CURRICULUM AND ITS CONTRIBUTION TO AWARENESS OF CLIMATE CHANGE AMONG LEARNERS IN SECONDARY SCHOOLS IN GITHUNGURI SUB-COUNTY, KIAMBU COUNTY, KENYA

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DECEMBER, 2017

DECLARATION

Student's Declaration

This thesis is my original work and has not been presented to any other university for academic award.

Signature…….. Date……

Charles Ndiritu Kariuki

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Supervisors' Declaration

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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DEDICATION

To all that love knowledge, those that love and care for mother earth and to all that dedicate their time to undertaking research of environmental issues.

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ABBREVIATIONS AND ACRONYMS

ASALs	Arid and Semi-Arid Lands
BS	Business Studies
CC	Climate Change
CCED	Climate Change Education
CCESD	Climate Change Education for Sustainable Development
CRE	Christian Religious Education
EAC	East African Community
EACCCMP	East African Community Climate Change Master Plan
GHG	Greenhouse gas
GoK	Government of Kenya
ICCA	Institute for Climate Change and Adaptation
IPCC	Intergovernmental Panel on Climate Change
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KCSE	Kenya Certificate of Secondary Education
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examination Council
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NGO	Non-governmental Organization
RoK	Republic of Kenya
UN	United Nations
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
USIU	United States International University
WMO	World Meteorological Organization

ABSTRACT

Climate change poses a danger to the current and the future generations. Sad to note though is the fact that although developing countries have contributed the least to the current mess, they will be more impacted due to their limited technology to adapt to the consequences. As a remedy to the current situation, formal education has been identified as a major tool of passing the required knowledge, skills and changing people's attitude towards climate change. However, most education curricula in developing countries have little content on climate change. It is for this reason that this study set out to establish the contribution of curriculum in creating awareness of climate change among learners in secondary schools in Githunguri Sub-county of Kiambu County in Kenya. The study was guided by three objectives: To establish the key areas of climate change addressed by the current Kenya's secondary school formal curriculum; to establish the extent to which implementation of the curriculum contributes to awareness of climate change among teachers and students and to evaluate effectiveness of curriculum developers in infusing climate change content into Kenya's secondary school curriculum. To achieve the set objectives, the study adopted a descriptive survey research design. The study adopted purposive, stratified and simple random sampling techniques to compose a representative sample. Using stratified sampling technique, schools were divided into either boys, girls or mixed before selecting a sample of 10 schools. From the sampled schools, stratified sampling was used to dividing teachers into departments before employing simple random sampling technique to select a sample of 8 teachers from each of the sampled schools making a total sample of 80 teachers. Purposive sampling technique was used to select form four students before employing simple random sampling to select a sample of 10 students from each of the schools making a total of 100 students as part of the sample. Purposive sampling was also used to select a sample of 8 subjects for content analysis. Purposive sampling technique was also employed to select 8 respondents from the curriculum developer in Kenya. The study used a thematic area content analysis template to undertake content analysis on sampled subjects. Data from teachers and students was obtained using different questionnaires for each of the categories. An interview guide was used to collect data from sampled Kenya Institute of Curriculum Development officers. Quantitative data collected was analysed using inferential statistics while qualitative data was analysed through descriptions and narratives. Statistical Package for Social Science and Minitab programs were utilised to enhance quality analysis. Analysed data was presented in tables of frequencies, graphs and charts. Analysed data established that sampled subjects had an aggregate variation ratio of 0.44. A statistical test established that the chi-square value was greater than the significant value, that is 0.567>0.495. A conclusion was made that climate change content in the sampled subjects was inadequate. On the relationship between implementation of curriculum and awareness among teachers, the chi-square value was greater than the significant value, 0.794>0.659, and therefore the relationship was not significant. However for students a significant relationship was established with likelihood ratio being less than the significant value, 0.196>0.658. Finally the study established that 63% and 13% of sampled curriculum developers rated the curriculum as poor or very poor respectively. This implied that infusion of climate change content into the curriculum was not been effective. Results of this study are likely to be beneficial in policy, practical and theoretical dimensions.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This study aimed at assessing the contribution of curriculum in creating awareness of climate change among learners in secondary schools in Githunguri Sub-county of Kiambu County. In this introductory chapter, the study outlines a background of the study, a statement of the problem, the research questions, objectives and the research hypotheses as well as the significance of the study and a conceptual framework.

1.2 Background to the Study

The East African Community Climate Change Master Plan (EACCCMP) (2011), acknowledged that climate change and global warming are the biggest environmental issues of our time. Jekayinfa and Yusuf (2012) submit that climate change threatens the existence of mankind as well as his environment and is therefore a contemporary issue worldwide. Notably, the consequences of climate change will be, by far, more felt in less developed and developing countries although its causes are global (Small and Nicholis, [2003]; Jekayinfa and Yusuf, [2012]). Climate change impacts are already visible in the changing weather patterns. These have had serious impacts on human beings, destroying ecosystems and water supply, causing sea-levels to rise, distressing agriculture and food production. Climate change therefore has a swelling effect on both natural resources and the balance of nature (Jekayinfa and Yusuf, 2012).

It is on the basis of the dangers posed by a changing climate that awareness is needed on its causes, impacts, mitigation and adaptation. The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2009), suggests that the understanding, mitigation and adaptation to the changing climate will to a great deal, depend on education. They also argue that although education is needed at all levels and both formally and informally, creating awareness and understanding at a young age is the best way of changing attitudes and behaviours. Similarly Bangay and Blum (2010), liken the

importance of education to health. They assert that to recognize in advance threats posed by climate change, education will play a key role. These arguments are in tandem with one of the United Nations' millennium development goals which states that 'environmental sustainability must be ensured which is only possible through ongoing education around environmental issues.'

It is also important to note that climate change consequences are likely to impact disproportionately on the people of Africa, Asia and those living in Small Islands of Developing States. However, the specific nature of climate fears will vary between countries. Vietnam having recognized her dangerous exposure to a changing climate, the government gave priority to climate change adaptation. The Ministry of Education and Training (MOET) in Vietnam developed the MOET Action Plan on Education Sector Response to Climate Change (UNESCO, 2009).

For the case of South Africa, Sunassee et al., (2012), explain that the National Curriculum Statement (NCS) requires learners in the intermediate and senior phases "to behave as responsible citizens and make informed decisions on environmental management and lifestyle choices for a sustainable future." Learners in these levels are expected to be aware of acid rain and its consequences, the ozone, the greenhouse effect as well as the global warming phenomena. They are also supposed to be able "to present scientific arguments on the risks and benefits of the combustion of organic products and the manufacturing of synthetic products on human development, society and the environment." For learners in the Further Education and Training phase (FET), the requirement is that they are supposed to "be familiar with the different gases that are present in the atmosphere and their proportions at different levels of the atmosphere as well as be able to identify carbon dioxide, oxygen and photosynthesis through reactions."

In Kenya since independence, commissions have been established to look into the education system. It is however important to note that none of all the commissions touched on climate change and possible infusion into the education curriculum. It is therefore apparent that climate change, in Kenya's education policies, is casually treated and learning is hardly there at primary, secondary and tertiary levels. The National

Climate Change Response Strategy (NCCRS) attributes this to lack of adequate climate change information, knowledge and long-period data to researchers, planners, policy makers and the general public on climate change adaptation, impacts and mitigation measures (RoK, 2012).

It is therefore evident that curriculum is likely to play a crucial role in creating awareness about causes, impacts, mitigation and adaptation to the changing climate. The study therefore set out to establish which aspects of climate change were addressed in the current curriculum and in which subjects that was done. The study also sought to find out the level of awareness of climate change among teachers and students. It also sought to find out how effective curriculum developers had been in infusing climate change content into the curriculum. By undertaking this study, it was sought to establish the extent to which use is made of the curriculum in contributing to creation of awareness among leaners in schools about climate changes and their adverse effects on environment. However, as noted earlier, the contribution of curriculum in creating awareness about climate change has not been given much emphasis in Kenya's education curriculum. The dangers posed by a changing climate and the little emphasis given to curriculum in Kenya as far as its contribution to creating awareness on climate change is concerned formed the basis for this study.

1.3 Statement of the Problem

According to McCarthy et al., (2001), there is now scientific opinion consensus that human activities are affecting the earth's climate. They affirm that such activities are modifying the concentration of atmospheric constituents that absorb or scatter radiant energy. The result of this is explained by Sarmiento et al., (2004), who warn that the warming could cross certain thresholds for unforeseen climate change. This will likely trigger shutdown of the ocean currents that supply nutrients to important fisheries and moderate the climate in most regions of the world. Again IPCC (2007), synthesis predicts that sea levels could rise by between 20 cm and 88 cm following global rise in temperatures by between 1.4° C and 5.8° C by the year 2100. In addition, weather

patterns will become less predictable and the occurrence of extreme climate events, such as floods, storms and droughts will increase.

On the basis of the dangers posed by the changing climate, O'Neill and Oppenheimer (2002), proposed that we may have only a constricted time frame to act before the levels of emission reductions needed to prevent catastrophic and irreversible climatic changes become extremely expensive. Bangay and Blum (2010) propose that the solution lies in formal education. They argue that "formal education is as important as health" and that an educated population is better equipped to recognize in advance the threats posed by a changing climate and act accordingly.

Recognizing the crucial role played by formal education in creating awareness about climate change, this study asked the question: Is the content in the current secondary school curriculum adequate and explicitly presented to create awareness of climate change among the learners? This study examined the scope of the work done by the scientific community in the area of climate change. A wide range of studies reviewed delved on issues of students' awareness of climate change (Henry et al., 2012); teachers' awareness (Eunice and Joy, 2014; Ekpoh and Ekpoh, 2011; Nkechi, 2014); climate change impacts (Aja, 2015); infusion of climate change into secondary school agricultural science (Michael, 2014) and the role of media in creating climate change awareness (Onkargouda et al., 2013). Studies reviewed from Kenya mainly touched on indigenous coping and adaptation strategies (Edward et al., 2014) and perceptions of teachers towards the integration of adaptation strategy topics on climate change into secondary school agriculture syllabus (Stephen et al., 2014). Notably, few studies have been conducted in Kenya in regard to climate change.

Recognizing the dangers posed by the changing climate and acknowledging the limited research especially in Kenya to link contribution of curriculum in creating awareness about climate change, it was pertinent for this study to investigate curriculum and its contribution to awareness of climate change among learners in secondary schools in Githunguri Sub-county of Kiambu County, Kenya.

1.4 Objectives

The research was guided by the following objectives:

i. To establish the key areas of climate change addressed by the current Kenya's secondary school formal curriculum.
ii. To establish the extent to which implementation of the curriculum contributes to awareness of climate change among teachers and students.
iii. To evaluate effectiveness of curriculum developers in infusing climate change content into Kenya's secondary school curriculum.

1.5 Research Questions

The study sought to answer the following research questions:

i. To what extent are key areas of climate change addressed in the current Kenya's secondary school formal curriculum?
ii. How does implementation of curriculum contribute to awareness of climate change among teachers and students?
iii. How effective has the curriculum developer been in infusing climate change content into Kenya's secondary school curriculum?

1.6 Research Hypotheses

i. There is no significant climate change content in the current Kenya's secondary school formal curriculum.
ii. There is no significant relationship between implementation of secondary school curriculum and climate change awareness among teachers and students.
iii. The curriculum developer has not been effective in infusing climate change content into Kenya's secondary school curriculum.

1.7 Significance of the Study

This study aimed at establishing the contribution of curriculum in creating awareness about climate change in secondary schools in Githunguri Sub-county of Kiambu County.

The study is therefore expected to have both theoretical and practical importance. Practically, the study, is expected to benefit numerous institutions as well as individuals. For instance:

The curriculum developer (KICD) will understand the strengths and weaknesses in the current curriculum. This will assist the KICD in improving the curriculum to better address the emerging issues around climate change. The study is likely to shed light on whether the current curriculum is creating awareness about climate change and therefore look for possible ways of improving on the same.

The study will also be of much benefit to teachers. The study will make them aware of the extent to which their learners are knowledgeable about climate change issues. This will enable teachers improve on how they deliver content to learners in a bid to create more awareness about climate change. Teachers will also be challenged by this study to make effort to take the teaching of climate change more serious owing to the dangers it presents to the current and future generations.

Environmental campaigners will, from this study, establish whether the education curriculum is sufficient in creating awareness about climate change. If not, they would advocate for other ways of doing the same. For instance, environmental campaigners may find it necessary to intensify campaigns in schools to enlighten teachers and students on causes, impacts, mitigation and adaptation measures. The environmentalists may also push the government and education stakeholders in improving the curriculum to address issues around climate change.

The teacher training institutions will also be made aware of the knowledgeability of teachers about climate change. This will inform their decisions on the kind of courses they offer to their clients. In so doing, teacher training institutions will make their courses more marketable. Such institutions may also develop new courses in line with the emerging issue of climate change and therefore widen the scope of the courses they offer.

Finally, the study is expected to lead to advancement of knowledge on how best Kenya's education curriculum can address climate change issues and some of the challenges of

infusion of climate change content into the curriculum. The study will also form a base on which other scholars and institutions can develop their studies. More scholars are likely to take interest in the contribution of curriculum and education to creating climate change awareness in other levels of education.

1.8 Conceptual Framework

The diagrammatic representation of the relationship between variables in the study is shown in figure 1.1 and a discussion of the same advanced thereafter.

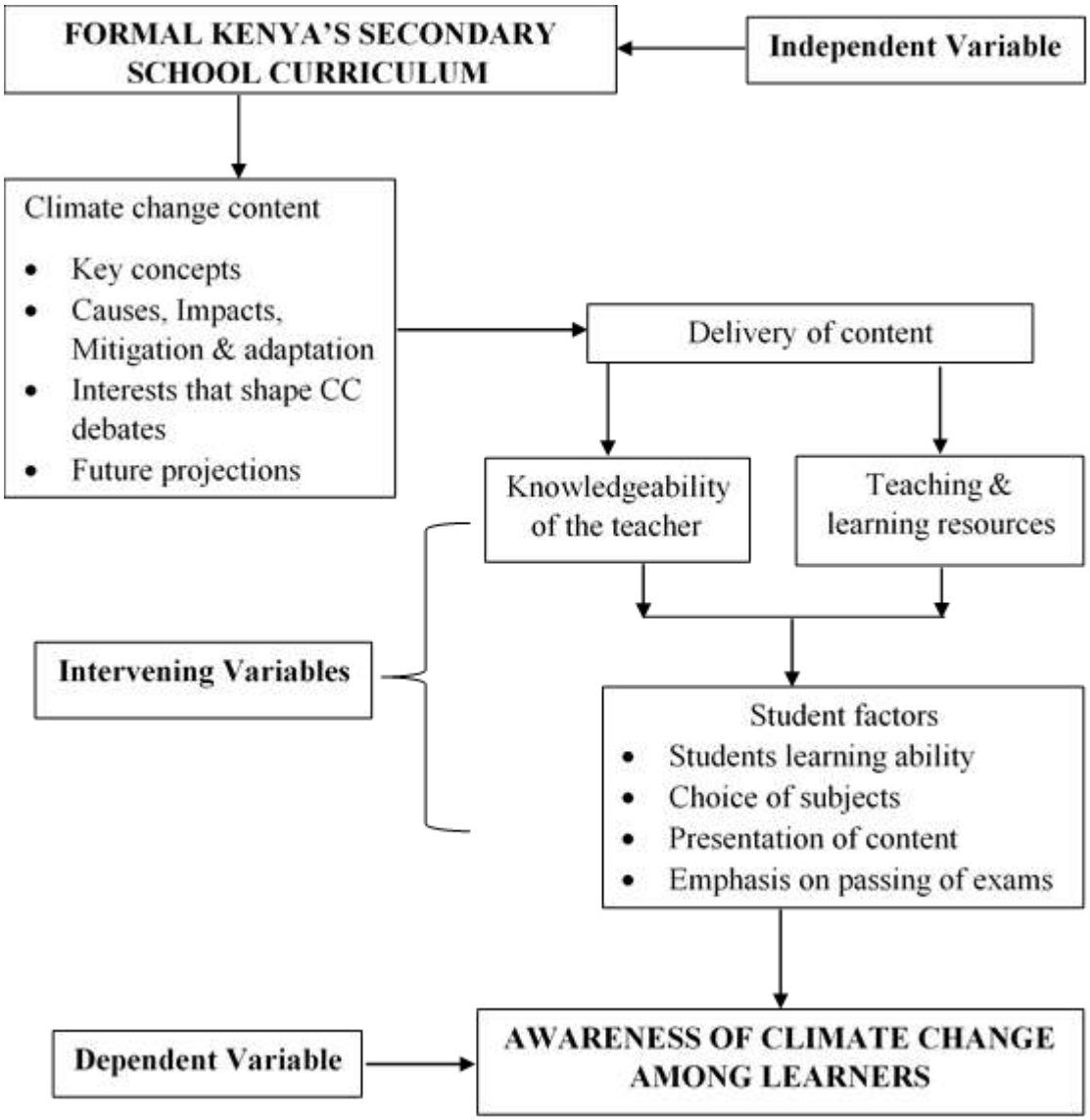

Figure 1.1: The Conceptual Framework

Source: Developed by the researcher

CC: Climate change

Figure 1.1 shows that awareness of climate change among learners (dependent variable) relies on the formal curriculum's (independent variable) content and delivery of the same to the learners. However, this will depend on several intervening variables. The delivery of content will be affected by both teachers' as well as students' characteristics. Assuming the required content was available, its delivery will depend on teachers' knowledgeability and availability if teaching and learning resources to effectively deliver the content. Creating the awareness will also depend on student characteristics as shown in the figure. Such factors that will lead to effective conceptualization of taught knowledge among learners include their mental ability, choice of subject, the presentation of content among others. The teacher and student factors also formed part of the intervening variables.

1.9 Operational Definitions of Terms

Adaptation: Human adjustment to a changing climate to ensure his continued survival in more severe climatic conditions.

Climate change content: Content in Kenya's secondary school formal curriculum that meets the threshold as per 8 thematic areas addressed in Appendix 1.

Climate Change Mitigation: Human interventions aimed at reducing greenhouse gases and consequently reduce their impact on climate systems.

Climate Change: These are changes in weather patterns attributed to increase in greenhouse gases in the lower atmosphere mainly due to human activities but also due to some natural events.

Curriculum: The formal and informal content and process by which learners develop skills, gain knowledge and understanding, and alter attitudes, appreciations, and values under the support of an academic institution.

Global warming: This is a situation that results from the effect of greenhouse gases. The gases trap heat in the atmosphere and re-radiate it leading to warming of the lower atmosphere.

Greenhouse Gases: They are gases that exist in the atmosphere, naturally or aggravated by human activities, which absorb infrared radiation and re-radiate it back to the lower atmosphere leading to its warming. Such gases include carbon (IV) oxide, methane, sulphur dioxide and water vapour.

1.10 Conclusion of the Chapter

The introductory chapter has given a detailed perspective towards the research problem. The chapter has given background information concerning the topic of study and therefore introduced the research problem which is basically assessing whether the current secondary school curriculum is effective in creating awareness about climate change among learners. In so doing, the study has developed three objectives to guide the study and consequently three research questions that the study aims to answer. The significance of the study has also been outlined in this chapter showing how different institutions will benefit from the findings of the study. The chapter has also explicitly shown the relationship between the variables in the study through a conceptual framework developed by the researcher. Finally, operational definition of key terms used in the study has been provided at the end of the chapter. The study in the next chapter reviewed other scholars' contribution towards the topic under study with an aim of establishing a gap in knowledge that justified the conducting of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The previous chapter gave an introduction to the study that aimed at stating the problem and charting the way forward for solving the research problem. In this chapter, the study reviewed published work, journals, scholarly articles and previous researches done in regard to climate change, the topic of study. The chapter is organized in sections relating to the objectives of the study. The chapter is concluded by giving a summary and identifying the research gap that needs to be filled by undertaking this research.

2.2 The Context of Climate Change and Curriculum

The fragile nature of the earth today as a result of a changing climate is a danger to humanity as well as to our natural environment and thus requires urgent attention. Nkechi (2014) argues that education is a most powerful weapon for such needed change and direction. The arguments are supported by Ukeje (2000) who argues that education is so powerful that it can heal and build but the same depends on the type of education provided and particularly the teacher who is the pillar of the education process.

Similarly, UNESCO (2009), argued that education has a central role to play in understanding, mitigating and adapting to the changing climate. They added that although education at all levels and in both formal and informal settings is needed, imparting climate change understanding and awareness at a young age is the best way to change attitudes and behaviours. EACCCMP (2011), posed similar sentiments that acknowledged the role of education as a key tool in responding to climate change issues. Learning institutions are expected to play an important role developing climate change

knowledge and presenting the same in a way to benefit local communities and East African Community member states.

The issues under discussion in this research are inarguably, climate change and education (guided by a curriculum). There is therefore need to give an overview of the concepts of climate change and curriculum to better understand issues surrounding them. Sections 2.2.1 and 2.2.2 give an in-depth review of the concepts of climate change as well as curriculum.

2.2.1 Climate Change and Related Concepts

Different authors have advanced different definitions for the concept of climate change. For instance, The Intergovernmental Panel on Climate Change (IPCC, 1990), defined climate change as an occurrence created by nature and human beings, which is likely to overwhelm the earth and cause dire suffering of unpredicted extent to the living. On the other hand the United Nations Environmental Programme (UNEP) defined climate change as extreme responses of the weather phenomenon which creates negative impacts on human health, agricultural resources, vegetation, water resources, soil, depletion of the ozone layer, and doubling of carbon (IV) oxide (CO_2) in the ecosphere (Ezra, 2010).

Medugu (2009), in a more recent study submitted that climate change is a scenario believed to be contributing to an increase in average global temperatures and that, it is caused by natural events and human activities. Anyadike (2009), points out that a situation in which a change in the weather pattern continues in one direction at a swift rate and for a remarkably long period of time is known as climate change. Similarly Eboh (2009), explained climate change as statistically substantial variation in weather patterns that continues for an extended period, normally decades or longer, and that are associated with inconsistencies in the occurrence and magnitude of erratic weather events.

All the previous definitions attribute climate change to human as well as natural causes, however, the United Nations Framework Convention for Climate Change (UNFCCC) defined it as a change of climate that is attributable directly or indirectly to human activities and, which alters the composition of the global atmosphere, in addition to

natural climate variability observed over comparable time periods (cited in Omotosho, 2007). From the definition, the idea that climate change is human induced and the concept 'climate variability' emerges. United Nations Framework Convention on Climate Change (UNFCCC, 2004), uses 'climate variability' for non-human caused variations and argues that climate change only refers to the changes in modern climate, including the rise in average surface temperature (global warming) caused by human beings. The idea of human induced climate change was later advanced by The Intergovernmental Panel on Climate Change (IPCC, 2007), who stated categorically that climate change is predominantly human-induced. They stress that people's actions are escalating the climate's natural variability, and the earth's temperature is rising.

Climate change goes hand in hand with the concepts of global warming or global weather patterns. According to Jekayinfa and Yusuf (2012), the concept of global warming refers to a situation where Greenhouse Gases (GHGs) absorb terrestrial emissions from the earth and re-radiate the heat back to earth. They explain that the sun discharges heat onto the earth's surface which absorbs part of the heat and reflects another share into the atmosphere and sends out a third share in the form of infra-red rays. The rays are then prevented from escaping by clouds and water vapour and other greenhouse gases, which stabilize the earth's temperature under normal circumstances. However, due to a significant increase in concentration of GHGs, produced by human activity, temperatures have consequently increased in the lower atmosphere. This scenario is referred to as global warming.

As we stand now climate change is the biggest environmental problem of our time. Former United Nations (UN) Secretary-General, Ban Ki Moon, in 2008 declared climate change to be the defining challenge of our time (UNESCO, 2010). Romm (2007), observed that climate change was coming faster and rougher than scientists had expected while Medugu (2009), warned of the dire consequences posed by climate change warning that it has the potential of affecting all natural and human systems hence posing a threat to human development and survival politically, economically as well as socially.

Scholze and Prentice (2006), attribute climate change to increased human prompted actions such as: the extensive use of land, large scale deforestation, major shifts in technology and /socio-economic activities leading to reduced dependence on organic fuel, and the increased uptake of fossil fuels. Human-induced (anthropogenic) climate change is caused by accelerated production of greenhouse gases, including nitrous oxide, carbon (IV) oxide (CO_2) and methane. Carbon (IV) oxide, the main GHG responsible for global warming, is primarily produced by the burning of fossil fuels such as coal, natural gas and oil. Although methane occurs in smaller extents than CO_2, it has higher warming effects. Increased methane production is attributed to increased numbers of livestock kept for meat production. It is also attributed to warming of permafrost areas of Siberia and Canada since the permafrost lakes store methane gases and therefore their melting would lead to emission of the gas into the atmosphere. In general, increases in greenhouse gas production are directly associated with the post-industrial period of 1750 in Western countries. The gases now far exceed the natural rate of greenhouse gas production and are responsible for the current warming.

The consequences of a warming climate are highlighted by Ishaya and Abaje (2008) as loss of biodiversity, reduction of wildlife and other natural resource base, deterioration in soil conditions including soil moisture and nutrients, increased damage to the environment, regular droughts, increased rural-urban migration, increased invasion of crops by pests and diseases, depletion of household assets, changing livelihood systems, changes in the type of vegetation, decline in forest resources, increased health risks and the spread of infectious diseases (in Jekayinfa and Yusuf (2012). Such changes as noted by United Nations Development Program (UNDP, 2011), will impact on major sectors of the economy as well as crucial drivers of growth, including natural resources, agriculture, health, water and infrastructure. Coupled with developing country's low adaptive capacity to climate change, the countries will experience a high level of vulnerability and a complex development picture.

Locally Birkett et al., (1999), noted that rain-fed agriculture being one of the main sectors of the country's economy and livestock production being central to livelihoods and food security in the arid and semi-arid lands (ASALs) all depend largely on agro-ecological

factors such as rainfall, temperature and soil characteristics. Climate change and resultant weather-related hazards therefore present a serious threat to the socio-economic development of the country. Although climate change impacts will vary based on locality, the probability of disruption of Kenya's agricultural sector is very high. Ability to adapt to future changes, they suggested, depends on improved technology transfer such as more reliable long-term weather forecasting among such measures as changes in crops and crop varieties, improved water management and irrigation systems, and changes in planting schedules and tillage practices.

EACCCMP (2011), submitted that changes in climatic conditions (as a result of climate change) such as changes in temperatures, precipitation, humidity as well as wind patterns are likely to create conducive conditions that will ensure increased reproduction and development as well as guarantee disease carrying vectors a longer life. This will lead to increase in the prevalence of vector borne diseases. They exposed a case scenario where malaria (an example of a vector borne disease) is spreading into the highlands of Lake Victoria basin that were previously free of the disease. They also warn that water systems are going to be affected and as a result waterborne diseases including dysentery, typhoid and cholera will become more prevalent. Food security for East African Nations will also be impacted negatively owing to the fact that climate change is likely to lead to prolonged droughts. This will affect subsistence farming and livestock rearing and consequently lead to increased cases of malnutrition. This is also likely to worsen the situation for other diseases such as HIV/AIDS, which are highly dependent on proper nutrition. All these put together are going to strain the already overstretched and underfunded health facilities in East Africa.

Ngecu and Mathu (1999) as cited in EACCCMP (2011), explain another risk to countries as a result of climate change. They cite adverse weather events. Extreme weather events have already had their share of impacts in Kenya. For instance the elnino phenomena that was experienced in East Africa in 1997/98 cost Kenya more than a billion US dollars of infrastructural damage. Other impacts included hundreds of deaths related to flooding.

Other impacts of climate change that are likely to be experienced include increased temperatures that are likely to result in distorting of railway tracks thereby worsening the chances of derailment of trains while rainstorms accompanied by landslides could possibly wash away rail tracks and bridges RoK (2010). IPCC (2007), also envisages a global rise in sea levels of up to 59 centimetres by 2100. If this was to happen Awuor, Orindi and Adwera (2008), warn that Mombasa which stands 45 meters above sea level is likely to have 17% of its land surface submerged by only a 30 centimetres rise in sea level. This is likely to greatly impact negatively on Mombasa Port facilities as well as lead to complete disappearance of popular beaches greatly affecting the tourism sector. In a parting shot, climate change impacts are already being felt in East Africa and Kenya in particular with reduced ice cap on Mount Kenya and Kilimanjaro. Further warming will lead to disappearance of the ice caps and subsequently impact negatively on tourism, a major foreign exchange earner for Kenya.

2.2.2 The Concept of Curriculum

According to Pratt (1994), and Barrow and Milburn (1990), the word "curriculum" is derived from the Latin verb *currere*, "to run." "*Currere*" became a diminutive noun and meant a "racing chariot" or "race track." Later an extension was made that associated the term with *curriculum vitae* that means "the course of one's life." It was also associated with *curricula mentis* that figuratively refers to "the (educational) course of the mind." After the nineteenth century the term became commonly used in the educational field.

Over the years several writers have advanced different definitions for the concept of curriculum. For instance Saylor and Alexander (1954), defined it as the total effort of the school to bring about desired outcomes in school and other teaching institutions. The definition was later improved by Kerr (Quoted in Kelly 1983), who defined it as all the learning which is guided by the school whether it is carried out individually or in groups inside or outside schools. Beauchamp (1968), deviated from earlier definitions and viewed curriculum as a document which contains ingredients and is used as a plan for education of pupils during their enrolment in a given school. However, Wheeler (1978), explained curriculum as "a sequence of potential experiences set up in schools for the purpose of disciplining children and youths in ways of thinking and acting." He

expounded that the curriculum of any school entails all the experiences that a school may select and constantly organize for the purpose of "bringing about changes in the behaviours of the learners and as a means of developing the personality of the individuals."

More recent studies by Doll (1996), explicate that curriculum is the formal and informal content and process by which learners develop skills, gain knowledge and understanding, and alter attitudes, appreciations, and values under the support of an academic institution. He argues that curriculum is the total experience that includes not only the content selected and delivered, but also the planned and unplanned activities in which individuals' participate as students. Similarly Offorma (2002), referred to curriculum as the total experience involving the school in the process of educating young people which includes the subjects, content, teacher, method of teaching and evaluation as well as the psychological and physical dimensions of the experience.

Curriculum goes hand in hand with the concept of a syllabus. According to Kelly (2009), curriculum differs from syllabus in different ways, such as: whereas curriculum refers to a blue print of education at a certain level, a syllabus refers to the quantity of content to be taught in an academic year/term. Again, curriculum is long term in nature and visionary while a syllabus refers to content to be covered in a particular time. Lastly, curriculum is a macro plan constituting a whole while on the other hand a syllabus is a micro plan which is a part.

Curriculum development involves a complex process. Different models have been developed concerning development of a curriculum. However Abul (2013), highlights four major steps in the development of a curriculum. In his model, he argues that the first step in development of a curriculum is Situation analysis. According to Print (1993), situation analysis forms the point for commencement of the construction of a curriculum. Situation analysis gives an ideal opportunity for curriculum developers, aware of the curriculum indication factors affecting them, to put forward a reasoned and rational approach to the development of curricula. At this stage important figures and facts are established first before developing the curriculum. Such factors according to Nicholls and

Nicholls (1974) include: facilities and equipment, pupils' home background, the school, its climate and staff. Situational analysis is done through a needs assessment and aims at identifying tasks and problems and seeking possible solutions, identifying difficulties and possible areas of resistance, clues to planning for the resources and the organizational changes that will be required (Abul, 2013).

The second step involves formulating objectives. Abul (2013), asserts that objectives are derived from analysis of the situation to reflect: the needs of the learner and institution, the needs of the instructor/teacher and the needs of the society. They constitute the behaviours which the learners are expected show if the aim of the course is attained. For instance, what knowledge and perceptions they should have, what skills they should possess, what values and attitudes they should develop.

Formulation of objectives according to Abul (2013) is followed by selection of content. Curriculum content is a body of facts, ideas, concepts and skills that are presented, discussed and involved in the course. The selected content should reflect the curriculum objectives and experiences needed by the learner. Selection of content should be guided by what society has achieved, aspirations, its institutions, traditions and beliefs. The curriculum designer should ensure that the knowledge to be selected must be of reputable value to the learners and the society they are going to serve after learning.

Third in the model is Evaluation and Assessment. Curriculum evaluation involves the collection of information to facilitate judgment about the worth and the effectiveness of a curriculum (Afzaal, 2011). It involves continuous assessment throughout the course as well as final examination at the end of the course in order to measure the success of curriculum. Curriculum evaluation and assessment enables curriculum developers make judgments so as to make a decision on whether to retain the curriculum or whether the needs to be reviewed or done away with altogether (Abul, 2013).

Curriculum takes three major dimensions as Claudio (1988) noted. Firstly, it is could be formal education. This is a rather rigid form of curriculum in terms of objectives, content and methodology. It forms an organized education model, which is systematically structured and administered according to a given set of laws and norms. It is

characterized by a prescribed syllabus and is carried out on a regular basis in a classroom or outside a classroom but in an organized manner with regular attendance by students. Teachers and students alike are expected to adhere to a strict schedule involving transitional and final assessments in order to advance students to the next learning stage. Formal education formed the basis for this study.

Education can also be Non-formal. Ward et al., (1974) claim that a comprehensive and standard definition of non-formal education is not yet available in common usage. However, it is seen as an aspect of curriculum that is organized in a less rigid manner with programs not restricted to a specific class, level or age. The two main features that characterize non-formal education are centralization of the process on the student, as to his previously identified needs and possibilities; and, the immediate usefulness of the education for the student's personal and professional growth.

Lastly, education can be Informal. Claudio (1998) argues that informal education consists of unplanned activities in which students learn by observing and interacting with the school environment, home community, electronic media etc. It does not necessarily include the objectives and subjects usually encompassed by the traditional curricula. It is aimed at students as much as at the public at large and imposes no obligations whatever their nature. Curriculum in this influences practices and behaviour which may be desirable or undesirable. There generally being no control over the performed activities, informal education does not of necessity regard the providing of degrees or diplomas; it merely supplements both formal and non-formal education.

2.3 Climate Change Content in the Curriculum

Section 2.2 of the study acknowledges the crucial role that education is able to play as far as creation of awareness on causes, consequences, mitigation and adaptation to climate change is concerned. However, despite the crucial role played by education, the East African Community Climate Change Master Plan (EACCCMP) (2011) asserts that curricula of most developing countries, especially in Africa, show critical shortage of climate change content at all educational levels from primary to tertiary levels and as a result, Africa has the least intellectual capacity to deal with the climate change challenge.

Africa countries therefore, have to make significant and well-targeted investment in education and training, curriculum development, research and effective practices for communication of research findings. Such investments would yield dividends when carried out around climate change.

However, African countries have made efforts to arrest the situation. For instance, Nkechi (2014) reports that the Dar-res-Salaam forum on Education Capacity Building and Climate Change Curriculum and Strategy for Collective Action in Africa met to articulate a vision and to come up with a strategy for developing appropriate curricula on climate change, to reinvigorate teaching in order to better address climate change issues, to cultivate demand for climate change course and to bring existing courses to include issues of climate change and to put in place certain professional training modules. Thus curriculum for climate change will lead students to a progression of understanding of how humans cause climate change, the impact of greenhouses and the action necessary.

In tandem with this EACCCMP (2011), concurred that in EAC Partner States, climate change education holds a peripheral position with only a few courses being offered in some colleges, private universities and public universities. Main universities in Kenya including Kenyatta University, The University of Nairobi, and The United States International University are only reported to offer courses in Meteorology, Geography, Environmental and Resource Management which contain content related to climate change.

As a specific discipline, EACCCMP (2011) states that some institutions have incorporated climate change studies in the post graduate level. For instance, Egerton University through its Tegemeo Institute has incorporated climate change research in its research agenda. The University of Nairobi in its Institute for Climate Change and Adaptation (ICCA), a research institute has been introduced to focus on climate change adaptation. The university also offers an executive course on climate change mitigation and adaptation (Climate Change and Renewable Energies) in the Department of Meteorology. However the master plan acknowledges that considering the threat posed by climate change to mankind and especially in developing countries, more effort is still

required from educational institutions to create awareness, impart skills and change people's attitudes to face climate change.

A study by Ochieng (2010) on Kenya's primary school syllabus also revealed that Kenyan pupils are taught basic principles of weather and climate, addressed through Science and Social Studies subjects. However, he argues that despite the presence of weather and climate knowledge, the current syllabus only offers limited knowledge on climate change but is only restricted to factors influencing climate and impacts of climate on human activities. Adaptation to climate change, though a very important concept for Kenya, is seemingly lacking in the current syllabus. Similar concerns are expressed in RoK (2012), which states that only 0.36% of issues related to climate change is either addressed directly or indirectly by the Kenya's primary school curriculum and recommends integration of climate change knowledge into all subjects taught in under the curriculum.

GoK (2012), recognizes this fact and in its National Climate Change Action Plan acknowledges that to support a future climate resilient economy, students at secondary school level will need to be equipped with climate change knowledge and skills. The plan proposes that such infusion of climate change content into the curriculum should be done through introduction of content that is likely to equip learners with climate adaptation and mitigation skills. Such content should touch on specific areas such as alternative clean energy and reduction of deforestation.

Studies reviewed in this section expose the fact that climate change content remains inadequately addressed in curricula of most African countries, Kenya being one them. Reviewed literature however shows a gap as far as secondary school curriculum is concerned. It does not expose some of the areas that are addressed in the current secondary school curriculum. This study therefore, went out to establish climate change content that is available in the current secondary school curriculum as guided by objective one of the study expressed in section 1.4.

2.4 Awareness of Climate Change among Teachers and Students

Guided by the objective two of the study in section 1.4, this section reviews literature on awareness of climate change among students and teachers. The section study was interested in establishing how well teachers are versed with knowledge on climate change issues and how best they are passing the same to their students. The study was also interested in establishing the source of such knowledge to ascertain whether it is actually as a result of the secondary school curriculum.

Before delving into awareness among teachers and learners, it is important to note that people's awareness of climate change depends on some factors. Ochieng (2014) argues that people's level of awareness of climate change is influenced by among other factors, level of education. His arguments are in tandem with Acquah (2011) who asserts that individuals with high levels of education are more likely to be aware of climate change. Other factors, according to Ochieng, include: demographic factors including age, gender, and personal experience including experience of extreme weather events; and access to information including media coverage of the issue and advocacy.

In general, Pugliese and Ray (2009) affirm that numerous studies conducted reveal that the vast majority of people across the world, especially in developing countries, are still unaware of climate change despite their high vulnerability to the impacts of climate change. Taderera, (2010) also asserts that despite their experience of changing weather patterns, people in Africa, are poorly informed about global climate change. UNFCCC (2007) argues that the low level of awareness on climate change across sub-Saharan African countries is attributed to limited awareness campaigns on one hand and the fact that African countries have got too many problems ranging from poverty to political conflicts on the other hand hence climate change is never a priority issue.

Locally, Otieno, Pauker and Maina (2009) affirm that the majority of Kenya's population is unaware of climate change, notwithstanding climate variability being experienced in the country. However, they remain very much aware and concerned about frequent droughts and food scarcity in the country The government of Kenya acknowledges this fact and as a result has developed the National Climate Change Response Strategy (2010)

and its implementation plan, the National Climate Change Action Plan (2013-2017), outlining actions to be taken to mitigate and build resilience to the impacts of climate change. Following this, Ochieng (2014) argues that even as resources are put together to mitigate climate change, there is need to educate people on what climate change really is. Increasing people's awareness on climate change through education is an important measure to persuade people at all levels in the community to play an active role in mitigating and adapting to climate change.

Intentions of reviewing school curricula to include climate change knowledge at all levels is demonstrated in the NCCAP 2013-2017. However, Ochieng (2014) affirms that before that is done it is important to assess the teachers' level of awareness on climate change since their level of awareness is likely to influence how they transfer climate change knowledge to the learners. Anderson (2010) reaffirms that teachers are an untapped resource that the world can use to combat climate change. They can use their expertise to disseminate information on climate change in the classroom and beyond the school compounds to help individuals and communities make informed decisions and take sustainable actions to build a climate resilient society. However, Otieno, Pauker and Maina (2009) confirm that very little research has been done to investigate the level of climate change awareness among teachers.

Some of such studies have been conducted in Nigeria and include one Akinnubi et al. (2012) that reviewed secondary school teachers' level of awareness in Ondo West Government Local Area and another by Ekpoh and Ekpoh (2011) in Ondo State and Calabar Municipality. Both studies revealed a general low level of awareness of climate change issues among secondary school teachers.

In Kenya, RoK (2012) affirms that only 1.11% of issues related to climate change are either addressed directly or indirectly by the Primary Teacher Education Curriculum in Kenya and hence, the majority of primary school teachers in Kenya may have limited understanding of climate change and this may affect their delivery on this subject. Another study by Ochieng' (2014), among primary school teachers in Kisumu County, Kenya revealed that primary school teachers recorded a medium level of awareness on

climate change, which shows that they have some good understanding of climate change, but gaps exist in their knowledge.

Ochieng' argued that although teachers appeared to be aware of the causes, effects and mitigations of climate change, they expressed limited understanding of the role of fossil fuel and poor management of waste in climate change. Teachers also exhibited little knowledge surrounding the existence of the UNFCCC, Kyoto Protocol and IPCC. They also portrayed limited understanding of the effect of climate change on sea level as well having poor understanding of the scientific consensus on anthropogenic climate change. Ochieng's analysis also revealed that teachers' personal reading of books and related materials, research in the internet, and informal trainings by Non-Governmental Organisation (NGOs) has played a significant role as sources of their climate change knowledge.

Literature and arguments in this section reveal that there is limited research as far as awareness of climate change among teachers is concerned. The study reviewed in Kenya was among primary school teachers in Kisumu County. No such study was found to have been done in Githunguri Sub-county of Kiambu County Also, studies reviewed here did not link the level of awareness among teachers to the current curriculum in secondary schools. This study therefore felt that there exists a gap in knowledge as far as awareness of climate change among teachers in secondary schools in Kenya is concerned. This necessitated the study in a bid to address the second objective of this study as expressed in section 1.4.

This study also sought to establish level of awareness of climate change among secondary school students. The study established that limited studies exist that delve into students awareness of climate change issue. One such study was conducted by Oruonye (2011) who examined the level of awareness on the impacts of climate change effects among tertiary institution students in Jalingo Metropolis, Nigeria. The study established that low level of awareness existed among the students. Of the 225 students Oruonye interviewed, 18.8% had never heard of climate change before while 89% of those who claimed to be aware of climate change were unaware of its causes, effects, and possible

adaptations or mitigations measures. A study was also conducted among junior high school students in Ghana by Owolabi, Gyimah and Amponsah (2012). Their study sought to compare students of different ages as far as awareness of climate change was concerned. The study revealed that awareness of climate change and sustainable development was more significant among younger students (below 15 years) are than in older students.

In conclusion to this section, it is important to note that very limited research was found in the area of climate change awareness among learners in secondary schools. The study from Nigeria was on tertiary institution students and mainly assessed level of awareness of climate change impacts only. The second study mainly emphasised age of students as far as awareness of climate change is concerned. None of the two studies reviewed linked the awareness of students to the learning process (curriculum). This study saw this as a gap in knowledge and delved into it in a bid to establish to what extent curriculum is creating awareness about climate change among Kenyan secondary school students.

2.5 Effectiveness of Curriculum Developers in Infusion

2.5.1 The Development and Need for Environmental Education

In a bid to solve environmental and climate change issues, education has been seen as a crucial player. UNESCO (2009) has argued that understanding, mitigating and adaptation to the changing climate will largely depend on education, either formal or informal, at all level but education at a young age would be best in facing the challenge. It is on these basis that education around environmental issues has been evolving over the years. Environmental education according to Stapp et al., (1975) dates back to the first International Environmental Education Conference, which took place in Belgrade in 1975. The conference defined environmental education as an integral part of the educational process, aimed at practical problems of an interdisciplinary character, build a sense of values, and contribute to public well-being. Its focus should reside mainly in the initiative of the learners and their involvement in action and guided by both the immediate and future subjects of concern.

The idea was further advanced in the Conference on Environmental Education later held in Tbilisi in 1977. The conference defined Environmental Education more explicitly as a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and has the attitudes, motivation, knowledge, commitment and skills to work individually and collectively towards solutions of current problems and the prevention of new ones (Stapp 1997).

According to Stapp (1969), Environmental Education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work towards their solution. UNESCO and UNEP identified six key objectives of environmental education as to: create awareness and sensitivity to the environment and its associated problems; help individuals and social groups to acquire understanding of the environment and its related problems; help an individual acquire a set of values and feelings of concern for the environment and the motivation for active participation in environmental improvement and protection programmes; foster and assist in conservation practices and the skill needed to prevent environmental degradation; evaluate government programmes and land management practices that are being introduced and to opportunity for social groups and individuals to be actively involved at all levels in working towards resolution of environmental problems.

Recently UNESCO (2010), introduced the concept of Climate Change Education for Sustainable Development (CCESD). They argue that knowledge, skills and competences relevant to mitigation and adaptation of climate change are the core elements that the school curricula should include. They propose that Climate Change Education should introduce basic scientific concepts, theories and projections of climate change with themes such as disaster preparedness, sustainable consumption, recycling, water, desertification, environmental protection and renewable energies should be discussed, taking into account their significance in the specific national and local context.

2.5.2 Efforts and Challenges of Infusing Climate Change into Curricula

Although Environmental Education has been given an increasing attention at the global level, realising the crucial role of Environmental Education as well as Climate Change Education, numerous challenges still exist in their development. For instance, (Bangay & Blum (2010) argue that Environmental Education in many cases is seen as an alternative education which is given little attention in the mainstream education but only addressed as an 'add-on' involving environmental topics in the curriculum. Rickinson (2001) argues that such inclusion of some environment related themes or topics in the form of classroom lessons across various school subjects may not be sufficient to bring about meaningful pro-environmental behaviour among learners - which is the ultimate goal of Environmental Education.

UNESCO (2005), also identified the professional development of teachers in education for sustainable development as the top priority, in recognition of the transformative role that teachers and teacher educators need to play in re-orienting education to help realize a sustainable future. Chakeredza et al., (2009), affirms that university education has a vital role to play in strengthening knowledge systems. They noted that issues of climate change should be infused into curricular of universities as a matter of urgency. The growing need for evidence based scientific data on African experiences to be infused into the curricula to serve the African specific problems is overdue. However, UNESCO (2005), sadly noted that development of teacher education in Climate Change Education for Sustainable Development is in its infancy.

Bloom et al., (2005), affirms that fact and claims that despite the fact that Higher Education plays a critical role in preparing and providing leadership to meet these challenges and to stimulate sustainable development, Africa is among the continents with the least intellectual institutional and technological capability to address the climate challenge. Rolls et al., (2009), endorsed the thoughts by claiming that climate change education has peripheral status in educational research and practice, and when it is addressed, it is only within science education. He emphasized the clear and present need to respond to climate change challenges through systematic education programmes that are not restricted to a single subject area while Okey and Ndum (2013) pointed out that

the curricula could be handled as a separate subject or infused and integrated into the existing courses.

According to Ochieng' (2014), the Kenyan government being aware of and concerned about climate change as a development issue. The government recognized the need to develop the National Climate Change Response Strategy – 2010 and its implementation plan, the National Climate Change Action Plan 2013-2017, which outlines actions to be taken to mitigate and build resilience to the impacts of climate change. The NCCAP recognized the need to infuse climate change content into the curriculum. Efforts have also been made through the eight goal of education that was introduced in 2003. The goal states that education is meant to promote positive attitudes towards good health and environmental protection.

The discussion in this section exposes limited research exists as far as efforts made by curriculum developers in infusing climate change content into the curricula if different countries. Although the NCCAP appreciates the need to infuse climate change content into the curriculum. Literature available does not explain the extent to which the curriculum developer (KICD) has made effort in infusing climate change content. It is for this reason that the study established a gap and delved into the field to establish the efforts being made by KICD and some of the challenges they face in so doing.

2.6 Identified Knowledge Gaps

A wide range of studies were reviewed in this research. It was established that most studies delved on issues of students' awareness of climate change (Henry et al., 2012); teachers' awareness (Eunice and Joy, 2014; Ekpoh and Ekpoh, 2011; Nkechi, 2014); climate change impacts (Aja, 2015); infusion of climate change into secondary school agricultural science (Michael, 2014) and the role of media in creating climate change awareness (Onkargouda et al., 2013). Studies reviewed from Kenya mainly touched on indigenous coping and adaptation strategies (Edward et al., 2014) and perceptions of teachers towards the integration of adaptation strategy topics on climate change into secondary school agriculture syllabus (Stephen et al., 2014). Notably, few studies have been conducted in Kenya in regard to climate change.

The studies reviewed in this chapter expose gaps in knowledge as far as contribution of curriculum in creating awareness about climate change is concerned. For instance, studies that have assessed the level of infusion of climate change content into the curriculum are limited. The few studies that exist, especially in Kenya, have delved mainly in curricula of primary schools and also universities. The studies have failed to establish main climate change areas addressed in the current secondary school curriculum in Kenya. It is for this reason that this study went out to undertake content analysis on selected secondary school subjects in a bid to establish the extent to which climate change content exists in the current formal secondary school curriculum.

The review on awareness of climate change among teachers and students also established gaps in research as well. The study established that limited research had been done to ascertain the levels of awareness among teachers and students. As far as awareness among teachers was concerned, the study found out that research had been done in Kisumu County among primary school teachers (Ochieng', 2014). The research had established moderate levels of awareness among teachers in that region. This study however, noted a gap in that Ochieng's study had not included secondary school teachers. His study also did not link awareness among teachers to the curriculum. It is for these reasons that this study set out to establish the level of awareness among sampled secondary school teachers in Githunguri Sub-county and also attempt to link level of awareness among teachers to the secondary school curriculum.

Review of awareness among students was mainly concentrated in other countries, especially Nigeria. Limited research was found to have been done in Kenya therefore prompting this study. Research found and reviewed established awareness among tertiary institution students hence left a gap in secondary schools. Another study compared level of awareness Vis a Vis the age of students. All the studies failed to establish the level of awareness of climate change among secondary schools students and link the same to exposure to secondary school curriculum. This study established that gap and sought to find out the level of awareness of climate change among students in secondary schools in Githunguri Sub-county as well as establish the link between awareness and the school curriculum.

Lastly the study reviewed literature on effectiveness of curriculum developers in infusing climate change content into the curriculum. This study established that most of the available research delved into curriculum policies and challenges of infusing climate change and environmental education into the curriculum. The study established that a gap existed as far as establishing the situation on the ground away from policy documents. The studies in Kenya mainly concentrated on the NCCAP that highlights the need to change curricula to include climate change content. However, there are no studies that establish the efforts being done by KICD to that effect. This study established that gap and saw the need to move out to the field and establish efforts that have been made to infuse climate change content into the curriculum and the challenges being met.

2.7 Conclusion of the Chapter

In this second chapter of the study, scholarly work, policy documents and journals have been reviewed in a bid to shed more light on curriculum and its contribution in creating awareness of climate change in secondary schools. Numerous studies have been reviewed and provided vital information around the topic of study. However, this study establish that limited research has been undertaken especially in Kenya about the topic. The study also established that gaps existed in the studies already done. The gaps established in the previous section therefore necessitated the need for this study in a bid to fill them. The next chapter outlines the research methodology that was adapted to undertake the research with the aim of filling the identified gaps in knowledge.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

Cohen & Manion (2007), defined the concept of research methodology as the range of approaches used in research to gather data, which is used as a foundation for interpretation, for explanation and prediction. This chapter is therefore aimed at explicitly outlining the procedures that were used in collecting data in a bid to make conclusions about the topic of study. This section will elucidate the study area, research design, sample size and sampling procedure, data collection and data analysis procedures among other sections.

3.2 Research Design

The study adopted a descriptive survey design. The study also used both qualitative and quantitative approaches. However it was more inclined to the qualitative approach. According to Orodho (2005) a descriptive survey design is useful in gathering information by interviewing or administering questionnaires to a sample of individuals to

obtain data useful in evaluating present particulars which have not controlled or manipulated the situation. Ogula (2005) also affirms that the design is used in preliminary and exploratory studies, to allow the researcher to collect data, organize, summarize, present and interpret for the purpose of clarification. Since this study is highly qualitative and aims at seeking clarification as pertains the issue of climate change and Kenya's curriculum by collecting data from individuals by administering questionnaires and interviewing, the design was deemed the best and was therefore adopted for the study.

3.3 Study Area

The study was conducted in Githunguri Sub-county located in Kiambu County (see the map in figure 3.1). Kiambu County is located in the central region of the country and it borders Nairobi County and Kajiado County to the South, Nakuru County to the West, Nyandarua County to the North West, Murang'a County to the North and North East and Machakos County to the East. The county lies between latitudes 0° 25´ and 1° 20´ south of the Equator and Longitude 36° 31´ and 37° 15´ east. The county extends between 1200 M to 2550 M above sea level. It covers an area of 2,543.5 Km^2 with 476.3 Km^2 under forest cover according to the 2009 Kenya Population and Housing Census. Currently, the County is divided into twelve (12) sub-counties namely: Gatundu North, Gatundu South, Githunguri, Juja, Kabete, Kiambaa, Kiambu, Kikuyu, Lari, Limuru, Ruiru and Thika Town. There are 303 secondary schools consisting of 227 public and 76 private schools. The total enrolment rate is 89,065 out of which 44,777 are males and 44,288 are females. The gross enrolment rate is 69.3 percent and the net enrolment rate is 61.8 percent. The number of teachers in the county stands at 3,479 and the teacher/pupil ratio is 1:25. (Kiambu County Government website).

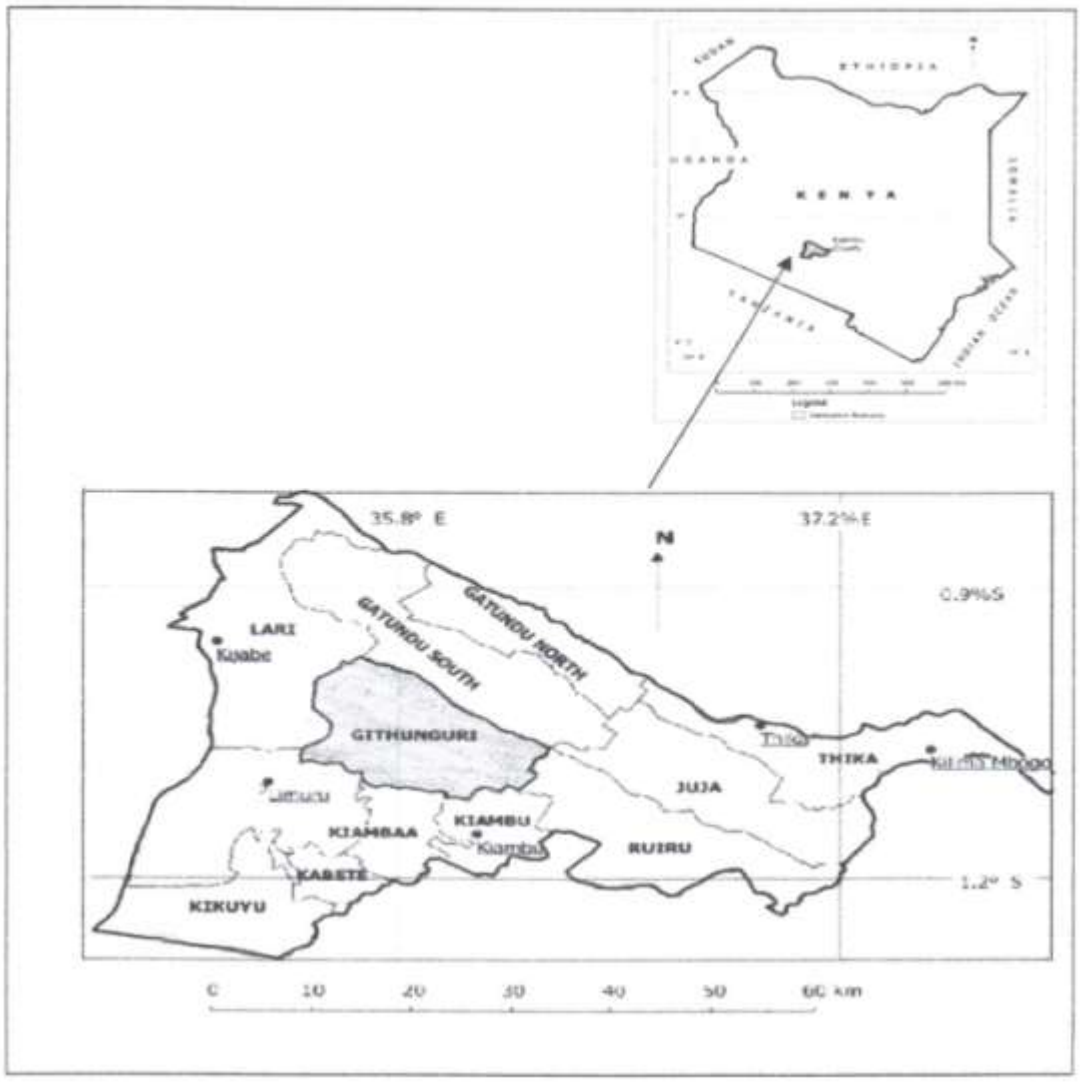

Figure 3.1 Map of Kiambu Showing Study Area

Source: IEBC 2013

3.4 Target Population

The study population according to Mugenda & Mugenda (2003) is the entire set of individuals on which the research findings are made. The target population for this study was 31 public secondary schools, 570 secondary school teachers and 3038 form four students (as per 2013) from Githunguri Sub-county. The study also targeted 25 examinable subjects in Kenya's secondary school education curriculum (Appendix 5), as well 25 KICD officers representing each of the examinable subjects.

3.5 Sample Size and Sampling Procedure

The study adopted several sampling techniques in constituting a representative sample. Using purposive sampling technique, 8 out of 25 examinable subjects were selected to form part of the sample. The subjects were selected based on prior knowledge that they possessed content relating to the topic of study. The subjects were also selected based on the number of students who sat for them at the national examination in Githunguri Sub-county. A subject ought to have been done by at least 20% of the candidates at the national exam (appendix 6).

Using stratified sampling technique, the study divided the schools into boys only, girls only and mixed before selecting the sample. Out of the 31 public secondary schools in the sub-county, 5 are boys only while 4 are girls only and 22 mixed schools. From each of the stratum, simple random sampling was used to select 2 boys' schools, 2 girls' schools and 6 mixed schools to form part of the sample. The technique was used to ensure that major categories of schools were included into the sample owning to their unique characteristics.

From the sampled schools, purposive sampling technique was adopted to select a sample from the teachers. Teachers selected to the sample constituted those that taught the sampled subjects since the researcher felt that they possessed the required information. Therefore 8 teachers were selected from each of the sampled schools making a sample of 80 teachers.

Purposive sampling technique was also employed in selecting a sample from the students. The technique was employed owing to the fact that the form four students had gone through the secondary school curriculum and were therefore best suited to test their knowledgeability of issues under study. From 3038 form four students in Githunguri Sub-county, 10 students were selected from each of the sampled schools using simple random sampling to make up a sample of 100 students. The sample size for the teachers and students was arrived at using a formula by Nassiuma (2000):

$$n = \frac{NCv^2}{Cv^2 + (N-1)e^2}$$

Where n= Sample size, N= Population, Cv = Coefficient of variation (take 0.5) & e = Tolerance of desired level of confidence (0.05).

Finally, using purposive sampling technique, 8 KICD officers were selected to form part of the sample. The sampled officers were those who represented the sampled subjects. The technique was used since the researcher felt that the officer knew the content in the subjects they headed and were therefore in a position to shed more light in a bid to answer the research questions. A summary of the sample and sampling techniques is outlined in table 3.1.

Table 3.1: Sample Size and Sampling Techniques

Category	Sampling Technique	N	n	%
Subjects	Purposive	25	8	32.00
Schools	Stratified	31	10	32.25
Teachers	Purposive	570	80	14.03
Students	Purposive/simple random	3038	100	3.29
KICD Officers	Purposive	25	8	32.00

Key: KICD- Kenya Institute of Curriculum Development, N- Population, n- Sample size

3.6 Research Instruments

Data was collected using four data collection tools namely a thematic area content analysis template, questionnaire for teachers, a questionnaire for students and an interview guide for KICD officers. The instruments are described in the following section:

3.6.1 Thematic Areas Content Analysis Template

A template containing 8 climate change thematic areas identified prior to the study was used to undertake content analysis in the sampled subjects. The thematic areas included: scientific concepts and processes, certainties, uncertainties and projections, causes of climate change, mitigation and adaptation measures, consequences/impacts, time-space

dynamics and interests that shape responses to climate change. The template was used against the syllabi of the sampled subjects to establish the areas that were addressed and those that had not been addressed in a bid to answer the first research question of the study. The thematic areas were drawn from UNESCO (2013). The instrument is presented in Appendix 1.

3.6.2 Questionnaire for Teachers

The teachers' questionnaire had two main sections. Section one of the questionnaire aimed to solicit demographic data about the sampled teachers. This included gender, academic qualifications, teaching experience and subject of specialization. Section two of the questionnaire aimed at soliciting information from teachers as pertains the topic of study in a bid to answer the research questions. The questionnaire for teachers was aimed at establishing the level of awareness of climate change among sampled teachers as expressed in the second objective of the study. Both sections had closed-ended. The questionnaire for teachers is shown at the end of the report as Appendix 2.

3.6.3 Questionnaire for Students

The questionnaire for students aimed at establishing the extent to which learners were knowledgeable about issues surrounding climate change in line with the second objective of the study. The questionnaire had two sections. Section A of the questionnaire aimed at soliciting bio data from the students including their gender, age, type of school and optional subjects they took. This section had closed-ended questions. Section B of the questionnaire contained both closed-ended and open-ended questions that sought to establish students' knowledge of climate change and how much of it had come from the secondary school curriculum. The questionnaire is shown as Appendix 3 in the appendix section.

3.6.4 Interview Guide for KICD Officers

The interview guide for KICD officers aimed at establishing their views on whether the current curriculum adequately addresses climate change issues. The interview guide also aimed at establishing efforts being made by the curriculum development body and the

challenges they face in a bid to infuse climate change content into the curriculum. Information obtained from the tool was crucial in making conclusions on the third objective of the study. The interview guide is shown as Appendix 4.

3.7 Validity

According to Kombo and Tromp (2009), validity of a data collection instrument is a measure of how well it measures what it is supposed to measure. To ensure content validity, the instruments were subjected to the supervisors as experts to establish how well they can measure what they were intended to measure. This is because the study was highly qualitative.

3.8 Reliability

Orodho (2009) asserts that reliability of an instrument is the consistency in producing a reliable result. To establish the reliability, the instruments were subjected to a pilot study. The pilot study aimed at measuring the relevance and clarity of items in the instrument. Items that were found to be inadequate in measuring of the intended variables were removed or edited to improve the quality of the research instruments.

3.9 Pilot Study

Before the actual study, the researcher conducted a pilot study in 3 schools that were not part of the sample. The pilot study was aimed at establishing the reliability and validity of research instruments. The research tools were then examined in relation to the results obtained from the pilot study. Questions that were seen to be ambiguous were modified or done away with altogether.

3.10 Data Collection Procedure

Using the content analysis thematic area template, the researcher personally reviewed syllabi of the sampled subjects as well as text books and checked the content against the template. The researcher would tick on the template according to information that was found in the syllabi and the text books.

The researcher also personally visited the sampled schools and administered questionnaires to both teachers and students. Time was allowed for the teachers and students to fill the questionnaires before the researcher collected them. Counting of the questionnaires was done to ensure that they had been returned.

The researcher also personally visited KICD offices to undertake interviews on the sampled respondents. The researcher conducted one on one interviews with thee sampled KICD officers. Information obtained from the interviewees was recorded as the interviews continued to avoid forgetting the responses.

Relevant observations were also obtained from textbooks, journals, magazines, newspapers and the internet. Personal experiences as regards to the problem under investigation also provided vital source of information.

3.11 Data Analysis Procedures

Completely filled questionnaires, were closely examined to ensure no errors were present. Data was carefully then extracted and coded numerically. The responses were stored in a computer's spreadsheet program. Data analysis included both descriptive and inferential analysis. Descriptive analysis was used for categorical data which was described in terms of frequencies, means standard deviations and percentages. For this type of data, associations were also done by the use of Chi-square test. As for continuous and discrete data, analysis was done using the variation ratio. Variation ratio is defined as the proportion of cases in a dispersion that are not the mode (Linton 1965) and it ranges from 0 to 1. A zero value implies absence of any variation while 1 implies maximum variation. To compute variation ratio, the following formula was be used:

$$v := 1 - \frac{f_m}{N}$$

Where: v- variation ratio, f_m- frequency of the mode, N- total number of case

Qualitative data obtained was analysed using narratives in form of discussions and explanations. Programs used to conduct the analysis were; Statistical Package for Social Sciences (SPSS) and Minitab.

3.12 Conclusion of the Chapter

Chapter three of the study has outlined the research design and methodology utilized for the study. The chapter outlined how sampling was done and described the data collection instruments as well as the procedure used to collect data from sampled respondents. The chapter also gave an overview of how data analysis was done and reporting of the findings. The following chapter outlines how collected data was handled and manipulated to achieve the objectives of the study, answer the research questions and test the hypotheses of the study.

CHAPTER FOUR

PRESENTATION OF THE RESEARCH FINDINGS

4.1 Introduction

This section of the study contains outputs resulting from data manipulations and computations. By so doing the raw data collected has been made meaningful and more understandable. Findings have mainly been presented in tables and an explanation following the presentation. The main aim of the study was to determine the contribution

of curriculum in creating awareness of climate change among learners in secondary schools in Githunguri Sub-county, Kiambu County. The findings of the study are presented based on the following research objectives:

i. To establish the key areas of climate change addressed by the current Kenya's secondary school formal curriculum.
ii. To establish the extent to which implementation of the curriculum contributes to awareness of climate change among students and teachers.
iii. To evaluate effectiveness of curriculum developers in infusing climate change content into Kenya's secondary school curriculum.

4.2 Respondents' Response Rate

The study targeted 80 teachers, 100 students and 8 KICD officers. The study also aimed at undertaking content analysis on 8 sampled secondary school subjects to evaluate the status of climate change content in the subjects. However, the study achieved 65 respondent teachers representing 81.3% acceptance rate and 96 respondent students representing 96%. All the 8 KICD officers targeted for interview were also available and therefore 100% response rate was reported. Content analysis was also undertaken in all the 8 (100%) sampled subjects. The response rates are as summarized in Table 4.1.

Table 4.1: Respondents' Response Rate

Respondents Category	Expected responses		Analysed responses	
	No.	(%)	No.	(%)
Teachers	80	100	65	81.3
Students	100	100	96	96
KICD officers	8	100	8	100
Total	108	100	93	86.1

Key: KICD- Kenya Institute of Curriculum Development

The response rates were considered adequate because they exceeded the 65% level set by Dolsen and Machlis (1991) assuming a limited response bias, random sampling error, and a reasonable degree of homogeneity in the sample.

4.3 Analysis of Demographic Data

4.3.1 Students' Age and Optional Subject Analysis

The study sought to establish the age and gender of sampled students. Data collected was analysed and is presented in table 4.2.

Table 4.2: Students Age and Gender

Age (Years)	Number of Respondents			Percentage (%)
	Male	Female	Total	
16 and Below	3	2	5	5.2
17	14	17	31	32.3
18	19	23	42	43.8
Above 18	8	10	18	18.8
Total	**44**	**52**	**96**	**100.0**
Percentage (%)	**45.8**	**54.2**	**100**	**-**

From table 4.2, 54.2% of sampled students were female while 45.8% were male. Most of the sampled students (43.8%) were aged 18 years while only 5.2% were either 16 years or below. Those who were above the age of 18 constituted 18.8%. The trend I gender in this study corresponded to Kenya National Examinations Council statistics of 2014 where 8 counties recorded more female candidates than male candidates including Kiambu, Taita Taveta, Nyandarua, Nyeri, Kirinyaga, Meru and Tharaka Nithi (KNEC, 2014). Increase in the number of female candidates is likely due to increased campaigns in the society of the need to educate the girl child that has rendered the boy child vulnerable.

Students were asked to identify the optional subjects that they took from a list of identified optional subjects. The number of students taking each subject was taken and a comparison made with KNEC's database. Table 4.3 has the number of students sampled

based on each subject (frequency), percentage of the sampled students per subject and percentage representing data from KNEC.

Table 4.3: Optional Subjects Analysis

Subject	Data from Sampled Students			KNEC 2014 Analysis (%)
	Frequency	Out of	%	
Chemistry	77	96	80.2	99
Biology	71	96	74.0	89
CRE	81	96	84.4	75
History	52	96	54.2	69
Business Studies	44	96	45.8	45
Agriculture	39	96	40.6	40
Physics	24	96	25.0	27
Geography	10	96	10.4	25

From the table 4.3, majority of sampled students did CRE (84.4%) while minority of the students (10.4%) did Geography. When the data was compared with KNEC (2014), similar characteristics stood out. Some of the subjects such as Business Studies and Agriculture recorded close range of scores, 45% and 40% respectively. The trend was also found to be in consonance with data from *Githunguri Sub-county KCSE analysis 2013* (unpublished) shown on appendix 6. Considering the fact that Geography contained much of the climate change content (as per analysis of variation contained in table 4.5) yet contained the least number of candidates in Githunguri as well as countrywide, this is likely to pose detrimental consequences on the effort of the curriculum in creating awareness about climate change.

4.3.2 Teachers' Demographic Information

Teachers were sampled randomly and asked to identify their gender, highest academic qualifications, years of experience and the subject they majored in. Data collected was analysed and is as presented in table 4.4.

Table 4.4: Teachers' Demographic Data

	Gender		Total	Percent. (%)
	Male	Female		
Academic Qualifications				
Diploma	7	5	12	18.5
Degree	26	18	44	67.7
Post-graduate Diploma	1	1	2	3.1
Masters	6	1	7	10.8
Years of experience				
1-5	16	8	24	36.9
6-10	7	6	13	20.0
11-15	6	3	9	13.8
16-20	5	6	11	16.9
Above 20	6	2	8	12.3
Majored Subjects				
Physics	6	2	8	12.3
Chemistry	7	2	9	13.8
Business Studies	4	3	7	10.8
Agriculture	5	4	9	13.8
Geography	5	2	7	10.8
History and Government	3	6	9	13.8
Biology	5	3	8	12.3
CRE	5	3	8	12.3

Based on table 4.4, teachers' academic qualifications are as described. Degree holder teachers were the majority representing 67.7% followed by diploma holders with 18.5% and master's degree holders with 10.8%, while post-graduate diploma teachers were few having a 3.1%. This is because the minimum requirements for employment of teachers in secondary schools is a diploma. However during recruitment of teachers, degree holders are given priority and therefore form the greatest number. With higher qualifications, teachers seem to leave service for other jobs and therefore the number of master's degree holders was also found to be low. It was also found that there were more male teachers

(61.5%) than female teachers (38.5%) while a comparison between academic qualification and gender showed that male teachers had higher qualifications than female teachers. For instance 63% and 85.7% of the male teachers had degree and master's degree qualifications respectively. An earlier study by Collette (2002) expressed that gender representation in the Kenyan civil service shows gross under-representation of women in top management and policy-making positions. The situation is attributed to the existence of social, cultural and structural barriers to effective female participation in the labour force.

Historically, women in Kenya have had limited access to education, particularly the high drop-out rate among girls at upper-primary, secondary and tertiary levels is attributed to factors, such as teenage pregnancies, early marriages, social attitudes towards women, cultural practices, inadequate and gender-biased curriculum and teaching materials, family preferences to educate boys, sexual harassment and heavy domestic workload for the girl child. (RoK, 1999b).

As far as teaching experience is concerned, teachers who had taught for between 1-5 years formed the greatest percentage of 36.9% while those above 20 years formed the lowest percentage of 12.3%. Most majored subjects were Chemistry, Agriculture and History which recorded the same percentage of 13.8. Subjects with the smallest number of specialized teachers are; Business studies and Geography. They both had the same percentage of 10.8. Again Geography performed decimally as far as having teachers, which is also likely to impact negatively on its teaching and ultimately learning of various climate change aspects.

4.4 The Status of Climate Change Content in Sampled Subjects

The objective of the study was to establish the status of climate change content in the current Kenya's secondary school curriculum. The research question to which response was made was: To what extent are key areas of climate change addressed in the current Kenya's secondary school formal curriculum? The research instrument used to elicit responses to this question was a thematic area content analysis template (Appendix 1).

To ascertain the status of the identified climate change content in the sampled subjects, variation ratio was computed for each subject. The variation ratio is a measure of dispersion that presents the proportion of cases that are not the mode (vary with identified thematic areas). The ratio ranges from 0 to 1 with a zero value implying absence of any variation while 1 implies maximum variation (Linton, 1965). Findings of the computed variation ratio were as shown in table 4.5:

Table 4.5: Variation Ratio for Sampled Subjects

Subject	Candidature in Githunguri in 2013 (%)	Variation Ratio
Geography	24.29	0.63
Agriculture	33.61	0.66
Christian Religious Education	92.50	0.72
Physics	34.76	0.81
Business Studies	43.48	0.84
Chemistry	91.64	0.84
Biology	81.01	0.91
History and Government	68.66	0.91

Note: Variation ratio computed using the equation on page 33.

The targeted thematic areas that were sought from the sampled subjects included: scientific concepts and processes; certainties, uncertainties and projections; causes of climate change; mitigation and adaptation measures; consequences of climate change; climate change time-space dynamics; and interests that shape responses to climate change.

From table 4.5, Geography had a candidature of 24.29% in Githunguri Sub-county in 2013. The subject also recorded the lowest variation ration of 0.63. This meant that it possessed only 37% of the identified crucial climate change content as per the thematic template. The subject was identified by KICD experts as the 'carrier subject' for environmental content and therefore contained most of the climate change content. The subject under a topic in form two (Climate) addresses the issue of climate change. The

sub-topic ‘Climate Change’ clearly defines the concepts of climate change, global warming, greenhouse effect and greenhouse gases. However, it fails to neither define nor mention the term climate variability. The topic also discusses natural and anthropogenic causes of climate change but fails to highlight specific human causes but rather discusses more of the natural causes. The sub-topic also discusses impacts of climate change in depth but fails to discuss mitigation and adaptation measures. However some mitigation and adaptation measures are encouraged in other topics in the syllabus. For instance, in the topic Energy (form four) that highlights advantages of renewable sources of energy as well as disadvantages of dirty forms of energy. Other topics that were seen to be of great importance in combating climate change in the Geography syllabus included Management and Conservation of the Environment (form four), Vegetation and Forestry (form two) among others. To note though is that there are topics on Industrialization, Transport and Communication as well as Agriculture but which totally fail to capture the roles of the same in aggravating the climate change menace.

Agriculture recorded a variation ratio of 0.66. The variation implies that 66% of the identified thematic areas were not captured in the subject and only 34% were captured. The concept of climate change was defined in the subject but it failed to define other concepts, such as climate variability, global warming, greenhouse gases and the greenhouse effect. Notably also, the subject did not address certainties, uncertainties and climate change future projections; the time-space dynamics neither did it address the interests that shape responses to climate change. The subject, however, addressed most of the causes of climate change as well as fairly addressing mitigation, adaptation and impacts of climate change. The results were in tandem with an earlier study in Kenya by Stephen et al., (2014) who noted that despite agricultural production being highly sensitive to climatic conditions, climate change related topics are not adequately covered in the entire secondary school agriculture syllabus. For instance, out of a total of thirty three units that constituted the agriculture syllabus, only two, provided aspects addressing climate change adaptations, in particular, water supply, irrigation and drainage, and risks and uncertainties in farming.

Christian Religious Education (CRE) had a variation ratio of 0.72 implying that 72% of the identified thematic areas were missing from the subject's entire syllabus. The subject addressed climate change directly and indirectly in two varying ways. The subject teaches the creation story, which in a way gives man the way leave to use resources on earth. For instance, according to Gichaga et al., (2007) God commanded human beings to be fruitful and multiply and fill the earth and subdue it. The study was of the opinion that this would negatively impact on the earth as man is given power to use everything for his needs. However, the subject in a form four topic (Christian Response to the Impact of Science and Technology on the Environment) some key concepts such as global warming and greenhouse gases are addressed. The subject also addressed anthropogenic causes of climate change as well as some of the mitigation and adaptation measures.

Physics was also selected to constitute the sample considering its role especially in developing better technologies that can address climate change. The subject also met the threshold after being at 34.76% of candidature in Githunguri Sub-county at the KCSE exam of 2013. The subject, however, fared poorly with 81% of the climate change thematic areas missing in the syllabus. The subject however defined global warming and the greenhouse effect but claims that it is 'feared' that greenhouse gases are causing global warming. The choice of words here brought out a scenario that climate change/global warming may just be feared to happen but are not real. Other areas shallowly addressed in the subject were mainly mitigation and adaptation measures, specifically introduction of new technologies; designing and using of greener technologies as well as use of renewable forms of energy. Other areas in the template remained largely unaddressed.

Business Studies recorded a variation ratio of 0.84. The variation implies that 84% of what was on the content analysis template did not reflect on the Business Studies Syllabus. The subject had only one topic in form three that addressed Emerging Issues in Business Studies. The topic mentions very briefly on some causes of climate change such as widespread use of land, large scale deforestation and increased fossil fuel use. It also highlights some of the consequences of climate change such as increased pests and diseases, and depletion of natural resources. For instance, the topic explains that there is

increased desertification resulting from changes in climate regimes and reduction in rainfall. However, most of the other thematic areas went unmentioned in the entire syllabus.

Chemistry, despite being compulsory in most schools in the Sub-county, recorded a variation ratio of 0.84. This implies that Chemistry and Business Studies alike only contained 16% of what was identified as necessary in the content analysis template. The subject addressed some of the concepts and scientific processes including global warming, greenhouse gases and the greenhouse effect. The subject also scantly mentioned a few causes and consequences of climate change. Notably though is the fact that the subject gave very misleading information on the cause of global warming. According to the subject global warming is caused by destruction of the ozone layer leading to direct penetration of the sun's rays hence increasing temperatures in the lower atmosphere. This is an incorrect explanation.

Biology established the greatest variation of 0.91. This indicated that 91% of the identified areas were never found in the subject. The subject only addressed some mitigation and adaptation measures including changes in consumption patterns, mitigating bio-diversity loss as well as introduction of alien species and new technologies. All other thematic areas were not found in the subject. The situation is unfortunate since the subject is done by about 89% of candidates nationally (table 4.3) and would therefore be one of the best suited subjects to carry climate change content and consequently create awareness on climate change.

Similarly, History performed decimally with a variation ratio of 0.91. None of the subject's topics addressed the climate change issue, at least directly. However, topics mentioned disadvantages of sources of energy that have been used in the past, such as coal by highlighting that such material caused environmental pollution. The subject gives a historical background of development of industries but doesn't mention the effects of the same on the current global warming situation. However, History as a subject is also the only subject that mentions United Nations bodies such as the United Nations Environmental Programme (UNEP) and gives their roles. Nevertheless it fails to mention

the United Nations Framework Convention on Climate Change (UNFCCC) and the Inter-governmental Panel on Climate Change (IPCC). Finally, the History syllabus acknowledged the role played by the late Professor Wangari Mathai in protecting the environment.

The overall variation ratio was also computed to establish the status of climate change content in general in the sampled subjects. Overall, sampled subjects had a mean variation ratio of 0.44. This implies that approximately 44% of what the study deemed important content in creating climate change awareness was not featured in the sampled subjects but 56% of the content was addressed in varying details in different study subjects. The study established that main concepts and processes related to climate change were addressed in the sampled subjects except for the concept of climate variability. Main causes of climate change were also found to have been addressed in one subject or the other either directly or indirectly. Mitigation and adaptation measures were also addressed though not directly and the same case applied to the consequences. However, none of the sampled subjects touched at all on certainties, uncertainties and future projections of climate change; time space dynamics and neither did any of the subjects address interests that shape responses to climate change. The results were in tandem with previous studies for instance Henry et al., (2012) in a study conducted in Nigeria noted that climate issues are treated in the Social Science subject in most secondary schools with few topics focusing on climate and its elements like rainfall, temperature and wind. Similarly in Ethiopia, Abraham (2013), showed that in primary school, there is a separate subject called Environmental Science which was being given from grade 1-4. However, beginning from second cycle primary school (grade 5-8) through secondary school (grade 9-12) and higher learning institution, environmental education is given in the form of infusion so that environment related issues are incorporated in various subjects (as unit and sub-units) such as, Biology, Geography, Chemistry, Social Studies, Civic and Ethical Education, and English.

A Chi-square test was performed to ascertain whether there was significant climate change content in the current secondary school curriculum in Kenya. The results of the test established that the chi-square value was greater than the significant value, that is

0.567 > 0.495. Based on the results, the null hypothesis which stated that there is no significant climate change content in the current Kenya's secondary school formal curriculum was accepted at 5% significant level. Results of the chi-square test are presented in table 4.6.

Table 4.6: Chi-Square test for Climate Change Content in the Curriculum

Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.567	2	0.495
Likelihood Ratio	0.738	2	0.39

4.5 Climate Change Awareness among Sampled Respondents

The objective of the study was to establish the extent to which implementation of the curriculum contributes to awareness of climate change among students and teachers. The research question to which response was made was: How does implementation of curriculum contribute to awareness of climate change among students and teachers? The research instruments used to elicit responses to this question were a questionnaire for teachers and a questionnaire for students (Appendix 2 and 3 respectively). Findings are as shown and discussed in the following section.

4.5.1 Awareness among Sampled Teachers

Data was collected from sampled teachers to establish their understanding on issues of climate change. Teachers were asked to express their understanding of major climate change concepts and the results are as displayed in table 4.6

Table 4.7: Teachers' Awareness of Key Concepts

Concepts	1*	2*	3*	4*	5*
Climate change	29.2	33.8	10.8	15.4	10.8
Climate variability	3.1	1.5	38.5	26.2	30.8
Global warming	64.6	26.2	0.0	6.2	3.1
Greenhouse gases	35.4	32.3	1.5	16.9	13.8
Greenhouse effect	26.2	20.0	15.4	20.0	18.5

NOTE: 1= strongly agree, 2= strongly disagree, 3= undecided, 4= Disagree and 5= strongly disagree. All the scores between 1 and 5 are in percentages. N=65.

Table 4.7 outlines the perception of teachers towards their understanding of the key concepts that are related to climate change. Notably from the table, most teachers expressed their understanding of the concepts of climate change, global warming, greenhouse gases and greenhouse effect. For instance, 64.6% of the respondents said that they understood the concept of global warming while 35.4% understood the concept of greenhouse gases. Notably also majority of the teachers did not have an idea of the concept of climate variability as indicated in table 4.7 where 38.5% were undecided while 26.2% and 30.8% disagreed and strongly disagreed to understanding the concept respectively. This shows correspondence to the concepts being addressed in the sampled subjects as discussed in section 4.4.

When teachers were asked whether their subjects of specialization addressed the main identified concepts (appendix 2, question 6), results obtained are as shown in the table 4.8.

Table 4.8: Subjects Address of Key Concepts

Key concepts	Yes	%	No	%
Climate change	34	52.3	31	47.7
Climate variability	0	0	65	100
Global warming	41	63.1	24	26.9
Greenhouse effect	38	58.5	27	41.5
Greenhouse gases	43	66.2	22	33.8

Table 4.8 probably also explains the understanding of teachers hardly unaddressed in their teaching subjects (0%) while concepts such as climate change (52.3%), global warming (63.1%), greenhouse effect (58.5%) and greenhouse gases (66.2%) were well addressed. This probably expresses why most sampled teachers had and understanding of the concepts.

The study went on to establish teachers understanding of the causes of climate change. Teachers were asked to identify their understanding on the causes, mitigation and adaptation measures as well as consequences of climate change. Results obtained from sampled teachers were analysed and are presented in table 4.9.

Table 4.9: Understanding of Causes, Impacts, Adaptation and Mitigation of CC

STATEMENT	1*	2*	3*	4*	5*	Total
Climate change is natural	4.6	24.6	33.8	32.3	4.7	100
Climate change is human caused	32.3	29.2	13.9	13.8	10.8	100
I have knowledge of natural causes of CC	7.7	3.1	9.2	43.1	36.9	100
I have knowledge of human causes of CC	26.2	40.0	1.5	16.9	15.4	100
I have knowledge of impacts of CC	20.0	32.3	18.5	15.4	13.8	100
I have knowledge of mitigation measures	13.8	20.1	10.6	26.3	29.2	100
I have knowledge of adaption of CC	6.2	13.8	18.5	29.2	32.3	100

NOTE: 1= strongly agree, 2= strongly disagree, 3= undecided, 4= Disagree and 5= strongly disagree. All the scores between 1 and 5 are in percentages (n=65). CC- Climate Change

Table 4.9 expressed teachers' understanding of causes, impacts, mitigation and adaptation to climate change. From the table, majority of teachers strongly agreed (32.3%) and agreed (29.2%) that climate change was human caused and on the same note strongly agreed (26.2%) and agreed (40.0%) to understanding human causes of climate change. Notably though, 33.8% were undecided on whether climate change was natural while another 13.9% remained undecided on whether it was human caused. This trend raises doubts on whether teachers really understood what actually caused climate change. Sampled teachers also exhibited low understanding of the natural causes of climate

change with only 7.7% and 3.1% strongly agreeing or agreeing to have knowledge of the same. Those who had knowledge of the natural causes of climate change were mainly skewed towards those that had Geography as a subject of specialization. From the discussion on section 4.4, geography was noted as having expounded on natural as well as anthropogenic causes of climate change but was skewed on the natural. This is likely to have influenced the results in this section.

From the table also, teachers expressed having knowledge on impacts of climate change. Majority of the respondent teachers 32.3% agreed to have knowledge while 20.0% strongly agreed to the same. Only 13.8% strongly disagreed to have knowledge on climate change impacts. However the high percentage of those that remained undecided (18.5%) leaves a lot to be desired.

As for mitigation measures, a gleam picture emerged from this study. Majority of the respondents strongly disagreed to have knowledge of mitigation measures of climate change constituting 29.2% and 26.3% who disagreed to have knowledge of the same. On the other hand 13.8% and 20.1% of the respondents strongly agreed and agreed to have knowledge of mitigation measures while 10.6% remained undecided. A similar trend was reported when it came to adaptation measures. Only 6.2% and 13.8% of the respondents strongly agreed and agreed respectively to have knowledge on adaptation measures while majority (32.3%) strongly disagreed to have any knowledge of adaptation to the changing climate. This was the same trend respondents to the discussion on climate change content in the current curriculum as expressed in section 4.4. Whereas causes and impacts of climate change were discussed in some of the sampled subjects, adaptation, and mitigation remained barely unaddressed except in the carrier subject, Geography, which also did not address adaptation measures.

This study sought to establish from sampled teachers whether their subjects of specialisation addressed causes, impacts, adaptation and mitigation measures. Data form sampled teachers is expressed in figure 4.1.

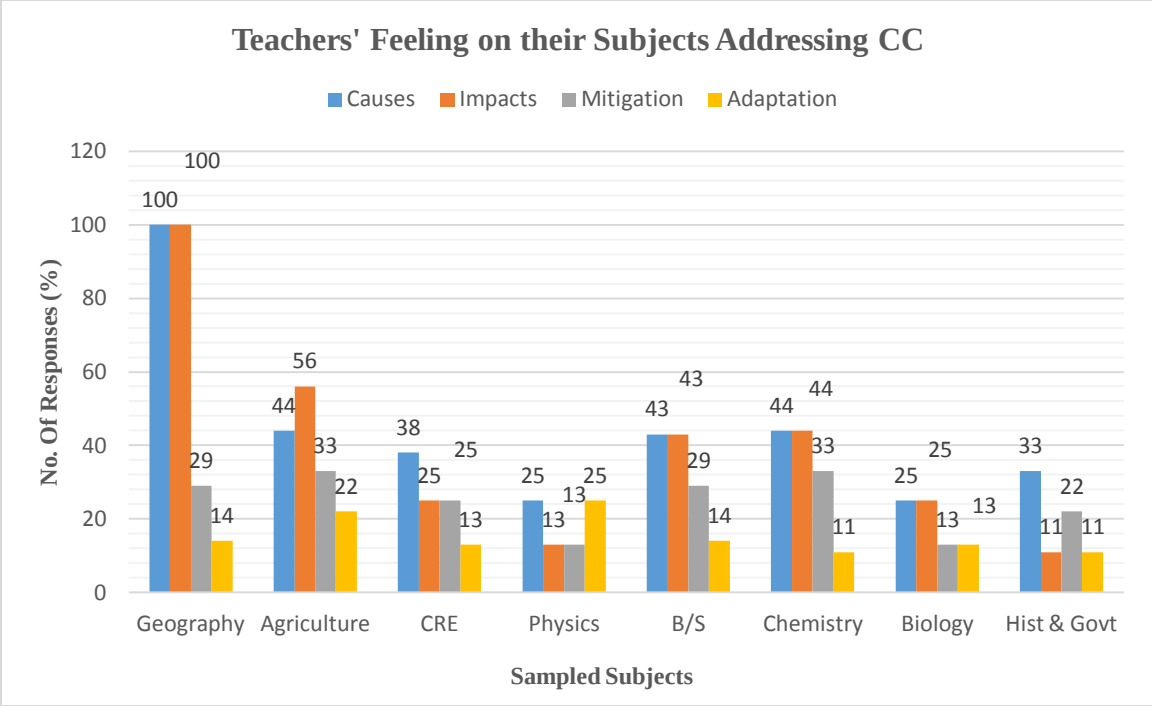

Figure 4.1: Teachers Feeling on whether their Subjects Addressed CC Aspects

Note: Figures expressed in the chart are in percentages. BS- Business Studies, CRE- Christian Religious Education

Figure 4.1 expresses teachers who had a positive (YES) response on whether their subjects addressed the identified areas. The figure basically shows that causes and impacts were mainly addressed as per the opinion of the respondent teachers. For instance, 100% of the sampled teachers (n=7) in geography were for the opinion that causes as well as impacts of climate change were addressed in the subject. The figure also shows that mitigation was addressed fairly in some of the subjects, for instance, 33% of the sampled teachers in chemistry and agriculture felt that mitigation was addressed in the subjects while 29% of geography teachers felt the same. However, adaptation faired decimally as per teachers opinions. Only 25% of respondent physics teachers felt that adaption was well addressed in the subject while in the carrier subject, geography, a mere 14% were for the opinion that adaptation measures were addressed in the subject. The results of this study are in agreement with an earlier study by Ochieng' (2010) on Kenya's primary school syllabus. Ochieng' established that adaptation to climate change,

though a very important concept for Kenya, is seemingly lacking in the current primary school syllabus.

The study went on to establish teachers' understanding of the certainties, uncertainties and future projection of climate change. The teachers were asked to express their opinion 4.10.

Table 4.10: Understanding of Certainties, Uncertainties and Projections

STATEMENT	1*	2*	3*	4*	5*	Total
Climate change is real	40.0	35.4	0.0	15.4	9.2	**100.0**
Climate change is a myth	3.1	9.2	23.1	26.2	38.5	**100.0**
Climate change is a natural cycle	4.6	7.7	26.2	40.0	21.5	**100.0**
CC will continue despite stopping emissions	3.1	10.8	35.4	23.1	27.7	**100.0**
CC will affect countries disproportionately	9.2	4.6	29.2	33.8	23.1	**100.0**

NOTE: 1= strongly agree, 2= strongly disagree, 3= undecided, 4= Disagree and 5= strongly disagree. All the scores between 1 and 5 are in percentages (n=65). CC- Climate Change

From table 4.10, majority of the respondents felt that climate change was actually real with 40.0% of respondents strongly agreeing and 35.4% strongly agreeing. However the study's attention was drawn to the high number of respondents who remained undecided on most of the statements. For instance, 35.4% were undecided on whether climate change will continue when emissions are stopped with another 29.2% remaining undecided on where climate change will affect countries disproportionately. The trend only means that teachers had limited knowledge as pertains the certainties, uncertainties and future projections of climate change. When asked whether their subjects of specialization touched on the same, sampled teachers unanimously felt that the area was not addressed at all. Controversies have existed over the years as pertains whether climate change is real and whether it is natural or human caused. Omotosho (2007) claims that arguments have been advanced that climate change is natural while others feel that it is human induced. However, IPCC (2007), stated unequivocally that climate change is

predominantly human-induced. They stressed that people's actions are intensifying the climate's natural variability, and the Earth's temperature is rising.

The foregoing discussion established that teachers had some knowledge on climate change but which was skewed on some areas such as causes, impacts and mitigation measures while other areas such as climate variability and future projections remained poorly performed. The study therefore sought to establish the main source of climate change knowledge possessed by teachers. Sampled teachers were asked to identify their source of climate change knowledge from a list of sources provided and results obtained are shown in figure 4.2.

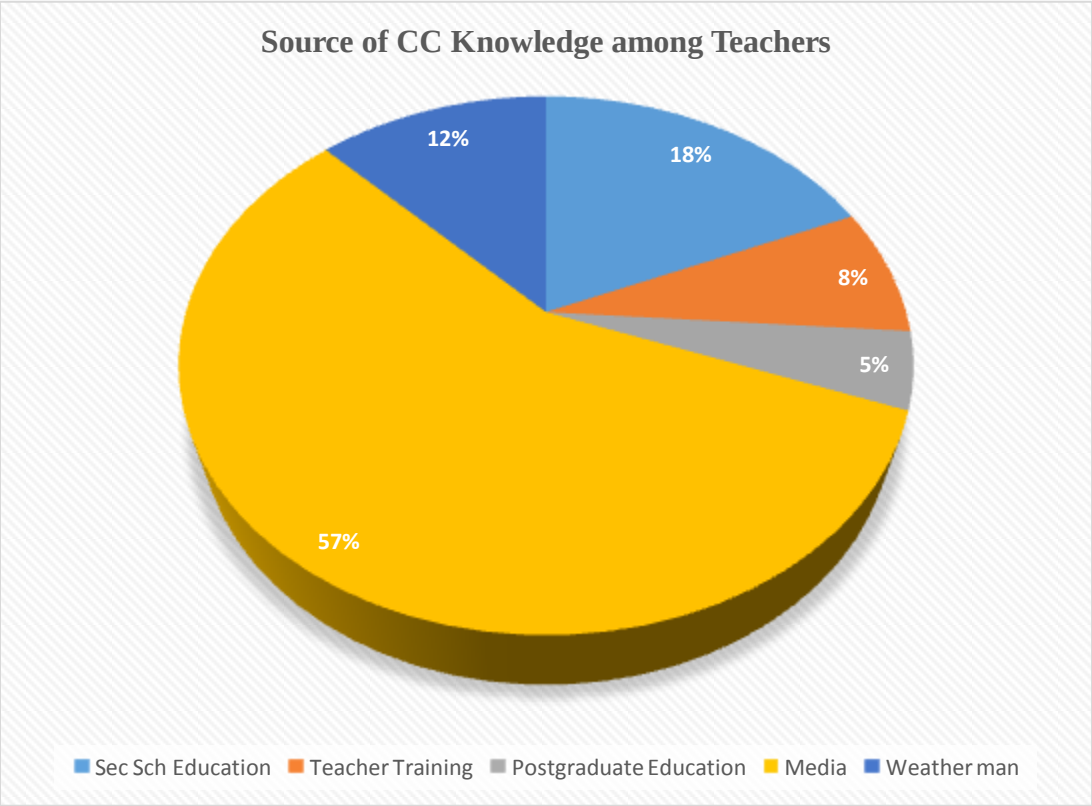

Figure 4.2: Teachers Source of Climate Change Knowledge

From figure 4.2, the study established that 57% of the teachers obtained their understanding on issues related to climate change from the media. The least number of them (5%) had obtained knowledge from postgraduate education while 12% had obtained such knowledge from secondary school education. Information obtained from teachers, shows that education is contribution to creating awareness about climate change but its

contribution is meagre as compared to the media. The results were in tandem with Ochieng' (2014) whose analysis also revealed that teachers' personal reading of books and related materials, research in the internet, and informal trainings by Non-Governmental Organisation (NGOs) had played a more significant role as sources of their climate change knowledge as compared to education.

4.5.2 Awareness among Sampled Students

The study subjected learners to questions to ascertain how well they possessed knowledge as pertains climate change. Information obtained from leaners is presented and discussed in this section of the study.

First, the study sought to establish learners understanding of causes of climate change, consequences, mitigation and adaptation measures to the changing climate. The study collected data on the same using a questionnaire designed for the students. Information obtained is as shown in table 4.11.

Table 4.11: Students' Understanding of Climate Change

Students Understanding	Yes	%	No	%
Human causes of climate change	53	55.2	9	44.8
Natural causes of climate change	19	19.8	16	80.2
Consequences of climate change	58	60.4	8	39.6
Mitigation measures	24	25.0	15	75.0
Adaptation measures	14	14.6	17	85.4

From table 4.11, students expressed diverse understanding of climate change related areas. Majority of the students reported to understand the human causes of climate change constituting 55.2% however only 19.8% reported to having knowledge on the natural causes of climate change. Emphasis is mainly placed on anthropogenic causes of climate change since nothing much can be done over the natural causes. This is likely the reason why very few students reported to understanding natural causes. On the same note, the study had earlier noted that except for geography that had brought out the natural causes of climate change, other subjects remained silent on the issue. However,

despite the fact that majority (55.2%) of the sampled students expressed having knowledge on the causes of climate change, when asked to identify some of them, some of the students' responses showed low understanding. Such responses included: use of nuclear energy; quarrying, afforestation; planting of trees that attract rain among others. The study also noted that most students linked climate change to the destruction of the ozone layer. On further research, the study established that in chemistry, students were made to understand that the destruction of ozone has led to more solar energy reaching the earth and as a result climate was changing. This is a misleading interpretation. In spite of this majority of the students correctly identified human activities related to causing climate change such as: industrialization, deforestation, use of aerosol sprays, and release of exhaust gases from vehicles among others.

From table 4.11, majority of the students (60.4%) also reported an understanding of the consequences of climate change with only 39.6% reporting low understanding. Students were then asked to identify some of the impacts and some of the mentioned included: drying of water sources; shortage of food due to prolonged droughts; deaths as a result of flooding; discouragement of agricultural activities among others. However, some of the students elicited responses that showed some level of inadequate knowledge on climate change impacts. Some of such responses include: destruction of ozone layer; environmental pollution; global warming among others.

Mitigation and adaptation measures remained misunderstood among the students with 75.0% and 85.4% of the students reporting no understanding of mitigation and adaptation respectively. When students were asked to mention some of the mitigation and adaptation measures, the study established very poor understanding of the same. As earlier noted, mitigation and adaptation were hardly outlined even in the carrier subject, Geography, and therefore students were unlikely to explicitly mention them.

The study then sought to find out how students rated the curriculum they had gone through in terms of equipping them with awareness on climate change. Results obtained from students are as shown in figure 4.3.

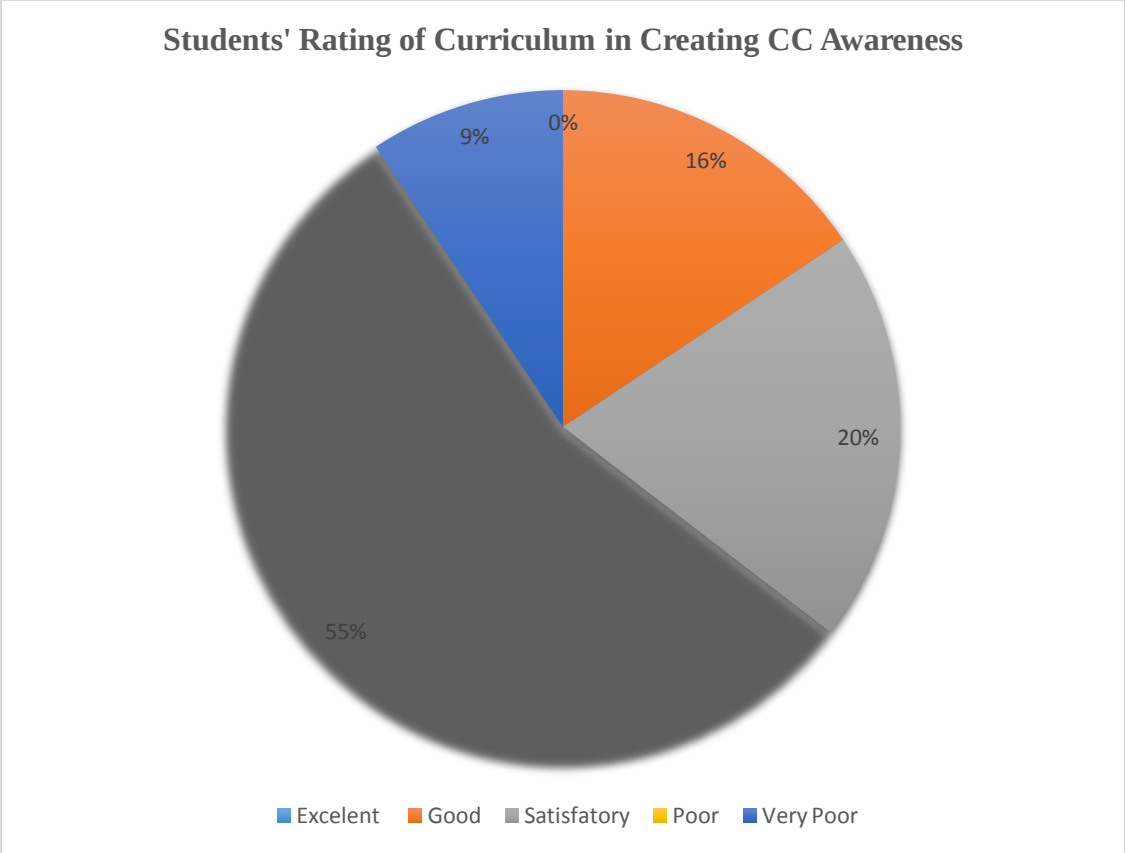

Figure 4.3: Students' Rating of Curriculum in Creating CC Awareness

Figure 4.3 shows the rating of the curriculum in creating awareness on climate change as poor (55%). None of the students rated it as excellent but 15% felt that it was good (mainly Geography students) while 20% felt it was satisfactory. However, 10% rated it very poor. The results correspond with a study by Michael et al., (2014), in Nigeria who affirmed that curricula for secondary schools in most African countries do not have contextualized information on climate change.

The study also sought to find out the students own rating of themselves as far as understanding climate change. Results obtained are as expressed in figure 4.4.

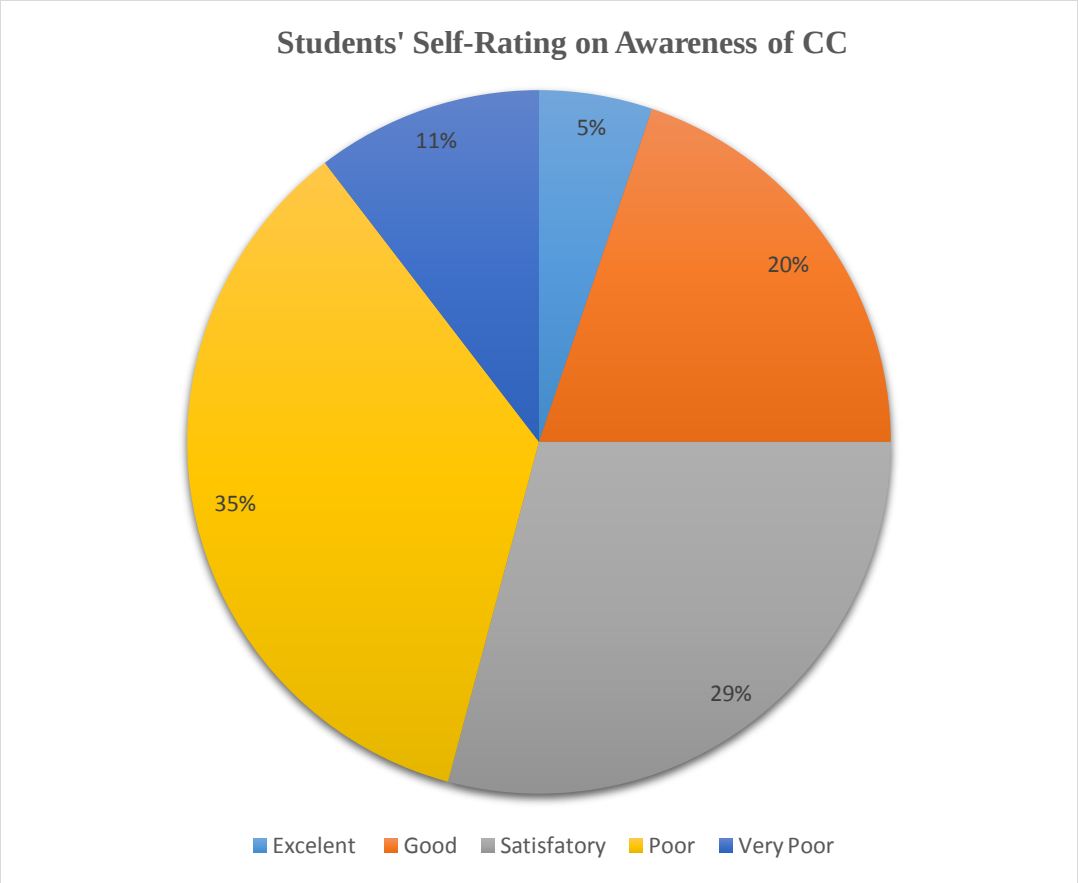

Figure 4.4: Students' Self-Rating on Awareness of Climate Change

From table 4.4, majority of the students (35%) rated themselves as poor when issues climate change were concerned while another 11% rated themselves very poor. However 29% of the students gave themselves a satisfactory rating with another 20% and 5% recording good and excellent respectively.

Having noted a satisfactory performance among leaners' understanding of climate change, the study was then interested in identifying their source of climate change knowledge. Information obtained from students is presented in figure 4.5.

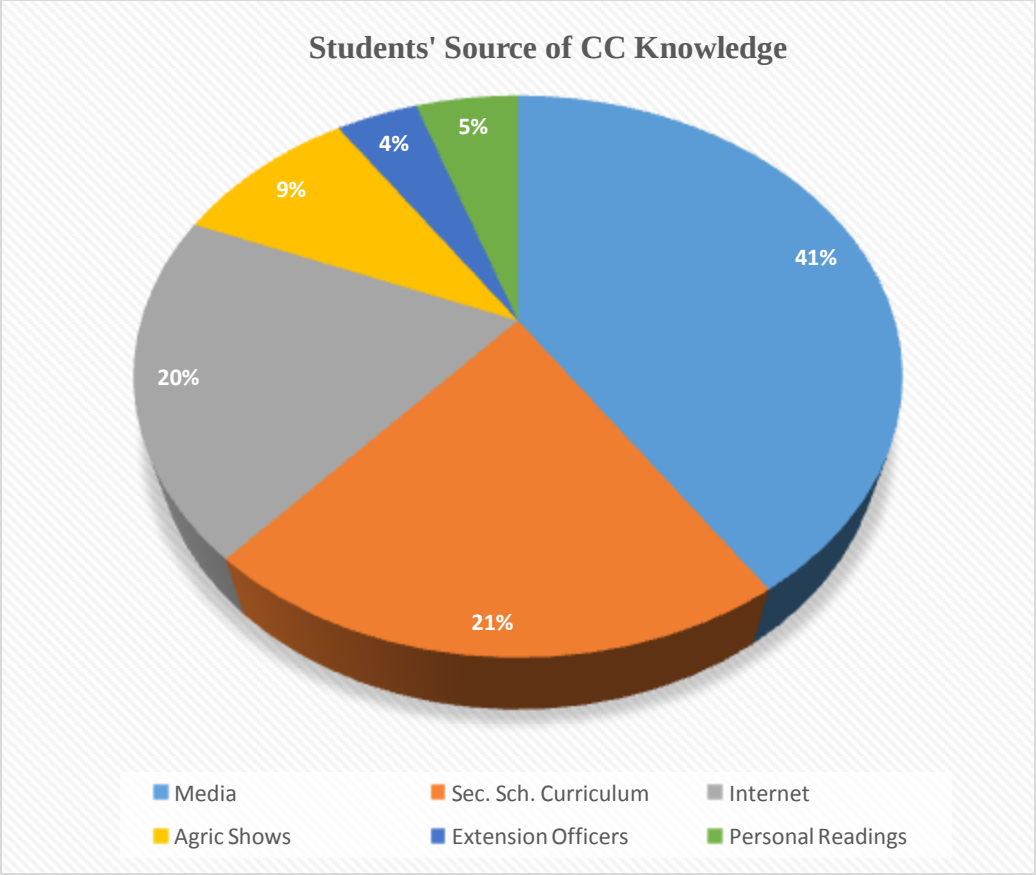

Figure 4.5: Students' Source of CC Knowledge

As per figure 4.5, the study established that majority of the students (41%) had obtained knowledge of climate change from the media while from 20% had obtained the same from internet sources. Education that had formed the basis for this study contributed 21%. Education which should play a key role had again performed poorly as far as creating awareness on climate change.

To ascertain whether there existed a no significant relationship between implementation of secondary school curriculum and climate change awareness among teachers and students. The study finally performed a chi-square test. Results of the test are presented in table 4.12.

Table 4.12: Chi-Square Test for Teachers' and Students' Awareness

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.794	2	0.659

Likelihood Ratio	0.196	2	0.658

According to table 4.12, the chi-square value is greater than the significant value. That is 0.794>0.659 (n=65). The hypothesis was therefore accepted at 5% confidence level indicating that there is no significant relationship between implementation of secondary school curriculum and climate change awareness by teachers. The results are likely because the curriculum does not target the teacher rather the students and the fact that teachers only specialized in two teaching subjects and are therefore only well versed in their areas of specialization. The results were in tandem with findings of two studies in Nigeria. Akinnubi et al. (2012) reviewed secondary school teachers' level of awareness in Ondo West Government Local Area while by Ekpoh and Ekpoh (2011) in Ondo State and Calabar Municipality. Both studies revealed a general low level of awareness of climate change issues among secondary school teachers.

On the side of the students, the likelihood ratio presented is less than the significant value (0.196>0.658), thus implying that students were aware of the climate change, hence there is a significant relationship between implementation of secondary school curriculum and climate change awareness by students. Sampled students were form four students and having gone through the secondary school curriculum were likely to have gathered knowledge on climate change. Again, students specialized in at least seven subjects and therefore have a wider base of access to climate change knowledge from their different subjects. A study by Oruonye (2011) in Ghana also established that 18.8% of the 225 students interviewed, had never heard of climate change while 89% of those who claimed to be aware of climate change were unaware of its causes, effects, and possible adaptations or mitigations measures.

4.6 Effectiveness of KICD in Infusing of CC Content into the Curriculum

The objective of the study was to evaluate effectiveness of curriculum developers in infusing climate change content into Kenya's secondary school curriculum. The research question to which response was made was: How effective has the curriculum developer been in infusing climate change content into Kenya's secondary school curriculum? The research instruments used to elicit responses to this question was an interview guide for

KICD officers (Appendix 4). Findings are as shown and discussed in the following section.

4.6.1: Perception of KICD on Infusion of CC Content

Curriculum development officers were asked to give their opinion on how well the current secondary school curriculum had addressed identified climate change concepts and content. Their responses are as shown in table 4.13.

Table 4.13: KICD Officers Assessment of the Curriculum in Addressing CC

STATEMENT	Responses (%)				
	SA	**A**	**UD**	**D**	**SD**
The concept of CC is addressed in the curriculum	12.5	75	0	12.5	0
Global warming is well addressed in the curriculum	25	50	12.5	12.5	0
GHGs are addressed by the current curriculum	25	37.5	0	25	12.5
The concept of GHE is addressed by the curriculum	12.5	25	37.5	12.5	12.5
Causes of CC are well addressed by the curriculum	12.5	25	12.5	25	25
Mitigation and adoption measures are addressed	0	0	12.5	62.5	25
Impacts of CC are addressed by the curriculum	25	25	0	37.5	12.5
Certainties, uncertainties and future projections are addressed by the curriculum	0	0	0	25	75
Interests that shape responses to CC are addressed by the curriculum	0	0	0	0	100
Bodies that deal with CC are addressed in the curriculum	0	12.5	12.5	12.5	62.5

Key: SA: Strongly Agree, A: Agree, UD: Un-Decided, D: Disagree, SD: Strongly Disagree, CC- Climate change, GHE- Greenhouse Effect, GHGs- Greenhouse Gases

Analyses of responses by curriculum developers from the eight subjects sampled for this study are shown in the table 4.13. The responses reveal 75% of the sampled respondents agreed that the concept of climate change was addressed in the curriculum. An equally high percentage agreed that the concepts of global warming (50%), greenhouse gases (37.5%) and greenhouse effect (25%) were addressed in the curriculum currently.

However some climate change areas, according to the experts were not addressed at all in the current curriculum. For instance, all respondents (100%) strongly disagreed to the idea that interests that shape responses to climate change are addressed in the curriculum. The same case reflected as far as certainties, uncertainties and future projects were concerned with 25% disagreeing while 75% strongly disagreed that the same was addressed in the curriculum. However, curriculum experts unanimously agreed that climate change in the curriculum was skewed towards some of the subjects for instant Geography that seems to address the issues explicitly while other subjects seemed to address them indirectly. Mitigation measures received low ratings as far as being addressed in the curriculum is concerned. No subject was directly reported to addresses mitigation and adaptation measures at all. However Geography, Biology, CRE and History highlighted some good practices that if adopted by students would act to mitigate and adopt to climate change. Such measures include afforestation, reduction in emissions, and use of renewable sources of energy among others.

Regarding the study carried out, the following frequency tables represent information of curriculum developers.

4.6.2 Successes, Challenges and Future of CC in Kenya's Curriculum

To establish the successes made in infusing climate change content into the curriculum as well as the challenges that KICD faces in so doing, 8 sampled curriculum experts were interviewed independently on several issues. Their responses are presented in table 4.14 and a discussion extended thereafter.

Table 4.14: Analysis of Curriculum Developers' Responses

STATEMENTS	RESPONSES			
	Yes	**%**	**No**	**%**
Climate change issues have been successfully infused into the curriculum	3	37.5	5	62.5
There are challenges involved in infusing climate change into the curriculum	8	100	0	0
There are future plans of having climate change issues	1	12.5	7	87.5

addressed more comprehensively

Successes in Infusion of Climate Change Content

From the 8 sampled curriculum experts, 3 of them (37.5%) were for the opinion that climate change content had been successfully infused into the curriculum as it is currently. However majority of them (62.5%, n=8) felt that the infusion had not been successful. Some of the successes that were highlighted include:

All the respondents interviewed (100%) established that the first major step in the infusion of climate change content into the curriculum can be traced to the review of the national goals of education in the year 2003. During the review, two goals were incorporated into the original goals of 1964. The eighth goal that was introduced (To promote positive attitudes towards good health and environmental protection) paved way for introduction of environmental issues into the curriculum. Following the review and introduction of the eighth goal the following successes have been made in different subjects according to experts in charge:

Geography became the carrier subject for environmental issues. The subject, under the topic Climate, has a sub-topic, climate change. The sub-topic defines explicitly the major concepts of climate change, global warming, greenhouse gases and greenhouse effect. It also highlights causes and impacts of climate change. The interviewee however admitted that adaptation and mitigation measures are not explicitly addressed. The other major success highlighted was production of radio programs. KICD was reported to make radio programs to sensitize the public on emerging issues since such programs would have a wide reach.

The other sampled subjects were also reported to make effort in infusion of climate change content but the interviewees admitted that the content was not explicit enough. For instance History gives a historical background of development of industries, the history of energy sources etc. These briefly highlight the negative impacts of

industrialization and forms of energy such as coal and oil. The representative for History however accepted that such were not explicit.

In Biology, conservation measures were addressed under the topic Ecology. The interviewee however admitted that owing to the fact that the content was not explicit, it would require the effort of the teacher to put it into perspective for the students to understand the whole concept. Similar scenarios were reported in other subjects, for instance Christian response to the impact of science and technology on the environment (CRE); emerging issues in business studies (BS); carbon and its compounds (Chemistry). Such topic addressed pollution, desertification but as expressed by the interviewees, it needed a lot of teachers' effort to bring in the idea of climate change which they highlighted as an emerging issue.

Curriculum experts also cited the introduction of emerging issues in each and every subject at the end of each topic. The section paves way for teachers to address such issues as climate change under the emerging issues. However this also requires teachers to have adequate knowledge on such issues without which they would hardly address them.

Challenges in Infusion of Climate Change Content

The challenges that curriculum developers faced in their attempt to infuse climate change content into the curriculum was also an area of interest in the study. All the interviewed respondents (100%, n=8) agreed that challenges existed in the infusion of climate change content into the curriculum. Some of the outstanding challenges exposed by those interviewed are discussed in this section.

The main challenge highlighted by most of the interviewees is that the content is not explicit in the curriculum. They mentioned therefore that it required the teachers to go out of their way to bring out the whole concept. This they said that it was highly uncertain since the current Kenyan education system is exam oriented and therefore teachers seem to teach only what is likely to be examined. The content therefore receives little attention.

Respondents also reported that little is known concerning climate change. Teachers as well as curriculum developers have limited knowledge on the whole issue and are

therefore not in a position to educate learners on the same. Litus (2012), noted the same lack of teacher knowledge of climate change will remain a barrier to effective climate change education.

The interviewees also felt that despite the fact that climate change needed to be addressed in a special discipline, infusing more content into the curriculum would be unwelcome by most stakeholders. They claimed that needs assessment conducted by the institute established that most parents felt that the curriculum was already overloaded. A study by (Bangay & Blum, 2010), lays similar claims that 'the over loaded nature' of secondary school curricula is the other problem that could potentially reduce the role that schools contribute to equip learners with the necessary knowledge, desirable attitude and relevant skills to impact their local environment.

The other challenge that was highlighted is the issue of policy guidelines concerning subjects' selection. Curriculum developers felt that the climate change content carrier, Geography, is an optional subject as per the ministry's guidelines. This makes the subject attract less attention and therefore the content hardly reaches all learners.

It was also established that the institute (KICD) has no control over universities' programs. Some of the teachers trained in universities therefore may not have relevant knowledge on some of the content in the KICD curriculum and for that reason are unqualified to teach some of the concepts.

Respondents also expressed reservations on teaching of the practical part of climate change. They were for the idea that Kenya being a developing country is not well equipped to handle technical details of climate change rather can only infuse into the curriculum simple theoretical concepts.

The issue of offering in-service training to teachers upon review of the curriculum also emerged as a problem. Such training would equip teachers with necessary knowledge, attitude and skills to handle any new concepts. Majority (75%, n=8) of the interviewed heads of sections expressed that although such training ought to be undertaken, it has not happened in the past. Respondents cited limited funds for that and expressed concerns

that the same posed serious threat to successful implementation of new curriculum. The head of Business Studies however said that following the 2003 review they conducted orientation. Few teachers received the orientation and were expected to orient other teachers. However the orientation did not work since those that received training hardly passed the knowledge to other teachers. The head of Physics however said that the solution to that problem was that the institute uses online platforms to provide knowledge to teachers and members of the public on reviews. Similarly Dal et al., (2009), acknowledge that the number of in-service teacher training workshops aiming to increase both teachers' awareness on climate change and to develop their teaching strategies and skills regarding climate change should be increased. They however note that it may be better to integrate climate change education into teacher education programs for both social science and science education teachers. For instance, it may be helpful to design courses about climate change awareness. Besides, pedagogical courses focusing specifically on the instructional skills for the teaching of environmental problems such as climate change may provide teachers with the competencies to teach climate change in science classrooms.

The study wished to establish the institutes stand on individual's contribution to curriculum content as a solution to the challenges they face in infusing climate change content into the curriculum. Respondents expressed KICD's willingness to receive additional instructional materials through personal writings. However the institute only has a vetting role to confirm whether such materials conform to the required standards. Respondents also expressed that they welcomed the public's views especially during curriculum review. They welcomed memoranda from members of the public highlighting sections of the curriculum that need review.

Future of Climate Change in Kenya's Curriculum

The respondents were asked to comment on the future of climate change in Kenya's curriculum. Only 12.5% were for the opinion that there are any plans to infuse climate change into the curriculum. Even those that said plans existed ruled out the possibility of it being addressed in a special subject. They argued that parents and education stakeholders felt that current curriculum was already overloaded hence needed no extra

subject. In a similar way, Ethiopia's Environment Policy Document (EPA, 2002) aimed to promote the teaching of environmental education on a multidisciplinary basis and to integrate it into the on-going curricula of schools and colleges and not to treat it as a separate or additional subject, though they acknowledge that the it should be done at the tertiary level. However, all the interviewees (8) unanimously expressed their support for infusion of climate change content into the curriculum. They were for the idea that since the curriculum is currently undergoing reforms, there are plans to infuse emerging issues into the curriculum and such would include environmental sustainability, protection of bio-diversity, eliminating processes that endanger environment, sustainable use of resources etc. Such a move is likely to yield positive fruits to mitigation of climate change.

4.6.3 KICD Officers' Ratings of the Curriculum on Climate Change

The study wished to establish the experts' personal rating of the current curriculum as far as creating climate change awareness is concerned. Responses garnered are displayed in figure 4.1.

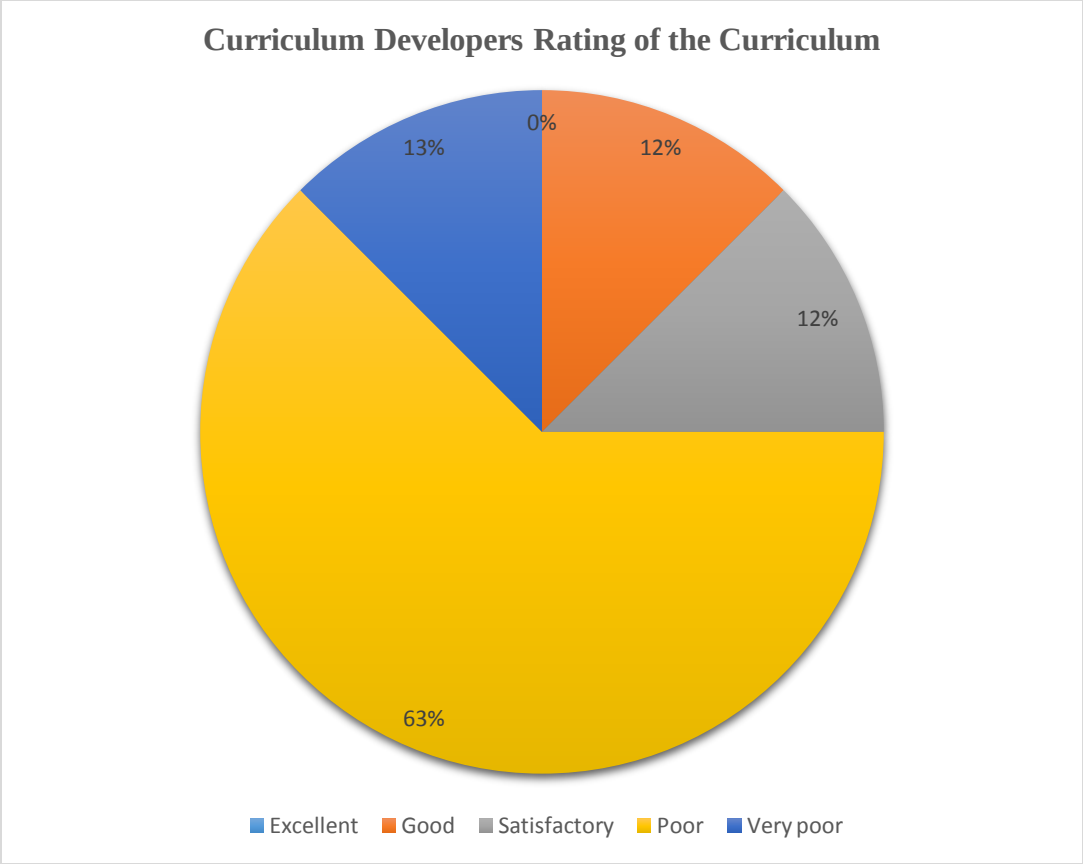

Figure 4.6: KICD Officers Rating of the Curriculum in Creating CC Awareness

From the figure 4.1 the score was greatly skewed towards a negative response with 63% of the respondents rating it poor with another 13% rating the curriculum as very poor. Cumulatively only 24% rated the curriculum as either satisfactory or good each contributing 12% of the respondents. None (0%) of the respondents rated the curriculum as excellent. It was however the view of one of the respondents that the curriculum was poor at implementation. The respondent was of the view that although not explicitly highlighted in the curriculum, adequate climate change content exists in the curriculum and with teachers' effort would be adequate to create climate change awareness among learners. However, the respondent expressed the concern that teachers only concentrated on what they felt is examinable therefore throwing the whole effort to infuse climate change content into the curriculum in dismay. Similar assertions are made by Damtew (2008), that actual teaching and learning practice in most Ethiopian schools' classrooms seem to be more teachers' dominated and subject centred teaching processes where

teachers are considered as sole sources of knowledge while learners remained passive recipients and more exam-oriented.

4.7 Conclusion of the Chapter

After carefully analysing data from the field, the study outlined its findings in this chapter. Varying results were obtained as pertains the objectives, research questions and hypotheses of the study. The chapter sought to establish climate change content in the current secondary school curriculum. It was also meant to establish the extent to which implementation of current curriculum has created climate change awareness among teachers and students. Finally analysis was meant to establish the effectiveness of KICD in infusing climate change content into the curriculum. Results from the findings in this chapter formed the basis of making conclusions and recommendations that follow in the next chapter.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter comprehensively draws conclusion from all the findings as pertains the goals and objectives the study set out to attain. It outlines a summary of the study, a conclusion to the study as well as the researcher's recommendations about the research problem.

5.2 Summary of the study

The study aimed at investigating curriculum and its contribution of awareness of climate change among learners in secondary schools in Githunguri Sub-county of Kiambu County. To investigate the research problem, the researcher sought information from teachers, students and curriculum developers from KICD. The researcher also carried out content analysis on sampled subject to establish climate change content in them.

To achieve the main aim of the study, the research was guided by three objectives that is: To establish the key areas of climate change addressed by the current Kenya's secondary school formal curriculum; To establish the extent to which implementation of the curriculum contributes to awareness of climate change among teachers and students and to evaluate the effectiveness of curriculum developers in infusing climate change content into Kenya's secondary school curriculum. Other scholars' views about the research problem were sought because of their importance in the study.

After preparing the research proposal the researcher sought to collect data to identify the actual situation on the ground. Content analysis was conducted on eight (8) sampled subjects (appendix 6) to establish the status of climate change content in the current secondary school curriculum. Data was collected from the sampled teachers and students in ten (10) sampled secondary schools (appendix 7) to establish their level of awareness of climate change. The study finally sought data from curriculum developers at KICD to establish successes and challenges in infusion of climate change content into the curriculum. Instruments used in the research were a thematic area content analysis template (appendix 1), teachers' questionnaire (appendix 2), students' questionnaire (appendix 3) and an interview guide for curriculum developers (appendix 4). The research instruments were administered by the researcher in person.

Collected data were then analysed using scientific methods and presented in charts, tables, figures as well as qualitative narrations. Interpretations of the findings are presented in chapter four of this research report. Based on the findings, the following conclusions have been drawn:

5.3 Conclusions of the Study

Subject to data collected from both primary and secondary sources, it was established that:

The sampled subjects had an overall variation ratio of 0.44. The ratio suggests that 44% of identified themes (appendix 1) were absent in the sampled subjects. Geography being the carrier subject of environmental content performed best with a variation ration of 0.63 while Biology, History and Government had the largest variation ratio at 0.91. Main concepts such as climate change, global warming, greenhouse gases and the greenhouse effect were found to be addressed in several of the sampled subjects but were most explicitly addressed in Geography. Based on the null hypothesis set in regard to climate change content in every subject, it was accepted hence providing evidence that, climate change was not well presented in sampled subjects. Though some subjects had some climate change content like Geography, this was not enough. All subjects needed to have climate change content to cater for majority of students. To some extent, causes and impacts of climate change are addressed in Geography and indirectly addressed in other subjects through practices, such as encouraging environmental conservation, discouraging deforestation, encouraging use of green energies and reducing GHG emissions but there is need to do more. The study established that mitigation and adaptation measures were poorly addressed and not directly. Areas deemed important in climate change studies such as: certainties, uncertainties, future projections, interests that shape climate change debates as well bodies charged with addressing climate change were not addressed at all in the entire syllabi of sampled subjects.

The study also established that understanding of climate change among teachers and students was different. The hypothesis set in line with teachers' and students' awareness on climate change issues was divided into two parts. The first part showed that majority of students were informed about climate change, while majority of teachers were not. Therefore the set hypothesis in regard to relationship between curriculum implementation and climate change awareness among students was rejected at 5% significant level while for teachers it was accepted at 5% significant level. However the awareness was skewed at different levels. More awareness among learners was likely due to the fact that students did more subjects and therefore gathered information from a wider range while teachers majored in only two subjects. Most of the learners that had good knowledge on climate

change were reported to take Geography as a subject and only understood as much as was in the curriculum. The same trend was established among teachers with those teaching Geography exhibiting better understanding. Other subjects had limited climate change content, thus majority of students and teachers had no adequate information. Again the interests that shape climate change response, certainties, uncertainties and future projections were mainly unfamiliar among sampled teachers and students.

The study also sought to establish the effectiveness of curriculum developers in infusing climate change content into the curriculum. The study found out that KICD has not met the required standard. Officers from KICD themselves rated the curriculum as poor (63%) and very poor (13%). Further emphasis that KICD had not been effective in infusing climate change content into the curriculum was based on the set null hypothesis. The hypothesis stating that the curriculum developer has not been effective in infusing climate change content into Kenya's secondary school curriculum was accepted at 5% significant level. Notably though, curriculum developers have put effort over the years to address environmental issues.

The introduction of goal eight that addressed environmental issues paved way for introduction of content that would directly or indirectly address climate change. Topics have been introduced in different subjects including environmental conservation, ecology, pollution, energy and forestry but this was still too minimal. There is more to be done in all subjects, more especially the compulsory ones. Currently curriculum developers have also initiated e-materials and radio programs aimed at creating in learners and the general public positive attitudes towards nature. This is an awesome step. However KICD still faces major challenges. For instance it was established that policies from the ministry have made the carrier subject (Geography) optional making many students not access required knowledge. The institute also doesn't control teacher training in universities and therefore most teachers emanating from universities may not have the required knowledge to handle infused content. Finally, the curriculum developers cited insufficient funds for implementing some of the aspects of climate change especially the practical. Finances also hindered successful in-service training to teachers whenever curriculum was reviewed. The study therefore makes the following recommendations to

improve policy on education to address climate change as well recommendations for further research:

5.4 Recommendations of the Study

From the foregoing findings of this study the following recommendations are proposed for the Ministry of Education, curriculum developers (KICD), teacher training institutions, teachers, students and researchers. These recommendations are aimed at enhancing the effectiveness of secondary school curriculum in creating public climate change awareness in Kenya.

i. Curriculum developers (KICD) should ensure that more content is availed in subjects especially on certainties, uncertainties, future projects as well as interests that shape climate change responses. Bodies that deal with climate change should also be entrenched into the taught curriculum. These will give learners a wider understanding on the whole issue of climate change. Content in the curriculum should also be made more explicit to allow learners' better understanding of climate change.

ii. Teacher training institutions should ensure that deliberate effort is made to equip teacher trainees with knowledge, skills and attitudes on climate change. This will ensure that teachers are well versed and able to pass required knowledge to students.

iii. The ministry of education should also ensure that they provide proper policy guidelines. This will ensure that climate change content is availed in a compulsory subject so as to reach a wider audience of students. The ministry should also ensure that teachers are given proper in-service training to equip them with necessary knowledge to handle emerging issues including climate change.

iv. Teachers and students should also make personal effort to look for information and pass the same to others. They should also ensure that they change their behaviour and attitudes towards causes, adaptation, mitigation and impacts of climate change through their system of extra-curricular activities.

v. Efforts should also be made to ensure that curriculum developers have more control on teacher training curriculum to ensure teachers are trained on what they expect in the secondary school curriculum.

5.5 Areas for Further Research

i. Further research should be conducted on curriculum and climate change to ensure that curriculum is exploited to create climate change awareness among learners in the early stages.

ii. Researchers should consider doing extra research in teacher training curricula to ascertain whether teachers are getting relevant information during their pre-service training to channel to students.

iii. Other research concerning climate change should be done in the areas of role of local media in creating climate change awareness.

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APPENDICES

Appendix 1: Thematic Areas Content Analysis Template

Subject……. THEMATIC AREA	***FEATURED***	
	YES	***NO***
Scientific concepts and processes		
Climate change		
Climate variability		
Global warming		
Greenhouse gases (GHGs)		
Greenhouse effect (GHE)		
TOTAL SCORE (5)		
Certainties, uncertainties and projections		
Is climate change a myth?		
Is it a reality?		
What are the future projections?		
TOTAL SCORE (3)		
Causes of climate change		
Widespread use of land		
Large scale deforestation		
Increased fossil fuel use		
Increased livestock farming		
Natural causes		
TOTAL SCORE (5)		
Mitigation and adaptation measures		
Reduce energy consumption		
Use of renewable forms of energy		
Design and use greener technologies		
Changes in consumption patterns		
Mitigate bio-diversity loss		
Drought resistant farming		
Introduction of new technologies		
TOTAL SCORE (7)		
Consequences/impacts		
Extreme weather events		
Depletion of natural resources		
Increased rural-urban migration		
Depletion of household assets		
Increased pests and diseases		

TOTAL SCORE (5)		
Time-space dynamics		
Delayed consequences of GHEs		
Security & development options in future		
TOTAL SCORE(2)		
Interests that shape responses to climate change		
Business interests		
Consumer interests		
Farmer's interests		
Political interests		
Future generations' interests		
TOTAL SCORE (5)		

Appendix 2: Teachers' Questionnaire

I am Charles N. Kariuki, a student of Kenyatta University undertaking a Master Degree in Environmental Studies (Climate Change and Sustainability). I am carrying out a research on *curriculum and its contribution in creating awareness of climate change among learners in secondary schools in Githunguri, Kiambu County, Kenya*. It is my humble request that you kindly fill this questionnaire as honestly and accurately as possible. The information you give will only be used for this research and will be treated with utmost confidentiality. Kindly **DO NOT** write your name anywhere in this questionnaire.

Demographic information

1. Kindly indicate your gender.
    a. Male [ ]
    b. Female [ ]

2. Indicate your highest academic qualification
    a. Diploma [ ]
    b. Degree [ ]
    c. Post-graduate diploma [ ]
    d. Masters [ ]
    e. PhD [ ]
3. Tick (√) the bracket indicating the number of years you have taught in secondary school.
    a. 1-5 years [ ]
    b. 6-10 years [ ]
    c. 11-15 years [ ]
    d. 16-20 years [ ]
    e. More than 20 years [ ]
4. Indicate your subject(s) of specialization……

5. Tick (√) in the appropriate area the extent to which you agree with the following statements.

Note: SA-strongly agree, A-agree, UD-disagree, D- disagree, SD- strongly Disagree, CC-climate change

STATEMENTS	SA	A	UD	D	SD
Climate change concepts					
Climate change					
Climate variability					
Global warming					
Greenhouse Emissions					
Green House Gases					
Causes of climate change					
Climate change is natural					
I understand the natural causes of climate change					
Climate change is human caused					
I understand the anthropogenic causes of climate change					
Impacts, Mitigation and Adaptation					
I possess knowledge on mitigation of climate change					
I possess knowledge on adaptation to climate change					
I understand the consequences of climate change					
Contentious issues about climate change					
Climate change is real					
Climate change is a myth					
Climate change is a natural cycle					
CC will continue despite stopping emissions					
CC will affect countries disproportionately					

6. Kindly respond to the following questions on curriculum and climate change.

STATEMENT	YES	NO
Does the subject you teach define the following concepts?		
• Climate change		
• Climate variability		
• Global warming		
• Greenhouse effect		
• Greenhouse gases		
Are the causes of CC discussed in your subject of specialization?		
Are mitigation measures addressed in your subject of specialization?		

Are adaptation measures addressed in your subject of specialization?		
Are climate change impacts addressed in your subject of specialization?		
What is the source of your knowledge on climate change?		
• Secondary school education		
• Teacher training		
• Weather Man		
• Postgraduate studies		
• Media (TV, Radio, Newspaper, Internet)		

Appendix 3: Students' Questionnaire

I am Charles N. Kariuki, a student of Kenyatta University undertaking a Master Degree in Environmental Studies (Climate Change and Sustainability). I am carrying out a research on *curriculum and its contribution in creating awareness of climate change among learners in secondary schools in Githunguri, Kiambu County, Kenya.* It is my humble request that you kindly fill this questionnaire as honestly and accurately as possible. The information provided will only be used for this research and will be treated with utmost confidentiality. Kindly **DO NOT** write your name anywhere in this questionnaire.

Section A: Demographic information

1. Please indicate your gender.
   a) Male [ ]
   b) Female [ ]
2. Please indicate the age bracket applicable to you.
   a) Below 14 years [ ]
   b) 14-16 years [ ]
   c) 16-18 years [ ]
   d) Above 18 years [ ]
3. Indicate the name of your school……
4. What type of school do you attend:
   a. Boys only [ ]
   b. Girls only [ ]
   c. Mixed (boys & girls) [ ]
5. Please pick the optional subjects you do from the list below.
   a. Agriculture [ ]
   b. Biology [ ]
   c. Business Studies [ ]

d. C.R.E [ ]

e. Chemistry [ ]

f. Geography [ ]

g. History and Government [ ]

h. Physics [ ]

Section B: Knowledge of Climate Change

6. (i) Are you aware of any natural causes of climate change?

   a. Yes [ ]

   b. No [ ]

   (ii) If yes, highlight some of natural causes in the spaces provided below.

……

……

……

……

7. (i) Are you aware of any anthropogenic causes of climate change?

   a. Yes [ ]

   b. No [ ]

   (ii) If yes, mention some of the human activities that cause climate change.

……

……

……

……

8. (i) Are you conversant with any adaptation measures to climate change?

   a. Yes [ ]

   b. No [ ]

   (ii) If yes, mention some adaptation measures to climate change.

……

……

……

……

9. (i) Are you aware of any measures that can mitigate climate change?

a. Yes [ ]

b. No [ ]

(ii) If yes, kindly mention some of the measures that you are aware of.

……

……

10. (i) Do you feel that you are well versed with knowledge on climate change impacts?

a. Yes [ ]

b. No [ ]

(ii) Please mention some of the impacts you know.

……

……

……

11. Rate the secondary school curriculum as far as creating climate change awareness in the scale below.

a. Excellent [ ]

b. Good [ ]

c. Satisfactory [ ]

d. Poor [ ]

e. Very poor [ ]

12. How would you rate your own understanding of climate change issues?

a. Excellent [ ]

b. Good [ ]

c. Satisfactory [ ]

d. Poor [ ]

e. Very poor [ ]

13. If you possess any knowledge on climate change, tick below the source of such knowledge.

a. Secondary school education [ ]

b. Media [ ]

c. The internet [ ]

d. Agricultural shows [ ]

e. Personal readings [ ]

f. Extension officers [ ]

THANK YOU FOR YOUR COOPERATION

Appendix 4: Interview Guide for KICD Officers

1. To what extent do you agree or disagree with these statements as far as your subject of specialization is concerned?

STATEMENT	SA	A	UD	D	SD
The concept of climate change is addressed in the current curriculum					
The concept of global warming is well addressed in the curriculum					
The concept of greenhouse gases is addressed by the current curriculum					
The concept of greenhouse effect is addressed by the curriculum					
Causes of climate change are well addressed by the curriculum					
Mitigation and adoption measures are addressed well by the curriculum					
Impacts of climate change are addressed by the curriculum					
Certainties, uncertainties and future projections are addressed by the curriculum					
Interests that shape responses to climate change are addressed by the curriculum					
Bodies that deal climate change are well expounded in the curriculum					

NOTE: SA- Strongly Agree; A- Agree; UD- Un-decided; D- Disagree; SD- Strongly Disagree

2. Do the national goals of secondary school education in Kenya address climate change?
3. How many times have the national goals of education been reviewed since independence?
4. If they have ever been reviewed, were climate change issues factored in the review?

5. Mention some of the successes you have made in infusing climate change into the curriculum.
6. Highlight some of the challenges you face in your endeavors to infuse climate change issues into secondary school curriculum.
7. Dou you give any in-service training to teachers upon review of the curriculum?
8. Mention some of the topic(s) (if any) in your area of specialization that can create awareness among learners on climate change.
9. Rate the current secondary school curriculum as far as creating climate change awareness is concerned.
    a. Excellent [ ]
    b. Good [ ]
    c. Satisfactory [ ]
    d. Poor [ ]
    e. Very poor [ ]
10. Do you think it would be necessary to introduce a subject at secondary school level to specifically address climate change?
11. What are the future plans for KICD to address the menace that climate change is?
12. Does KICD welcome contributions from members of the public on the curriculum?
13. What is the procedure for presenting such views?

Appendix 5: Examinable Subjects in Kenya

No.	CODE	NAME
1.	101	English
2.	102	Kiswahili
3.	121	Mathematics
4.	231	Biology
5.	232	Physics
6.	237	Chemistry
7.	311	History and Government
8.	312	Geography
9.	313	Christian Religious Education
10.	314	Islamic Religious Education
11.	441	Home science
12.	442	Art and Design
13.	443	Agriculture
14.	444	Woodwork
15.	445	Metalwork
16.	446	Building and Construction
17.	447	Power Mechanics
18.	448	Electricity
19.	449	Drawing and Design
20.	450	Aviation Technology
21.	451	Computer Studies
22.	501	French

23.	502	German
24.	511	Music
25.	565	Business Studies

Source: *Kenya National Examination Council (KNEC)*

Appendix 6: Percentage Number of Students/Subject

Code	Subject	Frequency	Percentage
101	English	3038	100
102	Kiswahili	3038	100
121	Mathematics	3038	100
231	Biology*	2461	81.01
232	Physics*	1056	34.76
233	Chemistry*	2784	91.64
311	History and Government*	2086	68.66
312	Geography*	738	24.29
313	Christian Religious Education*	2810	92.50
441	Home science	106	3.49
443	Agriculture*	1021	33.61
446	Building and Construction	27	0.89
449	Drawing and Design	9	0.30
451	Computer Studies	95	3.13
501	French	6	0.20
511	Music	3	0.10
565	Business Studies*	1321	43.48

Source: *Githunguri Sub-county KCSE analysis 2013* (unpublished)

Note: Subjects marked with an asterisk (*) form the sample of study

Appendix 7: Schools in Githunguri Sub-County and Their Categories

PUBLIC SCHOOLS		
No.	**Name**	**Category**
1	Gathaithi Secondary School	Mixed
2	Gathanji Secondary School	Mixed
3	Gathirimu Girls High School	Girls
4	Gathiru-ini Boys High School	Boys
5	Gathugu Secondary School	Mixed
6	Gikang'a Kageche Secondary School	Mixed
7	Githiga Boys high School*	Boys
8	Githima Secondary School	Mixed
9	Githunguri Technical and Secondary*	Mixed
10	Gitiha Secondary School	Mixed
11	Gitwe Girls High School*	Girls
12	J.G. Kiereini Secondary School	Boys
13	Kagema School	Mixed
14	Kahunira Secondary School*	Mixed
15	Kambui Girls high School*	Girls
16	Kamondo Secondary School	Mixed
17	Kanjai Secondary School*	Mixed
18	Kiairia Secondary School*	Mixed
19	Kiambururu Secondary School*	Mixed
20	Kigumo Secondary School	Mixed
21	Komothai Boys High School	Boys
22	Komothai Girls High School	Girls
23	Miguta Secondary School	Mixed
24	Mukua Secondary School	Mixed
25	Mukuyu Secondary School	Mixed
26	Ndireti Secondary School	Mixed
27	Nyaga Secondary School*	Mixed
28	St. Josephs Githunguri*	Boys
29	St. Vincent Lioki	Mixed
30	Thuita Secondary School	Mixed
31	William Ng'iru Gitau Sec.	Mixed
PRIVATE SCHOOLS		

32	Moriah Mount	Girls
33	Pioneer Academy	Mixed
OTHERS		
34	Kiawairera Education Center	Mixed
35	Ngewa Pride Centre	Mixed
36	PCEA Kambui Sec Sch for Hearing Impaired	Mixed
37	Restoration of Hope	Mixed

Source: *Githunguri Sub-county KCSE analysis 2013* (unpublished)

Note: Schools marked with an asterisk (*) comprise the sampled school

Appendix 8: Research Authorization (NACOSTI)

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

29th October, 2015

NACOSTI/P/15/4435/7989

Charles Ndiritu Kariuki
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Role of curriculum in creating climate change awareness in secondary schools in Githunguri, Kiambu County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Kiambu County** for a period ending **26th October, 2016.**

You are advised to report to **the County Commissioner and the County Director of Education, Kiambu County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

SAID HUSSEIN
FOR: DIRECTOR GENERAL/CEO

Copy to:

The County Commissioner
Kiambu County.

The County Director of Education
Kiambu County.