

**W VALUING HABITAT PROTECTION:
THE CASE OF RUTHUMBI FOREST IN KENYA G**

BY

MARTIN M. KINYUA ✓

**A RESEARCH PAPER SUBMITTED TO THE DEPARTMENT OF ECONOMICS,
UNIVERSITY OF NAIROBI IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR AN AWARD OF MASTERS OF ARTS (ECONOMICS) DEGREE.**

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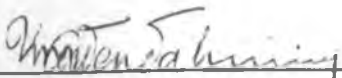


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DECLARATION

This paper is my original work and has never been submitted for an award of a degree in any other university.


Signed 

Date: 8th of September 2002

Martin M. Kinyua

C/50/7009/2000

This research paper has been submitted for examination with our approval as University and Economics Department supervisors.

Signed 

Date: 9th September 2002

Dr. Wilson S.K. Wasike

Signed _____

Date: _____

Mr. George K. Njiru

Dedication

To Mollie.

Acknowledgement

Had it not been for Dr. Thomas McDonald I would probably not have taken any initiative to return to university so soon for graduate training. He encouraged me, and more still, he secured for me a scholarship with KAAD, Germany. I express my sincere gratitude to KAAD and most importantly, to him.

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To clarify though: As much as I appreciate the input from other sources and feel greatly indebted to them, I am solely responsible for any errors or omissions that may be contained in this paper.

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ABSTRACT

The protection and preservation of natural forests generates a wide variety of market and non-market benefits, which, individuals derive through consumptive or non-consumptive uses. Benefits accruing from consumptive use include timber, fuelwood, medicinal and pharmaceutical products, and forage if existing policies allow extraction. Benefits such as recreation, ecotourism, protection of critical watersheds, carbon sequestration and climate regulation are non-consumptive.

This study made use of contingent valuation method to find rural households' value of protecting and preserving Ruthumbi forest in Eastern Kenya, which is currently undergoing high deforestation. We found that the underlying reason for the high deforestation is public policy failure with respect to enforcement and monitoring state's ownership rights. This has made the forest a de facto open-access resource with traders in forest products and rural households exploiting the forest without restraint. The Tobit model with sample selection was adopted since we were expecting to get invalid responses especially of the protest zero type. The analysis confirmed this because the coefficient testing for sample selection bias, (ρ , ρ) in the estimated models was significant at 1 percent level. The probit analysis revealed age of respondents and household income to significantly influence the probability of giving a valid response. The parameter estimates for these variables were negative and positive respectively.

The corrected regression part of the model was used in the analyses of the determinants of willingness to pay. Again, age of the respondents and household income were found to be significant. The parameter estimate for age was negative whilst that for income was positive. Moreover, we found the mean monthly willingness to pay per household for protection and preservation of the forest to be KSh. 125. This value may seem low, as it constitutes a 2.1 % proportion of the average monthly income for the subsistence farm households surveyed. Nevertheless, there is a justification for this. Our final good was establishment of communal ownership and management of the forest and the payment vehicle was a communal standing fund. The money was to be used for paying guards and allowances to the members of a local court – a "Njuri" – whose main duties would be to oversee the project and to settle any disputes. In addition, given that in this arrangement each household would be required to contribute substantially in non-monetary terms, we can thus say that the monthly KSh. 125 per household was quite a reasonable amount.

Therefore, given that the monthly payment per household was 'reasonable' and following the fact that the literacy levels are low in rural Kenya where the study was based, we concluded that contingent valuation exercises will be a success in a developing country context as long as design and implementation focus on real issues affecting households.

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Under this section we elucidate on the importance and benefits of natural forests, review the state of these forests in the world setting and highlight the present situation of natural forests in Kenya.

1.1.1 The importance and benefits of natural forest ecosystems

Natural forests are an important terrestrial ecosystem that could be regarded as a global commons for they play an important role in stabilizing greenhouse gas concentrations by making use of carbon dioxide and releasing oxygen into the atmosphere. Additionally, they perform several other important ecological functions that enhance life-support mechanisms, namely, acting as watershed areas for rivers and streams, prevention of soil erosion, nutrient cycling, and being rainfall catchments areas. Moreover, they support a wide variety of wildlife - species of mammals, reptiles and birds, which together with all other earth's species weave a complex, astonishing and intricate web of life. Other benefits derivable from these forests include timber, wood fuel, charcoal, fencing posts, and most importantly, they provide a very rich natural pharmacy giving them tremendous medicinal values (Bird, 1990). Indeed, about 25 percent of commercially manufactured medicines are derived from plants, and new medicinal plants are continually being discovered (Pearce, 1990). Some studies have even attempted to value medicinal and pharmaceutical benefits of forests. See for instance Mendelsohn and Balick (1995), Pearce and Puroshothaman (1995) and Ruitenbeek (1992).

The focus of attention on natural forests especially in the tropics has arisen because of the sheer diversity of functions that they serve, the uniqueness of these forests in evolutionary and ecological terms and the accelerating threat to their existence. According to Pearce (1991), their functions and benefits include the following: -are an homeland of many indigenous peoples; provide the habitat for extensive fauna and flora (biodiversity), which are valued in itself, and valued for educational, crop-breeding and medicinal purposes; supply hardwood timber and other forest products; provide a recreational facility; protects watersheds in terms of water retention, flow regulation, water pollution and organic nutrient cleansing; acts as a store of carbon dioxide; fix carbon in secondary forests and in reforested areas; and serve a possible

regional microclimatic function. He goes further to argue that all these are economic functions because they contribute to human welfare either directly or indirectly. Anything contributing to human welfare is deemed to be an economic function, and the flow of services may or may not have a cash flow associated with it. In the case of tropical forests most functions do not have evident cash flows.

In the view of Barbier *et al* (1991), the most commonly perceived, though not the most valuable, use of forests is for timber. In addition, there are several other uses. Forestland can be used for agricultural purposes, both in conjunction with its use for timber, or exclusively, and also of great importance are the non-timber products such as rattan, resin, honey, fruit, nuts etc. Then there are the displacement uses of forestland: i.e. its use for other purposes such as the construction of hydro dams, building of roads and so on. Finally, they highlight the uses of forest in a conserved state, uses which include key ecological functions like watershed protection, material cycling and energy flow, and microclimatic regulation; indirect values such as recreation and tourism; the option value of the future use of forest resources, particularly its biodiversity; and the existence value derived from the desire of people to pay for the existence of these resources, irrespective of whether they use them or not.

1.1.2 The state of world's natural forests

In spite of the many functions and benefits highlighted above, natural forests around the globe are undergoing destruction and degradation at an alarming rate. More than one-fifth of the world's tropical forests have been cleared since 1960, and tropical deforestation increased from 11.8 million hectares per year in the 1970s to 15.4 million hectares (0.8 percent of the total natural forest cover) in the 1980s. In the late 1990s, the world rate of tropical deforestation was typically averaging about 7.0 percent per year (Watson *et al*, 1998). Today, as never before, tropical forests are under threat. Apart from deforestation, which many people point to, there are other forces that have been subtly destroying trees, leaf-by-leaf. These are air pollution and acid rain – they slowly weaken trees, making them vulnerable to pests and diseases. If it were not for the earth's regenerative power, what had been foretold in 1980s would have befallen mankind: - After scientists in Germany studied the effects of acid rain and air pollution, they concluded: 'If

nothing is done, about the year 2000 people will be left to admire forests only in old photos and movies.’¹

This unprecedented rate of destruction and degradation of forests, coupled with several other serious global environmental issues² currently plaguing mankind, pose a great threat to survival and the very existence of humankind. Accompanying forest cover loss is an extinction crisis that has threatened the intricate web of life. The forests of our planet are teeming with life, including species that have yet to be discovered by man. The tropical forests cover less than two percent of the planet earth, and yet it is estimated that they are the only home of at least 50 percent and possibly as many as 90 percent of all species on earth³.

As outlined in Watson *et al.* (1998), the underlying causes of deforestation, unsustainable use and degradation of forests include: population growth and increasing per capita demands for forest products which increase pressures for forest exploitation and the conversion of forest lands to agriculture and other forms of development such as mining and fossil fuel extraction; market failures that undervalue both the benefits of forest ecosystems and the true costs of damages associated with forest exploitation and conversion; policy failures that provided perverse incentives for forest degradation and destruction; institutional failures that lead to insecure resource access rights for forest-dependent communities; and a lack of transparency in forest resource pricing and allocation processes which, in turn, encourages corruption and misuse of forest resources.

1.1.3 The present situation of Kenyan forests

Of the Kenya’s total landmass, only 2 percent is under forest cover. In light of the numerous ecological functions of forests and the tremendous benefits derived from them, then no doubt the Kenyan forest reserve is invaluable and very precious. Nevertheless, natural forests have been experiencing the same fate as those in the rest of the world – deforestation, degradation and unsustainable use on a scale previously unknown. This is mainly attributed to population growth and increasing per capita demands for forest products which increase

¹ See the May 22, 2000 issue of Awake! Journal. These journals are published by The Watch Tower Bible and Tract Society of New York, Inc.

² These are well outlined in Watson *et al* (1998) and they include greenhouse effects (global warming), depletion of stratospheric ozone layer, loss of biological diversity, International waters, and acid rain. See also Pearce and Warford (1993)

³ See the November 22, 2001 issue of the Awake! Journal

pressures for forest exploitation and the conversion of forest lands to agriculture; market failures that undervalue both the benefits of forest ecosystems and the true costs associated with forest exploitation and conversion; policy and institutional failures that have provided perverse incentives for forest degradation and destruction; and a lack of transparency in forest resource pricing and allocation processes which, in turn, encourages corruption and misuse of forest resources. Let us cite a few examples here with respect to these causes.

The main commercial timber trees have been very few, namely, in their order of value: - Mvule, *Vitex Keniensis* (Meru oak), *Cordia Abyssinica* (Muringa-Meru), *Lovoa Swynertonii* (Mukongoro-Meru), *Juniperus Procera* (E.A. Cedar), Muhugu (Kikuyu), and Camphor. But unfortunately by 1997, some of them had been made extinct whilst for others, it was hard to find mature trees worth converting into timber⁴. Mvule, which used to be found in the coastal Kwale and Lamu districts forests no longer exist. The *Cordia Abyssinica* and *Lovoa Swynertonii* had been made extinct also. For the Meru oak found in lower Imenti forest of Meru, Kiamuriuki block of South East Mt. Kenya, Tharaka-Nithi district and in Kakamega forest, it had been over harvested such that only immature trees could be found. Indeed, mahogany timber was being imported from Uganda to substitute for its timber. Also, the Muhugu trees that were remaining were only of non-commercial age. *Juniperus Procera* and camphor (Muthaiti-Meru) were back then facing extinction because the only few remaining were being cut uncontrollably. These and other tree species have been cut and exploited to produce timber and fencing posts for commercial and domestic use purposes. This can be attributed to market undervaluation whereby traders in these products have valued trees for their lumber content only.

Overwhelming increase in the rate of population growth too has had a significant share in the wanton destruction of the Kenyan forest reserve. After failing to secure a piece of land to settle and cultivate, the vast majority resulted to encroachment of forest land. Some have been settling there for years and in order to provide for their expanding families, the forests have seen further destruction as a result of increased conversion of the forest land into agriculture. Karura, Mt. Kenya and Mau forests have lost large pieces of land to the politically well-connected individuals in the pretext of resettling squatters. Ngong forest could be teetering towards the same demise following the recent sighting of private developers in the forestland. In the same

⁴ The facts presented here relate to the 1990s and were disclosed by a retired Forester. In fact, the information has been extracted from a copy of the letter he had sent the head of state in 1997 expressing his fears over the alarming rate at which forest trees were being felled back then.

vein of resettling squatters, the government since last year has targeted 167,000 hectares of gazetted forest cover for excision. The dust spewed by this unprecedented alienation, which affected 14 percent of Kenya's total forest land, is yet to settle.

Replacement of the licensing policy with total ban has had a significant role to play too. In the former case, only mature and over-mature indigenous trees were to be cut to produce timber and other products like fencing posts. Only licensed people would operate on various parts of forest reserves, and were required to fell only the trees hammer-marked by Forest Department officers. The licensees would in turn provide protection to forest areas by keeping out unlicensed people from their area of operations. The latter policy, total ban, entails keeping off the forest bounds completely—no exploitation of forest products is allowed at all. The impact of this policy decision has been detrimental: - Lack of ease in obtaining vital forest products did drive the local households and forest products traders to invade forests at night, thus felling trees indiscriminately. Moreover, they have greatly capitalized on monitoring and enforcing difficulties experienced by the Forest Department thereby considering the forests to be *de facto* open access resources.

In a nutshell, the existing policies, technologies and measures do not encompass sound management, and this has therefore led to unsustainable use of forest resources. What is happening to Kenya's natural forests partly undermines the import of long-term economic growth and sustainable development. The 1987 World Commission on Environment and Development (WCED), also known as the Brundtland Commission, defines sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their needs. For economists, sustainable development is the maximum development that can be achieved without running down the capital assets of a nation, which are its base. The base is interpreted widely to encompass man-made, natural, human, moral (ethical) and cultural capital [R. Kerry Turner, ed., 1993]. The government, having realized this, recently proposed a bill, The Forestry Bill 2000, to provide, as put therein "for the establishment, development and sustainable management, including conservation and rational utilization of forest resources for socio-economic development of the country".

1.2 Legal and institutional framework

The government of Kenya, having committed itself to the inter-sectoral development and sustainable use of forest resources, has put in place various laws geared towards conservation, rational utilization and sound management of the forest resources. These legal arrangements and measures are contained in the Environmental Management and Co-ordination Act. The administrative structure is outlined in the act, with identification of all posts of responsibility, with the rules governing forest use and management specified clearly.

In addition, there exist several institutional arrangements with a view to conservation of forest ecosystems in Kenya, the key player being the Forest Department of the Ministry of Environment and Natural Resources. This is bestowed with the overall national responsibility of making clear and sound policies to ensure that forests are used sustainably. Others include the Ministry of Local Government, the National Environment Management Authority, the Ministry of Energy, the Ministry of Agriculture, the Kenya Forestry Research Institute (KEFRI), and several Non-Governmental Organizations (NGOs) including the Green Belt Movement. The United Nations Environmental Programme (UNEP), an international organization with its headquarters here in Nairobi, also plays a major role. Moreover, Kenya is a signatory to international conventions and other agreements such as the International Tropical Timber Agreement (ITTA) of 1983 (renegotiated in 1994) and the Convention on Biological Diversity with a view to promoting sustainable utilization of forests and preservation of biological diversity.

1.3 The area of study⁵

Ruthumbi forest is found in the western region of Meru district, on the Eastern slopes of Mt. Kenya. It is at the high altitudes above 2200 meters, covering an area of well over 14,000 hectares and is among the indigenous forests gazetted in Kenya. At altitude above 2438 meters, the forest is populated with coniferous trees, while denser stands of bamboo are found at still higher altitudes. Below 2438 meters, broad-leafed evergreen forest species are dominant. Under ample rainfall conditions, the tree formation often reaches heights of 40 meters.

⁵ This study concentrates only on natural forests that have been gazetted as state property, and are under management of the Forest Department. Ruthumbi Forest is such.

Apart from the various species of trees and plants, which include E.A. Cedar (*Juniperus Procera*), Black Wattle (*Acacia Mearnsii*), Gum (*Eucalyptus ssp*) and podo among others, the forest is a home to many different kinds and species of wildlife including monkeys, baboons, elephants, birds, buffalo, dears, hyenas, etc. Surface water too is found in the forest since the forest acts as a catchment area and the volcanic rocks in the region retain much of the water⁶. The main river systems traversing the forest receive the run-off from the eastern slopes of Mt. Kenya, and they form waterfalls, which could even be used to tap hydroelectricity. They are permanent and large enough to keep the dry eastern lowlands well watered- indeed, water has been tapped from river Thingithu to form the largest irrigation scheme in Meru district- Mitunguu Irrigation Scheme- with the water also being utilized for domestic purposes as well as for watering livestock. In the area being studied, almost all rural households have piped water which, apart from being used domestically and for livestock, it irrigates their shambas. The wide range of animal and bird species, the magnificent waterfalls and the soothing forest environment offers a very attractive and appealing site for recreation and ecotourism. In fact, visitors who include foreign tourists visit the forest occasionally for ecotourism.

Between the forest land and people's pieces of land is the Nyayo Tea Zone owned by the government. This strip of tea along-side the forest was planted in order to prevent the local community from encroaching on the forest land. Tea thrives well in the region, making tea farming the main economic activity of the rural households comprising the forest community. Other economic activities include dairy farming, and production of potatoes, cabbages, carrots and French beans through irrigation.

As state forest, Ruthumbi is under the management of the Forest Department, Ministry of Environment and Natural Resources, which is represented by a Forester with an office at the Ruthumbi Forest Station right in the forest precincts. He handles all administrative issues and matters and supervises the forest officers (otherwise known as "*Atonyi*" by the local community) whose main work is to patrol the forest in order to ensure that no illegal activities such as logging and sawing of trees, firewood collection and farming take place. If these officers are to find anyone engaging in such activities, they are supposed to arrest and hand him/her to the Forester at the Forest Station, who is then to take legal action against such a person.

⁶ See the Meru District Development Plan (1997-2001).

1.4 Statement of the problem

As early as 1971, the Forest Department recognized that dependence on the gazetted forests by the local population was very serious and if left unchecked was going to threaten the existence of forests⁷. In recognition of this fact, the Department launched the Rural Afforestation and Extension scheme, whose main purpose was to promote growing of trees by farmers so that they would be able to meet their wood requirements from their own farms. This in turn would relieve the gazetted forests from the pressure exerted by the local forest communities. However, by assessing the activities taking place at Ruthumbi Forest, one can rightly conclude that, if anything, the pressure has been mounting. Trees have been felled indiscriminately for timber and fencing posts chiefly for commercial purposes. The rural households collect firewood from the forest, and some traders in firewood are felling trees indiscriminately. And now the latest activity that has taken root – felling trees to produce charcoal for commercial purposes. Accompanying the felling of trees is the loss of other forest cover due to cattle grazing. All these activities have led to degradation and deforestation of Ruthumbi forest at unprecedented rate. Worse still, this is what has been happening to all natural forests in Kenya.

This state of affairs can be attributed mainly to two factors: Failure of the administrative authority endowed with the privilege and responsibility of protecting, managing and conserving the resource- the Forest Department- to successfully monitor and enforce the State's forest ownership rights. As a result the forest community considers the forest to be a *de facto* open access resources; and market failures leading to undervaluation of both the benefits of forest ecosystems and the true costs associated with forest exploitation and conversion. If left unchecked, this will impose on, not only the local community but also all Kenyans in general, socio-economic costs and ecological consequences that go with deforestation, degradation and unsustainable use of forests. This would also undermine the very foundation of long-term economic growth and sustainable development and thus deny Kenyans rich and fulfilling lives. Also this destruction has a negative global effect since some benefits traverse national boundaries; that is why forests have been regarded as a global public good.

The recipe for hopefully reversing this situation or more realistically, for slowing down this state of affairs is for the forest community and others contributing to disappearance and

⁷ See the report published in 1983 entitled Proceedings of Agroforestry Workshop for High-Potential Areas in Kenya.

degradation of forests to change their attitudes and existing practices. Moreover, there should be willingness on their part to try new approaches. For this to happen, the policy makers in the government, the forest community and the general public need to be aware of the true benefits of the forest ecosystem, and the costs associated with deforestation and degradation of the forest due to their actions. With the foregoing in view we need to ask these questions: Is the forest community made of rural households aware of the true benefits from Ruthumbi forest? Are they aware of the socio-economic costs and ecological consequences associated with the destruction of the forest? If there were new approaches that could lead to sound management and sustainable use of the forest, would the forest community be willing to accept them? This study has been designed to address these critical issues. We will apply the contingent valuation method (CVM) to among other things, find the value of protecting and preserving Ruthumbi forest. We would like to establish whether the forest community would be willing to pay for protection and preservation of the forest, preferably through establishment of communal ownership and management, an institution that could avert the "tragedy of the open-access".

1.5 Objectives of the study

The broad objective of this study is to provide measures and technologies and to design policies, which, if adopted, would lead to sustainable use, sound management and preservation indigenous (natural) forests in Kenya. However, the specific objectives include: To: -

- i. Analyze the underlying cause(s) of deforestation, degradation and unsustainable use of Ruthumbi forests
- ii. Use the contingent valuation method in finding the value of protecting and preserving the forest and thus to determine whether the forest community is aware of the true benefits associated with forest ecosystems.
- iii. Analyze the determinants of rural households' willingness to pay (WTP) for the protection and preservation of the forest resource.
- iv. Apply contingent valuation results in the analysis of collective action theory to find out whether communal ownership and management of the forest could be successful.
- v. Based on (ii), (iii) and (iv), suggest and recommend policies that would ensure sustainable use, sound management and preservation of indigenous forests in Kenya.

1.6 The hypotheses of the study

For the purpose of stating testable hypotheses, this study will adopt the following two assumptions:

- 1) That due to the 'publicness' of forest ecosystems, the individuals are likely to understate the willingness to pay (WTP) values.
- 2) That rural households' willingness to pay for protection and preservation of the forest is evidence that they are aware of the true benefits from the forest and that this should form the basis for ownership and management of the forest by the community.

Now we are ready to state the hypotheses of this study: -

Hypothesis one

H₀: The local forest community is not aware of the true benefits associated with the forest ecosystem.

H₁: The local forest community is aware of the true benefits associated with the forest ecosystem

Hypothesis two

H₀: There is no significant divergence of WTP from WTAC values

H₁: There is a significant difference between WTP and WTAC values

Hypothesis three

H₀: There is no significant difference between valid and invalid (protest zeros, outliers and missing bids) WTP responses.

H₁: There is a significant difference between valid and invalid WTP responses.

1.7 Justifications and significance of the study

The Kenya's natural forest ecosystem is currently undergoing degradation and destruction at unprecedented rate. This poses a serious threat as it evidently amounts to 'killing the goose that lays the golden egg'. A thick cloak of ignorance surrounds this destruction and degradation of the forests throughout the country, which is amply lined with layers of greed and shortsightedness. If nothing is done sooner than later, the result will be to partly cripple the

prospects for future economic growth and hence sustainable development as these are based on rational and sustainable use of environmental commodities and natural resources.

It is the high time the government, policy makers and the public came to a realization of the true socio-economic costs and ecological catastrophes associated with unsustainable use, destruction and degradation of natural forests. This must be followed by an adoption of better forestry policies if these forests are to enjoy permanent protection, preservation and existence.

This study, which has been designed with the above in view, seeks to find how important these forests are to indigenous communities. In particular, it will be looking for rural households' value of protecting and preserving natural forests. We would like to establish whether the forest community would be willing to pay for protection and preservation of the forest and then come up with policies, which, if they were to be adopted, will lead to protection, sound management and preservation of the entire natural forest ecosystem in Kenya.

1.8 Definition of terms

1.8.1 Forests and forest degradation

Forest refers to any land containing a vegetation association dominated by trees of any size, whether exploitable or not, capable of producing wood or other products, potentially capable of influencing climate, exercising an influence on soil, water regime, and providing habitat for wildlife.

Forest products includes among other things bark, beeswax, honey, fibre, grass, plants, charcoal, timber, sap, seeds, spices, trees, wax.

Indigenous forest means a forest that has come about by natural regeneration of trees indigenous to Kenya, and includes mangrove and bamboo forests.

Forest community means a group of persons who live within a five-kilometre radius of the forest edge

Deforestation in this context will be taken to mean a reduction to any degree, of the crown cover of a natural forest. In some contexts this term has been replaced by forest destruction.

Forest degradation refers to deterioration or changes in the functions that have been originally carried out by a forest ecosystem. For instance, if a natural forest is eventually replaced by a species of eucalyptus trees, then definitely the ecological functions of this forest will be altered. It does not necessarily imply a reduction in forest cover

Protection means keeping away those who are destroying the forest whilst *preservation* is ensuring continued and permanent existence of the forest.

1.8.2 Property rights and forest management

Property rights are often referred to as “bundles” of rights concerning use, sale, transfer/alienation, management and exclusion concerning a resource.

Common property will refer to a resource that is held by people in conjunction with each other. It has the property of a public good (as the term is used in economics) as in many people can use the resource at once because exclusion is difficult.

Forest Conservation is wise management and use of natural forests so that they continue to produce sustainable benefits indefinitely.

Sound forest Management means management of forests so as to yield constant or increasing supply of forest products to meet the increasing needs of the present generation without limiting the options of future generations in obtaining such products from the forest.

Sustainability is concerned with knowing what the resource capacity is, and managing the resource to the maximum of that capacity, but not beyond. With regard to environmental resources, sustainability involves using the interest produced by natural capital, but never ‘eating’ into the capital itself.

Sustained yield will be taken to mean a forest production system with a constant or increasing supply of forest product.

Sustainable use means optimal (rational) utilization of natural resources by the present generation to meet their needs without compromising the ability of the future generations to meet their needs. Resources are used in such a way that intergenerational and intragenerational equities are met.

CHAPTER TWO: REVIEW OF THE EXISTING LITERATURE

2.1 Introduction

Several studies have been done on forests but with variability based on the issues addressed. For the purposes of this study, literature on the causes of tropical deforestation and forest degradation, the social and economic consequences of forests loss and contingent valuation (CV) studies on forest ecosystems will be reviewed. Additionally, we will give some consideration to literature on property rights and communal property resources based on the theory of collective action.

2.2 Underlying causes of deforestation and unsustainable use of forests

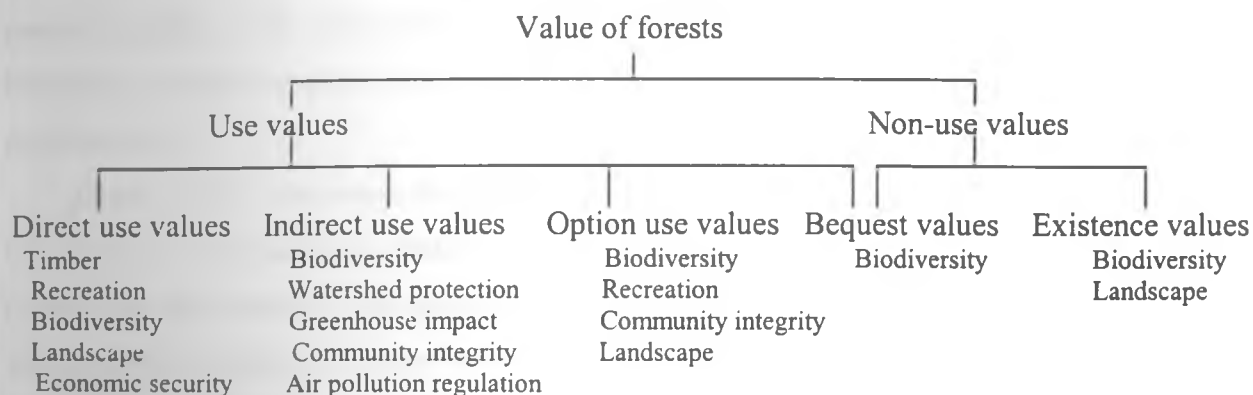
Barbier, Burgess and Markandya (1991) observed that approximately 7.1 million hectares of tropical closed forests were being cleared annually, and they attributed this high rate of exploitation mainly to the fact that those responsible for management and use of tropical forests undervalue many of their functions. Governments often reinforce and even exacerbate these tendencies by exacerbate these tendencies by employing misguided policies and sanctioning inadequate or inappropriate ownership and usufructuary rights to forest resources. They allude to the view that sustainable management of tropical forests is dependent on accounting correctly for all the economic uses of the forests.

Pearce (1991) attributes ignorance of the concept of total economic value (TEV) to deforestation. According to him, the concept of TEV offers a comprehensive framework within which to value tropical forests. Total economic value comprises use values (direct and indirect), option values and existence values. Direct use values include timber, non-timber products and ecotourism. Indirect use values include the ecological functions, namely, watershed protection and mineral cycling. Existence value relates to the value of the forest 'in itself', unrelated to any use. These economic arguments alone could well be sufficient to justify a dramatic reduction on deforestation, without resulting to moral arguments such as conserving tropical forests based on 'rights' in nature. Turner (ed.), 1993 uses Fig. 1 below to show the total economic value of a forest.

In the early 1990s, 12 million hectares of forests (an area about the size of England) were being cleared annually. Whereas in 1950 about 15 percent of the earth was covered by tropical

forest, it had been predicted that by the year 2000, only an estimated 7 percent would still be covered. Besides tropical forest elimination, an estimated 10 million of hectares of mostly tropical forests were being significantly degraded. Hartwick (1992) attributes this tropical forest depletion to underpriced trees, even in cases where there is perfect and very long-term property rights for landowners for cutters value the trees for their lumber content alone. After constructing a first best growing economy in which land is being switched continuously from use in forestry to an alternative use (agriculture), he found that implicitly for such activity to take place, there must be no net loss to landowner, which implies no deduction in the national accounts for deforestation. With soil erosion on deforested land, he recommends the levying of Pigouvian taxes in order to sustain a first best.

Fig.1: The total economic value (TEV) of a forest ecosystem.



It is widely observed that population pressure contributes to the deterioration and depletion of important natural resources such as forests in developing countries⁸. Growing population has led to increased search for more fodder and forage for livestock, more fuelwood for cooking, and new lands to farm thereby reducing the forested areas, bringing with it the well known adverse effects of deforestation. According to FAO assessment, the major role in deforestation, as opposed to degradation of forest stands, is assigned to agricultural expansion. This conclusion was arrived based on several comprehensive studies that were done, including Lanly (1982), Bunker (1980), and Plumwood and Routley (1982). However, Repetto and Holmes (1983), after employing simulation analysis and examples, concluded that population growth per se is not the

⁸ See the studies by G.O Barney, ed. 1980; P. Kunstadter, E. Chapman, and S. Sabharie 1978; and the U.S Department of State 1980.

main cause of resource pressures in the Third World. They point to the effects of breakdowns in traditional systems of resource management and the creation of virtual open-access situations; the terms and conditions under which natural resources are being commercially exploited; the importance of export demands arising in the international economy; changes in technological methods of resource extraction and harvest; and the inequality of access to natural resources as the factors operating in conjunction with population growth leading to considerably more rapid deterioration of natural resources in Third World countries. Their analysis further indicates clearly the conditions under which resources are most threatened: when demands, subsistence or commercial, are already large or are becoming large relative to the maximum sustainable yield of the resource; when the regenerative capacity of the resource is relatively low; and when the incentives and restraints facing the exploiters of the resource are such as to induce them to value present gains more highly than future gains. These incentives may arise because of incomplete property rights, as in open-access situations, or because of shortsighted official policies, or because of severe economic want inducing resource users to sacrifice future livelihood to meet present needs.

Godoy (1989) attributes the global destruction of forests to failure by policy people to incorporate all the benefits (both tangible and intangible) in the planning process. Anderson (1989) has demonstrated this observation clearly. By omitting the intangible benefits he was studying, the overall net present value (NPV) was negative. However, by incorporating such benefits from the forest as conservation of biodiversity and recreation, the value became positive. He concludes that when appraising a project, environmental intangible costs and benefits ought to be considered in order to give a more realistic result of its value.

2.3 The contingent valuation method (CVM)

Under this subheading, three categories of literature relating to CVM will be reviewed. The first section will address some theoretical and methodological issues surrounding the use of CVM in valuating environmental commodities. The second section will dwell on the problem of valuing preferences for commodities once CVM has been adopted, that is, whether one should use willingness to pay (WTP) or willingness to accept compensation (WTAC), also known as willingness to accept payment (WTAP), and the last section will comprise literature on CVM studies on forest ecosystems.

2.3.1 The definition and status of CVM

CVM is a survey technique used to elicit from a sample of consumers their WTP and /or WTAC for a change in the level of environmental goods or services in a carefully structured hypothetical market. Maximum WTP and minimum WTAC values are elicited in different ways, but the commonly used hypothetical question simply asks people what value they place on a specified change in an environmental quality or the maximum amount they would be willing to pay to have it occur (in the case of WTP questions). The responses, if truthful, are direct expressions of value. The other main steps involved in a CVM exercise include empirical analysis of responses using econometric techniques, estimating and aggregating benefits (WTP and/or WTAC), and evaluating the CVM exercise.

It is Ciriacy-Wantrup (1947) who first suggested the use of the "direct interview method" to measure the values associated with natural resources, but it was not until 1963 that this method was first applied, when Davis (1963) originally used CVM to estimate the benefits of outdoor recreation. Since then, several theoretical and methodological issues and criticisms have been raised concerning the use of CVM in general in valuation in developing countries in particular. A look at the literature indicates that, at least at a theoretical level, a large number of criticisms, particularly those related to economic theory, are in one way or the other linked with problems in the details of specific studies such as how the questionnaire was prepared and data was collected and analysed.

In a status report on non-market valuation of environmental resources, Smith (1996) wrote: "Contingent valuation seems deceptively simple—just ask people what a specific hypothetical resource change is worth to them and assume they will answer the question in exactly the terms it was asked." He went ahead to summarize four characteristics important to any judgment about CV (contingent valuation) estimates with regards to providing reliable measures of economic values. The standard response of CV skeptics is that hypothetical questions yield hypothetical answers. Writing in 1996, Whittington stated: "ten years ago only a handful of rudimentary contingent valuation studies had been conducted in developing countries; at the time the conventional wisdom was that it simply could not be done. The problems associated with posing hypothetical questions to low income, perhaps illiterate respondents were assumed to be so overwhelming that one should not even try. Today we have come full circles; it is now assumed

by many environmental and resource economists working in developing countries that CV surveys are straightforward and easy to do.”

One major challenge posed by critics of the CVM, which is a stated preference approach has been, however, the use of stated preference as opposed to revealed preference. Hanemann (1994) gives three explanations in response to this criticism, namely; the difficulty of applying revealed preference methods especially to a national public good and when non-use values are expected to be significant; revealed preference methods are also not foolproof; and, observing behaviour and asking about behavioural intentions and motives are not mutually exclusive. Of particular importance is the flexibility of the hypothetical methods. As Sen (1977) has observed, “once we give up the assumption that observing choices is the only source of data on welfare, a whole new world opens up, liberating us from the information shackles of the traditional approach.” Sen (1973) encourages all to take a balanced view of the difficulties regarding each approach when he observes that ‘the thrust of the revealed preference approach has been to undermine thinking as a method of self-knowledge and talking as a method of knowing about others, ending up being too prone, on the one hand, to overstate the difficulties of introspection and communication and, on the other, to underestimate the problems of studying preferences revealed by observed behaviour.’

Following the commissioning of a blue-ribbon panel of experts called the NOAA Panel (co-chaired by Nobel laureates Kenneth Arrow and Robert Solow) by the National Oceanic and Atmospheric Administration of the USA to consider the use of CVM, a qualified support for its use was made. The panel’s report is contained in (Arrow *et al.*, 1993).

However, it is worth noting that the basic concern addressed by measurement theory is the relationship between the observed response and the underlying unobserved “true” value that generated it. The difference between the two is defined as “measurement error”, and our understanding of this relationship in the contingent valuation case is complicated by the fact that as there is usually no external criterion against which we can compare a WTP amount, the “truth” may be inherently unobservable. Nevertheless, each method of valuing the benefits of quasi-private and public goods has particular methodological challenges that its users must address. For a CV study designer or researcher, the principal challenge facing her is to make the scenario sufficiently understandable, plausible, and meaningful to respondents so that they can

and will give valid and reliable values despite their lack of experience with one or more of the scenario's dimensions.

Nevertheless, there are some methodological and theoretical issues related to CV studies that need not be taken for granted. For instance, exclusion of invalid responses, especially protest zeros and outliers may not be random. This implies that the group that is excluded and the one that is not may have a significant difference. Under such a circumstance, discarding invalid responses may lead to sample selection bias with at least two consequences. First, the empirical analysis of the valuation function used to test theoretical validity may give inconsistent parameter estimates. An example of these is found in Amemiya (1985). Second, the estimated benefit measures and thus the aggregated values may also be biased. On top of sample selection bias, Mitchell and Carson (1989) discuss other three issues related to sample design and execution which need to be considered while assessing the viability of benefit aggregation: population choice bias, sampling frame bias, and sample non-response bias.

2.3.2 Willingness to pay versus willingness to accept compensation

Once a researcher has decided to adopt the CV technique, another problem arises-how to value the preferences for environmental commodities. The bottom line of the analysis by Pearce and Markandya (1994) is whether preferences should be measured by WTP or WTAC. They alluded to the fact that the choice of the method should be determined by the choice decision in question. Removal of a bad necessitates the use of willingness to accept compensation (WTAC) whilst the introduction of a good merit the application of willingness to pay (WTP). They used the following illustration to support their claim: supposing a project is to be introduced in an area. If it has adverse effects on local residents they would need to be compensated in some form for their loss in welfare for it to progress. The measure of the minimum compensation that would fully indemnify their welfare loss is the WTAC. However, if the project was socially beneficial and the residents were campaigning to obtain it, the maximum amount each resident pay to express his/her need for the project is termed as WTP.

For quite some time, there used to exist a belief among economists that in most practical situations, the difference between WTP and WTAC was small. Willig (1976) analysed this issue and concluded that in a variety of market situations, the difference would be negligible. Russell (1978) also held the same view, arguing that the difference between WTP and WTAC in

empirical studies is by chance and therefore should not be taken seriously. Nonetheless, from several empirical studies employing both methods of measuring preferences, convincing evidence has been provided to prove that WTP diverges significantly from WTAC (Cheng'ole, 1995).

Theoretically, we expect the two measures to be the same. However, in reality, WTAC is greater than WTP. Some theories and hypotheses have been advanced in order to explain this disparity. They include the rejection of the loss of property rights theory; the cautious consumer hypothesis — there can be risks and uncertainties involved, and; the prospect theory — individuals value losses more than gains. Knetsch (1990) explained the reason for this difference as follows: People tend to overstate what they must receive and understate what they must pay out so as to make a gain.

2.3.3 CVM studies on forest ecosystems

Although the theory of public goods did progress rapidly since Paul Samuelson's seminal article of 1954, the empirical measurement of the value of (demand for) public goods started receiving increased attention only in the 1970s. Organized markets are a major mechanism for identifying the values and preferences of individuals and society and hence in guiding their consumption and investment decisions. However, in the absence of these markets, some mechanisms can be used to reveal preferences of individuals and society for mostly public goods. Perhaps the best known and most widely accepted empirical approach had been the hedonic pricing method, an indirect approach. An alternative approach that is intuitively appealing is use of contingent valuation method- it involves directly asking individuals or households to state their willingness to pay for public goods using survey techniques. The results of using the survey approach for estimating the value of public goods appear to be internally consistent, replicable and consistent with demand theory.

An unfenced forest resource might be called "common-pool" resource-a subset of public goods. As the term is used in economics, public goods have the property that many people can use them at once, because exclusion is difficult, even impossible. Whereas some public goods yield infinite benefits, common-pool resources, by contrast, are public goods with finite, or subtractive, benefits. In the case of forest resources, they are thus potentially subject to depletion and/or degradation (Blomquist and Ostrom 1985; Randall 1983).

As such, several studies have used CVM to determine the value of forest resources. However, there are slight variations in these studies. Some use CVM to value the establishment of community or social forestry in order to reduce pressure on natural forests. Other studies have used CVM to determine the value of tree resources in a natural forest ecosystem. Still, there are those studies that focus specifically on recreation benefits of forests. There is yet another category of CV studies on forests that measure values for preserving or protecting natural forest ecosystems. Respondents are asked to state their willingness to pay towards preservation of forests. We will review some studies on each of these categories, but we shall dwell more on the last category as these types of studies are much closer and related to our study.

In order to examine the determinants of the value of community forestry in rural Ethiopia when the plantations are to be planted, managed and used by the forest communities themselves, Mekonnen (1997) employs CVM and uses discrete question with open-ended follow-up format for value elicitation. He then uses a Tobit model with sample selection in the empirical analysis of the bid function to look into the effect of excluding invalid responses (protest zeros, outliers and missing bids) from the analysis and finds that the exclusion of these responses would lead to sample selection bias. One implication of such bias is that mean WTP values computed using data that does not include households with invalid responses should be adjusted downwards before they are used for benefit aggregation. The analysis of the bid function reveals that household size, household income, distance of homestead to proposed place of plantation, number of trees owned and sex of household head are significant variables that explain WTP. He also found that there are significant differences in WTP across sites, suggesting that Community Afforestation projects should consider household and site-specific factors as determinants of success.

Kohlin (1994) assesses the reliability of CVM in valuing a Social Forestry project in Orissa, India. In the introduction the respondent was asked to consider not only the direct benefits (both final and intermediate) of a new forest plantation but also the reduced time for firewood collection, reduced pressure on the natural forest and alternative use of dung and residues that were previously used as fuels. A bidding game was expected to give compensating variation measure for the complete change in welfare due to a new plantation. Compared with other methods like conventional cost-benefit analysis (CBA) and the revealed opportunity cost of time, and considering that he was asking for the total value, the figures he got seemed rather low.

He attributes the main cause for this to be strategic bias, even though this was not revealed in the follow-up question that required the respondents to state why they would not pay the amount of money required for planting a social forestry project. They said they were 'too poor' rather than that 'the government should pay'. Another downward bias could be that they were cash-constrained for the payment would be a lump sum today. Alternatives would be to ask for yearly (or monthly) payments, or that they would give up a certain sum when the plantation is harvested. In fact, the provision to restate the bids in terms of labour days generally gave a substantially higher WTP. He concludes that it is possible to apply CVM to estimate benefits in forestry projects in developing countries. However, he notes that there are problems in eliciting individual values of a resource that is managed by the community but still, more such applications would indeed be worthwhile especially in valuing the indirect effects on nearby natural forests.

Lyman *et al* (1994) uses CVM to determine the value of tree resources to smallholder farmers in Zimbabwe. According to his findings, the farmers valued direct inputs to the household (fuel and materials) most, then inputs to other production activities (crop and animal production), then ecological services, food and shade, and lastly, cash income, health and social services. The value of tree resources could be between 12 and 160 per cent of the annual household incomes derived from off-farm employment and agricultural production. Further, the values of farmers obtained in the survey reflect the relative scarcity of tree resources with these values being higher in areas with low tree cover than in those with high tree cover. Tests of validity indicates that survey results were valid reflections of the values of smallholder farmers for the tree resources to which they have access, and they conclude that the use of contingent valuation methods for valuing common access resources in the smallholder farming sector can produce valid and reliable results. These methods may provide the only means for determining the value for common access resources where scarcity of accurate production and consumption data as well as the non-market nature of some of the commodities precludes the more conventional valuation approaches. Non-market goods and services such as ecological services, social services and shade comprise a significant proportion of the total value, to smallholder households, of the goods and services provided by tree resources.

Cheng'ole (1995) used CVM to find the economic value of Karura Forest (Kenya) as a recreation site. He found that the WTP to gain access to the forest as a site for recreation to be

KSh. 233, whilst WTAP to forego the use of the site to be KSh. 131,917. He noted that the value of the forest as a recreational site depends on the method of valuation used to estimate benefits and costs, further pointing out that other benefits of the forest resource like soil erosion control and regulation of carbon dioxide in the atmosphere need also to be incorporated in such analyses to obtain a fair value of the multiple use of forestry. Since the net value of the demand for recreation at the forest was significant, he suggest the need for the government to properly conserve and manage the forest so as to maximize the welfare of the visitors using the resource either directly or indirectly.

Kramer *et al.* (1994) applied contingent valuation method to measure the willingness to pay of US residents for preserving a portion of the world's tropical forest considered as a global environmental good. Focus group discussions were used to identify the final good: creation of parks and reserves to protect 110 million acres (or 5 %) of the remaining rain forests (in addition to the 5 % already preserved). The payment vehicle was an hypothetical UN Save the Rain Forests Fund. The survey was mailed to a random sample of 1200 US residents. The respondents had also been asked to rank 7 major environmental problems on a scale of 1 to 7 with 1 being the most important. Air pollution received the highest ranking whereas tropical deforestation was ranked 5th. Both payment card and referendum models were estimated using maximum likelihood. The parameter estimate for income was significant and positive in both models. Household size too was significant; however, it was positive for payment for payment card model and negative for the referendum. The dummy variable capturing the ranking given to tropical deforestation compared with other environmental problems revealed that the more the more important the ranking, the higher the willingness to pay in the payment card model. However, the importance given to the cutting of old-growth forests in the Northwest US had the opposite effect in the referendum model. They gave the possible explanation to be: people who are concerned about old-growth forests in the US may have more of national focus and be less concerned about tropical forests, and hence have a lower propensity to pay for protection in the tropics. The referendum and the payment formats yielded a mean willingness to pay of \$ 24 and \$ 31 per household respectively. They concluded that US residents are able to respond to valuation questions about the value of tropical rainforest protection and to give consistent responses across two different CV formats.

Kramer *et al* (1994) adopted CVM and then employed willingness to accept payment (WTAP) to estimate the value of preservation of a forest for recreation among other uses in Madagascar. They estimated the net value of the forest to be \$ 100 per person. In a follow up, Kramer *et al* (1995) did an extensive study of Mantadia National Park in Madagascar and found that villagers would lose around US \$ 91 per household per year from foregone forest products (rice, firewood, crayfish etc.) Tobias and Mendelsohn (1991), using CVM, found values of recreation demand of the forest they were studying to be \$ 35 per person. Further, they estimated the net return of the forest to be \$1,250 per hectare per annum.

Hanley and Ruffell (1991) sought to place economic values on the characteristics of several public forests in UK. Three approaches for valuing were used, among them the conventional CVM bid curve approach. The respondents included visitors to the forest for recreational purposes. They were asked to state the most they would be willing to pay per visit in case the visitors were to be charged an entrance fee. The valuation question, which was designed to give a reason for payment being required, too sought an estimate of user option price (option use value) of the forest. Zero bids were recorded as either protests or genuine zeros, depending on the motive given. Total protests were 7.5 percent of all bids, and included responses like: impossibility of charging for access; should be free — public have right to access; object to specific payment mechanism; and unfair for poor people. WTP bids were hypothesized to depend on socio-economic characteristics of respondents (age, income, education), preferences of respondents, the respondents' purpose of visit and purpose of characteristics. Moreover, they specified dummy variables to control for weather conditions when the WTP option price question was asked.

In the estimation of the bid curve, both ordinary least squares (OLS) and maximum likelihood (ML) results were sought for comparison, with the ML estimates reflecting truncation at zero and the error lower truncated normal. The ML results indicate that WTP is highly positively related to income, and significantly but negatively related to respondents' age. Among the forest characteristics that significantly influenced WTP include the mean height of the forest cover for various sites and surveyors' rating of views and visitor facilities. All significantly increase WTP. Reasons for the visit and conditions under which the study was performed were also significant.

Walsh *et al* (1984) applied CVM to measure the option, existence, bequest as well as recreation values of wilderness (of course forests are part of wilderness). They conducted a mail survey of Colorado residents in 1980 where households were asked to state their annual willingness to pay into a fund for continued existence of various sizes of wilderness. Following this question they asked what percent of their WTP was for recreation use that year, maintaining the plants, fish and wildlife, and finally, knowing that future generations would have wilderness areas. They found that the WTP per household head and in aggregate increases with the number of acres protected, but at a decreasing rate due to diminishing marginal rate of substitution. Option, existence and bequest values represent about half the total economic value (TEV) of the wilderness. The present value per acre of wilderness ranged from a high of \$ 1246 per acre for 1.2 million acres to \$ 220 per acre when 5-10 million acres was to be preserved.

Pop and Jones (1990) conducted a study on the benefits of wilderness preservation in Utah. They conducted telephone interviews of Utah households regarding designation of alternative quantities of Bureau Land Management (BLM) land as wilderness. They obtained a 62 percent participation of households contacted. They obtained results that illustrated a pattern of willingness to pay rising at a decreasing rate for increased acreage designated.

Another wilderness preservation study was conducted by Gilbert *et al* (1992) to value the Lye Brook wilderness area and other wilderness areas in the New England region of the US. Two versions of a mail questionnaire were mailed to separate samples of Vermont residents. One version of the questionnaires asked respondents to value continued protection and management of the Lye Brook wilderness area; the other asked them to value protection of all wilderness areas east of the Mississippi River. For residents who had never visited any wilderness areas in the east, their willingness to pay for Lye Brook averaged \$ 8. The separate sample of non-visiting households valued preservation of the entire eastern wilderness at \$ 6. In contrast, the two separate samples of those households who had visited the eastern wilderness gave an annual total value of \$ 9.21 and \$ 14.28 for the Lye Brook and the entire eastern wilderness respectively. This latter group therefore did not exhibit embedding or scope problems mainly encountered in CV studies. The study further showed that passive use values form the largest component of total economic value of the wilderness.

Lockwood *et al* (1993) performed a CV exercise to estimate the value of placing forest lands off limits to logging in national parks. The study focused on the preservation of wet and

dry eucalyptus forests on the Errinundra Plateau in Victoria and New South Wales states of Australia. A mail survey of households in the two states was sent out asking the respondents their willingness to pay to preserve about 100000 hectares of old-growth forests. The survey had a response rate of 65 percent. Dichotomous choice value-elicitation format was used. They found the mean willingness to pay to be \$ 52 per household. The distribution of total economic value was dominated by existence and bequest values. This illustrates the importance of including these values in economic analyses of forest allocation decisions.

Still, there are benefits of preserving old growth forests and the dependent wildlife. That is why some studies have presented the total economic value of preserving old-growth forests as the value for preserving habitat for endangered species. Such a study was carried out by Hagen *et al* (1992) who used the northern spotted owl as a species to serve as an indicator for old-growth forests. In some sense, willingness to pay for preventing the extinction of the endangered northern spotted owl was to be viewed as willingness to pay for preservation of old-growth since it is their natural habitat. They used a mail survey of a random sample of US households. They also presented a map showing the approximately 7 million acre Habitat Conservation Areas recommended by the US Scientific Committee. Adoption of these old-growth protected areas was suggested as a means of preventing the extinction of the northern spotted owls that were an endangered species. Their CVM exercise used the voter referendum approach with higher taxes and wood product prices being the payment vehicle (means of payment). Their results indicate that households were willing to pay an average of 189 dollars.

Measurement of passive use values from keeping forests healthy is yet another way the value of preserving a forest could be determined. Haefele *et al* (1992) used this approach when they sought to get willingness to pay to reduce losses of red and Fraser fir trees from insects and air pollution. They conducted a mail survey of North Carolina residents. Respondents were first shown photos and provided with pie charts of alternative forest conditions. They were then asked two willingness to pay questions: (i) annual willingness to pay to provide protection programmes for spruce-fir forests along roads and trails in the southern Appalachian mountain (representing about one-third of the remaining forest area); (ii) annual willingness to pay to provide protection for all spruce- fir forests in the southern Appalachian mountains. In eliciting value, both payment card and dichotomous choice techniques were used. The total economic value for the first question was \$ 58 whilst for the second was \$ 98. In addition they asked respondents to partition

their bids into recreation, existence and bequests value. The results showed that well over 80 percent of the total economic value (benefits) is related to existence and bequest values for both valuation questions.

Echeverria *et al* (1995) also uses the contingent valuation technique to value non-priced amenities provided by the biological resources within the Montverde Cloud Forest Preserve. Respondents were required to state the amount of money they would be willing to pay to support an institutional arrangement that would end up preserving the reserve and thus guarantee its continued existence. He got reliable and consistent results.

Epp and Gripp (1992) surveyed Pennsylvania residents and applied the contingent valuation method to estimate the mean households' willingness to pay to protect all remaining tropical forests in the world. They surveyed many of the households 10 months later to examine the stability of preferences and reliability of contingent valuation estimates. Though they did not report the mean bids, they were able to conclude that respondents gave similar answers to each round of the survey.

2.4 Property rights and common property resources

Many theorists on property rights argue that common property resources will be overexploited as demand rises, so only private enclosure or state regulation stands a chance of preventing such a result. Likewise, many writers on collective action argue that people in a situation in which all could benefit from cooperation will be unlikely to cooperate without an external agent to enforce agreements. In his influential paper on the development of private property rights, Demsetz (1967) holds the view shared by many others (North and Thomas 1977; Johnson 1972; Picardi and Siefert 1976) that users of communally owned resource will fail to come to an agreement on managing the resource even though it is in the interest of all users to co-operate and reduce their rates of use of the resource. He develops his argument by giving a classical example of a land that is communally owned. The reason for failure to agree is that if an improved situation is attained, every user will earn even higher returns by free-riding on the virtuous behaviour of the remaining co-operators. As a result, united action on the part of the users can be expected to be unstable; co-operative agreements, even if they are reached, will not persist. The only way out of the common property dilemma, as Demsetz makes clear, is intervention by the state, the courts or the leaders of the community. This intervention manifests

itself through the development of full private property rights. Still, there exists another school of thought that believes it is essential to give an external agency—usually the state—the full authority to regulate the commons (Carruthers and Stoner 1981; Hardin 1976)

One of the theories that have generated pessimism about the viability of collective action is Mancur Olson's "logic of collective action". His core proposition is this: "unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests" (Olson 1971). In the observation of Wade (1987), this theorem says that (i) voluntary collective action will not produce public goods, and (ii) collective action based on selective (that is, excludable) penalties or rewards may produce public goods. Existing cases of common interest groups are thus to be explained by selective punishments or inducements.

Clearly there can be no general presumption that collective action rather than privatization or state regulation will work, especially if one assessed the frequency of degraded grazing commons, despoiled forests, overexploited groundwater, and depleted fisheries. However, there are many examples of villagers (or rural households) collectively managing property for long periods, and with great success. Some of these examples are cited below.

Robert Netting (1981) has described how Swiss villagers have, for at least the last 700 years, continuously used their communally held and managed alpine environment, subject to all the dangers of deforestation and erosion of other mountain regions, without any deterioration whatever, through a combination of land use and demographic constraints. Moreover, in early 1980s, there were still over 3 million hectares of village commons in Japan that had been successfully managed by the villages collectively for over 350 years, and McKean (1982), in his study regarding these "commons" reported that while some villages had sold off their lands for golf courses and shopping malls, she had never heard of one village, out of 70,000, that allowed its common land to be seriously degraded through over-exploitation.

After analyzing forty-one villages in South India (Kurnool district, Andhra Pradesh), thirty-one of which are irrigated from one or another of two large canal systems, while the other ten are dry, Wade (1985) found that despite the controversial view, to the contrary, a significant number of these village do provide public goods and services through local arrangements that have nothing to do with outside bodies, whether governments or voluntary agencies. A public or

collective good is provided when action by more than one person intended to achieve a common goal or satisfy a common interest is accomplished.

The most promising experiment with decentralized, community-based resource management is found in Zimbabwe. Before the scheme for wildlife to be managed by village committees, tagged the Communal Areas Management Programme For Indigenous Resources (CAMPFIRE)⁹, was launched in 1980s, skyrocketing numbers of villagers were clearing bush, an habitat for wildlife, to grow food and raise cattle. For villagers struggling to survive, the animals were dangerous pests (since they attacked people and livestock) as well as sources of food. The scheme required farmers to manage wildlife as livestock, which meant not hunting the animals but guarding them from poachers, looking after them like cattle, and harvesting a few every year as a farmer does. These animals could be sold to rich people who would pay the farmers money to hunt for them. Skeptics warned that farmers would shoot every animal on sight for a quick buck, but the very opposite happened. For decades, the cornerstone of conservation had been the principle of protecting wildlife from humans. In contrast, CAMPFIRE built on the logic of "sustainable use", that people would use wildlife with common sense if they had incentive to do so. The revenues generated were invested in various development projects like the building of schools, shopping and health centers. Word of CAMPFIRE's success spread through Zimbabwe and by the end of 1997, 36 of the country's 57 districts had adopted the scheme. Out of an escalating ecological disaster, CAMPFIRE created a win-win situation. The people won and the habitat too, and therefore the animals flourished.

It is widely believed, due in large part to Garrett Hardin's (1968) essay on "The tragedy of the commons," that traditional communal forms of resource management have been unstable and inefficient, tending toward ecological collapse under internal population pressure. However, this view is held out of the confusion that exists between common property and open-access resource, as Ciriacy-Wantrup (1975) has pointed out. Traditional communal systems usually limited access to the resource to members of the group or invitees, and, through social mechanisms, maintained internal controls over the use of the resource. They dealt successfully, and, within the limit of technology, efficiently, with fragile environments, whether they were mountains, tropical forests, or semiarid savannas.

⁹ See the article *From poachers to Protectors* by John Dyson in the July 1998 issue of Reader's Digest. Also see Murphee (1991)

Repetto and Holmes (1983) observed that if there was a true "tragedy of the commons", it is that these traditional systems of resource management were weakened or destroyed. In many areas, the impact of national governments has been to convert resources that were under effective communal management into virtually open-access resources, with open-access conditions leading to stock depletion unless demands on the resource are small. For instance, forested areas in developing countries have been taken over mostly by national governments or their agencies, overriding the rights of indigenous populations. Indeed, 70 to 80 percent of tropical forests are state-owned¹⁰. Though nominally controlled, these 'protected' or 'reserved' forests have become virtually open-access resources for large- and small-scale exploitation, because the responsible forestry agencies have not been able to provide effective management¹¹. In conclusion, they observe that traditional systems of resource management have been undermined along with the power and social organization of indigenous communities. At a minimum, this has made the resource base more vulnerable to the pressures of an increasing population. In some areas, stable traditional systems have been replaced with clearly unsustainable and largely unmanaged exploitation.

2.5 Overview of the literature

Forests do have a wide variety of market and non-market benefits that individuals derive through consumptive or non-consumptive uses. Benefits accruing from consumptive use include timber, fuelwood, medicinal and pharmaceutical products, and forage. Benefits such as recreation, ecotourism, protection of critical watersheds, carbon sequestration and climate regulation accrue through non-consumptive use. All these uses amount to the value of a natural forest, otherwise classified into timber and non-timber values. Non-timber values include extractive, non-extractive and preservation values - by which we mean passive or non-use value.

Those tremendous benefits notwithstanding, the literature review above reveals that forests have been undergoing destruction and degradation at unprecedented rate. Market failures that undervalue these benefits is identified as the major underlying cause. Following this, many contingent valuation studies have been conducted seeking to value the benefits from forests. Though with some variability in design and implementation, the general results indicate that individuals and households as well are willing to pay for the protection and preservation of

¹⁰ See also Lanly, 1982 cited before.

¹¹ See also J. Thompson in Michael Glantz, ed. (1977).

where Y is a vector of willingness to pay which is censored at 0; X is a matrix of explanatory variables that are hypothesized to influence the willingness to pay; Z is a vector of a dummy variable which is 1 if the observation has a valid response and 0 otherwise; V is a matrix of explanatory variables which may influence the probability of giving a valid (invalid) response; α and β are vectors of unknown parameters to be estimated corresponding, respectively, to the matrices of explanatory variables V and X ; ε and μ are disturbances which could be correlated with correlation coefficient ρ ; and Y^* and Z^* are latent variables corresponding to Y and Z respectively. Note that values of Y and X are only observed when Z equal to 1. Whether or not there is selection bias depends on whether or not there is a significant correlation between the error terms of equations [3.6] and [3.7] as measured by the estimates of ρ and its standard error. In other words, if after estimation ρ is found to be significant, then this will have the implication that exclusion of invalid responses would lead to sample selection bias.

The Tobit specification represented by equation [3.6] implies that the left hand side variable takes on zero values in addition to positive ones, and its likelihood function is shown below.

$$L = \prod_{y \leq 0} \left[1 - \Phi \left(\frac{X\beta}{\sigma} \right) \right] \prod_{y > 0} \frac{1}{(2\pi\sigma^2)^{1/2}} \exp \left[-\frac{1}{2} \frac{(Y - X\beta)^2}{\sigma^2} \right] \quad [3.8]$$

Taking logs, we get:

$$L = \sum_{y \leq 0} \ln \left[1 - \Phi \left(\frac{X\beta}{\sigma} \right) \right] + \sum_{y > 0} \left[\ln \frac{1}{(2\pi\sigma^2)^{1/2}} - \frac{1}{2} \frac{(Y - X\beta)^2}{\sigma^2} \right] \quad [3.9]$$

The first part resembles a probit model where the observed dependent variable Y , takes on the values either 0 or 1, with a normal distribution of the disturbance term. In our case 0 will represent invalid responses whilst 1 will be for valid responses. The second part of the likelihood function is a resemblance of the conventional ordinary least squares (OLS) on those sample points that are not censored. In our analysis of censored data, maximum likelihood will be used for estimation.

Assuming normality, the probability density function for a positive value of Y is given by:

$$(2\pi\sigma^2)^{-1/2} \exp[-Y(-X\beta)^2 / 2\sigma^2] = \sigma^{-1} f(u) \quad [3.10]$$

natural forests. This willingness to pay has been termed as the value of protecting and preserving a natural forest, which in principle is the value of the forest itself.

The discussion on common property resources has further revealed that communal ownership and management of certain resources is in most cases stable and sustainable. A natural or indigenous forest is an example of such resources. The taking over of forested areas in developing countries mostly by national governments or their agencies has not only overridden the rights of indigenous populations but has also subjected the forests into destruction and degradation. Though nominally controlled, these 'protected' or 'reserved' forests have become virtually open-access resources for large- and small-scale exploitation, because the responsible forestry agencies have not been able to provide effective management. This is exactly what has happened to Kenya's indigenous forests.

This study holds the view that natural forests owned by state could be managed sustainably if the government transferred ownership to local forest communities through creation of common property rights and thereby enjoy permanent preservation and continued existence. Since this study will use contingent valuation method to value protection and preservation of a natural forest, we intend to ask households' willingness to pay for establishment communal ownership and management of the forest. The whole idea here is to operationalise the theory of collective action using contingent valuation method to find out whether this stable and sustainable institutional arrangement could be applicable in the case of Kenya's indigenous forests.

CHAPTER THREE: THEORETICAL FRAMEWORK AND RESEARCH METHODOLOGY

3.1 Theoretical framework

Under this section, we first elucidate on a particular ad hoc structure onto which valuation of environmental commodities in general is typically based. Further, we will give a specific note on the conceptual framework for valuing protection and preservation of natural forests. Then the second part will deal with the theoretical underpinnings of property rights creation as a policy instrument.

3.1.1 Theoretical framework for valuing environmental amenities

By using a set of questions to obtain bids from individuals that would represent their maximum willingness to pay for a non-market commodity, the user of contingent valuation technique attempts to reveal individuals' preferences over these commodities. The consumer of non-market commodities in these studies is viewed as a utility maximizer, who combines purchase of private goods (and use of public goods), constrained by a household technology, to produce a set of desired characteristics.

A general modeling structure must include the possibility of individual (or precisely, consumer) substitution across activities and locations; and site- or activity-specific levels of environmental quality. Individual utility is thus specified as a function of levels of activities, $A_1, \dots, A_i, \dots, A_n$; as a function of a composite commodity X , "unaffected" by activity-specific environmental quality; and, (where the subscripts denote different activities) as a function of environmental quality for each activity, $Q_1, \dots, Q_i, \dots, Q_n$, where we take the increases in Q_i as increasing environmental quality. We can allow possibly different environmental quality levels both by varying Q_i for a specific activity A_i , which can occur over many sites, or by defining a site-specific activity, in which case different Q_i 's are associated with different sites. Utility is then a quasi-concave function,

$$U = u(A_1, \dots, A_n; Q_1, \dots, Q_n; X) \quad [3.1]$$

where $U / A_i = U_{A_i}^i \geq 0$, $\partial U / \partial Q_i = U_{Q_i}^i \geq 0$ and $\partial U / \partial X = U_x \geq 0$.

Therefore, utility is increasing in A_i , Q_i , and X , and this kind of utility function helps us to focus on the *form* of an individual's marginal willingness to pay for environmental quality.

The budget constraint necessary to specify the consumer's optimization problem is given

by:

$$Y - \sum_{i=1}^n P_i A_i - X \geq 0 \quad [3.2]$$

That is, income Y minus the sum of expenditures on activities, $\sum_{i=1}^n P_i A_i$

P_i is taken as the price of activity i , which may, in fact, represent joint consumption of several market commodities; for example, activities might include driving to work, recreating, shopping, etc.) minus expenditures for the composite commodity X (price for X is taken as unity to simplify the analysis) must be nonnegative.

For a given vector of environmental quality, the household will then choose to allocate activities such that [3.1] is maximized subject to [3.2]. This in turn implies that:

$$\frac{U_A^i}{U_X} \leq P_i, \left(\frac{U_A^i}{U_X} - P_i \right) \cdot A_i = 0, A_i \geq 0; i = 1, 2, \dots, n \quad [3.3]$$

or the marginal rate of substitution between activity i and the composite commodity X equals the price of activity i , if that activity is chosen ($A_i > 0$). We, of course, assume $X > 0$.

To determine the marginal willingness to pay for environmental quality for a particular activity, for example $i=1$, we set utility as given in equation [1] equal to a constant and totally differentiate the resulting expression. By then taking the total differential of equation [2], setting $dQ_i=0$ for all $i \neq 1$, $dP_i=0$ for all i , and by using [3.3] we obtain:

$$\frac{U_Q^1}{U_X} = - \frac{dY}{dQ_1} \quad [3.4]$$

as the change in income necessary to offset a change in environmental quality for activity

¹² This is equivalent to the compensating variation measure of consumer surplus where the initial level of utility is maintained. See for example Mishan (1971)

If the objective is to determine the marginal willingness to pay for environmental quality (U^i_q/U_x), one obvious approach is to simply postulate in a survey questionnaire that Q_1 increases by a small amount, dQ_1 , where market prices are hypothetically held constant, and then request information on the contingent willingness to give up income for an increase in quality (dY would be negative in this case). A second approach, and which forms the core of empirical work on CVM, is to actually assume that prices of activities do not change in response to a change in environmental quality. In that case the marginal willingness to pay can be determined by again setting utility in equation [1] equal to a constant, and totally differentiating the resulting expression by using equation [3.3] and by assuming $dQ_i=0$ for all i , to obtain:

$$\frac{U^i_q}{U_x} = - \left(\sum_{i=1}^n P_i \frac{d A_i}{d Q_i} + \frac{dX}{dQ_i} \right) \quad [3.5]$$

Where prices are known, an estimate of the value of environmental quality can then be obtained empirically by collecting data on dA_i/dQ_i , the compensated change in the pattern of, for example, recreation activities in response to a change in quality, and on dX/dQ_i , the compensated change in expenditures not related to recreation activities. That is, the marginal willingness to pay is imputed from these data. Note that here we assume that Q_1 is tied to a specific recreation site. Of course, the change in environmental quality can be hypothetical resulting in contingent changes in activities, or actual cross-sectional or time series data can be employed where environmental quality varies over space or time (Schulze, d'Arge and Brookshire, 1981).

Valuing protection and preservation of natural forests

The empirical efforts to value protection and preservation of natural forests are based on welfare concepts of environmental economics. A fundamental assumption of environmental economics is that the neoclassical concept of economic value based on utility maximization behaviour can be extended to non-market goods such as environmental commodities. In particular, an individual or a household should demand greater or lesser quantities of an environmental commodity if a variable price for the commodity exists (Kramer *et al.* 1994).

In operationalizing these principles in valuation of protection and preservation of natural forests, we assume that households maximize utility subject to income constraint by choosing a

bundle of market and non-market goods. If one of the non-market goods is a public good known as natural forest protection and preservation, then willingness to pay will be a function of the price of natural forest protection and preservation, prices of other non-market goods, prices of market goods, income and household tastes. We then hypothesize that these tastes will be conditioned by a variety of socio-economic characteristics including household size, age, education level and environmental attitudes. A set of questions is then used in the contingent valuation method to obtain households' willingness to pay bids that would represent their maximum price for the natural forest protection and preservation.

3.1.2 Theoretical basis for property rights

The evolution of property rights is closely linked to the development of various types of scarcity, and the assignment of new types of property right is the ultimate policy "instrument" of natural resource or environmental management. One can alter property rights among individuals or groups to accomplish a certain desired end (Bromley, 1991). In essence, environmental policy is concerned with altering actual or presumed property rights among independent agents. On a continuum of property rights, exclusive possession (freehold) is at one end and no property at the other, as in the case of atmosphere. In between lies common property, where the rights to exploit a resource are held by people in conjunction with each other (Wade, 1987). This category of property rights has important implications on the welfare of poor people, especially in many developing countries (Ostrom, 1990).

Creation of common property rights may be a superior form of institution to private rights regime and/or government regulation in certain conditions, especially in cases where technological factors favour productivity of common property management. Common property resources (CPRs) such as the traditional commons can be analysed in terms of the Prisoner's Dilemma game. Notice that there are externalities in both directions so construed that cooperation produces a form of public good that both parties have a common interest in protecting (as long as the other does). Individually, however, both appear to gain by defecting from this common strategy. The following simple example demonstrates this dilemma.

	A plays a1 ("cheat")	A plays a2 ("collaborate")
B plays b1 ("cheat")	(0, 0)	(11, -1)
B plays b2 ("collaborate")	(-1, 11)	(10, 10)

It is a game that clearly illustrates the dilemmas involved in the management of CPRs.

Several ways out of prisoner's dilemma have been postulated. One line of analysis emphasizes the distinction between playing a game once and playing it repeatedly. Another emphasizes the costs of control and punishment. This amounts to state intervention. Supposing the state puts a "tax" penalty of say, 2 dollars on cheating. The above prisoner's dilemma problem becomes:

	A plays a1 ("cheat")	A plays a2 ("collaborate")
B plays b1 ("cheat")	(-2, -2)	(9, -1)
B plays b2 ("collaborate")	(-1, 9)	(10, 10)

In this case, there is no incentive to cheat. However, the trouble with this is that for the state to exercise effective control, it will need, among other things, information, which is neither costless nor perfect. An unfortunate but unlikely outcome is that the state controller starts fining the wrong people at the wrong time, creating havoc with the common property resource (CPR) being analysed. Local people will then be worse off than before. The natural conclusion is that privatization is the only solution. However, some ecological settings are such that the transactions costs associated with private property are greater than the potential benefits. This therefore takes us to the third alternative – the cooperative management of CPRs with local, cooperative enforcement. The cost of this enforcement is often lower than for state-enforcement and the judgement of the carrying capacity as well as of infringements etc is likely to be more accurate and appropriate. These explain some of the advantages of this system. Local authority when exercised by peers has more legitimacy than the kind of control exercised by state authorities. CPRs management inherently involves a cultural setting, which is much better modeled as a repeated game and hence it turns out to be profitable for the players to "invest" in such "assets" as reputation, good relationships with neighbours and the build-up of collective institutions (Sterner, forthcoming).

Wade and Ostrom suggest a number of conditions essential for a collective action to be stable and successful. In particular, Wade (1987) noted that the likelihood of successful collective action depends on the following:

- 1) *Resources*. The smaller and more clearly defined the boundaries of the common resources, the greater the chances of success.

- 2) *Technology*. The higher the costs of exclusion technology (such as fencing), the better the chances of success.
- 3) *Relation between resources and users*. Greater overlap between the location of the CPRs and the residence of users, greater demands (up to a limit) of the resource, higher vitality of the resource for survival, and users' increased knowledge about sustainable yield all increase the chances of success.
- 4) *Characteristics of users*. A smaller number of users increase the chances of success. However, there is a minimum below which the tasks able to be performed by such a small group cease to be meaningful. With more clearly defined boundaries of the group, more developed arrangements for discussing common problems, and people's increased concern about their reputations, the chances of success are greatly boosted. Moreover, the more powerful are those who benefit from retaining the commons and the weaker are those who favor enclosing private property, the greater the success rate.
- 5) *Noticeability*. The more noticeable is cheating on agreements, the better the chances of success. Noticeability is a function partly of how clearly defined are the resource boundaries, how near they are to users' residences, and how large is the group of users.
- 6) *Relation between users and the state*. The less the state can or wishes to undermine locally based authorities and the less it can enforce private property rights properly, the better the chances of success.

Ostrom's (1990) conditions essential for stable CPRs are similar to those listed above and they include:

- 1) Clear boundaries and exclusion of outsiders
- 2) Adaptation of provision and appropriation rules to site specific situation
- 3) Participatory (Democratic) decision-making
- 4) Monitoring by agents designed locally
- 5) The existence of some form of local court or other conflict-resolution arena
- 6) Use of graduated sanctions for infringements, and
- 7) Respect for the CPR institutions by outside government

As the list implies, there can be no presumption that collective action will generally work – any more than there can be presumption that private property or state regulation will generally

work. What is advanced, particularly by Wade, is the argument that (a) the propensity to descend into anarchy or destruction is neither as strong nor as general as mainstream collective action theory implies and (b) that where the circumstances look promising for collective action, government officials should treat this option as seriously as the other two. It is worth to note that CPR is an environmental policy instrument that is, by definition, mainly operative at the local level. However, the central government (and the local government as the case may be) does have an important role to play. If the central government is prepared to accept the autonomy implied by CPR management, it can often benefit from the good management these can provide. The most important help the central authorities can give is often just to provide the necessary legitimacy and to avoid interfering too much.

3.2 Empirical model specification

In order to analyse empirically the determinants of willingness to pay (WTP), the model to be estimated typically uses WTP values as the dependent variable. The willingness to pay is a function of variables expected or assumed to be the influence it. Since the WTP question was to ask whether the respondent would be willing to contribute money towards the preservation of the forest through the establishment of communal ownership and management, we expected to get invalid responses particularly of protest zero type. As invalid responses should be excluded in estimation procedures and since there could be a significant difference between valid and invalid responses, we expect to encounter the problem of sample selection bias. Thus, a Tobit model with sample selection (Greene, 1995) will be used, which, on top of enabling us to do a rigorous examination of whether or not this difference is significant, will enhance our analysis of the determinants of WTP. In addition, this type of model corrects for sample selection bias.

Below is the specification of the form this Tobit model will take:

$$\begin{aligned}
 Y^* &= X'\beta + \epsilon \\
 Y &= 0 \text{ if } Y^* \leq 0; Y = Y^* \text{ otherwise}
 \end{aligned}
 \tag{3.6}$$

$$\begin{aligned}
 Z^* &= V'\alpha + \mu \\
 Z &= 1 \text{ if } Z^* > 0 \\
 \text{and } Z &= 0 \text{ if } Z^* \leq 0
 \end{aligned}
 \tag{3.7}$$

where u is a standard normal variate, and $u = (Y - X\beta)/\sigma$

The probability of a zero value of Y depends on the value of $X\beta$ and is given by:

$$\Pr\{\varepsilon < -X\beta\} = \Pr\{\varepsilon/\sigma < -X(\beta/\sigma)\} = F(-X(\beta/\sigma)) \quad [3.11]$$

The likelihood for the whole sample is then:

$$L = \left[\prod_1 \sigma^{-1} f(u) \right] \left[\prod_0 F(-X(\beta/\sigma)) \right] \quad [3.12]$$

where the first and the second products refer to positive and zero values of Y respectively. This is maximized with respect to β and σ using non-linear methods with the resulting maximum likelihood estimates being consistent and efficient. Moreover, the information matrix obtained from maximum likelihood estimation provides the estimated variances from which the usual tests on the parameters may be constructed.

3.3 The specific estimation equations

The factors thought, a priori, to influence household's willingness to pay are represented by vector X in equation [3.6] and are thus defined as follows in the case our study:

- HY = Monthly household income.
- DK = Distance of homestead to forest
- AG = Age of an individual.
- HS = Size of a household
- YE = Years of formal education
- MS = Marital status of the respondent
- SX = Sex of the respondent
- HH = Household headship
- RD = Rate of deforestation

where some of the variables take the values shown below:

- MS: 0 if single (NMR)
- 1 if married (MRD)

- SX:** 0 if female (FEM)
1 if male (ML)
- HH:** 0 if non-household head (NHH)
1 if household head (HHH)
- RD:** 0 if no deforestation
1 if low rate of deforestation
2 if high rate of deforestation

Based on the Tobit specification represented in equations [3.6] and [3.7] above, two estimation equations are required, and are thus specified below:

$$BWTP = \alpha_0 + \alpha_1 HY + \alpha_2 DK + \alpha_3 AG + \alpha_4 HS + \alpha_5 YE + \alpha_6 RD + \alpha_7 MRD + \alpha_8 ML + \alpha_9 HHH + \varepsilon \quad [3.13]$$

where BWTP is a dummy variable which takes a value of 1 when the observation has a valid response and 0 (zero) otherwise. The right hand side of the equation gives explanatory variables that are thought to influence the probability of giving a valid or invalid response.

The next equation is:

$$WTP = \beta_0 + \beta_1 HY + \beta_2 DK + \beta_3 AG + \beta_4 HS + \beta_5 YE + \beta_6 RD + \beta_7 MRD + \beta_8 ML + \beta_9 HHH + \varepsilon \quad [3.14]$$

where WTP is the willingness to pay values (bids), and on the right are the variables that may influence the willingness to pay.

Equation (3.13) is a probit, and its estimates are obtained using Heckman's two-step, or 'Heckit' estimation method, which is based on the method of moments and consistent, rather than efficient, estimation. It is necessary to precede the maximum likelihood estimator with the probit model in order to obtain starting values for the maximum likelihood estimation (MLE). At the beginning of Step 2 of Heckman's procedure, a second step least squares regression is computed in order to obtain the starting values for the MLE. These values are corrected for selection, to a degree, but they are still inconsistent. They are then used as starting values for the iterations in estimation of the Corrected (Tobit) equation [3.14] by maximum likelihood procedure obtaining, as said above, consistent and efficient estimates in equations.

3.4 The expected relationships

A priori, it is difficult to predict how all of the independent (explanatory) variables would affect willingness to pay due to the nature of the WTP question: willingness to pay for the preservation of the forest through communal ownership and management. Nevertheless, we can hypothesize on the expected relationships between some of the variables and willingness to pay. We would expect the coefficient of household income parameter to have a positive sign. As the monthly income of households increase, they should be willing to pay more. This is in line with demand theory which shows that there exist a positive relationship between quantity of a good demanded and the level of income. We expect age to have a negative relationship because of intergenerational considerations; specifically, existence and bequest values are likely to diminish as people get older. They would therefore wish the younger generations to play a major role in the preservation of the forest as these would benefit relatively more and for a longer period of time. Also, we expect household size to have a negative sign. As the size of household increases, a greater proportion of income is allocated to the basic needs of the family members like education, health and food. Large households are thus left with lower incomes, willing to pay less as a result.

For distance of homestead from the forest, we expect the sign to be positive. This is at least for two reasons. First, currently the forest is virtually an open-access resource and thus those near the forest might have a quick access to the forest and its products. Therefore, they may end up placing a lower value to the forest and taking its preservation for granted. Second, those near the forest may feel that they are the ones to contribute more in non-monetary terms once communal ownership and management has been established and so could end up willing to pay less money. Education level of the respondent is another factor that is likely to affect willingness to pay, and we expect those with higher education to be willing to pay more. Another important factor is the variable capturing the rate at which deforestation is taking place. We would expect those who perceive the rate of forest disappearance to be high to be willing to pay more in order to see the situation contained the soonest possible.

Household heads are likely to pay more than those who are not. For one, they make direct and final decisions in the family. Thus, if one is not the head of the family, and this would be mostly female, she may understate the amount in fear of retribution from the husband if he felt that the amount is 'too much'. Unmarried household heads too are likely to state higher amounts

since they decide on how to use their incomes. For the remaining variables, that is, sex and marital status, it is difficult to predict *a priori* how they would influence the willingness to pay. So it is only after the model has been estimated that we will be able to interpret the relationships between these variables and willingness to pay.

3.5 Data type, source and method of collection

The data used in this study is entirely primary, and was collected through a survey of a random sample of rural households from 2 locations fitting our definition of forest community in rural Kenya in July 2002. Apart from the main researcher, who supervised the entire fieldwork activities, the study enlisted the services of 5 assistant interviewers. The choice of these locations was influenced by the fact that they are further away from the forest station. Since monitoring and guarding services are minimal, it was believed that the respondents would be attracted to the idea of communal ownership and management of the forest if this could stop the depletion of the forest. In addition to the contingent valuation questions on willingness to pay and willingness to accept compensation, the structured questionnaire included questions on who should be largely blamed for the depletion of the forest and what should be done to preserve the forest. Also, data was collected on household characteristics and income. The total number of households surveyed was 215, but we ended up with 208 correctly filled questionnaires. Questionnaires were administered through in-person interview that can be thought of as the only feasible way considering that this was the first time for the individuals in the study site to be confronted with hypothetical questions.

In the specification of the scenario for the CV questions, an attempt was made to describe the nature of the good, the conditions under which it will be made available and the benefits to be derived by the respondents if they would pay for it. True, most of the respondents do not have awareness about the nature of the good as they have never before owned a natural forest communally. Yet, we attempted to make the experiment less hypothetical by explaining to them what is involved in communal ownership and management of the forest (See Appendix A).

The value elicitation format used is binary (discrete) question with open-ended follow-up question. Since we did not have starting prices, the binary question asked whether the respondent would be willing to contribute. An open-ended question followed that required those willing to pay to state the maximum amount per month. If the respondent was not willing to pay, a follow-

up question asked him to state the reason – this was designed to help us in identifying the protest zeros. This discrete-continuous elicitation format was chosen because, on top of providing plausible responses, we expected the respondents, as the buyer of the commodity, to be familiar with a scenario where the seller first asks them if they are attracted to a commodity. If so they are then asked to decide and state the best price one would pay for that commodity.

In addition to willingness to pay, the questionnaire was designed to elicit responses for willingness to accept compensation, both monthly and once-for-all, in case the forest was given to squatters for settlement and farming. This question had two-fold purpose. First, it would be used in the comparison of willingness to pay and willingness to accept compensation and thus in testing the hypothesis regarding divergence of the two measures. Second, it would help in making some conclusions on how the forest communities feel about the government's issue of resettling squatters in some designated forests around the country.

CHAPTER FOUR: RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the research findings. In particular, it highlights the underlying reason why Ruthumbi forest is experiencing deforestation and degradation, compares willingness to pay and willingness to accept compensation, and discusses the empirical results of the Tobit model with sample selection. In addition, the results of hypotheses that were to be tested have been presented.

4.2 The underlying causes of Ruthumbi forest depletion

Of the 208 respondents, only 4 said that the forest is not undergoing any destruction. As shown in Table 4.1 below, they represent a mere 1.9 percent of the total respondents. However, three of these were willing to pay for preservation of the forest. Majority of the respondents, that is, 74 percent, felt that the forest is disappearing at a high rate whilst about 20 percent said that the rate of destruction is low. The remaining nine respondents did not give the rate. Timber sawing for commercial purposes, charcoal production for commercial purposes and firewood collection were ranked by most as the major activities leading to depletion of the forest. Likewise, most people felt that the Forest Department is to blame for this. They said that the forest guards allow individuals to harvest forest products at a fee and that those caught 'illegally' are not charged and fined since they produce bribes. Almost every household agreed that their firewood supply comes from the forest by paying for a monthly license to the Forest Department. But as opposed to before when they were required to collect firewood from dry fallen trees, at the present they even fell trees for firewood. This is because the forest guards do not care much about whether trees are felled or not, and also due to the example individuals who sell charcoal and firewood from the forest have set.

Unfortunately, most of the people engaging in these commercial activities are not members of the local forest community. Since the area is a tea growing zone, people have come from far to seek jobs as casual labourers in tea farms. With time, they have discovered a far much greater source of income — trading with the forest products, especially selling charcoal and firewood. These two activities involve indiscriminate felling of trees. However, there is another side of the story. True, the guards allow some individuals to harvest forest products, but some do it without

the guards' permission. These individuals know it is hard for them to be caught since only two guards who have been assigned a stretch of over 5 kilometers (the area covered by the study). This has translated into inadequate guarding, wardening and monitoring services. In some occasions, however, even if the guards found them, they may not succeed in arresting some individuals who are 'assaultive' and thus dangerous. There is a case where a group of people transporting firewood and charcoal at night assaulted one guard with a panga not long ago when he tried to arrest them.

The rural households expressed sentiments and observed that if nothing is done sooner than later, the forest would be depleted altogether. This is a cause for fear because the lives of many are centered on the forest. They are aware that farming, which is their source of livelihood, would no longer be sustainable. Rivers supplying them with water for irrigation will dry up, and rains would be unpredictable and insufficient. Earlier in our statement of the problem, we had hinted that the forest is partly being destroyed because people are not aware of the benefits associated with the forest and the socio-economic costs of deforestation with its accompanying ecological consequences. However, from the foregoing discussion it is evident that this is not so. To the contrary, the forest is a valuable resource to the forest community to the extent that they would be willing to pay for its protection and preservation. Coincidentally, this study was being carried out when the local chief was organizing and mobilizing the community towards the formation of a vigilante group for protecting the forest from wanton destruction. They were committed to this very much. An analysis of willingness to pay will further be used to support this claim. The underlying reason for the alarming disappearance of the forest thus is failure of the Forest Department to carry out its duties and responsibilities successfully. This has turned the forest into a virtually open access resource, the tragedy that has consequently led to its depletion.

4.3 Data description

Tables 4.1 and 4.2 below give the descriptive statistics for the variables that were hypothesized to influence willingness to pay, and thus would be included in the estimation of the Tobit model with sample selection. We expected the respondent's perception of the rate at which the forest is disappearing, the distance of homestead from the forest, and household size to be determinants of willingness to pay. Age, income and the education level of the respondents is

another set of variables that would have a bearing on willingness to pay. Sex of the respondent, the marital status of the respondent and whether or not one is the household head too could influence willingness to pay.

As we can see from Table 4.1, males made the largest proportion of those interviewed. They were 148, a 71.2 percent of total respondents. Likewise, 169 of the respondents were married, representing a 81.2 percent of the total sample. Moreover, 170 of those interviewed were household heads, comprising 81.7 percent of the total number of respondents. We would expect such kind of results because the study focused households rather than individuals.

Table 4.1: Frequency distribution for variables

Variable	Frequency	Percentage of representatives	
Sex	Female	60	28.8
	Male	148	71.2
Marital status	Single	39	18.8
	Married	169	81.2
Household head	Is household head	170	81.7
	Non-household head	38	18.3
Deforestation rate	High	154	74.0
	Low	41	19.7
	No deforestation	4	1.9
	Missing	9	4.3

Turning to Table 4.2 now, we find that the age of those interviewed ranges between 22 and 75 years, with a mean of 40.57, whilst the years spent in education ranges from zero to 18 years. The smallest household had one member (mostly aged and widowed) and the largest had 12 members, with an average household comprising of about five members. The lowest monthly income was KSh. 500 whilst highest amount was KSh. 30000. An average household was earning about KSh. 5893 per month. This amount is reasonable, as the major source of income for the households interviewed is subsistence farming. We were also interested with the distance of homestead from the edge of the forest. Since our definition of forest community was inclusive of only those households that are not more than five kilometers away, the farthest household is thus 5 kilometers from the forest. The household nearest to the forest was 0.1 kilometers, and the mean distance for the interviewed households is 2.05 kilometers.

Table 4.2: Descriptives for households' socio-economic and demographic characteristics

Variable	Range	Min.	Max.	Mean	Skewness	Kurtosis
Age of the respondents	53	22	75	40.57	0.624	-0.820
Household size	11	1	12	5.13	0.577	-0.057
Monthly household income	9500	500	30000	5893.27	1.602	2.162
Years of education	18	0	18	8.86	-0.418	-0.324
Rate of deforestation	2	0	2	1.760	-1.7513	5.1766
Distance from home to forest	4.9	0	5	2.05	0.515	-1.020

Next, we present the frequency distributions for willingness to pay and willingness to accept compensation. The rest of the descriptive statistics for these two variables in addition to single time willingness to accept compensation have been discussed under section 4.3 below. This has been done to facilitate comparison of willingness to pay and willingness to accept compensation. We begin with the frequency distribution for willingness to pay, which Table 4.3 below represents.

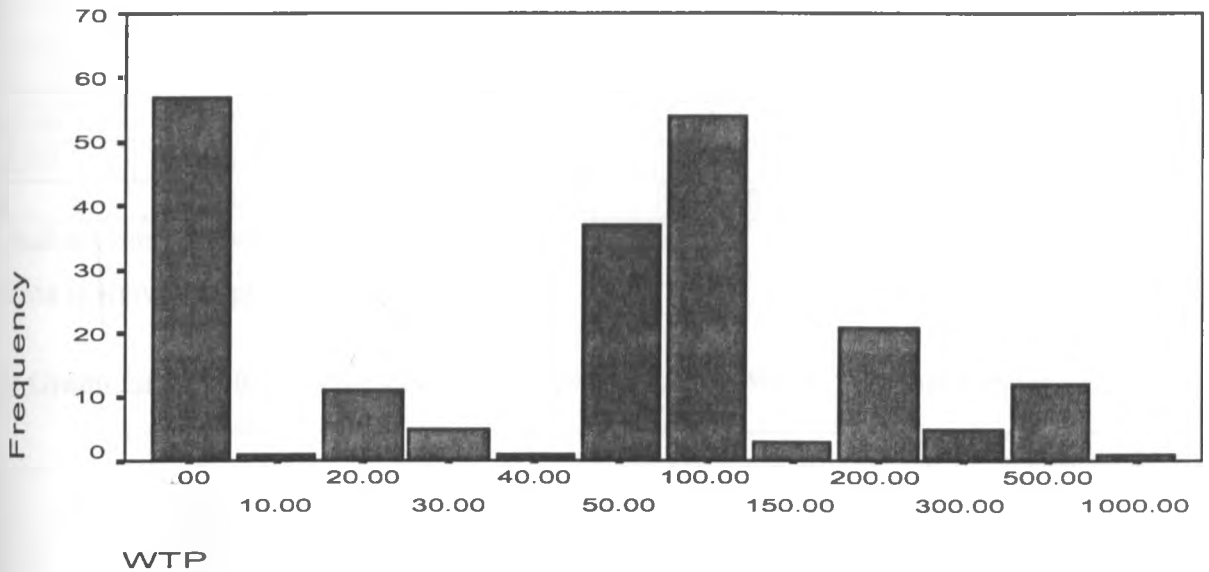
Table 4.3: Frequency distribution of willingness to pay (WTP) bids

WTP Bids	Frequency	Cumulative frequency	Percent	Cumulative Percent
0.00	57	57	27.4	27.4
10.00	1	58	0.5	27.9
20.00	11	69	5.3	33.2
30.00	5	74	2.4	35.6
40.00	1	75	0.5	36.1
50.00	37	112	17.8	53.8
100.00	54	166	26.0	79.8
150.00	3	169	1.4	81.3
200.00	21	190	10.1	91.3
300.00	5	195	2.4	93.8
500.00	12	207	5.8	99.5
1000.00	1	208	0.5	100.0
Total	208	208	100.0	

From the table, we see that the frequency distribution of the 12 categories of willingness to pay values we obtained, ranging from 0 to 1000. From the whole sample of 208 respondents, we obtained 57 zero bids. Out of these, 44 were protest zeros. The criteria for determining protest zeros has been discussed in section 4.3 below. Hence, we had only 13 respondents, a 6.25

percent of total, who were not willing to pay. All of these stated that they did not have enough information about the problem. This is to imply that they could not completely understand our hypothetical market, especially the nature of under consideration. Whether or not the interviewers made these respondents clearly understand the nature of good and the circumstances under which it was to be provided is hard to tell. Those willing to pay KSh. 100 made the highest number (valid responses only). This category represents 26 percent of the total respondents. It was followed by the KSh. 50 category, which represents 17.8 percent. The KSh. 10 and 1000 categories are among the three with 1 respondent each, and an additional note concerning them is given under section 4.3. Figure 2 below shows this data graphically.

Fig. 2: Graph for willingness to pay (WTP) against frequencies



The frequency distribution for monthly willingness to accept compensation is given in Table 4.4 below. We had up to 18 categories, ranging from zero to KSh. 20000 per month. The largest percent of the respondents, that is 40 percent, were not willing to be compensated. A detailed discussion has been undertaken under section 4.4 to explain why these respondents said they would not be willing to accept compensation in case the forest was cleared for settlement of squatters. In addition, we had three respondents who would be willing to accept compensation but they did not give us the minimum amounts.

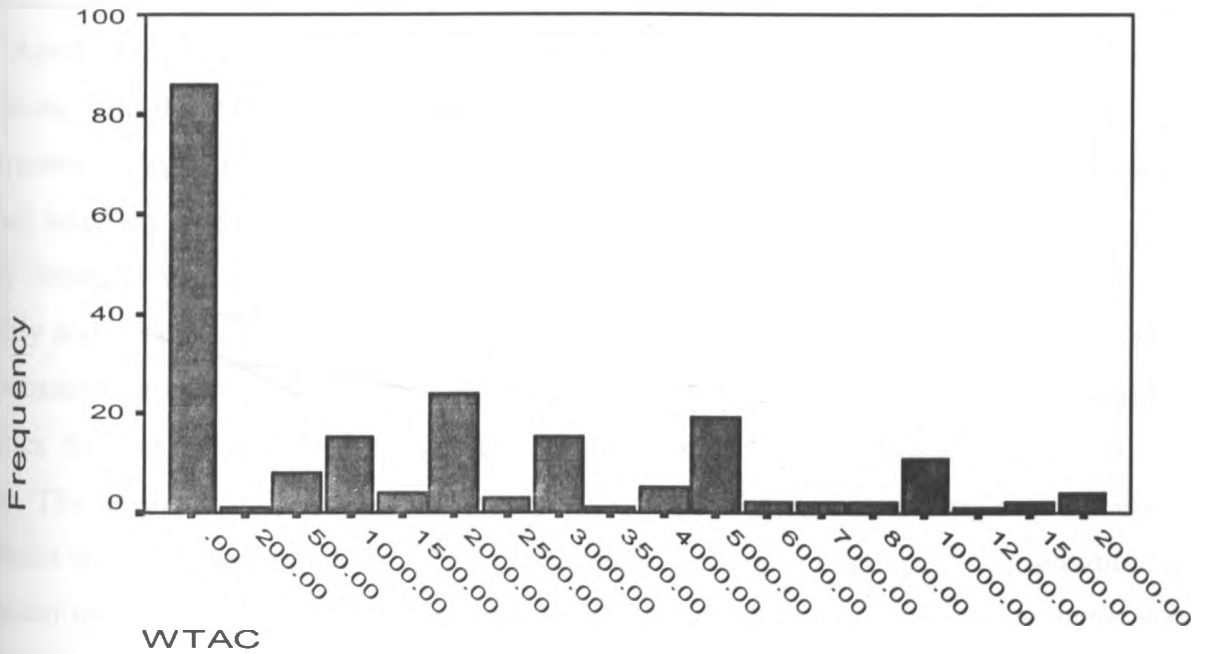
Table 4.4: Frequency distribution of willingness to accept compensation (WTAC) values

WTAC Values	Frequency	Cumulative frequency	Percent	Cumulative Percent
0.00	83	83	40.0	40.0
200.00	1	84	0.5	40.5
500.00	8	92	3.9	44.3
1000.00	15	107	7.3	51.7
1500.00	4	111	2.0	53.6
2000.00	24	135	11.7	65.3
2500.00	3	138	1.5	66.8
3000.00	15	156	7.3	74.1
3500.00	1	157	0.5	74.6
4000.00	5	162	2.4	77.0
5000.00	19	181	9.3	86.3
6000.00	2	183	1.0	87.3
7000.00	2	185	1.0	88.2
8000.00	2	187	1.0	89.2
10000.00	11	198	5.4	94.6
12000.00	1	199	0.5	95.1
15000.00	2	201	1.0	96.0
20000.00	4	205	2.0	98.0
Total	205*	205	100.0	

* We had three missing values

This data is shown graphically in Fig. 3 below:

Fig. 3: Graph for monthly willingness to accept compensation (WTAC) against frequencies



The correlation matrix for the explanatory variables is given in Table 4.5 below. From there we see that only household head and male are correlated to a large degree. The correlation coefficient is 0.69 showing that the two variables are positively correlated. Other set of variables that are correlated, but not so high are: household headship and being married; and age and years spent in education.

Table 4.5: The correlation matrix for explanatory Variables

	DK**	HS	AG	HY	YE	RD	ML	HHH
DK	1.00000	-.09103	-.18048	.18570	.15773	.12337	.02502	-.03950
HS	-.09103	1.00000	.24053	.35005	.06874	.13723	-.08140	-.02773
AG	-.18048	.24053	1.00000	.18224	-.47356	.23503	.15812	.30027
HY	.18570	.35005	.18224	1.00000	.32155	.11596	.01570	-.04280
YE	.15773	.06874	-.47356	.32155	1.00000	-.05501	-.01856	-.17788
RD	.12337	.13723	.23503	.11596	-.05501	1.00000	.03002	.03579
ML	.02502	-.08140	.15812	.01570	-.01856	.03002	1.00000	.69170
HH	-.03950	-.02773	.30027	-.04280	-.17788	.03579	.69170	1.00000
	DK	HS	AG	HY	YE	RD	ML	HHH
MRD	-.19931	.22101	.30545	.03321	-.10351	.05631	.11457	.42535
	MRD							
MRD	1.00000							

** All the variables are defined as before. See section 3.3 above

4.4 Willingness to pay versus willingness to accept compensation

Apart from willingness to pay, the study elicited willingness to accept compensation responses. This data would, on top being used to test whether there is a significant divergence of willingness to pay from willingness to accept compensation, would help us to analyse the idea of settling squatters in Kenya's natural forests. In turn, this would guide us in suggesting some policy measures with view to preserving all natural forests around country. We asked for both monthly and once-for-all minimum amounts that the respondents would be willing to accept as compensation in case the forest was cleared and squatters were resettled there. The descriptive statistics for these two variables together with willingness to pay are included in Table 4.6 below. The mean monthly willingness to pay for the whole sample including also the invalid responses was approximately KSh. 100. In the case for willingness to accept compensation, the minimum monthly and once-for-all amounts were both 0, whilst the maximum amounts were

KSh. 20000 and 5 million respectively, with corresponding means of KShs. 2527.80 and 459487.80.

Table 4.6: Descriptives for willingness to pay and willingness to accept compensation

Variable	N	Range	Min.	Max.	Mean	Std. Dev.	Skewness	Kurtosis
WTP ¹	208	1000	0.00	1000	100.10	137.55	2.79	10.56
WTAC ²	205	20000	0.00	20000	2527.80	3913.98	2.48	7.09
WTAS ³	205	5000000	0.00	5000000	459487.8	831483.90	3.53	14.89

(1) Monthly willingness to pay

(2) Monthly willingness to accept compensation

(3) Once-for-all willingness to accept compensation

In addition, we had 3 missing bids with regard to willingness to accept compensation. The three individuals were willing to accept compensation but they did not state the minimum amounts. One respondent said 'it is hard to quantify', the other one just said 'billions' and the third said 'any amount'. Of the total respondents, 85 were not willing to accept compensation, a 41 percent. Since we did not expect to get this kind of response (we would expect someone to demand compensation for the loss of benefits suffered by clearing the forest), a follow-up question was not included while designing the questionnaire. Here we were telling them that a local organization would pressure the government to compensate the forest community and that compensation would be done after the forest had already been given out, and yet they insisted they would not accept the compensation. May be this can explain why this was the case: the respondents felt that by their agreeing to accept compensation, they would be giving the government a 'greenlight' to resettle the squatters in the forest land. A question related to this issue asked the respondents to express their views regarding the best way the problem of squatters could be dealt with. Not one of these respondents gave the slightest indication that even sections of the forest should be allocated to the squatters. Only about 2 percent of the entire sample felt that squatters can be settled along the forest edge, especially the Nyayo Tea Zone, rather than clearing the forest.

Now we turn our attention to comparison of willingness to pay and willingness to accept compensation. The study empirical results were as follows: the mean for willingness to pay (only valid responses) was 125.79 (see table 4.8 below) whereas that for willingness to accept compensation is 2527.80 as shown in the table above. The assumption of equal variances gave us

an F value of 137.72 using Levene's test as shown in Table 4.7 below. This means that the appropriate t-statistic, -7.86, is highly significant at 1 per cent level, indicating that there is a very significant difference between the means for the two variables.

Table 4.7: t- test for equality of willingness to pay and willingness to accept means

Levene's Test for equality of variances			t-test for equality of means					
	F	Sig.	t	Sig. (2-tailed)	Mean difference	Std. error difference	99% Confidence Interval of the Difference	
							Lower	Upper
Equal variances assumed	137.72	0.00	-7.860	0.00	-2388.20	303.8474	-3174.92	-1601.48
Equal variances not assumed			-8.804	0.00	-2388.20	271.2676	-3093.45	-1682.95

Whenever goods with 'publicness' characteristics are analysed, the issue of free-rider problem arises. In our study we were asking individuals whether they would be willing to contribute towards the preservation of the forest with the benefits thereof being shared equitably. So individuals knew that as long as they contributed some amount, they would be entitled to their share of the benefits especially tangible ones, and the forest could be preserved anyway. We would thus generally expect understated willingness to pay. For willingness to accept compensation, we received answers that could be paralleled to protest zeros in the case for willingness to pay. As discussed above, as big as 41 percent of the respondents said that they were not willing to accept compensation. Regardless of that though, we would expect those willing to accept compensation to overstate their values.

The description of valid and invalid responses

Out of the 208 questionnaires, 46 were found to contain invalid responses; 44 were in form of protest zeros and 2 were classified as outliers. We never had missing bids in the case for willingness to pay. The selection of protest zeros was based on responses to a follow-up question to the valuation question, which asked those who were not willing to pay the reasons for that. The following responses were considered protest zeros: I don't want to participate in the survey,

I don't have anything to loose, I can't afford the money, the government has managed the forest well, and I don't like communal ownership. Based on the nature of the good, it was very difficult to identify outliers. However, we had two cases that could easily fit to be outliers, the KShs. 10 and 1000 categories. Each of these had only one respondent. The respondents were to pay for preservation of the forest and thereby continually receive a share of tangible benefits. So KSh. 10 per month could be a too low value considering even only the amount of tangible benefits he would be receiving. This is a reflection of the serious problem encountered in realm of public goods: the free-rider problem. Nonetheless, his willingness to pay is an indication that communal ownership and management of the forest is a welcome idea to ensure its preservation. The low WTP value implies that he expects others to contribute significantly towards this arrangement. For the KSh. 1000 case, this amount was 20 percent of his monthly income. Whether or not this was strategic behaviour is hard to tell. May be he felt that his monthly share of the especially tangible benefits he would be getting from the forest would be more than enough to offset his monthly contribution.

An analysis of means will help us in knowing whether there is a significant divergence of the group with valid responses from that with invalid responses. As shown in Table 4.8 below, the mean for valid responses was 125.79 (correct to 2 decimal places) whereas that for invalid responses was 25.0.

Table 4.8: The statistics for valid and invalid willingness to pay bids (responses)

	N	Mean	Std. Deviation	Std. Error Mean
Valid WTP responses	162	125.7923	127.1125	9.9869
Invalid WTP responses	46	25.0000	147.7347	21.7823

Before doing a comparison, we however need to test for equality of variances. These results are given in Table 4.9 below. Levene's test for equality of variances gave the F value of 6.122 when equal variances are assumed. This value is significant at 1 percent level, revealing that that the two groups had equal variances. Thus, our appropriate t value is 4.376 and is highly significant at 1 per cent level. This shows that the difference between the two groups is highly significant, and therefore the exclusion of the invalid responses from the valuation function would lead to sample selection bias. However, to be sure whether or not this difference would

Table 4.9: The t-test for equality of valid and invalid responses group means

Levene's Test for Equality of variances			t-test for equality of means					
	F	Sig.	t	Sig. (2-tailed)	Mean difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
WTP: Equal variances assumed	6.122	0.014	4.376	0.000	96.4198	22.0352	52.976	139.863
WTP: Equal variances not assumed			4.024	0.000	96.4198	23.9626	48.564	144.275

4.5 Empirical results of the Tobit model with selectivity

The empirical results of the Tobit model with sample selection (equations 3.13 and 3.14 in section 3.3 Chapter 3), both the probit and the corrected (Tobit) regression results, are presented in Table 4.10 below. These results represent the best model based on the likelihood function and the t ratio tests.

As was mentioned earlier, we were expecting to have sample selection bias after the exclusion of invalid responses. This means that the remaining sample would be non-random and thus a systematic, non-random difference between invalid and valid responses would result. This in turn would make the estimated parameters in the specified function inconsistent. The Tobit model with sample selection corrects for this, and this is basically the reason we adopted it for this study. The significance of ρ (rho) is used to determine presence of sample selection bias. From table 2, it is evident that ρ is significant at 1 per cent level. Hence, exclusion of invalid responses would lead to sample selection bias and thus our use of a Tobit model with sample selection is justified.

We begin with the probit coefficients in analyzing the effect of explanatory variables on the probability of giving a valid or invalid response. Two parameter estimates were significant at 10 percent level. These are household income and age of the respondents. The parameter estimate for household income was positive as expected, indicating that the probability of giving a valid response increases with income. Richer households are likely not to be relying much on forest resources in terms of tangible benefits and thus would want to see the forest saved from the

response increases with income. Richer households are likely not to be relying much on forest resources in terms of tangible benefits and thus would want to see the forest saved from the destruction it is undergoing. In fact, the correlation matrix in Table 4.5 above depicts a positive correlation between household income and the rate of deforestation. Richer households felt that the forest is disappearing at a high rate.

Table 4.10: Parameter estimates of the Tobit model with sample selection

Variable	Probit estimates		Tobit estimates	
	coefficient	t-statistic	coefficient	t-statistic
Constant	1.25 (0.72) ^a	1.727 ^{**}	319.22 (147.73)	2.161 ^{**}
Distance of homestead from the forest	-0.057 (0.073)	-0.777	-18.74 (15.04)	-1.246
Household size	-0.065 (0.051)	-1.258	0.73 (10.66)	0.068
Age of the respondent	-0.016 (0.011)	-1.501 ^{***}	-5.62 (2.23)	-2.490 [*]
Monthly household income	0.000030 (0.000021)	1.427 ^{***}	0.0094 (0.0048)	1.964 ^{**}
Years of formal education	-0.012 (0.035)	-0.342	-3.89 (8.22)	-0.473
Rate of forest disappearance ^b	0.039 (0.24)	0.162	-26.37 (60.51)	-0.436
Household headship ^c	0.29 (0.27)	1.083	25.32 (63.06)	0.402
Sigma			232.49 (18.45)	12.599
Rho			0.99 (0.017)	57.965
Number of observations	208			
Log-likelihood function	-1051.79			

*, ** and *** indicates 1, 5 and 10 percent levels of significance respectively.

(a) The terms in the parentheses are the standard errors of the parameter estimates

(b) 0 if no deforestation; 1 if low deforestation rate; and 3 if high deforestation rate

(c) 1 if one is household head; and 0 otherwise. The class for non-household head was dropped.

The age coefficient had a negative sign showing that the probability of having a valid response decreases with an increase in the age of the respondents. This can be explained in terms of intergenerational considerations. May be as people get older, they feel that they have little to loose even if the forest is not saved from destruction it is undergoing currently. Those relatively

younger would want the forest to be preserved for them and their families to continue benefiting from it, and so they are more likely to give valid responses.

Household size and household headship are other parameters that were significant, but at 15 percent level. The negative parameter estimate for household size suggests that the probability of having a valid response decreases as the household size increases. There is no straightforward reason why this would be so. In stating our expected relationships, however, we had hinted that larger households would have lower incomes in relative terms. That could be the case even though we see from the correlation matrix in Table 4.5 above that these two variables had some degree of positive correlation. Since from theory we find that poorer people rely more on natural resources, then we would expect larger households to be relying more on the forest resources and thus are more likely to give an invalid response. They are aware that the moment the forest comes under protection then much of what they get from it would be forfeited. Still, the idea of sharing benefits equally could not be so appealing; their share could become smaller. For household headship, the parameter estimate was positive implying that household heads are more likely to give valid responses. This is because they make decisions as to how household resources should be used and also due to welfare considerations for their families. They know that the forest should be protected if those they provide for are to enjoy rich benefits now and in the future. The remaining variables had insignificant parameter estimates.

Now we focus our attention to the corrected regression part where by willingness to pay is the dependent variable. The results are given in columns 4 and 5 in the Table 4.10 above. The parameter estimate for the distance variable was negative but its level of significance was 15 percent. This was not according to our *a priori* expectations. We were expecting those near the forest to be willing to pay less because they have a quick access to the forest and its products, which would cause them to take some of the benefits for granted. However, the results indicate that these households do value the forest more than those farther away from the forest and therefore would be willing to pay more for its preservation.

The parameter estimate for age was significant at 1 percent level, and the negative sign shows that those advanced in age are willing to pay less. This result was as expected. As people get older, they figure out that they would not enjoy the benefits from the preservation of the forest for long. In other words, the value of the forest declines. They expect the younger generations to play a dominant role in the preservation of the forest. While stating their

willingness to pay therefore, intergenerational equity does not seem to play a significant part, with little existence and bequest values being attached to the forest.

As we had postulated, the parameter estimate for household income was positive. Moreover, it was significant at 10 per cent level, suggesting that households that are richer would be willing to pay more. This is in agreement with economic demand theory since there exists a positive relationship between income and the quantity of a commodity demanded. Moreover, these households are less dependent on forest products and fear for depletion of the forest by poorer households.

The rest of the parameter estimates were insignificant. However, only household headship had the expected positive sign. Household size coefficient had a positive sign suggesting that larger households are willing to pay more. Even though these households could be having relatively lower incomes their disposal, they would be willing to pay more due to welfare considerations. Contrary to our expectation, the parameter estimate for deforestation was negative that implying that willingness to pay decreased with the respondents' perception of the rate of deforestation.

Education variable were negative suggesting that those with no formal education are willing to pay more. The reason for their willing to pay more could be due to the fact that these people are more indigenous to the forest and so were willing to pay more to protect the forest from destruction and ensure its preservation.

4.6 Aggregation of benefits

As brought out earlier in the literature, four types of bias need to be minimized if someone is to do benefit aggregation in a CV study. Our study attempted to do so in this regard. The study concentrated on two locations with a total of 1,367 households fitting our definition of forest community and thus represented the population of the study. Of these, 215 were picked from a sampling frame made of the list of the total households as our sample through a random sampling method. This was an attempt to render population choice bias and sampling frame bias insignificant. Moreover, we used in-person interview, which made sample non-response very small – only 7 respondents refused to cooperate fully. But as we have seen from the foregoing discussion, exclusion of invalid responses led to a significant sample selection bias.

The mean willingness to pay for the 162 households with valid responses was 125.79. This shows that the total willingness to pay is equal to KShs. 171,326.11. However, since the mean willingness to pay for the sample was calculated using only the valid responses, it is right to conclude that the total willingness to pay amount is incorrect or biased. This calls for compensation of aggregate benefit measures for this sample selection bias. We predicted the mean willingness to pay using the Tobit model with sample selection and found it to be 86.35, a value that is about 85 per cent of the mean willingness to pay value obtained from the sample with valid responses only (125.79). This therefore suggests that the mean willingness to pay value of 125.79 should be adjusted downwards before aggregation of the benefits to the population size of 1,367 that includes households that would have given invalid responses. Getting 85 per cent of the total willingness to pay value obtained above gives us the adjusted monthly total willingness to pay of about KShs 145,627. This is the much the forest community would be willing to pay per month to ensure the forest is protected and preserved. In other words, it is the monthly value for the protection and preservation of the forest.

4.7 Hypotheses tests

In section 1.6, the hypotheses of this study were stated. Following the results, now we are ready to test them:

Hypothesis one

This hypothesis was included in order to test whether the local forest community is aware of the true benefits associated with the forest or to put it differently, the socio-economic costs and ecological consequences of forest destruction. The null hypothesis stated that the local forest community is not aware of the true benefits associated with the forest ecosystem. In our discussion of the underlying cause(s) of Ruthumbi forest destruction in section 4.2 above, we highlighted the circumstances surrounding the destruction of the forest and mentioned that plans were under way for the forest community to form a vigilante group to protect the forest from destruction. Moreover, not even one respondent felt that the forest should be cleared and given to squatters for farming and settlement. Given also that households with valid responses (a 78 percent of total) were willing to pay an average amount of KSh. 125 per month for protection and preservation of the forest, we therefore reject the null hypothesis and conclude that the forest

community is aware of the true benefits from the forest and the socio-economic costs and ecological consequences that emanate from destruction of the forest ecosystem.

Hypothesis two

The null hypothesis stated that there is no significant divergence of willingness to pay from willingness to accept compensation values. In section 4.4 above, we compared the means for the two variables using SPSS statistical software. The t-test for equality of means was significant showing that the two variables had means that significantly differ from one another. So we reject the null hypothesis and conclude that there is a significant divergence of willingness to pay values from those obtained in willingness to accept compensation question.

Hypothesis three

Since in a CV study such as this we would expect invalid responses particularly in form of protest zeros, we included hypothesis 3 to test whether the group with valid responses significantly differ from the one with invalid responses. We used t-test for equality of means in section 4.4 above to test for this difference and found that the means for the two groups differ significantly. We, however, went ahead and tested whether this difference would persist if some household characteristics were controlled using the Tobit model with sample selection in section 4.5. The parameter estimate for rho (ρ), the coefficient used to test this was significant at 1 percent level. Thus, we reject the null hypothesis, which stated that there is no significant difference between valid and invalid responses, and conclude that the two groups differ significantly.

4.8 Discussion of results

Three important results have emerged from the study. These are: (i) the divergence between willingness to pay and willingness to accept compensation, (ii) the determinants of forest protection and preservation value, and (iii) the value of forest protection and preservation. Each of these will be discussed in turn below.

4.8.1 The divergence of willingness to pay from willingness to accept compensation

The study results depicted a significant divergence of willingness to pay for protection and preservation of the forest from willingness to accept compensation from loss of benefits derived

from the forest in case the forest was cleared. Some theories that could be used to explain this include the rejection of the loss of property rights theory; the cautious consumer hypothesis – there can be risks and uncertainties involved, and; the prospect theory – individuals value losses more than gains. Also the free-rider problem encountered in the realm of public or quasi-public goods offers an explanation.

The willingness to pay bids were generally understated because people knew that as long as the forest was protected and preserved then they would definitely have their share of benefits. So they stated low willingness to pay amounts thinking that others would contribute substantially. As for willingness to accept compensation, the values were overstated. This is because the respondents valued the loss of the benefits they derive from the forest so highly. According to Knetsch (1990), people tend to overstate what they must receive and understate what they must pay out so as to make a gain. This is what exactly happened in our case. The results we got are similar to those obtained by Cheng'ole (1995) and several others he has summarized in his work.

4.8.2 The determinants of the value of forest protection and preservation

The corrected (Tobit) regression, which has willingness to pay as the dependent variable and the factors, hypothesized to influence willingness to pay as the explanatory variables produced two variables that were significant. Age of respondents was significant at 10 percent level and the parameter estimate was negative. The parameter estimate for household income was positive and significant at 10 percent level. These results resemble those of Hanley and Ruffel (1991) who sought to place economic values on the characteristics of several public forests in UK. Their maximum likelihood (ML) results indicated that WTP is highly positively related to income, and significantly but negatively related to respondents' age. Their education variable was insignificant, same result as ours. Distance between homestead and the forest was significant though at 15 percent level. The parameter estimate was negative. These results agree with Mekonnen (1997). Even though he was analyzing determinants of willingness to pay for establishment of community forestry, we can say the studies fall in the same category since we were assessing the determinants of willingness to pay for establishment of communal ownership and management of natural forests as a means of preserving the forest. Moreover, his parameter estimate was positive and significant as we have also found in our study.

4.8.3 The value of forest protection and preservation

The rural households were willing to pay an average of KSh. 125 per month for protecting and preserving the forest. This amount is approximately equal to 1.6 US dollars¹³, indicating that each household would be willing to pay 19.2 US dollars annually. This amount may seem too low compared with what similar studies have found. For instance, Lockwood et al (1993) carried a study of this kind in Australia and found that each household was willing to pay \$ 52 per year. Haegen et al (1992) did a similar valuation for protection study in US and obtained \$ 189 per household per annum. Nevertheless, there is a justification. Our final good was establishment of communal ownership and management of the forest and the payment vehicle was a communal standing fund. The money was to be used for paying guards and allowances to the members of a local court – a “Njuri” – that would be overseeing the project and settle any conflicts. In addition, given that in this arrangement each household would be required to contribute substantially in non-monetary terms, we can thus qualify the monthly KSh. 125 per household to be quite a reasonable amount.

4.9 Limitations of the Study

In the absence of organized markets, an intuitively appealing approach to revealing preferences of individuals and society with respect to public and quasi-private goods is the use of CVM. Despite the appeal of simply asking an individual his or her WTP and the widespread use of these methods for resource valuation, the reliability of the values obtained has been under a vigorous debate. The acceptability of the values obtained using CVM is likely to depend on, one, the variance or reliability of the estimate, and two, the validity or the degree to which the estimate measures the theoretical construct under construction (Bishop and Heberlein, 1979; Knetch and Sinden, 1984; Mitchell and Carson, 1989). This study was designed to better meet these requirements. However it was not possible to ensure altogether that the values obtained were a 100 per cent reliable.

Also, we earlier saw under section 4.3 that 6.25 percent of the respondents gave zero bids that were classified as genuine. These stated that they did not have enough information about the problem. This implies they did not understand our hypothetical market. Unfortunately, the way the study was designed cannot tell us why this was so. This is could be a limitation in itself.

¹³ The conversion rate is KSh. 78 for 1 US dollar

CHAPTER FIVE: CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Conclusions

The results we obtained show that our contingent valuation (CV) exercise was a success in spite of about 53 percent of the respondents having primary education and below. In fact, 8.7 per cent of the respondents did not have any formal education whereas 7.2 percent had less than 5 years of formal schooling. The complexity of the nature of the good under consideration should have been daunting even to those with much education. Here we were asking for willingness to pay for preservation of the forest through communal ownership and management with the benefits thereof being shared equally. These were indeed three problems in one, and yet the respondents were able to give answers that produced reasonable and satisfying results based on the bid curve analysis. Many, even those who accept contingent valuation method as a non-market valuation technique, have expressed skepticism about the usefulness of contingent valuation in the context of developing countries (Dixon and Sherman 1990). Kenya is such a country, and given that the study was conducted among the rural households of Kenya, the 6.25 percent of genuine zeros (those who said they did not have enough information about the problem) we obtained is indeed too low. This is an indication that as long as a CV study is made less hypothetical in design and implementation and as long as it captures real issues affecting individuals as well as households, then its success is sure regardless of whether it is done in developing nations or not.

The analysis of bid curve has shown that the age of the respondent and household income are significant variables that determine the willingness to pay for the protection and preservation of the forest. The age coefficient had a negative sign indicating that as the age of the respondents increase, they would be willing to pay less. The parameter estimate for household income was positive suggesting that richer households are willing to pay more than those whose incomes were fewer. Another variable that was significant, though at 15 percent level is the distance of homestead from the forest. The coefficient was positive showing that households further away from the forest are willing to pay more. Moreover, household headship dummy variable was significant at 15 percent level, and its positive sign indicates that household heads would be willing to pay more.

We expected factors such as education, household size and the respondent's perception with regard to the rate at which the forest is disappearing to have a significant influence on

willingness to pay for forest preservation as well but the estimated coefficients revealed otherwise.

As large as 78.8 percent of the rural households interviewed was willing to contribute money to enhance protection and preservation of the forest. On average, each household would be willing to pay KSh.125.79 per month. This value is slightly over 2 percent of the average monthly income for the subsistence farm households surveyed. We have seen that this value is not low considering the final good we were offering respondents and the payment vehicle. The aggregated benefits for the whole population were found to be KSh. 145,627 per month. This was the total monthly value for protecting and preserving the forest to ensure its continued existence. By rural households willing to pay for preservation of the forest is evidence that the forest is disappearing and this due to lack of sound public forestry policies. We are concluding this because had they not been concerned over what is happening to the forest, our study in that event would be dominated by invalid responses of protest zeros type, and a large percentage should have insisted on improving the efficiency and effectiveness of the Forest Department.

The results further reveal that willingness to pay and willingness to accept compensation are significantly different. This was as expected, for theory shows there is a tendency for individuals to understate willingness to pay for public goods due to free-rider problem, and a tendency to overstate willingness to accept compensation. Nevertheless, we can make an observation concerning willingness to accept compensation. Its mean monthly value was slightly over KSh. 2500. Even though it is hard to quantify all the benefits associated with a forest ecosystem, both tangible and intangible, this value is a reflection of rural household's unwillingness to let go, as it were, of this invaluable resource. Whenever a respondent understood the question as demanding payment after allowing for settlement of squatters in the forest, he replied he was not willing to be compensated. It is only after clarifying that it was not for him to decide whether or not the forest should be cleared that he accepted compensation. Still, most of them remarked that monetary compensation could by no means compare with what would be lost. In addition, the answers of the majority to the question on the best way the government could solve the pressing problem of squatters indicated that forests should be left alone; it is no wise thing to settle squatters in a forest land.

We also found that exclusion of invalid responses leads to sample selection bias. The implication of excluding such responses is that the parameter estimates of the willingness to pay

function or the bid curve and the sample mean willingness to pay estimated using the valid responses only will be rendered incorrect or biased. Before aggregating benefits, therefore, the average willingness to pay values computed using data for households with valid responses only need to be adjusted downwards as the population contains households that would give invalid responses. To obtain consistent parameters, it was appropriate to use the Tobit model with sample selection – a model that corrects for sample selection bias – in our study in the analysis of the willingness to pay function.

5.2 Policy recommendations

The existence of natural forests in Kenya has been hinged on the decisions of the head of state, Minister for Environment and Natural Resources and political leaders in general. This has done the forests more harm than good. And if nothing better than entrusting their permanent preservation to yielding of the government and political leaders advocating their excision to pressures exerted by lobby groups like the Green Belt Movement is done sooner than later, we will be left with no such forests in the long run. It is only through adoption of better forestry policies we will see the preservation and thus continued existence of these natural forests. Several points stand out from our study, and it is worth considering them in formulation of such policies which, if were to be adopted, Kenya's natural forest would be protected from ongoing wanton destruction and thus enjoy permanent preservation. Below are some of the policies that this study recommends:

- I. Management of natural forests should not be left entirely in the hands of politicians. The local forest communities should be involved in management and decision making since these resources have a direct bearing on their very lives. This would save the forests from the fateful decisions of the head of state or any other political leader such as allocating forest lands to 'well-connected' individuals, as is presently happening, or even targeting them for resettling squatters. The government could do well to settle these people in other areas but not in land covered by natural forests.
- II. Even with achieving the above end, another problem would still be lurking — the inefficiency and ineffectiveness of the Forest Department. So much corruption was reported to be going on between those harvesting forest products and the Forest Department officials by rural households. Several factors contribute to this, one being

the inadequate staffing especially with regard to forest guards and lack of proper patrolling facilities like vehicles. If corruption was curbed and the efficiency and effectiveness of the Forest Department in general was improved, then forest destruction and degradation could be greatly reduced. The Forestry bill (2000) was designed with a view to improving the efficiency and effectiveness of all the stakeholders who would be concerned with the preservation of forests in Kenya, but a careful consideration of all the various entities and bureaucracies involved leaves one question: why so many entities, and if they are necessary, will successful coordination ever be possible? Instead of involving so many institutions in managing a resource something that could be characterized by clash of interests and conflicts, the government should think about letting the forest communities play the major role in managing the forest reserves.

III. The best way the government could save the natural forests is make them communal resources. Our study revealed that forest communities would be willing to contribute money to ensure the forests are preserved. This would be achieved through communal ownership and management. These people are indigenous to forest and much of their livelihood is dependent on the forest. True, their activities contribute to some degree to the disappearance of the forests, but there is an explanation for this: the tragedy of the open-access. The inefficiency and ineffectiveness of the authority entrusted with the responsibility of enforcing state's rights of ownership has rendered the forests virtual open-access resources, with the forest communities exploiting their share of benefits. But this they do knowing well the tragic repercussions of their actions. Thus, the government could reverse the tragedy of open-access by defining common property rights, thereby establishing a far much superior system of managing the natural forests to ensure their sustainable use and permanent preservation.

5.3 Areas for further research

Little research work has been done in the area of valuing natural forests for protection and preservation in Kenya. The study we did captured the general rural households' total willingness to pay for forest preservation. The value we got can be said to be total economic value since we were asking the respondents a valuation question requesting their willingness to pay to protect and preserve the forest for all reasons including recreation use, the option for future use, bequest

value and passive use value – the value of the forest independent of any use now or in the foreseeable future. Therefore we suggest that research be done incorporating valuation question(s) that would have the respondents prorate their total economic values of protecting and preserving the natural forests into separate recreation, option, bequest and passive use components.

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APPENDIX A: QUESTIONNAIRE FOR RURAL HOUSEHOLDS

Questionnaire No. _____

Interviewer's name: _____

INTRODUCTION

Hello.

I am a student from the University of Nairobi, Department of Economics and I am currently doing research on sustainable use and sound management of natural (indigenous) forests in Kenya. Kenya's forests are disappearing at an unprecedented rate and this trend, if not checked or reversed, will bring with it the many socio-economic costs and ecological consequences of depletion of forest ecosystems. Some of these include the loss of environmental protection services for critical watersheds and changes in the climatic patterns.

The research I am carrying out therefore aims at finding out what could be done to ensure conservation and preservation of natural forest ecosystems in Kenya. This entails a survey whereby a structured questionnaire is used to elicit responses from individuals. You have been selected to be a respondent through random sampling, and your readiness to spare some few minutes and to voluntarily answer the following questions will be, on top of being appreciated, very beneficial. Your responses will be strictly confidential and for academic use only.

SECTION A: DEFORESTATION AND DEGRADATION OF FOREST

(PLEASE TICK WHERE APPROPRIATE)

1. What is the approximate distance, in kilometers (Km), from your homestead to Ruthumbi Forest? _____ Km.
2. On a scale of 1 to 5, how would you rank your level of familiarity with the activities that have been taking place in Ruthumbi Forest? "1" represents "totally familiar" and "5" is for "totally unfamiliar". Score _____

Illustration of meaning of scores

- 1: **Totally familiar**
- 2: **Fairly familiar**
- 3: **Undecided**
- 4: **Little familiarity**
- 5: **Totally unfamiliar**

3. Are any of these activities leading to destruction of the forest?

Yes No.

4. If "No", please explain.

5. If “Yes”, please confirm them from the list below, and rank the main three starting with ‘1’ which represents the most serious cause. ‘3’ is for the third important cause.

TICK	RANK
<input type="checkbox"/> Timber sawing for commercial purposes	<input type="checkbox"/>
<input type="checkbox"/> Sawing timber for domestic use	<input type="checkbox"/>
<input type="checkbox"/> Charcoal production	<input type="checkbox"/>
<input type="checkbox"/> Fencing posts production for domestic use	<input type="checkbox"/>
<input type="checkbox"/> Fencing posts production for commercial purposes	<input type="checkbox"/>
<input type="checkbox"/> Firewood collection	<input type="checkbox"/>
<input type="checkbox"/> Cattle grazing in the forest land	<input type="checkbox"/>
<input type="checkbox"/> Conversion of forest land into agriculture	<input type="checkbox"/>
<input type="checkbox"/> Others (please specify) _____	<input type="checkbox"/>

6. In your view, what is the rate at which the forest has been experiencing destruction?
- High
 - Low
 - No deforestation

7. (a) Who should be largely blamed for all this?

- The local community
- The Forest Department.
- Others (please specify) _____

- (b) If it is the local community, which of these factors could you attribute this to?

- Growing population
- Ignorance of benefits from forests
- Greed and shortsightedness
- Others (please specify) _____

- (c) If the Forest Department, what are the underlying causes?

- The forest guards do not patrol the forest
- The forest guards allow individuals to harvest forest products at a fee
- Those caught illegally harvesting forest products are never charged or fined.
- Others (please specify) _____

8. Which of the following benefits do you or your household derive from Ruthumbi Forest?

- | | |
|---|--|
| <input type="checkbox"/> Firewood supply | <input type="checkbox"/> Enough water supply |
| <input type="checkbox"/> Clean air | <input type="checkbox"/> Medicine extraction |
| <input type="checkbox"/> Grazing and/ or cattle feeds | |
| <input type="checkbox"/> Timber | |
| <input type="checkbox"/> Fencing and building poles | |
| <input type="checkbox"/> Charcoal supply | |
| <input type="checkbox"/> Recreation | |
| Others (please specify) _____ | |

SECTION B: BENEFIT-VALUE ELICITATION PROCEDURE

9. (a) Ruthumbi forest is a state property and is currently under the management of the Forest Department. Managing the reserve involves monitoring and enforcement of state rights, which costs money. Suppose that due to financial pressures, there arose difficulties in monitoring and enforcing these rights. In realization that if nothing is done the forest could be depleted altogether, the government decides to transfer the ownership of the forest to people who live near it. This means that the forest could be owned and managed jointly, and all the benefits (at least tangible) from the forest could be shared equally among the members of the community. In this communal ownership and management, members would be required to contribute money to a standing fund for financing various activities including payment of guards and allowances to the members of a local court – a “Njuri” – whose work would be to oversee the project and to settle any disputes. Clearly, the higher the amount each member of the community contributed to this fund, the higher would be the chance of Ruthumbi forest enjoying permanent preservation, and thus the greater the benefits each member could derive. Would you be willing to contribute toward this arrangement on a monthly basis?

[1] Yes [0] No.

(b) If “Yes”, what is the maximum amount you would pay? Ksh _____ per month.

(c) If “No”, please state the reason you would not be willing to contribute.

- [] I can't afford the money
- [] I do not have enough information about the problem
- [] I don't I have anything to loose
- [] I don't want to participate in this survey
- [] I don't like communal ownership of property
- Others (please specify) _____

10. (a) We would like you to think about a different issue. There has been an increasing number of squatters in Kenya. These people are in need of a place for settlement and farming. Some Kenyans have suggested that they be allocated forest land, and Mt. Kenya Forest was one of the targets. Suppose the government saw it necessary to clear Ruthumbi forest so as to provide settlement and farming land for these. Would you wish to be compensated for the loss of the benefits you derive from the forest?

[1] Yes [0] No

(b) If “Yes”, and supposing the compensation would be monthly, what is the minimum amount you would be willing to accept as compensation from the government? Ksh. _____ per month.

(c) If “Yes”, and you wanted the compensation to be a single (or a once-for-all) payment, please state the minimum amount you would accept. Ksh _____

11. In your own view, how could the government best solve this pressing problem of Squatters?

SECTION C: SOCIAL, ECONOMIC AND DEMOGRAPHIC PROFILE

12. Sex:

Male Female

13. Marital status:

Married Single

14. Are you the household head?

Yes No

15. How many members constitute your household, you included? _____ members

16. Which of the following best represents your age bracket?

<input type="checkbox"/> 21-25 Years	<input type="checkbox"/> 46-50 Years
<input type="checkbox"/> 26-30 „	<input type="checkbox"/> 51-55 „
<input type="checkbox"/> 31-35 „	<input type="checkbox"/> 56-60....„
<input type="checkbox"/> 36-40 „	<input type="checkbox"/> Over 60 Years
<input type="checkbox"/> 41-45 „	

17. What is your educational level?

No formal education
 Primary education
 Secondary education
 Post secondary education

18. How many years have you spent in formal schooling? _____ years.

19. What is your main occupation?

Farmer
 Teacher
 Businessperson/ Trader
 Driver
Others (please specify) _____

20. (a) Do you belong to any group or organization that is concerned with environmental awareness?

Yes No

(b) If "Yes", please specify its name. _____

21. Have you ever worked for the Forest Department?

[] Yes [] No

22. Which of the following brackets **best** explains your household's total income per month? (Tick where appropriate, and if **agreeable**, fill in the actual amount).

EMPLOYMENT INCOME IN KSH. (A)			INCOME FROM OTHER SOURCES IN KSH. (B)			TOTAL INCOME IN KSH. (A+B)	
TICK	Income bracket	Actual income	TICK	Income bracket	Actual income	Income bracket	Actual income
	Below 1,000			Below 1,000		Below 2,000	
	1,001-3,000			1,001-3,000		2,001-6,000	
	3,001-5,000			3,001-5,000		6,001-10,000	
	5,001-7,000			5,001-7,000		10,001-14,000	
	7,001-9,000			7,001-9,000		14,001-18,000	
	9,001-10,000			9,001-10,000		18,001-20,000	
	Above 10,000			Above 10,000		Above 20,000	

Remarks/Comments: _____

Thank you very much for your time and cooperation.