WILLINGNESS TO ACCEPT PAYMENT FOR CONSERVATION OF ECOSYSTEM SERVICES IN MOUNT KILIMANJARO, TANZANIA AND TAITA HILLS, KENYA

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ABSTRACT

A Contingent Valuation Method (CVM) was adopted to elicit monetary values of ecosystem services among sampled households in Taita Hills, Kenya and Mount Kilimanjaro, Tanzania. The aim was to find out the amount of money the households are willing to accept as compensation every year to trade-off between conservation of ecosystems and the ongoing destructive socio-economic activities taking place in the areas; and how it differs along the altitudinal gradient and across users groups. Multi-stage and simple random sampling techniques were used to select respondents in the two study areas. Data were collected from 352 respondents through interviews using a structured questionnaire. Findings showed that mean Willingness to Accept (WTA) compensation in Mount Kilimanjaro were USD 128.72, 195.74 and 223.90 per household per year for low, mid and highland areas respectively. Mean WTA compensation in Taita Hills were USD 217.2, 310.97 and 429.84 per household per year for low, mid and highland areas respectively. Female headed households had a relatively higher mean WTA (USD 267.78 per household per year) as compared to male headed households (USD 234.79 per household per year). Household size, age and environmental income of the head of household were the significant predictors at 5% level of significant as determined by the multiple regression analysis. It can be concluded from this study that, households residing at highlands have a relative higher mean WTA payments as compared to their adjacent lowland households. Female, headed households had as well higher mean WTA payments as compared to male headed households. The study, therefore, recommends that PES schemes should be tailored to meet unique requirements of the different user groups along the altitudinal gradient and address their specific constraints.

DECLARATION

I, CHARLES STEPHEN do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work that it has neither been submitted, nor being concurrently submitted for a degree award in any other institution.

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DEDICATION

My work is firstly dedicated to my father Stephen G. N. Chandika and my mother Flora M. Sawasawa who both laid the foundation for my education and devoted much of their time to offer me their dedicated care and support. Secondly, this work is also dedicated to my wife Flora Rubibira, my daughters Blessing C. Chandika and Adiel C. Chandika and my brother James Stephen who tolerated my absence from home. Last but not least, the work is dedicated to my grandfather Gabriel N. Chandika, my uncle Sebastian Pius and my aunt Nancy Kihara for providing me with moral and financial support.

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LIST OF ABBREVIATIONS AND SYMBOLS

&	and
ANOVA	Analysis of Variance
CEPF	Critical Ecosystem Partnership Fund
CHIESA	Climate Change Impacts on Ecosystem Services and Food Security in Eastern Africa
CV	Contingent Valuation
CVM	Contingent Valuation Method
DAEA	Department of Agricultural Economics and Agribusiness
EABH	Eastern Africa Biodiversity Hotspot
EAPES	European Assessment of Provision of Ecosystem Services
FAO	Food and Agriculture Organisation of the United Nations
FGD	Focus Group Discussion
ITCZ	Inter-tropical convergence zone
IUCN	International Union for Conservation of Nature
KINAPA	Kilimanjaro National Park
KNBS	Kenya National Bereau of Statistics
MEA	Millennium Ecosystem Assessment
NBS	National Bereau of Statistics of Tanzania
NGO	Non-Governmental Organisation
PES	Payment for Ecosystem Services
PRA	Participatory Rural Apprisal
REDD	Reduced Emission from Deforestation and Forest Degradation
SPSS	Statistical Package for Social Science
SUA	Sokoine University of Agriculture
TEEB	The Economics of Ecosystems and Biodiversity

TEV	Total Economic Value
UNEP	United Nation Environment Programme
URT	Universal Recycling Technology
USD	United States Dollar
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

1.1.1 Ecosystems in eastern afromontane biodiversity hotspot

The Eastern Afromontane Biodiversity Hotspot (EABH) stretches over a curving arc of widely scattered but biogeographically similar mountains covering an area of more than 1 million square kilometres and running over a distance of more than 7000 kilometres from Saudi Arabia to Mozambique and Zimbabwe (Bird life International, 2012). The EABH is of global significance because of its high numbers of endemic species (Myers *et al.,* 2000; Brooks *et al.,* 2002). Kenya and Tanzania constitutes 29% of the EABH (Bird life International, 2012), which includes 34.9 million hectares (URT, 1998; Wass, 1995).

The variability in rainfall and physiography of the countries allows for diverse ecosystems that range from coral reefs and mangrove along the Indian Ocean, coast to arid shrubs land in the north, to dense mountain forests and to the shores and water of Lake Victoria, Tanganyika and Turkana (UNEP, 2001). The main types of ecosystems include bush lands and thickets, swamps, mangroves and plantations, wetland and water bodies, agro and urban ecosystems (UNEP, 2001; World Resource Institute, 2003b).

Mount Kilimanjaro in Tanzania and Taita Hills in Kenya are within the mountain range in the EABH. These mountain range has important biodiversity and its ecosystem service values arising from the water towers provides water for the low lying areas to support the production of major crops like maize, cabbages and plantation crops like coffee and avocado; recreation and eco-tourism; habitats and nutrient recycling (CHIESA, 2011).

1.1.2 Capacity and benefits of ecosystem's in the areas

Ecosystem service capacity and service output are strongly connected to the idea of (standing) stocks and flows. Layke (2009) defines stocks of ecosystem services as the capacity of an ecosystem to deliver a service while the flow corresponds to the benefits people receive. The benefits depend on the flow of ecosystem services and these benefits do not exist when these services cease to flow (Barbier, 2007).

To measure the relationship between ecosystem and biodiversity in East Africa is very complex because on one hand species perform different services for ecosystems and on the other hand the change in biodiversity has effects on the functioning and flow of ecosystem services (Loreau *et al.,* 2002). Thus, the East African ecosystem performs abundant and varied role to support micro and macro fauna and flora of both scientific and economic value (World Resource Institute, 2003a).

According to CEPF (2012), the countries of the EABH with the exception of Saudi Arabia, are characterized by a high poverty rate and rapid population growth. This high rate of poverty forces people to rely on agriculture thereby creating pressure on land use as the population grows. The increased pressure on land use has resulted into expansion of agriculture into the marginal and fragile high montane ecosystems. Growing energy needs also lead to increased deforestation for fuel wood which is the main energy source in the region. Degradation, fragmentation of habitats and unsustainable exploitation of natural resources are the most important threats to biodiversity in the region.

The IUCN (1996) proposed a careful protection of the ecosystem to ensure continuous flow of ecosystem services (benefits) in EABH. This will eventually maintain the flow of benefits to surrounding communities, national and global interests to save the current needs as well as the future needs and contribute to spiritual, mental and physical well being and also help to fulfil an ethical responsibility to respect nature and provide opportunities to learn about nature and the environment.

Recent studies in Mount Kilimanjaro and Taita Hills show that increase in population growth has resulted into competition for recourse use between agriculture and biodiversity conservation which threatens the sustainability of food production and community livelihoods (Soini, 2006, Soini, 2005a). On the other hand, the anthropogenic climate change is already adversely affecting the ecosystems, biodiversity, human health and livelihoods (Mwaipopo *et al.,* 2003; Boko *et al.,* 2007), thereby, increasing the risk of food insecurity and extinction of both micro and macro fauna and flora in the area (Brooks *et al.,* 2002).

1.2 Problem Statement and Justification of the Study

1.2.1 Problem statement

As human population grows, cultivation and residential areas have expanded into conserved areas. The expansion has destroyed fallow land of open grassland and shrubs within the confined ecosystems which then reduces the capacity and flow of ecosystem goods and services. Soini (2005b; 2006) and CEPF (2012) reported that, ecosystems in the altitudinal gradient of Mount Kilimanjaro and that of Taita Hills are among the most disturbed ecosystems in the EABH and are subjected to a variety of land use pressures and many biodiversity losses in next few years. Therefore, in the course of protecting and conserving these ecosystems and striking a balance between needs and utilization, a clear understanding on how surrounding communities are WTA compensation as an alternative means to forgo destructive social economic activities is of vital. Different stakeholders such as local communities, business communities, conservation agencies and local councils have different priorities for ecosystem services/benefits. Given any array of stakeholders around Mount Kilimanjaro and Taita Hills ecosystems, differences in priorities by different stakeholders are inevitable. These priorities range from local, national to global needs in terms of livelihood and biodiversity. Benefits and ecosystem exploitations to local communities along the altitudinal gradients are becoming very crucial and sensitive issues to be addressed. In the process of meeting these priorities there is a need to know how much the surrounding community are willing to accept as compensation to abandon or reduce their destructive social economic activities taking place in the ecosystems. Without this knowledge it will be difficult to manage these critical ecosystems and sustain the benefits to users. It is important to understand the WTA compensation along with factors influencing it to enable policy makers and other stakeholders to plan for sustainable ecosystems use and management.

Some studies have been conducted along the gradients of Mount Kilimanjaro and Taita Hills. Many of these have dealt with the ecosystems management and livelihood in the area and are useful in generating scientific understanding of various ecological, biodiversity conservation and ecosystem. Soini (2005a, b), for example, assessed land use change and changing livelihood dynamics on the slopes of Mount Kilimanjaro and identified key challenges and opportunities. Another study analysed the livelihood capital, strategies and outcomes in the Taita Hills in Kenya (Soini, 2006). Lanne (2007) undertook a study to monitor indigenous tropical montane forests in the Taita Hills using airborne digital camera imagery. A more general study which explored the importance of ecosystem services to human well-being and climate adaptation in Tanzania was conducted by Devisscher (2010). Other studies in Taita Hills are those which are undertaken on continuous basis by the University of Helsinki through its Department of

Geography to monitor biodiversity patterns and interactions, land use practices and land cover change, climate change implications and water resources.

While there is greater understanding of the extent and distribution of ecosystems in the Mount Kilimanjaro and Taita Hills areas, little is known with respect to the amount the surrounding community (resources-poor households) are willing to accept and/or pay for conservation of ecosystems along the altitudinal gradients.

1.2.2 Justification of the study

Willingness to accept compensation of ecosystems and its linkage to gender along altitudinal gradient has received minimal, if any, attention in literatures and little has been done to document people's WTA/WTP in the EABH. This study was carried out to address these challenges and fill this knowledge gaps by offering a detailed account and long-term initiative that can be integrated in ecosystems policy and management plans. Therefore this study is of important for different stakeholders as outlined hereunder:-

(a) The information generated will directly help the communities and farmers who are producing and using the ecosystem services in Kenya and Tanzania especially women, who are typically key actors in maintaining and managing the ecosystems.

(b) The government institutions that will be better equipped to design appropriate policy through effective use of early warnings for changes in ecosystem services.

(c) The study shades, light on how to reduce exploitation of forest products by the local community and thus is aligned to national and international interests of biodiversity conservation around the critical ecosystems in the areas and the EABH at large. Therefore it is important for local, national and international stakeholders that are interested to conserve the critical ecosystem services within the EABH.

1.3 Objectives of the Study

1.3.1 Overall objective

The overall objective of this study was to investigate the WTA payments for conservation of different ecosystem goods and services in Mount Kilimanjaro and Taita Hills areas.

1.3.2 Specific objectives

The specific objectives of this study were to:

i. Identification and characterisation of ecosystem services in the study areas.
ii. Calculate WTA payments for ecosystem services along the altitudinal gradients.
iii. Compare the WTA for ecosystem services across gender (male and female) groups in the study areas.
iv. Evaluate factors influencing WTA for ecosystem services in the study areas.

1.4 Research Hypotheses

i. There is no difference in WTA along the altitudinal gradient in the study areas.
ii. There is no difference in WTA between male and female headed households in the study areas.
iii. Age, household size and environmental income are not the major factors influencing WTA.

1.5 Conceptual Framework

Willingness to accept compensation or pay for ecosystem services is influenced by several characteristics of ecosystem users like the assets owned by the head of household (i.e. human, natural, financial, physical or social assets). The assets are functions of several factors including socio-economic policies and institutional framework set by the governments, political regimes, moral, ethics and other traditional backgrounds as revealed by different cultures.

Likewise, demographic characteristics such as gender, age, income, employment status, marital status and family size may influence the ability and willingness to pay or accept compensations for ecosystem services although the relative influence of these factors can vary along altitudinal gradients and across communities that tend to attach different values to ecosystem services based on their norms and culture (Figure 1).

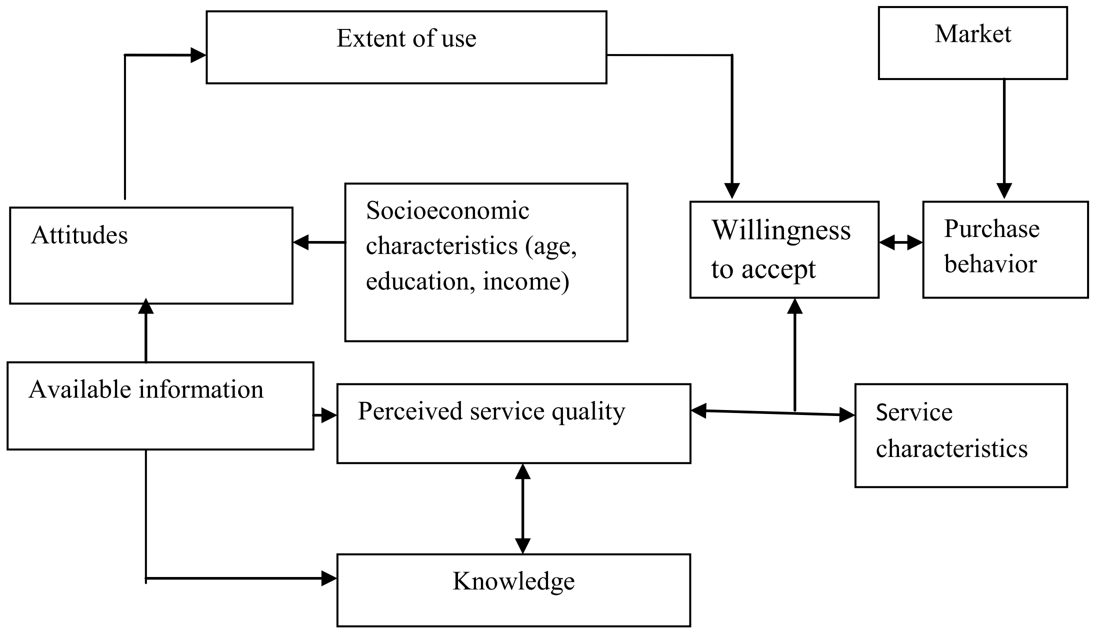

Figure 1: Conceptual frame work

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

The Eastern Afromontane Hotspot is one of the biological wonders of the world, with globally significant levels of diversity and endemism. Its ecosystems provide tens of millions of people with fresh water and other ecosystem services that are essential to their survival. However, there is a growing concern that many ecosystem services are undergoing rapid degradation due to overuse and misuse (MEA, 2005). The past and current conservation efforts face an ongoing threat from clearing of forest ecosystems. A common reason for this is a lack of institutions that guide the supply and demand for ecosystem services (Balmford *et al.,* 2002; Arrow *et al.,* 2000; Costanza *et al.,* 1997). One potential solution to the problem of overuse and misuse is a payment for ecosystem services (PES) program where households are paid to protect forests as a trade-off to their livelihood activities.

2.2 Ecosystem Services and Functions in the Hotspot

The Eastern Afromontane biodiversity hotspot was first recognized as globally important for species conservation by Mittermeier *et al.* (2004) when the global hotspot total was raised from 25 to 34 following a reappraisal in light of additional data. Its montane "islands" includes the highest peaks in Africa. Geological events in this hotspot have produced an extreme topography that dictates patterns of rainfall in the region and provides altitudinal gradients in ambient temperature, offering a breadth of climatic and edaphic regimes that support a variety of biomes and human enterprises. Localized volcanoes have fertile soils on their margins, supporting intense and productive agriculture, for example on the slopes of Mount Kilimanjaro (CEPF, 2012).

The Economics of Ecosystems and Biodiversity (TEEB) (Table 1) proposed a typology of 22 ecosystem services divided into 4 main categories: provisioning, regulating, habitat and cultural services (EAPES, 2011). This classification is similar to the MEA classification except the omission of supporting services such as nutrient recycling. The availability of these services is directly dependent on the state of the habitat providing the service.

Table 1: Typology of ecosystem services as adopted from TEEB

PROVISIONING SERVICES	THE GOODS OR PRODUCTS OBTAINED FROM ECOSYSTEMS • Food (*e.g. fish, game, fruit*) • Water (*e.g. for drinking, irrigation, cooling*) • Raw materials (*e.g. fiber, timber, fuel wood, fodder, fertilizer*) • Genetic resources *(e.g. for crop improvement and medicinal purposes)* • Medicinal resources *(e.g. biochemical products, test organisms)* • Ornamental resources *(e.g. decorative plants, pet animals, fashion)*
REGULATING SERVICES	THE BENEFITS OBTAINED FROM AN ECOSYSTEM'S CONTROL OF NATURAL PROCESSES • Air quality regulation *(e.g. capturing fine dust, chemicals, etc.)* • Climate regulation *(e.g. influence of vegetation on rainfall, etc.)* • Moderation of extreme events *(e.g. flood prevention, etc.)* • Regulation of water flows *(e.g. irrigation and drought prevention)* • Waste treatment *(e.g. water purification)* • Erosion prevention • Maintenance of soil fertility *(e.g. soil formation)* • Pollination • Biological control *(e.g. seed dispersal, pest and disease control)*
HABITAT SERVICES	SERVICES SUPPORTING THE PROVISION OF OTHERS BY PROVIDING HABITAT • Nursery habitat • Gene pool protection
CULTURAL SERVICES	THE NONMATERIAL BENEFITS OBTAINED FROM ECOSYSTEMS • Aesthetic information • Opportunities for recreation & tourism • Inspiration for culture, art and design • Spiritual experience • Information for cognitive development

Source: European Assessment of the Provision of Ecosystem Service, (2011)

Given the growing human population within the hotspot, scarcity of available fertile land, current global economic situation (high and increasing prices for food and minerals) and limited urban employment and livelihood opportunities are likely the threats to biodiversity (MEA, 2005).

2.2.1 Gender issue in relation to ecosystem use

In the hotspot, political and economic decision-making, access to and rights over natural resources are generally dominated by men, although women‘s rights vary significantly across countries. In most countries, there is active discrimination against women in terms of education, health care and financial possibilities. The gap in education and decision-making is particularly obvious in the natural resource management sector (in which the majority of both government agency and NGO staff across the region are male) (FAO, 2010). Women tend to have less access to education, lower incomes and reduced ability to own land and other assets. They are also typically the homemakers and are the ones who raise children, collect water and firewood and perform most of the farming activities (Patt *et al.,* 2009; CARE International, 2010). Therefore, women usually have more direct contact with natural resources and a better understanding of the critical value of biodiversity and ecosystem services.

Men tend to have higher levels of education and are typically involved in exploitation (e.g. logging and charcoal production; commercial and illegal hunting; commercial collection of medicinal herbs and wild products). This role gives men greater mobility and higher income levels in general. Agreements between governments and village committees for sharing natural resources and ecosystem services are generally dominated by men on both sides and they focus on issues of strategic and financial interest to male society. Women are given access to areas under participatory forest management arrangements to collect items of use to the household but not generally to profit economically (CEPF, 2012).

2.2.2 Payments for ecosystem services

Payments for ecosystem services (PES) have been proposed as mechanisms to deliver better conservation by linking beneficiaries of an ecosystem service with providers using a mechanism to pay the people who manage the natural habitats that provide the service. In developing countries these have included payments for ecological tourism (Clements *et al.,* 2010), water provision (Pagiola, 2008; Asquith *et al.,* 2008; Wunder *et al.,* 2008), forest carbon (Reducing Emissions from Deforestation and Forest Degradation plus carbon enhancement, REDD + (e.g. Burgess *et al.,* 2010; Clements 2010), pollination of crops (Ricketts, 2004) and delivery of biodiversity outcomes (Sommerville *et al.,* 2010; Clements *et al.,* 2010; Aryal *et al.,* 2009). Examples of the schemes involved in the PES programme in Tanzania and Kenya are the Reduced Emissions from deforestation and forest degradation (REDD+) and pilot projects exist in almost both countries with a greater investment in Tanzania (Burgess *et al.,* 2010).

Plate 1: A picture illustrating mechanism for PES

(Photo by: Charles Stephen)

In Tanzania, legislation for PES is pending but voluntary agreements on water management are already in place in the Uluguru and Usambara mountains (CEPF, 2012). Economic valuations have been done for the Eastern Arc Mountains in Tanzania, Mulanje Mountain in Malawi, and are currently being done for the Virungas in the Albertine Rift (CARE International, 2010). According to CEPF (2012), national REDD+ strategies/REDD readiness plans are being developed in DRC, Ethiopia and Kenya following the readiness plan produced in 2010. While similar projects are already in place and being implemented in Mozambique, for example the carbon-credit afforestation schemes around Gorongosa National Park (Envirotrade). A number of initiatives have begun piloting REDD under voluntary mechanisms in Kenya, Malawi, Tanzania and Uganda such as the Forest Carbon Portal.

2.3 Methodological Approaches for WTA Payments for Ecosystem Services

Many methods for measuring the utilitarian values of ecosystem services are found in the resource and environmental economics literature. Some are broadly applicable, some are applicable to specific issues and some are tailored to particular data sources (Pagiola *et al.,* 2004). A common feature of all methods of economic valuation of ecosystem services is that they are founded in the theoretical axioms and principles of welfare economics. Most valuation methods measure the demand for a good or service in monetary terms, that is, consumers' willingness to pay (WTP) for a particular benefit, or their willingness to accept (WTA) compensation for its loss (Hanneman, 1991; Shogren *et al.,* 1997).

2.3.1 Total Economic Value

The Total Economic Value (TEV) framework allows individuals to hold multiple values for ecosystems. Bishop *et al.* (1987) wrote that in TEV it is necessary to ensure that all components of value are given recognition in empirical analysis and that "double counting" of values does not occur when multiple valuation methods are employed.

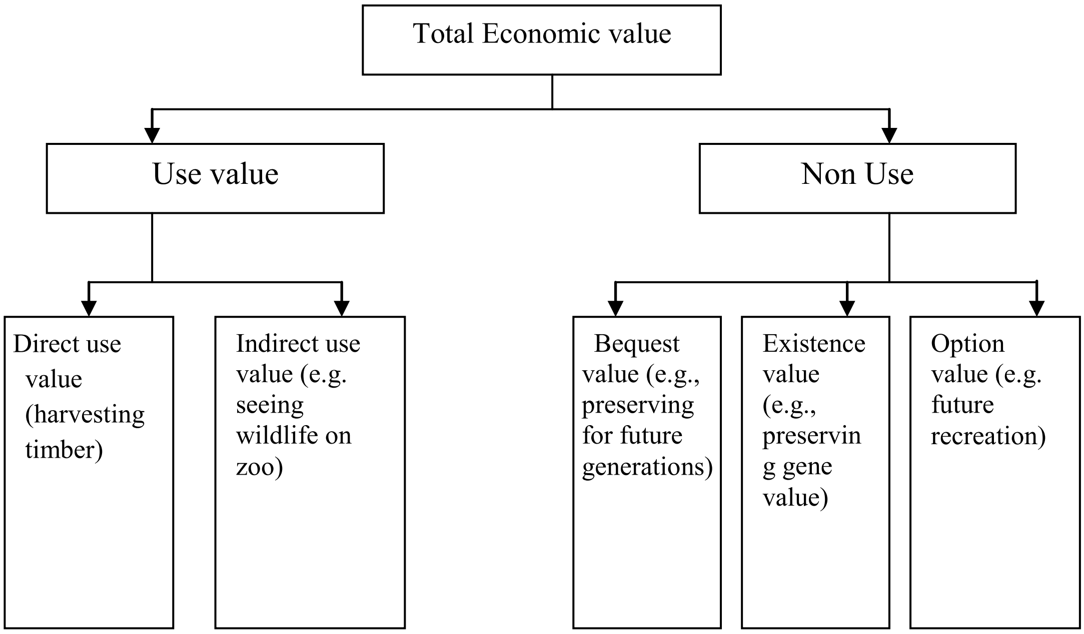

Figure 2: Total Economic Value Frame Work

The above breakdown and terminologies vary slightly from analyst to analyst but generally includes the use values and non-use values (Kadigi, 2011).

Economic, deliberative and participatory methodologies are used to try to reveal none use values of ecosystem service benefits by attempting to establish either individuals' willingness to pay (WTP) for an ecosystem service (to avoid its degradation) or willingness to accept (WTA) compensation for any degradation (or for forgoing an improvement or restoration of an ecosystem service). Five main of methodologies are normally employed to evaluate ecosystem services (Arrow *et al.,* 1993).

2.3.1.1 Market prices

These methods can be used to estimate the value of ecosystem goods that are traded in formal markets, such as timber or fish. The prices need to be adjusted for any environmental market distortions as they are prices and not value.

2.3.1.2 Cost methods

These methods are based on the cost of damage caused by the loss of an ecosystem service or expenditure to prevent that damage or the cost of replacing the ecosystem service altogether. These methods do not assess the welfare impact of gains or losses and hence provide estimates of 'value' in the same way revealed or stated preference methods can (Kadigi, 2011).

2.3.1.3 Revealed preference methods

These methods are based on observed behaviour. For example, values are estimated from proxies such as the cost and number of recreational visits or differences in property values (Kadigi, 2011). The travel cost model and hedonic pricing are good examples using this method. A practical example conducted and estimated by the travel cost model is that conducted by Navrud *et al.* (1994) on Lake Nakuru national park in Kenya.

2.3.1.4 Stated preference method

This method is used extensively to estimate the value of non market goods in the context of environmental policy and management by the use of contingent valuation and choice experiments (Arrow *et al.,* 1993). One advantage of this method is its flexibility that allows a wide range of environmental changes that can be valued (Kadigi, 2011).

2.3.2 Contingent valuation method

Contingent Valuation (CV) is generally a method used in the estimation of the value of nonmarket good such as clean air or water. CV methodology has been used to generate willingness to pay (WTP) or willingness to accept (WTA) functions for a large and diverse set of consumer goods. To-date the approach is increasingly being adopted in planning and policy formulation. The idea of CVM was first suggested in 1947 and the first study ever done was in 1961 by Davis (1963). Since then, CVM surveys have become one of the most commonly used methods for valuation of non-market goods.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Areas

The study areas are located between latitudes 03^0 00’ 00” and 03^0 35’ 00” S and Longitudes 35^0 00’ 00” and 37^0 30’ 00” E and are part of the Eastern Afromontane Biodiversity Hotspot (EABH). The areas encompass scattered but bio-geographically similar mountain ranges and are known for rich biodiversity plants and animal species of which 30% are endemic (CHIESA, 2011). The steep elevation gradients and associated climate and ecosystems provide a wide range of critical ecosystem services for agriculture and biodiversity conservation within the hotspot.

The climate of the areas is partly dependent on the inter-tropical convergence zone (ITCZ) which lies parallel to the equator but moves south and north with the seasonal passage of the thermal equator. The seasonal movements of the ITCZ cause a bimodal rainfall pattern in the Areas: the long rains (starting in March to May) and the short rains (in October to December) (Tuhkanen, 1991; Vogt *et al.,* 2000). Mist and cloud precipitation, on the other hand, occur throughout the year in the higher elevations’ of the mountains. The mountains are the first barrier for moisture-laden air masses that blow in from the coast (Beentje, 1988). The eastern and south-eastern slopes receive more rain from these humid south-east trade winds than do the western and northern slopes that are in the rain shadow area (Vogt *et al.,* 2000). The average annual rainfall ranges from 500 mm in the plains to 1,500 mm in the upper mountainous areas (Jaetzold *et al.,* 1983). The temperature in the areas is mainly determined by the altitude (Tuhkanen, 1990).

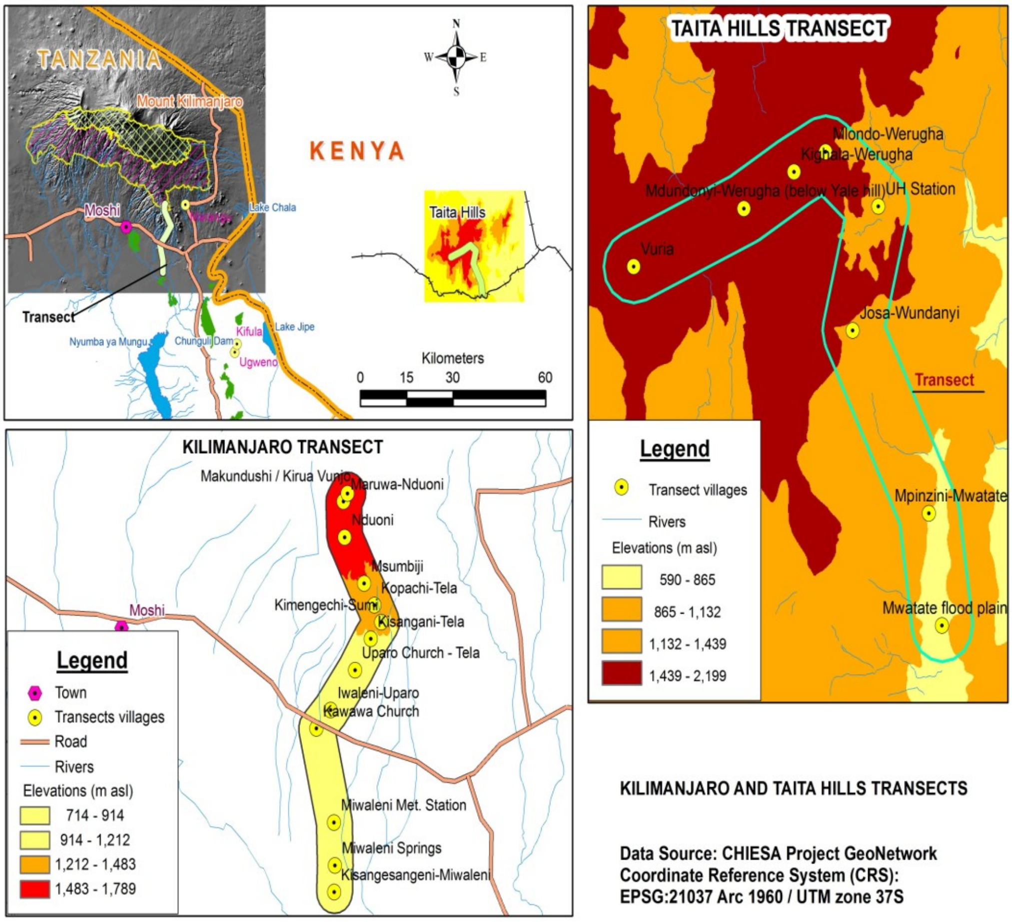

Figure 3: Map showing the study areas in Mount Kilimanjaro, Tanzania and Taita Hills, Kenya

3.1.1 Mount Kilimanjaro

Each study area was divided into three distinct altitudinal agro-ecological zones, namely lowlands, a zone of extensive livestock farming and open crop fields with remnant bush land patches extending from 700 up to 1200 metres above sea level (masl), midlands a maize-bean belt which is a mosaic of home gardens and open fields with few bush land patches interspersed between, extending from 1200 up to 1500 masl and highlands, a traditional Chagga home garden area dominated by coffee and banana with many large trees, extending from 1500 up to 1700 masl to the lower forest boundary of KINAPA (Figure 3).

The villages surveyed were Kisangesangeni, Uchira, Uparo, Iwa, Nduoni and Marua. The villages are situated along the altitudinal gradient of the Mountain. Two villages from each of the three agro-ecological zones namely lowlands, midlands and highlands were selected (Table 2).

Table 2: Sampled villages along the altitudinal gradient of Mt. Kilimanjaro

Study Village	Altitudinal zone
Kisangesangeni	Lowland
Uchira	Lowland
Uparo	Midland
Iwa	Midland
Nduoni	Highland
Marua	Highland

3.1.2 Taita Hills

In the Taita hills, two sub-locations were sampled in each of the agro-ecological zones namely lowlands, midlands and highlands. In the lowlands flood plain (around 843 masl) the two sub locations surveyed were Mwatate and Mwachabo, while in the midland (around 1500 masl) the two sub locations surveyed were Wundanyi and Sungururu. The last survey was done in areas near the natural forest reserve of Vuria (around 2193 masl) where two sub locations namely Mgange Nyika and Mgange Dabida were surveyed (Table 3).

Table 3: Sampled sub-locations along altitudinal gradient of Taita hills

Study Sub location	Altitudinal zone
Mwachabo	Lowland
Mwatate	Lowland
Wundanyi	Midland
Sungururu	Midland
Mgange nyika	Highland
Mgange Dabida	Highland

3.1.3 Similarities and differences of the study areas

The two study areas encompass scattered but bio-geographically similar mountain ranges. The areas have: unique ecosystem service values arising from the water towers they provide for the low lying areas; food production involving major crops like maize, cabbages and plantation crops like coffee and avocado; recreation and eco-tourism; habitats and refugia, and nutrient recycling. However, high population densities in the areas and effects of climate change have resulted into resource competition between agricultural activities and biodiversity conservation. The highland people have depended on the lowlands for supplying part of their food production, mainly maize and beans, while the highlands provide the bulk of the fruits and vegetables for both the highland and the lowland populations Soini (2006).

One of the most significant differences relates to the issue of land scarcity or availability. Taita farmers have on average two and a half times more land per family than Kilimanjaro farmers. Even though in both places farmers usually have two plots and some even more, parcel size is much bigger in the Taita Hills than in Mount Kilimanjaro areas (Soini, 2006). These differences are mainly due to policies where land consolidation has occurred in the Taita Hills while land ownership in Kilimanjaro has evolved without any major intervention by the Tanzanian government. Land renting is common in Kilimanjaro while it is almost nonexistent in the Taita.

3.1.4 Population and ethnicity

The population of the Taita-Taveta county is about 284 657 (KNBS, 2009) and of Moshi district council is about 466 737 (NBS, 2012). The areas are inhabited by different ethnic groups. In areas around Mount Kilimanjaro, the Chaga accounts for almost 79% of the population, the Pare accounts for 11% and other groups like Zigua, Bena, Nyamwanga, Nyamwezi, Luya, Nyaturu and Rangi account for 10% of the total population. In Taita Hills, 97% of the dwellers are Taita and the rest (Kikuyu, Kamba and Duluma) constitutes only 3% of the total population. The main economic activities in the area include farming; especially crop cultivation, horticulture. Other activities such as charcoal selling and small businesses are also practised. Crops grown include maize, banana, coffee, beans, cassava, paddy, potatoes and grams. Horticultural crops include avocado, mangos and vegetables like cabbage, greens and onions.

3.2 Data Collection

3.2.1 Research design, sampling procedures and sample size

The study adopted a cross-sectional design where respondents in different agro-ecosystems zone were interviewed using a questionnaire. Multi-stage and purposive sampling procedures were used to identify study areas, villages/sub-locations, households and individuals for interview. These sampling procedures were adopted because it facilitated sampling from a large population whose members were not known. The sampling frame was the number of households from the identified villages/sub-locations where respondents were selected using a proportionate sampling approach. The groups representing different gender groups (disaggregated by age, sex and physical disability) and income groups were interviewed.

Though Boyd *et al.* (2007) recommend that a reasonable sample size for a particular population under study should at least be 5%, a significant representation can also be achieved when sample units contains 30 households from a population under study (Akitanda, 1994). In this study an average of 30 households were selected and surveyed in each village/sub-location. Questionnaire surveys were conducted where a random sample from each stratum representing the female, male, rich, poor, disabled and able as well as youth and adult headed households were interviewed. In total 352 respondents were interviewed as per details provided in Table 4.

Table 4: Number of household sampled and interviewed

Village/Sub-location	Total number of households	Number of sample households
Kisangesangeni	671	24
Uchira	1544	30
Uparo	747	34
Iwa	400	31
Nduoni	500	35
Marua	370	30
Mwachabo	3065	30
Mwatate	1715	30
Wundanyi	1109	28
Sungururu	685	29
Mgange Nyika	788	28
Mgange Dabida	621	23
Total	**12215**	**352**

3.2.2 Preliminary studies

Reconnaissance survey was conducted to get acquainted with the study areas before the main survey. The aim was to identify and categorise stakeholders and study villages/sub-locations. The household questionnaire was pre-tested at Kisangesangeni village in Mount Kilimanjaro and Wundanyi sub-location in Taita Hills which enabled the researchers to identify the weaknesses, ambiguities and/or omissions. Necessary modifications were then made to suit the prevailing local circumstances.

3.2.3 Main study

3.2.3.1 Socio-economic data

Both close-ended and open-ended questions were designed to solicit information from respondents (Appendix 1). Focused group discussions (FGD) involving key informants were also conducted using checklist of questions (Appendix 2). Key informants are people who are accessible, willing to talk and have adequate knowledge on issues under investigation (Mayeta, 2004; Borrin-Feyerabend, 1997). Key informants were people who were involved in collecting and/or selling wood and non-wood forest products, local medicinal dealers, village environmental group leaders, local government leaders and village elders.

Transect walks were conducted in each village in which topography, land use, land degradation, vegetation, water resources, farming practice, socio-economic aspects and status of ecosystems were observed and recorded. The exercise also involved taking photographs of features that seemed to explain the characteristics of the ecosystem goods and services.

Participatory Rural Appraisal (PRA), in accordance to Campbell *et al.* (1995) and Luoga *et al.* (2000), was also carried out to capture the typology of ecosystem goods and services available to local communities and their conditions. At least three villages in Mount Kilimanjaro and three sub-locations in Taita Hills representing each agro-ecological zone namely lowland, midland and highland were surveyed.

3.2.3.2 Secondary information

Secondary data were obtained through the review of the current literature on various topics and related studies. Other sources of secondary information included consultation with District officials in Moshi district council, Tanzania and Taita county council in Kenya. Data from CHIESA projects was also used to nourish the report. Progress, reports, management plans, and policy and legislative documents were also reviewed.

3.3 Data Analysis

3.3.1 Analysis of qualitative data

Qualitative data collected through FDG and PRA techniques were analysed with the help of participant themselves. [1]*Content and structural functional analysis* techniques were employed to analyze the content of information collected through verbal discussion with the key informants. The analyses helped the researcher to ascertain values and attributes of respondents thereby generating themes and tendencies on obvious and concealed functions. Obvious functions as defined by Kajembe (1994) as those which are intended and recognised by actors in the system while concealed functions are defined to be consequences that are not recognised by the actors.

3.3.2 Analysis of quantitative data

The completed household interviews were coded and data from open ended questions were categorised into groups to enable easy coding and analysis. Quantitative data analysis was done using Statistical Package of Social Science (SPSS version 16) computer programme. Descriptive statistics such as measures of central tendency and measure of dispersion were used to analyze the quantitative data. Inferential statistics was used to establish the relationship between independent and dependent variables. According to Martins (1995), inferential statistics help in revealing whether patterns described in the sample are likely to apply to the whole population under the study. At the beginning, the contingent valuation procedures were employed to obtain the mean WTA compensation from the different groups of respondents. Then an independent *t*-test was used to compare the differences in mean WTA compensation among the different groups of respondents so as gauge whether there were statistically significant differences in WTA compensation

[1] A system of analysis of social phenomena and processses viewed as parts of structurally stratefied whole, where each structural element has definite function or purpose (The great soviety *Encyclopedia*, 1979)

among the segments of the study population surveyed. Lastly a multiple linear regression model with social-economic and demographic predictor's was employed to identify factors underlying respondents. WTA compensation for the model specification and predictor variables are as shown in Table 5.

Table 5: Predictor variables in the regression model

S. No.	Variable name	Variable explanations	Variable type	Variable label (if any)
1	AGEHH	Age of the head of household in years	Continuous	-
2	HHSIZE	Household size (indicating number of people living as a family)	Continuous	-
3	EDUHH	Level of education attained by the head of household	Categorical	1. No formal education 2. Primary education 3. Secondary education 4. Post secondary 5. Others
4	ALTITUDE	Location of the household in the three altitudinal zones namely lowlands, midlands and highlands.	Categorical	1. Lower 2. Middle 3. High
5	HHCATEGOLY	Type of the head of household	Categorical	1. Female 2. Young 3. Poor 4. Able 5. Disabled 6. Old
6	FORTSIZE	Total size in acres of the forest owned by the household.	Continuous	-
7	CASHENVIRN	Total income from forest products received by the household from selling various products in a year	Continuous	-
8	ECORANK	Perception of economic importance of the ecosystem goods and services found around the village or sub-location	Categorical	1. Low 2. Moderate 3. High
9	ENVIRONRANK	Perception of environmental importance of the ecosystem goods and services found around the village or sub-location	Categorical	1. Low 2. Moderate 3. High
10	STDAREA	Study area where the household is located	Dummy	1. Kilimanjaro 2. Taita

The model specification was:-

$$Y_i = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon \qquad \text{..(1)}$$

Where:

$Y_i =$ the i^{th} observed value (score) of dependent variable (WTA payments as compensation to conserve the ecosystem through abandoning all destructive social economic activities taking place in the study areas.

x_1 to x_k = predictor variables as shown in table 5 above.

β_0 = is the constant term or intercept of the regression model.

$\beta_1 \dots \beta_k$ = Are coefficients showing the marginal effect of the unit change in the independent variables on the dependent variables.

ε = random error term.

$i = 1, 2, 3, \dots, N$ is the total number of respondents in the sample.

k = Total number of predictor variables.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

This chapter presents the research findings and it is divided into three sections. The first section discusses results from identification and characterization of the ecosystem services. The second section evaluates the WTA compensation for ecosystem services disaggregated by gender along the altitudinal gradients in the study areas. The third section discusses factors influencing WTA compensation for ecosystem services in the study areas.

4.1 Identification and Characterization of Ecosystem Services

4.1.1 Forest ecosystems

Both, Mount Kilimanjaro and Taita Hills are endowed with forest ecosystems in which some patches fall under protection while others do not. The forest ecosystems are endowed with various plant and animal species. Forests were reported to have declined in terms of size and biodiversity compositions because there has been considerable forest clearance to open new farms and settlements and tree cutting for fuel wood. One of the locally perceived effects of such experience has been increased soil erosion, especially where there were inadequate soil conservation measures.

4.1.2 Aquatic ecosystems

The aquatic ecosystems in the study areas form the least part of the ecosystems. They are characterized by streams, rivers, valleys and artificial ponds. These water bodies were supported by numerous natural springs which were scattered on the slopes of the mountains and hills. However, due to climate change some of these natural springs have dried up while others are drying up. The remaining water bodies form a home for a number of fish species in the areas.

Aquatic ecosystems were reported to be deteriorating in terms of water flows in rivers and streams, fish catch in the rivers as well as water content in wetlands. Siltation was a problem in some villages/sub-locations and a serious case reported was that of Mwatate dam which had completely disappeared because of siltation. In the river systems, the major concerns were the increasing seasonality associated with rivers drying up much earlier in the dry season as compared to the past. Natural springs were reported to have decreased in terms of water discharge. Generally, responses from the discussions indicated that aquatic ecosystems, particularly rivers and springs, were progressively decreasing in terms of their reliability. These changes were attributed to changing climate and increased destruction of water catchments. A myriad of ecosystem goods and services were mentioned by villagers during both focus group discussions, PRA and during household interviews and were assessed by the researchers during transect walks. These goods and services include timber, water, food and cash crops, fire wood, building materials, pasture, medicinal services, honey, tourist attractions and micro climate moderation.

4.1.3 Timber

Timber was one of the forest products that were used by many households in the study areas for construction and furniture. The beneficiaries of this product included few people from outside the study areas because of strict rules on harvesting of forest products and thus very few licensed people were able to access the products. The rest of the people obtained timber from a reportedly illegitimate harvesting from forest reserves such as Kilimanjaro National Park (KINAPA) in Mount Kilimanjaro and Vulia forest in the Taita Hills. Sample data (Table 6) showed that about 9.8% and 7% of the households in Mount

Kilimanjaro and Taita Hills respectively have benefited in one way or another from these forest ecosystems in the last season.

Table 6: Rate of wood forest products use by households in the study areas

Wood forest products	Timber		Poles		Planks		Charcoal		Firewood	
	KL	TH	KL	TH	KL	TH	KL	TH	KL	TH
% In use	9.8	7	30	27	21	22	9	11	93	92
% Not in use	90.2	93	70	73	79	78	91	89	7	8

NB: KL = Mount Kilimanjaro, TH = Taita Hills

Source: This Study

4.1.3.1 Gender disaggregated domestic uses of timber

Males were found to be leading in exploitation of timber as compared to female and children. Sample data showed that adult male constituted 94% and 85% of the population involved in exploitation of timber in Mount Kilimanjaro and Taita Hills, respectively. Females using timber constituted on average 5.5% of the total population from both study areas, while none of the children were proved engaging in timber exploitation (Table 7). Therefore, males were more engaging in timber exploitation in both study areas.

Table 7: Percentage use of wood forest products by gender in altitudinal gradients

Wood forest products		Timber		Poles		Planks		Charcoal		Firewood	
		KL	**TH**	**KL**	**TH**	**KL**	**TH**	**KL**	**TH**	**KL**	**TH**
Gender group % Use	Female(F)	6	5	25	14	26	14	20	15	44	46
	Male(M)	94	85	55	57	58	69	67	74	13	15
	Children(C)	-	-	5	15	3	1	13	-	16	15
	M & C	-	-	10	-	7	12	-	-	6	8
	F & C	-	-	3	-	3	-	-	-	17	8
	All	-	15	2	14	3	4	-	11	4	8
Altitudinal % Use	Low	10	29	37	46	32	48	72	29	32	33
	Mid	48	33	23	31	29	24	21	50	35	32
	High	42	38	40	23	39	27	7	21	33	35

NB: KL = Mount Kilimanjaro, TH = Taita Hills

Source: This Study

4.1.3.2 Percentage use of timber along the altitude

Under domestic use midland areas in Mount Kilimanjaro accounted for a higher rate of exploitation of timber (48%) followed the highlands (42%) and in the lowlands (10%). Under commercial use, people in the highland areas were the majority (42%) followed by those in the lowlands (25%). This implied that timber availability and exploitation was much prominent in the highlands of Mount Kilimanjaro as compared to adjacent lowland areas (Table 7).

4.1.4 Water

It was mentioned that water was mainly used for domestic purposes, construction and fish farming/aquaculture. Household use was the most important type of water use in both study areas. The main domestic use included cooking and drinking (both for human and livestock), washing, and cleaning, and watering home gardens. In some other villages water was tapped and directed to homesteads through pipes. In Kilimanjaro, for example, almost all the households were connected to tap water in highlands and midlands while at the lowlands less than 50% were connected to tap water. Water supplied to villages was taped from sources around Mount Kilimanjaro and directed to different users. For those who were not connected to water pipe lines, they fetched water from streams and natural springs that were nearest to their home stead. It was reported by the respondent that in the past, a village had about 20 natural springs but only two natural springs existed when the survey was conducted.

The discovery of underground water spring at Miwaleni/Kisangesangeni was reported to be important in supporting irrigation and horticultural development. The production of vegetables, onions, maize and paddy under irrigation were reported to be important livelihood opportunity for communities around Mount Kilimanjaro. However there was a concern that water was not enough to support irrigation for both small and large scale farmers with a licensed private ownership rights.

Experience from Mount Kilimanjaro reveals that the possibility of being not connected to piped water decreases as the distance from town or road network increases. This affected the poorest households who failed to establish settlements around town centres or near road networks. In Taita Hills, the availability of water for domestic use was more problematic in the lowlands, where most of the households were not connected to piped water and the supply of this water was unreliable due to poor and old water infrastructures which were built during colonial time. In the highlands, people fetched water from points where public water was provided or from streams. It is approximated that 70% of the households in the highlands had access to piped water while the remaining 30% had access to stream water. However the respondents' acknowledged that there was a decrease in the flow of water in the streams and agriculture was identified as the main contributor to water pollution in the areas due to the application of inorganic fertilizers.

Gender disaggregated use of water

All age and sex groups were involved in water use. Women and children were more responsible to ensure that water for domestic uses was available while adult male and male children were more responsible for fetching water for livestock use and construction. Also it was reported that people from outside the study areas were benefiting from water flowing from ecosystem within Mount Kilimanjaro. Examples of these beneficiaries were the sisal estates at Mwatate and irrigated onions and paddy farms in and around Kisangesangeni in the low land areas of Mount Kilimanjaro. However, in Taita Hills there was more gender balance water use and management at family level where both male and females assisted each other in making decisions related to water use and management.

4.1.5 Fishing

Fish farming was one of the activities practiced using water obtained from the ecosystems in the study areas and it was an important livelihood option for people who were involved in this activity. In Mount Kilimanjaro, fish farming was reported in the highland and lowland areas, especially along the Miwaleni water spring channels.

In Taita Hills, fishing was mostly practised at midland areas and was rare in highland and lowland areas. Initially, this activity was being carried out in rivers but modernisation slowed people to establish artificial ponds. The government supported excavation of 250 fish ponds at Wundanyi location where the pond ownership was based on ownership. This project was established in 2010 and was reported to have increased the availability and marketing of fish in the area. It was further reported that only 20% of households in the highlands owned fish ponds and harvesting was done twice per year. In the lowlands, fishing was practiced at a relatively small scale where only 5% of the households had access to the fishing pond. The lowland ponds tapped water from Mwatate River which originates from Kidaya Ngerenyi sub-location. In general all agricultural products including fish in the lowlands were sold within Mwatate market although some were transported to other markets in Voi and Mombasa.

Generally, male, female and children were involved in one way or another in the process of production and keeping fishes although it was reported that decisions related to the use of income obtained after the selling of fish were made by the heads of the households. Since artificial fish layering is one of the environmental and ecosystem biodiversity friendly practices, it was perceived as environmental and biodiversity solution for degradation in Taita Hills. When the study was conducted fishing industry in Taita Hills was facing several problems like inadequate water flow to the ponds, theft from deceitful individuals and sometimes fishes were eaten by carnivorous birds like Minyange birds/kingfisher and homourhock. Also, there were emerging conflicts on water use rights between farmers and ponds owners.

4.1.6 Food and cash crops

Food and cash crops were mentioned to be among the ecosystem goods from the arable landscape. Various food crops were grown in the study areas thereby providing food for the local and nearby communities. However, climate change and high population growth that reduced the size of arable land were reported as the main factor that contributed to reduce crops in the study areas. It was also reported that some crops which were grown in the past were no longer being grown because of climate change and marketing problems. For example, coffee and cotton were no longer grown in Taita Hills due to marketing problems. The production of banana and sugarcane which were also common crops in the study area was declining overtime mainly due to the effect of climate change. Lowland areas that were previously suitable for the production of these crops were no longer suitable because of unfavourable temperature and erratic rainfall.

The common food crops grown in Mount Kilimanjaro were maize, avocado, banana, vegetables, groundnuts, beans, sunflower and coffee. Coffee was still the main cash crop in the area. Changes in climatic factors in Kilimanjaro favoured maize and rice production. Some of the peasants and a few commercial farmers reported having abandoned their coffee farms in the mountains due to low price and were using more resources and devoting more time to produce maize and rice in the lowland areas. The specific crops grown in highland areas included coffee, maize, yams, vegetables and banana.

Most of the farms under food crops were owned by the heads of households regardless of their gender though it was reported that coffee farms were traditionally owned by men. In Taita Hills the common crops grown were maize, banana, French beans, green grams, cassava, sorghum, cowpeas, pigeon peas, cassava, coco yams, fruits (avocado, oranges, passion, pawpaw and pumpkins) and vegetables (onions, cabbage, "*sukuma wiki*", pepper and tomatoes). Most of the women produced crops like sweet potatoes, "*sukuma wiki*" and vegetables while men were more responsible in growing cereal crops and it was reported that income from these crops was mainly used to finance family needs.

4.1.7 Firewood and charcoal

Firewood and charcoal were important ecosystem goods for generating energy at household level. Almost 93% of the household in Mount Kilimanjaro and 92% in Taita Hills used firewood for cooking and heating homes (Table 7). The households collected firewood from the forests located within the household compounds or nearby. Charcoal was the second most preferred fuel in small towns like Uchira in Kilimanjaro and Wundanyi and Mwatate in Taita Hills. It was approximated that Charcoal was used by 9% of the households in Kilimanjaro and 11% of the household in Taita Hills (Table 6).

Gender disaggregated use of firewood and charcoal

Women and men assumed different roles in the harvesting and production of these two ecosystem goods. Many women and children (75%) and few men were engaged in collecting firewood. In contrast more men and male kids (70%) were engaged in the production of charcoal (Table 7). In terms of commercial utilization children were involved in selling of firewood while men were mainly focusing on charcoal.

4.1.8 Building materials

Building materials that were common in the study areas included poles, timber/logs, thatch grasses, soil, ropes, sand, stones/gravel, and rocks. Most of the houses in the study areas were either made of burnt or un-burnt clay bricks with corrugated iron sheets although a considerable number of houses were thatched with grass. On the other hand, the innovation to use volcanic soil in marking bricks in Mount Kilimanjaro was reported to have reduced the extent to which forest products were used in construction of houses.

4.1.9 Pasture

Pasture was another important good obtained from the ecosystems in the study areas. However, during the focus group discussion, it was reported that the availability of pasture for livestock was declining as a result expansion of agricultural land resulting from rapid population growth. Another reason behind the decrease in the availability of pasture was the effect of climate change, especially the reduction in the intensity and frequency of rainfall. Consequently pasture was becoming more expensive because its supply was below demand.

Almost every household in the highland of Mount Kilimanjaro kept livestock under zero grazing practice. The average herd size was two cattle per household. About 25% of the households in the low land kept cattle (about 10 per household). Women ware responsible for cutting grass and feeding livestock in the highlands and they controlled the use of milk. The most common grazing practice in the lowland was free range system where male children were responsible for grazing.

It was estimated that 50% of households in the highlands of Taita Hills were livestock keepers with an average of 2 to 4 livestock. Population growth was also reported to have resulted into land scarcity and was perceived to be the major limitation for the development of livestock in the areas. Zero grazing was practiced by many households in highlands and few households in the lowlands practised zero grazing.

4.1.10 Medicinal plants

The respondents mentioned a number of medicinal plants which were used to treat certain diseases. One of the reasons that favoured the use of these medicines was that they were perceived to be cheaper that those sourced from the modern health sector. Traditional medicines were not only used to treat human diseases but also livestock and crop diseases. According to the respondents, problems like worms, fowl pox and new castle disease were treated using the traditional medicines obtained from the surrounding ecosystems. Some of the crop insects, pests and diseases were also reported to be treated with traditional medicine.

4.1.11 Honey

Honey was found to be one of the ecosystem goods from the ecosystems in the study areas. However, its economic importance was significant in Taita hills than Mount Kilimanjaro. This product was used as food and medicine and was an important source of income for actions involved.

4.1.12 Other values of the ecosystems

The study indicated that the Mount Kilimanjaro National Park (KINAPA), Kilimanjaro mountain ice caps, Tsavo national park, good vegetation cover in the highlands of Taita Hills, traditional and historical tombs in the Vulia Mountain peaks were good scenic areas that generated foreign exchange through tourism. The local communities in the study areas benefited from tourism by selling cultural items and other goods and services to tourists.

Some of the local people were employed as tour guides which was a significant source of income for these people. Mountain climbing in Mount Kilimanjaro and watching wild animals in Tsavo National Park in Taita hills were important touristic attraction.

Other ecosystem goods and services identified included mushroom, wild fruits and manure from decomposed organic matter, which were important to maintaining ecological balances and biodiversity. Other plants within these ecosystems were vital in performing regulatory functions and regulating atmospheric conditions.

4.2 WTA Payments for Ecosystem Services

Payments for ecosystem services (PES) compensate individuals or communities for undertaking actions that increase the provision of ecosystem services such as forest conservation, flood mitigation, or carbon sequestration. These payments rely on incentives to encourage behavioural change and can consequently be considered part of the broader class to stimulate market based mechanisms for environmental policy. The study intended to evaluate WTA payments for conservation of ecosystem services to forego benefits accruing from destructive social economic activities in favour of ecosystem. Thus evaluation is disaggregated by gender and altitudinal gradients in the study areas.

4.2.1 Mean WTA payments in the study areas

Result in Table 8 show that, the mean WTA in Taita Hills was USD 314.26 per year per household and that of Mount Kilimanjaro was USD 187.41 per year per household. This implies that, the average WTA compensation for respondents in Taita Hills was USD 126.85 higher than that of respondents in Mount Kilimanjaro. This difference in WTA compensation was statistically significant ($t = 5.957$, $\alpha = 0.05$).

Table 8: Means WTA across study areas (USD)

Name of the study area	Mean	N	Std. Deviation	% of Total N
Taita Hills	314.26	169	225.291	48.7%
Mt. Kilimanjaro	187.41	178	168.664	51.3%
All	**249.19**	**347**	**207.914**	**100.0%**

Generally, the standard deviation was relatively higher but below the mean average in all the study areas. This implies that the bid range among respondents across the two study areas was very high and thus WTA compensation varied among and across respondents in the study areas.

4.2.2 Aggregated WTA values for ecosystem services

The total annual WTA compensation was USD 1 329 948.32 in the sampled sub-locations in Taita Hills and USD 1 496 094.03 in the sampled villages in Mount Kilimanjaro, with a mean annual WTA of USD 314.26 and USD 187.41 for Taita Hills and Mount Kilimanjaro respectively (see Table 9).

Table 9: Aggregate WTA values for ecosystem services in the two study areas (USD)

Study area	N	Mean WTA compensation	Population	Aggregate WTA compensation
Taita	169	314.26	4232	1 329 948.32
Kilimanjaro	178	187.41	7983	1 496 094.03
Total	**347**	**249.19**	**12215**	**3 043 855.85**

These values represent the monetary estimates of ecosystem services functions for both forests and aquatic ecosystems from only sampled villages and sub-locations in the study areas. These findings are above those obtained by David *et al.* (2011) in the study on "payments for ecosystem services" (PES) program in Tanzania where farmers were paid to protect forest that lies on their farms only. The findings showed a maximum mean WTA compensation of USD 60 per acre per year. The management implications of these findings are that apart from values in use, land and other ecosystem services have exchange or market values and non-use values.

4.2.3 Mean WTA compensation along the altitudinal gradients

The study intended to compare mean WTA compensation along the altitudinal gradient and find if there was any significant difference among the three altitudinal zones namely lowlands, midlands and highlands for both study areas. The hypothesis that there is no difference in mean WTA compensation along altitudinal gradient was tested.

Table 10: Mean WTA compensation along the altitudinal gradients (USD)

Study areas	**Altitude**	**Mean**	**N**	**Difference when compared**	**Min...**	**Max...**
Taita Hills	Lowlands(L)	217.20	60	-	0	558
	Midlands(M)	310.97	57	93.77(M-L)	0	930
	Highlands(H)	429.84	52	118.87(H-M)	0	1395
	Total	**314.26**	**169**		**0**	**1395**
Mt. Kilimanjaro	Lowlands(L)	128.72	49	-	19	1065
	Midlands(M)	195.74	65	67.02(M-L)	0	743
	Highlands(H)	223.90	64	28.16(H-M)	0	743
	Total	**185.33**	**178**		**19**	**1065**

Results in Table 10 shows that the mean WTA compensation was increasing as you go from lowlands to highlands although the marginal increase was slightly different in the two study areas. While WTA compensation was increasing in Taita Hills from USD 93.77 in lowlands to USD 118.87 in the highlands it fell from USD 67.02 in lowlands to USD 28.16 in the highlands in Mount Kilimanjaro.

Results in Table 11 confirm that the difference in mean WTA compensation in Taita Hills was statistically significant between lowlands and midlands (t=6.341, α=0.05) and between midlands and highlands (t = 6.501, α=0.05). This lead to the rejection of the null hypothesis that "there is no difference in mean WTA compensation along the altitudinal gradient" and therefore people in the highlands of Taita Hills were more likely to accept compensation than those residing at the adjacent lowlands. These findings might be ascribed to the fact that most of the ecosystems are found in highlands. Thus, opportunity cost for people to forgo benefits from the multiple uses of ecosystem goods and services is likely to be higher than those at mid and lowlands.

Table 11: Significance difference in WTA along the gradients in the study areas

	Alt..	**N**	**M-WTA compensation**	**t**	**Sig.**	**Alt...**	**N**	**M-WTA compensation**	**t**	**Sig.**
Taita Hills	Middle	57	310.97	6.341	.013	High	52	429.84	6.501	.012
	Lower	60	217.20			Middle	57	310.97		
Kilimanjaro	Middle	65	195.74	3.583	.061	High	64	223.90	.181	.671
	Lower	49	128.72			Middle	65	195.74		

The same results (Table 11) indicate that the mean difference in WTA compensation between middle and lowlands of Mount Kilimanjaro was statistically significant (t= 3.58, α=0.1). However the difference between high and middle lands was not statistically significant at all levels of significance (1%, 5% and 10%). This implied that there is no difference in mean WTA compensation for people residing at highlands/midlands of Mount Kilimanjaro.

4.2.4 Gender disaggregated WTA compensation along the gradients

Different roles and status of women and men within the household or community can affect the use and management of ecosystems. Therefore, engaging all gender groups in making decision related to the use and management of ecosystem services is central to achieving sustainable management of ecosystems (Kadka *et al.,* 2012). This study intended to assess whether there were significant differences in mean WTA compensation between gender groups and how these differences vary along the altitudinal gradients. The hypothesis that "there is no difference in mean WTA compensation between male and female headed households along the altitudinal gradients" was tested. Table 12 summarises the ANOVA results for the two study areas.

Table 12: Mean WTA compensation between male and female along the gradients for both study sites

Location	Sex HH	Mean	N	t	Sig.
Lower	Male	157.73	67		
	Female	208.85	42	2.998	.086
	Total	**177.42**	**109**		
Middle	Male	234.21	74		
	Female	273.28	48	1.378	.243
	Total	**249.58**	**122**		
High	Male	312.43	66		
	Female	321.21	50	.033	.855
	Total	**316.22**	**116**		

NB: HH = Head of Household

The mean differences in WTA compensation between male and female headed households was statistically significant in the lowland areas ($t = 2.998$, $\alpha=0.1$) (Table 12). Therefore, there is enough evidence to reject the hypothesis that "there is no difference in WTA between male and female headed households residing at mid- and lowland areas of Mount Kilimanjaro and Taita Hills. These findings might be ideal because firewood and other popular ecosystem goods are very scant in the lowlands and women who tend to be more responsible for collecting firewood and fetching water are more likely to be concerned about their availability than men.

Table 13: Mean WTA compensation between Male and Female headed households disaggregated by sites

Area	Location	Sex	N	Mean	t	Sig.
Taita Hills	Lower	Female	25	248.27	.509	.478
		Male	35	195.01		
	Middle	Female	24	327.87	1.283	.262
		Male	33	298.68		
	High	Female	23	433.60	.729	.397
		Male	29	426.86		
Mt. Kilimanjaro	Lower	Female	17	150.87	.023	.880
		Male	32	116.95		
	Middle	Female	24	218.68	.931	.338
		Male	41	182.32		
	High	Female	27	225.48	.014	.908
		Male	37	222.74		

However, when disaggregated by study sites the mean difference in WTA compensation between males and females headed households along the altitudinal gradient were statistically insignificant (Table 13). Therefore the study failed to reject the hypothesis that male's headed and female's headed households residing in different altitudinal gradients of Mount Kilimanjaro and Taita Hills have no difference in their mean WTA compensation along the altitudinal gradients on the two study areas.

Results in Table 14 show that both males and females residing at different altitudinal gradients of Taita Hills had significant differences in their mean WTA compensation ($t=8.63, \alpha=0.01$; $t=5.54$, $\alpha=0.01$ for males and females, respectively). However, the difference in mean WTA compensation for males residing at different altitudinal gradient of Mount Kilimanjaro seem to statistically significant but the differences for females are not different.

Table 14: Comparison by individual sex along the gradients

Area	Sex of HH	Location	Mean	N	t	Sig.
Taita Hills	Male	Lower	195.01	35		
		Middle	298.68	33	8.628	.000
		High	426.86	29		
		Total	**299.59**	**97**		
	Female	Lower	248.27	25		
		Middle	327.87	24	5.544	.006
		High	433.60	23		
		Total	**334.01**	**72**		
Mt. Kilimanjaro	Male	Lower	116.95	32		
		Middle	182.32	41	3.462	.035
		High	222.74	37		
		Total	**176.90**	**110**		
	Female	Lower	150.87	17		
		Middle	218.68	24	1.221	.302
		High	225.48	27		
		Total	**204.43**	**68**		

4.3 Factors Influencing WTA for Ecosystem Services

Literature recognises different factors that influence WTA compensation for different ecosystem services. These factors could range from demographic to socio-economic factors. A brief discussion of demographic and social economic factors underlying respondents WTA compensation is provided in this section. Table 14 shows that the factors influencing WTA compensation for different ecosystem goods and services. The study considered demographic and social-economic predictors such as age, household size, education level, household category, altitude of households' location, size of forest owned, environmental income, area of study and economic and environmental importance of ecosystem services. Generally, the linear multiple regression model fitted well the data as shown by the R^2 value of 84.2% which was significant at 1% level of significance. All the significant variables were tested at 1% and 5% probability level and therefore the model can be used for prediction of WTA compensation for ecosystem services at 95% confidence limit.

Table 15: Linear multiple regression output

Model	Unstandardized Coefficients		Stand...Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	169.900	253.351		.671	.512
AGEHH	9.114	2.576	.591	3.538	***.003
HHSIZE	61.439	12.473	.528	4.926	***.000
EDUHH	-58.849	58.594	-.136	-1.004	.330
ALTITTUDE	43.973	44.893	.128	.980	.342
HHCATEGORY	-55.286	18.879	-.421	-2.929	***.010
FORTSIZE	-7.181	6.565	-.141	-1.094	.290
CASHENVIRN	.880	.454	.219	1.937	**.071
ECONRANK	190.155	53.803	.684	3.534	***.003
ENVRONRANK	-73.440	64.744	-.134	-1.134	.273
STDAREA	-52.250	14.527	-.95	-4.560	***.000
R Square					**.842**
Adjusted R Square					**.743**
Sig.					**.000a**

4.3.1 Household size

Household's size was significant ($p<0.01$) with a positive regression coefficient factor predicting that increase in number of household members tends to increase WTA compensation for protecting ecosystems. The plausible explanation for this is that as you increase household size by one member, WTA compensation per household per year will increase by USD 61.439 (Table 15). This finding relates to the article published by Borrini-Feyerabend *et al.* (1997) who wrote that where there is high population increase there is more mouth to feed and hence more demand for resources. This is because as the size of household increases the population in a given area also increases and then increases household demand for different goods and services from the ecosystem. The result also coincide with the report by Shrestha (1996) who documented that household size is an important variable in determining possible supply of family labour for different activities at the family level. The increased population creates increased labour supply and also the demand for different products and people's desire for diversified economic production. This in turn may result into increased consumption of ecosystem goods and services in order to meet increased household's demands for domestic and commercial energy supply like felling trees for building poles, charcoal and firewood for energy. When these activities increase, it is expected to increase the value of ecosystem services and hence higher WTA compensation.

4.3.2 Age of the head of households

The age of head of household had a positive regression coefficient; this indicated that increase in age of the head of household by one year will increase WTA compensation by USD 9.114 per household per year. The increase is explained by 1% level of significance and a p-value of 0.003 (Table 15). The increase in the age of an individual in community makes them realize the importance of protecting and managing the ecosystems for future generation. For example; young people may prefer harvesting forest resources such as cutting poles for constructions for their houses or selling of forest products for economic purposes while elders may prefer protection and conservation of these ecosystems (Zang *et al.,* 2014).

4.3.3 Environmental income

Environmental income refers to income obtained from selling of both timber and non timber forest products which includes poles, firewood, honey, wild meat, thatches, vegetables, mushrooms, planks, withies and timber. Results in Table 16 showed that average income obtained from the environment was increasing along the altitudinal gradients (USD 22.72, USD 27.77 and USD 37.10 from low, mid and highlands respectively).

Table 16: Mean environmental income along the gradients

	Lowland	Midland	Highland	Total
Mean (USD)	22.72	27.77	37.10	29.42
% of Total Sum	23.9%	32.7%	43.4%	**100.0%**

This implied that households in the highland were more benefited from using ecosystem goods and services compared to households in the lowlands. Many of the protected and unprotected forest ecosystems were found in the highlands. The forest ecosystems include the KINAPA in Mount Kilimanjaro and Vulia, Werugha and Ngangao forests in the Taita Hills.

The regression coefficient on environmental income was positive (Table 15), this implied that as household income from the environment increased by 1 USD this would increase WTA compensation by USD 0.88 per year. The result has been explained by 5% level of significance with a probability value of 0.071. Trading-off destructive social economic activities for conservation is an opportunity cost to households who are fully or partly dependent on ecosystem goods and services for their livelihood (Zang *et al.,* 2014). The increase in WTA compensation (0.88 USD) was less than the amount obtained from the environment (1 USD); this implied that communities around these ecosystems were willing to forgo party obtained from the environment for conservation.

4.3.4 Category of the head of household

Households differ in their socio-economic features as a result of various reasons. These results to households lead by either female, young, poor, able, disabled or old persons whom by their categories have different influences regarding WTA compensation.

The regression output had a negative coefficient of USD -55.286. The result was explained by 1% level of significance with the probability value of 0.010. This implied that change in the category of head of household would reduce the amount households are WTA compensation by USD 55.286. The result supports the findings of Wieland *et al.* (2014) in the paper on gender differences in the endowment effect where he argued that the effect size of gender differences in natural resource endowment women pay less but won't accept less.

4.3.5 Location of the study area

The regression output showed that as you change the location from Taita Hills to Mount Kilimanjaro households' WTA compensation is reduced by USD 52.250. The result was justified by negative coefficient which was significant at 1% with a probability value of 0.000. As someone change from Taita Hills to Mount Kilimanjaro, he doesn't change only the socio-cultural and socio-economic but also political and institutional set-ups. This finding complement to that reported by Peter *et al.* (2009) in the study on varieties of capitalism and institutional complementarities in the political economy where was reported that change is more serious when goes across international boundaries where differences in political and institutional arrangements are always very high.

4.3.6 Perception on economic importance of ecosystem services

People's perception on economic importance of ecosystem goods and services had a positive regression coefficient. The result was statistically significant at 1% level of significance with a probability value of 0.003. This implied that increase in the economic importance of ecosystem services to households by one unit, would increase WTA compensation by USD 190.155 (Table 15). Under normal circumstances, people perceives positively on something when have a positive gain extracted from it. As economic importance of ecosystem services increases the opportunity cost to trade-off with conservation also increases.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

The main aim of this study was to evaluate WTA compensation for conservation of ecosystem goods and services of Mount Kilimanjaro, Tanzania and Taita Hills, Kenya with special focus on gender and altitudinal gradients. Findings from this study have clearly proven that there is a significant difference in WTA compensation between households along the altitudinal gradients in both the study areas, and thus, households living in highland areas have a relatively higher mean WTA compensation for conservation than their fellow living in the lowland areas.

Female headed households have a relatively higher mean WTA compensation as compared to male headed household but with a diminishing difference as the altitude increases from lowland to highland. Overall there is no sufficient evidence to reject the hypothesis that "there is no difference in WTA compensation between female headed households and male headed households".

Results from regression analysis revealed that households' age, size, category, perception on economic importance of ecosystem services, location and environmental income earned by head of households had statistically significant influence on WTA compensation. This is an indication that WTA compensation for ecosystem services can vary across age, size, category, perception, location and income of the head of households. Approaches that promote payment for ecosystem services should consider differences in these attributes of the target households.

5.2 Recommendations

In order to manage ecosystems in these critical mountainous regions of the EABH, it is better to ensure a sustainable flow of goods and services and benefits from ecosystem goods and services. To ensure sustainable use, management and benefits of ecosystem services the following should considered:

(a) PES programmes have to take into account gender, minority groups and altitudinal gradients when implementing their activities. This will enable lowering costs in conjunction with meeting unique requirements of the different user groups and address their specific constraints.

(b) In trying to identify options for managing ecosystem services, local communities as co-managers should be involved accordingly. The Participatory Ecosystem Management (PEM) has been widely accepted in Africa as the best model for ecosystem management on both protected and unprotected areas and is ideal approach for sustainable ecosystem management in Mount Kilimanjaro and Taita Hills.

(c) In order to ensure progressive and sustainable conservation of the ecosystems in the areas and reduce dependency on external donor funded schemes, a detailed study on WTP for ecosystem services should be done. The study will establish a way to generate fund for conservation by disaggregating beneficiaries of ecosystem services by their scale of use.

(d) In order to relieve ecosystem exploitations, conservation income and energy generating projects such as beekeeping, mushroom cultivation, butterfly farming and bio-gas production should be emphasised.

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APPENDICES

Appendix 1: Households Questionnaires

BACKGROUND

This questionnaire aims to collect data on communities and ecosystem services to enable determination of ecosystem values along altitudinal gradient of Mt. Kilimanjaro in Tanzania and the Taita Hills in Kenya. The focus is on both socio-economic and biodiversity implications of land use change in the context of population pressure, global and local markets, climate change, cultural and regional historical factors.

Name of Numerator……….…………………………………………………

A. HOUSEHOLD LOCATION

1. County __________________________
2. District __________________________
3. Location _________________________
4. Sub-Location __________________________
5. Village _______________________
6. Altitudinal location i. High ii. Middle iii. Lower
7. Name nearby forest ……………………………………………………

B. RESPONDENT'S BACKGROUND

1. Name of Interviewee ________________________ Mobile No.

____

2. Sex of HH 1. Male 2. Female
3. Age of HH____________ (years)
4. Ethnic group _______________

5. Marriage status

    i. Single

    ii. Married

    iii. Separated

    iv. Divorced

    v. Widow

6. Household size _________________

7. No. of dependants ___________________

8. Level of education.

    i. No formal education

    ii. Primary education

    iii. Secondary education

    iv. Post-secondary education

    v. Others (specify)

C: Household Assets

Physical assets	***Quantity***
Houses	
Radio	
Mobile phone	
Chair	
Stools	
TV	
Car	
Bicycle	
Motorcycle	

Natural assets

Type	*Number of plots*	*Total land size*	*Ownership*
Land			
Forest			

D: Household production/activities

What are the main sources of livelihood in the household?

Livelihood activity	**Rank (1 to 7)**
Agricultural crops	
Making and selling forest products	
Small business (Petty business - kiosks, food vending)	
Remittance	
Livestock	
Wage employment	
Casual labour	
Crop trading	
Others (specify)	

Agriculture production last season

Crop	*Acre planted*	*Total production*	*Amount sold*	*Unit Price*	
				Wet season	*Dry season*

Livestock production last season

Type/product	*Number own*	*Number sold*	*Price*	*Value*
Cattle				
Goat				
Sheep				
Chicken				
Milk				
Hide/skin				
Eggs				

Wood Forest product collection in the last season and estimate for domestic use

Product	*Timber*	*Poles*	*Planks*	*Withies*	*Charcoal*	*Firewood*	*Post*	*Water*	*Pollination*
*Where collected									
Distance from homestead									
**Who collect									
Frequency of collection									
Amount of tree cut									
Amount of pieces per tree									
Rank (1 to 6)									

*(1) General land forests (2)Village land forest reserves, (3) Central Government Forest Reserves (4) Private forests

**(1) Female (2) Male, (3) Children, (4) Male and Female, (5)Female and Children, (6) All

Non-Wood Forest product collection last season and estimate for domestic use

Product	*Medicine*	*Mushroom*	*Vegetables*	*Fruits*	*Wild meat*	*Honey*	*Thatches*
*Where collected							
Distance from homestead							
**Who collect							
Frequency of collection							
Amount collected							
Rank (1 to 6)							

*(1) General land forests (2)Village land forest reserves, (3) Central Government Forest reserves (4) Private forests
**(1) Female (2) Male, (3) Children, (4) Male and Female, (5)Female and Children, (6) All

Wood Forest product collection last season and estimate for commercial use

Product	*Timber*	*Poles*	*Planks*	*Withies*	*Charcoal*	*Firewood*	*Post*
*Where collected							
Distance from homestead							
**Who collect							
Frequency of collection							
Amount of tree cut							
Amount of pieces per tree							
Price per unit							
Rank (1 to 6)							

*(1) General land forests (2)Village land forest reserves, (3) Central Government Forest reserves (4) Private forests
**(1) Female (2) Male, (3) Children, (4) Male and Female, (5)Female and Children, (6) All

Non-Wood Forest product collection last season and estimated for commercial use

Product	*Medicine*	*Mushroom*	*Vegetables*	*Fruits*	*Wild meat*	*Honey*	*Thatches*
*Where collected							
Distance from homestead							
**Who collect							
Frequency of collection							
Amount collected							
Price per unit							
Rank (1 to 6)							

*(1) General land forests (2)Village land forest reserves, (3) Central Government Forest reserves (4) Private forests
**(1) Female (2) Male, (3) Children, (4) Male and Female, (5)Female and Children, (6) All

E: Ecosystem Services and Perceptions

1. What are the available ecosystem services and their trends since past 10 years?

Name of identified ecosystem service	*Beneficiaries (1. Communities, 2.Institutions, 3. People from outside the village – capture categories of stakeholders)*	*Trend (1. Increasing, 2. Decreasing, 3. Remain the same)*

Reminder: Cultural values, Worshiping, Burial values, Existence values, Aesthetic values

Notes: ____

2. Give species names normally used for various forest products:

Forest products	*Species of origin (Scientific, Swahili and Local names)*
Firewood	
Poles	
Timber	
Traditional medicine	
Planks	

3. Is everybody in your household involved in making decisions about benefits sharing obtained from ecosystem services? i. YES ii. NO
4. If YES, how?---
5. If No, why?---
6. Is everybody in your household involved in making decisions regarding ecosystem conserve and protection? i. YES ii. NO
7. If YES, how?---
8. If No, why?---
9. How do you rank the following benefits from ecosystem services?

Ecosystem services	*Rank (1. High, 2 Moderate, 3. Low)*
Economic use	
Environmental use	
Social use	
No use	

10. Do you think that a healthy ecosystem helps you to access ecosystem services?

i. YES ii. NO

If yes, in what way(s)?

____

11. Has the quality of the ecosystems been degraded over the years?

i. YES ii. NO

If yes, why do you think it has so?

____

12. What would you suggest to help improve the situation?

____

13. Do you agree that ecosystem should be conserved for future generations (REDD, PES etc)?

1. YES 2. NO

Why do you think so?

____

Who do you think should conserve the ecosystem in your area?

14. Mention community activities that can attract tourism

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

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……………………………………………………

Do you know any ecotourism attractive features found in the forest or village? Mention

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………

F: Background to Willingness to Accept payment

Forests in this area provide critical habitat for fauna and flora, aesthetic and cultural values – including worshipping, burial sites, shelters and other ecosystem services. But these resources are now under threat or endangered. Continued protection of these areas required habitat improvements, as well as communities to change livelihoods that depend on forest resources and creation of alternative livelihoods. A contingent valuation survey hereby use to estimate the economic value for preserving the critical habitat. Efforts to raise funds for conservation would involve contributions from various users of ecosystem services. If a majority of households voted in favor of the fund, the forests would be protected from degradation and deforestation hence improve springs, rivers and availability of other ecosystem services etc. What is the minimum amount of money your household can accept to trade off destructive socio-economic activities for conservation?

My Household would accept a KSHS______ every year, in favor of conservation

G: Climate change perceptions

1. Are you aware that the climate has changed or is changing?

    i. Yes

    ii. No

2. How serious do you consider climate change?

    i. Very serious 1.Yes 2. No

    ii. Somehow serious 1.Yes 2. No

    iii. Not very serious 1.Yes 2. No

    iv. Not very serious at all 1.Yes 2. No

3. What are the climatic parameters that you think have changed over the past 10 years since now? (*Linked to rainfall, temperature, extreme events*)

____

____

4. Have there been any extreme climatic events (within the last 10 years)?

i. Droughts 1.Yes 2. No

ii. Floods 1.Yes 2. No

iii. High temperatures 1.Yes 2. No

iv. Low temperatures 1.Yes 2. No

v. Winds 1.Yes 2. No

vi. Do not know 1.Yes 2. No

vii. Others (specify) ___________________________________

5. What are the perceptions on patterns of change of climatic factors?

i. Rainfall 1.Increasing 2. Decreasing 3.No change 4. Do not know

ii. Temperature 1.Increasing 2. Decreasing 3.No change 4. Do not know

iii. Winds 1.Increasing 2. Decreasing 3.No change 4. Do not know

iv. Drought 1.Increasing 2. Decreasing 3.No change 4. Do not know

v. Flood 1.Increasing 2. Decreasing 3.No change 4. Do not know

6. What are the indicators for the patterns of observed changes?

i. Not enough rainfall 1.yes 2.No

ii. Lack of rainfall for a long period 1. Yes 2. No

iii. Traditional wells/boreholes have dried 1. Yes 2. No

iv. Land have become drier and now crack 1.Yes 2. No

v. Tender leavers of tree dies 1.Yes 2.No

vi. Irrigation water dries up more quickly 1. Yes 2. No

vii. Feel thirst 1. Yes 2.No

viii. More frequent storms 1. Yes 2.No

ix. Others...

7. What are the sources of information regarding climate change and variability?

i.	TV news	1. Yes	2.No
ii.	Radio News	1. Yes	2. No
iii.	News paper	1.Yes	2. No
iv.	Others…………………………		

8. What are the observable impacts of climate variability and change on ecosystem services delivery?

Appendix 2: Checklist for FGD

(a) Experiences of the stakeholder on harvests, markets, and prices:

(b) Extent of harvests of various forest products including timber within selected forest areas

(c) Values per unit for various forest products in the village near the forest, nearby town (trading place),

(d) Profitability of the forest product business including logging in forests

(e) Distribution of the benefits in terms of how much of the value of the forest products including timber goes to villagers, dealers, transport owners, etc.

(f) Cases of illegality and the proportion of forest products including timber involved.

(g) Any document /study that that will assist valuation activities

(h) What is the channel of flow of forest products from the forest areas to the markets

(i) Value addition policies and implementations

(j) What is their perception with regards to valuation techniques implemented by the researchers