

**ISSUES INFLUENCING SUSTAINABILITY OF THE
ABERDARE RANGE FORESTS: A CASE OF KIENI
FOREST IN GAKOE LOCATION. KIAMBU COUNTY.**

BY

JOHN MAKOKHA NYUKURI.

**A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF MASTER OF
ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY
OF NAIROBI.**

2012

DECLARATION

This research project report is my original work and has not been submitted to any other university for award of a degree.

John Makokha Nyukuri
Reg. L50/64270/2010.

Date

This research work has been submitted for examination with my approval as the University supervisor.

Dr. Guantai Mboroki.
Senior Lecturer,
Department of Educational studies,
University of Nairobi.

Date

DEDICATION

It is my wish to dedicate this research work first and foremost to the Almighty God for the abundant grace and strength given during the time of study. Secondly to my dear wife Florence Ludia, my kids Joshua, Faith, Daniel and Patience; who encouraged me and stood by my side at the hour of need. Chongana and Njuguna Kamau thanks for adding value to my research work.

ACKNOWLEDGEMENT

I desire to register my sincere appreciations to my classmates (the M.A PPM pioneer class of Thika post graduates) who motivated me to take my studies with the seriousness it deserved. I would also want to thank the University of Nairobi who remained focused and opened up Thika Extra-Mural Centre which enabled me to study out of my busy work schedule. My heartfelt gratitude is to my supervisor Dr, Guantai Mboroki for having accorded me all the necessary guidance in my research. I wish also to thank my employer Tropical Farm Management Kenya Limited for having allowed me time to undertake my studies. Much thanks to the University of Nairobi for its modern library services that formed basis of the literature review in this study. Mr. Peter Matanji College Librarian at Kikuyu Campus of the University of Nairobi; thanks for your commendable services.

TABLE OF CONTENTS

TITLEPAGE.....	i
DECLARATION	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES	x
LIST OF FIGURES	xii
ABBREVIATIONS AND ACRONYMS	xiii
ABSTRACT.....	xiv
CHAPTER ONE:INTRODUCTION	1
1.1 Back ground of the study	1
1.2 Statement of the problem.....	3
1.3 Purpose of the study.....	4
1.4 Objectives of the study.....	4
1.5 Research questions.....	4
1.6 Significance of the study.....	4
1.7 Delimitations of the study.....	5
1.8 Limitations of the study	5
1.9 Assumptions of the study.....	5
1.10 Definition of significant terms	5

CHAPTER TWO: LITERATURE REVIEW	7
2.1 Introduction.....	7
2.2 History of forest conservation.....	7
2.3 Community participation in forest sustainability.....	10
2.4 Socio-economic issues in forest sustainability	12
2.5 Community awareness in forest sustainability.	15
2.6 Forest management practices in forest sustainability.	17
2.7 Theoretical Framework.....	17
2.8 Conceptual framework	18
2.9 Summary of Literature Review.....	20
CHAPTER THREE: RESEARCH METHODOLOGY	21
3.1 Introduction	21
3.2 Research design	21
3.3 Target population	22
3.4 Sample size and sampling procedures	22
3.4.1 Sample size selection	22
3.4.2 Sampling procedures.....	23
3.5 Data collection Tools/Techniques.....	23
3.5.1 Collection of data through Questionnaire	24
3.5.2 Interview guide.	24
3.6 Validity of instruments	24
3.7 Reliability of instruments.....	25
3.8 Data collection procedures.....	25
3.9: Operational definition of variables.	26

3.10 Data analysis techniques.....	26
3.11 Ethical considerations.....	27
CHAPTER FOUR: DATA ANALYSIS, PRESENTATIONS, DISCUSSIONS AND INTERPRETATIONS.....	28
4.1 Introduction	28
4.2 Response rate	28
4.3 Demographic Information	28
4.3.1 Respondents' Gender.....	29
4.3.2 Respondent's age.....	30
4.3.3 Comparison of Gender and highest level of Education completed.....	30
4.3.4 Marital status of Respondents.....	31
4.3.5 Main occupation of the Respondents.....	32
4.4 Sustainability of Kieni forest	32
4.4.1 Community participation in Kieni Forest sustainability.....	33
4.4.1.1 Community members in Community Forest Associations (CFAs)	33
4.4.1.2 Respondents farming in Kieni Forest	34
4.4.1.3 Hectare of land being farmed in Kieni Forest by Respondents.....	35
4.4.1.4 Respondents involved in Kieni Forest policing.....	35
4.4.1.5 Means/form through which Kieni Forest is being destroyed.....	37
4.4.1.6 Respondents involved in tree planting in Kieni Forest.....	38
4.4.1.7 Importance of Kieni forest to the respondents.....	38
4.4.2 Socio-economic status of the community.....	40

4.4.2.1 Respondent’s economic activities.....	40
4.4.2.2 Fuel type used by respondents	41
4.4.2.3 Average income (wage) per month of respondents	42
4.4.3 Community awareness and sustainability of Kieni forest.	43
4.4.3.1 Respondent’s level of knowledge about need for Kieni forest conservation.....	44
4.4.3.2 Seminars on Kieni forest conservancy attended by respondents.	44
4.4.3.3 Exhibitions on Kieni forest conservation.	46
4.4.3.4 Posters/Billboards on Kieni forest conservation.....	47
4.5 Forest management practices	47
4.5.1 Respondents out come of the conflict.	48
4.5.2 Number of trees planted by Respondents: in Kieni forest.	50
4.5.3 Range of products made from NTFPs (Non timber Forest Products)	50
4.5.4 KFS efforts through provision of guards	51
4.5.5 Efficiency of shamba system in Kieni forest	52
CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.....	53
5.1 Introduction.....	53
5.2 Summary of Findings.....	53
5.3. Recommendation for improved sustainability	58
5.4.Conclusions.....	54
5.5. Recommendation for further studies	58
REFERENCES.....	59

APPENDICES.....	64
Appendix I: Letter of Transmittal on Data Collection	64
Appendix II: Questionnaire for Household Heads.....	65
Appendix III Interview Guide.....	71
Appendix IV: Interview Schedule for KFS Staffs at Kieni Office.	75
Appendix V: 326 Random Numbers	77
Appendix VI: Map of Aberdare Range Forest.....	79
Appendix VII: Map of Kieni Forest	79
Appendix VIII: Research Permit	81
Appendix IX: Research Authorization.....	82

LIST OF TABLES

Table 3:1: Operational definition of variables	26
Table 4.1: Gender of Respondents.....	29
Table 4.2: Respondent's age	30
Table 4.3: Comparison between Gender and Highest level of Education Completed.....	30
Table 4.4:The Marital Status of the Respondents	31
Table 4.5: Main Occupation of Respondents.....	32
Table 4.6: Community Members in Community Forest Association (CFA).....	33
Table 4.7: Respondents farming in the forest	34
Table 4.8: Hectare of Land Being Farmed In Kieni Forest by Respondents.....	35
Table 4.9: Respondents engaged in Kieni Forest Policing	36
Table 4.10: Respondents Perception on Whether Kieni Forest Is Under Destruction	36
Table 4.11: Form of Destruction of Kieni Forest	37
Table 4.12: Respondents involved in afforestation of Kieni Forest	38
Table 4.13: Importance of Kieni forest to the respondents	39
Table 4.14: Respondent's economic activity.....	40
Table 4.15: Fuel type used by Respondents.....	41
Table 4.16: Respondents' average income (wage) per month.....	42
Table 4.17: Respondent's level of information about the need of sustainability of Kieni forest	44
Table 4.18: Seminars attended by Respondents	45
Table 4.19: Host for the Seminars attended by Respondents	45
Table 4.20: Respondents confirmed to have attended exhibitions on Kieni forest conservation	46

Table 4.21: Respondents who had read posters on Kieni Forest Conservation.....	47
Table 4.22: Respondents who have had conflicts with KFS	48
Table 4.23: Action taken by KFS on Respondents found destroying Kieni forest.....	48
Table 4.24: Respondent’s opinion on how to handle those found destroying Kieni Forest.	49
Table 4.25: Non-timber forest products and their uses by respondents	50

LIST OF FIGURES

Figure 1: Conceptual framework	19
--------------------------------------	----

ABBREVIATIONS AND ACRONYMS

CFAs	-	Community Forest Associations
CFM	-	Community Forest Management.
CFW	-	Conceptual Framework.
CMs	-	Community Members
CP	-	Community Policing.
CSD	-	Commission on Sustainable Development
DRSRS	-	Department of Resource Surveying and Remote Sensing.
FAO	-	Food and Organization
FMPs	-	Forest Management Plans.
GDP	-	Gross Domestic Product.
GEF	-	Global Environment Facility
GHGs	-	Green House Gasses
IBA	-	International Birds Centre
IDPS	-	Internally Displaced Persons
JFM	-	Joint Forest Management.
KEFRI	-	Kenya Forestry Research Institute.
KFM	-	Kieni Forest Management
KFS	-	Kenya Forest Services
KFWG	-	Kenya Forest Working Group
KWS	-	Kenya Wildlife Services
NRC	-	Non Resident Cultivation.
NTFPs	-	Non Timber Forest Products
PFM	-	Participatory Forest Management.
RFD	-	Royal Forest Department.
UNEP	-	United Nations Environmental Program
UNGCHE	-	United Nations Global Conference on Human and the Environment.
WCED	-	World Commission on Environment and Development
WCFMPP	-	Wombat Community Forest Management Pilot Project

ABSTRACT

Forest sustainability is a global concern since forests are of great importance as they maintain climate by regulating atmospheric gases and stabilizing rainfall. Forests are also a home to a wide range of wild animals and birds. They protect against desertification and provide numerous other ecological functions. This phenomenon of forest sustainability was brought to focus in this study of Kieni forest in Aberdare ranges. The research covered four specific objectives that explored issues influencing sustainability of Kieni forest. The study explored literature review to capture what other researchers/scholars had contributed to this subject of forest sustainability. The study was based on a conceptual framework with four independent variables: Community participation, Socio-economic status of community members, Community awareness and Forest management practices, whose influence on the dependent variable (sustainability of Kieni forest) were determined. The study was grounded on the Common property theory as put forward by Agrawal Arun in 1997.

Cross sectional survey that is descriptive in nature was utilized to collect data from household heads/ representatives who were 18 years and above. This methodology was necessary in this study of a sample at a point in time (defined time). A sample size of 326 households drawn randomly from 1762 households based on formulae put forward by Yamane (1967) was used in the study whose findings were generalized to the entire population. Leaders of CFAs and KFS were sampled based on non probability techniques and were interviewed separately. This yielded data that was of value to the study. Data in this study was collected using quantitative tools mainly the Questionnaire, interview schedule and interview guide. To ensure validity of the study, the research tools were validated before use by use of the University of Nairobi educational experts' and peers' opinion. The pilot testing was done on the data collection tools to ensure that the tools were reliable. Test retest method was utilized. The questionnaires were given to a sample of the sample size twice in a period of two weeks prior to the main study. Reliability coefficient from the sets of data was determined. The coefficient represents a correlation. A correlation of $+0.869$ was got. This being above $+0.65$ indicated that the Questionnaire was reliable thus could be used in the study to collect reliable data.

The data collected was edited, codified, tabulated and analyzed using descriptive statistics by help of SPSS package. In the entire study the researcher upheld all ethical values. The study found out that Kieni forest had some appreciable level of sustainability since 400Ha of land has been planted with indigenous tree species in the last five years and 200,000 tree seedlings were in the nursery in readiness to address degraded areas of the forest. Findings indicated that community involvement in Kieni forest conservancy was on a very minimal level (31.1%).

The study recommends that all stakeholders must be involved to ensure that Kieni forest sustainability is upheld. Another finding in the study was that low income earners posed a lot of pressure on the forest through firewood extraction both for domestic use and for sale. The research recommends that the government through KFS, KEFRI and local administration helps the local community members living in the environs of Kieni forest to practice agro forestry to ease dependency on the forest.

In conclusion the government through KFS and other stakeholders to ensure the level of awareness on the need to conserve Kieni forest is increased and each local community member to participate in forest policing

CHAPTER ONE

INTRODUCTION

1.1 Back ground of the study

Worldwide our planet is losing 100 acres of tropical forests every minute. In Latin America an estimated 76,300 square kilometers (Sq km) are lost each year. In Africa 16,000, Asia (not including South East Asia) 17000 and in South East Africa 25,000 square kilometers. On global level, tropical forest destruction is not only resulting in the greatest loss of species ever experienced in the planet history but also contributing to changes in the world climate. Tropical forests are the store houses of the planet. Some estimates claim that tropical destruction is resulting in one species becoming extinct every hour. Tropical forests produce has been of great importance to the development of western industrial culture since 1970`s as it was estimated that active ingredient in 40% of prescribed drugs in the United States (US) originated from tropical forests (Hurst 1990).

Recognition of the issues of sustainability at international level dates back to 1972 when the United Nations Global Conference on the Human Environment in Stockholm called for a closer link between long term sustainability, economic growth and development (Banuri 1993). Forests just like the atmosphere and Oceans are global commons. The global demand for their numerous functions and outputs is increasing with the increase in population while the world wide forest resource is shrinking as a result of over harvesting, deforestation and permanent conversion to other forms of land use in many tropical regions. Forests presents a unique global challenge since physically they are located within the territories of sovereign states yet their environmental role extends beyond their borders at both trans-boundary and regional as well as global levels (Springer 1999). According to Anderson (1987), forest resources are increasing in demand in most developing countries. About 90% of people in those countries depend on firewood as chief source of energy.

Global demand for precious hard wood has gobbled up most of Madagascar's rare rosewood trees; Illegal loggers are posing a lot of havoc to the island's National parks

thus a great need for conservationists to step in to save rosewood and ebony which mature in 100-300 years.(Magazine of the Royal Geographical Society: Feb 2012.Vol.84 No.02). In Africa between 1.6 and 3.5 million hectares of forests are cleared every year. The increasing rates of deforestation of remaining forests and burning of grasslands in Africa require urgent attention.(Ominde 1991).

The East Usambara Agricultural Development and Conservation (EUADEC) project (IUCN project) launched in 1988 as part of efforts by conservation to halt deforestation in the area and support sustainable development (Hisham 1991). The plight of tropical forests has caused intense international concern during the past two decades. Attention has focused on resource degradation, declining biodiversity and the effects of decreasing forest resource on the global climate (Springer 1998).

Forests are fundamental to the maintenance of a habitable biosphere. They conserve biodiversity; within the forests there are many species of plants that provide home to wildlife. According to Salim (1999), forests are very important as they stabilize the landscape and control the water cycle. The binding action of tree roots slow erosion, reduce sedimentation, protect rivers, coast lines and fisheries. Forests make rain locally and keep landscapes moist in periods of drought.

Shem (1995) underscored that forests are a major resource of nearly every country as they provide many services including air cleaning, stabilizing the soil and moderating runoff. Aberdare Range (250,000 Ha) is located in Central Kenya on top of Aberdare National Park and Forest Reserve; the forest belt of the Aberdare range comprises several other reserves as Kikuyu Escarpment, Kijabe hills, Kipipiri and Nyamweru. They form the upper catchments of Tana River, Kenya's largest river as well as Athi, Ewaso Nyiro (North) and Malewa Rivers. They are also the main catchments for Sasumua and Ndakaini Dams which provides most of the drinking water to Nairobi city dwellers.

Aberdare Ranges are part of the Kenya's five major 'Water towers'. Others are: Mau Complex (400,000 Ha), Mt. Kenya forests (220,000 Ha), Mt. Elgon forest (102,695.6 Ha) and Cherangani Forests (120,000 Ha). Kieni is located in the South East of the Aberdare Ecosystem within Kikuyu Escarpment. It borders Kimakia Forest station to the North East, Kinale Forest Station to the West and Raggia Forest station to the North. It is under Thika District forest zone. Kieni forest covers a total area of 13,776 Ha

and is divided into three blocks namely: Kieni, Gakoe and Ndarugu. Kieni forest was gazetted vide legal notice no. 48 of 1948 as part of the Aberdare with an aim of forest conservation and development. The forest falls under an altitude of between 2200m to 3000m above sea level with a bimodal annual rainfall of between 1150mm and 2600mm. The long rains are recorded between March and May while the short rains fall between October and December.

1.2 Statement of the problem

The loss of tropical forests is a critical global environmental problem. It is also a matter of serious global concern. According to (Hurst 1990), the world is losing 100 acres of tropical forests every minute. In Africa 16,000 square kilometers are lost every year. In 1963 Kenya had forest cover of 10% and by 2006 it had dropped to 1.7% due to deforestation. Forests are a basis of water catchments thus their destruction increases pressure on a population grappling with hunger, water and power shortage. Forests are very important in protecting biodiversity, regulating climate patterns and acting as carbon sinks. Geist and Lambin (2002) points out that tropical deforestation is still on and that many conservation efforts in the tropics have not been effective. United Nations Environmental Program (UNEP) was set up in December 1972 with its headquarters being located in Nairobi Kenya to respond to the environmental concerns raised at Stockholm conference. Kenya Forest Services (KFS) mandated to conserve, develop and sustainably manage forest resources has done a lot in ensuring that forests are conserved in a sustainable manner. Through the Community Forest Associations (CFAs), the local community members living in the neighbourhood of Kieni forest have full knowledge that there is need to interact with the forest in a sustainable way, however from an aerial survey of the destruction of the Aberdare range forests presented by UNEP, Kenya Wildlife Services (KWS), Rhino Ark and Kenya Forest Working Group (KFWG) destruction of the Aberdare Range forests continues.

<http://www.unep.org/expeditions/docs/Aberdares-report-english-Aerial 2002>).

Aberdare forest being one of the Kenya's main water towers playing a critical role in supporting the country's economy, this study therefore seeks to establish the key issues influencing sustainability of the Aberdare Range forests. A case of Kieni forest in Gakoe location.

1.3 Purpose of the study

This study was out to determine issues influencing sustainability of Aberdare Range Forests .A case of Kieni Forest in Gakoe Location, Kiambu County.

1.4 Objectives of the study

1. To establish the extent to which community participation influences sustainability of Kieni forest.
2. To assess the influence of socio-economical status of the community members on the sustainability of Kieni forest.
3. To determine the influence of community awareness on the sustainability of Kieni forest.
4. To determine the influence of the forest management practices on the sustainability of Kieni forest

1.5 Research questions

1. To what extent does community participation influence the sustainability of Kieni forest?
2. To what extent does socio-economic status of the community members influence the sustainability of Kieni forest?
3. T o what extent does community awareness on forest issues influence the sustainability of Kieni forest?
4. To what extent do the forest management practices influence the sustainability of Kieni forest?

1.6 Significance of the study

Forests are ‘global commons’ just like oceans and the atmosphere. It is evident that with the eminent global issues of global warming emanating from the high rate of forest cover depletion, it becomes paramount for such a study to be conducted to determine key issues influencing the sustainability of Kieni forest in the Aberdare Range forests. The findings from this Research work are to be used by policy makers to ensure

that prompt decisions based on found facts will be implemented in order to sustain our precious forests. The study is a reference ground to other upcoming scholars as they endeavor to contribute to the body of knowledge about forest sustainability.

1.7 Delimitations of the study

The main respondents in the study were Gakoe location community members living in 1 km radius from Kieni forest, Kenya Forest Services staff living in the Kieni forest. Due to their close proximity to Kieni forest they were deemed to be interacting more with the forest thus able to partake in the study bringing out issues influencing sustainability of Kieni forest.

1.8 Limitations of the study

1. Funds constrain. All activities were managed efficiently thus the researcher operated within the set budget.
2. Time constrain. Proper planning of all activities was done to ensure time management thus completion of the study within the set time limits.
3. Language barrier. Competent local Research Assistants were trained and used in the study for language translation purposes.

1.9 Assumptions of the study

1. That the weather conditions would be favorable for data collection to be done.
2. Respondents were ready to willingly share in the study by availing the information they had without any reservation

1.10 Definition of significant terms

Sustainability is the ability to endure. It creates and maintains the conditions under which humans and nature can exist in productive harmony that permits fulfilling the social, economic and other requirements of present and future generations. Sustainability is important as it ensures that we have and will continue to have all benefits that we derive from forests.

An issue is something that takes time to be fixed. It is a point of concern.

Is something that causes debate, concern and conflict .Some issues can be broken down into small problems that can be answered easily.

Community participation implies allowing the community members to have a key role in contributing ideas, make decisions in all matters relating to forest utilization and conservation. It can also be defined as involvement of community members in forest affairs to enable them solve their own problems. Community participation is important as it motivates people to work together and own up the project/activity they are engaged in. Through community participation, community members see a genuine opportunity to better their own lives and that of the entire community as a whole.

Community policing (cp) is a policy of the people, for the people and by the people. In cp citizens are police without uniform. Through cp each and every community member has an obligation of ensuring that the forest is protected from any form of destruction. Community members keep an eye on the forest resources to ensure that any illegal forest activities are reported to KFS for urgent action.

Community awareness this has to do with the community members being informed of issues affecting them. This can be through special lectures, group discussions, training camps; posters/charts/photographs/exhibitions/media/press/short films/folk songs.

Community awareness is the key to community participation in forest conservation/sustainability well informed /aware people will have more role clarity in forest conservation. They will be able to contribute their best if they know the issues surrounding them.

Social economic issues have to do with poverty, gender violence, and joblessness.

Forest management practices these are the various activities carried out by the forest management team (KFS) that determines the sustainability of the forest. They include: manner in which forest laws are enforced, Handling of NTFPs, Efficiency of shamba system (shift cultivation) being practiced, extent of forest fencing done, extent of forest surveillances (patrols) done.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature related to the issues that influence the sustainability of Aberdare forests case of Kieni forest. Various aspects are thoroughly examined from the Global, Continental, Regional, National and study area respectively. Literature review for this study was drawn from books, research work, e-journals, magazines, government publications, Kenya Forest Service publications and the Internet. Literature was reviewed under the following main themes: history of forest conservation, community participation in forest sustainability, social economic issues relating to forest sustainability, community awareness on forest sustainability, forest management practices and how they impact on forest sustainability.

2.2 History of forest conservation

The issue of sustainability of forests at international level dates back 1972, when the United Nations Global Conference on Human Environment in Stockholm called for a closer link between long run sustainability-and economic growth and development. (Banuri, 1993). Neefjes (2000) noted that in 1972 at the United Nations Conference on Human Environment(UNCHE) or the Stockholm conference, Indira, Gandhi, the India's Prime Minister, set the tone for some of the differences of opinion and confrontations between industrialized countries and poorer states when she asked ‘ Will the growing awareness of one humanity? Will there be a more equitable sharing of environmental costs and a greater international interest in the accelerated progress of the less development world?’ The conference agreed to form UNEP with it’s headquarter being located in Nairobi, Kenya. In 1984 United Nations (UN) set up the World Commission on Environment and Development (WCED) also known as the Brandt land Commission which investigated Environmental and Developmental issues and proposed future management strategies. The commission produced the report Our Commission Future 1987 and famously defined sustainable development.

It recommended holding a World Conference on Environment and Development (UNCED) or Earth summit in Rio de Janeiro, Brazil in 1992 UNCEP agreed the terms of Agenda 21 a programs for promoting sustainability and development from 1992 through the twenty first century, various other treaties were discussed at UNCEP for example the frame work convention on climate change was produced and the convention on biological diversity was agreed in December 1993.

In Rio, the Global Environment Facility (GEF) was reinforced in order to provide funds for developing the countries for environmental programmes. UNCEP also initiated negotiations towards the ratification of the UN convention to combat desertification with particular relevance for Africa. This entered into force in December 1996. The Commission on Sustainable Development (CSD) was formed to ensure and monitor progress on Agenda 21. Salim (1999) underscored that immediately after the Earth summit in 1992, Oia Uiisten, former Prime Minister of Sweden and Emil Salim, former Minister of population and environment of Indonesia convinced a series of meetings of forest leaders to seek a way forward from the deeply divided post ions on forests between North and East.

Stoddard (1987) documented that in America as early as 1875, the American Forestry Association was founded to educate people on the need for conservation measures. In 1891 an act of congress authorized the establishment of the forest reserves and marked the real beginning of a National conservation policy.

Reed (2010) noted that since 1990`s sustainability become a more prevalent theme in public policy around forestry in Canada; different forms of engagement among government agencies, forestry companies and forestry communities emerged to address planning and management issues.

Okunade *et. al* (2007) noted that a Participatory Approach gives communities the right to control and manage the forest. The role of forests in climate is complex. Forests fix carbon and metabolize carbon compounds. Forests with their soils contain two to three times the amount of carbon currently held in the atmosphere. Forests are very important in stabilizing Green House Gases (GHG) concentration by making use of carbon dioxide through photosynthesis and releasing Oxygen (O₂) to the atmosphere through respiration. Forests are important in controlling global warming (Ominde 1991).

Production of woods and the manufacture of wood products from forests contribute about US \$ 400 billion to the world market economy (about 2% of total Gross Domestic Product (GDP)). There is also a wide range of non-wood forest products that benefit Man-kind such includes; Rubber, Fruits, Nuts and Medicinal herbs. In the Aberdare forests, non wood materials are extracted by the neighboring community members who make products like Plucking baskets sold to the tea farmers. The forest is rich in volcanic soils. The Western part of the forest has dark brown soils while the Eastern part of the forest has red volcanic soils. Generally the Kieni forest soils are rich in organic matter. Kieni forest is of great ecological and economic value. It is a water catchment area, a source of four rivers namely: Chania, Kariminu, Ndarugu and Thiririka with a chain of streams bisecting the forest.

The ecosystem is a vital source of water to the forest community and drain into the Tana River that sustains thousands of people in the Eastern and Coastal regions of this country. The ecosystem is rich in wide range Game animals that must be conserved. These include: African Elephant (*Lexodonta africana*), the Duiker (*Neotragas moschatus*), Bush pig (*Patomocherus porcus*), Porcupines, Bush baby (*Galago senegalenses*), Mongoose, Antelopes and Tree hyrax. Other animals present are Black and White colobus (*Colbus guereza*), Skyes monkey (*Cercopithecus mitis*) and Baboons. Kieni is also an International Birds Area (IBA) where different bird species are found. These include: *Abbotts staring*, *Jackson's francolin*, *Hunters costical*, African Green ibis, Red chested owlet and Crowned hawk eagle.

Kieni ecosystem is rich in a number of tree species some of which are endangered due to their high economic value; illegal logging is rampant in the forest. Some of the tree spp available in the forest include: Bamboo, *Croton macrostachyus* found along the rivers/streams, *Ocotea usambarensis*, *Olea Hochstelleri*, *Prunus Africana*, Podo and Syzygium. In the plantation zone there are exotic species such as *Eucalyptus* spp., pine spp., *Cypressus* spp. and *Acacia mearnsii*. Sustainable slogan is popular these days. The environment is on agenda for every nation whether the issue at stake is economic, politics or war. Some governments today can win or lose elections depending on how 'green' or brown they are in their policies. People demonstrate violently in defense of the environment than ever before. It is a question of survival of all mankind (Ominde 1991).

2.3 Community participation in forest sustainability

In February 2002 the Victorian government of Australia announced forestry reforms that included strengthening community participation in forest policy making and management (Bracks and Gabbutt 2002). One focus on this change in policy emphasis was the announcement of a Community Forest Management (CFM) pilot project in central Victoria. The Wombat Community Forest Management Pilot Project (WCFMPP) was the first significant government sponsored community based forest management project in Australia (Nelson and Pettit 2004). The WCFMPP continues today as an instance of the growing influence of community forestry in its many variants round the world (Egan and Ambus 2001). Models of community based natural resources management in Australia illustrate a range of devolution of powers to local communities from state agencies and commercial industries (Ross *et al* 2002).

Reed (2010) in his study noted that since 1990's sustainability has become a more prevalent theme in public policy around forestry in Canada. Different forms of engagement among government agencies, forestry companies emerged to address planning and management issues. Advisory committees were formed as a means of community based public engagement where local forest users along with people involved in the forest sector for their livelihood, representatives of other local agencies such as educational establishments and provide input into local decision making.

Benjamin 2010 in his study on Women in Community Forestry Organization. An empirical study in Thailand noted that women are continuously dominated with only 3 women out of 20 representatives on village forest committee and making decisions (women make up to 16% of the Village forest committees. His findings also showed that women are not well represented in forest conservation initiatives despite the fact that they are the source food security for their household.

According to (Proffenberger and McGeen 1994) promising experiences of dry Joint Forestry Management (JFM) schemes have emerged as highly influential force in restoring India's degraded forest lands. Jeffery (1997) underscored that JFM is a variant of community forestry widely adopted in India, in which responsibility and benefits are shared by local user groups with forest departments. As of now 16 of 25 states in India have issued JFM agreements covering about 2 million hectares of forests. JFM

agreements are increasingly influential worldwide model in attempts to reverse deforestation trends and uplift disadvantaged rural groups.

Deep in the heart of Mexico's Yucatan peninsula, 16,000 campesinos or subsistence farmers have joined together with the Government, Local Foresters and Conservationists to deal with issues of forestry and land degradation and periods of hunger is now being introduced to activities such as agro forestry which can stabilize land use and make the best use of cleared land (Salim 1999). Hazelwood (1987) notes that deforestation cannot be reversed and sustained patterns of forest land use established without the active participation of the millions of small farmers and land less people who daily depend on forests and trees for survival. A much greater emphasis on `bottom-up` approach is needed to balance prevailing `top down` policies.

Young (1990) explains that community forestry requires acceptance and involvement. Villages must be convinced that a village woodlot will really serve them; otherwise it is unrealistic to expect them to keep their starving herd from eating the seedlings as soon as they are planted. There are good examples of very successful of forestry programs from Korea and China. Involving the local people should start with the recognition that no society is homogeneous. It is important to identify all the interested parties list their priorities which may conflict and link these priorities with the interests of the majorities and improve their long term well-being (Hisham 1991).

The future of Tanzania's forests depends on stakeholders' cooperation to manage forest sustainably. The community forest conservation network enables forest adjacent communities to engage more actively in the development of Participatory Forest Management in the Eastern Arc and coastal forests. (<http://www.tfcg.org/docs/cfcn.htm>). Wiersum (1984) clarified that forestry can neither develop nor survive without the active involvement of the local community. Effective participation in conservation means involving people throughout the organization and decision making of process. The participation of local community will never materialize unless a sense of belonging is created among them through the practices of Joint Management, in which the Forest Service acts as co partner with the local community organization to serve the larger national needs for forests and forest products.

Richards *et al* (2003), asserts that forest conservation through community involvement has resulted into marked improvement in forest status in South East Asia. In Kenya much of community participation in forest conservation has been through formation of Community Forest Association (CFAs) and jointly with Kenya Forest services (KFS) and other partners, Kenya Forests working Group (KFWG) a lobby grouping forest conservation is supporting participatory forest management (PFM) process through development of Forests Management plans (FMP) and agreements and training CFAs on PMF (Negotiation, leadership, governance, conflict management etc.) The management plans has successfully facilitated the development of Dundori Forest, Bahati Forest and Maasai Mau Forest. The next step is to develop Management Agreements between KFS and CFAs. (<http://www.eawildlife.org/projects/kfwg>).

Cherono (2006) in her study about Community Participation in Conservation and Management of forests. Case of Karura forest underscored the fact that exclusion of community members from management of forests and woodland resources contributed to the vulnerability of forests. Local communities exist in or around forest areas. Active participation by local community should be more favorable for sustainable forest management. Community participation should be included even at the stage of developing management plan so that their benefits can be taken into account. In project implementation, local community members undertake in some tasks to ensure ownership of those projects. The local community members should be allowed to participate in Sustainable tropical forest management.

2.4 Socio-economic issues in forest sustainability

Geithner (1998) noted that many poor Asians live in rural areas where their income and welfare remains dependant on their access to and management of land, water and forestry resources. Western (1994) also pointed out that poverty and the desire to progress encouraged overexploitation and environmental destruction in rural areas. Poor people put survival above all things while those in search of progress often ignore environmental costs. In both cases sustainability is hampered/ goes to the wall.

In many countries, plans to protect forest ecosystems have failed to address the needs and knowledge of local forest Dependants communities. (Anan 1996, Wily1997, Tuxill and Nabhan 1998, Kumar 2000).

Extreme poverty results in heavy subsistent demands especially for firewood and building materials and illegal activities within the forest such as poaching (of firewood and animals). These activities endangered the forest resources that have up to now helped support local communities leading to a vicious circle of degradation all these seen in tropical forests. (<http://www.birdlife.org/action/ground/arabuko/>).

Salim (1999) underscored that lacking economic incentives to keep forest lands forested makes land owners to prefer to dedicate their lands to more financially rewarding users. A land owner in an upper watershed does not get paid for the protection against soil erosion or sedimentation that his forest provides for farmers or urban dwellers located downstream. Nor does the forest landowners profit from the atmosphere that helps to arrest global climate changes from maintaining scenic beauty in the land scape or from providing a natural habitat for endangered species. Forests in conservation use appear to produce lower returns than alternative uses of land. Financial regimes offer the land owners less profit for sustainable timber management than unstained logging practices; agro forestry offers lower returns than slash-and-urban sustainable timber and other forest products offer less than using the land for livestock, forests `mined` for firewood are more lucrative than forests managed for sustainable fuel wood consumption etc.

Dixon (1991) also explained that many of the benefits of conserving natural areas are difficult to measure and are not exchanged in markets thus the value of conserving rather than developing an area is after underestimated. This leads to a bias towards development and exploitative use of an area; the end result is that fewer natural areas are protected than would be the case if all the benefits of conservation were included in the economic analysis of alternative uses.

World Commission on Environment and Development 1987, United Nations conference on Environment and Development 1992, Commission on Sustainable Development,1995 and World Commission on Forests and Sustainable Development

1995 noted that social patterns like poverty and economic disenfranchisement and lack of control over local resources are major causes of global degradation.

According to the report of the United Nations Conference on Environment and development (June 1992). The problems that hinder efforts to attain the conservation and sustainability use of forest resources and that stem from the lack of alternative options available to local communities in particular the urban poor and poor rural populations who are economically and socially dependant on forests and forests resources should be addressed by government and the international community. Local community view initiatives focused on community involvement in forest conservation and management as a continuation of the state's control of forest resources. In some countries like Ethiopia, local communities have been unwilling to participate in forest activities with no clear basis on benefit sharing. Effective involvement of local people has mainly been discouraged through state monopolies on market for wood and forest products whose controlled prices are below the economic value thus leaving people without an incentive to engage in forest activities aimed at wise utilization of forest products. In Kenya local community support is still being hampered by the slow attitudinal change on the part of the policing persons who in some cases have been involved in fatal confrontations with local community user groups. In general, despite all these measures, local attitudes towards forest management installations are manifested in suspicion, fear and distrust thus illegal forest activities are on increase and the remaining portions of primary forest will soon be degraded and converted to secondary forests. (<http://www.fao.org/DOCREP/006/j0628E32.htm>).

In Zambia the high use of forests by households adjacent to forests has been said to be destructive for example using destructive methods to harvest wild foods and medicines. Emerton (1999) noted that in Zambia and many other countries, the impact of communities collecting such products on a sustainable yield basis has not been much researched and is largely unrecorded. Communities in Zambia have a large stake in forest management and in programmes and policies that promote or restrict use of forests. These is especially critical for the poorest households, while the richer households account for the bigger proportion of the harvested forest products` volume, the poorest

households are the worst victims of forest degradation or policies that might control use without proving significant alternative income.

Poverty is defined as an economic condition of lacking both money and basic necessities needed to successfully live such as food, water, education, health care and shelter. (en.wikipedia.org). Population living below income less than \$1.25 and less than \$ 2 per day are said to be under poverty. Wambua, (2008) noted in his study that household dependence on natural resources decline with increase in income/wealth. This was also underscored by Ready and Chakravarty (1999), Cavendish and Jodha (1986). Sander and Zeller, (2004) in a study in Madagascar points out that the poorest households suffer most from a strict forest conservation approach while better-off households benefit more due to improved provision of indirect forest services. Community forestry is promoted as it leads to improved welfare of forest adjacent people. Bryon and Anold (1999) in their study reported that household reliance on forests increases as their farm size or farm productivity reduces. The poor especially those with no land or less land use forests as a buffer on which they turn to in times of lack but as household income increases dependency on forests resources may reduce (Adhikari 2005).

Hisham (1991) points out that poverty was a major obstacle to sustainable forestry in Sudan. He noted that the poorest people fighting for survival could hardly afford to wait for slow process of a forestation. On the western part of Kieni forest there are Internally Displaced persons occupying a section of Kieni forest and on the Eastern side, there is a large tea plantation surrounded by the Kieni forest. There are other dwellers adjacent to Kieni forest in Gakoe and Ndiko sub-locations. The study found out how the socio-economic life of the under mentioned persons influenced the sustainability of Kieni forest.

2.5 Community awareness in forest sustainability

Nelson and Pettit (2004) argue that a crucial aspect of citizen participation in natural resources management is information. A community responsible for forests must have access to highly specialized information on forests ecology and the economic of forest based industries. Benjamin (2010) in his paper on Women in Community Forestry Organization; An empirical study in Thailand argues that lack of knowledge exchange

and women's' continued exclusion from the forests management are critical issues that could undermine the future of the world's forests. This research recommends a more participatory approach that will provide for women's equal participation in decision making and thus full contribution in forest conservation.

Nijhoff (1984) advocates that to foster public relations and to spread knowledge about forestry among the public, there should be clearly defined aspects of policy. The implementation of this policy should be the specific responsibility of one of the forest authority's senior officer. He noted that forest officers and foresters may be forestry's most effective ambassadors to the general public.

United Nations Environment programme (UNEP) acts chiefly as a coordinating body within the United Nations family on subjects related to the environment, promotes world/Regional interests in the major environmental subjects and an integrated approach to them. UNEP coordinates the monitoring of international programmes affecting the environment also supports the convincing of meetings, workshops, panels of experts and international conferences as well as publication of brochures, books and reports on subjects such as desertification arid land management, alternative energy sources and tropical forests.

In 1976 the American forestry Association was founded to educate people on the need for conservation measures (Stoddard 1987). More and better information from the local level needs to flow upwards to government International Aid Agencies both to improve communication and understanding at all levels and to ensure that forestry policies and programs fit local needs and conditions. The basic social economic and technical data needed can be provided most efficiently by local people themselves (Hazelwood 1987). In adequate awareness and understanding world wide of the adverse ecological, economic, and social impact of Tropical deforestation is a major constrain to developing the political will to address the Tropical situation.

Public awareness on forests legislation, management and silvicultural techniques via mass media and publication and distribution of forestry newsletter, the broadcasting of Radio programmer and production of films and Video programmes will go along way in enhancing forestry sustainability (Hisham 1991).

Local communities aware of the immediate environmental consequences of their actions are more likely to find innovative solutions which would allow them to coexist harmoniously with the environment. It has become evident that ecological health is necessary for the very sustainability of life upon this planet (Banuri 1993). The people living adjacent to Aberdare forest (Kieni forest) are presumed to be aware of their need to conserve the forest. The study will entail to know why there is still forest destruction despite the knowledge possessed by the local people.

2.6 Forest management practices in forest sustainability

Okunade and Yekinni (2007) points out that forestry practices have undergone dramatic changes over the past 30 years. In addition to its traditional role in the protection and management of trees, forestry now takes a holistic approach to resource use.

In Thailand, the Royal forest Department (RFD) informally allows the community to manage the forest with traditional regimes. According to the village heads; the forest (koke chantanang) forest has undergone a decline in the past two decades owing to pressure for more farm land and massive cutting of trees.

Kinyua (2002) in his study of the Ruthumbi forest observed that community members exerted enormous pressure on the forest through firewood trading, Timber logging, cattle grazing and charcoal burning.

2.7 Theoretical Framework

The study was grounded on the **Common property theory** as put forward Agrawal Arun in 1997. The study of forests as common has been one of the stimulus to the development of scholarship in common property. Forests yield multiple of products over which diverse stakeholder assert competing claims thus their proper governance is very important (Arnold and Sterwart 1991). Forests being part of common pool resources just like the atmosphere, variations in the institutional arrangements shape forest sustainability. Forests cover about 30% of the global land (FAO, 2005). However the total area under forests continues to decline. According to the most recent Global Forest Resource Assessment, 13 million hectares of forests are being lost annually. Forests are very important in terms of climate change and biodiversity loss. (Wilson, 1988). They

also store more carbon than does the atmosphere with 283 gigatonnes (Gt) in biomass alone, Forests being global commons are extremely important for the survival of humanity as a species thus sustainability of the same must be upheld by every individual.

This theory is very important as it strongly advocates for the conservation of forests as they benefit the rich and the poor globally. It must be stated that based on this theory, it is the sole responsibility of the community members living around Kieni forest to ensure its sustainability since the benefits of forest conservation will be enjoyed by all community members.

2.8. Conceptual framework

The study was grounded on the following conceptual framework (CFW) that provided a Structural description of the relationship between the variables forming the concepts of study on Kieni Forest sustainability. The framework gave a clear picture on how the independent variables influenced the dependent variable under study.

Independent Variables

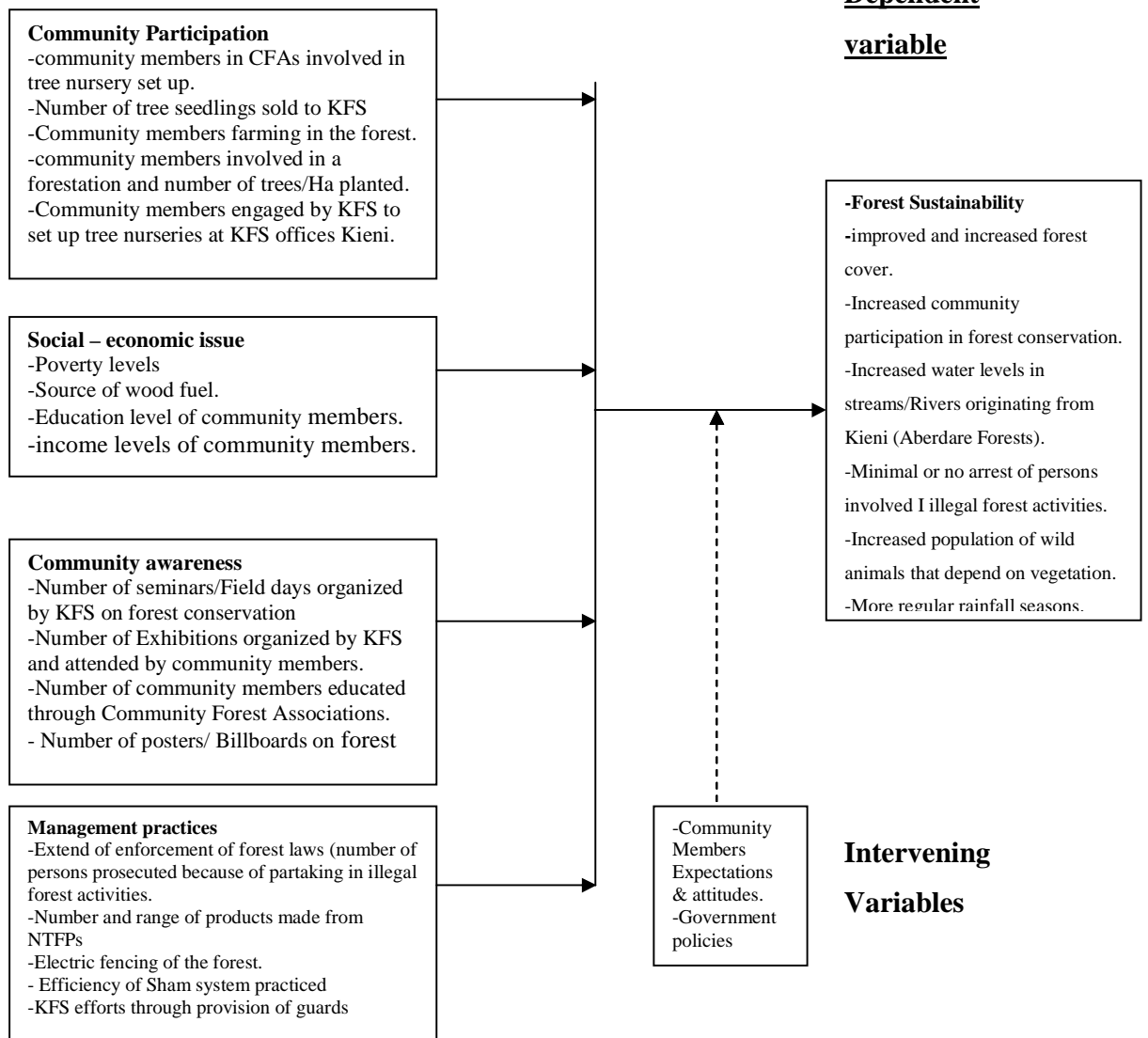


Figure 1: Conceptual Framework flow diagram

A conceptual framework was used in research to outline possible courses of action or to present a preferred approach to an idea or thought. (en.wikipedia.org/wiki). It was about cause and effect. Mugenda and Mugenda (2003) points out that a conceptual framework is a model identifying the concepts under study and their relationship. In a diagrammatic form it presented the manner in which the researcher had conceptualized the relationship between the independent and dependent variables. The conceptual framework provided a structural description of the relationship between the variables forming the concepts

under study (issues influencing sustainability of Kieni forest. The independent variables were placed on the left of the structure and connected with arrows to the dependent variable on the right hand side of the structure showing a direct relationship. As depicted from the conceptual framework, sustainability of Kieni forest was influenced by the extent of community participation in forest affairs, socio economic status of community members, community awareness and forest management practices. There were other factors which were likely to influence the sustainability of Kieni forest though the study narrowed down to the under mentioned issues.

2.4 Summary of Literature Review

In study, Literature Review was done with the main purpose of exploring issues influencing sustainability of Aberdare forests. A case of Kieni forest in Gakoe location. Through the literature review, gaps of knowledge were identified thus need for the study. The extent to which Community participation influences forest sustainability was reviewed from global, international, and regional to the area under study. Other issues influencing sustainability of Aberdare forest that were reviewed included: Socio economic status of community members, Community awareness and forest management practices. Most of the studies reviewed indicated the importance of ensuring that forests are managed in a sustainable manner since they are global commons whose benefits are enjoyed by all persons and wildlife across the world.

Studies reviewed show that the rate of forest loss in the world has reached alarming levels and it is the role of every individual in the respective countries to play a role in forest sustainability.

Most of the scholars have indicated in their studies that the present generation of human beings in every country must do all that it takes to ensure that forests are exploited in a manner that does not deny future generations enjoying the same benefits from forests. The current human generation must endeavour to pass over a well taken care of forests to the future generations. This can only be possible if the underlying issues influencing forest sustainability are keenly upheld.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter covered the study methodology employed in this research. The chapter clearly explains the research design that was used, target population, sample selection and sampling size, Tools of data collection, their validity and reliability, methods of data analysis and presentation.

Cross sectional survey which is descriptive in nature was used in the study to collect data from household heads/ representatives. This being a descriptive research as pointed out by Glass and Hopkins (1984) involved gathering data that describe, tabulate, depict events and then organize the collected data. A cross sectional survey is a type of study that involves gathering of information from a population or a sample at a point in time (defined time). The study was descriptive in nature. The respondents answered questions administered to them in form of questionnaires and interview schedules (Jackson, 2009). The methodology used in the study gave findings that are accurate, reliable and generalizable.

3.2 Research design

Cross sectional survey which is descriptive in nature was used in the study to collect data from household heads/ representatives. This being a descriptive research as pointed out by Glass and Hopkins (1984) involved gathering data that describe, tabulate, depict events and then organize the collected data. A cross sectional survey is a type of study that involves gathering of information from a population or a sample at a point in time (defined time). The study was descriptive in nature. The respondents answered questions administered to them in form of questionnaires and interview schedules (Jackson, 2009). The methodology used in the study gave findings that are accurate, reliable and generalizable.

3.3 Target population

This is the population to which the researcher seeks to generalize the results (Mugenda and Mugenda 1999). The population under study comprised of the two sub-locations in Gakoe location (Gakoe and Kieni sub locations). These sub-locations had a population that had an interaction with the Kieni forest in one way or the other, thus was able to give an inside into issues influencing the sustainability of Kieni forest of the Aberdare range forests. The respondents were household heads/Representatives. The total household from which a sample size was drawn was 1762 households.

3.4 Sample size and sampling procedures

This is a selected number of members or cases from the accessible population which is carefully selected so as to be representative of the whole population. Each member or case in the sample is referred to as a subject/respondent or interviewees (Mugenda and Mugenda 1990). Sampling is thus the process of selecting a number of individuals for a study in such a way that the cases/individuals selected are true representatives of the large group (sampling frame) from which they were drawn.

3.4.1 Sample size selection

A good sample size should have all the salient characteristics of the population to an acceptable degree. The bigger the sample the minimal is the sample error (i.e. the discrepancy between the characteristics of the population and the characteristics of the sample.)

The sample size for the study was determined using this formula as proposed by (Yamane, T (1967).

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

Where; n- the desired sample size.

N- Population of study (1762 households)

e-level of precision (sampling error) the range in which the true value of the population is estimated. In this study the range was $\pm 5\%$

Substituting the values in the equation,

$$n = \frac{1762}{1 + 1762(0.05)^2}$$

The sample size n will be 326 households

$$n = 326$$

The 326 households gave representative characteristics since the study cut across Gakoe location. Considering a 1 kilometer radius from the forest narrows down the sample size from 326 households to 120 households these being part of the 326 households found within a radius of one kilometer from the forest. It was deemed that the closer the distance the household was from Kieni forest, the higher the interaction and vice versa (Wambua, 2008) Unpublished. The researcher purposively selected 1 leader of a Community Forest Association (CFA) and the Forester of Kieni Forest to add to the total number of sample size to be 122 households.

3.4.2 Sampling procedures

As indicated by Mugenda and Mugenda, (1990) in order to select a representative sample the researcher must establish his sampling frame. In this study the sampling frame was Gakoe location.

A simple random sampling was used to select the households that were part of the sample size. This was done in such a manner that each of the 1762 households had equal chance of being included in the sample size. Random numbers were generated by use of Stat Trek's random number generator that uses a statistical algorithm to produce random numbers. Non probability sampling was also used in particular to collect data from CFAs and Forest Department (Kenya Forest Service) office.

3.5 Data collection Tools/Techniques

This study aimed at making use of both qualitative and quantitative techniques in collecting data in order to explore fully the issues influencing sustainability of Kieni forest. The key tools used to collect data were questionnaire, Interview guide and Interview schedule.

3.5.1 Collection of data through Questionnaire

This technique involved administration of typed closed and open questions printed on paper in a definite order aimed at answering specific objectives in the study. The questionnaires were administered to the respondents face to face and answered by the respondents and returned to the researcher on the date of interviewing to enhance the response rate/return rate. In this case Research assistants (Enumerators) were necessary.

Before the use of this tool in data collection, a pilot study for testing the questionnaires was done two weeks prior to the main study. This is also known as pretesting. This was out to improve accuracy of the tool as it gave the researcher room in advance to modify the questionnaire as need arises. Pilot study enhanced the validity and reliability of the tool thus a credible study.

3.5.2 Interview guide

This involved a set of open ended questions that brought the researcher and the respondent on face to face encounter. The interview method of data collection involved presentation of oral verbal stimuli and reply in terms of oral-verbal responses as depicted by (Kothari C.R 1990). Data gotten from structured in depth interview is easier.

3.6 Validity of instruments

Validity is the accuracy and meaningfulness of inferences which are based on the research results. It can also be seen as the degree to which results obtained from the analysis of the data actually represent the phenomena under study.

Validity means how accurately the data obtained in the study represents the variable of the study (Mugenda and Mugenda 2000).

The study was mainly concerned with content validity which ensured that research tools covered the subject matter of the study as purposed by the researcher; Validity is used to measure whether the research measures what it is intended to measure and to approximate the truthfulness of the results. Validity is to do with whether a study is able to scientifically answer questions it is intended to answer.

To ensure validity of the study, the research tools were validated before use based on the University of Nairobi experts' and peers' opinion. The pilot testing results helped the

researcher to modify the questions in the questionnaire as well as the language used. Any ambiguity in questions was removed. This ensured that the research instruments fully covered the variables under study.

3.7 Reliability of instruments

According to Mugenda and Mugenda (2000), it refers to the degree to which research instrument yields consistent results of data after repeated trials. Reliability in research is influenced by random error i.e. the deviation from a true measurement due to factors that have not been effectively controlled by the researchers. Reliability involves freedom from random error. The tendency toward consistency found in repeated measurements is referred to as reliability (Carmines & Zeller, 1979).

The researcher ensured that the tools are reliable by determining reliability coefficient; Test retest method was used. Questionnaires were administered to same members from the sample twice in a period of two weeks prior to the main study. A reliability coefficient from the two sets of data was determined to be +0.869. The coefficient represented a correlation. A high correlation i.e. above +0.65 indicated that the questionnaire was reliable thus could be used in the study to collect reliable data (Knapp 1985).

3.8 Data collection procedures

Upon securing approval from the University of Nairobi and acquiring permit from the National Council for Science and Technology, the Researcher assisted by the Research Assistants collected data from the sample population. The collected data was condensed (summarized) into manageable volumes, analyzed and conclusions/recommendations drawn. A report was compiled after a final defense with the guidance of the supervisor.

3.9: Operational definition of variables

Table 3:1: Operational definition of variables

Objectives	Variables	Indicators	Measure-ment	Scale of measurement	Tools of data collection	Tools of Data Analysis
To establish the extent to which community participation influences Sustainability of Kieni Forest	Community participation	-CMs in CFAs. -CMs farming in forest, -CMs involved in policing. -CMs involved in afforestation &no. Of trees planted.	Mode Mode Mode Mode	Nominal Nominal Nominal Nominal	Questionnaire	Descriptive analysis using SPSS
To assess the influence of Socio-economic status of Community members on the Sustainability of Kieni forest	Socio-economic status	-Income levels. -Gender and Marital status. -Economic activity. -Amount and type of fuel used. -Highest education Completed,	Mean Mode Mode Mode Mode	Ratio Nominal Nominal Ratio/Nominal. Nominal Ordinal	Questionnaire	Descriptive analysis using SPSS
To determine the influence of community awareness on the sustainability of Kieni forest.	Community awareness	-Cms educated through CFAs. -No.of field days/seminars attended. -No of exhibitions organized by KFS. -No, Posters/Billboards on forest conservation available,	Mode Mode Mode Mode	Nominal Nominal Nominal Nominal	Questionnaire	Descriptive analysis using SPSS
To determine the influence of the forest management practices on the sustainability of Kieni forest.	forest management practices,	-Forest law enforcement. (no. of persons arrested while found involved in illegal forest activities. -no. of trees planted), -No. of products from NTFPs. -No. of forest guards from KFS.	Mode Mode Mode Mode	Nominal Nominal Nominal Nominal	Questionnaire	Descriptive analysis using SPSS

3.10 Data analysis techniques

The Researcher was able to link the collected data to the relevant specific objectives and research questions. The collected data was edited, codified, tabulated and analyzed using descriptive statistics. As pointed out by Kothari 2004, editing improves the quality of data for coding where the categories of data are transformed into symbols

that may be tabulated or counted. Tabulation is a technical procedure that entails putting classified data into tables. The organized data was analyzed using descriptive statistics by help of Statistical Package for Social Sciences (SPSS) version 11.5. The organized and analyzed data was presented using percentages and frequency distribution tables. From these findings generalizations was worked out on issues influencing the sustainability of Kieni forest hence the Aberdare Range Forests.

3.11 Ethical considerations

The Researcher carried out the study with utmost professionalism and sincerity in mind. Prior to issuing of the questionnaires to respondents, their consent was sought to ensure that they partook in the study at will. The Researcher made sure that the information availed in the process of data collection was specifically used for the purpose of the research work. To ensure confidentiality, respondents' names were not captured on the questionnaire instead questionnaires were given numerical codes. High level of integrity and honesty was upheld in the entire course of the study. The outcomes of the study were presented without manipulations thus the study endeavored to give credible findings and conclusion.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATIONS, DISCUSSIONS AND INTERPRETATIONS

4.1 Introduction

This chapter covers data analysis, presentation, discussion and interpretation of the data collected from respondents. The collected data was codified and analyzed using descriptive statistics by help of SPSS soft ware in line with the specific objectives of the study. The results of the study were presented in form of percentages and frequency distribution tables. The chapter explored the demographic and socio-economic information of the respondents in relation to Kieni Forest sustainability. The collected data clearly showed the extent to which Community participation, community awareness and forest management practices influences sustainability of Aberdare Range Forests. A case of Kieni Forest.

4.2 Response rate

The data was collected from a sample size of 122 households who were in the radius of 1km from Kieni forest of the Aberdare range forests in Gakoe Location Kiambu County. The main respondents were randomly sampled community members that had interaction in one way or the other with Kieni Forest, the Community Forest Association (CFA) representative and the Forester of Kieni Forest Station. For the purposes of answering research questions, the researcher assisted with well trained research assistants administered all the 122 questionnaires in person to the respondents. Therefore the response rate was 100% which was very adequate for analysis, recommendations and conclusions. According to Frankel and Wallen, (2004) a response rate of over 95% in any study was deemed to be adequate.

4.3 Demographic Information

In this section, household heads/representatives were asked to fill up the questionnaires which captured information to do with gender of the respondent, age, marital status, level of education completed and main occupation engaged in. The study later analyzed the responses and related the same to the sustainability of Kieni forest.

4.3.1 Respondents' Gender

In this section, household heads/representatives were asked to fill up the questionnaires which captured information to do with gender of the respondent, age, marital status, level of education completed and main occupation engaged in. The study later analyzed the responses and related the same to the sustainability of Kieni forest.

Gender was one of the demographic characteristics that the researcher was concerned with in order to fully understand its influence on the sustainability of Kieni forest. To capture this researcher asked respondents to indicate their gender. The scenario of the respondents' gender interaction with forest sustainability was recorded in Table 4.1.

Table 4.1: Gender of Respondents

Gender	Frequency	Percent
Male	64	52.5
Female	58	47.5
Total	122	100.0

According to this study 64 (52.5%) of the respondents were men whereas 58 (47.5%) of the respondents were females: it was necessary for the researcher to understand the gender composition of Gakoe location since men and women interacted and influenced Kieni forest sustainability differently. Since the study was interviewing household heads, it confirms from our African set up that most homes are headed by men however the scenario is changing since now days most homes/ households are headed by female. In this study the representation between male and female had a very small margin according to 6(5.0%). The study findings confirms the study undertaken by Benjamin,(2010) in Thailand in which he found out that women were not well represented in forest conservation initiatives despite the fact that they were the source of food security in their families. Gender distribution was found to bear a strong influence on Kieni forest sustainability

4.3.2 Respondent's age

Age was another demographic characteristic that was likely to influence Kieni forest sustainability. To determine the extent to which age influenced sustainability of Kieni forest respondents were asked to indicate their age in complete years. The age of the respondents was captured in Table 4.2.

Table 4.2: Respondent's age

Age Distribution	Frequency	Percent
0 – 20	7	5.7
21 – 40	59	48.4
41 – 60	41	33.6
61 – 80	13	10.7
81 – 100	2	1.6
Total	122	100.0

According to Table 4.2, 59(48.4%) of the respondents were in the age bracket of 21-40 years whereas 41(33.6%) were in the age bracket of 41-60 years. This indicates that majority of the respondents were in their active reproductive age thus interacted to a large extent with Kieni forest.

4.3.3 Comparison of Gender and highest level of Education completed

Table 4.3: Comparison between Gender and Highest level of Education Completed

	Highest Level of Education				
	University	Tertiary	Secondary	Primary	Never
Gender of Respondent;					
Male	1	2	18	40	3
Female	2	0	10	36	10
Total frequency	3	2	28	76	13
Percent	2.5	1.6	23.0	62.3	10.6

The findings indicate that a total of 76 (62.3%) of the respondents had education up to primary level with another 13 (10.6%) having never had any education. This indicated that the literacy level of Gakoe was low. This implied that ability of Gakoe location residents to comprehend issues of conservancy of Kieni forest was low and this was negatively influencing the sustainability of Kieni forest. The findings also indicate that men were more represented at the various levels of qualification apart from university level where there were more women.

4.3.4 Marital status of Respondents

Table 4.4. The Marital Status of the Respondents

Marital Status	Frequency	percent
Married	78	63.9
Single	23	18.9
Separated	1	0.8
Divorced	6	4.9
Widowed	14	11.5
Total	122	100.0

From Table 4.4 it is clear that most of the respondents dwelling in the neighborhood were married 78(63.9%) of the total. This implied that most of the respondents had varied needs for themselves and their family members thus were interacting with Kieni Forest to meet some of their unsatisfied needs. Out of the total population 23(18.9%) were single. Six (4.9%) were divorced and 14(11.5%) were widowed. Most of these respondents who were either divorced or widowed were Internally Displaced Persons (IDPs) that were living on the western part of Kieni Forest. Three quarters of the IDPs had a very significant interaction with Kieni Forest.

4.3.5 Main occupation of the Respondents

This data was collected and presented in Table 4.5

Table 4.5: Main Occupation of Respondents

Occupation	Frequency	Percent
Employed	43	35.2
Employed by KFS	1	0.8
Farmer	43	35.2
Business	27	22.1
Vocational	4	3.3
Others	4	3.3
Total	122	100.0

The distribution in Table 4.5 shows that 43(35.2%) of the respondents were employed mainly in a large scale tea plantation that is surrounded by Kieni Forest thus had a close interaction with the forest. Also 43(35.2%) of the respondents were farmers, a fraction of them being mixed farmers in the environment of Kieni Forest while others were farmers farming in Kieni Forest on land allotted to them by Kenya Forest Service (KFS). KFS was using these farmers to afforest degraded/deforested areas of Kieni forest. The farmers were allocated land in the range of $\frac{1}{4}$ acre to 2 acres which they tilled KFS planted in trees which were maintained by these farmers for a period of 3 years then the farmers were moved to other areas and trees left to get established. Twenty seven (22.1%) of the respondents were small business owners, mostly selling wood fuel from Kieni Forest. Four (3.3%) of the respondents were engaged in vocational activities mainly spiritual related while the other four (3.3%) were in other occupations.

4.4 Sustainability of Kieni forest

Sustainability of Kieni forest was analyzed by looking at how community participation, socio-economic status of community members, community awareness and forest management practices influenced sustainability of Kieni forest. These variables were studied by looking at various indicators of community involvement in Kieni forest

sustainability. The indicators studied included community members in CFAs, community members farming in the forest. Hectares of land being farmed by community members, community members involved in forest policing, community members involved in tree planting exercise in Kieni forest.

4.4.1 Community participation in Kieni Forest sustainability

The data collected in this area endeavours to establish the extent to which community participation at various levels influences sustainability of Kieni Forest.

In order to establish the extent of participation of community members in Kieni forest sustainability, respondents were asked to indicate whether they were members of CFAs. Their responses were captured in Table 4.6

4.4.1.1 Community members in Community Forest Associations (CFAs)

Table 4.6: Community Members in Community Forest Association (CFA)

CFA Membership	Frequency	Percent
Yes	38	31.1
No	84	68.9
Total	122	100.0

The study found out that 38 (31.1%) of the respondent were members of CFA who were actively participating in Kieni forest conservation. The study noted that 84 (68.9%) were not members of CFAs thus were not involved in conservancy issues. Community members' failure to join CFAs was negatively affecting sustainability of kieni forest. Members of CFAs were involved in planting of trees in Kieni forest and also raising of tree seedlings.

The findings contradicts with what Salim,(1999) found out in his study in Mexico's Yucatan Peninsula where local community members had Joint hands with the government, local foresters and Conservationists do deal with issues of forestry and land degradation. The members of Gakoe location lacked the incentive of participating in Kieni forest conservation. This was the reason why only 38(31.1%) of the respondents

were members of CFAs. These were the few individuals who were working towards indigenous forest restoration by re planting degraded patches in the forest.

4.4.1.2 Respondents farming in Kieni Forest

The researcher also desired to establish community members who where farming in Kieni forest in order to determine their extent of participation in term a forestation of Kieni forest on PELIS programme. The respondents were asked to state whether they were farming in Kieni forest and the results of their responses were shown in Table 4.7.

Table 4.7: Respondents farming in the forest

Farming in Kieni Forest	Frequency	Percent
Yes	28	23.0
No	94	77.0
Total	122	100.0

Out of the total respondents 28 (23%) of them reported that they were farming a variety of crops in Kieni Forest including vegetables: cabbages, kales, carrots and Irish potatoes. This was being done on pieces of land given to them by KFS at an annual fee. However, the KFS was using the same pieces of land to plant trees that would be managed by these farmers under close supervision of the Forest Management (KFS).

The findings indicated that 94 (77.0%) of the respondents were not farming in Kieni Forest. Community members farming in the forest were very instrumental as they were being used by KFS to raise tree seedling on PELIS programmers; under this programme community members were allocated land on which tree seedlings were planted by KFS. The community members were benefiting by planting crops as they took care of the tree seedlings for a period of 3 years before they were moved to another section of the forest.

According to KFS members farming in the forest on shamba system risked claiming squatter rights on the forest land thus KFS was advocating for CMs to farm on Non-Resident Cultivation (NRC) basis where members were advised to join CFAs and farm as members of CFAs and not residing in the forest. Studies done by Proffenberger and McGeen (1994) and Jeffery (1997) in India shows that CMs through Joint Forest

Management (JFM) a model similar to CFAs helped a lot in afforestation of degraded areas of forested land in India.

4.4.1.3 Hectare of land being farmed in Kieni Forest by Respondents

The researcher was out to establish the amount of land that was being farmed by community members in the forest to determine each individual's extent of participation in nurturing of trees planted by KFS. Table 4.8 shows responses recorded.

Table 4.8: Hectare of Land Being Farmed In Kieni Forest by Respondents

Hectares Being Farmed	Frequency	Percent
<1/2 acre	14	11.5
1 acre	4	3.3
2 acres	6	4.9
3 acres	1	0.8
>3 acres	1	0.8
Not Applicable	96	78.7
Total	122	100.0

From Table 4.8 the study found out that 14(11.5%) of the respondents were farming less than ½ an acre in Kieni Forest. This was an area deemed to be adequate for that individual farmer to be able to well maintain the trees planted by KFS on the plot. Four (3.3%) of the respondents were farming at least 1 acre of land while 6(4.9%), 1(0.8%) and 1(0.8%) were farming 2 acres, 3 acres and more than 3 acres respectively. A farmer who would have been accessed by KFS and found to be a good performer in terms maintenance of the planted trees in the previous seasons would be honoured by being allotted more farming land though still at a fee. Ninety six (78.7%) of the respondents had no farming land in Kieni Forest.

4.4.1.4 Respondents involved in Kieni Forest policing

The level of community participation in Kieni Forest sustainability was also evaluated based on the level of policing by the respondents. This was determined based on the data in Table 4.9.

Table 4.9: Respondents engaged in Kieni Forest Policing

Forest Policy	Frequency	Percent
Yes	57	46.7
No	65	53.3
Total	122	100.0

From the study findings 57(46.7%) of the respondents acknowledged that they had Kieni Forest at heart and were out to ensure that any sort of destruction of Kieni Forest would be reported to KFS Kieni Station. The remaining 65(53.3%) of the respondents did not partake in policing of Kieni Forest. Efforts of KFS Kieni must be harnessed to ensure that community members own up Kieni Forest. This will assist in making sure that all the conservancy measures of Kieni Forest are upheld with all the seriousness that is required.

The findings of the study correlates with the study by Mbuvi and Musingo (1999) in Arabuko- Sokoke forest Kenya which indicate that people centered forestry was a new concept in Kenya that was why it was slowly being recognized. In Gakoe location in nearly half of the respondents were slowly taking up community policing concept.

The study found out that forest policing was important to help protect forest resources by keeping away various stake holders interest. The study noted that 57(46.7%) of the respondent were actively involved in forest protection through policing and this was strongly contributing towards kieni forest sustainability.

The result of the study agrees with what Richards (2003) found out in his study about community involvement that resulted in remarkable forest status in South East Asia.

Table 4.10: Respondents Perception on Whether Kieni Forest Is Under Destruction

Respondent Perception	Frequency	Percent
Yes	58	47.5
No	63	51.6
Don't know	1	0.8
Total	122	100.0

The study pointed out that 58(47.5%) of the respondents agreed to the fact that Kieni forest was under destruction; Sixty three (51.6%) of the respondents said that Kieni Forest was not under any threat of destruction. Fifty eight (47.5%) of the respondents can not be taken for granted all avenues must be exploited to ensure that Kieni Forest is sustainable.

4.4.1.5 Means/form through which Kieni Forest is being destroyed

It was necessary for the researcher to establish from the respondents means through which Kieni forest was being destroyed. The data to ascertain this was given in Table 4.11.

Table 4.11: Form of Destruction of Kieni Forest

Forms Of Destruction	Frequency	Percent
Logging of trees	21	17.2
Charcoal burning	6	4.9
Firewood sale	14	11.5
Not applicable	64	52.5
Logging ,Charcoal burning, Firewood sale	17	13.9
Total	122	100.0

The study noted that respondents were very open to yield information pointing out various ways through which Kieni Forest was being destroyed. According to (21) 17.2% of the respondents said that the forest was being destroyed through logging of indigenous trees. The targeted tree species were Camphor (Muthaiti) and Pondo due to their quality timber. Seventeen (13.9%) recorded that Kieni Forest was being destroyed through logging of trees, charcoal burning and sale of firewood. Based on 14(11.5%) of the respondents noted that Kieni Forest was majorly being destroyed through firewood sale. While 6(4.9%) of the respondents said that Kieni Forest was being destroyed mainly through charcoal burning. However, 64(52.5%) of the respondents had no idea on whether Kieni Forest was being destroyed. The Forester noted that the aliens especially from Uganda (Bukusu) were the main culprits in timber logging. The findings of the study agrees with the findings of Mt Kenya-report-Aerial survey-1999

(www.unep.org/expeditons/docs) in which major threats/damages to the forest were recorded as being charcoal production, fire occurrences, logging of indigenous trees, grazing and shamba system practices .

4.4.1.6 Respondents involved in tree planting in Kieni Forest

Respondents were asked whether they had participated in tree planting exercise in Kieni Forest. Table 4.12 summarized the information that was collected on respondents who had participated in afforestation of Kieni Forest.

Table 4.12: Respondents involved in afforestation of Kieni Forest

Afforestation	Frequency	Percent
Yes	46	37.7
No	76	62.3
Total	122	100.0

Many of the respondents 76(62.3%) had never been involved in tree planting exercise in Kieni Forest. However 46(37.7%) of the respondents confirmed that they had fully been involved in afforestation of Kieni Forest. Data collected from the forest office Kieni indicated that KFS had been able to plant 400 Ha of trees in the last 5 years. This had been possible through proper involvement of community members who had always been ready to offer casual labour force for tree planting exercise. The Forester Kieni also indicated that by use of community members at a small fee, Kieni forest station had been able to raise a tree nursery of 200,000 tree seedlings that will be planted in Kieni forest.

4.4.1.7 Importance of Kieni forest to the respondents

The respondents were asked whether Kieni forest was of any importance to them in whichever way. Their response was captured in Table 4.13.

Table 4.13: Importance of Kieni forest to the respondents

Importance	Frequency	Percent
Firewood For Domestic Use	59	48.4
Farming Land, Firewood For Sale& Home use	6	4.9
N/A	3	2.5
Wood For Construction	2	1.6
Fire wood for sale	25	20.5
Source of Water	5	4.1
Source of Pasture	2	1.6
Dwelling Place	2	1.6
Source Of Rainfall	12	9.8
Farming Land	6	4.9
Total	122	100.0

Out of all the respondents interviewed 59(48.4%) totally dependents on Kieni forest for their wood fuel requirements which they use for cooking. Twenty Five (20.5%) of the respondent's depended on firewood sale for their livelihood. This was their main source of income. The market for this firewood on the (Eastern side of Kieni forest) was majorly Gakoe shopping centre and other neighbouring shopping centers within the environs of Kieni forest. On the Western region of Kieni forest the residents mostly internally displaced persons (IDPs) staying in Kieni forest sale the firewood at Kirasha shopping centre and in other shopping centers towards flyover on Nairobi – Naivasha road. Twelve (9.8%) of the respondents noted that Kieni forest was very important to them for climatic reasons. They attributed the amount of rainfall being recorded in the area that supports their farming activities, to be contributed by Kieni forest. Other respondents as indicated in Table 4.13 said that the forest was useful to them in terms of: farming land, source of wood for construction purposes, source of water (various streams and rivers e.g. Karimenu) rivers originate from Kieni forest) source of pasture for their animals (cattle and sheep). Two (1.6%) of the respondents said that Kieni forest was not of any importance of them.

4.4.2 Socio-economic status of the community

The analysis of social economic status of the community members and how it influenced Kieni forest sustainability was studied based on the following indicators: Economic activities of respondents, fuel type used by respondents' income levels of respondents and education levels of respondents.

The socio-economic status of the Gakoe location community members was very important as it was a good indicator of the extent to which community members rely on Kieni forest and how this influenced the sustainability of Kieni forest. The study established that majority of the community members on the Eastern side of Kieni forest are small scale tea farmers thus their reliance on the forest for their livelihood is minimal as compared to the reside of the Eastern part of the forest.

4.4.2.1 Respondent's economic activities

The study sought to establish the respondent economic activity in order to determine the influence on the sustainability of Kieni forest. The respondents' responses were recorded in Table 4.14.

Table 4:14: Respondent's economic activity

Economic Activity	Frequency	Percent
Tea farming	24	19.7
Tea farming and dairy farming	7	5.7
Dairy farming	5	4.1
Business	14	11.5
Bee farming	1	8
Sale of wood fuel from Kieni	26	21.3
Employed	41	33.6
Others	4	3.3
Total	122	100.0

The study established that 41(33.6%) of the respondents were employed as tea pickers in a large tea Estate in the environs of Kieni forest while others were employed by economically stable community members on their tea farms. It was noted that as much as

these persons were employed, they were totally depending on Kieni forest for their firewood requirements.

The study found out that 26(21.3%) of the respondent's survived on sale of wood fuel from Kieni forest. This was quite a significant figure that influenced sustainability of Kieni forest. Twenty four (19.7%) of the respondent said that they were tea farmers in the neighborhood of Kieni forest. This group of persons was mainly depending on the forest for wood for construction of the tea seeding nurseries and was also harvesting ferns in the forest for construction of the seeding nurseries. Twelve (9.8%) of the respondents were both tea and dairy farmers who were depending on Kieni forest for pasture for their animals. Fourteen (11.5%) of the respondents responded that they were business persons, however it was not clear the goods and services they handle to establish their dependency on Kieni forest. Four (3.3 %) of the respondents said that they were involved in other various economic activities to make their living. Only 1(0.8%) of the respondents was utilizing Kieni forest in bee keeping.

The findings of the study indicate that the community members were involved in economic activities that had a direct bearing on Kieni forest sustainability. Those involved in firewood sale were obtaining the same from Kieni forest. Those who indicated that they were dairy farmers were either grazing in the forest or obtaining pasture from Kieni forest.

4.4.2.2 Fuel type used by respondents

The study was keen to ask the respondents what their main fuel was. Their responses were recorded in Table 4.15.

Table 4.15: Fuel type used by Respondents

Fuel Type	Frequency	Percent
Wood Fuel	112	91.8
Charcoal	6	4.9
Gas	2	1.6
Kerosene	2	1.6
Total	122	100.0

The study found out that 112(91.8%) of the respondents, made use of wood fuel as their main mean of cooking. This wood fuel was mainly sourced from Kieni forest. From the data collected in Table 4.15 6(4.9%) of the respondents were mainly using charcoal as their main fuel. The respondents being in Kieni forest and others in its environs, it was certain that this charcoal was being illegally sourced from Kieni forest thus logging of indigenous trees was on in some parts of the forest. Two (1.6%) of the respondents were using gas as their main source of fuel while the other 2(1.6%) was using kerosene as their fuel.

The findings of the study correlates well with what Anderson (1987) found out in his study which indicated that forest resources are reducing in demand in more developing countries and about 90% of the people in this countries depend on firewood as chiefs source of energy.

The findings of this Table indicate that respondents with high income levels owned land and depended on firewood sourced from their own land. Majority of the respondents (112) 91.8% being in lower income cadre totally depended on Kieni forest for their firewood needs.

4.4.2.3 Average income (wage) per month of respondents

The level of income of respondents was an important factor as it could tell the level of dependency of respondent in Kieni forest. Table 4.16 presents the income levels of the respondents.

Table 4.16: Respondents' average income (wage) per month

Income Distribution	Frequency	Percent
< 2500	45	36.9
> 2500 - < 5000	41	33.6
> 5000 - < 7500	20	16.4
> 7500 - < 10000	12	9.8
>10000	4	3.3
Total	122	100.0

The study shows that respondents earning Ksh 5,000 and below were 86(70.5%) Majority of these individuals were earning their living from the sale of firewood from Kieni forest while others were employed in the tea Estate in Kieni environs as tea pickers. Out of the 122 respondents only 36(29.5%) of the respondents had an average monthly income of above Ksh 5,000. The lower cadre respondents in terms of average monthly income have a lot of dependency on Kieni forest.

The findings of the study correlates well with the study carried out by Wambua (2008) who found out that household dependence on natural resources declined with increase in income/wealth. Hisham (1991) pointed out in his study that poverty was a major obstacle to sustainable forestry in Sudan. He said that the poorest people fighting for survival could hardly avoid to wait for slow process of afforestation. This explained why the low income cadre of Gakoe location residents were posing a lot of danger to the survival of Kieni forest especially the Internally Displaced Persons(IDPs) staying on the western part of Kieni forest. Bryon and Arnord, (1990) also found out that community members looked at forest as buffer zones on which they turned to in times of lack. Western (1994) underscored in his study that poverty and the desire to progress encouraged overexploitation and destruction in rural areas he noted that poor people would not put survival above all things at the expense of environment.

4.4.3 Community awareness and sustainability of Kieni forest

Community awareness on issues of conservancy of Kieni forest was very key in its sustainability. To help understand and evaluate how community awareness influenced Kieni forest sustainability the study looked at the number of respondents who were members of CFAs, number of field days/seminars on Kieni forest conservancy attended by respondents, number of exhibitions attended and number of posters/billboards on Kieni forest conservancy available. The various tables were generated to analyze this.

4.4.3.1 Respondent's level of knowledge about need for Kieni forest conservation

The researcher sought to know from the respondents the level of information about the need of the Kieni forest conservancy that the respondents knew. To answer this, the respondents were asked to answer questions. The data was collected in table 4.17.

To capture this information, respondents were asked whether they were aware that Kieni forest needed to be conserved in a suitable manner.

Table 4.17: Respondent's level of information about the need of sustainability of Kieni forest

Respondents Level	Frequency	Percent
Yes	101	82.8
No	21	17.2
Total	122	100.0

According to the findings 101(82.8%) of the respondents were informed about the need to conserve Kieni forest while 21(17.2%) of the respondents were not aware. This implied that the community members in Gakoe location were well informed of the importance of ensuring that Kieni forest was conserved in a sustainable manner so that the future generation could enjoy the same goodness that the current generation was deriving from Kieni forest (Aberdare range forests).

The findings of the study were in line with what Nelson and Pettit (2004) found out in their study that citizen participation in natural resource management was dependant on information acquired. They argued that a community responsible for forest must have specialized information on forest ecology and economic of forest best industries.

4.4.3.2 Seminars on Kieni forest conservancy attended by respondents

In order to establish whether CMs were fully involved in getting Kieni forest conservation information through attending seminars, respondents were asked whether they had ever attended seminars on Kieni forest. Their responses were recorded in Table 4.18.

Table 4.18: Seminars attended by Respondents

Attended	Frequency	Percent
Yes	44	36.1
No	78	63.9
Total	122	100.0

The findings on the study were that the community members were fully informed about the need to conserve Kieni Forest however only 44(36.1%) had ever attended seminars on Kieni forest conservation. Seventy eight (63.9%) of the respondents responded that they had never attended any seminars on Kieni forest conservation. At this point, it was also necessary to establish the host/organizers for the various seminars/fields days to understand and appreciate which organ was more involved in Kieni forest conservation. Table 4.19 showed the various organizers of the seminars attended by the respondents in the last 2 years.

The findings of the study were that the community members' failure to attend seminars on Kieni forest conservancy was limiting the level of awareness on issues of Kieni forest sustainability thus negatively affecting sustainability of Kieni.

Table 4.19: Host for the Seminars attended by Respondents

Host of Seminars	Frequency	Percent
Kieni forest management (KFS)	27	22.1
Local Community Forest Association (CFA)	5	4.1
Others	3	2.5
N/A	78	63.9
Tea Factory	2	1.6
KFS and CFA	6	4.9
Total	122	100.0

From the Table 4.19, it was evident that KFS was playing a crucial role in organizing seminars on Kieni forest conservation. Community Forest Associations CFAs 5(4.1%) and Tea factories like Gachege and Mataara at 2(2.5%) were equally instrumental in organizing for seminars. Seventy eight (63.9%) of the respondents had no idea about seminars being attended on Kieni forest thus had not attended any seminar.

4.4.3.3 Exhibitions on Kieni forest conservation

To understand more about the community members' attendance of exhibitions on Kieni forest conservancy, respondents were asked to indicate whether they had attended any exhibitions on Kieni forest. Respondents' responses were recorded in Table 4.20

Table 4.20: Respondents confirmed to have attended exhibitions on Kieni forest conservation

Respondents Confirmed	Frequency	Percent
Yes	40	32.8
No	82	67.2
Total	122	100.0

Majority of the respondents 82 (67.2%) responded that they had not attended any exhibition on Kieni forest conservation whereas 40 (32.8%) of the respondents agreed to the fact that they had attended exhibition on Kieni forest. This finding was an indication that the flow of information from the key stakeholders in forest conservation to the local community members was limited due to the fact that most community members were not attending seminars. This was affecting Kieni forest sustainability negatively. According to 44 (32.8%) of the respondents exhibitions were very important since community members received information on the need to conserve Kieni forest and the benefits they could derive by being involved in Kieni forest sustainability. Through exhibitions the local community members learned about how they could benefit from carbon trading and eco-tourism by the virtual of conserving Kieni forest.

The findings of the study indicated that organizers of Kieni forest exhibition must do a thorough preparation in terms of creating awareness to ensure that as many as possible community members attended the exhibitions. This was seen as a very important way of promoting Kieni forest sustainability.

4.4.3.4 Posters/Billboards on Kieni forest conservation

The respondents were asked to indicate whether they had read any poster/billboard on Kieni forest conservancy in Gakoe location. Their responses were put in Table 4.21

Table 4.21: Respondents who had read posters on Kieni Forest Conservation

Respondents Read	Frequency	Percent
Yes	70	57.4
No	52	42.6
Total	122	100.0

According to 70(57.4%) of the respondents, it was clear that this group had read posters/billboards on the need to conserve Kieni forest and its ecosystem. Fifty two (42.6%) of the respondents indicated that they had never read/seen posters/billboards on Kieni forest conservation.

Owing to the level of literacy in Gakoe Location where majority of the community members only completed/dropped out of primary school and 10% never attended school. It was clear that the posters/billboards may be available but the locals may not be aware of this.

4.5 Forest management practices

According to 87 (71.3%) of the respondents it was found out that during their stay in Gakoe location, they have not had any conflict with Kenya Forest Services. This implies that they had not been involved in illegal exploitation of Kieni forest. The study also found out that 35 (28.7%) had at one time had trouble with KFS forest for illegal activities in the forest. This can be confirmed from Table 4.22

Table 4.22: Respondents who have had conflicts with KFS

The respondents were asked whether they had even had any conflict with KFS guard. Their responses were captured in Table 4.22

Respondents Conflicted	Frequency	Percent
Yes	35	28.7
No	87	71.3
Total	122	100.0

4.5.1 Respondents out come of the conflict

It was also important for the researcher to get personal views of respondents on what the outcome of the conflict was established, how well the forest was well managed since this had a bearing on the sustainability of Kieni forest. The responses of respondents were captured in Table 4.23

Table 4.23: Action taken by KFS on Respondents found destroying Kieni forest

Action by KFS	Frequency	Percent
Arrested and charged in court of law	7	5.7
Asked for bribe and freed	10	8.2
Educated on the need for conservation and freed	17	13.9
N/A	88	72.1
Total	122	100.0

The study established that 88 (72.1%) of the respondents were Gakoe Location members who had never had conflict with KFS 17 (13.9%) of the respondents when found destroying Kieni forest, they were educated on the need to conserve Kieni forest and then released/freed. Most of the respondents felt that this was the best way of dealing with them. Based on 10 (8.2%) of the respondents when found destroying Kieni forest they were asked of kitu kidogo (bribe) and then freed. This finding exposed the level of corruption among Kieni Forest Rangers thus leading to continued destruction of Kieni forest. According to 7 (5.7%) of the respondents, the arrested victims found involved in

illegal Kieni forest activities should be arrested and charged in the court of law. This was one of the most ideal ways of dealing with those engaged in illegal forest operations that were likely to make Kieni forest unsustainable. The manner in which those found destroying the forest were handled significantly influenced Kieni forest sustainability. If many of the culprits found destroying the forest are arrested and charged in the court of law this was likely to influence Kieni forest sustainability positively likewise when other victims are educated on the need to conserve Kieni forest warned and freed this would also influence the forest conservancy positively but when victims are asked by forest guards to be bribed in order to be freed this would influence forest sustainability negatively. The researcher found out that the forest act has to be upheld to ensure that those found destroying could be dealt with according to the late down laws. This would help deter those planning to destroy the forest through whichever means. When stakeholders (KFS etc are corrupt forest sustainability will be negatively influenced.

Table 4.24: Respondent’s opinion on how to handle those found destroying Kieni Forest

Respondent Opinion	Frequency	Percent
Arrested	46	37.7
Be fined	56	45.9
Others	20	16.4
Total	122	100.0

The opinion of 56(45.9%) of the respondents based on Table 4.24 was that those destroying Kieni forest when found by KFS, they should be fined to deter them from degrading the forest. Forty six (37.7%) of the respondents advocated for the arrest and prosecution of the victims in the court of law. Twenty (16.4%) of the respondents felt that KFS should use other methods to sort out victims engaged in Kieni forest destruction.

The researcher personal interview with the Forester of Kieni forest found out that there had been cases of forest destruction through logging at night. This was being done by aliens staying in the environment of Kieni forest however they were being dealt with according to the provision of the Forest Act 2005. The Forester said that in the year 2011 22 persons had been arrested and prosecuted in the court of law. The forester confirmed

that the number of persons being prosecuted in the court of law based on the year 2008, 2009, 2010 and 2011 was on the decline.

4.5.2 Number of trees planted by Respondents: in Kieni forest

The forester confirmed that with the combined efforts of the community members 400 Ha of trees had been planted in the last five years. This was a clear prove that Kieni forest needed a good programme where the efforts of the locals would be mobilized to ensure that the forest was sustainable. By May 2012 the forest station had over 200,000 different species of tree seedlings that were to be planted in degraded/open areas of Kieni forest.

4.5.3 Range of products made from NTFPs (Non timber Forest Products)

The respondents were asked to state if they drew any NTFPs from Kieni forest. The researcher wanted to know if the range of NTFPs extracted from Kieni forest and how this influenced sustainability. The answers yielded were recorded in Table 4.25

Table 4.25: Non-timber forest products and their uses by respondents

Non timber forest product	Frequency	Percent
Bamboos	19	15.6
Bamboos and herbal medicine	2	1.6
Grass	13	10.7
Vegetation Twines	1	0.8
Herbal medicine	5	4.1
Others	6	4.9
N/A	57	46.7
Vegetables	6	4.9
Bamboos and grass	12	9.8
Bamboos, grass, and herbal medicines	1	0.8
Total	122	100.0

Members, 65 (52.5%) of Respondents hinted that they were getting NTFPs from Kieni forest including twines for weaving tea picking baskets, Vegetables, Bamboos for construction, firewood and basket weaving purposes, grass as pasture of cattle and sheep,

Herbal medicine for both Human and animal treatment. If these NTFPs are well managed by KFS such that those community members who extract them do so at a fee and in a sustainable manner then this will help generate more income for Kieni forest station. This income would help keep Kieni forest sustainable in its operation. The findings from this study indicated that a total of 65(53.3%) of respondents confirmed that they extracted various NTFPs from Kieni forest including: Bamboos, Herbal medicine, Grass vegetation, twines, vegetables and honey. The study found out that the manner in which NTFPs were managed will to great extent influence the sustainability of Kieni forest the KFS must ensure that all the NTFPs are extracted in a transparent way and at a fee to enable KFS to register income that would be ploughed back in running the forest activities in a sustainable way. The findings from this study indicate that a total of 65(53.3%) of respondents confirmed that they extracted various NTFPs from Kieni forest including: Bamboos, Herbal medicine, Grass vegetation, twines, vegetables and honey. The study found out that the manner in which NTFPs were managed would greatly influence the sustainability of Kieni forest. KFS must ensure that all the NTFPs are extracted in a transparent way and at a fee to enable KFS to register income that would be ploughed back in running the forest activities in a sustainable way.

4.5.4 KFS efforts through provision of guards

The researcher established that Kenya Forest Services had put guards in various sections of the forest to help curb illegal forest activities in Kieni forest. On the Eastern side of Kieni forest there were 3 guards (forest rangers) at Gakoe forest post and the Kieni Forest station there were several rangers that were very instrumental in keeping watch over the sustainability of Kieni forest. KFS should endeavour to remunerate rangers well so that they are not tempted to be part of the group contributing to destruction of Kieni forest. A study into whether this was being done and also whether they were well equipped for their job could be done in future.

The study also established that there was an electric fence along the edge of Kieni forest which also improved the security of the forest while reducing possible harm to humans and their properties from wild animals especially elephants.

4.5.5 Efficiency of shamba system in Kieni forest

The study established that residents of Gakoe location especially IDPs staying in Kieni forest were contributing immensely to the sustainability of Kieni forest under strict management of KFS since they were farming land in Kieni forest. On the same land trees were being planted and managed by the locals through weeding and protection until a period of 3 years when they are to shift and be given other portions of land.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of findings, conclusions on the issues under study influencing sustainability of Kieni forest and recommendations for improved sustainability of Kieni forest and for further research.

5.2 Summary of Findings

The study was out to investigate on issues influencing sustainability of Kieni forest with an aim of drawing proper mitigation strategies to reverse the current trend of forest degradation. The respondents that were involved in the study were households/representatives who were included in the study through random sampling. Based on gender as a demographic issue' the study found out that 64(52.4%) of the respondents were men while 58(47.5%) were women. The findings indicate that both men and women had nearly an equal chance of partaking in Kieni forest conservancy. As per research questions and the specific objectives of the study, the study came up with the following findings;

1. A very small fraction of the community members 38(31.1%) were members of the community forest association (CFAs) that were actively involving in Kieni forest sustainability through raising of tree nurseries and planting of trees in degraded areas of Kieni forest.
2. The study also found that 57(46.7%) of community members were involved in policing of Kieni forest, while 65(53.3%) of the community members were not concerned with Kieni forest policing. Only 58(47.7%) of the community members were aware that Kieni forest was under destruction mainly through logging of trees, charcoal burning and firewood sales.
3. The research found out that 112(91.8%) of the community members draw firewood from Kieni forest. Failure to control this so that the exploitation is done at a fee in a sustainable manner threatens to wipe out the forest in years to come. The study also established that 59(48.4%) of the community

members wholly depended on Kieni forest for their livelihood in terms of staying place (home), firewood, and income (from the sale of firewood). This had to be closely monitored since it was affecting Kieni forest sustainability negatively.

Socio-economic status of Community members

4. There are more married people 78(63.9%) members of Gakoe location living in the neighbourhood of Kieni forest thus closely interacting with the forest to get their changing needs satisfied. Widows 14(11.5%) and divorced 6(4.9%) of the community members' hail from the IDP camp in Kieni forest this lot totally depends on Kieni forest for their survival. It was necessary for the researcher to find what every married respondent does to earn a living and how this embarks on Kieni forest sustainability.
5. The literacy level of Gakoe location was low since 76(62.3%) of the population had been educated up to primary level to add on this lot, 13(10.6%) of the population had never attended any formal class. This gives reasons why most community members could not read posters in place on Kieni forest conservation. This has had a negative influence on Kieni forest sustainability.
6. The average income per month for Gakoe community members within the neighbours of Kieni forest was found to be Ksh 4,527. Most of the members were either working as tea pickers or as vendors of firewood drawn from Kieni forest thus putting a lot of pressure on Kieni forest resources. Some community members were being forced into illegal forest activities such as logging of trees and charcoal burning due to merger income levels (poverty). All there had a negative influence on Kieni forest sustainability.

Community awareness

7. The study noted that 101(82.8%) of community members were aware of the need to conserve Kieni forest however only a few attended seminars and exhibitions on Kieni forest conservation. The high awareness of community members on Kieni forest conservancy influenced Kieni forest positively.

8. Kenya Forest Services in conjunction with CFAs were very instrumental in organizing for seminars/field days and exhibitions on Kieni forest conservation. The study established that this had been a boost on Kieni forest sustainability.

Forest Management Practices

9. According to 88(71.2%) of community members had never had any conflict with KFS over Kieni forest however 34(28.7%) had been in illegal Kieni forest activities. The Forester confirmed that in the year 2011, 22 persons were either fined or arrested and prosecuted in the court of law over illegal forest activities. Based on 10(8.2%) respondents had been asked for a bribe by KFS rangers in their course of duty in order to be freed. The act of asking for bribe by Forest rangers was hindering forest sustainability efforts.

5.3. Recommendations for improved sustainability of Kieni forest.

This study has made recommendation for ensuring that Kieni forest remains sustainable. The recommendations are to be implemented by the different stakeholders for sustainability of Kieni forest to be upheld.

1. Community members must be fully involved in all matters pertaining conservation of Kieni forest so that they take ownership of the forest. The KFS and the local Administration must ensure that the community members are totally incorporated in all issues of conservancy.
2. Community members who join CFA and are involved in raising of trees seedlings and planting of trees in Kieni forest should be recognized and rewarded by KFS , the government and donors with keen interest in environment,
3. KFS and the local Administration to look for means of monitoring the local community members so that each and every member partakes in Kieni forest policing. This will help control illegal forest activities such as charcoal burning logging of indigenous trees for timber and firewood

4. The government to relocate the IDPS staying in Kieni forest since they were posing a lot of pressure to Kieni forest and as they are moved to an alternative place the government has to ensure that these people are economically empowered so that they do not come back to the forest which has been their source of livelihood.
5. The government through local administration should ensure that school going kids do not pluck tea during school days to raise the literacy level of the community members staying in the neighborhood of Kieni forest. The study had shown that more illiterate people tend to be poor thus has high dependency on the forest.
6. KFS should endeavor to put posters/billboards in most accessible areas of Kieni forest to increase awareness of Kieni forest conservation among community members. The posters should be written in both national and local language to enhance communication.
7. KFS to ensure that its guards (Forest Rangers) in the various stations of Kieni forest are corrupt free to enhance total protection of Kieni forest. This ensures sustainability of Kieni forest. This could be possible through training and better remuneration.
8. The government through KFS and KEFRI to help community members source and plant trees on their farms (Agro forestry) as this will ease dependency on Kieni forest for construction wood and firewood. Multipurpose tree species to be planted by local community members.

5.4. Conclusions

The study has established that the key issues studied contributes to a great extent on the sustainability of Kieni forest for instance very few members were involved in forest conservation through joining of community forest associations (CFAs) which are of great importance in rising of tree seedlings and provision of labor force at Kieni forest station for planting tree seedlings in degraded areas of the forest. This has seen the forest cover increase by 400Ha in the last five years based on the report from the Forester Kieni forest station.

A few members of the community have done very commendable work in terms of Kieni forest policing. All the community members should be encouraged to be part and parcel of the forest policing team to ensure that all illegal forest activities are reported to the persons concerned to enhance Kieni forest sustainability. Community members must be empowered to look at the forest as their own property. This ownership of the forest in their minds would promote community policing.

It has become evident from the study that social economic status of the community members has a lot of influence to the sustainability of Kieni forest. The study found out dependency of community members on forest resources increased with decrease in income. Community members living in the neighbourhood of Kieni forest must be involved in economic activities that promote forest sustainability. The study showed that only 1(0.8%) of the respondents were involved in bee keeping. This should be promoted as it does not interfere with forest sustainability.

The study unfolded that member of the community with low monthly income post a lot of pressure on the forest through firewood exploitation. Well to do members of the community had alternative sources of wood fuel; so were getting wood fuel from their own farm thus leaving Kieni forest to be sustained. Community members to be encouraged to practice agro forestry.

Community awareness on issues relating to Kieni conservation came out strongly as an important issue that needs to be addressed by all stakeholders. The community members must be involved in all matters relating to Kieni forest conservation. All seminars/Field days and exhibitions organized for community members should be well

scheduled and well communicated to the community members to enhance their level of attendance. The venues for the seminars must be convenient to the locals.

Kenya forest management (KFM) through KFS is doing a good job in terms of making Kieni forest sustainable however as the study points out, there is still a lot that need to be done to ensure Kieni forest sustainability. The forest rangers must be trained and be well paid to curb corruption which tends to promote forest destruction.

5.5. Recommendation for further studies

This study proposes areas of further research as follows;

1. An assessment into how levels of remuneration of Kenya forests services staff influences their performance at work
2. A study to establish the impact of Kieni forest electric fencing to the sustainability of Kieni forest
3. A study into factors influencing Community Member's Participation in Community Forest Association.

REFERENCES

- Adhika Bhim (2005); *poverty, property Rights and collective action; Understanding the distributive aspects of common property resource management*. Environment and Development Economics.
- Anan, G. (1996) *The politics of environment in Northern Thailand: Ethnicity and Highland Development programs*. In Hirsch, P. (Ed), seeing Forests for Trees. Environment and Environmentalism in Thailand. Silkworm Books Chiang Mai
- Anderson, D (1987). *Conservation in Africa, People, Policies and Practice*. Cambridge University press. Cambridge.
- Arnold, J.E.M. and W.C. Stewart. 1991. *Common Property Resource Management* Australian Geographer, Vol 35, no. 3, pp. 301-315 November. 2004.
- Banuri (1993) who will save the forest? Knowledge, Power and Environmental Destruction. United Nations University. USA.
- Benjamin, A.E (2010). *Women in Community Forest Organizations*. An empirical study in Thailand. Scandinavian journal of Forest Research. 25(Suppl) :62-68.
- Best, W.J (2004) *Research in Education*. Prentice Hall Inc, India.
- Bracts and Garbutt. S (2002). *Our forest, our future: Victoria government statement on forest*; Department of Natural Resources and Environment, (DNRE), East Melbourne.
- Bryon, N. and Arnold, M. 1999. *What future for the people of the Tropical forests?* World Development 27; (5) 789-805.
- Busha, C. H. and Harter, S.P (1980) *Research Methods in Librarianship: Techniques and Interpretation*. Orlando, FL: Academic Press, Inc.
- Cherono, N (2006). *Community participation in Conservation and Management of forests*. A case study, Karura forest (Unpublished).
- Commission on sustainable Department (1995). *Chapter 2 combating Deforestation and the Non legally binding Authoritative statement of principles for Global consensus on the management consensus on the management, conservation and S.D of all types of Forests*. In CSD, Third session 28 April 1995, Review of sectoral clusters: Land, Desertification, Forest and Biodiversity.
- Dixon, A. J and Sherman P.B (1991) *Economics of protected Area. A New look at Benefits and Costs*. Earth scans publications limited. London.

- DRSRS 2009, *Changes In Forest Cover In Kenya's Five "Water Towers" 2000 – 2007*
- Egan, B and Ambus, L. (2000) *when there is a will reports; models of community based natural resources management*, Eco Researcher chair of Environmental law and policy, University of Victoria, Vancouver (BC).
- Emerton, L (1999) *Community-based incentive for nature conservation*. IUCN East Africa Regional office. Nairobi, Kenya.
- Food and Agriculture Organization (FAO). 2005. *Global Forest Resource Assessment*.
- Frankel, J.R and Wallen, E.(2004). *How to Design and Evaluate Research in Education*. 7th ed. McGraw-Hill International Edition.
- Geist, H.J and Lambin, E F (2002) *proximate causes and underlying driving forces tropical deforestation*. Bio science 53:143-150.
- Geithner, P.F (1998) *Forestry for sustainable Rural Development*. Forest Foundation. New York.
- Hazelwood (1987) *Expanding the role of non governmental organizations in international Forestry programs*. World Resource Institute.
- Hisham (1991) *whose trees? A people's view of Forestry Aid*. Panos Publication Ltd.London NI 9PD UK.
- Hurst, P (1990) *Rainfall politics ecological Destruction in southern-East Asia*. Zed books London and Newjersey.
- IPCC (2007). *International panel on climate change. Climate change 2007. The physical science basis: contribution of working Group I To the fourth assessment report of the IPCC*. Cambridge University, Cambridge.
- Jackson, S.L. (2009). *Research Methods and Statistics: A Critical Thinking Approach 3rd edition*. Belmont, CA: Wadsworth.
- Jeffery, R (1997) *Organizing sustainability: NGOs and joint Forest Management in India*. Centre for south Asian studies, University of Edinburgh.E dinburgh.
- Jodha, N. S (1986): *Common property Resources and Rural poor in dry Regions of India*. Economic and political weekly 21(271169-1181).
- Johnson, N and Gabarle, B (1993). *Surviving the cut. Natural forest management in the Homic tropics* World Resource institute (WRI).
- Kieni Participation Management Plan 2011-2013(Unpublished)

- Kinyua, M (2002). A Thesis on *Valuing Habitat Protection*. (Unpublished).
- K napp, T.R., (1985). *Validity, Reliability and Neither*. *Nursing Research* 34(3) :189-192.
- Kumar, N. (2000) *All is not green with JFM in India*. *Forest, Trees and people* 42: 46-50.
- Marshall, C and Rossman, G. B (1989) *Designing qualitative Research*. Newbury Park, C A sage.
- Mbuvi and Musingu, (1999). *Framework of forest management partnership for joined management*, the case of Arabuko Sokoke forest, Kenya University of Reading UK.
- Mugenda O.M and Muganda A G (2000). *Research methods; quantitative and qualitative Approaches*. Acts press. Nairobi.
- Neefjes, K (2000). *Environments and Livelihoods Strategies for sustainability*. Oxford G.b Vietnam.
- Nelson, A and Pettit, C (2004) *Effective community engagement for sustainability; Wombt community Forest Management case study*.
- Okunade, E and Yekini, O (2007). *Women participation in forest management practices for sustainable livelihood in Aberdare local government*, Ogunstate. *Research Journals of Applied sciences*, 2, 377-381.
- Ominde S.H and Juma.C. (1991). *A change in Weather African perspective on Climate change*. African Centre for Technology studies. Nairobi , Kenya.
- Poffen Berger, M and McGrean (Eds) 1994) *Policy Dialogue on Natural Forest Regeneration and community Management*. *Research Network Report No' (April)*. Honolulu; Asia sustainable Forest Management Network.Press.Publisher Carfax publishing.
- Reddy, S.R.C and Chakravarty, S.P (1999); *Forest Dependence and income in a subsistence Economy. Evidence from India*. *World Development*. 27(7): 1141-1149.
- Reed.M (2010). *Guess who is (not) coming for dinner. Expanding the terms of public involvement in sustainability forest management (sfm)*. *Scandinavian Journal of forest Research*, 2010; 25(suppla):45-54.
- Report of the United Nations Conference on Environment and Development*. Rio de Janeiro June 1972. A/CON F.150/26 VOL.111.

- Richards. Maharjam, M and Keshav, K (2003). *Economics, poverty and transpare. Measuring equity in forest user groups*. Journal of forest and livelihood 3 (1) July 2003. Rome: Food and Agriculture Research Organization.
- Ross et al (2000) *laying down the ladder: a typology of public participation in Australia natural resource Management*; Australia Journal of Environment management 9, pp. 205-217.
- Salim, E and Ulisten, O (1999) *our forest is Our future. Report of the world commission on Forest and sustainable Development*. Cambridge printing press. Edinburgh. UK.
- Sander. Zeller M; (2004); *Forest Resource management between conservation and poverty Alleviation experiences from Madagascar*.
- Springer, J. (1998). *Areview of Ford Foundation supported Community Forestry Programms in Asia*. Foundation of Asia.
- Stoddard (1987) *Essentials of forest practices*. John Wiley and Sons. USA.
- Tuxill, J. and Nabhan, G.P (1998) *plants and protected areas a guide to instill management*. Stanely Thornes publisher limited, Cheltenham.
- UNFCCC (1998) The Kyoto protocol to the convention on climate change. Unep/iuc.
- United Nations Conference on Environment and Development, (1992) *None legally binding Authoritative statement of principles for Global consensus on the management, conservation and sustainable Development of all types of Forests (or Forest principles)*. Rio de Janeiro: UNCED.
- Wambua, M.S (2008). A Thesis on Economic Analysis of Forest Extraction and its linkage to Community Livelihoods. The case of Kakamega Rain forest (Unpublished).
- Western, D (1994). *Natural connects. Perspective in CommunityBased Conservation*. Island press. Washington D.C.
- Weztoby, J (1989) *Introduction to world of forestry*. Basil Blackwer; Limited. Oxford. UK.
- Wiersum, R F (1984) *Strategies and design for afforest ration, reforestation and trees planting*. Centre for agriculture publishing and documentation (Pudoc), Wageningen.
- Wilson, E.O. (ed.) 1988. *Biodiversity*. Washington, D.C., National Academy
- Wily, L (1997) *Villagers as Forest Managers and Governments. "Learning to let case of Duru-ttaitember and Mgori forest in Tanzania Forest participation series No. 9*. International institute for Environmental and Development. London.

World Commission on Environment and Development, (1987) *our common Future*. New York: Oxford University press.

World Commission on Forest and sustainable Development, (1995) *Activities of the WCFSD in the Area of conflict Revolution, policy reform and strengthening of scientific Research*. Geneva: WCFSD.

Yamane, T (1967). *Statistics, An Introductory Analysis*, 2nd Ed., New York: Harper and Row.

Young, R and Gieze, R (1990) *Introduction to Forest science*. John Wiley and Sons. Toronto. USA

APPENDIX I: LETTER OF TRANSMITTAL ON DATA COLLECTION

JOHN MAKOKHA NYUKURI

P.O BOX 18131-00100

NAIROBI.

17TH JUNE. 2012

REF: LETTER OF TRANSMITTAL ON DATA COLLECTION.

I am a Masters student of the University of Nairobi- Thika Extra Mural Centre undertaking Master of Art degree in Project Planning and Management. Reg. number. L50/64270/2010 conducting a study on issue influencing sustainability of Aberdare Range Forests case of Kieni forest in Gakoe location.

You have been randomly picked to provide information in this study by use of Questionnaire. Kindly note that your willing fully participation will be highly appreciated. Please be assured that the information you will give will be treated with utmost confidentiality and will solemnly be used for the purpose of this research alone.

Thanks a lot in advance for having taken your time to partake in this study. Kindly attend to all questions in the Questionnaire.

Yours truly,

John Makokha Nyukuri

Date_____

APPENDIX II: QUESTIONNAIRE FOR HOUSEHOLD HEADS

INTRODUCTION

This Questionnaire was for collecting data for a study into issues influencing sustainability of Aberdare forests. A case of Kieni forest in Gakoe Location. The questionnaire is organized into six sections: A, B, C, D, E and F. PLEASE KINDLY ANSWER ALL QUESTIONS. Note that the information you share in this study will be treated with very high level of confidentiality and will be used totally for the purpose of the research.

A. 1. Do you agree to participate in to provide information in this study?

Agreed or not agree (TICK (✓) APPROPRIATELY BASED ON RESPONSE).

1. Yes

2. NO

B. HOUSEHOLD INFORMATION

2. Gender 1. Male 2. Female

3. Age of household head (in years)

4. Marital Status 1. Married

2. Single

3. Separated

4. Divorced

5. Widowed

5. Highest Education level completed

1. University

2. Tertiary College

3. Secondary

4. Primary

5. None

6. Informal

6. Main Occupation

- 1. Employed
- 2. Employed by KFS
- 3. Farmer
- 4. Business
- 5. Vocational
- 6. Others

C. Community Participation

7. Are you a member of any community forest Association (CFA) in this location?

- 1. Yes
- 2. No

8. Do you have any land in the forest where your farm?

- 1. Yes
- 2. No

9. If yes, about how many acres are you farming?

- 1. Less than 1/2 acre
- 2. 1 acre
- 3. 2 acres
- 4. 3 acres
- 5. More than 3 acres
- 6. N/A

10. Are you involved in any forest policing efforts to help stop the destruction of the Kieni forest?

- 1. Yes
- 2. No

11. In your opinion is Kieni forest being destroyed?

- 1. Yes
- 2. No
- 3. Don't know

12. If yes, how is it being destroyed?

- | | | | |
|----------------------|--------------------------|-----------------------------------|--------------------------|
| 1. Logging of trees | <input type="checkbox"/> | 8. N/A | <input type="checkbox"/> |
| 2. Charcoal burning | <input type="checkbox"/> | 9. Logging, charcoal and firewood | <input type="checkbox"/> |
| 3. Firewood sales | <input type="checkbox"/> | | |
| 4. Fodder harvesting | <input type="checkbox"/> | | |
| 5. Grazing | <input type="checkbox"/> | | |
| 6. Burning | <input type="checkbox"/> | | |
| 7. Others | <input type="checkbox"/> | | |

13. Are you as a member of this location been involved in tree planting exercise in Kieni forest?

1. Yes
2. No

14. In your own opinion is Kieni forest of any importance to you?

1. Yes
2. No

15. If yes, how do you benefit from Kieni forest?

- | | | | |
|---------------------------------|--------------------------|---------------------------------------|--------------------------|
| 1. Firewood for domestic use | <input type="checkbox"/> | 7, Source of herbal medicine | <input type="checkbox"/> |
| 2. Firewood for sale | <input type="checkbox"/> | 8, Source of rain | <input type="checkbox"/> |
| 3. Source of water | <input type="checkbox"/> | 9. Farming land | <input type="checkbox"/> |
| 4, Source of pasture | <input type="checkbox"/> | 10. Farming land, Firewood for sale / | |
| 5. Source of building materials | <input type="checkbox"/> | home use | <input type="checkbox"/> |
| 6, dwelling place | <input type="checkbox"/> | 11, N/A | <input type="checkbox"/> |
| | | 12, Wood for construction purposes | <input type="checkbox"/> |

D. Socio-economic issues in forest sustainability

16. How much do you earn per month?

1. Less than 2000
2. > 2000 - < 4000
3. > 4000 - < 6000
4. > 6000 - < 8000
5. > 8000 - < 10,000
6. More than 10,000

17. Which economic activity are you involved in?

- | | | | |
|--------------------|--------------------------|--|--------------------------|
| 1. Tea farming | <input type="checkbox"/> | 2. Dairy farming | <input type="checkbox"/> |
| 3. Business | <input type="checkbox"/> | 4. Sheep farming | <input type="checkbox"/> |
| 5. Bee keeping | <input type="checkbox"/> | 6. Sale of fuel wood from Kieni forest | <input type="checkbox"/> |
| 7. Poultry keeping | <input type="checkbox"/> | 8. Others specify | <input type="checkbox"/> |
| 9. Employed | <input type="checkbox"/> | 10. Tea and dairy farming | <input type="checkbox"/> |

18. What are your main sources of fuel?

1. Wood fuel
2. Charcoal
3. Gas
4. Electricity
5. Bio gas
6. Kerosene

19. If its wood fuel or charcoal. What is the source?

1. Kieni forest
2. Buy
3. Kieni Forest own farm
4. Own land
5. Others specify

E. Community awareness

20. Do have any information on the need to conserve Kieni forest?

1. Yes 2. No

21. In this year have you attended any seminars, field days, workshops, training on Kieni forest conservation?

1. Yes 2. No

22. Who had organized for the seminar, field day, workshop training?

1. Kieni forest management (KFS)
2. Local Community Forest Association (CFA)

3. Others specify _____

4. N/A

5. NGO

6. Tea factory

7. KFS & CFS

8. Local Administration

23 Are there any posters/ billboards in your area spearheading the need for conservation of Kieni forest?

1. Yes

2. No

24 Have you had any exhibition on Kieni forest conservation?

1. Yes

2. No

25 If yes how many exhibitions have you had on Kieni Forest in the last 2 years?

1. 1

2. 2

3. None

4. Others (specify) _____

F. Forest Management practices

26 Do you have any conflict with the forest guards?

1. Yes

2. No

27 When you had conflict with the Kieni forest guards what happened?

1. Was arrested and changed in the court of law

2. Was fined and freed at Kieni forest station

3. Was asked to give "kitu kidogo" (bribe) and freed

4. Was advised on the need for conservation of Kieni forest and freed

5. N/A

28 In your own opinion what should the forest guards do to you when illegally found destroying the forest?

1. Arrested

2. Be fined

3. Others (specify) _____

29 Which NTFPs do you collect from Kieni forest?

a. Bamboos

b. Grass

c. Vegetation twines

d. Herbal medicine

e. Others(specify)_____

30 How do you use the NTFPs mentioned?

a. Weaving Tea plucking baskets

d.Others (specify)

b. Construction purposes

c. Feeding animals

d. Treatment of People/Animals

31. How many trees have you planted within Kieni forest? _____

APPENDIX III: INTERVIEW GUIDE
INTERVIEW GUIDE TO THE LOCAL COMMUNITY FOREST ASSOCIATIONS (CFAs) IN GAKOE LOCATION.

Gender _____

1. When did you join this CFA?

2. What is the name of your CFA?

3. Why did you decide to join this CFA?

4. Do you have a Community Forest Management Plan in place?

1. Yes

2. No

5. Are you involved in the Kieni forest conservation? 1. Yes

2. No

6. If yes how are you participating in the conservation of Kieni forest?

1 _____
2 _____
3 _____
4 _____
5 _____

7. If No, what is hindering you from participating in Kieni forest conservation?

1 _____
2 _____
3 _____

8. In your own opinion, are the community members aware of the need to conserve Kieni forest? 1. Yes No

9. In this year, how many seminars/workshops/training/field days have you attended towards conservation of Kieni forest. _____

10. Who had organized the seminars/workshop/training/field day?

11. Do you think Kieni forest is under destruction?

1. Yes

2. No

12. If yes who are those involved in the destruction?

1. _____

2. _____

3. _____

4. _____

13. How is the forest being destroyed in case you think it is being destroyed?

1. _____

2. _____

3. _____

4. _____

14. Are community members being allowed to collect products from the forest?

1. Yes 2.No

15. If yes which products

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

16. How is this affecting sustainability of Kieni forest?

17. Are community members allowed to farm and graze in the forest?

1. Yes 2.No

18. If yes how is this affecting sustainability of Kieni forest?

19. In your own opinion is Kieni forest of any importance to you?

20. Are you happy with the current Kieni forest Yes No

21. If No what should be done to enhance Kieni forest conservation?

1. _____

2. _____

3. _____

4. _____

22. Are you happy with what KFS is doing in order to conserve the forest?

1. Yes 2. No.

23. If no what are you not happy with?

1 _____

2 _____

3 _____

4 _____

APPENDIX IV: INTERVIEW SCHEDULE FOR KFS STAFFS AT KIENI OFFICE.

1. When was this forest station established? **PUT A TICK IN THE BRACKETS.**
 - a) Years ago ()
 - b) Others (specify) ()
2. How many hectares is Kieni Forest?
 - (a) 10 hectares ()
 - (b) 12 hectares ()
 - (c) Others (specify)_____
3. How many hectares of trees have you planted in the last five years?_____
4. How many local community members have you employed?
 - (a) 20 ()
 - (b) 50 ()
 - (c) Others (specify)_____
5. How many seedlings did you have in your own tree nursery as per end of April 2012?
 - (a) <5000 tree seedlings ()
 - (b) 10000 tree seedling ()
 - (c) Others (specify)_____
6. In your opinion is Kieni forest sustainable
 - (a) Yes ()
 - (b) No ()
7. If no who are those destroying the forest?
 - (a) Local community members ()
 - (b) Forest guards ()
 - (c) External individuals ()
 - (d) The Government ()
8. How have you been dealing with those individuals found involved in illegal forest activities?
 - (a) Beat them up ()
 - (b) Arrest and prosecute in the court of law ()
 - (c) Levy a fine on them and release them ()

(d) Ask them to give in something bride and pardon them ()

(e) We don't mind what people do in the forest ()

9 In which way is Kieni forest being destroyed if you think it is under destruction?

(a) Timber logging ()

(b) Charcoal burning ()

(c) Grazing ()

(d) Fires ()

(e) Mining ()

(f) Other specify_____

10. In 2011 how many persons did you prosecute/ fine for having been found destroying the forest?_____

11. If you did prosecuted persons in 2011 for having been found destroying the forest is this figure on increase or decline as compared to the last 4 average years (2011, 2010, 2009 and 2008)

12. What is your source of income as KFS?

(a) Government grants ()

(b) Fines ()

(c) Donations ()

(d) Sale of NTFPs ()

(e) Others (Specify) ()

APPENDIX V: 326 RANDOM NUMBERS

1008	0199	0864	0161	0977	1584	0700	1591	0210	0003	0624	0055
0827	0274	0639	0838	0707	1102	1678	0417	0676	0725	1045	0086
1671	0907	0970	0311	0526	1177	1452	1095	0406	0243	0262	0206
0375	1629	0097	0342	0902	0048	0022	0568	0224	0319	0036	0883
0104	1147	1076	0462	0074	0770	0443	0130	0601	0951	0368	0356
1685	1690	0850	1140	1565	0756	1422	0718	1535	0380	0789	0387
0300	0093	0714	0613	1384	0831	1196	1396	1264	1659	0474	0507
1234	1283	1603	0643	1761	0996	1528	0869	1083	1735	0248	1652
0963	0801	0820	0763	0933	0424	0187	0431	1459	0605	0112	0657
0782	0876	0594	1441	0662	1704	1165	1019	0631	1328	1001	0688
1158	1509	0925	0914	0481	0017	0940	1697	0361	0846	0217	0808
0330	0469	1347	0944	0857	0650	1271	1170	0180	0921	1753	0191
0060	0455	0563	1064	0029	0078	0398	0733	0556	1554	0323	0958
1641	0530	0337	1742	1053	1358	1377	1321	1490	0982	0744	0989
0255	0695	0669	1215	1339	1434	1151	0236	0751	0500	1723	1109
1189	0123	1090	1245	1716	0304	1015	1471	1038	0575	1497	0493
0450	1403	0775	1365	0888	1027	0142	1034	1415	1208	0067	1728
0737	1478	0549	0281	0149	0544	1121	1622	0587	0168	0488	1290
1114	0349	0413	1516	0436	0620	0895	0537	1610	0154	0173	0116
0285	1071	1302	1546	0812	1252	1227	0010	0135	0229	1709	0794
1309	1057	0518	1667	1746	0681	1648	0041	0511	0394	1572	0267
1128	1132	0293	0582	1142	1448	1467	1410	1580	0603	0834	1079
0345	0785	0759	1304	1429	1523	1241	0326	0841	0589	0051	1199
1278	0213	1180	1335	0043	1688	1104	1561	0660	0664	1587	0114
0540	1493	0396	1455	0509	1116	0232	1123	1504	1297	0156	1349
0359	1568	0171	0370	0239	0634	1210	1711	0208	0258	0577	1380
1203	0439	0502	1605	0058	0709	0984	0627	1700	1537	1556	1500
1669	1161										

Specs: This table of 326 random numbers was produced according to the following specifications: Numbers were randomly selected from within the range of 1 to 1762. Duplicate numbers were not allowed. This table was generated on 4/19/2012.

Source. <http://stattrek.com/statistics/random-number-generator.aspx>

TABLE 1**Tropical Forest moist: present status in selected African countries**

Country	Area (Sq KM)	Original extent of forest cover, in square kilometers.	Present extent of forest cover, in square kilometers.	Present extent of primary forest in square kilometers.	Current amount of annual deforestation in square kilometers.	ADR
Cameroon	475,442	220,000	164,000	60,000	2000	1.25
Congo	342,000	100,000	90,000	80,000	700	0.8
Gabon	267,670	240,000	200,000	100000	600	0.03
Ivory Coast	322,463	160000	16000	4000	2500	15.6
Madagascar	590,992	62,000	24000	10000	2000	8.3
Nigeria	924,000	72000	28000	10000	4000	14.3
Zaire	2,344,886	1,245,000	1,000,000	700,000	4000	0.04
Total	2,099,000	1,522,000	967,000	15800		

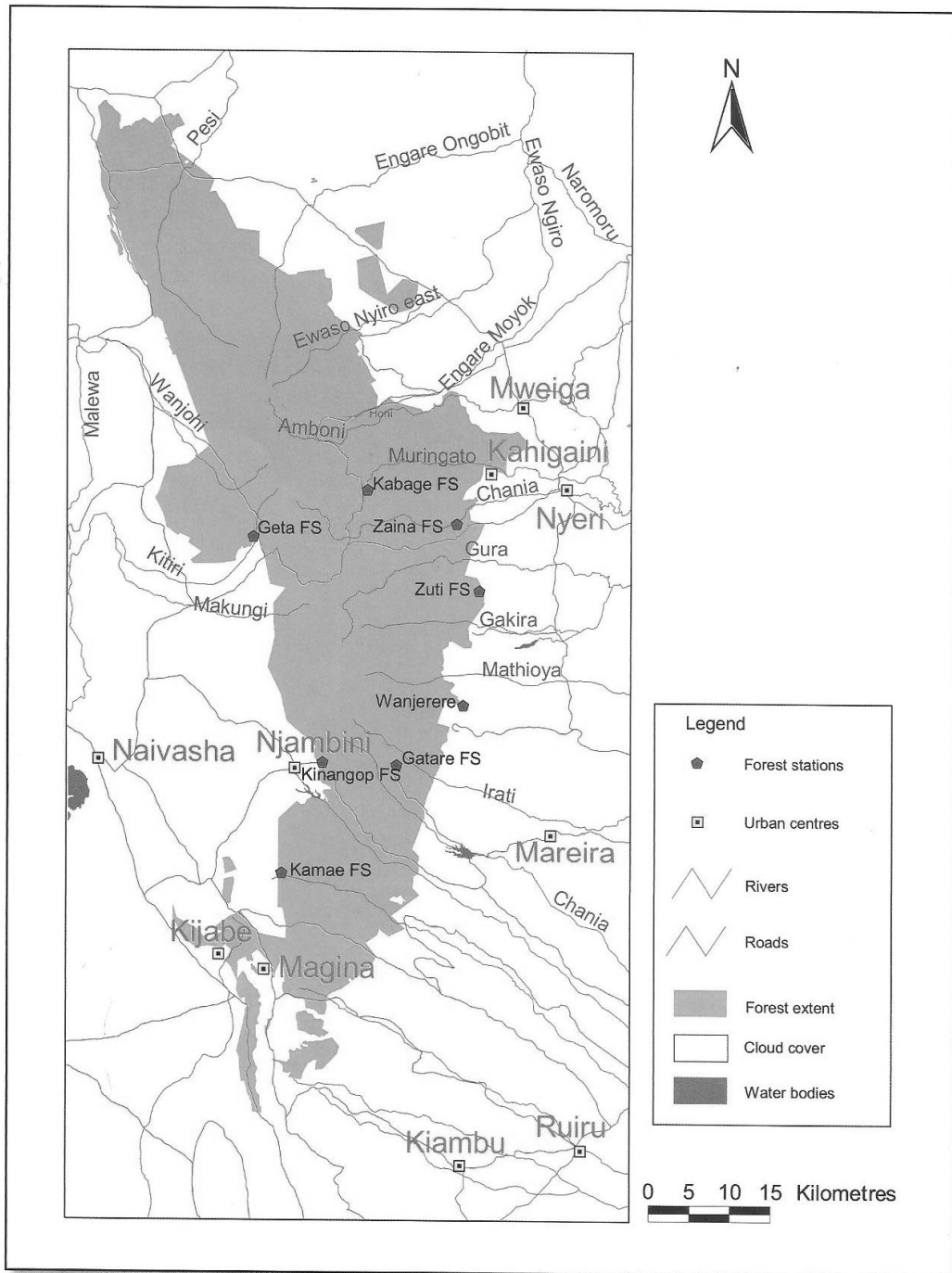
Notes;

1. Original extent of forest cover, in square kilometers.
2. Present extent of forest cover, in square kilometers.
3. Present extent of primary forest in square kilometers.
4. Current amount of annual deforestation in square kilometers.

ADR - Annual Deforestation Rate.

Source: Myers, 1989.

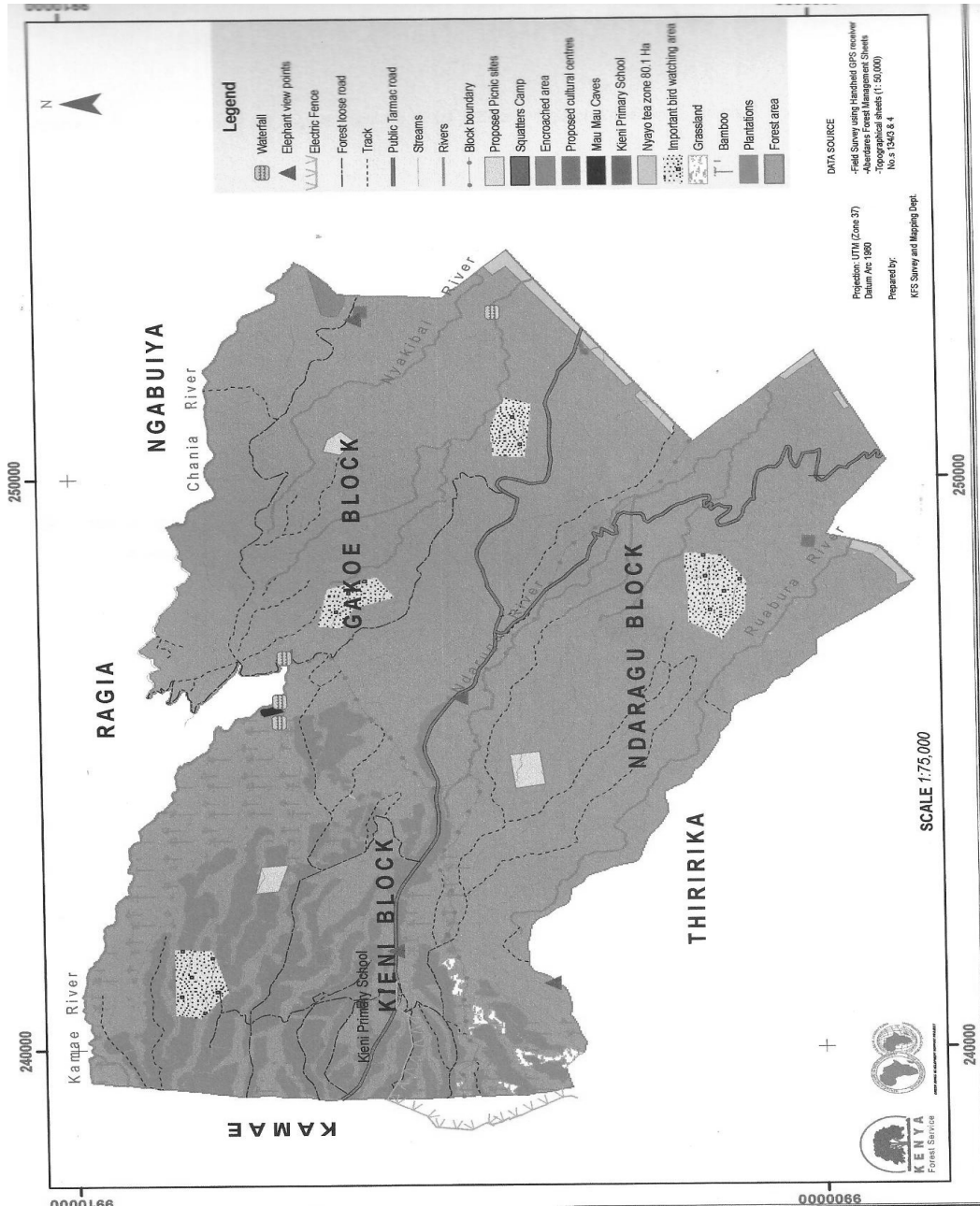
APPENDIX VI: MAP OF ABERDARE RANGE FOREST



Adapted From Changes in Forest Cover in Kenya’s Five “Water Towers”

2000 – 2007

Appendix VII: Map of Kieni Forest



Adapted From Kieni Forest Participation Management Plan 2012 - 2013

APPENDIX VIII: RESEARCH PERMIT

PAGE 2 PAGE 3

Research Permit No. **NCST/RCD/17/012/14**

THIS IS TO CERTIFY THAT: Date of issue **24th May, 2012**

Prof./Dr./Mr./Mrs./Miss/Institution Fee received **KSH: 1,000**

John Makokha Nyukuri

of (Address) University of Nairobi

P.O.Box 30197-00100, Nairobi.

has been permitted to conduct research in

Location

Gatundu North District


Central Province

on the topic: Issues influencing sustainability

of the Aberdare Forests: A case of Kieni

Forest in Gakoe Location.

for a period ending: 30th June, 2012.


Applicant's Signature **Secretary**
National Council for Science & Technology

APPENDIX 9: RESEARCH AUTHORIZATION

REPUBLIC OF KENYA



NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349
254-020-310571, 2213123, 2219420
Fax: 254-020-318245, 318249
When replying please quote
secretary@ncst.go.ke

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/17/012/14**

Date: **24th May 2012**

John Makokha Nyukuri
University of Nairobi
P.O.Box 30197-00100
Nairobi.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "*Issues influencing sustainability of the Aberdare forests: A case of Kiini Forest in Gakoe Location,*" I am pleased to inform you that you have been authorized to undertake research in **Gatundu North District** for a period ending **30th June, 2012**.

You are advised to report to **the District Commissioner, the District Education Officer and the District Forest Officer, Gatundu North District** before embarking on the research/project.

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


DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:

The District Commissioner
The District Education Officer
The District Forest Officer
Gatundu North District.

"The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development."