EFFECTS OF LEARNING ENVIRONMENTAL MANAGEMENT CONCEPTS ON SECONDARY SCHOOL PUPILS IN MACHAKOS COUNTY, KENYA

BY

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DECLARATION

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

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

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To my family, Kenyatta University and the entire world of Education for Sustainable Development

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ABSTRACT

In Kenya, the integration of environmental concepts into the school curriculum was effected in 1985. The goal of the study was to assess and determine secondary school pupils' understanding of environmental management concepts infused in the Secondary School Curriculum in Kenya, and how they act to improve their environment. The influence of sex and the school environment on pupils' understanding of environmental management concepts was examined. The study investigated forms three and four pupils' grasp and understanding of environmental management concepts infused in various subjects in the secondary school curriculum and its effect on their attitude toward the environment. This study was conducted in Machakos County, Kenya. Random sampling was employed to select a total of 140 pupils (70 girls and 70 boys). Forty-two teachers of physical science, agriculture, geography and biology, and fourteen school heads were selected for the study from fourteen schools to determine the challenges to teaching and learning Environmental Education in the secondary schools. The instruments for data collection were structured questionnaires, Focus Group Discussion Guide and Observation Schedule. Past Kenya Certificate of Secondary Examination papers were also analysed for Environmental Education content in deforestation, overgrazing, soil erosion, air and water pollution, depletion of energy resources, ecological disruption, loss of biodiversity and environmental conservation among others which revealed that not more than two Environmental Education questions appeared per year between 1995 and 2005 in science, agriculture and geography. Data analysis was done qualitatively and quantitatively. A chi-square test revealed significant differential understanding based on sex and school type ($p = .05$). However, the overall understanding of the environmental concepts was rated moderate, even among the teachers. The study recommended a refresher course for head teachers, in the short term, to improve the management of the school plant and enhance its role as a learning resource for Environmental Education. The study concludes that there is attainment of low to moderate understanding of environmental management concepts and environmental awareness, very positive attitude and desire to act for the welfare of the environment among secondary school pupils.

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ACRONYMS

ASESP	African Social and Environmental Studies Programme
CSD	Commission on Sustainable Development
DESD	Decade of Education for Sustainable Development (2000-2014)
EE	Environmental Education
ESD	Education for Sustainable Development
GHC	Geography, History and Civics – a combined course of study
GoK	Government of Kenya
IUCN	International Union of Conservation of Nature
KIE	Kenya Institute of Education
MoE	Ministry of Education
NEMA	National Environment and Management Authority
QASO	Quality Assurance and Standards Officer
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
WCED	World Conference on Environment and Development
WSSD	World Summit on Sustainable Development

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

Despite the fact that the earth is the only place in the universe known to sustain life, human activities are progressively reducing the planet's life supporting capacity (IUCN, 1980). Man does not seem to recognize himself as part of nature but as an outside force destined to conquer and dominate it. However there are ways in which religious and philosophical beliefs may influence human management of the environment (Rambo, 1982; Kay, 1989).

Over the last four decades there has been a growing concern for the future of mankind in the face of a steadily deteriorating environment. Major issues of concern have included population explosion, food shortage; air, water pollution and land degradation and depletion of resources like energy, fisheries and forests among others. These well publicized environmental issues have promoted awareness that humanity's prosperity and survival on earth is dependent upon the finite resources and delicate life support system (Ehrlich *et al,* 1977). The global nature of this awareness and concern led to the convening of the United Nations Conference on the human Environment in Stockholm, Sweden in 1972. The main purpose of the Stockholm Conference was to take stock of the global Environmental situation and chart out a course of action that would involve as many communities as possible.

The Belgrade Workshop followed in 1975 and adopted the 'Belgrade Charter' that laid the global framework for environmental education (UNESCO, 1985). The real starting point for Environmental Education as a discipline is the Tbilisi Declaration (UNESCO – UNEP, 1978), which was produced after the Tbilisi

Conference of 1977. The Tbilisi guidelines included the proposal for "development of a school curriculum that addresses the needs of the environment at the local, national, regional and international levels". This included the provision of environmental education for learners and teachers (UNESCO, 1980). The integration of environmental concepts into the school curriculum is based on the premise that it prepares the youth as future stewards of the environment and will promote sustainable livelihoods (WECD, 1987). In Kenya the teaching of Environmental Education started with the onset of the 8-4-4 system. (MoST, 1985). At the time only the then Kenya Science Teachers' College was offering an Environmental Education course to teacher trainees.

1.2 Statement of the Problem

Environmental concepts have been infused in Kenya's school curriculum for more than fifteen years today (MoE, 1985). The school curriculum inadequately prepares the youth to develop "...responsible environmental behaviour" (Karembu, 2002). This could be a consequence of inadequate provision for critical thinking, local relevance and problem solving skills in both the primary and secondary school syllabuses or the delivery modes, learning resources, inadequate funding or capacity of the trainers (KIE, 1994; KIE, 2002; NEAP, 2009). Environmental degradation in Kenya continues with insufficient abatement in different sectors of the environment, including rural and urban areas (Nema, 2011). Between 1985 and 2009 there was scarcity of research based literature on the impact of exposure to environmental concepts among school pupils in Kenya. The continuing deterioration of the environment implies there are some deficiencies in the Kenyan school curriculum or its implementation on teaching and learning of Environmental Education concepts infused in it. The focus of this

research was investigation of forms three and four pupils' understanding of environmental concepts infused in the secondary school curriculum and its effects on their attitude toward the welfare of the environment.

1.3 Research Questions

i. What environmental concepts are infused in the school curriculum?

ii. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

iii. What influence does pupils' perception of environmental concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?

iv. Is there a significant difference in the understanding of the environmental concepts between boys and girls?

v. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?

vi. What is the level of environmental awareness of secondary school pupils?

vii. What are the impediments to teaching/learning Environmental Education concepts in secondary schools?

1.4 Objectives

The goal of this study was to assess and determine pupils' understanding of environmental concepts infused in the secondary school curriculum in Kenya and how they act to protect improve, and conserve their environment. The specific objectives were to:

i. Identify the environmental concepts infused in the school curriculum;

ii. Determine pupils' comprehension of key environmental concepts infused in the secondary school curriculum;

iii. Determine the activities the pupils undertake both at school and at the community level (home) after their exposure to the concepts infused in the school curriculum;

iv. Establish if there is a significant difference in the understanding of environmental concepts between pupils in rural and those in urban schools;

v. Assess the role of the school environment in enhancing environmental knowledge and awareness for wider application by the pupils;

vi. Find out the impediments to teaching/learning Environmental Education concepts in secondary schools.

1.5 Research Hypotheses

i. H_{o1} There is no relationship between sex and pupils' comprehension, of environmental concepts infused in the secondary school curriculum;

ii. H_{o2} Pupils' comprehension of environmental management concepts infused in the secondary school curriculum is not influenced by the school environment;

iii. H_{o3} Pupils' attitude toward the welfare of the environment is not influenced by sex

iv. H_{o4} Pupils' attitude toward the welfare of the environment is not influenced by the school environment.

1.6 Conceptual Framework

Acquisition of environmental awareness begins with exposure to environmental problems in ones surroundings. This provides direct experience to the learner followed by critical reflection and conceptualization according to the Experiential Learning Model (www.bctf.caleepsa, 2006). This process may be facilitated by the school environment guided by the school curriculum together with the learner's out of school experiences. Learning is a continuous process which the pupil may repeat to gain insight into confounding situations (Yager, 2000; www.walkingthetalk.bc.ca, 2006; Baraza & Robbotm, 2008). The output should be socially responsible environmental behaviour on the part of the learner under the guidance of the school curriculum (Figure 1). The arrows indicate the direction of influence followed after exposure to environmental problems.

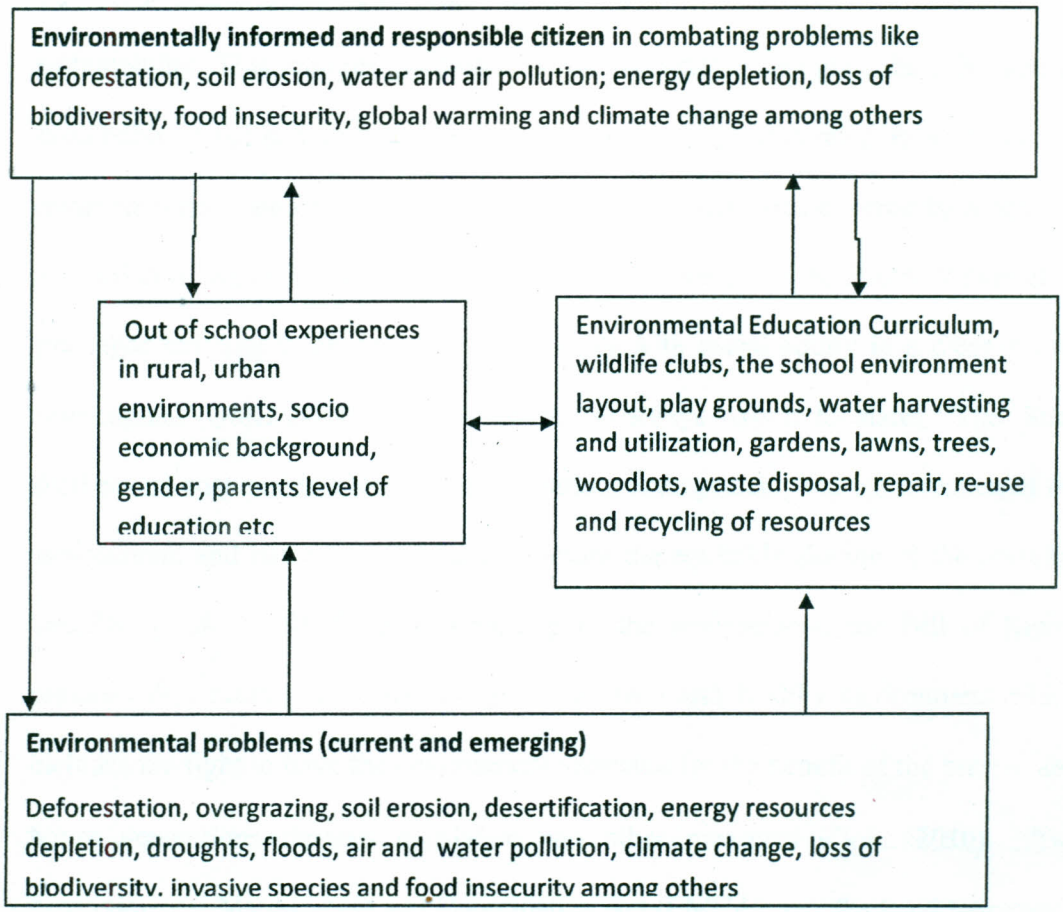

Figure 1.1: Conceptual framework: Continuous Learning Model for Environmental Education (Adapted from Yager's Constructivist Learning Model, 2000; Baraza & Robbotom, 2008).

Back arrows indicate the continuous learning and reflection on EE concepts for all age groups. The learning leads to continuously improving awareness levels.

1.7 Rationale of the Study

The UN Millennium Campaign Goal No.7 is on ensuring environmental sustainability. This requires governments and countries to integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources. This includes proportion of land area covered by forest and proportion of water resources used among other indicators (UN, 2000). Vision 2030 envisages building a just and cohesive society with social equity in a clean secure environment (GoK, 2007). The Constitution of Kenya Article 69 states ' The State shall ensure sustainable exploitation, utilization, management, and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits' (GoK 2010). Further pertaining to the environment, the Bill of Rights provides that every person has a right to a clean and healthy environment which includes the right to have the environment protected for the benefit of the present and future generations through legislative and other measures (GoK, 2010). The Environmental Management and Coordination Act (EMCA), sets the legal framework for the protection and conservation of the environment in Kenya. (GoK, 2000) This includes conservation and protection of biodiversity and abiotic resources such as water sources and catchment areas. To a large extent the reason for incorporating environmental concepts into the school curricula is the assumption the youth as future decision makers represent the long term hope for the sustainable use of natural resources. The formal school education offers a worldwide institutional base for the transmission of this environmental principle (Dissinger, 1983; Knamiller, 1987; Otewa, 2006; UNESCO, 2005;

http://maintenance.unesco.org/404/?host=portal.unesco.org&uri=/education/en/ev.php URL_ID=23279&URL_DO=DO_TOPIC&URL_SECTION=20.1html, retrieved 2012-04-24).

Children, youth and adults should be able to construct sustainability issues, understand and use sustainably the complex environmental systems of which they are part (Meadows, 1989; Otewa, 2006; Baraza & Robbotom, 2008). Education for sustainable Development (ESD) focuses on and balances concerns about the society, the environment and the economy (NEMA, 2009). This will involve giving the learner education 'in' and 'for' the environment which complements EE that has been providing mainly education about the environment. One of the goals of education in Kenya for the Primary and Secondary School cycles is 'to promote positive attitudes towards good health and environmental protection' (KIE, 2002). This should lead the youth to appreciate the need for a healthy environment. In Kenya's school curriculum various environmental concepts are infused in almost every subject and at every stage of formal education (MoE, 1987; KIE, 2002). This is aimed at achieving the above stated goals.

This study focuses on how the forms three and four pupils understand some environmental concepts in their school curriculum. These concepts highlight the components of the environment and their interaction. The understanding on such concepts may create an awareness of the state and future conditions of an environment. The beneficiaries of the knowledge of these concepts may be capable of proposing and effecting relevant solutions should a problem arise in an environment. The target population of this study forms the upper stage of Secondary Education in Kenya. Their understanding of the concepts may adequately be taken as the baseline

knowledge of Secondary School graduates in Kenya, considering that the fourth year is spent on preparing for the final examination.

1.8 Limitations of the Study

Environmental Education (EE) was first recommended for introduction in Kenya school curriculum in 1981 following the Report of the Presidential Working Party on the Second University (GoK, 1981). Environmental Education topics were first infused in the school curriculum in 1985 at the introduction of The 8:4:4 System of Education (GoK, 1985), with the first Kenya Certificate of Secondary Education (KCSE) done in 1989. The first limitation is that since 1985 there has been little or no documented research on the impact of EE topics on environmental management among secondary school pupils to be reviewed for background information. The literature review was therefore drawn from other developed and developing countries that have different education systems and covered mainly science (physics, chemistry and biology). Most EE concepts were infused in science, agriculture and geography at secondary school level, but it is in science where there is differential achievement between the sexes (Twoli, 1986; Orodho, 1996). The second limitation was that since the data was collected in the third term when end of year and KNEC exams were being done, there were restrictions on the amount of time spent with each respondent.. The third limitation, was that the study did not consider, or highlight in any meaningful way, other factors like Indigenous Knowledge (IK) of the pupil's background, ecological challenges and community expectations concerning the performance of youth on environmental management matters and their preferences in the consumption of goods and services (Tuncer et al. 2005; Otewa, 2006; Jeronen *et al.*, 2009). Lastly was the design limitation. Owing to the resource limitations, both

temporal and financial, listed above the study adopted a cross-sectional design rather than a longitudinal one which would have correctly followed trends over time. This research approach might not effectively determine or account for the genesis or origins of effects of environmental management concepts among secondary school pupils (Orodho,1996; Kothari, 2004; Otewa, 2006; Curwin & Slater, 2008)

1.9 Delimitations of the Study

As noted earlier the main drive of this study was to assess and determine secondary school pupil's understanding of environmental concepts integrated in the secondary school curriculum and how they act to address environmental problems and improve their environment. The study covered twenty eight (28) classes from which five (5) pupils were drawn per class, making a sample of approximately 140 pupils extracted from 14 schools. The sample of 140 students was selected for the study out of a population of 15,344 pupils in sixty two (62) secondary schools in Machakos District, as per data obtained from D.E.O's Office, May 2010. However considering that the sample was randomly selected, it was the hope of the researcher that it would provide a general overview pertaining to the effects of environmental management concepts among secondary school forms 3&4 pupils and the influence of the school and the local environments on their environmental conduct. (Mitchell, D., Wirt, F. & Marshall, C., 1986 **http://education.astate.edu/dcline/guide/limitations.html,** Retrieved 25 06 2011).

1.10 Significance of the Study

Kenya continues to experience environmental problems in critical areas like deforestation, overgrazing, declining soil fertility in agricultural lands, food insecurity, ecosystem disruption, water scarcity and water pollution among others (UNEP,2000; NEMA, 2005). Learning about the environment is a course that involves recognizing 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 (UNESCO, 1985). Such environmental concepts like deforestation, overgrazing, loss of biodiversity, desertification and climate change are closely related and have high implications on ecological stability. The diversity of organisms in an environment is a key factor in influencing its complexity, productivity, stability and sustainability. Environmental conservation seeks to make wise use and careful management of resources so as to optimize social benefits in the long term and attain ecological stability and sustainability. Environmental Education is regarded as an effective tool for preparing citizens to deal with the deteriorating state of the environment. This preparation has been enhanced through the implementation of Education for Sustainable Development (NEMA, 2009)

Kenya has made a notable effort in making Environmental Education a part of the formal education curriculum (GoK, 1988). So far no significant study has been done to assess secondary school pupils' comprehension of the Environmental Education concepts infused in the secondary school curriculum in the study area. This study will determine whether or not the current curriculum is delivering the necessary information, education, awareness and change of attitude to bring about the required environmental responsibility for sustainable living. The findings of the study

will hence inform policy formulators, curriculum planners and quality assurance and education managers in Kenya.

Studies in sciences have revealed that there are significant differences in the achievement levels of females compared to males whereby females score lower grades than their male counterparts (Erickson & Erickson,1984; Twoli, 1986; Orodho, 1996). Also it should be noted that many Environmental Education concepts are science based and require basic understanding of ecological principles. Gender and development studies have further revealed that women are the main users of the environment and major victims of environmental degradation together with their children (Enarson, 1998). In Africa women till the land to grow 80 per cent of the food, in addition to travelling far afield to fetch firewood and water (Maathai, 1998). Knowledge of females grasp and understanding of environmental concepts like ecological interdependence, food chains and webs, conservation and environmental degradation in general may shed light on how the curriculum could be re-designed to enhance their comprehension.

Rural and urban environments differ in their components. Rural surroundings are mainly natural, composed of wild flora and fauna, domestic animals, crop fields and unspoilt landscapes. Rural communities work with nature, rearing domestic animals and raising crops to produce food for both rural and urban communities. The urban environment is mainly built up or man-made. It has structures like buildings, roads, water supply and sewerage systems, factories, power lines and large concentrations of human beings and vehicles. It has very few grass fields, tree lots and non-human animals. It is an incomplete or special ecosystem (Miller, 1999; Rana, 2006). The industries in urban centres and large concentrations of human populations generate wastes that degrade the environment through air and water pollution, noise

and land pollution (Rana, 2006). The two different environments require totally different approaches to manage. Learning experiences and the environment affect our behaviour by giving us the information we need to behave effectively (Bandura, 1999). The environment exerts its influence on behaviour by affecting our thoughts; a farmer working on a field that is prone to soil erosion may be influenced by the environment to undertake soil conservation measures in his plot if the efforts will enhance the productivity of his plot.. Pupils' understanding of their local environment may enable them to behave effectively in that environment. This could be the case for pupils in urban schools. The study will therefore try to identify any differences in understanding of environmental concepts infused in the school curriculum between pupils in rural secondary schools and their counterparts in urban schools

1.11 Definition of Terms

For relevance, uniformity and avoidance of ambiguity in this study a brief statement of the meaning of some key terms is provided below.

1.11.1 Conservation

Wise use and careful management of resources so as to obtain the maximum possible social benefits from them for the present and future generations (Miller, 1999).

1.11.2 Curriculum

All the learning which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school (Krlly, 1999).

1.11.3 Deforestation

The clearance of naturally occurring forests by the processes of humans' logging and/or burning of trees and plants in a forested area to create space for crop production, infrastructure development or urban expansion. (FAO, 2000; UNFCCC, 2002).

1.11.4 Depletion

Also natural resource depletion is the result of the extraction of a biotic resource (non-renewable) like oil, coal, and base minerals like iron and uranium from the environment or the extraction of biotic resources (renewable) like trees and wild animals faster than they can be renewed. Depletion is used most commonly in relation to fishing, farming, mining and fossil fuels (Miller, 1999; Mason, 2010).

1.11.5 Desertification

The process of land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations (drought) and human activities that involve over exploitation of dry lands.(Reynolds, 2002).

1.11.6 Environment

The totality of ones surroundings, composed of the living (biotic) and non living (abiotic), which may also include the complex of social and cultural conditions affecting the nature of an individual or community (Dissinger 1983, 1997; Stapp 1997; Shmueli, 2008; http://www.thefreedictionary.com/environment, Dec.2011).

1.11.7 Environmental Education (EE)

A learning process that increases peoples knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges and foster attitudes, motivation and commitments to make informed decisions and take responsible action (Stapp 1969; Dissinger1983; UNESCO, 1978).

1.11.8 Overgrazing

Grazing by livestock or wildlife to the point where the grass/plant cover is depleted, leaving bare, unprotected patches of soil. As a result, water and wind cause erosion, especially on clay soils, and the growth of poisonous plants and thorny shrubs may increase.(Hardin, 1968; Rayburn, 2000).

1.11.9 Pollution

Undesirable change in the physical, chemical or biological characteristics of the air, water or land that can harmfully affect the health, survival or activities of humans or other living organisms resulting from discharges of emissions to the air, water or land from manufacturing processes, agriculture, transport or domestic sources. It is driven by population and consumption (Hardin, 1968; Miller, 1999; Tuncer *et al.*2005).

1.11.10 Recycling

The process of re-using material for the production of new goods or services on the same quality level (http://whatis.techtarget.com/definition/reduce-reuse-and-recycle-3r.html, May, 2010).

1.11.11 Natural Resources

Materials found in the environment that can be extracted in an economic process. There are abiotic resources (non-renewable) like oil, coal, minerals and biotic resources (renewable) like forests, wildlife and fisheries (Miller,1999; Hanink, 2002).

1.11.12 Reuse

The additional use of a component, part, or product after it has been removed from a clearly defined service cycle. Reuse does not include reformation. However, cleaning, repair, or refurbishing may be done between uses (http://whatis.techtarget.com/definition/reduce-reuse-and-recycle-3r.html/, May 2010).

1.11.13 Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (UNCED, 1987).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The definition of the concept of environment may depend on the perspective in consideration. Different professions have given the concept of environment different perspectives, such as social, political, psychological and spiritual (Stapp, 1997; www.**thefreedictionary.com/environment** , retrieved 1/ 5/2012). Despite all these, the study focuses on the understanding of the biophysical environment whose components include living things (plants and animals); non-living things (water, air and soil) and man-made things like roads, factories, buildings and power lines. The study also explored social aspects of the environment like the economic, the political and the ethical ((Disinger, 1997; Stapp, 1997).

In the past, research in knowledge comprehension has gained advantage from methodological and epistemological outlooks by science researchers. Scientific epistemology holds that knowledge is that which has been approved or confirmed by the senses. Ideally this knowledge should evolve via the scientific method; sensing and identifying a problem, locating and delimiting the problem, researching and gathering empirical data that could offer a solution, predicting the likely results of tentative options and finally, selection of a solution. If the solution works, then the outcome is knowledge (Oderman, 1992; Robertson, 1994). The same view is shared by behaviourist researchers in education considering that they concentrate on observable behaviours which are easily quantifiable, can be characterized, allow for statistical analysis, and have easily generalizable conclusions (Passer and Smith, 2001).

Behaviourist research approaches have tended to ignore learners' cognitive activity, which is the mode of acquiring knowledge. From a behaviourist point of view, for instance, a learner who is thinking actively while seated still is not displaying acceptable conduct in the classroom. However, listening, the most common observable behaviour found in the classroom situation is not easily detectable or discernible. Nevertheless, for many behaviourists the mental processes that we ourselves experience, cannot be ignored or declared off limits, for scientific purposes, just because we can't observe them (Passer & Smith, 2001). Further, critics of the behaviourist approach contend that the most significant aspect of human behaviour is the ability to form and label concepts with language symbols and manipulate such symbols.

To inquire into how learners perform these, the researcher may have to engage alternative approaches such as constructivism. Constructivist approaches especially in science education research have employed qualitative designs with the objective of understanding the meaning of an experience as expressed by an individual. Many such approaches have used interview as the mode of data collection. Considering that interview based studies attempt to characterize the kind of beliefs or ideas people give support to, such approaches are regarded as qualitative in design and explicitly interpretive since the researcher gathers the data and analyses it himself/herself (Passer & Smith, 2001; Otewa, 2006).

The literature review in this study is discussed under three sections: The constructivist theory of knowledge acquisition and studies based on constructivist theory in knowledge acquisition in school curriculum in general and specifically in environmental education.

2.2 Constructivism

The process of learning, termed knowledge acquisition has had a number of theories in education. Other theories depicted the learner to be passive, before the establishment of constructivism. A major theme in the theoretical framework of Bruner is that learning is a dynamic process in which learners actively construct new ideas or concepts based upon their current/past knowledge (Bruner, 1990). The Vygotskian theory of knowledge acquisition regarded the learner as a less mature member of community and that knowledge is possessed by the teacher, who is a more mature member of the society. (Giyoo, 1992; Moshman, 1999). Going by this theory the teacher holds knowledge in the form of skills or strategies for solving specific problems. The teacher is expected to instruct the learner on how to solve such target problems progressively. When the learner attains such capability of solving problems, the act of knowledge transmission is considered successful. On the other hand, the human brain, regarded as a passive receptor of information, instead actively constructs its interpretation of information and draws inferences from them. The brain ignores some pieces of information and selectively attends to others much more than a "blank slate" that passively receives the incoming information (Osborn & Wittrock, 1983; Oderman, 1992). Since effort is required to construct meaning, it has further been confirmed that, ultimately the learner is responsible for her/his own learning (Driver and Bell, 1986; Bodner, 1986; Appleton, 1997). Those are the characteristics of constructivism.

Piaget (1952) is regarded as one of the founders of the theory of constructivism. He undertook many studies into children's acquisition of knowledge and affirmed that the acquisition of knowledge proceeds by both physical maturation of the learner's nervous system and interaction with the environment (Bodner, 1986).

Piaget may be regarded as the first constructivist in the sense that his view that knowledge was constructed in the mind of the learner was based on research on how children acquire knowledge (Bodner, 1986). Piaget identified the four stages that a learner may go through in acquiring knowledge with distinguished features as follows: Sensorimotor (0-2 years), in which, through physical interaction, the concept of object permanence is established. This means that the child understands that the object exists irrespective of whether it is visible or out of sight. This denotes the starting point of symbolic thinking, which is crucial for the subsequent intellectual development of the child. The pre-operational (2-7 years), in which the child makes conclusions on the basis of insufficient evidence, sees things only from his/her own point of view and treats inanimate objects as if they have life. The Concrete operational (7-12 years), in which the child is able to perform tasks successful relating to the conservation of matter, the transitive form of reasoning and the classification of objects. Lastly, the Formal operational stage (12 + years), in which the child is capable of engaging in a high level of thinking without basing it on concrete evidence, and hence a child is more abstract, animated and flexible in his/her operations. (Mwamwenda, 1989; Passer & Smith, 2001).

These age designations for different stages are approximate because each stage does not end suddenly but dies away, and Piaget's model stresses that the degree of understanding of any given concept is determined largely by the cognitive stage which the child has reached. That means a concept which requires formal operational thought cannot be mastered by a child who has only attained the level of concrete operational thinking; unless some intuitive thinking is involved (Okeke & Colinhood, 1980; Passer & Smith, 2001).

Despite Piaget's contribution to the constructivist approach to knowledge acquisition, he has heavily been criticized especially by the behaviourists for the speculation on the inner working of the mind as well as his attempt to generalize children's stages of logical structures of their thought (Robertson, 1994; Lord, 1998). From the point of view of the Vygotskian theorists, the Piagetian concept of knowledge acquisition has the inadequacy of emphasizing construction of knowledge without paying attention to: the contribution of the knowledge of more informed members of the society; cultural artefacts that mediate interactions between individuals and their physical environment; and the large social-historical context of the teaching-learning process (Giyoo, 1992). Rather than Piaget's age dependent cognitive levels, what the learner already knows is the key to his /her subsequent learning. Indeed this is one of the basic principles of the constructivist viewpoint (Bodner, 1986; Appleton, 1997).

The constructivist theory recognizes the influence of prior knowledge (experience) in the manner phenomena are perceived and interpreted. Regardless of whether knowledge is constructed in the mind of the learner or corresponds to an iconic image or picture of the real world, it must be based on our pictures of reality, which should be based on trust in our senses (Driver and Oldham, 1986; Bodner, 1986). The term "construct" emphasizes the understanding that the learner establishes in his/her attempt to account for the world and theoretical entries of categories such as atoms or genes which in turn take on reality in his/her experience (Driver, 1987). Such categories exist in the learner's thinking frame because they have been framed in meaning from his/her previous experiences. The sense made of the world therefore is seen to be dependent on both the situation itself and the learner's purposes and active construction of meaning (Driver and Oldham, 1986).

Constructivism as a paradigm or worldview posits that learning is an active, constructive process. The learner is an information constructor. People actively construct or create their own subjective representations of objective reality. New information is linked to prior knowledge, thus mental representations are subjective. (Klein and Merrit, 1994; Robertson 1994 cited in Otewa, 2006). It is further affirmed that learners have experienced and thought about the world: they therefore enter into the learning situation with a complex cluster of ideals, beliefs, values and emotions. It is the potential match between the existing experience/prior knowledge and the new information, which determines the learner's response to the instructional input from the learning situation/ teacher. Learning therefore involves the re-organization of the cognitive structure of the learner, which may necessitate a change in meaning of his/her experience (Robertson, 1994; Jeronen *et al.* 2009).

The learner's construction of knowledge is facilitated by both horizontal interactions (peer-peer) and the vertical interactions (teacher-learner). The horizontal interactions have proved to be more effective than the vertical because in the peer-peer interactions, members' motivation to disclose their ideas in a discussion tend to be more natural and strong since no authoritative correct answers are expected to come immediately (Giyoo, 1992; Terwel, 1999).

Construction of knowledge therefore involves the interpretation that the learner places on what he/she hears, sees or reads, which depends on the learner's existing experience or "prior knowledge" and on his/her interpretation of the total context in which the propositions are encountered- 'learning situation' (Forman et al. 1993). With time, the learner's knowledge about the world expands as a result of his/her construction efforts. Each step in the learner's constructive process involves the transaction in which what is already been known (prior knowledge) is brought to

bear on the new information. It is this marriage that creates new meaning and enhances understanding and control on the part of the learner in his/her surroundings.

From the foregoing discussion, it is observed that most of the researches in education have taken the part of the learner in knowledge acquisition as being passive. Some have adopted that knowledge acquisition is based on the age of the learner. Many of the researchers have tended to look into what the learners acquire after presentation of contents by the teachers. Constructivist approach, on the other hand, looks at what the learner has constructed before formal teaching is presented to him/her. What the learner already knows may be regarded as the most important factor influencing learning (Bodner, 1986).

This study, based on the constructivist theory of knowledge acquisition, tries to establish what learners have constructed on their perception of the concepts of environment and environmental management as outlined in the secondary school syllabus. The study, therefore, appreciates the active participation of the learner in knowledge acquisition.

2.3 Constructivist Theory of Knowledge Acquisition in School Curriculum

In a brief review of constructivist science education research, written from the perspective of a related discipline, it was concluded that a goal of interpretive science education research has been to probe pupils' knowledge or understanding in an attempt to make it explicit so that it can be characterized (Robertson, 1994). Studies based on the constructivist approach to knowledge acquisition involve researches that endeavour to: uncover the learner's frame of reference on the ideas he/she has on curriculum concepts; investigate the reactions and responses the learner expresses as instructional contacts are shared with him/her by teachers, and utilize the knowledge

gained to develop the teaching-learning programmes that would be appropriate and usable to the learner (Robertson, 1994; Bodner, 1990)

Studies on the learner's perception of concepts that are taught in the school curriculum have mainly been undertaken in science subject such as biology , chemistry and physics at the secondary school level. Researchers have focused on different concepts, for example, in biology, (Okeke and Collinwood, 1980) studied Nigerian students' understanding of biological concepts such as reproduction, transport and growth. Bell and Barker, (1982) considered the scientific concept of 'animal'; Adeniyi, (1985) focused on the misconceptions in concepts such as ecosystem, population, biotic community and habitat; and Munson (1994) focused on the misconception in concepts such as food web, carrying capacity, ecological adaptation, ecosystem and niche. In chemistry, Nassbaum and Norvick (1981) studied pupils' understanding of the particulate nature of matter, and in physics, Osborne (1981) inquired into children's ideas about electric current.

The study by Okeke and Colinwood cited above, (1980), involved secondary school pupils' whose ages ranged between sixteen and eighteen years. He interviewed the students individually to assess their level of understanding of the biological concepts of reproduction, transport and growth. The students' common misconceptions were identified, for example, 40% were unable to distinguish between reproduction and the act of copulation in animals; and 37% maintained that diffusion and osmosis were opposite processes in the concept of transport. The concept of growth was generally conceived in an observational way and the student appeared unable to conceptualize it in terms of increasing length, mass and volume or in other parameters. Munson (1994) also reported misconceptions held by students on the concept of food web that organisms higher in the food-web eat everything that is

lower in the food web. The truth being that organisms higher in the food web only feed on some of the organisms lower in the food web.

The current research attempts in science education are framed within the constructivist theory of knowledge acquisition. Researchers have taken this direction because views have changed from focusing on the input-output trend that is, input by teachers and the output by learners, to cognition where they concentrate on how learners acquire the knowledge. Environmental Education researchers should equally concentrate on how the learners construct the knowledge during the teaching-learning process (Robertson, 1994)

Hence this study, based on constructivist approach, is designed to investigate the learner's perception of the same in the classroom situation, as planned in Secondary school syllabus. This is an attempt in environmental education to explore how learners construct knowledge in the teaching-learning process of the infused environmental topics in the school curriculum.

The contribution of the school situation to the prior-knowledge of the secondary school pupils on the concept of environment could be reflected on the topics the pupils covered in the school curriculum in the previous classes and in subjects such as GHC, Agriculture and Science (Otewa, 2006). Analysis of the current Primary School Syllabus and the available text books on the same revealed that the concept of environment had been introduced in lower classes in themes such as 'Environment' in standard two English, deforestation and water pollution in standard four English conservation and soil erosion in standard five English and varieties of life forms (biodiversity) in standard seven English (Muitung'u *et al* , 2004) In Primary Science soil erosion is introduced in standard six, (Nyoro, 2003); Meaning of 'environment' and its components in standard seven; interdependence in the

environment in standard seven (Embeywa *et al.*, 2003), deforestation, energy depletion and conservation in standard eight(Rai & Richardson, 2005). Social Studies; Christian Religious Education (CRE), caring for Water pollution is first taught in standard seven Science (KIE, 2002).

The classroom presentation of environmental concepts, namely, soil erosion, deforestation, pollution of air and conservation of soil in both school syllabus and text books, in carrier subjects such as English, social studies and Science (KIE, 2002; Berluti & Njenga, 2001), stresses the individual components of environment e.g. water, air and soil plants, animals and phenomena such as drought and deforestation, rather than their interconnectedness. In standard eight Science abatement of environmental degradation is addressed as terracing, contour farming, tree planting, afforestation, not smoking cigarettes, not burning tyres and plastics, driving vehicles with well maintained engines and reducing use of farm chemicals; avoiding dumping industrial wastes among others (Rai and Richardson 2003; Embeywa *et al.*, 2003).

2.4 Constructivist Theory of Knowledge Acquisition in Environmental Education

Generally curriculum developers often offer a basic set of knowledge and skills to be covered with little consideration of the learners' past experience on the same (Richmond & Morgan, cited in Blum, 1987). Despite the current global environmental awareness and concern, the question of experiential baseline knowledge of the learners on the concept of environment has not received much attention from researchers. On the other hand, it has widely been recognized in Africa that incorporation of environmental concepts into the school curriculum focuses on topics that relate to land, river, forests, deserts and to agriculture and health, all of which are deemed to be most suitable to the children (UNESCO-UNICEF, 1974).

The background of African children is rich in environmental issues because they are often involved in fetching firewood and water, and sometimes they passively participate in family decisions, like making environmental decisions in clearing a nearby bush for agriculture (Knamiller, 1981). Despite such a rich background of the African child, Knamiller & Obeng-Asamoah (1979), noted that there is little documented information about the African children's perception of their environment.

Ohuche and Otaala (1981) carried out a study on the African child and his environment. However, the study focused more on the psychological environment with little emphasis on the biophysical environment. On the other hand Knamiller and Obeng-Asamoah (1979) studied the perception of the Ghanaian children on local water and fuel resources and consumption. The study specifically investigated what Ghanaian children knew and thought about local water and fuel resources and how the use and continuing supply of such resources related to the local development issues then. The students were interviewed in their respective schools. The findings revealed that the environmental awareness, in terms of water and fuel resources, that the rural children had was different in kind and extent from that of their urban counter parts. The rural children knew more about water and fuel resources, while the urban children knew more about the marketing of fuel resources such as charcoal. All the children involved could not relate the concept of conservation to the idea of depleting natural resources. To these children conservation meant saving money and reducing the workload.

Most studies in environmental education have tended to place more emphasis on 'environmentalness than educationness' (Robottom, 1987). This means that research in environmental educational focuses on environmental context and much inquiry has been done in environmental system in the name of environmental

education but very few incidents have focused on the educational situation in the name of environmental education. Unless environmental education researchers attend to the educative aspects of their practice, in terms of both underlying theories of knowledge and learning, one may be at a loss to frame a study within a particular epistemology (Robertson, 1994).

Studies that provide a strong empirical support for a constructivist interpretation of learning as well as rich descriptions of learner's understanding of concepts have mainly been done in science education. Again, studies in environmental education have received remarkably little attention of constructivism as a theoretical research foundation. Between 1989 and 1994 less than five research reports published in the journal of Environmental Education were based on constructivism except Wals' (1992) that reported on the young adolescents' perception on environmental issues which was explicitly constructivist based (Robertson, 1994).

In the Kenyan context, Mang'uriu (1987) assessed the incorporation and teaching of environmental concepts in primary schools in Muranga district. He found that incorporation of environmental concepts had been done mainly in subject such as GHC, Science, Agriculture, and Home Science and teachers faced socio-economic problems in teaching such concepts in the school system. Kawa (1991) surveyed the approaches used in teaching environmental concepts in Upper Primary classes in Kisumu Municipality, and found that most teachers used question – answer and lecture method approaches. This showed lack of adjustment on the part of the teachers to suit the needs of environmental education. Keiru (1991) focused on the basic awareness of what Standard Seven pupils had already acquired in common environmental issues such as soil, water, trees, population and wildlife after taking the

course involving the same concepts. Keiru concluded that the majority of pupils had problems in applying the acquired knowledge about the environment to solve problems encountered in everyday life. The study did not specify or identify challenges encountered by the pupils in the course of acquiring environmental concepts. Karembu (2002) evaluated the quality of environmental education taught in primary schools in terms of its ability to impart responsible environmental behaviour among standard eight pupils. The researcher found that the learners were inadequately prepared to translate the environmental knowledge acquired into responsible action at personal level. This could imply some deficiency in terms of curriculum design and mode of instruction. Otieno (2002) studied the promotion of environmental ethics through environmental education in the entire school system from standard one to form four. She found that the learning process does not provide the learner with opportunities to make value judgement regarding environmental issues in the country. Again pupils' comprehension of environmental concepts could be the main problem. Otewa (2006) used constructivist approach to study experiential baseline knowledge of learners on the concept of the environment before formal instruction as outlined in the standard seven science course. The study was done in Nyanza Province.

From the foregoing, it is manifestly clear that not much has been done by researchers to determine secondary school pupils' comprehension of environmental concepts infused in the school curriculum. This study therefore attempts to determine secondary school pupils' comprehension of Environmental Education concepts infused in the school curriculum, their level of environmental awareness, attitude change and behaviour towards the environment.

2.5 The Theoretical Framework

This study is based on the constructivist theory of knowledge acquisition. The constructivist approach to learning may be summarized in terms of the following propositions.

- Leaning does not occur by the learner responding in a passive way to the learning situation but actively interacting in it;
- What a person learns depends not only on the learning situation but also on what the learner brings to the situation (prior knowledge);
- The construction of meaning by the learner in making links with the prior knowledge occurs in situations involving texts, listening to someone talking and observing or manipulating the physical phenomena;
- Knowledge is constructed by the individual through social interactions and experience with the physical environment; and

Learning of curricular concepts involves not only adding to and extending on existing conceptual structure but may also involve reorganizing it radically Driver & Oldham, 1986; Klein & Merritt, 1994; Robertson, 1994).

Figure 2.1 below represents the constructivist-learning model of how to conceptualize learning process in children. It is adapted from Driver and Oldham's (1986:113) constructivist model for curriculum development and teaching of science. The model is divided into three compartments: sources of knowledge, factors affecting knowledge acquisition, and the learning process. The sources of knowledge are the home and the school environments. The factors affecting learning are varied, but psychologists have grouped them into organic and physical maturation of the learners; experimental background (i.e. people learn better when they are exposed to ideas with which they are brought up);

motivation level and the attitudinal set of the learners (Mwamwenda, 1989). In this model, all these factors are reduced into two: the learners' prior knowledge from the home environment and the learning situation constituted by the school environment. The learning process begins with the learner's construction of new knowledge that is perceived as tentative version, which is continually tested against the learner's life experience and where necessary modified to suit the accepted shared knowledge (Driver & Oldham, 1986).

The accepted shared knowledge by the experts influences teachers in the school environment in their preparation of the learning situation. It equally influences the knowledge held in the home environment through books and the impact of learner's constructed knowledge. This, then proportionately shows the influence of school environment activities on the home environment and the subsequent transfer of learning that aids the construction of new knowledge at the learning situation.

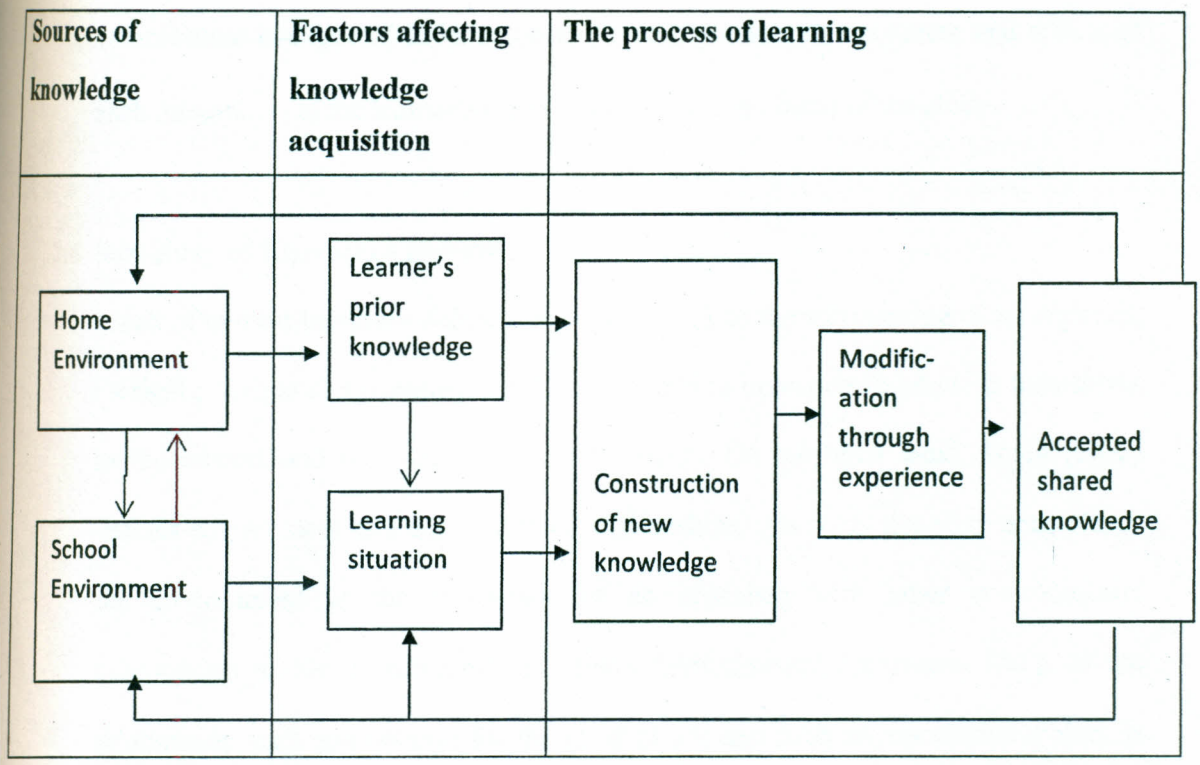

Figure 2.1 Constructivist Theoretical Learning Model: Source: Adapted and redrawn constructivist model for curriculum development and science teaching by Driver and Oldham, 1986.

The arrow indicates the direction of influence based on this model, it has been observed that when information is received by the learner, it does not drop into an empty pigeonhole but comes up against what is there already. Thereafter a process has to occur of integrating the new and the old information. The new may be interpreted in the light of the old (prior knowledge) 'assimilation" or the old may be modified to take into account the new information "accommodation" (Bruner, 1963; Driver & Bell, 1985)

Therefore in presenting a concept such as 'environment' to the Standard Seven pupil in Science course, it is important to find out the old information (prior knowledge) that the learner already has, that new information about the concept of

environment is expected to be subjected to and to establish the nature and effects of such integration in the learner's experience. This is the focus of the study.

2.6 Summary of Literature Review

Much of current literature defines the environment as the surrounding of an organism (Wright.; Wright & Flemming, 2004), which makes humanity to perceive themselves as the owners and not part of the environment. On the other hand, Shalit (2005) defines environment as a description of relationships; this study therefore understands the environment as the interaction of an organism with other environmental components within its surroundings. Each environmental component has a unique relationship with one another for the good of all; and such an association maintains the quality of the wider environment, hence the holistic nature of the environment.

Although various studies have been carried out on children's perception of school curricular concepts, mainly is Science education and at secondary education level, it is clear that much focus has been on children's general awareness on different environmental issues such as water and energy sources but very little has been done on

- children's perception of the concept of environment in totality, that is, the environment taken as a single unit. There is therefore, a dearth of literature to inform the environmental stakeholders' understanding of how others such as the pupils, students and colleagues conceptualize Human-Environmental relationships (Alaimo & Doran, 1980).
- The environmental knowledge learners have from home experience has not been much studied especially in Kenya, yet being a society where customs and traditions are still salient forces, it would be important to

find out the extent to which the learners carry such traditional beliefs/knowledge about the environment into the formal school system and what possible effects such beliefs/knowledge would have in their understanding of the environmental concepts infused in the school curriculum.

- The constructivist theory of knowledge acquisition has not been employed by many researchers in the field of Environmental Education, yet from its point of view "Environment" is not something that can be separated from humanity and its surrounding. Instead, constructivism considers environment to be understood as the interactions within the mind between the biophysical surroundings and the social, political and economic forces that organize humanity in the context of these surroundings (Robertson, 1994).

From the identified gaps in the current research practices in Environmental Education, this study endeavours to highlight the status of Environmental Education teaching/learning that would inform teachers and curriculum planners to adopt approaches that may be appropriate to teaching/ learning Environmental education concepts integrated in the various subjects in the school curriculum. The learners would in turn, improve their understanding of the concept of environment for better environmental awareness and management in Kenya.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Research Design

This inquiry was a survey. It sought to find out the interrelationships among rural/urban pupils and boys/girls in the comprehension of environmental concepts integrated in the school curriculum and how they act to manage the environment. In descriptive/diagnostic studies also known as surveys, the researcher takes out a sample and then wishes to make statements about the population on the basis of the sample analyses (Kothari, 2004; Curwin & Slater, 2008). Probabilistic sampling was employed to attain a representative sample.

3.2 The Target Population

The study involved forms three and four pupils in the Kenya Secondary Education system. Their ages range between thirteen and eighteen years. According to Piagetian Theory of knowledge acquisition, that age group belongs to the formal operational stage (Passer & Smith, 2001).

The target population in this study, falling within the formal operational stage, are capable of logical thinking with abstractions. Such pupils can draw conclusions, offer interpretations and develop hypotheses. They can work out logical possibilities without determining which ones actually occur in the real world; can generalize from prepositions based on one kind of content; and can organize information in markedly different ways (Passer & Smith, 2001).

The study was conducted in Machakos District, Machakos County, Kenya. In the year 2009 Machakos District had 62 secondary schools with a total population of 15,344 pupils of which 7,018 (approximately 46 per cent) were girls and 8,326 were

boys. The district had eight 'Provincial Schools', four of which were girls schools. The rest were classified as 'district Schools'. The urban area (Machakos Town) had fifteen secondary schools; two provincial girls' Schools, two provincial boys' schools, six district girls' schools and five district boys' schools. All the girls' schools in the district were boarding schools.

3.3 The Study Area

Machakos County falls in the Dry Transitional agro-ecological zone, also known as agro-ecological zones 4&5, which is drought prone. Machakos County stretches from latitudes O° 45′ to 1° 31′S from north to south and longitudes 36° 45′E to 37° 45′ from east to west. It covers an area of 6,281km² (GoK,2001). The County consists of hills and small plateaus rising between 1,800- 2,100m above sea level. The mean elevation is 1,357m above sea level. The undulating landscape is broken by isolated hill masses like Donyo Sabuk and Kalama Hills among others. Rainfall distribution is bimodal and received in the months of October/ November-January/February and again March-May. Mean rainfall ranges from 381mm-635mm for each season depending on altitude and other factors. The mean temperature varies between 18° andn25° C, the coolest month being July and the hottest months being February and October. (Gichuki *et al*, 1994, Jaetzold *et al* , 2006,).

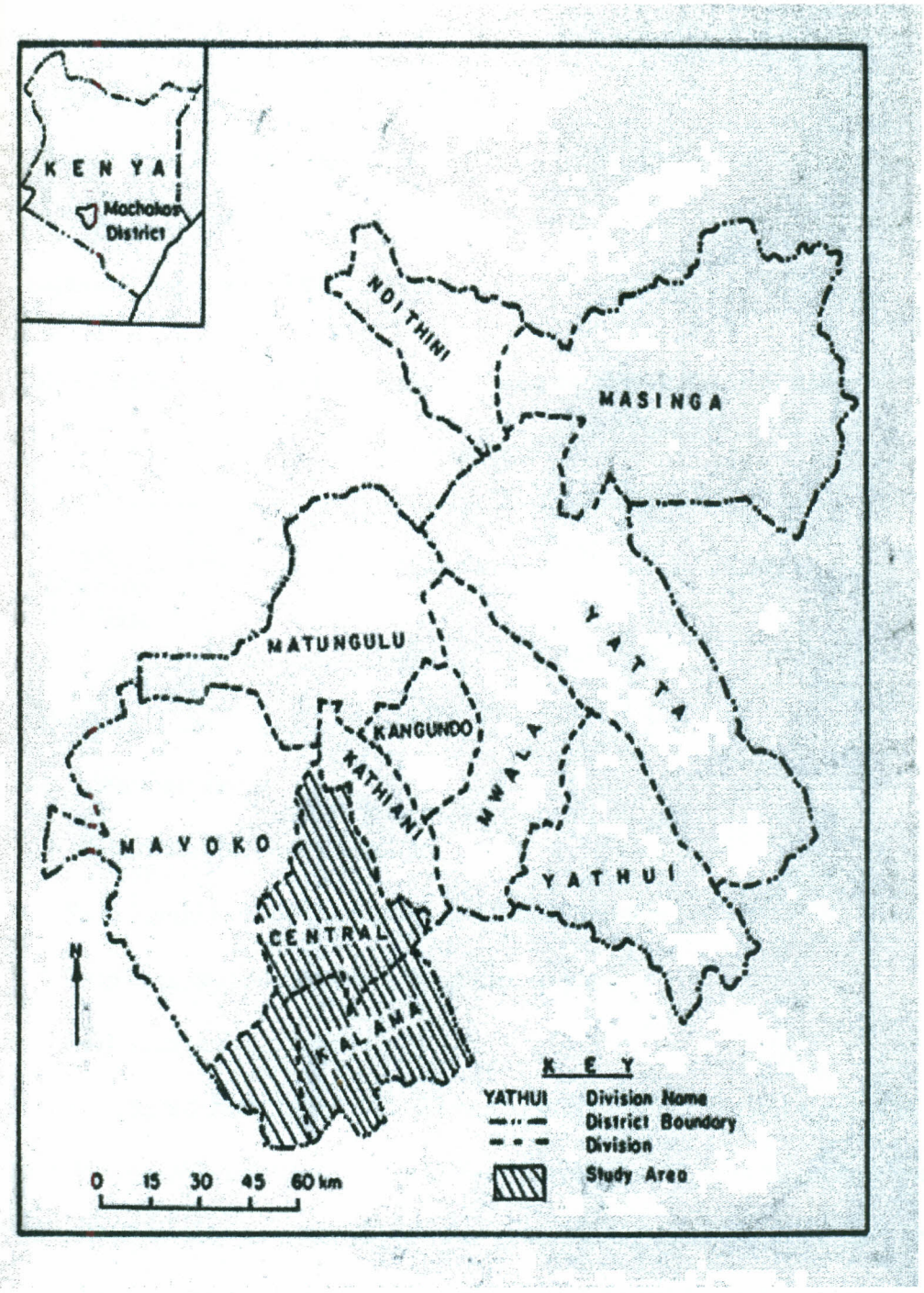

Figure 3.1 Map of the Study Area

With the exception of small areas of relatively well-watered uplands (high potential), the County is semi-arid. Nevertheless the area where Machakos County is situated supports a wide range of agricultural activities and livestock production. Rain fed integrated crop and livestock production dominate land use and household livelihoods, especially in the small-scale semi-subsistence sector.

Table 3.1 Classification of Agricultural Land In Agro-Ecological Zones (%)

	Zone					
County	2,3	3/4	4	5	5/6	6
Machakos & Makueni %	1.2	5.1	26.2	53.5	4.3	9.7
Kitui %	-	0.5	14.0	50.7	-	34.8

Key to land use Zones

2, 3. Suitable for bananas and coffee

4 Semi-humid to semi-arid transition; suitable for maize

5 Semi-arid; suitable for livestock , millet, sorghum

6 Arid; suitable for ranching

Source: Adapted from Jaetzold & Shmidt (1983), Vol. 2; Natural Conditions and Farm Management Information. Part C. East Kenya (Eastern and Central Provinces).

Before the introduction of soil conservation technology in the 1930s, Machakos County landscape was severely degraded. In 1937, a Colonial Government senior soil conservation officer described the Machakos Reserve (The Akamba Native land) as an appalling example of a large area of land which had been subjected to uncoordinated and practically uncontrolled development by natives where every phase of misuse of land was poignantly and vividly displayed. In his view the inhabitants of the area were rapidly drifting to a state of hopelessness and miserable

poverty and their land to a parched desert of rocks, stones and sand (Gichuki et al., 1994). At the time (1937) the population of the Area (Ukamba Reserve) was approximately 250,000. Extensive livestock-raising was combined with shifting cultivation on small hand-cultivated plots of maize and other food crops. Frequent and unpredictable droughts decimated food production and damaged the heavily grazed land. Much natural woodland had been cut and replaced by sparse shrub and grassland. Farm yields were low and thought to be declining, soil nutrients were depleted and top soil was eroding away and livestock numbers considered far in excess of the carrying capacity. The official view was that the farming system was not sustainable and in terminal decline. However after the introduction of soil and water conservation, encouraged by the Colonial Government in the 1940s through construction of terraces on steep slopes, the environment changed for the better. Soil and water conservation structures spread during the 1990s to nearly 100% of the County's arable land, excepting only the flattest and least densely populated areas. By 1990, rangeland was also coming under increasingly careful management. Currently conservation activities including terracing and tree planting on cultivated lands are routine. This has made agriculture almost sustainable in the area compared to fifty years ago.

3.4 Urban and Rural Schools Involved in the Study

1-14	
1	Machakos Boys (Urban)
2	Machakos Girls Urban)
3	A.I.C Nyayo Girls (Rural)
4	Mumbuni Boys (Urban)
5	Pope Paul's Seminary (Boys-Urban)
6	Machakos Baptist Mixed (Urban)
7	St. Valentine Girls (Urban)
8	Ngelani Mixed (Rural)
9	Muvuti Mixed (Rural)
10	Mang'auni Mixed (Rural)
11	Kitonyini Mixed (Rural)
12	Muindi Mbingu Mixed (Rural)
13	Machakos Central Mixed (Urban)
14	Mbembani Mixed (Rural)

3.5 Sampling Procedure

The schools used in the study were selected through stratified random sampling involving four categories of schools; urban boarding, urban day, rural boarding and rural day secondary schools. Three schools were selected from each stratum using simple random sampling. In the urban boarding category, which had a higher concentration of girls' boarding schools, two girls' schools were purposively selected so as to enhance girls participation in the study. A total of fourteen schools were selected. Then systematic random sampling was employed to select ten pupils per school (Mugenda and Mugenda, 2003; Kothari, 2004; Kombo and Tromp, 2006).

In systematic random sampling the first item on the sampling frame (in this case the class list) was selected at random Then by applying a predetermined sampling interval the required sample was selected from the sampling frame. The sampling interval was obtained by dividing the number of items on the sampling

frame by the required sample size. For example in a school with 120 form 3 pupils the sampling interval was (120/5)=24; based on a sample of 5 pupils for form three, (Kothari, 2009).

In each single sex school the researcher selected five pupils per form three and five pupils per form four class. The total was ten pupils per school. For mixed schools the selection was done such that out of the ten pupils selected five would be from either sex. This could mean varying the sampling interval to balance the sexes per school where the number of boys and number of girls in a class were not equal. Therefore ten pupils were systematically selected for each of the sampled fourteen schools, giving a total of 140 pupils for the study (70 girls and 70 boys).

Table 3.2 Respondents Included in the Study

Category / Type of school	School Principals	Agriculture Teachers	Geography Teachers	Science Teachers	Girls	Boys	Total
Rural	7	7	7	7	35	35	98
Urban	7	7	7	7	35	35	98
Total	14	14	14	14	70	70	196

3.4.1 Other Respondents Involved in the Study

Geography, science (physics, chemistry and biology) and agriculture teachers were also included in the study. These were selected from the participating schools, giving three teachers per school and a total of forty two (42) teachers and fourteen (14) principals. Overall sample size for the study was one hundred and ninety six (196) for all respondents.

3.4.2 Grounds for the Sample Size

The subjects selected for the study were both interviewed and involved in a focus group discussion. Also considering that the subjects were randomly selected, a sample of 196 respondents was regarded as adequate. Such a sample served the objectives of the study in terms of data presentation and analysis. This was sufficient for the study taking into account the level of funding and time available for completion of the study.

Otherwise the sample may also be determined from the expression:-

Where:-

$$e = Z \cdot \frac{\sigma_p}{\sqrt{n}}$$

Z = Standard variate at a given level of Confidence

n = Size of sample

$$e^2 = \frac{Z^2 \cdot \sigma_p}{n}$$

e = acceptable error

σ_p = Standard deviation of population

$$n = \frac{Z^2 \cdot \sigma^2_p}{e}$$

N = The population universe (assuming the population is infinite).

OR

$$n = \frac{Z^2 \cdot N\sigma^2 p}{(N-1)e^2 + Z^2\sigma^2_p}$$ (Assuming the population is finite)

NB: This must be based on prior knowledge of population parameters or the results of a pilot study.

3.5 Phasing and Development of the Instruments

The development of the instruments was done in phases such that the materials containing the concepts were selected and then a desk study undertaken and finally the items for inclusion into the instruments were developed based on selected themes.

3.5.1 Phase One: Desk Study

The desk study involved identification of the specific documents containing the Environmental Education concepts to be investigated and the carrier subjects. On examining the Primary and Secondary school syllabi, (KIE,2002; KIE 2008; KIE 2009) the researcher found that the main carrier subjects for environmental concepts included English language, Science, CRE and agriculture at the primary school level; biology, geography, physics, chemistry and agriculture were the carrier subjects for the secondary school cycle. The word environment first appears in the English syllabus at standard two. The term environment is then infused in different disciplines and repeated at different degrees of detail up to form four. The same approach is used for other environmental concepts like pollution, conservation and soil erosion among others. More advanced concepts like carrying capacity and food chains are introduced

in form four. The researcher identified all the environmental management concepts included in this study from the school syllabi.

3.5.2 Second Phase

The desk study conducted in Phase One of the inquiry provided this researcher with the raw 'material' for developing pupils', teachers' and principals' questionnaires. The development of the pupils' questionnaire, as the main instrument of the study, required a careful analysis of the concepts under study so that they fit in selected thematic areas. The themes covered were environmental degradation including pollution, resource conservation, population growth impact on trees, capacity of technology to solve environmental problems, ecological stability and youth attitude toward the welfare of the environment. The researcher deliberately mixed simple and complex aspects of each theme to estimate level of awareness.

The development of the Checklist and the FGD items was also informed by the material gathered in phase one and refined during and after the pilot test. The Checklist filling in and FGDs assisted the researcher in estimating the level of environmental awareness of the pupils involved in study. The FGD items required the respondents to provide answers to the what, where, when, how and why of global warming , weather extremes and climate change.

3.6 Administration of Data Collection Instruments

The filling in of the questionnaires was overseen by the researcher and his assistants, accompanied by a teacher appointed by the school principal. At each school, the appointed teacher would avail forms 3&4 admission class lists from which ten pupils were randomly selected. In mixed schools, five boys and five girls would be selected.

The exercise was conducted on an agreed day and time to the convenience of the school management. This would cause minimum disruption of learning for the selected pupils.

The Focus Group Discussions were conducted by the researcher personally, involving the same respondents as for the questionnaires. The group sat beside the researcher and all of them would focus on the photographs presented to them, one by one. The group would then be allowed time to familiarize themselves with the theme depicted by the photographs. The researcher then asked relevant questions based on the inquiry and let one pupil respond at a time. The respondents were asked to explain, predict outcomes and suggest appropriate interventions after being presented with different manipulations of the problem depicted by photographs. Whenever a pupil asked the researcher a question the researcher redirected it to the group members for response and remained neutral. "Why." questions were asked to probe pupils' reasoning. This was repeated until all selected themes were covered. The proceedings were tape recorded for transcription and analysis. At the end of each FGD, the researcher would record a summary of the pupils' responses in a notebook. This served as a back-up for the tape recorder. Thirty minutes were allowed per group. The FGD, was designed to gauge pupils' awareness on weather extremes and climate change, causes, effects, challenges to sustainability and possible interventions. The entire exercise was repeated for seven of the schools selected for study due the limited time available.

3.7 The Pilot Test

A pilot test, also known as a feasibility study, (Teijlingen, & Hundley, 2001) was conducted on the questionnaires and the other instruments, that is the Focus Group

Discussion (FDG) and the checklist. The exercise proved invaluable because it helped this researcher in assessing the likely success of the proposed recruitment approaches and in determining the resources, both financial and human, that would be necessary to complete the study. It also assisted in assessing the time needed by the pupils to complete their questionnaire. One girls' Provincial Boarding School and two mixed day/ boarding schools were sampled for the pilot test. The researcher selected thirty (30) pupils for the pilot study in three different schools. The pilot schools were selected simultaneously with the main study sample employing the same sampling procedure. Hence the Pilot Test sample was randomly selected and this ensured it was not included in the main study.

3.8 Validity of the Instruments

The validity of the instruments was established by ensuring that the items covered only the concepts specified in the objectives of the study. The concepts covered in the study were extracted from the secondary school syllabuses for Agriculture, Geography and Science (KIE, 2002). Some of the items in the instruments were standardized since they were drawn from KCSE past papers.

3.9 Reliability of the Instruments

The reliability of a research instrument concerns the extent to which the instrument yields the same results on repeated trials. Although unreliability is always present to a certain extent, there will generally be a good deal of consistency in the results of a quality instrument gathered at different times. The tendency toward consistency found in repeated measurements is referred to as reliability (Carmines & Zeller, 1979). The researcher used the split-half method to assess the reliability of the instruments. The

researcher preferred the split halves method as it is more cost effective and less time consuming. In split-halves method the total number of items is divided into halves, then a correlation is estimated between the two halves. This method only estimates the reliability of each half of the test. The split half method produced 0.68, which the researcher considered adequate for the study.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

4.1 Introduction

This study was an attempt to determine the effects of learning environmental management concepts among secondary school pupils in Machakos County, Eastern Kenya. Its object was to determine pupils' understanding of environmental management concepts infused in the secondary school curriculum in Kenya and how they act to protect, improve and conserve the environment, both at school and community levels.

A sample of 140 (a hundred and forty) pupils was randomly selected from 14 (fourteen) schools randomly preselected for the study. The sample comprised 70 (seventy) girls and 70 (seventy) boys. The primary data presented in this chapter was collected from forms three and four pupils using a questionnaire employing a Five Point Lickert Scale. To confirm the pupils' data collected using the questionnaire a checklist and focus group discussion (FGD) were employed. One teacher each for science, agriculture and geography as well as the principal administrator for each school involved in the study were interviewed to corroborate the findings on pupils. A response rate of at least 94% (ninety four per cent) for each item on the pupils' questionnaire was realized.

The resulting data was coded and keyed in using Microsoft Spread Sheet software. Statistical Package for Social Sciences (SPSS) was employed for analyzing the data. The data analysis was done progressively starting with frequencies, percentages and cross tabulation. Hypothesis testing was done using chi-square to check for association between the independent variables sex of respondent or type of

school, with the various dependent variables; understanding, awareness and attitude. Conditions for the application of chi-square test require that response levels on the agree side are regrouped by combining the frequencies (agree combined with strongly agree) so that the new frequencies are not less than 5. The same regrouping may be done on the disagree side (Orodho, 2009; Curwin and Slater, 2007; Kothari, 2009; http://www.wellesley.edu/Psychology/Psych205/chisquareindep.html retrieved 15/11/2012). The combined frequencies resulting from the chi-square test requirements formed the basis for the data presentation and analysis for this study. The data presentation, analysis and discussion, in this chapter was guided by the following research questions;

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?
ii. What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?
iii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?
iv. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?
v. What is the level of environmental awareness of secondary school pupils?
vi. What are the impediments to teaching/learning environmental management concepts in secondary schools?

The main source of data for the study was the pupils. Authenticating and corroborating information on challenges and impediments to teaching and learning environmental management concepts infused in the secondary school curriculum was provided by the teachers and the school heads. The findings of this study were arranged and presented as per the following themes;

- Environmental degradation and pollution
- Water Conservation
- Population growth and firewood use impact
- Capacity of technology to resolve environmental problems
- Ecological stability and environmental sustainability
- Youth attitude and involvement in addressing environmental issues.

This chapter provides a presentation of the findings of the study on the main pupil variables that affect their actions in and interventions for the environment. The main variables considered are pupil sex, the classification and boarding status as well as the location of the secondary school that is rural or urban. The level of education of the teachers as well the support by school administration and their implications on pupil characteristics such as knowledge, awareness, attitude and participation in activities for the welfare of the environment are taken into account. Finally, the challenges facing the teaching of Environmental Education in secondary schools are determined. For each item on the questionnaire three tables are presented for frequencies and percentages, means & standard deviations, cross tabulation for sex and for type of school, then a chi-square test for association followed by a discussion of the findings for the variable.

4.2 Environmental Degradation and Pollution

When the environment becomes less valuable or damaged; biodiversity is lost, or natural resources are depleted the environment is considered degraded. The largest areas of concern at present are deforestation in rain forests, air pollution, ozone depletion and the destruction of marine environment. In the Kenyan situation overgrazed and eroded lands, deforested areas and polluted urban environment are examples of degradation.

4.2.1 Overgrazing as an Factor in Environmental Degradation

The first theme explored in this study is 'Environmental degradation and pollution'. The variable 'overgrazing may be caused by economic, social or political factors' was developed from the environmental concepts infused in Form Four Geography Syllabus (KIE, 2002). The reason for including this variable in that overgrazing leads to depletion of plant cover and soil erosion, which may be termed environmental degradation. The pupils' responses would therefore reflect on their understanding of the 'overgrazing' and its causes. The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?

iii. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?

iv. What is the level of environmental awareness of secondary school pupils

To address the above research questions three tables, presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. The response rate for this item was 100%. The data on all variables is based on a Five Point Likert Scale. (The coding definition was; strongly agreed=5, agreed=4, neutral=3, disagreed=2, strongly disagreed=1). At the end of each set of three tables for each statement follows a discussion of the data.

Table 4.1: Pupils' responses to 'overgrazing may be caused by economic, social or political factors'

	Frequency	Percentage	
DISAGREED	42	30.9	
NEUTRAL	23	16.9	
AGREED	71	52.2	
Mean			3.213235
Std Deviation			0.889512
N	136	100	

The mean and standard deviation in this case demonstrate moderate understanding and wide variation of opinions pertaining to the causes of overgrazing.

Table 4.2: Pupils' responses to 'overgrazing may be caused by economic, social, or political factors' cross tabulated with sex of respondent

cross tab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	DISAGREE	Count	20	22	42
		% within OVERGRAZ CAUSED BY ECO, SOCIAL OR POL FACTORS	47.6%	52.4%	100.0%
		% within SEX OF RESPONDENT	28.6%	33.8%	31.1%
	NEUTRAL	Count	11	12	23
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	47.8%	52.2%	100.0%
		% within SEX OF RESPONDENT	15.7%	18.5%	17.0%
	AGREE	Count	39	31	70
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	55.7%	44.3%	100.0%
		% within SEX OF RESPONDENT	55.7%	47.7%	51.9%
Total		Count	70	65	135
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.3: Pupils' responses to 'overgrazing may be caused by economic, social or political factors' cross tabulated with type of school

Cross tab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	DISAGREE	Count	21	21	42
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	50.0%	50.0%	100.0%
		% within TYPE OF SCHOOL	30.0%	31.8%	30.9%
	NEUTRAL	Count	11	12	23
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	47.8%	52.2%	100.0%
		% within TYPE OF SCHOOL	15.7%	18.2%	16.9%
	AGREE	Count	38	33	71
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	53.5%	46.5%	100.0%
		% within TYPE OF SCHOOL	54.3%	50.0%	52.2%
Total		Count	70	66	136
		% within OVERGRAZ CAUSED BY ECO,SOCIAL OR POL FACTORS	51.5%	48.5%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.2.2 Overgrazing may be caused by economic, social or political factors

This statement was devised to gauge pupils' understanding of the concept of overgrazing as given in the geography syllabus for secondary schools. The rationale for this item was to gauge pupils' comprehension of the complex nature of overgrazing and hence the need for a multifaceted approach to address it as argued in the Tragedy of The Commons (Hardin, 1968; http://www.bookrags.com/essay-2005/1/24/15152/0130). Further, Resource use, waste production and environmental degradation are accelerated by population growth (Ehrlich & Ehrlich, 2009). From Table 4.1 Fifty two per cent of those interviewed agreed with the statement while thirty one per cent disagreed. This would appear to reflect low understanding of the complex nature of the factors that may lead to overgrazing. From Table 4.2 of those who agreed with the statement fifty six per cent (56%) were male while forty four (44%) were female. This is an indication of a small difference between the two sexes in their understanding of the factors behind overgrazing. The relevant research questions were 'What is the secondary school pupils' perception of environmental concepts infused in the school curriculum?' and 'Is there a significant difference in the understanding of environmental concepts between boys and girls?'

Concerning association between sex and pupils comprehension of environmental concepts infused in the school curriculum, the chi-square test results showed χ^2 (2, 0.05) =11.07 (critical), asymp. sig =.648 and calculated χ^2 =.869. Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by sex' was accepted at .05 level of confidence for 'over grazing may be caused by economic,

social or political factors'. The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, obtainable from tables, bearing in mind the .05 level of significance (Orodho, 2009; Curwin and Slater, 2007; Kothari, 2004).

From Table 4.3 on the connection between type of school, that is rural or urban, and pupils' comprehension of environmental concepts infused in the school curriculum, 53.5 % of the respondents from rural schools and 46.5% of the respondents from urban schools agreed with the statement. This shows the pupils in rural schools had a slightly better understanding of the underlying causes of overgrazing. The relevant research question was 'Is there a difference in the understanding of environmental concepts infused in the school curriculum between pupils in rural and those in urban schools? ' The chi-square test results showed $\chi^2(2, 0.05) = 11.16$ (critical), asymp. Sig =.870 and calculated chis square (χ^2) = .278. The decision for acceptance of the null hypothesis requires the calculated Pearson chi-square value to be smaller than the critical value (obtainable from tables of Critical Values of χ^2), bearing in mind the .05 level of significance (Kothari, 2009). Therefore it appears the null hypothesis (H_{o2}) which states 'pupils' comprehension of environmental concepts infused in the secondary school curriculum is not influenced by the school environment or type of school' was accepted at .05 level of confidence for 'over grazing may be caused by economic, social or political factors'. The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, (obtainable from tables of Critical Values of χ^2) bearing in mind the .05 level of significance (Kothari, 2009).

4.2.3 Noise Pollution

The item 'playing very loud music in a matatu causes noise pollution' was developed from the environmental concepts infused in Form Four Chemistry Syllabus (KIE, 2002). The reason for including this variable is that noise pollution may be termed a form of environmental degradation. The pupils' responses would therefore reflect on their understanding of the term 'pollution' and its various manifestations like chemical waste, solid waste, and sound pollution among others. To address the research questions for this theme three tables, presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. The response rate for this item was 99.3%.

Table 4.4: Pupils' responses to 'playing very loud music in a matatu causes noise pollution'

	Frequency	Percentage	
DISAGREED	15	11.0	
NEUTRAL	1	.7	
AGREED	119	87.5	
Mean			3.77037
Std Deviation			0.634114
N	135	99.3	

The small standard deviation is indicative of consensus among the respondents that loud music in a matatu causes noise pollution.

Table 4.5: Pupils' responses to 'playing very loud music in a matatu causes noise pollution' cross tabulated with sex of respondent,

Cross tab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
PLAYING VERY LOUD MUSIC IN A MATATU CAUSES NOISE POLL	DISAGREE	Count	9	6	15
		% within LOUD MUSIC CAUSES NOISE POLL	60.0%	40.0%	100.0%
		% within SEX OF RESPONDENT	13.0%	9.2%	11.2%
	NEUTRAL	Count	0	1	1
		% within LOUD MUSIC CAUSES NOISE POLL	.0%	100.0%	100.0%
		% within SEX OF RESPONDENT	.0%	1.5%	.7%
	AGREE	Count	60	58	118
		% within LOUD MUSIC CAUSES NOISE POLL	50.8%	49.2%	100.0%
		% within SEX OF RESPONDENT	87.0%	89.2%	88.1%
Total		Count	69	65	134
		% within LOUD MUSIC CAUSES NOISE POLL	51.5%	48.5%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.6: Analysis of pupils' responses to 'playing very loud music in a matatu causes noise pollution' cross tabulated with type of school

Cross tab

			TYPEOF SCHOOL		
			RURAL	URBAN	Total
PLAYING VERY LOUD MUSIC IN A MATATU CAUSES NOISE POLL	DISAGREE	Count	7	8	15
		% within LOUD MUSIC CAUSES NOISE POLL	46.7%	53.3%	100.0%
		% within TYPE OF SCHOOL	10.1%	12.1%	11.1%
	NEUTRAL	Count	1	0	1
		% within LOUD MUSIC CAUSES NOISE POLL	100.0%	.0%	100.0%
		% within TYPE OF SCHOOL	1.4%	.0%	.7%
	AGREE	Count	61	58	119
		% within LOUD MUSIC CAUSES NOISE POLL	51.3%	48.7%	100.0%
		% within TYPE OF SCHOOL	88.4%	87.9%	88.1%
Total		Count	69	66	135
		% within LOUD MUSIC CAUSES NOISE POLL	51.1%	48.9%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.2.4 Playing very loud music in a matatu (public transport car) causes noise pollution

This item was designed to gauge pupils' comprehension of the concept of pollution as given in chemistry syllabus (KIE, 2002). The logic for including this item was to gauge pupils' comprehension of noise pollution in particular and the concept of degradation of the environment generally. Noise is a prominent feature of the environment including noise from transport, industry and the neighbourhood. In children chronic noise exposure impairs reading comprehension and long term memory and may be associated with raised blood pressure (Stansfeld and Matheson, 2003, http://bmb.oxfordjournals.org/content/68/1/243.full, retrieved 20/05/2012).

From Table 4.4, by far the majority of the respondents agreed with the statement at 87.5%. Only 11% disagreed with the statement. This is a show of clear understanding that very loud noise even in the form of music could be a pollutant and therefore harmful to the environment, including mankind. The figures in Table 4.5 indicate that there may be some difference between the females at 48.5% and males at 51.5% in their understanding of very loud noise as a form of pollution. The relevant research question for this item is 'What is secondary school pupils' perception of environmental concepts infused in the school curriculum? 'Chi-square test on association between sex and pupils' comprehension of environmental concepts infused in the secondary school curriculum did no produce significant results. Regarding the connection between type of school and pupils' comprehension of environmental concepts infused in the school curriculum, Table 4.6 shows that the respondents from rural schools are only slightly better at 51.1% compared to respondents from urban schools at 48.9%. Chi-square test on association between the

school environment and pupils' comprehension of environmental concepts infused in the secondary school curriculum did no produce significant results

4.3 Resource Conservation

This refers to the management of the human use of natural resources to provide the maximum benefit to current generations while maintaining capacity to meet the needs of future generations. Conservation includes both the protection and rational use of natural resources.

4.3.1 Rainwater Harvesting

The item 'rainwater harvesting can enhance local agricultural and livestock production' was developed from the environmental concepts infused in Form Three Agriculture Syllabus (KIE, 2002). The reason for employing this variable is that rain water harvesting is a form of resource conservation for sustainable living. The pupils' responses would therefore reflect on their understanding of the term water conservation and its implications for sustainable living. To address the research questions for this theme, which are the same as for the previous one, three tables, presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. The response rate for this item was 99.3%.

Table 4.7: Pupils' responses to 'rain water harvesting can enhance local agricultural and livestock production'

	Frequency	Percentage	
DISAGREED	8	5.9	
NEUTRAL	7	5.1	
AGREED	120	88.2	
Mean			3.82963
Std Deviation			0.511666
N	135	99.3	

The small standard deviation may be viewed as a measure of consensus among the students in their understanding of the concept of noise pollution.

Table 4.8: Pupils' responses to 'rain water harvesting can enhance local agricultural and livestock production'

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	DISAGREE	Count	3	5	8
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	37.5%	62.5%	100.0%
		% within SEX OF RESPONDENT	4.3%	7.8%	6.0%
	NEUTRAL	Count	4	3	7
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	57.1%	42.9%	100.0%
		% within SEX OF RESPONDENT	5.7%	4.7%	5.2%
	AGREE	Count	63	56	119
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	52.9%	47.1%	100.0%
		% within SEX OF RESPONDENT	90.0%	87.5%	88.8%
Total		Count	70	64	134
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	52.2%	47.8%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.9: Pupils' responses to 'Rain water harvesting can enhance local agricultural and livestock production'

Cross tab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	DISAGREE	Count	3	5	8
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	37.5%	62.5%	100.0%
		% within TYPE OF SCHOOL	4.3%	7.7%	5.9%
	NEUTRAL	Count	4	3	7
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	57.1%	42.9%	100.0%
		% within TYPE OF SCHOOL	5.7%	4.6%	5.2%
	AGREE	Count	63	57	120
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	52.5%	47.5%	100.0%
		% within TYPE OF SCHOOL	90.0%	87.7%	88.9%
Total		Count	70	65	135
		% within RAIN WATER HARVEST CAN ENHANCE LOCAL AGR	51.9%	48.1%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.3.2 Rainwater harvesting can enhance local agricultural and livestock production'

This statement was devised to determine pupils' understanding of the concept of conservation as given in the geography and agriculture syllabuses for secondary schools. The logic for this item was to test pupils' comprehension for the value of conservation of resources in enhancing and sustaining productivity in agriculture and livestock rearing in a semiarid place and generally (Fengrui, 2000; Hatibu & Mahoo 2000). From Table 4.7 those who agreed with the statement made up 88.2% of the respondents. Six per cent of the respondents disagreed with the statement. This would reflect a good understanding of the concept of conservation of water and its value to agriculture and livestock production. Table 4.8 shows that 52.9% of the males agreed with the statement while 47.1% of the females agreed with it. There appears to be a small difference between the two sexes in their understanding of the meaning of conservation of water and its value to farming in this case. The relevant research question being 'What is the secondary school pupils' perception of environmental concepts infused in the school curriculum?' Chi-square test on association between sex and pupils' comprehension of environmental concepts infused in the secondary school curriculum did no produce significant results.

From Table 4.9 on the connection between type of school, that is rural or urban, and pupils' comprehension of environmental concepts infused in the school curriculum, 52.5 % of the respondents from rural schools and 47.5% of the respondents from urban schools agreed with the statement. This shows that pupils in rural schools had a slightly better understanding of the value of rainwater harvesting to agriculture and livestock farming (Fengrui *et al,* 2000). Chi-square test on association between the school environment and pupils' comprehension of

environmental concepts infused in the secondary school curriculum did no produce significant results.

4.3.3 Water Conservation Technology

The statement 'rainwater harvesting employs simple and appropriate technology' was developed from the environmental concepts infused in Form Three Agriculture Syllabus (KIE, 2002). The reason for using this item is that rain water harvesting requires simple technology that is easily adopted for sustainable living. The pupils' responses would therefore reflect on their understanding of the viability of rainwater harvesting technology for enhancement of sustainable living.

To address the research questions for this theme, which are same as for the previous variable, three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. The return rate for this item was 95% and realized a response rate of 97.8%.

Table 4.10: Pupils' responses to 'rain water harvesting employs simple and appropriate technology'

	Frequency	Percentage	
DISAGREED	20	14.7	
NEUTRAL	13	9.6	
AGREED	100	73.5	
Mean			3.601504
Std Deviation			0.737932
N	133	97.8	

It would appear there was some consensus that rain water harvesting employs simple and appropriate technology.

Table 4.11: Pupils' responses to 'Rain water harvesting employs simple and appropriate technology'

Cross tab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	DISAGREE	Count	10	10	20
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	50.0%	50.0%	100.0%
		% within SEX OF RESPONDENT	14.3%	16.1%	15.2%
	NEUTRAL	Count	4	9	13
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	30.8%	69.2%	100.0%
		% within SEX OF RESPONDENT	5.7%	14.5%	9.8%
	AGREE	Count	56	43	99
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	56.6%	43.4%	100.0%
		% within SEX OF RESPONDENT	80.0%	69.4%	75.0%
Total		Count	70	62	132
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	53.0%	47.0%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.12: Pupils' responses to Rain water harvesting employs simple and appropriate technology

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	DISAGREE	Count	10	10	20
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	50.0%	50.0%	100.0%
		% within TYPE OF SCHOOL	14.7%	15.4%	15.0%
	NEUTRAL	Count	5	8	13
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	38.5%	61.5%	100.0%
		% within TYPE OF SCHOOL	7.4%	12.3%	9.8%
	AGREE	Count	53	47	100
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	53.0%	47.0%	100.0%
		% within TYPE OF SCHOOL	77.9%	72.3%	75.2%
Total		Count	68	65	133
		% within RAIN WATER HARVEST EMPLOYS SIMPLE & APPRO TECH	51.1%	48.9%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.3.4 Rain water harvesting employs simple and appropriate technology

This statement was devised to determine pupils' understanding of the concept of conservation of water as given in the geography and agriculture syllabuses for secondary schools and also assess pupils' understanding of the adoptability, viability and sustainability of the accompanying technology. It was also supposed to measure comprehension of the value of innovation in conserving resources. The rationale for including this item was to gauge pupils' attitude towards adoption of appropriate technology for attainment of sustainable livelihoods. (Fengrui *et al,* 2000; Ngigi & Kariuke, 2010)

According to Table 4.10, seventy three point five per cent (73.5%) of the respondents agreed with the statement, while 14.7% disagreed with it. Thus reflecting a good understanding of the underlying values to rain water harvesting that is appropriateness of technology, maintenance and sustainability. Table 4.11 shows that 80% of the males agreed with the statement while 69.4% of the females agreed with it. This is an indication of a small difference between the two sexes in their understanding of the practicability of conservation of water and its viability considering the underlying issues like appropriateness of the technology and maintenance of the same. The relevant research question was 'What is the secondary school pupils' perception of environmental concepts infused in the school curriculum?' As for the association between sex and pupils' understanding of the appropriateness viability and sustainability of water harvesting technology and conservation from Table 4.12 fifty per cent (50%) of the male respondents and 50% of the female respondents agreed with the statement. This reflects parity in the

appreciation of the appropriateness of rainwater harvesting technology between males and females.

Chi-square test on association between sex and pupils' comprehension of environmental concepts infused in the secondary school curriculum did no produce significant results.

From Table 4.12 on the connection between type of school, that is rural or urban, and pupils' comprehension of environmental concepts infused in the school curriculum , 77.9 % of the respondents from rural schools and 72.3% of the respondents from urban schools agreed with the statement. Within sex of respondent 50% males and 50% females agreed statement. This shows that the pupils in rural schools had a slightly better understanding of rainwater harvesting technology and the attendant challenges. Chi-square test on association between the school environment and pupils' comprehension of environmental concepts infused in the secondary school curriculum did no produce significant results.

4.4 Population Growth Impact on Natural Resources

Globally environmentalists don't dispute that many if not all of the environmental problems, ranging from climate change, loss of biodiversity, environmental degradation to overzealous resource extraction are either caused or exacerbated by population growth. In developing countries there is too much strain on the resource base and this strain is increasing due to increasing wealth, urbanization, and more importantly, run away population growth rates (Tuncer *et al.*, 2005).

4.4.1 Population Growth Impact on Tree Cover

The variable 'the more the people in a village the more they cut the local trees for firewood' was developed from the environmental concepts infused in Form Four Geography Syllabus (KIE, 2002). The reason for including this variable is that rising human population growth has a negative impact on tree cover where firewood is the main source of cooking energy as is the case in rural areas. The pupils' responses would therefore reflect their understanding of the impact of rising population on tree cover.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?

iii. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?

iv. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 96.4% and a response rate of 99.2%

Table 4.13: Pupils' responses to 'the more the people in a village the more they cut the local trees for firewood'

	Frequency	Percentage	
DISAGREED	15	11.0	
NEUTRAL	24	17.6	
AGREED	96	70.6	
Mean			3.6000
Std Deviation			0.68240
N	135	99.2	

There seems to be some consensus among the respondents that the more the people in a village the more they cut the local trees for firewood.

Table 4.14: Analysis of pupils' responses to 'the more the people in a village the more they cut the local trees for firewood ' cross tabulated with sex of respondent

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
THE MORE THE PEOPLE IN A VILLAGE THE MORE THEY CUT	DISAGREE	Count	9	6	15
		% within MORE PEOPLE MORE CUT	60.0%	40.0%	100.0%
		% within SEX OF RESPONDENT	12.9%	9.4%	11.2%
		% of Total	6.7%	4.5%	11.2%
	NEUTRAL	Count	14	10	24
		% within MORE PEOPLE THE MORE CUT	58.3%	41.7%	100.0%
		% within SEX OF RESPONDENT	20.0%	15.6%	17.9%
		% of Total	10.4%	7.5%	17.9%
	AGREE	Count	47	48	95
		% within MORE PEOPLE MORE CUT	49.5%	50.5%	100.0%
		% within SEX OF RESPONDENT	67.1%	75.0%	70.9%
		% of Total	35.1%	35.8%	70.9%
Total		Count	70	64	134
		% within MORE PEOPLE MORE CUT	52.2%	47.8%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%
		% of Total	52.2%	47.8%	100.0%

Table 4.15: Pupils' responses to 'the more the people in a village the more they cut the local trees for firewood' cross tabulated with type of school

Cross tab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
THE MORE THE PEOPLE IN A VILLAGE THE MORE THEY CUT	DISAGREE	Count	8	7	15
		% within THE MORE THE PEOPLE IN A VILLAGE THE MORE THEY CUT	53.3%	46.7%	100.0%
		% within TYPE OF SCHOOL	11.4%	10.8%	11.1%
	NEUTRAL	Count	6	18	24
		% within THE MORE THE PEOPLE IN A VILLAGE THE MORE THEY CUT	25.0%	75.0%	100.0%
		% within TYPE OF SCHOOL	8.6%	27.7%	17.8%
	AGREE	Count	56	40	96
		% within THE MORE THE PEOPLE IN A VILLAGE THE MORE THEY CUT	58.3%	41.7%	100.0%
		% within TYPE OF SCHOOL	80.0%	61.5%	71.1%
Total		Count	70	65	135
		% within THE MORE THE PEOPLE IN A VILLAGE THE MORE THEY CUT	51.9%	48.1%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.4.2 'The more the people in a village the more they cut down the local trees for firewood'

This item was drafted to assess pupils' perception of the impact of rising human population on the conservation of resources, particularly local tree resources. The logic for including this item was to examine pupils' awareness of ecosystem resource depleting effects of expanding population. An analytical study on household energy sources and utilization technologies undertaken in Kiambu and Murang'a counties concluded that wood fuel supply sources were decreasing and that there was need to integrate its production with the local farming systems as the agricultural sector has the potential to play a key role in sustainable wood fuel production (Githiomi *et al*, 2012)

Table 4.13 the findings show that 70.6% of the respondents agreed with the statement while 11% disagreed with it. That demonstrates a reasonable understanding of the impact of rising population on tree resources as a result of firewood collection.

Table 4.14 shows that of those that agreed with the statement, 50.5% were female and 49.5% were male. Out of all females 75% agreed with the statement compared to 67.1 % of the males. It would appear the two sexes showed a small difference in their understanding of effect of rising human population on tree resources at the local level. The slight edge in female understanding of the problem could be due to their role in collecting firewood which affords them first-hand experience of the impact of rising human population on local tree resources.

Chi-square test on association between sex and pupils' comprehension of environmental concepts infused in the secondary school curriculum did not produce significant results.

Regarding the connection between type of school and pupils' comprehension of environmental concepts infused in the school curriculum, Table 4.15 shows that the

respondents from rural schools were better at 80% compared to respondents from urban schools at 61.5% in their comprehension of the impact of rising human population on local tree resources. In interpretation of SPSS cross tabulated data, if differences in column percentages are equal to or larger than ten per cent (10%) in any category of the dependent variable (ignoring rows or columns with less than ten (10) subjects), then we conclude that there is a relationship (Orodho, 2009: 45; Curwin and Slater, 2007: 334-348; Kothari, 2004: 147 http://hmdc.harvard.edu/projects/SPSS). However, this does not indicate the degree of relationship between the two variables under study. The chi-square test results showed χ^2 (2, 0.05) =7.22 (critical), asymp. Sig =.014 and calculated chis square (χ^2) = 8.560. The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, obtainable from tables, bearing in mind the .05 level of significance (Orodho, 2009; Curwin &Slater, 2007; Kothari, 2004). Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by type of school or school environment' was rejected at .05 level of confidence and the corresponding H_A accepted.

In Africa over 90% of the rural population obtains its cooking and heating energy from wood and brush. The figure for Kenya being 87% (Agyei,1998; http://www.scienceinafrica.co.za/2006/april/wood.htm). Kenya's population growth rate was about 3% (GoK, 1999). This implies there is a growing demand for firewood in the country. During data collection it was observed that most schools in the rural areas use firewood to prepare meals for the pupils. Perhaps this is the one reason that makes the rural pupils more aware of the relationship between population growth and tree depletion

4.5 Capacity of Technology to Address Environmental Problems

While we may continue to depend on the capacity of technology to address environmental problems, we must accept that it is hardly sufficient to solve our all our environmental problems. This could be due to limitations of affordability, accessibility and technical expertise. (http://cjcpig.wordpress.com/2011/10/26/how-far-can-we-depend-on-science-and-technology-to-solve-our-environmental-problems retrieved 03/06/2012).

4.5.1 Capacity of Technology to Sort out Food Security Problem

The variable 'man does not have to worry about food security because biotechnology and genetic modification will always help us to develop better crops that will produce sufficient food' was developed to assess pupils' awareness and confidence in technology to sort out the issue of food security. The reason for including this variable is that rising human population and environmental degradation have a negative impact on food security. The pupils' responses would therefore reflect their understanding on the capacity of technology to effectively address the food security problem.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?

iii. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?

iv. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 96.4% and a response rate of 99.2%

Table 4.16: Pupils' responses to 'man does not have to worry about food security because biotechnology and genetic modification will always help us to develop better crops that will produce sufficient food'

	Frequency	Percentage	
DISAGREED	91	66.9	
NEUTRAL	18	13.2	
AGREED	26	19.1	
Mean			2.518519
Std Deviation			0.799737
N	135	99.2	

The large standard deviation appears to have indicated lack of consensus among the respondents on the capacity of technology to resolve food the security challenge.

Table 4.17: Pupils' responses to 'man does not have to worry about food security because biotechnology and genetic modification will always help us to develop better crops that will produce sufficient food'

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
MAN DOES NOT HAVE TO WORRY ABOUT FOOD SECURITY	DISAGREE	Count	50	40	90
		% within MAN NOT WORRY ABOUT FOOD SECURITY	55.6%	44.4%	100.0%
		% within SEX OF RESPONDENT	71.4%	62.5%	67.2%
	NEUTRAL	Count	12	6	18
		% within MAN NOT WORRY ABOUT FOOD SECURITY	66.7%	33.3%	100.0%
		% within SEX OF RESPONDENT	17.1%	9.4%	13.4%
	AGREE	Count	8	18	26
		% within MAN NOT WORRY ABOUT FOOD SECURITY	30.8%	69.2%	100.0%
		% within SEX OF RESPONDENT	11.4%	28.1%	19.4%
Total		Count	70	64	134
		% within MAN NOT WORRY ABOUT FOOD SECURITY	52.2%	47.8%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.18: Pupils' responses to 'man does not have to worry about food security because biotechnology and genetic modification will always help us to develop better crops that will produce sufficient food' cross tabulated with type of school

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
MAN DOES NOT HAVE TO WORRY ABOUT FOOD SECURITY	DISAGREE	Count	46	45	91
		% within MAN NOT WORRY ABOUT FOOD SECURITY	50.5%	49.5%	100.0%
		% within TYPE OF SCHOOL	66.7%	68.2%	67.4%
	NEUTRAL	Count	8	10	18
		% within MAN NOT WORRY ABOUT FOOD SECURITY	44.4%	55.6%	100.0%
		% within TYPE OF SCHOOL	11.6%	15.2%	13.3%
	AGREE	Count	15	11	26
		% within MAN NOT WORRY ABOUT FOOD SECURITY	57.7%	42.3%	100.0%
		% within TYPE OF SCHOOL	21.7%	16.7%	19.3%
Total		Count	69	66	135
		% within MAN NOT WORRY ABOUT FOOD SECURITY	51.1%	48.9%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.5.2 'Man does not have to worry about food insecurity because biotechnology and genetic modification will always help us to develop better crops that will produce sufficient food'

This item was designed to assess pupils' perception concerning the capacity of current technology to take care of food security. The rationale for this item was that pupils' responses would be a reflection of their faith, or otherwise, in bio-agricultural technology to sort out the food insecurity problem

From Table 4.16 that 66.9 per cent of the pupils disagreed with the statement would seem to indicate that a majority of them do not consider biotechnology to be able the tackle the problem of food insecurity in Kenya and even globally.

In Table 4.17 fifty six point six per cent (55.6) of the boys and forty four point four (44.4) per cent of the girls disagreed with the statement. The results appear to suggest that the girls were more persuaded about the ability of technology to sort out environmental problems like food insecurity facing mankind, without considering some of the possible challenges like cultural, moral acceptability and perceived risks of the products of biotechnology, Genetically Modified Organisms (GMOs), being a typical example of technology going against the wishes, expectations and preferences of the consumer (George et al, 2000). Not much research has been done in Kenya and Africa about the impact of GMOs on Kenya's agriculture and the ecosystems generally. Nevertheless there are moral, safety and consumer education issues that need to be addressed (WHO, 2011).

The chi-square test results showed $\chi^2(2, \quad 0.05) = 8.60$ (critical), asymp. Sig =.035 and calculated chis square (χ^2) = 6.702, $p \leq .05$

The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, obtainable from tables, bearing in mind the .05 level of significance, a condition that was met in this case. Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by sex' was rejected at .05 level of confidence and the corresponding H_A accepted.

From Table 4.18 on the connection between type of school, that is rural or urban, and pupils' comprehension of environmental concepts infused in the school curriculum, 50.5 % of the respondents from rural schools and 49.5% of the respondents from urban schools disagreed with the statement. This shows that pupils from both rural and urban schools are more or less at par in their persuasion that technology can solve the problem of food insecurity globally.

Chi-square test on association between the school environment and pupils' comprehension of environmental concepts infused in the secondary school curriculum did not produce significant results.

4.5.3 Capacity of technology to address difficult human and veterinary diseases

The variable 'we should not bother about cures for difficult crop animal and human diseases like HIV/AIDS since technology will always help us discover cures' was developed to assess pupils' awareness and confidence in technology to sort out the issue of emerging human and veterinary diseases that are a serious threat to human survival. The reason for including this variable is that climate variation or change could engender the emergence of difficult human and veterinary diseases that again are a threat to human survival. The pupils' responses would therefore reflect their

understanding of the capacity of technology to effectively address both human and animal health challenges.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?

iii. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?

iv. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 96.4% and a response rate of 99.3%

Table 4.19: Pupils' responses to 'we should not bother about cures for difficult crop animal and human diseases like HIV/AIDS since technology will always help us discover cures'

	Frequency	Percentage	
DISAGREED	119	87.5	
NEUTRAL	6	4.4	
AGREED	10	7.4	
Mean			2.518519
Std Deviation			0.799737
N	135	99.3	

Although this statement is made in the reverse, the mean and the standard deviation values reflect a moderate understanding of the underlying issues.

Table 4.20: Pupils' responses to ' we should not bother about cures for difficult crop animal and human diseases like HIV/AIDS since technology will always help us discover cures'

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
WE SHOULD NOT BOTHER ABOUT CURES FOR DIFFICULT CROP	DISAGREE	Count	63	55	118
		% within NO BOTHER ABOUT CURES	53.4%	46.6%	100.0%
		% within SEX OF RESPONDENT	90.0%	85.9%	88.1%
	NEUTRAL	Count	2	4	6
		% within NO BOTHER ABOUT CURES	33.3%	66.7%	100.0%
		% within SEX OF RESPONDENT	2.9%	6.2%	4.5%
	AGREE	Count	5	5	10
		% within NO BOTHER ABOUT CURES	50.0%	50.0%	100.0%
		% within SEX OF RESPONDENT	7.1%	7.8%	7.5%
Total		Count	70	64	134
		% within NO BOTHER ABOUT CURES	52.2%	47.8%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.21: Pupils' responses to ' we should not bother about cures for difficult crop animal and human diseases like HIV/AIDS since technology will always help us discover cures'

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
WE SHOULD NOT BOTHER ABOUT CURES FOR DIFFICULT CROP	DISAGREE	Count	60	59	119
		% within NOT BOTHER ABOUT CURES	50.4%	49.6%	100.0%
		% within TYPE OF SCHOOL	85.7%	90.8%	88.1%
	NEUTRAL	Count	4	2	6
		% within NOT BOTHER ABOUT CURES	66.7%	33.3%	100.0%
		% within TYPE OF SCHOOL	5.7%	3.1%	4.4%
	AGREE	Count	6	4	10
		% within NOT BOTHER ABOUT CURES	60.0%	40.0%	100.0%
		% within TYPE OF SCHOOL	8.6%	6.2%	7.4%
Total		Count	70	65	135
		% within NOT BOTHER ABOUT CURES	51.9%	48.1%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.5.4 'We should not bother about cures for difficult crop, animal and human diseases like HIV/AIDS since technology will always help us discover cures'

This item was designed to assess pupils' perception and confidence concerning the capacity of current technology to manage human, crop and animal diseases including those without cure like HIV/AIDS. The logic for the inclusion of this item was that the pupils' responses would mirror their belief in the capacity of technology to sort out complex environmental problem. From Table 4.19 Eighty seven point five per cent (87.5%) of the respondents disagreed with the statement while 7.3% agreed with it. It would appear the majority have no faith in the capacity of technology to sort out or manage the health problems stated above. It should be noted from the mean of 2.5 and standard deviation of 0.8 that answers given by the respondents varied widely as provided in Table 4.31. From Table 4.20 fifty five point six per cent (50.6%) of the male respondents and forty four point four per cent (44.4%) of the female respondents disagreed with the statement. It seems the females have a little more confidence in the ability of technology to manage the problems of crop, livestock and human diseases. Chi-square test on association between sex and pupils' comprehension of environmental concepts infused in the secondary school curriculum did not produce significant results.

For the connection between type of school and pupils' comprehension of environmental concepts infused in the school curriculum, Table 4.21 shows that the respondents from rural schools were 50.5% compared to respondents from urban schools at 49.5% in their disagreement with the statement. This is a reflection of parity in the responses. Chi-square test on association between the school environment and pupils' comprehension of environmental concepts infused in the

secondary school curriculum did not produce significant results for the item under consideration.

The current mechanistic, reductionist science is inherently incapable of providing the complex and accurate information required to successfully address environmental problems. Hence environmental science and technology have only very limited potential in solving current and future environmental problems. Consequently it will be necessary to address the root cause of environmental deterioration, namely, the prevailing materialistic values that are the main driving force for both overpopulation and overconsumption. The long term protection of the environment is, therefore, not a technical problem but rather a social and ethical problem that can only be solved by drastically reducing the strong influence of materialistic and hedonistic values (Huesemann, 2001; Zelenzy & Shultz 2000).

4.6 Ecological stability

One of the most striking features of the earth's biota is its extraordinary diversity, estimated at 10 million different species. Among the most conspicuous aspects of contemporary global change is the rapid decline of this diversity in many ecosystems. The decline is not limited to increased rates of species extinction, but includes losses in genetic and functional diversity across population, community, ecosystem, landscape and global scales. The term 'biodiversity' refers collectively to all these aspects of biotic diversity. The wide-ranging decline in biodiversity results from habitat modification and destruction, overexploitation and other anthropogenic (human caused) impacts. Loss of biodiversity may impact negatively on a number of ecosystem functions; plant production, ecosystem resistance to environmental

perturbation such as drought, ecosystem processes like nitrogen levels, water use and pest disease cycles among others (Naeem *et al.*, 1999; Ives & Carpenter, 2007).

4.6.1 Ecological stability and environmental sustainability

The variable 'pollinating animals like bees, butterflies and bats are not important in the balance of nature' was developed from Secondary School Syllabus form three biology section on concepts of ecology (KIE, 2002). The reason for using the item was to determine pupils' perception of the value of biodiversity, interdependence, ecological stability and environmental sustainability. Pupils' responses would therefore be a reflection of their understanding of the importance of the diversity of life forms in an ecosystem. The relevant theme for this variable is 'Ecological stability and environmental sustainability'

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?
ii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?
iii. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?
iv. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to

determine association between sex and type of school respectively with perception.

This item realized a return rate of 96.4% and a response rate of 100%

Table 4.22: Pupils' responses to 'pollinating animals like bees, butterflies and bats are not important in the balance of nature'

	Frequency	Percentage	
DISAGREED	115	84.6	
NEUTRAL	7	5.1	
AGREED	14	10.3	
Mean			2.257353
Std Deviation			0.632412
N	136	100.0	

Since the statement is made in the negative a low mean value is indicative of a higher appreciation of the value of pollinating animals to the balance of nature.

Table 4.23: Pupils' responses to 'pollinating animals like bees, butterflies and bats are not important in the balance of nature' cross tabulated with sex of respondent

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
POLLINATING ANIMALS ARE NOT IMPORT IN THE BAL OF NATU	DISAGREE	Count	64	50	114
		% within POLLINATING ANIMALS NOT IMPORT IN THE BAL OF NATU	56.1%	43.9%	100.0%
		% within SEX OF RESPONDENT	91.4%	76.9%	84.4%
	NEUTRAL	Count	1	6	7
		% within POLLINATING ANIMALS NOT IMPORT IN THE BAL OF NATU	14.3%	85.7%	100.0%
		% within SEX OF RESPONDENT	1.4%	9.2%	5.2%
	AGREE	Count	5	9	14
		% within POLLINATING ANIMALS..	35.7%	64.3%	100.0%
		% within SEX OF RESPONDENT	7.1%	13.8%	10.4%
Total		Count	70	65	135
		% within POLLINATING ANIMALS.	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.24: Pupils' responses to 'pollinating animals like bees, butterflies and bats are not important in the balance of nature'

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
POLLINATING ANIMALS ARE NOT IMPORT IN THE BAL OF NATU	DISAGREE	Count	61	54	115
		% within POLLINATING ANIMALS NOT..	53.0%	47.0%	100.0%
		% within TYPE OF SCHOOL	87.1%	81.8%	84.6%
	NEUTRAL	Count	1	6	7
		% within POLLINATING ANIMALS NOT..	14.3%	85.7%	100.0%
		% within TYPE OF SCHOOL	1.4%	9.1%	5.1%
	AGREE	Count	8	6	14
		% within POLLINATING ANIMALS NOT..	57.1%	42.9%	100.0%
		% within TYPE OF SCHOOL	11.4%	9.1%	10.3%
Total		Count	70	66	136
		% within POLLINATING ANIMALS NOT.. I	51.5%	48.5%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.6.2 'Pollinating animals like bees, butterflies and bats are not important in the balance of nature'

The item was designed to test pupils' understanding of interrelationships in an ecosystem. The rationale for this item was that pupils' responses would be a reflection of their awareness of the value of biodiversity in a functioning ecosystem. Table 4.22 gives the proportion of respondents who disagreed with the statement as 84.6%. Those who agreed with the statement were 10.3%. This appears to indicate a large majority of the respondents regard pollinating animals as important to ecosystem functioning or the balance of nature. From Table 4.22 again, the mean value of 2.26 for the sample would indicate that the level of environmental awareness of the sample is moderate, bearing in mind that this statement was based on topics covered under ecology in form three. It could also be generalized to cover the wider population of secondary school pupils' in the District and Machakos County as a whole. The relevant research question was 'what is the level of environmental awareness of secondary school pupils'. Considering the association between sex and pupils' understanding of the importance of pollinating animals to the balance of nature, From Table 4.23, sixty four per cent (64%) of the boys and 50% of the girls disagreed with the statement 'Pollinating animals like bees, butterflies and bats are not important in the balance of nature.

This item was designed to gauge understanding of interdependence among organisms and its contribution to ecological stability. This was derived from concepts of ecology that are infused in biology syllabus, Form Three. In interpretation of SPSS cross tabulated data, if differences in column percentages are equal to or larger than ten per cent (10%) in any category of the dependent variable (ignoring rows or columns with less than ten (10) subjects), the we conclude there is a relationship (Orodho, 2009;

Curwin and Slater, 2007; Kothari, 2004; http://hmdc.harvard.edu/projects/SPSS retrieved 15/4/2012). However this does not indicate the degree of relationship between the two variables under study.

This finding corroborates earlier studies on sex differential performance in the natural sciences. (Bell & Barker, 1982; Adeniyi, 1985; Twoli, 1986). These researchers found the performance of girls to be lower than that of boys in the natural sciences due to a number of factors, including girls' tendency to avoid tackling problems that require exploring a diversity of difficult solutions, socio cultural environments and societal expectations (Orodho, 1996; Jegede & Okebukola, Jha & Kelleher, 2006). The pupils' overall responses to this item indicate their moderate level of understanding of the inter connectedness of life in a stable ecosystem. The chi-square test results showed χ^2 (2, 0.05) =3.37 (critical), asymp. Sig =.044 and calculated chis square (χ^2) = 6.257

The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, obtainable from tables, bearing in mind the .05 level of significance for the item under consideration. Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by sex' was rejected at .05 level of confidence and the corresponding H_{A1} accepted.

From Table 4.24, on the connection between type of school, that is rural or urban, and pupils' comprehension of environmental concepts infused in the school curriculum, 53.0% of the respondents from rural schools and 47.0% of the respondents from urban schools disagreed with the statement. This shows that the pupils in rural schools had a slightly better understanding of the importance of pollinating animals to the ecosystem. Chi-square test on association between type of

school or the school environment and pupils' comprehension of environmental concepts infused in the secondary school curriculum did not produce significant results.

4.6.3 Composition of a Sustainable Forest Reserve

The item 'a sustainable forest reserve should have many species of trees, shrubs, herbs and grasses among others' was developed from Secondary School Syllabus form three biology section on concepts of ecology (KIE, 2002). The reason for using the item was to determine pupils' perception of the value of biodiversity and interdependence in an ecosystem. Pupils' responses would therefore be a reflection of their understanding of the importance of biodiversity in a normally functioning ecosystem. The relevant theme addressed by this variable is 'Ecological stability and environmental sustainability'

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?
ii. Is there a significant difference in the understanding of the environmental concepts between boys and girls?
iii. Is there a difference in the understanding of environmental concepts infused in the secondary school curriculum between pupils in rural and those in urban schools?
iv. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to

determine association between sex and type of school respectively with perception. This item realized a return rate of 95.7% and a response rate of 98.5 at N=134.

Table 4.25: Pupils' responses to 'a sustainable forest reserve should have many species of trees, shrubs, herbs and grasses among others'

	Frequency	Percentage	
DISAGREED	11	8.1	
NEUTRAL	15	11.0	
AGREED	108	79.4	
Mean			3.723881
Std Deviation			0.605635
N	134	98.5	

It appears from the high mean value there was some appreciation of the value of species diversity in sustainability of a forest reserve. The small standard deviation is a show of consensus of the appreciation.

Table 4.26: Pupils' responses to ' a sustainable forest reserve should have many species of trees, shrubs, herbs and grasses among others

Cross tab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
A SUSTAINABLE FOREST RES SHOULD HAVE MANY SPECIES	DISAGREE	Count	7	4	11
		% within A SUSTAINABLE FOREST MANY SPECIES	63.6%	36.4%	100.0%
		% within TYPE OF SCHOOL	10.1%	6.2%	8.2%
	NEUTRAL	Count	3	12	15
		% within A SUSTAINABLE FOREST MANY SPECIES	20.0%	80.0%	100.0%
		% within TYPE OF SCHOOL	4.3%	18.5%	11.2%
	AGREE	Count	59	49	108
		% within A SUSTAINABLE FOREST MANY SPECIES	54.6%	45.4%	100.0%
		% within TYPE OF SCHOOL	85.5%	75.4%	80.6%
Total		Count	69	65	134
		% within A SUSTAINABLE FOREST MANY SPECIES	51.5%	48.5%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

Table 4.27: Pupils' responses to ' a sustainable forest reserve should have many species of trees, shrubs, herbs and grasses among others cross tabulated with sex of respondent

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
A SUSTAINABLE FOREST RES SHOULD HAVE MANY SPECIES	DISAGREE	Count	8	3	11
		% within A SUSTAINABLE FOREST MANY SPECIES	72.7%	27.3%	100.0%
		% within SEX OF RESPONDENT	11.6%	4.7%	8.3%
	NEUTRAL	Count	10	5	15
		% within A SUSTAINABLE FOREST MANY SPECIES	66.7%	33.3%	100.0%
		% within SEX OF RESPONDENT	14.5%	7.8%	11.3%
	AGREE	Count	51	56	107
		% within A SUSTAINABLE FOREST MANY SPECIES	47.7%	52.3%	100.0%
		% within SEX OF RESPONDENT	73.9%	87.5%	80.5%
Total		Count	69	64	133
		% within A SUSTAINABLE FOREST RES SHOULD HAVE MANY SPECIES	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

4.6.4 'A sustainable forest reserve should have many species of trees, shrubs, herbs and grasses among others'

This statement was devised to determine pupils' understanding of the concept of biodiversity and its relevance to sustainability as given in the geography and biology syllabuses for secondary schools. The logic for this item is that pupils' responses will mirror how they value, or otherwise, the conservation of ecosystem resources especially bio-diversity. From Table 4.25 those who agreed with the statement made up 79.4% of the respondents. Eight point one per cent (8.1%) of the respondents disagreed with the statement. This would reflect a good understanding of the concepts of biodiversity and sustainability and also their relevance to the management of forest resources. Table 4.26 Shows that of those that agreed with the statement 52.3% were female and 47.7% were male. Of all females 87.5% agreed with the statement compared to 73.9 % of all the males. It would appear the females were slightly better than the males in their comprehension of the necessary requirements for a sustainable forest reserve. The slight edge in female understanding of the problem could be due to their role in collecting firewood which affords them first-hand experience on the composition of sustainable wood lots or tree resources. The relevant research question is 'Is there a significant difference in the understanding of environmental concepts between boys and girls?' As for the association between sex and pupils' understanding of the necessary composition of a sustainable forest reserve or forest resources, chi-square test on association between sex and pupils' comprehension of environmental concepts infused in the secondary school curriculum did not produce significant results. Further, from Table 4.27 on the connection between type of school, that is rural or urban, and pupils' comprehension of environmental concepts infused in the school curriculum , 54.6 % of the respondents from rural schools and

45.4% of the respondents from urban schools agreed with the statement. Within the rural respondents 85.5% agreed with the statement, and within the urban respondents 75.4% of the respondents agreed. This appears show to that pupils in rural schools had a slightly better understanding of the necessary composition for a sustainable forest reserve. The relevant research question was 'Is there a difference in the understanding of environmental concepts infused in the school curriculum between pupils in rural and those in urban schools?' The chi-square test results showed χ^2 (2, 0.05) =5.34 (critical), asymp. Sig =.030 and calculated chis square (χ^2) = 7.031. The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, obtainable from tables, bearing in mind the .05 level of significance for the item under consideration. Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by type of school or school environment' was rejected at .05 level of confidence and the corresponding H_A accepted.

The rural based respondents are constantly exposed to the reality of using wood fuel to prepare meals both at school and at homes. They also observe the depletion of tree cover resulting from gathering of fire wood. The environment exerts its influence on behaviour by affecting our thoughts. Learning experiences and the environment affect our behaviour by giving us the information we need to behave effectively (Bandura, 1977; Passer & Smith, 2001)

4.7 Youth Attitude and Involvement in Environmental Matters

To protect and conserve the environment calls for a radical change in the way we think, live and work. Environmental Education has the potential to bring about the necessary change of attitude among young people so as to advance toward sustainable

living (Larijani, 2010). Sustainable development is about the interface between human society and the environment. A sustainable future would not be possible without integrating three basic issues of sustainability into our lives; Production, distribution and consumption. It may not be easy to change lifestyles and consumption patterns for the youth in developing countries where highly brilliant marketing techniques by multinationals run the show (Tuncer et al., 2005). In Kenya one of the National Goals of Education seeks to ' ... foster positive attitudes towards environmental development and conservation. It should lead the youth to appreciate the need for a healthy environment (KIE, 2002)'.

4.7.1 Youth Involvement in Clean-Up Activities

The variable 'young people should take part in clean-up activities, for example removing plastic materials from their market centre and dumping them appropriately' was developed to assess pupils' perceptions and actions 'in' and 'for' the welfare of the environment. The rationale for the inclusion of this item was that the pupils' responses would be a reflection of their attitude toward the environment. Again, their attitude would be a reflection of the effects of the environmental management concepts infused in the school curriculum to which they have been exposed. The relevant theme addressed by this variable is 'Youth attitude and involvement in addressing environmental issues'.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they

undertake at both the school and community levels to improve their environment?

iii. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 97.1% and a response rate of 100% at N= 136

Table 4.28: Pupils' responses to 'young people should take part in clean-up activities, for example removing plastic materials from their market centre and dumping them appropriately'

	Frequency	Percentage	
DISAGREED	3	2.2	
NEUTRAL	5	3.7	
AGREED	128	94.1	
Mean			4.595588
Std Deviation			0.670861
N	136	100.0	

The small standard deviation appears to have indicated pervasive appreciation of youth involvement in clean-up activities.

Table 4.29: Pupils' responses to 'young people should take part in clean-up activities, for example removing plastic materials from their market centre and dumping them appropriately'

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
YOUNG PEOLPE SHOULD TAKE PART IN CLEAN-UP ACTIVITIES	DISAGREE	Count	2	1	3
		% within YOUNG PEOPLE CLEAN-UP ACTIVITIES	66.7%	33.3%	100.0%
		% within SEX OF RESPONDENT	2.9%	1.5%	2.2%
	NEUTRAL	Count	4	1	5
		% within YOUNG PEOPLE CLEAN-UP ACTIVITIES	80.0%	20.0%	100.0%
		% within SEX OF RESPONDENT	5.7%	1.5%	3.7%
	AGREE	Count	64	63	127
		% within YOUNG PEOLPE CLEAN-UP ACTIVITIES	50.4%	49.6%	100.0%
		% within SEX OF RESPONDENT	91.4%	96.9%	94.1%
Total		Count	70	65	135
		% within YOUNG PEOLPE CLEAN-UP ACTIVITIES	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.30: Analysis of pupils' responses to 'Young people should take part in clean-up activities, for example removing plastic materials from their market centre and dumping them appropriately'

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
YOUNG PEOLPE SHOULD TAKE PART IN CLEAN-UP ACTIVITIES	DISAGREE	Count	2	1	3
		% within YOUNG PEOPLE CLEAN-UP ACTIVITIES	66.7%	33.3%	100.0%
		% within TYPE OF SCHOOL	2.9%	1.5%	2.2%
	NEUTRAL	Count	3	2	5
		% within YOUNG PEOPLE CLEAN-UP ACTIVITIES	60.0%	40.0%	100.0%
		% within TYPE OF SCHOOL	4.3%	3.0%	3.7%
	AGREE	Count	65	63	128
		% within YOUNG PEOPLE CLEAN-UP ACTIVITIES	50.8%	49.2%	100.0%
		% within TYPE OF SCHOOL	92.9%	95.5%	94.1%
Total		Count	70	66	136
		% within YOUNG PEOLPE CLEAN-UP ACTIVITIES	51.5%	48.5%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.7.2 Young people should take part in clean-up activities for example removing plastic materials from their market centre and dumping them appropriately

The item was devised to assess and determine pupils' attitude, application of knowledge and participation in activities for the good of the environment. The ground for using this item is that the popular response will be a reflection of the dominant attitude of the pupils toward keeping their surroundings clean.

The figures in Table 4.28 show that 94.1% of the respondents agreed with the statement while 2.2% disagreed. From Table 4.46 again the mean value of 4.6 and a standard deviation value of 0.6 reflected a very good attitude among the majority of the respondents considering the small dispersion of values around the mean. (The coding definition was:- strongly agreed=5, agreed=4, neutral=3, disagreed=2,strongly disagreed=1). The relevant research question was 'What influence does pupils' perception of environmental concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?' From Table 4.29 Fifty point four per cent (50.4%) of the respondents who agreed with the statement were male while forty nine point six per cent(49.6%) were female. Out of all female respondents 96.9% agreed with the statement compared to 91.4% of all males in the sample who agreed with the statement it seems the females had a slightly better attitude to the welfare of their environment. Chi-square test on association between sex and pupils' attitude toward the welfare of the environment did not produce significant results. From Table 4.30 on the connection between type of school, that is rural or urban, and pupils' attitude to the welfare of the environment, fifty point eight per cent(50.8%) respondents were from rural schools and forty nine point two per cent (49.2%) were from urban schools. Within type of school, 92.9% of the respondents from rural schools, and 95.5% of the respondents from urban schools agreed with the statement. This shows that pupils

from both rural and urban schools are almost at par in their attitude to the welfare of the environment.

Chi-square test on association between type of school or the school environment and pupils' attitude toward the welfare of the environment did not produce significant results. A study on youth attitude and development conducted in Ankara, Turkey, concluded that one way to equip young people in the area of environmental concern and sustainable development is through more effective environmental education (Tuncer et al., 2005).

4.7.3 Youth Involvement in Celebrating World Environment Day

The item 'the youth should be involved in celebrating events like World Environment Day' was developed to assess pupils' perceptions and actions in and for the welfare of the environment. The rationale for the inclusion of this item was that it would be a reflection of pupils' attitude toward their environment. Their attitude would be a reflection of the effects of the environmental management concepts infused in the school curriculum to which they have been exposed. The relevant theme addressed by this variable is 'Youth attitude and involvement in addressing environmental issues'.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?

iii. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 97.1% and a response rate of 100%

Table 4.31: Analysis of pupils' responses to 'the youth should be involved in celebrating events like World Environment Day'

	Frequency	Percentage	
DISAGREED	1	.7	
NEUTRAL	3	2.2	
AGREED	132	97.1	
Mean			3.963235
Std. Deviation			0.2247
N	136	100.0	

The very small standard deviation seems to imply near total consensus in appreciation of youth participation on World Environment Day and the attendant advocacy value associated with it.

Table 4.32: Analysis of 'the youth should be involved in celebrating events like World Environment Day'

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
THE YOUTH SHOULD BE INVOLVED IN CELEBRATING EVENTS	DISAGREE	Count	0	1	1
		% within THE YOUTH CELEBRATING EVENTS	.0%	100.0%	100.0%
		% within SEX OF RESPONDENT	.0%	1.5%	.7%
	NEUTRAL	Count	2	1	3
		% within THE YOUTH CELEBRATING EVENTS	66.7%	33.3%	100.0%
		% within SEX OF RESPONDENT	2.9%	1.5%	2.2%
	AGREE	Count	68	63	131
		% within THE YOUTH CELEBRATING EVENTS	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	97.1%	96.9%	97.0%
Total		Count	70	65	135
		% within THE YOUTH CELEBRATING EVENTS	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.33: Pupils' responses to 'the youth should be involved in celebrating events like World Environment Day'

Crosstab`

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
YOUNG PEOPLE SHOULD BE INVOLVED IN CELEBRATING EVENTS	DISAGREE	Count	0	1	1
		% within YOUTH SHOULD BE INVOLVED IN CELEBRATING EVENTS	.0%	100%	100.0%
		% within TYPE OF SCHOOL	.0%	1.5%	.7%
	NEUTRAL	Count	3	0	3
		% within YOUTH SHOULD BE INVOLVED IN CELEBRATING EVENTS	100%	.0%	100.0%
		% within TYPE OF SCHOOL	4.3%	.0%	2.2%
	AGREE	Count	67	65	132
		% within YOUTH SHOULD BE CELEBRATING EVENTS	50.8%	49.2%	100.0%
		% within TYPE OF SCHOOL	95.7%	98.5%	97.1%
Total		Count	70	66	136
		% within YOUTH SHOULD BE CELEBRATING EVENTS	51.5%	48.5%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.7.4 The youth should be involved in celebrating events like World Environment Day

The item was devised to assess and determine pupils' attitude, participation in and advocacy activities for the good of the environment. The basis for this item being that pupils' responses would mirror their attitude, conviction and commitment to the welfare of the environment for their present and the future.

The figures in Table 4.31 show that 97.1% of all respondents agreed with the statement. Only .1% disagreed. This is a reflection of positive attitude towards making a show for and promoting the welfare of the environment. Table 4.51 again provides a mean value of 3.9 and a standard deviation of .2 indicating a small dispersion of values around the mean which demonstrates a very positive attitude among the respondents. (The coding definition was; strongly agreed=5, agreed=4, neutral=3, disagreed=2,strongly disagreed=1) The relevant research question was 'What influence does pupils' perception of environmental concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?'

From Table 4.32 Fifty point four per cent (51.9%) of the respondents who agreed with the statement were male while forty nine point six per cent(48.1%) were female. Within female .respondents 96.9% agreed with the statement., compared to 97.1% of all males in the sample who agreed with the statement. It would appear the two sexes are almost at equal footing in their attitude towards advocating for the welfare of the environment. The relevant research question was 'What influence does pupils' perceptions of environmental concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment.

Chi-square test on association between sex and pupils' attitude toward the welfare of the environment did not produce significant results.

From Table 4.33 on the connection between type of school, that is rural or urban, and pupils' attitude to the welfare of the environmental , 95.7% of the respondents from rural schools and 98.5% of the respondents from urban schools agreed with the statement. This shows that pupils from both rural and urban schools are almost at par in their attitude to the welfare of the environment.

Chi-square test on association between type of school or the school environment and pupils' attitude toward the welfare of the environment did not produce significant results.

The principles of sustainable development clearly demand that the simultaneous achievement of environmental, social and economic goals should meet the needs of the present generation without compromising those of future generations. The youth have a special interest in those goals since they are the future contributors, decision makers and citizens of the world. The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve a sustainable development and ensure a better future for all (Malone, 2001; Tuncer et al. 2005)

4.7.5 Youth involvement in presenting and reciting poems on World Environment Day

The item 'the youth should present and recite poems about the environment on World Environment Day' was developed to assess pupils' perceptions and actions in and for the welfare of the environment. The rationale for the inclusion of this item was that it would be a reflection of pupils' attitude toward their environment. Their attitude

would be a reflection of the effects of environmental management concepts infused in the school curriculum to which they have been exposed. The relevant theme addressed by this variable is 'Youth attitude and involvement in addressing environmental issues'.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?

iii. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 96.4% and a response rate of 99.3%.

Table 4.34: Pupils' responses to 'the youth should present and recite poems about the environment on World Environment Day'

	Frequency	Percentage	
DISAGREED	2	1.5	
NEUTRAL	6	4.4	
AGREED	127	93.4	
Mean			3.925926
Std. Deviation			0.314563
N	135	99.3	

The high mean value and the small standard deviation seems to reflect a high appreciation of youth involvement in environmental advocacy.

Table 4.35: Analysis of pupils' responses to 'the youth should present and recite poems about the environment on World Environment Day'

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
THE YOUTH SHOULD PRESENT AND RECITE POEMS	DISAGREE	Count	1	1	2
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	50.0%	50.0%	100.0 %
		% within SEX OF RESPONDENT	1.4%	1.5%	1.5%
	NEUTRAL	Count	4	2	6
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	66.7%	33.3%	100.0 %
		% within SEX OF RESPONDENT	5.8%	3.1%	4.5%
	AGREE	Count	64	62	126
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	50.8%	49.2%	100.0 %
		% within SEX OF RESPONDENT	92.8%	95.4%	94.0%
Total		Count	69	65	134
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	51.5%	48.5%	100.0 %
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0 %

Table 4.36: Pupils' responses to 'the youth should present and recite poems about the environment on World Environment Day

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
THE YOUTH SHOULD PRESENT AND RECITE POEMS	DISAGRE	Count	0	2	2
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	.0%	100.0%	100.0%
		% within TYPE OF SCHOOL	.0%	3.0%	1.5%
	NEUTRAL	Count	1	5	6
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	16.7%	83.3%	100.0%
		% within TYPE OF SCHOOL	1.4%	7.6%	4.4%
	AGREE	Count	68	59	127
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	53.5%	46.5%	100.0%
		% within TYPE OF SCHOOL	98.6%	89.4%	94.1%
Total		Count	69	66	135
		% within THE YOUTH SHOULD PRESENT AND RECITE POEMS	51.1%	48.9%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.7.6 The youth should present and recite poems about the environment on World Environment Day

This item was devised to determine pupils' attitude towards creating and presenting poems to advocate for and enhance the welfare of the environment. The basis for this item is that the pupils' responses will reflect motivation creativity and involvement potential in sharing their concerns for the welfare of the environment from an informed position.

The figures in Table 4.34 show that 93.4% of all respondents agreed with the statement. Only 1.5% disagreed. This is a reflection of positive attitude towards creating information, communicating the same widely and making a show for and promoting the welfare of the environment. Table 4.56 provides a mean value of 3.9 and a standard deviation of 0.3 indicating a small dispersion of values around the mean which seems to demonstrate a very positive attitude among the respondents. (The Likert Scale coding definition was: - strongly agreed=5, agreed=4, neutral=3, disagreed=2, strongly disagreed=1) The relevant research question was 'What influence does pupils' perception of environmental concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?' From Table 4.35 fifty point four per cent (50.8%) of the respondents who agreed with the statement were male while forty nine point six per cent(49.2%) were female. Out of all female .respondents 95.4% agreed with the statement., compared to 92.8% of all males in the sample who agreed with the statement it seems the females had a slightly better attitude to the advocacy of the welfare of the environment. Chi-square test on association between sex and

pupils' attitude toward the welfare of the environment did not produce significant results.

From Table 4.36 on the connection between type of school, that is rural or urban, and pupils' attitude to the welfare of the environment, 53.5% of the respondents from rural schools and 46.5% of the respondents from urban schools agreed with the statement. Out of all respondents from rural schools 98.6% of them agreed with the statement., compared to 89.4% of all respondents from rural schools who agreed with the statement. It seems the respondents from rural schools had a better attitude towards the advocacy and enhancement of the welfare of the environment through the creation and recitation of poems for the environment. This appears to show that pupils from both rural and urban schools are not at par in their attitude to the welfare of the environment. Chi-square test on association between type of school or the school environment and pupils' attitude toward the welfare of the environment did not produce significant results.

Youth willingness to participate in celebrating the World Environment Day would be a consequence of an enabling environment; an effective education system that includes good teachers since in the formal education system teachers play a very significant role in developing greater awareness on the environment among pupils (Larijani, 2010).

4.7.7 Youth involvement in tree planting

The item 'young people should take part in planting trees at the local forest reserve and the local school on the national tree planting days' was developed to assess pupils' perceptions and actions in and for the welfare of the environment. The rationale for the inclusion of this item was that it would be a reflection of pupils' attitude toward their environment. Their attitude would be a reflection of the effects of environmental management concepts infused in the school curriculum to which they have been exposed. The relevant theme addressed by this variable is 'Youth attitude and involvement in addressing environmental issues'.

The research questions addressed by this theme are:-

i. What is the secondary school pupils' perception of the environmental concepts infused in the school curriculum?

ii. What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?

iii. What is the level of environmental awareness of secondary school pupils

To address the research questions for this theme three tables presenting different and increasingly insightful statistics are provided; starting with frequencies, percentages, cross tabulations with sex and type of school and chi-square tests to determine association between sex and type of school respectively with perception. This item realized a return rate of 97.1% and a response rate of 100%. For N=136

Table 4.37: Pupils' responses to 'young people should take part in planting trees at the local forest reserve and the local school on the national tree planting days'

	Frequency	Percentage	
DISAGREED	2	1.5	
NEUTRAL	7	5.1	
AGREED	127	93.4	
Mean			3.919118
Std Deviation			0.323297
N	136	100.0	

The high mean value and small standard deviation shows high appreciation of youth involvement in tree planting beyond the home level. The small standard deviation is a reflection of consensus on the need for youth involvement in tree planting

Table 4.38: Pupils' responses to 'young people should take part in planting trees at the local forest reserve and the local school on the national tree planting days'

Crosstab

			SEX OF RESPONDENT		
			MALE	FEMALE	Total
YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	DISAGREE	Count	0	2	2
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	.0%	100.0%	100.0%
		% within SEX OF RESPONDENT	.0%	3.1%	1.5%
	NEUTRAL	Count	4	3	7
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	57.1%	42.9%	100.0%
		% within SEX OF RESPONDENT	5.7%	4.6%	5.2%
	AGREE	Count	66	60	126
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	52.4%	47.6%	100.0%
		% within SEX OF RESPONDENT	94.3%	92.3%	93.3%
Total		Count	70	65	135
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	51.9%	48.1%	100.0%
		% within SEX OF RESPONDENT	100.0%	100.0%	100.0%

Table 4.39: Pupils' responses to 'young people should take part in planting trees at the local forest reserve and the local school on the national tree planting days'

Crosstab

			TYPE OF SCHOOL		
			RURAL	URBAN	Total
YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	DISAGREE	Count	1	1	2
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	50.0%	50.0%	100.0%
		% within TYPE OF SCHOOL	1.4%	1.5%	1.5%
	NEUTRAL	Count	6	1	7
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	85.7%	14.3%	100.0%
		% within TYPE OF SCHOOL	8.6%	1.5%	5.1%
	AGREE	Count	63	64	127
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	49.6%	50.4%	100.0%
		% within TYPE OF SCHOOL	90.0%	97.0%	93.4%
Total		Count	70	66	136
		% within YOUNG PEOLPE SHOULD TAKE PART IN PLANTING TREES	51.5%	48.5%	100.0%
		% within TYPE OF SCHOOL	100.0%	100.0%	100.0%

4.7.8 Young people should take part in planting trees at the local forest reserve and the local school on the national tree planting days

This item was delineated to determine pupils' attitude towards actual participation in activities that enhance the wellbeing of the environment and its resident human and non-human communities. The justification for this item is that the pupils' responses would be a good reflection of their status as participants in the environment for the welfare of the same. The figures in Table 4.37 show that 93.4% of all respondents agreed with the statement. Only 1.5% disagreed. This is a reflection of positive attitude towards creating a conducive environment to life generally and to humankind in particular. Table 4.37 again provides a mean value of 3.9 and a standard deviation of 0.3 indicating a small dispersion of values around the mean which appears to demonstrate a very positive attitude among the respondents. (The Likert Scale coding definition was:- strongly agreed=5, agreed=4, neutral=3, disagreed=2,strongly disagreed=1). The relevant research question was 'What influence does pupils' perception of environmental concepts infused in the school curriculum have on the activities the pupils' undertake at both the school and community levels to improve their environment?' From Table 4.38 Fifty two point four per cent (52.4%) of the respondents who agreed with the statement were male while forty seven point six per cent(47.6%) were female. Out of all female .respondents 92.3% agreed with the statement compared to 94.3% of all males in the sample who agreed with the statement it seems the males had a slightly better attitude to tree planting for the welfare of the environment. Chi-square test on association between sex and pupils' attitude toward the welfare of the environment did not produce significant results on this item.

From Table 4.39, on the connection between type of school, that is rural or urban, and pupils' attitude to the welfare of the environment, 49.6% of the respondents from rural schools and 50.4 % of the respondents from urban schools agreed with the statement. Out of all respondents from rural schools 90.0% of them agreed with the statement, compared to 97.0% of all respondents from urban schools who agreed with the statement. It seems the respondents from urban schools had a slightly better attitude towards the betterment of the environment by participating in tree planting. This shows that pupils from rural and urban schools are not exactly at par in their attitude to the welfare of the environment. Chi-square test on association between type of school or the school environment and pupils' attitude toward the welfare of the environment did not produce significant results.

4.8 Introduction to Teachers' Data

This study explored some school and teacher characteristics to try to determine the impediments experienced in teaching/learning environmental management concepts infused in the secondary school curriculum. Among the characteristics explored were sex, location of school (rural or urban), availability of teaching/learning resources, the subjects they (teachers) taught, their qualifications, views on the challenges they faced when preparing and teaching environmental management concepts and the support they received from the school managers or administrators. The relevant research question was 'What are the impediments to teaching/ learning environmental concepts in secondary schools?' Tables 4.40 to 4.55 and Figure 4.1 present teachers data, then a discussion of the same follows. However the main focus and source of data for this study was the secondary school pupils. Teachers' data only corroborates/ authenticates the findings on pupils.

Data for Teachers of Environmental Education

Table 4.40: Type of School

	Frequency	Percentage
RURAL	21	53.8
URBAN	18	46.2
TOTAL	39	100

Table 4.41: Sex of Respondent

	Frequency	Percentage
MALE	25	64.1
FEMALE	10	25.6
TOTAL	35	89.7

Table 4.42: Topics in Environmental Management clearly cover all ideas that Forms 3&4 pupils need to understand the effects of pollution on air, water, land and living things

	Frequency	Percentage	
DISAGREED	13	33.3	
NEUTRAL	1	2.6	
AGREED	25	64.1	
Mean			3.3077
Std Deviation			0.95018
N	39	100.0	

Table 4.43: The topics in Environmental Management cover well the concept of interaction of the components of the environment with one another

	Frequency	Percentage	
DISAGREED	9	23.1	
NEUTRAL	9	23.1	
AGREED	20	51.3	
Mean			3.3684
Std Deviation			1.02459
N	38	97.4	

Table 4.44: The concept of components of the environment is adequately covered in Forms 3&4 science and geography syllabus

	Frequency	Percentage	
DISAGREED	15	38.5	
NEUTRAL	11	28.2	
AGREED	13	33.3	
Mean			2.9487
Std Deviation			0.85682
N	39	100	

Table 4.45: The environmental concepts placed under the topic 'Environmental Management' in Forms 3&4 science and geography syllabus are equally examined in Kenya Certificate of Secondary Education (KCSE)

	Frequency	Percentage	
DISAGREED	17	43.6	
NEUTRAL	8	20.5	
AGREED	13	33.3	
Mean			2.8947
Std Deviation			0.89411
N	38	97.4	

Table 4.46: Understanding of environmental concepts such as conservation, deforestation and pollution requires the pupil to be involved in related practical exercises in addition to class discussion

	Frequency	Percentage	
NEUTRAL	1	2.6	
AGREED	38	97.4	
Mean			3.9744
Std Deviation			0.16013
N	39	100	

Table 4.47: Pupils often have some ideas about the topics in the secondary school curriculum before the topics are taught

	Frequency	Percentage	
NEUTRAL	4	10.3	
AGREED	35	89.7	
Mean			3.8974
Std Deviation			0.30735
N	39	100	

Table 4.48: Human beings need not adapt to the natural environment because they can remake it to suit their needs

	Frequency	Percentage	
DISAGREE	15	38.4	
NEUTRAL	6	15.4	
AGREED	18	46.2	
Mean			3.0769
Std Deviation			1.28523
N	39	100	

Tables 4.49-55 Present frequencies on impediments to teaching/learning 'Environmental Management concepts'

Table 4.49: Large class size

	Frequency	Percentage	
DISAGREE	15	38.4	
AGREED	21	54	
Mean			3.3889
Std Deviation			1
N	36	92.3	

Table 4.50: Inadequate support by school administration

	Frequency	Percentage	
DISAGREE	7	17.9	
NEUTRAL	8	20.5	
AGREED	23	59	
Mean			3.7632
Std Deviation			0.79293
N	38	97.4	

Table 4.51: Inadequate time during school days

	Frequency	Percentage	
DISAGREE	14	35.9	
NEUTRAL	4	10.3	
AGREED	20	51.3	
Mean			3.3421
Std Deviation			0.94515
N	38	97.4	

Table 4.52: Limited environmental knowledge by the teachers

	Frequency	Percentage	
DISAGREE	11	28.2	
NEUTRAL	6	15.4	
AGREED	21	53.8	
Mean			3.1842
Std Deviation			0.89092
N	38	97.4	

Table 4.53: Inadequate preparation time for teachers

	Frequency	Percentage	
DISAGREE	11	28.2	
NEUTRAL	8	20.5	
AGREED	19	48.7	
Mean			3.3158
Std Deviation			0.87481
N	38	97.4	

Table 4.54: Unavailability of natural environment

	Frequency	Percentage	
DISAGREE	12	30.8	
NEUTRAL	2	5.1	
AGREED	23	59	
Mean			3.5405
Std Deviation			0.93882
N	37	94.9	

Table 4.55: Inadequate instructional materials

	Frequency	Percentage	
DISAGREE	9	23.1	
NEUTRAL	5	12.8	
AGREED	25	64.1	
Mean			3.6667
Std Deviation			0.8497
N	39	100	

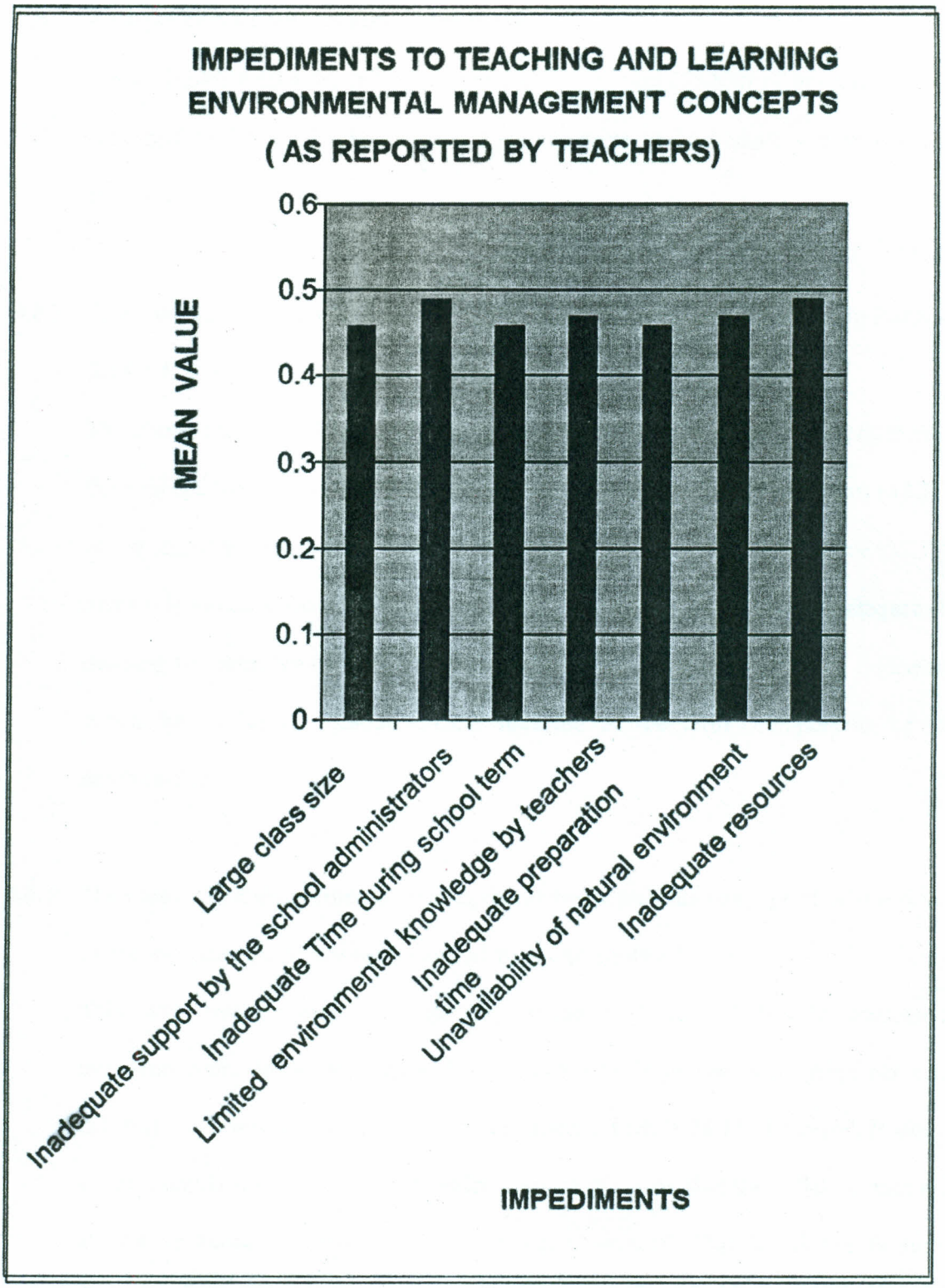

Figure 4.1: Impediments to teaching/learning environmental management concepts (according to teachers)

4.8.1 Composition of schools used in the study

From Tables 4.40-4.41, fifty three point eight per cent (53.8%) of the schools were rural and 46.2% were urban. The respondents were 25.6% female and 64.1% male teachers.

4.8.2 'The concept of components of the environment is adequately covered in Forms 3&4 Science and Geography syllabuses'

The above item was designed to assess teachers' views concerning the definition of the concept 'environment'. From Table 4.44, thirty eight point five per cent (38.5%) of the respondents disagreed with the statement while thirty three point three (33.3%) agreed. It would appear the teachers consider the material in syllabus inadequate in defining the term 'environment'. This is unfortunate since Environmental Education would be confusing without a clear meaning of the term 'components of the environment.

4.8.3 'The topics in Environmental Management cover well the concept of interaction of the components of the environment with one another'.

This item was devised to gauge the adequacy of the syllabus in addressing interdependence in an ecosystem. From Table 4.43 Fifty one point three per cent (51.3%) of the respondents agreed with the statement while 23.1% disagreed. It seems a considerable number of the respondents are of the view that the syllabus does not adequately address 'interactions in an ecological system'. This is unfortunate since environmental degradation revolves around the disruption of the smooth functioning of ecosystems. It would be difficult to understand environmental pollution without first having a clear picture of how undisrupted ecosystems function.

The use of agricultural pesticides like DDT led to the decline in the populations of birds of prey 1950s. After the use of DDT was banned in 1972 the populations of many birds of prey recovered to some extent in the United States of America. While many natural forces - drought, fire, flood, frost or species migration can affect it, an ecosystem will usually continue to function in a recognizable way. For instance, a pond ecosystem may go through flood or drought but continues to be a pond. This natural resilience of ecosystems enables them to resist change and recover quickly from disruption. On the other hand, toxic pollutants and other non-natural phenomena can overwhelm the natural stability of an ecosystem and result in irreversible changes and serious losses, as illustrated by the following examples:

- decline of forests, due to air pollution and acid deposition;
- loss of fish production in a stream, due to death of invertebrates from copper pollution;
- loss of timber growth, due to nutrient losses caused by mercury poisoning of microbes and soil insects;
- decline and shift in age of eagle and hawk (and other top predator) populations, due to the effects of DDT in their food supply on egg survival;
- losses of numbers of species (diversity) in ship channels subjected to repeated oil spills;
- loss of commercially valuable salmon and endangered species (bald eagle, osprey) from forest applications of DDT. (http://www.rachelcarson.org/; http://pmep.cce.cornell.edu/profiles/extoxnet/TIB/eco logical.html both retrieved 4/3/2012).

4.8.4 The environmental concepts placed under the topic 'Environmental Management' in Forms 3&4 science, agriculture and geography syllabuses are equally examined in Kenya Certificate of Secondary Education Examination

This item was designed to determine the involvement of Kenya National Examinations Council (KNEC) in evaluating Environmental Education in secondary schools. From Table 4.45 thirty three point three per cent (33.3%) agreed with the statement while forty three point six per cent (43.6%) disagreed. Considering that teachers spend more time on topics that have higher chances of producing at least a question in the Kenya Certificate of Secondary Education (KCSE) examination then the implication is clearly that teachers are not encouraged or incentivized to spend time on Environmental Management Concepts, which may not enhance their performance in examinations.

4.8.5 'Pupils often have some ideas about the topics in the Environmental Management in secondary school curriculum before the topics are taught'.

The item was intended to find out if there are other sources of environmental Education information available to teachers and pupils other than the school syllabus. From Table 4.47 eighty nine point seven per cent (89.7%) of the respondents agreed with the statement. It would seem there are other more dynamic and diversified sources of EE information than what the school syllabus provides, albeit unstructured and uncoordinated. The main sources were given as government officials and Non-Governmental Organizations (NGOs), with chiefs not providing much useful information. This may be surprising but understandable considering that many chiefs have little more than secondary school education.

4.8.6 Tables 4.49-4.55 Present frequencies on impediments to teaching/ learning 'Environmental Management concepts'

This study identified leading impediments to teaching/learning 'Environmental Management Concepts' infused in the secondary school curriculum as presented in Tables 4.49 to 4.55. Inadequate instructional materials was supported by 64 per cent of respondents; presented in Table 4.55, unavailability of natural environment; espoused by 59 per cent of respondents; presented in Table 4.54, inadequate support by school administration, presented in Table 4.50, endorsed by 59 per cent of respondents and limited environmental knowledge by teachers, Table 4.52, agreed to by 53.8 per cent of respondents.

Tables 4.49-4.55 also present means and standard deviations on impediments to teaching/learning Environmental Management concepts. Teachers were in agreement that school heads are not giving Environmental Education the support it needs, which explains the lack of teaching/learning resources in schools. However, the teachers' views on the different impediments were widely varying, with a good number avoiding aspects that would point a finger at the school administration. This is captured by the large standard deviations from the means.

Figure 4.1 Summarizes the impediments to teaching/learning environmental management concepts infused in the secondary school syllabus. The leading impediments were identified as inadequate resources, lack of support by school heads or principals and insufficient knowledge by the teachers. This may require a policy revision on teacher education curriculum, at universities and other institutions, so that environmental education content is deliberately enhanced. Emerging environmental issues such as global warming and adaptation to the same could be included in the enhanced syllabus. This could also positively affect the attitude of school principals in

the long term. However, in the short term school principals together with KCSE examiners need a refresher course on environmental education so as to promote its standing in schools. This is pertinent since it has implications on how the school environment and by extension Kenya's environment is managed in the future.

4.9 Introduction to school administrators' data

The head teacher or principal in Kenya's secondary school education system is many things in one; chief curriculum officer, human resource manager, planner, financial controller and environment manager among others. This study interviewed the school principals in an endeavor to establish how much importance they attach to environmental education; their support for the teaching of environmental education through provision of teaching /learning resources and good maintenance of the school compound through planting ornamentals, trees and general maintenance of the school grounds including landscaping and harvesting of ground surface run-off and roof water to arrest soil erosion and utilize the water. The findings were used purely to corroborate the findings on the pupils since they were the focus of this study. It should also be borne in mind that the school compound serves as a learning/teaching resource for environmental education. The relevant research question was ' What are the impediments to the teaching/learning environmental management concepts in secondary school?'

The Head teachers provided data on different aspects of environmental education like qualifications of the teachers teaching subjects that serve as carriers of many environmental management concepts and other sources of environmental education concepts. They also provided their perceived challenges to the teaching of environmental education. The resulting data is presented in frequency and percentage

tables. The challenges to teaching environmental education are presented in a bar graph. Then a discussion of the entire data follows.

4.10 School Administrators' Data

The principals' data is presented in tables 4.56-4.62

Table 4.56: Sex of respondents

SEX	Frequency	Percentage
MALE	10	76.9
FEMALE	3	23.1
N	13	100

Table 4.57: Age of respondents

Age	Frequency	Percentage
30-39	1	7.7
40-49	9	69.3
50-60	2	15.4
N	12	92.3

Table 4.58: Type of school

Location	Frequency	Percentage
RURAL	7	53.8
URBAN	6	46.2
N	13	100

Table 4.59: Qualifications of staff teaching Agriculture Form 4

Qualification	Frequency	Percentage
B.Ed	4	30.8
Diploma	8	61.5
N	12	92.3

Table 4.60: Qualifications of staff teaching Geography Form 4

Qualification	Frequency	Percentage
B.Ed	9	69.2
Diploma	3	23.1
N	12	92.3

Table 4.61: Qualifications of Staff Teaching Chemistry, Physics, Biology Form 4

Qualification	Frequency	Percentage
B.Ed	8	61.5
Diploma	2	15.4
N	10	76.9

Table 4.62: Other Sources of Environmental Information apart from the School Curriculum

Source	Frequency	Percentage
Government officials	3	23.1
Chief's Baraza	1	7.7
Local Non-Governmental Organizations	2	15.4
Magazines	2	15.4
Others	4	30.8
N	12	92.3

It would appear there is not one reliable source of environmental information known to the school administrators.

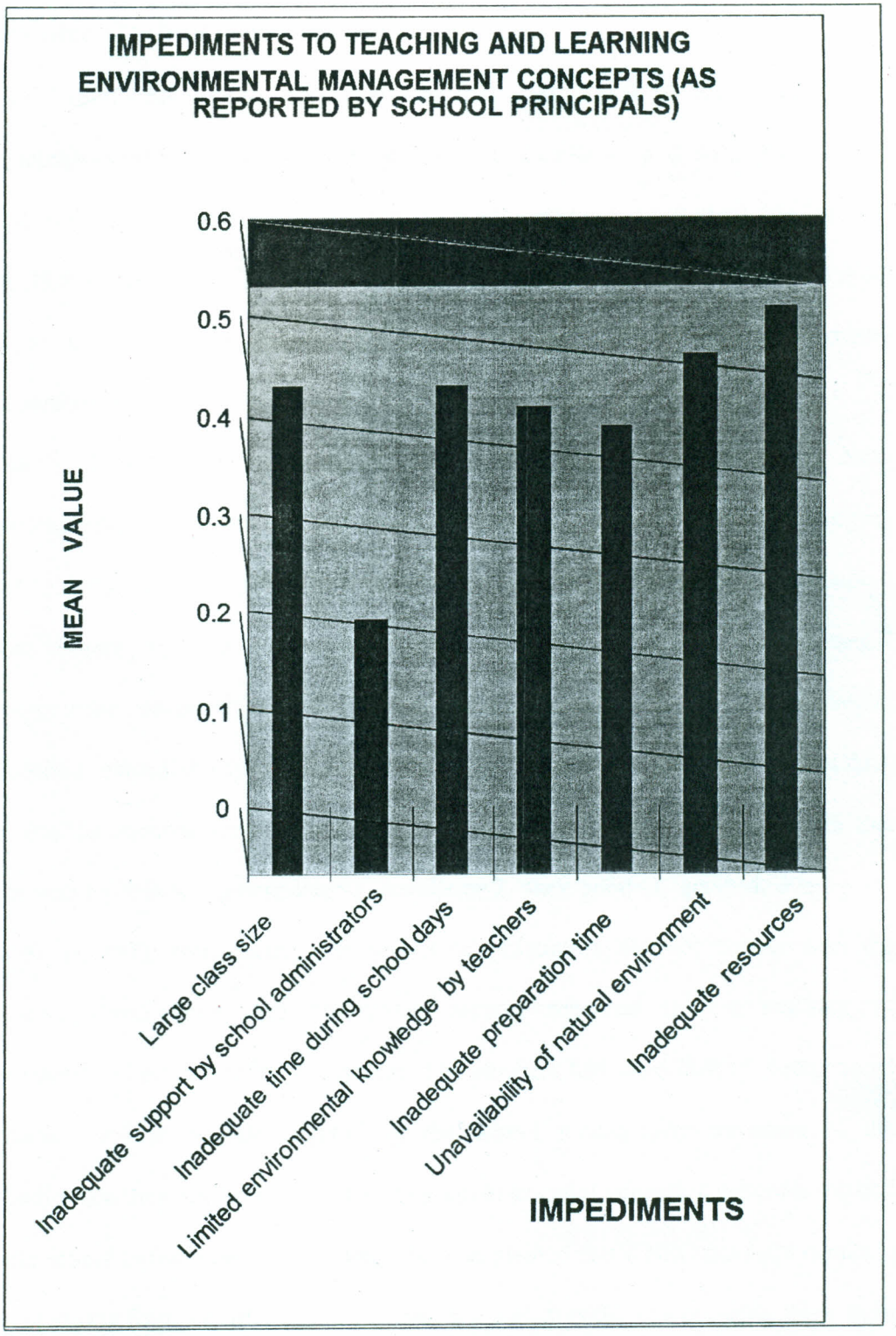

Figure 4.2: Impediments to Teaching/ Learning Environmental Management Concepts (According to Principals)

4.10.1 Discussion of School Administrators' data

From Table 4.56 seventy six point nine per cent (76.9) of the administrators (principals) were male and twenty three point one (23.1%) per cent were female.

From table 4.59 the staff teaching Form four Agriculture comprised 61.5% Dip. Ed. and 30.8% Bed. From Tables 4.60 and 4.61 the teachers of geography, physical science and biology comprised 61% and 69% Bed for science and geography teachers respectively.

From Table 4.62 other sources of environmental information are local Non-Governmental Organizations (NGOs), Magazines and "Others" together making up over sixty per cent (60%) of other sources of Environmental Education information.

From Figure 4.1 the main impediments to teaching/learning Environmental Management concepts are inadequate learning resources for Environmental Education, unavailability of natural environment, inadequate time during school days and limited environmental knowledge by teachers. (The coding formulation for this item was as follows outstanding=1, excellent=2, very good=3, good=4, average=5, fair=6, poor=7). Interestingly the school administrators did not concur with the teachers views about the inadequate support rendered to the teaching of environmental education by the system. The teachers had cited lack of instructional materials and inadequate support by the school management as some of the impediments they encountered in teaching environmental education concepts infused in the school curriculum. The teachers also complained that KNEC does not regularly set questions from Environmental Education topics, thereby discouraging them from spending time with pupils on such topics. This complaint by the teachers was lent credence by the observation that curriculum evaluation in Kenya's education system up to sub- university level is coordinated by the KNEC (Otewa, 2006). The

experience of this researcher was that the school managements do not have a high regard for environmental issues, even those affecting their own schools. In one instance a principal (head teacher) was unable to see the savings his school would make from harvesting roof water, that he conceded was otherwise damaging the road leading to his school, and using the same water in an adjacent kitchen, yet he was complaining about the cost of repairing the road after every rainy season. From Table 4.57, over seventy five per cent of the school principals interviewed were between ages 30-49. This implies a refresher course on environmental education mounted for them would definitely enhance their management of the school environments and could save money by working with nature and conserving resources since they have more than ten years to retirement.

4.11 Findings from Focus Group-Discussion

The objective of the Focus Group-Discussion was to gauge pupils' knowledge and awareness of the causes and consequences of global warming and climate change. Owing to time and funding constraints ten schools were selected for the Focus Group Discussion (FGD). The selection of the groups was based on their performance in interviews such that schools that did well in the interviews as well as those did not do well were selected for FGD. The assumption was that the pupils would have to apply their knowledge of environmental management concepts to explain how industry contributes to global warming and climate change. The pupils were presented with three different photographs of floods, drought and a family living in an area suffering the effects of a prolonged drought. The photographs were all depicting extreme weather. They were asked to explain the cause of each weather event and why the weather event has become more frequent in the last decade. They were to suggest

intervention measures that could reduce the effects of the phenomena depicted by the photographs.

Eighty per cent (80%) of the students said global warming is caused by the depletion of the ozone layer due to poisonous gases generated by industry. Only twenty per cent of the students were able to give the correct explanation for the cause of global warming, that accumulation of greenhouse gases in the atmosphere, principally carbon dioxide is the cause of global warming and that the main source of the carbon dioxide is the burning of fossil fuels. This finding shows that pupils have either been given wrong information about global warming or they have not been exposed to any information on this important emerging environmental issue. The pupils again cited deforestation as a cause of global warming. On abatement measures water catchment management, afforestation and environmental education for all citizens, particularly for the youth was recommended. This finding once again implied that the Environmental Education teacher in secondary school is inadequately equipped to handle topics pertaining to global warming, climate change and sustainable development. Perhaps one may blame the college or university curriculum that prepared the teacher for his career. A review of the Environmental Education course at college/university is long overdue.

The pupils expressed the need for more serious enforcement of the law on conservation of the environment and blamed the government ministries concerned for laxity. Lastly they suggested that legislation should be put in place to tax industry for funding the 'war' against environmental degradation and global warming at the local level. The study established that the pupils are very interested on the future of the environment.

4.12 Checklist Discussion

The filling of checklists was done for the same schools as for the Focus Group Discussion. The objective of this exercise was to find out the challenges and impediments facing the teaching/learning of environmental management concepts, particularly those infused in the secondary school curriculum. The analysis of the checklists established that other than text books containing environmental management topics only twenty percent of the schools had any magazines or newspaper cuttings on environmental education content of any relevance to their learning. In two Provincial Secondary Schools visited by this researcher only one copy each of Njiwa and Komba Magazines were on display, curiously in a Fine Art room. None-the less the schools were rich in real life teaching/learning aids for this area of study. Seventy five per cent (75%) of the schools had a project on tree planting that involved the pupils and several teachers, where appropriate tree species were planted under the guidance of a qualified person from the Local District Forest Station. The schools had managed demonstration agriculture gardens and active Environment Clubs. Unfortunately, manure was imported from outside the school, in some cases, instead of composting on site using the plentiful raw materials readily available on most school compounds. Practically all secondary school kitchens would serve as reliable sources of raw materials for composting. The school gardens had ornamentals that would complement the kitchens in supplying raw materials for composting, all free of charge.

Beyond the school compounds of all schools visited by this researcher there were many teaching/ learning aids, managed plots terraced and well planted with grass and different tree species, woodlots, overgrazed plots, even severely eroded private plots. In many market centres there was the usual polythene paper pollution and other solid

wastes. One principal told this researcher that doing a clean-up in the local market centre was not going to add value to the learning of his students or the community so he was not interested in such an exercise. Clearly we have a long way to go before environmental awareness building becomes a routine exercise in the area.

4.13 Overview of findings

The overview of this study is arranged such that after the statement of each research objective a recapitulation of the findings is provided. This study was guided by five objectives. The first objective was to identify, analyze and select the environmental concepts infused in the school curriculum, that is the first two levels of the 8-4-4 system of education in Kenya, for inclusion in the study. The appropriate goal of education states 'In Kenya education should promote positive attitudes towards good health and environmental protection' (KIE, 2002). This provided the origin, basis and relevance of the concepts that were included in the study. The identified concepts were used in the development of the conceptual framework that guided the development of the items included in the instruments that facilitated data collection for the study. The integration of environmental concepts in the school curriculum involves many subjects starting from English at standard two. It then spreads to other subjects in upper classes at primary level and continues to secondary school level.

Going by the findings of the study nearly all subjects at the secondary school level carry environmental concepts. However, a greater and more detailed treatment of the environmental management concepts may be found in geography on deforestation, desertification and land degradation; biology for relationships and interdependence in an eco-system and loss of biodiversity. In the physical sciences one finds detailed treatment for radio isotopes and the potential dangers they pose to the environment.

Agriculture covers, to reasonable detail, environmental issues like soil and water conservation, water harvesting, and water catchment management together with afforestation and re-afforestation (KIE, 2002). The main weakness with this arrangement lies in students' dropping some subjects at form three and then missing out on some important environmental concepts altogether.

The second objective was to determine pupils' comprehension of key environmental concepts infused in the school curriculum. To effectively address himself to this objective and the subsequent objectives, the researcher sequenced the findings of the study according to themes. The themes included:-

i. environmental degradation
ii. conservation of resources
iii. impact of population growth on resource utilization
iv. use of technology to solve environmental problems
v. sustainable use of resources and ecological stability
vi. youth attitude toward the welfare of the environment and youth involvement in addressing environmental issues.

Pupils' comprehension of most of the concepts was moderate as indicated by the frequency tables on the analyses of their responses to the different items presented to them. Items on sustainable utilization of resources and ecological stability were the least understood, implying low awareness and understanding of how ecosystems function. Moreover, it was noted that the pupils were unable to provide a concise explanation on the link between environmental degradation like air pollution and problems like global warming and its consequences like climate variation. In the focus group discussions the students consistently informed the researcher that global warming was a result of depletion of the ozone layer. The prevalence of that answer

implied somebody may have explained it that way to them. Perhaps this is a reflection of limited environmental knowledge by their teachers. To corroborate these findings the principals (school administrators) were of the view that limited environmental knowledge, on the part of the teacher, was a constraint to teaching and learning environmental concepts infused in the school curriculum. This kind of situation is better addressed by curricular change at the teacher training level (Larijani, 2010). Once the teachers are given the appropriate level of training the pupils will, in all likely hood, benefit and sustainable living approached.

The third objective was to find out if there is a significant difference in understanding of the environmental concepts between boys and girls. The study found that items that explored complex interrelationships in an ecosystem were better understood by boys than girls. For example the statement 'Pollinating animals like bees, butterflies and bats are not important in the balance of nature'

Considering the association between sex and pupils' understanding of the importance of pollinating animals to the balance of nature, from Table 4.24, fifty sixty point one per cent (56.1%) of the boys and 43.9% of the girls disagreed with the statement 'Pollinating animals like bees, butterflies and bats are not important in the balance of nature.

This item was designed to gauge understanding of interdependence among organisms and its contribution to ecological stability. This was derived from concepts of ecology that are infused in biology syllabus, Form Three. This finding corroborates earlier studies on sex differential performance in the natural sciences. (Bell & Barker, 1982; Adeniyi, 1985; Twoli, 1986). These researchers found the performance of girls to be lower than that of boys in the natural sciences due to a number of factors, including girls' tendency to avoid tackling problems that require exploring a diversity of

difficult solutions, socio cultural environments and societal expectations (Orodho, 1996; Jegede & Okebukola, Jha & Kelleher, 2006). The pupils' overall responses to this item indicate their moderate level of understanding of the inter connectedness of life in a stable ecosystem.

The chi-square test results showed χ^2 (2, 0.05) =3.37 (critical), asymp. Sig =.044 and calculated chis square (χ^2) = 6.257. Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by sex' was rejected at .05 level of confidence and the corresponding H_{A1} accepted.

Another example concerned the use of technology to sort out environmental problems like food security. The item 'Man does not have to worry about food insecurity because biotechnology and genetic modification technology will always help us to develop better crops that will produce sufficient food'. This item was designed to assess pupils' perception concerning the capacity of current technology to take care of food security

From Table 4.16 that 66.9 per cent of the pupils disagreed with the statement would seem to indicate that majority of them do not consider biotechnology to be able the tackle the problem of food insecurity in Kenya and even globally. From Table 4.17 fifty six point six per cent (55.6) six per cent of the boys and forty four point four (44.4) per cent of the girls disagreed with the statement. The results appear to suggest that the girls were more persuaded about the ability of technology to sort out environmental problems like food insecurity facing mankind without considering some of the possible challenges like cultural or moral acceptability and perceived risks of the products of biotechnology, Genetically Modified Organisms (GMOs) being a typical example of technology going against the wishes, expectations and

preferences of the consumer (George *et al*, 2000). Not much research has been done in Kenya and Africa about the impact of GMOs on Kenya's agriculture and the ecosystems generally. Nevertheless there are moral safety and consumer education issues that need to be addressed (WHO, 2011).

Concerning the association of sex with secondary school pupils' responses on technological solution to food security issue, chi-square test results showed χ^2 (2, 0.05) =8.60 (critical), asymp. Sig =.035 and calculated chis square χ^2= 6.702. Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by sex' was rejected at .05 level of confidence and the corresponding H_A accepted.

The fourth objective was to establish if there is a significant difference in the understanding of environmental concepts infused in the school curriculum between pupils in rural schools and those in urban schools.

Consider the statement:-

The more the people in a village the more they cut down the local trees for firewood.

This item was drafted to assess pupils' perception of the impact of rising human population on the conservation of resources, particularly local tree resources. In Table 4.13 the findings show that 70.6% of the respondents agreed with the statement while 11% disagreed with it. That appears to demonstrate a reasonable understanding of the impact of rising population on tree resources.

Regarding the connection between type of school and pupils' comprehension of environmental concepts infused in the school curriculum, Table 4.15 shows that the respondents from rural schools were better at 80% compared to respondents from urban schools at 61.5% in their comprehension of the impact of rising human

population on local tree resources. The chi-square test results gave χ^2 (2, 0.05) =7.22 (critical), asymp. Sig =.014 and calculated chis square (χ^2) = 8.560. The decision for rejection of the null hypothesis requires the calculated Pearson chi-square value to be larger than the critical value, obtainable from tables, bearing in mind the .05 level of significance (Orodho, 2009; Curwin and Slater, 2007; Kothari, 2004). Therefore it appears the null hypothesis (H_{01}) which states 'pupils' comprehension of environmental concepts infused in the school curriculum is not influenced by type of school or school environment' was rejected at .05 level of confidence and the corresponding H_A accepted. It seems rural based pupils have better awareness about the impact of rising human population on tree resources. In Africa over 90% of the rural population obtains its cooking and heating energy from wood and brush (Agyei, 1998). Kenya's population growth rate is about 3% (GoK, 2009). This implies there is a growing demand for firewood in the country. During data collection it was observed that most schools in the rural areas use firewood to prepare meals for the pupils. Perhaps this is the one reason that makes the rural pupils more aware of the relationship between population growth and tree depletion. The rural based respondents are constantly exposed to the reality of using wood fuel to prepare meals both at school and at homes. They also observe the depletion of tree cover resulting from gathering of fire wood. The environment exerts its influence on behaviour by affecting our thoughts. Learning experiences and the environment affect our behaviour by giving us the information we need to behave effectively. This upholds the social learning theory. (Bandura, 1977; Passer & Smith, 2001).

The fifth objective was to determine the activities secondary school pupils actually undertake or would like to undertake both at school and community levels following their exposure to the environmental concepts integrated in the school

curriculum as a reflection of their attitude and commitment to the welfare of the environment. The item 'young people should take part in clean-up activities, for example, removing plastic materials from their market centre and dumping them appropriately, was designed to assess the views and attitude of the youth toward taking responsibility and acting for their own as well as the welfare of the environment. The figures in Table 4.28 show that 94.1% of the respondents agreed with the statement while 2.2% disagreed. From Table 4.28 the mean value of 4.6 and a standard deviation value of 0.6 reflected a very positive attitude among the majority of the respondents considering the small dispersion of values around the mean. (The coding definition was:- strongly agreed=5, agreed=4, neutral=3, disagreed=2,strongly disagreed=1)

The relevant research question was 'What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?' From Table 4.29 Fifty point four per cent (50.4%) of the respondents who agreed with the statement were male while forty nine point six per cent(49.6%) were female. Out of all female respondents 96.9% agreed with the statement compared to 91.4% of all males in the sample who agreed with the statement it seems the females had a slightly better attitude to the welfare of their environment. Chi-square test on association between type of school or the school environment and pupils' attitude toward the welfare of the environment did not produce significant results.

'Youth should present and recite poems about the environment on World Environment Day'

This item was devised to determine pupils' attitude towards creating and presenting poems to advocate for and enhance the welfare of the environment.

The figures in Table 4.34 show that 93.4% of all respondents agreed with the statement. Only 1.5% disagreed. This is a reflection of positive attitude towards creating information, communicating the same widely and making a show for and promoting the welfare of the environment. Table 4.34 provides a mean value of 3.9 and a standard deviation of 0.3 indicating a small dispersion of values around the mean which demonstrates a very positive attitude among the respondents. (The coding definition was; strongly agreed=5, agreed=4, neutral=3, disagreed=2,strongly disagreed=1). The relevant research question was 'What influence does pupils' perception of environmental management concepts infused in the school curriculum have on the activities they undertake at both the school and community levels to improve their environment?'

Concerning youth attitude to the welfare of the environment it is necessary to keep in mind the responsibility of young generations, since they are the future adult society and they represent a sort of promise (UNESCO, 2000). From a cultural and sociological point of view it should be borne in mind that young generations have historically and socially distinguished themselves by promoting changes and innovative values, at times generating social collective movements that have given rise to culturally and socially relevant transformations. Perhaps this is the reason the youth may be considered a natural and primary target for surveys, political decisions and cultural initiatives relevant to sustainable life styles and environmental protection. Young generations are the more pre-eminent carriers of change. They can act as change agents and advocates because development is emphatically directed at safeguarding interests of future generations (http://www.ensi; UNEP, 2000). The

Screen-ager generation born after 1985, have the potential to spear head transition to sustainable society/ development on account of their living in the information and digital interaction age. They can easily create networks and share environmental information very fast on sustainable development, including local environmental problems very fast. This puts them in good stead to steer the necessary change of attitude toward consumption of resources and sustainable living.

In a study on young attitude and sustainable development in Ankara, Turkey, it was concluded that one way to equip young people to contribute to sustainable development is through effective environmental education (Tuncer et al., 2005).

The Constitution of Kenya Article 69(1) (a) says "The State shall ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources and ensure equitable sharing of the accruing benefits" (Go K, 2010). Vision2030 aspires to create a globally competitive and prosperous Kenya, as a middle income country. This requires the economy to grow at 10% per annum starting from the year 2012. Its attainment could face serious challenges unless Environmental Education for Sustainable development is in fact factored in as the fourth pillar. The basis for this proposition is that Kenya is a resource poor country. The proportion of the land area under forest cover is 6.1%. (UN, 2011; http://mdgs.un.org/unsd). The Constitution of Kenya Article 69(1) (b) says "The state shall work to achieve and maintain a tree cover of at least 10% of the land area of Kenya. Vision 2030 addresses environmental concerns, water conservation, water catchment management and reviving the five water towers, which include Mount Kenya, The Aberdares, Mount Elgon, Cherangany Hills and The Mau Forest, in one small paragraph, through increased forest tree cover. The environmental awareness aspect is completely missing. Industrial development inevitably engenders disruption of the environment

and enhances degradation of the same leading to air, water and land pollution. It would be a serious oversight not to factor into the Vision 2030 an appropriate sustainability plan (http://www.ku.ac.ke; http://www.planning.go.ke/).

The researcher considers it a necessary condition that Environmental Education for sustainable development for all age groups is aggressively pursued to avoid a scenario where environmental degradation slows the pace of development reducing Vision 2030 to a mirage that entices but cannot be attained. Moreover the Environmental Education topics infused in the secondary school curriculum are shallowly taught and not regularly tested in KCSE. This sort of discourages teachers from spending adequate time to ensure environmental management concepts are well understood by the pupils. Limited environmental knowledge by the teachers was identified as one of the challenges to teaching Environmental management concepts in secondary schools. This information was provided by the teachers themselves as well as the school principals. It would appear the college and university curricular where the teachers train is inadequate and in needs of upgrading. or review.

In Kenya over 80 per cent of the land area is classified as Arid or Semi-Arid (ASAL), with a large proportion of it affected by moderate to severe land degradation and desertification. About 10million people (30 per cent of Kenya's population) live in the ASALs. More than 50 per cent of this population lives in extreme poverty (subsisting on <US$1/day). The challenge in the ASALs of Kenya is to develop an innovative approach to sustainable development through sustainable land management where resource conservation and land rehabilitation can be combined with improved livelihoods through income generation for the local communities (www.fao.org; http://www.aridland.go.ke/). It is the view of this researcher that sustainable land management and resource conservation in Kenya cannot be

comprehensively addressed unless the secondary school segment of the of education system is included in the plan with enhanced infusion of environmental management concepts and the appropriate support from Kenya National Examinations Council (KNEC). As a significant stake holder in curriculum assessment / evaluation the KNEC can push for more effective coverage of environmental management concepts by regularly setting/ and including examination questions from the environmental management topics. In all likelihood environment-related questions would then get more attention since teachers have a tendency to lay more emphasis on topics that have contributed more examination questions in past examinations. Secondary school leavers who would not continue with their education would then have some knowledge of resolving environment related problems in their areas of residence or work. Vision 2030 would then be approached with a component of sustainable development among the other pillars.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The main goal of this study was to assess and determine pupils' understanding of environmental concepts infused in the 8-4-4 Secondary School Curriculum in Machakos County and the effects the comprehension has on how they (the pupils') act to protect, improve, and conserve their environment for sustainability.This chapter focuses on the discussion of the findings of the study. The relationship between some school variables, like the location of the school, that is rural or urban and pupil environmental awareness; the relationship between sex (being boy or girl) and pupils' comprehension of environmental concepts infused in the school curriculum are discussed as well as the impact of both on pupils' attitude and behaviour towards protecting, conserving and enhancing the quality of the environment for sustainable living. The identified challenges to teaching and learning the environmental concepts infused in the 8-4-4 secondary school curriculum are also discussed. The discussion and conclusions are given in the order in which they relate to the stated research questions and the appropriate hypothesis

The Chapter then presents the major conclusions drawn from the findings of the study (as presented in Chapter Four) and also makes recommendations. The recommendations are divided into two broad categories. The first category pertains to policy matters, where consideration is given to ways of improving the teaching and learning of environmental concepts to secondary school pupils to augment government efforts and strategies for ensuring quality environment and sustainability

as provided in the Constitution of Kenya (GoK, 2010). The second category of recommendations pertains to further research.

Briefly, this chapter includes summary of findings, as per research objectives, a conclusions based on the findings and recommendations based on the same.

5.2 Conclusion

This study was focused on determining effects of learning environmental management concepts infused in the secondary school curriculum in Kenya among secondary school pupils. The specific research objectives are available in pages four and five.

The researcher concluded that:-

1. There was sex based difference in the comprehension of environmental concepts pertaining to the complex interrelationships in ecosystems at $p \leq .05$ in favour of males. The specific conclusion was that males had a better understanding of complex interrelationships in ecosystems.
2. There was a difference between the type of schools in the comprehension of environmental concepts pertaining to the impact of population growth on tree resources, especially firewood collection, at $p \leq .05$ in favour of rural based pupils. The conclusion is that rural based pupils had a better understanding of the negative effects of population growth on tree resources.
3. There was differential appreciation on the capacity of technology to resolve environmental issues like food security and difficult diseases like HIV/AIDS, at $p \leq .05$ in favour of females. The conclusion is that the females perceived technology to be able to provide solutions to food insecurity and difficult diseases.

4. The level of environmental awareness of the secondary school pupils was estimated, after considering their performance at FGDs, to be low to moderate. The conclusion was that secondary school pupils in the study area displayed a low to moderate level of environmental awareness on the themes covered in this study.
5. The school environment and sex of respondent did not appear to have a differential influence on attitude of respondents toward their environment.

Overall the researcher concluded that there was attainment of low to moderate understanding of environmental management concepts and environmental awareness, very positive attitude and desire to act for the welfare of the environment among secondary school pupils. The basis of this conclusion was the environmental management concepts infused in the school curriculum in Kenya and the understanding of the same as determined in the Focus Group Discussions with individual pupils. Unavailability of print and electronic Environmental Education teaching/ learning resources in the schools was also put into consideration, as well as the views of the environmental education teachers and the school administrators.

5.3 Recommendations

On the basis of the main findings discussed earlier a number of recommendations are made aimed at improving secondary school pupils' comprehension of environmental management concepts infused in the school curriculum. The recommendations have been grouped into two broad categories depending on their policy or further research implications.

This researcher recommends refresher courses for secondary school head teachers so that they are able to manage the school compounds as teaching aids for

Environmental Education and the wider promotion of environmental awareness. The second recommendation is development of an education policy to mainstreams Education Sustainable Development (ESD) considering that Environmental Education in its current form has been inadequate in effectively addressing threats to the environment in Kenya. Besides it is the biophysical aspect of the environment that has been given prominence in the teaching of Environmental Education in secondary schools in Kenya with little or no reference to the economic or social perspective. The policy should address assessment and coordination of EE as per the National Environmental Management Authority (NEMA) national framework ESD Strategy for 2005-2010. The strategy seeks to mainstream ESD in Kenya's Education System. It focuses on key domains of ESD namely reorienting existing programmes, basic education, developing public awareness of sustainability and training in achieving ESD. The third recommendation is that ESD should be made the fourth pillar of Vision 2030. Lack of an appropriate package for promoting environmental awareness among all people including industry players would inevitably make the desired pace of development unsustainable. Prevention of environmental problems can only be effectively attained by an environmentally informed citizenry. Hence there cannot be a healthy and secure environment without the input of ESD. The reorientation of education as a whole towards sustainability involves all levels of formal, non-formal and informal education in all countries. The concept of sustainability encompasses not only environment but also poverty, population, health, food security, democracy, human rights, and peace. Sustainability is, in the final analysis, a moral and ethical imperative in which cultural diversity and traditional knowledge need to be respected. Children and youth will not only inherit the responsibility of looking after the earth but in many developing countries they comprise more than a half of the population.

Furthermore children and youth in many developing and developed countries are highly vulnerable to the effects of environmental degradation. They are also highly informed supporters of environmental thinking and reasoning. The specific interests of children and youth need to be taken fully into account in the participatory process on environment and development in order to safeguard the future sustainability of any actions taken to improve the environment.

This study inquired into the effects of learning environmental management concepts among secondary school pupils in Machakos County of Kenya. In the course of the study some baseline data has been documented. The propensity to conserve or neglect the environment may be discerned from youth consumer patterns. A sustainable future would not be possible without integrating three basic issues of sustainable development into our lives; consumption, production and distribution. Is it possible to change lifestyles and consumption patterns, especially of young people of a developing country where lots of brilliant marketing techniques are employed?

Bearing in mind that research is crucial for acquisition of novel knowledge and development, especially in the area of Environmental Education for sustainable living further research is recommended in the areas listed below:-

i. How do other sources of environmental information affect secondary school pupils entering (prior) behaviour and attitude toward the environment?
ii. Level of Environmental Education awareness of secondary school teachers
iii. Level of Environmental Education awareness of the primary school teacher
iv. Youth lifestyles, consumer preferences and patterns
v. Competence of Bachelor of Education & Diploma in Education holders in teaching Environmental Education in Kenya's secondary schools

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APPENDICES

APPENDIX I

PRINCIPALS' QUESTIONNAIRE

Instructions:

Please answer all the questions in the spaces provided. The response will be kept confidential. For any other additional information please use the back of each page.

PERSONAL INFORMATION					
1.	Name				
2.	Sex		3	Age	
4.	Name of School				
5.	School's Address				

6. What are the professional qualifications (B.Ed, Diploma) of your staff that teach the following subjects in the indicated classes?

Subjects	**Classes**	
	Form 3	Form 4
a) Agriculture	_____	_____
b) Geography	_____	_____
c) Science(Chem, Phys. Bio)	_____	_____

7. Does the school have any project in the following areas?

	Yes	No
Soil conservation	_____	_____
Water conservation	_____	_____
Afforestation	_____	_____

8. Rank the following as Challenges to effective teaching of environmental concepts in the school curriculum, from the most effective to the least effective with special reference to your school. The most effective barrier to be ranked 1 and the least ranked 7:

a) Large class size _____

b) Inadequate support by administration _____

c) Inadequate time during school days _____

d) Limited environmental knowledge by teachers_____

e) Inadequate preparation time for teachers_____

f) Unavailability of natural environment _____

g) Inadequate learning resources for Environmental concepts _____

h) Others (Specify) _____

9. Give reasons why the school should be involved in environmental management activities in the local community.

_____

_____

_____

_____

10. From your experience as the principal, what other sources of environmental information apart from school curriculum, are available to the teachers and the pupils especially in your community?

_____

_____

_____

APPENDIX II

FORMS 3&4 SCIENCE, GEOG. & AGRIC. TEACHERS'

QUESTIONNAIRE

Instructions

Your class has been selected for this study. Kindly answer all the questions in the spaces provided or by ticking below the most Fitting response to each question

PERSONAL INFORMATION					
1.	Name of Teacher(Optional)				
2.	Sex		3	Age	
4.	Name of School				
5.	School's Address				
6.	Pupils' enrolment in Forms 3&4		Boys	Girls	Total
7.	How long have you been teaching Science, Geography or agriculture		0 – 1 yr	2 – 3 yrs	> 3 yrs
a.	In other Classes (specify)				
b.	In Forms 3&4?				

Date _____

	Strongly agree	Agree	neutral	Disagree	Strongly Disagree
8. The topics in "Environmental management" clearly cover all the ideas Forms 3&4 pupils need to understand about the effect of pollution in each component of the environment (air, soil and water, living things etc)					
9. The topics in "Environmental management" cover well the concept of interaction of the components of the environment with one another…					
10. The environmental concepts placed under the topic " Environmental management" in Forms 3&4 science and geography syllabus are equally examined in national examination (KCSE)					

	Strongly agree	Agree	neutral	Disagree	Strongly Disagree
11. Understanding of environmental concepts such as conservation, deforestation, pollution of the environment requires the pupil to be involved in the related practical exercises in addition to class discussion.					
12. There are other sources of environmental information available to the teachers and learners, apart from the school curriculum.					
13. Human beings need not adapt to the natural environment because they can remake it to suit their needs.					
14. Pupils often have some ideas about the topics on environmental management concepts infused in the					

	Strongly agree	Agree	neutral	Disagree	Strongly Disagree
secondary school curriculum even before such topics are formally taught.					
15. The following are challenges to effective teaching of environmental concepts, please rank them in order of priority from most to least important:-					
• Large class size					
• Inadequate support by school administration					
• Inadequate time during school days					
• Limited Environmental Knowledge by teachers					
• Inadequate preparation time for teachers					
• Unavailability of natural environment					
• Inadequate instructional materials for					

	Strongly agree	Agree	neutral	Disagree	Strongly Disagree
Environmental Concepts					
• Others (Specify)					

APPENDIX III

PUPILS' QUESTIONNAIRE

Instructions

Your class has been selected for this study. Please answer all the questions by writing in the spaces or ticking below the most relevant response to each question.

PERSONAL INFORMATION					
1.	Name of Pupil				
2.	Sex		3	Age	
3	Mother's level of Education(tick)	Illiterate, Primary, Secondary, College			
4	Father's level of education(tick)	Illiterate, Primary, Secondary, College			
5	Class				
6	Name of School				

S/No		Strongly Agreed	Agreed	Neutral	Disagreed	Strongly disagreed
7	Overgrazing may be caused by economic, social or political factors.					
8	Playing very loud music in a matatu causes noise pollution					
9	Rainwater harvesting can enhance local agricultural and livestock production					
10	Rainwater harvesting employs simple and appropriate technology					
11	The more the people in a village the more they cut the local trees for firewood					
12	Man does not have to worry about food security because biotechnology and genetic modification will always help us to develop better crops that will produce sufficient food					
13	We should not bother about cures for difficult crop, animal					

S/No		Strongly Agreed	Agreed	Neutral	Disagreed	Strongly disagreed
	and human diseases like HIV/AIDS since technology will always help us discover cures .					
14	Pollinating animals like bees, butterflies and bats are not important in the balance of nature					
15	A sustainable forest reserve should have many species of trees, shrubs, herbs and grasses among others					
16	Young people should take part in clean- up activities, for example, removing plastic materials from their market centre and dumping them appropriately					
17	The youth should be involved in celebrating events like World Environment Day					
18	The youth should present and recite poems on environmental					

S/No		Strongly Agreed	Agreed	Neutral	Disagreed	Strongly disagreed
	awareness on World Environment Day					
19	Young people should take part in planting trees at the local forest reserve and the local school on the national tree planting days					

APPENDIX IV

FOCUS GROUP DICUSSION GUIDE

Introduction:

You have been selected for this study. The information you will provide is for research purpose only and your response will be kept confidential. Please answer the following questions as precisely as possible:

The photograph below shows a weather event.

a) What does the weather event depict?

b) What is the cause of the weather event?

c) Why has this weather phenomenon become more frequent in recent years?

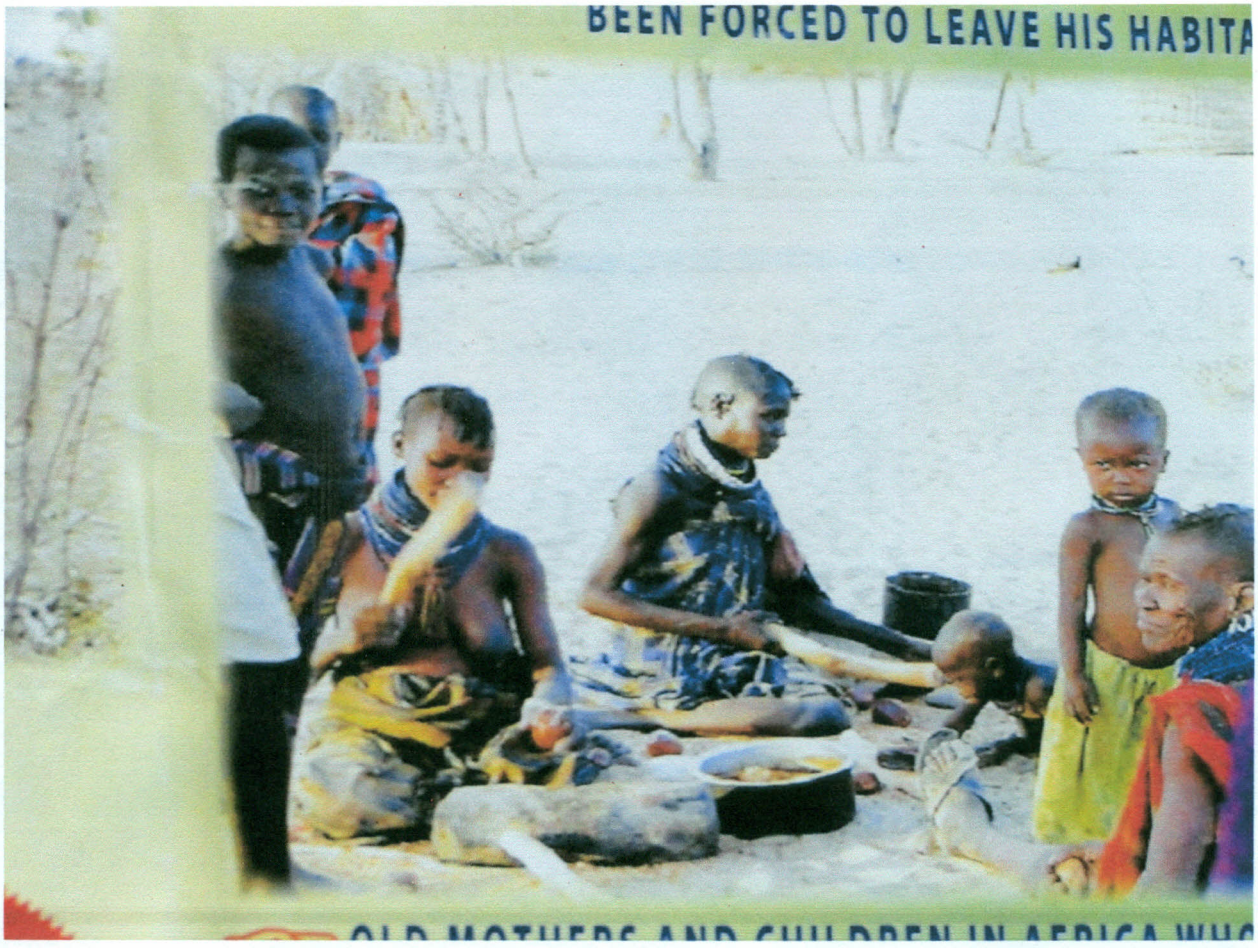
2. The photograph below shows the effects of a prolonged drought:

a) How can the effects of the drought be reduced?

b) Why has this phenomenon become more frequent and more severe in the past decade?

c) What can man do to reduce the recurrence of the above weather related phenomena?

3. The photograph below shows a family that is suffering the impact of a prolonged drought.



a) What needs of the family members are most affected by the drought?

b) Who should take blame for this situation?

c) What needs to be done to reduce the effects of this phenomenon?

APPENDIX V

RESEARCH PERMIT

PAGE 2

THIS IS TO CERTIFY THAT:

Prof./ Dr./ Mr./ Mrs./ Miss...NELSON TIMOTHY MUTHIANI.....

of (Address) ...KENYATTA UNIVERSITY P.O. BOX 43844, NBI.....

has been permitted to conduct research in .....

..... Location,

.....MACHAKOS..... District,

.....EASTERN..... Province,

on the topic...Effects of Environmental concepts comprehension on environmental management among Forms Three &.....

Four Pupils in Machakos District, Kenya.....

for a period ending...31ST OCTOBER..., 20...12.

PAGE 3

Research Permit No.NCST/RRI/12/1/SS/744

Date of issue...17/08/2010.....

Fee received ...SHS 2,000.....

Applicant's Signature

Secretary National Council for Science and Technology

The bearer has been allowed to carry the research.

26/8/10.

(Mulei Boru)

DISTRICT EDUCATION OFFICER
MACHAKOS.