CLIMATE CHANGE AWARENESS AND POLICY IMPLICATIONS AMONG PRIMARY SCHOOL TEACHERS IN KISUMU CITY, KENYA

BY

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DECLARATION

Student's Declaration

This thesis is my original work and has not been presented for a degree in any other university or any other academic award.

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Supervisors' Declaration

We confirm that the work reported in this thesis was carried out by the candidate under our supervision and has been submitted for examination with our approval as university supervisors.

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DEDICATION

To my grandmother, the late Clementina Atieno Luodo, for being such an inspiration in my life.

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ABBREVIATIONS AND ACRONYMS

CC	Climate Change
CO_2	Carbon Dioxide
GoK	Government of Kenya
IPCC	Intergovernmental Panel on Climate Change
KMD	Kenya Meteorological Department
MEO	Municipal Education Office
MOE	Ministry of Education
NASA	National Aeronautics and Space Administration of the United States
NCCAP	National Climate Change Action Plan of Kenya
NCCRS	National Climate Change Response Strategy of Kenya
NCEP	National Centre for Environmental Prediction of the United States
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration of the United States
TSC	Teachers Service Commission of Kenya
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund

ABSTRACT

Climate change awareness is much needed for public support in its mitigation and adaptation. In this regard, public education is critical in raising levels of awareness on the subject. This research was designed to assess the level of climate change awareness among primary school teachers in Kisumu City. Objectives of the study were to: describe climate variability in Kisumu area during the period 1972-2011, assess teachers' level of climate change awareness, identify factors influencing teachers' level of awareness, determine teachers' perception of climate change as a threat, and assess teachers' opinion on inclusion of climate change knowledge into Kenya's primary school curriculum. Descriptive survey design was adopted in which some 100 randomly selected respondents were drawn from 20 primary schools within Kisumu City. A structured questionnaire was administered to obtain data on teachers' knowledge and perception as well as opinion on inclusion of climate change into Kenya's primary school curriculum. Climate variability was described using meteorological data on temperature and precipitation from Kenya Meteorological Department (Kisumu Weather Station No. 9034025). Data was statistically analysed and results displayed in tables, graphs and charts. Results show that Kisumu area recorded significant temperature ($t = 8.475$, $df = 38$, $p = 0.0001$) and precipitation ($t = 9.806$, $df = 38$, $p = 0.0001$) variability during the period 1972-2011. Monthly average temperature increased by 0.66 ± 0.24 °C while annual precipitation amounts increased by 111.82 ± 20.8 mm during that period. Results also show that the level of climate change awareness among primary school teachers in Kisumu City is not significantly low ($\chi^2 = 62.818$, $n = 89$, $df = 2$, $p = 0.0001$). Teachers registered a medium level of awareness albeit gaps in their knowledge. Factors such as age ($r = 0.108$, $p = 0.318$, $n = 88$), gender ($r = -0.110$, $p = 0.308$, $n = 88$), level of education ($r = 0.149$, $p = 0.168$, $n = 87$) and school location ($r = 0.138$, $p = 0.201$, $n = 88$) emerged influential on teachers' level of awareness though their influence remained statistically weak and insignificant. Results further show that primary school teachers in Kisumu City perceive climate change as a threat ($\chi^2 = 63.202$, $n = 89$, $df = 1$, $p = 0.0001$) and support its inclusion into Kenya's primary school curriculum ($\chi^2 = 176.25$, $n = 96$, $df = 3$, $p = 0.0001$). Key recommendations included: the Ministry of Education should undertake climate change capacity building among teachers through organising climate change workshops for teachers and circulating materials on climate change to primary school; and curriculum developers should work with teachers during revision of the primary school syllabus to ensure that climate change knowledge developed for primary schools is not only simple but is also one that teachers can comfortably deliver.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Problem

Climate change constitutes one of the 21st century key challenges to development the world over (UNDP, 2007). As such, climate change and global warming have become issues of global concern in the recent decades. This is evidenced by the flurry of conferences, campaigns, reports and researches on this subject since the Rio Earth Summit in 1992. While there are natural causes of climate change, the current warring trend has been largely blamed on human activities mainly the burning of fossil fuels, industrial pollution, deforestation, and land use changes (IPCC, 2007; Canadel *et al*., 2010; Weart, 2010). All these anthropogenic activities either increase the concentration of greenhouse gases in the atmosphere (Canadel *et al*., 2010), as is the case of combustion of fossil fuel and industrial pollution, or interfere with the absorption of carbon by terrestrial sinks (IPCC, 2007), as is the case of deforestation and land use changes, leading to global warming.

Global attention on climate change was sort for the first time by the Brundtland Report, *Our Common Future*, which stated that the unsustainable development practices of humankind have pushed the world's climate to a warming trend (UNWCED, 1987). On the contrary, the public's concern on climate change was not triggered by the Brundtland's report, but by the unusual northern hemisphere heat wave and drought of the summer 1988 (Christianson, 1999). Numerous studies conducted since then 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 (Bostrom *et al*., 1994; Bord, Fisher and O'Conner, 1998; Pew Research Centre, 2006; Pugliese and Ray, 2009; Godfrey *et al*., 2009).

Despite their awareness of changing weather patterns, people in Africa, are poorly informed about global climate change (Godfrey *et al*., 2009; Taderera, 2010). 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 (UNFCCC, 2007; UNDP, 2007).

Just like awareness, perception of climate change varies across regions in the world. Various studies show that people in developing countries are more likely to perceive climate change as a threat (GlobeScan, 2006; Pew Research Centre, 2006; Godfrey *et al*., 2009). Contrary results were, however, reported by Pugliese and Ray (2009) who states that climate change is more likely to be perceived as a serious problem in the developed world than in developing countries, despite developing countries being the most vulnerable to climate change impacts. Nevertheless, perception of climate change as threat has been increasing over the years thanks to the severity and increased frequency of climate change impacts (UNDP, 2007).

At the national level, the majority of Kenya's population is unaware of climate change, notwithstanding climate variability being experienced in the country (Otieno, Pauker and Maina, 2009; GoK, 2010b). Nevertheless, the Kenyan government is aware of and concerned about climate change as a development issue. In this regard, the government has developed 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.

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. Consequently, Kenya is considering a revision of its school curricula to include climate change knowledge at all levels as demonstrated in the *NCCAP 2013-2017*. Before, integrating climate change knowledge into school curriculum, especially at primary school level, it is paramount to assess the teachers' level of awareness on climate change since the teachers' level of awareness is likely to influence how they conduct climate change knowledge transfer in the classroom. Whereas attempts have been made to assess

the level of climate change awareness among Kenyans in general, as documented in RoK (2013), GoK (2010b) and Otieno, Pauker and Maina (2009), very little, if any, have been done to investigate the level of climate change awareness among teachers. This study was designed to fill this gap by assessing the level of climate change awareness among primary school teachers in Kisumu City.

1.2 Statement of the Problem

Climate change is real and its impacts have become obvious in Kenya (GoK, 2010b; RoK, 2013) necessitating the need for adaptation and mitigation at the country level. However, adaptation to and mitigation of climate change require the public to be fully aware and perceive climate change as a problem of global concern. Yet, the vast majority of Kenyans is unaware of climate change, but is at least concerned about the changing weather patterns in the country (Otieno, Pauker and Maina, 2009; GoK, 2010b). Consequently, the government expresses intent of integrating climate change knowledge into Kenya's school curricula right from primary school level, as documented both in the NCCRS - 2010 and NCCAP 2013 – 2017, to improve nationwide awareness on climate change.

Primary school teachers will thus have a critical role to play in the national climate change awareness campaign as educators of young Kenyans. However, only 1.11% of issues related to climate change are either addressed directly or indirectly by the *Primary Teacher Education Curriculum* in Kenya according to RoK (2012). 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. Therefore, the study sought to assess the level of climate change awareness among primary school teachers in Kisumu City with a bid to highlighting policy planning implications.

1.3 Research Questions

This study intended to assess primary school teachers' level of awareness and perception of climate change, but also described climate variability in Kisumu area. The study was interested in finding answers to the following questions.

1. How have climatic conditions (temperature and rainfall) in Kisumu area varied between 1972 and 2011?
2. What is the level of awareness on climate change among primary school teachers in Kisumu City?
3. What factors influence teachers' level of awareness on climate change?
4. Do primary school teachers in Kisumu City perceive climate change as a threat?
5. Do primary school teachers in Kisumu City support inclusion of climate change knowledge into primary school curriculum in Kenya?

1.4 Objectives

This study was designed to assess primary school teachers' knowledge of on climate change and also examined climate variability in Kisumu area. With this broad objective, the specific objectives of this study were:

1. To describe climate variability (temperature and rainfall) in Kisumu area between 1972 to 2011
2. To assess the level of awareness on climate change among primary school teachers in Kisumu City
3. To identify the factors influencing teachers' level of awareness on climate change.
4. To determine primary school teachers' perception of climate change.
5. To assess primary school teachers' opinion on inclusion of climate change knowledge into primary school curriculum in Kenya.

1.5 Hypotheses

Based on the above objectives, the study was guided by the following null hypotheses.

1. Kisumu City did not experience any significant climate variability (rainfall and temperature) between 1972 and 2011.
2. The level of climate change awareness among primary school teachers in Kisumu City is significantly low.
3. Primary school teachers in Kisumu City do not perceive climate change as a major threat.

4. Primary school teachers in Kisumu City do not support the inclusion of climate change knowledge into primary school curriculum in Kenya.

1.6 Significance of the Study

This study was designed to assess the level of climate change awareness among primary school teachers and highlight the associated policy implications. The findings of this study will not only aid in understanding teachers' knowledge and perception of climate change, but also inform climate change policy planning in Kenya. Further, most documented research on climate change has concentrated on climate change impacts, adaptation options, and to some extent general public perception. Studies on climate change awareness based on specific populations are scanty. This study, therefore, filled this gap by taking a different approach to assess teachers' awareness and perception of climate change. This study will also provide a framework for future research on climate change education as an important tool for awareness creation. Furthermore, limited studies have been conducted on climate change in Kisumu City. To the best of researcher's knowledge, there has never been a study of this nature undertaken in Kisumu City hence the study filled this perceived gap.

1.7 Conceptual Framework

This study aimed at assessing teacher's level of awareness and perception of climate change as well as examining climate variability in Kisumu area. The dependent variables for the study were level of climate change awareness, climate change perception and teachers' opinion on inclusion of climate change into primary school curriculum. Teachers' demographics, information access and school environment factors were treated as independent variables influencing teachers' level of awareness on climate change. The study was then conceptualised as illustrated in Fig. 1.1.

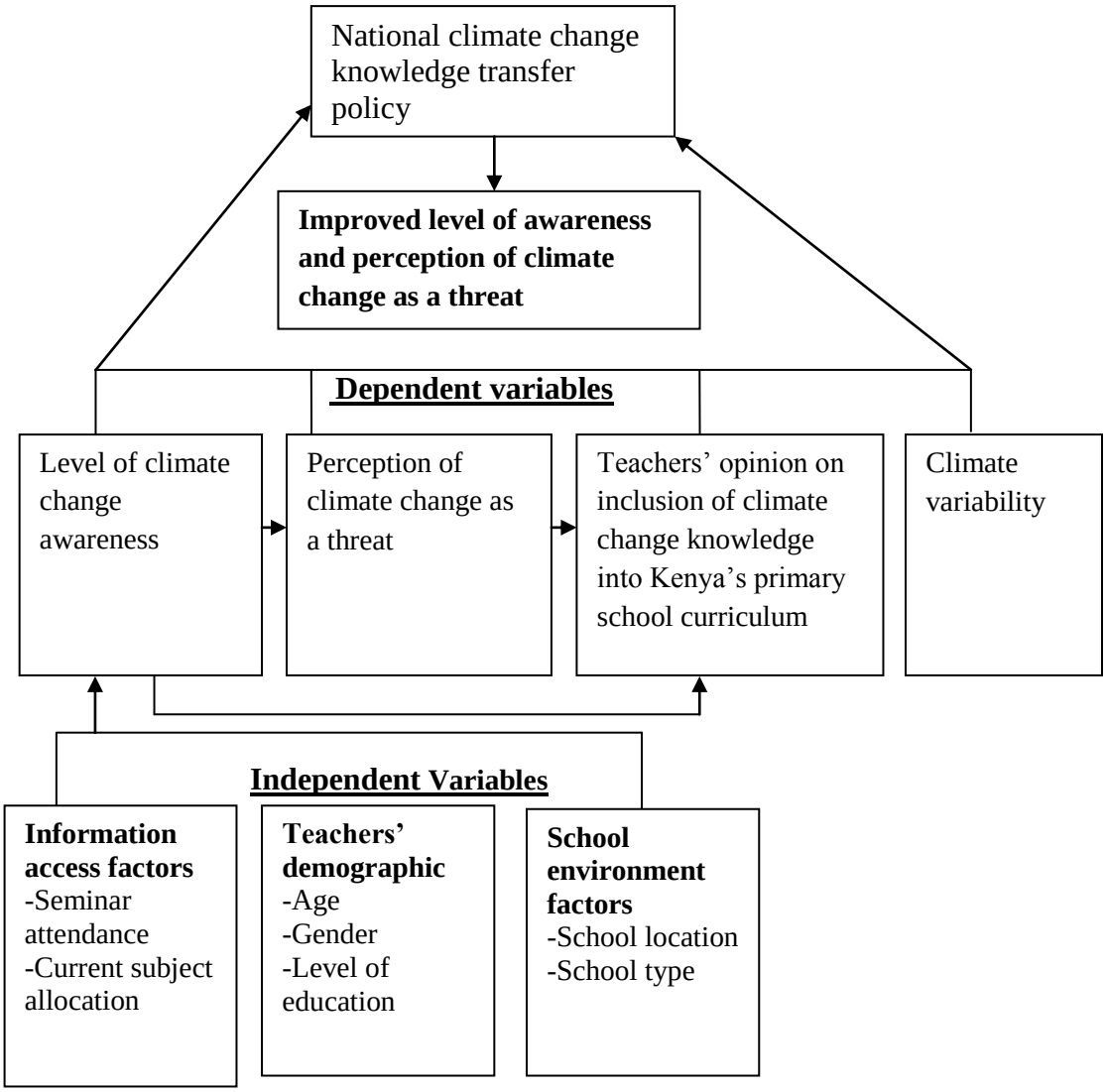

Figure 0.1: Conceptual framework

The level of climate change awareness and perception among primary school teachers is influenced by a number of factors including age, gender, level of education, current subject allocation, seminar attendance, school type and school location. When teachers are aware of climate change, they are likely to perceive it as a threat and support its inclusion into the curriculum as well. Teachers' perception of climate change as a threat is also likely to influence their support for inclusion of climate change knowledge into the curriculum. Given knowledge of teachers' level of awareness on climate change, perception of the same and opinion on inclusion of climate change into primary school curriculum, appropriate policy for enhancing knowledge transfer may be designed to

eventually lead to improved level of awareness and positive perception of climate change as a threat among teachers. Knowledge of climate variability can also inform policy planning to ensure that information on appropriate adaptation options is passed on to the public hence leading to improved awareness and positive perception of climate change as a threat.

The research thus pursued five important objectives: describe climate variability in Kisumu area; assess teachers' level of climate change awareness; identify factors influencing the teachers' level of awareness; determine teachers' perception of climate change; and assess teachers' opinion on inclusion of climate change knowledge into Kenya's primary school curriculum. The results of the study were used to recommend appropriate policy interventions that might help in improving teachers' level of climate change awareness and perception.

1.8 Operational Definition of Terms

Climate change: measurable shifts in traditional climate patterns of a given place outside the normal range of natural climate variability attributed to anthropogenic factors.

Climate variability: short term fluctuations in elements of climate including rainfall, temperature and humidity attributed to both anthropogenic and natural factors.

Climate change education: the type of education targeting attitudes and behaviour change towards sustainability, and which is able to help learners understand and interpret impacts of climate change.

Climate change awareness: teachers' common knowledge and understanding of climate change.

Climate change perception: teachers' interpretation of climate change as a threat.

Upper primary: standard four to eight of the 8-4-4 system.

CHAPTER TWO: LITERATURE REVIEW

2.1 Evolution of Climate Change as a Problem of Global Concern

The debate on climate change is surrounded by a lot of controversy. On one side is a group of believers presenting all available evidence to prove to the world that climate change is real and is being driven by unsustainable human activities while on the other side is a group of sceptics refuting evidence presented to stick to their belief that global warming is a myth.

Scientific warnings on the possibility of human influence on the global climate system dates back to the late 19th century. However, conclusive evidence linking climate change to anthropogenic factors emerged as from 1950s when Charles D. Keeling from Scripps Institution of Oceanography started measuring atmospheric CO_2 concentration in ice-cores. The preliminary results of Keeling's study revealed beyond any reasonable doubt that the concentration of CO_2 in the atmosphere was increasing, but with seasonal variations, and this increase had a link to industrial development (Keeling, 1960).

The 1970s saw some development in the concern about global warming. However, the public attention on climate change was only captured for the first time by the Brundtland Report, *Our Common Future*, published in 1987 which highlighted a number of environmental problems including climate change. The report stated that the world's climate is on a warming trend being driven by the unsustainable development practices of humankind (UNWCED, 1987). On the contrary, the global concern on the possibility of a changing climate was not triggered by the Brundtland's Report, but by the unusual heat wave and drought of the summer 1988 (Christianson, 1999).

With this concern and the Brundtland Report placed into global perspective, the Intergovernmental Panel on Climate Change (IPCC) was established in 1989 to carry out periodic assessments on the global climate system. IPCC has three committees, commonly referred to as working groups, each dealing with different aspects of climate change. Working group I deals with assessment of the scientific aspects of climate system; working group II deals with impacts, vulnerability and adaptation options; and working group III assesses mitigation options. IPCC, the leading global scientific

research body on climate change, produces assessment reports based on scientific research submissions from various scholars across the world. While the IPCC creates global awareness on climate change through its assessment reports, it leaves a gap in as far as information on public awareness and perception of climate change is concerned as it does not publish any research work on this area. IPCC published its first assessment report in 1990. The report of Working Group I confirmed that the world's climate is actually warming and action needs to be taken to curb further anthropogenic interferences of the climate system (IPCC, 1990). IPCC have published three more assessment reports since then and all of them point to the same direction: global warming is real. The forth assessment report, for instance, asserts that climate change is unequivocal and there is a 99% probability that it has been caused by greenhouse gases from anthropogenic activities (IPCC, 2007). Even so, IPCC's work has come under sharp criticism with authors questioning the credibility of its reports (Tol, 2007; Trainer, 2008). The fourth assessment report was particularly criticized for containing a lot of errors and exaggerated results. Issues such as the disappearance of Himalayan glaciers by 2035, 50% reduction of crop yields in Africa by 2020, increased frequencies of extreme weather related events since 1990s and the loss of Amazon forest cited in IPCC's fourth assessment report were disputed by scientists as being too exaggerated and based on incredible sources (Ravindranath, 2010).

Despite criticisms, IPCC's first assessment report managed to trigger global concern in as far as climate change is concerned. This was evidenced by the 1992 UNCED (also known as the Rio Earth Summit), which was attended by heads of states from over 100 countries across the world (UNCED, 1992). Even though the 1992 UNCED was a follow-up conference of the 1972 Stockholm Conference on Human Environment, it for the first time brought to the attention of the world the fact that climate change is happening, it is being driven by human interference of the climate system, and there is need for immediate and joint action to mitigate it while at the same time adapting to its disastrous impacts (UNFCCC, 1992). Consequently, the *UN Framework Convention on Climate Change* (commonly referred to as the UNFCCC) was adopted during the 1992 Rio Earth Summit to provide a framework for global action against climate change (UNCED,

1992). A protocol to the UNFCCC (commonly known as Kyoto Protocol) was later adopted in 1997, and came into force in 2005 to provide a legally binding framework for containment of greenhouse gases to the 1990 levels. Both the UNFCCC and Kyoto Protocol have come under criticism for using the principle of "*common but differentiated (historic) responsibility*" which critics feel gave newly industrialized, but heavy polluting countries like China and India a right to emit (Rajamani, 2000; Bortscheller, 2010). This explains why the United States, one of the countries that should be in the forefront in the fight against climate change, has never ratified the protocol.

Nevertheless, the implementation of the UNFCCC and its Kyoto Protocol has managed to not only spark global action on climate change, but also create awareness on the issue (Eze, 2011). The implementation of the UNFCCC and Kyoto Protocol required constant monitoring, something that has been achieved through the yearly conference of parties (also known as CoPs) (UNFCCC, 1992). While these meetings were meant to monitor progress and chart the way forward on a yearly basis, they have played a significant role in creating awareness on climate change. The media coverage of these conference proceedings has made the public more aware of climate change now than it was when the Climate Change Convention was adopted in 1992.

Despite scepticism that surrounds climate change and global warming, most governments across the world have adopted the view that climate change is happening and there is need for action against it. This is evidenced by the fact that most countries, Kenya included, have ratified and domesticated the UNFCCC and its Kyoto protocol through development of national response strategies and action plans as part of their implementation efforts. This shows the level of concern about climate change as a global problem by these nations. However, this high level of concern can also be attributed to the severity of climate change impacts being experienced by many countries around the world hence forcing governments to act to improve their resilience (UNDP, 2007).

Even with these developments, there is still a substantial minority of the population the world over that is unaware of climate change. Most people only understand climate change to mean variations in weather patterns while the majority of people around the

world are not able to differentiate between climate change and global warming hence the need to create awareness on climate change especially through education (Bostrom *et al*., 1994; Christianson, 1999; Pugliese and Ray, 2009).

2.2 Climate Change Concept

Climate change is most often equated to global warming yet climate change is more than just the warming of the earth. Many authors define climate change simply as the anthropogenic alteration of global climate system through combustion of fossil fuel, deforestation, and other related activities that contribute to increased concentration of greenhouse gases in the atmosphere (Sexton *et al*., 2001; Weart, 2010; Trenberth, 2011; Curry, 2011). This definition is in line with the United Nations Framework Convention on Climate Change (UNFCCC, 1992). However, the anthropogenic nature of the current climate change is still debatable (Cook *et al*., 2013). In this regard, IPCC defines climate change as a change in the state of average weather patterns attributed to both natural and human induced factors and which in addition to variability persists over long periods (IPCC, 2007). Nonetheless, both of these definitions concentrate on the cause of climate change more than giving a clear impression of what "climate change" really mean.

A comprehensive definition of climate change was provided by John P. Holdren, a renowned scientist from Harvard University, in his 2006 public lecture titled *Meeting the Climate-Change Challenge*. In his lecture notes, Holdren (2006) defines climate change as alterations in earth's weather patterns in terms of the averages, the extremes, the timing, and the spatial distribution of weather events manifested in the form of hot or cold, wet or dry, snowpack or snowmelt, winds or storm tracks, and ocean currents or upwelling, which are in addition to rising global temperatures. From Holdren's definition, climate change thus entails a measurable trend in global climate towards extreme regardless of the cause. Hence, when talking about climate change, the indicators in question has to be measurable and they must portray an extremity in their behaviour, i.e. a trend different from the normal pattern.

2.2.1 Global Warming

Climate change is often used interchangeably with global warming. Yet global warming simply refers to a sustained increase in the average atmospheric temperature, which is

capable of causing changes in the global climate system. Available scientific evidence shows that the earth experienced an average warming of approximately 0.6 °C during the 20th Century (IPCC, 2001) and is expected to warm by about 2-3 °C by the end of the 21st century (IPCC, 2007). According to Holdren (2006), the last 50 years of the 20th Century were the warmest in 600 years. Further, the top ten global warmest years with temperatures above the 20th C average are all in the first decade of the 21th Century except for one (NOAA, 2010) sufficing as evidence of a warming earth as illustrated in Table 2.1. This warring trend is blamed on human activities mainly burning of fossil fuel, deforestation, and industrial air pollution (Weart, 2010). All these activities have led to increased concentration of carbon dioxide in the atmosphere thereby enhancing greenhouse effect and hence the rising temperatures.

Table 0.1: Global top 10 warmest years

Year	Temperature anomaly (°C)
2010	0.62
2005	0.62
1998	0.60
2003	0.58
2002	0.58
2009	0.56
2006	0.56
2007	0.55
2004	0.54
2001	0.52

Source: NOAA (2010)

Climate change and global warming are often discussed in global terms, yet their effects vary across the globe. Nevertheless, one thing that remains clear is that the world is warming and this warming has altered the global climate system hence climate change. The 2010 *NOAA State of the Climate Report* confirmed that all the indicators are already behaving as earlier predicted by climate models (those expected to increase like temperature, humidity and sea level are increasing while those expected to decrease like glacier, snow cover, and sea ice are decreasing) hence sufficient evidence to show that

the world's climate has changed and is being driven by the sustained warming of the climate system since late 19th century (Blunden, Arndt and Baringer, 2011).

2.3 Public Climate Change Awareness and Perception

2.3.1 Factors Influencing the Public Level of Awareness on Climate Change

Various studies have revealed that climate change awareness and perception varies within and across regions (GobeScan, 2006; Pew Research Centre, 2006; Pugliese and Ray, 2009). But why does the level of awareness differ? A review of literature shows that people's level of awareness and perception of climate change is influenced by factors which can be categorized into three, namely: demographic factors including age, gender, and level of education; personal experience including experience of extreme weather events; and access to information including media coverage of the issue and advocacy.

Age is a critical predictor of individual's familiarity with climate change issues. According to a study conducted by Saroar and Routray (2010), there is a positive correlation between age and familiarity with climate change/extreme weather events. It is thus expected that older people should be more aware of climate change than younger people. However, this is not a rule of thumb. Surveys conducted in Europe revealed that younger people are more aware of environmental problems including climate change (Patched, 2006). A study of junior high school students' awareness of climate change and sustainable development in Ghana by Owolabi, Gyimah and Amponsah (2012) also revealed that younger students (below 15 years) are more aware of climate change than older students but their results were not statistically significant. Older people are, however, more likely to be worried about climate change (Saroar and Routray, 2010). Hence, it is clear that age has an influence on the public's level of awareness and perception of climate change but it is difficult to set with certainty whether the correlation is positive or negative.

Another important predictor of the public level of awareness and perception of climate change is the level of education. Studies have proved that individuals with high levels of education are more likely to be aware of climate change (Acquah, 2011; Hasan and Akhter, 2011; Olajide *et al*., 2011; Adebayo *et al*., 2013). However, people with less

years of education are likely to perceive climate change as a threat since they are likely to have less income and remain highly vulnerable to the impacts of climate change (Brulle, Carmichael and Jenkins, 2011; Hasan and Akhter, 2011).

Just like age and level of education, gender is another predictor of climate change awareness. Studies have revealed that men are more aware of climate change than women (Patchen, 2006; Acquah, 2011; Olajide *et al*., 201; Ekpoh and Ekpoh, 2011). This is mainly due to the fact that men have a relatively high access to information through print and electronic media (Ekpoh and Ekpoh, 2011). However, women are more likely to perceive climate change as a serious threat. This was confirmed by a study of public perception of climate change done by Semenza *et al*. (2008), which found out that women in both Portland and Houston were significantly more concerned about climate change. This perception pattern reflects the fact that women are more vulnerable to climate change given their home makers role in the society, which forces them to directly interact with the environment.

Away from demographic factors, personal experience of the impacts of climate change also plays a key role in shaping people's familiarity with climate change. People who live in disaster prone areas are likely to be more familiar and concerned about climate change. According to a longitudinal survey on Americans conducted between the years 2008 and 2011 by Myers *et al*. (2013), experience of the impacts of climate change provides the opportunity for experiential learning especially among people who are less engaged in climate change issues. It is only through experience of the impacts of climate change that lay people become more certain that climate change is happening and they need to do something in order to increase their level of resilience. Whitmarsh (2008), however, failed to find any significant relationship between personal experience and climate change awareness and perception. According to the results of his study, victims of air pollution appeared to be more aware and concerned about climate change than other people compared to the victims of floods. Experiential learning may thus only occur among people who are still sceptical about climate change. Weber (2013) also asserts that personal experience only shapes the beliefs about climate change for individuals with no

strong beliefs about the same but is less likely to influence the level of awareness for people with a firm belief on climate change.

Lastly, access to information is critical in shaping the public level of climate change awareness. According to Saroar and Routray (2010), access to information determines individual's knowledge of climate change, which eventually influences behaviour. People who either read newspapers and other related prints, listen to radios, watch TVs, or have access to the internet are more likely to be familiar with climate change than those who do not have access to such media of information. According to a study on the influence of media coverage on Japanese public awareness of climate change issues conducted by Sampei and Aoyagi-Usui (2009), intense newspaper coverage of global warming issues is associated with an increase in public concern over global warming. Similar findings were also revealed in a study of public perception of climate change by Lowe *et al*. (2006) in which viewers of a film, *The Day After Tomorrow*, were interviewed to check if the film changed their perception of climate change. Many viewers of the film expressed increased anxiety over environmental risks and a strong motivation to act to counteract climate change. Patchen (2006), however, warns that access to information does not necessarily shape individual's perception of climate change hence may not trigger action to counteract the change in most cases.

2.3.2 Global Public Level of Awareness on Climate Change

Climate change only became a serious issue of global concern after 1988- the first hottest year recorded since mid-19th century (Christianson, 1999). Awareness studies conducted since then, especially in the developed world reveals that climate change awareness level is high in developed countries (Bostrom *et al*., 1994; Bord, Fisher, and O'Conner, 1998; Pew Research Centre, 2006; Pugliese and Ray, 2009), but still not a priority environmental issue in most of these countries (Leiserowitz Kates and Parris, 2005; Leiserowitz, 2006; Pew Research Centre, 2013).

Global public opinion on climate change has been extensively explored by research companies mainly Gallup and Pew Research Centre. Results from their studies shows that awareness of climate change is high in developed than in developing countries.

According to Pew Research Centre *Global Attitudes Project* survey conducted in 2006, people from developed countries are increasingly aware of climate change compared to those in developing countries. Similar findings were revealed by Gallup's global opinion poll conducted between 2008 and 2009 in 128 countries around the word, which shows that people in Europe and America are more aware of climate change than those in Africa, Asia, and Middle East regions (Pugliese and Ray, 2009). While the Gallup and Pew Research Centre studies provide a global outlook, they are shallow studies based on opinion polls and hence reveal very little information on climate change awareness. A conclusion made based on such studies may be misleading hence the need to feel this gap with detailed empirical studies. Nevertheless, the low level of awareness in developing countries calls for attention as it might have serious implications for climate change policy implementation.

2.3.3 Global Perception of Climate Change

There is a public consensus throughout the world that climate change is happening, but perception of climate change differs across countries in the world. A *Global Health of the Planet Survey* conducted in 1992 on 24 countries around the world revealed that 13 countries, out of which 8 are European countries, perceived climate change as a serious problem of global concern (Dunlap, Gallup and Gallup 1993). Similar results also emerged in a study by Bord, Fisher and O'Conner (1998) whereby 63% of those who responded to the opinion question perceived global warming as a 'major threat'. GlobeScan (2006) also confirmed from its follow up study conducted in 30 countries around the world between 2005 and 2006 that climate change is perceived as a serious risk worldwide and concern for climate change risk seems to have grown over the years. This increased concern can be attributed to increased frequency of observed impacts worldwide, scientific certainty and awareness campaigns worldwide arising from the yearly UNFCCC CoPs that draws global attention.

Just like awareness, perception of climate change as a major threat also varies between developed and developing countries. While some studies have revealed that perception of climate change as a major threat is high in developing countries (GobeScan, 2006; Pew Research Centre, 2006), the Gallup survey conducted between 2008 and 2009 revealed

that people in developed countries are more likely to perceive climate change as a major threat (Pugliese and Ray, 2009). However, a recent opinion poll by Pew Research Centre (2013) revealed that people in the U.S. are less likely to perceive climate change as a threat. Still, opinion polls may be misleading hence the need for an in-depth study to gauge the public level of awareness and perception of climate change. All the same, the low level of awareness and perception of climate change as a major threat profound the need to educate the public on climate change.

2.3.4 Public Climate Change Awareness and Perception in Africa

According to a regional survey conducted by Africa Talks Climate in ten sub-Saharan countries including Kenya in 2009, people in sub-Saharan Africa are poorly informed about climate change (Godfrey *et al*., 2009). Most people in Africa consider climate change to be an abstract, despite their understanding of changing weather patterns. Similar findings were revealed by a report on South African awareness of climate change, which stated that Africans have very limited understanding of global climate change, despite their awareness of changing weather patterns (Taderera, 2010). However, country specific studies reveal conflicting findings.

A descriptive survey conducted by Acquah (2011) using a random sample of 78 respondents to evaluate public awareness and quality of knowledge regarding climate change in Ghana revealed a higher level of awareness on climate change among inhabitants of central region of Ghana. Nonetheless, Acquah's study is limited in its sample size and may not be representative of the general population in central Ghana.

In a similar study, Oruonye (2011) examined the level of awareness on the impacts of climate change effects among tertiary institution students in Jalingo Metropolis, Nigeria and found a surprisingly low level of awareness. Of the 225 students Oruonye interviewed, 18.8% had never had 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. Studies of secondary school teachers' level of awareness by Akinnubi *et al*. (2012) and Ekpoh and Ekpoh (2011) also revealed a general low level of

awareness among secondary school teachers in Ondo West Government Local Area, Ondo State and Calabar Municipality, Nigeria respectively.

2.3.5 The Level of Awareness and Perception of Climate Change in Kenya

Literature on public awareness and perception of climate change in Kenya is relatively scarce. Most of the available literature is in the form of government reports. Nevertheless, the available literature reveals a low level of climate change awareness in Kenya. According to a research conducted by Africa Talks Climate in 2009, most Kenyans are unfamiliar with the concepts of climate change and global warming, but are aware and concerned about frequent droughts and food scarcity in the country (Otieno, Pauker and Maina, 2009). The authors observed that there is eminent confusion among Kenyans on the true meaning of climate change even though they live with the impacts of climate change. Similar concerns are expressed in GoK (2010b) and RoK (2013), which state that the vast majority of Kenyans are unaware of climate change, despite their knowledge of changing weather patterns, but the authors also recognize the fact that data on climate change awareness is scanty in the country. The low level of climate change awareness among most Kenyans in confounded by the apparently lack of a uniform translation of climate change as a concept into the various vernacular languages in the country (RoK, 2012). GoK (2010b), in particular, calls for in-depth studies to examine the level of climate change awareness, and how this perceived low level of awareness can be improved in all age groups across the country. The report also recommends education as a potential avenue for dissemination of climate change knowledge to various groups in Kenya.

2.4 The Role of Education in Creating Awareness on Climate Change

The need for education in dealing with climate change is well spelt in Article 6 of UNFCCC. Education, whether formal or informal, has a central role to play in understanding, mitigating and adopting to climate change. In this regard, UNESCO (2009) states that climate change education should focus on transforming learners into critical thinkers, life-long learners and adoptable. International conventions and protocols geared towards climate change mitigation like the UNFCCC and its Kyoto Protocol can only succeed if the general public is sensitized to play a role in mitigating climate change.

While there are other methods of creating awareness like the media, education remains the most significant method for creating awareness on climate change especially among young people. According to Anderson (2010), teachers are an untapped resource that the world can use to combat climate change. Teachers 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.

Hence, climate change education does not only lead to awareness creation, but also a total change in behaviour and attitude towards sustainability. Nevertheless, education is not a 'magic bullet' in tackling the problems of climate change unless coordinated educational interventions are pursued (UNESCO, 2009). Climate change education programme should be developed in such a way that it is able to help learners become responsible citizens who are capable of making responsible decisions that can lead to climate change mitigation and adaptation. Such programmes should not just have a narrow focus on learners, but also on educators to ensure that teachers have the required expertise to create awareness on climate change in the classroom.

2.4.1 Climate Change Knowledge in Kenya's Primary School Curriculum

Kenya's primary schools already offer knowledge expected to introduce pupils to basics of environmental study. A review of Kenya's primary school syllabus revealed that Kenyan pupils are taught basic principles of weather and climate, addressed through Science and Social Studies subjects, as outlined in Table 2.2.

Table 0.2: Weather and climate knowledge in Kenya's primary school curriculum

Class	Knowledge currently present	Subject in which it is taught
Standard 1	Weather	Science
Standard 2	Weather	Science
	Weather around our school	Social Studies
Standard 3	Weather	Science
	Weather and seasons in our district	Social Studies
Standard 4	Weather and the sky -Weather measuring instruments	Science
	The physical environment	Social Studies
Standard 5	Weather -Weather instruments	Science
Standard 6	Weather	Science
	Meaning of climate	Social studies
	The solar system	Science
Standard 7	Physical environment	Science
	Climate in Africa -Climatic regions -Influence of climate on human activities	Social studies
Standard 8	Climate -Weather observation -Factors influencing climate change -Impacts of climate change on human activities	Social studies

Source: Researchers' content review of Kenya's primary school syllabus

Despite the presence of weather and climate knowledge, current syllabus only offers limited knowledge on climate change as from Standard 7, but 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.

2.5 Knowledge Gaps in the Literature Reviewed

From the literature reviewed in this chapter, there exists a universal consensus across the world that climate change is happening, despite sceptical views from a minority group of scientists. The level of climate change awareness is surprisingly low in the developing world, despite the fact that these countries are the most vulnerable to the impacts of climate change. Perception of climate change as a major threat has increased over the years but is still low, especially in developing countries. However, most documented studies on climate change awareness and perception are in the form of opinion polls with no scientific backing. It also emerged from the literature reviewed that gender, age, level of education, personal experiences, and access to information are key determinants of the public level of awareness and perception of climate change. Nevertheless, literature on climate change awareness and perception, especially in Kenya is relatively scarce. This study intends to fill these gaps by undertaking an empirical study to assess the level of awareness on climate change among primary school teachers in Kisumu City, Kenya.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

This study was carried out in Kisumu City located along the equator in western Kenya. Kisumu lies along the shores of Lake Victoria within latitudes 0° 02' N and 0° 10' S and longitudes 34° 20' E and 34° 55' E at an altitude of 1, 134 metres above sea level (Maoulidi, 2008). The main physical feature in the area is Lake Victoria. The City covers an area of 417 Km^2 of which only 297 Km^2 is landmass (City Council of Kisumu, 2012). It is the third largest city in Kenya with a population of 388, 311 based on the 2009 census (Kenya National Bureau of Statistics, 2011). The City covers both Kisumu East and West districts consisting of urban and peri-urban settlements and is divided into 25 sub-locations, which are grouped into 10 locations as illustrated in Fig. 3.1.

Kisumu City originated as a railway terminus in 1901 and has since grown to be the Headquarter of the then Nyanza province and currently the Headquarter of Kisumu County. Kisumu City also holds high political and economic significance in the East Africa Lake region serving as a trade and communication confluence for Uganda, Tanzania, Rwanda and Burundi through its well-developed road, rail, air and water transport network (City Council of Kisumu, 2012).

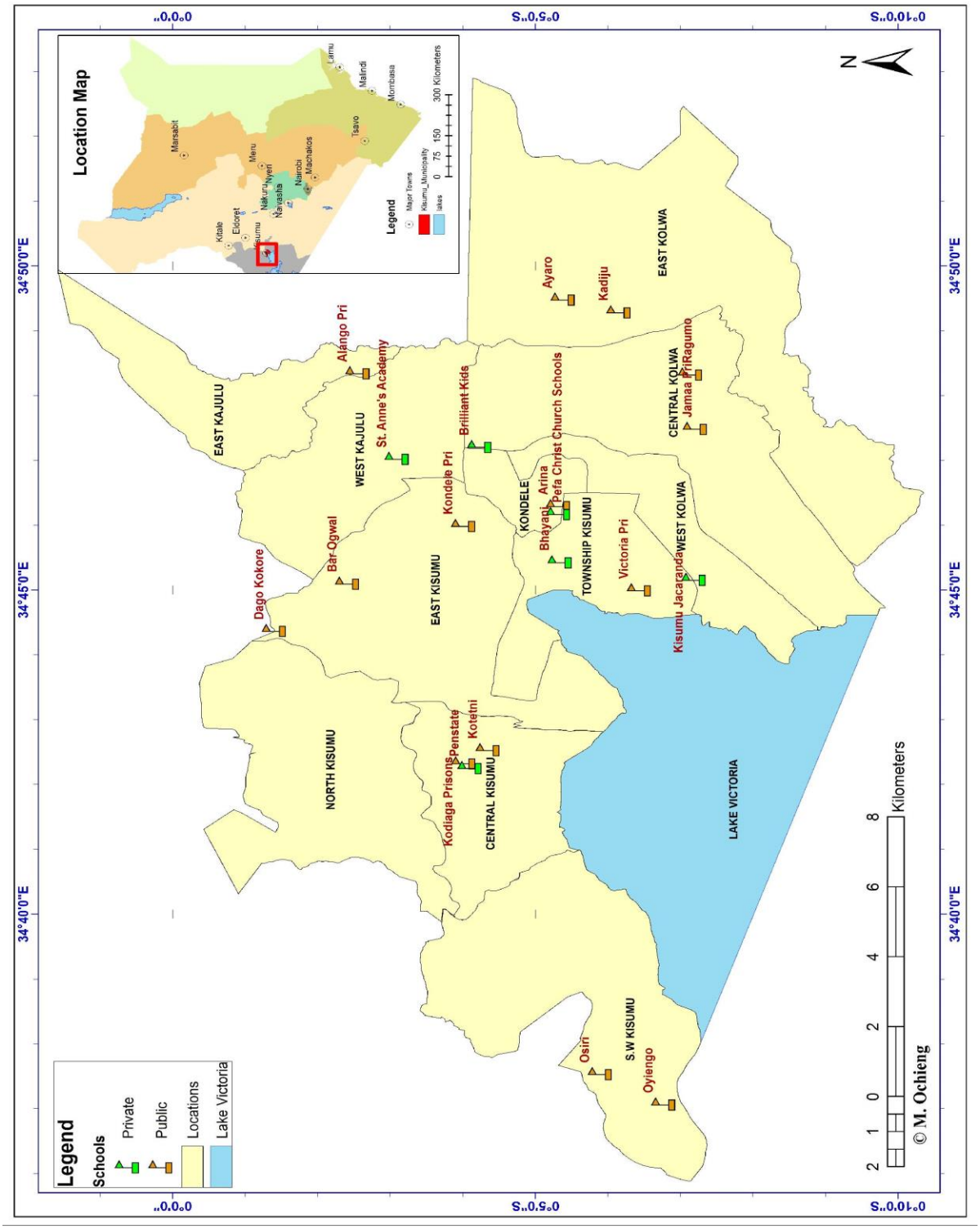

Figure 0.1: Kisumu City: Administrative locations and sampled schools

3.1.1 Climate of Kisumu Area

Kisumu is warm to hot all year round. Average monthly temperature in the area ranges between 20 °C and 23 °C while annual precipitation averages 1287mm (Kisumu City Council, 2005). The area is already experiencing climate variability as discussed in Section 4.2 of chapter four.

3.1.2 Education in Kisumu City

Education in Kisumu City is provided both by public and private sectors and consists of both formal and non-formal institutions. Education institutions in the City include pre-primary institutions, primary and secondary schools, non-formal education centres, vocational institutions, and tertiary institutions (Maoulidi, 2008). The City Council of Kisumu has a Municipal Education Office, which handles the management of primary and Early Childhood Education Centres (ECEC) within the City on behalf of the Ministry of Education.

According to information obtained from the MEO, Kisumu City has a total of 184 primary schools out of which 119 are public. Table 3.1 provides an illustration of education institutions within Kisumu City as at October, 2012. Primary schools in Kisumu City are grouped into nine distinct school zones namely: Nyahera, Otonglo, Ojolla, Kajulu, Manyatta, Rweya, Central, Southern, and Ragumo (Information Obtained from MEO, Kisumu). An elaborate illustration of the distribution of primary schools in Kisumu City by zone is provided in Section 3.5 of this chapter.

Table 0.1: Education institutions in Kisumu City as at October, 2012

Category of education institution	Public	Private	Total
Pre-Primary Schools	120	392	512
Primary Schools	119	65	184
Secondary Schools	28	8	36
Non-Formal	-	-	14
Vocational Institutions	-	-	10
Tertiary (Public and private)	-	-	More than 15

Source: Information obtained from MEO and MOE offices, Kisumu

3.2 Research Design

This study took the form of a descriptive survey. A descriptive survey was deemed most appropriate for this study as it allows for identification and description of people's opinion about a phenomenon (Mugenda and Mugenda, 2003), in this case climate change. This involved a critical review of literature as well as field collection of primary data to provide the variety of information needed to assess teachers' level of awareness and perception of climate change. Primary data was collected from upper primary school teachers in Kisumu City while secondary data was obtained from Kenya Meteorological Department (KMD) as well as through a review of scholarly journal articles, books, and reports.

3.3 Population

The study was carried out in public and private primary schools located in both urban and peri-urban areas within Kisumu City. The study targeted a population of upper primary teachers in schools in the study area. Schools that only had lower primary classes as well as schools practicing education systems other than the 8-4-4 were excluded from this study leaving a population of 172 schools. The choice of upper primary school teachers was guided by the researchers' assumption that climate change concept is too complex for lower primary classes. Description of climate variability was also limited to temperature and precipitation covering a period of 40 years from 1972 to 2011. The assumption was that temperature and rainfall are the most well understood indicators of climate change.

3.4 Sample and Sampling Procedure

Kisumu City was purposively selected as the study area due to its diverse nature of settlement, which gave the researcher the opportunity to collect data from schools, located both in urban and peri-urban settlements. The decision of selecting Kisumu City as the study area was also informed by its high vulnerability to climate change given its location and poverty levels. The choice of a 40 years period (1972 -2011) for examination of climate variability as well as the choice of temperature and rainfall as

units of observation was also arrived at purposively guided by the need for a comprehensive and current data.

The education sector was also purposively selected given its significant role in instilling knowledge on climate change at all levels. Further, the choice of primary school teachers as the unit of observation was guided by the vital role they would play not only in imparting knowledge of climate change, but also in shaping attitudes and behaviours of Kenyan pupils.

The researcher used multistage stratified random sampling to select 100 respondents from 20 primary schools within Kisumu City. Multistage stratified sampling involves selection of random samples from successive homogeneous groups (strata) until the intended individual is reached (Orodho, 2009). Mugenda and Mugenda (2003) posit that multi-stage sampling is most appropriate when the sampling unit contains sub-clusters that are of interest to the researcher. In this case school zones, school type and gender were important clusters and the sample obtained ought to reflect these characteristics.

A sample of 20 schools was first stratifically drawn from 172 schools by grouping schools into zones and a sample selected depending on the number of schools in each zone. The researcher used Orodho's (2009) proportionate approach, which begins by determining the probability of selecting any individual from the sampling unit using the formula:

$$n/N$$

Where: n is the desired sample size; N is the total population for all the strata

The probability for inclusion of any school within Kisumu City in the sample was thus 0.1163 (20/172). The number of schools from each zone to be included in the sample was then arrived at by multiplying the number of schools in each zone by 0.1163 as illustrated in Table 3.2 (column 3 and 6).

Table 0.2: Sample frame for the schools (based on data from MEO, Kisumu)

Zone	Total number of schools			Number of sampled schools		Total number of sampled schools
	Public	Private	Totals	Public	Private	
Nyahera	16	2	18	2	0	2
Otonglo	15	10	25	2	1	3
Ojolla	17	2	19	2	0	2
Kajulu	11	6	17	1	1	2
Manyatta	9	7	16	1	1	2
Central	12	12	24	1	2	3
Southern	10	10	20	1	1	2
Rweya	15	0	15	2	0	2
Ragumo	14	4	18	2	0	2
Totals	**119**	**53**	**172**	**14**	**6**	**20**

At the zone level, schools were stratified into public and private strata to ensure equitable allocation of samples and the same formula used to first determine the probability of selecting an individual school in each strata then multiplying this by the population in each stratum as illustrated in Table 3.2 (columns 1, 4 and 2, 5). A comprehensive list of the sampled schools is provided in Appendix I while Fig. 3.1 provides information on the physical location of the sampled schools within the city.

Using a predetermined sample size of 5 teachers per school, teachers were grouped into male and female and samples drawn using the above formula. A total of 100 teachers were sampled from the 20 schools. A sample frame of 20 schools from which 100 teachers were drawn was believed to be representative enough in this study as it was within Mugenda and Mugenda's (2003) 10% recommendation.

3.5 Data Collection Procedures

The study relied on both primary and secondary data. Primary data involved teachers' awareness and perception of climate change and was collected through a field survey. Secondary data included meteorological data on temperature and precipitation, which was collected from KMD database.

3.5.1 Research Instrument

Semi-structured questionnaire consisting of both open-ended and closed questions was used to collect data for this study. The use of a structured questionnaire in this study is in congruent with UNEP (2006), which emphasized the importance of questionnaire survey in gauging level of awareness on climate change among stakeholders and potential partners including government officials, business leaders, NGO representatives, journalists, scientists, clergy and youth. Data collected included teachers' knowledge and perception of climate change as well as opinion on inclusion of climate change knowledge into Kenya's primary school curriculum. The questionnaire consisted of 4 sections labelled A to D. Section A consisted of demographic questions. Section B consisted of awareness questions to establish respondents' basic knowledge of climate change. Section C consisted of both positive and negative Likert Statements to further assess the respondents' knowledge and perception of climate change including its causes, effects, and possible mitigations. A five-point Likert Scale ranging from Strongly Agree to Strongly Disagree was used to rate respondents attitude towards various Likert items. Section D consisted of policy questions to assess respondents' opinion on inclusion of climate change knowledge into primary school curriculum in Kenya.

3.5.1.1 Construction of Likert Scale

Developed in 1932 by Rensis Likert, Likert Scale is a five-point scale used in a survey to measure attitude based on the respondents' level of agreement and can be analysed as individual Likert items or a group of items measuring a construct (Jamieson, 2004). Likert Scale was used in this study to measure teachers' awareness of climate change causes, effects and mitigation as well as perception of climate change. A total of 28 paired statements were designed and responses weighted on a scale of 1-5 where 1 = Strongly Disagree and 5 = Strongly Agree for the positive statements and the reverse scale for the negative statements. "Don't know" response was used in this study instead of the Likert's "Undecided" response since the instrument was used to measure teachers' knowledge of climate change and "don't know" means lack of awareness. Out of the 28 statements, 20 were designed to measure level of awareness. Six out of the remaining eight statements were used to measure perception of climate change while another two

measured teachers' opinion on inclusion of climate change knowledge in primary school curriculum in Kenya. The reliability of the Likert items as measures of the level of climate change awareness and perception was tested using Cronbach's Alpha. According to George and Mallery (2003), a Cronbach's Alpha of ≤ 0.5 is unacceptable, ≥ 0.7 is adequate, ≥ 0.8 is good, and ≥ 0.9 is excellent.

3.5.2 Administration of Research Instrument

Data collection was carried out in the month of October, 2012 and was conducted only during official week days. The meteorological data was also obtained from KMD during the same month. Prior to data collection, the researcher carried out a one week pilot study in 4 schools within the study area in July, 2012 to test the research instrument and also familiarize herself with administration procedures. A total of 100 questionnaires were distributed as the research targeted a sample frame of 100 teachers. The questionnaires were self-administered since the respondents were literate, but the researcher was always available to provide clarification whenever sort by respondents.

3.6 Data Analysis

The researcher used computer aided statistical packages to analyse volumes of information collected using the above mentioned procedures. Specifically, Statistical Package for Social Sciences (SPSS) and Microsoft Excel were used for purposes of data analysis. All the completed questionnaires were first examined for completeness and consistency. This was then followed by numerical coding of the qualitative responses for ease of storage and analysis. The responses were then entered into SPSS creating a data set of climate change awareness and data analysis commands ran to test hypotheses on climate change awareness, perception, teachers' opinion on inclusion of climate change knowledge and factors affecting teachers' level of awareness on climate change were analysed using SPSS. Similarly, meteorological data was examined for accuracy and completeness before creating a data set of climate variability in Ms Excel for analysis.

The analysis involved both simple descriptive methods and detailed statistics. Descriptive statistics including frequency counts, percentages and mean were used to summarize data. The Likert statements were analysed both as individual items and as a group of

statements using summative method. Detailed data analysis involved Student-t test, one-way ANOVA, chi-square test and correlation analysis. The hypotheses were tested at a statistical confidence level of 95%. The data analysed were presented in tables, charts and graphs.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Questionnaire Response Rate

The desired sample size for this study was 100 respondents. To achieve this, 20 schools were stratifically sampled out of which 5 teachers were sampled and approached to participate in the study in each school. Out of the 100 teachers approached, 2 declined to participate resulting to 98 responses. This represents a 98% acceptance rate. The decline by some teachers to participate in the study was attributed to suspicion among teachers as the study was conducted immediately after the September, 2012 teachers strike hence some teachers perceived the researcher to be a government spy.

A review of the questionnaires later revealed that two questionnaires were completed by respondents outside the study scope (i.e. lower primary school teachers) and were thus excluded leaving only 96 questionnaires that were finally analysed in this study. A response rate of 96% was considered adequate for this study as it fell above the 75% response rate recommended by Kelley *et al*. (2003).

4.2 General Characteristics of the Population Sampled

4.2.1 Respondents Distribution by Gender, Level of Education and Current Subject Allocation

For ease of data analysis respondents' current subject allocation was categorized into three, namely: Arts- consisting of languages, Social Studies, C.R.E and other skills related subjects such as Life Skills, and Creative Arts; Science- consisting of Science and Maths; and Arts/Science- which consisted of a combination of the first two categories. This method of categorization was deemed best for this study as the researcher was more interested in assessing whether science teachers are more versed with climate change than arts teachers or the reverse. This would not have been possible if the national primary school subject categorization system of languages, sciences and social subjects was adopted.

The sampled population consisted of 96 respondents of which 67% (n = 64) were male while 33% (n = 32) were female. A chi-square goodness of fit analysis found a

statistically significant difference in respondents distribution by gender (χ^2 = 10.667, df = 1, n = 96, p = 0.0001). The big difference in sample size between male and female respondents was attributed to the low population of female teachers in upper primary level especially in private schools, which left male respondents dominating the sample frame. This was confirmed through a chi-square analysis, which also found a statistically significant relationship between gender and school type (χ^2 = 5.455, df = 1, n = 96, p = 0.020).

It also emerged from the data collected that the majority of respondents, 84.4% (n = 81), fell in the Arts/Science category. Science and Arts categories accounted for only 9.4% (n = 9) and 6.2% (n = 6) of the respondents respectively. The data collected also revealed that the majority of respondents, 55% (n = 52), had acquired up to P1 Certificate. Respondents who reported their highest level of education as diploma, degree or high school (untrained form four leavers) constituted 15% (n = 14), 14% (n = 13), and 12% (n = 11) of the sample respectively. The remaining 4% (n = 4) of the 95 respondents had acquired a Master's degree. One respondent failed to state his level of education.

Significant gender disparity was observed in the respondents' current subject allocation whereby no female respondent fell in the pure science category as illustrated in Table 4.1. This conforms to the stereotypical relationship between women and science, which assumes that women have limited interest in science and hence remain under represented in science fields as was observed by Fox and Frebraugh (1992). However, a chi-square analysis failed to find any significant relationship between gender and current subject allocation (χ^2 = 2.806, df = 2, n = 96, p = 0.246) hence the disparities may be due to chance.

Gender also influenced respondents' distribution by highest level of education especially as from degree level as shown in Table 4.1. Female teachers in the study area appeared to be more educated than their male counterparts as 71% (n = 12) of the 17 respondents who had acquired at least a Bachelor's degree were female. This was confirmed through a chi-square analysis, which revealed a statistically significant relationship between gender and highest level of education (χ^2 = 14.998, df = 4, n = 95, p = 0.005).

Table 0.1: Respondents distribution by gender, level of education and subject

	Number of respondents			
Categories	**Male**	**Female**	**Totals**	**%**
High School (Untrained Form 4 leavers)	9	3	11	11.7
P1 Cert	41	11	52	54.7
Diploma	8	6	14	14.7
Degree	4	9	13	13.7
Masters	1	3	4	4.2
All education category	63	32	95	100
Proportion %	66.3	33.7	100	-
Arts	3	3	6	6.2
Science	9	0	9	9.4
Arts/Science	53	28	81	84.4
All subject category	64	32	96	100
Proportion %	66.67	33.33	100	-

A scan through the data did not reveal any striking relationship between the highest level of education and current subject allocation. This was confirmed through a chi-square test, which also failed to find any statistically significant relationship between current subject allocation and respondents' highest level of education ($\chi^2 = 7.027$, df = 8, n = 95, p = 0.534). This was attributed to the fact that subject specialization is rarely exercised in Kenya's primary school education explaining why the majority of respondents fell in the Arts/Science category.

4.2.2 Respondents Distribution by Age and Length of Stay in the Study Area

Data obtained shows that respondents were aged between 20 and 72 years with a range of 52 years. However, it was noted that there existed an outlier in the data as only one respondent fell above 55 years and reported his age as 72 years. Probing during data collection revealed that the respondent who reported his age as 72 years was a retired teacher working on contract arrangements. The researcher therefore, decided to remove this value from the subsequent analysis as it represented an outlier in the data and its inclusion would increase the error margin of conclusions made as advised by Osborne and Amy (2004).

With this value excluded, the sampled data recorded a mean age of 30.91 years (s = 7.817). This shows that teachers sampled for the study were young, but there was a significant difference in respondents distribution across various age groups (χ^2 = 38.432, df = 3, n = 95, p = 0.0001). It was noted that the majority of respondents, 50% (n = 48), fell in the age group 26-35 while age group 46-55 accounted for only 8.33% (n = 8) of the respondents. Age groups 18-25 and 36-45 accounted for 25% (n = 24) and 15.63% (n = 15) of respondents respectively as illustrated in table 4.2.

Table 0.2: Respondents distribution by age and length of stay in the study area

	Length of stay in the study area				
Age group in years	**1-5 Years**	**6-10 Years**	**>10 Years**	**Total**	**%**
18-25	6	3	15	24	25.00
26-35	6	6	36	48	50.00
36-45	1	0	9	15	15.63
46-55	1	0	7	8	8.33
>55	0	0	1	1	1.04
Total age groups	13	15	68	96	100.00
%	13.54	15.63	70.83	100	-

Closely related to age was respondents' distribution by length of stay in the study area as can be seen in Table 4.2. The majority of respondents, 71% (n = 68), had lived in the study area for more than 10 years, while another 16% (n = 15) had lived in the study area for a period of 6-10 years. The remaining 13% (n = 13) had spent between 1 and 5 years within the study area. The longest time lived by a respondent in the study area was reported as 54 years while the shortest length of stay in the area was reported as 10 months, which was later rounded off to 1 year. The length of stay in the study area produced a range of 53 years with a mean of 20.26 years and a standard deviation of 12.49. This implies that the majority of respondents have spent a great deal of their life time within the study area.

The data analysed revealed a close association between age and length of stay in the study area as illustrated in Fig. 4.1.

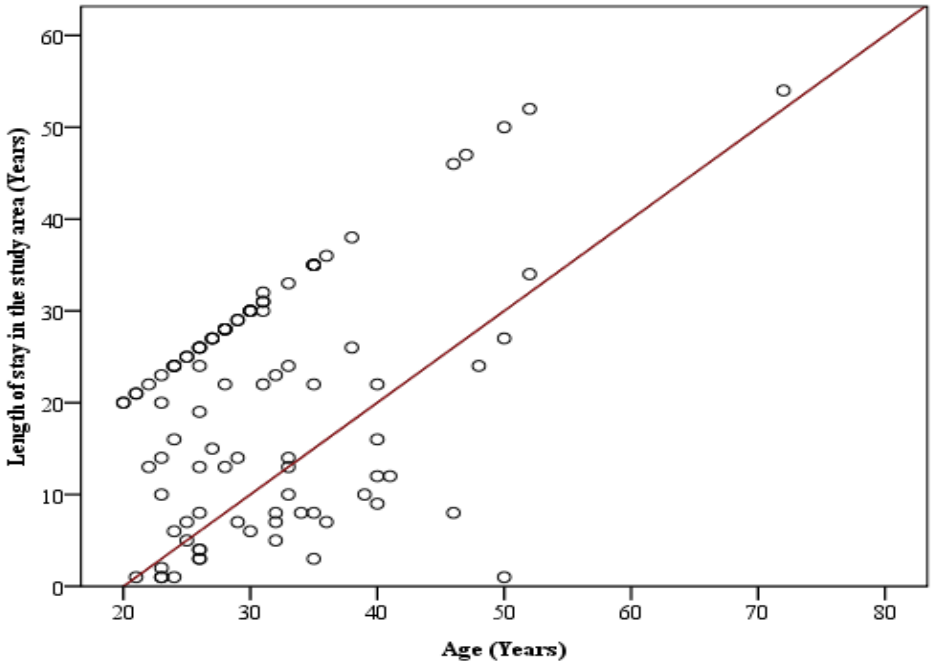

Figure 0.1: The relationship between age and length of stay in the study area

Results show a close association between age and length of stay in the study area (r = 0.35, p = 0.0001, n = 96), but this was only true for respondents who had lived in the study area for at least 20 years as revealed by the behaviour of the scatter graph. This shows that the length of stay in the study area increases with every increase in respondent's age. This association portrays the possibility that most teachers in Kisumu City are local residents in the area.

The data analysed also revealed a statistically significant difference in respondents age by school type (t = -3.568, df = 93, p = 0.0001). Respondents from private schools were relatively young ($\overline{X}$ = 26.93, s = 5.39, n = 30) compared to their counterparts from public schools ($\overline{X}$ = 32.74, s = 8.11, n = 65). The difference in respondents' age distribution by school type was attributed to the fact that most teachers in Kenya use private schools as starting point in their career as they await eventual absorption into public schools after employment by the Teachers Service Commission (TSC). There was no statistically significant relationship between the respondents' length of stay in the area and school type (χ^2 = 0.466, df = 2, n = 96, p = 0.792). The data analysed also reflected a close

relationship between length of stay in the study area and school location, but the relationship remained statistically insignificant (χ^2 = 4.753, df = 2, n = 96, p = 0.093), despite there being a high tendency of respondents who had stayed in the study area for less than 5 years to be found in schools located in the urban area. The close relationship between respondents' length of stay in the study area and school location was attributed to TSC's decentralized teacher recruitment approach (TSC, 2006), which encourages the appointment of teachers within their home districts.

4.2.3 Respondents Distribution by School Type and School Location

Fourteen out of the 20 schools sampled for inclusion in this study were public while the remaining 6 were private. Given the sampling design of only five respondents per school, the majority of respondents sampled for this study, 69% (n = 66), were thus from public schools while the remaining 31% (n = 30) were from private schools. It also emerged that all the 2 non-responses and 2 spoilt questionnaires that eventually reduced the sample frame to 96 from the initial 100 were from public schools. Closely related to school type was school location. Only 8 out of the 20 schools sampled for this study were in the urban area. The remaining 12 were located in the peri-urban area. As such, the majority of respondents sampled for this study, 58% (n = 56), were from schools located in the peri-urban area while the remaining 42% (n = 40) were from schools located in the urban area. Table 4.3 illustrates the statistics of respondents by school type and location

Table 0.3: Respondents distribution by school type and location

School type categories	Number of respondents			
	Urban	Peri-urban	Total	%
Public	20	46	66	69
Private	20	10	30	31
Total	40	56	96	100
Proportion %	42	58	100	-

The data analysed reveal a significant relationship between respondents distribution by school type and school location (χ^2= 11.221, df = 1, n = 96, p = 0.0001). While urban schools had no influence on the distribution of respondents by school type, the majority of the 56 respondents in peri-urban schools, 82% (n = 46), were from public schools as

reflected in Table 4.3. This can be attributed to the fact that most private schools in Kenya prefer urban area location, since many parents in such settings can afford to pay school fees for their children. As such, respondents in the peri-urban schools could only fall in the public school category.

Further, data analysed reveal significant gender influence on the distribution of respondents across public and private schools (χ^2 = 5.455, df = 1, n = 96, p = 0.02). The majority, 84% (n = 27), of 32 female respondents sampled for this study were from public schools. This can be attributed to the strict working conditions in private schools making such schools unfriendly for female teachers who have to double their role as working class women and home makers.

4.2.4 Respondents Distribution by Home County

The majority of respondents sampled for this study, 61% (n = 58) were from Kisumu County. Other counties with noticeable representation were Siaya and Homabay accounting for 15% and 8% of the responses respectively. The remaining counties had a representation of less than 5% as illustrated in Fig. 4.2.

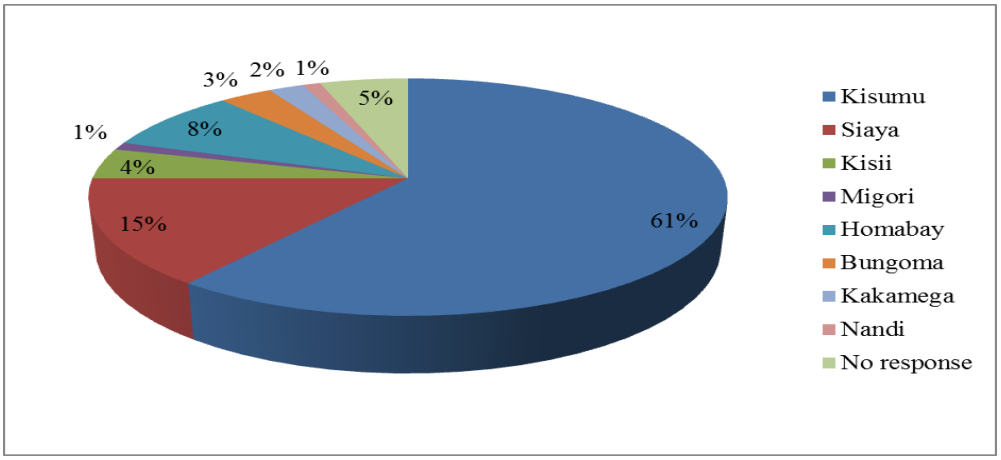

Figure 0.2: Respondents' distribution by county

It was also evident in the data collected that a substantial minority of respondents accounting for 5% (n = 5) of the 96 responses failed to indicate their home county. This was attributed to the fact that county system of government was still a new concept in

Kenya as at the time of data collection for this study and hence was not well understood by most respondents.

4.3 Climate Variability in Kisumu Area between 1972 and 2011

It was necessary to examine climate variability in the study area before assessing the teachers' level of awareness on the same. As such, rainfall and temperature were considered most appropriate indicators of climate variability as they are the most widely studied elements of climate globally. To achieve this analysis, 40 years (1972-2011) meteorological data on temperature and precipitation for Kisumu Weather Station (No. 9034025) was obtained from the Kenya Meteorological Department (KMD) and a series of analyses performed to test the null hypothesis that Kisumu area has not experienced any significant climate variability between 1972 and 2011.

4.3.1 Temperature Trends for the Period 1972-2011

Using monthly minimum and maximum temperature dataset obtained from KMD, the researcher computed monthly average temperatures. The computed monthly average temperatures were then used to perform a series of analyses to study temperature trends in Kisumu and examine the significance of temperature variability in Kisumu area 1972 and 2011.

A time series analysis of the monthly average temperatures during the period 1972-2011 revealed that Kisumu is slowly warming as illustrated in Fig. 4.3. The long-term average monthly temperature recorded in Kisumu during the 40 years period under analysis was 23.5 ± 0.06 °C. The lowest average monthly temperature recorded was 22.97 °C in 1972 while the highest was 24.35 °C in 2010.

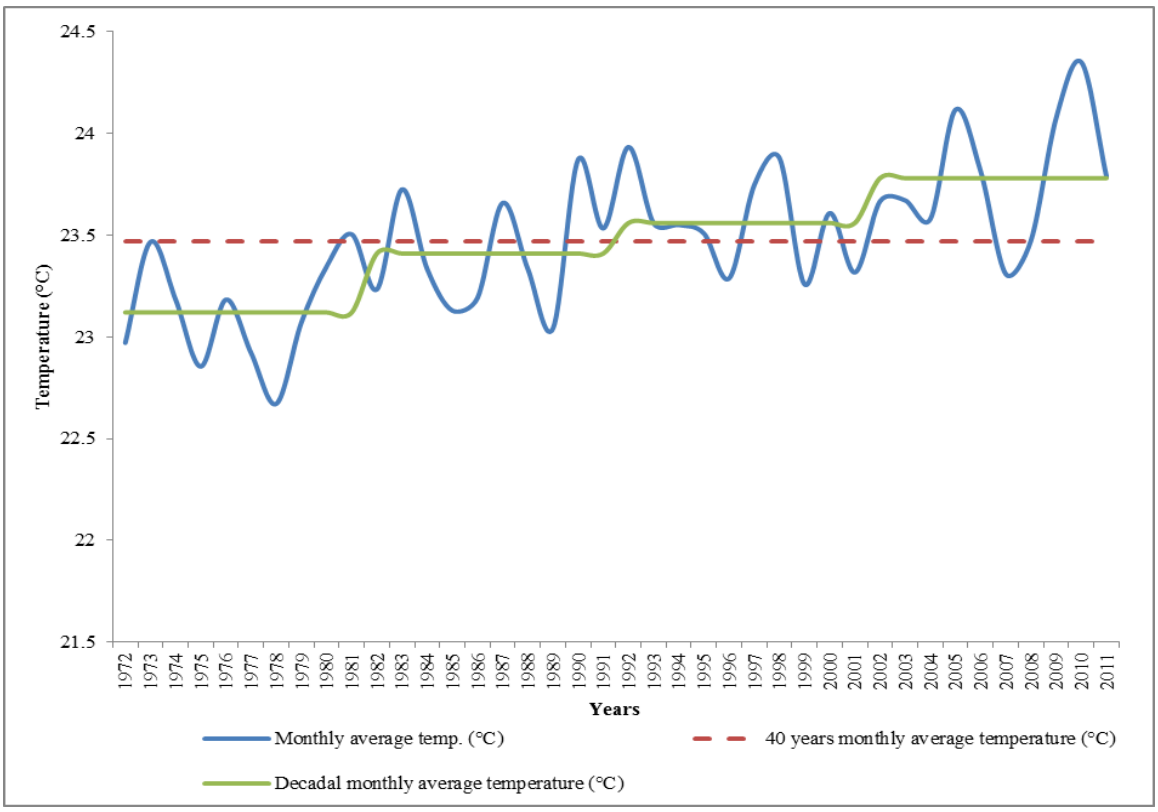

Figure 0.3: Monthly average temperature variability in Kisumu during the period 1972-2011

Results show that average monthly temperatures are slowly increasing, but with annual variability as reflected in the shape of the line graph. Of the 40 years, 53% (n = 21) recorded average monthly temperatures above the long term mean with 86% (n = 18) of these years occurring as from the last decade of the 20th century. The significance of temperature variability in Kisumu area was tested by comparing the long-term means of the years that recorded temperatures below 40 years long-term mean and those that recorded temperatures above the long-term mean, which returned significant results (t = 8.475, df = 38, p = 0.0001)

Temperatures for the years 1972 to 1980 remained below average, but rose from 22.97 °C in 1972 to 23.35 °C in 1980. 1981 recorded a sharp increase in monthly average temperature to 23.50 °C followed by a sharp decline back to 23.23 °C in 1982 and

another sharp increase to 23.73 °C in 1983. The subsequent 3 years witnessed a temperature fall up to 23.13 °C in 1985. A sharp rise in temperature was recorded again in 1987, but this was not sustained in the subsequent years as temperatures declined from 23.66 °C in 1987 to 23.04 °C in 1989. Temperatures for the period 1990 to 2011 remained above the 40 years mean temperature, but revealed an increasing trend with annual variability except for the years 1996, 1999, 2001, and 2007, which recorded below average monthly temperatures. A major increase and variability is seen as from the year 2005 when the monthly average temperatures hit the 24 °C mark, but dropped back to 23.81 °C in 2006 and further to 23.32 °C in 2007 followed by an increase in 2008 to 23.48 °C. The years 2009 and 2010 witnessed temperature increases to 24.35 °C, but temperatures dropped back to 23.79 °C in 2011.

A ten years moving average analysis of temperatures across the four decades revealed that temperatures in Kisumu area rose at an annual rate of 0.0165 °C and increased by 0.66 ± 0.24 °C during the 40 years period as illustrated in Table 4.4. This magnitude of temperature increase is in congruent with IPCC reporting. IPCC (2001) stated that the world experienced an overall warming of approximately 0.6 ± 0.2 °C during the 20th Century while IPCC (2007) observed a 100 (1906- 2005) years temperature increase of 0.74 ± 0.18 °C of which the results presented in this study are still within the range.

Table 0.4: Average monthly temperature trend in Kisumu area during 1972-2011

Period	Monthly Average Temp. (^{o}C)	Magnitude of Increase (^{o}C)
1972-1981	23.12	-
1982-1991	23.41	0.29
1992-2001	23.56	0.15
2002-2011	23.78	0.22
Overall increase	**-**	**0.66**
Annual increase rate	**-**	**0.0165**

Results show that temperature in Kisumu increased from 23.12 °C in the 1970s to 23.78 °C in the 2000s. Noticeable increase in temperature occurred in the 1980s when the monthly average temperature rose by 0.29 °C from 23.12 °C in the 1970s to 23.41 °C in

the 1980s. Another noticeable temperature increase was recorded in the 2000s when monthly average temperature rose by 0.22 °C from the 1990s value. On the other hand, 1990s recorded very small temperature increase of 0.15 °C.

An analysis of the monthly minimum and maximum temperatures for the area revealed that the temperature increase in in Kisumu area is during 1972-2011 was driven by a steeper rise in the minimum monthly temperature component as illustrated in Table 4.5.

Table 0.5: Kisumu's monthly minimum and maximum temperature trend during 1972-2011

Period	Minimum Temp. (°C)	Magnitude of increase (°C)	Maximum Temp. (°C)	Magnitude of increase (°C)
1972-1981	16.83	-	29.40	-
1982-1991	17.16	0.33	29.65	0.25
1992-2001	17.23	0.07	29.90	0.25
2002-2011	17.58	0.35	29.99	0.09
Overall increase	-	**0.75**	-	**0.59**
Annual increase rate	-	**0.0188**	-	**0.0151**

The minimum monthly temperature rose by 0.75 ± 0.15 °C at an annual increase rate of 0. 0188 °C while the maximum monthly temperatures increased by 0.59 ± 0.13 °C with annual increase rate of 0.0151 °C for the period under analysis. The substantial average monthly temperature increase witnessed in the 1980s was mainly contributed to by the minimum monthly temperature component, which recorded a temperature increase of 0.33 °C while the maximum temperatures only rose by 0.25 °C during this period. While the maximum temperature component maintained the same rate of increase, a major decline in the increase rate of the minimum monthly temperature component in the 1990s contributed to the negligible overall average monthly temperature increase in the 1990s. However, the area recorded another major increase in the minimum monthly temperature component in the 2000s, which led to a noticeable increase in monthly average temperature for this decade even though the maximum temperature component recorded a significant decline in the rate of increase. In simple terms, the results of the minimum

and maximum temperature trends in the area depict a warming scenario driven by a sharp increase in the minimum monthly temperatures resulting into a reduction in the diurnal temperature. These findings corroborates the findings presented in GoK (2010b), which revealed that temperature trends in Kenya since 1960s are slowly rising and the increase is more on the minimum temperatures than maximum temperatures. This pattern of increase in temperature is not confined to Kenya alone. IPCC (2007), based on the findings of various studies from different countries, concluded that cold nights and days are slowly being replaced by warm nights and days all over the world.

4.3.2 Precipitation Trends for the Period 1972-2011

Just like temperature, precipitation is another key indicator of climate change. An analysis of annual precipitation amounts recorded in Kisumu for the period 1972-2011 revealed that rainfall amount in the area is slowly increasing, but with annual variability as illustrated in Fig. 4.4.

The area recorded a 40 year average annual precipitation amount of 1352.13 ± 28.85 mm, which is slightly higher (by 65.13mm) than the known precipitation of 1287, but with cyclical highs and lows characteristic of climate variability. The lowest annual precipitation amount recorded in the area was 1029.1mm in 1973 while the highest amount recorded was 1765.7mm in 1978.

Annual precipitation amounts decreased by 424.7mm from 1453.8mm in 1972 to 1029.1mm in 1973. The subsequent years witnessed an increase in precipitation up to 1978 when the area recorded an all-time high of 1765.7mm. This was followed by a sharp decline in 1979 and this decline continued up to 1981 when annual precipitation amount of 1118.4mm was recorded after which annual precipitation amounts increased to 1448.2mm in 1982. This increase was not sustained in the subsequent years as 1983 recorded a low precipitation amount of 1145mm, but there was a noticeable increment in precipitation amounts as from 1984 through 1988, but with a break in 1987. Annual amounts dropped from 1421.8mm in 1988 to 1172.6mm in 1990 followed by an increase to 1337.1mm in 1991 and a further decrease up to 1137.9mm in 1993. 1994 to 1997

recorded relatively high amount of precipitation reaching up to 1610.7mm, but with a break in 1995.

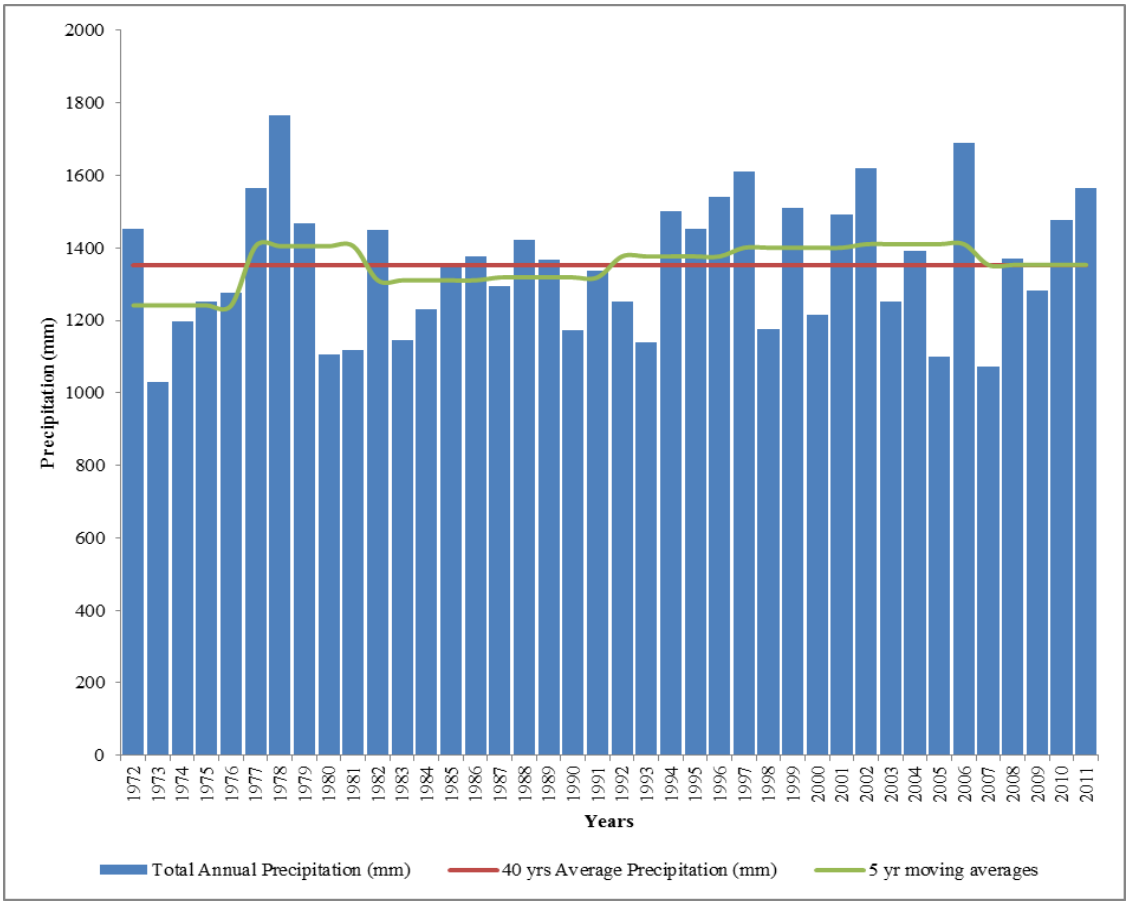

Figure 0.4: Annual precipitation variability in Kisumu area for the period 1972-2011

A sharp decline in precipitation from 1610.7mm in 1997 back to 1175.1mm was witnessed in 1998, but this was followed by a sharp increase to 1511.3mm in 1999 and a subsequent sharp decline back to 1214.9mm in 2000. The years 2001 and 2002 recorded an increase in precipitation up to 1618.5mm in 2002, but the subsequent year recorded very low annual precipitation of 1252.4mm. 2005 to 2007 recorded striking precipitation anomalies characteristic of drought years. The remaining years recorded an increase in annual precipitation amounts up to 1563.7mm in 2011, but with a break in 2009.

Precipitation anomalies characteristic of climate variability were clearly depicted when annual precipitation deviations from the long-term mean precipitation was computed and a graph plotted as in Fig. 4.6.

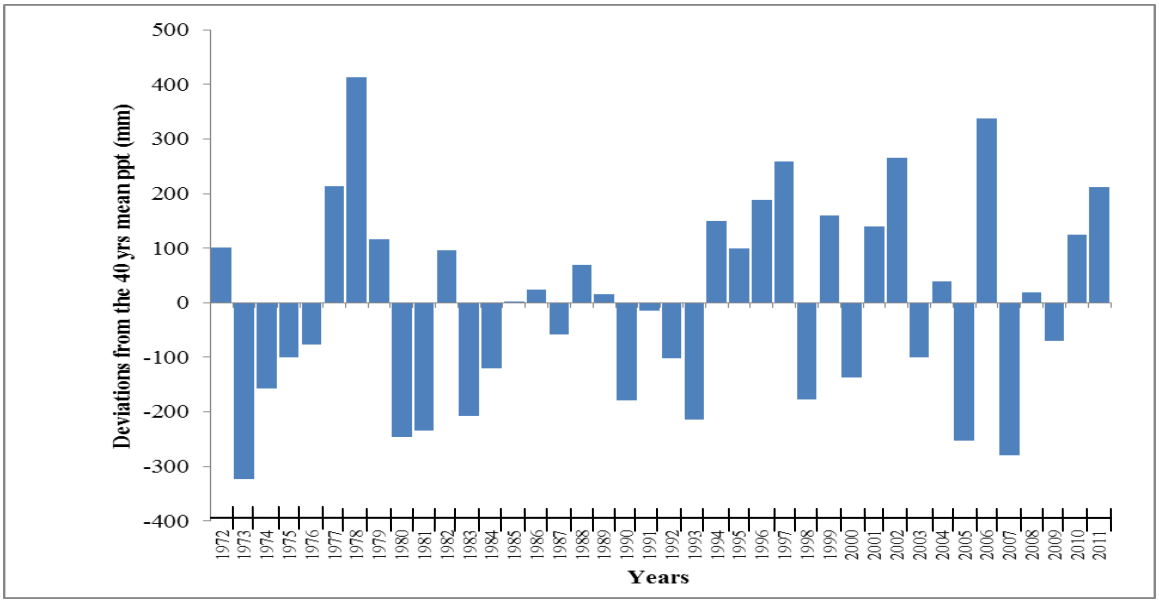

Figure 0.5: Annual precipitation anomalies in Kisumu area during the period years 1972-2011

Results show that 53% (n = 21) (out of which 11 years fall in the last two decades) out of the 40 years under analysis recorded above average annual precipitation amounts. Similarly, the area recorded 10 years with striking negative deviations from the 40 years mean sufficing as possible drought years. According to results in Fig. 4.6, Kisumu area recorded 9 droughts during the period 1972-2011 which occurred in the following sequence: 1973, 1980-1981, 1983, 1990, 1993, 1998, 2000, 2005, and 2007. The significance of precipitation variability was tested using a t-test which revealed significant difference in the means between the years that recorded above average precipitation and those with below average precipitation ($t = 9.806$, $df = 38$, $p = 0.0001$).

While the anomalies captured in this data portray significant evidence of climate change in the area, the role of El Niño-Southern Oscillation effect must also be considered. According to data presented in the U.S's NCEP website, 1972, 1982, 1986, 1987, 1991, 1997, 2002, 2004, 2006, 2009 are classified as El-Niño years while 1973, 1975, 1985, 1988, 1998, 2000, 2007, and 2010 are classified as La-Niña years (NCEP, 2013). As such

the meteorological droughts depicted in 1973, 1998, and 2007 and the excessive precipitation amounts recorded in 1972, 1982, 1997, 2002, and 2006 are best explained by El Niño-Southern Oscillation effect and not climate change.

To further investigate precipitation trends in Kisumu, a five-year moving average was computed to study the increment trend in precipitation after every five years and results presented both in Fig. 4.4 and Table 4.6.

Table 0.6: Five-year moving average precipitation in Kisumu during 1972- 2011

Period	Mean ptt. Amounts (mm)	Deviations from the 40 years mean (1352.13mm)	Magnitude of increase from previous decade	Trend
1972-1976	1241.44	-110.69	-	-
1977-1981	1405.04	52.91	163.60	Increase
1982- 1986	1310.66	-41.47	-94.38	Decrease
1987-1991	1318.90	-33.23	8.24	Increase
1992-1996	1376.60	24.47	57.70	Increase
1997-2001	1400.70	48.57	24.10	Decrease
2002-2006	1410.46	58.33	99.76	Increase
2007-2011	1353.26	1.13	-57.20	Decrease
Total ppt. increase	-		**111.82**	**Increase**

Results show that Kisumu recorded an increase in precipitation amounts of 111.82 ± 20.8 mm between the years 1972 to 2011, but with periodic variability characteristic of climate change. Only 3 out of the 8 5-year periods recorded precipitation amounts lower than the 40 years annual precipitation. Precipitation amounts substantially rose by 163.6mm from 1241.44mm to 1405.04mm between the periods 1972-1976 and 1977-1981 before decreasing to 1310.66mm in the period 1982-1986. The subsequent periods recorded an increase in precipitation amounts up to the period 2002-2006 after which a decrease of 57.2mm was recorded in the period 2007-2011.

Another significant indicator of climate variability in Kisumu was depicted in the time series analysis of seasonality trends in precipitation. A decadal analysis of the seasonal trends presented in Table 4.7 reveals fluctuating, but increasing trend in rainfall amounts for the period September-to-February suggesting the possibility of the short rain season

of September-November spilling over to the normally dry season of December-February. On the other hand, a fluctuating, but decreasing trend is depicted in the period March-to-August.

Table 0.7: Seasonal precipitation trend in Kisumu area for the period 1972-2011

Season	1972-1981	1982-1991	1992-2001	2002-2011	Trend
Dec-Jan-Feb	244.78	235.67	270.85	258.84	Increasing
Mar-Apr-May	548.38	504.24	538.88	528.63	Decreasing
Jun-Jul-Aug	250.94	235.65	243.86	246.75	Decreasing
Sept-Oct-Nov	279.58	339.22	335.06	347.64	Increasing

A comparison of the precipitation amounts for Dec-Jan-Feb and Jun-Jul-Aug seasons revealed that Dec-Jan-Feb recorded higher amounts than Jun-Jul-Aug as from 1992 showing that Jun-Jul-Aug was the driest season of the year during the period under analysis and not the traditionally Dec-Jan-Feb. This seasonality trend portrays a shift in seasonality pattern in which the Sept-Oct-Nov is becoming more reliable than the traditionally long rain season of Mar-Apr-May. These results confirm the findings presented in GoK (2010b), which also stated that Kenya is slowly registering a shift in the seasonality pattern of rainfall. Similar shifts in seasonal rainfall patterns were revealed by Shisanya, Recha and Anyamba (2011) in their study of rainfall variability in arid and semi-arid lands of Kenya in which the authors concluded that the September-December season is becoming reliable than the March-May season.

Based on the results presented in Sections 4.2.1 and 4.2.2, there is sufficient evidence to prove that Kisumu area experienced significant climate variability during the period 1972-2011. Hence, the null hypothesis which state that Kisumu area did not experience significant climate variability between 1972 and 2011 was rejected and the alternative hypothesis adopted.

4.4 Primary School Teachers Awareness of Climate Change

As a guiding question on teachers' perceived awareness, the respondents were asked to state how much they know about climate change. Answers to this question was intended

to give a synopsis view on teacher belief about their level of awareness on climate change and ranged from “I have never heard of it” to “I know more about it.” The result of the analysis of this question is presented in Table 4.8.

Table 0.8: Primary school teachers’ perceived awareness of climate change

Variable	n	%	χ^2	df	p(value)
I have never heard of it	6	6.25	47.688	2	0.0001
I know a little about it	61	63.54			
I know more about it	29	30.21			
Total	96	100			

The results presented in Table 4.8 shows that primary school teachers in Kisumu City are significantly aware of climate change (χ^2 = 47.688, df = 2, n = 96, p = 0.0001). Only 6.25% (n = 6) of the respondents included in this study had never heard of climate change while another 30.21% (n = 29) claimed to know more about it. The majority of respondents, 63.54% (n = 61), knew a little about climate change. While these results may be taken to mean that teachers in Kisumu City are extremely aware of climate change, such a conclusion may as well be misleading as knowing a little or a more about climate change at this level might mean just knowledge of the phrase climate change or even misinformed knowledge about climate change. A study by Oruonye (2011) revealed that 81.8% of students in tertiary institutions in Jalingo Metropolis, Nigeria were aware of climate change based on the question that asked them whether they had heard of climate change. When the same respondents were probed further, an overwhelming majority of students (89%) who fell in this category did not understand what climate change is all about. The author, therefore, concluded that students in tertiary institutions in Jalingo Metropolis, Nigeria have a low level of awareness on climate change. Similar results were presented by Adebayo *et al*. (2013) who also found out that 90% of the populace in Adamawa State, Nigeria claimed to be aware of climate change, but only 70% of those who claimed to be aware were knew the causes of climate change.

It was thus necessary to further subject respondents who claimed to know a little or a great about climate change to detailed questions on the same and hence make an

informed judgement as to whether or not primary school teachers in Kisumu City are aware of climate change.

It was assumed that respondents who claimed to be aware of climate change should be able to understand what climate change is all about even in a lay-man's language. As such, respondents who claimed to be aware of climate change were asked to explain their understanding of the phrase "climate change." An overwhelming majority, 86% (n = 77), of the 90 respondents who provided a response to this question was able to give the correct definition of climate change and associated it with long term changes in average weather patterns. The remaining 14% (n = 13) understood climate change simply as rising global temperatures. None of the respondents confused climate change with hole in the ozone layer or even daily variations in weather patterns.

As a test of consistency, responses to the question "how much do you know about climate change?" were cross tabulated against responses on the definition of climate change and results plotted in Fig. 4.6.

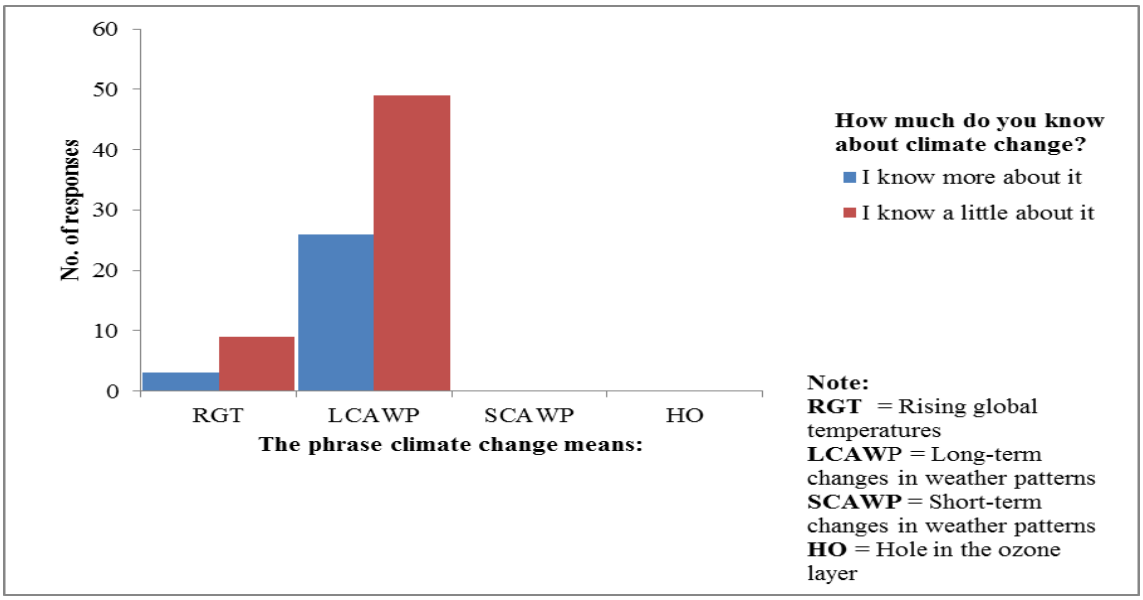

Figure 0.6: Respondents' understanding of the definition of climate change

The results show that only 10% (n = 3) of the 29 respondents who claimed to know more about climate change understood climate change simply as rising global temperatures

while the rest were able to relate it to long term changes in average weather conditions. While this descriptive analysis found some relationship between the teachers' knowledge of climate change and their understanding of what climate change means, a chi-square analysis failed to find any statistically significant relationship between these two parameters ($\chi^2 = 0.435$, df = 1, n = 87, p = 0. 51). The observed relationship was therefore due to chance.

Apart from understanding the right definition of climate change, knowledge of the driving force behind the current climate change is another good measure of awareness. Available literature reveals a scientific consensus across the world that the current climate change is anthropogenic. According to an analysis done by Cook *et al*. (2013) on 11, 944 peer-reviewed literature, only 0.7% of the abstracts rejected anthropogenic global warming. It was thus necessary to assess whether teachers opinion on the driving force behind the current climate change conform to the scientific consensus. This was achieved by presenting two alternating statements asking respondents to rate them expressing their level of agreement with each statement. The initial five-point Likert scale used during the survey was collapsed into three during data analysis; i.e., Agree, Disagree and Don't know to allow for a chi-square analysis. Results of the analysis of responses to these statements are presented in Table 4.9.

Table 0.9: Teachers' attribution of climate change to either natural or human factors

		The current climate change has been caused by natural factors						
		A	**DK**	**D**	**Total**	χ^2	**df**	**p(value)**
Human activities are entirely to blame for the current climate change	**A**	44	0	32	76	4.707	4	0.319
	DK	3	2	1	6			
	D	3	0	1	4			
	Total	50	2	34	86			

A = Agree, DK = Don't Know, D = Disagree

Results show that teachers support the view that the current climate change is anthropogenic (88% (n = 76) of the respondents agreed), but are not sure whether the effect of natural factors should be ruled out (58% (n = 50) of the same 76 respondents

still agreed with the statement). This was confirmed through a chi-square analysis, which also revealed an insignificant relationship between responses to these two statements (χ^2 = 4.707, df = 4, n = 86, p = 0.319). That is, it is not guaranteed that teachers who agree to the theory that the current climate change is anthropogenic will disagree to the theory that natural factors are to blame for the current climate change. These results point to the fact that primary school teachers in Kisumu City are not sure whether or not anthropogenic activities bear the greatest blame on climate change and thus do not conform to the scientific consensus. This also reflects the existence of some gap in teachers Knowledge of climate change.

Further, teachers' awareness of climate change was tested through knowledge of the existence of such important climate change instruments/institutions as the UNFCCC, Kyoto Protocol and IPCC. It was assumed that teachers who claimed to know more about climate change should at least know a little about these important climate change instruments/institution while those who claimed to know a little about climate change may have knowledge of the existence of at least one of them. Results of the descriptive analysis of this question are presented in Table 4.10.

The outcome of analysis indicates that 62% (n = 55) of the 86 respondents who provided response to this question knew something about the UNFCCC compared to 48% (n = 41) and 29% (n = 24) of the same respondents who knew something about Kyoto Protocol and IPCC respectively. Even though knowledge of the existence of these important institutions at this point may not reveal much about teachers' awareness of climate change, the fact that majority of respondents stated having not heard about them shows an inherent lack of awareness on climate change among teachers in Kisumu City. Similar results were recorded by Pandve, Chawla and Pawar (2011) who revealed a surprisingly low level of awareness of the UNFCCC, Kyoto Protocol and IPCC among urban populace of Pune City, India. According to their findings, only 3.27% had heard about the UNFCCC and Kyoto protocol while 4.5% of the respondents were aware of the IPCC.

Table 0.10: Teachers' awareness of climate change Vs knowledge of important climate change instruments

Knowledge of:		How much do you know about climate change? I know a little about it	I know more about it	Total	χ^2	p-value
UNFCCC	I've never heard of it	24	10	34	0.107	0.743
	I know something about it	34	18	52		
Kyoto Protocol	I've never heard of it	32	13	45	0.986	0.321
	I know something about it	25	16	41		
IPCC	I've never heard of it	41	20	61	0.104	0.747
	I know something about it	17	7	24		

Relationship not significant at $\alpha = 0.05$; df = 1

The results also found no statistically significant relationship between the respondents understanding of the important climate change institutions/instruments and how much they knew about climate change. An overwhelming 74% (n = 20) of the 27 respondents who claimed to know more about climate change had never heard about the IPCC while another 36% (n = 10) of the 28 respondents and 45% (n =13) of the 29 respondents who claimed to know more about climate change had never heard about UNFCCC and the Kyoto Protocol respectively. This shows that teachers in Kisumu City have narrow understanding of climate change and what they consider as great knowledge of climate change is very limited in reality.

Finally, teachers' awareness of climate change was assessed through a series of both positive and negative five-point Likert statements that addressed respondent's understanding of the causes, effects and mitigations of climate change. The statements were weighted as follows: 1= Strongly Disagree and 5 = Strongly Agree for the positive statements while the reversed scale was used for the negative items. The results were analysed into means in which case a mean score of ≤ 3 was treated as being unaware and > 3 reflected climate change awareness. Results of the analysis are presented in Table 4.11.

Table 0.11: Teachers awareness of the key causes and effects of climate change

Statements on causes, effects and mitigations of CC	Frequency count of responses						$\bar{X}$	s
	SA	A	DK	D	SD	Total		
Causes								
Climate Change is caused by Deforestation	29	54	2	3	2	90	4.17	0.811
Climate change is caused by combustion of fossil fuels	17	46	9	9	9	90	3.59	1.198
Climate change is caused by poor agricultural practices	17	49	9	12	2	89	3.75	0.992
Climate change is caused by air pollution from industries	32	48	3	1	5	89	4.13	0.968
Climate change is caused by poor management of waste	26	38	5	15	3	87	3.79	1.153
Effects								
Climate change is associated with the increased frequencies of droughts and floods	23	47	6	7	7	90	3.80	1.144
Climate change leads to rise in sea levels	18	30	16	16	10	90	3.33	1.290
Climate change leads to food shortages	39	41	4	4	2	90	4.23	0.900
Climate change leads to shrinking of lakes and rivers	18	46	9	12	5	90	3.67	1.112
Mitigations								
We cannot mitigate climate change by planting more trees	1	1	1	38	48	89	4.47	0.692
We cannot mitigate climate change by using renewable energy sources instead of fossil fuel	1	3	5	31	50	90	4.40	0.832
We cannot mitigate climate change through organic farming	0	4	10	49	27	90	4.10	0.832
We cannot mitigate climate change by minimizing air pollution from industries	0	4	4	45	37	90	4.28	0.750
Use of land-fills instead of open damp sites does not provide a mitigation option for climate change	3	5	23	42	16	89	3.71	3.71
Aggregate awareness score	-	-	-	-	-	-	3.97	0.546

SA = Strongly Agree, A = Agree, DK = Don't Know, D = Disagree, SD = Strongly Disagree

Results show that primary school teachers in Kisumu City are aware of the causes, effects and mitigations of climate change, but there are gaps in their knowledge. The respondents recorded an aggregate awareness score of mean of 3.97 (s = 0.546) showing that respondents have some level of awareness of climate change. Most respondents had a tendency to agree or strongly agree with all the items presented, but there was still a substantial minority of the respondents who either disagreed or stated "Don't know" to the items depicting a potential limited understanding of climate change issues in the general population of primary school teachers in Kisumu City. For example, the role of fossil fuels combustion in climate change is not understood by primary school teachers in Kisumu City as respondents recorded very low mean ($\bar{X}$ = 3.59, s = 1.198) while a substantial minority, 10% (n = 9), of the respondents stated "Don't know" to the statement that combustion of fossil fuel is a cause of climate change. Similarly, results portray a limited understanding of the role of waste in climate change whereby 6% (n = 5) of the respondents did not know whether or not poor management of waste is a cause of climate change while another 26% (n = 23) of the respondents did not know whether embracing landfills would offer any mitigation to climate change. Respondents also portrayed limited understanding of the effect of climate change on sea level ($\bar{X}$ = 3.33, s = 1.290) whereby 18% (n = 16) of the respondents did not know whether climate change would lead to sea level rise while another 29% (n = 26) respondents remained negative to the statement.

According to the frequency counts of respondents' level of agreement on each item, deforestation emerged as the most significant cause of climate change, supported by 92% (n = 83) of the respondents, followed by industrial pollution, supported by 90% (n = 80) of the respondents, while combustion of fossil fuel emerged last in the list, only supported by 70% (n = 63) of the respondents. On the contrary, use of renewable energy as a mitigation of climate change emerged number three, supported by 90% (n = 81) of the respondents, but afforestation and control of air pollution topped the list respectively. This shows that primary school teachers in Kisumu City are relatively unaware of the role of carbon dioxide emissions in climate change. Similarly, food shortages was considered the most significant effect of climate change, supported by 89% (n = 80) of the

respondents, followed by increased frequency of droughts and floods, supported by 78% (n = 70) of the respondents, while sea level rise emerged last in the list, only supported by 53% (n = 48) of the respondents while another 18% (n = 16) stated "Don't Know" to the statement. These results are not surprising given that deforestation is the most significant cause of climate change in Africa, of which Kenya is part, while Agriculture remains the most vulnerable and affected sector of the economy (UNFCCC, 2007). The results, however, point to the fact that teachers have knowledge of climate change, but are also not able to make a clear distinction between climate change and environmental problems. Deforestation and industrial pollution are viewed more as environmental concerns in Kenya (GoK, 2010a; GoK, 2011) and their emerging top might as well be influenced by teachers understanding of them as environmental problems and not as causes of climate change parse. The results also point to the fact that teachers in Kisumu City understand the impacts of climate change based on their day-to-day interaction with the environment. This explains why food shortages and increased frequency of floods and droughts were considered the most significant effects of climate change while sea level rise was least understood as an effect of climate change. These findings confirm the results of Otieno, Pauker and Maina (2009), which also revealed deforestation and pollution as the main causes of climate change being mentioned by Kenyans while droughts and floods emerged top in the Kenyans list of climate change impacts. The authors concluded that Kenyans only understand climate change from their day-to-day interaction with the environment and therefore global aspects of climate change like combustion of fossil fuel and sea level rise remain abstract in their knowledge of climate change.

As a matter of test for consistency, a Spearman rank order correlation analysis was run to test for the significant of the association between responses to the positive and negative statements. All the responses on effects of climate change yielded statistically significant positive correlations meaning that respondents who remained positive to the positive statements also remained negative to the negative statements and hence remained consistent except for statements regarding sea level rise ($r = 0.181$, $p = 0.089$, $n = 89$) reflecting the fact that the role of climate change on sea level rise remains an abstract in the minds of primary school teachers in Kisumu City. On the contrary, not all statements

on causes of climate change, which were correlated against their paired statements on mitigations, yielded statistically significant results as illustrated in Table 4.12.

Table 0.12: Correlation of teachers' awareness of causes and mitigations of climate change

	Spearman Rho Correlation		
Correlated items	**n**	**r**	**p(value)**
Deforestation vs. Afforestation	89	0.336	0.0001**
Fossil fuel Vs. Renewable Energy	90	0.133	0.213
Poor agric. Practices Vs. Organic farming	89	0.25	0.018**
Industrial Pollution Vs. Air Pollution Control	89	0.473	0.0001**
Poor Waste Mgt Vs. Use of Landfills	86	0.170	0.117

**Correlation significant at $\alpha = 0.05$

The results show a significant positive association between respondents understanding of deforestation as a cause of climate change and afforestation as a mitigation of climate change ($r = 0.336$, $p = 0.0001$, $n = 89$). Poor agricultural practices and organic farming ($r = 0.25$, $p = 0.018$, $n = 89$) as well as industrial pollution and control of air pollution ($r = 0.473$, $p = 0.0001$, $n = 89$) also recorded significant positive correlations meaning that an increase in respondents awareness of these causes also produce an increase in the respondents awareness of their mitigations. However, combustion of fossil fuel as a cause of climate change and use of renewable energy produced a weak statistically insignificant positive association ($r = 0.133$, $p = 0.213$, $n = 90$) meaning that an increase in awareness of one parameter may not necessarily result in an increase in awareness of the other parameter. This was confirmed through comparison of the means of these two statements, which proved that teachers were more aware of renewable energy as a mitigation of climate change ($\overline{X} = 4.40$, $s = 0.832$) than combustion of fossil fuel as a cause of climate change ($\overline{X} = 3.59$, $s = 1.198$). The same scenario was also observed in poor management of waste as a cause of climate change ($\overline{X} = 3.79$, $s = 1.153$) and use of landfills as a mitigation of climate change ($\overline{X} = 3.71$, $s= 0.944$), which also produced a weak, but statistically insignificant positive correlation coefficient ($r = 0.170$, $p = 0.117$, $n = 87$). These results point to the fact that combustion of fossil fuel as a cause of climate change still remains an abstract in the minds of most Kenyans.

The outcome of the analyses presented in this section shows that primary school teachers in Kisumu City have some understanding of the basics of climate change though with gaps in their knowledge. The null hypothesis was thus rejected and the alternative, which states that primary school teachers in Kisumu City are aware of climate change, adopted. These results corroborate the concerns expressed by RoK (2013), GoK (2010b) and Otieno, Pauker and Maina (2009) all of whom states that Kenyans are poorly informed about climate change and hence portrays significant gaps in their knowledge of the same. These authors expressed the need for awareness campaigns to ensure that Kenyans acquire relevant information on climate change. This scenario is not confined to Kenya alone. Acquah (2011) assessed the level of awareness and quality of Knowledge on climate change among residents of Central Ghana and revealed that people in Central Ghana are aware of climate change, but there exists significant gaps in their knowledge of the same.

4.4.1 The Level of Climate Change Awareness Among Primary School Teachers

Having established that primary school teachers in Kisumu City are aware of climate change, but with gaps in their knowledge, it was necessary to assess their level of awareness. This was achieved by using a composite awareness scale developed using summative method, which added respondent's score for the 20 Likert items on climate change awareness. The "Don't know" responses, rated 3 in the Likert scale were re-rated zero to omit their effect on the resultant summative score. This decision was guided by the fact that the don't know responses had a tendency of increasing the final score as was discovered in the preliminary analysis, despite their reflection of a lack of awareness, and would have led to a wrong judgement on the respondent's level of climate change awareness. The reliability of these items as a measure of teachers' level of climate change awareness returned a Cronbach's Alpha of 0.816 (n = 20), which is considered good according to George and Mallery's (2003) rule of thumb.

It was expected that a respondent who scored 5 in all the 20 items would have a composite awareness score of 100 while one who scored 1 in all the 20 items would have a composite awareness score of 20. Hence, a composite awareness scale ranging from 20 to 100 was designed in which case any respondent whose score fell below the middle

score (60) was treated as being negative while those who fell above the middle score were treated as being positive. The researcher then designed a three category level of awareness scale demonstrated in Fig. 4.7.

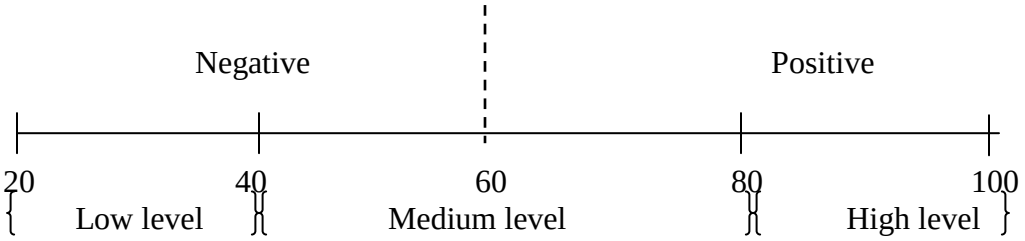

Figure 0.7: A composite awareness scale

Low level of awareness: Respondents in this category remained negative (i.e. either disagreed or strongly disagreed) to the positive statements and positive (i.e. either agreed or strongly agreed) to the negative statements hence could only score a maximum of 40 points (2*20 items) in the composite awareness scale. Respondents who fell in this category were considered unaware of climate change.

Medium level of awareness: Respondents in this category had mixed responses in either direction of the statements hence their score in the composite awareness scale could only range from 41 to 79 points. Respondents who fell in this category were considered aware of climate change, but with gaps in their knowledge.

High level of awareness: Respondents remained positive (i.e. agreed or strongly agreed) to the positive statements and negative (i.e. disagree or strongly disagreed) to the negative statements and hence could only score a minimum of 80 points (4*20 items) in the composite awareness scale. Respondents who fell in this category were considered highly aware of climate change.

A chi-square goodness of fit analysis was then performed to test for the null hypothesis that the level of climate change awareness among primary school teachers in Kisumu City is significantly low. The results of the chi-square analysis are presented in Table 4.13.

Table 0.13: Teachers' level of climate change awareness

Level of Awareness	n	%	χ^2	df	p(value)
Low	2	2.2	62.818	2	0.0001
Medium	63	70.8			
High	24	27.0			
Total	89				

Results show that the level of climate change awareness among primary school teachers in Kisumu City is not significantly low (χ^2 = 62. 818, df = 2, n = 89, p = 0.0001). The respondents recorded a composite awareness mean score of 72.17 (s = 11.72, n = 89), which when interpreted using the composite scale provided in Fig. 4.9 denote a medium level of climate change awareness. This shows that even though teachers in Kisumu City are aware of climate change, there exist gaps in their knowledge of the same. These results are consistent with the results found earlier in the previous section of this discussion, which also revealed that primary school teachers in Kisumu City are aware of climate change though with some noticeable gaps in their knowledge. By comparison, studies reporting the level of climate change awareness in Kenya reveal a low level of climate change awareness among Kenyans (Otieno, Pauker and Maina, 2009; GoK, 2010b; RoK, 2013). The relatively high level of awareness among teachers in Kisumu City compared to the general public in Kenya is not surprising as primary school teachers represent an elite group in the society with a relatively high level of access to information especially through reading. Besides, teachers in Kisumu City have also benefitted from information on environmental changes disseminated by NGOs in the study area as will be discussed later in Section 4.3.2. The results of this study, however, contradicts results presented by studies on teacher population by Akinnubi *et al.* (2012) and Ekpoh and Ekpoh (2011) who revealed a general low level of awareness among secondary school teachers in Ondo West Government Local Area, Ondo State and Calabar Municipality, Nigeria respectively.

As a matter of confirmation, respondents' level of awareness was cross tabulated against their awareness of UNFCCC, Kyoto Protocol and IPCC as well as their knowledge of climate change.

Table 0.14: Teachers' level of awareness and their knowledge of important climate change instruments

Knowledge of:		No. of Respondents based on level of awareness			
		Low	**Medium**	**High**	**Total**
UNFCCC	I've never heard of it	2	21	10	23
	I know something about it	0	40	14	54
Kyoto Protocol	I've never heard of it	2	33	9	44
	I know something about it	0	26	14	40
IPCC	I've never heard of it	2	40	17	59
	I know something about it	0	19	5	24

Results show that respondents who fell in the low level of awareness category also indicated having not heard about the UNFCCC, Kyoto Protocol and IPCC. There is also a tendency of respondents who fell in the high level of awareness category to state being unaware about the existence of such important climate change instruments/institutions such as UNFCCC, Kyoto Protocol and IPCC. It was thus concluded that even the respondents who fell in the high level of awareness had gaps in their knowledge of climate change hence a medium level of awareness for the whole population was deemed appropriate.

There was also a close association between level of awareness and respondents perceived knowledge of climate change as illustrated in Fig. 4.8. All the two respondents who fell in the low level of awareness category only knew a little about climate change. Besides, half of the respondents who fell in the high level of awareness category indicated only knowing a little about climate change also sufficing as evidence of gaps in respondents' knowledge of climate change.

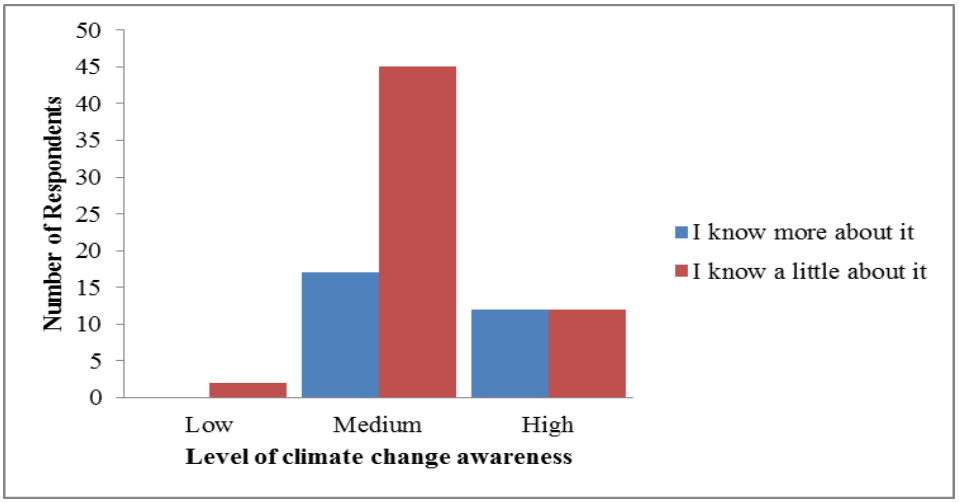

Figure 0.8: Level of awareness on climate change vs. how much teachers know about climate change

4.4.2 Sources of Climate Change Awareness among Primary School Teachers

Having established that teachers in Kisumu City are aware of climate change, establishing the sources of awareness became equally important. Medium of information transfer, seminar attendance and availability of learning materials on climate change in schools were considered potential sources of information transfer. As such, questions were designed to capture respondents view on whether or not these sources have played any role in creating awareness on climate change.

4.4.2.1 Information Transfer Through Various Media

The respondents were asked to rate various channels of information transfer as either appropriate or not appropriate based on how much those channels have contributed to their understanding of climate change. A frequency count analysis of the responses was then performed and results presented in Fig. 4.9.

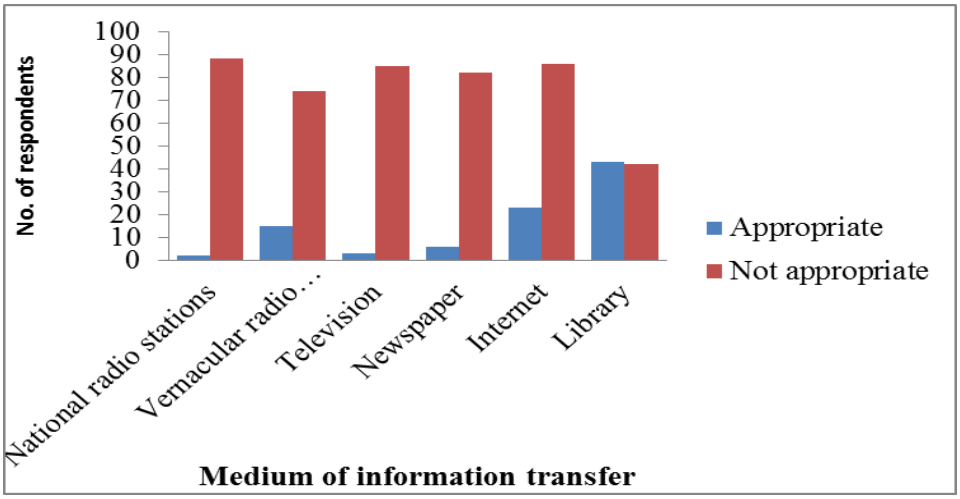

Figure 0.9: The appropriateness of various media of information transfer on climate change

The results show that library was considered most appropriate by respondents followed by the internet and local radio stations respectively while national radio stations and television were perceived the least appropriate. This shows that most teachers have obtained the information they have on climate change through reading books and other associated contents in the library while a few more others have obtained information on climate change from the internet. These results reveal the fact that teaching profession exposes individuals to a lot of reading and hence any attempt to raise teachers' level of awareness on climate change should be directed through books and other associated prints and to some extent the internet. The findings also portray an eminent lack of information on climate change channelled through the widely used and easily accessed media such as radios, newspapers and televisions.

4.4.2.2 Seminar Attendance

Apart from information on climate change being disseminated through the library and other channels discussed above, seminar and workshops provide another significant source of awareness especially for the literate public like teachers. There has been a flurry of conferences and seminars on climate change, both locally and internationally, since 1992, when the UNFCCC was adopted. It was thus necessary to investigate whether teachers in the study area have benefited from such seminars. It emerged from the results

of the study that only 14% (n = 13) of the 90 respondents who provided response to the question had attended a seminar or workshop on climate change. However, probing during data collection revealed that UNICEF has offered primary school teachers (especially from public schools) in the study area some training on environmental changes, which also covered climate change and have to a greater extent improved teachers understanding of climate change in the area. Other local NGOs like Osienala (Friends of Lake Victoria) were also reported as working with schools, especially public schools, in the area and have also offered trainings on environmental changes including global warming and climate change. As such it was concluded that the respondents interviewed for this study may not have obtained their knowledge on climate change through attending formal seminars, but through informal trainings offered by NGOs operating in the area.

4.4.2.3 Availability of Learning Materials on Climate Change

Respondents were also asked whether they had any learning materials on climate change in their schools. It emerged from the descriptive analysis that only 13% (n = 12) of the 90 respondents who provided a response to this question reported having any learning materials on climate change in their schools. Out of the 12 respondents, only 58% (n = 7) were able to provide details of the learning materials. The learning materials cited include text books (cited by 2 respondents), magazines (cited by 2 respondents) and charts (cited by 3 respondents). It was thus concluded that there is a lack of learning materials on climate change available in primary schools in Kisumu City. This can be well explained by the fact that climate change knowledge is still not integrated in the primary school curriculum in Kenya and there is an eminent lack of awareness campaigns by the government within schools. GoK (2010b) expressed serious concern over the "*lack of adequate climate change information, knowledge and long-period data* ....." in Kenya and proposed a revision of the school curriculum to integrate climate change knowledge in schools at all levels as one of the potential solutions (p. 69).

4.5 Factors Influencing Teachers' Level of Awareness on Climate Change

This study was not only designed to assess primary school teachers' level of awareness on climate change, but also to explore some of the factors affecting their level of

awareness. Using the level of awareness as measured by the composite awareness score as the dependent variable and respondents' demographic attributes as independent variables, a correlation analysis was performed to test for the existence of association and results presented in Table 4.15.

Table 0.15: Correlation between socio-economic factors and teachers' level of awareness

Attribute	n	r	p(value)
Gender	88	-0.110	0.308
Age	88	0.108	0.318
Home County	84	-0.047	0.671
Highest Level of Education	87	0.149	0.168
School Type	88	-0.057	0.640
School Location	88	0.138	0.201

Correlation not significant at $\alpha = 0.05$

The results show a weak association between the respondents' level of climate change awareness and various demographic attributes including gender, age, school location and highest level of education, all of which yielded a correlation coefficient of at least 0.1. School type and home county did not produce any meaningful association hence were considered not influential in determining the respondents level of climate change awareness. Only the former attributes (gender, age, school location and highest level of education) were explored further to determine their influence on the respondents' level of awareness on climate change.

4.5.1 Gender

Gender is a key determinant of the level of awareness on climate change as has been revealed by most studies. Being male or female influences people's level of access to information and eventually influences their knowledge of climate change (Patchen, 2006). Most documented studies have revealed that men are generally more aware of climate change than women (Acquah, 2011; Olajide *et al.*, 2011; Ekpoh and Ekpoh, 2011; Patchen, 2006).

The results of the correlation analysis presented in Table 4.15 revealed a weak, but negative association between gender and level of climate change awareness ($r = -0.110$, $p = 0.308$, $n = 88$) meaning that the level of climate change awareness varies on each side of gender. This influence came out clear from the results of the computation of awareness mean scores, in which female respondents recorded a higher score ($\overline{X} = 74.78$, $s = 8.95$, $n = 27$) than male respondents ($\overline{X} = 71.03$, $s = 12.71$, $n = 61$) pointing to the possibility of gender influence even though the differences in the mean scores remained statistically insignificant, ($t = 1.636$, $df = 69.23$, $p = 0.106$).

The influence of gender on the level of climate change awareness among teachers in Kisumu City was further explored using other questions that also measured teachers' understanding of climate change. Fig. 4.10 illustrates results of the analysis of the respondents' level of awareness and how much they knew about climate change.

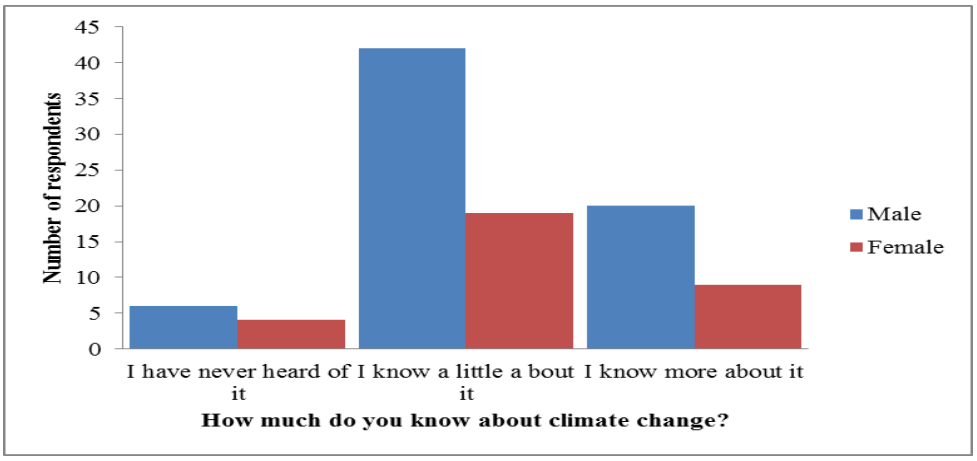

Figure 0.10: The relationship between gender and teachers' knowledge of climate change

Results revealed noticeable evidence of gender influence on respondent's knowledge of climate change. Only 31% (n = 9) of the 29 respondents who reported knowing more about climate change were female and 67% (n = 4) of the 6 respondents who had never heard about climate change were also female. A chi-square analysis, however, found no significant relationship between gender and respondents' knowledge of climate change ($\chi^2 = 3.200$, $df = 2$, $n = 96$, $p = 0.202$). On the other hand, more men than women (61% (n = 8) of the 13 respondents) understood climate change simply as rising global

temperatures. There was, however, no significant relationship between gender and respondents' understanding of the definition of climate change ($\chi^2 = 0.144$, df = 1, n = 87, p = 0.705).

Further, a chi-square analysis was performed to test the significance of the relationship between gender and respondents' awareness of the existence of such important climate change instruments/institutions as the UNFCCC, Kyoto Protocol and IPCC. A chi-square test was performed to test the significance of the relationship between respondents' level of climate change awareness and their knowledge of the important climate change institutions/instruments and results presented in Table 4.16.

Table 0.16: Gender influence on teachers' awareness of important climate change instruments

		Frequency Counts				
Knowledge of:	**Gender**	**n**	**I have never heard of it**	**I know something about it**	**χ^2**	**p(value)**
UNFCCC	Male	61	36%	64%	0.375	0.540
	Female	28	43%	57%		
Kyoto Protocol	Male	59	42%	58%	7.462	0.006*
	Female	27	74%	26%		
IPCC	Male	59	71%	29%	0.032	0.858
	Female	26	73%	27%		

*Relationship significant at $\alpha = 0.05$; df = 1

Results show no significant relationship between gender and respondents' awareness of the UNFCCC ($\chi^2 = 0.375$, df = 1, n = 89, p = 0.540) and IPCC ($\chi^2 = 0.032$, df = 1, n = 85, p = 0.858). There was, however, a statistically significant relationship between gender and respondents' awareness of the Kyoto Protocol ($\chi^2 = 7.462$, df = 1, n = 86, p = 0.006). Male respondents appeared to be more aware of the protocol than their female counterparts as only 26% (n = 7) of the 27 female respondents reported knowing something little about Kyoto protocol compared to 58% (n = 34) of the 59 male respondents who knew a little about the protocol.

Based on the analyses presented in this section, it was concluded that gender may have some influence on teachers' level of awareness on climate change, but the influence

remained statistically insignificant in this study. Similar results were revealed by Acquah (2011) who also found the possibility of gender influence on the respondents' level of awareness on climate change, but the results were not statistically significant. Studies by Olajide *et al.* (2011) and Ekpoh and Ekpoh (2011) however found statistically significant gender influence on tertiary students and teachers level of climate change awareness respectively.

4.5.2 Age

Apart from gender, age is another key determinant of the level of awareness on climate change. The correlation analysis presented in Table 4.15 revealed a weak, positive, but statistically insignificant correlation between age and level of climate change awareness ($r = 0.108$, $p = 0.318$, $n = 88$). This means that the level of climate change awareness increases with increase in age. A computation of awareness mean scores revealed that the scores increases with increase in age from younger to older age groups, but this was only true up to age 45 years above which increase in age did not produce any influence on respondents level of climate change awareness as illustrated in Table 4.17.

Table 0.17: Age influence on teachers' level of awareness on climate change

Age Category	n	$\overline{X}$	s
18-25	23	69.83	11.159
26-35	43	72.56	12.560
36-45	15	74.87	12.671
46-55	7	70.71	6.824
Total	88	72.09	11.768

Results show that respondents in the age category 36-45 recorded the highest awareness mean score of 74.87 ($s = 12.671$) while those who fell in the age category 18-25 recorded the lowest awareness mean score of 69.83 ($s = 11.159$). This means that youthful teachers are less aware of climate change compared to middle aged teachers. However, an interpretation of the scores presented above using the composite awareness scores revealed that all the age groups recorded a medium level of awareness hence no significant influence of age on the level of awareness on climate change. This was

confirmed through a one-way ANOVA test, which also failed to find any statistically significant difference in climate change awareness mean scores across the age groups ($F = 0.608$, $df = 3, 84$, $p = 0.611$). These results confirm the results of a study by Saroar and Routray (2010) which also revealed a positive correlation between age and level of climate change awareness. However, the results contradict the findings of Owolabi, Gyimah and Amponsah (2012) who revealed that younger students Ghana's junior high school are more aware of climate change and sustainable development than older students even though their results were also statistically insignificant.

The relationship between age and the level of climate change awareness was further explored through analysis of various questions that also tested respondents' awareness of climate change as shown in Fig. 4.11.

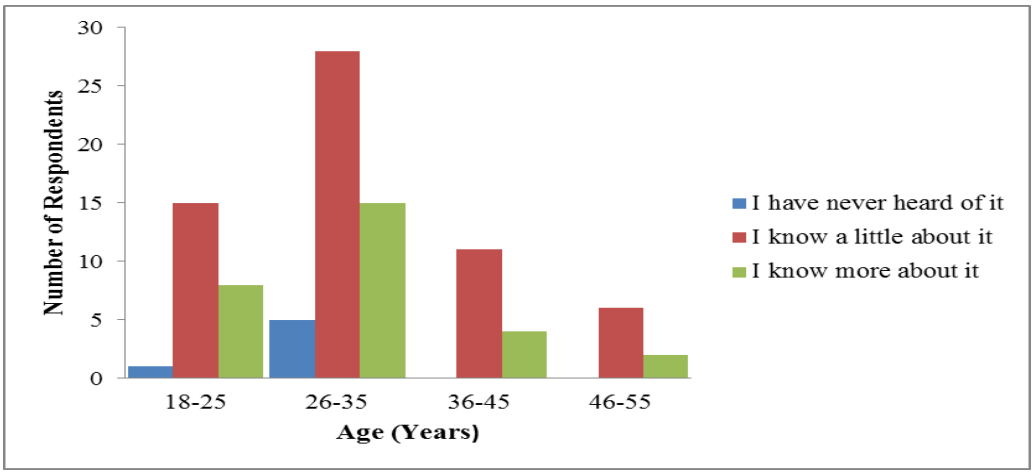

Figure 0.11: The relationship between age and knowledge of climate change

Results revealed noticeable evidence of age influence on respondent's knowledge of climate change. All the respondents who reported having not heard about climate change fell in the age category 18-35 years. However, this influence remained statistically insignificant ($\chi^2 = 3.732$, $df = 6$, $n = 95$, $p = 0.713$). Age, however, had a statistically significant influence on respondents' understanding of the definition of climate change ($\chi^2 = 14.244$, $df = 3$, $n = 86$, $p = 0.003$).

A chi-square analysis was further performed to test the significance of the relationship between age and respondents' awareness of the existence of such important climate

change instruments/institutions as the UNFCCC, Kyoto Protocol and IPCC and results presented in Table 4.18.

Table 0.18: Age influence on teachers' awareness of important climate change instruments

Knowledge of:	n	χ^2	df	p(value)
UNFCCC	88	3.853	3	0.278
Kyoto	85	0.542	3	0.910
IPCC	84	2.361	3	0.501

Relationship not Significant at $\alpha = 0.05$

Results failed to find any statistically significant relationship between age and respondents understanding of the UNFCCC ($\chi^2 = 3.853$, df = 3, n= 88, p = 0.278), Kyoto Protocol ($\chi^2 = 0.542$, df = 3, n= 85, p = 0.91) and IPCC, ($\chi^2 = 2.361$, df = 3, n = 84, p = 0.501).

Just like in the case of gender, it was concluded that age may have some influence on teachers' level of awareness of climate change, but the influence remained statistically insignificant in this study.

4.5.3 School Location

According to results presented earlier in Table 4.15, there is a weak, positive relationship between school location and level of awareness on climate change (r = 0.138, p = 0.201, n = 88). A comparison of the composite awareness mean scores revealed that respondents from schools located in the urban area are more aware of climate change ($\overline{X} = 74.50$, s = 10.98) compared to their counterparts from schools located in the peri-urban area ($\overline{X} = 70.42$, s = 12.11), but these differences remained statistically insignificant (t = -1.613, df = 79.86, p = 0.105).

A chi-square analysis was further performed to test for the significance of the relationship between school location and the respondents understanding of climate change definition and important climate change instruments/institutions, earlier used in Sections 4.4to measure teachers' awareness of climate change as illustrated in Table 4.19.

Table 0.19: School location influence on teachers' knowledge of climate change

Knowledge of:	n	χ^2	df	p(value)
Climate change knowledge	96	1.087	2	0.581
Climate change definition	87	1.540	1	0.215
UNFCCC	89	0.147	1	0.702
Kyoto Protocol	86	0.625	1	0.429
IPCC	85	0.692	1	0.406

Relationship not Significant at $\alpha = 0.05$

Note:
Climate change knowledge = "How much do you know about climate change?"
Climate change definition = "The phrase "climate change" means"

Results of the analysis failed to find any statistically significant relationship between school location and teachers' awareness of climate change as measured by "how much respondents' knew about climate change" ($\chi^2 = 1.087$, df = 2, n = 96, p = 0.581) and their understanding of the definition of climate change ($\chi^2 = 1.54$, df = 1, n = 87, p = 0.215). School location did not also have any statistically significant relationship with teachers knowledge of the UNFCCC ($\chi^2 = 0.147$, df = 1, n = 89, p = 0.702), the Kyoto Protocol ($\chi^2 = 0.625$, df = 1, n = 86, p = 0.429) and IPCC ($\chi 2 = 0.692$, df = 1, n = 85, p = 0.406).

The results discussed in this section show that school location does not have any significant influence on teachers' level of awareness hence the weak positive correlation revealed earlier may be due to chance. Similar results were revealed by Nwankwo and Unachukwu (2012) who did not also find a statistically significant influence of school location on teachers level of awareness on climate change even though their results pointed to the fact that teachers from schools located in urban areas are relatively more aware of climate change than their counterparts from rural areas.

4.5.4 Highest Level of Education

Results presented in Table 4.15 shows the existence of a weak positive, but insignificant association between highest level of education and level of climate change awareness (r = 0.149, p = 0.168, n = 87). The significance of the relationship between highest level of

education and level of climate change awareness was tested further using a one-way ANOVA and results presented in Table 4.20.

Table 0.20: Level of education influence on teachers' awareness of climate change

Level of Education	n	$\bar{X}$	s	F	df	p(valve)
High School (Untrained form 4 leavers	9	71.00	8.660	1.335	4	0.264
P1 Certificate	49	71.10	13.098			
Diploma	14	70.64	10.012			
Degree	11	79.73	10.780			
Masters	4	70.75	1.893			
Total	87	72.09	11.836			

The results portray an increase in the level of awareness with increase in the level of education, but with breaks in respondents with up to diploma and Master's degree levels of education. Teachers with degree appeared to be more conversant with climate change issues ($\bar{X}$ = 79.73, s = 10.78) than the general sample used in this study ($\bar{X}$ = 72.09, s = 11.836). Teachers with up to Master's level of education as well as diploma registered surprisingly low mean scores of ($\bar{X}$ = 70.75, s = 1.893) and ($\bar{X}$ = 70.64, s = 10.012) respectively. This may be interpreted to mean that climate change knowledge is extremely lacking in diploma and Master's course syllabuses for those pursuing educational courses.

A look at the frequency counts of the distribution of respondents in the awareness scale revealed that respondents with up to degree level of education are more aware of climate change as respondents who registered high level of awareness outnumbered respondents with medium level of awareness while no respondent in this category recorded low level of climate change awareness as illustrated in Fig. 4.12. Besides, none of the respondent with up to master's recorded a high level of climate change awareness.

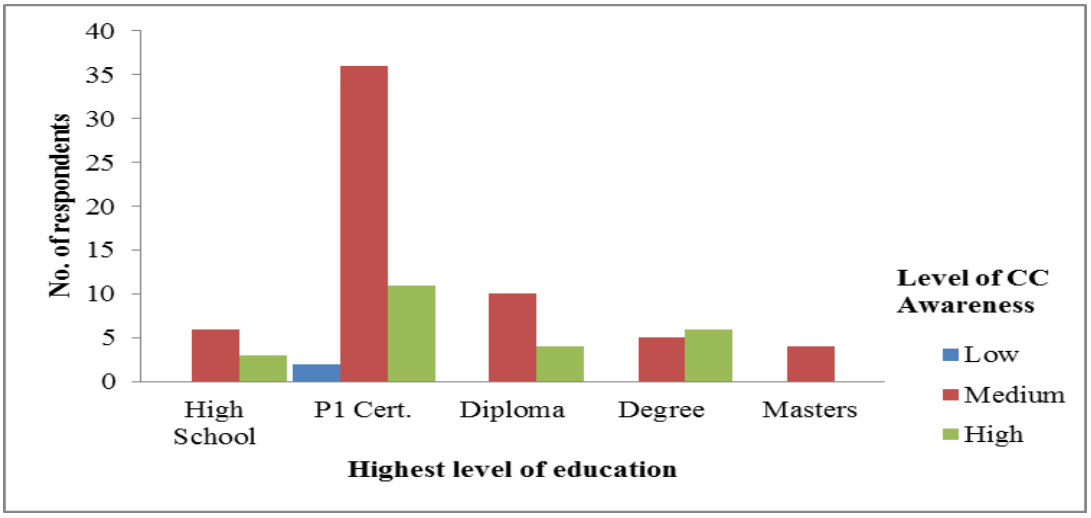

Figure 0.12: Highest level of education Vs teachers' level of climate change awareness

A one-way ANOVA test failed to find any statistically significant influence of level of education on teachers' awareness of climate change ($F = 1.335$, $df = 4, 82$, $p = 0.264$). The differences revealed may thus be due to chance. A study by Adebayo *et al.* (2013), however, found a statistically significant influence of education on the awareness and knowledge of causes of climate change among the populace of Adamawa State, Nigeria. Similar results were also revealed by Acquah (2011), who cited education as significant predictor of the awareness of the importance of climate change among the populace of Ghana.

In addition to demographic attributes, factors such as current subject allocation and seminar attendance were also tested to establish their influence on teachers' level of climate change awareness. This involved an analysis of the responses of the question on seminar attendance and current subject allocation against the level of awareness.

4.5.5 Current Subject Allocation

Teachers' current subject allocation can have a direct influence on their level of climate change awareness, in that teachers who teach subjects that has topics on weather and climate like Science and Social Studies are more likely to have come across information on climate change. To investigate the influence of current subject allocation on teachers' level of awareness on climate change, subject categorization already discussed in Section

4.1.2.1 together with the categorized level of awareness discussed in Section 4.3.1 were used. The researcher first performed a descriptive analysis to investigate the distribution of respondents in the various categories of the level of climate change awareness by current subject allocation and came up with the results presented in Table 4.21.

Table 0.21: Current subject allocation influence on teachers' level of climate change awareness

Subject Allocation	No. of Respondents based on Level of CC Awareness			
	Low	Medium	High	Total
Arts	0	4	2	6
Science	0	7	2	9
Arts/Science	2	51	20	73
Total	2	62	24	88

Results reveal that pure Arts teachers are relatively more versed with climate change than their pure Science counterparts. 33% (n = 2) of the 6 respondents in the Arts subject category recorded a high level of climate change awareness compared to only 22% (n = 2) of the 9 respondents in Science subject category. The differences were confirmed using the composite mean scores, which also revealed that Arts teachers are generally more aware of climate change ($\overline{X}$ = 74.5; s = 10.08, n = 6) compared to science teachers ($\overline{X}$= 73.56, s = 6.71, n = 9). A combination of Science and Arts produced no significant influence on the mean score ($\overline{X}$= 71.71, s = 12.43, n = 68). This may be explained by the fact that much of knowledge on climate in Kenya's primary school syllabus is delivered through Social Studies, which fell in the Arts category in this study. These results, however, remained insignificant since all the groups still fell in the medium level of awareness category. This was confirmed through a one-way ANOVA test, which revealed no statistically significant influence of current subject allocation on teachers' level of climate change awareness (F = 0.229, df = 2, 85, p = 0.796). These results, however, contradicts the experts opinion that climate change is well understood by people in science fields.

As a matter of comparison, a correlation analysis was performed to test for the significance of the association between current subject allocation and level of climate

change awareness. The results of the Spearman Rho correlation revealed no correlation between current subject allocation and level of climate change awareness ($r = -0.072$, $p = 0.502$, $n = 88$). The observed differences in level of climate change awareness across various subject categories were thus attributed to chance.

4.5.6 Seminar Attendance

The majority of respondents interviewed for this study had never attended any seminar or workshop on climate change. Only 14% (n = 13) of the 90 respondents who responded to the question on seminar attendance had attended a seminar or workshop on climate change. A correlation analysis of the association between seminar attendance and level of climate change awareness revealed a weak and insignificant correlation, ($r = 0.09$, $p = 0.405$, $n = 88$). As a matter of confirmation a descriptive analysis of the relationship between seminar attendance and respondents knowledge of climate change was conducted. Even though no respondent who reported having attended a seminar fell in the low level of awareness category, only 31% (n = 24) of the 77 respondents who reported having never attended any seminar or workshop on climate change reported knowing a great about climate change compared to 38% (n = 5) of the 13 same respondents who reported having attended any seminar or workshop on climate change as illustrated in Fig. 4.13.

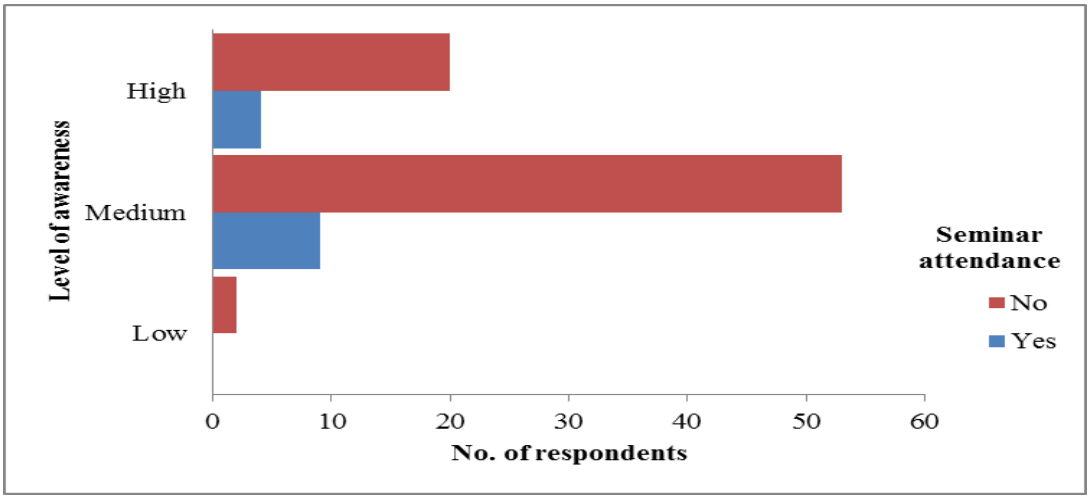

Figure 0.13: Seminar attendance Vs teachers' level of climate change awareness

It was thus believed that seminar attendance may have influence on the respondents' level of awareness on climate change but the influence remained insignificant in this study.

4.6 Primary School Teachers' Perception of Climate Change

Apart from assessing the teachers' level of awareness on climate change, the study was also designed to determine teachers' perception of climate change. While awareness is necessary for acceptance of climate change policies, perception is important in sparking action. Hence there is need for teachers to be aware of climate change and perceive it as a threat if their effort is desired in ensuring the success of the implementation of the country's policy on climate change knowledge transfer. As such, the null hypothesis was set that primary school teachers in Kisumu City do not perceive climate change as a major threat.

The respondents' perception of climate change was tested through a series of Likert Scale statements asking respondents how much they agree or disagree with each statement. Both negative and positive statements were presented. The responses were weighted on a five-point scale in which case 1= Strongly Disagree and 5= Strongly Agree for the positive statements while the reverse scale was used for the negative statements. A total of six paired Likert items were used and their reliability test as a measure of teachers' perception returned a Cronbach's Alpha of 0.809, considered good according to George and Mallery's (2003) rule of thumb. The data was analysed both as a group of statements using the summative approach discussed in Section 4.3.1 and as individual items using frequency counts and computation of mean. Based on the summative scores, respondents were grouped into two as illustrated below and analysed using chi-square goodness of fit to test the hypothesis. Results of the analysis are presented in Table 4.22.

Climate change is a threat: respondents in this group registered a summative perception score of at least 19 out of the 30 possible score.

Climate change is not a threat: respondents in this group registered a summative perception score of at most 18 out of the 30 possible score.

Table 0.22: Primary school teachers' perception of climate change as a threat

Perception of climate change	n	χ^2	df	p(value)
Climate change is a threat	82	63.202	1	0.0001
Climate change is not a threat	7			

Results show that primary school teachers in Kisumu City perceive climate change as a major threat (χ^2 = 63.202, df = 1, n = 89, p = 0.0001). Similar results emerged when the statements were analysed as individual items. An overwhelming 93% (n = 84) of the 90 respondents either agreed or strongly agreed with the statement that climate change is an issue of global concern yielding a mean of 4.51 (s = 0.877, n = 90). This was also reflected in the negative version of this statement, which returned a mean of 4.31 (s = 1.196, n = 90) showing that the majority of the respondents do not agree with the statement that we should not be worried about climate change. Respondents also overwhelmingly agreed with the statement that climate change poses a serious threat to Kenya ($\overline{X}$ = 4.38, s = 0.978, n = 90) as well as the statement that Kisumu is warming just like the rest of the world returning a mean of 4.00 (s = 1.006, n = 90) and 4.35 (s = 0.740, n = 90) respectively.

There was a close association between teachers' level of climate change awareness and perception of the same (r = 0.619, p = 0.0001, n = 88). All the 24 respondents who registered high level of awareness also perceived climate change as a threat while only 10% (n = 6) of the 63 respondents who registered a medium level of awareness did not perceive climate change as a threat.

Based on the findings presented in this section, there is evidence that primary school teachers in Kisumu City do perceive climate change as a major threat hence the null hypothesis was rejected and the alternative hypothesis adopted. These results confirms findings of earlier studies by GlobeScan (2006) and Pew Research (2006), but contradicts the results of Pugliese and Ray (2009) who pointed out that perception of climate change

as a threat is low among people in sub-Saharan countries as well as other developing countries in the world.

4.7 Primary School Teachers' Opinion on Inclusion of Climate Change Knowledge

The last objective of this study was to assess primary school teachers' opinion on inclusion of climate change knowledge into Kenya's primary school curriculum. Teachers' opinion on knowledge inclusion can have a direct influence on the success of the government's policy, which intends to incorporate climate change knowledge into Kenya's education system at all levels. The researcher presented respondents with questions to gauge their opinion and performed chi-square goodness of fit analysis to test the hypothesis that Primary school teachers in Kisumu City do not support the inclusion of climate change knowledge into primary school curriculum in Kenya. The results are presented in Fig. 4.23.

Table 0.23: Teachers opinion on the most appropriate entry point for climate change into Kenya's education system

Appropriate entry point	n	χ^2	df	p(value)
Primary	80	176.25	3	0.0001
Secondary	11			
Tertiary/College	2			
University	3			
Total	96			

Of the respondents interviewed, 83% (n = 80) considered primary school the most appropriate entry point for climate change knowledge into Kenya's education system. The significance of teachers' support for the inclusion of climate change knowledge into Kenya's primary school curriculum was confirmed through a chi-square goodness of fit test, which returned significant results (χ^2 = 176. 25, df = 3, p = 0.0001).

Teachers support for inclusion of climate change knowledge further emerged from the descriptive analysis of responses to the statement that "the government should include climate change knowledge into primary school curriculum in Kenya." Of the 90 respondents interviewed, 93% (n = 84) either agreed or strongly agreed with this

statement. Further, 86% (n = 77) of the 90 respondents interviewed refuted the statement that “climate change knowledge is too complex for primary school curriculum.” These results point out the fact that primary school teachers in Kisumu City hold the opinion that climate change concept is manageable at primary school level and would thus support the governments’ intent to integrate climate change knowledge into primary school curriculum in Kenya.

Based on these results, there is significant evidence to prove that primary school teachers in Kisumu City are for the inclusion of climate change knowledge into Kenya’s primary school curriculum hence the null hypothesis was rejected. These findings confirm the findings presented in RoK (2012), which shows that 100% of all the respondents interviewed suggested that climate change should be taught at all levels in Kenya’s education system.

The influence of teachers’ level of climate change awareness and perception on teachers’ opinion for inclusion of climate change knowledge into Kenya’s primary school curriculum was examined using correlation analysis. While teachers’ level of awareness had an insignificant association ($p = 0.183$), teachers’ perception of climate change as a threat appeared to have significant influence ($p = 0.051$) on teachers’ support for inclusion of climate change knowledge.

The respondents who considered primary school level as the most appropriate entry point for climate change knowledge into Kenya’s education system were further probed to establish their opinion on relevant subjects for integration of climate change knowledge, as well as training needs. This was achieved through a series of open ended questions that allowed respondents to give their personal views.

First, respondents were asked to state the aspects of climate change knowledge they would consider appropriate for primary school syllabus. A content analysis of the respondents’ answers to this question was undertaken and results presented in Table 4.24.

Results show that teachers consider definitions, causes, effects and mitigations of climate change most appropriate for primary school syllabus. Other very important aspects that

would be appropriate for elementary knowledge like adaptation to climate change and global warming only attracted a frequency of less than 10 responses each. Besides, there was also a tendency of respondents mentioning aspects that are not part of climate change reflecting teachers' limited knowledge of these aspects.

Table 0.24: Aspects of climate change knowledge considered relevant for primary school syllabus in Kenya

Aspect	No. of Respondents out of 77	%
Causes of CC	31	40.26
Effects of CC	24	31.17
Mitigation of CC	24	31.17
Definition of CC	18	23.38
Environmental conservation	8	10.39
Adaptation to CC	7	9.09
Pollution	6	7.79
Waste management	6	7.79
Global warming	6	7.79
Weather and weather instruments	5	6.49
Water resources	3	3.90
Environmental degradation	2	2.60
Climatic regions in Kenya	2	2.60
Ozone layer depletion	2	2.60
CC as a global problem	2	2.60
Rainfall patterns	2	2.60
Environment	2	2.60
Erosion control	2	2.60
Sustainability	1	1.30
Indicators of CC	1	1.30
Vegetation	1	1.30
Desertification	1	1.30
Altitude	1	1.30
Health Education	1	1.30
Environmental change	1	1.30
Renewable energy	1	1.30

Respondents were also asked to state which subjects in the current Kenyan primary school syllabus are appropriate for integration of climate change knowledge. From the results of a descriptive analysis presented in Fig. 4.14, primary school teachers in Kisumu City considered a combination of Science and Social Studies as the most appropriate

subjects for integration of climate change knowledge into the current primary school curriculum with 56% (n = 45) of the 80 respondents indicating that climate change knowledge should be incorporated in both Science and Social Studies. Integrating climate change knowledge into either Science or Social Studies alone was considered least appropriate while a combination of Science, Social Studies and languages presented another potential avenue for integration of climate change knowledge into the current primary school curriculum as illustrated in Fig. 4.14. These results point out the fact that climate change is cross cutting and its knowledge at elementary level is best addressed by more than one subject.

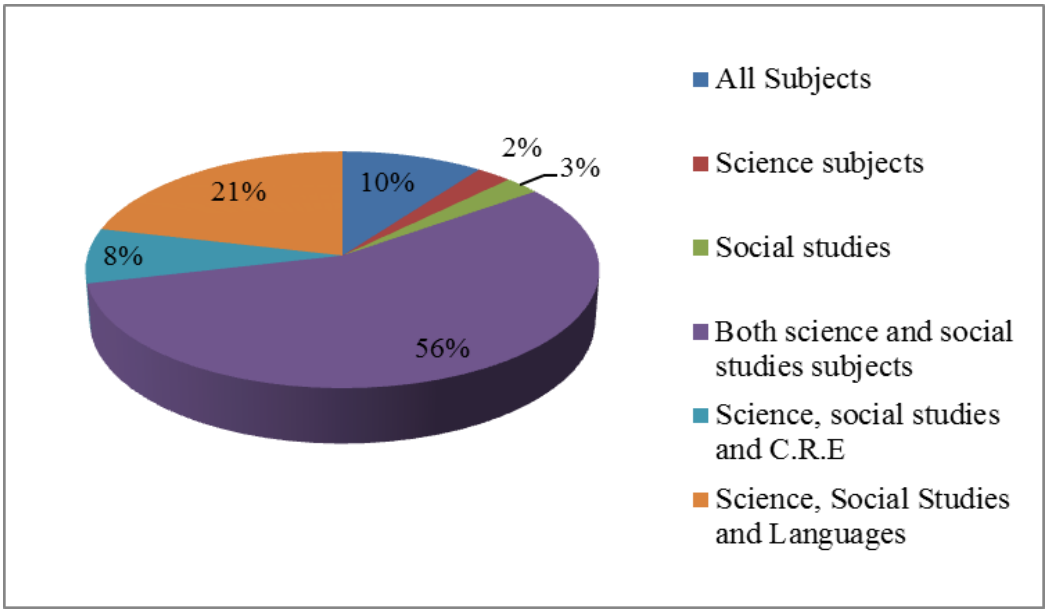

Figure 0.14: Subjects considered most appropriate for integration of climate change knowledge

Further, respondents were asked whether they would support the introduction of a new subject in the primary school curriculum to address climate change. Of the 80 respondents interviewed, only 46% (n = 37) expressed the need for introduction of a new subject to comprehensively address climate change. Some of the subjects cited by this group included Environmental Studies, Agriculture, Geography, History, and Climate Change Studies as illustrated in Fig. 4.15.

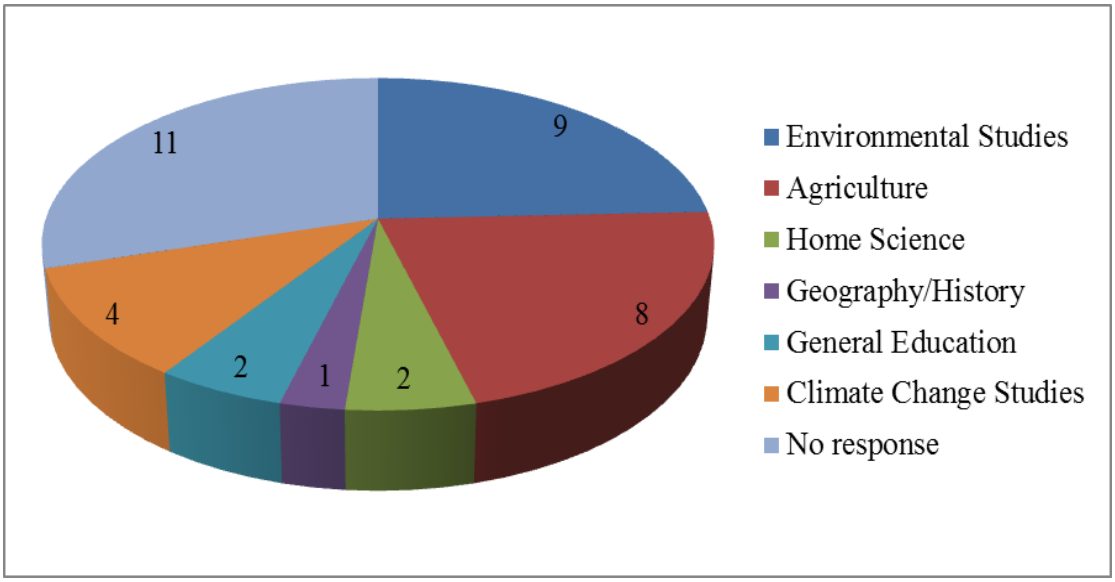

Figure 0.15: Potential new subjects for inclusion of CC into Kenya's primary school curriculum

Environmental Studies and Agriculture stood out as the most appropriate subjects that could be introduced into Kenya's primary school syllabus to convey knowledge on climate change. The choice of environmental studies and Agriculture by many respondents could be attributed to the fact that climate change is directly linked to the environment and its impacts in the country have become more obvious in the agricultural sector. In simple terms, teachers felt that climate change is an environmental problem directly influencing agriculture in the country, hence its knowledge should be addressed in the context of environment or Agriculture. Climate change studies was equally considered a potential new subject, but emerged number three with only 11% (n = 4) of the 37 respondents mentioning it. Another striking feature in Fig. 4.15 is the number of missing responses for this question. 30% (n = 11) of the 37 respondents who expressed the need for introduction of a new subject failed to provide their preferred new subject. This reflects teachers' limited understanding of climate change hence remaining unsure of which subject would comprehensively address climate change knowledge at primary school level.

To sum up teachers' opinion on inclusion of climate change knowledge into primary school curriculum in Kenya, the respondents were asked whether primary school teachers

should be offered any professional training on climate change. Of the 96 respondents 96% (n = 92), felt that primary school teachers should be offered professional training while the remaining 4% (n = 41) felt that professional training on climate change is not necessary. Various methods of professional training as suggested by respondents are presented in Fig. 4.16.

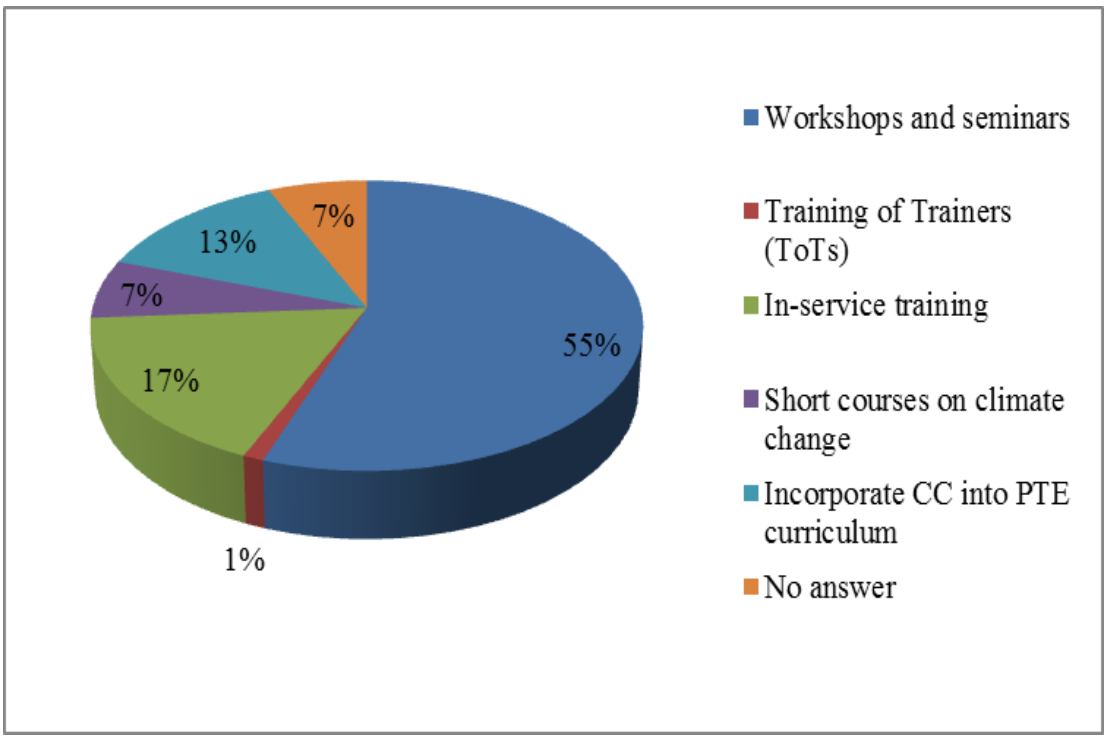

Figure 0.16: Potential methods of teachers' professional training on climate change

Workshops and seminars remained the most preferred method of climate change capacity building among primary school teachers in Kisumu City cited by 55% (n = 51) of all respondents. In-service training and inclusion of climate change into Primary Teacher Education (PTE) curriculum were equally considered appropriate professional training methods cited by 17% (n = 16) and 13% (n = 12) of all respondents respectively. There was also a substantial minority of respondents, 7% (n = 6) of the 92 respondents, who failed to provide any appropriate method reflecting their limited understanding of the subject.

4.8 Policy Planning Implications

The results presented in this chapter shows that Kisumu area experienced significant climate variability during the period 1972-2011. The level of climate change awareness among primary school teachers in Kisumu City is also not significantly low though gaps exist in their knowledge. Teachers recorded a medium level of awareness contrary to most documented work, which report a general low level of awareness on climate change in Kenya (RoK, 2013; GoK, 2010b; Otieno, Pauker and Maina, 2009). Teachers also perceive climate change as a problem of global concern and a major threat to Kenya. Further, primary school teachers in Kisumu City are for the opinion that climate change knowledge should be integrated into primary school curriculum in Kenya. These results have the following policy planning implications:

1. Evidence of climate variability revealed in this study confirms government's prior findings (GoK, 2010b). There is, therefore, urgent need for dissemination of information on climate variability not only to Kisumu residents, but also to the general public in Kenya.

2. Teachers' perception of climate change as a problem of global concern and a serious threat to Kenya shows that they would be supportive of any policy geared towards the fight against climate change including dissemination of climate change knowledge in primary schools. However, the gaps identified in teachers' knowledge of climate change calls for attention to ensure that teachers' quality of climate change knowledge is of the recommended standard before they are used as actors in the implementation of the national climate change policy.

3. The eminent lack of learning resources on climate change in primary schools revealed in this study confirms earlier concerns by the government and needs to be addressed as a way of improving awareness both among teachers and pupils at large.

4. The role of information technology in creating awareness on climate change not just to teachers, but to the general public cannot be underestimated. The results of this study shows that teachers consider internet an appropriate medium of

information transfer on climate change yet some information presented in the internet may be misleading. This necessitates the need for an official climate change knowledge portal that can provide one-stop information on climate change not only for teachers, but also for the general public in Kenya.

5. Further, the success of inclusion of climate change knowledge into primary school curriculum in Kenya would require an integrated approach in which teachers are not only viewed as policy implementers, but also critical players in the policy planning process.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

The results presented in this study proved that Kisumu area experienced significant climate variability during the period 1972-2011. The area recorded an average monthly temperature increase of 0.66 ± 0.24 °C during this period. The increase was much higher in the monthly minimum temperature component than the maximum temperature component. This suggests that the warming being experienced in the area is driven by a decline in the diurnal temperature, i.e. the difference between daily maximum and minimum temperature. Further, Kisumu recorded an increase in precipitation by 111.82 ± 20.8 mm during the period under analysis, but with significant annual variability. An analysis of the seasonality pattern revealed a fluctuating, but increasing trend in precipitation for the September-November and December-February seasons while a fluctuating, but decreasing trend was observed for the March-May and June-August seasons reflecting a potential shift in rainfall pattern with September-November season becoming more reliable than the March-May Season.

The results also proved that the level of climate change awareness among primary school teachers in Kisumu City is not significantly low. Teachers recorded a medium level of awareness on climate change, which shows that teachers have some good understanding of climate change, but gaps exist in their knowledge. Teachers expressed limited understanding of the existence of the UNFCCC, Kyoto Protocol and IPCC. Teachers also expressed non-conformity with the scientific consensus on anthropogenic climate change. However, teachers appeared to be aware of the causes, effects and mitigations of climate change, but also expressed limited understanding of the role of fossil fuel and poor management of waste in climate change. Teachers also portrayed limited understanding of the effect of climate change on sea level. The analysis revealed that teachers' personal reading of books and related materials, research in the internet, and informal trainings by NGOs has played a significant role as sources of their climate change knowledge. Factors such as gender, age, highest level of education, school location, and current subject allocation showed some degree of influence on the respondents' level of awareness on climate change, but the influence remained statistically insignificant in all cases.

Further, the results show that teachers in Kisumu City perceive climate as a serious threat. Teachers overwhelmingly supported the view that climate change is an issue of global concern and poses a serious threat to Kenya. All the statements that measured respondents' perception of climate change returned a mean of at least 4 suggesting that primary school teachers in Kisumu City perceive climate change as a threat and can thus be counted upon to support any initiative that seeks to tackle climate change in the country.

Finally, the results show that primary school teachers overwhelmingly support the inclusion of climate change knowledge into primary school curriculum in Kenya. The majority of teachers stated that inclusion of climate change knowledge into Kenya's education system should start at primary school level. Teachers also believed that climate change knowledge can easily be integrated in the subjects being taught under the current primary school syllabus with a combination of both Science and Social Studies considered most appropriate for integration. Aspects such as definitions, causes, effects and mitigations of climate change were cited by most respondents as most appropriate for primary school syllabus. The fact that concepts such as adaptation and global warming (both of which are appropriate for elementary knowledge) were not frequently mentioned by respondents shows that teachers do not have a clear understanding of climate change and may require capacity building to enhance their knowledge before using them as agents of climate change knowledge transfer in primary schools in Kenya. This explains why an overwhelming majority of respondents felt that teachers should be offered professional training on climate change.

5.2 Conclusions

Climate change is a complex subject usually surrounded with a lot of scepticism hence the need for conclusive evidence to support climate change reality. Results of this study shows beyond reasonable doubt that Kisumu area is experiencing climate variability just like the rest of the country. Hence, the need for dissemination of information, through formal and informal education, to help the public adapt to the new climatic conditions should not be overlooked.

The findings of this study have also revealed that primary school teachers in Kisumu City are aware of climate change though with gaps in their knowledge of the same. By implication, the relatively high level of awareness on climate change recorded by primary school teachers is a positive ingredient in the country's policy on climate change knowledge transfer, but the gaps existing in teachers' knowledge cannot be underestimated calling for capacity building to enhance their quality of knowledge on climate change. Factors such as gender, age, highest level of education, school location, and seminar attendance showed some level of influence on teachers' awareness of climate change though the influence remained statistically insignificant in this study.

Further, the study revealed that primary school teachers in Kisumu City perceive climate change as a problem of global concern and a serious threat to Kenya. By implication, teachers can be counted upon to support actions geared towards mitigating or adapting to climate change through dissemination of the relevant information to Kenyan pupils.

Lastly, primary school teachers in Kisumu City support the inclusion of climate change knowledge into primary school curriculum. These teachers can, therefore, be counted upon in the implementation of the policy on climate change knowledge transfer. However, it is imperative that climate change awareness campaign be carried out among primary school teachers to improve their understanding of climate change and enhance their capacity as agents of climate change knowledge transfer in the classroom.

5.3 Recommendations

Based on the findings of this study, the following recommendations are proposed for policy makers, education curriculum planners and researchers:

5.3.1 Recommendations for Policy Makers

1. Primary school teachers play a critical role as agents of climate change knowledge transfer within the classroom yet this study revealed gaps in their knowledge of the same. The government, through the Ministry of Education, Science and Technology, should embark on capacity building to ensure that teachers' understanding of climate change is improved before incorporating climate change

knowledge into primary school curriculum. The ministry should come up with comprehensive awareness creation programmes for primary school teachers highlighting the content as well as methods for capacity building. Capacity building can be undertaken in the following ways:

I. The Ministry of Education, Science and Technology should organise seminars and workshops on climate change for teachers, especially those teaching subjects that have topics on weather and climate like Science and Social Studies to help them acquire current knowledge on this subject.
II. The Ministry of Education, Science and Technology should also develop and circulate learning materials on climate change to all primary schools in Kenya. The ministry should strive to provide small books, magazines and charts that illustrate climate change in a simple and easy to understand manner for primary schools. Teachers can use such materials not only for teaching purposes, but also for their own learning.

2. While this study gave a bird's eye view of the situation, the Ministry of Education, Science and Technology should carry out a countrywide survey on the level of climate change awareness among primary school teachers as part of a needs assessment for inclusion of climate change knowledge into primary school curriculum in Kenya.

5.3.2 Recommendations for Curriculum Developers

1. Climate change is a complex subject and may not be easily understood by primary school pupils. Curriculum developers should not overlook the complex nature of climate change and should work with teachers when designing climate change knowledge for primary schools to ensure that the content developed is simple and easy to understand.
2. Curriculum developers should also involve teachers in the revision of the curriculum when incorporating climate change knowledge into primary school syllabus to ensure that teachers' concerns are taken into consideration. Teachers should be consulted to give their opinion on how much of climate change

knowledge is appropriate for primary school pupils as well as what stage of learning should form appropriate entry point of climate change in primary schools.

5.3.2 Recommendations for Further Research

1. Further research should be carried out to determine factors influencing teachers' level of awareness on climate change.
2. Researchers should also explore the link between level of awareness on climate change and behaviour change to inform any policy that seeks to make the public adopt positive environmental behaviours through awareness creation.

REFERENCES

Acquah, H.D. (2011). Public awareness and quality of knowledge regarding climate change in Ghana: A logistic regression approach. *Journal of Sustainable Development in Africa*, vol. 13, pp. 146-157.

Adebayo, A.A., Mubi, A.M., Zemba, A.A. & Umar, A.S. (2013). Awareness of climate change impacts and adaptation in Adamawa State, Nigeria. *International Journal of Environment, Ecology, Family and Urban Studies,* vol. 3(1), pp. 11-18.

Akinnubi, R.T., Akinwande, D.D., Oketayo, O.O., Ijila, P.O., Ifedayo O.O. & Iwetan, C.N. (2012). Assessing the level of climate change awareness among secondary school teachers in Ondo West Local Government Area, Ondo State. *Journal of Science and Science Education, Ondo,* vol. 3(1), pp. 18-22).

Anderson, A. (2010). Combating climate change through quality education. *Global Views, Policy Brief* 2010-03. Washington, DC: Global Economy and Development at Brookings.

Blunden, J., Arndt, D.S. & Baringer, M.O. (Eds.) (2011). State of the climate in 2010. *Bull. Amer. Meteor. Soc.*, vol. 92(6), ss. 1-266.

Bord, J.R., Fisher, A. & O'Conner, R.E. (1998). Public perceptions of global warming: United States and international perspectives. *Climate Research,* vol. 11, pp. 75- 84.

Bortscheller, M.J. (2010). Equitable but ineffective: How the principle of common but differentiated responsibilities hobbles the global fight against climate change. *Sustainable Development Law and Policy*, vol. 10(2), pp. 49-86.

Bostrom, A., Morgan, M.G., Fischhoff, B. and Read, D. (1994). What do people know about global climate change? *Risk Analysis*, vol. 14(6), pp. 959-970.

Brulle, R.J., Carmichael, J. & Jenkins, C. (2011). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002-2010. Springler. DOI 10.1007/s10584-012-0403-y.

Canadel, J.G., Ciais, P., Dhakal, S., Dolman, H., Friedlingstein, P., Gurney, K.R., Held, A., Jackson, R.B., Le Quéré, C., Malone, E.L., Ojima D.S., Patwardhan, A., Peters, G.P. & Raupach, M.R. (2010). Interactions of the carbon cycle, human activity, and the climate system: a research portfolio. *Current Opinion in Environmental Sustainability*, vol. 2, pp. 301-311.

Christianson, G.E. (1999). *Greenhouse: the 200-year story of global warming*. New York: Walker and Company.

City Council of Kisumu (2012). *Background and history*. Retrieved December 10, 2012 from http://www.citycouncilofkisumu.or.ke/background-and-history.

Cook, J., Nuccitelli, D., Green, S.A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P. & Skuce, A. (2013). Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters*, vol. 8(2), pp. 1-7.

Curry, J. (2011). Nullifying the climate null hypothesis. *WIREs Climate Change*, vol. 2, pp. 919-924.

Dunlap, R.E., Gallup, G.H. & Gallup, A. M. (1993). "Of Global Concern: Results of the Health of the Planet Survey." *Environment*, vol. 35, pp. 7–15.

Ekpoh, U.I. & Ekpoh, I.J. (2011). Assessing the level of climate change awareness among secondary school teachers in Calabar Municipality, Nigeria: Implication for management effectiveness. *Int. Journal of Humanities and Social Science*, vol. 3, pp. 106-110.

Eze, C. (2011). UN climate change conference, Durban, South Africa, 28 Nov- 9 Dec, 2011. Retrieved 2nd October 2012 from http://www.shcj.org/documents/UNClimateChangeConferencereport.pdf.

Fox, M.F. & Fregbraugh, G. (1992). Confidence in science: The gender gap. *Social Science Quarterly*, vol. 73, pp. 101-113.

George, D. & Mallery, P. (2003). *SPSS for windows step by step: A simple guide and reference. 11.0 update* (4th ed.). Boston: Allyn & Bacon

GlobeScan. (2006). *30-country poll finds worldwide consensus that climate change is a serious problem*. Toronto, Canada: GlobeScan, Inc.

Godfrey, A., Le Roux-Rutledge, E., Cooke, S. & Burton, M. (2009). Africa talks climate. The public understanding of climate change in ten countries. *Research Report*. London, U.K.: BBC World Service Trust.

GoK (2010a). *Kenya state of environment report 2009.* Nairobi, Kenya: The National Environment Management Authority (NEMA)

GoK (2010b). *National climate change response strategy-2010*. Nairobi, Kenya: Government Printers.

GoK (2011). *Kenya State of Environment and Outlook 2010*. Nairobi, Kenya: The National Environment Management Authority (NEMA)

Hasan, Z. & Akhter, S. (2011). Determinants of public awareness and attitudes on climate change in urban Bangladesh: Dhaka as a case. *European Journal of Social Sciences*, vol. 21(1), pp. 154-162.

Holdren, J.P. (2006). *Meeting the Climate-Change Challenge*. Wood Hole Research Center's former Director John Holdren's PowerPoint presentation given at the SES Distinguished Scientist Seminar of the Marine Biological Laboratory in Woods Hole, November 3rd 2006. Retrieved 2nd October 2012 from http://www.whrc.org/resources/essays/2005-2006.html#sthash.vDkM3KIF.dpu.

IPCC (1990). Climate Change 1990. *The scientific assessment. Contribution of working group I to the first assessment report of the Intergovernmental Panel on Climate Change (IPCC).* Cambridge: Cambridge University Press.

IPCC (2001). Climate Change 2001. *Synthesis Report. Contribution of Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).* Geneva, Switzerland: IPCC.

IPCC (2007). Climate Change 2007. *Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).* Geneva, Switzerland: IPCC.

Jamieson, S. (2004). Likert scales: How to use them. *Medical Education,* vol. 38, pp. 1217-1218.

Keeling, C.D. (1960). The concentration and isotopic abundances of carbon dioxide in the atmosphere. *Tellus*, vol. 12, pp. 200-203.

Kelley, K., Clark, B., Brown, Vivienne, B. & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *Int. Journal for Quality in Health Care*, vol. 15(3), pp. 261-266.

Kenya National Bureau of Statistics (2011). Kenya Population and Housing Census, 2009. *Table 7(a): Population of municipalities, towns, cities and other urban area*. Retrieved 5th October 2012, from http://www.knbs.or.ke/census1999.php.

Kisumu City Council (2005). *The Kisumu City environmental profile on sustainable urban mobility*. Kisumu, Kenya: Kisumu City Council

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change,* vol. 77, pp. 45-72.

Leiserowitz, A., Kates, R.W., & Parris, T.M. (2005). Do global attitudes and behaviors support sustainable development? *Environment*, vol. 47, pp. 22-38.

Lowe, T., Brown, S.D., Doria, M.F., Haynes, K. & Vincent, K. (2006). Does tomorrow ever come? Disaster narrative and public perceptions of climate change. *Public Understanding of Science*, vol. 15, pp. 435-457.

Maoulidi, M. (2008). Education needs Assessment for Kisumu City, Kenya. *MCI Social Sector Working Paper Series*, No. 01/2008.

Mugenda, O.M. & Mugenda, A. G. (2003). *Research Methods:Quantitative and Qualitative Approaches.* Nairobi, Kenya: ACTS Press.

Myers, T.A., Maibach, E.W., Roser-Renouf, C., Akerlof, K. & Leiserowitz, A.A. (2013). The relationship between personal experience and belief in the reality of global warming. *Nature Climate Change*, vol. 3, pp. 343- 347.

NCEP (2013). Cold and warm episodes by season. Changes to Oceanic Nino Index (ONI). Retrieved 15th June, 2013 from http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears/shtml.

NOAA (2010). State of the Climate: Global Analysis for Annual 2010, published online December 2010. Retrieved 2nd October, 2012 from http://www.ncdc.noaa.gov/sotc/global/2010/13.

Nwankwo, C.A. & Unachukwu, G.O. (2012). Teachers' awareness of the causes and effects of climate change and their classroom management strategies in climate change era. *Research Journal in Organizational Psychology & Educational studies*, vol. 1(3), pp. 161-167.

Olajide, F.O., Owolabi, O.A., Olajide, A.O., Oospore, A.G., Unlade, A.O. & Omobuwa, O. (2011). Knowledge about the causes, consequences and control of climate change among undergraduates of Obafemi Awolowo University, Ile Ife. In Salami A.T. & Orimoogunje O.O.I (Eds) *Environmental research and challenge of sustainable development*. Ile Ife: OAU Press.

Orodho, J.A. (2009). *Elements of education and social science research* (2nd Ed.). Maseno, Kenya: Kenezja Publisher.

Oruonye, E.D. (2011). An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo Metropolis, Taraba State Nigeria. *Journal of Geography and Regional Planning*, vol. 4, pp. 513-517.

Osborne, J.W. & Amy, O. (2004). The power of outliers (and why researchers should always check for them). *Practical Assessment, Research & Evaluation*, 9(6), pp. 1-12.

Otieno, S., Pauker, E. & Maina, P. (2009). Kenya talks climate. The public understanding of climate change. *Research Report.* London, U.K.: BBB World Service Trust.

Owolabi, H.O., Gyimah, E.K. & Amponsah, M.O. (2012). Assessment of junior high school students' awareness of climate change and sustainable development in central region, Ghana. *Educational Research Journal*, vol. 2(9), pp. 308-317.

Pandve, H.T., Chawla, P.S. & Pawar, S. (2011). Assessment of awareness regarding climate change in an urban community. *Indian Journal of Occupational and Environmental Medicine,* vol. 15(3): 109-112.

Patchen, M. (2006). Public attitudes and behaviour about climate change. What shapes them and how to influence them. Indiana: Purdue Climate Change Research Center.

Pew Research Centre (2006). *No global warming alarm in the U.S., China*. Washington, D.C.: The Pew Research Centre for the People & the Press.

Pew Research Centre (2013). *Most Americans believe climate change is real, but fewer see it as a threat*. Washington, D.C.: The Pew Research Centre for the People & the Press.

Pugliese, A. & Ray, J. (2009). Gallup presents...A heated debate: Global attitudes toward climate change. *Harvard International Review,* vol. 31, pp. 64-68.

Rajamani, L. (2000). The principle of common but differentiated responsibility and the balance of commitments under the climate regime. *Reciel,* vol. 9(2), pp. 120-131.

Ravindranath, N.H. (2010). IPCC: Accomplishments, controversies and challenges. *Current Science,* vol. 99(1), pp. 26-35.

RoK (2012). Integrating climate change in education system. In *Knowledge management and capacity development* (chapter 5). Research findings report on the National Climate Change Action Plan prepared by Alin for the Ministry of Environment and Mineral Resources, Kenya. Nairobi, Kenya: Government Printers.

RoK (2013). *National climate change action plan 2013-2017*. Nairobi, Kenya: Government Printers.

Sampei, Y. & Aoyagi-Usui, M. (2009). Mass-media coverage, its influence on public awareness of climate-change issues, and implications for Japan's national campaign to reduce greenhouse gas emissions. *Global Environmental Change*, vol. 19, pp. 203-212.

Saroar, M. & Routray, J. K. (2010). Why does climate change awareness differ? Lessons learned from Bangladesh. *Paper presented at the 2nd International Conference on Climate Change, Sustainability and Development in Semi-arid regions held between 16-20 August, 2010 in Fortaleza - Ceará, Brazil*.

Semenza, J.C., Hall, D. E., Wilson, D.J., Bontempo, B.D., Sailor, D.J. & George, L.A. (2008). Public perception of climate change: Voluntary mitigations and barriers to behaviour change. *American Journal of Preventive Medicine*, vol. 35(5), pp. 497-487.

Sexton D.M.H., Rowell, D.P., Folland, C.K. & Karoly, D.J. (2001). Detection of anthropogenic climate change using an atmospheric GCM. *Climate Dynamics*, vol. 17, pp. 669–685.

Shisanya, C., Recha C. & Anyamba (2011). Rainfall variability and its impacts on normalized difference vegetation index in arid and semi-arid lands of Kenya. *International Journal of Geosciences*, vol. 2(1), pp. 36-47.

Taderera, D. (2010). South African's Awareness of Climate Change. *Briefing Paper No. 235.* Cape Town, S.A: The Catholic Parliamentary Liason Office.

Tol, R.S.J. (2007). Biased policy advice from the Intergovernmental Panel on Climate Change. *Energy and Environment*, vol. 18, pp. 929 – 936.

Trainer, T. (2008). A critique of the Stern and IPCC analyses of CO2 mitigation: Consumer capitalist society cannot solve the problem. *The International Journal of Inclusive Democracy*, vol. 4(4), pp. 1-12.

Trenberth, K.E. (2011). Attribution of climate variations and trends to human influences and natural variability. *WIREs Climate Change*, vol. 2, pp. 925-930.

TSC (2006). *Policy on teacher recruitment and selection*. Nairobi: Teachers Service Commission.

UNCED (1992). *Report of the United Nations conference on environment and development between 3-14 June, 1992, Rio de Janeiro.* United Nations publication, Sales No. E. 93.I. 8.

UNDP (2007). *Fighting climate change :Human solidarity in a divided world.* New York: UNDP.

UNEP (2006). Raising awareness of climate change. *A handbook for government focal points.* Nairobi, Kenya: United Nations Office.

UNESCO (2009). Learning to mitigate and adapt to climate change: UNESCO and climate change education. *Brochure of UNESCO International Seminar on Climate Change Education between 27-29 July, 2009, Paris.*

UNFCCC (1992). *Convention on Climate Change*. Germany: UNEP/IUC for Climate Change Secretariat.

UNFCCC (2007). *Climate change: Impacts, vulnerabilities and adaptations in developing countries*. Germany: The UNFCCC Secretariat.

UNWCED (1987). *Report of the world commission on environment and development: Our common future*. Oxford: Oxford University Press

Weart, S.R. (2010). The idea of anthropogenic global climate change in the 20th century. *WIREs Climate Change*, vol. 1, pp. 67-81.

Weber, E.U. (2013). Psychology: Seeing is believing. *Nature Climate Change*, vol. 3, pp. 312-313.

Whitmarsh, L. (2008). Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research*, vol. 11(3), pp. 351-374.

APPENDICES

Appendix I: List of the Sampled Schools

School Name	School Zone	School Type	School Location
Penstate Primary School	Otonglo	Private	Peri-Urban
Kodiaga Prisons Primary School	Otonglo	Public	Peri-Urban
Kotetni Primary School	Otonglo	Public	Peri-Urban
Kondele Primary School	Manyatta	Public	Urban
Brilliant Kids Primary School	Manyatta	Private	Urban
Bhayani Primary School	Central	Private	Urban
Arina Primary School	Central	Public	Urban
Pefa Christ Church Schools	Central	Private	Urban
Bar Ogwal Primary School	Nyahera	Public	Peri-Urban
Dago Kokore Primary School	Nyahera	Public	Peri-Urban
Victoria Primary School	Southern	Public	Urban
Kisumu Jacaranda Primary School	Southern	Private	Urban
St. Anne's Academy	Kajulu	Private	Peri-Urban
Alango Primary School	Kajulu	Public	Peri-Urban
Ragumo Primary School	Ragumo	Public	Peri-Urban
Jamaa Primary School	Ragumo	Public	Urban
Kadiju Primary School	Rweya	Public	Peri-Urban
Ayaro Primary School	Rweya	Public	Peri-Urban
Osiri Primary School	Ojolla	Public	Peri-Urban
Oyiengo Primary School	Ojolla	Public	Peri-Urban

Appendix II: University Research Authorization

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: admissions-graduate@ku.ac.ke
dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: N50/20302/10 Date: 8th September, 2012

The Permanent Secretary,
Ministry of Higher Education, Science & Technology,
P.O. Box 30040,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION
MS. OCHIENG A. MILLICENT - REG. NO. N50/20302/10

I write to introduce Ms. Ochieng A. Millicent who is a Postgraduate Student of this University. She is registered for a M.Sc. degree programme in the Department of Environmental Education in the School of Environmental Studies.

Ms. Ochieng intends to conduct research for a Thesis entitled, **"Assessing the Level of Climate Change Awareness among Primary School Teachers in Kisumu Municipality, Kenya: Implication for Policy Planning."**

Any assistance given will be highly appreciated.

Yours faithfully,

OFFICE OF DEAN
10 SEP 2012
GRADUATE SCHOOL

for MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

Appendix III: City Council Research Authorization Letter

MUNICIPAL COUNCIL OF KISUMU

DEPARTMENT OF EDUCATION

Tel. No: Kisumu
Office: (057) 530158
Fax: (057) 530159
When replying please quote:

Municipal Education Officer
Okore Road, Milimani
P.O. Box 105 – KISUMU

REF: MEO/43/VOL XI

DATE: 8/10/2012

To All Head Teachers
Public and Private Schools
KISUMU MUNICIPALITY.

RE: RESEARCH AUTHORIZATION: MS. OCHIENG A. MILLICENT - N50/20302/10.

The bearer is a student at Kenyatta University in the department of Environmental Education in the school of Environmental Studies and would wish to carry out her research in our schools.

She is duly authorized by this office to undertake research in Educational Institutions within the Municipality.

Attached is the University's authorization letter.

Please accord her the necessary assistance.

Juma K. Omwendo
MUNICIPAL EDUCATION OFFICER.

MUNICIPAL COUNCIL OF KISUMU

Appendix IV: Introductory Letter

MILLICENT OCHIENG,
KENYATTA UNIVERSITY,
SCHOOL OF ENVIRONMENTAL STUDIES,
P.O. BOX 43844-00100,
NAIROBI-KENYA.

DATE: 8TH OCTOBER 2012

Dear Respondent,

RE: REQUEST FOR YOUR PARTICIPATION IN THE RESEARCH

Kind reference is made to the above subject.

I am a postgraduate student at Keyatta University currently conducting a research study as a requirement in partial fulfilment of my degree course.

I therefore request for participation in this study. I have attached a copy of the questionnaire which you are required to complete accordingly. Please follow the instructions and answer all questions as truthfully as you can. This is not a test hence there is no wrong or right answer.

This research is conducted purely for academic purposes. Any information provided will be treated as private and confidential and will be used only for purposes of this study. Thanking you in advance for your participation.

Yours Faithfully,

Millicent Ochieng
Student-Kenyatta University

Ref. No:
……

Appendix V: Climate Change Awareness Questionnaire

SECTION A: DEMOGRAPHIC INFORMATION

Please provide the following information (Tick **(**√**)** inside the box for multiple choice questions).

1. I am ..... years old.
2. I am: Male ☐ Female ☐
3. I come from..... county
4. My highest level of education is:

   ☐ P1 certificate ☐ Diploma ☐ Degree (Bachelors) ☐ Master's Degree ☐ Other (Specify).....

5. I have lived in Kisumu since.....
6. I teach at..... primary school
7. Our school is: Public ☐ Private ☐
8. It is located in the: Urban area ☐ Peri-urban area ☐
9. I teach the following classes:

   …….....

10. I teach the following subjects:

    ……..

SECTION B: CLIMATE CHANGE AWARENESS

The following are a number of questions on climate change. (Tick **(**√**)** the most appropriate answer)

11. How much do you know about climate change?

    a) ☐ I have never heard of it

    b) ☐ I know a little about it

    c) ☐ I know more about it

If your answer is (a), go to question No. 45

12. The following are important institutions and instruments concerning climate change. Tick **(√)** where appropriate to show whether you know about their existence or not.

Institution/ Instrument	**I have never heard of it**	**I know something about it**
United Nations Framework Convention on Climate Change (UNFCCC)		
Kyoto Protocol		
IPCC		

13. Listed below are channels through which information on climate change can be disseminated to the public. Mark them accordingly (**as Appropriate or Not Appropriate**) expressing how you feel they have played a role in helping you learn about climate change issues.

Medium	**Appropriate**	**Not Appropriate**
National Radio Stations (e.g. KBC, Radio Citizen, Easy FM, Kiss 100)		
Vernacular Radio Stations (e.g. Ramie FM, Radio Lake Victoria, Radio Nam Lolwe)		
Television		
Newspapers and Magazines		
Internet		
Public libraries		

14. Have you ever attended a seminar/workshop on climate change?

☐ Yes, I have attended a seminar/workshop on climate change

☐ No, I have never attended any seminar/workshop on climate change

15. Are there any learning materials on climate change provided by the government (e.g. NEMA, Ministry of Education) and/or non-governmental organizations (e.g. OSIENALA, UNESCO) available to your school?

☐ Yes, there are

☐ No, there aren't

If yes, give details of the available learning materials

……

……

……....

.....

16. The phrase "climate change" means:

☐ Rising global temperatures

☐ Changes in the average weather conditions towards extremes recorded over long periods

☐ Short term variations in weather patterns

☐ Hole in the ozone layer

SECTION C: CAUSE, EFFECT AND ACTION

Questions No. 17 to 44 consist of statements on causes, effects, and possible mitigations of climate change. Rate them on a scale of 1-5 expressing how much you agree with each statement. Where **SD = Strongly Disagree, D = Disagree**, **DK = Don't Know, A = Agree, SA = Strongly Agree.** (Tick inside **(√)** the appropriate box)

Statement	**SD**	**D**	**DK**	**A**	**SA**
17. Climate Change is caused by Deforestation					
18. Climate change is caused by combustion of fossil fuels					
19. Climate change is caused by poor agricultural practices (e.g. Fertilizers)					
20. Climate change is caused by air pollution from industries					
21. Climate change is caused by poor management of waste					

22. We cannot mitigate climate change by using renewable energy sources (e.g. hydro-power, geothermal, solar, and wind) instead of fossil fuel					
23. We cannot mitigate climate change through organic farming					
24. Use of land-fills instead of open damp sites does not provide a mitigation option for climate change					
25. We cannot mitigate climate change by minimizing air pollution from industries					
26. We can mitigate climate change by planting more trees					
27. The world's temperatures have risen over the years					
28. Climate change leads to rise in sea levels					
29. Climate change leads to food shortages					
30. Climate change is associated with the increased frequencies of droughts and floods					
31. Climate change will lead to expansion of rivers and lakes					
32. Climate Change is not associated with sea level rise					
33. Climate change has led to increased food availability					
34. Climate change leads to shrinking of lakes and rivers					
35. Climate change is not a cause of droughts and floods					
36. The current climate change has been caused by factors other than human activities					
37. Climate change is an issue of global concern					
38. Kenya is not affected by climate change					
39. Human activities are entirely to blame for the current climate change					
40. The government should include climate change knowledge into primary school curriculum					
41. Kisumu has become hotter than it was					
42. We should not be worried about climate change					
43. Climate change poses a serious threat to Kenya					
44. Climate change concept is too complex for primary school curriculum					

SECTION D: CLIMATE EDUCATION POLICY PLANNING

45. At what level of education should climate change be taught in Kenya's Education system? (Tick **(√)** the most appropriate answer)

☐ Primary ☐ Secondary ☐ Tertiary/College ☐ University

If your answer is **NOT** primary**,** go to question no. 49

46. What aspects of climate change knowledge do you consider appropriate for the primary school curriculum in Kenya? Please list them here.

a).....

b).....

c).....

d).....

e).....

f).....

47. In your opinion, what subjects should carry messages about climate change?

……

……

……

48. In your opinion, are there other subjects that should be added to what is currently taught to address issues of climate change in primary school curriculum?

☐ Yes ☐ No

If yes, give your suggestion of the subjects you consider most appropriate

……

……

49. In your opinion, should primary school teachers be offered professional training on climate change?

☐ Yes, they should

☐ No, they shouldn't

If yes, explain how this can be done

.....

.....

.....

.....

.....

THANK YOU

Interview Date: ……..