INFLUENCE OF COMMUNITY PARTICIPATION IN FOREST PROTECTION, GATHIURU FOREST, NYERI COUNTY.

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DECLARATION

This research project is my original work and has not been presented for award of a degree in any University.

Signed ……. **Date…….....**

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This research project has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

This research project is dedicated to my mother Josephine, my father Patrick, my wife-Maureen, my daughters Immaculate and Mary and my colleagues who have been a great source of inspiration and support during my entire Masters Program.

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ABBREVIATIONS AND ACRONYMS

CBO	Community Based Organization
CFA	Community Forest Association
FAO	Food and Agricultural Organization
Ha	Hectares
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
PELIS	Plantation Establishment and Livelihood Improvement Scheme
PFM	Participatory Forest Management
PFMP	Participatory Forest Management Plan
RELMA	Regional Land Management Unit (RELMA)
SPSS	Statistical Package for Social Sciences

ABSTRACT

Many countries in the world are endowed with rich natural resource base which supports livelihoods of local communities as well as business. However, these natural resources are increasingly threatened by unsustainable exploitation and inadequate benefits and incentives for their protection. The purpose of this research study was to investigate the influence of community participation in forest protection, Gathiuru forest, Nyeri County. The objectives of this study were; To assess how community silvicultural practices influence protection of Gathiuru forest in Nyeri County; To examine how community user groups activity influence protection of Gathiuru forest in Nyeri County and; To establish how community patrols influence protection of Gathiuru forest in Nyeri County. This study was pursued in the context of community and government perceptions to allow forest adjacent communities participate in forest protection as opposed to command and control approach that has been inexistence based on theory of Planned Behaviour and the Theory of Reasoned Action. The sample size for the study was 86 members selected from North and South Community Based Organizations (CBOs) of Gathiuru forest. The limitations of the study included selection of a sample of the population for the study as opposed to census hence was not generalizable. The researcher assumed that the respondents would be available to answer the questions in the questionnaires and that their responses would be truthful and honest. To carry out this study, a descriptive survey research design was used to achieve the study's objectives by which both structured closed and open ended questionnaires and document review were used to collect data from the respondents based on the objectives of the study. A content analysis and descriptive analysis were employed to analyze the collected data. The content analysis was used to analyze the respondents' views. Tables were used to present the collected data for ease of understanding. The study found out that there is a positive correlation between the community participation and forest protection. This infers that community silvicultural practice has the highest influence on forest protection, followed by community user group activities and community patrols in that order. Based on the findings, the study recommends enactment of a National Forest Policy to spell out community scouts training; harmonization of policies of line ministries and diversification on non-consumptive forest products. The findings of this study will help all stakeholders, Kenya Forest Service and Government in decision making and developing appropriate Participatory Forest Management Programs as well as act as an invaluable source of information to scholars.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The concept of community participation originally grew out of radical criticism of mainstream development projects in the 1960s and 1970s. In forest protection, participation is often associated with community forestry, which refers to forest management or co-management by people living close to the forest (Kagombe, 2012). Community forestry is often associated with South and South East Asia, but it is also common in other regions (Gachanja, 2013). Although local participation is important in forest protection, there are circumstances in which it is absolutely necessary, for example high population pressures and resource use conflicts, communal ownership and in smaller and more vulnerable protected areas. In such cases, forest protection without local participation is doomed to failure (Konuche, 2012). Participatory Forestry encompasses all those different types of forestry activities that involve local stakeholders, especially villagers, with different degrees of decission-making authority (FAO, 2011). Concepts such as community forestry, community-based forest management, social forestry, joint forest management, collaborative forest management, common property forest management and participatory forestry, all refer to approaches that involve local stakeholders.

Earth summit of 1992 identified local community participation in natural resource management as critical to the continued existence of forest landscapes globally. During the precolonial era, forests were managed by communities.There were community structures as well as beliefs that promoted conservation. For example, there were beliefs that some trees were sacred while others harbored evil spirits. This helped in conservation (Matiku, 2013). Alienation of communities from forest management started during the colonial era through enactment of various legislation and policies that had inadequate provisions for community participation in forest management. These laid emphasis on protection through command and control system with minimal participation of other stakeholders. Consequently, communities have been alienated from the forest resources and participation in decission making. Over time, this has created animosity

between forest managers and communities neighbouring the resources.The result was that communities started viewing forests as state forests. In view of the aforesaid, there has been a significant reduction of the forest cover, unsustainable utilization of the forest resource and skewed distribution of resources (Matiku, 2013).

Participatory forestry is now a widely accepted concept and many governments have put policies and laws in place to support the local management of forest resources. In the case of Kenya, Forest management and protection is based on Constitution of Kenya ,Article 42 and 69(1), Vision 2030, 2nd pillar, Sustainable Development Goals (SDGs), Nos.1&9, Draft Forest Policy (Sessional Paper No.1 of 2007), the Forest Act, 2005, Environmental Management and Coordination Act (EMCA), 1999, Wildlife (Conservation and Management) Act, CAP 376, Water Act, 2002 and the National Land Policy, 2009, Grass Fires Act Cap 327 among other policies and legislative frameworks. All these are geared towards attaining 10 per cent tree cover. (KFS, 2010). The Forest Act 2005 has been in operation since 1st February 2005 (Itamano, 2012). Thus the Kenya Forest Service (KFS) can now co-manage forests legally with the communities through Community Forest Associations (CFAs). It is a requirement that the forest adjacent communities can only co-manage with KFS through CFAs registered with the registrar of societies. After negotiation with the KFS on how management of a forest would be done, an agreement/contract is signed as provided for in the act. (Konuche, 2012). In Kenya, forest destruction, encroachment, conversion to other uses and unsustainable exploitation, had become the hallmark of forest management. In line with this, Kenya together with other like minded countries, set out to put in place measures to mainstream this new management approach within national forestry programmes (Mbugua, 2012).

The Forest Act 2005 provides for ecotourism and recreational activities, collection of forest produce for community based industries, development of community wood and non-wood forest based industries as well as scientific and educational activities, among others, as possible user rights (GOK, 2005). Although the law supporting Participatory Forest Management (PFM) in Kenya was operationalised on February 1, 2007, piloting of PFM in this country started way back in 1997 with the first case being in Arabuko Sokoke Forest Reserve. This was followed by a number of similar initiatives in other forest ecosystems mainly supported by donors through

local non-governmental organizations and projects within the Forest Department. At present, Kenya has over ninety seven PFM sites. Among the approved management plans, sixty Community Forest Associations (CFAs) have signed management agreements.These include; Gwassi forest, Irangi forest, Njukiini forest, Kabage forest, Kathandaini forest, Cheptais forest, Kiambicho forest, Kinale forest and Gogoini-Gazi forest among other others (Wambugu, 2014). As shown in Table 1.1, a total number of ninety seven Participatory Forest Management Plans have been prepared and some are even due for revision. These plans cover a total area of 1,031,459.69 ha of forests nationally (Wambugu, 2014).

Table 1.1 Approved Plans and Forest Areas under PFMPs

Conservancy	**No. of Stations**	**Total Forest Area (Ha) under PFMPs**	**Approximate Total Forested Area (Ha)**	**Percent**
Central	40	320,681	327,439.61	97.9
Coast	12	39,808	766,372	5.2
Eastern	15	116,806.59	231,648.28	50.4
Ewaso	2	185,710	344,087.28	54.0
Mau	12	160,294	458,151.13	35.0
Nairobi	2	11,071.7	19,156.50	57.8
North Eastern	0	0	0	0
North Rift	8	100,135	289,472.19	34.6
Nyanza	2	5,234	-	-
Western	2	45,332.4	80,464.2	56.3
Total	95	985,072.69		
County Forests	2	46,387		Masaai Mau and Karima Hill (Narok and Nyeri County respectively)
Total	**97**	**1,031,459.69**		

Table extracted from: National Status of PFM Development,in KEFRI *Proceedings of the 2nd National Participatory Forest Management Conference,* 2014 (pp 69) KEFRI.

Trees have an important role not only in climate change mitigation but also in reducing vulnerability to climate related risks. Also, long term climate change is being persued through the increased use of trees for intensification, diversification and buffering of farming systems. The joint work will contribute to improved and sustained agro-ecosystem productivity in the face of climate change, as well as enhanced income generation Maathai (2010). We must hault unsustainable agricultural practices and embrace mitigation strategies. Faced with the challenges of climate change, environmental degradation, food shortages, worsening poverty and the global financial downturn, it is ever more important the we double our efforts to protect and rehabilitate the environment, reduce emissions of green house gases, and provide especially the smallholder farmers around the world with sustainable ways of increasing their production and meeting their livelihood needs (Maathai, 2010). The community benefits in all forestry activities and benefit sharing through ecotourism income and research fees, water resources from the forest for domestic consumption and livestock, enterprises from donor funding and other forest products.This help to protect forest and also give communities as sense of ownership of the forest (Itamano, 2012). Itamano further observed that there is need to improve protection in forests and other resources to ensure that green cover is maintained in the country. By doing so, land degradation and soil erosion will be reduced in addition to adverse effects of drought on the growth of trees and floods, encroachment of deserts and the unpredictaable weather patterns.

Forest protection has undergone several changes dating back 1891 through 1964 (Cap 385) command and control to the current Forest Act 2005, which encourages Participatory Forest Management (PFM) in response to the country's changing needs (Thenya, Wandago, & Nahama, 2012). The most significant, though gradual, has been the introduction of Participatory Forest Management (PFM) in the late 1990s, a shift from the command and control system. The latter forest management system alienated communities and by extension PFM (Thenya, Wandago, & Nahama, 2012).

The sustainable management and protection of forest resources plays an important role in sustainable land use, poverty reduction, and food security. Food security depends on the sustainable management and protection of fish, forests, and wildlife. In many indigenous

communities these resources are the principal sources of protein in their diets. Therefore, promoting the sustainable production and use of the food, fodder, fuel and other products derived from forests will enhance food security. Such action will also result in rural income and employment security (FAO, 2011).

1.2 Statement of the Research Problem

Even though some successes have been achieved in forest protection, tremendous threats and pressures on forests remain. The major threats and pressures facing the forests are excisions of forest and its conversion from forest to agricultural uses to satisfy land use demands for increasing population resulting to de-gazzettment, that has often been highly political in nature; Encroachment for human settlements due to population pressure and greed; Unsustainable commercial and subsistence resource use within the Forest Reserve; Illegal logging of plantation and valuable indigenous species; Uncontrolled water abstraction which leads to drying up of rivers; Insecurity and poor infrustructure which makes the area unattractive for tourism investment; Over grazing by livestock and wild animals; Wildfires which occur during dry spell in the forests, grasslands and adjacent farmlands; Conflicting institutional mandates on management of natural resources ; Human/Wildlife conflict and game damage on forest plantations (KFS, 2010).

Research study conducted by Kinyili (2010) revealed illegal activity of logging, cedar posts hewing and charcoal making along Nyeri-Nyandarua County forest boundaries in Aberdare ranges, Kenya. This happens due to exclusion of community in forest protection matters.

In the United Republic of Tanzania, communities and indigenous peoples, with few legal rights or responsibilities over the public forest domain, have been ignored in forest protection despite their willingness to participate in forest protection matters (Kajembe, Nduwamungu & Luoga, 2014). Growing rural populations competing for poorly controlled forest resources are intensifying use pressures and accelerating deforestation.

The aforementioned being attributed to the ever increasing population, poverty as well as unemployment levels. Thus, this study focuses on the community participation in relation to

forest protection. This include: silvicultural practices of the community, various activities of user groups of the community and forest protection patrols by the community. This study therefore intended to investigate the influence of community participation in protection of forests, Gathiuru forest, Nyeri County.

1.3 Purpose of the study

The purpose of this study was to investigate the influence of community participation in protection of forests, Gathiuru Forest, Nyeri County, Kenya.

1.4 Objectives of study

The objectives of this study were:

i. To assess how community silvicultural practices influence protection of Gathiuru forest in Nyeri County.
ii. To examine how community user groups activities influence protection of Gathiuru forest in Nyeri County.
iii. To establish how community patrols influence protection of Gathiuru forest in Nyeri County.

1.5 Research questions

The research questions of this study were:

i. To what extent do community silvicultural practices influence protection of forests?
ii. In what ways do community user group activities influence protection of forests?
iii. How do community patrols influence protection of forests?

1.6 Significance of the study

This study is important because it examines the extent to which community silvicultural practices, community user group activities and community patrols influence the protection of forests. Thus, the findings of this study will help all stakeholders in decision making on improving protection of Gathiuru Forest in Nyeri County. The study may be of great importance to the community for guidance on the appropriate application of the techniques, knowledge and

skills in participative approach in enhancing their activities in forestry for better returns and utilization of forest resources. To coordinators of forestry activities, this study may be important as it would point to the most relevant and sustainable curriculum development for training communities in Nyeri County and other parts of the country. These findings are also invaluable to the Plantation Enterprise Division, Natural Forest Conservation Division and the Enforcement and Compliance Division both of Kenya Forest Service as policy makers by providing them with evidence on the human factors that affect Forest protection. To the Government which is the main agent behind the Participatory Forest Management in the country, the study may assist in refining the application of PFM programs across the country depending on the specific needs and climatic conditions that are favorable in different parts of the country. In addition, scholars interested in further research on how community participation influences forest protection will also find the study an invaluable source of information.

1.7 Limitations of the Study

The result of this study is not generalizable since only a sample of the farmers practicing nursery establishment was used as opposed to consensus. The distance between different groups remained a challenge as they were far flung around the forest. Poor transport and communication networks posed a challenge inform of time and accessibility. To overcome these, the researcher issued out the questionnaires the same day of planting where groups met at the forest station before starting planting being a planting season.

1.8 Delimitation of the study

The study was confined to Gathiuru Forest in Nyeri County in Kenya. Also, only 86 community members carrying out nursery establishment were selected out of the 600 registered members. The study focused on community participation as a Participatory Forest Management approach which is currently in use in Kenya with an aim of improving environmental sustainability and community development through empowerment of the participating communities.

1.9 Assumption of the study

The study assumed that the respondents would be available to answer the questions in the questionnaires and that their responses would be truthful and honest.

1.10 Definitions of Significant Terms

Community Forest Patrol : This is an act of moving about an area especially by an authorized and trained person or group, for purposes of observation, inspection or security.

Non- commercial thinning: This is the removal of some trees to allow for the growth of others. It is not done for commercial purposes.

Non-commercial pruning: This is the selective removal of parts of a plant, such as branches, buds, or roots to remove deadwood, shaping (by controlling or directing growth), improving or maintaining health, reducing risk from falling branches, preparing nursery specimens for transplanting, and both harvesting and increasing the yield or quality of the tree. The practice entails targeted removal of diseased, damaged, dead, non-productive, structurally unsound, or otherwise unwanted tissue from crop and landscape plants.

Participatory Forest Management : is an arrangement where forest adjacent communities enter into mutually enforceable agreements that define their respective roles, responsibilities, benefits and authority in the sustainable management of a defined forest resource.

Plantation Establishment and Livelihood Improvement Scheme:It is a process whereby forest adjacent communities are allowed to cultivate in the forest while assisting to raise forest plantation as they benefit from cultivation of food crops in the forest and the forest authority benefit from establishment of forest plantation at a low cost.

Seedlings Production: It is the raising of tree seedlings in a tree nursery either from a seed or vegetative for a particular purpose.

Silvicultural Practice: This is the practice of controlling the establishment, growth, composition, health, and quality of forests to meet diverse needs and values.

User Group Activities: These are activities carried out by forest adjacent individuals who have come together for a common objective such prunning, fuelwood collection, sawmilling, grazing and nursery establishment.

1.11 Organization of the Study

This research project is organized in five chapters. Chapter one is the introduction of the study and it contains the background of the study, statement of the problem, purpose of the study, objectives, research questions, significance of the study, limitations of the study, delimitations of the study, assumptions of the study, definition of significant terms and organization of the study. Chapter two forms the literature of the study and includes the following sub sections: Introduction, global review of community participation in forest protection in various countries such as India, Canada and Congo; literature review based on the objectives, that is, community silvicultural practices, community forest user group activities in the forest and community patrols. Summary of literature review and conceptual framework constitutes the last part of this chapter. Chapter three constitutes the research methodology employed which includes the research design, target population, sample size selection, sampling procedure, research instruments, validity and reliability of the instruments, piloting of the research instruments, data collection procedures, data analysis techniques, ethical considerations and a Table of operationalization of variables.

Data analysis, presentation and interpretation forms chapter four of the report and includes the response rate; demographic data analysis; and analysis of the findings based on the study objectives, that is, community silvicultural practice, community user group activities and community patrols. Discussions of findings, conclusions and recommendations forms chapter five of the report and includes introductions, discussions of findings based on the objectives of the study; conclusion; recommendations; and recommendations for further study. The research report ends with a list of references and appendices.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature reviewed on the influence of community participation in protection of forests. The approach considered in this section is community participation as a major stakeholder in forest protection through silvicultural practices, varied activities carried out in the forest and respective patrols and their influence in protection of forests. The study winds up by summarizing the literature review and presenting the researcher's conceptualization of the relationship between the variables.

2.2 Community Participation in Forest Protection

Around the world many nations are experimenting with new ways to bring communities formally into the management of public forest lands. Emerging strategies in each country reflect different political environments, past historical relationships between governments and forest communities, and resource management goals and economic development needs. Despite this diversity, management transitions tend to follow a limited number of patterns. The following case studies are characteristic of some of the current fundamental approaches to community involvement in forest protection.

2.2.1 Community Participation in Forest Protection in Tangi Orissa, India

In response to growing environmental problems in India, village leaders from five neighboring communities of Kurdha Forest Division began holding meetings in Tangi in 1985 to discuss how to preserve and restore their natural forests. In 1987, the communities agreed to form the Five-Village Forest Protection Committee. The communities' ability to initiate collective action drew upon a tradition — jointly celebrating the rain god festival each year, as well as a more recent cooperative endeavor to establish a local middle school.

The five communities' ability to control access and protect the degraded forest was enhanced by their close proximity to the resource and historic ties, and knowledge of the land. Patrols of ten men, two from each village, began watching over the 840 hectare forest areas. Initially, each

household contributed rice and volunteer labor to support the protection activities. Now the Forest Protection Committee generates revenues from a maturing cashew plantation and recovering bamboo grove. Rules framed through village meetings regulate use and stipulate fines for violators. Seasonal access rules are designed to facilitate monsoon regeneration and minimize fire danger during the hot, dry summer (Bekelle, 2013). Ten years of community forest protection have resulted in vigorous coppicing tree shoots and seedbased regeneration, which are renewing this mixed dry deciduous forest. Periodic forest cleaning and thinning is reducing fire danger, improving tree growth, and generating fuelwood. Bamboo is harvested on rotation.

Over the past decade, 120 villages have joined the original five in the Kurdha Forest Division alone. Statewide, 4,000 communities currently protect over 250,000 hectares of vigorously regenerating mixed *Shorea robusta* forests. By 1996, between 10,000 and 15,000 communities across India have joined this grassroots forest protection movement with minimal cost to the government. Lands at images have shown that the area of closed sal forest increased from 11% to 20% in Midnapore District alone, and that many square kilometres of degraded scrub forest have been restored to open forest. In many areas, flora and fauna that had been disappearing from these habitats have begun to return (Ellen, 2012).

2.2.2 Community Participation in Forest Protection in Canada

Canada is the largest exporter of forest products in the world. The province of British Columbia, which accounts for half of the nation's total production, harvests and reforests 200,000 hectares of forest annually out of a total forest land base of 45 million hectares. In recent years, concerns over the sustainability of past forestry practices, environmental health, and the rightsof aboriginal people and other forest-dependent communities, combined with shrinking government budgets, have driven a rethinking of forestry and environmental policies.

There are 603 separate aboriginal First Nations in Canada. Many of these, particularly in British Columbia, have traditional territories which cover thousands, and often hundreds of thousands, of hectares and include large areas of productive forest lands. In recent years, both the federal and provincial governments have shown increasing recognition for the rights of aboriginal people and have increased the roles of aboriginal and other local communities in forest management. Many provinces and corporations are developing "comanagement" agreements

with aboriginal groups. Canada's1992 National Forest Strategy identifies aboriginal participation as one of the indicators of sustainable forest management.

2.2.3 Community Participation in Forest Protection in Congo, Africa

In Africa, countries such as in Congo, ethnic communities jointly manage watersheds with different government agencies. The communities have gradually improved the condition of these watersheds, thus rendering strict enforcement of regulations or community resettlement unnecessary Arnold (2012). In some countries, the proposals of local watershed network committees have been incorporated into sub district development plans. Capacity building among government agencies and local groups alike has been the key to establishing mutual understanding and collaboration among various stakeholders (Marten & Cuomo, 2013).

2.2.4 Community Participation in Forest Protection in Kenya

The Forest Department(FD) was created in 1902 when the first Conservator of Forests, arrived.It was around the same time that the 'East Africa Forestry Regulations of 1902 were published. These regulations were expanded by the Forest Ordinance of 1911.The Ordinances included a section dealing with the appointment of Honorary Forest Officers. Those appointed were usually farmers with forestry interests living in areas remote from any forest station and they did much valuable work. (Thenya, et al, 2007).

By 1908, major forest blocks in the county were declared forest areas.Work on surveying of these large forest blocks was initiated but was unfortunately interrupted by the First World War. Between 1915 and 1916, Ordinances dealing with the recruitment and terms of service of Forest Guards were published. This approach was purely military in nature, which involved engagements for periods for three years at a time and was armed with rifles. This marked the beginning of command and control system that the Forest Department operated on for over 100 years.

Between 1941 and 1954, the Forest Ordinance was amended to fit in with Constitutional changes that were taking place in Colony. These changes transferred responsibility for forestry from the

Governor, first to a member of the Legislative Council and in 1954, to a Minister. In 1964, the Forests Ordinance was ammended again and adopted as the Forest Act (Cap.385). The Act provided for the establishment, control amd regulation of central forests and forest areas in Nairobi and on un-alienated Government land by the Forest Department (FD). (Thenya, et al, 2007) . Since then , the legislation has received only minor ammendments, mainly with regard to rules made by the Ministers in charge of forests as provided for in section 15 of the Act. These piecemeal changes were not able to accommodate new and emerging national and global forest related challenges. This necessitated the start of a campaign for a review of forest legislation, which culminated in the current Forest Act No.7 of 2005 that enabled the provisions of the Act apply to all forests and woodlots on state, local authority and private land, but with varying provisions applicable to the respective ownership categories (Thenya, Wandago, & Nahama, 2012).

In Kenya, "recent experiences at the local level, in community forestry programmes, provide lessons in new forms of local governance aimed at addressing the interests of people who depend on the forest" (Emerton, 2008). This is because of the enactment Forest Act, 2005 that identifies community participation in forest protection (GOK, 2005). Several studies have been conducted on community participation in forest management, effects of PFM on household poverty and opportunity cost of forest conservation and protection (Emerton, 1999; Mogaka et al., 2001; Colfer, 2005; Mbuvi et al., 2007; Ongugo, 2007; Guthiga et al., 2008; and Borner et al., 2009). The introduction of Participatory Forestry Management (PFM) under the Act has led to the formation of 325 Community Forest Associations (CFAs) at the community level countrywide, including in Cherangany Hills and Mount Elgon. These CFAs are formed by forest (adjacent) communities and are working with KFS to sustainably manage forest resources. Most of the CFAs are currently preparing to enter into forest management agreements with KFS based on agreed forest management plans. (Lowe & Ombai, 2013).

2.3 Community Silvicultural Practices and Forest Protection

Silviculture is 'the art & science of cultivating the forest crop'. This study looks into the community silvicultural practice and in particular nursery practice that involves seedlings production. Forests are globally important in conservation of the environment, biodiversity, water and soil resources. Conservation of these resources is very vital because of their

contribution to the livelihoods of communities living adjacent to the forest by providing them with various ecosystem goods and services (Musyoki & Mbuvi, 2014).

Local people have been manipulating the natural forest for many years, often applying silvicultural practices they have developed themselves to protect forests. Increasingly, it is being recognized that farmers' knowledge is sophisticated, systematic, and comparable with scientific counterpart. Protection doesn't necessarily mean development, and that forest protecting communities should also think of the development of the forest under their protection. Thus "*surakshya* (protection) is not enough, and we have to think of *utkarsha sadhana* (development) also" (Regional Centre for Development Cooperation, Bhubaneswar, 2010). Good tree nursery practice is the backbone of successful afforestation activities. The community involvement in silvicultural practice of raising tree seedlings ensures continuity of the forest thus protecting their depletion especially the ones for industrial enterprise. A tree nursery is a managed site, designed to produce tree seedlings grown under favorable conditions until they are ready for planting. It can be an informal, small-scale arrangement or a large commercial enterprise (Roshetko, et al., 2010). Tree nurseries vary greatly from a few dozen seedlings grown under the backyard tree to a mechanized commercial enterprise producing millions of seedlings per year. Despite the great variety, there are four major nursery types: institutional nurseries, project nurseries, group nurseries, and individual nurseries. Institutional nurseries are further comprised of three sub-categories: research nurseries, government nurseries, and industrial nurseries (Roshetko, et al., 2010). Establishment of tree nurseries by communities provides optimum care and attention to seedlings during their critical juvenile stage, resulting in the production of healthy, vigorous seedlings (Roshetko, et al., 2010). In many cases successful reforestation requires nursery-grown seedlings, since degraded areas have unfavorable conditions making natural regeneration or direct seeding not feasible. The constitution, the Kenya Vision 2030 and other development blueprints, have stringy emphasized the need for Kenya to work towards attaining the 10% tree cover (Muratha, 2014).

Good nursery operations incorporate the selection of the best quality seeds and seedlings, thus initiating tree improvement. Nurseries are also good venues for vegetative propagation operations Mugo (2014). The cultivation of species that are otherwise difficult to propagate, can be enhanced/expanded through good nursery operations (proper seed storage, vegetative

propagation, attentive seedling care) (Roshetko, et al., 2010). Annual seedling production for group nurseries is commonly 100 to 1,000 but may be as little as 50 or less. In commercially-oriented individual nurseries, annual production capacity may be as high as 10,000 to 50,000 seedlings. This can help in rehabilitating between 10 hectares to 50 hectares of forest. As commercial enterprises with reputations to uphold, those nurseries are more likely to use quality germplasm and other materials (KFS, 2013).

Nursery operations are generally documented, especially in project-supported nurseries. Once external support ceases, group nurseries are often privatized by a sub-group of the members who are willing to continue operating with their own resources. Quality seedling production depends on a sound understanding and implementation of the key principles of nursery planning and management (Better Globe, 2012). Planning is essential for a successful and productive nursery. Factors to be taken into account are: efficient use of inputs and resources, identifying problems and potential solutions, monitoring progress, and working towards nursery objectives. Nursery plans vary in detail and in how they are implemented. Nursery plans may be formal written documents or a list of informal management guidelines. Recommended elements of a nursery plan include: site selection, objectives, demand forecasting (including species and source of germplasm), inputs and scheduling, contingencies, documentation, staff training, promotion and marketing, and networking (Better Globe, 2012).

Besides the use of quality seed, proper nursery production and maintenance activities are essential to multiply quality seedlings. Seedling production and maintenance include the following: seed pre-treatment and sowing; soil management; shade and water management; pricking; root pruning; pests and disease control; hardening; seedling grading and handling (FAO, 2011). For various reasons, sufficient quantities of viable seed are not always readily available, making seed-based nursery propagation difficult or impossible. Under such circumstances, other production methods are warranted, including: wildlings, stumps, cuttings and other vegetative propagation.

2.4 Forest User Groups Activities and Forest Protection

The Global Forest Resources Assessment 2010-Main Report (FAO, 2010a), which was released in October 2010, pointed out that the overall rate of deforestation remained alarmingly high, although the rate was slowing. On global scale, community participation in various activities is the core in the quest for sustainable development and environmental protection related issues (FAO, 2011).The highest forest area worldwide was found in Europe, primarily because of the vast swaths of forest in the Russian Federation, while Latin America and the Caribbean had the highest net forest loss over the last decade (FAO, 2011). Although continued forest loss has been reported in Africa, the overall trend in net forest loss in the region slowed between 1990 and 2010. The area of planted of forests is increasing in Africa, in particular in West and North Africa as shown in Table 2.1 (FAO,2011). The community user groups' activities in forest protection involve engagement in forest planting, non-commercial pruning and noncommercial thinning. Some forest planting programmes are established to combat desertification, while others are created in an effort to secure industrial wood and energy sources.

The current fuel wood consumption is estimated at 35 million m^3; it is expected to rise to about 62 million m^3 by the year 2020, when the population will have almost doubled - to 35.7 million people. The natural forest formations, from which more than 98 percent of the wood is collected, can supply only about 19 million m^3 without being detrimentally overcut (FAO, 2015).

To bridge this energy supply-demand gap, a massive amount of tree-planting is needed. The natural forest is shrinking very fast, and most alternative energy sources have had no significant impact so far. Either they are physically and economically unavailable or their technology is still relatively new and more time is needed for further development. Community involvement in tree planting in Kenya is as old as modern agro forestry that started in 1971 (Ekisa, 2011). Forests support the livelihoods of more than a billion people living in extreme poverty worldwide and provide paid employment for over one hundred million people. More than 80% of the world's land biodiverssity is found in forests and they help protect watersheds that are critical for the supply of clean water to most of humanity (Rose, 2013). Long-tree growing is important to the economic development of African countries. This has been the message of national and regional forestry services, NGOs, and private timber companies for long (Aronson, 2013).

Protecting the forest not only ensures a continuous supply of ecosystem goods and services but also enhances Kenya's ability to achieve a green economy and sustainable development (KFS, 2013). The involvement of communities in tree growing efforts will enable the country achieve its 10 per cent forest that currently stands at 6.99 percent and still empower the farmers economically (Kahuria, 2014). Tree planting is actually a great investment opportunity that has remained appreciated in many parts of the country. Kenya Forest Service has continued to lead tree planting exercises and supervise afforestation activities in all forest land both for natural resource conservation and timber production (Muratha, 2013).

Because of the benefits that our planet and ourselves get from trees, such as trees being oxygen filters, providing shelter and food for humans as well as other animals and their influence on the climate (to mention a few); it is essential that we make sure we make up for all the trees we lose or use. If performed properly tree planting can ensure the successful restoration of a deforested area, hence creating ecologically sustainable resource use (UNEP, 2015).

Table 2.1: Area of planted forest in Africa, 1990-2010

Sub region	Area (1000 ha)			Annual Change (1000 ha)		Annual change rate (%)	
	1990	2000	2010	1990-2000	2000-2010	1990-2000	2000-2010
Central Africa	482	606	709	12	10	2.32	1.58
East Africa	1,184	1,258	1,477	7	22	0.61	1.62
North Africa	6,794	7,315	8,091	52	78	0.74	1.01
Southern Africa	2,316	2,431	2,639	12	21	0.49	0.82
West Africa	888	1,348	2,494	46	115	4.26	6.35
Total Africa	11,663	12,958	15,409	129	245	1.06	1.75
World	178,307	214,839	264,084	3,653	4,925	1.88	2.09

Table extracted from: Extent of Forest Resources. In FAO *State of the World's Forests* 2011*(pp4).* FAO

Another community activity is thinning. Thinning is the selective removal of trees, primarily undertaken to improve the growth rate or health of the remaining trees. This may be done to make the stand more profitable in an upcoming final felling or to achieve ecological goals such as increasing biodiversity or accelerating the development of desired structural attributes such as large diameter trees with long tree crowns. As pointed out by Muratha (2013), Community Forest Associations (CFAs) involvement in forest management has also seen them assist in pruning, thinning thus helps in cost reduction.

Non-commercial thinning provides economic benefits. By giving each tree adequate lateral room to grow, the trees achieve normal diameter growth and will increase in value at a much faster rate. Community involvement in thinning activities, especially the non-commercial ones, help in protecting the trees from unnecessary deformities that may arise due to overstocking or competitions for the available resources such as sunlight and even soil nutrients.

Participatory Forest Management is based on the implemenTable activitiess, which are usually based on the forest uses. The use of forest depend on the resources that are available for use. The forest station is usually the minimum forest management unit where PFM practices can be implemented through the formation of Community Forest Associations by merging of several user groups and Community Based Organizations (Mbithi, 2014).

Forest resources are in two broad categories.These are plantation forests and natural forest, which are highly influenced by forest types. Natural forests present broader opportunity for PFM values to be derived through extraction of products that may include wood and non-wood forest products, grazing and hunting and non-extractive forest values such as eco-tourism, biodiversity conservation, social and cultural values and carbon sequenstration (Mbithi, 2014). Therefore, the PFM activities planned in each station depend on the available resources. It is therefore necessary to understand the forest type before PFM activities are introduced. Under PELIS arrangement Ksh 10,000 is normally required to plant one hactare, as compared to Kshs 40,000 with bush planting (Muratha, 2013). Hence, the Kenya Forest Service will continue to work closely with individual farmers and and communities, the latter under the Plantation Establishment and Livelihood Improvement Scheme as well as work out concessions in line with the provisions of the Constitution and the Forest Act 2005 for interested corporations (Muratha, 2013).

Plantation Establishment and Livelihood Improvement Scheme (PELIS) address food security, employment and wealth creation thereby reducing over reliance on forest products for livelihood (Kinyili, 2014). Some of the CFAs such as the one in Gathiuru forest station, which boasts of making meaningful change in household incomes and has been cited severally as a case study, heavily rely on crops harvested from forest plantation areas under Plantation Establishment and Livelihood Improvement Sheme (PELIS) (Mbuvi, Nahama, & Musyoki, 2014). KFS undertook a case study on the cost benefit analysis of Plantation Establishment and Livelihood improvement system (PELIS) focusing on the tangible benefits and found out that farmers benefit from growing of food crops in the forest at a rate of Kshs. 59,000 per ha per year, while KFS make cost savings of Kshs. 19,000 per ha for the duration of four years the farmer is using forest land. The study revealed that payment of shamba rent was positively correlated with a high percentage of seedling survival in the PELIS plots (Kenya Forest Service, 2010/2011).

Table 2.2 : Seedlings Production and Industrial Plantation Establishment

S.No	Conservancy	Seedlings Production (No)	Plantation Establishment (Ha)
1	North Rift	4,176,913	1,448.85
2	Central Highlands	3,816,417	1,168,.2
3	Mau	2,287,218	1,057.96
4	Eastern	894,975	483.3
5	Nyanza	855,735	143.0
6	Western	500,600	605.0
7	Nairobi	198,811	25.0
8	Coast	396,725	288.0
	TOTAL	**13,127,394**	**5,219.31**

Table Extracted from:*Kenya Forest Service Annual Report* 2010/2011 (pp 17). Kenya Forest Service

Plantation forest is a type of forest established through planting and or seeding in the process of afforestation or reforestation for commercial purposes. The overall objective of the programme is to maintain and enhance productivity of industrial forest plantation and increase efficiency in wood utilization for wealth and employment creation. About 14 million seedlings were produced over the period. In addition 5,219 ha of industrial forest plantations were established. This was

achieved through the use of Plantation Establishment and Livelihood Improvement Scheme (PELIS) in 4,000ha with a resultant cost reduction of Kshs. 67 million. The rest of the area was established using the conventional planting system (Kenya Forest Service, 2010/2011). The major undertakings include seedling production, silvicultural operations, survey of young plantations, implementation of forest plantation management inventory, implementation of management felling plans.

2.5 Community Forest Patrol and Forest Protection

Community forest patrol is normally done by community identified scouts. They are selected young youths both male and female among the community to work hand in hand with the Kenya Forest Service rangers in patrolling and enforcing forest policies. Scouting involves observing terrain and /or the enemy, and accurately reporting those observations.

A number of benefits from community based forest patrols can be seen over the long term.These include improved forest conservation and mangement benefits, growth of community institutions and social capita, and contributions to poverty reduction. In case of Nepal, Community Based Forest Management took along time to transform the rehabilitatted landscapes (FAO,2011). In Gambia, decentralization has led to the re-establishment of customery forest resource management laws, which have enabled the protection of forest species. In the Bonga forest in Ethiopia, illegal timber harvesting, firewood marketing and charcoal production have been contained over the years through regulated access and forest development work by the communities (Farm Africa, 2012). Studies in the United Republic of Tanzania (Kajembe, Nduwamungu & Luoga, 2014) show a remarkable increase in the density of saplings and trees following the launch of community-based management regimes. In India, studies also indicate an increase in productivity and diversity of vegetation following the introduction of CBFM.

Rhodes (2000), found out that regardless of the category or means of conducting a patrol, the keys to successful patrolling involves detailed planning where every portion of the patrol must be planned and all possible contingencies considered; Productive, realistic rehearsals whereby each phase of the patrol is rehearsed, beginning with actions in the objective area.

Kinyili (2014), observed that illegal activity of logging, cedar posts hewing, charcoal making in the forest has drastically reduced with the help of CFAs surveillance, sharing of information,

arrest and prosecution of offenders in Nyandarua County, Kenya. Some CFAs have trained community scouts. For example, Ndaragwa, Olbolossat and Geta CFAs has got twenty trained community scouts each who assist the Forest Rangers in forest patrols and protection duties.With involvement of CFAs and community scouts,the trend on cases prosecuted dropped from 106 in the year 2009 when CFA was initiated and PFMPs developed to 17 cases in the year 2013 in Nyandarua county (Kinyili, 2014). Forest Act, 2005 recorgnizes local communities participation in joint management of forest reserves by protecting the forest from illegal resources collection, fire and any other destructive activities. The community members normally monitor the use of resources and relay information of misuse to the relevant authorities for action (Kanyanya, 2009).

In Asia, Forest Rangers are taken through an offensive and intense counter poaching operation training being undertaken in an effort to save and provide security to Asia‘s forest reserves. Named ARREST (Asia‘s Regional Response to Endangered Species Trafficking), the program is aimed at equipping Forest Rangers with improved patrolling techniques and law enforcement. Designated PROTECT (Protected Area Operational and Tactical Enforcement Conservation Training); the course is designed primarily at saving Asia‘s remaining reserve forests, with enhanced techniques. It is expected to provide best practical training to Forest Rangers in patrolling, reconnaissance, navigation, first aid, raids, takedowns, crime scene processing, search and arrests as also certain other skills that the Forest Rangers may require. This effort has improved the security and protection of Asia‘s reserve forests and wild life. The training hosts Forest Rangers numbering around 50 across Asia. This includes Park Rangers from India, Bhutan, Laos and Thailand. Guidance is provided by experienced instructors at Khao Yai National Park‘s Regional Nature Protection Training Center in Nakhon Ratchasima Province. Female officers from Indonesia‘s Satan Polisi Hutan Reaksi Cepat (SPORC) – Rapid Reaction Forest Police Brigade, also take part in the ARREST (FreeLand Foundation, 2011).

Community scouts involvement in forest protection controls illegal activities which fetch poachers billions of dollars in profit, making it even more difficult to curb the trend. From animals like Buffaloes, Columbus Monkeys and elephant ivory to plants and trees like Camphor, *Podocarpus* spp. and other valuable plants , the forest wealth is plundered by poacher gangs and trafficking syndicate. Even local villagers are forced into the act. To protect wild life habitat,

both animal and plant, and maintain a healthy balance in the ecosystem on which the local communities depend for agriculture, it is imperative that park patrolling is enforced effectively.

The PROTECT course utilizes ASEAN Center for Biodiversity (ACB) competency standards for protected area law enforcement jobs and is designed and delivered by FREELAND Foundation. This course is adapted and delivered across Asia to strengthen forest protection. The ―better preparedness of Park Rangers to counter poachers may usher in new hopes for the survival and protection of forests and wildlife. And the more Indian Forest Rangers learn here, the better they get prepared to tackle the poachers looting Indian forest. (Free Land Foundation, 2011).

Surveillance is continuous during security operations. Even during security missions that involve fighting the enemy, the scouts' primary task remains gathering information. Scouts do this by establishing observation posts (OP), conducting patrols, and performing reconnaissance. Liaison with the protected force is critical during security missions. This ensures both the security force and the protected force remain abreast of the full situation and maintain synchronized operations. Successful security operations are planned and performed with five main fundamentals in mind which include orient on the main body, continuous reconnaissance, provision of early and accurate warning, providing reaction time and maneuver space and maintaining enemy contact. (Global Security, 2000-2015)

2.6 Theoretical Framework

This research study is grounded on the Theory of Planned Behaviour (Ajzen, 1988) and the Theory of Reasoned Action (Ajzen and Fishbein, 1980) to understand and promote individual behaviour change. The Theory of Reasoned Action asserts that intention to perform certain behaviour is determined by the individual's attitude toward the performing the behaviour and by the subjective norm held by the individual. The theory has been applied to many health campaigns relating to breastfeeding, AIDS, anti-smoking, safety belt usage, and anti-drugs to determine which factors influence individuals to act in certain ways and to identify better ways of effectively communicating the message.

The Theory of Planned Behaviour, an extension of the Theory of Reasoned Action, can help to explain why community participation is integral in any development. The attitude change of policy makers to include community in matters pertaining to forest protection made the forest protection approach move from command and control approach to participatory approach (GOK, 2005).

Increasing knowledge alone does not help to change behaviour but campaigns aimed at attitudes and perceived norms in making adoption decisions can produce better results. Forest adjacent community members have been trained to acquire forest patrol skills, enforcement techniques and forest operation skills as well being educated on the importance of the forest and own them. This has made the communities change their individual perceptions and fully participate in matters of forest protection with a feeling of ownership. The participation has also been motivated by realizing the benefits they can get from forest at subsidized rates such as timber harvesting, fuelwood collection, herbs bee keeping and grazing as outlined in the Forest Management Agreements (FMAs).

The likelihood of intended audiences' adopting a desired behaviour can be predicted. By assessing and understanding the factors we can develop messages to influence their attitudes and perceptions of benefits of the behaviour and how their peers will view their behaviour. Research by Fishbein and Ajzen (1975) supports the idea that individuals' and society's (perceived) attitudes are important determinants of action. Therefore, an important step towards influencing behaviour is an assessment of intended audience attitudes. The more favorable the attitude and the subjective norm, and the greater the perceived control the stronger should be the person's intention to perform the behavior in question.

2.7 Conceptual Framework

The study was guided by the following conceptual framework in figure 1.

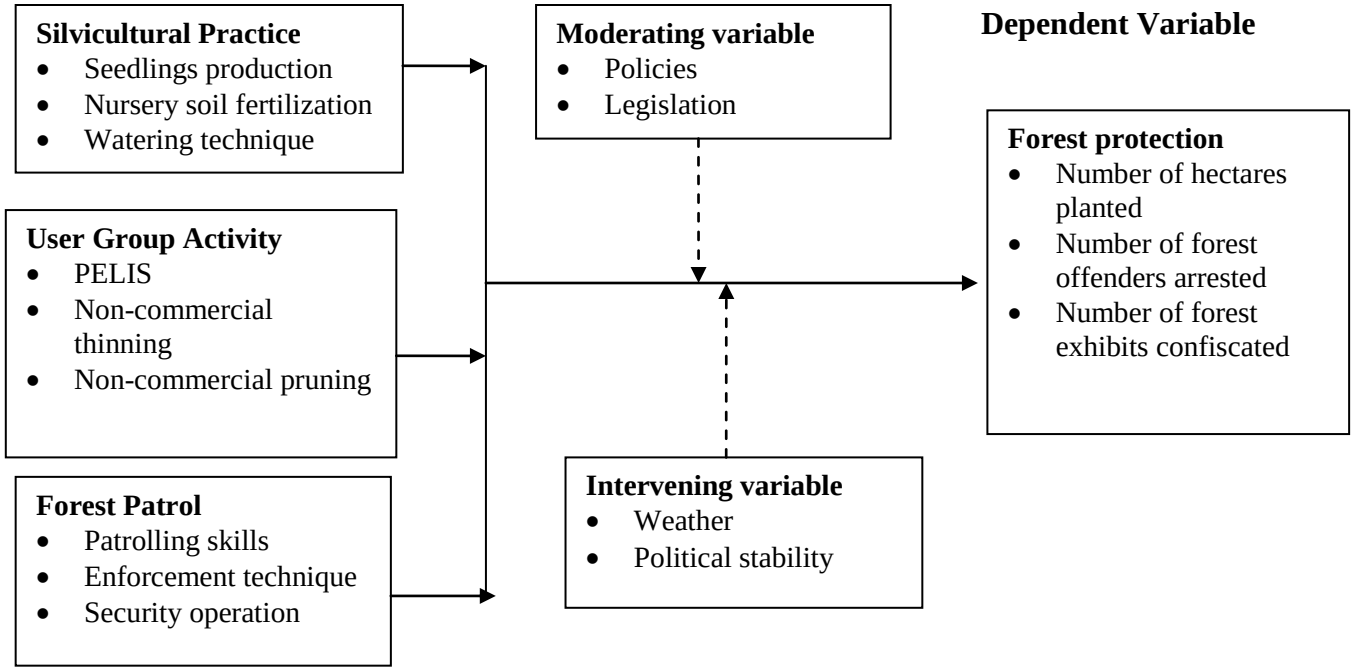

Figure 1: Conceptual Framework of the Study Variables

2.8 Discussion on the Conceptual Framework

The conceptual framework in figure 1 provides clear links between the dependent and independent variables as they relate to each other in the intended research study.

2.8.1 Silvicultural Practice and Forest Protection

Seedlings production forms a basis of forest and is very critical in forest protection. It is being recognized that farmers' knowledge is sophisticated, systematic, and comparable with scientific counterpart hence their knowledge in seedlings productions, nursery soil fertilization and watering techniques as silvicultural practices greatly contribute to forest protection (Musyoki & Mbuvi, 2014).

2.8.2 User Group Activity and Forest Protection

The community user groups' activities in forest protection include engagement in forest planting, non-commercial pruning and non-commercial thinning as well as Plantation Establishment and Livelihood Improvement Scheme (PELIS). By community engaging in forest planting programmes they combat desertification and at the same time secure industrial wood and energy sources through establishment of plantations. Their involvement in clearing and cleaning of firebreaks controls the spread of ground fire during fire outbreaks hence are actively involved in forest protection (KFS, 2011).

2.8.3 Forest Patrol and Forest Protection

Effective community forest patrols ensures that illegal activity of logging, cedar posts hewing, charcoal making, illegal growing of bhang and illegal settlement in the forest drastically reduce through CFAs' surveillance, sharing of information, arrest and prosecution of offenders Kinyili (2014). By so doing, the community therefore contributes to forest protection.

2.9 Summary of the Literature Review

The literature has covered community participation in protection of forest globally narrowing to Gathiuru forest in Nyeri County. The major areas reviewed include: Community silvicultural practices and forest protection, community forest user group activities and forest protection and finally community patrols and forest protection.

Engagement of forest adjacent communities in silvicultural activities such as nursery seedlings productions ensures continuity of both industrial and natural forests and towards attainment of 10% forest cover. In addition, community engagement in forestry activities such as pruning, thinning and PELIS allows for cost effective sustainable management of forests as well as controlling illegal activities in the forest and the neighbouring areas through patrols and operations.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter sets out the research methodology that was adopted so as to meet the objectives stated in chapter one of this study. It is divided into study design, target population, sample size and sampling techniques used in the study. It also gives a brief description of the instrument used, its validity and reliability. Finally, the chapter gives an insight on data collection instruments as well as data analysis techniques and presentation methods that were used.

3.2 Research Design

This study was carried out using descriptive survey research design. The descriptive survey research design is appropriate for this study because it is relatively inexpensive and is useful in describing the characteristics of a large population (Grbich, 2007). Also, the researcher recorded information about the study subjects without manipulating the study environment.

3.3 Target Population

The study was carried out in Gathiuru Forest and specifically targeted 600 registered community members of Gathiuru CFA registered under various forest user groups carrying out nursery practices. All the user groups in Gathiuru Forest Station manage and protect state forests under them and hence share in the same silvicultural practices, similar forest activities, same forest patrols and also similar geographical characteristics as they are under one Gathiuru Forest Station Manager.

3.4 Sampling Procedure

The registered members of the CFA were stratified according to their Community Based Organization (either Gathiuru North CBO or Gathiuru South CBO). This stratum was further divided as per user group activity classification of nursery establishment in the CFA register at the user group level as shown in Table 3.1. Simple random sampling technique was then used to randomly select the respondents from the list of the registered members (sampling frame) in each

of the user groups which gives all the individuals in the defined sample size an equal chance of being picked as a respondent in the study.

3.5 Sample Size Selection

This section describes the strategies that were used to identify the main categories of respondents for the study. A sample is part of the target population that has been procedurally selected to represent the population (Oso & Onen, 2009). The sample size was drawn from the user group registers which formed the sampling frame by employing stratified sampling technique. The research targeted 86 respondents out of the target population of 600. The study adopted the following sampling formula advanced by Yamane (1967) to obtain a representative sample size from the population size.

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

Where: n- Sample Size

N-Population Size

e- Level of Precision at 90% Confidence level.

Employing the above formula, the sample size will be:

$$n = \frac{600}{1+600(0.1)^2} = 86$$

The sampling frame therefore had 86 respondents selected from the target population of 600.

To obtain an appropriate sample size for each stratum, the study used the following proportionate stratification formula provided by Stattrek (2015):

$$n_{h=(Nh/N)*n}$$

Where; n_h=Sample size for stratum h

N_h=Population size for stratum h

N-Total population size

n=Total Sample size

For example, to get the sample size for Burguret:

$n_{h=(Nh/N)*n}$

Nh=(80/600)*86=11.47

The registered members from each user group were divided based on their population representation (ratio) at the CBO level as shown in Table 3.1.

Table 3.1 Sample size

Serial Number	Name of the User Group	Name of CBO	Number of registered members	$n_{h=(Nh/N)xn}$	Sample Size
1	Burguret	North	80	11.47	11
2	Hurage	North	80	11.47	11
3	Naremap	North	70	10.03	10
4	Gatuanyaga	North	35	5.02	5
5	Mikaka	North	25	3.58	4
6	Njoguini	South	135	19.35	19
7	Kambi Miguna	South	50	7.17	7
8	Kimbo	South	70	10.03	10
9	Ntumburi	South	55	7.88	8
	Total		**600**	**86.00**	**86**

Table extracted from: Gathiuru Forest User group,*Nursery management activities*, 2014 (pp 8), KFS.

3.6 Research instruments

The study employed questionnaires to collect both qualitative and quantitative data. A questionnaire is a carefully designed instrument consisting of a set of items to which the respondents are expected to react, usually in writing Amin (2005), Oso & Onen (2009). Questionnaire was used because the study is concerned mainly with the views, perceptions and feelings of the respondents and such variables cannot be observed directly. Secondly, the questionnaires are convenient to use when handling a large group of respondents. In addition, given the time constraint, the questionnaire was an ideal tool for collecting data.

The study used structured questionnaires whose questions are accompanied by a list of all possible alternatives from which respondents select the answer that best describes their situation Mugenda & Mugenda (2003). In addition to that, the questionnaires had a mixture of focused and free response items in a single instrument Kothari (2004). This enabled the study to collect quantitative data from the closed-ended sections, and qualitative data from the open-ended sections.

3.7 Validity and Reliability of the Instrument

This section highlights how validity and reliability of the research instrument was ensured.

3.7.1 Pilot Testing of Instruments

To ensure reliability and validity, pilot survey was conducted in Hombe Forest station since it was one of the three pilot stations of community participation in forest protection in Kenya. This area has almost similar climatic condition and the individuals interact and share lots of similarity with those in Gathiuru. The researcher administered the questionnaire to three respondents from each of the user groups of the Hombe Integrated Community Forest Association (HICOFA). The results of the pilot study were discussed between the researcher, respondents and enumerators for correction of ambiguous and wrongly structured questions. This enabled the researcher to develop instruments that would yield valid, relevant and reliable data.

3.7.2 Validity of the instruments

Validity indicates the degree to which an instrument measures what it is supposed to measure Mugenda & Mugenda (2003). It is the appropriateness, meaningfulness and usefulness of the inferences a researcher makes. Validity therefore has to do with how accurate the data obtained in the study represents the variables of the study. To ascertain the content validity of the research instrument, the instruments were pre-tested in order to ensure that that they yielded the required information during the survey through a pilot study. The questionnaires were well structured to ensure that the questions remained focused, accurate and consistent. This was assured through wide consultation between the researcher and the University supervisor giving guidelines. Peer proof reading was also used to ensure both face and content of the instruments. After the pre-test, the questionnaires were revised to make it fully appropriate to collect the required data. The instruments were designed in a simple format to ensure ease of administration.

3.7.3 Reliability of the Instruments

Reliability is the consistency of scores or answers from one administration of an instrument to another and from one step of items to another , (Bishop, 2007) and the closer the value is to +1.00, the stronger the congruence measure (Mugenda and Mugenda, 2003). In this study, the reliability of the research instrument was improved through the use of Split half reliability procedure where the researcher administered the entire instrument to a sample of respondents during the piloting and calculated using the total score for each randomly divided half i.e. odd and even numbered items of the questionnaire. The reliability coefficient between the two equal scores was calculated using the Spearman-Brown prophecy tool. According to Fraenkel & Walken (2000), if the results produce a reliability coefficient greater or equal to 0.7, the instrument is considered reliable. The following formula was used:

Re = 2r⁄1+r; Where:

Re - Reliability of the whole test

2r - Correlation Coefficient of the first half.

1+r - Correlation Coefficient of the second half.

If the results yield a reliability coefficient of 0.698 then the instrument is reliable and can therefore be used for the study.

3.8 Data Collection Procedure

After obtaining the research permit from National Commission for Science, Technology and Innovation (NACOSTI), two enumerators were identified and trained. This was followed by pre-testing of the research instruments that took one week from which arising issues were incorporated into the instrument. Sampling was then done and data collection exercise commenced for a period of approximately three weeks. For triangulation purpose, both primary and secondary data were gathered. Primary data was collected with the help of closed and open ended structured questionnaire while secondary data was obtained from CFA manual, reports and other relevant documentaries. After data collection, checking was done to identify obvious errors and inconsistencies. At the end of each day, the researcher held a brief meeting with the enumerators to review the day's experiences and also check the completeness and consistency of the data collected. All the questionnaires administered in a particular day were collected at the end of the day to avoid cases of alterations of the collected data.

3.9 Data Analysis Techniques

The data collected was both quantitative and qualitative in nature. The questionnaires were cross examined to ascertain their accuracy, completeness and uniformity. Data was first cleaned by ensuring completeness of information at the point of collection and then captured in the computer. The raw data was then appropriately coded in readiness for analysis in order to organize it and provide a means to introduce the interpretations into quantitative and qualitative methods. This involved the researcher reading the data and demarcating segments within it. Each segment was labeled with a "code" –a word or short phrase that suggests how the associated data segments inform the research objectives. Descriptive statistics such as mode, means and standard deviations aided by Statistical Package for Social Scientists (SPSS) software, were used to analyze data while Karl Pearson's coefficient of correlation was used to analyze inferential statistics. Qualitative data was analyzed by daily briefs, categorization into themes and narrations of the respondents' quotations and verbatim.

Moreover, the researcher used frequency Tables, percentages and frequencies to establish the relationship between different variables of the study. The results from the data analysis were interpreted and presented using the frequency distribution Tables and stored in soft and hard copies.

3.10 Ethical Considerations

After getting an introduction letter for the research study from the university, the researcher obtained a research permit from National Commission for Science, Technology and Innovation (NACOSTI). The researcher then sought appropriate permission from the Ecosystem Conservator, Nyeri County to collect data in one of his stations. Informed consent was obtained from all those participating in the study by filling the consent form before being issued with the questionnaires. Those unwilling to participate in the study were under no obligation to do so. Respondents' names were not indicated anywhere in the data collection tools for confidentiality and information gathered was only used for the purposes of this academic study.

3.11 Operationalization of Variables

Indicators were denoted by the main variables in order to render them measurable as shown in Table 3.1.

Table 3.2: Operationalization of Variables

Objective	Variable	Indicators	Measurement	Scale	Data Collection Method	Data Analysis
To assess how community silvicultural practices influence protection of Gathiuru forest in Nyeri County.	Silvicultural practice	Seedlings Production	Number of tree seedlings produced	Ordinal	Questionnaire Document Review	Descriptive statistics Cross-tabulation
		Nursery soil fertilization	Number of community nurseries adopting nursery soil fertilization method	Nominal	Questionnaire	Descriptive statistics Cross-tabulation
		Watering techniques	Number of community nurseries using watering techniques	Ordinal	Questionnaire	Descriptive statistics Cross-tabulation
To examine how community user groups activities influence protection of Gathiuru forest in Nyeri County.	User Group Activities	Tree planting	Number of mature trees harvested	Ordinal	Questionnaire Document Review	Descriptive statistics Cross-tabulation
		Plantation Establishment	Size of the area planted	Ratio	Questionnaire	Descriptive

		and Livelihood Improvement Scheme (PELIS)			Document Review	statistics
		Non- Commercial Thinning	Number of trees thinned	Ratio Ordinal	Questionnaire Document Review	Descriptive statistics Cross-tabulation
		Non-Commercial Pruning	Number of trees pruned	Ratio Ordinal	Questionnaire Document Review	Descriptive analysis Cross-tabulation
To determine how community patrols influence protection of Gathiuru forest in Nyeri County	Patrols	Patrolling Skills	Number of arrests made	Ordinal Ratio	Questionnaire Document Review	Descriptive statistics Cross-tabulation
		Enforcement Techniques	Number of successful convictions secured before court	Ordinal Ratio	Questionnaire Document Review	Descriptive statistics Cross-tabulation
		Security operations and patrols	Number of patrols and operations per month	Ratio Ordinal	Questionnaire Document Review	Descriptive statistics

3.12 Summary of Chapter Three

The research methodology laid out the methods and techniques of research that were used in the research. It defines the research problems, designed how it was researched, analysis approach and outlined and detailed sample of the respondents.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents the data analysis, presentation, and interpretation of the findings of the study as per the data collected through questionnaires and content analysis.

4.2 Response Rate

The first item on this section presented information on the response rate in Table 4.1 per user group.

Table 4.1: Response Rate

Serial Number	Name of the User Group	Number of Respondents		Non-Respondents	
		Frequency	Percentage (%)	Frequency	Percentage
1	Burguret	11	100.00	0	0.00
2	Hurage	7	63.64	4	36.36
3	Naremap	10	100.00	0	0.00
4	Gatuanyaga	4	80.00	1	20.00
5	Mikaka	2	50.00	2	50.00
6	Njoguini	19	100.00	0	0.00
7	Kambi Miguna	7	100.00	0	0.00
8	Kimbo	9	90.00	2	20.00
9	Ntumburi	8	100.00	0	0.00
Total		**77**	**89.53**	**9**	**10.47**

Table 4.1 shows that after administering 86 questionnaires to the respondents, 77 questionnaires were filled and returned for analysis while 9 questionnaires were not returned. This translated to 89.53 response rate and 10.47 non-response rate respectively. 11(100%) were from Burguret, 7 (63.4%) from Hurage, 10(100%) from Naremap, 4(80%) from Gatuanyaga, 2(50%) from Mikaka, 19(100%) from Njoguini 7(100%) for Kambi Miguna, 9(90%) from Kimbo and

8(100%) from Ntumburi. This was mainly achieved by the researcher handing over the questionnaires of the various forest user groups to the respective heads of the CFA through the station forest manager. The commendable response was also realized as a result of the researcher's emphasis to the enumerators on maximizing on data collection and making follow ups to ensure that the data collection process was carried out as planned. This response rate is considered adequate, as according to Idrus & Newman (2002); a response rate of 50% is good enough in social studies. Therefore for the purpose of analysis, the sample size was taken as 77 (n).

4.3 Demographic Data Analysis

The study was interested in the demographic information of the respondents to help understand better the data on the topic under study. This entailed information on respondents' user group, gender, level of education, the duration they have been in the CFA, the duration they have been planting trees and other activities carried out by farmers in the forest other than trees.

4.3.1 Distribution of Respondents by Gender

It was necessary to get the gender of the respondents so as establish the percentage of each gender and therefore be able to tell whether the information collected was balanced. This is also due to the fact that both genders have unique factors influencing their performance. The response is shown in Table 4.2

Table 4.2 Distribution of Respondents by Gender

Gender	Frequency	Percentage
Male	41	53.25
Female	36	46.75
Total	**77**	**100**

Table 4.2 shows 41 (53.25%) of the respondents being male and 36 (46.75%) as female. This shows that the number of male surveyed was greater than the number of female. This implies that more male participate in forest protection of Gathiuru forest as compared their female counterpart.

4.3.2 Level of Education

The study sought information about the farmers' level of education. The farmers' distribution based on their level of education was presented in Table 4.3.

Table 4.3 Distribution of Respondents by Level of Education

Level of Education	Frequency	Percentage
Primary	23	29.87
Secondary	32	41.56
Tertiary	18	23.38
University	4	5.19
None	0	0
Total	**77**	**100**

Table 4.3 shows that the majority of the respondents had a basic education with secondary education ranking the highest at 32(41.56%), followed by primary education at 23(29.87 %). Those with tertiary level ranked at 18 (23.38%) and those with university level formed 4 (5.19%). This implies that CFA members are equipped with basic skills in forest protection through elementary education and therefore their participation through Participatory Forest Management approach is quite appropriate and relevant to them as this empowers them with knowledge and skills that are tailored towards forest protection through participation.

4.3.3 Duration in the Community Forest Association

In order to collect information on the subject under study, it was important to provide some information on the duration in the Community Forest Association by the respondents. The findings were presented in Table 4.4.

Table 4.4 Distribution of Respondents by Their Duration in the CFA

No. of Years	Frequency	Percentage
Less than 1 year	3	3.90
1-5 Years	33	42.86
Over 5 Years	41	53.25
Total	**77**	**100**

Table 4.4 shows that majority of the respondents had been in the CFA for over 5 years at 41(53.25%) , followed by between 1 and 5 years at 33 (42.86%) while those with less than 1 year ranked lowest at 3(3.90%). This implies that most of the respondents have more experience in regard to forest protections.

4.3.3 Duration in Tree Planting

The respondents were required to indicate the duration of time they have been involved in tree planting. The findings were presented in Table 4.5.

Table 4.5 Distribution of Respondents by Their Duration in Tree Planting

No. of Years	Frequency	Percentage
Less than 1 year	1	1.30
1-5 Years	28	36.36
5-10 Years	32	41.56
10-15 Years	11	14.29
Over 15 Years	5	6.49
Total	**77**	**100**

From Table 4.5, most of the farmers have been involved in tree planting for between 5 and 10years at 41.56% followed by between 1 and 5 years at 36.36%. Those who have been involved in tree planting between 10 and 15 years came in third at 14.29% followed by those with over 15 years at 6.49%. Those with less than 1year ranked lowest at 1.30%. This implies that most of the farmers in the station have high experience in tree planting based on the duration of the time they have been in the practice.

4.4 Community Silvicultural Practices

This section sought information on the influence of community silvicultural practices in protection of forests through seedlings production, nursery soil fertilization and watering techniques.

4.4.1 Tree Nurseries

The farmers were asked to indicate whether they have tree nurseries. The response was presented in Table 4.6.

Table 4.6 Establishment of Tree Nursery

Response	Frequency	Percentage
Yes	71	92.21
No	6	7.79
Total	**77**	**100**

Table 4.6 shows that most farmers in Gathiuru forest have established their tree nurseries with a response rate of 71 (92.21%) as compared to 6(7.79%) of those who have not established tree nurseries. This indicates that most farmers are applying the skills they have acquired in protecting the forest by establishing tree nurseries as a key aspect in forest protection.

4.4.2 Tree Species Raised

After the farmers had indicated that they own tree nurseries, it was important to know the type of tree species being raised and the reason. The response was presented in Table 4.7

Table 4.7 Establishment of Tree Nursery

Species	Frequency	Percentage
Cypress	41	57.75
Eucalypts	6	8.45
Podo	12	16.90
Olea	8	11.27
Others	4	5.63
Total	**71**	**100.00**

Table 4.7 shows that out of those who have tree nurseries, cypress is the most preferred species by the farmers at 41(57.75%). This is mainly due to establishment of plantations for areas earmarked for industrial plantations in Gathiuru forest. It is followed by Podo at 12 (16.90 %) and Olea at 8 (11.27%). This is because the tree species are commonly used for rehabilitation of degraded areas in Gathiuru forest. Eucalyptus at 6 (8.45%) and other mixed species 4 (5.63%) are rarely raised in Gathiuru due to their low demand in the area. Also most of the areas in Gathiuru are not earmarked for Eucalyptus establishment.

4.4.3 Seedlings Production

The study then sought information on the average number of seedlings being produced by the farmers on a monthly basis. The response was presented in Table 4.8.

Table 4.8 Seedlings Production

No. of Seedlings	Frequency	Percentage
Less than 500	18	23.38
5001-1000	20	25.97
1001-2000	18	23.38
2001-5000	11	14.29
Over 5000	10	12.99
Total	**77**	**100**

Table 4.8 shows that most of the farmers raise seedlings between 5001 and 1000 monthly with a response rate of 20 (25.97%). Farmers who produce less than 500 monthly are the same as those who produce seedlings between 1001 and 2000 monthly responding at 18 (23.38%). Those who produce seedlings between 2001 and 5000 per month comes third with a response of 11 (14.29%) while those who produce over 5000 ranked lowest at a response rate of 10 (12.99%). We can conclude that majority of the farmers are committed to seedlings production hence nursery seedlings production influences forest protection.

4.4.4 Nursery Soil Improvement

Nursery soil is very important for the raising and survival of plantable tree seedlings. The study sought information on the methods used by farmers to improve nursery soil fertility. The response was presented in Table 4.9.

Table 4.9 Nursery Soil Improvement

Method	Frequency	Percentage
Fertilizer	6	7.79
Compost Manure	64	83.12
Livestock Droppings	5	6.49
Others	2	2.60
Total	**77**	**100**

Use of compost manure for enriching nursery soil is the most preferred method at a response rate of 64 (83.12%), followed by use of fertilizer at a rating of 6 (7.79%). 5 (6.49%) of the farmers indicated that they use livestock droppings while other methods such wild nursery soil ranked lowest at a rate of 2 (2.60%).This implies that most farmers in Gathiuru forest who are planting trees prefer to use compost manure for improving nursery soil fertility.

4.4.5 Watering Techniques

For the survival of tree seedlings in the nursery, the respondents were asked to provide information on some of the watering techniques they use in their nurseries. The findings was then presented in Table 4.10

Table 4.10 Watering Techniques

Method	Frequency	Percentage
Bottle Feeding	23	29.87
Dripping	27	35.06
Others	27	35.06
Total	**77**	**100**

Table 4.10 indicates that most farmers use dripping and other methods in watering their tree seedlings at a rate of 27 (35.06%) each while 23 (29.87%) of the farmers use bottle feeding. In other methods, they indicated that they mostly use watering cans and buckets.

4.4.6 Benefits of Silvicultural Practices

To assess the benefits achieved by the farmers through silvicultural practices, the researcher asked the respondents to rate their level of agreements with benefits identified in Table 4.11.

Table 4.11: Extent respondents agreed with silvicultural practice on forest protection.

Benefit	Modal Choice	Frequency	Percentage
Adopt viable tree planting systems that are agreeable with climatic conditions in our areas	Strongly Agree	56	72.73
Ensure increased practice in nursery seedlings production	Strongly Agree	58	75.32
Ensure minimum degradation of non-renewable soil resource base	Strongly Agree	56	72.73
Ensure increase in forest cover	Strongly Agree	61	79.22
Sustain agricultural production for many generation	Strongly Agree	58	75.32
Adopt proper nursery watering techniques	Strongly Agree	64	83.11

Through silvicultural practice, farmers indicated that they have equally been able to adopt viable tree planting systems that are agreeable with climatic conditions in their areas and ensure minimum degradation of non-renewable soil resource base at 72.73% each who strongly agreed. The same applies to ensuring increased practice in nursery seedlings production and sustaining agricultural production by 75.32% of the respondents each who strongly agreed; In addition, 79.22% of respondents strongly agreed that silvicultural practice has enabled them increase forest cover as well as adopting proper nursery watering techniques at 83.11% who strongly agreed.

From the data it is clear that farmers are satisfied with most aspects of their silvicultural practices in protection of forest.

4.5 Community User Group Activities

This section sought information on the influence of community user group activities in protection of forests through PELIS, non-commercial thinning and non-commercial pruning.

4.5.1 User Group Activities

Various user groups have various activities in the forest. The researcher sought to know the type of activities conducted in the forest by the farmers. The findings were presented in Table 4.12.

Table 4.12 Community User Group Activities

Activity	Frequency	Percentage
Planting	5	6.49
Non Commercial Pruning	26	33.77
Non Commercial Thinning	9	11.69
PELIS	36	46.75
Others	1	1.30
Total	**77**	**100**

From Table 4.12, it can be seen that most of the farmers practice PELIS in Gathiuru forest at 46.75% followed by non-commercial pruning at 33.77%. Non- commercial thinning is also

practiced at 11.69% as well as planting at 6.49%. However, it was noted that PELIS encompasses planting in some instances as it opens up new planting sites for plantation establishment only. Other activities in the forest take 1.30%. This is because through PELIS, farmers grow crops for three years as they plant trees before they move to new areas earmarked for plantation establishment.

Table 4.13 Extent respondents agreed with Community User Group Activities on forest protection.

5 Point Ratings	No. of Farmers	Percentage
Strongly Disagree	19	3.53
Somewhat Disagree	6	1.11
Neither Agree nor Disagree	28	5.19
Somewhat Agree	133	24.68
Strongly Agree	353	65.49

Table 4.13 shows that most farmers 486 (90.17%) strongly agreed that user group activities had an influence on forest protection of Gathiuru forest. Only 25 (4.64%) of the respondents had somewhat disagreed including those who strongly disagreed that user group activities had influence on forest protection, while 28 (5.19%) of the respondents neither agreed nor disagreed.

The mean calculated was 4.47. Therefore, the calculated mean was in between likert scale point values of 4 and 5, where 4 represented somewhat agree and 5 strongly agree which when combined for the purposes of this study stood for strongly agree. Thus, the findings of the study were interpreted were in agreement that the involvement of user groups in various activities in the forest positively influenced protection of Gathiuru forest.

4.6 Community Patrols

This section of the study sought information on the influence of community patrols in the protection of forests. This included patrolling skills, enforcement techniques and security operations.

4.6.1 Community Forest Patrols and Operations

Forest patrol and operations being key approaches in forest protection, the respondents were asked if they participate in community forest patrols and operations. The finding were presented in Table 4.14

Table 4.14 Community Forest Patrols

Response	Frequency	Percentage
Yes	40	51.95
No	37	48.05
Total	**77**	**100**

Table 4.14 shows that 51.95% of the farmers participate in community forest patrols and operations as compared to 48.05% of the farmers who do not engage in forest patrols and operations.

4.6.2 Basic Training on Forest Patrols and Operations

For a successful patrol and operation, it is important that those involved have some basic tactics and skills. It is to this respect that the study sought to know if the farmers have acquired basic forest patrol tactics. The findings were presented in Table 4.15

Table 4.15 Basic Training on Forest Patrols and Operations

Response	Frequency	Percentage
Yes	26	33.77
No	51	66.23
Total	**77**	**100**

Table 4.15 shows that majority of the community members have not been trained at 66.23% as compared to those who have been trained at 33.77%. This is mainly due to the fact that only community youth aged between 18 and 35years are trained on basic forest patrol skills conducted by KFS Enforcement and Compliance (ENCOM) division.

Table 4.16 Extent to which Community Patrols support Forest Protection

Community Patrol	No. of Farmers (modal class)	Percentage
Make informed decisions based on the knowledge and experience acquired	59	76.62
Take the right action to protect the forest	54	70.13
Improve skills on forest matters	56	72.73
Develop a better internalization and retention of knowledge on forest protection	53	68.83

Table 4.16 shows that most farmers 59 (76.62%) strongly agreed that community protection had an influence on forest protection of Gathiuru forest by making informed decisions. This has enabled them make informed decisions based on the knowledge and experience acquired , take the right action to protect forest 54 (70.13%) , Improve skills on forest matters and develop a better internalization and retention of knowledge on forest protection. This implies that basic training has improved the community problem solving abilities through observation and intelligence gathering as well as providing them with the ability to critically analyze a situation and develop social networks for consultations aimed at protecting Gathiuru forest.

4.7 Importance of Community Participation in Forest Protection

Asked to rank their responses based on the importance of community participation in protection of forests, the farmers responded as shown in Table 4.17.

Table 4.17 Importance of Community Participation in Forest Protection

Importance of Community Participation in protection of forests	Modal Class	Frequency	Percentage
Changed the attitude and perceptions of forest adjacent communities and forestry officials on forest protection	Strongly Agree	50	64.94
Created a sense of ownership of the forest by the forest adjacent communities	Strongly Agree	62	80.52
Enabled full participation by all stakeholders in matters pertaining to forest protection	Strongly Agree	68	88.31
Enabled better understanding of forest protection through awareness on the importance of forests	Strongly Agree	60	77.92
Enabled identification and engagement in non-timber forest products such as eco-tourism, bee keeping in the forest	Strongly Agree	65	84.42

Table 4.17 shows that most of the respondents strongly agreed that community participation has enabled full participation by all stakeholders in matters pertaining to forest protection in Gathiuru forest at 88.31%. It has enabled identification and engagement in non-timber forest products such as eco-tourism, bee keeping in the forest at 84.42%, created a sense of ownership of the forest by the forest adjacent communities at 80.52%, enabled better understanding of forest protection through awareness on the importance of forests at 77.92%. Further more 64.94% of the respondents strongly agreed that community participation in forest protection has

changed the attitude and perceptions of forest adjacent communities and forestry officials on forest protection.

In order to establish the relationship between community participation and forest protection of Gathiuru forest, Pearson product moment correlation analysis was used. This was presented in Table 4.18

Table 4.18 Pearson's Correlation Matrix

Dependent Variables		**Forest Protection**	**Silvicultural Practices**	**User Group Activities**	**Community Patrols**
Forest Protection	Pearson Correlation	1			
	Sig.(2-tailed)				
Silvicultural Practices	Pearson Correlation	0.739	1		
	Sig.(2-tailed)	0.032			
User Group Activities	Pearson Correlation	0.59	0.758	1	
	Sig.(2-tailed)	0.316	0.045		
Community Patrols	Pearson Correlation	0.065	0.024	0.122	1
	Sig.(2-tailed)	0.623	0.362	0.026	

A correlation is a number between -1 and +1 that measures the degree of association between two variables. The correlation coefficient value (r) ranging from 0.1 to 0.29 is considered to be weak, from 0.3 to 0.49 is considered medium and from 0.5 to 1 considered strong. A positive value for the correlation implies a positive correlation. A negative value for the correlation implies a negative or inverse correlation.

The data on community silvicultural practices, user group activities and community patrols were computed into single variables per factor. Pearson‘s correlations analysis was then conducted at 95% confidence interval for a two tailed test and presented in Table 4.18. According to Table 4.18 there is a positive relationship between community silvicultural practices and forest protection, user group activities and forest protection, and community patrols and forest protection of magnitude of 0.739, 0.59 and 0.065 respectively. The positive relationship indicates that there is a correlation between community participation and forest protection. This infers that community silvicultural practice has the highest influence on the protection of forests, followed by user group activities and community patrols in that order.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter entails a summary of findings from the responses of the questionnaire items by the community members of Gathiuru forest; discussion of findings in regard to the literature review and the objectives of the study; recommendations for policy action based on the outcome of the study; suggestions for further studies and contribution of the study to the body of knowledge.

5.2 Summary of the Findings

This section provides discussion of the findings of the study based on the three objectives, that is, To assess how community silvicultural practices influence protection of Gathiuru forest in Nyeri County; To examine how community user groups activities influence protection of Gathiuru forest in Nyeri County and; To establish how community patrols influence protection of Gathiuru forest in Nyeri County.

5.2.1 The Influence of Community Silvicultural Practices on Forest Protection

The first objective of the study was to assess how community silvicultural practices influence protection of Gathiuru forest.

Results indicated that the number of male (53.25%) farmers who participate in forest protection is slightly more than their counterpart female (46.75%) farmers. Majority of the farmers (41.56%) have acquired secondary education and have been in CFA for over 5 years at 53.25%. It was also found that most farmers (41.56%) in Gathiuru forest have been involved in tree planting for between 5 and 10years.

The results of this study established that farmers in Gathiuru forest use compost manure to increase the soil fertility as well as using drip irrigation method in watering their tree seedlings. They also majorly produce cypress seedlings for plantation establishment since low level areas of Gathiuru forest are earmarked for plantation establishment. On the other hand, Olea and Podo are majorly raised for rehabilitation purposes. It is also evident from the study that silvicultural

practices have enabled the farmers to adopt proper nursery watering techniques and viable methods of soil improvement mechanisms which are key aspects of forest protection. Lal & Greenland (2006) argues that there is need to develop an integrated soil fertility management approach to soil improvement issues.

Most farmers in Gathiuru use compost manure for enriching nursery soil fertility due to the availability of materials compared to those who use wild nursery soil. Other methods like fertilizer are not commonly used due to the cost incurred in their procurement as farmers tend to minimize cost towards the establishment of tree nurseries.

Through silvicultural practice, farmers in Gathiuru forest have equally been able to adopt viable tree planting systems that are agreeable with climatic conditions in their areas and ensure minimum degradation of non-renewable soil resource base, ensure increased practice in nursery seedlings production and sustaining agricultural production. In addition, through silvicultural practice the farmers have been able to increase forest cover as well as adopting proper nursery watering techniques. This has ensured minimum degradation of non-renewable soil resource base, and increased practice in seedlings production. Leakey (1996) defined community tree planting as a dynamic, ecological based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustain production for increased social economic and environmental benefits for land users at all levels.

5.2.2 The Influence of Community User Group Activities on Forest Protection

The second objective of the study was to examine how community user group activities influence protection of Gathiuru forest. The study found that most farmers are actively involved in forest protection through PELIS (46.75%). The larger percentage in PELIS is contributed to the fact that the farmers have an opportunity to grow crops such as potatoes, maize, beans, and peas among other crops as they tend to trees for a period of three years and then move to another site earmarked for plantation establishment. They then sell the harvested potatoes which in turn help them meet their day to day financial needs as well as cheaply available food. The farmers are also involved in non-commercial thinning since they enjoy the privilege of being freely given the small branches of the trees that are usually sold. This serves as their source of income as they sell the branches to horticultural farmers. This is in agreement with OECD (1999) who defines

innovation as the ability to use knowledge creatively in response to market opportunities or other social needs.

Community participation has reduced the incidences of poaching, reduced cases of fire incidents and increased seedlings survival rate in Gathiuru forest. It is also evident from the study that quite a number of farmers have not ensured healthy trees through spot weeding and creeper cutting. This is majorly in the indigenous forest where minimal maintenance activities are carried out as compared to PELIS sites which are occupied by farmers carrying out routine activities frequently.

Participation of the farmers in forest protection have assisted in reducing cases of forest fire outbreaks, reduced cases of poaching, adopted proper pruning and thinning techniques, increased seedlings survival rate and has reduced infestation by pests and diseases such as cypress aphids. This agrees with Van et al (2004) that more participatory approach is preferred, in which farmers decides which farmers decide which changes are desirable and what kind of supports are needed from extension to realize these changes.

5.2.3 The Influence of Community Forest Protection on Forest Protection

The last objective of the study sought to establish how community patrols influence protection of Gathiuru forest. The study revealed that community members of Gathiuru forest participate in forest protection at 51.95% and the youth who have been trained on basic tactics on forest patrols operate jointly with Kenya Forest Service rangers. From the basic training and patrols, the farmers are able to apply their experiences and skills to protect the forest through proper decision making based on the knowledge and experience acquired. This agrees with Mutandwa & Mpangwa (2004) that better internalization and retention of knowledge, attributed to the discovery learning process, coupled with social benefits of forest protection training, are key justifications for the relatively high time, human and cost investments required to implement community participation in forest protection.

Majority of the farmers have not acquired basic training on forest protection. This is attributed to the fact that only youth aged between 18 and 35 years in CFA are being trained on basic forest protection drills conducted by KFS Enforcement and Compliance (ENCOM) division. This eliminates other community members who are above 35 years.

Basic training on forest patrols has enabled farmers conduct successful forest operations, make informed decisions based on the knowledge and experience acquired, improve their skills in research on forestry matters, take right action to protect the forest, develop a better internalization and retention of knowledge on forest protection, improve their problem solving abilities through observation and intelligence gathering, improve their ability to critically analyze a situation and develop social networks for consultations and conduct patrols on their own and take action depending on the observations made. This shows that through basic training, the farmers are able to make informed decissions based on the knowledge and experience acquired.

The researcher further sought farmers view on the importance of their involvement in forest protection. They study found out that community participation has enabled full participation by all stakeholders in matters pertaining to forest protection in Gathiuru forest (88.31%),enabled identification and engagement in non-timber forest products such as eco-tourism, bee keeping in the forest (84.42%), created a sense of ownership of the forest by the forest adjacent communities (80.52%), enabled better understanding of forest protection through awareness on the importance of forests (77.92%) and has changed the attitude and perceptions of forest adjacent communities and forestry officials on forest protection (64.94%).

5.3 Conclusions

From the findings of the study, it is established that forest protection is influenced by various factors to varying degrees. On community silvicultural practices, the study concludes that the farmers in Gathiuru forest have acquired the skills and knowledge in nursery practices thus ensuring forest protection by producing healthy plantable seedlings with increased survival rate in the planting sites.

The findings of the study further conclude that community forest user group's activities influence forest protection to a greater extent. It has assisted in reducing cases of forest fire outbreaks, cases of poaching as well as adopting proper pruning and thinning techniques.

Finally, the study realized that community forest patrol has an influence on the protection of forests. It reiterates that through training, the farmers have been provided with the necessary

capacity to make participatory decisions and come up with solutions for the problems affecting them.

5.5 Recommendations

Based on the findings, the study recommends that:

1. There should be enactment of a National Forest Policy which will spell out how community scouts training should be structured so as to achieve the objectives laid out in the policy. This will see to it that sufficient criteria is applied in the selection of Instructors for training assignments at the Kenya Forestry College-Paramilitary wing as the quality of training depends largely on the aptitude and experience of these Instructors. Only officers who have had sufficient exposure to field work and who have experience and a proven aptitude for teaching should be seconded for paramilitary teaching-cum-training job. This selection process could be facilitated by the development of inventories or rosters of suitable ENCOM Officers.

2. More farmers in Gathiuru forest should be encouraged to establish more trees nurseries with various species. As such more trees will be planted to diversify on the benefits accrued from tree planting.

3. Key line ministries should provide farmers with more training opportunities on other income generating activities (IGAs) especially on non-consumptive forest product to assist farmers diversify their economic efforts.

5.6 Suggestions for Further Studies

1. The influence of community scouts as an approach to forest protection
2. The effect on non-consumptive forest products on forest protection.
3. The perception of farmers on PELIS approach to forest protection versus non –PELIS method of forest protection

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APPENDICES

Appendix I: Letter of Transmission

Fredrick Onyango Rabongo

University of Nairobi

School of Continuing and Distance Education

Department of Extra-Mural Studies

Dear Respondent,

REF: <u>REQUEST TO FILL QUESTIONNAIRES</u>

The above subject refers.

I am a University of Nairobi student undertaking a Master of Arts degree in Project Planning and Management. As part of the requirement for the course, I am carrying out a study on influence of community participation in protection of forests, Gathiuru forest in Nyeri County. I believe the study will help in improving forest cover which will ultimately ensure maximum benefits to the forest adjacent communities and to the general society at large.

Despite your busy schedule, I request for your opinions and suggestions in response to questions contained in the questionnaire. These will be of great value and importance to the completion of this study.

Kindly note that the information provided will be treated with a lot of confidentiality and will only be used for the purposes of this study.

Yours sincerely,

Fredrick Onyango Rabongo

Appendix II: Consent Form

FREDRICK ONYANGO RABONGO

P O.BOX 30513-00100

NAIROBI

Title of Project: INFLUENCE OF COMMUNITY PARTICIPATION IN FOREST PROTECTION, GATHIURU FOREST, NYERI COUNTY

Name of Researcher: **FREDRICK ONYANGO RABONGO**

Please initial all boxes

1. I confirm that I have had the opportunity to ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐
3. I understand that relevant sections of data collected during the study, may be looked at by individuals from University of Nairobi, from regulatory authorities or from the Kenya Forest Service, where it is relevant to my taking part in this research study. I give permission for these individuals/Institutions to have access to my records. ☐
4. I agree to my CFA officials being informed of my participation in the study. ☐
5. I agree to take part in the above study. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of Person Taking Consent.	Date	Signature

Appendix III: Questionnaire for the Community members

Serial No…….

INSTRUCTIONS

I am a University of Nairobi student undertaking a Master of Arts degree in Project Planning and Management. As part of the requirement for the course, I am carrying out a study on influence of community participation in protection of forests, Gathiuru forest in Nyeri County. I believe the study will help in improving forest protection which will ultimately ensure maximum benefits to the forest adjacent communities and to the general society at large.

You have been selected to participate in this study being a registered member of Gathiuru CFA. **Please answer these questions as honestly as possible. Write your responses in the spaces provided. Please don't write your name on the questionnaire. Tick where applicable.**

Section 1: Bio Data

1. User Group_____
2. What is your Gender? (a) Male [ ] (b) Female [ ]
3. What is the level of your education

   a) Primary b) Secondary c) Tertiary d) University e) None
4. How long have you been in the CFA?

   a) Less than 1 year b) 1-5 years c) over 5 years
5. How long have you been planting trees?

   a) Less than 1 year b) 1-5 years c) 5-10 years d) 10-15 years e) over 15 years
6. Other than trees, which other activity do you conduct in the forest?

   ……

   ……

Section 2: Community Silvicultural Practices and Forest Protection

7. Do you have a tree nursery? (a) Yes [ ] (b) No [ ]

   If yes, what are the tree species raised in the nursery and why?

   a) Cypress b) Eucalyptus c) Podo d) Olea e) Others

8. How many seedlings do you produce per month on average?

   a) 1-500 [ ] b) 501-1000 [ ] c) 1001-2000 [ ] d) 2001-5000 [ ] e) over 5000 [ ]

9. What do you use to improve the nursery soil?

   a) Fertilizer [ ] b) Compost manure [ ] c) Livestock droppings [ ] d) others [ ]

   (Specify)…….

10. Which method do you use for watering seedlings in the nursery?

    a) Bottle feeding [ ] b) Dripping [ ] c) others (specify)…….

11. To what extent do you agree with the following statements regarding community silvicultural practices and forest protection in a scale of 1-5? whereby;

    5 is strongly agree, 4 is somewhat agree, 3 is neither agree nor disagree, 2 is somewhat disagree and 1is strongly disagree. Tick appropriately.

    Through silvicultural practices in forest protection, I am able to:

Silvicultural practice	**1**	**2**	**3**	**4**	**5**
Adopt viable tree planting systems that are agreeable with climatic conditions in our areas					
Ensure increased practice in nursery seedlings production					
Ensure minimum degradation of non-renewable soil resource base					
Ensure increase in forest cover					
Sustain agricultural production for many generation					
Adopt proper nursery watering techniques					

Section 3: Community User Group Activities and Forest Protection

12. Which activity do you engage in in the forest?

a) Planting [ ] b) Non-commercial Pruning [ ] c) Non-commercial Thinning
d) PELIS [ ] e) others [ ] specify……..

(Tick where applicable)

13. To what extent do you agree with the following statements regarding community user group activities and forest protection in a scale of 1-5? whereby;

5 is strongly agree, 4 is somewhat agree, 3 is neither agree nor disagree, 2 is somewhat disagree and 1is strongly disagree. Tick appropriately.

By participating in forest user group activities in forest protection, you are able to:

User Group Activities	**1**	**2**	**3**	**4**	**5**
Increase forest cover through increased seedlings survival rate					
Reduce cases of pests and diseases such as cypress aphids					
Ensure healthy trees through spot weeding and creeper cutting					
Reduce the incidences of fire outbreaks					
Reduce cases of poaching					
Adopt proper pruning techniques					
Adopt proper thinning techniques					

Section 4: Community Patrols and Forest Protection

14. Do you participate in forest patrols/operations? (a) Yes [ ] (b) No [ ]

If yes, explain.

……

……

15. Have you been trained in forest protection? (basic security patrol tactics)

(a) Yes [ ] (b) No [ ]

If Yes, Explain

……..…

……

16. To what extent do you agree with the following statements regarding community forest patrol and forest protection in a scale of 1-5? whereby;

5 is strongly agree, 4 is somewhat agree, 3 is neither agree nor disagree, 2 is somewhat disagree and 1is strongly disagree. Tick appropriately.

Having undergone the basic training, are you able to:

Community Patrol	**1**	**2**	**3**	**4**	**5**
Take the right action to protect the forest					
Make informed decisions based on the knowledge and experience acquired					
Conduct patrols on your own and take action depending on the observations made					
Improve your problem solving abilities through observation and intelligence gathering					
Develop a better internalization and retention of knowledge on forest protection					
Improve on the ability to critically analyze a situation and develop social networks for consultations					
Improve your skills in research on forestry matters					
Enhance your arrests and prosecution skills					
Conduct successful forest operations					

17. To what extent do you agree with the following statements regarding the importance of community participation and forest protection in a scale of 1-5? whereby;

5 is strongly agree, 4 is somewhat agree, 3 is neither agree nor disagree, 2 is somewhat disagree and 1is strongly disagree. Tick appropriately.

Community participation in forest protection has;

Importance of Community Participation in protection of forests	**1**	**2**	**3**	**4**	**5**
Changed the attitude and perceptions of forest adjacent communities and forestry officials on forest protection					
Created a sense of ownership of the forest by the forest adjacent communities					
Enabled full participation by all stakeholders in matters pertaining to forest protection					
Enabled better understanding of forest protection through awareness on the importance of forests					
Enabled identification and engagement in non-timber forest products such as eco-tourism, bee keeping in the forest					

Appendix IV: Research Permit

THIS IS TO CERTIFY THAT:
MR. FREDRICK ONYANGO RABONGO
of KENYA FOREST SERVICE, 30513-100
Nairobi,has been permitted to conduct
research in *Nyeri County*

on the topic: *INFLUENCE OF COMMUNITY PARTICIPATION IN FOREST PROTECTION, GATHIURU FOREST, NYERI COUNTY*

for the period ending:
~~*2nd June,2015*~~
31st August 2015

.....
Applicant's Signature

Permit No : NACOSTI/P/15/8601/6239
Date Of Issue : 22nd July,2015
Fee Recieved :Ksh 1,000

.....
Director General
National Commission for Science, Technology & Innovation