EXPLORING STRATEGIES FOR ADDRESSING CLIMATE CHANGE: THE ROLE OF AN EDUCATION FOR SUSTAINABLE DEVELOPMENT PERSPECTIVE IN LAKE VICTORIA CATCHMENT, KENYA

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DECLARATION

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

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To Mum and Dad. The virtues of determination, excellence and focus that you instilled in me enabled me endure the long arduous doctoral journey. To you, this thesis belongs.

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ABBREVIATIONS AND ACRONYMS

DESD	Decade of Education for Sustainable Development
EAC	East African Community
EE	Environmental Education
ESD	Education For Sustainable Development
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel On Climate Change
IPO	Input-Process-Output Model
IUCN	International Union For Conservation Of Nature
LVCEEP	Lake Victoria Catchment Environmental Education Programme
MAAIF	Ministry Of Agriculture, Animal Industry And Fisheries
NEMA	National Environment Management Authority
NIDOS	Network Of International Development Organisation In Scotland
PPM	Parts Per Million
OXFAM	Oxford Committee For Famine Relief
SARDC	Southern Africa Research And Documentation Centre
UN	United Nations
UNCED	United Nations Conference For Environment And Development
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational Scientific And Cultural Organisation
UNFCC	United Nations Framework For Climate Change
WSSD	World Summit On Sustainable Development
WWF	World Wildlife Fund For Nature

ABSTRACT

The purpose of the study was to examine Education for Sustainable Development as a possible modality of dealing with the climate change challenges in Lake Victoria and Kenya in general. The study was carried out in the Lake Victoria catchment in Kenya with the main objective of demonstrating the role that a sound and practical ESD programme can play in addressing the adverse effects of climate change, thereby contributing to solutions to the current climate change challenges. The study focused on the Kenyan project sites of Homabay, Nandi and Transmara. Options for combating the effects of climate change are of key interest to policy makers globally. International, regional and national policy makers have come up with and implemented various strategies for combating the effects of climate change such as information sharing about national greenhouse emissions, international cooperation and national activities, wide range of climate change policies and measures, energy, industry, agricultural and educational sectors related policies, international carbon trading market amongst others; despite these actions, the effects of climate change continue to worsen. In 2010, the Kenya Government came up with the National Climate Change Response Strategy (NCCRS), this is one of the guidelines against which the study bench marks the capacity of ESD to support the efforts towards climate change abatement. The case study of Lake Victoria Catchment Environmental Education Programme (LVCEEP), an ESD project, was conducted using multiple methods of data capture. The study used random sampling to select 6 sample project schools. Total population sampling was done for the community groups and project stake holders. While the primary source of data collection was done using semi-structured in-depth interviews, questionnaires, direct observations, focus group discussions and field observations, secondary data was obtained from programme literature. The results showed that LVCEEP positively influences response to climate change. 66.7% of the teachers in the study felt that the LVCEEP activities are addressing real climate change issues. Further, 82.6% of the community members in the study were of the opinion that the projects they are implementing under LVCEEP are closely related to the subject of climate change because the projects are aimed at conserving the catchment resources and restoring the catchment ecosystem as it was before, and thereby combating the effects of climate change. Moreover, the findings indicated that there is a relationship between LVCEEP interventions and the expected outcomes of climate change mitigation and adaptation efforts. The study concludes that Education for Sustainable Development should be recognized as a possible response to the effects of climate change and recommends that the findings of this exploration of the ESD programme (LVCEEP) interventions should be promoted to enhance the methods for coping with climate change and climate variability in Kenya.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Problem

Climate change presents a new type of challenge for development. It is now widely acknowledged that climate change impacts amplify existing unfavorable conditions in developing countries (McCarthy *et al.,* 2001). The 1992 Sustainable Development Conference in Rio de Janeiro, the Kyoto protocol and the United Nations Framework Convention on Climate Change drew international attention to the challenges of climate change.

Climate change is defined as "the change in climate over a time" as a result of human activities that alters the composition of the global atmosphere and that is in addition to the natural climate variability observed over time" (IPCC, 2007). It includes shifts in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in global mean surface temperature. According to Ozor (2009), climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity and is widely recognized as the most serious environmental threat facing our planet today. According to United Nations Framework Convention on Climate Change, Climate change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1992).

Climate variability refers to the variations in the mean state and other statistics (standard deviation, occurrence of extreme events) of climate on all time scales beyond that of individual weather events. Variability may be due to natural processes within the climate system or to variations in natural or anthropogenic external forcing (Mubiru, 2010).

The primary cause of climate changes is the variation in gaseous content of the atmosphere, changes in the reflective properties of the earth's surface and alteration in intensity of sunlight reaching earth surface (Pickering and Owen, 1994).The causes of global climate change can also be traced to the activities of man that have resulted in an increased concentration of greenhouse gases in our atmosphere, including carbon dioxide, water vapor, methane, ozone, and nitrous oxide (Bothe, 2003).

Changes in climate have impacted both human and natural systems both locally and globally Ozor (2009). These effects/impacts range from drought events to flooding events, sea level rise, drying of rivers and streams, decrease in water quality, melting of glaciers, loss of biodiversity, changes in rainfall pattern and amounts, increases in temperature, among others (IPCC 2014). These effects have negative impacts on the economy, food security, agricultural production, health, and social statuses (conflicts and migration) of many nations especially the developing countries Ozor (2009).

As the effects of global climate change become more evident and in response to anticipated effects of climate change, conservation organisations and government

agencies are developing “adaptation strategies” to facilitate the adjustment of human society and ecological systems to altered climate regimes (Mawdsley *et al.,* 2009).

The Kenya National Climate Change Response Strategy (NCCRS) proposes some mitigation and adaptation programmes and projects such as promoting growing of drought tolerant, pest resistant and disease resistant species; developing countrywide maps depicting areas that will require shoreline protection and those to be left to adapt naturally; and, improving timber yields by planting mixture of species, maintaining several age classes, reducing tree density, and pruning trees at strategic intervals (GOK, 2010).

Growth of the global economy in the early 2000’s and an increase in its carbon intensity (emissions per unit growth), combined with a decrease in the capacity of ecosystems on land and the oceans to act as carbon “sinks”, have led to a rapid increase in the concentrations of carbon dioxide in the atmosphere, leading to faster sea-level rise, ocean acidification, melting Arctic sea ice, warming of polar land masses, and shifts in the circulation patterns of the oceans and atmosphere, (IPCC, 2007). Recurring droughts in South Africa, floods in Europe, Mozambique, Bangladesh, Vietnam and hurricanes in Central America and the USA- destabilising and reshuffling the world’s hydrological systems, economies, and livelihoods (IPCC, 2007). Because of low adaptive capacities and given the projected impacts of climate change, a consensus has emerged that developing countries are more vulnerable to climate change than developed countries, because of the predominance of rain fed agriculture in their economies, the scarcity of capital for adaptation measures, their

warmer baseline climates, and their heightened exposure to extreme events (Fischer *et al.,* 2005).

Global warming is real and its effects are now being felt globally (IPPC AR5, 2013). Studies indicate that the developing countries will be worst hit by the impacts of the projected changes (Smith *et al*., 2003, Ahmed *et al*., 2009) because widespread poverty in these countries limits adaptation (IPCC, 2012). For these countries, efforts to adapt to the changing climate are inseparable parts of the broader challenges of natural resources management, poverty reduction, and sustainable development (Bapna & McGray, 2009).

Africa is identified by Intergovernmental Panel on Climate Change (IPCC, 2007) as one of the most vulnerable regions to climate variability and climate change and yet the least resilient due to multiple stresses and low adaptive capacity. Although Africa has contributed very little to global warming (fossil fuel emissions account for only 3.7% of the global total), it will be affected severely by climate change mostly because the continent has more to lose in terms of biodiversity (Hepworth, 2010).

Climate change and variability are already manifesting in Africa with the different regions of the continent experiencing diverse changes (IPCC, 2007). The evidence shows warming of about 0.7°C on average over most of Africa during the twentieth century (IPCC, 2007). There has also been a 25 percent decrease in rainfall across large portions of the Sahel over the past 30 years (Desanker, undated). Southern and eastern Africa had more intense and widespread droughts, while central Africa

experienced increased rainfall and less severe droughts (Desanker undated, Shongwe *et al.,* 2010, IPCC, 2007).

Eastern African countries are vulnerable to extreme climatic events such as droughts and floods which historically have affected the countries' socioeconomic development (DFID, 2009). There is evidence that future changes in climate may lead to a change in the frequency or severity of such extreme weather events, potentially worsening these impacts (DFID, 2009). In addition, future climate change will lead to increases in average mean temperature and sea level rise, and changes in annual and seasonal rainfall. These will have potentially important effects across all economic and social sectors in the region, possibly affecting agricultural production, health status, water availability, energy use, biodiversity and ecosystem services (DFID, 2009).

The study's intention was to investigate how the implementation of Lake Victoria Catchment Environmental Education Programme (LVCEEP) which is an Education for Sustainable Development (ESD) programme in the selected areas within the catchment contributes to efforts towards climate change adaptation and mitigation and if ESD can be incorporated as one of the strategies of meeting the challenges of climate change.

1.2 Statement of the Problem

Climate variability and change is one of the greatest environmental, social and economic challenges facing humanity today. It is a phenomenon that undermines the drive for sustainable development, particularly in Sub-Saharan Africa (Scholes and

Biggs, 2004). Climate scientists predict increasingly dry conditions in much of sub-Saharan Africa due to climate variability and change. This is expected to aggravate the situation further by causing more frequent and intense droughts and increasing temperatures. Rainfall variability in eastern Africa is predicted to increase further (IPCC, 2007). In Kenya, this phenomenon is already unmistakable and intensifying at an alarming rate as is evident from countrywide temperature increases and rainfall irregularity and intensification. These climate-driven changes affect resources critical for economic development of Kenya. An example is the 1999/2000 La Niña droughts, which left approximately 4.7 million Kenyans facing starvation. In addition, increased average temperatures have led to the spread of vector-borne diseases like malaria to areas where the disease is not known to be endemic.

Although Kenya came up with the National Climate Change Response Strategy in 2010, the impacts of the implementation of the recommended action plans are yet to be felt, possibly because of lack of ecosystem specific modalities of implementation.

The study focused on Lake Victoria Catchment Environmental Education programme which is an Education for sustainable development project under implementation in Lake Victoria catchment .Lake Victoria is an international water body that offers the riparian communities a large number of extremely important environmental services. In recent years the lake has come under increasing and considerable pressure from climate change related fluctuating water levels and a variety of interlinked human activities such as overfishing, species introductions, industrial pollution,

eutrophication, and sedimentation. These pressures have brought about changes in the lake that seriously threatens its ecosystem function and overall diversity.

This study sought to examine Education for Sustainable Development as a possible modality of dealing with the climate change challenges in Lake Victoria and Kenya in general.

1.3 Research Questions

The research endeavoured to respond to the following specific research questions:

(i) Is the promotion of Education for Sustainable Development associated to responses to the challenges of climate change?

(ii) Is there a relationship between the activities and outputs of Lake Victoria Catchment Environmental Education Programme (LVCEEP) and climate change mitigation and adaptation efforts.

(iii) What are the contributions of the activities of Lake Victoria Catchment Environmental Education Programme to the national mitigation and adaptation efforts to cope with climate change?

1.4 Objectives of the Study

The main objective of the study was to explore the role that a sound and practical ESD programme can play in addressing the adverse effects of climate change.

1.4.1 Specific Objectives

i. To determine how the promotion of Education for Sustainable Development contribute to the responses to the challenges of climate change.

ii. To examine the relationship between Lake Victoria Catchment Environmental Education Programme (LVCEEP) activities and outputs and climate change mitigation and adaptation.

iii. To establish whether the activities of Lake Victoria Catchment Environmental Education Programme contribute to the national mitigation and adaptation efforts to cope with climate change.

1.5 Research Hypothesis

In this study, the following research hypotheses were tested.

That:

Ho_1: The promotion of Education for Sustainable Development has no association with the identified responses to climate change challenges.

Ho_2: There is no relationship between Lake Victoria Catchment Environmental Education Programme activities and outputs and climate change mitigation and adaptation efforts.

Ho_3: The activities of Lake Victoria Catchment Environmental Education Programme do not contribute to the national mitigation and adaptation efforts to cope with climate change.

1.6 Significance and Justification of the Study

The study continues the research and professional practice in the field of Education for Sustainable Development particularly the role of education and awareness in meeting the challenges of climate change with emphasis on East Africa and specifically the Lake Victoria Catchment.

Previous responses to adaptation have been interventions designed based on globalised scenarios (Kituyi *et al.,* 2002). These have largely disregarded local complexities that include the social, cultural and other economic and political realities that drive systems (Kituyi *et al.,* 2002), examples of these interventions can be seen in the list of technology prescriptions such as heat resistant crops, building walls and dykes and others issued by the climate change secretariat (UNFCCC, 2006) or even the assisted migration of tree species populations, or seed sources as adaptive strategies to mitigate the projected effects of climate change on the structure, productivity, and distribution of forest ecosystems as outlined in the report. It is important that any strategies to meet the challenges of climate change in Africa address poverty (Kituyi *et al.,* 2002). The ESD programme in the Lake Victoria Catchment considers poverty and food security issues as important parts of the programme.

Although there are lots of activities on ESD in schools and even more literature addressing ESD, nearly half of the papers are theoretical and centred on the concept and approaches of ESD and the other half simply describes how ESD were conducted

in schools (Jin, 2009). This calls for a need to provide comprehensive details of actualisation of ESD as a participatory strategy encompassing all sectors.

There is a need to develop a framework for understanding to those practitioners who wish to reflect more on ESD as a strategy to address the effects of climate change and a need for well-informed policymakers (and decision makers) who should be determining levels of resources allocation to the various efforts and strategies geared towards combating the effects of climate change.

To understand any group, or any culturally significant act, event or process it is necessary to undertake the study in the events/activity's natural setting (Punch, 1998). The study was conducted in the area where implementation of LVCEEP is taking place.

The study aimed to come up with new data that would enrich the adaptation and mitigation initiatives for the East African countries, and more specifically for Kenya for the purpose of informing the process of crafting climate change policies for the region and to coordinate a wide range of objectives into one comprehensive document that can be used by the East African countries to reduce the impacts of climate change. This study therefore hoped to contribute practical information and tools to address impacts of climate change in ecosystems of trans-boundary nature**.** The research specifically studied the use of ESD to address climate change issues in East Africa and although the findings are of more relevance to the Lake Victoria

Catchment, the study hoped to add to the knowledge currently available on the role of sustainability and education in climate change initiatives.

Most researchers in the field of Education for sustainable development have tended to concentrate on the formal education system (Alsop, 2007; Ravindranath, 2007) focused on teacher training. Some studies have given priority to students' perspectives on learning about sustainable development (Lundegard & Wickman, 2007). Summers (2003) and Hart (2003) conducted studies on the beliefs of teachers in teaching about sustainable development. The study is the first one of its kind in East Africa, and hopefully, from the findings, interested researchers may want to study other participatory project initiatives as potential strategies for addressing the challenges posed by climate change.

The findings of this study could be used to enhance the role of ESD in the combating climate change. This could be done by informing education policy formulation, planning and conservation efforts at both County and National government levels. The study proposed to be of significant value to ESD practitioners, communities and ESD donors in East Africa, education systems and governments of the three East African countries by making visible efforts of LVCEEP in recovering the ecological integrity of the Lake Victoria catchment. Within limitations, the study's findings may also be extrapolated to inform other African countries with similar challenges.

1.7 Conceptual Framework of the Study

The objective of this study was to investigate the relationship between the education for sustainable development activities implemented by the communities and schools in Lake Victoria Catchment and climate change mitigation and adaptation. The framework of the conceptual model is shown in Figure 1.1.

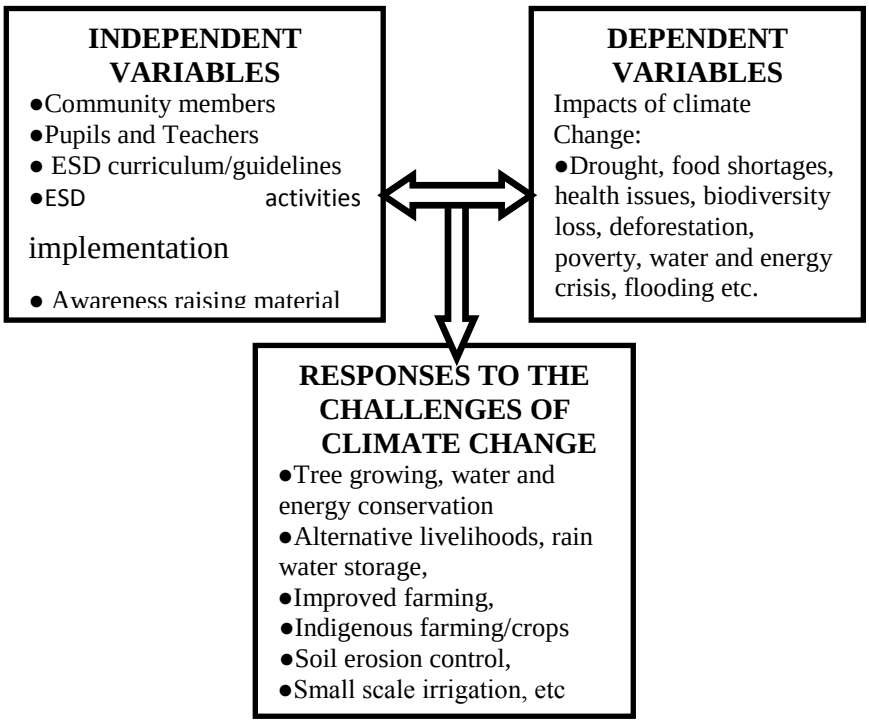


Figure 1.1: The framework of the conceptual model of the study

The paradigm illustrates the conceptual framework of the study and how ESD can contribute to the fight against climate change.

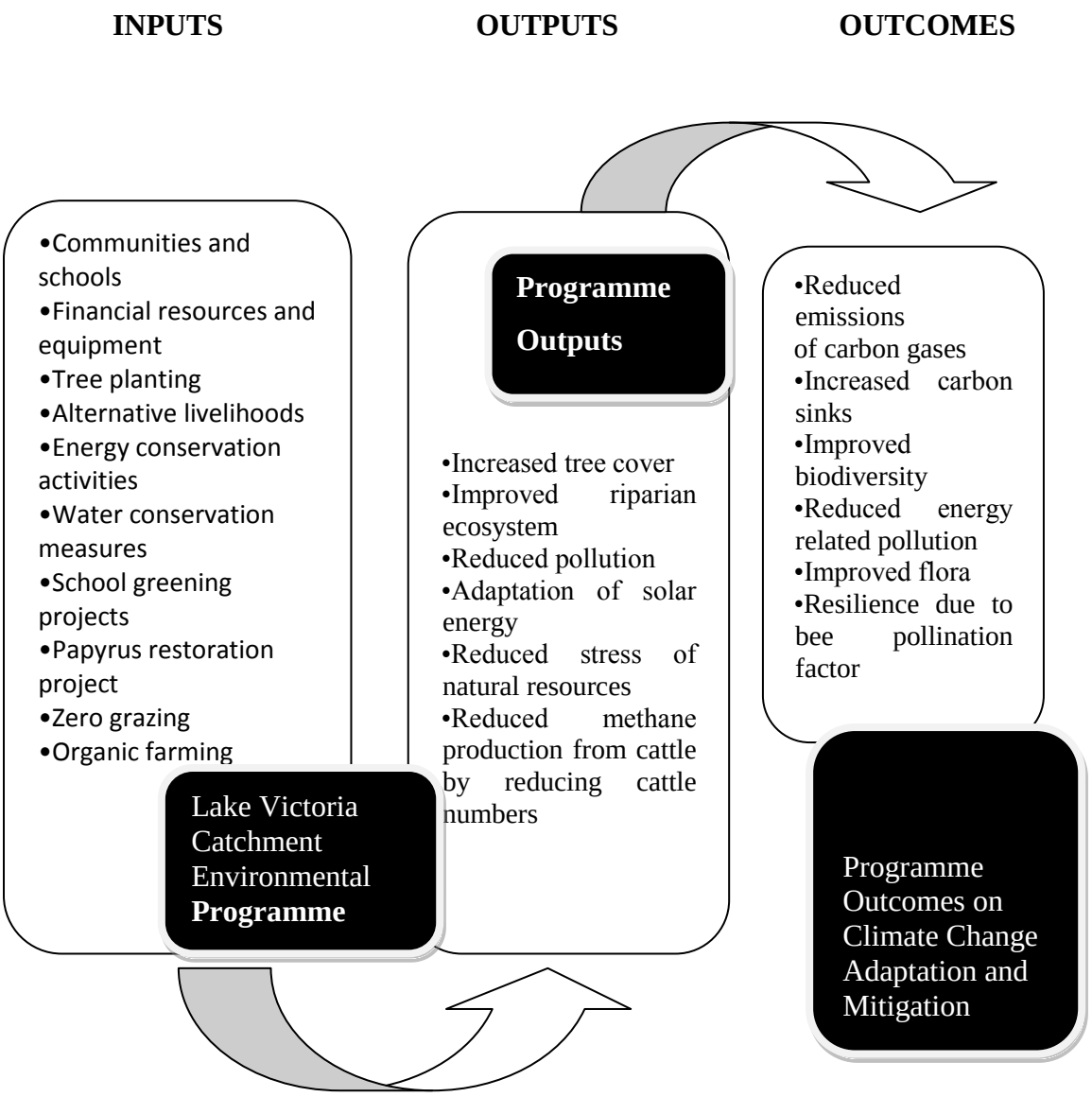
1.8 Theoretical Framework

While the existing literature indicates that climate change is a symptom of "unsustainability", not much has been done to relate local participation on sustainability activities and the impact of this on the effects of climate change (Cohen *et al.,* 1998). For this reason, efforts towards adaptation and mitigation against climate change do not have adequate background information to enable them to tap the opportunity of local participation in fighting the effects of climate change. To address this gap, this study explored the outcomes of the implementation of the Lake Victoria Catchment Environmental Education Programme (LVCEEP) in Kenya and to identify relationships between these outcomes and the national climate change agenda.

The study used an adaptation of the Input-Process-Output Model (IPO) to expound on the contribution of the implementation of LVCEEP in the efforts to combat climate change. In the IPO model, a process is viewed as a series of boxes (processing elements) connected by inputs and outputs. Information or material objects flow through a series of tasks or activities based on a set of rules or decision points (Harris and Taylor, 1997).

The Input-Process-Output model provided the general structure and guide for the direction of the study. By substituting the variables of this study on the IPO model, the researcher intended to assess the relationship between the LVCEEP outcomes with

Climate Change Adaptation and Mitigation initiatives. An illustration of the Input-Process-Output model as adopted for the study is presented in Figure 1.2.



Source: (Cobar, 2009).

Figure 1.2: Theoretical Framework of the Study

In the adapted model, the LVCEEP objectives are the inputs, the activities are the processes or outputs and the final results are the outcomes or the impacts. The selection of this model is based on its ability to define the process (ESD), recognize the inputs (all the resources in the implementation required for the programme including the community members, schools, activities, information, and finances) and the outcomes/impacts (contributions to the fight against climate change).

1.9 Operational Definition of Terms

Adaptation: Adjustments in ecological, social and economic systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Biodiversity: Broad range of aquatic and terrestrial living organisms.

Climate Change: The variation in the global or regional climates over time. It describes changes in the variability or average state of the atmosphere over time scales ranging from a decade to millions of years. It is also known as Global Warming.

Climate Vulnerability: The extent to which a natural or social system is susceptible to sustaining damage from climate change including climate variability and extreme weather events.

Conservation Awareness: Formal or informal public sensitization on conservation values and its importance in enhancing positive perception towards conservation.

***Conservation Education*:** Formal or informal education to various target groups on conservation values and their importance in promoting support and participation in conservation.

Ecological Integrity: The abundance and diversity of organisms at all levels, and the ecological patterns, processes, and structural attributes responsible for that biological diversity and for ecosystem resilience.

Education for Sustainable Development: A process of learning how to make decisions that considers the long-term future of the economy, ecology and equity of all communities.

Environment: The complex physical, chemical and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival.

Environmental Conservation: The prevention of loss, waste, damage or destruction of the environment.

Environmental Education: A learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.

Indigenous Knowledge: *I*ntricate knowledge systems acquired over generations by communities as they interact with their environment and it comprises technologies, service, economic and philosophical learning.

Mitigation: Actions to limit the magnitude and or rate of long term climate change involving reductions in human (anthropogenic) emissions of greenhouse gases.

Sustainability: The practice of human utilization of the natural resources which ensures the greatest benefit to present generations while maintaining its potential to meet the needs and aspirations of the future generations.

Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Resilience: The capacity to absorb shocks while continuing to function

Vulnerability: Propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects.

1.10 Study Limitations

The study was delimited to the Kenya programme areas although LVCEEP covers the three East African countries (Lake Victoria Catchment Environmental Education Programme, Baseline Report, 2009). The research project focused on the Kenyan programme areas and the study area comprises of 18 schools, 6 community groups and 2 teachers training colleges, however, the study was limited to 6 schools and 3 community groups. This sample is small considering the total programme population and the diversity of the area of coverage. To address this constraint, a total population sample of the projects community groups was implemented.

The project executants of Lake Victoria Catchment Environmental Education programme played a major role in the study. There is a possibility of a certain degree of biased responses either because the respondents may want to portray the project as perfect or due to the desire to ensure that the donor's interests are well presented.

To assess the impact of the implementation of Lake Victoria Catchment Environmental Education Programme, the researcher compared the LVCEEP pre project literature and assessed this in comparison with the current catchment situation. Apart from the programme records and related literature, an important source for this data was from the participants' memory. Since the programme had been running for the last 8 years, the participants, especially the community group members were unable to recall all the necessary details, (Harris and Brown, 2010), moreover, most of the students who were in the schools at the programme commencement had left the schools and most were unavailable to give their input, a study of the historical records of the programme minimized this constraint. To a large extent, this study was conducted in English, which is a second or third language in the identified study sites, the implication of this is that there was a possibility of some miscomprehension of either the questions or the responses which might have led to the loss of some facts. To address this disadvantage, local translators were used during the interviews.

1.11 Summary and Conclusions

Although Chapter one presents the background of the programme under study i.e., the case of the Lake Victoria Catchment; the findings could contribute to any strategy for addressing the challenges of climate change in similar ecosystems. It is believed that Africa is most vulnerable to climate change and climate variability because most people are dependent on subsistence rain-fed agriculture (Boko *et al*., 2007). Africa is in need of urgent and effective development action, which, by definition, is resilient to current and increasing climate variability (DFID, 2004). Research, based on current scientific predictions, has revealed that 185 million people in sub-Saharan Africa

alone could die of disease directly attributable to climate change by the end of the century (Christian Aid, 2006). In East Africa, 11 million people have been put at risk of hunger by years of unprecedented drought, (DFID, 2004). Climate change and climate variability pose major threats to the environment, to economic growth and to sustainable development in Kenya (Nzau, 2013). The pressures of climate change and climate variability make Kenya highly vulnerable to the impacts of climate change. This vulnerability is further aggravated by the fact that Kenya's economy is reliant on climate sensitive natural resources such as agriculture, wildlife-based tourism and water for social and economic sustenance (Mutimba and Wanyoike, 2013). Adaptation to global warming covers all actions aimed at coping with climate changes that cannot be avoided and at reducing their negative effects (GOK, 2010c).

According to DFID, the poor have mechanisms to cope with climate variability but many of these will be overwhelmed by the extent of changes or by other pressures on their livelihoods. Pastoralists in Kenya were unable to draw on traditional migration strategies during the 2000 drought because land had been sold off to meet income needs and more affluent farmers had erected barriers across grazing lands (Karekezi, 2002). Climate change will severely disrupt livelihoods among vulnerable groups (Mutimba and Wanyoike, 2013). It is therefore necessary to strengthen systems for coping with climate variability and reducing vulnerability, and to integrate these into planning. Strengthened systems for coping with current climate variability will enable Africa to address the longer-term impacts of climate change (DFID, 2004).

The section presents a specific ecosystem scenario and introduces the case study as the subject of consideration as a practical strategy for meeting the challenges of climate change profiled in the national climate change response strategy. Chapter 1 presents an adaptation of the Input-Process-Output Model (IPO) to expound on the contribution of the implementation of LVCEEP in the efforts to combat climate change. The work introduces an Education for Sustainable Development (ESD) paradigm to the Kenya government climate action plan which is participatory and whereby the objective is reduction of the catchment community's vulnerability to the effects of climate change and the protection of the catchment's resources from the impacts of climate change.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This Chapter provides background information on the economic, social and environmental conditions of Lake Victoria Catchment and further, provides a presentation of Lake Victoria Catchment Environment Programme (LVCEEP). The chapter covers issues underlying the foundations of Education for Sustainable Development (ESD). The terms Environmental Education (EE), Sustainable Development (SD) and Education for Sustainable Development are explained in detail in terms of their significance for this study. The development of ESD is discussed so as to unfold the reasoning behind the recognition of EE as an important tool to be used in the endeavors to meet the challenges of climate change. The components of ESD are explained and the relationships between them delineated in order to highlight the importance of having a framework with which global communities should align the efforts to combat the impacts of climate change.

The Chapter presents the subject matter of climate change and also analyses linkages and understanding of ESD and Climate Change set out in the discussions. The Chapter is divided into five sections. Section 2.1 gives the background information on the catchment, section 2.2 is a presentation of LVCEEP, 2.3 covers the subject of Environmental Education, section 2.4 discusses Sustainable Development, and literature on Education for Sustainable Development is discussed in section 2.5, while section 2.6 presents the empirical literature on Climate Change.

2.2 Lake Victoria Catchment

Lake Victoria (84m maximum depth, mean depth 40m) and with a surface area of 68,000 km² was created after tectonic activity (Talling, 1966; Serruya and Pollinger, 1983; Bugenyi and Balirwa, 1989). The catchment area of 193,000 km² is covered by grassland, savannah, agricultural crops and forested mountains of Rwanda and Burundi. The lake supports about 35 million people who are among poorest rural inhabitants in the world. The population density is over 100 persons per square kilometer with estimated household incomes of less than US$270, which is about 40% of the average per capita income in Sub-Saharan Africa (Bugenyi and Balirwa, 1989). The Kagera and Nzoia are the main inflowing rivers and the main outflow is the River Nile. The Lake is comparatively shallow (40m deep on average), river inflow is quite limited. The surface area is very large surface when compared to its volume. The lake is therefore sensitive to climate change, and can dry out quite easily (Saundry and Fund, 2010). Its exposure to siltation and pollution makes it even more vulnerable to climate changes.

The socio-economic importance of Lake Victoria to the Eastern Africa region is because it is the largest inland water fishing sanctuary; a major inland water transport linkage for the East African countries; a source of water for domestic, industrial and commercial purposes; a major reservoir for hydroelectric power generation; a major climate modulator in the region; and its rich biodiversity. Changes in the catchment (Bugenyi and Balirwa, 1989; Kendall, 1969) are due to the construction of drainage systems, vegetation removal, soil erosion, increased livestock, recreation and industrial development. The most serious changes in the catchment have been caused

by deforestation (Hanking, 1987) to create land for agriculture, charcoal and firewood production. The lake has been and continues to be under extensive impacts of climate change exacerbated by an array of interlinked human activities.

Tanzania shares 44% of the catchment, Kenya 22%, Uganda 16%, Rwanda 11% and Burundi 7 % (Lake Victoria Basin Communication, November 2007).(Figure 2.1). The Kenyan part of the catchment is occupied by 42% of the country's population and drained by several rivers (Ochumba, 1984). Pollutants and wastes from urban centres, industries and agricultural farmland flow into the lake via rivers and direct runoffs (Allabaster, 1981). Lake Victoria is very significant to the Ugandan economy since it is the source of almost all of the country's hydropower and provides domestic and industrial water supply for the 3 big towns in Uganda - Kampala, Jinja and Entebbe (Awange and Onganga, 2006).

The water balance of Lake Victoria has been modeled many times, using different approaches, with various aims in mind (Georgekakos *et al*., 2005). In general, the studies show that direct rainfall over the Lake Victoria Catchment is the key factor controlling its outflow, and research indicates that changes in water levels in Lake Victoria are due to climatic changes and human activities in the catchment (Obae, 2009). The outflow from the catchment is of major importance for the whole of the Nile Basin, and climate change could have a marked impact on the delicate link between the catchment rainfall, inflow and evaporation. Fluctuations in water levels in Lake Victoria (Birkett *et al.*, 1999; Latif *et al,.* 1999) have been attributed to climate variations and may become more variable in the future.

Strategies for future designations of protected areas in East Africa that include projections of future climate changes and corresponding changes in geographical range of plants and animal species to ensure adequate protection need to be developed. Due to increased population growth, deforestation, unsuitable farming methods, unsustainable use of the lake's natural resources- specifically the lake's fish, effluent pollution caused by unchecked industrial growth around the lake, biodiversity loss, economic hardship and related social problems, Lake Victoria catchment is today facing many problems (Awange and Onganga, 2006).

According to Odada (2007), Lake Victoria has experienced the greatest mass extinction of vertebrates in modern times, 30 years ago; the lake boasted about 500 fish species, more than half are now extinct, 70% of the forests in the catchment have been lost through excisions, deforestation, and poor land management practices in all the 3 countries. Rivers flowing into the lake have continued to carry increasing loads of silt and agro-chemicals due to agricultural practices within the catchment (Odada, 2007).

In 2006, the Ugandan government came up with a National Adaptation Plan of Action, which sets out plans to increase awareness of climate change in local communities and invest in technology to enable better long-term weather forecasting. There is evidence that changes in rainfall reliability, onset and cessation cause crop failure and hunger, exacerbated by other stresses such as land degradation and insecurity (NIDOS, 2009). Rainfall variability has major implications for the use of other resources.

Low lake levels since 2005 have led to power shortages, disruption to water supply, transportation and infrastructure and are linked to reduced productivity in Lake Victoria's fishery (NIDOS, 2009). An indirect consequence of these climate change impacts is increased pressure on wetlands and forests, which suffer from encroachment and deforestation as people turn to charcoal, fuel wood and agricultural expansion as coping strategies. It is certain that temperatures are likely to increase in Uganda by up to 2 °C in the next 20 years and by up to 4.3 °C by the 2080s (Simonett, 1998). Climate change is likely to have a wide range of interrelated impacts for the environment, economy and well-being of the Ugandan people.

These impacts and their mechanisms, identified in existing literature indicate that the seasonality of rainfall could also change in the future. People in Uganda, whose contribution to global warming has been minuscule, are feeling the impacts of climate change first and worst (Oxfam, 2008). The highest percentage increase in rainfall is projected for December, January and February, which is historically the driest season for many parts of Uganda. This indicates that the current wet season from March to May shift forwards in time or the September to November rains, known as the short rains, may extend (Basalirwa, 2006). Changes in climate are already threatening Uganda's ecosystems and the livelihoods that depend on them (Hepworth and Goulden, 2008). Between 1991 and 2000, for instance, seven droughts were experienced (Oxfam, 2008).

The main impacts of a 1.5 °C temperature rise and of more extreme and/or more frequent occurrences of climatic incident will be on food security, the quantity and

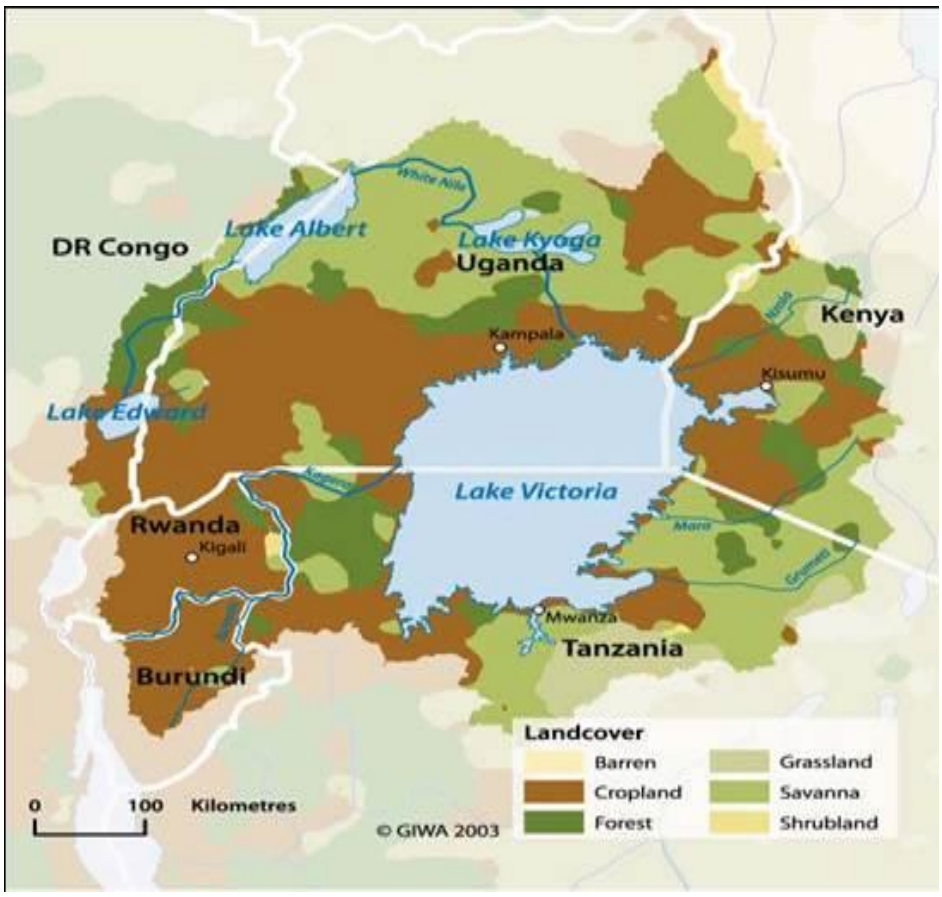
quality of water and other natural resources, human health, settlements and infrastructure (MAAIF, 2008). Vulnerability to climate change in Uganda is high due to heavy reliance on climate-dependent resources such as rain-fed agriculture, natural disasters and poverty (MAAIF, 2008). At the same time, adaptive and mitigation capacity is low due to shortages of economic resources and technology.

Lake Victoria is also an important location for the fisheries and horticulture industries (UNESCO, 2009). Additionally, the lake serves as a key transport link between Uganda, Kenya and Tanzania (EAC, 2006). Further Uganda's vulnerability to climate change is likely to increase (MAAIF, 2008).

In Tanzania, most of the economic activities depend heavily on climate change-sensitive sectors such as agriculture, livestock, fisheries, forestry, water, and unmanaged ecosystems, the possible impacts of climate change on these sectors include reduced crop yield due to drought and floods, and reduced water availability (UNEP, 1999). Shifting of the seasonal rainfall, one of the predicted outcomes of climate change, may bring too much rain when it is not required, is predicted to damage plants. In addition, dramatically rising temperature trends, responsible for increased evapo-transpiration in the soil, may keep crops from maturing due to inadequate moisture in the soil, and thus lead to food shortage (Levira, 2009). Climate change is also expected to have a direct impact on livestock production through reduced water and forage in the catchment. In addition, increased atmospheric CO2 levels will result in changes in plant species and create favourable conditions for ticks, snails, blood-sucking insects, and other pests that will increase incidences of trypanosomiasis, liver flukes, and outbreak of armyworms (Mwandosya *et al.*, 1998).

The major towns of Bukoba, Musoma and Mwanza are dependent on waters of Lake Victoria for both domestic and industrial use (SARDC, 2009).

The Lake Victoria basin drains 10% of Kenya's land surface, with rivers draining into the lake including Nzoia, Mara, Yala, Nyando, Sondu-Miriu, Awach and Kuja (Ong'or, 2005). The local communities in this region depend heavily on this resource for their livelihood. Water for industrial and domestic use in Kisumu city is from Lake Victoria (Nyamu, 1986). Figure 2.1: Displays the coverage of Lake Victoria catchment.



Source: **(**Odada *et al*., 2004)

Figure 2.1: General features of the Lake Victoria basin

Impacts of climate change and vulnerability in Kenya include food scarcity, destruction of marine and coastal ecosystems, range lands and game resources, the country's economy and agriculture (Stockholm Environment Institute, 2009). Along with warming surface waters, deep water temperatures (which reflect long term trends) of the large east African lakes (Victoria) have warmed by 0.2 to 0.7degrees C (IPCC, 2001). Climate change effects are already being felt in Kenya. Widespread poverty, recurrent droughts and floods, inequitable land distribution, overdependence on rain-fed agriculture, and few coping mechanisms all combine to increase people's vulnerability to climate change. For instance, poor people have little protection against extreme climatic events (Mutai *et al.,* 2010).

Kenya faces a myriad of challenges in sustainable development in spite of its economy's reliance on its natural resources base. Kenya's sustainable development issues (societal, economic and environmental) are complex and interlinked. Education for Sustainable Development (ESD) has been recommended as one of the tools to ensure sustainable development is implemented. The Government, Non-governmental organisations (NGOs), Community based organizations (CBOs) and private sectors have made notable ESD-based responses in relation to society, environment and economic spheres of sustainable development. These include; policy formulation, advocacy and public awareness, resource material development, research and innovations, capacity building, networking, partnerships and vision building (Kidundo, 2012).

The life support systems of the riparian communities and the ecological integrity of the lake's ecosystem as a source of freshwater is increasingly threatened due to ecological degradation. A plan of action to redress the situation is imperative. Several conservation and management initiatives have concentrated on the lake itself, but little has been done on catchment basin. Climate change has become one of the most urgent challenges of sustainable development and is one of the key action themes of the UN Decade of Education for Sustainable Development (UNESCO, 2009).

In 2008, Kenya developed an ESD Implementation strategy to provide an enabling environment and capacity for all sectors and stakeholders to effectively contribute towards the achievement of sustainable development and as a guideline for the implementation and coordination of ESD activities.

The ESD strategy implementation framework specifies the strategic objectives, activities, outputs, objectively verifiable indicators, means of verification and actors involved in implementation. A wide range of ESD activities are taking place on the ground and are being led by the government, civil society organizations as well as indigenous communities (Kidundo, 2012). These activities are raising awareness, providing capacities and skills, and empowering people and communities to create more sustainable futures (Kidundo, 2012).

2.3 Lake Victoria Catchment Environmental Education Programme (LVCEEP)

The Lake Victoria Catchment Environmental Education Programme (LVCEEP) is a key ESD initiative being implemented not just in Kenya, but in 4 East African countries of Rwanda, Uganda, Tanzania and Kenya. Co-ordinated by World Wide Fund for Nature (WWF) (LVCEEP, 2009). The programme aimed to empower catchment communities, schools and regional partners in sustainable use and management of the natural resources (LVCEEP, 2009). LVCEEP, whilst part of UNDESD interventions, specifically sought to secure ecological integrity and sustainability in the Lake Victoria catchment for the benefit of its inhabitants and biological diversity, which is affected by high levels of silt, reduced water level and pollution (LVCEEP, 2009). The objectives of the programme were to be realised through influencing change in attitudes and behaviour of communities and youth in schools (LVCEEP, 2009)

A fast increasing population, spiraling poverty, excessive exploitation of natural resources, unsustainable urban development and equally unsustainable agricultural practices, delineate the context for environmental and sustainable development that the Lake Victoria Catchment Environmental Education Programme (LVCEEP) sought to address (LVCEEP, 2012). LVCEEP contributes to similar initiatives in the broader United Nations Decade of Education for Sustainable Development (UNDESD). Together, all these initiatives, the LVCEEP included, seek to integrate the values inherent in sustainable development into all aspects of learning to encourage changes in behaviour that allow for more sustainability and just society for all (LVCEEP, 2009). LVCEEP's endeavors to contribute to securing the ecological integrity and

sustainability of the Lake Victoria catchment involves empowering schools, communities and regional partners through community-based natural resources management strategies and other interventions which empower communities to manage their local resources (LVCEEP, 2012)

This approach is based on the premise that those who are most dependent on natural resources for their livelihoods have the greatest incentive to manage such resources responsibly and often possess an intimate knowledge of their local resources. The programme also addresses important needs which include improving farming practices, diversifying food and incomes sources, increasing knowledge on ESD, greening of schools, and protection of wetlands among others (LVCEEP, 2012). By working with schools and communities, LVCEEP has enhanced citizen participation in natural resource management and protection of the fragile ecosystem (LVCEEP, 2012).

The United Nations Decade of Education for Sustainable Development (UNDESD) encapsulates the global priorities for ESD. These priorities are set out in the objectives of the Decade of Education for Sustainable Development (DESD) and the thrusts of ESD as follows:

1. Facilitate networking, linkages, exchange and interaction among stakeholders in ESD;
2. Foster an increased quality of teaching and learning in education for sustainable development;
3. Help countries make progress towards and attain the millennium development goals through ESD efforts;
4. Provide countries with new opportunities to incorporate ESD into education reform efforts.

(DESD, 2009)

LVCEEP clearly fits into the above objectives of the DESD, making this programme of relevance to the global priorities on sustainable development. LVCEEP also comprehensively addresses the following thrusts of ESD:

1. Improving access to quality basic education
2. Reorienting existing education programmes
3. Developing public understanding and awareness of sustainability
4. Providing training

(LVCEEP, 2009)

Previous studies conducted on LVCEEP implementation show that on the whole, the programme has had partial success in securing ecological integrity and sustainability of Lake Victoria catchment for the benefit of its inhabitants and biological/ecological diversity (LVCEEP, 2012). LVCEEP activities involve mainstreaming of ESD in the school curriculum and in community development activities and in this way, the programme has contributed to the realisation of national level commitments for ESD in Uganda, Kenya, and Tanzania (LVCEEP, 2012)

In conclusion, LVCEEP has partial success as a strategy for the protection of ecologically sensitive areas such as Lake Victoria and this needs to be developed to include projections of future climate change and corresponding changes in geographical range of plant and animal species to ensure adequate protection (LVCEEP, 2012)

2.4 Environmental Education

In the 1970s, the international community began to explore how education should address pressing environmental and development challenges. National and

international events, existing educational traditions and the rise of concern for the state of the environment contributed to the development of environmental education (MESSAGES, 1996).

The field of environmental education dates back at least to the 1972 Stockholm conference on the environment. An international vision for Environmental Education was first described in the Belgrade Charter of 1975, which outlined goals, objectives, principles, and the target audiences for environmental education (UNESCO-UNEP, 1975).

These ideas were expanded at the 1977 Intergovernmental Conference on Environmental Education (ICEE) in Tbilisi, Georgia. The ICEE yielded the Tbilisi Declaration, which defined the concept and content of environmental education at the local, national, and international levels. It also clearly defined environmental education as “a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action” (UNESCO-UNEP, 1978).

Education is defined in the Oxford English Dictionary as “systematic training and instruction designed to impart knowledge and develop skill” (OED, 1990); effectively, education involves both the acquisition of knowledge and the ability to evaluate that knowledge (Howe, 2009). In the 1960’s, the knowledge about environment was

taught only to students in Biology classes applying the concepts of ecology. In 1970's it was taught as a subject when the effect of technology was felt on the environment (Hassan *et al.,* 2010). Therefore, Environmental Education is not new, it is a product of our growing concern for the environment, it is a movement that has evolved over many years (Palmer, 1998). Prior to 1960's, communities all over the world held cultural beliefs and practices that integrated environmental conservation, communication and education aspects passed from generation to generation. Some of these indigenous knowledge and principles have helped to inform societies about what sustainability entails (Ndaruga, 2013).

Environmental education (EE) is known for the underlying concept that humans are part of nature; EE emerged out of environmental concern, as opposed to Education for sustainable development which is centred more on humans. According to IUCN, environmental education is the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings. Environmental education also entails practice in decision making and self-formulation of a code of behaviour about issues concerning environmental quality (IUCN, 1970).

"Environmental education is a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO, Tbilisi Declaration, 1977). The principles of environmental education as stipulated in the Tbilisi Declaration of 1977 includes the fundamental elements of sustainable

development: the need to consider social aspects of the environment and take into account the close links between economy, environment and development; the adoption of both local and global perspectives; the promotion of international solidarity, etc.

Promoting environmental awareness, behavior and eventually action through education and raising public awareness and training are the goals of environmental education (Hens, 2004). Environmental education helps learners achieve environmental literacy, which has attitude and behaviour components in addition to a knowledge component. Thus, the purpose of environmental education is to instill in learners knowledge about the environment, positive attitudes toward the environment, competency in citizen actions, skills, and a sense of empowerment. Environmental literacy depends on a personal commitment and motivation to help ensure environmental quality and quality of life. This commitment and motivation often begins with an awareness of one's immediate surroundings. Belgrade Charter (UNESCO/UNEP, 1976) states that environmental education learning goals involve content knowledge and behavioral change.

A report by the Intergovernmental Panel on Climate Change stated that humans are strong contributors to a changing climate (IPCC, 2007). Based on evidence on ice cores that record weather patterns from the last several thousand years, it has been determined that concentrations of certain greenhouse gases (namely carbon dioxide, methane, and nitrous oxide) "have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values" (IPCC, 2007). The IPCC report further states that the rates of anthropogenic greenhouse gas emissions are increasing

and that the annual carbon dioxide concentration growth rate was larger during the last 10 years (1995 to 2005 average: 1.9 ppm per year), than it has been since the beginning of continuous direct atmospheric measurements (1960 to 2005 average: 1.4 ppm per year) although there is year-to-year variability in growth rates.

Computer models show unambiguously that a "critical threshold is approaching. Crossing over it will be easy, crossing back likely impossible" (Kolbert, 2006). Education can illuminate incentives, showing people both how they could personally benefit from changing their behaviour, and how they would suffer from a lack of change. Meaningful lifestyle changes will require a certain amount of direct financial and lifestyle sacrifice from individuals.

In their book Effective Environmental Education Programmes, Athman and Monroe (2001) stress that for optimum success, stakeholders in environmental education programmes must be involved throughout the lifespan of the programmes. According to them, such programmes empower learners with skills to help prevent and address environmental issues and with a sense of personal and civic responsibility; they are instructionally sound, using "best practices" in education. McKeown and Hopkins (2003) state that environmental education is based on the premise that humans are part of nature and that sustainable development was founded in a search for a balanced approach to environmental, social and economic interests.

The New Zealand Council for Education Research and Waikato University (2004) see the aims of environmental education as being to create environmental awareness and

consciousness and to develop students knowledge and skills on systems of and interconnectedness of nature while the Social Network for Sustainability define the goal of environmental education as being to create a world population that is aware of, and concerned about, the environment and human impacts on the environment. An environmentally educated population will have the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solving current problems and preventing new ones. The objective of environmental education is to generate knowledge to enable the sustainable management of global natural and physical resources (The Social Network for Sustainability, 2007).

According to the International Union for the Conservation of Nature, environmental education (EE) is:"... the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among men, and their biophysical surroundings. EE also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning environmental quality" (IUCN, 1971).

The 1977 Tbilisi Conference, which followed soon after the launch of the United Nations Environmental Programme (UNEP), is known to have spearheaded clarification on the nature of environmental education. This conference resulted in a declaration which listed the principles for environmental education (EE) programmes as being holistic, interactive, participatory, practical and as lifelong, continuous educational process which creates acknowledgement of the interactions between nature, built and social environment which should lead to enhanced understanding of

the interrelations in the three areas. The purpose of Environmental education, according to the conference resolutions was to inculcate attitudes and value systems leading to socio-economic improvement through social harmony and conservation. Environmental Education aims to develop understanding, skill and capacity necessary for conservation and group participation for solving environmental problems (UNESCO, 1977).

Robottom and Hart (1993) resonate that the language of environmental education is still dominated by UNESCO Conference rhetoric, while according to (Kwong, 1997), the problem with environmental education is that it emphasizes issues rather than sequential teaching of natural processes. Education is therefore a key instrument in addressing global/ societal challenges such as climate change and variability because of its power to bring about qualitative changes in values, attitudes and its capacity to impart skills and knowledge.

Environmental education encourages the exploration of the major local and global environmental problems with a focus on current and potential environmental problems, taking into account their trend in history while at the same time promoting values and local needs, national and international to prevent and resolve environmental problems (Sabo, 2011). Environmental education should enable learners to discover symptoms and real causes of environmental problems and promote cooperative learning (Sabo, 2011).

The various conceptions of environmental education are outlined in Table 2.1

Table 2.1: Illustration of Environment in Environmental Education

Source: (Sauvé, 1992, 1994).

Environment	Type of relationship	Principal characteristics	Examples of teaching/learning strategies
as nature	To be appreciated, respected, preserved	the original, "pure" environment; nature -as-a-cathedral/ as-a-uterus	•nature exhibitions; •immersion in nature
as a resource	to be managed	our collective biophysical heritage, sustaining quality of life	• 3Rs campaigns; • audit of energy use
as a problem	to be solved	the biophysical environment, supporter of life, threatened by pollution, deterioration	•problem-solving strategies • case study
as a place to live	to know and learn about, to plan for, to take care of	our daily living environment with its sociocultural, technological and historical components	•environmental story of our place •eco-gardening project
as the biosphere	in which we all live together, into the future	the spaceship Earth, object of planetary consciousness, a world of interdependence between beings and things	• case study on a global issue; • storytelling illustrating different cosmologies
as a community project	in which to get involved	a shared living milieu; the focus of socially critical analysis; a political concern for the community	• integral action- research (participatory process aimed at transformation); • environmental issue forums

The conceptions of the environment as presented in table 2.1 may be considered from a synchronous perspective: they actually coexist and can be identified in different contemporary environmental education discourses and practices. But they can also be approached diachronically, as they are also the result of an evolution in time (Sauvé, 1996).

The Tbilisi Declaration pushed environmental education past strictly environmental concerns to:

prepare the individual for life through understanding of the major problems of the contemporary world, and the provision of skills and attitudes needed to play a

productive role towards improving life and protecting the environment with due regard to ethical values. By adopting a holistic approach, rooted in a broad interdisciplinary base, it recreates an overall perspective which acknowledges the fact that natural environment and man-made environment are profoundly interdependent. It helps reveal the enduring continuity which links the acts of today to the consequences for tomorrow.

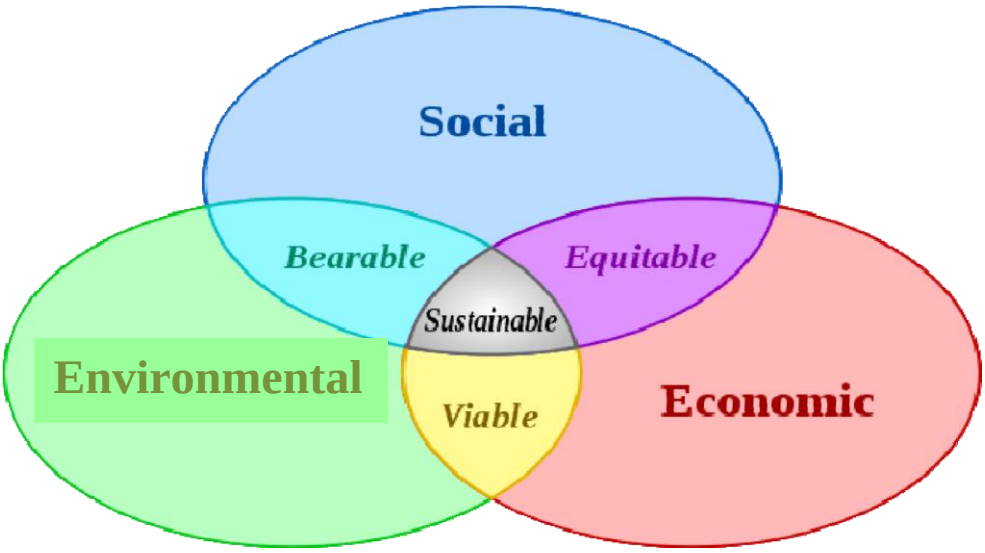
The words above foreshadow the thinking that became known as the concept of sustainable development in the early 1990s. A more inclusive educational system had to be incorporated to not only sensitise and create awareness about the impacts of unsustainable lifestyles, but also to empower people and encourage them to take action for sustainability (Otieno, 2005). This identified need contributed to the development of sustainable development.

2.5 Sustainable Development

In 1983, in the pursuit of a sustainable way of living, the United Nations established the *World Commission on Environment and Development* (WCED) led by Gro Harlem Brundtland of Norway. The Brundtland Commission report and the Earth Summit Conference popularised the concept of sustainable development, which incorporated economic prosperity and social equity with environmental protection. Sustainable development and the interdependence of the environment and the economy are increasingly important concepts to policy makers all over the world. The concept grew out of the "limits to growth" debates of the 1970's (Meadows *et al*., 1972, Cole *et al*., 1973) which discussed the possible impact of global growth and development.

The concept was popularised in the run up to the UN conference on the environment and development (UNCED), held in Rio de Janeiro in 1992. The most cited definition was published almost 20 years ago in the report from the World Commission on Environment and Development (WCED, 1987): "meeting the needs of the present without compromising the ability of future generations to meet their own needs". The concept of sustainable development keeps changing in its definition as it is dependent of human engagement with the environment at the time and in place, it is therefore an ever-evolving concept embracing emerging challenges and concerns. As pointed out by Gibson (2005), the Brundtland report presented a two pillars version; it stressed development with emphasis on protecting the environment. The Brundtland Report was seen as a significant advance on addressing the issue because the report focused on causes of environmental problems rather than the effects of environmental degradation (Redclift, 1987). The concept developed in response to the realization that economic and social activities have the potential to compromise environmental quality as well as lower production potential and natural resources. Sustainable development seeks to reconcile economic development with environmental protection and was thus a means of avoiding the tensions between rich and poor nations that blighted an earlier UN conference in 1972 (Huckle, 2006).

Various scholars have conceptualized sustainable development. (Hattingh, 2005) has developed a three-sphere model from which the figure below has been adopted.



Source: (Hattingh, 2005)

Figure 2.2: Illustration of Sustainable Development

The three pillars represented as spheres, are intertwined thereby embracing a holistic approach in the process of sustainable development. This illustration further implies that activities in one sphere may have a negative or positive impact on the other. The most important implication of the relationship between the three embedded spheres is that economic, social and environmental considerations do not each have their own logic and values separate from the other spheres (Hattingh, 2005).

Sustainable Development brings together the need to protect and conserve the natural environment with concern for the social and economic development needs of the community (Ramona *et al.*, 2010). Education for Sustainable Development emphasizes the need for people from all sections of the community and from all parts of the world to take joint responsibility for development decision (Ramona *et al.*, 2010). It recognises that sustainable development cannot be achieved through policy

imposed from above, but that local action must be informed and carried out in partnership with those people who know their community best (Ramona *et al*., 2010). The Earth Summit Agenda was further reinforced at the Johannesburg world summit on sustainable development (WSSD, 2002), where a new paradigm of sustainable development was endorsed. It was decided that sustainable development is built on three interdependent and mutually reinforcing pillars of social development, economic development and environmental protection (WSSD, 2002).

Sustainable Development became popular after the Conference on Environment and Development, organised by the United Nations in Rio de Janeiro in 1992, known as the "Earth Summit", since then, the concept has become a global goal. The emergence of sustainable development countered the view that environmental education was limiting coverage to the protection of natural environments (for their ecological, economic, or aesthetic values), without taking into account the needs and rights of human populations associated with these same environments as part of the system (Sauvé, 1996). Sustainable development was also an update of the environmental education discourse by emphasising aspects related to contemporary economic realities and placing greater emphasis on concerns for global solidarity.

The 1992 Earth Summit in Rio recognized that the protection of natural environments and human development are part and parcel of each other. Sustainable Development is therefore a vision of development that encompasses populations, animals and plant species, ecosystems, natural resources and that integrates concerns such as the fight against poverty, gender equality, human rights, education for all, health, human

security, intercultural dialogue etc. This vision also ensures the well-being of the human person by integrating social development, economic development, and environmental conservation and protection. Sustainable development is an alternative to unsustainable development, which was caused by the countries in the North and is responsible for the current unequal situation of the world (Redclift, 1987).

Agenda 21 called for education in every chapter; while, Chapter 36 of Agenda 21 set the foundation for ESD as promoting and improving quality (and lifelong) education to share knowledge, skills and values. Reorienting all levels of education including curricula to encourage content and pedagogy that supports sustainable development (UNCED, 1992), building public understanding and awareness through community education, including informal education through media and providing practical training of businesses, institutions and civil society to build their capacity to carry out sustainable practices at local, district, provincial and national levels (UNCED, 1992).

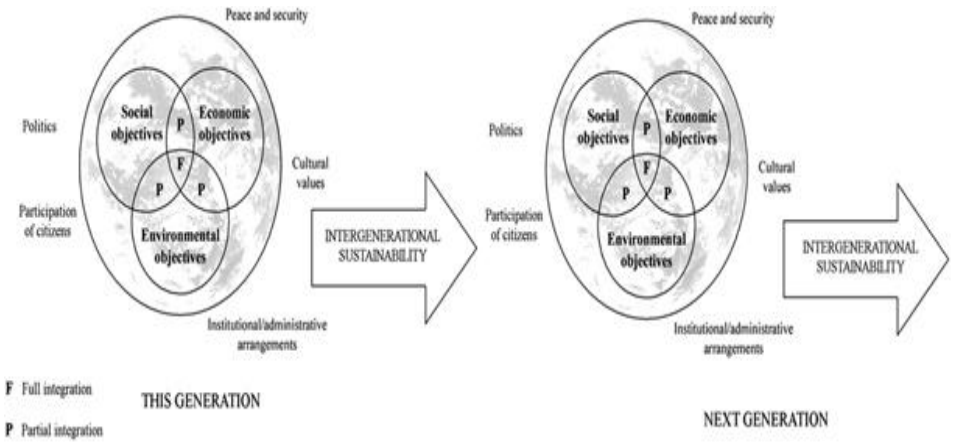
According to the Brundtland Commission report, "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). The Report brought the development and environment merger and marked the beginning of international call for the efficient management of natural resources as part of the development package (Sachs, 1992). The Brundtland Commission Report elevated sustainability to a global level while emphasizing that nature is not only our resource base but the absorber of pollution and our living space (Sulman, 1993).

International conservation organisations agree that sustainable development is the action of improving the quality of human life while living within the carrying capacity of the economy which depends on the stock of natural capital, human capital and technology that future generations inherit from the present generation (IUCN *et al*, 1991). It has been understood "as a mandate to meet the needs of all people at present while ensuring that the needs of the future generations are not compromised" (World Commission on Environment and Development, 1987).

The definition of sustainable development by the World Commission on Environment and Development emphasises intergenerational sustainability, a process designed to safeguard the rights and abilities of future generations to also meet their needs.

Sustainable development, as illustrated in figure 2.5, means that this generation will not exhaust the earth's resources for the sake of future generations (intergenerational justice); sustainable development also aims to eliminate the differences in resource use between the North and the South, which is to say the gap between the rich and the poor (intragenerational justice) (Haruhiko, 2003).

Figure 2.3 illustrates the concept of intergenerational sustainability.



Source: (Lozano, 2003).

Figure 2.3: Illustration of Intergenerational Sustainability

The concept of sustainable development has been embraced as a useful guide in both development and conservation efforts by both governments and nongovernmental organisations.

The challenge of sustainable development involve the need to build capacity to direct development founded not only on ecological bases, but on social equity, cultural diversity and political democracy. This implies establishing the right to environmental education and training as a principle of sustainable development, to empower everybody to participate in sustainable livelihoods (Leff, 1997). Education/learning for sustainable development focuses on the learning process in or for a sustainable society (Bjorneloo *et al*., 2007).

2.6 Education for Sustainable Development

Sustainable development was first endorsed at the UN General Assembly in 1987 and since that time, discussions of parallel concept of education to support sustainable development became important (McKeown *et al.* 2002). As the concept of sustainable development was discussed and formulated, it became apparent that education is key to sustainability. Education for sustainable development (ESD) was first described by Chapter 36 of *Agenda 21*. Education is an essential tool for achieving sustainability. It is recognized globally that the trend at which development is taking place is unsustainable and that sensitisation of this fact is important if sustainability is to be achieved (McKeown *et al.*, 2002). Education is therefore very important in the promotion of sustainable development and helping people to develop competencies enabling them to solve environmental and development problems (UNCED, 1992).

In 1948, education was described as the greatest resource for achieving a just and ecological society (Schumacher, 1973). The Brundland Report (WCED, 1987) argued that through teachers advocating for social change necessary for sustainable development, challenges related to climate change are minimised. In addition, *Agenda 21*, the internationally agreed report of the Earth Summit, committed countries to promoting environmental sustainability through education. Chapter 36 on "Promoting education, public awareness and training" was one of the few aspects of *Agenda 21* that did not provoke contention at the Earth Summit. Countries from both North and South agreed that education was critical for promoting sustainable development and increasing the capacity of the people to address environment and development issues

(UNESCO-UNEP 1996). This view was reiterated in the Discussion Paper for the Thessalonikki Conference (1997) on Environment and Society: Education and Public Awareness for Sustainability, which stated that it is widely agreed that education is the most effective means that society possess for confronting the challenges of the future. Education, to be certain, is not the whole answer to every problem. But education, in its broadest sense, must be a vital part of all efforts to imagine and create new relations among people and to foster greater respect for the needs of the environment (UNESCO 1998).

In May 1996, the Commission on Sustainable Development (CSD) which had been set up by the UN to monitor the follow-up of decisions taken at the Earth Summit met for its Fourth Session in New York. The noteworthy feature of this session was that Chapter 36 of *Agenda 21* was considered for the first time since 1992. The CSD Session concluded that in order to change unsustainable production and consumption patterns and lifestyles, it (is) essential to give great emphasis to the role of education for sustainable development, including environmental economics as well as environmental awareness (UNESCO-UNEP 1996). According to the document proposed by UNESCO (1992) at the ECO-ED Conference, Environmental Education (EE) is just one of many thematic educations that contribute to the overall education for sustainable development. Some scholars have argued that the difference between earlier forms of EE and ESD is that while EE perceived the environment as nature, system, object of study or field of values, ESD conceives environment as ‘resource for economic development or shared resource for sustainable living’ (Sauvé, 2005).

In February 2003, the UN announced that 2005 – 2015 would be the Decade of Education for Sustainable Development with UNESCO as the lead agency. The importance of education in achieving sustainable development outcomes is outlined by Koïchiro Matsuura – Director General of Unesco: "Education – in all its forms and at all levels – is not only an end in itself but is also one of the most powerful instruments we have for bringing about the changes required to achieve sustainable development" (UNESCO, 2005).

The DESD integrates the vision of sustainable development in all teaching-learning areas. All international information embedded in International Implementation Scheme (IIS) which was developed by UNESCO. IIS could be synthesized in the objectives for the DESD presented in Figure 2.4.

1.	Facilitate networking, linkages, exchange and interaction among stakeholders in ESD;
2.	Foster an increased quality of teaching and learning in education for sustainable development;
	Help countries make progress towards and attain the Millennium Development Goals through ESD efforts;
4.	Provide countries with new opportunities to incorporate ESD into education reform efforts.

Source: (UNDESD, 2005-2014)

Figure 2.4: Objectives of the Decade of Education for Sustainable Development

Education for Sustainable Development (ESD) is a means of making such abstract concepts as sustainable development real. ESD is a learning process geared to empower the learner to move from unsustainable ways. This calls for public awareness and participation for bringing about an attitudinal change and finally restricting further damage to the environment. Effective implementation of environmental management and conservation programmes depends on education, awareness raising and training in the relevant areas. Without an understanding of how to conserve natural resources and the compelling need to do so, few people would be motivated to participate actively in programmes on environmental conservation, environment education and awareness are therefore critically important.

The Stockholm declaration of 1972 and the 1992 World Conference on Environment and Development recognized education as a strategy for sustainable development. In December 2002, the United Nations (UN) General Assembly dedicated 2005-2014 as the UN Decade of Education for Sustainable Development (DESD) to be observed by all member nations within their contexts, priorities and approaches. One of the angles developed by UNESCO for approaching ESD is the reorientation of existing education programmes with the aim of educating the younger generations about climate change and to stimulate the problem solving and critical thinking skills needed to generate solutions at local and global levels. Another angle is to raise public understanding and training. To attain sustainable development, education plays a critical role to develop citizens with competencies to embrace globalisation and sustainable development. Education is central to sustainability and the Decade of Education for Sustainable Development (DESD), it is an opportunity to highlight the

importance of education and learning for sustainability worldwide. Sterling (2006) sees sustainability as an indication of the need for a change of education paradigm as a whole, rather than a modification of the existing paradigm because people are using natural resources in ways which are not sustainable in the long run (O'Connor, 1989).

The overall goal of DESD is to integrate the values inherent in sustainable development into all aspects of learning to encourage changes in behavior that allow for a more sustainable and just society for everybody. The Geographical Association describes ESD as technically challenging teaching which requires teachers to engage pupils in a culture of argument, complexity, uncertainty and risk analysis if teachers are to deliver ESD effectively; they need the right skills and tools. However, there are concerns that initial teacher training and continuing professional development do little to equip teachers with skills and knowledge necessary to teach ESD in the cross-curricular manner (Geographical Association Newsletter, 2005). Since that time sustainable development and by extension ESD has grown to encompass and address far reaching ideals and visions. According to UNESCO, Education systems everywhere need to include a focus on the causes, consequences and solutions to climate change (UNESCO, 2006).

Addressing the causes and the consequences of climate change requires content and methodologies that will build capacity in society for mitigation, adaptation and transformability. The overall aim of ESD is to empower citizen to act for positive environmental and social change by giving people knowledge and skills to help them find new solutions to their social, economic and environmental issues, i.e. educating

in ways which enable people to address sustainable development challenges of societal nature such as poor governance, bigotry towards cultural diversity, ethnic animosity, gender inequality, and the like, economic issues like systems of production, high levels of poverty, inefficient wasteful production, unsustainable utilisation of natural resources and other environmental issues such as droughts, natural disasters, acute water shortage, climate changes and variability, loss of biodiversity and forest cover, poor waste management and pollution amongst others.

Many key issues regarding sustainability were identified by the Brundtland Commission and were incorporated into Agenda 21 and the Earth Summit process. The 40 issues found in the 40 chapters of Agenda 21 are the core of ESD and should be reflected in any programme related to reorienting education for sustainability. These 40 issues are organized in four sections within Agenda 21 (UN, 1997):

Section 1: social and economic dimensions- International cooperation, combating poverty, changing consumption patterns, population and sustainability, protecting and promoting human health, sustainable human settlements, decision-making for sustainable development.

Section 2: conservation & management of resources -Protecting the atmosphere, managing land sustainably, combating deforestation, desertification and drought, sustainable mountain development, sustainable agriculture and rural development, conservation of biological diversity, management of biotechnology, protecting and managing the oceans, protecting and managing freshwater, safer use of toxic

chemicals, managing hazardous wastes, managing solid waste and sewage, managing radioactive wastes.

Section 3: strengthening the role of major groups Women in sustainable development, children and youth, indigenous people, partnerships with NGOs, local authorities, workers and trade unions, business and industry, scientists and technologists, strengthening the role of farmers.

Section 4: means of implementation financing sustainable development, technology transfer, science for sustainable development, education, awareness and training, creating capacity for sustainable development, organizing for sustainable development, international law, and information for decision-making.

In ESD, there is the recognition of the interdependence of environmental, social and economic perspectives and the dependence of humanity on a healthy biosphere. Participation and involvement are necessary components of ESD, with an emphasis on empowerment and agency for active citizenship, human rights and societal change. Re-orientation is necessary at all levels and in all phases of education, and encompasses community learning, thus making ESD a wider process challenging the form and purpose of education itself (The Gothenburg Recommendations on Education for Sustainable Development, 2008).

ESD as presented by the United Nations is directly related to the comprehensive document on sustainable development- Agenda 21. The Bonn declaration re-affirmed

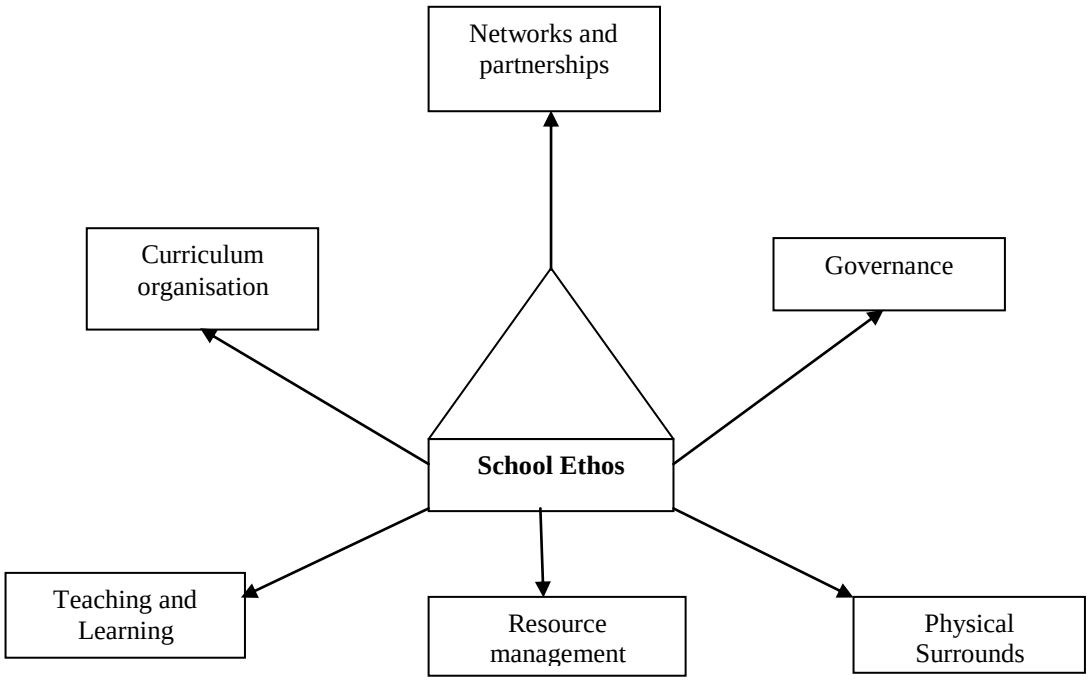
the importance of ESD for a sustainable future, in responding to current and future challenges, in helping societies address issues of environmental degradation including climate change, in promoting sustainable living, in empowering people to deal with uncertainty and with skills to find solutions to complex issues by incorporating both indigenous and modern knowledge (UNESCO World Conference on Education for Sustainable Development, 2009).

ESD is a form of empowerment and a key component of both social literacy and a curriculum in and for a democratic society (Carr, 1998). ESD should shape both the overt and hidden curriculum: classroom lessons, the ethos and management of the school and its grounds, and links with the wider community. It is about equipping individuals, communities, groups, businesses and government to live and act sustainably; as well as giving them an understanding of the environmental, social and economic issues involved (Sustainable Development Education Panel, *1998*).

Education for sustainable development represents a new vision of education that emphasises a holistic, interdisciplinary approach to developing the knowledge and skills needed for a sustainable future as well as changes in values, behaviour, and lifestyles (UNESCO, 2003).

ESD should be lifelong, permeating learning programmes at all levels, including vocational education, training for educators, and continuing education for professionals and decision makers (UNECE, 2005).

Effective Education for Sustainable Development in schools incorporates all the activities conducted in/by the schools including curriculum, teaching and learning, and the entire school community (students, teachers, non-teaching staff, community, etc.).



Source: Australian Government: A National Environmental Education Statement for Australian Schools.

Figure 2.5: A framework for Environmental Education for Sustainability

Kenya's new development blue print puts emphasis on sustainable development across all sectors. The Medium Term Plan for the Vision 2030 under environmental education and awareness requires that Kenya has an ESD Policy developed and all training institutions curricula re-oriented to address ESD concerns. Kenya has an ESD Implementation Strategy and the policy development process is ongoing (Nema,

2008). Sustainable development issues in Kenya are complex and interlinked. The policy makers have acknowledged the role of ESD in moving the country towards sustainability (Kidundo, 2012).

The Kenya Government, CSOs and the private sector have made notable ESD-related responses such as resource material development, research and innovations and advocacy and related responses in relation to society, environment and economic spheres of sustainable development. Examples of issues under the society pillar include: poor governance, corruption, bigotry towards cultural diversity, ethnic animosity, gender inequality, HIV/AIDS, malaria, tuberculosis (TB) and other communicable and non-communicable diseases, human rights abuses, all forms of violence and increased insecurity, degraded lifestyles and behaviour, drug and substance abuse, and erosion of cultural values and morals while the economic issues revolve around systems of production, consumption, investments and service delivery towards an enhanced GDP among others.

ESD implementation has been hindered by challenges such as high levels of poverty and related issues impede optimal performance of the economy. ESD implementation aims to empower Kenyans with skills in sustainable use of resources at all levels. This will inculcate sustainability values among the citizenry aimed at influencing informed decisions on various issues on sustainability. Other challenges affecting ESD implementation under the economy pillar include inadequate investment infrastructure leading to rising levels of unemployment, rural/urban migration, corporate irresponsibility and lack of accountability and corruption. The inefficient

and wasteful production systems lead to unsustainable utilisation of natural resources resulting in their degradation.

The environment sector has a number of challenges which include; frequent droughts, natural disasters, acute water shortages, climate change and variability, loss of biodiversity and poor waste management systems. This has resulted in land degradation and loss of forest cover, which currently stands at 1.7 per cent of the total territorial surface area falling far below the globally recommended 10 per cent minimum cover. Moreover, about 88 percent of the country's total surface area is comprised of ASALs while desertification is on the rise as a result of fragility of the ecosystems. The robust industrial development experienced in the country over the last four decades has caused negative impacts on the environment such as increased waste generation leading to unsustainable waste management practices.

The Kenya Vision 2030 has, as a key goal, the attainment of status of a 'nation living in a clean, secure and sustainable environment' driven by the principles of sustainable development. To realize this, the focus will be on four strategic thrusts, namely; conservation of natural resources, pollution and waste management; ASALs and high-risk disaster zones and environmental planning and governance.

Kenya has developed an ESD implementation strategy to provide an enabling environment and capacity for all sectors and stakeholders to effectively contribute towards the achievement of sustainable development. The development and

implementation of the ESD strategy was, therefore, a major step towards attaining sustainable development in Kenya.

ESD seeks to enable individuals to make informed and responsible decisions and actions, now and in the future. Educating about climate change builds the skills and attitudes needed to question the way we think, the values we hold and the decisions we make in the context of sustainable development. The integrated, multifaceted vision provided by ESD is particularly well-suited to addressing climate change in terms of understanding its causes, recognising its impact and effects, and preparing and implementing appropriate responses.

ESD teaching and learning methodologies that are participatory, experimental, critical and open minded are required to adequately respond to climate change. Jickling in 2005 questioned the necessity of changing the term Environmental Education (EE) to Education for Sustainable Development (ESD), as he saw the concept of sustainable development as being too hollow to guide educational ideas.

Jickling, amongst many other critics see ESD as an alien concept in developing countries and which is yet to be accepted wholly. More extensive efforts may be needed for incorporating eminent social issues into ESD in developed countries because the concept of sustainable development emphasises the ‘world’s poor’ in its definition, yet its development is at the international level, considering the situation of the global south (Jickling, 2005).

In his Bulletin article on the definition of environmental education, (Disinger, 1983), admits that his definition encompasses what is popularly known as Education for Sustainability but that he chooses to use the term Environmental Education because majority of education and policy makers around the globe recognise the subject as such, and also because the subject of environmental education has evolved throughout four decades, earning its place globally.

ESD involves implementing locally relevant and culturally appropriate programmes (McKeown *et al*., 2002). All sustainable development programmes including ESD must take into consideration the local environmental, economic, and societal conditions. Global implementation of ESD will vary depending on the diversity of the societal, environmental and economic issues (McKeown *et al*., 2002).

2.7 Climate Change, Adaptation and Mitigation

Climate change is possibly the most significant environmental challenge of our time and it poses serious threats to sustainable development in Kenya (Mutai *et al.*, 2010). The Kenya Government acknowledges that climate influences all socio-economic sectors, and further appreciates that different sectors will be differently impacted by climate change (NCCRS, 2009). These impacts are already being experienced in some sectors (NCCRS, 2009), there has been increasing rainfall variability from year to year with a recognizable decline in rainfall during the main rainfall season. These changing patterns have had adverse impacts on a cross section of social economic activities and the current projections are predicting worsening situations in the future (Government of

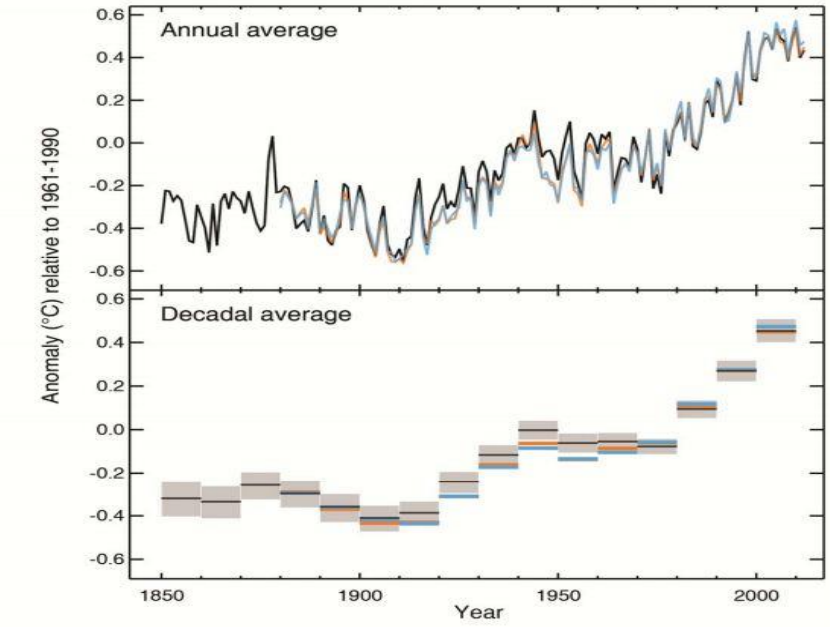
Kenya, 2010). The country has been experiencing extreme and very harsh weather patterns since the early 1960s (Simwa, 2012). According to the Kenya Meteorological Department, minimum temperatures have generally risen by 0.7 –2.0 degrees centigrade and the maximum by 0.2 –1.3 degree centigrade depending on the season and the region (Government of Kenya, 2010).

A recent study on the economics of climate change in Kenya by the Stockholm Environment Institute revealed that the future economic costs of the impacts of climate change on market and non-market sectors might be close to 3% of GDP per year by 2030 and potentially much higher than this (more than 5% of GDP per year) by 2050 (Stockholm Environment Institute, 2009).

Reporting on issues related to mitigation, the IPCC Working group 111 point out that since 1850, the warmest years were those between1995-2006 (1PCC, 2007). The 100 year linear trend (1906-2005) indicates an increase in temperatures of 0.74^0C. The fact that global mean surface temperature has risen around 0.5c (0.6+/-0.2c) over the last century is now widely accepted (Houghton, 1991).

The Fifth Intergovernmental Panel on Climate Change (IPCC) Working Group Report on the Physical Science Basis of Climate Change has confirmed that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC, 2013). This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of

the climate system (IPCC, 2013). The changes in temperature are shown in Figure 2.6.



Source: (IPCC, 2012)

Figure 2.6: Observed global averaged combined land and ocean surface temperature anomaly 1850-2012

The report further says that warming is likely to exceed 2℃, concentrations of CO2 and other greenhouse gases in the atmosphere have increased to levels that are unprecedented in at least 800,000 years, sea levels are expected to rise a further 26-82cm by the end of the century and among other scientific evidence, that the oceans have acidified as they have absorbed about a third of the carbon dioxide emitted (IPCC, 2013). The scientists warn that without immediate action to solve the climate crisis, catastrophic warming will fundamentally change our planet and disrupt the climate balance in which human civilization has flourished (IPCC, 2013). Growth of the global economy in the early 2000's and an increase in its carbon intensity

(emissions per unit growth), combined with a decrease in the capacity of ecosystems on land and the oceans to act as carbon "sinks", have led to a rapid increase in the concentrations of carbon dioxide in the atmosphere, leading to faster sea-level rise, ocean acidification, melting Arctic sea ice, warming of polar land masses, and shifts in the circulation patterns of the oceans and atmosphere, (IPCC, 2007). Recurring droughts in South Africa, floods in Europe, Mozambique, Bangladesh, Vietnam and hurricanes in Central America and the USA- destabilising and reshuffling the world's hydrological systems, economies, and livelihoods (IPCC, 2007). Because of low adaptive capacities and given the projected impacts of climate change, a consensus has emerged that developing countries are more vulnerable to climate change than developed countries, because of the predominance of rain fed agriculture in their economies, the scarcity of capital for adaptation measures, their warmer baseline climates, and their heightened exposure to extreme events (Fischer *et al.*, 2005).

Climate change and human development are inextricably linked. Development can both contribute to climate change and reduce vulnerabilities to its impacts (UNDP, 2011). Climate change effects are location specific and disproportionately distributed among different countries, income groups, occupations and between genders (IPCC, 2007). Global warming is real and its effects are now being felt globally (IPPC AR5, 2013). Studies indicate that the developing countries will be worst hit by the impacts of the projected changes (Smith *et al*., 2003, Ahmed *et al*., 2009) because widespread poverty in these countries limits adaptation (IPCC, 2012). For these countries, efforts to adapt to the changing climate are inseparable parts of the broader challenges of

natural resources management, poverty reduction, and sustainable development (Bapna & McGray, 2009).

Growth of the global economy in the early 2000's and an increase in its carbon intensity (emissions per unit growth), combined with a decrease in the capacity of ecosystems on land and the oceans to act as carbon "sinks", have led to a rapid increase in the concentrations of carbon dioxide in the atmosphere, leading to faster sea-level rise, ocean acidification, melting Arctic sea ice, warming of polar land masses, and shifts in the circulation patterns of the oceans and atmosphere. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2008). Abrupt reported increase in the frequency of extra- tropical depressions in the Central North Pacific has been reported (Bardin, 1994). According to IPCC, global climate warming in the late 20^{th} century appears to be rapid when viewed in the context of the last millennium.

The impacts of climate change are likely to vary greatly both within and among countries, some counties will suffer from the warming while others will benefit. In the absence of mitigation policies or significant technological advances that reduce emissions and/ or enhance sinks, concentrations of greenhouse gases and aerosols are expected to grow throughout the next century impacting on populations and economic growth, land use, technological changes, energy availability and fuel. As a consequence, the global community risks loss of biodiversity, huge costs to the

economy, inability to adapt due to poverty, loss of land, scarcity of drinking water, etc.

Climate change presents the global policy makers with a set of formidable complications, large uncertainties, the potential for irreversible damages or costs, very long planning horizon, policies and strategies that mitigate or assist adaptation to climate change particularly in developing countries. The climate change crisis is a global challenge which cannot be answered by a single country, mitigation must be coordinated globally (IPCC, 2007).

Africa is identified in the 4th Assessment report of the IPCC as one of the regions most vulnerable to climate variability and climate change and the least resilient due to multiple stresses and low adaptive capacity (IPCC, 2007). In Africa, Climate change is already determining the cause of people's lives and yields from rain-fed agriculture could halve in the next decade (IPCC, 2007). Africa's environment is the most fragile in the world and this vulnerability has been pushed to the limit over the past 100 years (Sulman, 1993). Extreme weather events and greater unpredictability in weather patterns are already having serious consequences for people who rely on land, lakes and seas for livelihoods. It is projected that impacts in Africa will include increased water stresses that would negatively impact livelihoods, access to water, and decreased fresh water fisheries. There have been recent food crises in Kenya, Uganda, Somalia and Ethiopia (Guardian, 2009). The stark impacts of changing rainfall patterns on Africa are manifest.

Africa has experienced a 0.5°C rise in temperature over the course of the 20th century, with some areas warming faster than others (Eriksen *et al.,* 2008). Predictions show that annual mean surface air temperatures are expected to increase between 3°C and 4°C by 2099, roughly1.5 times average global temperatures (Boko *et al.,* 2007). Africa citizens are the least responsible for generating the greenhouse gases that are contributing to global climate change, African fossil fuel emissions account for only 3.7% of the global total. Fossil fuel emissions per capita in Africa are also among the lowest in the world.

The only African country with significant emissions is South Africa which ranks 13th in the world for fossil fuel emissions (Carbon Dioxide Information Analysis Centre of the UN, 2007). However, the worry is that emissions from Africa have demonstrated an upward trend (Canadell *et al.,* 2009). One of the key findings of the British Council sponsored *Africa Talks Climate Change research* indicate that people in Africa do not connect changes in the weather or environment to the global causes of climate change; a necessity if the people have to tackle climate change.

Temperatures in East Africa are expected to rise by between 2-4 ºC by 2100, shifting agro-ecological zones (IPCC, 2013). Climatic patterns are becoming both less predictable and more severe (IPCC, 2001). Although Africa has contributed very little to global warming, it will be affected severely by climate change mostly because Africa has more to lose in terms of biodiversity (Hepworth, 2010). Across the East African coast, sea level rise and climatic variation may decrease the attenuation of coral and patch reefs that have evolved along major sections of the continental shelf

(IPCC, 1997). There is general agreement from education and policy makers that education is needed to achieve sustainable development and to address climate change (Hodge *et al.*, 2013). People around the world recognize that current economic development trends are not sustainable and that public awareness, education, and training are key to moving society toward sustainability (McKeown *et al.*, 2002). Education is the ultimate long-term solution to climate change. As climate change now reaches the top of the political agenda, the educational response to climate change should elevate education for sustainable development among key political priorities (Saugier, 2008).

Climate change is an element of sustainability because the challenges brought about by its effects are dependent on the level of sustainability, i.e., how the pillars of sustainable development interact (Munasinghe, 2003); since Education for sustainable development is the educational manifestation of the concept of sustainable development (Selby, 2006), ESD initiatives must include attention to climate change.

A recent report by the UK National Commission for UNESCO (2008) pointed out that climate change is in fact giving additional urgency to discussions and activities related to ESD. Climate change related learning and activities must therefore be at the forefront of development policies and plans. A dedicated ESD programme allows participants to question, analyse and find solutions to their community's pressing problems; one of which is globally agreed as climate change. In its 8th year of implementation, the findings of this study will be vital in informing LVCEEP on the weight that the interventions are giving to climate change. This study was both timely

and topical given the outcomes of the UNESCO World Conference on Education for Sustainable Development (Bonn, 2009) and in light of the United Nations Climate Change Conference (Copenhagen, 2009), which clarified the issues of global warming and called for urgent concerted action. The DESD provides a framework for adaptation to and mitigation of climate change by enhancing and promoting active learning and innovative ways of framing climate change issues so that they make sense in the context of people's everyday lives, helping to translate passive awareness into active concern and be involved in appropriate practical activities to meet these challenges.

There are two types of responses to the changes in climate: the first is to try and reduce the extent to which our climate is altered. This is known as climate change mitigation. The second is to learn to live with the inevitable changes. This is known as adaptation to climate change. The strategies for meeting the challenges of climate change are therefore either mitigation focused or adaptation based though some strategies involve both adaptation and mitigation activities. Strategies for meeting the challenges of climate change can be grouped as follows:

1 Local level interventions– Tend to be very linear and simple projects.

2. Sub-national levels – Scope is beyond a single investment and the coverage is either sector based or regional

3. National levels – These are State driven interventions, they are key in formulating the national climate change objectives and translating them into national realities.

4. Global levels – Global approaches tend to be simple as very few actual approaches exist on the global level.

(Wörlen, 2013).

The approaches on the intermediate levels (e.g., local level and sub-national levels) are not only the ones with the shortest traditions but also the ones with the most potential for catalyzing transformations (Wörlen, 2013).

Mitigation is an anthropogenic intervention to reduce the sources of or enhance the sinks of greenhouse gases. Mitigation strategies are aimed at the reduction of GHG emissions and the delivery of mitigation activities are implemented via energy conservation measures; carbon sequestration through enhanced sinks (e.g. reforestation, afforestation; reduced sources of emissions through land use management, and macro- engineered carbon capture and storage (Boyd and Tompkins, 2010). Mitigation aims both to reduce emissions of GHGs and to enhance sinks for these gases. Achieving the lowest possible stabilization of GHGs in the atmosphere requires an emphasis on early action to reduce emissions (IPCC, 2007).

According to IPCC WG3 (2007), some of the main technological mitigation options are improving energy efficiency and energy conservation, reducing the carbon intensity of energy, e.g. by switching fuels such as substituting gas for coal, introducing carbon capture and storage technologies, energy from renewable energy sources, nuclear power and development of new technologies and practices to reduce GHG from agriculture and land use. Other examples of mitigation activities include afforestation and reforestation; better land management practices such as conservation tillage and agroforestry; rehabilitation of degraded crop and pasture land; rangeland rehabilitation to improve productivity; and livestock management practices. All of

these activities can contribute significantly to improving soil cover and reducing carbon emissions as a mitigation strategy (IFAD, 2010).

In the context of climate change planning, the term adaptation generally refers to human activities intended to minimize the adverse effects of climate change on human infrastructure and sensitive aspects of the natural environment (Fischlin *et al*., 2007; Julius & West, 2007). It is generally agreed that effective adaptation strategies should reduce present vulnerability as well as future vulnerability to climate change. Adaptation measures can contribute to equitable and sustainable policies and to the present development decision framework by reducing present day risks from climate variability and by being relevant to immediate national development priorities (Downing *et al*., 1997; Adger, 2001; Apuuli *et al*., 2000; Hulme *et al*., 2001). The enhancement of adaptive capacity is a way of reducing vulnerabilities and promoting sustainable development (IPCC, 2001). Adaptation is a critical part of societal responses to the threats of global warming and climate change. Such strategies are already implemented to improve the resilience of specific sectors, such as in the health and transport sectors. Figure 2.7 provides definitions of adaptation.

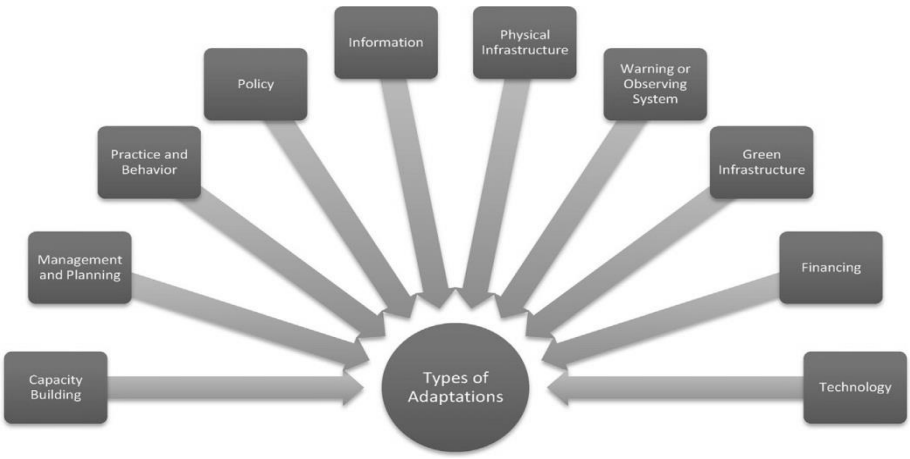
Some definitions only refer to societal adaptation: Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides. Other definitions distinguish between different types of adaptation: The term adaptation means any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for ameliorating the anticipated adverse consequences associated with climate change. Another definition given is very broad: Adaptation to climate change includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system.

Source: (Olmos (2001) and Smit *et al* (1999:2000)

Figure 2.7: Different definitions of adaptation

Countries have introduced green economies in efforts to target mitigation and adaptation to climate change; others have enforced measures to reduce water wastage and put in place systems to improve water quality. Most countries have implemented national guides on how communities can plan and adapt to specific ecosystems. Some countries have come up with environmental restoration and tree planting initiatives, while others have gone the way of putting in place litigation and various deterrent measures to eradicate environmental degradation.

Preventive health interventions strategies that simultaneously prepare for anticipated climate change impacts and address existing health needs have been recommended as practical strategies given the predicted health impacts and also the uncertainty in the predictions (Hall, 2009). Technological change has emerged as a climate change mitigation strategy and so has the enforcing of emissions quotas and trading, to make each ton of COF2 more expensive to emit (OECD, 2008). An array of adaptation activities under implementation by Non-governmental organisations, governments and community based organisations is illustrated in Figure 2.8.



Source: (Biagini *et al.*, 2014).

Figure 2.8: Categories of adaptation activities

Climate change experts have warned that Sub-Saharan Africa will be disproportionately impacted not only due to the result of projected warming and rainfall deficits, but also because of the structural vulnerability of the population (Thompson *et al*., 2010). Some climate change researchers see adaptation to climate change as the most appropriate strategy for meeting the challenges of climate change (Yamin *et al.,* 2005 Adger *et al.,* 2003; Handmer, 2003; Kates, 2000; Watson and Ackerman, 2000); while an analysis of adaptation as a response to climate change conducted by Copenhagen Consensus Center reports that the most effective response to climate change is one which combines both mitigation and adaptation measures and that the adaptation mix is both diverse and region specific (Bosello *et al.,* 2009). The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report states that "adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions" (IPCC, 2007: 18). As such, it supports adaptation as a complimentary response strategy to mitigation.

In Africa both short and long-term adaptation strategies in response to regional climate change are beginning to emerge in a region that is rife with challenges (WWF, 2006). The authorities in Zimbabwe have implemented a programme whereby distribution of climate data regarding seasonal climate forecasts (based on short-term and long-term forecasts) to farmers is done to enable the farmers make more informed farming decisions and adapt to the changing climate conditions. Some farmers have already started to use this information and are preparing themselves for dry conditions by planting drought-tolerant crops (Patt *et al*., 2005). Table 2.2 outlines ecosystems based adaptation options.

Table 2: Adaptation Options in Selected Ecosystem Types

(Source: CBD Ad Hoc Technical Expert Group on Biodiversity and Climate Change)

Forests - Options may include: (i) Maintaining representative forest ecosystem types across environmental gradients, providing buffer zones for possible spatial shifts in reserve boundaries and practice low- intensity harvesting and site preparation methods; (ii) Avoiding fragmentation and providing ecological connectivity through planted forests; (iii) As there are strong links with mitigation, when planting forests: establish indigenous, mixed-species stands, maximise natural genetic diversity (and minimise highly selected material), mimic the structural properties of surrounding natural forests, and avoid the direct replacement of native ecosystems. **Marine and Coastal** – Options may include: (i) Designing marine protected areas so that they include reef areas that have demonstrated resilience/resistance to raised sea temperatures; (ii) Conserving and restoring coastal ecosystems to protect coastlines from the impacts of climate induced sea-level rise; (iii) Undertaking aquaculture and mariculture as options to potential climate-change induced decline of wild fisheries in a sustainable manner. **Inland waters** – River biota is within reasonable limits – relatively well adapted to rapid and unpredictable changes in environmental conditions. Thus, options may include maintaining near-natural flow patterns, channel morphology, water quality and quantity, and overall connectivity.

Traditional agro-ecosystems – Local, traditional agro-ecosystems harbour centuries of locally adaptive information that result in diverse landscapes managed for multiple uses.

They are more knowledge- than use-intensive and are shown to spread the risk of climatic variability through: high species numbers, high structural diversity in time and space, exploitation of the full range of micro-habitats available, complex biological interactions leading to pest suppression, and use and maintenance of local varieties of crops, wild plants and animals. Resilience in the face of changing climate has been documented for smallholder farmers that depend on local agro-ecosystems in many locations across the globe. Options may include conservation of crop genetic resources, and their incorporation in breeding programmes to maintain future options arising from the impacts of climate change.

Mountain and arctic ecosystems are under particular stress and threat of degradation due to their high sensitivity and vulnerability to climate change but few adaptation options are available except for building barriers against coastal erosion. Adaptation activities that best address how mountain ecosystem management leads to adaptation benefits may be those that link upland-lowland management strategies.

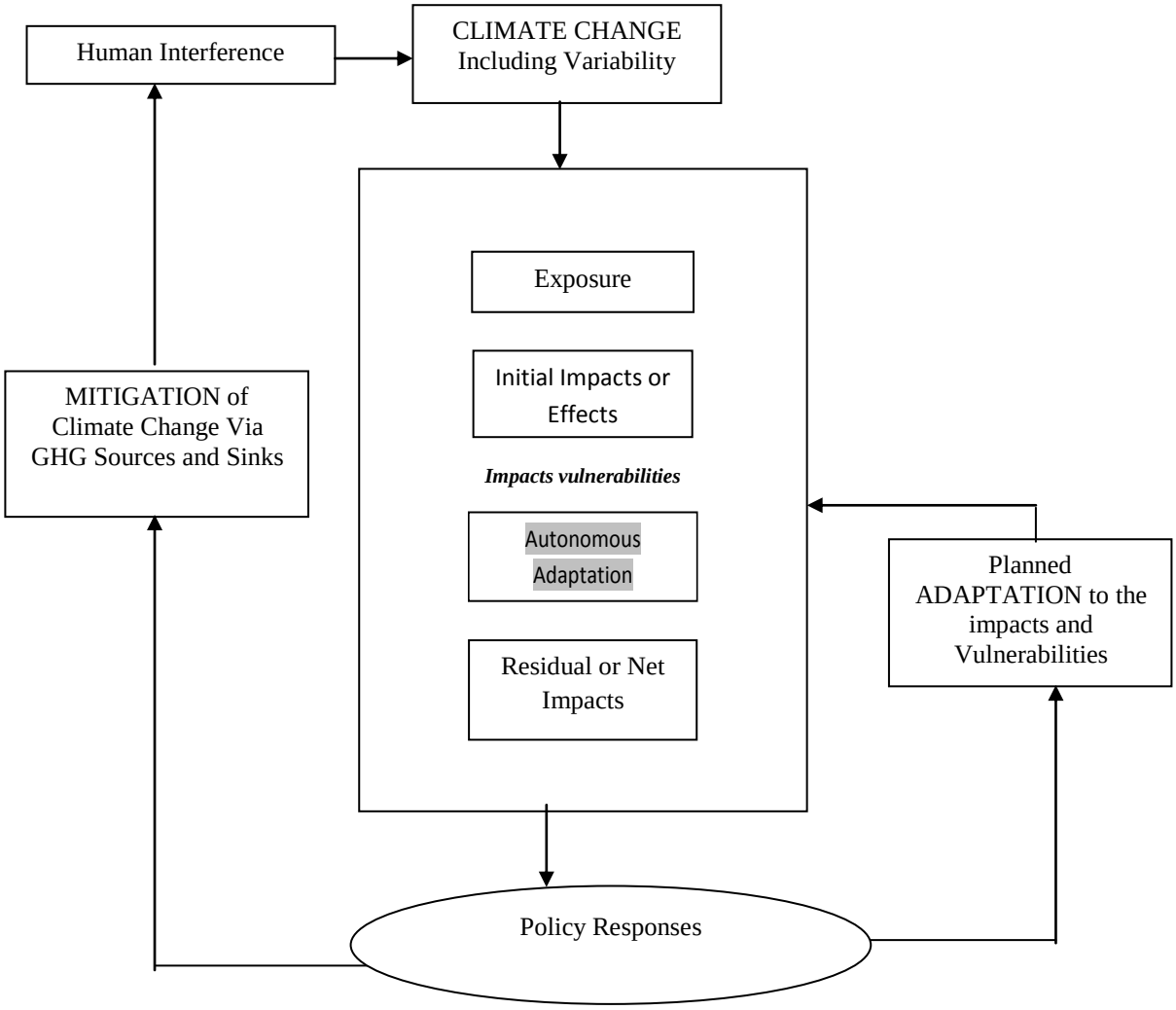
Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts because adaptation has the potential to reduce adverse impacts of climate change and to enhance beneficial impacts (IPCC, 2001). Figure 2.9 demonstrates the benefits of adaptation.

Source: Stockholm Environment Institute, (2013)

Figure 2.9: Adaptation Pyramid

Along the Tanzanian coast, leading conservation groups are working with natural resource managers and other stakeholders to integrate climate change adaptation strategies into their management philosophies and plans (Hansen *et al*., 2003). Some Non-Governmental Organisations and governments bodies in East Africa are now involved in building the capacity of natural resources managers to assess vulnerability and to adapt management strategies to respond to expected climate change impacts (Hansen *et al*., 2003).

An illustration of adaptation and mitigation as strategies for meeting the challenges posed by the effects of climate change is presented in Figure 2.10.



Source: (Smit *et al*., 1999).

Figure 2.10: Climate Change: Challenges and Responses

In the Sub-Saharan Africa, climate change has drastically reduced agricultural production due to extreme weather events, such as recurrent droughts and floods (Hassan and Nhemachena, 2008; Deressa *et al.*, 2008). Kyuso, a semi-arid district in the Eastern Province of Kenya experienced severe drought impacts in the last decade (Maitima *et al.,* 2009). From 2004 to 2007, the district experienced low amounts of

rainfall with total crop failure for the main crops like maize,sorghum, millet, beans and peas (Ndambiri *et al.,* 2012). Any resulting impacts are likely to have a strong distributional pattern and amplify inequities in health status and access to resources, as vulnerability is exacerbated by existing developmental challenges, and because many groups (such as rural communities) will have low adaptive capacity (DFID, 2009).

Temperatures in East Africa are expected to rise by between 2-4 ºC by 2100 (Paavola, 2003), shifting agro-ecological zones, and there is scientific evidence that emissions from Africa are increasing (Canadell *et al.,* 2009).

The water sector is considered to be very sensitive to climate changes. In East African lakes (Edward, Albert, Kivu, Victoria, Tanganyika and Malawi), deepwater temperatures, which reflect long-term trends, have risen by 0.2 to 0.7°C since the early 1900s. Inter-annual lake- level fluctuations and lake-level volatility have been observed in East African lakes (GTZ, 2009). Historic context of climate extremes in East Africa:

I. Large variability in rainfall with occurrence of extreme events in terms of droughts and floods.
II. Droughts in the last 30 years -1983/84, 1991/92, 1995/96, 1999/2001, 2004/2005 (led to famine).
III. El-Niño related floods of 1997/98 – very severe event enhanced by unusual pattern of SST in the Indian Ocean (IPCC, 2007.)
IV. The La Niña related drought of 1999/2001. (DFID, 2009).

Climate scientists project that like all sub-Saharan countries, Tanzania is at risk from more extreme and erratic rainfall resulting in droughts and flooding, rising sea levels, with water and food insecurity seriously affecting farmers and pastoralists. Other potential impacts include the destruction of coral reefs and marine habitats from sea warming as well as ecosystems being affected by deforestation and changing weather patterns, projected to have serious impacts on the country's vital tourism trade. Tanzania is not resilient to these impacts due to weak economies, poor capacity and therefore it is vulnerable to climate change (Agrawala *et al.*, 2003).

In recent decades, the climate in Uganda has become wetter and more variable. Low lake levels (especially Lake Victoria) since 2005 has led to power shortages, disruption to water supply, transportation and infrastructure and are linked to reduced productivity in Lake Victoria's fishery (Case, 2006). An indirect consequence of these climate change impacts is increased pressure on wetlands and forests, which suffer from encroachment and deforestation as people turn to charcoal, fuel wood and agricultural expansion as coping strategies.

Studies have confirmed that over the next 20 to 100 years mean annual temperatures in Uganda will rise at a rate which has been unprecedented over the last 10,000 years (Hepworth, 2010). Temperatures are likely to increase in Uganda by up to 1.5 °C in the next 20 years and by up to 4.3 °C by the 2080s (Mutagamba, 2010). Changes in rainfall patterns, total annual rainfall amounts and rainfall intensity are expected (Hepworth, 2010). The main impacts of a 1.5 °C temperature rise and of more

extreme and/or more frequent occurrences of climatic incidents will be on food security, the quantity and quality of water and other natural resources, human health, settlements and infrastructure(Paavola, 2003).

Kenya is vulnerable to climate change. The report "Adapting East African ecosystems and productive systems to climate change" by Maitima *et al*., (2009), reveals that in the last 100 years, Kenya has suffered 28 major droughts with three of them having occurred during the last decade, leading to countrywide energy crisis, water shortages, food insecurity general poverty, yet rain-fed agriculture and livestock production are the key sectors of the country's economy (DFID, 2009). Studies indicate that temperatures have generally risen throughout the country, primarily near the large water bodies (King'uyu *et al.,* 2000, GoK 2010).

The country's arid and semi-arid lands (ASALs) have also witnessed a reduction in extreme cold temperature occurrences (Kilavi, 2008). This warming is leading to the depletion of glaciers on Mount Kenya (IPCC, 2007, UNEP 2009).Weather-related hazards therefore present a serious threat to the socio-economic development of the country (DFID, 2009). Rainfall varies from over 2000mm/year in some areas to less than 300mm/year in the arid northern areas. Droughts and floods are the major climatic hazards in Kenya, with an estimated 23 million people affected by the widespread drought in 1999. Livestock and livestock-related activities such as deforestation and increasingly fuel- intensive farming practices are responsible for over 18% of human-made greenhouse gas emissions (Owen, 2008 and Kedar, 2008), including 9% of global carbon dioxide emissions, 35-40% of global methane

emissions chiefly due to enteric fermentation and manure and 64% of global nitrous oxide emissions mostly due to fertilizer use. Scientists predict that climate change will lead to increasingly unpredictable rainfall patterns in Kenya, causing more extreme droughts and flooding and exacerbate the spread of disease including malaria (Nganga, 2006). These impacts will further complicate the chronic food, water and energy shortage that already affects the lives of most Kenyans (Mutimba *et al.*, 2010). Table 2.3 gives a presentation of climate trends in Kenya.

Table 2.3: Summary analysis of climate trends for Kenya

Source**:** DFID, 2009

Threat	**Example**	**Location**	**Observed Trends**			
			Trend in likelihood	*Trend in magnitude*	***Trend in location***	*Other trends/ descriptions/ Identified thresholds*
Drought	Periodic Drought	Arid and semi-arid lands (<500mm annual rainfall) (plus Muranga, Embu, Kajiado, Makueni, Laikipia, Kitui and Machakos districts).	Frequency of droughts expected to increase. Observations show that southern Kenya becoming dryer	Severity expected to increase	Shifting borders of arid and semi-arid lands	Asal Population is increasing due to natural growth and immigration- so more people are at risk. Increasing deforestation is also affecting rainfall
Floods	Flash floods 2006	Arid and semi-arid lands, Coast and lakeshore	Increased frequency of floods	Severity expected to increase		
Temperatures			Increasing, particularly minimum temperatures			Reduce the number of species in parks and reducing wildlife population

Loss of 30% of corals has already affected Mombasa tourism. Those living in Kenya's cities and regional towns will also be increasingly affected by rural to urban

migration, which is already stretching public infrastructure to its limits. Impacts of climate change and vulnerability in Kenya include food scarcity, destruction of marine and coastal ecosystems, range lands and game resources, droughts and floods, upsetting the country's economy and reducing agricultural production.

The ten member countries of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) i.e., Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania, and Uganda have adopted, or are planning to adopt, a range of climate change adaptation strategies in agriculture (Nzuma *et al.*, 2010). Some of the strategies considered by the ASARECA member countries include the development and promotion of drought-tolerant and early-maturing crop species, exploitation of new and renewable energy sources, conservation of genetic resources, harnessing new and renewable energy sources, including solar power, wind power, hydro and geothermal sources, biofuels, promotion of rainwater harvesting, the conservation and restoration of vegetative cover in degraded and mountain areas, reduction of overall livestock numbers through sale or slaughter, cross-breeding, zero-grazing, and acquisition of smaller livestock (for example, sheep or goats), adoption of traditional methods of natural forest conservation and food use, community-based management programmes for forests, rangelands, and national parks and the promotion of environmentally friendly investments and Clean Development Mechanism (CDM) projects that can be funded through carbon trading, and soil conservation (Nzuma *et al.*, 2010).

The magnitude of the environmental problem posed by climate change, which we are witnessing in recent decades, calls for the development and implementation of programmes in education, awareness and communication about it and its effects, to facilitate access to information to the entire society and promoting public participation in developing responses. Education for sustainable development has to play an essential role in the fight against climate change, since the challenge we face is not only technological, but also social and educational. Despite climate change being an obvious symptom of 'unsustainability', the challenge has not influenced sustainable development, the impacts of climate change on sustainable development have been given minimal consideration, instead, global warming has been politicized (Cohen *et al.*, 1998). The subject matter of climate change is relatively new in environmental education, although air pollution and energy issues have been areas of concern in environmental education from the very beginning. To educate on climate change, awareness should be given priority after which the scientific background and social policy should be considered for incorporation into education for sustainable development.

2.8 Climate Change and Education for Sustainable Development (ESD)

The links between climate change and sustainable development are strong (UN, 2007). Climate change has been recognized as a global sustainable development challenge with strong social, economic and environmental dimensions. Climate change will impact the availability of basic necessities like freshwater, food security, and energy, while efforts to redress climate change, both through adaptation and mitigation, will similarly inform and shape the global development agenda (Unep *et*

al., 2011). Threats posed by climate change to human development include water shortages and droughts, increased frequency and severity of floods, decreased agricultural productivity and rising food insecurity and public health problems amongst others.

Internationally agreed frameworks and goals have set an agenda for integrating climate change and sustainable development. Agenda 21, which addresses climate change under its Chapter 9 (Protection of the atmosphere), recognizes, " that activities that may be undertaken in pursuit of the objectives defined therein should be coordinated with social and economic development in an integrated manner, with a view to avoiding adverse impacts on the latter, taking into full account the legitimate priority needs of developing countries for the achievement of sustained economic growth and the eradication of poverty" (UN, 2007). The United Nations General Assembly of 2012 acknowledged the interference of climate change, especially in the developing countries, in the efforts towards achieving sustainable development and the Millennium Development Goals (Renton, 2009).

Sustainable development in Africa cannot be addressed effectively without accounting for the impacts of climate change on agriculture, conflicts and disease patterns, all of which have particular impact on the poor (Elasha, 2009). Like many other sub-Saharan African countries, Kenya faces dual pressures from population dynamics and climate change that mutually undermine poverty alleviation, social development and economic growth efforts (AFIDEP *et al*., 2012). Climate change is possibly the most significant environmental challenge of our time and it poses serious threats to

sustainable development in Kenya (Mutai *et al*., 2010). The combined effects of climate change and population dynamics in Kenya are increasing food insecurity, environmental degradation, and poverty (AFIDEP *et al.,* 2012). Moreover, Kenya's fragile ecosystem will be put under intensive pressure arising from species migration due to habitat destruction and reduction (Stockholm environment institute, 2009). Already, almost 50% of the country's ecosystems are threatened by reduced habitat and other human induced pressures (Stockholm environment institute, 2009). Kenya is therefore highly vulnerable to climate change (Herrero, 2010).

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This calls for the urgent implementation of a range of mitigation and adaptation measures of the development targets as espoused in the country's vision 2030 are to be met (Mutai *et al.,* 2010). The UN Framework Convention on Climate Change underlined the importance of education, training and activities to raise public awareness at both national and International levels.

Faced with the severe increasing impact of climate change, equipping people with the necessary knowledge is more relevant than ever (Bokova, 2010). Education for sustainable development is an intellectual mechanism; environmental education serves both as a means of persuasion and a way to bring about behavioral change (Leite *et al.*, 2005).

Education has been described as the ultimate long-term solution to climate change and has been recommended for inclusion in the climate change negotiations at the same level as mitigation and adaptation; as an immediate priority (Saugier, 2009). Climate

change calls for a radical acceleration of Education for Sustainable Development in all sectors of education worldwide (Saugier, 2009). That responding to climate change must start with attitudes and behavioural changes, i.e. all such activities must start with education (Bokova, 2010). Development efforts will be seriously hampered by the risks of climate change if these are not tackled (Kok *et al.*, 2008).

Education can help build foundations for more resilient societies that are able to respond and adapt to the pressures of change. Through purposeful education, development of skills and attitudes necessary for rethinking behaviours and for making sustainable decisions when faced with challenges as climate change.

There is evidence that aligning climate change concerns with sustainable development concerns has resulted to reduced poverty, improvements in health and energy sectors, food security and others as well as climate benefits, (Halsnæs *et al.,* 2008; O'Brien *et al.,* 2008; Ribeiro and Abreu, 2008).The alcohol fuel programme in Brazil, for instance, has created a cost-effective way to substitute for fossil fuels. Labour-intensive sugarcane production systems provide opportunities for income and job generation, thereby increasing the economy's resilience to oil price fluctuation while generating income for the rural population. The programme has helped to reduce its import dependency from oil, has saved about US$52 billion (January 2003 US$) between 1975 and 2002 in foreign exchange, has created 900,000 relatively well-paid jobs, and has considerably reduced local air pollution in the cities as well as decreasing greenhouse gas emissions (Moreira *et al*., 2005; Lebre la Rovere *et al.,* 2006).

Like any other developing country, land pressure is increasing with the growing population in Senegal. Climate change poses an additional stress, which increases the vulnerability of forest and agricultural systems. To stabilize agricultural production levels, the restoration of soil fertility is a key factor. An ESD initiative, i.e., Agroforestry assists agricultural development and addresses climate change by providing a local energy supply for the rural poor, rehabilitating degraded lands, and sequestering carbon from the atmosphere (Sokona *et al.*, 2003; Sow and Saint Sernin, 2005).

In addition to the various human development challenges brought about by climate change, it also compounds persistent development problems such as population dynamics, land fragmentation, migration of people into sparser and drier lowland areas, inadequate infrastructure and provision of social services (Awuor 2008, Wandiga *et al.*, 2008, CCCCD and IISD 2009).

LVCEEP endeavours to promote skills and attitudes that support sustainability through the programme's activities. Development agenda, however important it is, must be implemented in ways that recognize the impacts of climate change; it is only by doing this that the development is sustainable. Development initiatives which do not consider climate change will lead to vulnerability and be the cause of increased greenhouse gases emission which will exacerbate climate change (Sathaye *et al*., 2007; Yohe *et al*., 2007).

2.9 National Climate Change Response Strategy

In 2010, in recognition that risks posed by climate change are legitimate but highly unpredictable, the Government of Kenya published the National Climate Change Response Strategy (NCCRS) aimed at putting in place measures needed to address the challenges posed by climate variability and change. The strategy's vision was to create a prosperous and climate change resilient Kenya with the mission of strengthening nationwide focused actions by ensuring commitment and engagement of all Kenyans towards adapting to and mitigating against climate change (GoK, 2010).

The NCCRS advocates diversification of livelihoods; adaptation of agricultural technologies from analogue environments; and enhancing early warning systems with drought monitoring and seasonal forecasts for the purpose of ensuring food security (GoK, 2010). Some of the key objectives of the national response strategy that this research endeavored to meet are recommending robust mitigation and adaptation measures needed to minimise risks associated with climate change while maximising opportunities, enhancing understanding of climate change and its impacts nationally and in local regions, recommending vulnerability research and technological needs and avenues for transferring existing technologies and providing a concerted action plan, resource mobilisation plan and robust monitoring and evaluation plan.

2.10 Research Gaps and Summary

Climate change has been characterized as one of the most important symptoms of unsustainability (Cohen *et al.,* 1998). Meeting the challenges of climate change has

been associated with meeting the challenge of achieving sustainable development (Robinson and Herbert, 2000). Climate change is also considered to be important for sustainable development because it triggers broader international, regional and local concerns about destabalising "spaceship earth" (Wilbanks, 2000).

Education for Sustainable development incorporates the pillars of economic, social and environmental development so that the process of poverty reduction is maintained throughout the changes in climate. The question of poverty must go hand in hand with any adaptation strategies in Africa (Kituyi *et al.*, 2002).

ESD is interdisciplinary education which concerns everything connected to the world; - space, time and quality of life. (Halder, 2004); the task of achieving sustainable development has to be shared by all sections of society—not just the Ministry of Environment, or international environmental bodies (Rao, 2001). No single unit can take on the tremendous responsibility of achieving sustainable development by itself, for it requires the concerted and urgent efforts of many agents, and a sea change in the type of development (Rao, 2001).

Although a large number of studies conducted in Lake Victoria Catchment have included the subject matter of climate change, research activities in Lake Victoria basin that have direct relationship with meeting the challenges of climate change have not been well represented in most available literature.

Following are some of the gaps that this research seeks to address:

1. Only a handful of these have deliberately set out to investigate strategies of meeting the challenges of climate change.
2. Little work is available on strategies which involve whole community participation approach (pupils, teachers, communities and non-governmental organisations) and more so, through education for sustainable development.
3. There is lack of awareness about the potentials of education for sustainable development or simply none appreciation of all- inclusive/cross sector interventions, Also, studies in this trans boundary system have focused on climate change policies related issues as evidenced from the numerous literature.
4. Other studies have focused on specific areas within the catchment such as the research on Community Based Approach to the Management of Nyando Wetland, Lake Victoria Basin, Kenya (Raburu *et al.,* 2012). The study: The Assessment of Community Adaptation Strategies to the impacts of Climate Change on trans boundary water: A Case Study of Katuk-Kapsitii Microcatchment, River Nyando Basin, Lake Victoria Region (Mwaura, 2010) comes close to the objectives of this study in that its objective was to assess community adaptation strategies to impacts of climate change on trans boundary water in the micro catchment, equitable water utilization and to realize interventions. However this particular study focused on a specific micro catchment, i.e., Katuk-Kapsitii, whereas the current study focused on diverse regions of the Lake Victoria Catchment. Moreover, the study targeted only the community groups within the micro catchment as opposed to the current study whose emphasis was on the multi-disciplinary, participatory nature of Education for Sustainable Development. However, findings from the Katuk-Kapsitii case study

revealed that the communities in this area implemented adaptation strategies such as generation of high value trees and tree-seedlings for income, draught and disease resistant varieties of crop and livestock and resorting to alternative livelihoods.

However, some studies have recently addressed strategies for reducing subsistence farmers' vulnerability to climate Change (Thorlakson, 2011), and Climate Change Adaptation Strategies: Water Resources Management Options for Smallholder Farming Systems in Sub-Saharan Africa (Ngigi, 2009). The study on Water Resources Management options for smallholder farming systems in sub-Saharan limits its scope to smallholder farmers and focuses on mitigation strategies specifically, as opposed to the current study which is involved in the various strata of the community (including the smallholder farmers) and which explores both adaptation and mitigation strategies.

It appears that research activities in Lake Victoria basin that have direct relationship with meeting the challenges of climate change have not been well represented in most available literature that was covered in relation to this study.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter focuses on the research design and the methodology adopted. It also gives an overview of the literature review which informed the decision to select the methodology used. Section 3.2 presents the scope of the study, section 3.3 presents the data collection methods and section 3.4 presents the data analysis methods and finally the overall assessment concludes chapter 3.

3.2 Scope of the Study

The Lake Victoria Catchment Environmental Education Programme (LVCEEP), then the only programme in the region targeting the catchment communities through environmental education, was a regional programme implemented under WWF-East and Southern Africa Regional Programme Office. The goal of the programme was to secure the ecological integrity and sustainability of the Lake Victoria catchment for the benefit of its inhabitants and biological diversity. Although LVCEEP covers the Lake Victoria catchment in Kenya, Tanzania and Uganda, the study focused on the Kenyan Programme areas of Homabay, Nandi and Transmara Regions.

Details of the programme sites and groups are presented in Table 3.1.

Table 3.1: LVCEEP Project Sites in East Africa

Source: LVCEEP Progress Report (2009)

COUNTRY	PROJECT AREAS	TOTAL NUMBER OF SCHOOLS	NUMBER OF TEACHERS COLLEGES	COMMUNITY GROUPS
Kenya	Homabay, Nandi South, and Transmara	18	2	6
Tanzania	Musoma, Tarime	13	2	8
Uganda	Kyejonjo, Masaka	18	3	26
TOTAL		**49**	**7**	**40**

3.3 Research Site and Research Participants

In order to seek insights about the implementation of Education for Sustainable Development programme in the Lake Victoria catchment and its link to the government's efforts in meeting the challenges caused by climate change as well as the aspects related to international strategies to combat climate change, detailed empirical research in a specific geographical context was needed . For this reason, a case study approach was used. Moreover, case studies are appropriate for exploratory research (Yin, 1994).

The study focused on the three areas covered by the Kenyan LVCEEP areas of Homabay, Nandi and Transmara as displayed in Table 3.2.

Table 3.2: Study Population

Source: LVCEEP Progress Report (2009)

Schools and number of students from Class 4 to 8

NANDI	MALE	FEMALE	TOTAL
Kapkitony Primary	117	105	219
Enego Primary	105	70	175
Ndurio Primary	92	93	185
Koyo Primary	95	113	208
Ndurio Secondary	100	99	199
Kamarich Primary	125	101	226
HOMABAY			
Pedo Primary	100	102	202
Lala Primary	101	66	167
Maguti Primary	105	85	190
Nyagidha Primary	107	75	182
Lala Secondary	102	95	197
Lieta Primary	106	184	190
TRANSMARA			
Olopikindongoe Primary	112	48	160
Olmotonyi Primary	105	99	204
Illkarian Primary	85	101	186
Emurutoto Primary	79	107	186
Sitoka Primary	102	73	175
Illokwaya Primary	113	78	191
TOTAL	**1851**	**1591**	**3442**

Simple random sampling which is the process of selecting from the population that provides every sample of a given size an equal probability of being selected was used to identify 6 out of the 18 schools that formed the sample.

According to Mugenda and Mugenda, (1999) a sample size of between 10 and 30 % is a good representation of the target population and is adequate for analysis. Therefore, 2 schools out of 6 which is 33% per project site or 6 schools out of the 18 schools which is 33% was an appropriate sample as presented in Table 3.3.

Table 3.3: Study Sample for the Schools

Source: LVCEEP Progress Report (2009)

NANDI	**MALE**	**FEMALE**	**TOTAL**	**TEACHERS**
St John the Baptist Enego Primary	105	70	175	6
Ndurio Primary	92	93	185	3
HOMABAY				
Lala Primary	101	66	167	7
Lieta Kabunde Primary	106	84	190	3
TRANSMARA				
Olopikindongoe Primary	112	48	160	4
Illkarian Primary	85	101	186	7
TOTAL	601	462	1063	30

Questionnaires were distributed to the 955 students. Moreover Total Population Sampling was done for the 6 community groups in the target population as listed in Table 3.4.

Table 3.4: Study Sample for the Community Groups

Source: LVCEEP Progress Report (2009)

NANDI	TOTAL NUMBER OF MEMBERS
Enego Environmental Group	12
Ndurio Community Environmental Group	16
HOMABAY	
Nyagidha Environmental	11
Lieta Kabunde Nyalieta	18
TRANSMARA	
Enkutoto	17
Enkangesoit	13
TOTAL	**87**

Invitation letters to participate in the study were sent to 10 CBO's, Ngo's and other networking/partnering organizations working in the Lake Victoria Catchment. 7

representatives of these organizations together with one programme officer from LVCEEP participated in the focus group discussions as presented in Table 3.5.

Table 3.5: Representatives of networking partner organisations

Source: LVCEEP Progress Report (2009)

ORGANISATION	**NUMBER OF REPRESENTATIVES**
Uhai Lake Forum	2
Sunset Birders	1
Osienala	1
Lake Victoria Basin Authority	1
Maseno University Environmental Club	1
Kisumu Environmental Teachers Association	1
Lake Victoria Environmental Management Programme	1

Moreover the teachers' training colleges were not involved because they were only 2, both situated in the same project site and both displayed poor response in the pilot study and the researcher reasoned that they might not add value in terms of diversity of data.

Total number of student respondents was 770 out of the anticipated 955, 30 teachers , 87 community group members and 2 LVCEEP Staff together with 8 representatives of networking partner organisations working in the lake's catchment.

3.3.1 Research Design

The study aimed to present a 'holistic overview' through the application of a case study strategy. Case studies can be anchored in real life situations (Merriam, 1998); cover contextual situations (Yin, 2003); offer insights and illuminates meanings (Merriam, 1998).

Results derived from case studies are more easily understood even by non -academic audience because the writing is usually simple (Cohen *et al.,* 2007). According to Cohen, the results do not usually require professional interpretation; because they are intelligible immediately as they are self- explanatory and they also capture unique features that can be lost in large scale data from e.g. surveys (Cohen *et al.,* 2007).

According to Denscombe (2007), because case studies focus on specifics, it is possible for the researcher to employ a variety of methods, encourages the use of multiple methods of data capture enabling triangulation and validation. According to O'Donoghue and Punch (2003), triangulation is a "method of cross-checking data from multiple sources to search for regularities in the research data". Snow and Anderson (cited in Feagin, Orum and Sjoberg, 1991) asserted that triangulation can occur with data, investigators, theories, and even methodologies. Stake (1995) stated that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. The need for triangulation arises from the ethical need to confirm the validity of the processes. In case studies, this could be done by using multiple sources of data (Yin, 1984). Yin (1994) suggested using multiple sources of evidence as the way to ensure construct validity. This study applied data source triangulation Denzin (1984) to corroborate the data gathered from other sources. The multiple

sources of data were; documentation, archival records, in-depth interviews, direct observation and Focus Group Discussions.

Denscombe (2007, however, warns that gaining access to conduct case studies can pose a challenge. The researcher's presence can change the responses of those being researched.

3.3.2 Research Methods

Prior to the start of the study, a circular was sent to the schools, community groups and partner organizations participating in the survey indicating the aims of the study and the required information. The circular served to introduce the researcher to teachers, students, community members and the partner organizations.

There is an increasing recognition in the literature on field methods in development studies that judicious combination of qualitative and quantitative methods can help solve problems that are associated with each type of methods taken separately (Kanbur, 2001; White, 2002). Quantitative and qualitative data collection approaches were employed in the primary and secondary sources covering the in-puts, processes, and the LVCEEP outputs (Harris and Taylor, 1997). The study therefore adopted a combination of qualitative and quantitative methodology, including

1. Focus Group Discussions (FGDs),
2. In-depth interviews (IDIs) with stakeholders
3. Structured and semi-structured questionnaires survey.

4. Relevant policy and programme documents of Lake Victoria Catchment Environmental Education Programme were collected and reviewed.
5. Triangulation of methods because a single method was considered inadequate in its capacity to capture sufficient data to come up with a sound and systematic analysis of the issues to be assessed (Beal, 1985).

Various researchers have discussed the importance of implementing verification strategies throughout a study (Morse *et al*., 2002). Triangulation is identified as a strategy for increasing the validity or rigor of a study (Golafshani, 2003).

3.3.3 Data Collection

The primary data were collected using semi-structured in-depth interview schedules direct observations and focus group discussions. However the order of the questions and the exact wording of the questions were left to the discretion of the interviewer (Bryman, 2001; Hessler, 1992). Both questionnaires and interview schedules were applied. Questionnaires and interviews are often used together in mixed method studies investigating educational assessment (Brookhart & Durkin, 2003; Lai & Waltman, 2008). The questionnaires for the interviews were designed to offer the respondents freedom in their choice of answer so that their thoughts could flow without being directed or influenced by the interviewer (Oppenheim, 1992). To gain in-depth understanding of the LVCEEP implementation, it was deemed necessary to directly experience the practical situation and dynamics in the field; supporting data was therefore collected through field observations in which the researcher acted as a non-participant observer in project activities (Punch, 1998). The Field observations were conducted in the schools and the community members' homes. All the sample

schools were included in the field observations while a random selection of the community members' homes was done such that 10 homes were selected for the field observations.

Recording sheets and checklists were used to collect observation data (Taylor *et al.*, 1996). These included a list of implemented activities that had been recorded in the questionnaires. Field notes were also written as observation took place. In addition, the researcher took photographs as part of observation data.

The field observations generated evidence from the context where the events occur exactly as they ordinarily occur or as the researcher observed them (Denscombe, 2003). This data collection method was relevant in this study because LVCEEP activities are largely practical-on the ground actions such as tree planting, rain water harvesting and fish ponds among others.

3.3.4 Secondary Data and Data from Focus Group Discussions

The main method of Secondary data collection used was a review of pertinent literature and documents. LVCEEP programme documents such as the baseline report, audit reports, internal topical studies and project documents such as progress reports, technical reports and other relevant programme literature. For relevance, the researcher opted to use LVCEEP programme documents covering the last five years.

The Focus Group Discussions

According to Cohen *et al* (2007), incorporating focus group discussions in case studies provides a collective view on the subject material in hand and yields insights that may not otherwise be found in straight forward interviews. Focus groups are a form of group interview that capitalises on communication between research participants in order to generate data (Kitzinger, 1995). Focus groups have advantages for researchers because they do not discriminate against people who cannot read or write and they can encourage participation from people reluctant to be interviewed on their own or who feel they have nothing to say (Kitzinger, 1995).

In this study, focus group discussions were conducted after the collection of secondary data and participant observation process but before interviews. This order was used because focus groups have the potential of establishing crucial issues which would be important to follow up on during the interviews; from the focus group discussions, the researcher also reviewed the list of the participants to include in the interview session (Williamson, Schauder and Bow, 2000). Focus group discussions were held with local communities whose homes had been subjects of direct observation and another one of 2 LVCEEP Staff together with 8 representatives of networking partner organisations working in the lake's catchment. The researcher focused on homogeneity within each group in order to capitalise on the sample's shared experiences.

Focus group discussions for both the community group members and for the LVCEEP staff and partners took place at the LVCEEP project offices. The Focus group discussions took place on the same day, 1 in the morning and the other in the afternoon because the community members needed to travel from their homes to the LVCEEP offices in Kisumu; their focus group discussions took place in the morning. The sessions were conducted in a circle sitting. 10 community members were involved in the first focus group discussion and the one which involved partners and LVCEEP staff also had 10 participants in the sessions. The researcher explained the aim of the exercise to the participants while encouraging them to talk to each other. The researcher facilitated the selection of a group leader who would moderate/guide the discussions from amongst the groups. Cards with guidelines/questions were given to these group leaders. The researcher did not participate in the discussions but intervened at intervals to encourage the participants to continue the debate and urging them to discuss the inconsistencies in their discussions.

The discussions were tape recorded for transcription and the group leaders also recorded the key issues on a flip chart.

3.4 Summary of the Kenya National Climate Response Strategy

To determine the relationship between Education for Sustainable Development and the government's guidelines on responses to the challenges of climate change, the Kenya National Climate Change Response Strategy (NCCRS) was a key resource. The NCCRS's primary focus is ensuring adaptation and mitigation measures are integrated in all government planning, budgeting and development objectives.

As a response to the challenges posed by climate change to Kenya, the Strategy has proposed a number of measures meant to curb the adverse impacts of climate change on the country (adaptation measures) and to tame global warming (mitigation measures).

1. Adaptation

a) Health (clinics, human capital, heightened surveillance of new outbreaks with consequent rapid responses; and health education campaigns

b) Agriculture (provision of downscaled, water harvesting, irrigation, (soil and water conservation techniques); and research and dissemination of superior crops

c) Water (water harvesting, water conservation, water recycling facilities, building capacity for water quality improvement, and awareness campaign to promote water efficiency measures.

d) Fisheries (shore protection measures; developing financing mechanisms using non-consumptive options for supporting marine ecosystem research and development; and encouraging a coastal and watershed- basin management approach linking land-use practices to marine and fisheries resource conservation.

e) Tourism/Wildlife(development a suite of well assessed climate change adaptation strategies by the Kenya Wildlife Service (KWS) and Stakeholders, development and enforcement of Green Strategy and Code; and branding of Kenya as a Green Destination

f) Livestock/pastoralism (developing special livestock insurance schemes; breeding of animals that adapt well to climatic vagaries; regular vaccination campaigns; promotion of economic livelihood diversification, e.g. cultivation of drought-tolerant food crops and bee-keeping and awareness campaigns among pastoral communities to

underscore the importance of balancing stocking rates with the available land resources as a way of ensuring sustainable pastoralism.

g) Physical Infrastructure including transportation and telecommunication networks (ensuring that the infrastructure is climate-proof over its lifespan, maintenance; and designing infrastructure that can withstand the prevailing climatic conditions)

h) Social Amenities including human settlements(strengthening disaster preparedness; proper planning of urban settlements which takes into consideration the expected high growth rate of urban population and establishing insurance schemes)

2. Mitigation

Proposed mitigation interventions include projects of the Kenya Forest Service's Forestry Development Plan (FDP); Energy Ministry's Green Energy Development; as well as other interventions in the transport and agricultural sectors such as:

a) Tree growing by schools and communities

b) The Green Energy Development Programme e.g. geothermal steam reserves, wind power generation, solar energy capture and utilisation and biofuels.

c) Mandatory energy audits of large commercial and industrial consumers; Review of tax policies to encourage the importation of energy efficient motor vehicles; Subsidies and other tax incentives to promote and sustain wider adoption of energy efficient electrical gadgets such as compact fluorescent light (CFL) bulbs and solar hot water heating; and Constructing energy efficient buildings, e.g. buildings that use as much sunlight as possible

d) Transport (promotion of low-cost public transport modes such as Bus Rapid Transit (BRT) and other means of mass transport; proper urban and transport planning to facilitate efficient and low GHG modes of transportation, e.g. decongesting roads;

encouraging non-motorised modes of transport (NMT) by creating bikeways and pedestrian walkways; creating transport demand management measures that encourage or favour public transport and NMT; establishing a Light Rail Transit (LRT) along with the BRT in major cities and towns to help decongest traffic; and improving the country's railway network to facilitate low-cost and low-carbon long-distance transportation of cargo and passengers.

e) Agriculture (appropriate use of biotechnologies which increase food production per unit area while simultaneously limiting GHG emissions; proper management of agricultural waste e.g. using manure to produce biogas; and promotion of agroforestry.
f) Carbon Markets (e.g. energy, transport, agriculture) as well as manufacturing and others. These projects can gain monetarily from 'carbon markets' that allow them to sell Certified Emission Reduction (CER) credits to developed countries
g) Climate Change Communication, Education and Awareness Programmes
h) Vulnerability Assessment, Impact Monitoring and Capacity Building
i) Research, Technology Development, Absorption and Diffusion
j) Climate Change Governance

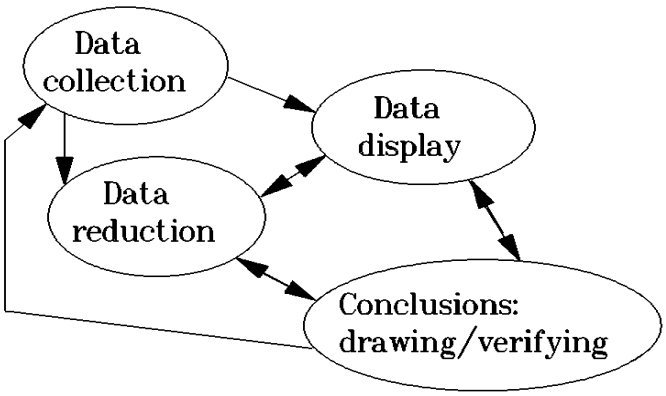
3.5 Data Analysis Methods

In the same way as in the collection of data where triangulation of data source was used, data analysis triangulation was employed. Data analysis triangulation involves utilizing more than one type of analysis in order to create more understanding of

the phenomenon under study and also to validate the data analysis result (Leech and Onwuegbuzie, 2007).

The use of multiple methods included combining analytic approaches (constant comparison, events analysis, descriptive analysis, matrices) and computer-assisted analysis, and analyzing the same data with two different methodological approaches (Meadows and Morse, 2001). The study used Statistical Package for the Social Sciences (SPSS) for the computer assisted analysis. SPSS is a programme used for statistical analysis in social science.

The data analysis followed the process of data reduction, data display and the drawing of conclusions as outlined by Miles and Huberman (1994). This process is shown in Figure 3.1.



Source: (Miles and Huberman 1994)

Figure 3.1: Components of Data Analysis: Interactive Model

In this model, the various stages of data analysis are interconnected. The researcher reduced the data in line with the research questions. Miles and Huberman (1994) state that, "data reduction refers to the process of selecting, focusing, simplifying,

abstracting, and transforming the data that appear in written up field notes or transcriptions."

This process was followed by data display whereby the now more organized data was displayed in tables to enable cross-case analysis and pattern identification. These activities were conducted to facilitate the drawing of conclusions. According to Miles and Huberman's (1994), data display provides an organized assembly of information that permits analyzing of conclusions. The conclusions drawn from the display analysis, however had to be further verified by looking back at the earlier stages of the data analysis, including the raw data, and confirming the significance of the suppositions.

3.6 Overall Assessments

To assess and represent LVCEEP activities and contributions to climate change adaptation and mitigation efforts based on the current national framework of policies on climate change adaptation and mitigation, a matrix analysis based on impacts of the implementation of LVCEEP and the Government of Kenya's Strategy "National Climate Change Response Strategy of 2010" was done.

3.7 Chapter Summary and Conclusion

Guided by Johnson (1994, p. 174) the researcher recognised the need to pay extra attention in selecting the research methods as the methods selected would impact on the quality of data generated thereby affecting the entire research process.

The study employed diverse research methods (both quantitative and qualitative) through interviews with the students and teachers in the sampled population, employees and stakeholders involved in the programme, observations and examination of documentary evidence in order to form the case study but with some initial documentary research for the purpose of gathering information on the background of LVCEEP.

This chapter has introduced and justified the choice of case study strategy as a suitable research methodology for this study. The real-life situation of the Lake Victoria Catchment Environmental Education Programme enabled data collection as the programme activities were on going. Further, because LVCEEP is still under implementation, it was possible to access the programme staff, their partners and the target stakeholders. The views of the schools and communities involved in LVCEEP as well as their interaction with the catchment resources are necessary.

Implementing verification strategies also added credence to the data collected. But more significant was the use of a triangulation of methods in this study as it enabled the study to collect adequate and diverse data thereby leading to more accurate and systematic analysis of the collected data. The interactive model of data analysis as outlined by Miles and Huberman (1994) helped to shape the whole process.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Introduction

Chapter four presents the empirical findings of the study and discusses the results and interpretation of the data obtained from the field. This chapter discusses the subject of climate change and links it with the activities of LVCEEP, providing a framework in which to examine the programme impacts alongside the National Climate Change Response Strategy and draw conclusions about how the implemented programmes support the National Strategy to deal with the challenges of Climate Change.

Data was analyzed using descriptive statistics and regression analysis. Data has been presented using tables, graphs and charts. The data obtained was analyzed to determine areas of LVCEEP involvement and its applicability in the fight against the impacts of climate change. The descriptive statistics are presented in section 4.2. The relationship between ESD and Climate Change was examined and presented in section 4.3, while section 4.4 presents comparative congruency test results between LVCEEP and climate change mitigation and adaptation and section 4.5 examines whether the activities of LVCEEP contribute to efforts on coping with climate change in relation to the National Mitigation and Adaptation Strategy. Sections 4.6 to 4.8 present the results of the hypothesis testing. Chapter 4 also presents an analysis of the data gathered, along with a series of propositions relating to the research questions.

The purpose of this chapter was to analyze the variables involved in the study and estimate the model described in the previous chapter. Data collected was both qualitative and quantitative.

Data was analyzed using descriptive statistics and regression analysis. Data has been presented using tables, graphs and charts. The data obtained was analyzed to determine areas of LVCEEP involvement and its applicability in the fight against the impacts of climate change. The descriptive statistics are presented in section 4.2. The relationship between ESD and Climate Change was examined and presented in section 4.3, while section 4.4 presents comparative congruency test results between LVCEEP and climate change mitigation and adaptation and section 4.5 examines whether the activities of LVCEEP contribute to efforts on coping with climate change in relation to the National Mitigation and Adaptation Strategy. Sections 4.6 to 4.8 present the results of the hypothesis testing.

The study applied the regression model to enable the researcher to quantify the contribution of each sub-variable towards the dependent variable. The purpose of the multiple regression was to enable the analysis of the relationship between metric or dichotomous independent variables and a metric dependent variable (McDonald, 2009).

For example, by forming the equation:

y=a1b+a2c+a3d

$Y = \beta_0 + \beta_1 B + \beta_2 C + \beta_3 D + \varepsilon$

the contribution of B towards Y (dependent variable) could be quantified.

4.2 Background information

The researcher found it necessary to establish the respondents' background information since it is a determining factor in their involvement in the programme.

Table 4.1: School and Programme background information

	Min	Max	Mean
Age of the school (Years)	10	87	14.5
The size of the school (size in hectares)	3	90	16
Total number of students	22	953	159
Total number of teachers	9	440	73
Total number of students involved in ESD projects	1	953	159
Total number of teachers involved in ESD projects	1	22	3.6
Total number of non-teaching staff involved in ESD projects	1	76	12.6
Total number of parents/community members involved in the ESD projects	1	450	75.00

From the study findings and according to the teachers, the average age of the schools is 15 years; the average size of the school is 16 hectares, average number of the pupils in most of the schools is 159 students.

The study further sought to establish the schools' population that is involved in LVCEEP programme in the schools. According to the teachers, the average number of students involved is 159 pupils, 4 teachers, non-teaching staff is 13 and the total number of the parents/community members' involved in the ESD projects in most of the schools is 75 as shown in Table 4.1.

The findings indicate that most of the children in the programme schools are involved in the ESD activities. By identifying schools as important stake holders and therefore working with young people, this strategic choice by LVCEEP is in sync with UNICEF's report which emphasises that since the bulk of the global population is under 18 years of age, this group should be a centre of focus in climate change related activities (UNICEF, 2014). The report further states that empowered children are dynamic and capable of leading the fight against environmental degradation. According to the UNICEF report children are among the most vulnerable groups to climate change and may be the greatest victims of its impacts (UNICEF, 2014).

A case study exploring children's views and experiences in the school grounds (Christidou *et al.,* 2013) further supports this view by emphasizing that children's interaction with the environment is an important aspect of learning (Fleer *et al.,* 2003, Malone *et al.,* 2007; Maynard *et al.,* 2007; Rivkin, 1997, 2000; White *et al.,* 1998). Children are capable of understanding interrelationships in nature (Tsevreni *et al.,* 2006; McDonald *et al.,* 2002).

To determine the backgrounds of the teachers involved in the programme, the study sought to establish the respondents age and the findings indicated that most of the teachers 16(53.3%) were aged between 31-40 years old as illustrated in Table 4.2.

Table 4.2: Teachers' background information

Age	Frequency	Percentage
21-30years	5	16.7
31-40 years	16	53.3
41-50 years	6	20.0
51-60 years	2	6.7
No response	1	3.3
Total	30	100.0
For how long have you been in this school		
less than 2 years	**6**	**20.0**
2-5 years	13	43.3
5-8 years	4	13.3
More than 8 years	6	20.0
No response	1	3.3
Total	30	100.0
For how long have you been involved with LVCEEP		
Less than 3 years	**10**	**33.3**
2-5 years	10	33.3
5-6 years	2	6.7
Since inception	7	23.3
No response	1	3.3
Total	30	100.0

The results also indicated that 13(43.3%) of the teachers had been in the same school for between 2-5 years while 10(33.3%) had been involved with LVCEEP projects for less than 3 years with the same number having been involved for between 2-5 years. This implies that most of the respondents had been involved with the project for between 1-5 years as shown in Table 4.2 above.

The study wanted to determine the gender composition of the pupils involved in LVCEEP. Figure 4.1 illustrates the gender composition.

Gender disparity and involvement in LVCEEP Programme

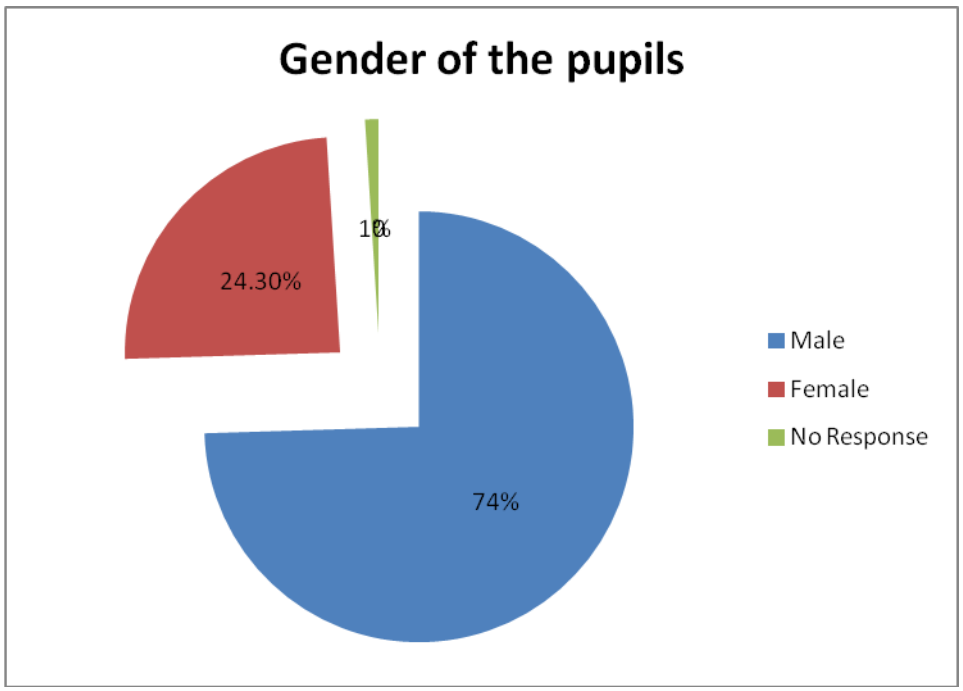


Figure 4.1: Pupils' Gender

From the study findings, most of the pupils 567(74%) were males while 399(23.3%) of them were females. Climate change is increasingly being recognized as a global crisis, but responses to it have so far been overly focused on scientific solutions, rather than on the significant human and gender dimensions as observed by Skinner (2011). Climate change increases the risks to the most vulnerable and less empowered social groups (UN, 2008). There is a strong link between gender and climate change and both are considered as cross cutting issues (Lwando *et al.,* 2013). Various studies have shown that gender is an important variable affecting adoption decision at the farm level. Female farmers have been found to be more likely to adopt natural

resource management and conservation practices (Newmark *et al.,* 1993; Burton *et al.,* 1999; Dolisca *et al.,* 2006; Bayard *et al.,* 2007).

The findings of this study revealed that 76% of the pupils involved in LVCEEP activities were male as compared to 23.3% females. This ratio is an indication that there is no special focus on the girl child involvement in the activities. These results are in tandem with those of a study of actions, achievements and challenges with reference to school education in India (Bhagat and Oraon, 2006) which identified the girl child as one of the categories of people left out of the mainstream education in India. The results of the study reflects the Gender Parity Index (GPI) of 0.6 (Bhagat and Oraon, 2006).

The results of studies conducted by Ribeiro and Chaúque (2010), UNFPA (2009) and Osman-Elasha (2008) demonstrated that the effects of climate change on women and men is not the same and that women are more likely to be severely affected by climate change. More boys than girls participated in the LVCEEP activities and might affect the efforts to mitigate and adapt to climate change as the contribution and the role of the female gender is critical given their interactions with water, trees and other natural resources. Integrating gender concerns into climate change adaptation policies and programmes ensures that gender-differentiated capacities and impacts are considered and women are involved in the design and implementation of policies, planning and programming initiatives, not just as beneficiaries but as drivers of climate change adaptation (UNDP, 2011). A study by Plan International indicated that climate change will make life even more difficult for adolescent girls in the developing world.

The study reports that it is the girls who walk for long distances to fetch water and firewood (Scientific American, 2011). It is now widely agreed that mainstreaming gender into climate change activities is necessary (Joto Africa, 2011).

A related research conducted by Plan International in Bangladesh and Ethiopia shows that girls are worse affected than boys when the environment is degraded and by the effects of climate change because women and girls are in continuous interaction with natural resources in activities such as collecting firewood and fetching water amongst (Plan International, 2011). Because of these gender assigned responsibilities, the effects of climate change including drought and desertification make it hard for them to secure these resources. (UN, 2008). Women's dependence on the local commons, the everyday nature of that dependence and their primary responsibility for children make women (and girls) more motivated to ensure that the environmental resources are conserved (Agarwal, 2000). Statistics indicate that women provide up to 90% of the rural poor people's food and produce 60-80% of the food in most developing countries yet they are not represented in decision making processes on climate change e.g., women can contribute different perspectives and experiences, they are closest to natural resources because they are dependent on them (Joto Africa, 2011).

A study by Dennings *et al.* (2009) further emphasizes the importance of gender balance in sustainable development initiatives. The study pointed out that in sub-Sahara Africa, women and girls are responsible for collecting and carrying water, among many other domestic activities which involves direct contact with the

environment and as such should be more involved in activities touching on such resources (Dennings *et al.* 2009)

Similarly, a study conducted on climate variability and gender in Western Zambia revealed that women have been hit hardest by climate variability such as droughts and floods (Lwando, 2013). The study results indicated that there was no gender responsive funding allocation to support communities in the implementation of adaptation measures to climate variability and that further, activities and funding did not have a gender element and also lacked information specifying how women and men will be incorporated into the various proposed activities (Lwando, 2013).

Young (2008) stated that "as communities cope with the effects of changes in climate, demands on women's time and workloads are likely to increase. To compensate for increased demands on their time, poor families may pull girls out of school". The added stresses incurred by a changing climate compound the many risks already faced by women in developing countries. The female gender has been identified as being major drivers of sustainable development and the incorporation of their gender specific roles and responsibilities in climate change strategies ensures that the whole society will benefit (Denton, 2002).

In order to promote sustainable development there is the need for citizens (males and females) to participate in the economy, policy and social development of the society (Ukpore, 2009). It has been emphasized that gender differences and inequalities may influence response to sustainable development and challenges (Nasreen *et al*, 2009). "ESD should actively promote gender equality, as well as create conditions and

strategies that enable women to share knowledge and experience of bringing about social change and human well-being." (UNESCO, 2009), Vulnerable groups including girls, women, indigenous and coastal populations are hardest hit by impacts of climate change, including the increasing intensity and frequency of extreme weather events and natural disasters. Especially girls and women who often play an important role in managing risks in the household and community are aimed to benefit from climate change education and education for disaster risk reduction (UNESCO, 2009). Exposure to ESD therefore develops human potential to address future change and challenges such as climate change (Bangay and Blum, 2009). Climate change effects are location specific and disproportionately distributed among different countries, income groups, occupations and between gender (IPCC, 2007). Various studies including Ribeiro and Chaúque (2010) and Osman-Elasha (2008) have revealed that the effects of climate change on women and men is not the same and that women are more likely to be severely affected by climate change. Vulnerable groups including girls, women, indigenous and coastal populations are hardest hit by impacts of climate change, including the increasing intensity and frequency of extreme weather events and natural disasters. Especially girls and women who often play an important role in managing risks in the household and community are aimed to benefit from climate change education and education for disaster risk reduction (UNESCO, 2009). The participation of the girl child in LVCEEP should therefore be enhanced for maximum benefit. ESD emphasises that for interventions on climate change to have impact, girls should be incorporated into the projects. The promotion of Education for Sustainable Development contributes to responses to the challenges of climate change.

The Intergovernmental Panel on Climate Change (IPCC, 2007) report predicted that climate change would exacerbate extreme weather events such as tropical storms, heat waves, and heavy precipitation leading to flooding. Whether in developing or developed countries, there is evidence to suggest that women are more likely to die as a result of such disasters, and, if they survive, suffer more in the after-effects (IPCC, 2007). Global studies are in general agreement that poor countries, particularly those in Africa will suffer the most from climate change impacts. Economic impact assessment studies at a global level indicate that the global benefits of acting today outweigh the global future costs of uncontrolled emissions, particularly because of the high damage estimates for the poor parts of the world (Reid, 2005).

Although the Kenya government is yet to implement climate change specific policies, there are a wide range of policies and programmes concerning natural resource management and sustainable development under current climatic conditions, despite this, just a handful of these programmes are integrated in the education system and thus the need for programmes like LVCEEP to empower the pupils especially in upper primary to participate in activities geared towards coping with climate changes challenges, it is for this reason that the study sought to find out their involvement in LVCEEP activities as shown in Figure 4.2.

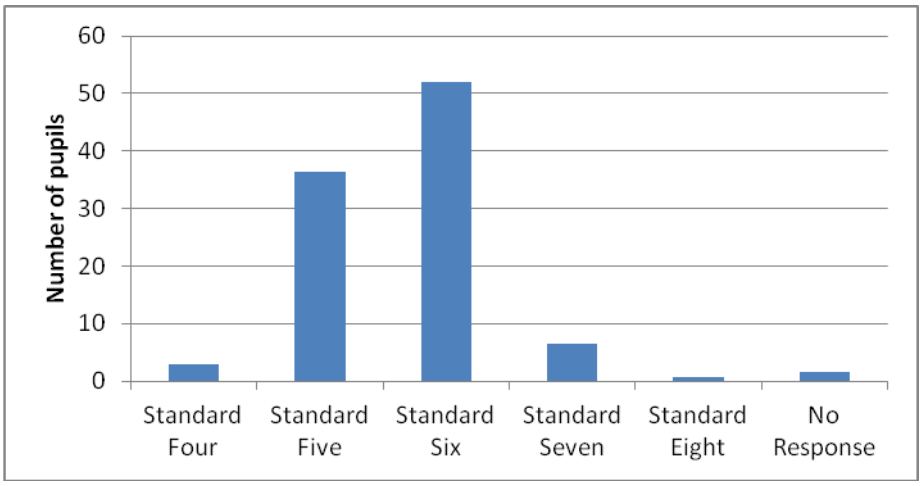


Figure 4.2: Pupils Class

The sample study was from class 4 to 8. LVCEEP activities focuses on this classes because they are able to understand the contents of the programme and also because they are old enough to participate in the programme implementation. Available data indicated that 51.9% of the respondents were in class six, 36.3% were in class five while 6.6 % were in class seven and 2.9% in class four. Further findings indicated that less than 1% were in class eight. Conservation experts emphasise the importance of teaching primary school pupils how to conserve their environment at a tender age (Cullingford, 1996). Moreover, studies have indicated that children were worried about environmental problems and that they regard their environment as the 'green horizon' around their schools or homes (Cullingford, 1996).

The study sought to establish the age of the community members involved in LVCEEP. The findings revealed that most of them, i.e., 42(48.8%) were aged between 18-28 years while 22(25.6%) were aged between 29-39 years (Table 4.3).

Table 4.3: Age of the Community Members

Age	Frequency	Percentage
Below18	2	2.3
18-28 years	42	48.8
29-39years	22	25.6
40-50 years	16	18.6
No response	4	4.7
Total	86	100.0

This is an indication that younger community members are more inclined to engage in conservation related activities. These findings contrasts with those of a study conducted to investigate the determinants of household decision to join Forest Associations (Musyoki *et al.*, 2012) whereby the results indicated that older people were more interested conservation related activities.

Other studies have reported different findings with regard to the influence of age on participation in conservation activities. For instance, Thacher *et al* (1997), Anim (1999), Bekele and Drake (2003) and Zhang and Flick (2001) found age to be insignificant on community members' decision in engaging in similar activities, while Dolisca *et al* (2006) found that age had a negative impact in the level of participation in forestry activities. The research by Dolisca *et al* (2006) revealed that the young people were more willing to participate in forest activities, a similar finding to the case under study.

The study sought to find out the length of time the community members had lived in the area of study and also the duration of their involvement with the community groups, details of this is illustrated in Table 4.4.

Table 4.4: Community Members Involvement

	N	Min	Max	Mean
For how long have you lived here	75	6	64	67
How long have you been a member of the group	75	2	10	6
Valid N (list wise)	75			

The findings indicated that most of them had lived in the area for a minimum of 6 years and a maximum of 64 years; on average the community members had lived in the same neighbourhood for 35 years. Further findings indicated that the bulk of the community members joined the groups between 2004 and 2012. Moreover, 98.8% of them belonged to government registered community development groups. These findings are in tandem with those of an Assessment study of Rural Water Supply Management in Selected Rural Areas of Oyo State, Nigeria (Gbadegesin and Olorunfemi, 2007) which found out that more than 30% of all respondents in all communities in the study had stayed in their respective communities for upwards of 20 years. These findings also concur with those of the results of a research conducted on a community based forest management project in Buru, Tarab State, Nigeria which revealed that indigenous people living adjacent to forests are important stakeholders

in forest conservation because they acknowledge their dependency on the forest for their livelihoods (Akinsoji, 2013).

The implications of having lived in the same place for long is that the individual/s are generally aware of the environmental and sustainable development related issues in their communities and they may also be in a better position to detect changing trends in their interactions and the management of the situation especially if their capacity is built through ESD. Education for environmental sustainability involves education geared towards enhancing responsible societies (Sauve, 1999).

There is need to involve local people in all aspects of conservation and development processes, empowering them with appropriate skills, knowledge, technical and financial assistance, with the goal of improving their quality of life (Gurung *et al.*, 2005) This way, the community is encouraged to participate towards natural resources conservation, tourism management and sustainable community development.

4.3 How Education for Sustainable Development contributes to the Government's guidelines on responses to the challenges of Climate Change

Awareness raising amongst populations and capacity development are key policy options and recommendations which came up in the Eastern African Workshop held in Arusha/Tanzania on 29th of August 2009 (GTZ, 2009). Awareness raising, education and training are core activities of LVCEEP. This approach is supported by Article 6 of the UN Framework Convention on Climate Change whose mandate is

climate change education and which emphasizes the importance of implementing programmes to educate, train, and access information on climate change and its effects.

To determine the reason for the community members' involvement in LVCEEP, the study sought to find out the motivation as presented in Figure 4.3.

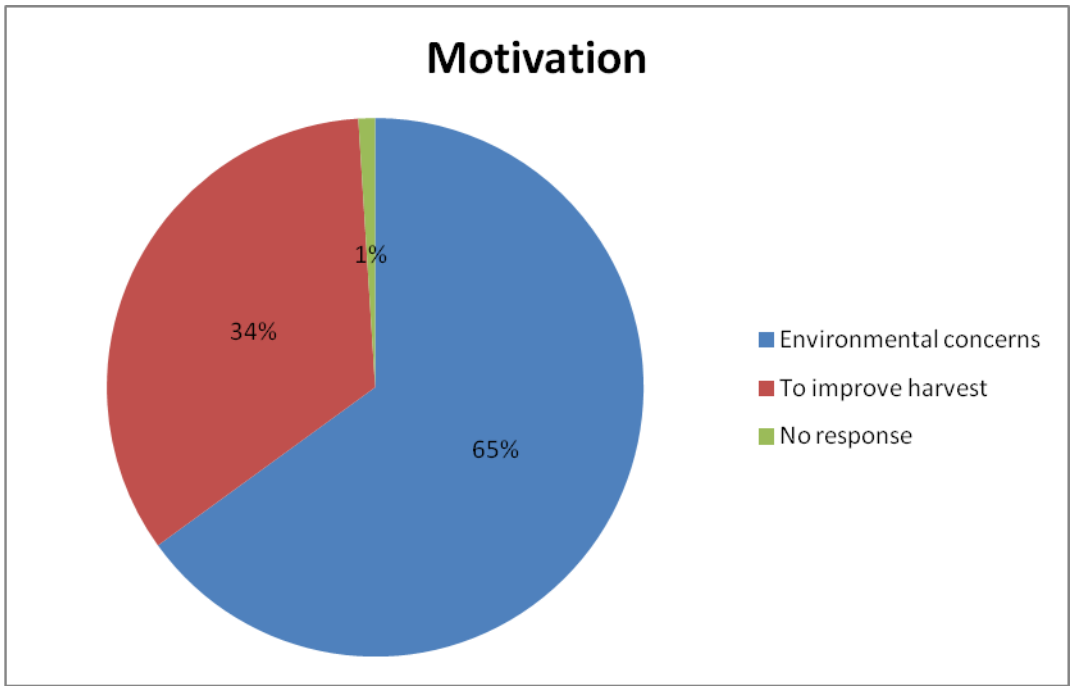


Figure 4.3: Motivation to join the group

When asked what motivated them to join the community programme, the study revealed that 85(98.8%) respondents were motivated by environmental concerns. These findings concur with those of the study by Babikwa (2004), which revealed that the main motivating factor for the farmers' involvement in the sustainability programme in Uganda was because they had resolved to pursue those activities to

protect the environment, and secondly, because the activities were directly related to their material and economic well-being.

Findings from other studies indicate that communities will support and participate in conservation activities when they can benefit directly from them; this potential benefit makes the community members view natural resources as assets for their development (Bulte *et al.,* 2003). A study conducted in Derre Forest Reserve in Mozambique also identified financial benefits as the motivation for the community members to engage in conservation activities (Nhantumbo *et al.*, 2003).

To find out the attention given to LVCEEP activities, the study sought to find out the amount of time that is dedicated to the activities as illustrated in Table 4.5.

Table 4.5: Time dedicated to ESD activities

	Frequency	**Percent**
Adequate	**21**	**70.0**
Fair	**8**	**26.7**
None	**1**	**3.3**
Total	**30**	**100.0**

Teachers were asked to comment on the amount of time they had dedicated to the ESD programme and most of them 21(70%) stated that the time they had dedicated to cover the planned activities was adequate (Table 4.5). On their involvement in ESD programmes, 26.7% of the respondents indicated that they were involved but not fully. This implies that majority of the teachers involved in ESD programmes

dedicated ample time to the programme. These findings are contrary to those of other studies which have indicated that while effort has been made to incorporate teachers into the education for sustainable development programmes, the uptake of the same is very low among them (Cloud, 2000). However, the results of the contradictory findings could have been influenced by lack of pre-service and in-service training on environmental conservation (Cloud, 2000).

A study conducted in Costa Rica reported that teachers' training on environmental sustainability is carried out in the teacher training institutions (Estrada and Oliveira, 2000). The rationale behind this is that when one or more teachers from various schools receive the relevant training, the trained teachers would have the capacity to disseminate the material in their schools.

Although several studies confirm that children are capable of understanding interrelationships in nature (Tsevreni *et al.*, 2006; McDonald *et al.*, 2002), children in Kenyan schools have limited opportunities for acquiring experiences in the natural environment. The implementation of the free primary and secondary school education in Kenya means that the teachers are expected to bear heavier workloads (Asyago, 2005), leaving them with even less time to incorporate environmental education as they deliver the education curriculum which is already top heavy.

In order to determine the teachers' were knowledge on the subject matter of Education for sustainable development, the study sought to find out whether the teachers had received the relevant training as presented in Figure 4.4.

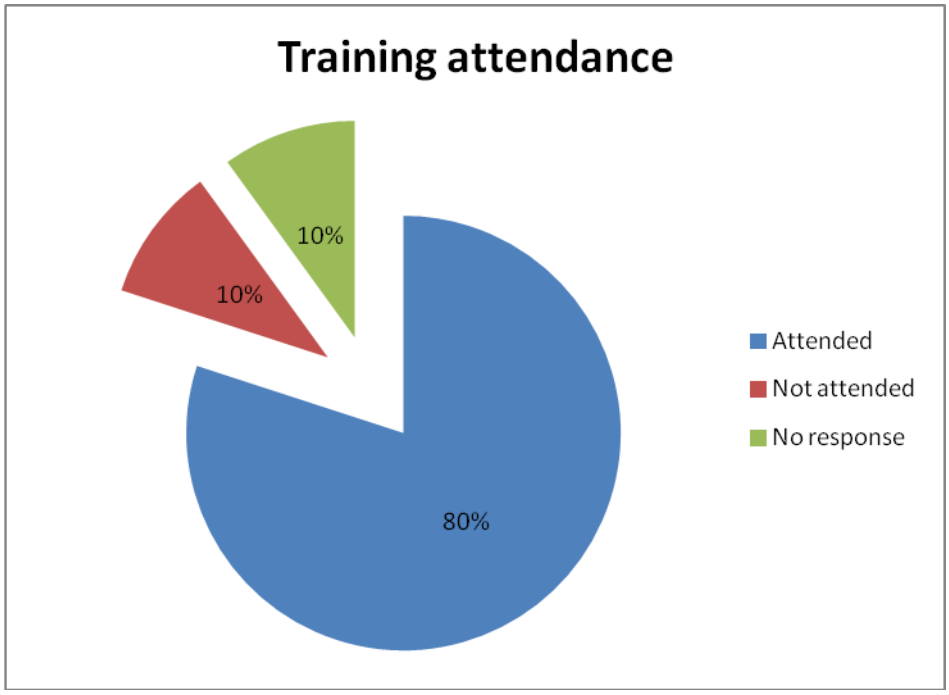


Figure 4.4: Attendance in Sustainable Development Workshops

The teachers were asked if they had attended any workshops or training sessions on Education for Sustainable Development and from the findings majority of them 24(80%) had attended training/workshops as shown in Figure 4.4. The finding implies that most of the teachers had received training on Education for Sustainable Development. These findings are supported by Taylor (1997) who found that regional changes in teaching focus and practice have presented a challenge to educators and therefore they have had to come up with various means of ensuring environmental education is embraced. For example, the duration of teacher training programmes on Education for Sustainable Development vary in length to suit the availability of the teachers concerned because the teachers may not have much extra time given their tight schedules, and again, they may not be willing to attend long training programmes during

the school holidays as they consider this their free time. The workshops are organised by educators who are specialists in environmental matters and through awareness and ecological knowledge enhancement, they involve teachers in critical thinking about environmental issues.

The study further sought to find out the areas of training that the teachers were trained on during the workshops, the findings are presented in Figure 4.5.

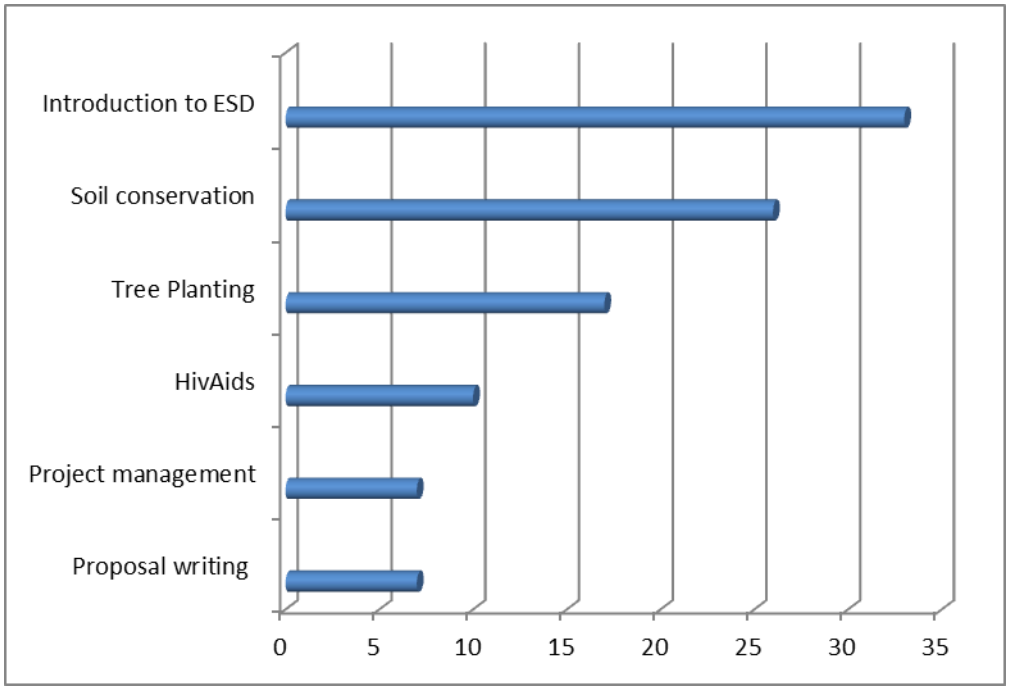


Figure 4.5: Areas of Training in the Workshops

From the findings, 10(33 %) reported that they were trained on introduction to ESD projects, 8(26%) on soil conservation, 5(17%) on tree planting, 3(10%) Hiv/Aids, 2(7%) on project management, 2(7%) on proposal writing as shown in Figure 4.4. The above results are supported by findings acknowledging that in order to be able to overcome the challenges posed climate change, it is advisable to sensitise the

communities on the need to conserve the environment, especially by water and soil conservation (IPCC, 2001).

In tandem with the above findings, trainers in environment conservation should be taught how to empower the community to participate in major programmes that involve conservation awareness and tree planting (Thakali, 1995), by having their capacity building skills developed in the first place. The researcher observed that though not reviewed by many studies, proposal writing skills is key in environmental conservation training as proposals for funding requests help the local communities raise funds and other materials necessary to cater for the conservation initiatives and related activities. The training on Hiv/Aids by LVCEEP is very important because according to IPCC (2001), Hiv/Aids is classified among the social/economical challenges that can hinder the fight against climate change, thus should be addressed.

The study wanted to find out the type of ESD related activities that had been implemented in the project schools. The findings are presented in Figure 4.6.

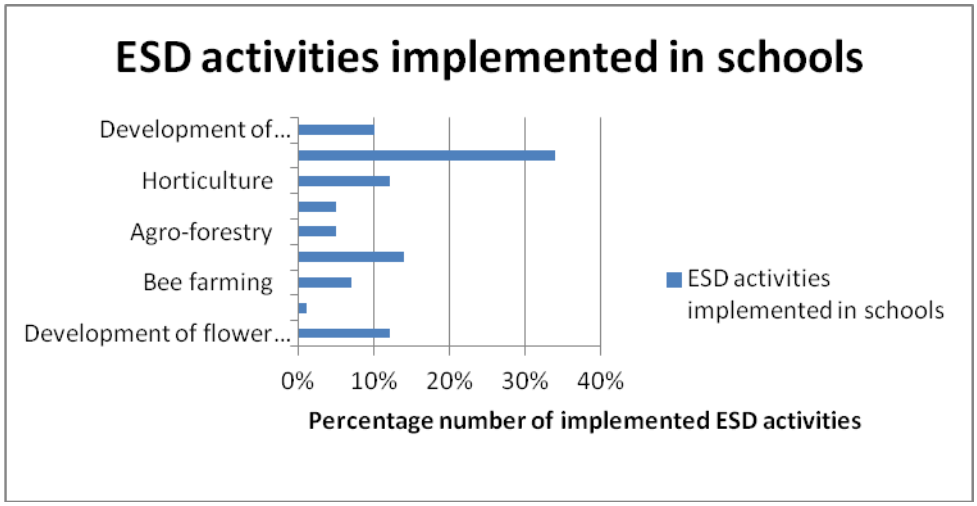


Figure 4.6: ESD activities implemented in the schools with the help of LVCEEP

The research findings indicated that as a result of knowledge gained from the LVCEEP programme, 34% of the teachers interviewed had been able to plant trees, 14% were involved in kitchen garden farming, 12% engaged in horticulture, 12% had gone into the development of flower beds, 10% had taken up development of teachers' and pupils' woodlots, 7% had gone into bee farming, 5% were engaged in waste management, 5% had implemented agro-forestry while 1% had been able to build a dam. This implies that the LVCEEP programme had enabled participating teachers to plant trees and also build their capacity to engage in activities that support conservation and their livelihoods.

These findings agree with the previous findings as presented in Figure 4.5 which pointed out tree planting as an area where the teachers had been trained on. These findings are in tandem with Taylor (1997) who established that environmental education exposes the beneficiaries to a range of environment conservation programmes and ways of earning their livelihood. The environmental conservation programmes include tree planting, soil and water conservation while means of earning a livelihood includes bee farming, horticulture and agro-forestry.

Poverty reduction, land reform, and redistribution of resources are important if vulnerability to the effects of climate change is to be reduced (Kituyi *et al.,* 2002). According to the findings of this study, LVCEEP activities have played an important role in poverty reduction in the communities in Lake Victoria catchment. In order to change unsustainable production and consumption patterns and lifestyles and to it is essential to emphasise the role of education for sustainable development, including

environmental economics as well as environmental awareness because only then, will the learners appreciate the holistic view of the environment, i.e., natural, social, economic and political systems (UNESCO-UNEP, 1996).

4.4 How the Activities and Outputs of LVCEEP are similar with the need to mitigate and adapt to climate change

From the project documents the objective of LVCEEP was to secure the ecological integrity and sustainability of the Lake Victoria catchment for the benefit of its inhabitants and biological diversity. While the aim of this programme was to empower catchment communities, schools and regional partners with the knowledge, motivation and abilities for sustainable use and management of natural resources. The expected outputs of the programme were identified as follows:

1. Capacity of teachers and teacher trainers to deliver ESD as an integral part of their normal education activities built and strengthened in selected sites and best practice spread in wider areas.

2. School children understand the rationale for conserving freshwater ecosystems and other natural resources and the linkage between natural resource management and sustainable livelihoods.

3. National and regional decision makers sufficiently supporting education for sustainable development through curriculum and other policy documents, support to pre- and in-service teacher training and giving clear signals of the importance of learning for sustainable development

4. Riparian communities achieve capacity to conserve and sustainably manage natural resources and improve livelihoods within selected sites of the Lake Victoria catchment and best practice spread in wider areas.

5. Education materials to support formal and non-formal environmental education and awareness initiatives developed and disseminated in selected sites.

6. A practical partnership building mechanism for ESD delivery with and among key stakeholders developed and operationalized.

LVCEEP Activities

1. Increased appreciation of EE/ESD and its importance.

2. Strengthened capacity of Teachers to implement it, as is reflected in the infusing of EE in lesson plans and the use more participatory methodologies.

3. School grounds have turned from naked to green and become talking compounds, showing where students are actively engaged in different sustainable practices, such as tree planting and woodlots, organic farming, rain water harvesting, soil erosion control and usage of toilets and improved sanitation.

4. Training programmes for teachers, teacher trainers and school inspectors in EE/ESD teaching methodologies and sustainable resource-use.

5. Development of whole school approach, different EE/ESD themes, greening initiatives, action learning and research.

6. Increasing the skills of teachers to train others and also other forms of dissemination (such as documenting lessons learned through action research and working with cases) and how to increase the students' capacity to be engaged in outreach activities and for example acting as guides for visiting schools.

7. Incorporate and integrate ESD in the school curriculum.

8. Workshops between curriculum developers, examiners and teachers to consult on the delivery mechanisms of ESD as contained in the existing national school curriculum

9. Sensitising curriculum developers on EE/ESD Activity 3: Policy work.

10. ESD curriculum and Lobbying and Advocacy

11. A study to find out how EE/ESD is being addressed within the curriculum.

12. Strengthen the on-going support to school environmental club activities in complementing existing curriculum contents on environmental education in targeted schools.

13. Support the clubs especially through the training of its members and leaders

14. Support to school initiatives to reduce the degradation and/or pollution of the local environment while also improving livelihoods. Some of these initiatives include; energy saving stoves, water harvesting, and school eco-sanitation systems among others.

15. Poster competitions guided by themes to show the level of awareness amongst students themselves.

16. Setting up a network of teachers, pupils, and educational officials for ESD in the project sites to explore their local environmental problems, teaching and learning challenges and approaches to resolving these.

17. Regional and Project country level exchange visits amongst the teachers.

18. Greening initiatives including tree planting, water harvesting, grass and flower planting, taking compounds and gardens.

19. Documentation of best practice of clubs so as to share best practice to other clubs.
20. Setting up a national or regional ESD Award scheme.

21. Trainings of community members in higher awareness of ecosystem services, skills in critically analysing problems and developing solutions, increased production and use of energy efficient stoves (and thereby decreased workload and rate of deforestation), improved farming practices and decreased degradation of wetlands, income generating activities, hygiene, amongst others.

22. Training of Community leaders to enable them actively participate in sustainable natural resource management.

23. Raising the capacity of community members of more sustainable practices such as energy efficient stoves, organic farming and other income generating activities.

24. The communities to be trained to train others to achieve outreach of best practices and raise their dissemination skills.

25. Training in funding possibilities to increase the sustainability in the greening initiatives

26. Organise and facilitate exchange visits within the programme and between other programmes/projects to enhance sharing of existing skills and experiences in natural resource management by selected communities.

27. Support different "green initiatives" by communities in targeted areas such as soil conservation measures, tree planting and nursery establishment (coupled with water harvesting techniques to sustain these activities) and waste management.

28. Support community conservation initiatives which promote use of alternative resources, among others based on indigenous knowledge.

29. Encourage communities to link natural resource management to sustainable livelihoods through increased practice of environmentally friendly traditional skills within the catchment, and reduce the use of agro-chemicals.

30. Communities' training in skills for environmental monitoring and evaluation.

31. Outreach and publicity activities to publicise the work and initiatives of the communities (and also jointly with government officials and schools) to the wider members of the community. The activities here will include: Campaigns, public and school rallies, competitions and prize giving days, use of local radio stations, songs, poems, dances, and plays, and posters/leaflets.

32. Launching and arranging a regional ESD Day for increased attention and outreach.

33. Providing learning resources for teachers, trainers, pupils and communities in order for them to effectively respond to ESD.

34. Develop, produce and distribute an EE/ESD Toolkit

35. Document some of the best practices as experienced by the communities.

36. Publish a termly environmental newsletter with contributions and balanced representation from key players

36. Set up a web site with information on the programme

37. Media outreach such as interactive shows, talk shows write-ups, interviews and spots in the newspapers, radio and the television.

38. Engaging journalists from some of the existing networks and media houses by showing them what we are doing and sensitising them on the activities of the project.

39. Sponsored clips and programmes on radio to people not within the project area.

40. Networking

41. Conduct complementary baseline surveys in Kenya, Uganda and Tanzania including baseline data on the situation in the present model schools and colleges, development of sufficient baseline surveys for new schools wanting to join the programme or copying the ways of working.

42. Proper documenting any new school, TTC or community entering the programme, including pictures, before they start for follow-up of progress.

43. Monitoring of activities

44. Development of suitable monitoring frameworks and tools

45. Introduce and strengthen linkages between ESD practitioners and actors in the Lake Victoria catchment and the Eastern Africa region as a whole.

46. Provide training on the fundamentals of action research, participatory threats monitoring and managements, livelihoods assessments, school policy, teaching and learning, pupils' participation and school management among others.

47. Trainings of the project executants and core group with the objective to bring out the best available expertise and experiences in the region and also international expertise.

The representatives of networking partner organisations in this study were asked to identify the focus of LVCEEP from their interactions with the programme. The response is presented in Table 4.6.

Table 4.6: Focus of LVCEEP according to partner organisations

OBJECTIVE	FREQUENCY	PERCENTAGE
Conservation of Lake Victoria	2	25
Poverty Eradication	1	12.5
Combating Climate Change	3	37.5
Species Conservation	1	12.5
Sustainable Development	1	12.5

According to 37.5% of the representatives of networking partner organisations, the focus of LVCEEP is combating climate change, while 25% of the respondents were of the opinion that the focus is to conserve Lake Victoria. Of the representatives of networking partner organisations, 12.5% stated that the focus of LVCEEP was poverty eradication, 12.5% were of the opinion that LVCEEP's focus was species conservation while the remaining 12.5% considered sustainable development to be the focus of LVCEEP.

The study wanted to know the objectives of LVCEEP from the perception of the community members. The findings are presented in Figure 4.7.

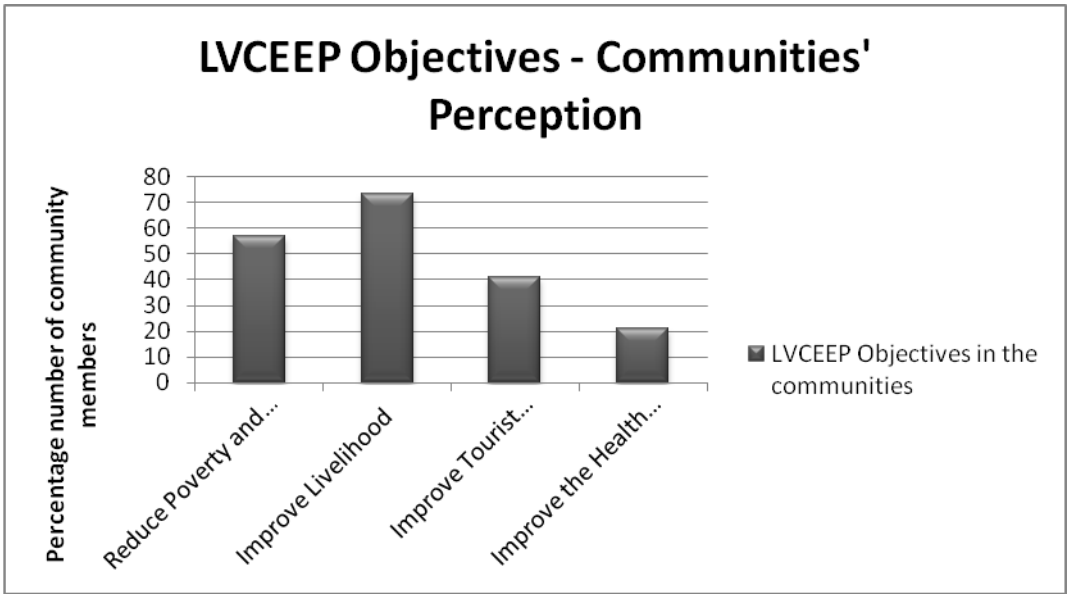


Figure 4.7: LVCEEP Objectives

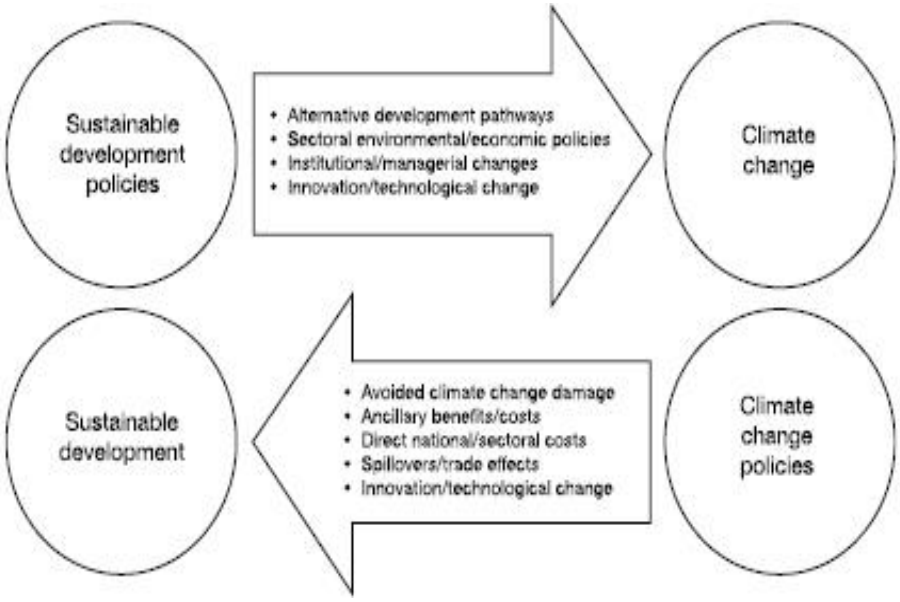
Figure 4.7 reveals that according to 57% of the community members in the study the objectives of the LVCEEP programme was to reduce poverty and malnutrition, 73.3% said the objective was to improve livelihoods, 40.7% felt the objectives were to improve tourists attraction and according to 20.9% it was to improve communities' health. These results together with those from those from the representatives of networking partner organisations are a reflection of the outputs of sustainable development projects as espoused by the African Development Bank which stated that low income countries and poor people are particularly vulnerable to climate change (African Development Bank *et al*., 2003). Studies show that some of the most adverse effects of climate change will be in developing countries, where populations are most vulnerable and least likely to easily adapt to climate change. Changes in temperature, water supply and quality will impact on agricultural production, human settlement and health, biodiversity and animal migratory patterns (IPCC, 2001a, b). Sustainable development entails promoting economic development as a requisite for

maintaining environmental quality (Elasha, 2009) Economic development leads to increased capacity to address environmental and social problems. Maintaining environmental quality, in turn, is essential for sustainable development (Elasha, 2009). The link between climate change and sustainable development stems from the fact that climate change is a constraint to development, and sustainable development is a key to capacities for mitigation and adaptation (Elasha, 2009). Moreover, It is now recognises that climate change and environment are strongly related and also that climate and poverty levels are inextricably interwoven (Nelson and Agbey 2005).

Studies reveal that arid and semi-arid regions in Africa have high poverty level, a confirmation that harsh climate conditions will likely worsen the poverty levels of these areas (Nelson and Agbey 2005). Some of the fundamental reasons underlying the persistence of poverty can be traced to environmental causes. Indoor and outdoor air pollution, inadequate sanitation and poor hygiene practices, lack of access to safe drinking water are major causes of diseases. Poor people are more vulnerable and might suffer disproportionately from the effects of natural disasters such as flooding, earthquakes etc. The figure below demonstrates that climate change will have a direct impact on development in relation to climate-sensitive activities such as agriculture, and indirect consequences on social issues such as poverty and education (Swart *et al*., 2003).

According to the findings of the Human Impact Report of 2009, because the amount of available fresh water is relatively finite, increases in population result in corresponding decreases in the per capita water supply. With the rising temperatures

exacerbating an already alarming situation in Africa, annual run-offs and water availability are projected to increase by 10-40 percent at high latitudes but to decrease by 10-30 percent over some dry regions at mid-latitudes and in the dry tropics (Falkenmark, 2007). This means that drought-affected areas will likely increase in extent. Agricultural production is projected to be severely compromised in many regions by these trends (UNFCC, 2008). This shows that there is need to conserve the environment and develop the capacity to meet the challenges caused by climate change and thus the need for this study. Figure 4.8 demonstrates the link between climate change and development.



Source: (Swart *et al.* 2003).

Figure 4.8: Two-way linkages between climate and sustainable development.

Climate change is clearly relevant to priority development objectives such as combating poverty, food security, access to basic services such as clean water, sanitary living conditions and energy and education (Morlot *et al.*,2002) Poor

countries are in general least endowed with these factors and their vulnerability to climate change is therefore high (African Development Bank *et al*., 2003). Ability to adapt clearly depends on the state of development (Munasinghe, 1998).

To have an overview of the experience and impact involvement with LVCEEP, the study sought to find out the practical knowledge that the community members had acquired through their involvement in the project. Figure 4.9 outlines the lessons from this involvement.

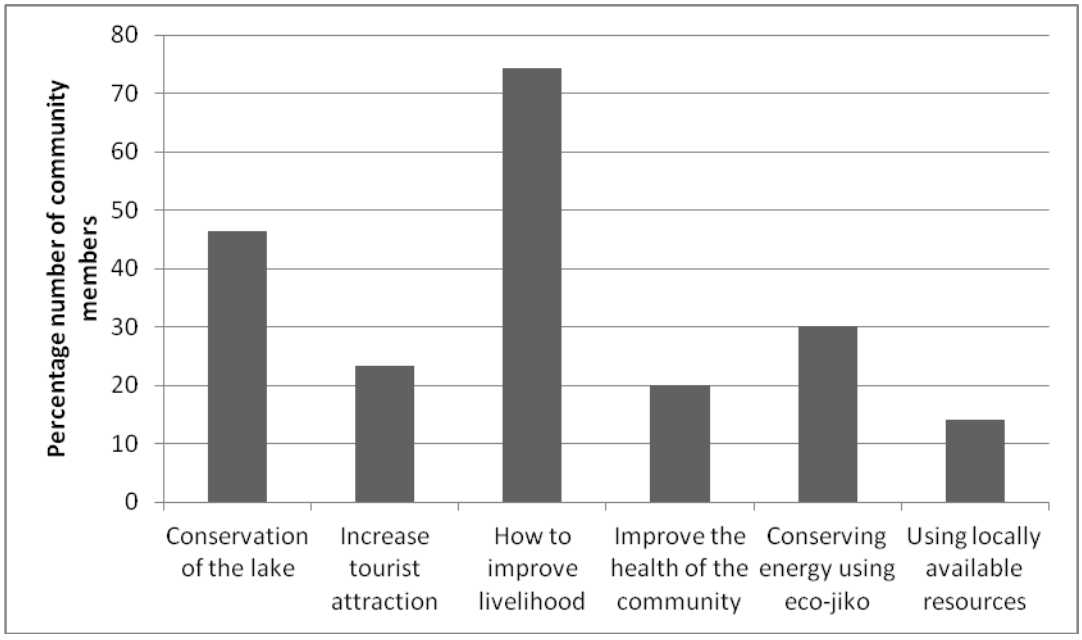


Figure 4.9: Lessons from LVCEEP involvement

Through LVCEEP, 40(46.5%) of the interviewed community members reported that they had learnt how to contribute to the conservation of Lake Victoria and its resources, 20(23.3%) said that they had learnt how to increase tourists attraction,

64(74.4%) stated that they had learnt about livelihoods improvement and 26(30.2%) responded that they had learnt to conserve energy by using eco-jikos. Some African countries are much more economically dependent on agriculture, leaving them more vulnerable than others (Kurukulasuriya *et al*., 2006). The precarious state of water resources in Africa is such that water stress (use exceeds renewable supply) is relatively high for the majority of the continent's population yet nearly two thirds of Africans rely on limited water sources which in addition, is prone to high yearly variability. Further, UNEP stresses that in total, about a quarter of the continent's entire population lives in water-stressed regions (UNEP, 1999). Water has been identified as one of the main problems in Africa impacting negatively on hygiene and health of communities (Nhantumbo *et al.,* 2003). The lessons learnt from LVCEEP demonstrate the multi- dimensional benefits of sustainable development projects.

These results concur with the findings of the case study of the Bushbuck Ridge Project in South Africa, where the programme 'Working for Wetlands' objective was to restore degraded wetlands to enhance water supplies and conserve biodiversity for the benefit of society. The communities' capacity was built in creating awareness of wetlands and their importance, improved nutrition and food production, alternative livelihoods, improved water supply for the people and their livestock, improved health, tourism infrastructure development amongst others (United Nations, 2008). This is evidence that community sustainable development activities carry diverse benefits for the environment and the communities (United Nations, 2008).

The study sought to find out the differences in the general livelihood occupations and daily activities prior to LVCEEP intervention and after, Table 4.7 illustrates the livelihood related activities implemented after LVCEEP intervention.

Table 4.7: Conservation activities implemented by the communities after LVCEEP intervention

Activities due to LVCEEP influence	Frequency	Percentage
Have a kitchen farm	56	65.1
Have kitchen farm with both vegetables and fruit plants	44	51.2
Using eco-jiko	26	30.2
Planted trees	24	27.9
Have a woodlot	19	22.1
Operational Fish ponds	1	1.2

According to the findings presented in Figure 4.7, 56(65.1%) had established kitchen farms, 44(51.2%) now have kitchen farms with fruit plants, 26(30.2%) are using eco-jikos, 24(27.9%) had planted trees, 19(22.1%) had woodlots while one person now has a fish pond as a result of the programme.

Sustainable development policies encompass three general policy areas: economic, environmental and social. The research wanted to find out whether the communities' involvement with LVCEEP engaged the three pillars of sustainable development. The findings are presented in Table 4.8.

Table 4.8: Sustainable Development activities Implemented in community members' homesteads

HOMESTEAD	ENVIRONMENTAL	ECONOMY	SOCIAL
1	Tree planting Kitchen garden Eco-jiko	Dairy goats Fish pond Kitchen garden	Indigenous crops (vegetables, millet and cassava)
2	Tree nursery Composting Eco-jiko Agro-forestry	Seedlings sales Beekeeping	Involvement of all family members
3	Kitchen garden Gabions to stop gulley Erosion Eco-jiko Tree growing	Fish pond Poultry	Involvement of all family members
4	Tree growing Woodlot Eco-jiko	Eco-jiko sales Dairy goats	Indigenous vegetables Intercropping
5	Composting Eco jiko Rain water harvesting and storage Tree growing	Dairy goats sales Milk sales Poultry farming	Involvement of all family members
6	Tree nursery Tree growing Eco-jiko Small scale irrigation	Bee keeping Sale of vegetables	Indigenous vegetables production
7	Composting Eco-jiko Tree growing Woodlot Fruit tree nursery	Sale of fertilisers Fruit sales Seedlings sales	Involvement of all family members
8	Tree growing Eco-jiko Woodlot Irrigation	Beekeeping Honey sales Firewood sales	Millet and cassava farming
9	Composting Agro- forestry Eco-jiko, woodlots, Waste separation Tree growing	Sale of organic fertilisers Dairy goats Milk sales Kitchen garden	Involvement of all family members
10	Composting, Eco-jiko Rain water harvesting and storage Small scale irrigation	Fish ponds Fingerling sales	Indigenous vegetables Traditional crops (millet)

The findings demonstrate LVCEEP had influenced the communities' lives by empowering them with skills to lead more sustainable lives. Figure 4.16 illustrates the actual activities implemented by the community group members in their homesteads.

Further, the findings presented in Table 4.8 indicated that 100% of the respondents were involved in tree growing. Further the findings demonstrate that the respondents were implementing the 3 pillars of sustainable development, moreover, the respondents' implementation of activities under the social pillar was weak with on involvement of the whole family (gender inclusiveness) and indigenous cropping systems being their engagement. These findings agree with those of a case study of Local vulnerability, forest communities and forest- carbon conservation in southern Cameroon (Chia *et al.*, 2013) which reported that after exposure to conservation issues, the farmers embarked on improving their agro-forestry farming by planting fruit trees as a means of supporting household food consumption and diversified their sources of income through marketing of fruits, nuts and edible oils.

Agro-forestry is a major climate change adaptation strategy for communities (Somorin, 2010; Verchot *et al*., 2007). When asked what indigenous things they had incorporated in the programme, 20.1% revealed that they had continued using animal manure for farming, 9% stated that they were practicing intercropping and rotational farming, 21.9% were planting and caring for indigenous trees while 5% indicated that they had planted traditional food crops such as vegetables, millet and cassava.

The findings of this study indicate that people have incorporated some indigenous practices in agriculture, livestock rearing and forest resource management. Although these indigenous practices are short-term solutions for sustainable resource management and have minimal capacity to cope with the adverse effects of climatic change, they may be the best option to adapt to climate change since the local people understand them well. It is therefore necessary to integrate indigenous methods with new technology to improve the capacity to cope with the impacts of climate change. This is supported by Aw and Diemer (2005), who reported that reforms in government-controlled schemes, which give farmers more responsibility in water management, operation and maintenance, have shown positive results. A good model is the case of the Mwea Irrigation Scheme in Kenya (Blank *et al*., 2002). In Mali, reforms of the *Office du Niger* irrigation scheme which involved integrating indigenous and modern technology over a period of 20 years led to a quadruple increase in rice yields per acre, a six-fold increase in total rice production.

The study sought to find out the impact of LVCEEP on attitudes towards the catchment resources. A presentation of the impact on the attitudes is presented in Figure 4.10.

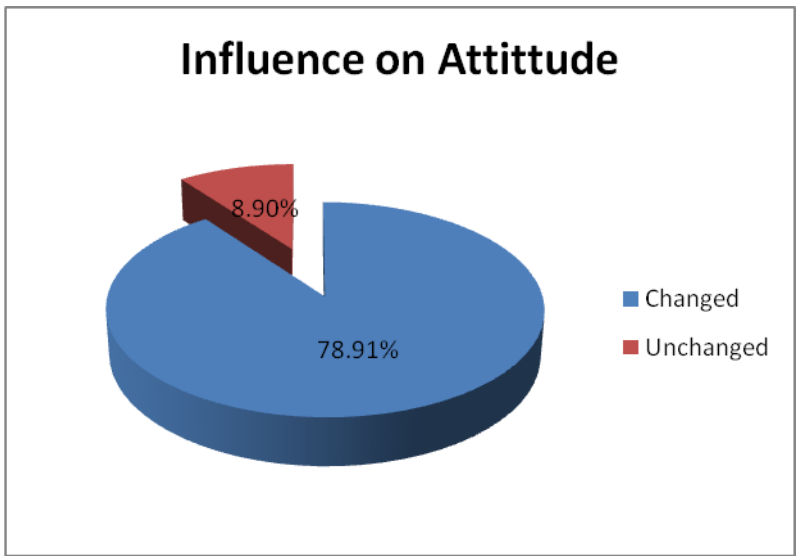


Figure 4.10: LVCEEP influence on attitude towards catchment resources

Attitude is a critical construct for research in science education. According to Ajzen & Fishbein (1980), attitude is a set of beliefs "connected with pursuing a given line of behavior and the relative rewards and costs connected with those outcomes". The researcher concluded that it was important to know the impact of the ESD programme on the attitudes of the local communities towards the Lake Victoria resources.

According to the study 78(91%) of the community members agreed that LVCEEP programme had changed their perspectives towards catchment resources and that they now know that they need to implement adaptation activities to protect the catchment resources from the impacts of climate change. These findings concur with those of a study conducted in the Delta State to determine Awareness and Accessibility of Environmental Information in Nigeria (Babalola *et al*., 2010).

The findings indicated that as a result of the environmental awareness information they had received, the community was aware of the implications of environmental degradation in the delta, therefore environmental awareness is a pre-condition for pro-environmental behaviour and sustainable environmental management (Babalola *et al*., 2010). The international community has placed great emphasis on mitigation and adaptation strategies to address climate change impacts. This is also gaining importance particularly in developing countries (Bernier *et al.*, 2009). In addition, there are arguments that adaptation to climate change and mitigation against climate change are often combined to provide greater benefit to the people.

To find out the level of awareness of Education for sustainable development, the teachers in the study were asked to give a description of ESD. The responses are presented in Figure 4.11.

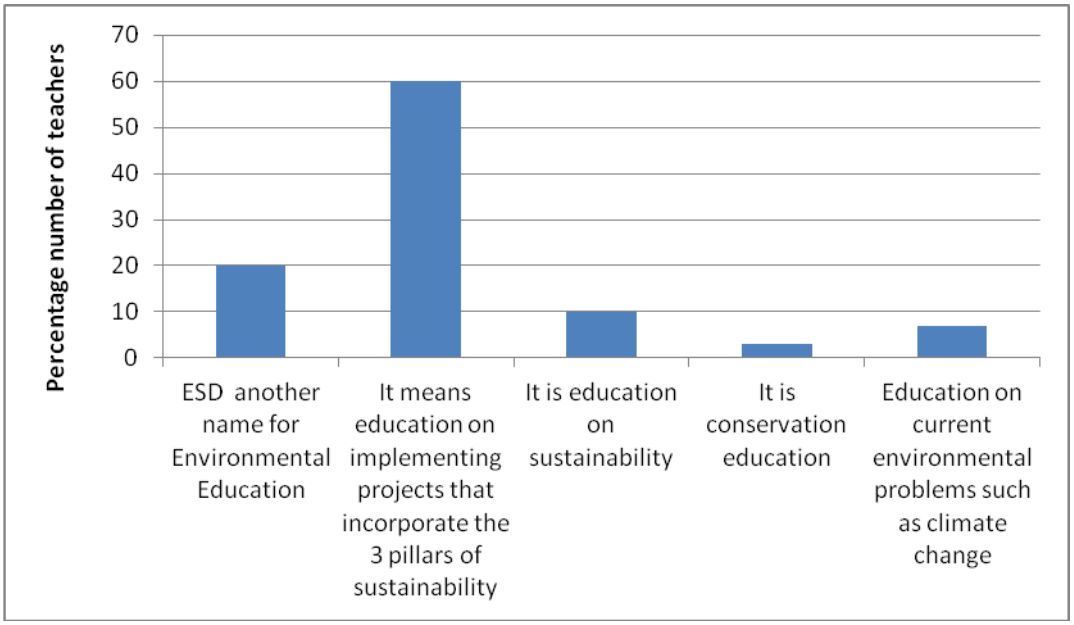


Figure 4.11: Teachers comprehension of Education for Sustainable Development

When asked about the thematic areas of ESD that they had implemented with the help of LVCEEP in their homes, 13(43.3%) of the teachers responded that they had planted trees at home, 8(26.7%) had embarked on kitchen garden farming, 5(16.7%) had implemented agro-forestry at their homes while 3(10%) had started managing their waste as shown in Figure 4.12.

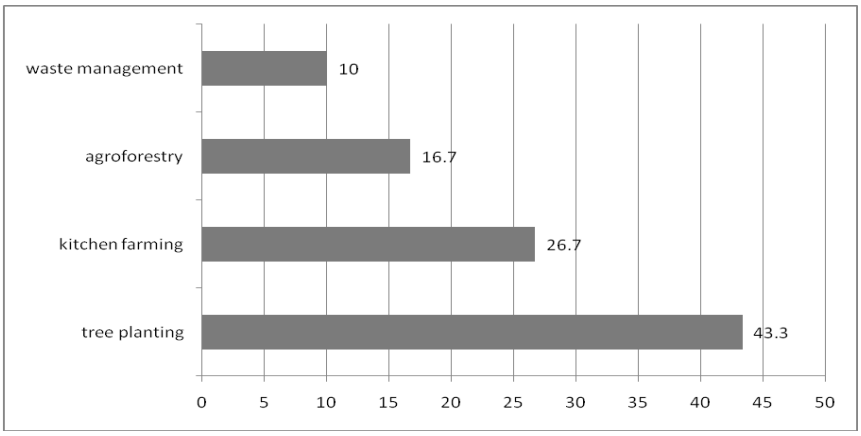


Figure 4.12: ESD areas implemented in homes with help of LVCEEP

The results indicated that despite being exposed to adaptation related activities, 79% of the respondents had not adopted adequate adaptation measures to cope with or adapt to the hazards caused by climate change. Some of the respondents reported that they had made changes in their cropping patterns by introducing hybrid variety of crops. In addition, some of the respondents indicated that they had replaced the local varieties of livestock with cross breeds.

To find out how engaging in LVCEEP had reduced the environmental hardships experienced in the communities, the community members were asked about the challenges they faced prior to their involvement in the project. Table 4.9 is a presentation of this.

Table 4.9: Environmental challenges that local communities faced before engaging with LVCEEP according to community members

Community challenges	Frequency	Percentage
Poor agriculture	45	52.3
Deforestation	52	60.5
Low income/hunger	59	68.6
Soil erosion	66	76.7
Inadequate water	26	30.2
Malnutrition and poor standard of living	26	30.2

The study findings revealed that the communities faced a lot of challenges before they started participating in the LVCEEP activities. Some of the challenges were according to 66(76.7%) soil erosion, 59(68.6%) pointed out that they had low incomes and limited food, 52(60.5%) reported that there was massive deforestation before LVCEEP intervened, 45(52.3%) felt that poor agriculture was the main challenge that the community suffered before they got involved with LVCEEP and 26(30.2%) stated that their problems before the implementation of LVCEEP was inadequate water and malnutrition and poor standards of living respectively.

These findings are in tandem with those of a case study describing the progressive efforts of Watershed Task Group (WTG) a local NGO, whose aims are to strengthen participatory wetland management using sustainable livelihood approaches in the Lake Ossa in Dizangue, Littoral Region of Cameroon (Global Water Partnership, 2012). The case study revealed that the communities in the Lake Ossa catchment experienced challenges of food security resulting from reduced fish resources, massive soil erosion and land degradation due to subsistence farming along the banks of the lake, water pollution from pesticides and chemicals used by the large agro palm industries and low household incomes(Global Water Partnership, 2012). These results demonstrate that important resources such as lakes' catchment provide livelihood services to communities, dependency of which results into diverse sustainability challenges. Education for sustainable development can play an important role in overcoming these challenges. According to Olusola (2012) developing countries are least prepared for the impacts of climate change. The effect of climate change has brought about the rise in sea levels and erosion along the coastlines. The weather patterns have also changed leading to frequent dry seasons and drought causing many challenges especially to the rural communities.

The study also sought to find out the challenges experienced prior to the LVCEEP interventions, according to the pupils. The pupils' responses are presented in Table 4.10.

Table 4.10: Challenges faced by the communities before LVCEEP according to the pupils

Environmental problems	Frequency	Percentage
Soil erosion	254	37.9
Deforestation	448	66.9
Poor waste management	35	5.2
Drought	49	7.3
Wetlands conservation	148	22.1
Economic problems		
Lack of money	537	80.1
Poverty	151	22.5
Illiteracy	39	5.8
Unemployment	25	3.7
Social problems		
Hunger	83	12.4
Lack of understanding	86	12.8
Language problem	70	10.4
Drunkenness	394	58.8
Theft	108	16.1

The pupils in this study were asked to state the problems facing the community in terms of environmental, economic and social issues. The environmental challenges revealed were 254 (37.9%) soil erosion, 448 (66.9%) deforestation, 148 (22.1%) wetlands conservation, 49 (7.3%) drought and 35 (5.2%) poor waste management. These results concur with those of a study in the Irangi Hills, Kondoa District in the northern part of Dodoma Region, Tanzania to determine the study community's perception of land degradation (Kangalawe, 2012). 58% of the respondents considered soil degradation as being a serious problem in their vicinities. Soil erosion and surface runoff featured as indicators of soil degradation were identified as problems facing the community by 44% of the respondent farmers (Kangalawe, 2012). The responses are an indication that farmers in the Irangi Hills are aware of land/soil degradation and its various processes, with levels of perception varying between villages and among respondents depending on the severity of the land degradation problem. (Kangalawe,

2012). Moreover, a similar study conducted by Adjaye (2008) to determine factors affecting the adoption of soil conservation measures in cane farming community in Fiji revealed that the community members were aware that soil erosion was a major problem and that the significant perceptions of the problem of soil erosion are age, education, ethnicity extension services amongst others (Adjaye, 2008).

The response given by 49 of the students that drought was the main challenge prior to LVCEEP engagement is supported by Adelana and MacDonald (2008) who found out that "groundwater is one of Africa's most precious natural resources, providing reliable water supplies for many people for drinking, ensuring vegetation (forest growth), and enabling irrigation. Sixty six percent of the respondent agreed that deforestation was the main challenge, a result which is supported by Markham (2009), who reported that the use of wood fuel is the main cause of deforestation, a major challenge to the fight against climate change**.** In addition, climate change has had adverse effects on water supplies and shortages leading to low food production, reduced sanitation and hindering economic development.

According to 537 (80.1%) of the pupils, the economy related problems experienced by the communities before LVCEEP intervention was lack of finances, poverty was pointed out by 151 (22.5%) as having been the main challenge while, 39(5.8%) of the pupils were of the opinion that the main challenge was illiteracy and according to 25 (3.7%) of the pupils felt that unemployment was the main challenge experienced in the community prior to LVCEEP implementation. The social problems were identified as drunkenness by 394(58.8%) pupils, 108 (16.1%) identified theft as the

main social problem, 86 (12.8%) felt it was lack of understanding, according to 83(12.4%) hunger was the main social challenge while 70 (10.4%) pointed at language problems as source of the social challenges in the community. Bryant *et al.*, (2000) findings agree with above findings, that climatic conditions are drivers for human activities and also a critical hazard.

Climate change is a source of significant stress (and perhaps significant opportunities) for societies, yet it has always been and will remain only one factor among many. The consequences of a shift in climate regimes are not calculable from the physical dimensions of the shift alone, but require attention to human dimensions through which they are experienced. Water resources related challenges caused by climate change have resulted to serious implications on socio-economic development (IPCC (2001). These challenges have been identified as problems associated with land use such as erosion due to population pressure, and hunger as a result of drought.

The findings on the environmental, social and economic problems resulting from the impacts of climate change are similar to those of a study conducted in Dodoma (Swai *et al.,* 2012) which identified socio-economic effects of climate change as waste of resources; increased hunger and weakness; farmers being subjected to bad food debts; increased family conflict; out-migration; decreased sanitation, hygiene and domestic water; waste of productive time in less productive activities; and loss of status and failure of respondents to improve family well-being Climate change plays a fundamental role in agriculture because of its direct influence on production (Orlandini *et al.,* 2008). Climate change significantly affects quantity and quality of

farm produce, livestock, and crop suitability. Since a large population in the lake catchment depends on agriculture as a means of earning an income, climate change impacts on their source of livelihoods leads to poverty and an increase in social vices such as crime. In tandem also, are the findings of a case study on Local vulnerability, forest communities and forest- carbon conservation in southern Cameroon where the communities reported that their crops had died as a result of over and unexpected sunshine and temperature during periods initially considered rainfall seasons. Cocoa farmers from the same community identified poor harvest attributing it to unprecedented prolonged rainy season observed in the area (Chia *et al.,* 2013).

The findings also concur with those of a similar study conducted in the same humid forests zone of southern Cameroon on community vulnerability and coping strategies in Yokadouma and Nkol-evodo (Bele *et al.,* 2013). The changes identified by the 3 studies agree with the observations and predictions of the IPCC (2007) on variations in temperature, precipitation and a distortion in the seasonal calendar in general. The perception of a decline in agriculture production in community areas is in accordance with the IPCC predictions for Africa, which indicates that agriculture production will decline with en- suing impacts on food security and income (IPCC, 2007).

There is a concern that meeting the rising demand for food is leading to further environmental degradation thereby exacerbating factors in part responsible for climate change, undermining food systems upon which food security is based even more, (Ingram *et al.,* 2008).

The study sought to find out how LVCEEP had equipped the pupils to overcome environmental challenges. Table 4.11 illustrates how LVCEEP has equipped the pupils to overcome environmental problems,

Table 4.11: How LVCEEP has equipped pupils to overcome environmental problems

How LVCEEP has equipped pupils to overcome environmental problems	Frequency	Percentage
Soil erosion management	583	87.0
Developing tree nurseries	390	58.2
Rainwater harvesting	294	43.9
Waste management	270	40.3

The study sought to find out how LVCEEP had equipped the pupils to address the problems facing the community and according to 583(87%) of the pupils in the study them they can now control soil erosion, 39(58.2%) pupils reported that had learnt how to develop tree nurseries, 294(43.9%) stated that they had learnt and implemented improved rain water harvesting while 270(40.3%) pupils said that they can now manage waste. However, in addition to the above findings, surface run-offs in Africa can be harnessed from a wide range of catchments such as roads, home compounds, hillsides and open pasture lands, and the source of this water may also include run-offs from water courses and gullies that can be stored in small reservoirs such as ponds or water pans instead of being left to go to waste during the rainy seasons (Malesu *et al*., 2006). These findings which serve to prove that when children are exposed practical conservation activities, they tend to develop an appreciation for

flora, fauna and the environment, are supported by Taylor who reported that in Hungary, education for sustainable development is introduced to children early in their life so as to help them contribute positively to the fight against climate change. The issues taught are generally related to environmental conservation such as soil conservation and waste management (Taylor, 1997).

The study further sought to find out how LVCEEP had influenced the pupils' lives, the findings of this is presented in Table 4.12.

Table 4.12: How LVCEEP has impacted the pupils' lives

How LVCEEP has impacted on the pupils' lives	Frequency	Percentage
Capability of making money by selling trees	350	52.2
Ability to plant tree nurseries	270	40.3
Ability to conserve energy by using alternative sources of energy instead of firewood	263	39.3
I am able to engage in livestock farming	186	27.8

According to 350(52.2%) pupils, they are now able to get money by selling the trees they had planted, 270(40.3%) of the pupils in the study stated that they are now able to put up their own tree nurseries, 263(39.3%) of the pupils can conserve energy by using alternative sources instead of firewood while 186(27.8%) can comfortably engage in livestock farming at home as shown in Table 4.12. The findings of this study are in tandem with those of a survey conducted in 14 schools to determine the success levels in developing pupil's experience and understanding of sustainable

development and whether an increased commitment to sustainability had wider benefits. The results indicated that there was an increase in the pupils' knowledge and understanding of the importance of leading more sustainable lives. The findings further revealed that 93% of the study schools improved the overall effectiveness of their provision for sustainable development by at least one inspection grade. A similar study was conducted to find out the impacts of environmental education programme implemented by a local organization in Catalonia by Rovira (2000). The findings indicated that there had been a positive change in the understanding of the subject matter of environmental education by the target. The researcher concluded that if habits are considered in forming environmental awareness then primary school children are the most conscious and best target Rovira (2000). Moreover, according to Huckle (2002) children who are exposed to ESD are healthier and armed with the knowledge that they will need to live and flourish in a rapidly changing world (Huckle, 2002).

According to USAID, appropriate interventions must incorporate disaster planning response and mitigation into governance systems, engage vulnerable civil society groups in participatory forums to address their vulnerability and to identify adaptations to climate impacts, and examine existing laws and regulations for opportunities to improve governance and resilience to climate variables. Moreover, interventions should mitigate risk of conflict by strengthening institutional capacity to respond to extreme climate events, promote resilience in livelihood strategies, develop early warning response and mitigation programmes, support insurance and other

safety net programmes, and support capacity to manage effects of climate change at local, national and regional levels (USAID, 2007).

The study also sought to know the activities that the pupils are engaged in as a result of LVCEEP programme implementation in the region. Table 4.13 presents the list of activities in practice.

Table 4.13: Activities in practice as result of LVCEEP

Activities practiced	Frequency	Percentage
Tree planting	608	90.7
Tree nursery establishment	398	59.4
Kitchen gardening	210	31.3
Conserving water and practicing drip irrigation	49	7.3
Waste management	81	12.1

According to 608(90.7%) pupils, they are now planting trees, 398(59.4%) pupils can now establish tree nurseries, 210(31.3%) have kitchen gardens, 49(7.3%) pupils now conserve water and practice drip irrigation while 81(12.1%) are now managing waste. Maddox *et al* (2011) argue that Students' awareness about environmental problems and solutions can be increased through education. Skills and knowledge gained from environmental education help in changing human behaviour towards the environment Ballantyne *et al* (2006). Students with some knowledge and skills on environmental education are more motivated to take part in environmental protection activities and plans (Tal, 2004) thus would generate new ideas for the solution of environmental

problems (Desa *et al.*, 2012).Moreover, results of a study conducted in a Malaysian University to determine the role of environmental awareness and education on waste management showed that more than half of the students (64%) had high awareness status concerning SWM (Desa *et al*., 2012).

Huckle observes that waste management is usually a core theme in any conservation programme geared towards environmental sustainability (Huckle, 1996). In Budapest, for example, the Municipality of Budapest promotes waste and recycling activities as a priority through school programmes (Huckle, 1996). LVCEEP activities incorporate greening initiatives in schools and in communities. The initiatives involve tree planting, water harvesting, grass planting and gardening (Ndungu and Karani, 2007). The findings of this study are similar to those of a research on environmental education in Turkey which revealed that direct nature experiences are well known to develop individual's environmental awareness and foster related attitudes (Erdogon *et al.*, 2000 and 2011).

Figure 4.13 provides the general perceptions on the importance of engaging in LVCEEP activities.

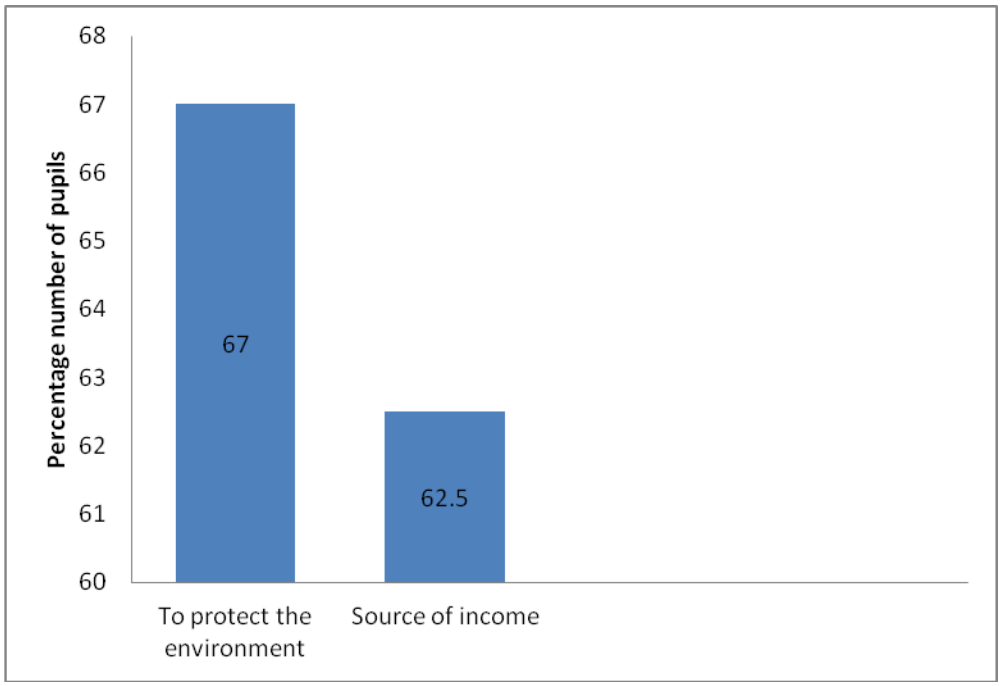


Figure 4.13: Perceptions on the importance of involvement in LVCEEP activities

According to 449 (67%) of the pupils, it is necessary to carry out activities learnt from LVCEEP because it protects the environment while 419(62.5%) see revenue generation as the reason for implementing the activities. Long drought was identified as the most threatening hazard among all the effects of climate change as it impacts on agriculture, livestock and forest resources. Most of the respondents stated that long droughts had severely affected forest ground pastures, water resources and agricultural crops. This study confirmed that rural communities in Africa are vulnerable to long droughts. However, the degree of vulnerability differs among the different economic classes of the respondents. This study concluded that poor people are in higher degree of vulnerability to the effects of climate change than well -off rural people.

The pupils were asked about the activities or projects that they had either implemented or influenced their families to implement in their homes as a result of lessons learnt from LVCEEP programme, the responses are presented in Figure 4.14.

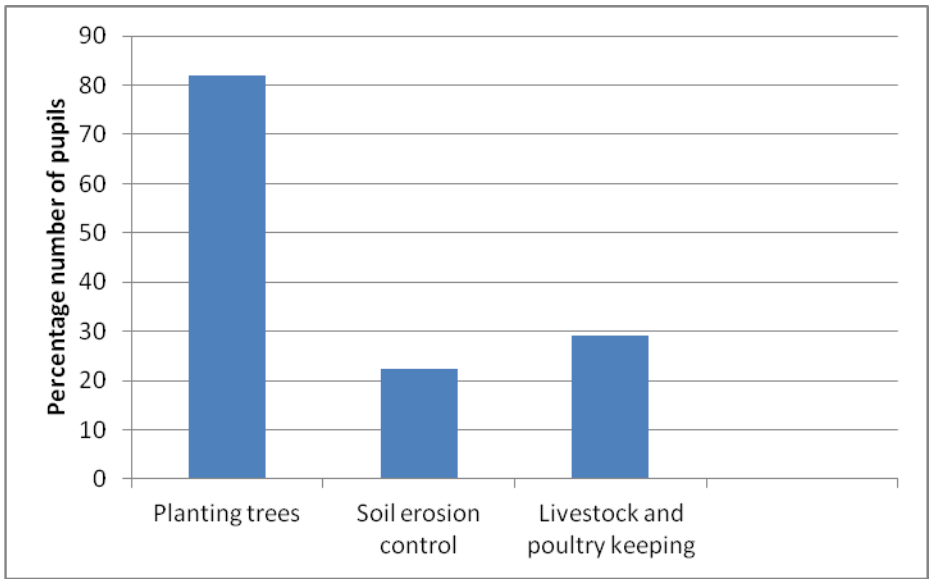


Figure 4.14: Lessons learnt from LVCEEP implemented at home

According to 549(81.9%) pupils they had planted trees, 150(22.4%) reported that they have implemented soil erosion control measures and 194(29%) pupils responded that as a result of lessons from LVCEEP, they are now engaged in livestock and poultry farming poultry in their homes. ESD is more than just knowledge related to the environment, economy and society. ESD addresses learning skills, perspectives and values that guide and motivate people to seek sustainable livelihood, participate in democratic society and to live in a sustainable manner. A study conducted to evaluate the impact of Healthy Learning programme in Kenya revealed that both pupils and

communities had replicated lessons and skills related to water harvesting, kitchen gardens and tree growing from the school projects and that they were implementing similar activities in their homes (Vandenbosch *et al.*,2009). Moreover, the study the study proved that knowledge and skills learnt in childhood are more likely to be retained and practiced in future life. (Vandenbosch *et al.,* 2009). LVCEEP's strategy of using whole school approach has worked to strengthen school community links by ensuring that there is knowledge transfer from the schools to the communities (LVEEP, 2012). The overall aim of ESD is to empower citizens to act for positive environmental and social economic change. Learning institutions can play a major role in bringing about the above desired changes. To be able to achieve the above, learning institutions need to embrace principles, skills and values related to ESD programmes.

4.5 Whether the Activities of LVCEEP contribute to efforts on coping with climate change as espoused in the National Mitigation and Adaptation Strategy

According to IPCC findings of 2007, Africa is one of the most vulnerable continents because of multiple stresses and low adaptive capacity. The multiple stresses may arise from current climatic hazards, poverty and unequal access to resources, food insecurity, globalization trends, social and political conflicts and incidences of diseases such as malaria, tuberculosis and HIV/AIDS. Nevertheless, the overall climate will largely be defined by the change in precipitation corresponding to what appears to be a marked increase in temperature (IPCC, 2007). This will lead to extreme rainfall events with dire consequences to agricultural production, especially for the vulnerable smallholder farmers.

The impact of climate change on Africa will be aggravated by demographic changes. Ziervogel *et al* (2008) findings indicate that in Eastern and Southern Africa, climate change vulnerability is heightened by the large number of people who depend on the already marginalized natural resource base for their livelihoods. Moreover, within the next 15 to 20 years, the area considered to have relative water security in Africa will fall from 53 percent to 35 percent (Ashton, 2002). Therefore, due to the current population growth, many countries in Africa are expected to experience a severe increase in water stress, with or without climate change; the high population growth could in fact nullify any increases in precipitation/available water. The situation will be aggravated by over-dependence on natural resources (Raleigh and Urdal 2007). Overdependence on surface water, especially for irrigation, will aggravate the impacts of climate change and variability on agricultural development. That is why the study seeks to establish how the programme contributes to the objectives of the country's mitigation and adaptation efforts to cope with climate change, the findings presented under this section was one of the study objectives.

As a response to the challenges posed by climate change to Kenya, the National Climate Change Response Strategy has proposed a number of measures meant to curb the adverse impacts of climate change on the country (adaptation measures) and to tame global warming (mitigation measures) (NCCRS, 2010).

The study revealed that LVCEEP is involved in the following activities

1) **Health:** Implementation of low cost treatment for drinking water, improved nutrition through promotion of growing and consumption of climate resilient

indigenous food crops, improved hygienic conditions and lifestyles through ESD, support to pit latrine construction, support to hand washing practice in schools.

2) **Agriculture:** Implementation and capacity building on environmentally sustainable agriculture, provision of technical and logistical support to school farms establishment, promotion of growing of alternative food crops like sorghum, cassava and millet by catchment communities to help them cope with and adapt to climate change, introduction and promotion of modern bee keeping, introduction to agroforestry: moringa tree intercropped with tomatoes and paw paws, schools and communities now growing *grevillea* species *sesbania* and *calliandra* species intercropped with various crops. Planting indigenous trees and establishment of seedling beds and woodlots, mushroom growing, piggery and sustainable farming practices, support to dairy projects by introducing fodder trees, soil conservation measures, introduction of basic drip irrigation.

3) **Water:** Introduction of water conservation measures such as use of grey water for irrigation and for bee keeping, rainwater harvesting, Spring water protection, wetlands conservation

4) **Fisheries:** Establishment of fish ponds as alternative income activities as opposed to charcoal burning and unsustainable fishing from the lake, restocking of threatened fish species in the schools and community groups' fish ponds

5) **Tourism and Wildlife:** Improved biodiversity due to beekeeping, reduced human wildlife conflict through introduction of live fencing, creation of forests as wildlife habitats, motivating of community groups to support tourism and wildlife by building their capacity to enable them package and sell e.g. honey, craft articles to hotels within the catchment.

6) **Livestock/pastoralism:** Introduction of poultry farming, piggery, beekeeping (improved bee hives for more and better quality honey) and dairy goats.

7) **Forestry:** Tree growing initiatives, woodlots establishment, introduction of energy saving initiatives such as the eco-jikos (improved fire place) and fireless cookers have reduced the rate of deforestation, schools greening initiatives.

8) **Range lands and Wildlife:** Construction of gabions in rangelands for soil erosion prevention.

9) **Climate Change Communication, Education and Awareness Programme:** Workshops and training programmes for target on conservation and climate change, outreach/mobile education programmes, production and dissemination of various resources materials covering e.g., water conservation, tree planting, pollution, community to community exchange visits, mobilising schools, communities, youth groups and teachers training colleges for participation in the observation of Earth hour. Schools competition on issues of energy and climate change, production and distribution of environmental education newsletters, web site information sharing and media coverage of conservation activities, documentation and dissemination of best practice. These results indicated that there was a relationship between majority of the activities of LVCEEP and the government strategies as outlined in the National Mitigation and Adaptation efforts to cope with climate change. The findings also indicated that LVCEEP is involved in all the NCCRS thematic areas except the areas of Physical Infrastructure, The Green Energy Development Programme, Transport, Carbon markets, Vulnerability Assessment, Impact Monitoring and Capacity Building, Research, Technology Development, Absorption and Diffusion and Climate Change Governance.

To find out about the general appearance of the schools prior to the intervention of LVCEEP, the study asked the pupils to describe the physical state of their schools before LVCEEP implementation. Figure 4.15 presents the description of the schools before LVCEEP implementation.

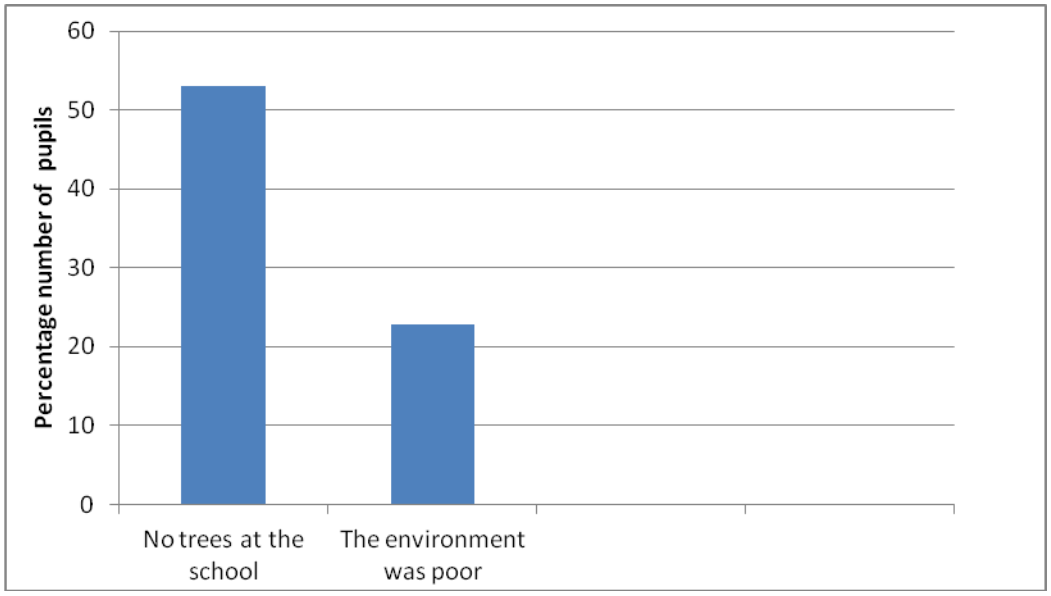


Figure 4.15: Description of the physical appearance of the schools before LVCEEP interventions

According to 356(53.1%) pupils, there were no trees in the compound while 153(22.8%) pupils described the environment prior to LVCEEP as poor. Education at all levels is key to sustainable development (Anan, 2002). Educating people for sustainable development means not just adding environmental protection concepts to the curriculum but also, promoting a balance among economic goals, social needs and ecological responsibility. Education should provide learners with skills, perspectives, values and knowledge to live sustainably in their communities. It should be

interdisciplinary, integrating concepts and analytical tools from a variety of disciplines.

The study sought to find out if indeed there was a difference in the appearance between the LVCEEP programme schools and other schools not involved in the programme. Table 4.14 illustrates the differences between the programmes schools and those not involved with the programme.

Table 4.14: Difference between LVCEEP Programme schools and others

Difference	Frequency	Percentage
No trees at the school	534	69
They do not have tree nurseries	97	12.6
They do not know how to keep their environment clean	81	10.3
They do not know how to manage waste	58	7.5

The pupils were asked to describe the general appearance of the nearest school which is not involved with LVCEEP. Thereafter, the students outlined the difference between their school and other schools which are not involved in LVCEEP activities and from the study findings, 534(69%) confirmed that the non-programme schools do not have trees, 97(12.6%) stated that the other schools do not have tree nurseries, 81(10.3%) indicated that other schools do not keep their environment clean while 58(7.5%) reported that the other schools has used plastic bags and other waste in the school compound.

One of the expected outputs of LVCEEP is to change the learners from passive recipients of knowledge to active constructors of knowledge. ESD values and builds upon learners experience, spiraling gracefully towards greater depth and understanding. It changes the role of the teacher from supervisor to that of a guide in the learning process. It should not just be a case of the transfer of knowledge from the big desk to the smaller desk but rather teachers should try to provide opportunity for interesting (fun) and meaningful way of learning where students enjoy exercising their minds and talents.

The pupils were asked whether what they learnt through LVCEEP was applicable in real life. The responses are presented in Figure 4.16.

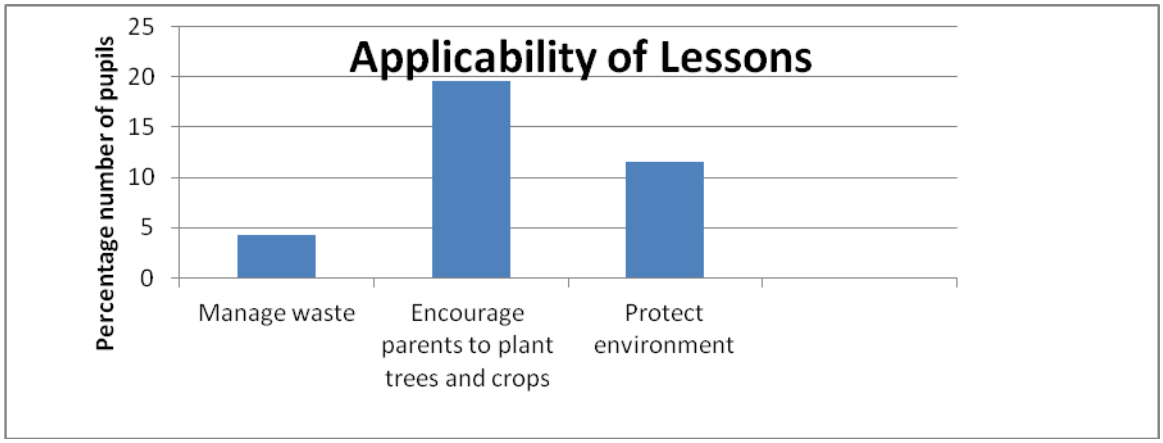


Figure 4.16: Applicability of lessons learnt from LVCEEP in real life situations

Six hundred and sixty (98.5%) agreed that it was applicable. And when asked how they can apply the lessons learnt in real life situations, 29(4.3%) reported that they can manage waste, 131(19.6%) actively encourage their parents to plant trees and crops while 78(11.6) stated that they can protect their environment. On the knowledge of what climate change means, (97.8%) of the pupils stated that it is a change in weather

patterns while 153(22.8%) termed climate change as change in the atmosphere. The above results confirms the World Bank report that human wellbeing paradigms have recently been influential in the development policies for the energy and food/water sectors as reflected in the World Banks Poverty Reduction Strategies (World Bank, 2001).

Further, Teachers from the Programme schools were asked about the difference between their schools and other schools that are not in the programme. Figure 4.17 presents their responses.

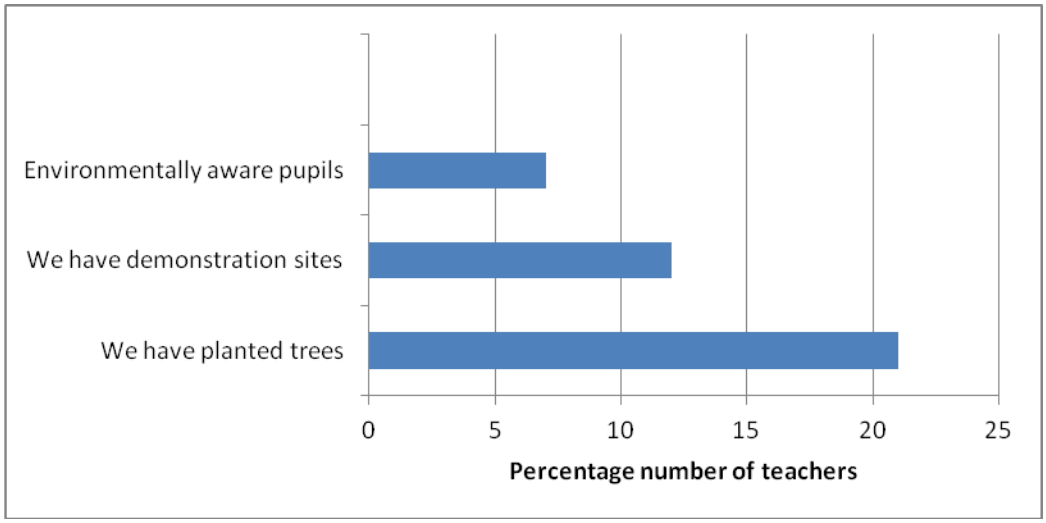


Figure 4.17: Difference between schools in the programme and other schools according to the teachers

From the analysed study data, 3(10%) responded that they have planted trees as compared to the non-programme schools which were not involved in tree planting, 19(63.3%) teachers felt that they planted more trees as compared to the non-

programme schools, 12(40%) reported that they have vibrant illustrative demonstration plots within their schools as opposed to schools not involved in the LVCEEP programme, 7(23.3%) reported that they have environment friendly pupils while 8(26.7%) responded that they have a beautiful school environment as compared to those of schools that are not in the programme. All the strategies mentioned above add environmental services to the compound by increasing biodiversity, improving scenic beauty, improving water quality and or quantity, and sequestering carbon. These are also important climate change adaptation strategies. As a result, these strategies are important to the communities because they increase the farms resilience to the effects of climate change as well as providing other environmental and social benefits. The focus of the LVCEEP programme has been on the implementation of environment conservation projects for environmental reasons.

The researcher considered the influence that teachers traditionally have on their pupils and wanted to verify whether the teachers comprehended the subject matter of climate change as this would determine the knowledge they would pass to the pupils. If the teachers are to engage the students in conservation lessons that impacts positively on the fight against climate change then the teachers must have the right information on climate change. Figure 4.18 illustrates the teachers' comprehension of climate change.

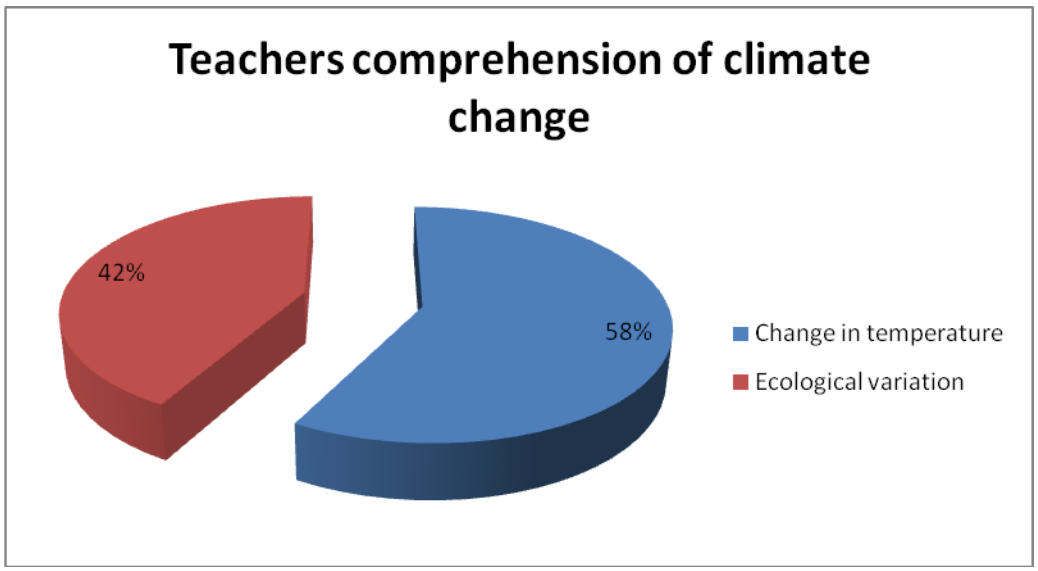


Figure 4.18: Teachers' comprehension of climate change

The teachers were asked to describe what climate change is and from the findings, 19(63.3%) described it as change in temperatures while 14(46.7%) described it as ecological variation. Teachers are an important component of education whose services are important in the realization of educational goals the world over. Due to their central role in the enterprise of education, teachers at all levels require effective and sufficient education to be able to adequately carry out their roles and responsibilities (Namunga and Otunga, 2012). Otiende *et al* (1992) acknowledge that trained teachers are vital for quality education. Teachers take actions and incorporate different instructional approaches relying on their own belief constructs. As they display their values of science, students will likely assimilate similar attitudes into their dispositions (National Research Council, 1996).

A teacher, according to Shiundu and Omulando (1992), is the most important person in teaching who sees that educational programmes are successfully implemented by

organising and managing the learning experiences and environments. The results indicate that the teachers in the programme have a comprehension of the concept of climate change. The findings concur with the results of a study conducted in 2012 to find out the attitudes and believes of In-service teachers' about Climate Change (Liu *et al.*, 2012) which reported that the teachers' knowledge about climate change became more complex and elaborate after exposure to the subject through training and workshops.

The study also sought to find out whether the teachers felt that the projects they are involved in are addressing real climate change issues, Figure 4.19 presents the teacher' opinion on the relationship between the projects and climate change.

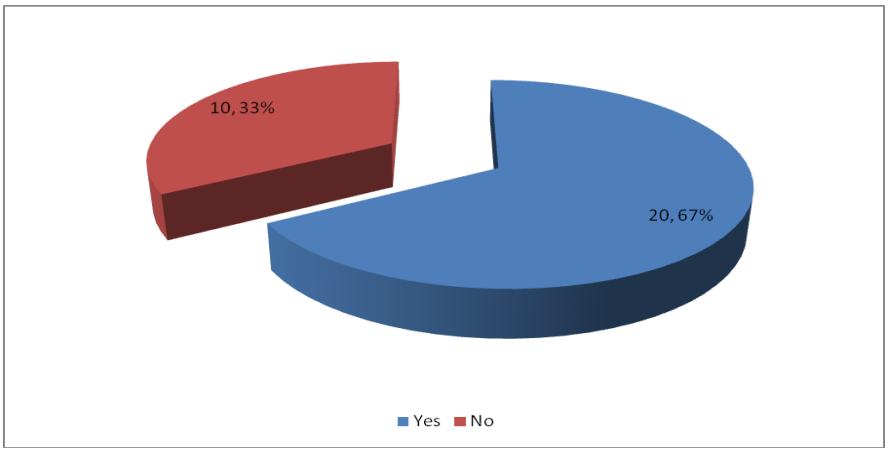


Figure 4.19: LVCEEP role in addressing issues of climate change

The study results revealed that 20(66.7%) agreed that LVCEEP projects address issues of climate change. LVCEEP aims to instill decision making skills, problem solving skills, communication skills, inquiry/research skills, creative skills, critical thinking skills, conflict management skills and practical citizenship skills.

The study sought to find out the pupils' opinion on how ESD activities addresses climate change challenges. Table 4.15 presents the pupils views on the relationship between Education for Sustainable Development and responses to the challenges of climate change.

Table 4.15: How ESD activities address climate change challenges according to the pupils

Project Activity	Frequency	Percentage
Health : by planting trees we get fresh air	177	26.4
Agriculture		
Enough rainfall for crops	75	11.2
Controls soil erosion	50	7.5
Planting crops and keeping animals	493	73.6
Water		
Through planting trees there is enough rain and water	137	20.4
We can harvest water to be used for irrigation	70	10.4
Fisheries		
Enough fish through fish farming and enough rainfall	399	59.6
We can have big fish	79	11.8
Tourism and wild life		
From forest we can attract tourism and wildlife benefits from the environment (ecotourism)	313	46.7
We can protect our animals and birds	30	4.5
Forestry		
Through planting trees we have created man made forests	479	71.5
Energy		
By planting trees we get enough fuel wood	45	6.7
We can conserve energy through energy- jikos	610	91.0
Rangelands		
By constructing gabions we have prevented soil erosion	220	32.8

According to 313(46.7%) pupils, by planting trees and protecting the forests, they can benefit from tourism and wildlife benefits from the environment and therefore use the incomes generated for their livelihoods instead of cutting trees to make charcoal for the market. 30(4.5%) pupils felt that through the programme they had developed the capacity to protect animals and birds in the community. Climate is a principal resource for tourism as it co-determines the suitability of locations for a wide range of tourist activities, it is a principal driver of global seasonality in tourism demand, and has an important influence on operating costs, such as heating-cooling, snowmaking, irrigation, food and water supply, and insurance costs. Thus, changes in the length and quality of climate-dependent tourism seasons (e.g., sun-and-sea or winter sports holidays) could have considerable implications for competitive relationships between destinations and therefore the profitability of tourism enterprises (UNWTO-UNEP-WMO, 2008). Studies indicate that a shift of attractive climatic conditions for tourism towards higher latitudes and altitudes is very likely. Uncertainties related to tourists' climate preference and destination loyalty require attention if the implications for the geographic and seasonal redistribution of visitor flows are to be projected. According to a study by Kissui and Packer, tourism is a key economic activity in Africa, particularly wildlife and coastal tourism (Kissui and Packer 2004). But the impacts of climate change on wildlife and coastal areas in Africa are uncertain. It is argued that climate change induced droughts and floods might have caused the outbreaks of canine distemper virus that has devastated lion populations in East Africa in recent years.

On forestry, 479(71.5%) of the respondents stated that their tree planting initiatives had resulted to man-made forests in their environment and on energy, 640(91%) of the pupils reported that they are conserving energy by using eco-jikos while 45(6.7%) stated that they now have enough woodlots in the area and are therefore not engaging in the destructive habit of deforestation. On the question related to rangelands 220(32.8%) agree that they have taken care of rangelands by constructing gabions to prevent soil erosion. Effective management of subsistence rangelands will be important as many species will need to be able to track suitable habitats in response to climate change (Von Maltitz *et al*., 2007).

According to 177(26.4%) the pupils, LVCEEP tree planting project has improved the general environment and made the air fresh. This is in agreement with Jiang on his study on China in which he concluded that integrated energy efficiency improvements in power production, industry, and the building sector can offer economic benefits, reduced local air pollution, and green gas emission reductions (Jiang, 2003). These findings are also supported by several programmes which have been involved in studying the relationships between health and nature and, more recently, implementation of the outcomes of the research by Jiang has been replicated in several countries or states, including Victoria (Australia), British Columbia (Canada), the United Kingdom and the Netherlands. The Secretariats of the Convention on Biological Diversity and the World Health Organization have also played a significant role in developing understanding and providing liaison between health and conservation (Blaschke, 2009). Studies on environmental projects conducted by researchers at Deakin University in Victoria, Australia focusing on groups involved

in conserving certain local areas; a society focused on private land of high conservation value; and a project targeting people with mental health problems confirmed that involvement in environment conservation activities brought physical, mental and social benefits (Townsend 2006; Townsend & Ebden 2006). An understanding of this relationship is illustrated in Figure 4.20.

Source: (Groenewegen *et al.,* 2006).

Figure 4.20: General mechanisms postulated to explain the relationship between green space, health, wellbeing and social capital.

On agriculture, 493(73.6%) of the pupils reported that they are now involved in animal husbandry as well as crop planting in the area, 75(11.2%) of the pupils stated that there is enough rainfall, 50(7.5%) agreed that they have controlled soil erosion for improved agricultural production. FAO findings support the view that agricultural production and the biophysical, political and social systems that determine food security in Africa are expected to be placed under considerable additional stress by climate change (FAO, 2007). Adverse impacts on agriculture sector will exacerbate the incidence of rural poverty (Dinar *et al*., 2008).

When asked about water, 137(20.4%) of the respondents said they believed that tree planting has led to an increase in rainfall and water for use, 710(10.4%) of the pupils responded that they can now harvest the rain water and use it for irrigation. When asked about fishing 399(59.6%) pupils stated that the programme activities such as tree planting has improved the amount of rainfall water in the rivers and that this, together with the introduction of fish farming has resulted to an improvement in the fish quantities while 79(11.8%) reported that fish of larger sizes are now available in the area**.** The study sought to find out opinions on the role ESD in addressing the challenges of climate change. Table 4.16 presents the teachers' perception on how ESD activities address climate change.

Table 4.16: How ESD activities addresses climate change challenges according to the teachers

	Frequency	**Percentage**
Health: Source of herbs	28	93.3
Reduced health problems	27	90.0
Trees enhance oxygen flow in air	13	43.3
Health clubs have been able to help pupils understand their health and environment	10	33.3
Agriculture		
Agro-forestry and intercropping	14	46.7
Pupils encouraged to participate in farming	11	36.7
Improved farming methods	9	30.0
Reduction of soil erosion	2	6.7
Water		
Harvesting of rain water for use and boiling drinking water	13	43.3
Recycling of water at home	1	3.3
Reduced water pollution	2	6.7
Fishing		
Soil erosion prevention has reduced soil/silt and chemical deposition thus fish are increasing	11	36.7
Creation of ponds to reduce over-reliance in lake fish	10	33.3

	Frequency	Percentage
Tourism and Wildlife		
Forests have become home of birds and animals have also increased	13	43.3
fencing the wild parks to reduce human interference	9	30.0
Livestock and Pastoralism		
keeping right number of animal to reduce soil cover damage	6	20.0
The locality looks green due to planted trees	18	60.0
Pupils and community have positive attitude towards tree planting	12	40.0
Planting of early maturing trees	1	3.3
Energy		
The use of energy saving jikos	13	43.3
There is sufficient firewood	8	26.7
Using renewable energy instead of fuel-wood	4	13.3
Rangelands		
There are no rangelands	10	33.3

The study revealed that on the issue of health, 28(93.3%) teachers were of the opinion that the programme's tree planting initiatives and environmental protection activities had restored the indigenous vegetation thus enabling people to access medicinal herbs, 27(90%) believed that the programme had reduced health problems, 13(33.3%) agreed that trees enhanced oxygen flow in the air while 10(33.3%) agreed that health clubs introduced by LVCEEP had enhanced the pupils' understanding of their health. Some of the sustainable development thematic priorities identified by UNESCO include Social Good Governance, Gender Equity, Health and HIV & AIDS, Reproductive Health, Peace/Conflict, Human Rights, Access to Education, Human Trafficking, Drug Addiction (UNESCO, 2009). Health is therefore a key priority area for sustainable development considerations.

One of the impacts of climate change in the developing countries has been identifies as the exacerbating of the existing vulnerability to disease and food security risks. This is because the populations in these countries are more reliant on agriculture and more vulnerable to droughts, a situation worsened by their low adaptive capacity (Huynen *et al.,* 2013). According WHO, in developing countries the most sensitive diseases to climate change are diarrhoeal disease, malaria and malnutrition related diseases (WHO, 2006). Other examples of climate change -induced risks are malnutrition and tuberculosis. Climate change is therefore an amplifier of existing health and food security risks (Huynen *et al.,* 2013). Strategies for meeting the challenges of climate change must incorporate climate change health risks to for more positive impact in the developing countries.

In relation to agriculture 14(46.7%) of the teachers reported that the programme has introduced agro-forestry and intercropping in the region, 11(36.7%) stated that the programme encourages pupils to participate in farming, 9(30%) felt that it has improved the farming methods while 2(6.7) feel that the programme has led to reduced soil erosion.

This is in agreement with Blank's findings that farmers have identified several problems that affect adaptation, including lack of information on proper sizing, design information and the high infiltration rates experienced with some types of soils (Blank *et al.*, 2007). In relation to water 13(43.3%) teachers reported that they are now harvesting rain water for drinking, 1(3.3%) indicated that they are now recycling water while 2(6.7%)reported that there is reduced water pollution.

When asked about fishing, 11(36.7%) teachers stated that they are preventing soil erosion so as to reduce soil deposition of chemicals into rivers and thus there is an increase in fish production, 10(33.3%) are creating fish ponds to reduce over-reliance on the lake's fish. Inadequate information and data management is one of the challenges and constraints affecting climate change adaptation and mitigation in Africa (Turner, 2006). Different countries have a scattered number of stations that collect different meteorological, and to some extent, hydrological data. Some countries have experts responsible for weather predictions and forecasts providing early warning signals on climate variability. However, data consistency and its availability in usable forms are hindered by inadequate coverage, personnel and modern equipment.

When asked how they related tourism and wildlife to the programme; 13(43.3%) agreed that the conserved/planted forests have increased the range and numbers of suitable habitats for birds and animals. 9(30%) reported that LVCEEP programme has facilitated the fencing of wildlife parks thereby reducing human interference with wild animals. (Midgley *et al*., 2005) findings in Namibia, supports above findings that climate change and associated aridification could threaten the lucrative tourism sector. Indeed, the contribution of nature-based tourism (including landscape, game viewing and trophy hunting) is estimated to be 75 per cent of Namibia's total tourism sector.

Six (20%) of the teachers were in agreement that people are now keeping reduced number of livestock relative to available land size so as to reduce tempering with soil cover. When asked how the programme has impacted on the areas' forestry, 18(60%) reported that their locality looks green due to tree plantations, 12(40%) of the pupils

in the region now have a positive attitude towards tree planting. Conservation agriculture often reduces evaporation from the soil, especially in drier environments (Tilman *et al.,* 2002) and (Miller and Donahue, 1990). Since the combined water loss through runoff and evaporation often leaves less than half of the rainfall (or irrigated water) available for crops, the adoption of these technologies can increase crop yields and food production.

On energy, 13(43.3%) of the teachers are using energy saving jikos, 8(26.7%) agree that they now have access to sufficient firewood, while 4(13.3%) of them are using renewable energy. But 10 (33.3%) of the teachers reported that there are no rangelands in the schools. The use of energy saving jikos is important as use of forest fuels (wood for charcoal and firewood) is a major contributor to deforestation which hampers the efforts to combat climate change (Ndungu and Karani, 2007). These findings concur with those of the study conducted on locals adapting to the effects of climate change in Oyola and Wakesi communities (Wakhungu *et al.,* 2010) in which some Oyola community members have now adopted an improved jiko which enables them to use less fuel wood. Up to 90% of the rural population in Africa is dependent on biomass for domestic energy requirements (Rowlands, 2011). When combusted in cook stoves, this biomass generates carbon dioxide, i.e., global warming (Rowlands, 2011). According to a study by Rowlands, access to more-efficient cook stoves is an important climate change mitigation strategy. This observation is in tandem with the results of a study studies conducted by GTZ HERA reported that the use of energy-efficient stoves has double benefits in that they could help reduce unhealthy emissions and also reduce the quantity of biomass required while cutting down on cooking time.

ESD enables the community to take measures to reduce rate and magnitude of climate changes caused by human activities (Olusola, 2012). The measures include tree planting which increases reforestation, modification of agricultural practices, and adopting of technology geared towards energy conservation and less carbon emissions. This is supported by Holden who observes that some of the options that are available to enhance climate change mitigation and adaptation include changing the cropping patterns; stopping further development on wetlands, flood plains, and close to sea level; developing crops that are resistant to drought, heat and salt; strengthening public health and environmental engineering defenses against diseases; designing and building new water projects for flood control and drought management; construction of dykes and storm surge barrier against sea level rise (Holdren, 2010).

The study sought to find out the environmental situation in the area before the community got involved with the activities of Lake Victoria Catchment Environmental Education Programme. Table 4.17 presents details of environment related problems experienced in the community before LVCEEP intervention in the area.

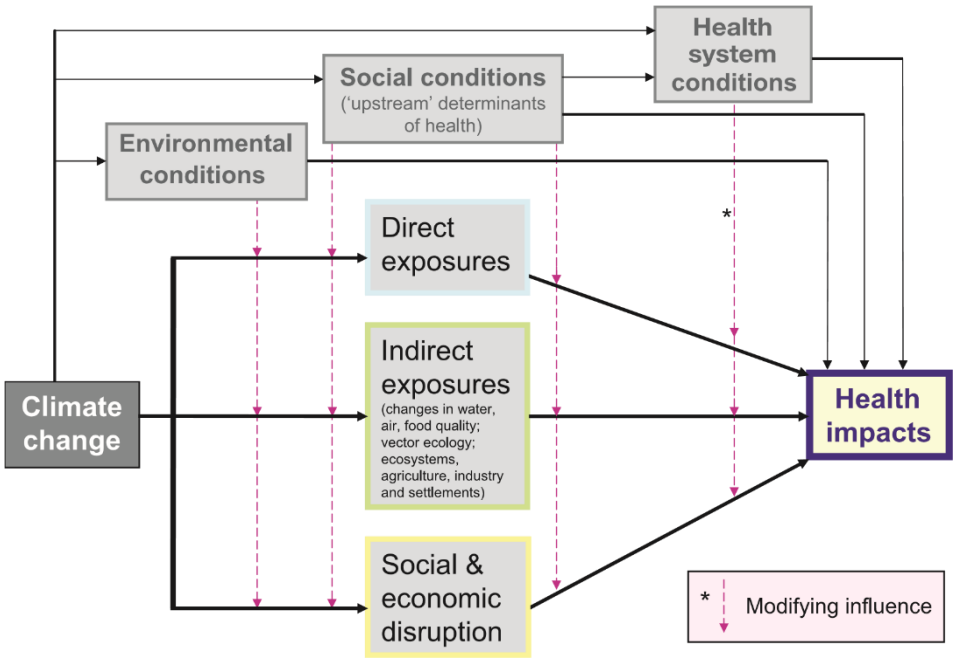
Table 4.17: Environment related problems in the community before LVCEEP intervention

Challenges	Frequency	Percentage
Health		
There was no health facility around or any health awareness	**24**	**27.9**
People were prone to diseases	**36**	**41.9**
Lack of pit latrines	**21**	**24.4**
Agriculture		
There was drought in the area	**41**	**47.7**
Reliance on traditional farming methods	**38**	**44.2**
Lack of market for farm produce	**14**	**16.3**
Water		
Inadequate (and dirty) water for domestic use and agriculture	**85**	**98.8**
Fishing		
There was too much dependence on fish	**56**	**65.1**
Tourism and Wildlife		
The forests were cleared and wildlife were displaced (or died/ poached)	**71**	**82.6**
Livestock and **Pastoralist**		
Poor livestock production because of persistent drought	**56**	**65.1**
Forestry		
There was poor tree coverage due to drought and deforestation	**79**	**91.9**
Energy		
The community depended entirely on charcoal, firewood and kerosene for lighting and cooking	**78**	**90.7**
Source of livelihood		
Subsistence farming, fishing and charcoal burning	**66**	**76.7**
Limited sources of livelihood	**12**	**14.0**

The study sought to find out the health of the community members before the implementation of LVCEEP programme in the region and according to the findings; 24(27.9%) lacked easily accessible health facility, 36(41.9%) reported that people

were prone to diseases while 21(24.4%) stated that there were no pit latrines in the region before the programme.

Climate change endangers human health, affecting all sectors of society, both domestically and globally (Portier *et al.*, 2010). Climate change impacts five components of the human environment: water, air, weather, oceans and ecosystems which in turn impacts additional environmental factors; these impacts could affect multiple disease categories (Portier *et al.*, 2010). There is evidence indicating that the impacts of climate change such as flooding and drought, heat waves, more intense hurricanes and storms, degraded air quality, food insecurity amongst others will affect human health (Portier *et al.*, 2010). Figure 4.21 illustrates the relationship between climate change and human health.



Source: (IPCC, 2007)

Figure 4.21: Relationship between Climate Change and Human Health

Changes in greenhouse gas concentrations and other drivers change the global climate altering human health; mitigation alters climate and both mitigation and adaptation alter the human environment; the predominant impact on human health is through environmental changes as a result of climate change although there are direct impacts from both climate changes and mitigation/adaptation (Portier *et al.*, 2010).

When asked about agriculture at that time, 41(47.7%) of the community members responded there was persistent drought in the area 38(44.2%) of them stated that they were relying on traditional farming methods while 14(16.3%) felt that they lacked market for their agricultural produce. According to 85(98.8%) of the community members, before the programme implementation there was inadequate and dirty water for both domestic use and for agriculture. When asked about fishing, 56(65.1%) agreed that there was too much dependence on fish in general while 32(37.2%) feel that there was over-reliance specifically on Lake Victoria fish. Findings by Ziervogel *et al* (2008) confirms the above responses when they report that in eastern and southern Africa, climate change vulnerability is heightened by the large number of people who depend on the already marginalized natural resource base for their livelihoods.

According to 71(82.6%) of the respondents, the forests were cleared leading to lose of wildlife. 56(65.1%) reported that there was poor livestock production because of persistent drought in the area, 71(91.9%) stated that there was poor tree coverage due to drought and deforestation in the community before the implementation of LVCEEP programme. On energy 78(90.7%) of the respondents agreed that the community

depended entirely on charcoal, firewood and kerosene for lighting and as their source of livelihood. According to 66(76.7%), their source of livelihood was subsistence farming, fishing and charcoal burning, while 12(14%) felt that their source of livelihood was minimal at that time. This implies that over use of forest resources led to deforestation and soil erosion. Findings on cases similar to the above confirms that within the next 15 to 20 years, the areas considered to have relative water security in Africa will fall from 53 percent to 35 percent (Ashton, 2002). Therefore, due to the current population growth, many countries south of the Sahara are expected to experience a severe increase in water stress, with or without climate change. Population changes could in fact nullify any increases in precipitation/available water (Raleigh and Urdal, 2007). The situation will be aggravated by over-dependence on natural resources.

According to Jeffries on the environmental issues, risks and the associated sustainable development challenges in the Lake Victoria catchment, the catchment today holds a marginal place in the region's economy as well as social-ecological fabric despite its rich array of natural resources (Jeffries, 2010). This is partly due to the environmental issues and the associated sustainable development challenges that have continued to affect the catchment and its people. The environmental issues, risks and the associated sustainable development challenges are caused by several factors which include population pressure, increasing poverty, unsustainable agricultural practices, and over-exploitation of the catchment's natural resources among others. Similarly, agriculture and its invasion and consumption of natural forests, poor livestock keeping practices, increased and unsustainable demands on the natural forests for fuel-wood

were some of the activities that were identified as serious threats to the lake catchment and therefore urgently needed appropriate responses so as to restore the balance of nature.

Additionally, the Lake Victoria catchment which supports a thriving fishery and agriculture (sugar, tea, coffee, maize, horticulture and livestock production) was being threatened by massive soil erosion leading to soil being drifted from the farmlands to the Lake Victoria through the drainage system. This affected food production in the farmlands as well as life and biodiversity in the lake waters. Further, wetlands surrounding the vibrant urban centres of Musoma, Kampala, Jinja, Kisumu and Mwanza, were becoming dumping grounds for effluents, solid-waste, agro-chemicals and industrial waste. This was also affecting the rivers and rivulets within the Lake Victoria, and Mara River Catchment which is an important tourism paradise serving Kenya's Maasai Mara and Tanzania's Serengeti National park ecosystem (Ndungu and Karani, 2007).

When asked if there has been a change in the challenges facing the communities as a result of ESD awareness, the results as presented in Figure 4.22 below revealed that 78(91%) of the community members agreed that there was a noticeable positive change

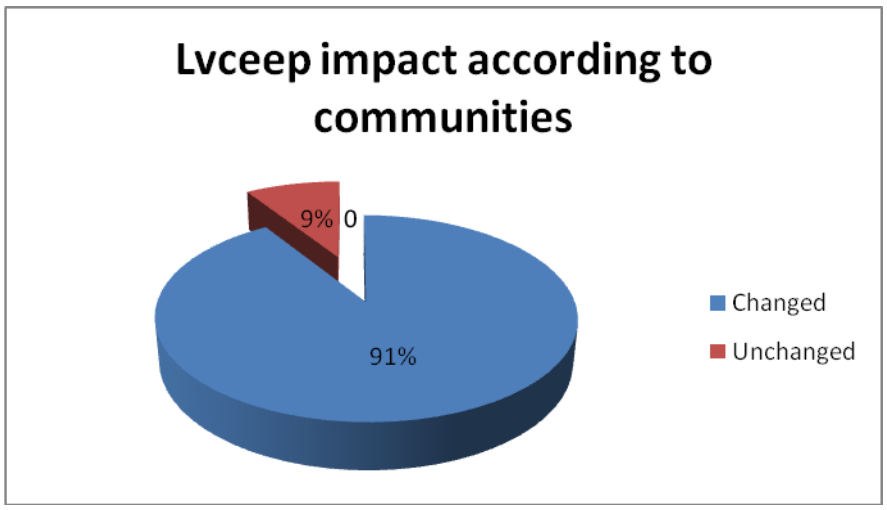


Figure 4.22: Communities' perception of LVCEEP's impact

This view is supported by Tilbury, Stevenson, Fien and Schreuder (2002) who observed that education is an essential tool for achieving environmental sustainability. For example, educating the community on the need to conserve the environment has helped in the alleviation of the adverse effects of climate change.

On how LVCEEP has enabled them overcome the environmental challenges, the community members responded as presented on Table 4.18.

Table 4.18: How the programme has helped to address the environmental challenges

The Changes	Frequency	Percentage
Livelihoods have improved	**42**	**48.8**
People now have income and hunger has been reduced	**38**	**44.2**
People are using improved farming methods	**22**	**25.6**
Soil erosion has been reduced	**19**	**22.1**

The study revealed that 42(48.8%) of the respondents felt that livelihoods have improved, 38(44.2%) responded that people now have some income and that hunger has been reduced, 22(25.6%) reported that people are using improved farming methods while 19(22.1%) agreed that there is a reduction in soil erosion.

These findings support the observation that the introduction of ESD through LVCEEP in the region has enabled the community to develop adaptive measure to climate change while carrying out activities that will help protect the environment from further degradation (Jeffries, 2010). A similar study conducted in Tanzania reported that about 96% of the respondents had implemented diversification of crops as a coping strategy to climate change. The main crops intercropped in the growing season included maize, beans, peas and sunflower (Msalilwa *et al.,* 2013). The results are also in tandem with the findings of a study in Oyola and Wakesi on "Locals adapting to effects of climate change" which reported that the farmers in the 2 communities diversified their crops by planting cassava, sweet potatoes and sorghum alongside the maize crop because these crops are drought and flood tolerant, enhancing their food security when droughts and floods hit the village (Wakhungu *et al.,* 2010). In agreement with these findings is also a study on climate change adaptation in Ethiopia (Tafere *et al.,* 2013). Farmers in some of the communities in the study reported that they have had to stop planting some varieties of cereals and instead have resorted to short maturing varieties as a precaution in the face of the uncertain climate patterns (Tafere *et al.,* 2013).

However, a case study of Rural Cambodia conducted to find out the links between poverty and environment observed that most respondents did not have proper mitigating strategies, instead, they had responded to drought by selling durable assets, sending further household members (including children) out to work, and migration although some villagers had used new rice seed varieties to adapt to extreme weather and relied more on common property resources such as vines to weave mats (Kimsun & Bopharath, 2011).

The study sought to find out about the communities' thoughts on the future of the catchment resources, the responses are presented in Figure 4.23.

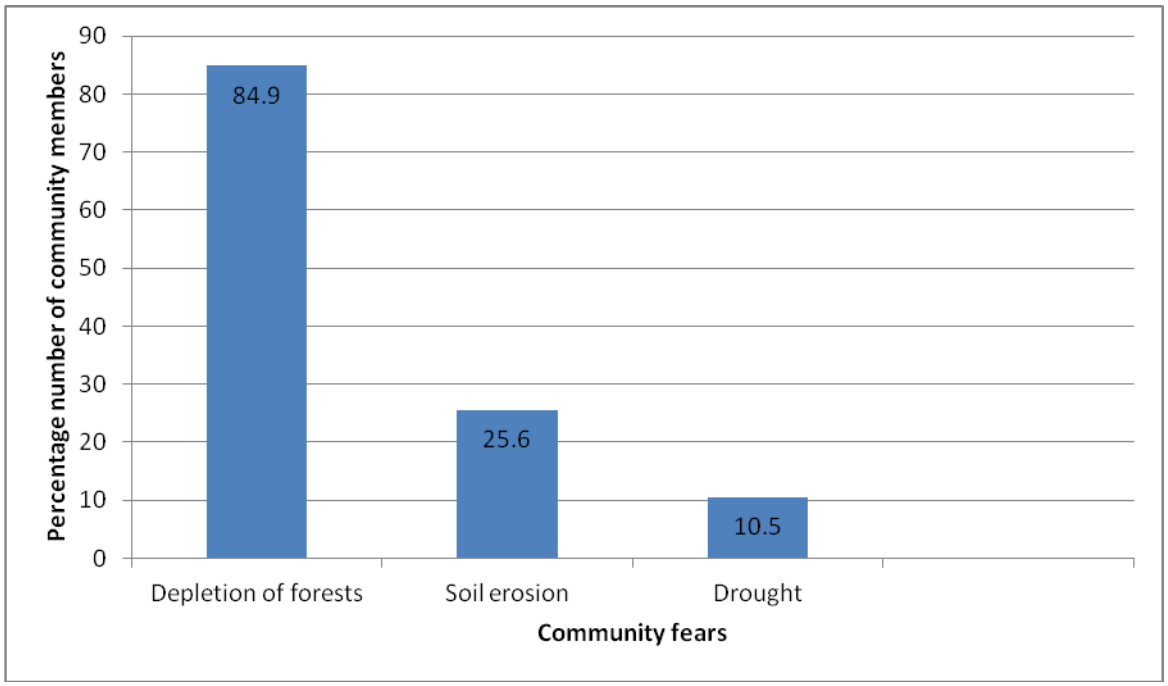


Figure 4.23: Potential challenges that the lake catchment might experience

Seventy three or (84.9%) projected that the depletion of forests would be a big challenge, 22(25.6%) identified worsening of the soil erosion problem as a potential

challenge, and 9(10.5%) stated that if more interventions are not put in place, drought will affect the region as presented in Figure 4.23.

These findings are similar to those of a study to assess the indigenous women's preferences for climate change adaptation and aquaculture development to build capacity in the Northern Territory conducted in by Petheram *et al.,* in 2013. During the said study, initially the participants had difficulties to imagine the future, but after exposure to conservation and climate change information the members talked about the way biophysical changes could impact on people and their health, changes in flora and fauna, poverty, food shortage and severe changes in the landscape in general (Petheram *et al.,* 2013). These findings are also similar to those of a study conducted in the Congo Basin forests of Cameroon on adaptive capacity and climate change response (Brown *et al.,* 2010), in which all interviewees were aware of the issue of climate change and pointed out that it would degrade the forest and have a negative effect on local communities who depend on the forest for their livelihoods. The results of the three studies indicate that awareness raising, information sharing and exposure to conservation education enables communities to comprehend a potential situation and take action to minimize the risks.

Climate change exerts multiple stresses on the biophysical as well as the social and institutional environments that underpin agricultural production. Some of the induced changes are expected to be abrupt, while others involve gradual shifts in temperature, vegetation cover and species distributions. Climate change is expected to, and in parts of Africa has already begun to, alter the dynamics of drought, rainfall and heat waves,

and trigger secondary stresses such as the spread of pests, increased competition for resources, the collapse of financial institutions, and attendant biodiversity losses.

To find out about the possible solutions to the potential challenges, the respondents were asked to suggest possible solutions. The various suggestions are presented in Table 4.19.

Table 4.19: Possible ways to overcome the potential challenges

Possible ways	Frequency	Percentage
Creating awareness and empowerment of community	40	46.5
Preventing soil erosion	30	34.9
Conserving natural resources	37	43.0
Planting more trees	27	31.4

To overcome the potential environmental challenges, 40(45.6%) respondents identified community awareness raising and community empowerment as one way of overcoming the challenges, 30(34.9%) felt that enhanced soil erosion prevention is a suitable strategy, 37(43%) advocated for conserving natural resources as the way to overcome the potential challenges and 27(31.4%) felt planting more trees is the solution.

The study sought to find out about awareness of climate change and the source of the knowledge and 71(82.6%) confirmed that they had heard about the issue, with

78(90.7%) reporting that they heard about climate change from the schools, LVCEEP and the media.

The study further sought to find out about the relationship between the activities they were involved in, conservation and climate change. The responses are presented in Figure 4.24.

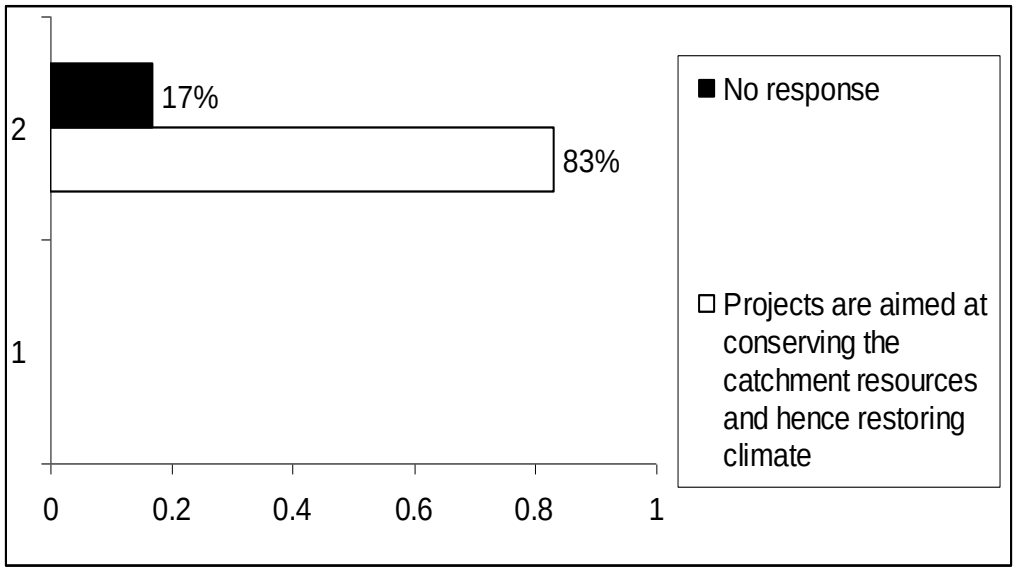


Figure 4.24: Relationship between LVCEEP, Conservation and Climate Change

From the findings in figure 4.24 above, the respondents are of the opinion that the projects they are implementing under LVCEEP are closely related to the subject of climate change because the projects are aimed at conserving the catchment resources and restoring the catchment ecosystem as it was before, and thereby combating the effects of climate change as stated by 71(82.6%) of the respondents. According to Ndungu and Karani, one aim of LVCEEP was to educate the catchment community on how to restore and protect the catchments area from the adverse effects climate

change (Ndungu and Karani, 2007) This has been done through the introduction of several projects all geared towards conservation and mainly focusing on tree planting and alternative ways of energy provision and use. This is implemented as the community earns a means of livelihood through the same projects concurrently.

On how they had inspired other people as a result of their engagement with LVCEEP, the respondents felt that they had changed how people do certain things as presented in Table 4.20

Table 4.20: Inspiring people to do things differently

Inspiration	Frequency	Percentage
Have become role model	21	24.4
People are planting trees	51	59.3
Some have started fish farming	38	44.2
Reduced charcoal burning	24	27.9
people have started conserving soil	38	44.2

Through their activities, 71(82.6) of the respondents felt that they had influenced the other community members to do things differently, while 51(59.3%) reported that they did this by becoming role models, 38(44.2%) responded that they have inspired others to start fish farming, 38(44.2%) have inspired them to conserve the soil, while 24(27.9%) have inspired people to reduce charcoal burning.

When asked if they had shared information with other teachers that are not in the programme, majority of the respondents 26(87%) reported that they had shared the information as presented in Figure 4.25.

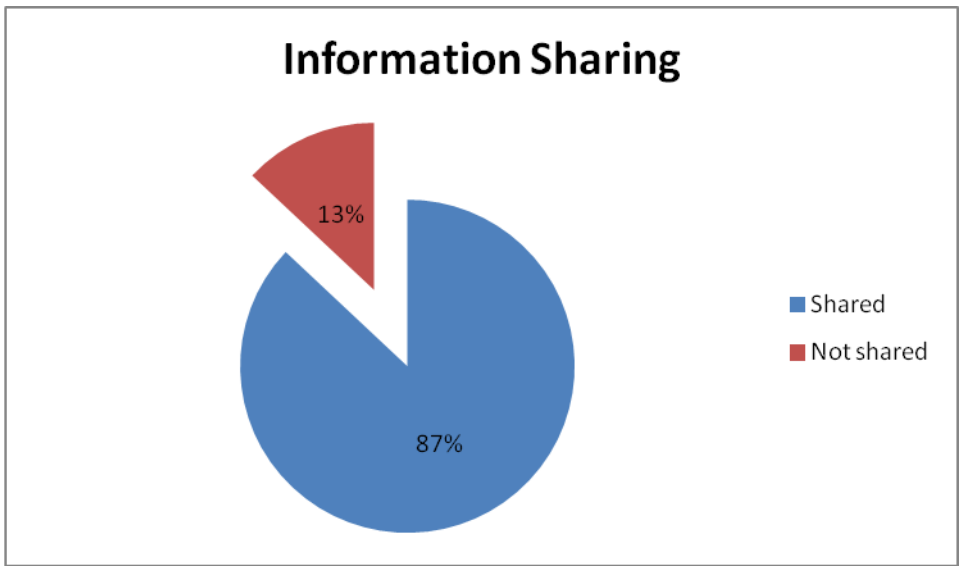


Figure 4.25: Information sharing

This implies that most of the teachers 87% share information with teachers that are not in the programme as shown in figure 4.38. These responses are supported by WMO findings which stated that the role of information and knowledge as a component of any climate change adaptation strategy cannot be overemphasized (WMO, 2007).

While economic development is the best means by which to build resilience, climate-informed policy and practice supported by climate information services and data may help to reduce the burden and contribute to the achievement of the MDGs and sustainable development. Climate information is a broad term that includes summary

statistics of climatic variables (rainfall, temperature, wind.), historic time- series records, near real-time monitoring, predictive information from daily weather to seasonal to inter-annual time scales and climate change scenarios. Table 4.21 illustrates the role of the teachers in education for sustainable development.

Table 4.21: Teachers' role in Education for Sustainable Development (ESD)

Ways of information sharing	Frequency	Percentage
Encourage them to plant trees	4	19.4
Discussed advantages of trees and flowerbeds planting	3	14.0
Encourage people to irrigate during dry season using water from the local well	4	19.4
Encourage parents to build underground tanks to harvest water for use during the dry seasons	1	4.8
Create awareness on the dangers of environmental degradation	3	14.0
Discussion on how to improve environment	6	28.6

The study further sought to find out how the teachers had influenced other teachers through information sharing and from the findings 4(19.4%) have encouraged them to plant trees, 3(14%) encouraged people to irrigate during dry season using water from the well, 5(23.4%) encouraged parents to build underground tanks to harvest rain water for use during the dry seasons, 6(28.6%) held discussions on how to improve the environment, while 3(14%) created awareness on the dangers of degrading the environment. These findings are supported by a study which found that teachers are

critical in facilitating educational development to the students, parents, the school community and the society at large.

Among the identified role of the teachers included sensitizing the above named on the hazards associated with environmental degradation (Cloud, 2005). In line with these findings, Huckle observes that teachers are agents of change in issues of environmental concern. This is attributed to the fact that majority of them were taught environment sustainability while on training and it is therefore their mandate to pass the knowledge to the rest of the community (Huckle, 1996). Some of the ways identified were knowledge on water conservation and the need to plant trees.

4.6 Inferential Statistics

The study utilised t-test in testing the following hypotheses.

Ho_1: The promotion of Education for Sustainable Development has no association with the identified responses to climate change challenges.

Ho_2: There is no relationship between Lake Victoria Catchment Environmental Education Programme activities and outputs and climate change mitigation and adaptation efforts.

Ho_3: The activities of Lake Victoria Catchment Environmental Education Programme do not contribute to the national mitigation and adaptation efforts to cope with climate change.

4.6.1 Relationship between promotion of Education for Sustainable Development and responses to climate change challenges

The analysis first looked at the relationship between promotion of Education for Sustainable Development and responses to climate change challenges. The following illustrates the statistical relationship between them.

Table 4.22: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Promotion of Education for Sustainable Development	3.7922	172	1.66411	.66411
	Responses to climate change challenges	2.9115	172	.74456	.07445

Table 4.23: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Promotion of Education for Sustainable Development & Responses to climate change challenges	19	0.79	0

The results indicate that the parametric Pearson correlation or 'r' value is significant at .79 and the p-value (Sig) for the correlational coefficient is less than $p < .05$ and significant.

Table 4.24: Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Promotion of Education for Sustainable Development & Responses to climate change challenges	1.44	1.66411	.66411	1.06485	0.12088	1.551	172	.017

Results and Hypothesis Statement (Promotion of Education for Sustainable Development & Responses to climate change challenges)

There is a significant relationship between Promotion of Education for Sustainable Development and Responses to climate change challenges (M = 3.79; M = 2.91). However their respective standard deviations are 1.66 and .74 are very far apart statistically. Further the $t(172) = 1.551$, $p < .05$. Therefore we reject the null hypothesis that promotion of Education for Sustainable Development has no association with the identified responses to climate change challenges and accept the alternative hypothesis that there is a relationship. Further with a 95% confidence interval from .18075 to 1.97925; the t-test statistic was 1.551 with 172 degrees of freedom and an associated P value = .017.

4.6.2 Relationship between Lake Victoria Catchment Environmental Education Programme activities and outputs and climate change mitigation and adaptation efforts

The analysis also looked at the relationship between Lake Victoria Catchment Environmental Education Programme activities and outputs and climate change mitigation and adaptation efforts. The following illustrates the statistical relationship between them.

Table 4.25: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Lake Victoria Catchment Environmental Education Programme activities and outputs	3.8196	172	1.11412	.11412
	Climate change mitigation and adaptation efforts	3.6522	172	.98442	.09844

Table 4.26: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Lake Victoria Catchment Environmental Education Programme activities and outputs and climate change mitigation and adaptation efforts	172	0.81	0

The results indicate that the parametric Pearson correlation or ‘r’ value is significant at .81 and the p-value (Sig) for the correlational coefficient is less than $p < .05$ and is significant.

Table 4.27: Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Lake Victoria Catchment Environmental Education Programme activities and outputs & climate change mitigation and adaptation efforts	1.04	1.11412	.11412	1.85302	1.03923	7.2377	172	0.02

Results and Hypothesis Statement (Lake Victoria Catchment Environmental Education Programme activities and outputs / climate change mitigation and adaptation efforts)

There is a significant relationship between Lake Victoria Catchment Environmental Education Programme activities and outputs (M = 3.8, SD = 1.1) and climate change mitigation and adaptation efforts (M = 3.6, SD =.98); t (172) = 7.2377, $p < .05$ and is significant. LVCEEP activities involve tree growing, awareness raising, energy conservation initiatives and alternative livelihoods amongst others, these are key climate change adaptation activities recommended by UN Initiatives UNFCCC (2008). Therefore we reject the null hypothesis that there is no relationship between Lake

Victoria Catchment Environmental Education Programme activities and outputs outputs and climate change mitigation and adaptation efforts and accept the alternative hypothesis that there is a relationship. Further with a 95% confidence interval from 1.85302 to 1.03923; the t-test statistic was 7.2377 with 172 degrees of freedom and an associated P value = 0.00.

4.6.3 Relationship between the activities of Lake Victoria Catchment Environmental Education Programme and the national mitigation and adaptation efforts to cope with climate change.

The analysis looked at the relationship between the activities of Lake Victoria Catchment Environmental Education Programme and the national mitigation and adaptation efforts to cope with climate change. The following illustrates the statistical relationship between them.

Table 4.28: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Activities of Lake Victoria Catchment Environmental Education Programme	3.7821	172	1.06994	.10699
	The national mitigation and adaptation efforts to cope with climate change	3.5229	172	.89723	.08972

Table 4.29: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Activities of Lake Victoria Catchment Environmental Education Programme & The national mitigation and adaptation efforts to cope with climate change	172	0.69	0.008

The results indicate that the parametric Pearson correlation or 'r' value is significant at .69 and the p-value (Sig) for the correlational coefficient is less than $p < .05$ and significant.

Table 4.30: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Activities of Lake Victoria Catchment Environmental Education Programme and The national mitigation and adaptation efforts to cope with climate change	1.21	1.06994	.10699	1.51291	.78364	6.240	172	.001

Results and Hypothesis Statement (activities of Lake Victoria Catchment Environmental Education Programme and the National Mitigation and Adaptation efforts to cope with climate change)

There is a significant relationship between activities of Lake Victoria Catchment Environmental Education Programme (M = 3.78, SD = 1.06) and the national mitigation and adaptation efforts to cope with climate change (M = 3.5, SD = .89); t (172) = 6.240, $p < .05$ and is significant. LVCEEP is involved in awareness training programmes on conservation and climate change, outreach/mobile education programmes, production and dissemination of various resources materials covering e.g., water conservation, tree planting, pollution, community to community exchange visits, mobilising schools, communities, youth groups and teachers training colleges for participation in the observation of Earth hour. These activities are in tandem with education and awareness guidelines as outlined in the National Climate Change Response Strategy (NCCRS, 2009). Therefore we reject the null hypothesis that there is no relationship between activities of Lake Victoria Catchment Environmental Education Programme do not contribute to the national mitigation and adaptation efforts to cope with climate change and accept the alternative hypothesis that there is a relationship. Further with a 95% confidence interval from 1.51291 to .78364; the t-test statistic was 6.240 with 172 degrees of freedom and an associated P value = .001.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the findings

This chapter is structured in four major sections and presents a summary of the main findings in relation to the study objectives, gives the study conclusions, makes recommendations arising from the study findings and highlights the contributions to the climate change abatement knowledge by the study. Finally it presents possible areas for further research.

The study findings revealed that the community members joined the group due to the environmental problems facing them and because they hoped to improve their farm yields. The respondents reported that during the training/workshop they were taken through diverse subjects including introduction to Education for Sustainable Development, soil conservation and HIV Aids. The teachers further agreed that the programme has enabled them to develop woodlots in schools, engage in horticultural farming, manage waste and practice agro-forestry.

Through the programme the community members were able to conserve Lake Victoria, understand how to increase tourist attractions, improve livelihoods and conserve energy by using the eco-jiko. This shows that the programme enabled the members to have kitchen farms, plant fruit trees, use eco-jikos, plant trees, establish woodlots and operate own fish ponds as a result of the programme's interventions. The community members were in agreement that LVCEEP implemented activities had influenced community members' views on catchment resources.

Through LVCEEP, the pupils can address environmental problems. According to the pupils, their confidence in addressing environmental problems was because they could prevent soil erosion, they were now capable of starting tree nurseries, they could manage waste and that through their activities, rainfall within the catchment had improved. The study results show that the LVCEEP programme influenced pupils' life and empowered them because through the programme they benefited from various projects. The pupils were now able to make money by selling the trees they planted, they were able to start their own tree nurseries, could conserve energy by using alternative sources instead of firewood and they could now practice animal husbandry at home. The pupils were now engaged in several activities that they did not practice before such as tree nursery establishment, kitchen gardens, water conservation and irrigation. The pupils felt that LVCEEP environment related activities were important to them because they protect the environment and were also a source of income.

The findings revealed that before the programme implementation in the region there were no tress and the schools' environment was poor. The study results further revealed that the activities implemented by LVCEEP were applicable in real life because the participants could now manage waste and had encouraged their parents to plant trees and crops.

According to the teachers, the difference between their schools and schools that were not in the programme was because their pupils were involved in tree planting, their schools had environment friendly pupils and that their schools had beautiful environment as compared to those of schools not involved in the programme. Due to

the programme, the teachers comprehend the subject matter of climate change and were of the opinion that LVCEEP activities addressed climate change. The teachers have, through the programme been able to plant trees at home, implement kitchen gardens and agro-forestry and manage their waste. The representatives of Further, as shown by the regression analysis null hypothesis was rejected which implied that the aims, objectives, activities and outputs of Lake Victoria Catchment Environmental Education Programme are congruent with the need to mitigate and adapt to climate change.

The findings revealed that that the objectives of the LVCEEP programme in the community was to conserve Lake Victoria, implement sustainable development, reduce poverty and malnutrition, to improve livelihoods to improve tourist attraction and to improve the health of the community. According to the study the community faced challenges of soil erosion, low income/hunger, deforestation, poor agriculture, inadequate water, malnutrition and poor standards of living before they joined LVCEEP. The findings also revealed that the environmental challenges experienced by the communities were soil erosion, deforestation, wetlands degradation, drought and poor waste management. According to the pupils, the economic problems experienced by the community members before LVCEEP intervention were due to lack of money, poverty and theft. Illiteracy, unemployment, drunkenness, lack of understanding, language problem were identified as the social problems in the area. According to representatives of networking partner organisations working in the lake's catchment, the objectives of LVCEEP were to conserve Lake Victoria,

eradicate poverty, species conservation, implement sustainable development and to combat climate change

Study results on ESD projects showed that the respondents felt the projects address the challenges of climate change by enabling people to access medicinal herbs. The respondents also believed that LVCEEP interventions had resulted to reduced health problems. The teachers were of the opinion that the programme had facilitated the implementation of agro-forestry and intercropping in the region and encouraged the pupils to participate in farming. The teachers pointed out that LVCEEP activities had improved the farming methods, led to reduced soil erosion and enabled them get fresh air through tree planting. The students were now keeping animals and planting crops in the region and were now engaged in soil erosion control measures.

LVCEEP had empowered the teachers and pupils to conserve water, harvest and store rain water. The pupils were also using the harvested rain water for small scale irrigation. Fish production had improved because the teachers had constructed fish ponds to reduce over-reliance on the lake's fish and also because of reduced river silting and pollution.

As a result of the programme activities, forests had increased in size and range, thereby increasing suitable habitats for both birds and animals, which in turn have flourished in numbers thus improving tourism in the region. LVCEEP had facilitated the fencing of wildlife parks to reduce human interference with wild animals. The people are now keeping suitable numbers of livestock relative to available land size so as to reduce tempering with soil cover. The pupils in the region now have a positive

attitude towards tree planting; they can now conserve energy by using eco-jikos and have enough woodlots. The pupils have taken care of rangelands by constructing gabions to prevent soil erosion.

The community members stated that one of the indicators of adaptation and the impact of ESD through LVCEEP is that their lives had generally improved, they had acquired a means of earning an income and improved food production, the farming methods had been improved and that they had been able to control soil erosion Besides, the community members said they had been equipped to deal with potential environmental challenges through awareness raising and community empowerment, prevention of soil erosion advocating for conservation of natural resources and planting of more trees.

In addition, the community members who had participated in the programme revealed that they had inspired others to plant trees, to start fish farming and soil conservation, to reduce charcoal burning and had become role models through practicing of environmental conservation.

The teachers had shared information learnt from the programme by encouraging the community to plant trees and to irrigate their crops during dry seasons using water from the well. They had encouraged parents to build underground tanks to store water for use during the dry seasons and created awareness on the dangers of degrading the environment.

5.2 Conclusions

This research has provided a better understanding of climate change adaptation and mitigation and the role ESD programmes can play in encouraging people to participate in meeting the challenges of climate change. Empirically, the study provided information about adaptation programmes. Theoretically, this research combined several areas of research, including environmental education and climate change adaptation and mitigation.

Sustainable development and adaptation are related because the factors that determine the extent to which societies are adapted are considered to reflect the state of development of a society (Kahn, 2001). This is because "economic development achieved in a sustainable manner could itself be regarded as an adaptation measure" (Fankhauser, 1998). Increased economic output should eventually lead to poverty eradication and in an indirect way, to a reduction in vulnerability to climate change events (Suarez and Ribot, 2003). There are other schools of thought that see "adaptation as a practical means of achieving sustainable development in the long term and of reducing or avoiding costs of climate change hazards in the short term" (Smit, 1993). According to Fankhauser (2009), determining the difference between current development activities and adaptation related activities is difficult particularly in developing countries. There is evidence that development indicators like per capita income, literacy levels and institutional capacity are associated with lower vulnerability to climate events. In this sense, adaptation and sustainable development have a symbiotic relationship.

In the discussion papers geared towards enhancing resilience in the Horn of Africa, the report "An Exploration into Alternative Investment Options" argue that Education is the best option for the diversification of the economy in the horn of Africa because of the region's relatively young population, the low literacy rates (especially amongst the women), because education provides leverage for gainful employment , because educated women tend to have smaller families thus population control, and lastly because education will empower the communities and build their capacity to influence policy amongst other advantages. (Headly *et al.*, 2012). This argument on sustainable development, adaptation and education makes it practical to recognize Education for Sustainable Development (ESD) as an obvious response to the effects of climate change- capacity building and empowerment with education that facilitates sustainable development.

Based on my research, the following are the conclusions which will be the answers to my research questions:

1. LVCEEP, by implementing ESD, had positively influenced community members' views on catchment resources and they are gradually adopting sustainable lifestyles by balancing their social, economic needs and the environmental concerns.
2. There was a strong association between ESD outcomes and climate change adaptation outcomes and this relation can be explained by 65.3% of the respondents who reported that they felt/experienced positive changes after engaging with the programme. This is an indication that the activities of LVCEEP influences response to climate change. From above, it is evident that rural poverty in Africa is aggravated by climate change and climate variability.

3. 65.3% of the respondents reported positive changes towards better life following implementation of LVCEEP programme.
4. This indicated that the outcomes of LVCEEP were complimentary to identified national responses to climate change.
5. The activities and outputs of Lake Victoria Catchment Environmental Education Programme (LVCEEP) are parallel with the need to mitigate and adapt to climate change. The programme objectives and activities in the region have been able to support the community to mitigate and adapt to the effects of climate change: poverty level and incidences of malnutrition has reduced, and their livelihoods have improved.
6. The promotion of Education for Sustainable Development contributes to the responses to climate change challenges.

Adaptation and mitigation skills development

The programme had empowered the young people enabling them to address environmental problems. Most of them can now handle soil erosion, start a tree nursery, improve the catchment rainfall by planting trees. They can also better manage waste in their schools and homes.

Alternative livelihoods

The programme had also empowered pupils to be able to generate money through tree planting, developing own tree nurseries for seedling production and sales. The pupils were now involved in small scale livestock farming. Further, through the programme activities, the communities have participated in providing suitable habitats to birds and wildlife thus promoting the growth of tourism as an alternative livelihood activity.

Conservation activities and awareness raising

The schools implementing LVCEEP kept their schools' compounds cleaner and managed their waste better that the schools not involved with LVCEEP. The pupils raised awareness in their households and encouraged their parents/community to plant trees and to conserve their environment.

The respondents in the study now conserve energy by use of alternative sources, they are conscious that this also reduces the rate of deforestation as they no longer have to fell trees for fuel wood. The pupils have been empowered to change the environment at school and in their homes through planting trees, starting tree nurseries, implementing kitchen farming and even managing waste.

The programme activities positively impacted the climate change mitigation and adaption efforts which implied that there is a relationship between LVCEEP programme and the outcomes of climate change adaptation and mitigation strategies.

7. The activities of Lake Victoria Catchment Environmental Education Programme contribute to the national climate change mitigation and adaptation efforts to cope with climate change.

Tree Planting

Through the programme the number of planted trees in the region had increased from coverage of 8% to 31%. There were difference between the schools in the programme and others because the schools that participate in the programme had planted more trees in their compounds and had also developed tree nurseries and demonstration

plots. The pupils in were more environmentally aware and their environment is cleaner than the schools which are not in the programme.

Climate Change Awareness

The communities, teachers and pupils involved with LVCEEP demonstrated awareness of the linkages between weather/ecological changes with climate change.

The programme is addressing real life issues such as challenges caused by climate change and it had enabled the respondents understand various interconnections in nature such as the provision of fresh air and herbs by trees for good health. In relation to farming, the programme had enabled respondents to practice inter-cropping and use improved farming methods. The respondents had also implemented soil erosion control measures such as construction of gabions. The programme had enabled the respondents to harvest and store rain water, reduce water pollution, attract more rainfall by planting more trees, and practice irrigation. Fishing had also improved through the implementation of fish farming. Further, the communities were now harvesting more and bigger fish because they could control soil erosion and chemical deposition in the lake and in the catchment rivers and in addition they are also protecting the wetlands (fish breeding ground) in the catchment.

The communities were able to overcome the challenges of lack of health facilities, no latrines, drought, reliance on lake fish, lack of market for their farm produce, deforestation, poaching of animals and poor tree coverage by developing positive attitudes, creating man-made forests, conserving energy through using of alternative energy sources and eco-jikos and they now have enough woodlots, prevent soil

erosion, plant more trees and sensitise others on how to cope with the effects of climate change.

Education for Sustainable Development is a potential strategy for meeting the challenges of climate change.

5.3 Recommendations

The study identified feasible climate change adaptation and mitigation interventions that can be implemented through ESD by policy makers and development agencies to enhance coping with climate change in Kenya. Further, the study proposed ESD related projects that can address climate variability in Kenya.

5.3.1 Management Actions

There is need for the programme to frequently conduct sensitisation to the public and conduct training on importance of climate change mitigation and adaptation since it has a positive influence on the community members.

Activities such as rain fed agriculture through rainwater harvesting systems and the implementation of farming practices that retain water in crop land (terraces, contour bunds, ridges, tied ridges, planting pits, and conservation agriculture) need to be upgraded as ESD activities. There is also need to encourage rainwater harvesting and management systems that allow the farmers to store run-off in ponds, large storage structures such as earth dams or water pans can be considered. Water can be supplied to crop land either by gravity or pumping and applied to crops by surface irrigation.

Communities should be encouraged to be using alternative sources of energy and also to use the eco-jikos in their homes as this will reduce wood energy dependency and carbon emission into the atmosphere. ESD programmes should give enhanced focus on income generating activities such as fish farming, agro-forestry and poultry farming so as to enable the communities overcome climate change related challenges such as drought, financial hardships and hunger. In addition to concentrating on environmental issues, the programme should also address the social problems caused by low income/hunger, inadequate water, malnutrition, poor standards of living, lack of money, theft, illiteracy, unemployment, drunkenness, language problems and lack of understanding and this is because although they have been able to address some of the problems, majority of the community members are of the opinion that the identified issues are still a problem to the community.

The Lake Victoria catchment is vast yet LVCEEP coverage is limited to the 3 project areas, consideration should be given to extending LVCEEP programme more (if not the entire) catchment and to replicate it in other parts of the country for maximum benefit.

To popularize the programme, consideration should be given to linking of ESD to the arts and culture. The arts, whether photography, music, dance, painting, poetry, or other forms of expression, have proven to be an effective means through which to sensitive populations on important issues.

In addition to LVCEEP's ESD day, to encourage the adoption of ESD to vast audiences, the interventions should include annual ESD themed entertainment forums.

The events could include storytelling, music, songs and dances to entertain and educate both the youth and communities on the importance of conserving the environment plus the role of these activities in overcoming the challenges of climate change. The proposed entertainment, done in the form of theatre, should explore issues and foster environmentally and socially responsible values, attitudes and practices. The theatre should also be used as a communication platform about a wide range of health, socio and environmental issues.

5.3.2 Policy Responses

Policy-makers and politicians who are committed to the construction and implementation of evidence-based policies should ensure that efforts towards meeting the challenges of climate change incorporate existing knowledge on what has been proven successful.

It would be imperative that the findings of this study are given consideration for incorporation in the national agenda on responding to the effects of climate change. For better achievement of appropriate results, ESD related activities should be contextualized and linked to local phenomena and issues by covering topics such as food security, water resources, gender equality and human security in pursuing livelihoods of choice. This local focus must be linked to the global perspective, creating an understanding of the causes and ethical implications of climate change at the global level. It is also likely that the most effective adaptation solutions can be provided by a combination of both local strategies and larger scale adaptive measures.

Education for Sustainable Development should be structured in such a way that there is involvement (and participation) of learners and communities, as well as teachers and educators, in the planning and design of educational programmes and activities. It is essential that learners, whether in the formal, non-formal or informal context, take ownership of their adaptation and mitigation supporting activities. It is necessary that learners, parents and the community are involved in educational planning, including curriculum development.

One way to raise climate change concerns further up the agenda for policymakers is to try to put an economic value on the environmental impacts of climate change. This can both strengthen the argument for early action, and provide empirical evidence to convince the community that the lifestyle changes required will actually be of long-term benefit to them and their children and thus this study recommends the following;

1. Policy makers campaign to raise political and public awareness on climate change to influence development and implementation of appropriate programmes such as ESD.
2. Policy makers and the Development Community should be more involved in climate change negotiations so as to understand the legal provisions in the available instruments under UNFCC, the available options and their limitations.
3. The need to enhance capabilities and scientific strengths of African countries to address integrated climate change strategies, while addressing immediate societal needs.
4. Enhancing the sharing of expertise and networking among African professionals by establishing exchange programmes within Africa.

5. Participatory, government-led development and implementation of comprehensive climate change focused national plans and strategies for adaptation and mitigation in smallholder agriculture, fisheries and similar enterprises.
6. Introduce and support policies that are structured to reach and empower the most vulnerable. The most vulnerable to climate change are those facing the greatest difficulties in accessing food, information and education. These include children, the aged, girls, women and those with disabilities, those from poor families, ethnic minorities and communities living in particularly vulnerable locations such as coastlines and the arid and semi-arid areas.
7. Investment in ESD interventions is urgently needed to ensure improved agricultural production, while promoting integrated water resources management and minimizing environmental degradation. LVCEEP interventions include upgrading rain fed agriculture through improved soil and water management and appropriate systems such as rainwater harvesting and conventional irrigation systems.
8. Education for sustainable development should be made a continuous rather than a short-term process.

5.3.3 Recommendations for Further Study

It is imperative that future research examine the implications of climate change on various ecological systems, including the impacts on soil fertility. This will help develop a better sense of what adaptation and mitigation strategies will work and decrease the overall costs of implementing climate change response strategies.

ESD implementation should have climate data collection from the various regions of the country and the dissemination of this information to farmers. This is very important given the regional variations associated with determining the trends in specific regions. As communities begin to develop new climate change related farming methods, this climate information will be important to assist them in the development of their coping strategies.

Finally, I would like to recommend further research in the following areas:

1. Additional research to further develop the ideas and findings in this thesis
2. Follow-up study of ESD implementation and its contribution to adaptation to and mitigation against the effects of climate change. This study should include culture, traditions and beliefs etc. as these might be barriers or even drivers to efforts to combat climate change.
3. Explore ways of integrating practitioners' research in the implementation of more effective and efficient ESD related programmes with potential for contributing to the country's mitigation and adaptation efforts.
4. Policy oriented action research on the appropriate modes for educating policy-makers at County and National levels to enable them develop policies that not only take into account the goals of Education for Sustainable Development but consciously relate these with the challenges of climate change.

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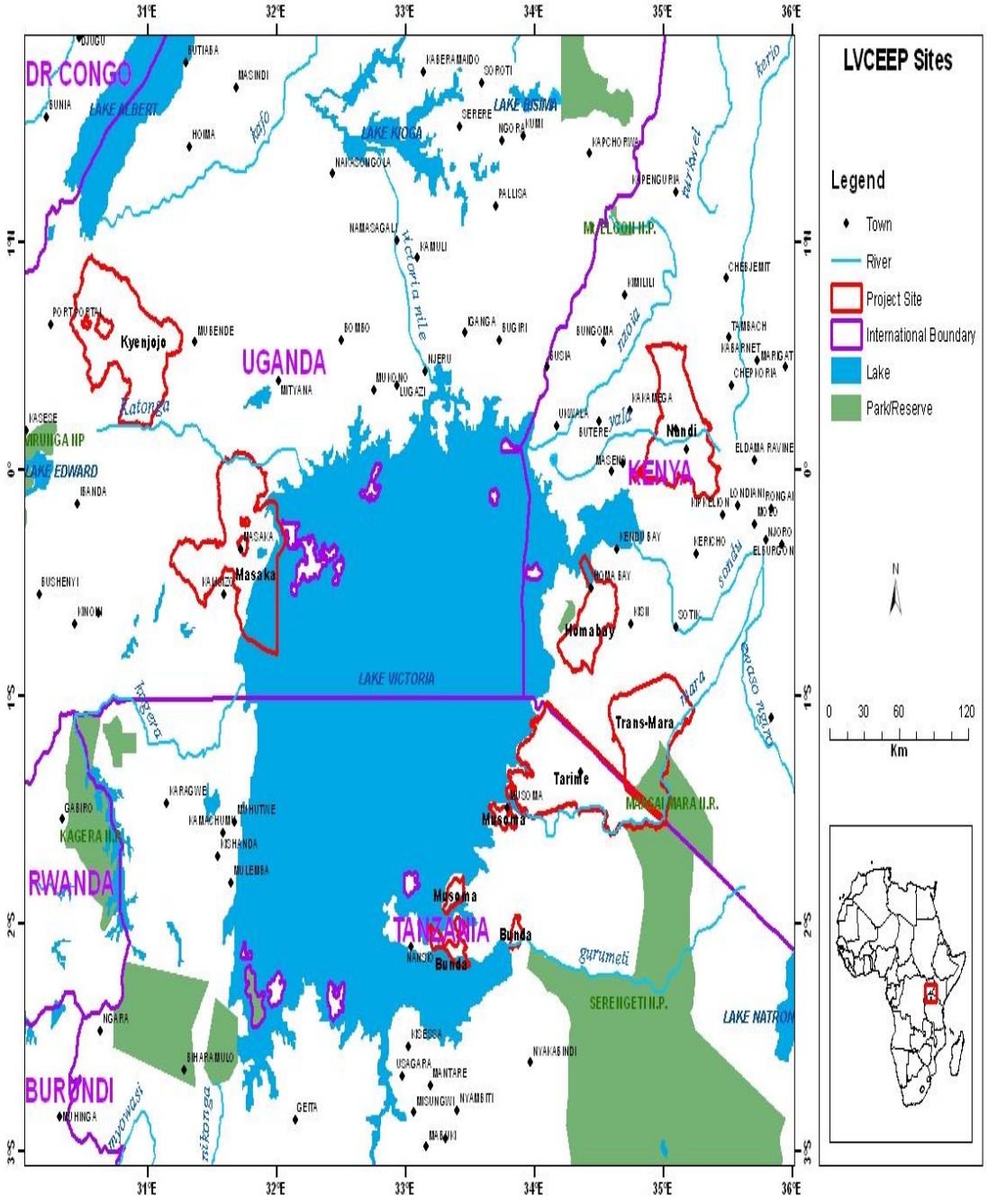
APPENDICES

APPENDIX 1: Lake Victoria Catchment Environmental Education Programme Coverage



APPENDIX II: Introductory Remarks

RESEARCH TITLE - EDUCATION FOR SUSTAINABLE DEVELOPMENT AS A STRATEGY FOR ADDRESSING CLIMATE CHANGE IN LAKE VICTORIA CATCHMENT

Date: _____

INTRODUCTION

My Name is Margaret Otieno. I am PhD student at Kenyatta University.

Kenyatta University has permitted me to carry out this Research and I would like to get your opinions. I will treat your personal details confidentially. Your honesty is both critical and paramount when you respond to the questionnaires.

Yours faithfully,
Margaret Otieno
Introduction to this Research
Dear respondent, this research is on Education for Sustainable Development (ESD) and its potential is contributing to the fight against the challenges of climate change. Education for Sustainable Development is education that is conscious of utilizing resources for the benefit of the people living today while conserving them for the future generation. It addresses all spheres of life: economic, environment, emerging challenges like HIV/AIDS, gender issues among others. ESD believes that education should be relevant to the needs of the immediate society and that it is life-long. Climate change has now been acknowledged as the biggest challenge of our time and experts have come up with various ways of dealing with the effects of the phenomenon. I would like to therefore find out the ESD activities you are involved also addresses the issues around climate change, especially as proposed in Kenya's climate change response strategy.

APPENDIX III: Questionnaire for Students

SCHOOL_____ DATE_____

NAME_____

SEX F M

CLASS_____

INTERVIEWER:

SECTION 1: LVCEEP AND PRORAMME IMPLEMENTATION

1. Please list some of the problems facing your community?

   Environmental_____

   Economic_____

   Social_____

2. For how long have you been involved with LVCEEP? _____
3. Please give an outline of what you have learnt, and how this helped to address the above problems as a result of your schools involvement with LVCEEP?_____
4. Kindly state how this help/affect your life in school? Your life at home? Your future life?_____
5. Please list the things you are now practicing in relation to LVCEEP that you didn't before you were involved in the project._____

   Why do you think they are necessary?_____
6. What have you done at home in relation to lesson learnt from LVCEEP?_____
7. Please describe your school before LVCEEP?_____
8. What is the difference between your school and the other schools which are not part of LVCEEP?_____
9. Are the things you have learnt through LVCEEP applicable in your life?

Yes_____ No_____

Please provide details_____

SECTION 2: CLIMATE CHANGE AND THE PROGRAMME

10. What is climate change?_____
11. How in your view are you and LVCEEP addressing issues on climate change in the following sectors:

Health_____

Agriculture_____

Water_____

Fisheries_____

Tourism and Wildlife_____

Livestock and Pastoralism_____

Forestry_____

Energy_____

Rangelands_____

APPENDIX IV: Interview Guide Questions for Teachers

INTRODUCTION

The purpose of this questionnaire is to collect data regarding the schools ESD Project. We would like to know your engagement with Lake Victoria Catchment Environmental Education Programme, the ESD activities that the school has been involved in and the relationship between the activities and their possible role in addressing the challenges of climate change.

Please fill in the provided questionnaire.

Your contribution in this research study is very important towards the development of strategies for climate change adaptation and mitigation. Thank you in advance for committing your time to responding to this questionnaire.

SECTION 1: BACKGROUND OF THE SCHOOL

1. Name of School_____
2. Level of school (tick as appropriate) a. Primary School b. Secondary School
3. Age of School_____
4. Approximate size of school_____
5. Total Number of students in the school_____
6. Total Number of teachers in the school_____
7. Number of students involved in the ESD Projects_____
8. Number of teachers involved in the ESD Projects_____
9. Number of None teaching staff involved in the ESD Projects_____
10. Number of parents/community members involved in the ESD Project

SECTION 2: DATA FROM THE TEACHER

(Tick as appropriate)

1. AGE RANGE : A. 21-30 B.31-40 C. 41-50 D.51-60

2. For how long have you been in this school? : A. Less than 2 years. B. More than 2 years but less than 5 years C. More than 5 years but less than 8 years D. More than 8 years

3. For how long have you been involved in the LVCEEP?

A. Less than 3 years B. More than 2 years but less than 5 years
B. C. More than 5 years but less than 6 years D. Since its inception
4. Please rate the amount of time the school commits to the ESD programmes?

A. Adequate B. Fair C. Inadequate D. None

Please fill in the blanks

5. Have you attended any training/workshop on Education for Sustainable Development (ESD)? Yes_____ No_____
6. If yes, list down the areas of coverage:_____
7. What areas of ESD have you been able to implement with the support of LVCEEP

In the school?_____

In your home? _____

8. What, in your view is the difference between your school and other schools not in the programme? _____

SECTION 3: CLIMATE CHANGE AND THE PROGRAMME

9. What is climate change?_____
10. In your opinion, are the projects you are involved in addressing the issues of climate change? (tick as appropriate) A. Yes B. No
11. How are the ESD projects you are involved in both at school and in your homes addressing the challenges of climate change in these areas:

Health_____

Agriculture_____
Water_____
Fisheries_____
Tourism and Wildlife_____
Livestock and Pastoralism_____
Forestry_____
Energy_____
Rangelands_____

12. Have you discussed/shared information with other teachers/persons not involved in LVCEEP? Yes_____ No_____

Please give details

_____

_____

_____

_____

APPENDIX V: Guide for Focus Group Discussions

1. Name of Participant _____
2. Institution/Organisation represented _____
3. What, in your opinion, are the objectives of LVCEEP?_____

---

4. Please list other key organisations working in the catchment and their project focus

ORGANISATION NAME	FOCUS

5. Does the subject matter of climate change come in the course of LVCEEP implementation? Yes_____ Somewhat _____No_____

6. Please give explanations for your answer

_____

_____

7. How is the subject matter of climate change covered in the objectives of LVCEEP and how do the activities of the programme address the challenges of climate change in the various sectors listed below?

LVCEEP OBJECTIVES	COVERAGE OF CLIMATE CHANGE

Please rate the level of the involvement of LVCEEP in addressing listed climate change challenges from 1 very low or negligible to 5 extremely involved.

CLIMATE CHANGE MEASURE	SECTOR	LEVEL OF INVOLVEMENT (1 to 5)	Explanations (Summary of relevant LVCEEP activities and initiatives)
ADAPTATION	Health		
	Agriculture		
	Water		
	Fisheries		
	Tourism and Wildlife		
	Livestock and Pastoralism		
	Physical Infrastructure including transportation and telecommunication networks		
	Social Amenities including human settlements		

MITIGATION	The Forestry Development Plan		
	The Green Energy Development Programmes		
	Transport		
	Agriculture		
CLIMATE CHANGE COMMUNICATION, EDUCATION AND AWARENESS PROGRAMME			
VULNERABILITY ASSESSMENT, IMPACT MONITORING AND CAPACITY BUILDING			
RESEARCH, TECHNOLOGY DEVELOPMENT, ABSORPTION AND DIFFUSION	Agriculture		
	Energy		
	Forestry		
	Health		
	Water		
	Fisheries		
	Rangelands and Wildlife		
CLIMATE CHANGE GOVERNANCE			

Within your mandate as ESD practitioners (considering the objectives of DESD), list down any other action/activities that you believe you can implement to address the challenges brought about by the impacts of climate change? _____

_____

_____

APPENDIX VI: Interview Guidelines for Community Groups

SECTION 1: BACKGROUND

LOCATION OF COMMUNITY GROUP_____

NAME OF COMMUNITY GROUP_____

NAME OF GROUP MEMBER_____

REGISTRATION STATUS OF GROUP (tick as appropriate)

A. Church Group B. Welfare Group C. Development Group

D. Others

SECTION 2: MEMBER DATA

1. For how long have you lived here?_____

2. Age of member A. Below 18 B. 18-28 B. 29-39 C. 40-50

D. 51 and above

3. When did you join this group? _____

4. Please tell me what motivated you to join the group_____

5. What do you consider as the key environmental challenge/s at the time your community group started working with LVCEEP? _____

6. Please describe the general environment in terms of the following during the time you joined the group:

a) Water_____

b) Health_____

c) Agriculture_____

d) Fish/Livestock_____

e) Tree cover_____

f) Wildlife_____

g) Energy_____

h) Source of livelihood_____

7. In your view, what was the reasons behind the scenario you have described in (4) above? _____

8. Do you believe there have been changes in the scenario you have described? Please give details? _____

9. Please list, what, in your view are the main objectives of LVCEEP? _____

10. Please list down what you have learnt since you got involved with LVCEEP? _____

11. What have you implemented out of the list above? What are you involved in that you were not doing before the implementation of LVCEEP? _____

b. Please provide details_____

12. Are there any activities that you are doing that are not entirely new, i.e., using culture/indigenous knowledge that you are implementing/have incorporated in the LVCEEP programme?_____

13. Has the knowledge you have gained because of your involvement with LVCEEP altered your attitude/behaviour towards the catchment resources? _____

14. Please state, in your view, what challenges the catchment resources will suffer if appropriate action is not taken_____

15. Any suggestions on how the above can be addressed? _____

16. Have you heard about climate change? Yes____ No_____

17. Please state from who/where you learnt about climate change?

_____

18. In your view, what is the relationship between your LVCEEP projects and climate change?

_____

19. Have your activities inspired other people/communities/villages to do things differently? (Tick as appropriate) Yes_____ No_____

b. Please provide details

_____

_____

APPENDIX VII: Field Visit/Observation Checklist

NAME OF RESEARCH ASSISTANT_____DATE
HOUSEHOLD_____

Dimension		**CHECK**	**NOTES**
Economy	Dairy goats Fish pond Kitchen garden Seedlings sales Beekeeping Eco-jiko sales Dairy goats sales Milk sales Poultry farming Pottery sales Bee keeping Sale of vegetables Sale of fertilisers Fruit sales Honey sales Firewood sales Sale of organic fertilisers Dairy goats Fingerling sales		
Society	Indigenous crops (vegetables, millet and cassava) Fruit trees		

	Involvement of all family members Traditional intercropping		
Environmental	Tree nursery Rain water harvesting and storage Improved husbandry Small scale irrigation Woodlots Waste management Tree growing Bee Keeping Soil Conservation Composting Eco-jiko Agro-forestry		