters, anthropogenic emissions and natural causes. Climate change contents contained in the themes are; difference between weather and climate, relationship between weather and climate, temperature, humidity, wind, precipitation, burning fossil fuel in car, industry, deforestation and burning of forests or bushfires. Though climate change contents are already found, there is need to discuss them to a greater detail.

**Grade 9:** The theme on climate change found is climate change concept and the theme unit is climate system. Climate change contents found include land surface and hydrosphere.

The result of the curriculum audit of Science for Upper Basic School, Grade 7- 9 revealed the following;

**Grade 7:** The themes on climate change found include, climate change concept and causes of climate change while the theme units include the climate parameters, gases causing climate change and the basic science of climate change.

The gaps identified and the suggestions include; Water vapour and CO<sub>2</sub> are not well explained (could be improved upon), the atmosphere not elaborate (could be improved upon), impact on ecosystem should be included.

**Grade 8:** The themes on climate change found include, impact of climate change and mitigation of climate change, the theme units include, impact on ecosystem, reduction of greenhouse gas production, proper waste management and impacts on human health.

The gaps identified and the suggestions include, inadequate emphasis on decrease in organism which could be a good entry point for ‘climate change impacts on population of organisms’, insufficient focus on impacts on human health which is a good entry point for ‘effects of climate change on normal functioning of human internal organs’.

**Grade 9:** The themes on climate change found include, impact and mitigation of climate change the theme units include, impacts on ecosystem, impacts on health, proper waste management, controlling the production of greenhouse gases.

The gaps identified and the suggestions include;

Interruption in the life cycle of organisms and adaptation to their environment- not found.

How climate change interrupts the normal functioning of the body system- not included.

Impacts of climate change on spread of diseases - not found. It should be added.

Switching to low to zero carbon energy sources such as solar, wind, wave energies (and other renewable sources of energy) -not well explained. There is need for further explanation.

The results above indicate some climate change topics already included in the curriculum but reflects the need to integrate additional climate change topics or clarify certain areas in the curriculum with limited breadth and depth of climate change information. This was addressed by suggesting relevant climate change topics to fill the gaps identified.

#### **4.4 Discussion on responses to the appropriate methods for climate change education:**

The results from tables 2.1 and 2.2 showed that appropriate methods for teaching the meaning, causes and mitigation of climate change include child-centered, resource-based learning, demonstration method, discussion method, field trip, excursion and site seeing, role play/modeling/drama, project work or activity, experimental/exploration and research for knowledge construction, student participation in community environmental project, Audio visual/ Video or picture show, Brainstorming, combination of different methods. This is in consonance with the findings of (UNICEF, 2012) which stated that environmental projects uphold the fundamental principles that are child-based, child-involving and environmentally protective like all other activities. It is also in alignment with the findings of (UNICEF, 2012), in which the involvement of school children in climate change projects was advocated, especially those from marginalized communities. It supported child-based approaches, which allow conduct

of research and communication of findings and ideas by students. The result of the analysis also revealed that child-centred approach and resource-based methods are the most appropriate methods for teaching the themes of climate change. The findings of the research were in consonance with the findings of (Oversby, 2015), in which innovative pedagogical methods such as provocative discussion statements, generation of questions, collaborative games which initiates engagement of learners, provoking student-relevant questions, considering instructions in the light of learners' prior knowledge and their skills of independent learning were considered the most appropriate methods for teaching climate change education. It helped to validate the findings of this research.

The climate change themes appropriate for integration in the curriculum included the meaning and the definition of climate change, the causes of climate change, and the impacts of climate change in the various aspects of the society, Mitigating climate change and adapting to climate change impacts

## CHAPTER FIVE

### 5.1 Conclusion and Recommendations

Integration of climate change education into the National curriculum of The Gambia involves a strategic process that should consider the needs or the level of understanding of the students based on the subject matter to be taught. It should then be followed by a carefully planned curriculum to deliver the relevant subject matter areas identified. This process was applied to prepare a list of climate change contents for integration in both the social and general science curriculum. This was arrived at after a thorough review of literature to determine the appropriate climate change themes for integration in the school curriculum. Then; curriculum audit was done to determine the extent to which climate change education is presently taught in The Gambia's national curriculum. Two subjects areas were targeted in the Upper Basic Schools which are Social and environmental Studies and General Science of Grades 7&9. An audit of the teachers' guide and the respective syllabi of the two grades were done to identify the gaps in them, which were to be filled with the necessary climate change content. It was followed by suggestions of the relevant climate content areas needed to fill the gaps. Subsequently, questionnaires were administered to the teachers and educators to sample their opinions about the most appropriate methods for teaching climate change topics. It was followed by the retrieval and analysis of the data obtained using Statistical Package for Social Sciences (SPSS).

The list of climate change themes for integration in the school curriculum included the meaning of climate change, the causes of climate change, impacts of climate change, mitigation of climate



change and adaptation to climate change. Each theme was sub-divided into units and contents covering several climate change aspects. Those aspects were used to carry out the auditing exercise to determine the suitable place for incorporation of climate themes in the syllabi of the upper basic schools. Various gaps were identified and the appropriate recommendation made. The result of the analysis of the data gathered from questionnaires administered revealed that there was no significant difference between the responses of the teachers and educators based on their mean ratings. The ratings of the method by teachers and educators were presented accordingly. Child-centered and resource-based methods were rated above teacher-centered method.

Given the themes and the gaps in the curriculum in relation to climate change topics, the following action plan is recommended.

**Table 7: Suggested Action Plan for Integrating Climate Change in the Curriculum**

Strategy/Activities	Objectives	Indicator/Output
Formulation of climate change integration policy.	A policy on how the integration process should take should be formulated	A well formulated policy
Climate Change education experts identified	The expert will be consulted to know which climate aspects require adequate attention in the curriculum	A List of the needed experts

Development of Climate change Content	The development of relevant themes	Relevant climate change themes fully developed
Climate change Curriculum support materials design	The design of relevant support materials	An effective design
Infusion of climate change themes in the gaps identified to enrich the climate change curriculum	To integrate climate change in the various subjects starting with the school syllabuses.	
Curriculum support materials development	The development of the support materials	A good structure of the developed material provided
Teacher training	To train teachers on the pedagogical practices identified in the research	
Validation and Approval	Approval of the materials	Validation and approval
Curriculum piloting	The curriculum will be put to test	Curriculum piloted in various schools to determine effectiveness.

## **5.2 Limitations and how to advance the study**

1. It is a small scale research
2. The sample size is limited. It is not a proportionate sample.
3. A similar research using a representative sample size could be more revealing
4. The study did not use classroom observation as a method which is important to advance this research.

Based on the above findings, it is recommended that all the items identified are appropriate methods for teaching climate change themes after inclusion in the National Curriculum of The Gambia. Other recommendations include capacity building for teachers to effectively teach the topics on climate change, discovery of and excursion to affected places e.g. coastal places of Banjul and Tanji, observation with question and answer, debates, one on one conversation, group presentation and invitation of special guests. It is also recommended that further research be conducted on the topic with a wider scope.

In order to effectively teach the above-listed themes of climate change, it is requisite to employ the above methods considered appropriate for doing so. This is necessary to entrench the understanding of the phenomenon in the students for deep ingestion of its components. It will also awaken in them a vivid consciousness of the environment and the urgent need to protect it.

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## **Appendix I: Research Questionnaire for data collection**

### **Research Questionnaire**

#### **Questionnaire addressed to respondents on teaching methods**

##### **General Information to the interviewee**

Dear respondent,

I am Owa Tobi, a student enrolled in the Master's program on climate change and education at the University of The Gambia. I am conducting a study on integration of climate change education in the national curriculum of The Gambia.

The purpose of this interview is to obtain information on the appropriate teaching methods for climate change education. It is voluntary and the identity of the respondent will not be disclosed. All the information provided are confidential.

The findings of the research will be used to provide relevant information on the suitable methods for teaching climate change education.

Date of investigation-----

Age of interviewee-----

Gender-----

Occupation-----



## II. Additional information

What is your nationality? (Kindly tick one option)

A. Gambian    B. Non-Gambian

What is your working experience?

A. 1-3 years    B. 5 years    C. Above 5 years

Please note the following definitions in responding to the questions that follow.

- Teacher-centered method is usually understood to involve the use of the lecture as a primary **means** of communication in the classroom. The goal of the classroom involves the dissemination of a relatively fixed body of knowledge that is determined by the **teacher**.
- Child-centered approach: It is child-centred and includes the following principles:
  - a. Interactive teaching methodologies;
  - b. Child participation;
  - c. Teachers as learning facilitators;
  - d. Group cooperation and positive competitions;
  - e. Activity-based learning methods.

- Resource-based approach is a system which structures resources into a learning framework enabling children to learn independently. It requires that the teacher fulfills a different role from that of the conventional teacher, who mainly teaches, instead, encourages his children to learn.

**(FOR GRADES 7-12)**

**PLEASE TICK AN ANSWER**

The phenomenon, climate change, is completely new to you - Yes/No

**The meaning of climate change:** Rate on the scale of 5 (the highest) to 1(the lowest) your view about the **most** appropriate **teaching methods** for teaching **the meaning of climate change**, the definition of terms e.g. global warming, greenhouse effect, solar radiation and so on. Aims and purposes for studying climate change as well as the basic science of climate change.

Theme of climate change (The meaning of climate change)	Teaching methods	Scores from highest to lowest (Strongly agree=5, Agree=4, Strongly Disagree=3, Disagree=2, Don't know=1)
	Teacher-centered	5 4 3 2 1
	Child-centered	5 4 3 2 1
	Resource-based learning	5 4 3 2 1

	<b>Specific methods for teaching the meaning of climate change, definition of terms :</b>	<b>Scores from highest to lowest (Strongly agree=5, Agree=4, Strongly Disagree=3, Disagree=2, Don't know=1)</b>
	Lecture method	5 4 3 2 1
	Demonstration method	5 4 3 2 1
	Discussion method	5 4 3 2 1
	Field trip, excursion and site seeing	5 4 3 2 1
	Role play/modeling/drama	5 4 3 2 1
	Project work or activity based learning	5 4 3 2 1
	Experimental/exploration and research for knowledge construction	5 4 3 2 1
	Student participation in community Environmental project	5 4 3 2 1
	Audio visual Video/picture show	5 4 3 2 1
	Brainstorming	5 4 3 2 1
	Combination of different methods	5 4 3 2 1
	Any other (please specify)	

**The causes of climate change:** Rate on the scale of 5 (the highest) to 1(the lowest) your view about the **most appropriate teaching methods** for teaching **The causes of climate change** e.g. release of greenhouse gas such as CO<sub>2</sub>, into the atmosphere through deforestation, burning of coal, fuel, bush burning and so on.

Theme of climate change	Teaching methods	Scores: (strongly agree=5, Agree=4, Strongly Disagree=3, Disagree=2, Don't know=1)
	Teacher-centered	5 4 3 2 1
	Child-centered.	5 4 3 2 1
	Resource-based learning	5 4 3 2 1
	<b>Specific methods for teaching The causes of climate change</b>	
	Lecture method	5 4 3 2 1
	Demonstration method	5 4 3 2 1
	Discussion method	5 4 3 2 1
	Field trip	5 4 3 2 1
	Role play/modeling/drama	5 4 3 2 1
	Project work or activity based learning	5 4 3 2 1
	Experimental/exploration and research for knowledge construction	5 4 3 2 1
	Student participation in community Environmental project	5 4 3 2 1
	Audio visual Video/picture show	5 4 3 2 1

	Brainstorming,	5 4 3 2 1
	Combination of different methods	5 4 3 2 1
	Any other (please specify)	

**The impacts of climate change:** Rate on the scale of 5 (the highest) to 1(the lowest) your view about the **most** appropriate **teaching methods** for teaching **The impacts of climate change** i.e. how it affects the biotic (living organisms) and abiotic components (non-living chemical and physical parts such as water, temperature, humidity etc.) of the environment resulting in extreme conditions such as drought, flooding, desertification and so on.

<b>Theme of climate change (The impacts of climate change)</b>	<b>Teaching methods</b>	<b>Scores from highest to lowest (strongly agree=5, Agree=4, Strongly Disagree=3, Disagree=2, Don't know=1)</b>
	Teacher-centered	5 4 3 2 1
	Child-centered	5 4 3 2 1
	Resource-based learning	5 4 3 2 1
	<b>Specific methods</b> for teaching the impacts of climate change.	
	Lecture method	5 4 3 2 1
	Demonstration method	5 4 3 2 1

	Discussion method	5	4	3	2	1
	Field trip	5	4	3	2	1
	Role play/modeling/drama	5	4	3	2	1
	Project work or activity based learning	5	4	3	2	1
	Experimental/exploration and research for knowledge construction	5	4	3	2	1
	Student participation in community Environmental project	5	4	3	2	1
	Audio visual Video/picture show	5	4	3	2	1
	Brainstorming,	5	4	3	2	1
	Combination of different methods	5	4	3	2	1
	Any other (please specify)					

**Mitigation of climate change:** Rate on the scale of 5 (the highest) to 1(the lowest) your view about the **most** appropriate **teaching methods** for teaching **Mitigation of climate change** i.e. the control or reduction of greenhouse production

Theme of climate change (Mitigation of climate change)	Teaching methods	Scores from highest to lowest (strongly agree=5, Agree=4, Strongly Disagree=3, Disagree=2, Don't know=1)
	Teacher-centered	5 4 3 2 1
	Child-centered teaching	5 4 3 2 1
	Resource-based learning	5 4 3 2 1
	Specific methods for teaching the mitigation of climate change.	
	Lecture method	5 4 3 2 1
	Demonstration method	5 4 3 2 1
	Discussion method	5 4 3 2 1
	Field trip	5 4 3 2 1
	Role play/modeling/drama	5 4 3 2 1
	Project work or activity based learning	5 4 3 2 1
	Experimental/exploration and research for knowledge construction	5 4 3 2 1
	Student participation in community Environmental	5 4 3 2 1

	project	
	Audio visual Video/picture show	5 4 3 2 1
	Brainstorming,	5 4 3 2 1
	Combination of different methods	5 4 3 2 1
	Any other (please specify)	

**Adaptation to climate change impacts:** Rate on the scale of 5 (the highest) to 1(the lowest) your view about the **most** appropriate **teaching methods** for teaching **Adaptation to climate change impacts** e.g. the use of irrigation facilities, drought-resistant crop varieties proper waste management and so on

<b>Theme of climate change (Adaptation to climate change impacts)</b>	<b>Teaching methods</b>	<b>Scores from highest to lowest (strongly agree=5, Agree=4, Strongly Disagree=3, Disagree=2,</b>
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		<b>Don't know=1)</b>
	Teacher-centered	5 4 3 2 1
	Child-centered	5 4 3 2 1
	Resource-based learning	5 4 3 2 1
	Specific methods for teaching adaptation to climate change impacts.	
	Lecture method	5 4 3 2 1
	Demonstration method	5 4 3 2 1
	Discussion method	5 4 3 2 1
	Field trip	5 4 3 2 1
	Role play/modeling/drama	5 4 3 2 1
	Project work or activity based learning	5 4 3 2 1
	Experimental/exploration and research for knowledge construction	5 4 3 2 1
	Student participation in community Environmental project	5 4 3 2 1
	Audio visual Video/picture show	5 4 3 2 1
	Brainstorming,	5 4 3 2 1
	Combination of different	5 4 3 2 1

	methods	
	Any other (please specify)	

## Appendix II: Climate Change Themes and Topics for integration

### CURRICULUM AUDIT FOR CLIMATE CHANGE EDUCATION

#### CLIMATE CHANGE THEMES FOR INTEGRATION

Theme	Units	Content
1. Climate change concept	1. Meaning of the concept 2. Definition of related concepts 3. Aims and purposes of studying climate change 4. The climate system The climate parameters	What is climate change? Difference between weather and climate Relationship between weather and climate What is greenhouse effect? Consist of five major components; The atmosphere, hydrosphere, cryosphere, land surface and the biosphere.

	5. The basic science of climate change	Temperature, humidity, wind, precipitation  The atmosphere; structure of the atmosphere; troposphere, mesosphere, stratosphere, thermosphere and exosphere.
2. The causes of climate change	<ol style="list-style-type: none"> <li>1. Natural causes</li> <li>2. Anthropogenic emissions</li> <li>3. Agricultural activities like clearing, tilling</li> <li>4. CO<sub>2</sub> from industrial and steam engines</li> <li>5. Increased refuse/waste dumps</li> <li>6. Ocean current process</li> <li>7. Gas flaring</li> </ol>	<p>How are we causing climate change</p> <p>Gases causing climate change include H<sub>2</sub>O vapour, CO<sub>2</sub>, CH<sub>4</sub>, NO<sub>2</sub> etc.</p> <p>Burning fossil fuel in car, industry and homes, deforestation, burning of forests</p>
3. The impacts of climate change	<ol style="list-style-type: none"> <li>1. Melting ice and sea level rise</li> <li>2. Changes in precipitation</li> </ol>	<p>Thermal expansion, melting of land ice</p> <p>Stronger hurricanes, reduced</p>

	<p>pattern</p> <ol style="list-style-type: none"> <li>3. Impacts on organism</li> <li>4. Impacts on ecosystem</li> <li>4. Impacts on human health</li> <li>5. Impacts on agriculture</li> <li>6. Aquatic lives</li> <li>7. Livestock</li> <li>8. Soil</li> </ol>	<p>rainfall, greater drought and more water</p> <p>Decrease in organisms</p> <p>Increase in ill-health related diseases and death</p> <p>Drought ,desertification, flooding</p>
4. Mitigation of climate change impacts	<ol style="list-style-type: none"> <li>1.Fossil fuel emission</li> <li>2. Control of greenhouse gas production</li> <li>3. Climate change education</li> <li>4. Proper waste management (burying of wastes).</li> <li>5.Bio-engineering of microbes to eliminate GHG</li> <li>6. Stipulating laws and policies</li> </ol>	<p>Switching to low to zero carbon energy sources such as solar, wind, wave energies (renewable energies).</p> <p>Expanding forests and other “sinks” to remove greater amount of CO<sub>2</sub> from the atmosphere.</p> <p>Conversion of agricultural or forestry waste to fuel.</p>
5. Adaptation to climate change impacts and disaster risk reduction.	<ol style="list-style-type: none"> <li>1. Use of irrigation facilities</li> <li>2. Practicing climate-smart agriculture</li> <li>3. Filling the sky with Sulphur</li> </ol>	<p>Increase crop production using Irrigation facilities</p> <p>Adopt climate change sensitive crop varieties and</p>

	IV Oxide to block intense solar rays	cultivars Strengthen early warning system Adopting agro-forestry system Creating grazing areas for herdsmen Concepts of disaster preparedness How to identify risks, local threats and vulnerabilities and their relationships

### Appendix III: Curriculum Audit

Social and Environmental Studies (Grade 7)

Theme of SES	Unit and Page	Climate Change(CC) Themes found	Gaps and Suggestions
		Theme	Units of CC Theme
Theme 1	2, pg. 8	Climate change	The climate

		concept The impacts of CC	system Changes in precipitation pattern	
Theme 2	1, pg.38	The impacts of CC	Impacts on agriculture	

Social and Environmental Studies (Grade 8)

<b>Theme of SES</b>	<b>Unit and Page</b>	<b>Climate change (CC) Themes found</b>		<b>Gaps and Suggestions</b>
		<b>Theme</b>	<b>Units of CC Theme</b>	
Theme 2	4, pg. 40	Climate change concept	Definition of related concept	Climate
	5, pgs. 44-49	Climate change concept	Definition of related concept	Difference between weather and climate Relationship between weather and climate
		Climate change concept	The climate system	Temperature, humidity, wind,

	5, pgs. 50-51	The causes of climate change	The climate parameters Anthropogenic emissions	precipitation Burning fossil fuel in car, industry, deforestation and burning of forests or bushfires.
	6, pgs. 52 -55	The causes of climate change	Natural causes	Gases causing climate change include; water vapour. Salt water intrusion resulting from evaporation which is caused by high temperature.

Social and Environmental Studies (Grade 9)

Theme of SES	Unit and Page	CC Theme found	Gaps/Suggestions



		<b>Theme</b>	<b>Units of CC Theme</b>	
1	1, pg. 5, 14	Climate change concept	The climate system	Land surface, hydrosphere.

Science (Grade 7)

<b>Theme of Science</b>	<b>Unit and Page</b>	<b>CC Theme found</b>		<b>Gaps/ Suggestions</b>
		<b>Theme</b>	<b>Units of CC Theme</b>	
2	1, pg. 29	Climate change concept	The climate parameters	
3	1, pgs. 54-57	Causes of climate change	Gases causing climate change	Water vapour, CO <sub>2</sub> not well explained (could be improved upon)
4	1, pgs. 67-68, 74-75	Climate change concept	The basic science of climate change	The atmosphere not elaborate (could be improved upon)
	2, pgs. 78-79	Climate change	The climate	

		concept	system	
5	1, pgs. 87-89	Impacts of climate change	Impacts on ecosystem	Impact on ecosystem should be included.
9	1, pg. 124	Mitigation of climate change impacts	Fossil fuel emission	

Science (Grade 8)

<b>Theme of Science</b>	<b>Unit and Page</b>	<b>CC Theme found</b>		<b>Gaps/ Suggestions</b>
		<b>Theme</b>	<b>Units of CC Theme</b>	
1	3, pg.12	Impacts of CC	Impact on ecosystem	Decrease in organism not emphasized but could be a good entry point
5	1, pgs. 41-42	Mitigation of climate change impacts	Reduction of greenhouse gas production	

			Proper waste management	
7	1, pgs. 52-55	Impact of climate change	Impacts on human health	Impacts on human health not focused on and could be a good entry point for effects on normal functioning of human internal organs.

Science (Grade 9)

Theme of Science	Unit and Page	CC Theme found		Gaps/Suggestions
		Theme	Units of CC Theme	

1	1, pgs. 4-9	Impact of climate change	Impacts on ecosystem	Interruption in the life cycle of organisms and adaptation to their environment missing
5	1, pgs. 55-75	Impact of climate change	Impacts on health	How climate change interrupts the normal functioning of the body system not included.
6	1, pg. 79	Mitigation of climate change impacts	Proper waste management	
6	2, pgs. 81-85	Impacts of CC	Impacts on health	Impacts of climate change on spread of diseases not found. It should be added.
7	1, pg. 89	Mitigation of climate change impacts	Controlling the production of greenhouse gases	Switching to low to zero carbon energy sources

				such as solar, wind, wave energies (and other renewable sources of energy) not well explained, it should be well explained.
7	1, pg. 89	Mitigation of climate change impacts	Proper waste management	Conversion of agricultural or forestry waste to fuel.

#### Appendix IV: Data Compilation and Analysis

Table 4. Mean rating of respondents on the most appropriate method for teaching the mitigation of climate change.

S/N	Item statement on	$X_E$	$SD_E$	$X_T$	$SD_T$	$X_G$	$SD_G$	t-cal	P-
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	the method								value
1	Teacher-centered	2.9600	1.09848	3.6582	1.10808	3.4904	1.14056	-2.752	.007
2	Child-centered	4.6000	.50000	4.1266	1.04227	4.2404	.96033	2.187	.031
3	Resource-based learning	4.4800	.87178	4.3038	.82204	4.3462	.83340	.921	.359
4	Lecture method	3.4000	1.11803	3.8101	1.09867	3.7115	1.11192	-1.620	.108
5	Demonstration method	4.3200	.90000	4.5063	.65776	4.4615	.72303	-1.124	.263
6	Discussion method	4.6000	.57735	4.3797	.80549	4.4327	.76023	1.266	.208
7	Field trip, excursion and site seeing	4.8000	.57735	4.1013	1.19395	4.2692	1.11678	2.817	.006
8	Role play/modeling/drama	4.4400	.82057	4.0253	1.03744	4.1250	1.00182	1.824	.071
9	Project work or activity	4.3600	.95219	3.9747	1.16547	4.0673	1.12573	1.501	.137
10	Experimental/exploration	4.6000	.57735	4.1266	.92497	4.2404	.87573	2.410	.018
11	Student participation in community	4.6000	.70711	4.3418	.97252	4.4038	.91926	1.227	.223
12	Audio visual Video	4.4800	.58595	4.2785	.89065	4.3269	.82958	1.059	.292
13	Brainstorming	4.2000	.76376	3.7975	1.20235	3.894	1.12274	1.574	.119
14	Combination of different methods	4.1600	1.06771	4.0506	1.06095	4.0769	1.05841	.449	.655

N= 104 (25 Educators and 79 Teachers).

Table 5. Mean rating of respondents on the most appropriate method for teaching adaptation to climate change.

S/N	Item statement on the method	X <sub>E</sub>	SD <sub>E</sub>	X <sub>T</sub>	SD <sub>T</sub>	X <sub>G</sub>	SD <sub>G</sub>	t-cal	P-value
1	Teacher-centered	3.2400	1.05198	3.6582	1.09645	3.5577	1.09568	-1.678	.096
2	Child-centered	4.7600	.43589	4.3544	.78508	4.4519	.73577	2.460	.016
3	Resource-based learning	4.6800	.47610	4.2532	.82382	4.3558	.77483	2.459	.016
4	Lecture method	3.5200	1.04563	3.7975	1.01754	3.7308	1.02617	-1.181	.241
5	Demonstration method	4.5600	.58310	4.3418	.76604	4.3942	.72965	1.308	.194
6	Discussion method	4.520	.65320	4.4430	.65529	4.4615	.65245	.512	.610
7	Field trip, excursion	4.6400	.63770	4.3165	.98116	4.3942	.91819	1.546	.125
8	Role play/modeling/drama	4.4000	.70711	4.0380	.97984	4.1250	.93151	1.709	.090
9	Project work or activity	4.3600	.90738	4.0759	.94424	4.1442	.93910	1.323	.189
10	Experimental/exploration	4.6000	.50000	4.1139	.94716	4.2308	.88384	2.454	.016

11	Student participation in community	4.5600	.76811	4.2911	.87928	4.3558	.85807	1.371	.173
12	Audio visual Video	4.5200	.65320	4.2278	.94665	4.2981	.89094	1.436	.154
13	Brainstorming	4.2000	.70711	3.9873	1.12653	4.0385	1.04206	.888	.376
14	Combination of different methods	4.2400	1.05198	4.0759	1.05942	4.1154	1.05488	.676	.501

N= 104 (25 Educators and 79 Teachers).