VALUATION OF FOREST BENEFITS: THE PERCEPTION OF COMMUNITIES ADJACENT TO MOUNT KENYA FOREST

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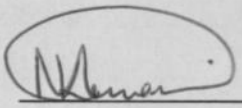
A Thesis submitted in fulfilment of the award of the Degree of Doctor of Philosophy of the University of Nairobi, School of the Built Environment, Department of Real Estate and Construction Management, Nairobi

NOVEMBER 2007

DECLARATION

I hereby declare that this thesis is my original work and has not been presented for a degree in any other University



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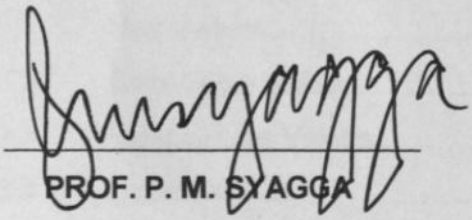

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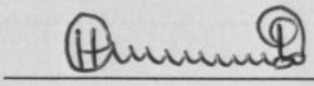

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ABSTRACT

The purpose of this study was to explore the full range of benefits that Mount Kenya forest provides to the forest-adjacent[1] communities and the linkage of these benefits to their perception of the value of the forest.

A field survey was carried out in households surrounding the Mount Kenya forest in three districts, Meru South, Embu and Nyeri, between January 2006 and April 2006. Household interviews were carried out in 300 households (100 in each of the districts) using structured interview schedules. Focus groups discussions and key informant interviews were held to explain the purpose of the study and identify the benefits that are enjoyed by the forest-adjacent communities.

The study found that the forest-adjacent households attached great importance to the forest benefits that offer environmental services. This is positive as it is an indication that the forest-adjacent communities can participate in the conservation of the forests to preserve these benefits.

The high importance placed on the environmental benefits by the forest-adjacent communities gives an important justification for the involvement of these communities in the management and conservation of forests efforts. The policy implication of these results is that any conservation efforts must be geared towards conservation of forests for the

[1] People living within 5 km of the forest edge

enhancement of environmental forest benefits that are derived from the forests by the local or forest-adjacent households.

The study also found that the value that the forest-adjacent households give to one acre of forestland, and by extension the forests is influenced by a combination of many other factors acting together beside forest benefits.

The study recommends that any attempt to value forests must first understand the needs and priorities of forest-adjacent communities before the valuation activity is undertaken. This would ensure that the valuation methodologies adopted or developed allow the local communities to define their own forest values within the context of their own perceptions, needs and priories.

ACKNOWLEDGEMENTS

This research would not have been possible without the invaluable contribution of many people who gave me encouragement and help during the course of the study. I am greatly indebted to my supervisors, Prof Paul M Syagga and Prof. Washington H. A. Olima who understood all my struggles through the research period. Their valuable and critical comments and guidance saw this work to completion. To you I say ASANTE SANA.

To my colleague Dr. Jennifer Murigu who tirelessly encouraged me even when I was at the verge of giving up. Your advice that I put aside three hours every day fot this work has borne fruits Receive my sincere thanks. To my other Colleagues in the Department of real Estate, School of the Built Environment who provided me with the drive to go on by accommodating me in the ADD family I am greatly indebted. I am especially grateful to Dr. Margaret Gachuru, Ms Njambi Kinyungu, Ms Winnie Mwangi, Mr. Nicky Nzioki, Mrs Catherine Kariuki, Mr Lawrence Muchiri, Dr. M. A Swazuri, Dr. S M Masu and Dr. Robert Rukwaro for the interest showed in my work and the encouragement you showed me throughout this work.

Without the funding from the Deutscher Akademischer Auslauschdienst (DAAD) this work would never have started.

Sincere thanks to my research assistants, Lillian Githaiga, Joy Wairimu and Joseph Kimaru for your invaluable assistance. To all the respondents to the research questionnaires and checklists asanteni sana.

To my mother, sisters and brothers for your love, understanding, encouragement and inspiration throughout the study, I am grateful.

And to the Almighty God: All glory and Honour for your faithfulness.

DEDICATION

To my Late Nephew Brian, for the joy you brought in my life when you lived.

Rest in Peace.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Forests, as a part of natural resources, provide a wide range of benefits for a wide range of users at the local, national, regional and global levels. The benefits are of direct use, indirect use, optional use and non-use nature. Direct use include the extractive Benefits (Wood Products including timber for furniture and building, poles and posts, firewood, charcoal, bamboo and non-wood products including fibre, wild game, fruits, medicinal extracts, livestock foliage, tannin and gum; and non-Extractive benefits including recreation, education and habitation/shelter. Indirect Benefits are non-physical ecological and environmental goods and services including nutrient recycling, soil maintenance and stabilization, microclimate improvement and carbon sequestration. Optional Benefits include the potential and actual use benefits deferred for future use which including extractive, non-extractive and indirect. Non-use Benefit is the intrinsic worth of forest regardless of actual or potential use including cultural and religious heritage, aesthetic and bequest. Some of the benefits depend on the forest being left untouched or subject to minimal interference. Other benefits can only be realized by harvesting the forest for wood and other non-wood products.

The ways in which forests are used and valued depends largely on people's economic needs and priorities in a particular place or at a particular time, balanced against the relative scarcity or abundance of forest resources. Over recent years, a complex array of social, economic and political changes have altered human demands on forests. These changing demands have had devastating impacts on

forest status and integrity (Emerton, 2003). Multiple-use forest management, incorporating non-timber forest products (NTFPs), is an important means to assigning value to natural forests in ways conducive to biodiversity conservation.

Different persons attach different values to resources, goods and services. No matter how many perceptions of value are identified, what ultimately matters in terms of action is the value perceptions of those who will actually determine what happens to the forest.

1.2 Problem Statement

Mount Kenya forest is one of the largest and most ecologically significant and commercially important natural forests in Kenya. However it is one of the most threatened forests in the country because of its commercially valuable reserves of indigenous timber and also due to the large human population living around its boundaries. This has led to significant qualitative changes in the forest (KWS, 1999). The forest-adjacent communities are normally accused of much of the degradation since they are seen to be only interested in the direct use values of the forests. These direct use values are in themselves destructive (Emerton, 1996, Emerton, 1998).

Traditionally forests have been seen as valuable resources because they provide timber with the main focus of forest management being on commercial logging and the major objective of forest valuation being to calculate potential timber revenues and profits and to balance these against costs of forestry. This leads to the under-valuation of forest resources.

Recently (see Emerton et al, 2002, Emerton, 2003) there has been considerable eagerness to value forests in monetary terms. The desire to demonstrate that forests are worth a lot more than is presently perceived by decision-makers may account for the many current efforts at estimating the total economic value (TEV) of forests. This is an aggregate of total use value and the total non-use value. However, literature shows that there has been a tendency to value particular forest uses as if they exist in isolation, are mutually independent and therefore can be considered additive as TEV implies. This suggests some contradictions in the Term TEV in that not all values of forests can be reduced to economic or monetary terms.

This approach ignores the central role forests play in providing livelihood opportunities to forest-adjacent households outside the formal monetary economy despite the fact they are often the primary users of the forests and hence key players in the conservation process. This leads to the danger of unfairly penalizing local households by cutting off vital sources of subsistence when they are excluded from forest management systems.

There have been few attempts to value subsistence use of forests by forest-adjacent communities (Lynam et al. 1991; Kramer et al. 1992; Godoy et al. 1993; Emerton, 1996, Emerton, 1998, Emerton et al, 2002, Emerton, 2003). The studies, based on the Total Economic Value model, work within the market paradigm and have been concerned almost entirely with products that are traded or are closely related to other traded products. They look at people's behaviour in actual, surrogate or hypothetical markets where goods are freely bought and sold for cash.

Asking people for their willingness to pay for (or willingness to accept compensation for the loss of) forest resources is also inappropriate in a non-cash economy where livelihoods depend on irreplaceable forest resources. Use of hypothetical cash payments in the Contingent Valuation Methods may be inappropriate in remote rural communities in the developing world where people for various reasons including, but not limited to:

- Most domestic forest utilisation takes place outside the licensing system and is therefore perceived as illegal. Thus no records kept and people unwilling to reveal the level of utilization.
- There is no market or price for the products because they are only consumed within the household level and are not bought or sold in the market.
- There are no close substitutes for forest products, either because of certain unique characteristics that forest products hold, or because the provision of non-forest alternatives such as cooking gas and electricity as a substitute for fuel wood are unlikely to be a realistic option in forest-adjacent areas. The substitutes may not be available or affordable to the households.
- Forests may also hold an additional value for local people over and above the price forest goods and services fetch when traded. This is due to the vital role that they play in the household socio-economy, for cultural or traditional reasons such as the Kaya forests of the Kenyan coast, or because goods originating in forests are preferred above those coming from other sources.

1.3 Objectives of the Study

The aim of the study is to explore the full range of benefits that Mount Kenya forest provides to the forest-adjacent[1] communities and the linkage of these benefits to their perception of the value of the forest.

1.3.1 Specific Objectives

1. To identify and categorize the benefits of forest to the forest adjacent households.
2. To examine the value/importance that forest-adjacent households attach to the forest benefits.
3. To evaluate the relationship between the forest benefits identified and the amount of money that the forest adjacent communities are willing to pay for the purchase of an acre of forestland[2].
4. To recommend how best to incorporate the value perceptions of the forest-adjacent communities in the valuation of forests.

1.4 Study Assumptions

The Study assumes that:

I. The importance that the respondents attach to the various benefits they receive from the forest can be used as a proxy for the value they attach to the forest.

II. The importance that the respondents attach to forests in general influence the way in which they utilize the forest.

III. The value that forest adjacent communities attach to the forest is influence by the benefits they receive from the forest.

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[1] People living within 5 km of the forest edge

[2] An acre is the conventional unit of purchase of land in Kenya

1.5 Study Hypothesis

The amount of money that the forest adjacent communities are willing to pay for the purchase of an acre of forestland is dependent on the forest benefits that are extractive in nature. This then would mean that those who do not give much importance to the extractive forest benefits will give a lower value of the amount they are willing to pay for the purchase of one acre of land than those who rate the extractive forest benefits much higher.

1.6 Significance of the Study

Forests provide many different economic benefits both tangible and intangible. Some of these values are reflected in market prices, due to widespread market imperfections and policy failures. Both private land users and policy makers typically focus on tangible, marketed uses and often neglect non-market forest benefits. This results in excessive conversion of forestland to other uses, or excessive damage to non-market forest services in the process of extracting marketed timber and other goods (Bishop, 1999).

A useful, and growing, body of literature dealing with forest environmental valuation methods has meant that forest benefits can now be much better quantified and expressed in monetary terms. Although environmental benefits are better understood, and can be more accurately quantified, their value is still intangible to many of the public decision-makers, private landholders and resource users whose actions have the potential to influence forest status.

Despite ecological values, and ways of measuring them, becoming a generally accepted component of forestry economics and management, the developed forest

valuation methodologies work within the market paradigm and have been concerned almost entirely with products that are traded or are closely related to other traded products thus ignoring the forest benefits outside the formal monetary economy.

The involvement of local communities in the development of forest valuation methods can ensure that the methodologies take cognisance of the needs, priorities and value perception.

The study intends to use the value perception to come up with ways in which forest benefits to the forest adjacent communities can be valued. The study will not only be useful to public decision-makers and private landholders but will also be important as an awareness raising for the local resource users of the value of forests to them. This will help the planners and policy makers improve on the decisions in guiding management and conservation of forests where the role of the local communities is recognised.

Conservationists in the past decades have been seeking ways to get stakeholder ownership. The emerging paradigm is "participation" thus getting those whom you wish to convince to participate in the valuation exercise from the initial planning to data collection to the analysis of conclusions. Part of valuation methodology must involve rural community level assessments of products used, quantum of use, time of use, as well as resource substitution. Participation in the exercise rather than being passive subjects can lead to recognition of new uses and amounts and scale of use. The study involves the local households at all stages of eliciting benefits and values of these benefits.

1.7 Scope and Organization of the Study

The study commenced with the collection of secondary information through literature search on the broad topic of natural resource management focusing particularly on forest conservation and management. Issues on the benefits and costs of forest conservation were reviewed with the aim of identifying the inherent problems in forest management and conservation. Issues related to how forest resources are valued were also reviewed.

The study was initially set to research on the applicability of the forest valuation methodologies in assessing the value attached to forests by communities adjacent to Mount Kenya forest. It was hoped that the applicability of the Contingent Valuation Method (CVM) which adopts the willingness to pay (WTA) for the conservation of an environmental good and willingness to accept compensation for the loss of an environmental good were to be tested. During the initial stages of the research it was revealed that the method was not applicable as the pretest sample indicated that the government owns the forest and hence it was the responsibility of the government to manage and conserve the forest. The scope thus changed to look at the benefits that accrue to the communities and what they perceive the value of these benefits to be as an indicator of what value they attach to the forest. Thus the study focused on eliciting the perception of the value or importance of forests by local households living adjacent to Mt. Kenya forest.

The value assigned to the forest is in relative terms as there is no absolute economic value for most of the forest benefits identified by the local households only those that

exist in their perception. A relative value was attached to the individual forest benefits depending on the perception of the household. However the households were asked to give a monetary value they were willing to pay to purchase an acre of forested land and this was compared to what they were willing to pay to purchase an acre of cropped land, an acre of grazing land and an acre built up area.

The area surrounding Mt. Kenya forest is extensive and carrying out a comprehensive census of the area would be a formidable job. Due to limitation of resources and time the area is represented by a sample of 300 households living adjacent to the Mt. Kenya forest in three areas, Chuka, Manyatta and Mathira divisions of Meru South, Embu and Nyeri districts respectively.

The study is organised into seven chapters. Chapter one is an introductory which introduces the problem and its context. Chapter two presents the conceptual and analytical framework applied in analysing the objectives outlined in chapter one. Chapter three discusses the methodology while chapter four gives the description and characteristics of the study areas. Chapters five and six present the findings of the empirical work based on the study objectives. The last chapter gives a summary of the findings and recommendations of the study. The recommendations focus on sustainable management and utilisation of forests resources especially taking into consideration the value perception of the local communities.

CHAPTER TWO

FORESTRY VALUATION METHODS

2.1 Introduction

Valuation is determining what things are worth to people. The worth of things in turn directs the decision-making behaviour of individuals and organisations. If values were readily available for everything foresters and forest owners analyse, plan and decide about, valuation as a subject would not be particularly important since there would be a price listing they could consult. Unfortunately such price listings are not available and we resort to a variety of creative and often debatable techniques to estimate value indirectly.

In the market place the individual has fairly clear information on which to base any choice. The product tends to be visible, its characteristics are generally well known, and it has a market price. The individual's choice is then based on a weighing up of the quantity, quality and price on offer, subject to some uncertainty arising from incomplete information. But when environmental assets and services are involved there is often very limited information about the nature of the product in question, and, there is no price posted in the market place. Thus making choices in the context of environmental quality, therefore, is more complex than making choices in the context of purely private goods and services.

The aim of valuation is to determine human preferences. Determining the value of an object or function is a question for the market place filled with willing buyers and sellers (Coder, 1996). The valuation of forest resources has been a concern in

forestry for quite a long time. However, most valuation efforts, until the 1950s, were limited almost entirely to the timber component of the forest (Chapman and Meyer, 1947; Hiley, 1956).

The value of forest resources has traditionally been calculated by using their market prices as a guide or by taking the price of the next best alternative available to forest users as a proxy. Yet finding suitable prices to use as a basis for valuation is often impossible in the case of most of the forest products that are used domestically for various reasons.

In trying to overcome the constraints of conventional economic valuation techniques, the Participatory Environmental Valuation (PEV) method was developed and used in Kenya for the valuation of subsistence use of Oldonyo Orok forest. (Emerton and Mogaka, 1995; Emerton, 1996; Emerton, 2003). This method combines conventional economic methods with Participatory Rural Appraisal survey techniques that use pictures to refer to different forest products. It uses a numaire for valuation of a commodity, which forms part of the local socio-economy, has wide local significance as an item of value and can easily be translated into a monetary amount.

2.2 Concept of Value

Value is a human perception. It is the worth of something to a particular individual at a given place and moment in time. The measure of worth is determined by the time, goods, or money an individual is willing to give up to obtain, posses, or use the good of service in question (Davis and Johnson, 1987). Valuation, the process of quantifying

values, must accordingly operate from the perspective of some individual or group of humans.

Forests have traditionally been seen as valuable resources because they provide timber (Emerton, 1996). But forests provide a wide range of benefits other than timber. Forest resources generally play three major roles in a community's economic and socio-cultural development at all levels. Forests provide resources that become the raw materials and energy for economic processes. It assimilates the waste products dissipated out of economic activities and also provides a continuous flow of goods and services to individuals and the society at large.

Davis and Johnson (1987) identified three different but related viewpoints that could be used to establish value. The first is market value, where the dollar price is established by trading activity in established markets. The second is the value in use of something to a given individual. The third perspective is that of society as a whole, which goes beyond and is different from the combined views of its members. Social values or benefits are established subjectively by legislators, public administrators and, sometimes, by citizens voting on bond issues and other special elections. Society emphasizes the goals of collective security, growth, and distributional equity more than do the individuals of society.

2.2.1 Market Value

The price in a competitive market where fully informed, willing and numerous buyers and sellers exchange goods and services is the standard value most frequently invoked. Economic theory provides strong and extensive support for this notion of

value since a reasonably competitive market ensures that the value received for a unit of a product or labour input at the margin will equal or exceed the cost or resources given up. Hence competitive market prices measure what decision-makers are "willing to pay" for goods and services. The notion argues that individuals will not only exchange their own time and other resources to receive maximum personal benefit, but also that when all individuals pursue their own interests, the aggregate use of resources in society will be socially efficient in the sense of providing the greatest total benefit to society as a whole.

But few markets are truly competitive and many do not reflect human values accurately. For example, markets with only one or a few buyers or sellers can be manipulated and the price offered or paid will not equal the marginal value of resources exchanged. The Kenya Government is the dominant supplier of many of the forest goods and services and thus by default, is a monopolist. Timber and forage have fairly well established markets. However, in the forest, there is not always an active market with lots of buyers and seller to indicate through their bidding what the standing tree or growing grass is worth.

2.2.2 Value in Use

Forest valuation questions centre on the value in use of forestland and the tree vegetation growing on the land. Both the potential buyers and seller (owner) of the land evaluate Land and trees. Each potential buyer of forestland calculates the value of a particular parcel for specific uses he or she is contemplating. A tree farmer estimates the value of the land by how much future income it will provide from

stumpage sales. The speculator evaluates the property by the expected increase in the market price of the land and timber together. The recreationist subjectively evaluates the satisfaction or utility received from owning and using the property for camping, cabin building, hiking or other purposes. The timber buyer looks only at the trees and determines stumpage value by figuring the sale value of lumber that can be made from the trees and subtracting what it costs to log, transport, manufacture the logs into lumber, and, adding back in, the resale value of the land after harvest.

Forest owners as land and/or timber sellers may calculate the value in three ways:

- The value to themselves in current or probable future uses
- The price it would sell for on the current market and
- The value in use to each possible buyer.

The first calculation establishes a base for the decision to sell or retain the property. The second calculation establishes an approximate market value while the third provides information about each buyer or bidder in order to facilitate individualized price negotiation. This may result in higher than "market" prices if the candidate buyer is not fully informed or has some unique attraction to the property (Davis and Johnson, 1987). For example the land might have certain tree sizes and species of critical importance to a sawmill owner, or the aesthetic setting may strike a particular responsive cord with one possible buyer.

2.2.3 Social Value

The total size of the national economic pie, roughly measured by the gross national product, although important, is only one of many social concerns. Society is also

concerned about the distribution of goods and services i.e. who benefits and who pays. Some of the questions raised by this category of value include:

- Does the tax, pricing, and market system lead to the rich getting richer and the poor getting poorer?
- Are we collectively destroying land, water and cultural commons?
- Is the economic system encouraging stable growth and increased opportunities for all segments of society?
- Does it enhance international strength and national security?
- Are desirable public goods being provided?

All these social gaols and concerns suggest that the values subjectively assigned by legislators and public administrators to evaluate actions, programs, plans and policies may be considerably different than values that would be assigned by individuals or by the market. These social goals and ideas are very difficult to put quantified values on. All in all the legislative and administrative bureaucracies of any government, through law making, rule making, regulations, and budget appropriations, do in fact make decisions that articulate social values.

2.3 Concept of Total Economic Value

The Total Economic Value (TEV) model is the most common economic modelling for the environment (Lette and de Boo, 2002). It derives from "use value" including the direst use values (DUV), indirect use values and optional value as well as the "non-use values" including Existence or intrinsic value. From a purely conceptual point of view,

forest utilities can be divided into two broad value categories: Use values and Non-use values.

2.3.1 Use Values

The landscape of forest resource use values is quite large. Nevertheless, from a hypothetical perspective, there are three main classes of use values. They include:

- Direct Use Values
- Indirect Use Values and
- Option Values.

2.3.2 Direct Use Values

These values refer to the direct and physical utility derived from forest resources. The direct value of an indigenous forest comprises the total value of all the direct uses that are made of it by various groups and individuals (Wass, 1995). They include:

- Extraction of wood and non-wood products
- Non-extractive activities such as recreation, education and habitation.

The most prevalent direct uses include timber, fuel-wood, poles and posts, medicines for livestock and human, fruits, gums and resins, recreation and habitation among others.

Indigenous forests are widely used by local populations and the majority of the forest-adjacent community use the forest to provide some of their subsistence needs. Depending on the type of the forest, most of these benefits accrue to local communities and other stakeholders at national level. Typically, local communities benefit most in

terms of using forest as sources of fuel-wood and charcoal, poles and posts, weaving materials, wild game and to a lesser extent as sources of foliage for livestock while non-forest residents benefit in terms of the timber and other commercially oriented services. Wild game harvesting in Arabuko-Sokoke forest reserve has taken place for many centuries and at one point in time was the mainstay of the local people (FitzGibbon et al, 1996). The forest has been a source of energy and construction materials for the forest adjacent dwellers.

The volumes of the sustainable yields per annum of timber, fuel-wood and pole wood together with their net economic values can help to calculate a direct use value of forests. It is difficult to estimate the educational and recreational value of indigenous forests. This is because many scientific and social studies that are carried out in areas of indigenous forests yield local, regional and sometimes global benefits as well as holding value for the individuals who carry them out. However, an indication of this value can be given by interviewing as many users as is possible using the contingent valuation method.

The degradation or clearance of indigenous forests implies the loss of direct use values. When assessing the value of conserving the indigenous forests it is the sustainable (calculated) rather than the current (actual) values that should be arrived at. The current actual direct use of the forest may be unsustainable and lead to further degradation (Wass, 1995).

Other direct values to be considered should include the use of indigenous forests for human habitat and the use of genetic materials from plant and animal species for

modern food crops, pharmaceutical and industrial applications. Biodiversity ensures a range of choices and alternatives for the direct use values of forests. Currently there are no quantified values available for these values.

2.3.3 Indirect Use Values

These values include utility functions that forestry fulfils which are indirect and mostly non-physical in nature. The indirect value of indigenous forests refers to the ecological and environmental goods and services that they provide. These values correspond to the ecologists' concept of "ecological functions" and deal primarily with the functions of ecosystems (McNeely et al 1990). They tend to reflect the value of biological diversity to society locally or at large rather than to individuals or corporate entities. The prominent indirect use values of indigenous forests include nutrient recycling, soil maintenance and stabilization, microclimate improvement, protection of water catchment sites and carbon sequestration. These values are important to a wide scope of communities at local, national, regional and/or international levels depending on specific roles under reference.

Forest degradation and destruction would imply a loss of many of these environmental benefits although this would depend on the subsequent alternative land use. However, general experience indicates that few other forms of land use provide the same benefits as indigenous forests. It is not easy to estimate the indirect value of indigenous forests, as the date requirements are substantial and the linkages between cause and effect often difficult to determine with any confident degree of precision.

2.3.4 Option Value

Option values primarily refer to potential use of the existing forest resources. This is the value of a differed use of an existing forest resource to future uses, which can either be direct or indirect. It relates to the amount that individuals would be willing to pay to conserve a forest for future uses, which are not carried out now, but for which future opportunities would be foregone if the forests were destroyed. It is essentially an expression of preference for the preservation of an environment against some probability that it will be made use of at a later date. It is by placing a high premium on the option value that policy regimes favourable to sustainable natural resource conservation can be promoted.

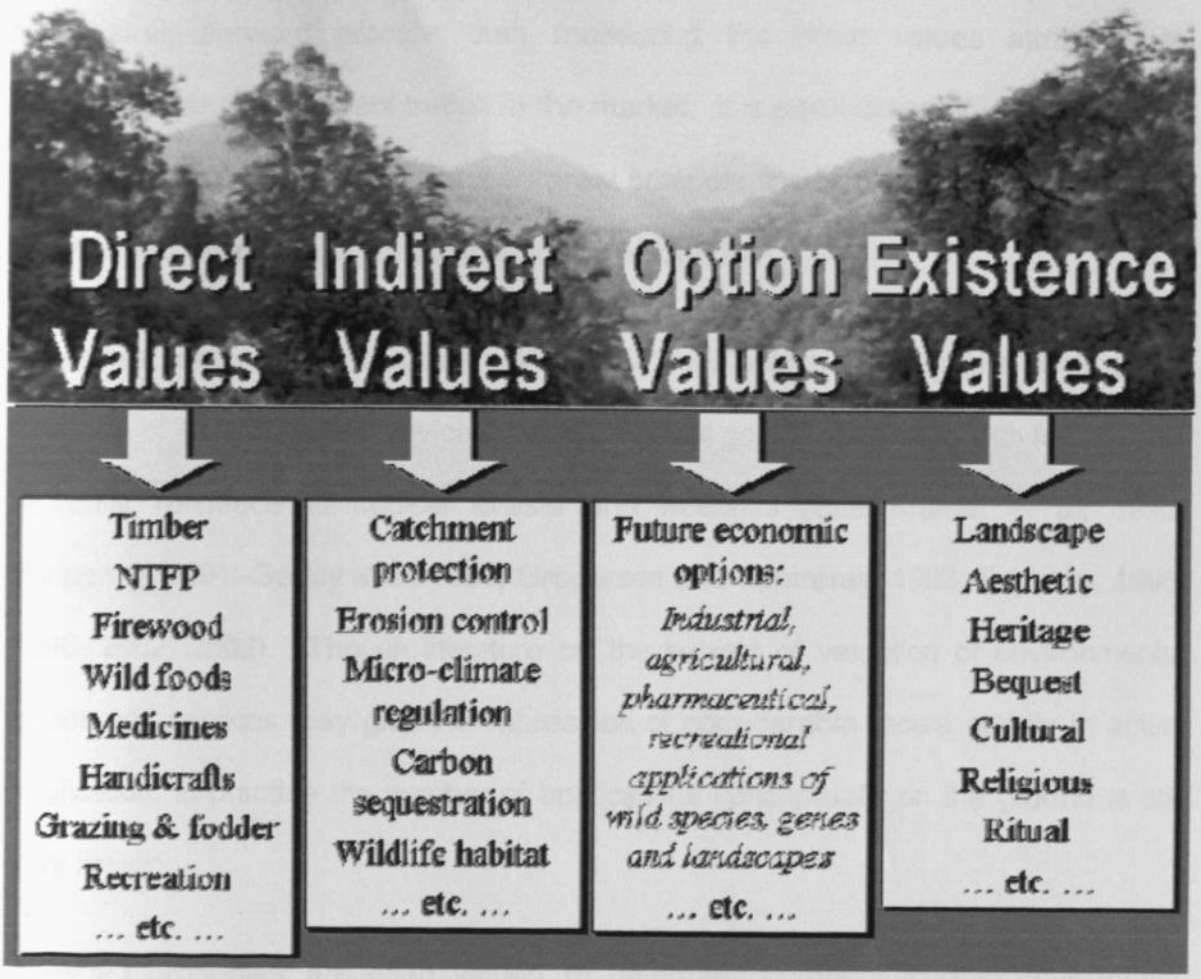
2.3.5 Non-use Values

There is only one prominent category of non-use values of forest resources. This is the value referred to as the existence value. It relates to the intrinsic worth of the forests regardless of the actual or potential use. It is the value people derive from simply knowing that a forest exists, even if they never visit it. It includes cultural, heritage, bequest and aesthetic values.

The concept of existence value is an elusive one remarkably dependent on individual perceptions and values, which are influenced by a wide range of factors. The complete array of use values and non-use values represents the benefits of indigenous forest conservation and management. Nevertheless, forest values will depend upon the perceptions of individuals, communities, firms or governments. The nature of past

and contemporary interaction that has prevailed upon human-natural resource capital has a major role to play in influencing the value people attach to forest resources.

Figure 1. The Total Economic Value of forests



Source: Adopted from Emerton 2003: Tropical Forest Valuation: Has it been a futile Exercise. Unpublished Paper presented in the xii World Forestry Congress.

2.4 Forestry Products Valuation Methods

The simplest way of assessing the value of a product is to look at how much people pay to buy it or receive to sell it i.e. the market price. However, for many non-timber

forest products and most environmental goods and services there are no direct market prices to act as a basis of valuation.

Measuring the direct values that are traded on commercial markets is likely to be a more straightforward process than measuring the other values attributed to protected areas that are not traded in the market. It is particularly difficult to find any realistic market-based price for minor forest products, the ecological services forests provide and the option and existence value of forests.

There has been remarkable growth in the academic economics literature dealing with valuation of environmental services and non-market goods associated with forests with particular reference to tropical forests and wetlands (See Kramer et al, 1992; Winpenny, 1991; Godoy et al, 1993; Gregersen and Contreras, 1993, Emerton, 1996, 1998, 2002, 2003). Though literature on the subject of valuation of environmental goods and services may give the impression of considerable recent activity in actual application, in practice the number of applications conceptually on the ground is still very limited.

Forested properties are often valued to determine compensation in government takings, to compute taxes on property values, or to determine collateral on loans. It is essential to do forest planning, evaluate proposed projects, write timber culture prescriptions or engage in buying and selling of forestland, know the price for land, timber and other forest outputs (Davis and Johnson, 1987). It has always been difficult enough to estimate the value of timber stumpage and land. Recreation,

visual amenity, water, wildlife and all other forest outputs are by social mandate being included in public forest management calculations.

2.4.1 Valuation of Timber

Timber was seen as the only recognizable benefit from the forests for a long time as it was typically the only marketed forest product. Therefore market prices were used for valuation purposes. The total value could then be derived by multiplying the price per unit of timber with the estimated quantities that could sustainably be harvested from the forest area under consideration. The costs of harvesting and transporting the timber are deducted from the market price to arrive at the net value of standing timber in the forest.

Market prices may be derived from a variety of sources including existing literature on economic and social studies, published or privately held statistics, socio-economic surveys and consultations with agricultural extension officers, forestry service personnel, government market specialists and statisticians (IIED, 1994).
Ideally, the valuation of timber should take account of the variations in market values from species to species, and the variation in residual values with location and topography.

There are many methods in literature for the valuation of forestlands. Most of them value timber stands depending on the timber volumes or amounts. Foresters have over time used two basic approaches for the valuation of forests. These include:

a) Arbitrary methods
b) Analytical methods

Arbitrary Methods

The pricing mechanism of these methods is guided by some arbitrarily chosen yardstick (Syagga, 1994). They include:

i) Fixed Royalty Rate

The charges are established administratively by legislation, regulation codes or ordinances. In Kenya, The Forest Act Cap 385 required that the Minister in charge of forests to fix the royalty charge in respect of each species on or before 30th June of each year. With the new Forest Act 2005, this is the function of the Forests Board.

Royalty on timber is calculated on the volume in cubic metres of logs from trees felled after deduction of any defect allowance relevant thereto. The royalty is payable to the government from those licensed to cut timber in the forests. The level of rates can be set to encourage or discourage the utilisation of a given species.

The method is simple, easy and sufficiently flexible. However, it does not accurately reflect stumpage values as it ignores all other values of the forest. The process of review, revision and implementation of these charges is lengthy and cumbersome.

ii) Value Related Charges

The method derives the fixed royalty charges as a percentage of the selling price of the processed or converted product (e.g. 30% of the average price of timber). The royalty rates are determined after the processed product has been sold.

The method is simple and flexible. However it does not take into account the other values of forests as it is based on timber and timber products prices in the market. It does not consider the non-market values of forests.

iii) Formula Approach

This is an extension of the value related charges approach. The level of charges is based on prices of timber, transportation costs, distances of haul, stand conditions and terrain. Charges are automatically revised as the price of logs or processed products change due to changes in costs and other factors included in the formula.

It only measures the direct use values with no consideration of indirect use value, option value and existence values.

iv) Auction Prices or Seller/buyer Negotiations

The rates are based on auction prices or seller/buyer direct negotiations, open or sealed bid auction or in public log markets. The approach is flexible but requires detailed knowledge of the forest industry. It is time consuming and where no bidders exist, auctions are not possible. It does not consider the indirect use value, the option value and the existence value.

Analytical Methods

These methods base stumpage value on:

- Costs of processing timber
- Margin profits for the seller and buyer of the stumpage.

Thus the value of standing timber will be equal to the price of processed timber less the costs of processing, transportation, logging and the allowance for profit. In other words the stumpage value is determined as a residual:

S = R-C-M

Where

S = Stumpage value

R = Selling Price/cubic metre

C = Operation cost including depreciation

M = Allowance for profit

The methods include:

i) Investment Method

The method relates profit to the working capital and capital equipment using an appropriate rate of return that reflects the rate of return earned by similar investment elsewhere. The valuation of stumpage is based on the prices of finished timber products. No consideration is made of other values of the forest.

ii) Conversion Return Method

The method has two categories

a) Turnover method: Turnover method: The profit is determined as a percentage of all production (processing) costs exclusive of stumpage purchases. A 50-50 split of conversion return between the seller and the buyer is used.

b) Business Ratio method: Profit allowance is determined by using one of the three ratios used in business between profit, operating costs and selling price (Openshaw, 1980)

The formula for conversion return is given by:

R - C = M = S

Where

R = Selling price/cubic meter

C = Operating costs

M = Allowance for profit

S = Stumpage value/cubic metre

The drawback of the method is that it does not consider costs involved in raising the stumpage. It only applies to products that can be sold, with established markets and hence is deficient in valuation of non-market products of forests.

iii) Multi-parametric Analysis

This method is normally applied to urban forest valuation because trees in urban areas are grown for purposes other than saw-log production. Aesthetic value predominates urban tree planting but if street trees of merchantable sizes and desirable timber species were to be felled, the timber will not be thrown away simply because the trees were grown in an urban environment (Syagga, 1994). The equation for calculating the value of an urban tree can therefore be assumed to take the form of:

Utv = f(Av, Tv, Fv);

Where:

Utv = Urban tree value

Av = Aesthetic value

Tv = Timber Value

Fv = Firewood value

The firewood portion of the tree may be calculated from the equation

Firewood portion can be valued on the basis of market price of firewood in the local markets. The most difficult value to quantify is the aesthetic value as it is susceptible to subjectivity because it involves sentiments depending on the aesthetic considerations of whoever planted the tree.

Though the Multi-parametric Analysis method is capable of capturing total economic value (TEV) has so far only included the direct use values and to some extent the existence values.

2.4.2 Valuation of Non-Timber Forest Products (NTFPs)

Non-timber forest products NTFPs) are a variety of physical goods, other than timber, that are derived from forests and that are used for subsistence purposes or are traded or sold. Include plants and plant based products (fruits, latexes and medicines) and animals and animal based products. They may either be:

i) Marketed Non-Timber Forest Products including Fruits, medicinal plants, fibres, canes, and wildlife may be traded or sold. Their Price can be established at the local market by direct observation of market exchanges to determine the value in exchange.

ii) Non-marketed Non-Timber Forest Products including forest goods, such as fruits and fuel wood acquired not through the market but by gathering or producing them themselves.

Unlike traditionally where forest value has been based on timber production, greater attention is now being paid to the importance and value of NTFPs. A number of economic studies have been undertaken in order to measure, in monetary terms, the value of NTFPs (Bishop, 1999; Pagiola, et al, 2002, Emerton et al 2002, Emerton 2003). These studies have demonstrated that the real (or potential) magnitude in many cases is substantial. A study in Amazon forest indicated that the economic value of NTFPs was in fact bigger than that of the timber in the long run (Peters et al, 1989). Other studies have shown that NTFPs are important sources of fuelwood, building materials, fodder, food and income to the rural people. A number of NTFPs (e.g. rattan, bamboo, resins, and medicinal plants) have shown potential economic value for further research and development. It has also been highlighted that higher economic values can be derived, if forest management emphasizes the production of both timber and NTFPs (Panayoutou and Ashton, 1992).

2.4.2.1 Valuation of Marketed Non-Timber Forest Products (NTFPs)

The valuation of NTFPs extracted for sale, is based on market prices. The method involves direct observation of market exchanges to determine the value in exchange of the particular goods or services. The estimated quantities are multiplied by the market prices, corrected to shadow prices as necessary to remove policy distortions and market imperfections. Costs of extraction and marketing should be deducted

from market values to find the net income, or in the case of timber, the derived 'stumpage' value should be used.

Peters, Gentry and Mendelson (1989) used the market prices approach in their valuation of alternative forest uses of an Amazonian Rainforest, in Mishana, Rio Nanay, Peru. They compared the financial benefits of maximum sustainable extraction of wild fruits and latex to the potential returns from forest conversion to timber extraction.

Using average retail prices for forest fruits, based on monthly surveys of Iquitos produce market, and rubber prices from the agrarian bank office, the value of the harvest was derived by multiplying yields by market prices. By deducting from market prices the estimated harvesting and marketing costs, the net revenue from a single year's harvest of fruit and latex production was estimated.

However, majority of NTFPs are not traded in local market systems, escaping formal monitoring and recording thus data on quantities and prices are often not readily available. The prices obtained in isolated rural markets do not necessarily reflect the value that a broader consumer population would be prepared to pay or incorporate the costs of bringing products to a wider market.

Access to markets and transport infrastructure may limit a location's ability to place products on the market competitively.

Though the price for the marketed NTFPs can be established at the local market or during an interview with the users of such products, majority of studies show that use price and expenditure information to value NTFPs appear to experience difficulty

in collecting data on quantities and inputs (Pagiola, et al, 2002, Emerton et al 2002, Emerton, 2003). Markets for NTFPs are often very thin, seasonal and localised (Bishop, 1999).

In addition, information on any seasonal variations in the goods harvested is important, since this can be significant and will thus impact benefits, especially locally. For NTFPs extracted for sale, valuation can be based on market prices. Many goods and services from tropical forestland uses including wood products, (timber and fuel), non-wood products (food, medicine), wildlife and recreation are traded, either in local markets or internationally.

2.4.2.2 Valuation of Non-Marketed Non-Timber Forest Products (NTFPs)

Non-marketed NTFPs may be valued using one of the following approaches:

Methods include:

i) Substitute or 'Surrogate' Market Approaches

These approaches depend on the existence of markets for substitute products, or of markets, which reflect changes in the value of the goods and services in question. The estimate the value of a particular good or service from the known values or prices of substitute (fuelwood versus gas) or comparable good or service under comparable conditions (Richards, 1994; Gregersen, 1995).

The disadvantage of these approaches is that alternative/substitutes may not be available in the market or may not be affordable. The methods here include:

Travel cost method

The method is based on the assumption that consumers value the experience of a particular forest site at no less than the cost of getting there, including all direct transport cost as well as the opportunity cost of time spent traveling to the site (i.e. foregone earnings).

This survey-based method has been used extensively, especially in richer countries, to estimate environmental benefits at recreational sites with little application in the developing countries (Bishop, 1999).

Tobias and Mendelssohn (1991) use the method in Costa Rica to estimate the ecotourism value of domestic use of the Monteverde Cloud Forest Biological Reserve. Data on costs of visits, origin, frequency and educational level were used in a multiple regression analysis to derive a demand function in which visitation rates for each area in Costa Rica could be estimated as a function of distance, population density and educational level.

Hedonic prices or property values method

The method attempts to isolate the specific influence of an environmental amenity or risk on the market price of a good or service. The most common applications of this method are the property value approach and the wage differential approach, which are used to value environmental amenities and dis-amenities. It has been used in developed countries to estimate the negative impact of air and noise pollution or the presence of waste disposal facilities on the market prices of residential property and conversely, the positive impact of proximity to water and public green space (Garrod and Willis, 1992 quoted in Bishop, 1999).

The method has limited practical relevance in most developing countries' forestry situations, due to imperfections in land markets and the difficulty of collecting the information.

Substitute Goods Approach

Value approximated by the market price of similar goods (e.g. fuelwood sold in other areas) or the value of the next best alternative or substitute good (purchased fuels such as kerosene and gas). Gathered products such as fuel-wood and fruits could be valued by reference to the opportunity cost of the time which household members spend collecting these products. The value of traditional medicine could be based on the cost of purchasing equivalent medication at local stores or pharmacies.

Ahmad (1993) used the method to calculate the value in increased fodder production and avoided pasture degradation of the Rural Development and Environmental Protection project in Djibouti. Increased fodder availability was calculated in dry-matter equivalent and multiplied by the price of an equivalent unit of sorghum while increased fuel-wood was valued at market price through kerosene price (direct substitute) or labour collection opportunity cost could have been used.

The weaknesses of the method rest on the facts that:

- It is less precise and requires more data.
- Substitute markets can also be distorted by government policies and market interventions.

- Some subsistence goods can be considerably more difficult to value as it is difficult to separate out their effect since they are used in combination with other products.
- For the valuation of fuel-wood, different fuels have to be expressed in the same delivered energy terms if they are to be compared.
- It is likely to overvalue subsistence supplies if the users would not purchase fuel when unable to gather fuel-wood.

Production Function Approach

The approach attempts to relate human well-being to a measurable change in the quality or quantity of a natural resource (Maler, 1992). It may be used to estimate the indirect use value of ecological functions of forests, through their contribution to market activities. The impact on the productivity or costs of a project that affects the production function or the input-output relationship of on-site or off-site users can be estimated. For example, soil conservation benefits are normally calculated through projected change in net incomes. Physical impacts or input-output relationship such as impact of soil fertility on crop yields and the change in productivity assigned a monetary value through market or shadow prices.

Anderson (1989) used the method to value benefits in terms of the effect on crop and fodder yields in the Shelterbelts and Farm Forestry project in Nigeria. In the Loukkos Basin Watershed management project in Morroco, erosion with and without the project was compared using a modified Soil-loss Equation (see Brooks et al, 1982; Winpenny, 1991). Hodgson and Dixon (1988) also used the approach to

estimate the impact of ecological effects of coastal logging on terrestrial and marine ecosystems, and thus on tourism and marine fisheries.

However, it relies on clear understanding of the often-complicated biological relationships, and local data availability often means reliance on comparable national and international data or on 'expert' estimations. Its application is more problematic where there are several direct and indirect use-values to be considered, as there will often be tradeoffs between them and double counting may occur (Babier, 1994).

Stated Preference Approaches

Price-based, surrogate market and production function approaches all rely on the use of market prices to estimate the value of forest goods and services. Where markets do not already exist as in the case of option and existence values, and markets have to be considered or imagined, Contingent Valuation Method (CVM) can be used.

The method is based on asking people what values they would place on hypothetical environmental changes, either in terms of the Willingness-to-Pay to secure an environmental improvement, or Willingness-to Accept (WTA) compensation for an environmental loss.

Respondents are not asked to place a monetary value on the environmental amenity itself. Instead, a range of amenities are ranked and then scored relative to each other, with one of the amenities serving as an 'anchor'. The anchor has a monetary value

itself (Pearce, 1993; Bishop, 1999; Emerton, 1996, Emerton, 1998; Emerton, et al 2002; Emerton, 2003).

Tukahirwa and Pomery, (1993) used WTP to estimate the value of standing timber in the study to assess the economic value of the Bwindi Impenetrable Forest National Park in order to justify funding for the establishment of the park. Timber was estimated at 5 times the royalty or stumpage fee.

Literature reveals a wide divergence of opinion about the use of CVMs. According to Markandya and Munoz (1994) CVMs have been underused while Pearce et al (1993) argue that CVM is the only practical means of estimating some kinds of benefits eg existence value. Ahmad (1993) argues that these methods still lack credibility and suffer from being unfamiliar to decision-makers while its Practicability in developing countries is doubted by Winpenny (1992). Due to differences in cultural perceptions, indigenous people may not measure the worth of something on the basis of monetary values. All these factors cause bias in the estimation of WTP. Contingent Valuation Methods are also expensive and time-consuming Pearce et al, 1994).

Cost-based Approaches

The approaches focus on the costs of providing, maintaining or restoring environmental goods and services. The methods include:

i) **Replacement Cost (RC):** Generates a value for the benefits of an environmental good or service by estimating the cost of replacing the benefits with an

alternative good or service. RC can be used when it is possible to replace a damaged or destroyed asset.

ii) **Preventive Expenditure (PE):** Involves the assessment of how much people, firms or governments have paid or are prepared to pay to avoid losses due to environmental damage such as flooding due to deforestation. Actual or potential PE can be used to place a minimum estimate of WTP.

iii) **Indirect opportunity Cost (IOC):** Non-marketed goods such as NTFPs and firewood are valued in terms of the opportunity cost of the labour involved. It was one of the methods used to estimate firewood values of the Nepal Hill Forest Development Project (Fleming, 1983; Dixon et al, 1986). Newcombe (1989) also used it to calculate the net benefit flows of Ethiopia's Reforestation in the Highlands Project by incorporating the land opportunity cost of tree planting. However the drawback of this method is that local landholders and forest-adjacent communities in particular, tend to receive little tangible evidence of forest environmental values in the prices and profits they face, while they typically face high marginal costs in shifting to sustainable land use and management practices. The opportunity costs of sustainable forest management, in terms of alternative land and resource uses foregone, is usually substantial, is typically far higher than direct forest management expenditures, and often accrues to rural households and villages who are least able to afford to bear them (Nasi *et al.*, 2002).

2.5 Conceptual Model

Also most published economic studies of forestland use options in developing countries appear to concentrate on direct use values that are marketed (Pearce, 1993, Bishop, 1999, Emerton, 1996; Emerton, 1998; Emerton et al 2002; Emerton, 2003). This is possibly because the value of marketed products and services of forestland is easier to estimate than the value of non-marketed or subsistence uses. For many non-marketed or subsistence uses there is little publicly available information of the quantities harvested, consumed and sold or the costs incurred.

Information on quantities harvested, consumed and sold or the costs incurred on non-marketed or subsistence uses is scanty. Literature revealed that most of the valuation methods use market prices to estimate the value of forest products. The study intended to look at all the forest values/benefits that accrue to forest-adjacent households. It uses a model that appreciates that finding suitable prices to use as a basis for valuation of forest products used for subsistence by the households living around the forest is often impossible for various reasons including but not limited to:

- Lack of market or price for these products since they are only consumed within the household and are not bought or sold. In many cases the harvesting of these products is officially prohibited and they are thus illegally harvested.
- In a non-cash or subsistence economy, as is the case for forest products consumed in the households by the forest adjacent communities, market prices are not an appropriate indicator of value.

- Often there are no close substitutes that are available and affordable to the forest adjacent households.
- The forest products may hold a non-monetary value for households in form of cultural or traditional value.

The model derives from the concept of Total Economic Value (TEV) and adopts a modified approach of the Participatory Environmental Valuation (PEV) developed by Emerton and Mogaka (1995) while valuing the subsistence use of Oldonyo Orok forest Kenya. Instead of using pictures to refer to different forest products and equating the identified uses with a numaire (a commodity, which forms part of the local socio-economy, has wide local significance as an item of value and can easily be translated into a monetary amount) the method asks the respondents to state the importance and assign importance points to the forest benefits on a cardinal scale of 1 to 4 with 1 being extremely important and. From literature, total economic value of a forest would be generated from the compilation of both the use values and non-use values. The use values include the direct and indirect use values as well as the option value while the non-use value includes the existence or intrinsic value of a forest. TEV can be expressed as a function of these values in the form of:

TEV = f (DUV, IUV, OV, EV/IV) Where;

TEV = Total Economic Value

DUV = Direct Use Value

IUV = Indirect Use Value

OV = Option Value

EV/IV = Existence Value/Intrinsic Value

The study uses the categorized benefits to determine the relationship with the between the value they are willing to pay for the purchase of one acre of land and the benefit they enjoy from the forests. These benefit categories are related to the value in the following equation:

TEV = f (EFB, NEFB, IFB, OFB, NUFB) where

EFB = Extractive Forest Benefit

NEFB = Non-Extractive forest benefits

IFB = Indirect Forest Benefits

OFB = Option forest Benefits:

NUFB = Non-Use Forest Benefits

2.6 Conclusion

The basic aim of valuation is to determine people's preferences in terms of how much they are willing to pay for or how much better or worse off they would consider themselves to be as a result of changes in the supply of different goods and services. Valuation provides a means of quantifying the economic costs and benefits that accrue to different people. The economic costs arise from the degradation of the environment while benefits arise from the relative profitability of the different economic activities that take place in or around a particular environmental resource.

The most common observable measure of economic value is derived through market transactions and is called market price. Value measures (prices) are developed in the markets by the willingness to pay of consumers (Buyers) and the willingness to sell of producers (sellers). Though market prices provide a strong tool for economic analysis,

they do not reflect the true willingness to pay (WTP) for a good or service. In other cases, as in goods and services of forests, market prices do not exist.

The justification for monetary valuation lies in the way in which money is used as a measuring rod to indicate gains and losses in utility or welfare, money being the means of measurement (Pearce & Tupner 1990). The reason for use of money as the measuring rod is that all of us express our preferences every day in terms of these units - when buying goods we indicate our "willingness" to pay (WTP) by exchanging money for the goods and in turn our WTP must reflect our preferences. A positive preference for something will show up in the form of a willingness to pay for it.

From the foregoing it is clear that forest valuation methods in many developed countries work within a market paradigm based on purchase of goods and services. However not all forest benefits can be reduced into monetary units. The model is therefore inappropriate for the various forest products which have no price or market substitutes or for which quantity is hard to estimate. Hence it has been difficult to quantify environmental consequences of alternative forest land-uses because they are highly complex and poorly understood.

Market imperfections and politics distort market prices. In addition, market prices do not take into account the social and environmental costs and benefits which are external to private market. For example, the environmental consequences of unsustainable logging are not paid for by the logger just as pollution and global warming costs of private car use are not paid by the motorists. Similarly, environmental benefits are enjoyed by so many people without the remuneration of the individuals or organizations responsible for conserving the resource.

CHAPTER THREE

STUDY DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the methods that were used to collect and analyse both secondary and primary information useful to the study. Both data collection and data analysis methods are discussed in this Chapter. The study uses both secondary and primary sources of information.

The sources of this literature included publications and reports in University libraries, relevant Government Ministries' libraries, and national and international organisations' libraries. Relevant government documents and records together with other publications were reviewed to give an insight of the different types of forest products, their uses and the various users of the various products for which licences are issued in Kenya as well as the forest management and conservation efforts.

3.2 Data Collection

Participatory Rural Appraisal methods (PRA) were used to collect primary information from the households living adjacent to Mount Kenya Forest in Manyatta, Mathira and Chuka divisions of Embu, Nyeri and Meru South districts respectively. Household interviews, focus group discussions and key informant interviews were carried out in these selected areas to collect both general and specific information on the forest benefits enjoyed by the households and the socio-economic characteristics of the households.

The study chose to use Participatory Rural Appraisal Methods based on the following assumptions:

i) The PRA methods can enable users to generate indigenous criteria for valuation of forest resources, i.e. criteria of local relevance that are considered important by users.

ii) The users can highlight qualitative attributes and their importance even when many of them cannot be quantified in numerical terms.

iii) 'Proxy' variables for valuation can be suggested by users and analysed in a flexible and relaxed setting.

iv) Individuals/groups/communities can participate in scoring different criteria for valuation showing relative priorities for different aspects of natural resources that they value.

v) The analysis made by the users can be used later for developing community action plans for regeneration of local resources.

A range of methods is available for information gathering. Some important methods include mapping, semi-structured household interviews, seasonal diagrams, transect walks, matrix scoring, preferential ranking, focus group discussions and key informant interviews among others. The study adopted the semi-structured household interviews, Key informant interviews, focus group discussions, scoring and ranking. Semi-structured interviews with key informants provided more information about the forest resource and helped in the development of the criteria that can be used to valuate the resource. Finally these criteria were scored and ranked in order to determine which were the most important.

3.3 Application and Identification of criteria for user-valuation

A focus group consisting of ten community key informants in each of the divisions was held. The group discussion included forest officer in charge of a forest station, forest guard, area chief, one village elder, one women's group leader, one youth group leader, one church group leader, one honey-gatherer group leader, medicine man, one beekeepers' group leader and one timber co-operative leader. These were selected because they are the key opinion shapers/leaders in the forest-adjacent areas. The discussions were held at the forest station's office where the purpose of the research was explained and the criteria used by the community to express their value for the forest identified.

3.3.1 Variables in the Study

Forest benefits that had been identified from literature were presented to the focus group discussions in order to identify the ones that are enjoyed by the forest adjacent households. The benefits so identified were then presented to the individual households who used the chosen criterion to state the importance to their households. The benefits include:

- Charcoal
- Firewood
- Furniture timber
- Building timber
- Bamboo
- Poles
- Wild foods (Including fruits, roots, game meat)

- Medicinal extracts/plants
- Honey
- Thatch Grass
- Fibre
- Hunting
- Grazing.
- Cultivation.
- Human Habitation
- Recreation
- Educational and Research.
- Biodiversity conservation
- Genetic Materials
- Local climate regulation such as cooling of the climate
- Forests as source of rivers.
- Contribution of forests to rain-making/formation
- Cleansing of air
- Soil fertility contribution.
- Cultural and Religious heritage
- Aesthetic beauty
- Bequest.
- Future use

3.4 Sampling

3.4.1 Choice of the Study Area

Forests in Kenya can be classified into four major zones based on climate, with each zone supporting a wide range of vegetation including the different types of forests, which occur (Wass, 1995). Within each of these four regions, there is considerable variation in forest plant communities as shown in table 3.1 below

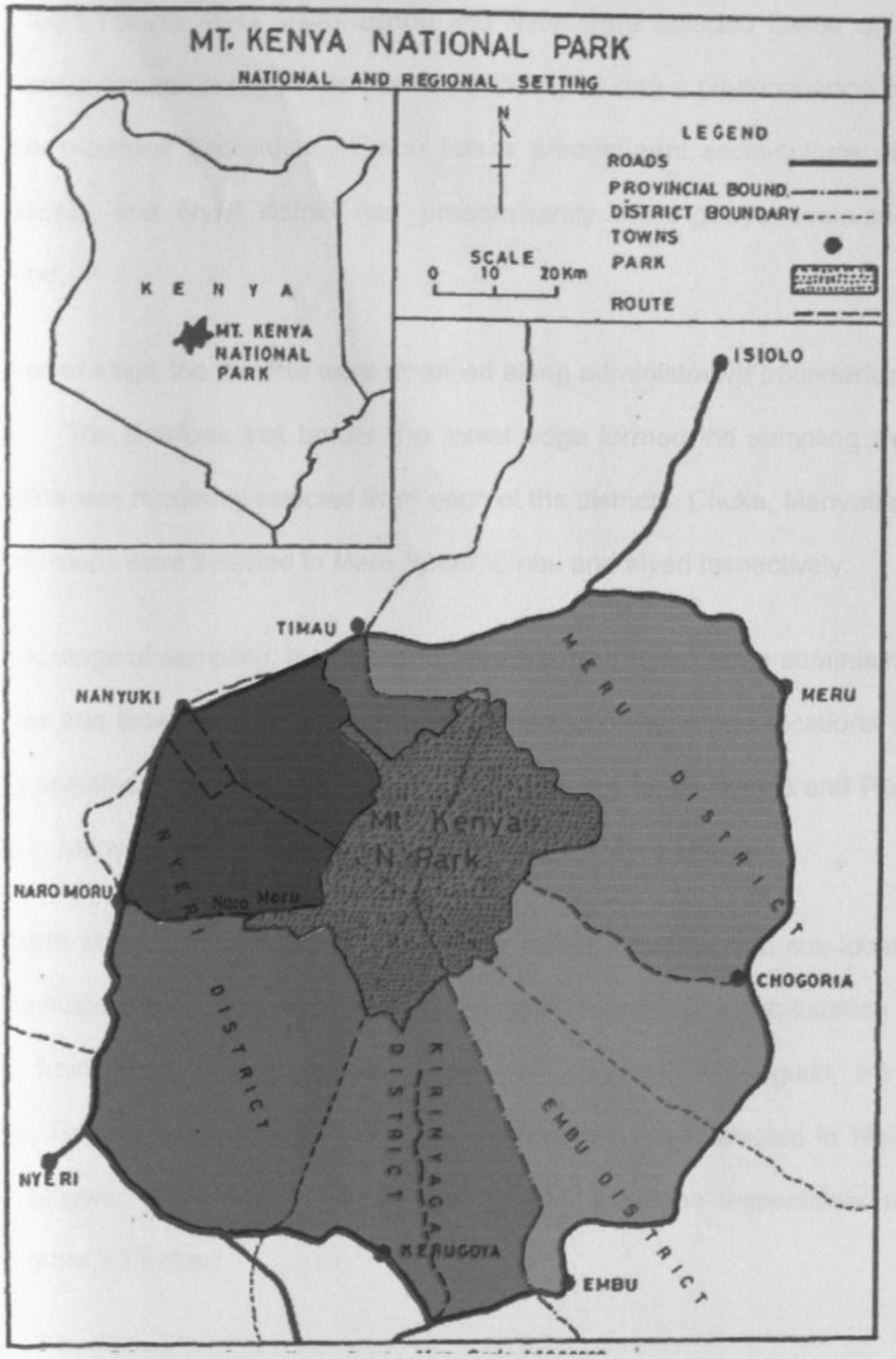
Table 3.1: Forest Zones in Kenya

ZONE	FOREST	ACREAGE (Ha)
COASTAL FORESTS (46,500 ha)	Arabuko Sokoke	37,000
	Shimba hills	9,500
DRY FORESTS (61,300 ha)	Leroghi	23,400
	Mathews	26,300
	Meru	6,400
	Mukogodo	3,000
	Ngare Ndare	2,500
MONTANE FORESTS (195,400 ha)	Aberdare	45,900
	Cherangani Hills (East)	30,600
	Cherangani Hills (West)	17,800
	Mount Kenya	51,000
	SW Mau and Transmara	50,100
WESTERN RAINFORESTS (32,100 ha)	Kakamega	10,100
	Nandi North	8,800
	Nandi South	13,200

Source: Wass, 1995

The Montane forest region was selected owing to its extensive size. The region also has exceptional value in biodiversity terms and contains diverse vegetation including several endemic afro-alpine plant species and provides habitat to a wide range of fauna including four endemic bird species and four rare mammal species (KWS, 1999). It forms one of the major water catchment areas in Kenya from which two major rivers (Ewaso Ng'iro and Tana) have their source. The Montane forest region was found to consist of five forests from which Mount Kenya was randomly selected as the study forest. At the early stage of the study a reconnaissance survey was carried around the Mount Kenya forest to identify the districts bordering the forest. The districts surrounding Mount Kenya Forest were identified as Meru Central, Meru South, Meru North, Embu, Kirinyaga and Nyeri.

Figure 2: Mount Kenya National Forest Reserve, National and Regional Setting



Source: WHC Nomination Documentation, 1997

A multistage sampling technique was used to select the study districts. From these districts, three namely Meru South, Embu and Nyeri were selected based on their different socio-cultural backgrounds. Meru South district has a predominance of the Ameru socio-cultural background, Embu has a predominant socio-culture of the Embu people, and Nyeri district has predominantly the Agikuyu socio-cultural background.

In the second stage the districts were stratified along administrative boundaries into divisions. The divisions that border the forest edge formed the sampling frame. One division was randomly selected from each of the districts. Chuka, Manyatta and Mathira divisions were selected in Meru South, Embu and Nyeri respectively.

In the third stage of sampling, the divisions were again stratified along administrative boundaries into locations. From each of the selected division, two locations were randomly selected. Mugwe and Kiang'ondu locations in Chuka, Nginda and Ruguru locations in Manyata and Magutu and Ruguru in Mathira were selected.

In the fourth stage, the selected locations were further stratified into sub-locations along administrative boundaries to form the sampling frame. One sub-location was selected from each of the selected locations. Nguviu, Kithunguriri, Kirege, Township, Gatei, Kiamariga and Kiamariga sublocations were selected in Nginda, Ruguru, Mugwe, Kiang'ondu, Magutu, and Ruguru locations respectively as is shown in table 3.2 below:

Table 3.2: Districts, Divisions, Locations and Sub-locations Bordering Mt Kenya Reserve Forest

DISTRICT	DIVISION	LOCATION	SUBLOCATION
EMBU	MAYATTA	NGINDA	KIBUGU
			NGUVIU
			MBUVORI
		RUGURU	KITHUGURIRI
MERU SOUTH	CHUKA	MUGWE	KIREGE
		KIANG'ONDU	TOWNSHIP
NYERI	MATHIRA	MAGUTU	GATEI
			GITUNDUTI
		RUGURU	RUTURU
			KIAMARIGA
			SAGANA
			IRURI
		IRIA-INI	CHEHE
			KIAMWANGI

Source: Compiled by author, 2004/2005

3.4.2 Choice of Households

Households in the selected sub-locations formed the sampling frame as is shown in table 3.3 below.

Table 3.3 Number of Households in the selected sub-locations

DISTRICT	DIVISION	LOCATION	SUBLOCATION	NO. OF HOUSEHOLDS
EMBU	MANYATTA	NGINDA	NGUVIU	1,738
		RUGURU	KITHUGURIRI	917
MERU SOUTH	CHUKA	MUGWE	KIREGE	991
		KIANG'ONDU	TOWNSHIP	1972
NYERI	MATHIRA	MAGUTU	GATEI	1,936
		RUGURU	KIAMARIGA	1,090

Source: Author 2004/2005

Systematic sampling was used to select the households to be interviewed. A household 1 kilometre away from the previous one was interviewed. The first household to be interviewed was randomly selected.

3.5 Household Data Collection

3.5.1 Household Interviews

A semi-structured questionnaire was used to collect information from households. The semi-structured questionnaire was administered to 300 households (100 households from each district) living adjacent to the forest edge in the selected study areas.

The data collected during these household interviews included:

- The household socio-economic characteristics such as composition of the household in terms of size, ages of household members, and level of education.
- The location of the of household in terms of distance from the edge of the forest
- Annual household production including types of crops and animals kept
- Economic activities of the household
- The importance of forest to the household
- Benefits derived from the forest and their relative value to the household.

The households were asked to identify and rank in order of importance the benefits they derive from the forest. They were also asked state the frequency of enjoyment of these benefits. In order to determine the importance respondents attach to various forest benefits, a variant of contingent valuation method, the Contingent ranking was used to collect data from respondents in the households. This method involved asking respondents to rank a series of alternative non-market goods

(Foster and Mourato, 1997). In the case of this study the benefits derived from the forest were considered to be the series of alternative non-market goods. The respondents were asked to state, on a cardinal scale of 1= extremely important to 4= extremely unimportant, to state the importance they attach to the individual benefits they receive from the forests. Using a scale of 1-4, they were asked to give points to each of the benefits according to its relative importance to the household with the most important benefit earning 4 points while the least important would earn 1 point.

3.6 Data Coding and Entry

The collected data was analysed using the Statistical Package for the Social Sciences (SPSS) software release 10. Data was thus entered into an SPSS spreadsheet. Prior to data entry a codebook was developed for ease of entry of the data into the computer programme. The codebook contained the question number, the variable name, location of the variable's code on the input medium and the descriptors for the response options (see Appendix II). The research assistants entered data manually.

3.7 Methods for Statistical Data Analysis

Measuring the direct use values that are traded in commercial markets is likely to be a more straightforward process than measuring other values attributed to forest products. This is because the markets have already done the work of eliciting values from the 'customers' of the forest products. But when dealing with natural environmental resources, there is often very limited information about the nature of the product and no price is posted in the market place. In recognition of this

difficulty, the study adopted a qualitative approach, which involved ranking of relative values.

Since finding suitable prices to use as a basis of valuation is often impossible in the case of forest benefits enjoyed domestically by local households, the study assumed that the importance respondents attach to various forest benefits can be used as a proxy for their value of the forest. Ranks were used to estimate the contribution of these benefits the value given to one acre of forest land as and indicator of the total value of forest as perceived by the local communities.

Since these values are not being measured in Kenya shillings or dollars but instead they are being assigned ranks 1, 2, 3, and 4 (with 1 being most important and 4 being for those who don't know), the rankings are considered ordinal data.

The Statistical Package for Social Sciences-SPSS- for Windows release 9.0 was used for the analysis of collected data. It was assumed that the variable distribution in the sample reflected the expectation from the population. Therefore the statistics calculated from the sample were assumed to be estimates of the variable parameters of the population of households interviewed.

3.7.1 Descriptive Statistics

Simple descriptive statistics such as mean, frequencies and percentages were used to observe the characteristics of the sampled households. The frequencies were useful in showing the rate of occurrence of the forest benefits. Weighted

frequencies were used to rank the forest benefits in order of their importance to the forest-adjacent households.

3.7.2 Regression and Correlation Analysis

The study intended to evaluate the relationship between the amount of money the forest-adjacent households were willing to pay for an acre of forestland as an indication of the perceived total value of an acre of forestland. Correlation and Regression analysis were selected for use.

The correlation analysis was used to test whether there was any relationship between the amount respondents were willing to pay for the purchase of one acre of forestland and the benefits they derive from the forest. On the other hand a Multiple Regression Analysis (MRA) was used to determine the strength of this relationship. MRA was found suitable since many of the benefits were found to be significant and hence contributed to the shaping of the perception of the forest value of the forest by the forest-adjacent households.

The MRA was designed to find out the contribution of each of the benefit category to the amount of money that the respondent's are willing to pay for an acre of forestland as an indication of the perceived total value of an acre of forestland. The primary objective of regression analysis is to obtain predictions of one or more variables using the known values of another. The predictions are made by employing an equation such as $Y=a+bx$. The regression analysis tells us how one variable is related to another by providing an equation that allows us to use the known value of one or more variables to estimate the unknown value of the remaining variable. In the regression

analysis used the amount of money the respondents are willing to pay for or sell an acre of land is the dependent variable and the rank values of the benefit categories as the independent variable.

This analysis was also useful in testing the stated hypothesis by helping to indicate the contribution each of the forest benefit made to the to the amount that the forest adjacent households were willing to pay for the purchase of an acre of forestland.

These two statistics combine two or more data sets to answer various questions about the relationship, strength of relationship and to predict values of one variable given another one.

3.8 Anova

Analysis of Variance (ANOVA) was used for testing the null hypothesis that the means of the benefit categories, which influence the perception of forest value by the forest-adjacent communities are the same. One-way Anova was used to compare the effects of the importance of forest benefits to the forest adjacent households on the amount they were willing to pay for the purchase of one acre of forestland.

3.9 Focus Group Discussions and Key Informant Interviews Data Analysis

Information collected through Focus Group discussions and Key Informant Interviews was analysed using a matrix where the participants present were asked to recode on the benefits that are enjoyed by the households living around the forest using an X. The results were presented in a similar matrix.

3.10 Data Presentation

The analysed data is presented in form of frequency and cross-tabulation tables as well as maps, photographs and diagrams. An equation was developed relating the overall value given to the forest and the individual values given to the individual benefits.

CHAPTER FOUR

DESCRIPTION OF STUDY AREAS

4.1 Introduction

Mount Kenya is located on the equator 180 km North of Nairobi, the Capital City of Kenya. It is a solitary mountain of volcanic origin with a base diameter of about 120 km (KWS, 1999). It's broad cone shape reaches an altitude of 5199m with deeply incised U-shaped valleys in the upper parts.

Various vegetation zones can be identified on Mount Kenya. Forest vegetation covers the major part of the mountain. Most of the indigenous forest is protected within the forest reserves with some small areas falling within Mt. Kenya National Park. Due to the wide range of altitude that spans the indigenous forest (1200m – 3400m) and the major climatic differences between the slopes, the forest vegetation of Mt. Kenya is characterised by a high diversity of forest types as shown in the Table 4.1 below.

Table 4.1: Mt Kenya's Major forest types

Major Forest Type	Location	Altitude (M)	Area (ha)
Newtonia Forest	East	1200 – 1800	3,500
Croton-Brachylaena-Calodendrum Forest	North East/South West	1450 – 1850	3,000
Croton Sulvaticus-Premna Forest	North (Upper Imenti)	1500 – 1800	1,600
Juniperus Olea Forest	West/North West	1800 – 2300	7,300
Ocotea Forest	East/South	1900 – 2400	27.500
Mixed Podocarpus Latifolius Forest	West/East	1900 – 2800	68,000
Junipenus Nuxia Podocarpus falcatus	West	1950 – 2250	3,500
Bamboo Zone	South West	2400 – 3000	80,000

Source: KWS, 1999

The most common species of large trees on Mt. Kenya include Camphor (Ocotea Usambarensis), Cedar (Juniperus Procera), Wild Olive (Olea europaea), Meru Oak (Vitex Kinensis), Podo (Podocarpus Latifolius), East African Rosewood (Hagenia Abyssinica), Croton (Croton Macrostachyus), Mugumo (Ficus thonningii). (KWS, 1999).

Mt. Kenya has a wide variety of wildlife. Six species of large mammals of international conservation interest found within the Mt. Kenya forests. They include the Elephant (Loxodonta Africana), Black Rhinoceros (Diceros Bicornis), Leopard (Panthera Pardus), Giant Forest Hogh (Hylochoerus Meinertzhageni), Bongo (Trangelaphus Euryceros), Black-fronted duiker (Cephalephus Nigrifrous hooki).

4.2 Geographical Setting, Climate and Vegetation of the Study areas

The sample was drawn from three study areas, Manyatta division in Embu district, Chuka division in Meru South District and Mathira division in Nyeri districts. The geographical setting, climate and vegetation of the districts are described below.

4.2.1 Embu District

Embu District is in the Eastern Province of Kenya. It borders Mbeere District to the East and South East, Kirinyaga to the West, Meru South to the North. It lies between a latitude of 0°8" and 0°35"South and longitude of 37° 19" and 37° 42"East.

Typical highlands, midlands and other features such as hills and valleys characterize its landscape. The highlands are found on areas of altitude range 1500m-4500m at the foot of Mount Kenya and covers parts of Manyatta, Kyeni and Runyenjes

Divisions. Midlands dominate areas of Nembure and Central Division and the altitude range is 1200m-1500m ranging from 910 to 152m above sea level.

The rainfall pattern is bimodal with two distinct rainy seasons. Long rains fall between March and June while short rains in October and December. The amount of rainfall received varies with altitude but averages 1495mm per year. The pattern changes above 1700m with a tri-modal pattern, which has a peak in July/August. Temperature in the district range changes from a minimum of 12° C in July to a maximum of 27.1°C in March.

The district has an agro-ecological profile that is typical of the windward side of Mt. Kenya. The district has 8 agro-ecological zones excluding the Tropical alpine at the top of Mt. Kenya, which has no economic activities, and the Upper highlands zone (UH_0) where forestry is the main land use. They include:

i) The Lower Highlands (LH)

ii) The Lower Highlands 1 (LH_1):

iii) The Upper Midlands (UM)

iv) The Upper Midlands 2 (UM_2)

v) The Upper Midlands 3 (UM_3)

vi) The Upper Midlands 4 (UM_4)

vii) Lower Midlands 3 (LM_3)

viii) The Lower Midlands 4 (LM_4)

Among these (LH), (LH_1), (UM) and (UM_2) are the wettest, receiving an annual rainfall of between 1750 and 2000mm and are suitable for coffee and tea growing as

well as dairy farming. The other zones, (UM_3), (UM_4), (LM_3) and (LM_4) receive rainfall in excess of 100mm.

The vegetation varies according to the soil profile. The upper highlands are so wet and steep that forestry is the best land use. Generally most of the land is under coffee and tea. Out of the district area of 7085sq/km, about 70% is arable while the remaining 30% is covered by forest.

Agriculture is the mainstay of the economy in the district. The climatic conditions create a very favourable environment for growing high value cash crops such as tea, coffee and macadamia. Other crops are cereals such as maize and beans and horticultural crops such as French beans, cabbages, Kales, tomatoes, avocadoes, oranges and other types of fruits. The main food crops grown are maize, beans, Irish potatoes, cowpeas, green grams, millet and sorghum. Oil seeds as castor and sunflower are not widely grown.

Livestock production is a significant supplementary source of income. The most important types of livestock kept are cattle and goats. Commercial layers and broilers are also kept particularly in central division.

Due to its location on the windward side of Mt. Kenya, there are favourable conditions for forestry and agro-forestry activities in Embu District. The forests occupy an area of about 22,264 hectares, representing 305 of the districts total area. Irangi forest located in the Mt. Kenya Forest Reserve is gazetted and occupies approximately 18,393 hectares (GOK, 1997). An additional area of 3871.1 hectares

has been approved and demarcated as forestland, but it is yet to be gazetted. Apart from the gazetted forest areas, there is approximately 600 hectares under forest plantation in Njukiini, Maranga and Nduuri.

Irangi Forest has a natural vegetation cover consisting of various valuable tree species, which include Ocotea Usambarensis and Bamboo. It has the potential supporting industries using indigenous hardwood timber. On the plantations, Pine and Eucalyptus are the main tree species, while Grevillea is the dominant tree species on the farms adjacent to the forest.

Irangi Forest is an important forest conservation and water catchment area. It also provides indigenous hardwood timber, fuel wood and other forest products. The forest is also a habitat for wildlife. Njukiini Forest forms good protection over Kii Riverbanks. It produces exotic timber, poles, posts and fuel wood for local consumption within Embu town and its surrounding small towns.

4.2.2 Meru South District

Meru South is one of the twelve districts that comprise Eastern Province. It was curved from the former Tharaka Nithi district. It borders Central Meru district to the North, Nithi district to Southeast, Embu to the Southwest. The district lies between latitudes 00° 03' 47"N and 00° 27'28"S and between longitudes 37°18' 24E and 28° 19'12"E.

The district has a bimodal rainfall pattern with the rains falling during the months of March and May and October to December with the highest precipitation being on the

latter. The annual rainfall ranges from 200mm in the Chogoria to below 700mm in the lower areas. Temperatures are cool, moderate and hot for the highland, middle and lowlands respectively. Temperatures in the highland areas ranges between 17°C-14°C while those of the lowland areas ranges between 21°C-27°C

The vegetation varies according to the agro-ecological zones as follows:

i) Tropical alpine UH_O, LH_O. The land here is under Mt. Kenya forest

ii) LH_1 Tea Dairy Zone. Most land in this area is under tea while dairy farming is widely practiced. There is very little land available for food crops.

iii) UM_1 Coffee Tea-Zone: Land in this zone is mainly put under tea production while little coffee is also grown. Dairy farming is also practiced. Only little land is available for production of maize, beans, bananas and yams. Most of the land is under maximum utilization. Chuka, Mwimbi, Muthambi and Magumoini divisions fall under this zone.

iv) UM_2: Main coffee zones: This cuts across similar divisions as the UM_1. It supports the growing of both coffee and tea with some dairy farming. The food crops grown are maize, beans, bananas and some yams. Substantial amounts of macadamia are also grown. Land utilization is optimal.

UM_3: Marginal coffee zone: Most of the coffee in the district is grown in this zone.. The zone covers Chuka, Mwimbi, Muthambi and Magumoini division next to UM_2.

v) LM_3: Cotton zone: This is the main food producing zone in terms of maize and beans. Other crops grown in this area include tobacco, cotton, pigeon peas,

sorghum and millet. Parts of Chuka Mwimbi and Muthambi divisions fall under this zone.

vi) LM_4: Marginal cotton zone: This is the zone where most of the cotton is grown. Other crops include sorghum, millet, pigeon peas, green grams and cowpeas. The zone is found in Lower Mwimbi, Muthambi, Chuka Divisions.

Agricultural activities are mainly determined by the amount of rainfall received. The district's agricultural activities fall under the category of small farm sector. Maize is grown as a staple food mainly on the upper divisions. Millet and sorghum are the second and third important food crop grown in the lower divisions. Other food crops include Irish potatoes, yams, sweet potatoes, arrowroots and cassava. Bananas act as both cash and food crop

Coffee and tea are the main cash crops grown in the upper divisions while cotton and tobacco are grown mainly in the lower division of Igambang'ombe and to a lesser scale in lower Mwimbi division. The full exploitation of the potential of horticultural production is inhibited by inadequate irrigation facilities. The district has 1100 acres under irrigation of which 500 acres fall under horticultural crops. The other 60 acres are scattered allover the district and are under pump fed irrigation. Main horticultural crops include tomatoes, kales, cabbage, macadamia, French beans, brinjals, okra karella and Meru herb (carcade, cammonla, lemon grass).

The main types of livestock reared in district include daily cattle, meat, goats, hair sheep, dairy goats, poultry, pigs and rabbits. Dairy cattle and goats, pig, layers and rabbits are mainly kept on the high potential areas of the district covering Chuka,

Magumoni, Muthambi and Mwimbi Divisions. The milk from dairy cattle is locally consumed but the excess is sold to KCC plant at Runyenjes in Embu District.

Beef cattle, meat, goats, hair sheep and bulk of indigenous poultry are mainly kept in the drier parts of the district covering Igambang'ombe division. Beef cattle, hair sheep and meat goats are slaughtered locally and also marketed outside the district. Indigenous birds are consumed locally.

Rabbit keeping is a new enterprise hence a little consumption and marketing of the same. Egg production doesn't satisfy the local demand and there is no export from the district. The same applies for pigs.

Forestry activities in the district embraces both rural afforestation and conservation and management of plantation and indigenous forests. The gazetted forests in the district cover an area of approximately 48,903.2 hectares of which 39,300 hectares from part of the Mt. Kenya Forest.

The forest boundary in the district is 107 km long and is threatened by encroachment. The forest provides timber, poles fuel wood, fodder, honey and medicinal plants. It has an Eco-tourism potential and hence is a great resource for the tourism industry. Due to the ban imposed by the Government on the exploitation of indigenous forests, the full potential of this resource has not been exploited. (GOK, 2001).

Agro-forestry is the most practiced system where trees are plated with food crops. Silvo-pastoral and Agro-forestry is also common in the high potential parts. The

main consumers are the pitsawers and furniture workshops. Most trees planted in the upper zones include grevellia, robusta, cypress lustanica and eucalyptus. In the lower zones are cassia siamea, jacaranda, mimisifolia.

4.2.3 Nyeri

Nyeri is one of the six districts of central province and is situated between longitudes 36^0 and 38^0 East and between equator and latitude 0^0 38' South. It is second in size after Nyandarua with an area of 3,266 sq. km. The district borders Laikipia district to the north, Kirinyaga district to the east, Murang'a district to the south, Nyandarua to the West and Meru central district to the Northeast. The Northern pattern of the district is flat whereas the southward is characterized by steep ridges and valleys occasionally interrupted by hills as Karima, Nyeri and Tumu tumu.

The main features of the district are Mt. Kenya (5199m) to the east and Aberdare Ranges (399m) to the West. These mountains are both of volcanic origin, determine relief climate and soils, and as a consequence, the agricultural potential of the district. The Aberdare and Mt. Kenya determine the drainage pattern in the district.

The district experiences equatorial type of climate with two rainy seasons. The long rains occur from March to May and the short rains from October to December. Annual rainfall varies from place to place and rapidly rises from 500m in the Kyeni plateau to 1500mm on the foothills of the Aberdare and Mt. Kenya. On the upper region the rain reaches 2300mm. The contrast in rainfall reliability is quite high from 1200m to 1600mm to 1500m in short rains.

The mean annual temperatures on the higher slopes of the Aberdare are less than 13^0C especially at the Ark, but rises to 17^0C on the lower mountain flanks i.e. parts of Mathira, Tetu and Othaya and 21^0C on the foot slopes mainly Kieni. The coldest months are June and July when temperatures fall as low as 8^0C while the hottest months are January-March when temperatures rise to 28^0C.

There are four major agro-ecological zones in the district. They include:

i) Tropical Alpine Zone: The Tropical Alpine Zone is found on the peaks of Mt. Kenya and Aberdare and consists of rocks and glaciers. It is between 2130-2400 metres above sea level. No major agricultural activity is practiced but two important national parks, the Aberdare and Mt. Kenya are found here.

ii) Upper Highland Zone: This is the forest zone and is therefore important as a catchment area. The upper parts of these zones are very steep and suited as forest reserves or parks for wildlife conservation. The predominant pasture is Kikuyu grass, which is suitable for dairy cattle. Pyrethrum and wheat growing is practiced here.

iii) The Lower Highland Zone: The zone is situated above the upper midland zone and lies between 1800-2130 metres above sea level. Part of it falls in the high economic potential area of the district. This is the tea and dairy-farming zone and borders the forest reserves in Tetu, Mathira and Othaya Divisions. The pasture here is also essentially Kikuyu grass suited to dairy farming.

iv) The Upper Midland Zone: The zone is situated between 1220-1800 metres above sea level. Coffee and tea are grown in this zone. These form the core of the district's agricultural activities. Other than the two leading cash crops, tea

and coffee, livestock keeping and food crop farming are also practiced here. Macadamia nuts have been introduced recently in this area as a cash crop. Horticultural farming is also practiced along the river valley bottoms and near the major market centres.

The small farm sector contributes significantly to the districts economy and covers an area of 2,564sq km accounting for 80% of the total land area of the district. The average farm size within the small sector is 0.78 acres per household in the high potential areas and 0.88 acres in the low potential areas. The high potential areas include Mathira, Mukurweini, Tetu, Othaya and Municipality.

Farming in the high potential areas is characterized by high intensive use of land holdings. Food crops such as maize and beans are for subsistence while coffee and tea are the major cash crops. Cash crop farming takes approximately 65% of the total farm leaving behind little and for livestock and food crops. Horticulture farming also takes place in the high potential areas mainly along the river valleys in Tetu and Mathira Divisions. In Kieni East and West Divisions only 50% of the total agricultural land has been put to productive use. Maize is grown as a subsistence crop in all parts of the district. Beans are also grown as a subsistence crop in all divisions of the district.

The district's potential in the production of horticultural produce is yet to be fully exploited. Tea remains the leading cash crop and major income earner for the majority of the households in the district. Tea ranks first in terms of income and employment creation. Macadamia nut is a newly introduced crop mainly grown in

Mathira, Municipality and Tetu Divisions. Mulberry is another crop gaining prominence in the district particularly in Kieni East, where the climate is ideal.

Livestock production is a major economic activity and covers an area of 2964 sq. km. Kieni East and West practice both dairy and beef farming. The two divisions as well as Tetu have the highest number of livestock as they are drier and more suitable for ranching. Othaya and Tetu Divisions lead in dairy farming.

There is a higher population of indigenous birds compared to exotic breeds except in Mathira, which has about 40% of the exotic birds. Rearing of milk dairy goats is increasingly becoming important especially in the traditional divisions of Othaya, Tetu, Municipality, Mathira and Mukurweini where land parcels are too small for dairy keeping. Rearing of woolen sheep is mainly in areas around the Aberdare Ranges where the climate is ideal.

There is marked increase in the number of livestock due to the improved methods of livestock keeping. Dairy cattle population is quite high as it is the main livestock activity in the district. The district currently has one cheese making facility at Gatarakwa in Kieni West Division. The hides and skins produced in the district are sold to other districts in their raw form.

Forest cover accounts for 9% of the total land area of the district. These forests are exploited for products such as saw logs, poles, firewood, herbs and wood- carvings. Exploitation of forests for saw logs is the highest followed by wood for carving industries. The carving industry is a fast growing industry due to the high demand from the tourism sector.

Fuel wood being the main source of energy is also a major forest produce. There are a total of 88 sawmills most of which are located at Mathira, Kieni East and Tetu Division. Timber is the leading forest product. Mukurweini Division is the lease endowed with forest resources and the only saw mills located imports logs from Othaya or Tetu Divisions.

4.3 The People

4.3.1 Embu

The population grew from 233,187 in 1989 to 278,196 in 1999 showing a growth rate of 1.9%. This population is distributed in 63, 893 households. The sex ratio stands at 1:1.05 for males to females respectively which could be attributed mostly to the prevalence of male migration to the other parts of the country.

Table 4.2 Population of Embu District by Division, sex, Number of Households, Area and density

DIVISION	AREA (in Sq. kms)	No. of Households	Male	Female	Total	Density
CENTRAL	70.6	14,726	26,237	26,209	52,446	743
KYENI	104.9	10,441	23,468	24,917	48,385	461
MANYATTA	107.1	15,523	34,829	36,503	71,332	666
NEMBURE	88.1	8,976	20,323	21,267	41,590	472
RUNYENJES	148.5	13,981	31,374	32,737	64,111	432
MT. KENYA FOREST	210.2	246	268	64	332	2
TOTAL	729.4	63,893	136,499	141,697	278,196	381

Source: 1999 Population and Housing Census Report

There is generally a high population in Runyenjes and Manyatta Divisions due to the high agricultural production potential. They account for 48.9% of the total population. The population density is higher in Central Division than in all others due to its small size and location as the Provincial and District Headquarters.

4.3.2 Meru South

According to 1999 Population Census the former Tharaka Nithi district from which Meru South was curved had a population of 257,887 with an inter-censal growth of 2.92%. According to the 1999 population census, the district had 205,451people with a male to female ratio of 1:1.05 as shown in Table 4.3 below.

Table 4.3 Population by Division, sex, Number of Households, Area and density

DIVISION	AREA (in Sq. kms)	No. of House holds	Male	Female	Total	Density
MUTHAMBI	84.8	7,194	15,601	15,936	31,539	372
MAGUMOINI	64.2	7,433	15,880	16,835	32,715	510
MWIMBI	203.4	14,473	31,715	32,665	64,380	317
CHUKA	169.6	12,596	26,113	27,404	53,517	316
IGAMBANG'OMBE	210.9	5,088	10,917	12,383	23,300	110
TOTAL	1,092.9	46,984	100,226	105,225	205451	188

Source: 1999 Population and Housing Census Report

Mwimbi division had the highest population followed by Chuka, Mugumoini and Muthambi whilst Igambang'ombe divisions had the least. The high agricultural potential areas of Mwimbi, Chuka, Mugumoini and Muthambi explains the high

population densities in the divisions while aridity explains the low population of Igambang'ombe.

4.3.3 Nyeri

The population grew at an annual rate of 2.32 percent in 1999 from 607,110 in 1989 to 661,786 in 1999. The sex ratio stood at 1:1.05 for males to females. Table 4.4 shows the distribution of this population in the district.

Table 4.4 Population by Division, sex, Number of Households, Area and density

DIVISION	AREA (in Sq. kms)	No. of House holds	Male	Female	Total	Density
KIENI WEST	626	16,699	33,683	34,778	68,481	109
KIENI EAST	695	21,738	44,090	39,545	83,635	120
MATHIRA	257.5	38,662	72,614	78,384	150,998	586
MUKURWE-INI	179.5	21,605	41,435	46,012	87,447	487
OTHAYA	184.2	21,368	42,170	46,121	88,291	479
TETU	212	19,496	37,869	42,231	80,100	378
MUNICIPALITY	167.9	28,712	50,022	51,216	101,238	603
ABERDARE FOREST	621.9	45	61	45	106	0
MT KENYA FOREST	411.6	461	577	303	880	2
TOTAL	3,355.6	168,786	322,521	338,635	661,786	197

Source: 1999 Population and Housing Census Report

The municipality division had the highest density followed by Mathira, Mukurweni, Othaya, and Tetu. Kieni West and Kieni East had the least densities.

4.4 Demographic Characteristics of Respondents

4.4.1 Respondents' Gender and Age

In Manyatta division, the sample consisted of 55 males and 26 females translating to a ratio of 2.12 males to 1 female. In Chuka division, the sample consisted of 78 males to11 females and which translates to a ratio of 7.09 males to 1 female, while in Mathira division, the sample consisted of 70 males and 21 females translating to a ratio of 3.33 males to 1 female. This is at variance with the districts' sex ratios of 0.954 males to 1 female in Manyatta, 0.952 males to 1 female in Chuka and 0.926 males to 1 female in Mathira (CBS, 1999 population census). This can be explained by the fact that the household interviews were carried out with the head of household and in many rural areas men are considered to be the head of households.

The ages of the respondents in the three district showed a more or less similar distribution with the majority of respondents being between 30-59 years old (63% in Manyatta, 76.4% in Chuka and 70.9% in Mathira) as is shown in table 4.5 below.

Table 4.5: Age of the Household Respondents in Manyatta, Chuka and Mathira Divisions

Age class (in Years)	Percentage of Respondents		
	Manyatta	Chuka	Mathira
0-19	3.7	2.2	0
20-29	18.5	5.6	11.8
30-39	22.2	24.7	29.0
40-49	28.4	29.2	17.2
50-59	12.4	22.5	24.7
60-69	9.9	13.4	9.7
Over 70	4.9	3.4	7.5

Source: Field Survey, 2006

4.4.2 Employment Characteristics

The sample included people that were engaged in different professions as is shown in table 4.3 below. Out of the 81 respondents interviewed in Manyatta, 67.9 percent were engaged in farming activities such as growing tea, coffee, maize and beans, 8.6 percent were traders engaged in various trade activities including running of small hotels, shops or kiosks. 13.6 percent were on wage employment in government offices and in jua kali enterprises as drivers, civil servant officers, motor mechanics, tailors and carpenters, while 9.9 percent were unemployed. The unemployed category included housewives who stayed at home taking care of their children.

In Chuka, of the 89 respondents interviewed 62.9 percent were farmers, 15.7 percent were self-employed in various trade activities, 13.5 percent were on wage employment while 7.9 percent were the unemployed including housewives. Out of the 93 respondents interviewed in Mathira division 39.8 percent were farmers, 21.5 percent

were engaged in trade activities, another 21.5 percent were on wage employment while 17.2 percent were unemployed as shown in Table 4.6 below.

Table 4.6: Occupation of Respondents in Manyatta, Chuka and Mathira Divisions

Occupation	Number of Respondents		
	Manyatta	Chuka	Mathira
Farmer	55	56	37
Trader	7	14	20
Wage Employment	11	12	20
Unemployed	8	7	16
Total	81	89	93

Source: Field Survey 2006

4.4.3 Education Characteristics

In terms of the education, 6.2 percent, 10.2 percent and 11.8 percent of the respondents in Manyatta, Chuka and Mathira respectively indicated that they had had no education at all while 1.2 percent and 5.6 percent respondents in Manyatta and Chuka respective had attended some form of adult literacy. Majority of the respondents (87.7 percent in Manyatta, 71.8 percent in Chuka and 82.8 in Mathira) had attained some primary and secondary education. A minority group had attained tertiary education level including middle level college education and university education as is shown in Table 4.4 below.

Table 4.7: Education Level attained by Respondents in Manyatta, Chuka and Mathira Divisions

Education Level	Percentage of Respondents		
	Manyatta	Chuka	Mathira
None	6.2	10.2	11.8
Adult literacy	1.2	5.6	0.0
Primary	58.1	43.8	43.0
Secondary	29.6	28.0	39.8
Tertiary	4.9	12.4	5.4

Source: Field Survey 2006

These results show that the population in these districts is fairly literate.

4.4.4 Land holding

The average land holding size for the households was 3.2 acres in Manyatta, 4 acres in Chuka and 4.25 acres in Mathira.

4.5 Conclusions

All the three study areas fall within the same agro-ecological zones with the main land use being agriculture. Similar crops including tea, coffee and maize are grown and the main livestock activity being dairying where zero grazing system of production is used.

Most of the respondents interviewed were in the age groups lying between 30 and 59 years. Most of those interviewed in Manyatta (67.9%) and Chuka (62.7%) were farmers. However, only about 40 percent of those interviewed in Mathira were farmers. This can be explained by the fact that most of those living around the forest

in Ragati were recent settlers who had been evicted the forests in Ragati, Chehe and Hombe.

Most of the respondents in the study had attained some form of primary or secondary education showing a relatively high literacy level amongst the communities living around the forest.

CHAPTER FIVE

FORESTS BENEFITS TO THE FOREST-ADJACENT HOUSEHOLDS

5.1 Introduction

The ways in which forests are used and valued depend largely on people's perception of their needs and priorities. By and large the perceived value of forests by the forest adjacent communities is strongly linked to use patterns, preferences, local livelihood needs and perception of how the forest resources are able to satisfy these needs and priorities. An understanding of the perception of forests and their benefits by the forest adjacent communities is essential for designing sustainable forest management regimes that take cognisance of these local communities who are key stakeholders of the forest resource.

This chapter identifies and categorizes the various benefits of forest to the forest-adjacent households. It continues to highlight the importance placed on each of these benefits by the respondents. The benefits are first presented for each study area and later aggregated for all the three areas.

5.2 Nature and Types of Forest Benefits Identified by Forest adjacent Households

The three focus group discussions held in the three study areas (one in each division) did not express the value of the forest benefits in quantifiable numerical terms when asked to give the price of the forest. They said that the forest is unique. It is a green treasure passed from generation to generation and each generation thought the forest is special. Thus the focus groups chose criteria for expressing the value of the forest based on the benefits they enjoyed from the forest, which was not

numerically quantifiable. They chose the use of a cardinal scale of 1-4 (1 = Extremely important to 4 = Don't know) to express the importance or non-importance (and hence the value) of the forest benefits to the forest-adjacent households.

From the literature review, 28 forest benefits were identified. These were presented in a matrix to the focus groups in the study areas and they were asked to identify the ones that they perceived to be enjoyed by marking them with a cross (X). The results of the exercise are presented in Table 5.1 below.

Table 5.1: Forest Benefits Enjoyed by Households in Chuka, Manyatta and Mathira

Benefit	Study Area		
	Chuka	Manyatta	Mathira
Charcoal	X	X	X
Firewood	X	X	X
Furniture Timber	X	X	X
Building Timber	X	X	X
Bamboo	X		
Poles	X	X	X
Wild Foods			
Medicinal extracts/plants	X	X	
Honey	X	X	X
Thatch Grass			
Fibre	X		
Hunting	X		
Grazing	X	X	X
Cultivation	X	X	X
Habitation	X		X
Recreation	X		
Education/Research	X	X	X
Biodiversity Conservation	X		X
Genetic Materials	X	X	
Local Climate regulation (cooling climate)	X	X	X
Source of Rivers	X	X	X
Rain-making/formation	X	X	X
Cleansing of Air	X	X	X
Soil Fertility contribution/ Soil erosion prevention	X	X	X
Cultural and Religious heritage	X		
Aesthetic beauty	X	X	
Bequest			
Future use	X		
Total benefits identified with	25	17	16

Source: Field survey 2006

From Table 5.1, it can be seen that the residents from the three different study areas identified various benefits that they derive from forests. Although wild foods, thatch grass and bequest were identified in the literature as some of the benefits that can

accrue to forest-adjacent households, they were not identified as benefits to the households living adjacent to the forest in Chuka, Manyatta or Mathira. This represents about 11 percent of the total forest benefits found in literature.

Only residents in Chuka identified bamboo, Fibre, recreation, hunting, genetic materials, cultural and religious use and future use as forest benefits. Medicinal extracts/plants and aesthetic beauty were common benefits to Chuka and Manyatta while habitation as a forest benefit was common to Chuka and Mathira. Table 5.2 presents the forest benefits that were identified as common to the study areas. Only 15 out of the 28 of the benefits presented to the respondents were common to all the three areas benefits as shown in Table 5.2 below. This represents about 54 percent of the benefits identified in the literature.

Table 5.2: Forest Benefits Common to Households in Chuka, Manyatta and Mathira

Benefit	Study Area		
	Chuka	Manyatta	Mathira
Charcoal	X	X	X
Firewood	X	X	X
Furniture Timber	X	X	X
Building Timber	X	X	X
Poles	X	X	X
Honey	X	X	X
Grazing	X	X	X
Cultivation	X	X	X
Education/Research	X	X	X
Biodiversity conservation	X	X	X
Local Climate regulation (cooling climate)	X	X	X
Source of Rivers	X	X	X
Rain-making/formation	X	X	X
Cleansing of Air	X	X	X
Soil Fertility contribution/ Soil erosion prevention	X	X	X
Total benefits identified with	15	15	15

Source: Field survey 2006

5.3 Categorization of the Forest Benefit

The benefits were thematically clustered into five categories by grouping the benefits similar in their functions in the same category. These benefit categories include:

i) **Extractive Forest Benefit (EFB):** This category consists of benefits that have to be physically removed from the forest in order to be put to use. They include wood and non-wood forest products. From the identified forest benefits extractive forest benefits can be said to include Charcoal, Firewood, Furniture timber, Building timber, poles, Bamboo, medicinal extracts/plants, honey, fibre Cultivation, Grazing and Hunting. Though Cultivation, Grazing

and Hunting are practiced in the forest itself, they are considered to belong to this category because their products are enjoyed outside the forest.

ii) **Non-Extractive forest benefits (NEFB):** These benefits are enjoyed in the forest except in cases where it is necessary to remove material for further analysis outside the forest. They include of Recreation, Education /Research and Habitation.

iii) **Indirect Forest Benefits (IFB):** These are utility functions that forests fulfill which are indirect and mostly non-physical in nature. They comprise the ecological and environmental goods and services provided by forests. Of the identified benefits, Cooling of climate, Rivers source, Rain formation, Cleansing of air, Biodiversity conservation/genetic materials and prevention of soil erosion/Soil fertility enhancement can be said to belong to this category.

iv) **Option Benefits (OB):** These are differed benefits of an existing forest resource for future uses which depend on how future generations will employ their technological capabilities in harnessing forest resources to meet their particular needs and priorities. Future use, only identified in one study area, can be said to fall in this category.

v) **Non-Use Forest Benefits (NUFB):** These benefits relate to the intrinsic worth of a forest regardless of actual or potential use. From the identified benefits only cultural and religious heritage and aesthetic beauty fall under this category.

In summary, the identified benefits in each of the study area can be categorised as follows:

Table 5.3: Categorization of Forest Benefits in Chuka, Manyatta and Mathira Divisions

Benefit Category	Study Area		
	Chuka	Manyatta	Mathira
Extractive	Charcoal	Charcoal	Charcoal
	Firewood	Firewood	Firewood
	Furniture Timber	Furniture Timber	Furniture Timber
	Building Timber	Building Timber	Building Timber
	Poles	Poles	Poles
	Bamboo		
	Medicinal extracts/plants	Medicinal extracts/plants	
	Honey	Honey	Honey
	Fibre		
	Cultivation	Cultivation	Cultivation
	Grazing	Grazing	Grazing
	Hunting		
Non-Extractive	Recreation		
	Education/Research	Education/Research	Education/Research
	Habitation		Habitation
Indirect	Cooling Climate	Cooling Climate	Cooling Climate
	Cleansing air	Cleansing air	Cleansing air
	River Source	River Source	River Source
	Rain formation	Rain formation	Rain formation
	Soil Erosion prevention	Soil Erosion prevention	Soil Erosion prevention
	Biodiversity Conservation		Biodiversity Conservation
	Genetic materials	Genetic materials	
Option	Future use		
Non-use	Cultural and Religious heritage		
	Aesthetic Beauty	Aesthetic Beauty	

Source: Field Survey, 2006

The benefits identified in Chuka belonged in all the five categories while those identified in Manyatta belonged in four categories and those identified in Mathira only belonged in three categories as shown in Table 5.3 above. Literature seems to

suggest that forest-adjacent communities are interested in benefits that are extractive in nature and are of direct use. The results in Table 5.3 show the contrary. The forest-adjacent communities place importance on other forest benefits beyond the direct use benefits.

5.4 Importance of the Forest Benefits to the Forest-adjacent Households

The second objective of this study was to assess the importance that households place on the identified benefit. They were asked to state on a cardinal scale (1 = Extremely important to 4 = Don't Know) the importance that the households attached to each of the benefits. Since a respondent could give multiple responses by classifying more than one forest benefit as being extremely important, the results are presented as number of responses rather than absolute number of respondents. Tables 5.3, 5.4 and 5.5 present the levels of importance that the forest adjacent households in Chuka, Manyatta and Mathira respectively attach to the forest benefits.

Table 5.4: Importance of Forest Benefits Enjoyed by Households in Chuka,

Benefit	Number of Responses				N
	Extremely Important	Fairly Important	Unimportant	Don't Know	
Charcoal	51	9	27	2	89
Firewood	37	10	36	6	89
Furniture Timber	44	5	37	3	89
Building Timber	40	5	40	4	89
Bamboo	17	2	66	4	89
Poles	51	8	28	2	89
Medicinal extracts/plants	18	6	62	3	89
Honey	15	6	61	7	89
Fibre	12	10	61	6	89
Hunting	10	5	68	6	89
Grazing	39	5	42	3	89
Cultivation	40	7	39	3	89
Habitation	15	3	65	6	89
Recreation/aesthetic beauty	61	3	25	0	89
Education/Research	32	7	41	9	89
Biodiversity Conservation	49	5	29	6	89
Genetic Materials	15	1	71	2	89
Local Climate regulation (cooling climate)	58	10	18	3	89
Source of Rivers	63	8	16	2	89
Rain-making/formation	65	16	3	5	89
Cleansing of Air	68	5	14	2	89
Soil Fertility contribution/ Soil erosion prevention	50	4	32	3	89
Cultural and Religious heritage	18	23	47	1	89
Future use	13	11	62	3	89
Total	866	173	919	89	2047

Source: Field Survey 2006

Results in Table 5.4 show that on the overall, out of the total responses of 2,047, about 51 percent indicated that either the identified forest benefits are of extreme

importance (866 responses) or are fairly important (173 responses). However, significantly large proportion (49%) of responses indicated that the forest benefits are either unimportant (919 responses) or they simply do not know the importance 89 responses to the households. These would be expected given that the Mount Kenya forest is a Government forest with restrictions of access and hence not a great majority would be benefiting from the benefits of the forest or would have a positive attitude towards the forest. However this is positive in that there is a simple majority of the households that appreciates the benefits of forests and can be involved in protecting the forests.

On further analysis the benefits offered by forests in cleansing of the air was considered to be of importance to the households by most (82%) of the respondents. Out of those interviewed, 76.4 percent said that cleansing of air, as a forest benefit, was extremely important while 5.6percent said it was a fairly important benefit. On the other 15.8 percent said this benefit was unimportant while2.2 percent said they did not know the importance of cleansing air as a forest benefit. Thus the proportion of respondents that believed that cleansing of air is not an important forest benefit is 18 percent.

The involvement of forests in rain formation/making or the hydrological cycle was considered as an extremely important benefit about 73 percent of the respondents. Another 18 percent said the benefit was fairly important. So it can be said that the majority (91%) of the respondents believed that the benefit the forest in terms of rain formation is important to the households. Consequently, 3.4 percent said this benefit

was unimportant to them 5.6 percent said the benefit they did not know the importance of this benefit to their household. Therefore, about nine percent of the respondents can be said to have considered rain-formation as being of no importance to their households.

About 71 percent of the respondents indicated that source of rivers, as a forest benefit, is extremely important to their households. Close to nine percent said it is a fairly important benefit. On the other hand 18 percent of the respondents said it is an unimportant forest benefit while 2.2 percent said they did not know the importance making a proportion of those who do not think that this benefit is important to their households to be about 20 percent. Many rivers such as the one in plate 1 were seen to emanate from the forest.

Plate 1: Nithi River Source at Mount Kenya Forest

Aesthetic beauty of forest as a benefit was seen to be of extremely importance by about 69 percent of the respondents. Another 3 percent said it is a fairly important forest benefit while 28 percent said it was unimportant.

The cooling of climate effect of forests was said to be extremely important by about 62 percent of the respondents. Another 11 percent said it is fairly important to their households. This gives a total of 72 percent of the respondents saying that cooling of climate is important to their households. About 20 percent of the respondents said the benefit is unimportant to their households while about three percent did not know the importance of this benefit to their household giving a total of 23 percent of the respondents who do not think this in an important benefit to their household.

Hunting was considered as the least important forest benefit with only 11 percent indicating that it is extremely important and four six percent saying it is fairly important to their households. Consequently the majority of the respondents (76.4%) said hunting is unimportant to their households while 6.6 percent said they do not know the importance of hunting to their households.

Habitation in the forest was the next least important forest benefit. Only 17 percent of the respondents said it is an extremely important benefit. Another three percent said it is a fairly important forest benefit to their households. On the contrary, 73 percent said it is unimportant while six percent did not know the importance of habitation to their households. However, it was found that there was human dwelling in the forest as depicted in plate 2 below;

Plate 2: Human Dwelling in Mount Kenya Forest in Chuka

Manyatta Division was the second study area where various forest benefits had been identified. Just as was the case in Chuka division, the respondents were asked to state on a cardinal scale (1 = Extremely important to 4 = Don't Know) the importance that their households attach to each of these benefits. The results are presented in Table 5.5 below.

From the results of total responses, only 38 percent said the forest benefits were extremely important to the households while 17 percent said the benefits were fairly important. This however constitutes 55 percent of those respondents who thought that the forest benefits are of some importance to the households. On the other hand, 37 percent of the respondents said the benefits were unimportant to the households while eight percent said they do not know the importance of the benefits.

Table 5.5: Importance of Forest Benefits Enjoyed by Households in Manyatta

Benefit	Number of Responses				N
	Extremely Important	Fairly Important	Unimportant	Don't Know	
Charcoal	27	11	31	12	81
Firewood	21	23	28	9	81
Furniture Timber	19	26	26	10	81
Building Timber	29	12	28	12	81
Poles	32	9	31	9	81
Medicinal extracts/plants	33	5	32	11	81
Honey	40	8	28	5	81
Grazing	42	6	27	6	81
Cultivation	29	7	40	5	81
Recreation/aesthetic beauty	18	24	33	6	81
Education/Research	4	20	50	7	81
Biodiversity/Genetic Materials	23	3	53	2	81
Local Climate regulation (cooling climate)	33	16	26	6	81
Source of Rivers	55	10	15	1	81
Rain-making/formation	59	14	8	0	81
Cleansing of Air	38	23	18	2	81
Soil Fertility contribution/ Soil erosion prevention	21	18	40	2	81
Total Responses	523	235	514	105	1377

Source: Field Survey, 2006

The majority of the respondents (73%) considered the role forest play in the formation of or in the hydrological cycle to being extremely important (73%) while about 17 percent said it is fairly important. Only 10 percent of respondents said rain-formation was unimportant to their households.

Forest as a source of rivers was considered to be extremely important by about 68 percent of the respondents and another 12 percent said it is a fairly important benefit.

The rest 20 percent of the respondents either said this was an unimportant forest benefit (19%) of they do not know the importance (1%)

Cleansing of the surrounding air through the uptake of carbon dioxide and release of oxygen, as a forest benefit, was considered to be either extremely important or fairly important by about 47 percent and 28 percent respondents respectively. The other 25 percent either said cleansing of air was an unimportant forest benefit (22%) or did not know the importance of this benefit (3%).

The role played by forests in cooling the local climate was considered to be an extremely important forest benefit by about 41 percent of the respondents while 20 percent said it is a fairly important forest benefit. Consequently 32 percent said it is unimportant while only seven percent of the said they did not know the importance of this forest benefit.

Grazing, as a forest benefit was seen as being extremely important by about 52 percent of the respondents. Another seven percent of the respondents said this benefit is fairly important to their household. On the other hand 33 percent said this is an unimportant benefit and another seven percent 6 respondents said they do not know the importance of grazing to their households.

Though building timber and furniture timer were not considered very important by a majority of respondents in Manyatta, observation revealed a lot of illegal timber harvesting in the forest adjacent to the people in Manyatta division. This is evidenced by the activities recorded in Plate 3 and 4 below.

Plate 3: Pit-sawing of Timber in Mount Kenya forest

Plate 4: Timber waiting collection in the Forest

Education and research as a forest benefit was the least important forest benefit to the respondents in Manyatta. Only five percent of the respondents thought this was an extremely important befit to their households. Another 25 percent of the respondents said the benefit was fairly important. The majority of the respondents (62%) said it is unimportant to their households. Another nine percent of the respondents said they do they do not know the importance of forests in research and education.

Biodiversity and genetic materials is next least important forest benefit with 28 percent of the respondents saying it is extremely important and another four percent said it is fairly important. Consequently the majority (65%) said it is unimportant while three percent of the respondents did not know the importance of biodiversity and genetic material as a forest benefit to their households.

The respondents in Mathira were also asked to subject the identified benefits to the same exercise of rating (1= extremely important to 4 = Don't Know) and the results are presented in Table 5.6.

Table 5.6: Importance of Forest Benefits Enjoyed by Households in Mathira

Benefit	Number of Households				N
	Extremely Important	Fairly Important	Unimportant	Don't Know	
Charcoal	5	11	74	1	91
Firewood	12	29	48	2	91
Furniture Timber	15	17	57	2	91
Building Timber	13	20	55	3	91
Poles	13	9	60	9	91
Honey	5	11	75	0	91
Grazing	11	27	50	3	91
Cultivation	11	22	55	3	91
Habitation	40	0	51	0	91
Education/Research	9	17	55	10	91
Biodiversity/Genetic Materials	12	12	63	4	91
Local Climate regulation (cooling climate)	12	30	45	4	91
Source of Rivers	19	28	38	6	91
Rain-making/formation	19	35	37	0	91
Cleansing of Air	22	27	38	4	91
Soil Fertility contribution/ Soil erosion prevention	17	33	39	2	91
Total Responses	235	328	840	53	1456

Source: Field Survey 2006

As can be seen from the table, only four out of the 16 identified benefits were considered to be either extremely important or fairly important by more than half of the respondents. These benefits include Cleansing of Air, Rain-making/formation, Source of Rivers and Soil Fertility contribution/ Soil erosion prevention. The remaining 12, though identified as forest benefits, the majority of the respondents rated them as not being of importance to the household.

Out of the total responses of 1,456, only 16 percent indicate that the identified forest benefits are extremely important while 22 percent indicate that the benefits are fairly important. The majority responses (58%) indicate that the benefits are unimportant to the households while four percent indicate that respondents don't know the importance of these benefits to their households.

Cleansing of the surrounding air was considered to be of extreme importance by only 24 percent of the respondents interviewed. Another 30 percent said it is fairly important bring the total of those who consider this benefit to be of some importance to be 54 percent. This however is just a simple majority. Close to 42 percent of the respondents said the benefit was unimportant while four percent said they have do not know the importance of this benefit.

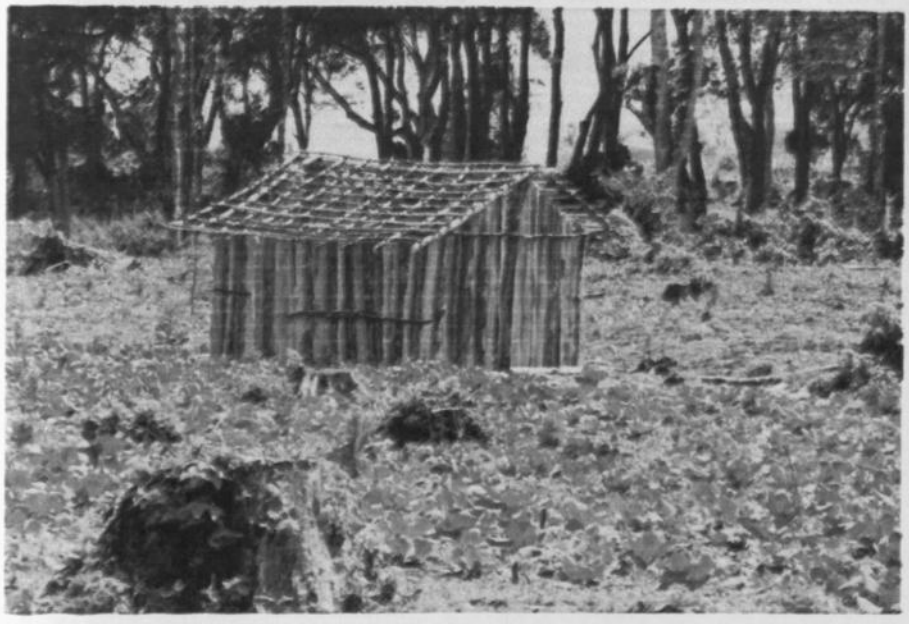
Rain formation was another benefit that was considered to be of some importance to the household by a majority (59%) of the respondents. However, only 21 percent said it is extremely important and while 38 percent said it is a fairly important benefit to their household. The remaining 41 percent said it is unimportant to the household.

Source of rivers as a forest benefit was considered to be extremely important by about 21 percent of the respondents while 31 percent said it is a fairly important benefit for their household. However close to 42 percent of the respondents said this is an unimportant benefit to their households with another six percent saying that they do not know the importance of this benefit.

Prevention of soil erosion as a forest benefit was considered to be extremely important by about 19 percent of the respondents while being seen as fairly important by another 36 percent The rest of the respondents either said the benefit was unimportant (43% of the respondents) or they did not know its importance (2% of the respondents)

From the results it can be seen that about 44 percent of the respondents said that cultivation in the forest was extremely important to their households. The majority of the respondents (56%) said the benefit was unimportant. This forest benefit can be said to go hand in hand with habitation, which was found to be extremely important by about 44 percent of the respondents and as unimportant by the rest 56 percent. However there was evidence on the ground that habitation of the forest area especially in places where forest had been harvested was common in Mathira as can be seen in Plate 5 below.

Plate 5: Habitation of forest cleared areas in Mathira.



The least important benefits in Mathira are honey and charcoal. Only five percent said that honey was an extremely important benefit to their households while 12 percent said it is fairly important. Majority of the respondents (82%) said this benefit was unimportant. The same trend was witnessed for the charcoal benefit where five percent of the respondents said this was an extremely important benefit and 12 percent said it is fairly important. However about one percent said they did not know the importance of the benefit and the rest 81 percent said it is unimportant.

The study also examined the importance placed to the combination of the forest benefits that were common to all the three areas. The results are presented in Table 5.7 below.

Out of the total responses of 3,915, only 35 percent of the respondents said that the forest benefits presented to them were extremely important to their households. Another 16 percent said the benefits were fairly important. This constitutes a simple majority (51%) of the respondents who said that the benefits were of some importance to their households. The rest 49 percent of the respondents either said the forest benefits were unimportant (44%) or they did not know (5%) their importance to the households. This is consistent with the results of the findings of the three study areas analyzed separately.

Table 5.7: **Forest Benefits Enjoyed by Households in Chuka, Manyatta and Mathira Divisions**

Benefit	Percentage of responses				Total
	Extremely Important	Fairly Important	Unimportant	Don't Know	
Charcoal	32	12	50.2	5.8	100
Firewood	26.8	23.8	42.9	6.5	100
Furniture Timber	29.9	18.4	46.0	5.7	100
Building Timber	31.4	14.2	47.1	7.3	100
Poles	36.8	10.0	45.6	7.6	100
Honey	23.0	9.5	63.1	4.4	100
Grazing	35.2	14.6	45.6	4.6	100
Cultivation	30.7	13.8	51.3	4.2	100
Education/Research	17.2	16.9	55.9	10.0	100
Biodiversity Conservation	32.2	7.7	55.6	4.5	100
Local Climate regulation (cooling climate)	39.5	21.5	34.1	4.9	100
Source of Rivers	52.6	17.6	26.4	3.4	100
Rain-making/formation	54.8	24.9	18.4	1.9	100
Cleansing of Air	49.0	21.1	26.8	3.1	100
Soil Fertility contribution/ Soil erosion prevention	33.7	21.1	42.5	2.7	100

Source: Field survey 2006

When the data from the three study areas was combined, rain formation emerged as the most important forest benefit. Close to 55 percent of the respondents said this benefit was extremely important to their households while 25 percent said it was fairly important. Only 18 percent considered this benefit unimportant to their households and another two percent did not know the importance of the benefit to their households.

The next most important benefit was found to be forest as source of rivers and as air cleansers. About 52 percent said the forest, as a source of their rivers was extremely important while 18 percent said it is a fairly important benefit. This constitutes 70 percent those who consider this benefit as having some importance to

the households. However, 26 percent said the benefit was unimportant and another three percent said they do not know the importance of the forest as source of rivers. On the other hand 49 percent of the respondents said cleansing of air was an extremely important forest benefit while 21 percent said it is fairly important. About 27 percent of the respondents said the benefit was unimportant and another three percent said they did not know the benefit's importance. Cooling of climate was considered to be an extremely important benefit by about 40 percent of the respondents while 21 percent said it was fairly important. Another 34 percent said this benefit was unimportant to their households and five percent did not know the importance of the benefit.

Soil erosion prevention was considered extremely important by about 34 percent of the respondents while 21 percent said it was fairly important. However close to 43 percent said the benefit was unimportant while two percent did not know its importance.

The forest benefits that were considered to be of least importance were honey and education/research. Only 23 percent of the respondents said that this benefit was extremely important to their households while nine percent said it was fairly important. The large majority (68%) said it was either unimportant (63%) or did not know its importance (5%). The next least important forest benefit was found to be education and research. About 17 percent each said the benefit was either extremely important or fairly important. However 56 percent of the respondents said that this was an unimportant benefit while 10 percent did not know its importance.

Again as in the three separate study areas, forest benefits that are environmental in nature were found to be more important to the households.

5.5 Ranking of the Forest Benefits to the Forest-adjacent Households

To rank the forest benefits in order of importance, a scale of 1-4 points was used. The benefit that was considered to be extremely important was awarded 4 points while that for whose importance was not known was awarded 1 point.

In Chuka the results of the ranking exercise was as shown in Table 5.8 below. It is worth noting that the highly ranked benefits are basically the ecological and environmental goods and services provided by forests. Rain-making/formation, Cleansing of Air, Source of Rivers and cooling of climate were ranked 1st, 2nd and 3rd respectively. These were followed by aesthetic beauty, which is a non-use benefit at position 4. Prevention of soil erosion and biodiversity conservation, both of which are environmental in nature, fall at the 8th and 9th position. Charcoal, poles, furniture timber, cultivation and building timber benefits, all of which are extractive in nature were ranked 6th 7th, 10th, 11th and 12th respectively.

Table 5.8: **Ranking of Forest Benefits Enjoyed by Households in Chuka in Order of Importance**

Benefit	Frequency of Points awarded				Total Points	Rank
	Four Points	Three Points	Two Points	One Points		
Rain-making/formation	65	16	3	5	319	1
Cleansing of Air	68	5	14	2	317	2
Source of Rivers	63	8	16	2	310	3
Aesthetic beauty	61	3	25	0	303	4
Local Climate regulation (cooling climate)	58	10	18	3	301	5
Charcoal	51	9	27	2	287	6
Poles	51	8	28	2	286	7
Soil Fertility contribution/ Soil erosion prevention	50	4	32	3	279	8
Biodiversity Conservation	49	5	29	6	275	9
Furniture Timber	44	5	37	3	268	10
Cultivation	40	7	39	3	262	11
Building Timber	40	5	40	4	259	12
Grazing	39	5	42	3	258	13
Firewood	37	10	36	6	256	14
Education/Research	32	7	41	9	240	15
Cultural and Religious heritage	18	23	47	1	236	16
Recreation	24	5	59	1	230	17
Medicinal extracts/plants	18	6	62	3	217	18
Future use	13	11	62	3	212	19
Bamboo	17	2	66	4	210	20
Honey	15	6	61	7	207	21
Genetic Materials	15	1	7	2	207	21
Habitation	15	3	65	6	205	23
Fibre	12	10	61	6	206	24
Hunting	10	5	68	6	197	25

Source: Field Survey, 2006

On the extreme end, fibre, habitation and hunting were ranked 23rd, 24th and 25th respectively meaning they are the least important forest benefits to the households in Chuka area.

The results of the ranking of the forest benefits in Manyatta were as shown in Table 5.9 below.

Table 5.9: Ranking of Forest Benefits Enjoyed by Households in Manyatta in order of Importance

Benefit	Frequency of Points awarded				Total Points	Rank
	4	3	2	1		
Rain-making/formation	59	14	8	0	294	1
Source of Rivers	55	10	15	1	281	2
Cleansing of Air	38	23	18	2	259	3
Grazing	42	6	27	6	246	4
Honey	40	8	28	5	245	5
Local Climate regulation (cooling climate)	33	16	26	6	238	6
Poles	32	9	31	9	228	7
Medicinal extracts/plants	33	5	32	11	222	8
Cultivation	29	7	40	5	222	8
Building Timber	29	12	28	12	220	10
Soil Fertility contribution/ Soil erosion prevention	21	18	40	2	220	10
Firewood	21	23	28	9	218	12
Furniture Timber	19	26	26	10	216	13
Aesthetic beauty	18	24	33	6	216	13
Charcoal	27	11	31	12	215	15
Genetic Materials	23	3	53	2	209	16
Education/Research	4	20	50	7	183	17

Source: Field Survey, 2006

As is the case in Chuka, the benefits ranked 1-4 are all of environmental nature. Grazing, honey, furniture timber, poles, cultivation and medicinal extracts, all of which are extractive in nature were ranked 4th, 5th, 7th and 8th respectively. Soil erosion prevention, which is environmental in nature was ranked 10th.

On ranking forest benefits in Mathira the following results were obtained.

Table 5.10: Ranking of Forest Benefits Enjoyed by Households in Mathira In order of Importance

Benefit	Frequency of points awarded				Total Points	Rank
	4	3	2	1		
Habitation	40	0	51	0	262	1
Rain-making/formation	19	35	37	0	255	2
Cleansing of Air	22	27	38	4	249	3
Soil Fertility contribution/ Soil erosion prevention	17	33	39	2	247	4
Source of Rivers	19	28	38	6	242	5
Firewood	12	29	48	2	233	6
Local Climate regulation (cooling climate)	12	30	45	4	232	7
Grazing	11	27	50	3	228	8
Furniture Timber	15	17	57	2	227	9
Building Timber	13	20	55	3	225	10
Cultivation	11	22	55	3	223	11
Biodiversity conservation	12	12	63	4	214	12
Poles	13	9	60	9	208	13
Education/Research	9	17	55	10	207	14
Honey	5	11	75	0	203	15
Charcoal	5	11	74	1	202	16

Source: Field Survey, 2006

As noted earlier, only four of the identified benefits were ranked as being of some importance by more that half the respondents interviewed. It is interesting to not that unlike in the other two areas habitation was ranked as the number one most important forest benefit. This could be explained by the fact that the respondents had recently been evicted from the Hombe and Ragati sections of the Mount Kenya forest after a ban on the "shamba system" was implemented. Hence their first priority was to take care of their shelter. Otherwise Rain-making/formation, Cleansing of Air, Soil Fertility contribution/ Soil erosion prevention and Source of Rivers and all of which are environmental in nature were ranked 2nd, 3rd, 4th and 5th respectively.

Table 5.10: Ranking of Forest Benefits Enjoyed by Households in Mathira In order of Importance

Benefit	Frequency of points awarded				Total Points	Rank
	4	3	2	1		
Habitation	40	0	51	0	262	1
Rain-making/formation	19	35	37	0	255	2
Cleansing of Air	22	27	38	4	249	3
Soil Fertility contribution/ Soil erosion prevention	17	33	39	2	247	4
Source of Rivers	19	28	38	6	242	5
Firewood	12	29	48	2	233	6
Local Climate regulation (cooling climate)	12	30	45	4	232	7
Grazing	11	27	50	3	228	8
Furniture Timber	15	17	57	2	227	9
Building Timber	13	20	55	3	225	10
Cultivation	11	22	55	3	223	11
Biodiversity conservation	12	12	63	4	214	12
Poles	13	9	60	9	208	13
Education/Research	9	17	55	10	207	14
Honey	5	11	75	0	203	15
Charcoal	5	11	74	1	202	16

Source: Field Survey, 2006

As noted earlier, only four of the identified benefits were ranked as being of some importance by more that half the respondents interviewed. It is interesting to not that unlike in the other two areas habitation was ranked as the number one most important forest benefit. This could be explained by the fact that the respondents had recently been evicted from the Hombe and Ragati sections of the Mount Kenya forest after a ban on the "shamba system" was implemented. Hence their first priority was to take care of their shelter. Otherwise Rain-making/formation, Cleansing of Air, Soil Fertility contribution/ Soil erosion prevention and Source of Rivers and all of which are environmental in nature were ranked 2nd, 3rd, 4th and 5th respectively.

The first highly ranked extractive benefit is firewood at rank 6 with grazing, cultivation, furniture timber, building timber and cultivation, all belonging to the extractive benefit category were ranked 8th, 9th, 10th, and 11th respectively. Some of the benefits belonging to this category were ranked lowest important. These include poles, charcoal and honey at positions 14th, 15th and 15th respectively.

Results of the ranking process for the combined data showed a similar trend where the benefits ranked highest were of environmental nature with Rain-making/formation, Source of Rivers, Cleansing of Air, cooling climate and Soil erosion prevention occupying the first five positions respectively as indicated Table 5.11 below. These are followed by forest benefits that are extractive in nature at the 6th to 12th positions.

Table 5.11: Ranking of Forest Benefits Enjoyed by Households Chuka, Manyatta and Mathira Divisions

Benefit	Frequency of points awarded				Total Points	Rank
	4 Points	3 Points	2 Points	1 Point		
Rain-making/formation	143	65	48	5	868	1
Source of Rivers	137	46	69	9	833	2
Cleansing of Air	128	55	70	8	825	3
Local Climate regulation (cooling climate)	103	56	89	13	771	4
Soil Fertility contribution/ Soil erosion prevention	88	55	111	7	746	5
Grazing	92	38	119	12	732	6
Poles	96	26	119	20	720	7
Furniture Timber	78	48	120	15	711	8
Cultivation	80	36	134	11	707	9
Firewood	70	62	112	17	707	9
Building Timber	82	37	123	19	704	11
Charcoal	83	31	131	15	702	12
Biodiversity Conservation	84	20	145	12	698	13
Honey	60	25	165	12	657	14
Education/Research	45	44	146	26	630	15

Source: Field survey 2006

These results show that the respondents are conscious of the environmental benefits offered by forests. This is an indication that the forest –adjacent communities would be interested in the conservation of the forest in order to enhance the possibility of continual harnessing of these benefits.

5.6 Conclusions

From the results, Chuka in Meru South district identified with most of the benefits presented to them. Out of the 28 benefits they selected 25 benefits as being of some importance to the households. However, Manyatta in Embu District and Mathira in Nyeri district identified with 17 and 16 benefits respectively. Though fibre is a useful product that is used in the construction of houses and other uses at the household, it was identified as a benefit only in Chuka study area.

The most important forest benefits according to the forest adjacent households are environmental in nature. This is positive, as it is a step towards the communities understanding the need for the conservation of the forest as a forest.

Forests provide the habitat for many of the commonly consumed wildlife species that are hunted by local communities. Though hunting was identified as a forest benefit in Chuka, it is a widely restricted practice in the country and hence it is only practiced at a very low level most of it being illegal so other areas may not have revealed their illegal hunting.

Forests may be seen as being of cultural and religious heritage benefit as they are held sacred for traditional ceremonies and worship with the notable example of the Kaya forests at the Coast province of Kenya. Certain plant and animal species in the forest hold sacred value or are used during ritual or witchcraft ceremonies. The households living in Chuka being a more traditional tribe (Ameru) who consider rituals an integral part of their society identified this benefit.

Due to the ban on cultivation in the forest, the use of forest as a dwelling place is not common in the Mount Kenya forest area. However this practice was found to exist in Mathira as shown in Plate 5 above.

CHAPTER SIX

VALUATION OF FORESTLAND BY THE FOREST ADJACENT HOUSEHOLDS

6.1 Introduction

This chapter evaluates the relationship between the forest benefits that were found to be of importance to the forest-adjacent households and the amount of money they are willing to pay for the purchase of an acre of forestland. It is assumed here that the importance of the benefits to the households informs them on the value they place on the forest. The chapter begins by finding out whether the households consider the forest to be of any importance at all. To households are also asked to state the amount of money they would be willing to pay for the purchase of one acre of forest land depending on the importance they place of the forest.

6.2 Importance of the Forest to the Forest Adjacent Households

Respondents were asked to state the importance of the forest to the households on a scale of 1-4 (1 = extremely important to 4 = don't know).

Table 6.1: Importance of Forests to the Households

Study Area	Number of responses			
	Extremely important	Fairly Important	Unimportant	Don't Know
Chuka	53	26	7	3
Manyatta	50	23	4	4
Mathira	55	8	19	9

Source: Field Survey 2005/2006

The results in table 6.1 above show that the majority of households in all the three study areas considered forests extremely important to their households. In Chuka about 60 percent of the households said the forest is extremely important to their

households while 29 percent said it was fairly important. Only 11 percent respondents either said the forest was unimportant (8%) or they did not know the importance (3%). On the other hand, about 62 percent of the respondents in Manyatta said that the forest is extremely important to their households. Another 28 percent said the forest is fairly important. About five percent each said the forest is either unimportant to their household or they did not know the importance of the forest. In Mathira 60 percent of the respondents said the forest is extremely important to their households while about 9 percent said it is fairly important. A significant proportion (21 percent) said that the forest is unimportant to their households while about 10 percent said they did not know the importance of the forest to their households.

It is clear from these results that the households living adjacent to the forests have a positive attitude towards the forests. It would thus be expected that they would engage in protecting the forest so as to maintain this importance.

6.3 Valuation of one acre Forestland by the Forest Adjacent Households

According to the importance that the respondents place on the forest, they were asked to state the amount of money they were willing to pay for the purchase of an acre of forestland for their use as an indicator of the total value they give to the forest. For comparison purposes they were also asked to state how much they would be willing to pay for other categories of land including cropped land, grazing land and commercial plot land. The results are presented in Table 6.2 below.

Table 6.2 ***Amount of Money Respondents would be willing to pay for the Purchase of one acre of various types of land.***

Study Area	Amount of Money			
	Forestland	Cropped Land	Commercial plot	Fallow Grazing Land
Chuka	107,640.50	162,236.00	290,988.80	55,331.50
Manyatta	134,356.20	235,679.00	350,061.70	147,037.00
Mathira	83,875.00	214,945.10	253,197.80	73,269.20

Source: Field Survey 2005/2006

On average the respondents in Manyatta said that they were willing to pay the highest amount of money (Kshs 134,356.20) for the purchase of one acre of forestland adjacent to them. In Chuka the respondents said they were willing to pay Kshs 107,640.50 for an acre of forestland while Mathira respondents gave the lowest bid of Kshs 83,875.00. Of course there were those who felt that the forest is a heritage that should not be sold out or allocated for other uses while other felt that the government should settle them in the forest without asking them for any money. These amounts were only comparable to those that the respondents were willing to pay for the purchase of one acre of grazing land. Other types of land uses cropped land and commercial plot, are more valuable to the respondents than forestland.

From the results it can be seen that. Commercial plot is the most valued type of land use at an average price of Kshs 299,597.00 per acre while they said they would pay Kshs 202,382 for an acre of cropped land. The crops on the land include tea, coffee and maize. Grazing land was considered to e the least valuable, as the respondents would be willing to pay an average of Kshs 89,666.60 for the purchase of an acre of the land. The same trend was observed when respondents were asked to state the amount of money they were willing to receive for the sale of that same of acre of land.

These values are based on the perceptions of what the respondents are willing to pay for the purchase of the various land types and are not necessarily actual values of land in the areas. The actual values need to be verified at the District Land Registry in the respective Districts.

6.4 Correlation Analysis

Correlation analysis using the Pearson Product Moment of Correlation (Correlation Coefficient) was used to isolate the most significant forest benefits that may have a positive contribution to the amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland. The individual benefits were considered to be the independent variable while amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland was considered to be the dependent variable. The independent variables were correlated to the dependent variable and the results of this correlation and can be ranked according to strength of the correlation coefficient or using the absolute magnitude of the correlation coefficient. This may then be compared with the ranking obtained in the fieldwork.

From the field survey in Chuka 25 forest benefits were identified. The benefits were correlated with the amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland and the results are presented in Table 6.3 below.

Table 6.3: ***Correlation Coefficients between the Independent and the Dependent Variable in Chuka.***

Dependent Variable: amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland (Kshs)			**Independent Variables Order from Fieldwork**
Independent Variable: Forest Benefits	Correlation Coefficient	Ranking	
HABIT	0.203	1	RAIN
GENETIC	- 0.200	2	AIR
HONEY	-0.180	3	RIVERS
CULTIVAT	- 0.171	4	BEAUTY
FUSE	0.167	5	CLIMATE
CHARCOAL	0.165	6	CHARCOAL
FTIMBER	- 0.132	7	POLES
POLES	- 0.122	8	SOIL
MEDICINE	- 0.113	9	BIODIVE
SOIL	- 0.109	10	FTIMBER
EDUC	- 0.107	11	CULTIVAT
AIR	- O.105	12	BTIMBER
GRAZING	-0.096	13	GRAZING
BIODIVE	0 088	14	FIREWOOD
BEAUTY	-0.063	15	EDUC
HUNT	0.061	16	HERITAGE
FIBRE	- 0.054	17	RECREAT
RIVERS	- 0.050	18	MEDICINE
BTIMBER	-0.049	19	FUSE
RAIN	0.041	20	BAMBOO
HERITAGE	- 0.037	21	HONEY
CLIMATE	- 0.034	22	GENETIC
BAMBOO	- 0.028	23	HABIT
FIREWOOD	0.020	24	FIBRE
RECREAT	0.014	25	HUNT

Source: Field Work and Correlation Analysis 2006/2007

The correlation analysis indicated that only 8 forest benefits were positively correlated with amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland. These include HABIT, FUSE, CHARCOAL, BIODIVE, HUNT, RAIN, FIREWOOD and RECREAT. The rest 17 had a negative correlation to amount

that forest-adjacent households are willing to pay for the purchase of one acre of forestland as shown in Table 6.3 above.

The strongest degree of correlation is between HABIT (habitation in the forest) and the dependent variable (amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland) at 0.203. This means that forest-adjacent households would consider habitation in the forest as a benefit before they state the amount of money they are willing to pay for the purchase of one acre of forestland. However, this is still a weak relationship as it is less that 0.5. Though this is a weak relationship, it is positive meaning that the more the forest-adjacent households perceive habitation in the forest as a benefit, the more the amount of money they would be willing to pay for the purchase of one acre of forestland. The variable with the weakest relationship with the amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland is recreation at 0.014. This means that amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland may not so much be influenced by the provision of recreation as a benefit of the forest. However being a positive, it means the more they consider recreation as a forest benefit, the more the amount of money they would be willing to pay for the purchase of one acre of forestland. The question that would then arise is whether they would retain this acre of forestland in its form for maintenance of this benefit or they would change this land use.

In Manyatta the 17 forest benefits were identified as being of importance to the forest-adjacent households. These benefits were correlated to the amount of money that

forest-adjacent households are willing to pay for the purchase of one acre of forestland. The results are presented in Table 6.4 below.

Table 6.4: Correlation Coefficients between the Independent and the Dependent Variable in Manyatta

Dependent Variable: amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland (Kshs)			**Independent Variables Order from Fieldwork**
Independent Variable: Forest Benefits	**Correlation Coefficient**	**Ranking**	
RAIN	- 0.257	1	RAIN
FTIMBER	0.215	2	RIVERS
RIVERS	-0.177	3	AIR
BEAUTY	-0.165	4	GRAZING
CHARCOAL	0.153	5	HONEY
EDUC	0.099	6	CLIMATE
FIREWOOD	0.082	7	POLES
MEDICINE	- 0.082	7 (8)	CULTIVAT
HONEY	- 0.073	9 (8)	MEDICINE
BTIMBER	0.069	10	BTIMBER
SOIL	0.059	11	SOIL
GENETIC	- 0.050	12	FIREWOO
CLIMATE	- 0.043	13	FTIMBER
POLES	- 0.043	13	BEAUTY
AIR	- 0.039	15	CHARCOAL
GRAZING	0.024	16	GENETIC
CULTIVAT	0.001	17	EDUC

Source: Field Work and Correlation Analysis 2006/2007

As is the case in Chuka, the correlations in Manyatta indicated that only 8 of the independent variables (forest benefits) were positively correlated to the dependent variable (amount of money that forest-adjacent households are willing to pay for the purchase of an acre of forest land). The rest 9 were negatively correlated with the dependent variable as is shown in Table 6.4.

The strongest degree of correlation is between the independent variable RAIN (Role of forest in rain-formation as a forest benefit) and the dependent Variable (amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland) at –0.257. This is a negative relationship meaning that the more the forest is considered to offer this benefit, the less the amount of money that forest-adjacent households would be willing to pay for the purchase of one acre of forestland. This is as would be expected in that they would not be willing to change the forest from its current state. They would rather leave the forest intact rather than buy it off for other land uses so that it continues to play this role of rain-formation. This trend similar to other forest benefits which are environmental in nature including RIVERS, GENETIC, CLIMATE AND AIR with correlation coefficients of –0.177, -0.050, -0.043 and –0.039 respectively.

The forest benefit with the weakest relations with the amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland is CULTIVAT (cultivation of forestland). It would appear that the amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland is not necessarily influenced by the need for the cultivation of forestland by the forest-adjacent households. However, this being a positive correlation coefficient, it would mean that the more for the cultivation of the forestland arises the more the amount of money they would be willing to pay for the purchase of one acre of forestland.

In Mathira only 16 out of the 28 forest benefits were identified as being of importance to households. These included:

The results of the correlation analysis in Mathira also indicated that only 8 out of the 16 forest benefits were positively correlated to the amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland. The rest 8 had a negative correlation.

Table 6.5: Correlation Coefficients between the Independent and the Dependent Variable in Mathira

Dependent Variable: amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland (Kshs)			Independent Variables Order from Fieldwork
Independent Variable: Forest Benefits	Correlation Coefficient	Ranking	
HONEY	- 0.274	1	HABIT
RIVERS	- 0.217	2	RAIN
POLES	0.0209	3	AIR
CULTIVAT	- 0.157	4	SOIL
HABIT	0.125	5	RIVERS
SOIL	0.110	6	FIREWOOD
CHARCOAL	0.072	7	CLIMATE
BIODIVE	0.067	8	GRAZING
CLIMATE	- 0.067	8 (9)	FTIMBER
EDUC	- 0.058	10	BTIMBER
RAIN	- 0.056	11	CULTIVAT
FIREWOOD	- 0.030	12	BIODIVE
AIR	0.017	13	POLES
GRAZING	-0.015	14	EDUC
BTIMBER	0.014	15	HONEY
FTIMBER	0.001	16	CHARCOAL

Source: Field Work and Correlation Analysis 2006/2007

The strongest degree of correlation is between HONEY and the amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland at – 0.274. This being a negative relationship means that the more the forest adjacent households perceive forest as providing this benefit (which is extractive in nature) the less the amount of money they would be willing to pay for the purchase of one acre of forestland. They would thus be seen to want the forest to remain protected from other

land uses in order to enhance the enjoyment of this benefit. This would enhance the conservation of the forest. Other extractive benefits that would have a similar effect include CULTIVAT and FIREWOOD at correlation coefficients of –0.157 and –0.030 respectively.

However, this is not the case with the other forest benefits that are extractive in nature such as POLES, CHARCOAL, BTIMBER (building timber) and FTIMBER (furniture timber) which have positive correlation coefficients at 0.209, 0.072, 0.014 and 0.001 RESPECTIVELY. Though these are weak relationships, it would that the more the forest is perceived to offer these benefits to the forest-adjacent households, the more the amount of money would be willing to pay for the purchase of one acre of forestland in order to harvest these benefits and thus reducing the chances of conservation of that forest.

The next strongest degree of correlation is between RIVERS (source of rivers) and the amount of money that forest-adjacent households are willing to pay for the purchase of one acre of forestland at –0.207. This is an environmental benefit in nature and having a negative correlation coefficient means that the more forest-adjacent household seen it as a benefit the less the amount of money that they would be willing to pay for the purchase of one acre of forestland. Thus they would retain the forest in its current status thus enhancing conservation.

The forest benefit with the weakest relationship with the amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland is FTIMBER (furniture timber) at correlation coefficient of 0.001. This means that the perception of

the forest as a provider of furniture timber (FTIMBER) would not so much influence the amount that forest-adjacent households would be willing to pay for the purchase of one acre of forestland. However being a positive relationship it would affect conservation negatively in that the more the forest is perceived as a source of furniture timber, the more the amount of money would be willing to pay for the purchase of one acre of forestland in order to harvest these benefits and thus reducing the chances of conservation of that forest.

Although coefficient correlation is one of the most widely used statistical measures, it is one of the most abused. Users sometimes ignore the fact that correlation only measures the strength of linear relationships and that it does not necessarily imply a relationship. Furthermore, correlation does not necessarily mean that a cause and effect relationship occurs between the variables. The correlation may have occurred due to pure chance.

Correlation coefficient is a weak measure because it merely gives some indication that both the dependent and independent variables are related. It does not give by how much they are related neither does it indicate the exact nature of the relationship (King'oriah, 2004). This calls for further analysis to establish the cause-effect relationship between the variables and the contribution of each of the independent variables to the dependent variable. Considering that forestland can be treated as any rural land then factors such as location, fertility, terrain, size, distance from major towns, income levels of the households as well as accessibility would come into play when considering how much that acre of land is worth.

6.5 Hypothesis Testing

It was hypothesised that that the value attached to an acre of forestland as an indicator of the Total Value of Mount Kenya forest to the forest-adjacent communities is highly dependent on the extractive benefits they enjoy from the forest. To test this hypothesis the a simple linear regression analysis was used to show the contribution of each of the benefit category to the value that forest-adjacent communities are willing to pay for the purchase of one acre of forestland. The analysis is presented in the next section below.

6.5.1 Regression Analysis

The study adopted the Conventional Multiple Regression Analysis (CMRA) to establish the cause-effect relationship between the variables and the contribution of each of the independent variables to the dependent variable. Regression analysis reveals how one variable is related to another by providing an equation that allows us to use the known value to estimate the unknown value of the remaining variable or variables.

The analysis was based on the amount of money that the respondents were willing to pay for the purchase of one acre of forestland if the Government was to sell the forest to the communities living adjacent to the forest and the benefits that were found to be important to the households. The amount of money that the respondents were willing to pay for the purchase of one acre of forestland was considered as the dependent variable while the individual forest benefits were the independent variable.

The Multiple Regression Analysis was designed to find out the contribution of each of the benefit category to the amount of money that the respondent's are willing to pay for

an acre of forestland as an indication of the perceived total value of an acre of forestland. The primary objective of any regression analysis is to obtain predictions of one or more variables using the known values of another. The predictions are made by employing an equation such as $Y= a + bx$. The regression analysis tells us how one variable is related to another by providing an equation that allows us to use the known value of one or more variables to estimate the unknown value of the remaining variable.

The study found the benefits being relevant to the valuation of forestland by the forest-adjacent households as falling in the following benefit categories:

i. Extractive Forest Benefit (EFB)
ii. Non-Extractive forest benefits (NEFB)
iii. Indirect Forest Benefits (IFB).
iv. Future forest Benefits (FFB).
v. Non-Use Forest Benefits (NUFB).

Although some may appear insignificant, they all have a contribution to the perception of the total value of Mount Kenya forest to the communities living adjacent to it. These benefit were regressed around the importance placed on the forest and the contribution of each of these benefit categories was assessed. The importance placed on the forest by the forest adjacent households was considered to be the dependent variable while the categorised forest benefits were seen as the independent variable upon which the total value of the acre of forestland depended.

Thus the total value of the forest could be expressed as:

- TFV=f (X_1, X_2, X_3, X_4, X_5) Where
- TFV=Total Value of an acre of forestland
- X_1 = Extractive Forest Benefits (EFB)
- X_2 = Non-Extractive Forest Benefits (NEFB)
- X_3 = Indirect Use Forest Benefits (IFB)
- X_4 = Future Forest Benefits (FFB)
- X_5 = Non-Use Forest Benefits NUFB)

The three different areas identified forest benefits that belonged to the different Forest Benefit Categories. The individual forest benefits in each of the benefit category were regressed around the amount of money that the respondent's were willing to pay for the purchase of an acre of forestland. The resultant R square indicated the variation of the original dependent variable that could be explained by the independent variables. Since all the variables were entered together at the same time, respective beta weights were used to isolate the variables with the highest significance in influencing the dependent variable. The beta weight values indicate the relative importance of the associated independent variables and hence indicate the relative contribution of each of the independent variable to the dependent variable.

In Chuka, all the 25 forest benefits were used in the regression analysis. The observed results at 95 percent confidence level were as follows:

Multiple R = 0.542

R Square = 0.294

Adjusted R Square = 0.014

Standard Error of Estimate = 95,386.587

F Change = 1.050

The 25 forest benefits correlate well with the amount of money that the respondents t in Chuka Division are willing to pay for the purchase of one acre of forestland as depicted by a multiple R of 0.542. However, the R^2 shows that only 29.4 percent of the variation in the amount of money that respondents are willing to pay for the purchase of one acre of forestland is explained by the 25 forest benefits for the sample of 89 households.

One-way ANOVA was used to test the significance of the forest benefits in influencing the amount that respondents are willing to pay for the purchase of one acre of forestland and the results are presented below:

Table 6.6: Summary of One-way ANOVA[b] Results in Chuka Division.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.39E+11	25	9.55E+09	1.050	0.423[a]
	Residual	5.73E+11	63	9.10E+09		
	Total	8.12E+11	88			

Source: Data Analysis, 2007

a. Predicators: (Constant), BEAUTY, HERITAGE, SOIL, FIBRE, HABIT, GENETIC, GRAZING, HONEY, AIR, CULTIVAT, RECREAT, BAMBOO, BIODIVE, FUSE, CHARCOAL, MEDICINE, RIVERS, CLIMATE, BTIMBER, EDUCATE, FIREWOOD, HUNT, POLES, FTIMBER.
b. Dependent Variable: How much respondents would pay to buy one acre of forestland (Kshs).

The ANOVA results show that the calculated F value is 1.050 as shown in Table 6.6 below. The critical value from the F-distribution Table (in the Appendix) is 1.68. Thus

the calculated F value is less than the critical value at (25, 63) degrees of freedom. These results imply that we fail to reject the null hypothesis and conclude that there are no significant differences between the means of the forest benefits. This then implies that the amount of money that the respondents are willing to pay for the purchase of one acre of forestland does not depend only of the forest benefits that are extractive in nature in Chuka.

This is reinforced by the use of the beta weights of the independent variables. These weights can be used to rank the most important variables influencing the amount of money that respondents are willing to pay for the purchase of one acre of forestland in descending order as shown in Table 6.7 below.

Table 6.7: Ranking Forest Benefits using Beta Weights in Chuka Division

FOREST BENEFIT	Beta Weights (Standardized Coefficient)	Rank	Forest Benefit Category
HONEY	-0.243	1	Extractive Use
GRAZING	-0.219	2	Extractive Use
FUSE	-0.216	3	Option Use
RAIN	-0.212	4	Indirect Use
CULTIVAT	-0.208	5	Extractive Use
FTIMBER	-0.202	6	Extractive Use
HABIT	0.178	7	Non-Extractive Use
GENETIC	-0.173	8	Indirect Use
CHARCOAL	0.164	9	Extractive Use
BTIMBER	0.162	10	Extractive Use
HUNT	0.162	10	Extractive Use
RECREAT	-0.113	12	Non-Extractive Use
EDUCATE	-0.113	12	Non-Extractive Use
CLIMATE	0.098	14	Indirect Use
POLES	-0.092	15	Extractive Use
FIBRE	-0.900	16	Extractive Use
BAMBOO	-0.086	17	Extractive Use
BEAUTY	0.070	18	Non-use
BIODIVE	0.063	19	Indirect Use
SOIL	-0.056	20	Indirect Use
AIR	-0.041	21	Indirect Use
HERITAGE	0.039	22	Non-use
FIREWOOD	0.037	23	Extractive Use
MEDICINE	-0.023	24	Extractive Use
RIVERS	-0.011	25	Indirect Use

Source: Data Analysis, 2007

The ranking does not show any trend of the forest benefits in the Extractive Forest Benefit category being ranked highest. Though the first two positions are taken by charcoal and grazing which are in the Extractive benefit category, the 3rd and 4th positions are taken by FUSE (Future use) and RAIN (rain formation), which are in Option Forest Benefit category and Indirect Use Forest Benefit category respectively.

The individual forest benefits in each category were regressed against the amount of money that the respondents were willing to pay for the purchase of one acre of forestland and their R^2 recorded as shown below:

Table 6.8: Contribution of Forest Benefit Categories to the amount of Money that respondents in Chuka are willing to pay for an acre of forestland

FOREST BENFIT CATEGORY	CONTRIBUTION (R^2)
Extractive Use	0.169
Non-Extractive Use	0.048
Indirect Use	0.079
Option Use	0.028
Non-use	0.005
Total Contribution	0.329

Source: Data Analysis, 2007

These results show that the total contribution of the benefits categories is below 50 percent meaning that many more variables contribute to the amount of money that the respondents in Chuka are willing to pay for the purchase of one acre of forestland. However, the extractive forest benefit category has the highest influence on the total contribution accounting for about 51 percent of the net contribution.

The observed results of the regression analysis in Manyatta Division at 95 percent confidence level were as follows:

Multiple R = 0.521

R Square = 0.272

Adjusted R Square = 0.075

Standard Error of Estimate = 112,677.49

F Change = 1.384

The results show that the 17 forest benefits in correlate well with the amount of money that the respondents were willing to pay for the purchase of one acre of forestland as depicted by a multiple R of 0.521. The R^2 shows that only 27.2 percent of the variation in the amount of money that respondents are willing to pay for the purchase of one acre of forestland is explained by the 17 forest benefits for the sample of 81 households.

The One-way ANOVA results to test the significance of the forest benefits in influencing the amount that respondents are willing to pay for the purchase of one acre of forestland are presented in Table 6.9 below:

Table 6.9: Summary of One-way ANOVA[b] Results in Manyatta Division.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.99E+11	17	1.76E+10	1.384	0.175[a]
	Residual	8.00E+11	63	1.27E+10		
	Total	1.10E+12	80			

Source: ***Data Analysis, 2007***

a. Predicators: (Constant), BEAUTY, SOIL, GRAZING, HONEY, MEDICINE, CHARCOAL, POLES, EDUCATE, FTIMBER, RAIN, FIREWOOD, BTIMBER, GENETIC, CULTIVAT, CLIMATE, AIR, RIVERS.

b. Dependent Variable: How much respondents would pay to buy one acre of forestland (Kshs)

The ANOVA results show that the calculated F value is 1.384. The critical value from the F-distribution Table at (17, 63) degrees of freedom (in the Appendix) is 1.80. Again the calculated F value is less than the critical value. These results imply that we fail to reject the null hypothesis and conclude that there are no significant differences between the means of the forest benefits. This then implies that the amount of money

that the respondents are willing to pay for the purchase of one acre of forestland does not depend only of the forest benefits that are extractive in nature in Manyatta.

This is reinforced by the use of the beta weights of the independent variables. These weights can be used to rank the most important variables influencing the amount of money that respondents are willing to pay for the purchase of one acre of forestland in descending order as shown in Table 6.10 below.

Table 6.10: Ranking Forest Benefits using Beta Weights in Manyatta Division

FOREST BENEFIT	Beta Weights (Standardized Coefficient)	Rank	Forest Benefit Category
RAIN	-0.348	1	Indirect Use
BEAUTY	-0.238	2	Option Use
SOIL	0.236	3	Indirect Use
FTIMBER	0.226	4	Extractive Use
EDUCATE	0.187	5	Non-Extractive
FIREWOOD	0.177	6	Extractive Use
MEDICINE	-0.175	7	Extractive Use
AIR	0.148	8	Indirect Use
CHARCOAL	0.122	9	Extractive Use
POLES	-0.114	10	Extractive Use
GRAZING	0.108	11	Extractive Use
RIVERS	-0.064	12	Indirect Use
CULTIVAT	0.059	13	Extractive Use
GENETIC	0.054	14	Indirect Use
HONEY	-0.051	15	Extractive Use
CLIMATE	0.042	16	Indirect Use
BTIMBER	0.027	17	Extractive Use

Source: Data Analysis, 2007

In Manyatta Division there is a mix of Forest Benefit categories occupying the first five positions with Indirect use category being ranked 1st and 3rd, Option 2nd, Extractive use 4th and Non-use category 5th. Thus it can be said that all these benefit categories influence the amount of money respondents are willing to pay for

the purchase of one acre of forestland as opposed to the hypothesis that suggests that this amount is dependent only on the extractive forest benefits.

The benefits identified in Manyatta belonged only to four Categories of forest benefits including Extractive Use, Non-Extractive Use, Indirect Use and Non-use categories. When regressed against the amount of money that respondents were willing to pay for the purchase of an acre of forestland.

Table 6.11: Contribution of Forest Benefit Categories to the amount of money that respondents in Manyatta are willing to pay for an acre of forestland

FOREST BENFIT CATEGORY	CONTRIBUTION (R^2)
Extractive Use	0.094
Non-Extractive Use	0.010
Indirect Use	0.100
Non-use	0.027
Total Contribution	0.231

Source: Data Analysis, 2007

Again the results show that all the forest benefits categories combined contribute less that 50 percent to the variation in the amount of money that respondents in Manyatta are willing to pay for an acre of forestland showing a total contribution of 0nly 0.231. Other factors contribute the rest 0.769. Thus the regression equation cannot be expressed using the forest benefit categories only as other factors come into play.

The observed results of the regression analysis in Mathira Division at 95 percent confidence level were slightly different from the other two areas. They showed that:

Multiple R = 0.491

R Square = 0.241

Adjusted R Square = 0.070

Standard Error of Estimate = 41,611.732

F Change = 1.410

At a multiple R 0.491 the 16 forest benefits can be said to correlate poorly with the amount of money that the respondents were willing to pay for the purchase of one acre of forestland. Only 24.1 percent of the variation in the amount of money that respondents are willing to pay for the purchase of one acre of forestland was explained by the 16 forest benefits for the sample of 91 households as is indicated by the R^2.

Table 6.12: Summary of One-way ANOVA[b] Results in Mathira Division.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.91E+10	16	2.44E+09	1.410	0.162[a]
	Residual	1.23E+11	71	1.73E+09		
	Total	1.62E+11	87			

Source: ***Data Analysis, 2007***

a. Predicators: (Constant), SOIL, EDUCATE, CULTIVAT, FTIMBER, RAIN, BIODIVE, HABIT, CLIMATE, GRAZING, BTIMBER, HONEY, FIREWOOD CHARCOAL, RIVERS, AIR, POLES.

b. Dependent Variable: How much respondents would pay to buy one acre of forestland (Kshs)

These results show that the calculated F value is 1.410. The critical value from the F-distribution Table at (16, 71) degrees of freedom (in the Appendix) is 1.79. The calculated F value is thus less than the critical value. We therefore fail to reject the null hypothesis and conclude that there are no significant differences between the means of the forest benefits. This implies that the amount of money that the respondents are willing to pay for the purchase of one acre of forestland does not depend only of the forest benefits that are extractive in nature in Mathira.

Using the beta weights, the forest benefits in Mathira were ranked in descending order according to the influence they exhibition the amount of money that

respondents are willing to pay for the purchase of one acre of forestland. The results are presented in Table 6.13 below.

Table 6.13: Ranking of Forest Benefit Categories in Mathira Division using Beta Weights

FOREST BENEFIT	BETA WEIGHTS (STANDARDIZED COEFFICIENT)	RANK	FOREST BENEFIT CATEGORY
POLES	0.265	1	Extractive Use
HABIT	0.247	2	Non-Extractive Use
HONEY	-0.202	3	Extractive Use
CULTIVAT	-0.185	4	Extractive Use
SOIL	0.179	5	Indirect Use
FIREWOOD	-0.168	6	Extractive Use
CHARCOAL	0.154	7	Extractive Use
RIVERS	-0.135	8	Indirect Use
BTIMBER	0.099	9	Extractive Use
BIODIVE	0.050	10	Indirect Use
GRAZING	-0.039	11	Extractive Use
AIR	-0.028	12	Indirect Use
RAIN	-0.014	13	Indirect Use
FTIMBER	-0.014	13	Extractive Use
EDUCATE	-0.007	15	Indirect Use
CLIMATE	0.005	16	Indirect Use

Source: Data Analysis, 2007

From the table it can be seen that in the first five positions, 3 forest benefits that are extractive in nature are ranked 1st, 3rd and fourth while HABIT which is a non-extractive benefit is ranked 2nd and SOIL, an indirect use benefit, is ranked 5th. This shows that the three forest benefit categories are important in determining the amount of money that the respondents are willing to pay for the purchase of one acre of forestland. This is in contrast with the stated hypothesis, which seems to suggest that the amount of money that the respondents are willing to pay for the purchase of one acre of forestland is dependent only on forest benefits that are extractive in nature.

Respondents in Mathira identified forest benefits that could only be categorized as being of Extractive Use, Non-Extractive Use and Indirect Use. The contributions of these categories are presented in the Table below.

Table 6.14: Contribution of Forest Benefit Categories to the amount of money that respondents in Mathira are willing to pay for an acre of forestland

FOREST BENFIT CATEGORY	CONTRIBUTION (R^2)
Extractive Use	0.161
Non-Extractive Use	0.017
Indirect Use	0.077
Total Contribution	0.255

Source: Data Analysis, 2007

The results show that the Extractive Forest benefit category accounts for about 63 percent of the total contribution of the forest benefit categories to the amount of money that respondents in Mathira are willing to pay for an acre of forestland. However the total contribution of all the forest benefit categories is very low and may not justify the expression of the regression equation using only the forest benefit categories.

After treating the three study areas separately, it was important to understand how the trend would be if all the three areas were treated together. The 15 forest benefits that were common in the three areas were used in the regression analysis and the observed results were as follows:

- Multiple R = 0.221
- R Square = 0.049
- Adjusted R Square = -0.010
- Standard Error of Estimate = 92,556.290
- F Change = 0.0832

At a multiple R 0f 0.221 the 15 forest benefits can be said to correlate poorly with the amount of money that the respondents were willing to pay for the purchase of one acre of forestland. Only 4.9 percent of the variation in the amount of money that respondents are willing to pay for the purchase of one acre of forestland was explained by the 16 forest benefits for the sample of 261 households as is indicated by the R^2. The analysis of variance results are presented in the Table below.

Table 6.15: Summary of One-way ANOVA[b] for Common Forest Benefits Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.07E+11	15	7.12E+09	0.0832	0.642[a]
	Residual	2.07E+12	242	8.57E+09		
	Total	2.18E+11	257			

Source: ***Data Analysis, 2007***

a. Predicators: (Constant), SOIL, CHARCOAL, GRAZING, HONEY, EDUCATE, CULTIVAT, FIREWOOD, RAIN, BIODIVE, FTIMBER, CLIMATE, POLES, BTIMBER, AIR, RIVERS.
b. Dependent Variable: How much respondents would pay to buy one acre of forestland (Kshs)

These results are not any different from the results obtained for the three study areas. The calculated F value of 0.0832 is less than the critical value of 3.64 from the F-distribution Table at (15, 242) degrees of freedom (in the Appendix). Just like in the three study areas we fail to reject the null hypothesis and conclude that there are no significant differences between the means of the forest benefits. This implies that the amount of money that the respondents are willing to pay for the purchase of one acre of forestland does not depend only of the forest benefits that are extractive in nature. The beta weights ranking in Table 6.13 below were used to reinforce this position.

From the beta weights ranking it is also evident that all the three benefit categories have an influence on the amount of money that the respondents are willing to pay for the purchase of one acre of forestland thus negating the hypothesis.

Table 6.16: Ranking of the Common Forest Benefit Categories using Beta Weights

FOREST BENEFIT	Beta Weights (Standardized Coefficient)	Rank	FOREST BENEFIT CATEGORY
CHARCOAL	0.189	1	Extractive Use
CULTIVAT	0.075	2	Extractive Use
RIVERS	-0.072	3	Indirect Use
FIREWOOD	0.068	4	Extractive Use
POLES	-0.051	5	Extractive Use
BIODIVE	0.045	6	Indirect Use
RAIN	0.035	7	Indirect Use
EDUCATE	-0.035	8	Non-Extractive
HONEY	-0.034	9	Extractive Use
GRAZING	0.027	10	Extractive Use
BTIMBER	0.025	11	Extractive Use
AIR	-0.022	12	Indirect Use
FTIMBER	0.016	13	Extractive Use
SOIL	0.013	14	Indirect Use
CLIMATE	-0.011	15	Indirect Use

Source: Data Analysis, 2007

The results of the beta weight ranking are not different when the three areas are treated in combination meaning that the conclusion that that the amount of money that the respondents are willing to pay for the purchase of one acre of forestland does not depend only of the forest benefits that are extractive in nature can be generalized for the populations living adjacent to the forest.

The contributions of the three benefit categories under which the forest benefits that were common in all the three areas are presented in Table 6.17 below.

Table 6.17: Contribution to the amount of money that respondents are Willing to pay for an acre of forestland of the Common Forest Benefit Categories

FOREST BENEFIT CATEGORY	CONTRIBUTION (R^2)
Extractive Use	0.042
Non-Extractive Use	0.001
Indirect Use	0.005
Total Contribution	0.048

Source: Data Analysis, 2007

The results above are indicative that other factors are responsible for the amount of money that respondents living around the forest are willing to pay for an acre of forestland. Thus the regression equation cannot be derived.

6.6 Conclusions

It is evident from the correlation results that there are very weak relationships between the forest benefits and amount that forest-adjacent households are willing to pay for the purchase of one acre of forestland. None of the correlated forest benefits in the three study areas had a correlation coefficient of more than 0.5. This then means that the value that forest-adjacent households give to one acre of land is influenced by a combination of many other factors acting together beside forest benefits. Considering that forestland can be treated as any rural land then factors such as location, fertility, terrain, size, distance from major towns, income levels of the households as well as accessibility would come into play when considering how much that acre of land is worth.

There is poor correlation between the forest benefits to the amount of money that respondents are willing to pay for the purchase of one acre of forestland as shown by the multiple Rs in the three study areas and the analysis of the combined data.

The regression analysis results showed that the forest benefits themselves hence the benefit categories contribute minimally to the variation in the amount of money that respondents are willing to pay for the purchase of one acre of forestland as depicted by the R^2s obtained both for the study areas analyzed separately and in combination. This shows that apart from the forest benefits accruing from the forest to the forest-adjacent communities, there are many more factors that influence the manner in which the households value the forest and hence the use patterns of the forest products.

CHAPTER SEVEN

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The chapter presents a summary of the main findings and concludes giving recommendations on how the communities living adjacent to forested areas could be involved in valuing the benefits of forests that will in turn improve their perception of the conservation of the forest. The author attempts to postulate a solution of improving the perception of value of forests by forest adjacent communities to enhance forest conservation and management practices.

At the onset the objectives of the study aimed at exploring the benefits derived from forests by forest-adjacent communities and how these influence their perception of the value of the forest. The specific objectives were to:

1) Identify and categorize the benefits of forest to the forest adjacent households.
2) Examine the value/importance that forest-adjacent households attach to the forest benefits.
3) Evaluate the relationship between the forest benefits identified and the amount of money that the forest adjacent communities are willing to pay for the purchase of an acre of forestland.
4) To recommend how best to incorporate the value perceptions of the forest-adjacent communities in the valuation of forests

Against these objectives, the hypothesis that the amount of money that the forest-adjacent communities are willing to pay for the purchase of an acre of forestland is

dependent on the forest benefits that are extractive in nature was set. This value can be used as a proxy to determine how valuable the forests are to these communities. This had the implication that the respondents who do not give much importance to the extractive forest benefits will give a lower value of the amount they are willing to pay for the purchase of one acre of land than those who rate the extractive forest benefits much higher.

7.2 Summary of Findings

The main findings of the study included:

1. Households living adjacent to the forests in the three study areas attach more importance to the forest benefits that offer environmental services. From the results on the importance of forest benefits, about 90 percent of the respondents said that rain-formation is either an extremely or a fairly important forest benefit as shown in Table 5.7. Only 10 percent of the respondents said that this benefit was either unimportant did not know its importance. Forests as sources of rivers (as evidenced by Plate 1) and air cleansers were said to be either extremely or fairly important or fairly as sources of rivers by 70 percent of the respondents while cooling of climate was considered extremely or fairly important forest benefit by about 61 percent. On ranking of the forest benefits, the first 5 positions were taken by forest benefits that are environmental in natures as can be seen in Table 5.11. These results indicate the respondents' consciousness of the environmental benefits offered by forests. Thus they would be interested in

the conservation of the forest in order to enhance the possibility of continual harnessing of these benefits.

2. People may place a premium on conserving a forest for future use over and above the direct use values. However this was only identified as an important forest benefit in only one of the study areas and by a very small proportion of respondents (27%) who said it was either extremely or fairly important to their households as depicted in Table 5.4. This may be due to the fact that it is impossible to identify all the future uses of forests because technology may have changed and new uses of forests emerged
3. Use of forestland for cultivation takes place on a small scale due to creeping encroachment. Households may supplement their food production through the cultivation of forestland. It was considered to be of either extreme or fair importance by a considerable proportion of respondents (44.4%) as depicted in Table 5.7. This could be explained by the fact that the forest adjacent communities are farming communities who depend on land to grow their food. So when confronted with landlessness they turn to illegal cultivation of the forestland.
4. As depicted by Plate 2 and 5 forests may contain a small permanent population or can be temporarily or seasonally inhabited by surrounding peoples. In Mount Kenya forest, groups of cultivators, hunters and honey-gatherers live in the forest for a period of several weeks or months although this is very limited. This is despite the fact that habitation of forests in this area has been banned since the ban on the "shamba system" was slammed.

5. Though timber harvesting either for furniture or building is ranked lowly (9th and 11th) there is enough evidence of illegal harvesting of timber in the study area as depicted by Plates 3 and 4.
6. The forests benefits accruing to the forest-adjacent communities were found to have very weak relationships with the amount of money that they were willing to pay for the purchase of one acre of forestland. None of the forest benefits in all the three study areas had a correlation coefficient of 0.5. (Tables6.3, 6.4 and 6.5). The highest correlation coefficient was negative 0.274 between HONEY and the amount of money the respondents were willing to pay for the purchase of one acre of forestland in Mathira, Nyeri. This then means that value that forest-adjacent households give to one acre of land is influenced not only by forest benefits but also by a combination of many other factors acting together beside. Considering that forestland can be treated as any rural land then factors such as location, fertility, terrain, size, distance from major towns, income levels of the households as well as accessibility would come into play when considering how much that acre of land is worth.
7. The Multiple Regression Analysis confirmed the poor correlation between the forest benefits to the amount of money that respondents are willing to pay for the purchase of one acre of forestland. Though the MRA results at 95 percent confidence level show that the forest benefits correlate well with the amount that the respondents are willing to pay for the purchase of one acre of forestland as depicted by the multiple Rs in the three study areas (0.542 in

Chuka, 0.521 in Manyatta and 0.491 in Mathira), the forest benefits contribute minimally to the variation in the amount of money that respondents are willing to pay for the purchase of one acre of forestland. This shows that apart from the forest benefits accruing from the forest to the forest-adjacent communities, there are many more factors that influence the manner in which the households value the forest and hence the use patterns of the forest products. Considering that forestland is similar to any rural land then factors such as location, fertility, terrain, size, distance from major towns, income levels of the households may be said to influence the perception of the value of forestland by the forest-adjacent communities.

7.3 Conclusions

The fact that forest-adjacent households rank environmental forest benefits highly this is positive as it acts as an entry point to the communities for the Conservation of the forest debate. However, the high ranking of the environmental benefits may not influence much their decision to utilize or conserve the forest adjacent to them if all other factors that may influence their perception of the value of forests are not addressed. This would hamper forest conservation activities.

Forests provide a valuable source of livelihood for forest-adjacent communities. With increased level of forest use due to increasing demands placed by a growing population, urbanization, commercialisation and a failure to control illegal and unsustainable use of forests, forest degradation continues unabated. Without new systems capable of achieving sustainable forest management, the future pattern of forest utilization is likely to be a continuation of the present trends of massive

destruction. Such a scenario will put an ever- increasing pressure on available forest resources. However the development of alternative sources for goods and services currently obtained from forests might ameliorate the situation by lessening the individual demand for forest products, as would the use of improved technology, which increases efficiency of wood use.

7.4 Recommendations

The study recommends that:

1) There is need to understand the needs and priorities of forest-adjacent communities in any activity when undertaking any forest valuation exercise since forests form an important part of their domestic and local livelihood. This can be done by allowing the communities to define their values for forests values within the context of their own perceptions, needs and priories. The valuation methodologies adopted must allow the households to incorporate their perception of value within the framework of the methodology.
2) In areas surrounding forests where levels of poverty are high, livelihoods are insecure, income and employment opportunities are few and land is scarce, many people may exploit forest resources because other goods are unavailable or unaffordable to them. A range of economic conditions can be put in place that deal directly with the local livelihood needs. These conditions would include:
    a) Permitting sustainable utilization of forest resources. For example grazing in forests, as a matter of practice, is provided for in the Forest Act, 2005. As a management tool, this practice enables suppression of weeds in forest

plantations, facilitating faster growth of the young trees, and reduces biomass that could otherwise pose fire hazards in the dry seasons.

b) Establishing a range of on-farm and off-farm developments and enterprises that aim to improve non-forest sources of income and employment. Local households should be encouraged to form registered local forest enterprises groups that are supported with funds from the Government for micro-enterprises training and start-up of business capital. For example the Constituency Development Funds and the recently established Youth and Women Funds could be channeled through these enterprises groups.

c) Making available or strengthening these non-forest alternative sources of subsistence, income and employment will go a long way in strengthening and engaging the local communities in forest conservation activities.

d) Substituting for natural resource use and support forest saving technologies. Households can be encouraged to engage in on-farm tree planting (agro-forestry) in order to provide for their fuel wood needs.

7.5 Areas of Further Study

1. An Investigation of the Factors other than forest benefits that Influence the value perception of the forest adjacent communities and Hence Determine Forest Utilization.
2. To investigate how best to relate the relative value of forest benefits to monetary value

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APPENDIX I

HOUSEHOLD QUESTIONNAIRE

General information

1. Questionnaire No.		
2. Respondents Gender		
3. District		
4. Division		
5. Location		
6. Sub-location		
7. How far are you located from edge of forest? (Kilometers)		
8. Respondent's Age		
9. Respondent's Level of Education		
10. Respondent's Occupation		
11. What is your Land size Land size (Acres)	Cropland	
	Grazing land	
	Commercial plot	
	Forestland	

Household Economy

12. Amount (Kshs) of respondents income from	Farming activities	
	Livestock activities	
	Non-farm activities	
	Employed relatives	
13. Amount (kshs) of respondents expenditure on	Food items	
	Water	
	Fuel wood	
	Kerosene	
	Gas	
	Electricity	
	Education	
	Transport	
	Shelter	
	Clothing	
	Medical	

14. State the importance of forest to your household.
1= Extremely important
2= Fairly Important
3= Unimportant
4= Don't Know

15. In the table below, indicate by marking X the benefits you derive from the forest.

Benefit	Mark X
Charcoal	
Firewood	
Furniture Timber	
Building Timber	
Bamboo	
Poles	
Wild Foods	
Medicinal extracts/plants	
Honey	
Thatch Grass	
Fibre	
Hunting	
Grazing	
Cultivation	
Habitation	
Recreation	
Education/Research	
Biodiversity Conservation	
Genetic Materials	
Local Climate regulation (cooling climate)	
Source of Rivers	
Rain-making/formation	
Cleansing of Air	
Soil Fertility contribution/ Soil erosion prevention	
Cultural and Religious heritage	
Aesthetic beauty	
Bequest	
Future use	
Total benefits identified with	

16. State for what purpose the forest benefits are important to your households.
    1. Subsistence use
    2. Commercial use
    3. Both Subsistence and Commercial uses

17. Indicate the importance of the selected benefits in the table below.
1= Extremely important
2= Fairly Important
3= Unimportant
4= Don't Know

Benefit	Importance
Charcoal	
Firewood	
Furniture Timber	
Building Timber	
Bamboo	
Poles	
Wild Foods	
Medicinal extracts/plants	
Honey	
Thatch Grass	
Fibre	
Hunting	
Grazing	
Cultivation	
Habitation	
Recreation	
Education/Research	
Biodiversity Conservation	
Genetic Materials	
Local Climate regulation (cooling climate)	
Source of Rivers	
Rain-making/formation	
Cleansing of Air	
Soil Fertility contribution/ Soil erosion prevention	
Cultural and Religious heritage	
Aesthetic beauty	
Bequest	
Future use	
Total benefits identified with	

19. What measures would you propose to ensure that you continue enjoying the state forest benefits?

20. What costs do you incur from the presence of the forest?

APPENDIX II

CODEBOOK

Question Number	Variable Number	Column Location	Code Descriptors	Software Variable Name
1	1	1	Record Number	ID
2	2	2	Sex of Respondent 1= Male 2= Female	GENDER
3	3	3	District 1= Embu 2= Meru South 3= Nyeri	DISTRICT
4	4	4	Division 1= Manyatta 2= Chuka 3= Mathira	DIV
5	5	5	Location 1= Nginda 2= Ruguru 3= Mugwe 4= Kiang'ondu 5= Magutu 6= RuguruM	LOC
6	6	6	Sub-location 1= Kithunguriri 2. Kibugu 3= Nguviu 4= Mbuvori 5= Mugirwa 6= Township 7= Kiang'ondu 8= Kirege 9= Gitunduti 10= Kiamariga 11= Gatei 12= Ruturu	SUBLOC
7	7	7	Record distance in kilometres	DISTANCE

8	8	8	Age of Respondent in years 1= 0-19 2= 20-29 3= 30=39 4= 40-49 5= 50-59 6= 60-69 7= over 70	AGE
9	9	9	Level of Education 1= None 2= Adult Literacy 3= Primary 4= Secondary 5= Tertiary	EDUCATE
10	10	10	Occupation of Respondent 1= None 2= Farmer 3= Self-employment 4= Wage Employment	OCCUPN
11	11	11-14	Record size of Cropland owned in acres	CROP
			Record size of Grazing land owned in acres	GRAZE
			Record size of commercial plot owned in acres	PLOT
			Record size of forestland owned in acres	TREES
12	12	15-19	Record income from farming	INCFARM
			Record income from livestock	INCLIVE
			Record income from non-farm activities	INCNONFM
			Record income from employed relatives	INCREMITT

13	13	20-30	Record expenditure on food items	EXPFD
			Record expenditure on Water	EXPWAT
			Record expenditure on fuelwood	EXPFWD
			Record expenditure on Kerosene	EXPKEROS
			Record expenditure LPG gas	EXPGAS
			Record expenditure on Electricity	EXPELEC
			Record expenditure on Education	EXPEDUC
			Record expenditure on transport	EXPTRANS
			Record expenditure on Shelter	EXPSHELT
			Record expenditure on Clothing	EXPCLOTH
			Record expenditure on Medical	EXPMEDIC

14	14	31	Importance of forest to the household 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	FOREST
15	15	32-56	Hunting	HUNT
			Grazing	GRAZE
			Charcoal harvesting	CHARCOAL
			Firewood harvesting	FIREWOOD
			Furniture timber harveting	FTIMBER
			Building timber harvesting	BTIMBER
			Poles harvesting	POLES
			Bamboo harvesting	BAMBOO
			Fibre havesting	FIBRE
			Medicinal plants harvesting	MEDICINE
			Honey Harvesting	HONEY
			Cultivation	CULTIVAT
			Habitation	HABIT
			Education	EDUC
			Genetic materials	GENETIC
			Biodiversity Conservation	BIODIVE
			Cleansing of climate	CLIMATE
			Source of rivers	RIVERS
			Cleansing of air	AIR
			Soil fertility maintenance	SOIL
			Aesthetic beauty	BEAUTY
			Recreation	RECREAT
			Rain formation	RAIN
			Cultural and religious heritage	HERITAGE
			Future use	FUSE
16	16	57	Purpose of use of forest 1= Subsistence use 2= Commercial use 3= Subsistence and Commercial uses	PUSE

17	17	58-82	Importance of hunting in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	HUNT
			Importance of grazing in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	GRAZE
			Importance of harvesting charcoal in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	CHARCOAL
			Importance of harvesting firewood in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	FIREWOOD
			Importance of harvesting furniture timber in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	FTIMBER
			Importance of harvesting building timber in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	BTIMBER

			Importance of harvesting poles in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	POLES
			Importance of harvesting bamboo in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	BAMBOO
			Importance of harvesting fibre in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	FIBRE
			Importance of harvesting medicinal plants in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	MEDICINE
			Importance of harvesting honey in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	HONEY
			Importance of cultivating in the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	CULTIVAT

			Importance of inhabiting the forest 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	HABIT
			Importance of forest for education 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	EDUC
			Importance of forest as source of genetic materials 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	GENETIC
			Importance of forest for biodiversity conservation 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	BIODIVE

			Importance of forest in microclimate regulation 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	CLIMATE
			Importance of forest as source of river 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	RIVERS
			Importance of forest in cleansing the air 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	AIR
			Importance of forest in maintenance of soil fertility 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	SOIL
			Importance of forest for aesthetic beauty 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	Beauty

			Importance of forest for recreation 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	RECREAT
			Importance of forest for rain formation 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	RAIN
			Importance of forest for cultural and religious heritage 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	HERITAGE
			Importance of forest for future use 1= Extremely important 2= Fairly Important 3= Unimportant 4= Don't Know	FUSE
18	18	84	Record amount (in Kshs) respondent is willing to pay for purchase of one acre of forestland	Payfores

			Record amount (in Kshs) respondent is willing to pay for purchase of one acre of cropland	PAYCROP
			Record amount (in Kshs) respondent is willing to pay for purchase of one acre of commercial plot	PAYPLOT
			Record amount (in Kshs) respondent is willing to pay for purchase of one acre of fallow grazing land	PAYGRAZE
19	19	85	Measures for ensuring continued forest use 1= Conservation 2= Preservation 3= sustainable harvesting 4= communities to be involved in the management of the forest	MEASURES
20.	20	86	Costs of presence of forest. 1= Loss of life 2= Loss of land for farming 3= Loss of crops Cost of management	COST