Assessing landholder preferences for alternative land management schemes and willingness to accept rewards for watershed services provision: the case of Kapingazi River basin, Mt. Kenya East

PROJECT REPORT

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Commissioned by:

Pro-poor Reward for Environmental Services in Africa (PRESA/ICRAF) for assessing landholders' preferences and reward demanded for land management contract for initiating 'RiverCare' programme in Kapingazi River basin, Mt. Kenya East

Key words:
Land management; watershed services; reward for environmental services; conjoint analysis; contingent valuation; willingness to accept; logit models; interval regression; preferences; landholders; land management contract; Kapingazi River; Mt. Kenya East

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ACRONYMS AND ABBREVIATIONS USED IN THE REPORT

CA	Conjoint analysis
CFA	Community forestry association
CJ	Contingent valuation
DEM	Digital elevation model
FDA	Focal development area
GPS	Global positioning system
GWC	Green water credit
ICRAF	International Centre for Research in Agro-forestry
MEA	Millennium Ecosystem Assessment
MKEPP	Mt. Kenya East Pilot Project
PES	Payment for environmental services
PMC	Project management committee
PRESA	Pro-poor reward for environmental services in Africa
RES	Reward for ecosystem services
RSP	Rand sample unit
RUT	Random utility theory
RWS	Reward for watershed services
SWAT	Soil and water assessment tool
USDA-ARC	United States Department of Agriculture-agricultural research centre
WRUA	Water resource user association
WTA	Willingness to accept

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EXECUTIVE SUMMARY

1. Many ecosystem services are being degraded or used unsustainably. Watershed environmental services are among the ecosystem services that have been degraded globally, particularly in developing countries. Land-use decisions and agricultural management practices appear to be the key factors that affect the provision of watershed services in developing countries. Land use decisions and agricultural management practices adopted upstream affect water quantity and quality available to beneficiaries downstream, but upstream landholders have no or little incentives to take these impacts into account in their decision making processes.

2. Payment/reward for environmental services (PES/RES) has emerged as an important tool to motivating landholders for provision of environmental services through land use changes and adoption of best management practices. In this regard, PRESA is playing an intermediary role in initiating, supporting, and facilitating reward-based environmental services provision mechanism and is also committed in paving ways for fair and effective agreements between rural stewards and beneficiaries of environmental services in Africa.

3. To play an intermediary role and provide a platform for negotiations in supply and demand of the environmental services, PRESA needs to identify and understand, among other things, (a) landholder's or farmer's preferences over various land use options and agri-environmental management schemes that enhance the provision of watershed services, and (b) landholder's or framer's willingness to accept (WTA) rewards for the provision of required watershed services (environmental services supply analysis).

4. Accordingly, the two key objectives of this study were: (a) to understand landholders'/users' attitudes and preferences over various land management options and agri-environmental management practices – expressed as combination of different land management attributes, and (b) to estimate

landholder's/ framer's willingness to accept (WTA) rewards for the provision of required watershed services (environmental services supply analysis)

5. The study sites chosen for the study are areas along River Kapingazi catchment in Mt. Kenya East (see figure 1 in the report). Mount Kenya is suffering from loss of forest cover which results in soil erosion, siltation of reservoirs and damage of roads and dams. Three communities (focal development areas (FDA); namely Kiriari, Kairuri, and Muthatari) – the boundaries of which were previously demarcated by the Mt. Kenya East Pilot Project (MKEPP) for natural resource management at a larger scale of Upper Tana region – were surveyed.

6. The primary data used in this study was collected through focus group discussions with different community members in the three FDAs, interview with key informants, and detailed questionnaire surveys of conjoint analysis and contingent valuation methods. In each of the three FDA, four groups of participants (a total of 12 focus groups) were identified and in-depth focus discussions were undertaken by trained facilitators. The questionnaire survey in its three parts (socio-economic and demographic (part I); conjoint survey (part II); and contingent valuation (part III)) contains detailed inquiries on the major information relevant to the study. The survey was administered in the three FDAs (see No.5 above) by a team of six trained enumerators (two enumerators in each site) and supervised by scientists from PRESA/ICRAF.

7. Both qualitative and quantitative techniques were applied in data analysis. Information gathered from focus groups on perceptions, views, attitudes, opinions and experiences of the local people was summarized qualitatively. For conjoint and contingent survey data, discrete choice models based on random utility theory were built. Three conjoint models were employed: a traditional conjoint ratings model, a binary logit model, and an ordered logit model. A binary logit model was used to assess the effect of the levels of the attributes on farmer's preference to *definitely* undertake a specific scenario among the different options presented during the conjoint experiment. For the analysis of the rating data, we employed an ordered logit model. For deriving the WTA estimates from the double-bonded dichotomous choice contingent valuation

survey, we adopted a generalized censored regression models (tobit models) known as interval regression for estimating the compensation demanded (WTA) to induce land uses.

8. Results from the focus group indicate that inadequate water (quantity) for both domestic and irrigation and water pollution (quality) are the utmost environmental problems in the area. This is as a result of drying up of water sources such as River Kapingazi and its tributaries, wetlands, springs and boreholes. Poor environmental conservation practices such as deforestation, cultivating along the riparian and other water sources such as springs and wetlands have been identified as key factors in accelerating water resource degradation. Following water quantity/quality problems, deforestation and land degradation were identified as other crucial environmental problems in the area. How to mitigate or halt these problems? Environmental education and training; introduction of incentive schemes for good environmental practices; and livelihood diversifications were three key issues that participants emphasised as remedial measures for environmental problems in that area.

9. Conjoint analysis (CA) refers to an overall approach and group of quantitative techniques that can be used to determine people's preferences for the attributes that make up a product or service or scenario, with the total worth of a product determined by the part-worths of its attributes. The objective of CA application in this study was to evaluate landholders' preferences towards different hypothetical land management schemes or contracts aimed at increasing the quantity and/or quality of water in River Kapingazi. Such an understanding appears to be crucial in designing the reward scheme for environmental services and negotiating with potential buyers (for instance, hydroelectric companies; municipal water companies etc.) of the environmental services.

10. Six attributes/factors; namely Land area to be committed; Length of commitment (contract) period; Right to harvest products from committed land in environmentally friendly manner; Right to harvest products from committed land in environmentally friendly manner; Reward scheme/incentive scheme; Local scheme administering agency; and Required free labour contribution

related to the contractual scheme were identified for the conjoint analysis. Attributes levels were initially assigned by the research team and later on modified during the stakeholders' workshop by accommodating local conditions. Using factorial design method on the six attributes a total of 972 land management scenarios were generated. The full set of scenarios were handled by asking each respondent to rate the nine scenarios on a scale of 1-5 for each hypothetical contract in terms of the likelihood that he/she would participate (108 respondents were handled the set of full scenarios). The survey was administered in face-to-face interviews with the respondents. Besides the attribute levels, thirteen demographic and socio-economic characteristics were also included in estimating the conjoint models.

11. On the basis of results from the traditional conjoint model, '*land area to be committed*, '*length of commitment period'*, and '*grating/denying rights to harvest products*' were the three principal attributes that influence landowners' ratings for various proposed management options.

12. A binary logit model was run to predict the probability that landholders would *definitely* undertake any of the land management/contract scenarios. In this model, the dependent variable takes the value of 1 for management scenarios which received a conjoint rating of 5, and 0 otherwise and the predictors were program attributes and selected socio-economic and demographic variables. The probability of scenario adoption decreased for options that require commitment of larger land areas, longer contract period, and increased restriction of harvest right. These three attributes were found to be the most important factors in influencing landholders' potential adoption of the proposed management contract.

13. The logit model sheds an important light in the relationship between size of land holdings and the likelihood of program adoption. Because of the prevalence of small holdings in the study are, it was expected that land size and program adoption would have strong and positive relationship. Contrary to this expectation, we found statistically insignificant relationship between size of land holding and program adoption. On the basis of our result, as long as other

appropriate measures are put in place, size of land holdings may not be a major constraint in implementing soil and water conservation and other environmental management programs. Environmental management programs could be realized despite small holdings, for instance, in village economies of developing countries where degradation land fragmentation of land holdings increases over time.

14. By and large the results from ordered logit model are very similar to that generated by binary logit model. The ordered logit result also indicate that land area required to be committed, length of contract period, and rights to harvest products from committed land exert strong influence in conditioning preferences. Among respondent characteristics that had significant effect on conditioning landholders' preferences were current participation in MKEPP projects, sex of respondent, experience in environmental management practices; level of education, and level of household income from agricultural sources.

15. Conjoint valuation method (CVM) is a survey based approach to measuring nonmarket values of environmental goods/services. Generally, in contingent valuation, respondents are given descriptions of a proposed hypothetical scenario or environmental change or policy alternative that would alter environmental quality or the provision of a public good or restrict access to the resource, and are asked to express (in monetary units) their maximum willingness to pay (WTP) to secure/enjoy a positive change or minimum compensation they would demand (willingness to accept (WTA)) for a negative change or loss of access to the resource.

16. Obtaining accurate benefit or cost estimates using CVM requires detailed description of the scenario or environmental change or policy alternative being valued. Consequently, maximum efforts need to be exerted for defining and displaying the proposed scenario or change to the respondents. In this study, we carefully described the contingent valuation scenario in terms of the interconnectedness of ecosystem services across landscape; the required land use change; ecosystem management objective; the key ecosystem/watershed services that could be provided; the potential cost to the landholder; and the

method of compensation for the provision of the required services. This study applied a so-called 'double-bounded' CVM survey procedure. According to the 'double-bounded' CVM procedure, each person is asked an initial bid and follow-up bid which is lower or higher depending on the response to the first bid (i.e., for WTA survey the follow-up bid is lower if the first bid was accepted and higher if the first bid was rejected). Thus, there are four possible outcomes: (1) both answers are "yes"; (2) both answers are "no"; (3) a "yes" followed by a "no"; and (4) a "no" followed by a "yes".

17. The ultimate goal pursued in contingent valuation studies is to estimate willingness to pay (WTP) or willingness to accept (WTA) measures and confidence intervals of the estimates. To this end, data from our 'double-bounded' contingent valuation survey was analysed applying a generalization of the models fit by censored regression (tobit models) known as interval regression using STATA11 software package.

18. Descriptive analysis of the CV data reveals that within each response category significant variation in WTA was observed. For instance, within the left censored, i.e., 'no, no' response category, ten respondents rejected the follow-up question with maximum amount designed in the survey (i.e. Ksh. 15000). This implies for these respondents the WTA is greater than Ksh.15000. On the other hand, among the left censored observations, i.e., in response category 'yes, yes', five respondents stated that they are willingness to accept compensation rewards as low as Ksh. 1000/ha/year which sheds light that their WTA appears less than or equal to Ksh.1000.

19. Results from interval regression analysis shows that respondents who have already been participating in MKEPP and agro-forestry schemes are willingness to adopt land management contract at relatively lower compensation reward compared to those who participate neither in MKEPP nor in any agro-forestry scheme. Household income level is related positively to compensation amount demanded, i.e., richer households tend to enter into the land management contract if they get rewarded relatively higher compensation. Age of the

respondent, household's current debt status, land size, and higher level of education were found statistically insignificant.

20. Using three different post estimation prediction methods (linear prediction, conditional expected method, and truncated method) mean WTA and standard deviation of estimates were obtained. All prediction methods yields more or less identical mean WTA. However, estimates of standard errors and ranges of willingness to accept figures generated by the three methods vary significantly. On the basis of the prediction result, the mean value of compensation demanded to induce entry to land management contractual agreement in the study area appears slightly more than Ksh. 8, 000. But, this is an average prediction and hence the actual WTA value may show wide variation. According to the prediction, more than Ksh. 20, 000 ha annual compensation payment may be needed to induce some farmers to voluntary participate in environmental management contractual schemes.

I. INTRODUCTION

Ecosystems provide people with a range of benefits that are fundamental to human wellbeing. The Millennium Ecosystem Assessment (MEA) grouped ecosystem services into four broad categories: *supporting services*, such as nutrient cycling, oxygen production and soil formation; pr*ovisioning services*, such as food, fibre, fuel and water; *regulating services*, such as climate regulation, water purification and flood protection; and *cultural services*, such as education, recreation, and aesthetic value. However, many of these ecosystem services are being degraded or used unsustainably (MEA, 2005).

Watershed environmental services are among the ecosystem services that have been degraded globally, particularly in developing countries. Land-use decisions and agricultural management practices appear to be among the key factors that affect the provision of watershed services. Landholders upstream can affect water quantity and quality available to beneficiaries downstream through their decisions on land-management practices and land use changes, but they have no or little incentives to take into account these impacts in their decision calculus. To address this problem, reward schemes for environmental services (RES) have emerged as important market-based incentive mechanisms for producers of environmental services. RES are broadly defined as rewarding someone to take actions that produces positive environmental impacts that benefits (and is valued by) others.

In recent years the interest in rewards for watershed services (RWS) as a tool for watershed management in developing countries has been growing. Among such initiatives, the Pro-Poor Rewards for Environmental Services in Africa (PRESA) is a large network to support and facilitate RES mechanisms in Africa. PRESA is working at sites in Kenya, Tanzania, Uganda and Guinea. One of the sites in Kenya that PRESA is interested in is along River Kapingazi in Mt. Kenya East. Mount Kenya is suffering from loss of forest cover which results in soil erosion, siltation of reservoirs and damage of roads and dams. Of the Mount Kenya Rivers, Tana River powers several hydroelectric plants, provides irrigation water, and supports fisheries, livestock production and biodiversity conservation. River sedimentation over the years has currently let to the closure of Kenya's important dams for hydropower generation: Masinga and Kiamburu dams leading to a deficit of 114 megawatts.

To create incentives for farmers for sustainable land use practices and adopt mitigation measures for reducing sediments and other negative environmental externalities, a reward mechanism should be designed. In this regard, PRESA is committed to facilitating reward-based conservation approach in the Mt. Kenya East landscape. PRESA is playing an intermediary role in facilitating fair and effective agreements between rural stewards and beneficiaries of environmental services.

Landholders/users will be the potential providers or sellers of the environmental services and hydroelectric power generators, municipal water companies, and irrigators will be among the major potential buyers. To play an intermediary role and provide a platform for negotiations in supply and demand of the environmental services, PRESA needs to identify and understand, among other things:

- Landholder's or farmer's preferences over various land use options and agri-environmental management schemes that enhance the provision of watershed services
- Landholder's or framer's willingness to accept (WTA) rewards for the provision of required watershed services (environmental services supply analysis)
- Potential buyers willingness to pay (WTP) for watershed services (environmental services demand analysis)
- A menu of negotiation approaches that is voluntary and conditional
- Design of effective and sustainable reward mechanism

It is beyond the scope of this study to tackle all these issues. The scope of the present study is limited to the first two major issues identified above. It is important to understand landholders'/users' attitudes and preferences (programs they are willing to undertake) whilst designing reward/compensation schemes. For tackling the first issue, the present study applied conjoint method to assess landholder's/ farmer's preferences over various land management options and agri-environmental management practices – expressed as combination of different land management attributes. To examine the second issue i.e., for estimating farmers' willingness to accept (WTA) reward for producing the required environmental services contingent valuation method (CVM) was applied.

Primary data (both qualitative and quantitative) were collected through key informant interview, focus group discussions, and formal conjoint and contingent valuation questionnaire surveys. Relevant secondary data were obtained from local governmental and non-governmental organizations and environment initiatives/projects such as Mt. Kenya East Pilot Project (MKEPP) and Green Water Credit (GWC) operating in the area. The rest of the study report is organized as follows. Section 2 presents detailed description of the material and methods (including study area description and overview of analytical methods) of the study. Insights from focus group discussion are presented in section 3. Results from conjoint analysis and contingent valuation survey data analysis are presented in sections 4 and 5 respectively. The last section provides conclusions and policy implications.

II. MATERIALS AND METHODS

2.1 Description of the study area – Kapingazi River catchment

River Kapingazi is a major tributary to the larger Rupingazi River running parallel to it on the South-eastern slope of Mt. Kenya. The Kapingazi eventually drains into the Rupingazi approximately 3.5 kilometres Southeast of Embu. The total area of the Kapingazi River catchment is 61.2 km^2. The length of the catchment, from the most Northern tip of the catchment within the Mt. Kenya forest reserve to the confluence where the Kapingazi drains into the Rupingazi River is approximately 24.5 kilometres. The bounding coordinates of the catchment are approximately: Longitude 37° 27’ – 37° 31’ E and Latitude 0° 20’ – 0° 34’ S. The elevation within the catchment varies approximately between 2100 and 1200 meters above sea level.

The catchment was defined with the Soil and Water Assessment Tool (SWAT) - a hydrological modelling extension developed by USDA-ARS’ Grassland, Soil & Water Research Laboratory. The modelling tool is implemented as an extension to ESRI’s ArcGIS software. The model required two inputs, an elevation model and a stream model. The river stream network was digitized from 1:50000 topographic map sheets. A digital elevation model (DEM) was produced with the ArcGIS Topo to Raster tool using

digitized 20 meter interval contours. The output was a hydrologically accurate river catchment boundary and sub-catchment boundaries within the main catchment.

The Kapingazi River

The Kapingazi River begins at the forest boundary on the Eastern slope of Mt. Kenya at approximately 2000 m.a.s.l. It flows southeast joining the larger, Rupingazi River 750 metres lower. The straight line of distance between the source and point of discharge is roughly 25 kilometres; the Kapingazi therefore has an average inclination of 3% which is about 4 times steeper than the remaining journey of the Rupingazi River to the Tana River. The Rupingazi eventually meanders into the Kamburu reservoir at about 1000 m.a.s.l. Kamburu is the second in a series of six reservoirs along Kenya's largest river, Tana. Flowing east across the entire country, the Tana eventually discharges into the Indian Ocean, about 60 kilometres north of the coastal town of Malindi.

Climate

As in most regions of Kenya, the rainfall pattern within the Kapingazi catchment is bimodal. Between March and May heavy rainfall is witnessed following a dry period from June to September. In October the rains will return at a slightly lesser amount extending until early December.

Rainfall data extending from 1978 to 2008 were collected from two rain gauging stations - the Irangi Forestry station, located near the northern most part of the Kapingazi catchment and the Embu town meteorological station. The two rainfall stations are only 18 kilometres apart. However due to the 480 meter elevation difference between the two stations the differences in measured rainfall are very apparent as illustrated in figure 1 below.

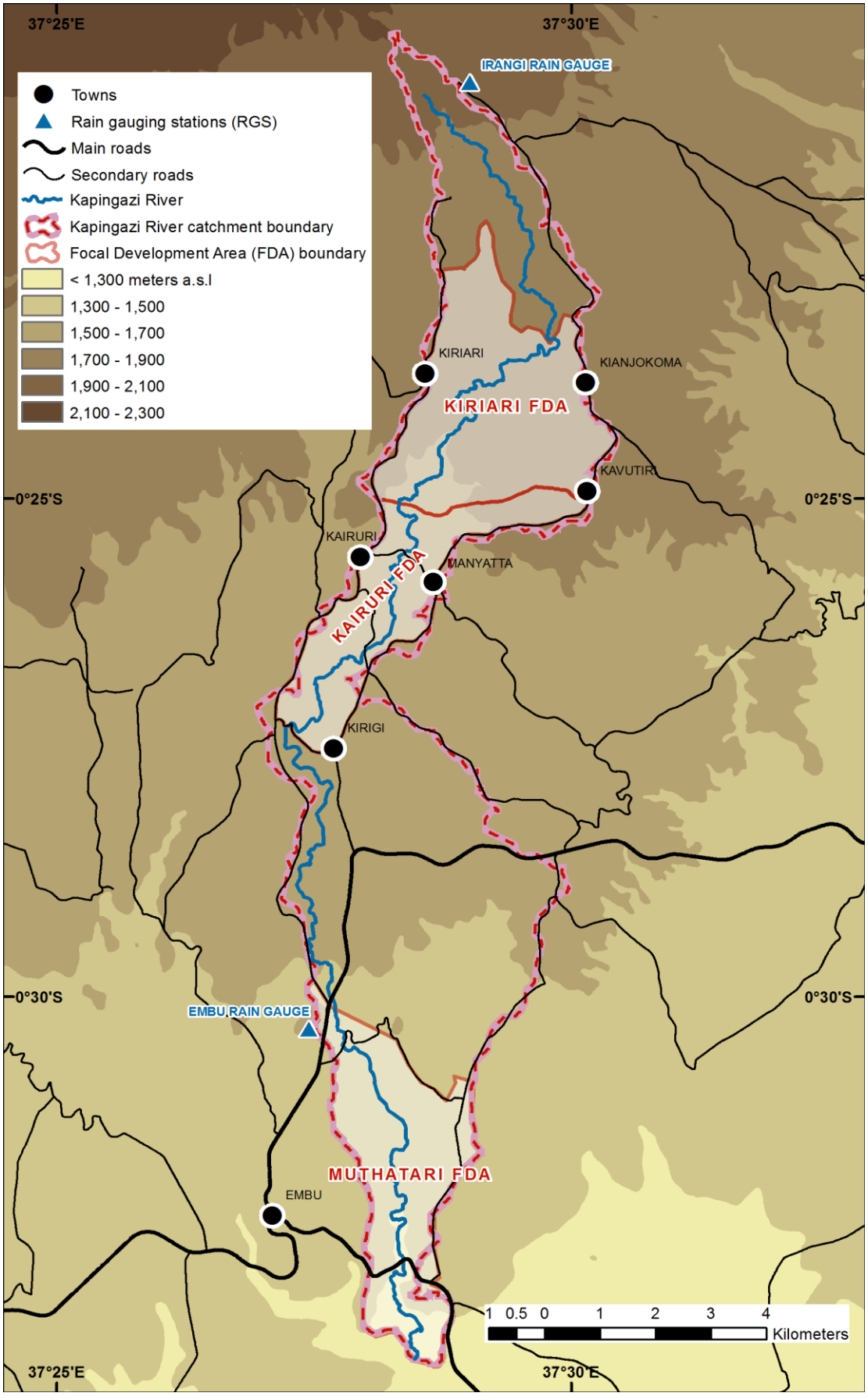

Figure 1. Location of the study sites in Mt. East Kenya area

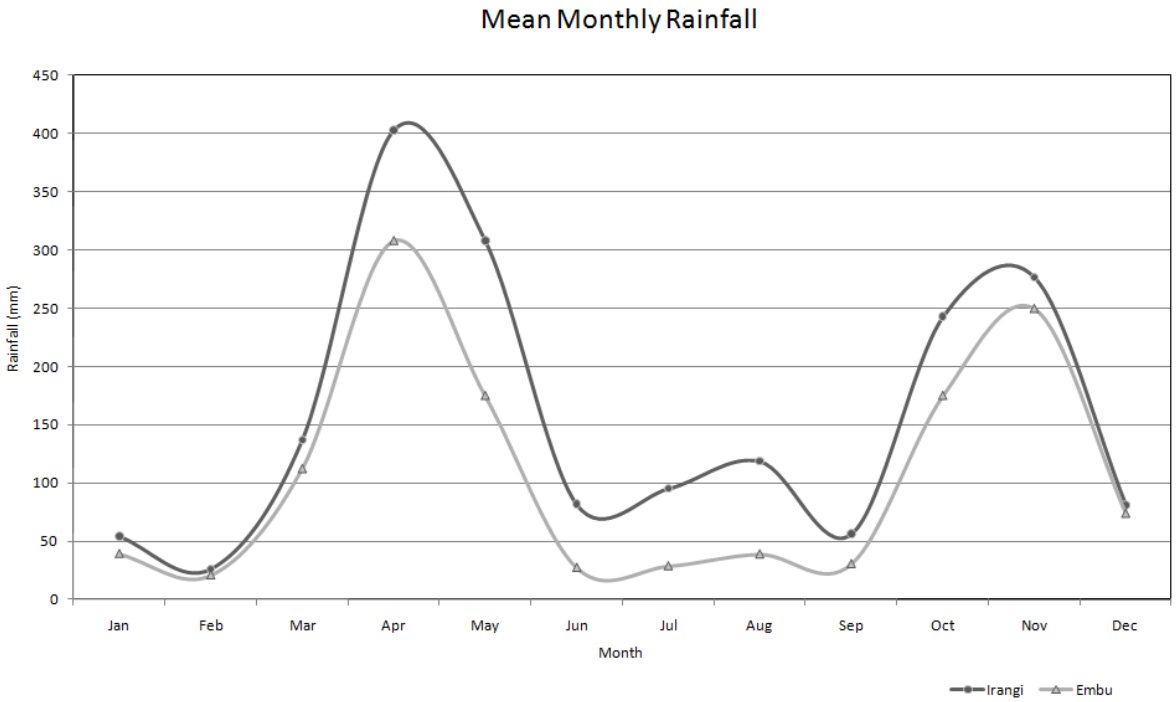

Figure 2. Rainfall pattern of the study area

During the long rains between March and May the tea and coffee growing slopes of the Kapingazi catchment will on average be receiving about 100 mm more rainfall than the lower altitude areas in the southern part of the catchment. Throughout the year Irangi, the upper rain gauging station, receives clearly more rain fall, only coming very close to same with the Embu station during the driest time of year – between December and February.

The maximum temperatures follow the bimodal pattern of the rains as can be seen in figure 2. In Embu town, the highest temperature peaks are measured in March when the mean maximum temperature can go as high as 27.1° Celsius. The lowest values are recorded in July when the mean maximum will only be 21.2° Celsius. The minimum temperature curve is more even throughout the year; though the bimodal pattern is still noticeable.

The temperature data was collected from the Embu meteorological station and reflects average monthly temperature measurements between 1977 and 2005. As no temperature data was available from the Irangi forest station, temperature data was estimated based on the Embu station measurements. If it is assumed that temperature decreases

approximately 6.5° Celsius with every 1000 m rise in altitude (in the lower atmosphere), as is often cited in climate related literature (e.g. Lindzen 2007), with the elevation difference of 480 meters between the two station the temperatures at Irangi should be about 3.1° lower than at the Embu station (figure 3).

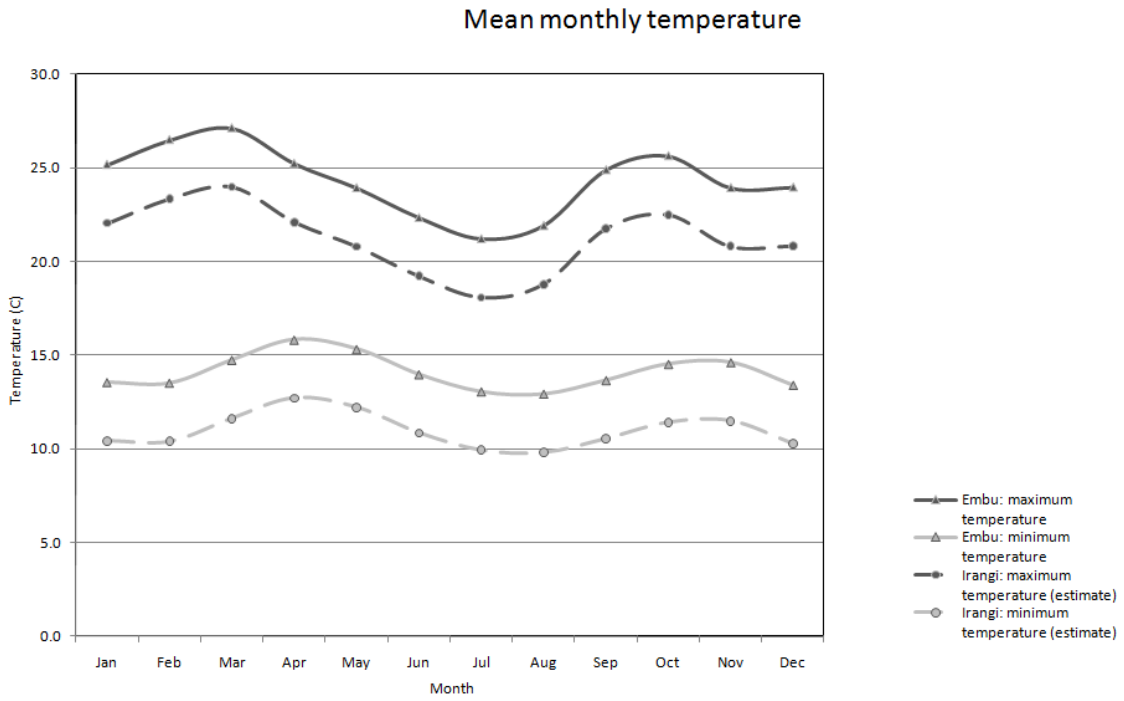

Figure 3. Pattern of temperature in the study area

Settlements

The Kapingazi River catchment is located entirely within Embu district. Major towns and settlements, such as Kianjokoma (1800 m.a.s.l), Manyatta (1650 m.a.s.l.), Kiriari (1750 m.a.s.l.), and Kairuri (1700 m a.s.l.) are located on the east and west boundaries of the catchment, central parts of the catchment are mostly in agricultural and homestead use. Embu town (1350 m.a.s.l.) is the largest settlement in the region. It is not however part of the Kapingazi catchment, but is within the neighbouring Rupingazi basin. It is approximately 1.5 kilometres to the Kapingazi catchment from the Embu town centre. The population density in the Kapingazi catchment is relatively high when compared to the mean population density of Kenya. This can mostly be attributed to the fertile soils and favourable climatic conditions to food and cash crops. Assuming a World Bank (2008) population estimate of 38,534 million and a square kilometre area of 580367 for Kenya as presented by Index Mundi (2009), Kenya's population density is 66.4 persons per square kilometre. According to the CIESIN (2005) population density estimates the projected population density for the Kapingazi region in 2010 is

roughly 720 persons per square kilometre. Assuming this average population density value, the Kapingazi catchment will have an approximate population of 44000 in 2010.

Agriculture and vegetation

Due to the favourable climatic conditions and fertile soils, the Kapingazi River catchment is highly populated. This has led to intensive agriculture in the catchment. Only the most northern tip of the catchment is still under forest cover as this area is being within the Mt. Kenya forest reserve. Dominant crops in the catchment include tea, coffee, maize and beans. The cropping pattern varies along the catchment with tea zone in the upper part of the catchment, especially around Kiriari, a transition zone where both coffee and tea are dominant in the middle part of the catchment around Kairuri, and the coffee zone in the lower part of the catchment. In all the agro-ecological zones, subsistence farming is practiced with beans and maize being the dominant crops. Small land holdings coupled and dominance of perennial farming practices manifests scarcity of grazing lands. Consequently, zero grazing appears to be a major livestock practice within the catchment.

2.2 Survey sites

Focus group discussions, conjoint analysis and contingent valuation surveys were administered in three communities within the Kapingazi catchment. The boundaries of these communities were previously demarcated by an existing project operating in the area –Mount Kenya East Pilot Project (MKEPP) for natural resource management at a larger scale of Upper-Tana region. As a way of facilitating community collective action and promoting participatory and sustainable local resource management, MKEPP has organized different communities under umbrella units called Focal Development Areas (FDA). Three FDA communities in Kapingazi catchment: Kiriari, Kairuri, and Muthatari were included in the survey. Kiriari FDA is the second most northern FDA within the Kapingazi catchment. It represents the higher altitude section of the catchment, located about 1700 to 1900 m.a.s.l and covers an area of 12.3 km^2. Kairuri FDA represents the central part of the Kapingazi River catchment. Its altitude falls between 1500 and 1700 m.a.s.l. and covers an area of 7.7 km^2 . Kairuri is the smallest FDA compared to other FDAs in the Kapingazi catchment. Muthatari FDA represents the lower areas of the catchment. As defined by MKEPP a large part of the Muthatari

FDA falls outside the Kapingazi catchment. So, PRESA has redefined the boundaries of Muthatari FDA to make sure that the households surveyed are located only within the Kapingazi catchment, which is only about 13% of the area of Muthatari as it was defined by MKEPP.

2.3 Sampling design

Selection of the sample households surveyed in this study was based on a spatial sampling technique referred to as the Systematic Unaligned Pattern by McCoy (2005). On each of the three FDA boundary (described in the preceding section), a 500 meter by 500 meter square grid was overlain using the repeating shapes tool programmed by Jenness (2006). Using the in-built "create random points" tool in ArcGIS 9.3, a random point was generated within each cell. Using the "completely within" geographical selection operator, all random points that were within the FDA boundary were selected as random sampling points for the survey. All points falling outside of the FDA boundaries were discarded (figure 4). The amount of random points in each FDA was therefore also random to some degree. If the points had been regenerated the number of points falling within the FDA could have been different. A total of 125 accepted random sampling points were generated (51 in Kiriari, 32 in Kairuri, and 42 in Muthatari). The selected sampling points were then each assigned a unique code. Kiriari sample points were labelled as KI01, KI02, …; for Kairuri as KA01, KA02, ...; and for Muthatari as MU01, MU02, ... The original sample point datasets were then converted to the GPS exchange file format (GPX) after which the sample points could be uploaded to GPS units.

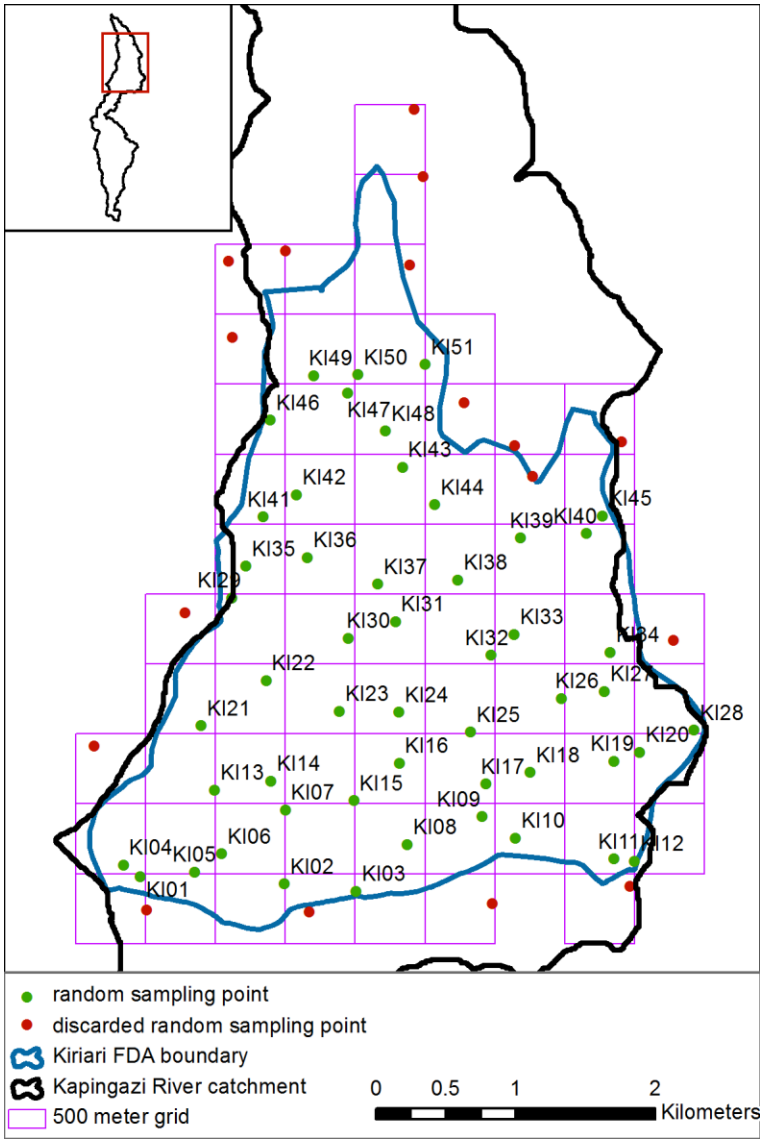

Figure 4. Systematic Unaligned sampling pattern for the Kiriari FDA.

GPS units containing all random sample points (RSP) were assigned to each enumerator. Enumerators were given paper maps showing the RSP's they should visit. Using the GPS units "Go to" function the enumerator would try to navigate within 15 meters of a RSP. Then the enumerator would identify the nearest household to the RSP for conducting the interview. If a RSP fell in an irrelevant location; for instance, in the middle of a wetland or a tea plantation, enumerators were instructed to consider their current location as a reference point and move to the nearest household to that point. Similarly, if enumerators could not find a respondent in the RSP household identified by the GPS unit, the enumerator would proceed to the nearest household relative to the one where the respondent was unavailable and continue in this way until an interviewee is identified.

2.4 Survey design and data collection

As indicated before, the main data used in this study was obtained from primary sources through focus group discussions with different community members in the three FDAs, interview with key informants, questionnaire surveys of conjoint analysis and contingent valuation methods. Details of each of the data collection methods, data types, and specific survey design are described in the relevant sections while reporting the results. In this section we give a brief overview of survey design and data collection methods.

Focus group discussions

In each of the three FDA, focus discussions with four groups (a total of 12 focus groups) were convened. The number of participants in each group ranges from 8-15 persons. The four groups consist of: (1) women group; (2) youth group; (3) FDA committees (community leaders) group; and (4) project management committees (PMCs) plus ordinary farmers group. Participants in all groups were selected with the help of local contact persons (FDA leaders), MKEPP Staff with field experience in the area and local government officers. The focus group discussions were completed in three days (one day for each FDA), from 6th to 8th of October 2009 and each discussion session consumed 2-3 hours. Group participation was sufficiently high. All the discussions were held in local language.

As focus group discussion involves a way of learning about opinions, views, attitudes, and experiences (in-depth qualitative information) of selected group of individuals about a particular topic, to keep the discussion focused, key open-ended discussion guide questions were developed (see appendix 3 for discussions guide). These questions were identified in consultation with local community leaders and PRESA research teams and hence were believed to reflect the local condition related soil and water management problems.

Each group discussion was moderated by two facilitators –a principal facilitator and an assistant. The principal facilitator's role was providing clear explanation of the purpose of the meeting, helping people feel at ease, facilitating interaction between group members, probing additional query or information when necessary, and keeping the

discussion appropriately focused. The assistant facilitator keeps notes of the discussion and jots down bullet points on a flip chart. Facilitators were drawn from MKEPP staff, PRESA staff, and local government officers. All the facilitators possess good knowledge of the study area and field experience in similar research undertakings. Two of the facilitators were MSc students hosted by ICRAF. Prior to the actual implementation of the discussions, facilitators were given training on effective facilitation of focus group discussion.

Questionnaire survey for conjoint analysis and contingent valuation

An eight page survey questionnaire that includes both conjoint and contingent valuation questions was developed (see appendix 4 the questionnaire). The survey was administered by a group of trained enumerators and was pre-tested in the field. Surveying was rigorously supervised to ensure that enumerators complied with established procedures. Pre-testing was conducted in all the three survey sites with fourteen respondents (six in Mutathari, five in Kiriari, and three in kairuri) to identify weaknesses in the presentation and comprehension of the questionnaire by both the enumerators and respondents, and to determine the most appropriate response formats to different questions. At the end the pretesting field survey a debriefing meeting was held with the enumerators and field supervisors to get feedbacks. Key issues and concerns identified during the pretesting were thoroughly discussed during the debriefing meeting and these were incorporated into the revised final version of the questionnaire. Eventually a consensus was reached that the scenarios presented in the final version of the questionnaire was found to be credible.

2.5 Method of analysis and models

Qualitative information from focus group discussions was qualitatively summarized. For conjoint and contingent data logit and ordered logit models were employed. Details of the frameworks, theoretical models and empirical implementations of these models are explained in the relevant sections of the results.

III. INSIGHTS FROM FOCUS GROUP

This section contains the synthesis of major issues raised during the focus group (stakeholders' views, perceptions, attitudes, etc) discussions held at Kapingazi River Catchment between 6th and 8th October 2009. Focus group discussions involve a way of learning about opinions, views, attitudes, and experiences (in-depth qualitative information) of selected group of individuals about a particular topic. It requires organized discussions with a small number of carefully selected people. To keep the discussion focused, key open-ended discussion guide questions have to be developed carefully. Accordingly, in consultation with local community leaders and PRESA researchers the following eleven key discussion guide questions were prepared (see appendix 3 for details on discussion guide questions.

1. key local environmental problems in the area
2. Main causes/drivers of environmental change
3. Trends of environmental changes/conditions
4. Environmentally harmful vs. environmentally friendly land uses and agricultural practices
5. Best and feasible ways to tackle/reduce land degradation
6. Local environmental priorities
7. Major benefits of conserving/managing local natural/environmental resources
8. Major constraints to adopting land uses and management practices in environmentally friendly manner
9. Local perceptions on reward mechanism for environmental services as an alternative remedial measure for the environmental problems
10. Existing soil and water conservation experiences in the area
11. Limitations and strengths of the community as a group in terms of local natural resource and environmental management

The focus group discussions were mainly focused on the local environmental problems as felt by the representative community groups in the various Focal Development Areas (FDAs) including Kiriari, Kairuri and Muthatari FDAs. The discussions revolved around issues, concerns and solutions that were linked to the key environmental problems in the area as they are being conceived by local stakeholders. In each FDA the community members were divided into 4 groups namely Focal Development Area

Committee (FDAC), Project Management Committee (PMC), Youths and Women groups. The group discussions were facilitated by the PRESA team and the finding are as summarized below.

Key Problems and their causes

One of the objectives of the group discussions was to find out the key environmental problems that are within Kapingazi River Catchment. It was noted that most of the problems are interlinked with one problem leading to the other. The community highlighted inadequate water for both domestic and irrigation as the major environmental problem in the area. This is as a result of drying up of the water sources such as River Kapingazi and its tributaries, wetlands, springs and boreholes. Also, the problem was attributed to reduced, erratic and unpredictable Rainfall (Poor rainfall patterns) coupled with prolonged draught as a result of climate change and variability. Poor environmental conservation practices such as deforestation, cultivating along the riparian and other water sources such as springs and wetlands have accelerated the reduction of the water. In addition, poor environmental policy implementation, lack of rain water harvesting technologies and poverty has also contributed to this scenario.

Further, the participants indicated that increased water and air pollution was also a major environmental problem. This has been as a result of poor sanitation in the area coupled with poor disposal of agro-industrial wastes e.g. effluents, gases and solid wastes into the rivers. Other activities carried out in the rivers such as laundry work and washing vehicles contribute to the pollution. The participants further indicated that, increased soil erosion experienced during the rainy seasons is a major cause of water pollution. This is due to lack of or poor soil and water conservation structures. As a result the chemicals used in the farms end up in the rivers hence worsening the scenario. Also, the community felt that, increased soil erosion coupled with intensive inorganic farming has resulted to soil degradation. They also noted that water and air pollution has resulted to increased incidences of both air and water borne diseases for both animals and human.

During the focus group discussions the community identified deforestation as another major environmental problem. They attributed the problem to increased population that has resulted to reduced size of land. As a coping mechanism the local people have

ended up cultivating in the areas that need to be conserved such as riparian, springs, wetlands and forests. On the other hand, lack of firewood and lack of knowledge on other alternative energy sources has also resulted to deforestation. As a result, the indigenous trees that are water friendly have diminished and in turn people have turned to high economic trees such as eucalyptus which takes up a lot of water. The situation would have been different if the community had had adequate knowledge on issues related to environment. However, this has not been the case due to reduced number of extension officers and hence lack of training and sensitization. Some members felt that they are not even motivated to establish tree nurseries that would serve as a source of income as well as seedlings that could be useful for agro-forestry.

Environmental Trend

From the preceding discussion, it can be deduced that there exists environmental problems within River Kapingazi Catchment. However, this was not the case 30 or 20 years ago. The community indicated that the area has undergone significant environmental changes. To begin with the community indicated that the water levels at River Kapingazi and its tributaries were very high such that the roaring sound of the flowing waters would be heard from a far distance. This is because the rains were in plenty and timely not as erratic as it is the case today due to the current climatic change and variability. In these rivers there was also great biodiversity such as frogs, mudfish, catfish, birds, dragonflies and 'Njururi[1]' and some have completely disappeared. This has been as a result of cutting down the diverse numbers of indigenous trees that were in existence and hence destroying their habitat. The biodiversity have also diminished due to increased water pollution as a result of increased soil erosion and poor disposal of wastes from the growing number of agro-industries and motor vehicles. As such the human and animal disease incidences have gone up. This has been compounded by poor nutrition due to reduced food production. Poor food production has been as result of soil degradation and land fragmentation which resulted in small landholdings. The participants felt that this has been as result of fast growing population that has resulted to subdivision of land into small unproductive units. Consequently, this has resulted to increased levels of poverty and increased rural-urban migration. This has also affected the land cover negatively.

[1] A swarm of black insects mostly found in rivers.

Harmful Agricultural Practices

Most of the changes described above occurred as a result of harmful agricultural practices such as riparian area cultivation, unregulated cutting of on-farm and immature trees e.g. indigenous trees and increased inorganic farming. Also poor farm management e.g. lack of or a poor soil and water conservation structures is also a contributing factor. In addition, practicing slash and burn, deforestation, improper/poor waste management has also contributed to the changes.

Priority Conservation Practices

To solve the environmental problems highlighted above, the farmers spontaneously felt that there are good environmental measures that can be undertaken and should be given priority. To begin with they felt that immediate protection of water sources such as springs, wetlands and swamps would result to increased water flows in the rivers and hence result to increased water for domestic and irrigation use. The immediate protection measures would include leaving a buffer along the river line and immediate removal of eucalyptus trees from the river bank and replacing the same with more water efficient trees such as indigenous trees. The respondents, however, felt that they cannot afford the seedlings because they are resource poor and hence there is therefore need for immediate provision of tree seedlings or availing micro credit/grants services (i.e. financial support) to boost the environmental conservation activities. This should be coupled with provision of water for irrigation that would help the community cultivate during the dry periods due to the current climate change.

Further, the farmers felt that if sustainable measures were to be implemented, there would be a need for training on environmental issues and farm management. This would be very important because of the reported reduced land sizes. The training should cover such areas as alternative energy sources such as biogas, solar, improved njikos, and fireless basket cooker. This would enhance conservation of the few trees that are in the farms and also sustainability of any other environmental conservation project. Other areas that should be covered are on growing of draught tolerant/escaping crops and small stock farming such as beekeeping, poultry and rabbit keeping, fish rearing as alternative livelihoods instead of rearing large animals that require large sizes of land.

There is also need for training and support on the implementation of soil and water conservation structures such as terracing, establishing benches, planting cover crops etc. This would result to reduced soil loss through soil erosion and hence reduced water pollution. However, the water pollution problem cannot be tackled by reducing soil erosion alone. Therefore, there would be need to handle the issue of poor disposal of agro-industrial wastes. The immediate action would be to carry out environmental audit on all the existing factories so as to establish how they dispose their wastes. In addition, it is also important to research on bio-fuels that would result to reduction of air pollution caused by the motor vehicles emissions.

Local perceptions on environmental conservation benefits

The community felt that, if the above activities are implemented, there are many benefits that could be accrued. To begin with, there would be increased rainfall due to positive climate change and hence enough water for irrigation and also plenty of clean and fresh water for domestic use. Also, there would be increased River water flows and subsequent increase of biodiversity. In addition, there would be reduced water and air pollution and subsequent reduction in air and water borne disease incidences and hence improved community health. The participants also indicated that, there would enhance food security as a result of increased rainfall and poverty levels would be lowered. Water availability enhances agricultural productivity which translates to improved community livelihoods. The resulting tree cover would lead to reduced soil erosion, adequate wood fuel and timber.

Local constraints

Despite the community's awareness about the benefits of undertaking environmental conservation activities, they indicated that a number of constraints have hindered them from undertaking the same. To begin with they sighted poverty and hence inadequate resources as their major constraint that has made it difficult for them to adopt technologies that are environmentally friendly. This situation coupled by lack of tree seedlings especially indigenous trees species has made it even worse. In addition, lack of knowledge including inadequate skills on best farm management practices has been a major constraint. For those who are knowledgeable, land size has been the main disadvantage.

Gender and youth related issues, especially on land ownership and decision making, have also been exerting constraints in environmental management. This is because usually women and youths do not have powers to make decisions on what should be done on their farms because in this community majority of women and youths do not own land. Other youth related limitations include influence of drugs, lack of youth dynamism and hostility from elderly community members. Also, weak youth forums and lack of inner drive/confidence/self motivation have also been a youth's constraint.

In addition, the community indicated that, the recent drought has been a major constraint. This is because most of the trees planted during the dry weather spell dried up. Further, poor timing of training and information dissemination to the farmers has also been a constraint to the locals. However, the community indicated that they were aware that, this has been as a result delayed funding from the government. In turn this results in late preparation/establishment of tree nurseries and hence late planting of the seedlings. Finally, the participants felt that weak law enforcement and poor policy implementation have also been a constraint.

Local perception on reward for environmental services (RES)

Despite the above constraints the community felt that the environmental conservation is viable. All the groups unanimously agreed that the reward mechanism was the way to go. In this regard focus should be made in formulating and formalizing friendly policies/guidelines that are adoptable. They felt that the strategy should be participatory/co-investment so as to enhance ownership. The participants indicated that cooperation between the upstream and down stream communities would avail much. They proposed that there is need for users to pay for the ecosystem services such as water companies and electricity generating companies. However, in order to succeed in such a mechanism, the community needs exposure on the same and this would be achieved through creation of awareness in exposition forums so as to enlighten the larger community about the same.

Previous/existing local environmental management experiences

During the discussions, the community indicated that they were willing to implement environmental conservation activities. This is because they have had experience on the

same and they know the benefits that are therein. Some of the previous and current conservation experiences include participation of some farmers in environmental management activities with MKEPP such as river pegging and spring protection. Others have put in place soil and water conservation structures e.g. benches, terraces and grass strips using Napier grass. Due to current government sensitization farmers started cutting down eucalyptus trees along the rivers and replacing with Napier grass on a 1m buffer.

The participants indicated that, some farmers have been using energy saving njikos so as to conserve firewood. Most importantly, there are other farmers who have established tree nurseries and have donated seedlings to schools, churches and some individuals who have in turn established woodlots. On the other hand some community members have been participating in the community forest associations (CFAs) and have also formed groups with focus on environmental conservation. To improve soil condition the farmers have established compost pits for generating compost manure for use in their farms. This would result in improved soil conditions.

Community strengths

Despite the constraints and limitations, the community felt that they have some strength that can be utilized for the community's advantage. For instance they have existing and registered environmental groups which can serve as the entry point for any environmental conservation programme. They sighted this as an indicator of their good will and their willingness to cooperate i.e. ready to cost-share both in kind and cash. In addition the community undertakes table banking activities/merry go round which means the community is capable of raising funds to undertake environmental conservation activities. In some areas they even have tree nurseries owned by members. They also sighted high literacy as strength within the community. They also felt that support and recognition by the government and development partners is a major strength to enable them to accomplish common objectives and goals. Most importantly there is plenty of labour resources if one wants to mobilize. From the discussions it was noted that there were some unique strengths that are youth specific such as high motivation, technological capabilities and skilful and long term vision.

IV. ASSESSING FARMERS PREFERENCES FOR ALTERNATIVE LAND MANAGEMENT CONTRACTS: RESULTS FROM CONJOINT ANALYSIS

4.1 What is conjoint analysis?

The term conjoint analysis (CA) is used in many different ways. It refers to an overall approach and group of quantitative techniques that can be used to determine respondent preferences for the attributes that make up a product or service, with the total worth of a product determined by the part-worths of its attributes (Sayadi *et al.*, 2005). A fundamental characteristic of this approach is that the utility derived from a product can be decomposed into part-worths relating to the different attributes of that product (Lancaster, 1966). CA methodology was long associated in marketing research, psychology, and transportation research for evaluating and understanding consumer preference for products or services (Green and Srinivasan, 1978; Anderson, 1982; Louviere, 1988; Hensher, 1994; Roe *et al.*, 1996; Admowicz *et al.*, 1998). Much of the early works in marketing emphasised modelling of behavioural processes to understand how individuals evaluate products or services and form preferences (Green and Rao, 1971; Norman and Louviere, 1974). Today variants of CA are used in many fields including Natural Resource Economics, Environmental Economics and Management, and transportation. A traditional conjoint question presents each respondent with a product or service descriptions which differ according to the attributes and ask respondents to rank or rate the desirability of each product or service.

Most CA applications involve a series of techniques that stem from several common hypotheses which may be summarized as follows (Alvarez-Farizo and Hanley, 2002; Sayadi *et al.*,2005; Louviere *et al.*, 2005):

(1) The product or service may be defined using an aggregate of features or attributes that take certain levels or values.
(2) Different levels of the features define different versions of the product or service under consideration.
(3) Product appraisal by individuals is a function of the value or worth which they assign to the product's features.
(4) During the decision-making process, individuals appraise the worth of each combination, and their rating, ranking or choice demonstrates prioritization among

the different combinations of features. It is assumed that the total worth of a particular product choice is determined by the different part utilities (part-worths) of each feature or attribute level.

4.2 What is the objective of the conjoint analysis in this study?

The objective of CA application in this study was to identify and evaluate landholders' preferences towards different hypothetical land management schemes or contracts aimed at increasing the quantity and/or quality of water in River Kapingazi. By generating negative environmental externalities such as soil erosion and sediments, land-based rural activities across the Kapingazi catchment threaten the watershed environmental services which entail the introduction of watershed management. This encompasses land use changes and/or adoption of best agri-environmental management practices. However, little is known about landholder's attitudes and preferences related to ecosystem management alternatives in River Kapingazi catchment. Thus, understanding landholders' preferences for the attributes of intended land use changes and new management practices becomes a vital element in designing and planning sustainable watershed management. Such an understanding also appears to be crucial in designing the reward scheme for environmental services and negotiating with potential buyers (for instance, hydroelectric companies; municipal water companies etc.) of the environmental services. In order to assess landholders' attitudes and preferences, it is necessary to create particular land management/contract scenarios and evaluate landholders' preferences for alternative schemes.

4.3 Selecting and defining attributes and levels of attributes

Selecting and defining attributes and levels of attributes relevant to the study under consideration lay the experimental foundations for the design of a conjoint analysis. This requires identifying factors that must be easily communicated for realistic evaluation and be capable of being put in practice. For this purpose, from the 5th to 9th of October 2009, series of focus group discussions (see section 3), stakeholders' workshop, and key informant interviews were held among communities in all the three Focal Development Areas (FDAs) along the Kapingazi River sub-basin. On the basis of review of a range of related literatures on potential attributes for evaluating land

management contract, PRESA's prior knowledge about the study area, and the huge information obtained from relevant government and non-government agencies operating in the area, we managed to identify six attributes – five of which have got three levels each and one attribute with four levels – for the conjoint analysis. Attributes levels were initially assigned by the research team and later on modified during the stakeholders' workshop by accommodating local conditions. The levels of attributes are selected to capture realistic alternative levels. A summary of the attributes and their levels are presented in Table 1. Below, we describe these attributes and their levels,

1. *Land area to be committed*: Land is the most important factor of production in rural-based economic activities (cropping, livestock, and forestry). It implies that any land use change or land management agreement must explicitly indicate the size of land that land owners are willing to commit. This has also got national level institutional back up in relation to agricultural land use along streams in Kenya. According to the Kenyan government land use law a minimum of 10 feet uncultivated buffer area is required along streams. For the purpose of experimental design a 10%, 20%, and 40% levels are defined to this attribute.

2. *Length of commitment (contract) period*: For rural communities whose livelihood is mainly dependent on land and where landholding becomes highly fragmented (small landholdings happens to be the norm), the length of period farmers commit their land appears to an important factor in designing land management contract. A commitment period of 5, 15, and 30 years were identified as the three levels for this attribute. The basis for these levels was some the existing land contracts in the area uncovered during the stakeholders' workshop. There has been some established short, medium and long term land renting out practices in the study area: renting out for 5 years (short term contract) for livestock producers interested in growing fodder; 15 years renting out contract (medium term contract) for some companies interested in the land retirement for ecosystem services; and 30 years renting out agreement (long term contract) for tree planting.
3. *Right to harvest products from committed land in environmentally friendly manner*: Given the scarcity of land in the study area, farmers may be interested to maintain their rights to harvest some environmental products, for instance

fodder grass or dead wood for fuel even after they committed land for the contract. Providing this right may influence farmers preference for alternative land management schemes and the degree of scheme adoption. Permitting, partially permitting, and not permitting were assigned as qualitative levels for this attribute.

4. *Reward scheme/incentive scheme*: 'How landholders get compensated once they enter into the agreement' was found to be an important factor in evaluating both landholders' preference and designing the reward scheme. Defining and determining levels for this attribute has become the most controversial topic during the stakeholders' workshop. After lengthy dialogue and discussion, finally the group came up with four attribute levels. Participants identified three most important priority lists among their community members – water for domestic use and irrigation, electricity, and extension services – and agreed that reward/compensation schemes for any proposed land management contract should revolve around these three most valued community priorities. Accordingly, three of the four levels assigned the this attribute were 'provide and/or waive annual water cost for domestic use and/or irrigation per acre of land committed', 'cover 50% of your annual extension service fee per acre of land committed', and 'provide micro-scale electricity and/or waive 50% of your annual electricity cost per acre of land committed'. The forth attribute being 'direct annual cash payment of Ksh. 4500 per acre of land committed'.

5. *Local scheme administering agency*: Effective local level land management contracts with small holders necessitate the involvement of local scheme administering unit/agency. This agent can act as an intermediary unit between suppliers and buyers of environmental services; may involve in negotiations, undertaking scheme monitoring, and facilitating the actual implementation of rewards. If farmers are given chances to choose local level contract administering agents, different farmers may reveal their preferences for different local scheme administering agents and therefore the inclusion of this attribute in the conjoint analysis. After evaluating the appropriateness and relevance of existing local level community organization, workshop participants have identified three local organizations – Water Resource Users Association

(WRUA), Focal Development Area Committees (FADCs), and Community Forest Association (CFA) – to be considered in designing the conjoint study.

6. *Required free labour contribution related to the contractual scheme*: It is important to acknowledge that land management contract may entail landholders' periodic contribution of free labour services in terms of establishing and maintaining the structure, certain forms of collective actions, training, attending scheme meetings; etc. This may play an important role in shaping farmers' preferences towards proposed management schemes. Three attribute levels – 1 day, 2 days, and 3 days per month free labour contribution – are identified for this attribute.

Table 1. Attributes and levels of attributes for land management contract in the River Kapingazi catchment, Mt. East Kenya

Attributes	**Levels**			
	Level 1	**Level 2**	**Level 3**	**Level 4**
1. Land area to be committed	10% of your land	20% of your land	40% of your land	-
2. Length of commitment period	5 years	15 years	30 years	-
3. Right to harvest products (grass/fodder/beekeeping)	permitted	Partially permitted	Not permitted	-
4. Reward scheme/incentive scheme	Provide and/or waive annual water cost for domestic use and/or irrigation per acre of land committed	Cover 50% of your annual extension service fee per acre of land committed	Provide micro-scale electricity and/or waive 50% of your annual electricity cost per acre of land committed	Direct annual cash payment of Ksh. 4500 per acre of land committed
5.Local scheme administering agency	Water Resource Users Association (WRUA)	Focal Development Area Committee (FDAC)	Community Forest Association (CFA)	-
6. Required free labour contribution related to the contractual scheme (training, attending scheme meetings; etc) per month	1 day	2 days	3 days	-

Table 2. Hypotheses regarding the effect of the attributes on ratings

Attributes	**Hypothesised effect on respondents ratings**
1. Land area to be committed	Negative and relatively important. Given the small landholdings in the study area, farmers will be not interested to commit more land
2. Length of commitment Period	Negative and relatively important. Longer contract/commitment periods imply loss of other economic opportunities from the land by tying-up the land for longer periods. Hence, the longer the contract period the less the preferred the scenario.
3. Right to harvest products (grass/fodder/beekeeping)	Positive and relatively important; having right to harvest environmental products from committed areas imply more potential benefits from the land and hence contracts that grant harvest rights may be more preferred than those do not allow such rights.
4. Reward scheme/incentive Scheme	Untenable to hypothesize the effect or sign *a priori* ; individual farmer can favour any of the reward schemes
5.Local scheme administering agency	Untenable to hypothesize the sign *a priori*; a farmer can favour any of the three local administering agency
6. Required free labour contribution related to the contractual scheme (training, attending scheme meetings; etc) per month	Negative and relatively unimportant; more days of free labour contribution discourages farmers from program participation but farmers may still consider this as a worthwhile contribution

4.4 Conjoint field survey design

Once the attributes and levels to be included in constructing the hypothetical land management contract is selected and defined, the next crucial task involves the design of the stimuli[2] to be evaluated by the respondents. Following Arifin *et al.* (2009) we employed *factorial design* method on the six attributes (five attributes with 3 levels each and the remaining one attribute with 4 levels) described in the preceding section to generate a total of 972 scenarios (3^5*4). From pre-tests of the conjoint analysis method,

[2] This refers to hypothetical product/service scenarios created by combinations of different attribute levels.

we determined that 9 scenarios was an appropriate number to ask each respondent to rate. We therefore ascertained that 108 respondents could handle the full set of scenarios, meaning that each respondent responded to a unique set of 9 scenarios (9 scenarios×108 respondents=972 scenarios). The 972 scenarios were divided among the108 respondents in a way that gave a design as near orthogonal as possible. ICRAF Scientist[3] handled experimental design using AlgDesign package from R statistical system (Wheeler, 2008).

Each respondent was asked to compare 9 scenarios, selected to give a near orthogonal design. The 108 interviews yielded a total sample size of 9 * 108 = 972 observations across the catchment. A total of 6 enumerators (two enumerators per site) and 3 field supervisors were deployed to administer the survey. The survey was administered in face-to-face interviews with the respondents. The questionnaire was written in English but the interview was conducted using the local language in order to ease the process of data collection and improve communication between enumerators and respondents.

The survey questionnaire consisted of three parts (see appendix 4) viz.: (1) a preliminary set of questions on respondent's demographics, socio-economics, and experience and membership in local pro-environment organization; (2) conjoint questions consisting of description of the situation and series of alternative land management arrangements that each respondent was asked to rate; and (3) contingent valuation question to elicit landholders willingness to accept (WTA) rewards for environmental services.

Before the formal interview respondents were given a general introduction concerning the research objectives and land use related environmental problems in the area. Again, prior to asking a respondent to rate the land management contract scenarios (just after finishing the demographic and socioeconomic sections in the questionnaire), the respondent was sufficiently introduced about the conjoint section in the survey questionnaire and the various hypothetical land management arrangements. The attributes and levels were summarized in the questionnaire in a simple one-page table that could be easily understood by the respondents. As explained above, each

[3] We are very thankful to Richard D. Coe, ICRAF scientist, for his valuable inputs in the identification process of attributes, attribute levels, and carrying out the experimental design.

respondent was asked to rate 9 scenarios. An example of the 9 scenarios format presented for a respondent for rating is shown in Table 2. Respondents were asked to provide ratings on a scale of 1-5 for each hypothetical contract in terms of the likelihood that he would participate, with 5 indicating scenarios, if any, that the respondent would definitely undertake and 1 for scenarios, if any, that he would definitely not undertake. And if the respondent is not sure, he can use 2 through 4 to indicate how likely he would be undertaking each scenario. Each version of the arrangement consisted of different combinations of levels of the six attributes.

Table 3. An example of the 9 land management contract options considered presented for a respondent for rating

Options	**Land area committed**	**Commitment period**	**Right to harvest**	**Reward scheme**	**Local administering agent**	**Required free labour contribution per month**	**Your Rating**
Option 1	10 % of land	15 years	not permitted	waive water costs	Community Forest Association (CFA)	3 Days	
Option 2	40 % of land	5 years	not permitted	cover 50% extension fees	Community Forest Association (CFA)	2 Days	
Option 3	10 % of land	30 years	not permitted	waive water costs	Water Resource Users Association (WRUA)	1 Day	
Option 4	20 % of land	15 years	partially permitted	waive 50% electricity costs	Focal Development Area Committee (FDAC)	1 Day	
Option 5	10 % of land	30 years	permitted	annual cash payment (4500 Ksh/acre)	Water Resource Users Association (WRUA)	1 Day	
Option 6	20 % of land	15 years	partially permitted	waive water costs	Community Forest Association (CFA)	3 Days	
Option 7	20 % of land	30 years	partially permitted	cover 50% extension fees	Water Resource Users Association (WRUA)	3 Days	
Option 8	40 % of land	30 years	permitted	annual cash payment (4500 Ksh/acre)	Focal Development Area Committee (FDAC)	2 Days	
Option 9	40 % of land	5 years	permitted	waive 50% electricity costs	Focal Development Area Committee (FDAC)	2 Days	

4.5 Conjoint models

Three conjoint models were employed: a traditional conjoint ratings model, a binary logit model, and an ordered logit model. A binary logit model was used to assess the effect of the levels of the attributes on farmer's preference to *definitely* undertake a specific scenario among the different options presented during the conjoint experiment. For the analysis of the rating data, we employed an ordered logit model.

4.5.1 Traditional conjoint model

The statistical method primarily used in traditional conjoint analysis is ordinary least squares regression (OLS). The underlying presumption of this method is that the rating scale responses satisfy the numerical properties associated with interval scales, i.e., humans can use rating scales to provide meaningful differences between scenario profiles and that the units of the rating scales represent equal differences. Thus, strong assumptions are required to be satisfied in traditional conjoint analysis. A Land holder's rating for each management scenario is assumed to be proxies for individual utility. Let the rating assigned by respondent n to land management scenario j be denoted as R_{nj}, and assume that: (a) the rating scale intervals are equal, b) the individual's utility function is strictly additive and linear in the model parameters, and c) the errors are distributed normally and independently with constant variance, we can express the observed rating data as a linear regression in the following way:

$$U_{nj} = \beta_o + \beta_1 R_{nj} + \varepsilon_{nj} \qquad (1)$$

where β_o and β_1 are unobserved "true" parameters that linearly relate the observed ratings to the unobserved latent utilities, U_{jn}. If the assumptions are satisfied, the ratings provide information about the true utilities, and equation (1) allows us to specify the rating data as a linear regression of attribute levels (K attributes each with m number of attribute levels) as follows (Stevens *et al.*, 1999; Louviere et al, 2005):

$$R_{nj} = \alpha_o + \beta_1 X_{1,1} + \beta_2 X_{1,2} + ... + \beta_{m-1} X_{1,m-1} + ... + \beta_{k(m-1)} X_{k(m-1)} + \varepsilon_{nj} \qquad (2)$$

where $\beta's$ are utility or preference estimates (sometimes called "part-worths") associated with each attribute level, and ε_{nj} is an error term that must satisfy the usual

OLS assumptions of mean zero, constant variance and independence. If the assumptions are satisfied, the estimated $\beta's$ can be interpreted as part-worth utilities, representing the conditional response means associated with each attribute level.

4.5.2 Logit model

The behavioural foundation of the logit model used in this study is the economic agent's utility maximization behaviour and the theoretical base comes from random utility theory (RUT). We begin with the assumption that farmers derive utility directly from the attributes of land management contract where each attribute is represented by a discrete number of levels.

(a) Theoretical logit model derivation

Following the random utility theory (RUT) tradition (Train, 2003), suppose that farmer n $(n = 1, \ldots, N)$ faces a choice among J alternative land management scenarios. Let U_{nj}, $j = 1, \ldots, J$ denote the utility that n obtains from alternative j. The farmer would reveal to undertake alternative i if and only if $U_{ni} > U_{nj}$ $\forall j \neq i$. On the basis of RUT, the utility (U_{nj}) that a farmer obtains from alternative j is decomposable into two components V_{nj} *and* ε_{nj} where V_{nj} is the portion of U_{nj} that can be represented from the observed attributes of the alternatives, labeled X_{nj} $\forall j$ and individual's socio-economic characteristics, labeled H_n, and ε_{nj} random disturbance term reflecting intrinsically random choice behaviour, measurement or specification error and unobserved attributes of the alternatives that affect utility but are not captured in V_{nj}. Then the utility function can be represented as:

$$\left.\begin{aligned} U_{nj} &= V_{nj} + \varepsilon_{nj} \;\; \forall j \\ &= V(X_{nj}, H_n) + \varepsilon_{nj} \end{aligned}\right\} \qquad (1)$$

Denoting the joint density of the random vector $\varepsilon_n = \varepsilon_{n1}, \ldots, \varepsilon_{nJ}$ by $f(\varepsilon_n)$, the probability that farmer n chooses land management contract i is given by:

$$\left.\begin{aligned} P_{ni} &= prob(U_{ni} > U_{nj}) : \forall j \neq i \\ &= prob(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}) : \quad \forall j \neq i \\ &= prob(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}) : \quad \forall j \neq i \end{aligned}\right\} \qquad (2)$$

The expression in (2) is a cumulative distribution that measures the probability that each random term difference $\varepsilon_{nj}-\varepsilon_{ni}$ is below the observed quantity difference $V_{ni}-V_{nj}$. Using the density $f(\varepsilon_n)$, this cumulative probability can be rewritten as:

$$\left.\begin{aligned} p_{ni} &= prob(\varepsilon_{nj}-\varepsilon_{ni} < V_{ni}-V_{nj}): \quad \forall j \neq i \\ &= prob(\varepsilon_{nj} < \varepsilon_{ni}+V_{ni}-V_{nj}): \quad \forall j \neq i \\ &= \int_{\varepsilon} I(\varepsilon_{nj} < \varepsilon_{ni}+V_{ni}-V_{nj} \quad \forall j \neq i) f(\varepsilon_n) d\varepsilon_n \end{aligned}\right\} \qquad (3)$$

where $I(\cdot)$ is the indicator function. It takes the value 1 when the expression in parentheses is true and 0 otherwise. Assuming that the unobserved portion of the utility (ε_n) is identically and independently distributed (iid) across alternatives[4], the last expression in (3) is the cumulative distribution for each ε_{nj} evaluated at $\varepsilon_{ni}+V_{ni}-V_{nj}$ with the density function[5]:

$$f(\varepsilon_{nj}) = f(\varepsilon_{ni}+V_{ni}-V_{nj}) = \exp(-\exp)\ \exp(-\exp(-(\varepsilon_{ni}+V_{ni}-V_{nj})) \qquad (4)$$

and cumulative distribution

$$F(\varepsilon_{nj}) = \exp(-\exp(-(\varepsilon_{ni}+V_{ni}-V_{nj})) \qquad (5)$$

Given that $\varepsilon's$ are independent, the choice probability becomes

$$p_{ni} = \int \prod_{i \neq j} F(\varepsilon_{nj}) f(\varepsilon_{ni}) d\varepsilon_{ni} = \int \prod_{i \neq j} \left(e^{-e^{-(\varepsilon_{ni}+V_{ni}-V_{nj})}} \right) e^{-\varepsilon_{ni}} e^{-e^{-\varepsilon_{ni}}} d\varepsilon_{ni} \qquad (6)$$

Evaluating the integral in eq.(6) results in eq.(7)

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[4] In probability theory, a sequence or other collection of random variables is independent and identically distributed (iid) if each has the same probability distribution as the others and all are mutually independent or unrelated.

[5] If a random variable x is identically and independently distributed (following extreme value), its density function is represented by $f(x) = e^{-x}e^{-e^{-x}}$ with cumulative distribution $F(x) = e^{-e^{(-x)}}$. This distribution is also called Gumbel distribution.

$$p_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}} \quad (7)$$

Equation (7) is a logit choice probability. Specifying V_{nj} as a linear function (linear in parameter) of X_{nj} and H_n as

$$V_{nj} = \beta' X_{nj} + \gamma' H_n \quad (8)$$

Substituting (8) in (7), the logit probability can be expressed as[6]

$$p_{ni} = \frac{e^{(\beta' X_{ni} + \gamma' H_{nj})}}{\sum_j e^{(\beta' X_{nj} + \gamma' H n_j)}} \quad (9)$$

For the binary choice logit, the probability of choosing the ith scenario would be:

$$p_{ni} = \frac{1}{1 + \sum_{j=1}^{2} e^{(\beta' X_{nj} + \gamma' H_{nj})}} \quad (10)$$

(b) Empirical logit model

Expanding eq. (8) the utility that farmer n derives from the observed attributes of the i^{th} land management scenarios can be represented as (eq. 11)[7]:

$$V_{ni} = \beta_1 X_{1i} + ... + \beta_K X_{Ki} + \alpha_1 H_1 + ... + \alpha_R H_R \quad (11)$$

Where: $X_{1i} ... X_{Ki}$ are levels of the six attributes identified

$H_1 ... H_S$ are respondent's individual socio-economic characteristics

$\beta_1 ... \beta_K \quad and \quad \alpha_1 ... \alpha_S$ are unknown parameters

Though V_{ni} cannot be observed, the conjoint rating experiment provides information about farmer's ratings of alternative scenarios. For the purpose of logit modelling we created a binary dependent variable Y and set $Y = 1$ for only those individuals who said they would definitely undertake a given contract scenario and $Y = 0$ otherwise (i.e., Y takes a zero value for ratings= 1- 4). In this approach only those individuals who said they would definitely undertake each management scenario were counted as participating (Stevens *et al.*, 1999). It assumed that individual's decision to participate depends upon program attributes such as the land area to be committed and length of

[6] The denominators in (7), (8), and (9) are the sum of the numerator over all alternatives. This assures that probabilities sum to one.

[7] The empirical models and their descriptions were adapted from Arifin *et al.* (2009).

contract and individual socio-economic characteristics such as age, education, and land size owned. The rational farmer will prefer to undertake the i^{th} contract scenario if the utility he expects to derive from i is greater than or equal to the utility he would expect to derive from other alternative contract scenarios.

In other words:

$$\begin{aligned} Y_i &= 1 \quad if \quad U_{ni} \geq U_{nj}, \quad \forall_{j \neq i} \quad and \\ Y_i &= 0 \quad if \quad U_{ni} \leq U_{nj}, \quad \forall_{j \neq i} \end{aligned} \tag{12}$$

Substituting equation (11) in (2) the probability that farmer n will undertake contract scenario i can be expressed as:

$$\begin{aligned} \Pr(Yi = 1) &= \Pr[(V_{ni} + \varepsilon_{ni}) > (V_{nj} + \varepsilon_{nj})] \\ &= \Pr[(\varepsilon_{ni} - \varepsilon_{nj}) > (\beta_1 X_{1j} + ... + \beta_K X_{Kj} + \alpha_{1j} H_1 + ... + \alpha_{Rj} H_R) \\ &\quad - \beta_1 X_{1i} + ... + \beta_K X_{Ki} + \alpha_{1i} H_1 + ... + \alpha_{Ri} H_R] \end{aligned} \tag{13}$$

where $X, H, \beta, and\ \alpha$ are as defined before.

Assuming that the ε's are independently and identically distributed, the appropriate functional form of $(\varepsilon_{ni} - \varepsilon_{nj})$ defines the appropriate estimation technique for estimating the utility difference (Eq. (13)). Here we assume that $(\varepsilon_{ni} - \varepsilon_{nj})$ is distributed according to the logistic function, making logit fitted with maximum likelihood an appropriate estimation technique. The logit technique has the advantage over other probability models such as probit in that the logit parameter estimates are easily interpreted as the logarithm of the odds ratios. An odds ratio is the ratio of the odds of an event occurring in one group to the odds of it occurring in another group. For a given attribute, an odds ratio of one implies that the attribute has no effect on the odds that respondents will prefer the hypothetical contract to other alternative contracts. An odds ratio less than one indicate that higher levels of the attribute reduce the odds that respondents prefer the hypothetical contract to the existing contract. An odds ratio greater than one implies that higher levels of the attribute increase the odds that respondents will prefer the given contract under consideration compared to other alternative scenario contracts.

4.5.3 Ordered logit model

For the analysis of the rating data, ordered logit model was applied. The dependent variable is the rating between 1 (a respondent preferred that he would definitely not undertake) and 5 (a respondent preferred that he would definitely undertake), while the independent variables are the levels of the 6 attributes and the specific characteristics of the respondents. We assume that any contract that the farmer rates with a higher number is preferred over any contract that he or she rates with a lower number, but we do not assume that the intervals between the ratings are equal. For example, we do not assume that the difference in preference between ratings 1 and 2 is the same as the difference in preference between ratings 4 and 5. The ratings therefore are characterized as discrete and ordered, but not ordered by equal interval. Again assuming that the error terms are distributed over the logistic function, ordered logit fitted by maximum likelihood is an appropriate analytical approach for this analysis (Greene, 1993).

The starting point for the ordered logit model is again Eq. (11) above, where the indirect utility that is derived from a hypothetical contract scenario is a function of the attributes of the contract and the respondent's characteristics. While the indirect utility derived from a particular contract cannot be observed, we observe the ratings 1 through 5, where:

$$
\begin{aligned}
&Rating = 1 \quad if \quad V_i \le \mu_1 \\
&Rating = 2 \quad if \quad \mu_1 < V_i < \mu_2 \\
&Rating = 3 \quad if \quad \mu_2 < V_i < \mu_3 \\
&Rating = 4 \quad if \quad \mu_3 < V_i < \mu_4 \\
&Rating = 5 \quad if \quad V_i > \mu_4
\end{aligned}
$$

where $\mu_1,...,\mu_4$ are estimated cutoff points.

The probability that the farmer will give a rating of j to the i^{th} contract scenario is given as:

$$\Pr(Rating = j) = \Pr[(\mu_{j-1} < (\beta_1 X_{1j} + ... + \beta_K X_{Kj} + \alpha_{1j} H_1 + ... + \alpha_{Rj} H_R) < \mu_j] \qquad (14)$$

4.6 Description of respondents' characteristics

Thirteen demographic and socio-economic characteristics are selected to be used in conjoint models. Demographic variables such as *age, sex, household size and education level* do normally influence one's preference. For instance, the higher one's education

level the more likely the individual will participate in environmental management or protection programs. Household's *main income source* (for example, broadly classified, from agricultural activities or non-agricultural activities) can influence preferences on land management contract. Households who earn their major livelihood income from agricultural activities may be reluctant in undertaking land management contract that limits their access to land. On other hand, households deriving their major income from non-agricultural sources may consider land management contract as a worthwhile engagement.

Table 4. Name and description of respondents characteristics used in conjoint analysis

Variable name	**Variable label**	**Description**
Sex	sex	Sex of the respondent (household head). [dummy: sex = 1 for male and 0 for female
Age	age	Respondent's age in years
Education	edu_primary edu_secondary edu_AboveSec	Respondent's highest level of education; dummy variable with four categories. The base category for illiterate i.e., respondents having never any schooling takes 0; then 1, 2, and 3 for primary, secondary and above secondary (college or university) levels schooling respectively
Household size	hhsize	Total household size (head count)
Agricultural income	Agri_income	Net household income from agricultural activities (cropping and livestock activities) in Ksh.
Non-agricultural income	NonAgri_income	Net household income from non-agricultural sources such as off-farm employment, transfers, pensions, interest income etc. in Ksh.
Land size owned	LandSize	Total land size owned by the household in acres.
Management practices	Env_mgt	Previous/existing experience in land management practices; dummy (yes=1; No=0)
Participation in MKEPP	MKEPP	Whether the household is participating in Mount Kenya Pilot Project[8] (MKEPP); dummy (yes=1; No=0)
Access to finance	Fina_access	Whether the household got access to financial services (i.e., credit); dummy (yes=1; and No=0)
Prior information on RES scheme	Envi-info	Whether the household got any prior information about market-based provision of environmental services; dummy (yes=1; No=0)

[8] MKEPP is a project operating in 8 districts in Eastern province of Kenya (eastern side of Mt. Kenya) whose prime focus is on natural resource management with six project components: water resource management, rural livelihoods, environmental conservation, community empowerment and coordination and management. The areas/sites covered in this study fall in this region.

Land size owned becomes the key factor in influencing households' preference to the land management contract. During the focus discussion and stakeholders' workshop, land holding fragmentation was identified as one of the major problems in the study area. As a large number of farmers are small holders, they do not favour land management contract schemes that limit their access to the land unless appropriate compensation scheme is put in place. Other things being equal, households owning larger land area are more likely to commit part of their land for proposed contractual scheme compared to small holders. Previous experience in environmental conservation practices; participation status in existing environmental protection project, specifically in MKEPP; and respondent's prior information on market based reward scheme for environmental services provision are also identified among the important factors that influence household's preference for a specified land management contract. For instance, others things remain the same, households who are already participating in MKEPP or practicing environmental conservation measures are more likely to undertake a given land management scheme than those who do not possess these characteristics. We also identified *access to finance/credit* as another important factor in conditioning individual's preferences for the proposed scheme. Households unconstrained with financial resources can choose to pursue alternative livelihood strategies and surrender their land for the contract (Bedru Babulo *et al.*, 2008).

4.7 Results from conjoint analysis

This section presents descriptive statistics of respondent characteristics, econometric results from traditional conjoint analysis, binary logit models, and ordered logit models.

4.7.1 Respondent characteristics

Table 5 presents the descriptive statistics of selected socio-economic and demographic characteristics of respondents deemed to influence preferences. The average respondent of this survey was 54.3 years of age with minimum of 22 and maximum of 85 years. The sex distribution of survey respondent seems unbiased – 61% male and 39% female. Taking male-dominated culture in major household level decisions in most rural Africans villages, this appeals a good sex balance. In similar studies in Indonesia, cultural dominance of men compels Arifin *et al.* (2009) to sample all survey respondents male.

Only 11% of the respondents cross education levels beyond secondary schooling. The rest falls either in 'never any schooling' or 'primary schooling' or 'secondary schooling' (16%, 31.5%, and 41.6% respectively) categories. With an average family size of 6 persons, survey sites generally reflect household sizes in typical African villages.

Table 5. Descriptive statistics of explanatory variables (respondent's characteristics) used in the empirical conjoint models

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
Age	54.32	14.84	22	85
Sex (1 if male)	0.6111	0.4877	0	1
Edu_primary	0.4167	0.4933	0	1
Edu_second~y	0.3148	0.4647	0	1
Edu_AboveSec	0.1111	0.3144	0	1
Hhsize	5.94	2.81	1	13
Agri_Income	61629.00	87028.78	3000	580000
NonAgri_income	38805.94	67210.62	0	360000
LandSize (acres)	3.18	2.97	0.5	20
Env_mgt	0.7963	0.4029	0	1
MKEPP	0.2685	0.4434	0	1
fina_access	0.9159	0.2777	0	1
Env_info	0.2129	0.4096	0	1

Survey respondents were asked to report their net income from both agricultural and non-agricultural sources. Incomes form both sources are distributed unevenly with mean annual income of Ksh. 61629 (std.87028) for agricultural income and Ksh. 38805 (std.67210) for non-agricultural income). Both agricultural and non-agricultural incomes were normalized as follows. $(X_i - Min.value)/(Max.value - Min.value)$; where Xi = observed value of agricultural or non-agricultural income; $Min.value$= the minimum value in the series and, $Max.value$ = the maximum value in each income series. Normalized values were used in both the binary and ordered conjoint logit models (Table 7 and Table 8).

In terms of land holdings, the study area is generally characterised by small holdings with average holdings of 3.2 acres/household. Only 36% of survey respondents possess greater than the average holding size. Households in the first quartile possess only one acre or even less than an acre unit of land. As size of land holdings is supposed to play a crucial role in respondent's preferences for the proposed program, the possible impact of small holdings could be inducing respondents to state low ratings for most contractual schemes. Access to financial resources happens to be overwhelmingly good as almost 92% of respondents stated that they access local financial sources. So, financial resources seem to be not a major constraint for implementing land management programs that may require additional funds. In terms experience and information in prior environmental management practices about 80% of the respondents responded 'yes' for the question "*have you had and environmental resource management practices on your private land*?" About 27% are participating in MKEPP scheme; but only 21% of the respondents possess information about market based provision of environmental services (in other words, payment for ecosystem services).

4.7.2 Results from traditional conjoint analysis

Results of the traditional conjoint analysis are reported in Table 6. Using equation (2), we run an OLS regression of '*Rating*' on coded attributes of management scenarios. Signs of estimated coefficients are generally consistent with prior expectations. Size of land areas to be committed (both *LandArea20percent* and *LandArea40percent* attribute levels), length of commitment period (*Commit period30yrs*), and prohibition of harvest right (*HarvestNotPermitted* attribute level) are negative and highly significant (at 1% level of significance) in conditioning respondent's rating of options. Land management options that require more land commitment and longer contract period were rated lower. Similarly, contracts that prohibit owner's rights to use or harvest some environmental products such as grass were not preferred by respondents. Provision and waiving of electric bills (*RewardElectricity* attribute) as a reward scheme does not motivate respondents for higher ratings (i.e., ratings decline as this reward scheme was presented). Rating also decline with partial restriction of harvest right and extension fee waiving as a reward scheme. However, these attributes are not statistically significant.

Table 6. Traditional conjoint model results

Attributes of the scheme	Estimated coefficient	Standard error	t-value	p > |t| (p-value)
LandArea20percent	-0.6116***	0.1156	-5.29	0.000
LandArea40percent	-1.4514***	0.1158	-12.53	0.000
CommitPeriod15yrs	-0.0704	0.1161	-0.61	0.544
CommitPeiod40yrs	-0.8489***	0.1172	-7.24	0.000
HarvestNotpermitted	-0.7952***	0.1164	-6.83	0.000
HarvestPartial	-0.1291	0.1165	-1.11	0.268
RewardExtensionFee	-0.1853	0.1337	-1.39	0.166
RewardElectricity	-0.2479*	0.1315	-1.89	0.060
RewardWater	0.1544	0.1318	1.17	0.242
LocalAdminFDAC	0.1673	0.1147	1.46	0.145
LocalAdminCFA	0.0145	0.1129	0.13	0.898
FreeLabour2dys	0.1652	0.1148	1.44	0.151
FreeLabour3dys	0.1093	0.1165	0.94	0.348
Cons	4.0777***	0.1772	23.01	0.000

*= significant at 10% level; ***= significant at 1% level

On the other hand ratings increase with FDAC as local scheme administrator and water provision and water cost waiving as a reward scheme; but these attributes are statistically insignificant. As the base category (with zero value) for the attribute "*Reward Scheme*" was 'direct cash payment', though not significant, the positive coefficient of "*RewardWater*" in Table 6 signals that people prefer 'water provision and water cost waiving' as a reward scheme to direct payment. It seems that respondents were not serious on the number of days they were required to free contribution of labour as the coefficients to *FreeLabourdys* variable do not change signs whilst changing the number free labour day requirement from scheme to scheme; and also these coefficients are not significant statistically. The possible explanation for this could be that landholders do not give much weight for free labour contribution requirement while evaluating options. Similarly, respondents did not clearly indicate their preference against the different local level scheme administrators.

On the basis of results from the traditional conjoint model, '*land area to be committed*, '*length of commitment period'*, and '*right to harvest products*' were the three principal attributes that influence landowners' ratings for various proposed management options.

4.7.3 Results from binary logit models: Landholders preferences for proposed land management contract

The probability that landholders would definitely undertake any of the management scenarios given in the survey was estimated using equation (13). The dependent variable in this model takes the value of 1 for management scenarios which received a conjoint rating of 5, and 0 otherwise. A binary logit model was run using program attributes defined in Table 2 and socioeconomic and demographic explanatory variables defined in Table 4. Table 7 reports results of this analysis. Both the estimated coefficients as well as the transformed coefficients (i.e., odds ratio) are reported in the table. The probability of scenario adoption decreased for options that require commitment of larger land areas, longer contract period, and increased restriction of harvest right. These three attributes were found to the most important factors in influencing a landholder's potential adoption of the proposed management schemes.

Though not significant statistically, supplying domestic water and/or irrigation water and waiving its cost as a reward scheme for the provision of environmental services enhances the likelihood of landholders' contract adoption. On other hand, local level scheme administering agents and required free labour contribution attributes were not statistically different from zero i.e., the likelihood of scheme undertaking was not related to these attributes.

On the basis of individual level socioeconomic and demographic characteristics; other things remain the same, people with prior experience in environmental management practices and who are already involving in MKEPP projects are more likely to undertake a proposed management option. The likelihood of program adoption was not statistically related the sex of the respondent, level of education, access to financial markets, and household size. The statistical insignificance of education is a pattern which was not anticipated. Previous studies also show that education and local environmental awareness play significant roles in environmental management programs in many developing countries (Bedru Babulo *et al.*, 2008). The contra *a priori* expectation findings on the role of education in this study may shed light that local community may possess sufficient environmental awareness and knowledge. Age of the respondent was significant and negative. An important implication of this result may be that younger people would possess more appreciation and understanding of

environmental problems and hence more likely to adopt environmental management programs. The most striking and unexpected result from the logit model was the relationship between 'land size owned' the likelihood of program adoption. Because of the prevalence of small holdings in the study are, it was expected that land size and program adoption would be related positively. Contrary to this expectation, we found a negative relationship between land size and program adoption.

Table 7. Logit conjoint model results on preferences to undertake proposed management contract

Variables	**Coef.**	**Std. Err.**	**z**	**P>z**	**Odds ratio**
Constant	1.7021**	0.7624	2.23	0.026	-
LandArea20percent	-0.9951***	0.2114	-4.71	0.000	0.3696
LandArea40percent	-2.2900***	0.2792	-8.20	0.000	0.1012
CommitPeriod15yrs	-0.2985	0.2132	-1.40	0.162	0.7419
CommitPeriod40yrs	-1.8199***	0.2620	-6.94	0.000	0.1620
HarvestNotpermitted	-1.6508***	0.2686	-6.14	0.000	0.1918
HarvestPartial	-0.3047	0.2124	-1.43	0.151	0.7372
RewardExtensionfee	-0.5538**	0.2674	-2.07	0.038	0.5747
RewardElectricity	-0.5109*	0.2701	-1.89	0.059	0.5999
RewardWater	0.1606	0.2485	0.65	0.518	1.1743
LocalAdminFADC	0.0217	0.2246	0.10	0.923	1.0219
LocalAdminCFA	-0.0064	0.2231	-0.03	0.977	0.9935
FreeLabour2dys	0.3469	0.2209	1.57	0.116	1.4147
FreeLabour3dys	0.2351	0.2339	1.01	0.315	1.2650
Sex	-0.0666	0.2228	-0.30	0.765	0.9356
Age	-0.0208**	0.0082	-2.52	0.012	0.9794
env_mgt	0.7261***	0.2663	2.73	0.006	2.0671
MKEPP	0.4697**	0.2316	2.03	0.043	1.5996
fina_access	-0.0468	0.3319	-0.14	0.888	0.9541
env_info	-0.3400	0.2732	-1.24	0.213	0.7117
edu_primary	-0.6098*	0.3348	-1.82	0.069	0.5434
edu_secondary	-0.0052	0.3356	-0.02	0.988	0.9947
edu_AboveSec	0.5993	0.4069	1.47	0.141	1.8208
Hhsize	-0.0293	0.0368	-0.80	0.426	0.9710
LandSize	-0.0637*	0.0376	-1.69	0.090	0.9382
NrmAgri_Income	-0.2408	0.7319	-0.33	0.742	0.7859
NrmNonAgri_income	0.1001	0.5493	0.18	0.855	1.1052

*** = significant at 1%; ** = significant at 5%; * = significant at 10%

LR chi2(26) = 218.14; Prob > chi2 = 0.0000; Log likelihood = -383.63177; Pseudo R^2 = 0.2214

This may possibly shed a very important light on practical environmental management issues in areas where small land holdings dominate. On the basis of our result, as long as other appropriate measures are put in place, size of land holdings may not be a major constraint in implementing soil and water conservation and other environmental management programs. Environmental management programs could be realized despite small holdings, for instance, village economies of developing countries where degradation land fragmentation of land holdings increases over time.

The odds ratio shown in the sixth column show that management options that require commitment of larger land areas, longer contract period, and impose restriction on harvest right would all be less preferred. Other things being the same, a contract requires 40 percent of one's land to be committed would be 0.10 times as likely to be chosen as a contract requires only 10 percent of land. Similarly, a contract with 40 years commitment period would be 0.16 times likely to be chosen as a contract that requires 5 years commitment period. People with prior environmental management practices are 2.1 times more likely to adopt a given contract compared those without such prior experience.

4.7.4 Results for ordered logit model

As shown in equation (14) the explanatory variables used in ordered logit model include contract attributes and characteristics of the respondents. The response variable in this analysis is the respondent's ratings for the alternative management scenarios. Ordered logit results were generated using equations (9) and (14). Table 8 presents results from ordered logit analysis of landholder preferences of the hypothetical land management contract options. In qualitative terms by and large the results from ordered logit model are very similar to that generated by binary logit model. The ordered logit result also indicate that land area required to be committed, length of contract period, and rights to harvest products from committed land exert strong influence in conditioning preferences.

Table 8. Ordered logit results on ratings of hypothetical land management contract options

Variables	Coef.	Std. Err.	z	P>z	Odds ratio
LandArea20percent	-0.8454***	0.1530	-5.52	0.000	0.4293
LandArea40percent	-2.0024***	0.1666	-12.02	0.000	0.1350
CommitPeriod15yrs	-0.1644	0.1515	-1.09	0.278	0.8483
CommitPeriod40yrs	-1.2918***	0.1624	-7.95	0.000	0.2747
HarvestNotpermitted	-1.1612***	0.1585	-7.32	0.000	0.3131
HarvestPartial	-0.2711*	0.1532	-1.77	0.077	0.7624
RewardExtensionfee	-0.3524**	0.1779	-1.98	0.048	0.7029
RewardElectricity	-0.3781**	0.1768	-2.14	0.033	0.6851
RewardWater	0.1899	0.1737	1.09	0.274	1.2091
LocalAdminFADC	0.2098	0.1527	1.37	0.170	1.2334
LocalAdminCFA	-0.0305	0.1495	-0.20	0.838	0.9699
FreeLabour2dys	0.2330	0.1521	1.53	0.126	1.2624
FreeLabour3dys	0.1518	0.1540	0.99	0.324	1.1639
Sex	-0.4878	0.1492**	-3.27	0.001	0.6139
Age	-0.0091	0.0054*	-1.69	0.092	0.9909
env_mgt	0.3738	0.1699**	2.20	0.028	1.4533
MKEPP	0.6590	0.1582***	4.16	0.000	1.9328
fina_access	-0.0178	0.2209	-0.08	0.936	0.9822
env_info	-0.3427	0.1816*	-1.89	0.059	0.7098
edu_primary	0.0269	0.2173	0.12	0.901	1.0273
edu_secondary	0.4799	0.2283**	2.10	0.036	1.6159
edu_AboveSec	0.4456	0.2722	1.64	0.102	1.5615
Hhsize	-0.0285	0.0238	-1.20	0.231	0.9718
LandSize	0.03129	0.0225	1.38	0.166	1.0316
NrmAgri_Income	1.0199	0.4466**	2.28	0.022	2.7729
NrmNonAgri_income	0.6484	0.3553*	1.82	0.068	1.9126
/cut1	-2.6450	0.5185		-3.660	-2.6451
/cut2	-2.1460	0.5167		-3.158	-2.1460
/cut3	-1.8780	0.5158		-2.889	-1.8780
/cut4	-0.2168	0.5119		-1.220	-.21679

*** = significant at 1%; ** = significant at 5%; * = significant at 10%

LR chi2(26) = 323.44; Prob > chi2 = 0.0000; Log likelihood = -1221.7316 ; Pseudo R^2 = 0.1169

Among respondent characteristics that had significant effect on preferences were current participation in MKEPP projects, sex of respondent, experience in environmental management practices; secondary level education, and household income level from agricultural sources. The odds ratio also confirms that agriculture income is an important variable affecting preferences.

V. ASSESSING LANDHOLDERS WILLINGNESS TO ACCEPT (WTA) REWARDS FOR LAND USE CHANGES: RESULTS FROM CONTINGENT VALUATION

Conjoint valuation method (CVM) is a survey based approach to measuring nonmarket values of environmental goods/services. As far as the value elicitation technique in CVM is concerned, the so-called "referendum" or "closed-ended" CV surveys have recently been gaining enormous popularity. Numerous applications of these methods now exist. Readers are referred to Cummings *et al.* (1986) and Mitchell and Carson (1989) for the comprehensive assessments of contingent valuation survey instruments and specific applications.

Generally, in contingent valuation, respondents are given descriptions of a proposed hypothetical scenario or environmental change or policy alternative that would alter environmental quality or the provision of a public good or restrict access to the resource, and are asked to express (in monetary units) their maximum willingness to pay (WTP) to secure/enjoy a positive change or minimum compensation they would demand (willingness to accept (WTA)) for a negative change or loss of access to the resource. There are three approaches to asking these questions. The arbitrarily assigned values vary across respondents (Cameron and James, 1986). (i) "open-ended" where the respondent is asked to state the sum, (ii) "closed-ended" where the respondent is asked only whether or not they would pay or accept a single sum of money. In this method, the sum is varied across respondents, and (iii) "sequential bids" where respondents are asked whether or not they would pay or accept some specified sum (repeating the question using higher or lower amount depending on the preceding response).

The attractiveness of the "closed-ended" questioning strategy is that it generates a scenario for each respondent in a manner similar to that they encounter in real market transactions. A hypothetical price is stated and the respondent decides whether to say 'yes' or 'no'. However, challenges do arise in estimation because the observed values are threshold levels of the respondent's WTP or WTA rather than the true value. Thus, the true valuation is an unobserved random variable. The actual challenge the researcher faces is to infer the magnitude of true WTA or WTP valuation through an indicator

variable (the respondent's "yes/no" responses to the offered threshold) that tells us whether this underlying value is greater or less than the offered value (Cameron, 1988). With the 'yes/no' responses to closed-ended contingent valuation surveys some variant of choice model is clearly imperative. Because the offered amounts are varied over individuals, the yes/no responses convey some diffuse information about the amount of variability in the underlying latent dependent variable, the willingness to pay or compensation demanded.

5.1 Contingent valuation survey

Obtaining accurate benefit or cost estimates using CVM requires detailed description of the scenario or environmental change or policy alternative being valued. This is implied by the name of the method itself – contingent valuation method – which produces values contingent upon, the description of the good/service and method of payment. Consequently, maximum efforts need to be exerted for defining and displaying the proposed scenario or change to the respondents. In our study, we carefully described the contingent valuation scenario in terms of the interconnectedness of ecosystem services across landscape; the required land use change; ecosystem management objective; the key ecosystem/watershed services that could be provided; the potential cost to the landholder; and the method of compensation for the provision of the required services.

After describing the CV scenario, the contingent valuation captures how much individuals are willing to accept for the provision of the required watershed services by changing their land uses and management practices. To find what an individual's WTA is, a respondent was not directly asked an open-ended question on what amount he/she would be willing to accept. Instead, we applied a so-called 'double-bounded' CVM survey procedure where each individual i was asked a different initial bid (B_i^I) and asked whether he would be willing to accept this amount or not. According to the 'double-bounded' CVM procedure, each person is asked a follow-up bid which is lower or higher depending on the response to the first bid (i.e., for WTA survey the follow-up bid is lower if the first bid was accepted and higher if the first bid was rejected)[9]. Thus,

[9] Conversely, for WTP survey the follow-up bid is higher if the response for the initial bid was "yes" and is lower if the first bid was rejected.

for each person we have an initial bid (B_i^I) and one of the follow-up bids B_i^L and B_i^U, where $B_i^L < B_i^I < B_i^U$. Each person faced a random initial bid and the follow-up was dependent on this amount according to the schemes presented below (Table 9).

Thus, there are four possible outcomes: (1) both answers are "yes"; (2) both answers are "no"; (3) a "yes" followed by a "no"; and (4) a "no" followed by a "yes".

Table 9. Random bid scheme used in the CV survey

Bid schemes	Follow-up bid (decreased) (if '*Yes*' for B_i^I)	Initial bid (B_i^I)	Follow-bid (increased) (if '*No*' for B_i^I)
Scheme 1	1000	3000	6000
Scheme 2	3000	6000	9000
Scheme 3	6000	9000	12000
Scheme 4	9000	12000	15000

5.2 Modelling contingent valuation survey data

The ultimate goal pursued in contingent valuation studies is to estimate willingness to pay (WTP) or willingness to accept (WTA) measures and confidence intervals of the estimates. To this end, two broad modelling approaches can be pursued in analysing contingent valuation survey data: (1) Models relating the 'yes/no' responses of the CV question to the monetary stimuli that induced respondents to derive quantitative measures of value., and (2) Models directly relating threshold bid values to estimate the actual WTP/WTA. Models under this category are based on econometric tools developed for the analysis of censored data or interval regression analysis.

5.2.1 Models based on Random Utility Theory (RUT)

Logit, probit, and other discrete choice models are routinely fitted to discrete choice contingent survey data to obtain estimates of the latent WTP or WTA. The economic foundations of such models are random utility theory (RUT). Here we focus on econometric framework developed in Hanemann *et al.* (1991). They developed a statistically efficient WTP estimation framework for double-bonded dichotomous

choice contingent valuation. We adapted this framework for estimating WTA from our CV survey.

(a) Single bounded model

Single bounded CVM survey involves asking a respondent if he would pay some amount to secure a given environmental quality (WTP) or would accept some amount (WTA) for sacrificing/losing certain benefits due to the proposed change. By adapting Hanemann at al. (1991) for WTA, the probability of obtaining a "yes" or "no" response for a given compensation amount, B, to induce respondents to give up their access to the resource can be represented by

$$\begin{aligned} P(yes) &= G(B;\theta) \\ P(no) &= 1 - G(B;\theta) \end{aligned} \quad \text{……..(15)}$$

where $G(\bullet;\theta)$ is some statistical distribution function with parameter vector θ. This model can be interpreted as a utility maximization response within a random utility framework where $G(\bullet;\theta)$ is the cumulative density function (cdf) of the individual's true willingness to accept. Utility maximization implies that

$$P(yes\ to\ B) \Leftrightarrow P(B \geq Minmum\ WTA); and \quad P(no\ to\ B) \Leftrightarrow P(B < Minmum\ WTA)$$

The $G(\bullet;\theta)$ function can be specified as log-logistic, logistic, or normal. In our study we assume a logistic cdf (equation 15) and apply maximum likelihood (ML) estimation technique.

(b) Double-Bounded model

As explained in section 6.2, for the double-bounded model the four possible likelihood outcomes can be represented by $P(yy)$; $P(nn)$; $P(yn$; *and* $P(ny)$ for "yes,yes", "no,no", "yes,no", and "no,yes" outcomes respectively. Assuming utility maximization, equations 16 through 19) present the formulae for these likelihoods. With $B_i^L < B_i^I$:

$$\left.\begin{aligned} P[yy(B_i^L, B_i^I)] &= P(B_i^L \geq Min.WTA \text{ and } B_i^I \geq Min.WTA) \\ &= P(B_i^L \geq Min.WTA) \\ &= G(B_i^L, \theta) \end{aligned}\right\} \text{……(16)}$$

With $B_i^U > B_i^I$ the $P(B_i^I < Min.WTA \mid B_i^U < Min.WTA) = 1$. Thus, the probability of "no,no" outcome can be represented by

$$\left.\begin{aligned} P[nn(B_i^I, B_i^U)] &= P(B_i^I < Min.WTA \text{ and } B_i^U < Min.WTP) \\ &= P(B^U{}_i < Min.WTA) \\ &= 1 - G(B_i^U, \theta) \end{aligned}\right\} \text{.....(17)}$$

When a "no" is followed by "yes", we have $B_i^I < B_i^U$

$$\left.\begin{aligned} P[ny(B_i^I, B_i^U)] &= P(B_i^I < Min.WTA \le B_i^U) \\ &= G(B_i^U, \theta) - G(B_i^I, \theta) \end{aligned}\right\} \text{.....(18)}$$

When a "yes" is followed by a "no" responses, then $B_i^L < B_i^I$

$$\left.\begin{aligned} P[yn(B_i^L, B_i^I)] &= P(B_i^L < Min.WTA \le B_i^I) \\ &= G(B_i^I, \theta) - G(B_i^L, \theta) \end{aligned}\right\} \text{.....(19)}$$

Using maximum likelihood method, Hanemann, Loomis and Kanninen (1991) compared this double-bounded model with a single-bounded model estimated from the responses to the initial bid, B_i^I, using logit model. They found that the double-bounded model provided a substantial gain in precision for the variance-covariance matrix of the coefficient estimates, leading to much tighter confidence intervals for the estimate of median WTP. Hanemann, Loomis and Kanninen also found that the double-bounded data yielded a lower point estimate of median WTP than the single-bounded data. Both the gain in efficiency and the direction of change in the estimate of median WTP can be explained by a poor selection of the initial bid. When setting their bids, Hanemann, Loomis and Kanninen had very limited pre-test results and their guess at the point value of median WTP turned out to be far too low. With the hindsight of the field survey results, an optimal design would have used a higher initial bid, B_i^I. The double-bounded format corrected for this on the second bid –the follow-up bid, B_i^U, came closer to where an optimal design would have placed the bid, and this helped considerably to pin down the estimate of median WTP. In effect B_i^U provides insurance

against too low a choice of B_i^I, and B_i^L provides insurance against too high a choice of B_i^I.

5.2.2 Models based on censored data/interval regression analysis

Data from double-bounded contingent valuation survey can be analysed by using a generalization of the models fit by censored regression (tobit models) known as interval regression(which though assumes normal distribution). As discussed above, double-bounded contingent valuation data can be organized in left-censored, right-censored and interval-censored dataset format. For double-bounded WTA questions those who answer 'yes, yes' are left censored, those with 'no, no' are right censored and those with 'yes, no' or 'no, yes' fall within an interval. Using interval regression the bids can be explicitly modelled and the mean WTA can be obtained by post-estimation prediction.

Interval regression can fit models for data where each observation represents interval data, left censored-data, right censored data, or point data. Regardless of the type of observation, the data should be stored in dataset; that is, two dependent variables (*depvar1, depvar2*), are used to hold the end points of the interval. If the data are left-censored, then lower endpoint is $-\infty$ and represented by a missing value, '.' in *depvar1*; and if the data are right-censored, the upper endpoint is $+\infty$ and is represented by a missing value, '.' in *depva2*. Point data are represented by the two endpoints being equal. Table 10 shows how our empirical bid data is organized in interval dataset format.

Table 10. Structure of WTA bid data for interval regression

Data type	*Depvar1*	*Depvar2*
Interval data (yes, no): $[B_i^L, B_i^I]$	B_i^L	B_i^I,
Interval data (no, yes): $[B_i^I, B_i^U]$	B_i^I	B_i^U
Left-censored data (yes, yes): $(-\infty, B_i^L]$	.	B_i^L,
Right-censored data (no, no): $[B_i^U, +\infty)$	B_i^U	.

To use interval regression, we created two dependent variables, '*LowerEnd and UpperEnd*' to represent the endpoints or boundaries of bids.

5.2.3 Methods and formulas for interval regression

The likelihood for interval regression subsumes that of the tobit models. Let $y = X\beta + \varepsilon$ be the model. The y represents continuous outcomes –observed or unobserved underlying latent variable. The model assumes normal distribution of the error term (ε) distributed as $\varepsilon \sim N(0, \sigma^2$. For observations $i \in P$ we observe y_i (point data); observations $i \in L$ are left-censored (we know only that the unobserved y_i is less than y_{Li} i.e., a censoring value. Similarly observations $i \in R$ are right-censored (we know only that the unobserved y_i is greater than or equal to y_{Ri}. Observations $i \in I$ are interval (we know only that the unobserved y_i is in the interval $[y_{1i}, y_{2i}]$. The likelihood function is:

$$\ln L = -\frac{1}{2}\sum_{i\in P} w_i \left\{ \left(\frac{y_i - X\beta}{\sigma} \right)^2 + \log 2\pi\sigma^2 \right\} + \sum_{i\in L} w_i \log\left(\frac{y_{Li} - X\beta}{\sigma} \right) + \sum_{i\in R} w_i \log\left\{ 1 - \Phi\left(\frac{y_{Ri} - X\beta}{\sigma} \right)^2 \right\}$$

$$+ \sum_{i\in I} w_i \log\left\{ \Phi\left(\frac{y_{2i} - X\beta}{\sigma} \right) - \Phi\left(\frac{y1i - X\beta}{\sigma} \right) \right\} \text{.....(20)}$$

where $\Phi(\ )$ is the standard cumulative normal and w_i is the weight for the i^{th} observation. If no weights are specified, $w_i = 1$. In our analysis of empirical CV data, we applied equation (20) to estimate the mean WTA. Weights are not attached in our empirical model.

5.3 Results from contingent valuation analysis

5.3.1 Descriptive analysis

Table 10 presents the summary of responses for the contingent valuation bids. Here only initial bid amount (column 1) is indicated; because the follow-up bid depends upon the response for the initial bid. The initial and follow-up bids scheme used in the survey is described in the preceding section (Table 10).

Table 11. Number of responses in each category response by offer amount

Initial bid amount (in Ksh)	(Yes, Yes)	(Yes, No)	(No, Yes)	(No, No)	Total
3000	5	3	8	12	28
6000	12	11	6	6	35
9000	13	6	8	17	44
12000	0	4	1	10	15
Total	30	24	23	45	122

As shown in Table 11, 24.7% of the respondents provide two positive responses and 37% gave two negative responses, whereas approximately equal number of the respondents, about 19.7% and 19%, fell in the "yes, no" and "no, yes" response categories respectively. To get just an idea of the distribution of censored observations we generated two separate histograms. Figures 5 and 6 show the frequency distribution of right-censored and left-censored observations respectively.

Table 12. Summary statistics of the various CV bids

Response category	# observation	Mean	Std.	Min.	Max.
(no, no): right-censored	45	10489	3335	6000	15000
(yes, yes): left-censored	30	4033	2042	1000	800
(yes, no): interval	47*	8343	3002	3000	15000
(no, yes): interval	47*	5468	2842	1000	12000
(yes, no) and (no, yes): midpoint	47*	6904	2904	2000	13500

*These are same observations

Table 12 describes the summary statistics of CV bids for different response categories. The data reveals that within each response category significant variation in WTA was observed. For instance, within the left censored, i.e., 'no, no' response category, ten respondents rejected the follow-up question with maximum amount in the survey design (i.e. Ksh. 15000). This implies for these respondents the WTA is greater than Ksh.15000. On the other hand, among the left censored observations, i.e., in response category 'yes, yes', five respondents stated their willingness to accept offers as low as Ksh. 1000 which sheds a light that their WTA less than or equal to Ksh.1000.

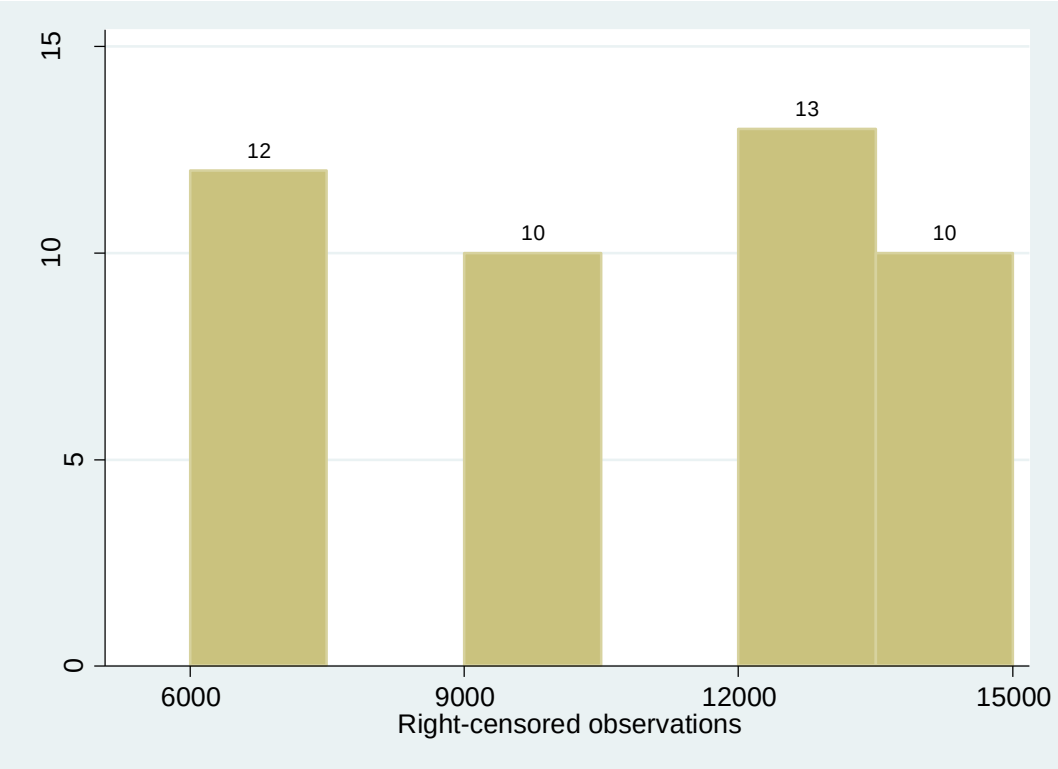

Figure 5. Right-censored observations (‘yes, yes’ responses)

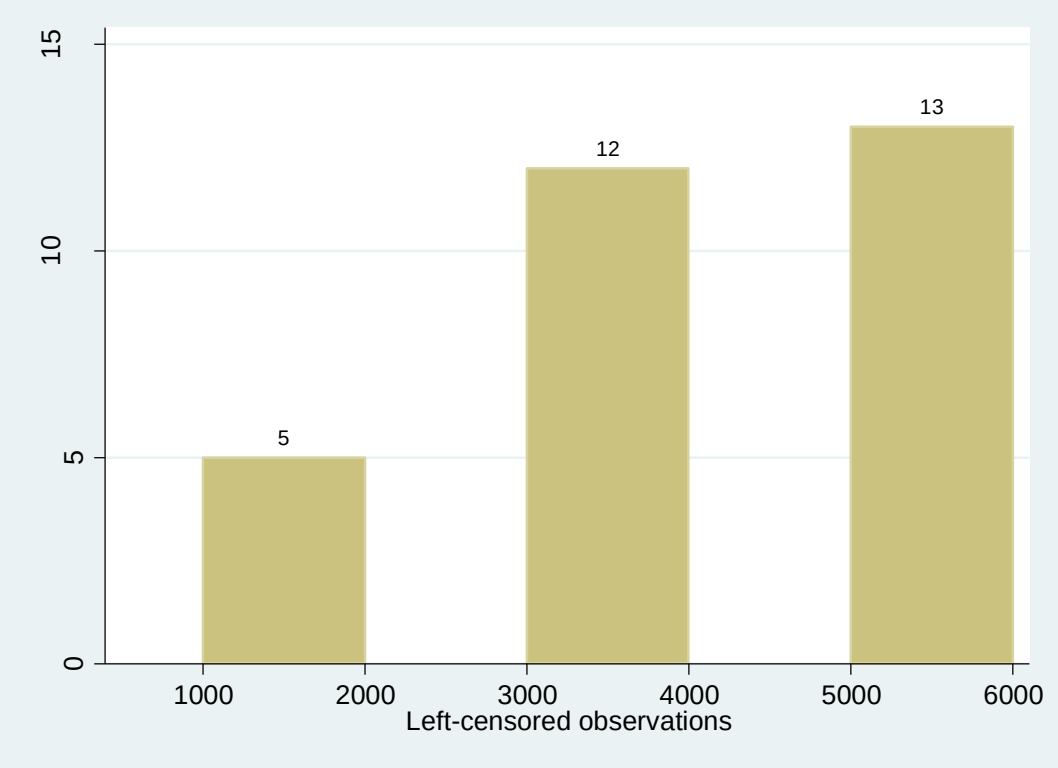

Figure 6. Left-censored observations (‘no, no’ responses)

From the box plots in figure 7 we can visually compare the distributions of initial bid, follow-up bid, left-censored observations, right-censored observations, and the midpoints of interval-censored observations. The scatter plot matrix in figure 8 provides a compact display of the relationships between key selected continuous independent variables (age of the respondent, household income, land size owned by the household, and household size) that were supposed to affect respondents' true willingness to accept and the CV follow-up bid. The last row in figure 8 shows how these exogenous variables are related to the follow-up bid. Total household income and the follow-up CV bid were expressed in their natural logarithm forms. Though we do not see a clear pattern of the relationships between the exogenous variables and CV follow-up bid, one can deduce appealing statements from the last row in figure 8. It seems that there is a positive relationship between the age of the respondent and WTA. The implication is that younger respondents are willingness to accept lower compensation to adapt conservation measures compared to older respondents. Better off households (in terms of total household income) seem to demand bigger compensation payment for their environmental protection efforts compared to poor households. This observation is consistent if the marginal utility of money is assumed to be decreasing. Similarly, larger households (in terms of household size) demand larger compensation to committing their land for conservation measures. The explanation for this tendency might be related to differences in the opportunity cost of land when household size changes (the higher the opportunity cost of land the larger the size of the household becomes). As it was true in conjoint analysis, here too land size owned does not show any conclusive relationship respondent's WTA.

5.3.2 Results from interval regression analysis

Applying the interval regression model presented in equation (20) in the WTA estimates were obtained. Table 12 presents the list of variable included in the models and the a priori expectation of the size and sign of the dependent variables (labels in parenthesis).

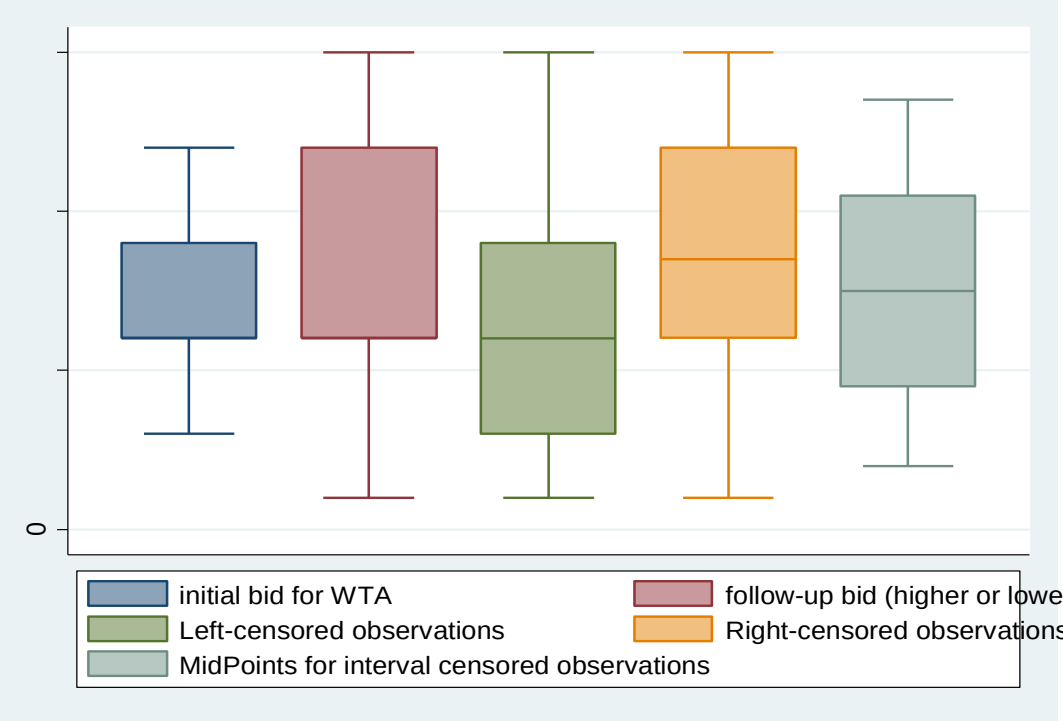

Figure 7. Box plots for various CV bid responses

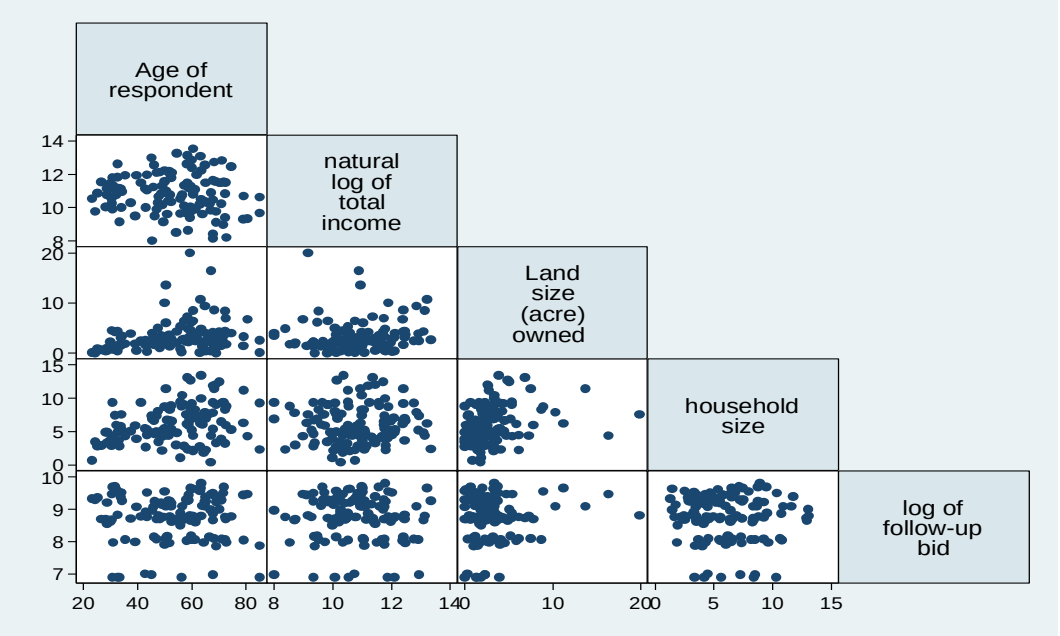

Figure 8. Scatter diagram showing relationship between follow-up bid and four variables

Table 13. Variables included in the model and their expected effects on WTA

Variables	**Hypothesised effect on respondent's WTA response**
1. Age of the respondent (age)	Positive but relatively less important.
2. Participation status in MKEPP	Negative and relatively important. Respondents already participating in MKEPP are expected to possess environmental awareness and experience to provide ES at relatively lower compensation reward
3. Participation status in agro-forestry scheme (agro_forest)	Negative and relatively important. Respondents already participating in some agro-forestry schemes are expected to possess environmental awareness and experience to provide ES at relatively lower compensation reward.
4. Previous information on reward-based ES provision (RES_info)	Untenable to hypothesize the effect or sign *a priori* ; depends on the success or failure story of any such previous schemes
5.Current debt status of the household (debt)	Negative; the demand for money by households with debt burden are expected to be high and hence willingness to accept relatively less compensation reward as a way of relieving from the debt burden
6. Respondent's education: primary (edu_primary)	Negative but relatively unimportant; education enhances environmental awareness but primary level education may not induce conservation commitment.
7.Respondent's education: secondary and above (edu_2above)	Negative and important; respondents with higher education level are supposed to be aware of the benefits of conservation and willingness to participate in environmental protection with relatively lower compensation scheme
8. Total household income: in log (logincome)	Untenable to hypothesize the sign *a priori*; depends on the marginal utility of money and perception
9.Size of land owned (LandSize)	Negative and important; because the opportunity cost of committing land is less for large land holders
10.Household size (hhsize)	Positive and important, because land commitment for conservation schemes costs more with household size.

Using the variables described in Table 13 and the 'LowerEnd' (*depvar1*) and 'UpperEnd' (*depvar2*), see sub-section 5.2.2 and Table 10, we run interval regression (`intreg`) with the following syntax (command) in STATA software release 11.

```
intreg LowerEnd UpperEnd age MKEPP agro_forest RES_info debt edu_primary
edu_2above logincome LandSize hhsize, nocons
```

```
Number of obs   = 122                    Wald chi2(10) = 120.91

 Log likelihood  = -174.92439             Prob > chi2   =  0.0000
```

Table 14: Results of interval regression

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	86.71412	56.6285	1.53	0.126	-24.2757	197.7039
MKEPP	-3462.462	2088.78	-1.66	0.061*	-8144.731	184.1282
agro_forest	-1607.074	1863.189	-0.86	0.088*	-5258.857	2044.709
RES_info	2049.196	2240.495	0.91	0.060*	-2342.093	6440.485
debt	668.0063	1661.806	0.40	0.688	-2589.073	3925.085
edu_primary	4276.466	2499.581	1.71	0.087*	-622.6229	9175.555
edu_2above	3208.327	2590.393	1.24	0.216	-1868.751	8285.405
logincome	322.8705	346.4841	0.93	0.007**	194.424	1204.707
LandSize	85.8315	290.553	0.30	0.768	-483.6419	655.3049
hhsize	-480.462	311.2949	-1.54	0.080*	-1017.508	56.58388
/lnsigma	8.939879	.1194353	74.85	0.000	8.705791	9.173968
sigma	7630.276	911.324			6037.773	9642.813

*= significant at 10%; **= significant at 5%

```
  Observation summary:        30  left-censored observations
                               0     uncensored observations
                              45 right-censored observations
                              47       interval observations
```

Table 15. Predicted WTA using various prediction methods

Prediction method	# observation	Mean	Std.	Min.	Max.
Linear prediction	122	8367.92	2371.61	1870.14	13429.00
$e(a,b)$: conditional expected value method[10]	122	8421.93	7193.72	4242.00	20555.23
$ystar(a,b)$: truncated method[11]	122	8157.13	4840.00	928.85	17322.88

[10] e(a,b)calculates E(xb + u | a < xb + u < b), the expected value of y|x conditional on y|x being in the interval (a,b), meaning that y|x is censored. 'a' and 'b' are specified as they are for pr( ).

Table 14 presents the results of interval regression. As expected respondents who participate in MKEPP and agro-forestry schemes willingness to adopt land management contract at relatively lower compensation reward compared to those who do not participate in either MKEPP or agro-forestry scheme. Household income level is related positively to compensation demand, i.e., richer households tend to enter into the land management contract at relatively higher compensation reward. The estimated relationship between the household size and compensation demanded for adopting land management contract has been found contrary to the *a priori* expectation. The explanation for this might be that family size may interact with other variables. Age of the respondent, household's current debt status, land size, and higher level of education were found statistically insignificant.

Using three different post estimation prediction methods (see Table 3), mean WTA and standard deviation of estimates were obtained. All prediction methods yields more or less identical mean WTA. However, estimates of standard errors and ranges generated by the three methods vary significantly. On the basis of the prediction result, the mean compensation demanded to induce entry to land management contractual agreement in the study area appears slightly more than Ksh. 8, 000. But, this is an average prediction and hence the actual WTA value may still show wide variation. According to the prediction, for some farmers more than Ksh. 20, 000 per ha compensation payment may be needed to induce voluntary land management contracts.

[11] ystar(a,b) calculates E(y*), where y* = a if xb + u < a, y* = b if xb + u > b, and y* = xb + u otherwise, meaning that y* is truncated. 'a' and 'b' are specified as they are for pr( ).

VI. CONCLUSIONS

Reward for environmental services (RES) has emerged as an important tool to motivating landholders for provision of environmental services through land use changes and adoption of best management practices. In this regard it becomes imperative to assess landholder's preferences over various land use options and agri-environmental management schemes and their willingness to accept rewards for the provision of required watershed services. Using data from a case study site in Mt. Kenya East area, this study aimed to understand landholders preferences over various land management options and agri-environmental management practices – expressed as combination of different land management attributes and estimate the compensation required for voluntary participation of farmers in the provision watershed services by changing land uses and/or adopting best agri-environmental practices.

Primary data were collected through focus group discussions, interviews, questionnaire surveys of conjoint analysis and contingent valuation methods. Both qualitative and quantitative techniques were applied in data analysis. Results from the focus group indicate that inadequate water (quantity) for both domestic and irrigation and water pollution (quality) are the utmost environmental problems in the area.

Results from the traditional conjoint model indicates that, '*land area to be committed*, '*length of commitment period'*, and '*grating/denying rights to harvest products*' were the three principal attributes that influence landowners' ratings for various proposed land management options. The binary logit model points out land management scenarios that require commitment of larger land areas, longer contract period, and increased restriction of harvest right are less likely to be adopted in the study area. These three attributes were found to be the most important factors in influencing landholders' potential adoption of the proposed management contract.

Results from the analysis of contingent valuation data Indicates that respondents who have already been participating in MKEPP and agro-forestry schemes are willingness to adopt land management contract at relatively lower compensation reward compared to those who participate neither in MKEPP nor in any agro-forestry scheme. Richer

households tend to enter into the land management contract if they get rewarded relatively higher compensation.

On the basis of the prediction from censored regression, the mean value of compensation demanded (mean WTA) to induce entry into land management contractual agreement in the study area appears slightly more than Ksh. 8, 000. But, this is an average prediction and the actual WTA value may show wide variation. According to model prediction, more than Ksh. 20, 000 per ha per annum compensation payment may be needed to induce some farmers in the study area to voluntary participate in environmental management contractual schemes. However, we observed significant variation in the estimates of standard errors and ranges of willingness to accept figures.

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APPENDICES

Appendix 1: Work plan

1. Tasks/Activities

1.1 Collect and collate relevant existing data related the study (both socio-economic and physical data) such as land use, agricultural practices, and livelihoods. Quick analysis and understanding of current farming systems, livelihood systems, land uses, and agricultural practices

1.2 Site field visits, focus group, key informant interview, survey questionnaire design, administer questionnaire survey, and develop and adapt empirical model

1.3 Data entry and analysis

1.4 Report writing

Time sheet

Tasks ↓	10/2009	11/2009	12/2009	01/2010
1				
2				
3				
4				

2. Deliverables

- Printed and electronic copy of all survey instruments such as focus group discussion guide and survey questionnaire
- Full dataset organized in appropriate formats such as in Microsoft excel spread sheet or other relevant computer software such as STATA
- Printed and electronic copy of project report including executive summary

Appendix 2: Workshop and trainings (stakeholders, enumerators, and supervisors)

Before the field survey implementation; two workshop and training sessions were organized in order to explain project objective, nature of the present study, type of data required, field work plan, sampling and survey designs/techniques and the raise the general understanding of environmental problems and the interdependence of socio-economic activities/decisions and environmental resources. Participants were: local stakeholders, ICRAF research team, and field enumerators.

Workshop/training session 1.

1. General information on:
   - Environmental problems and economics of the environment
   - Nature of environmental services; non-existence of markets and problems in environmental valuation: four major environmental services: watershed services; carbon sequestration; biodiversity; aesthetic (scenic beauty).
   - The linkages between environmental resources and local economic activities and livelihoods
   - Local level environmental management options and preferences

2. How local preferences can be assessed using conjoint analysis (CJ)
   - The concept of conjoint analysis
   - Why undertake CJ?
   - On attributes and attribute levels
   - Experimental design and generating alternative hypothetical scenarios: Here a simple of market good purchase decision was used.
   - How implement the conjoint survey. In CJ we generate possible set of options; using some statistical rules we reduce the number of options; present to respondents to rate or rank the options

Illustration 1:

This illustration was extracted from the study (Arifin et al. (2009) on community forestry contract in the Sumberjaya watershed. Indonesia.

- *Context*: Establishment of coffee agro-forests in the areas designated as state forest land.
- *Issue (contract)*: How to implement this scheme?

a) Coffee grower form farmers' association.
b) Forest Department and farmers' association enter into contractual agreement.
c) How to define the contract? The contract includes both environmental and economic issues and defined by various attributes.

Attributes	**Levels**		
1. Tenure security (length of contract)	15 yrs	25 yrs	35 yrs
2. Minimum density of trees per hectare	400	600	1000
3. Composition of trees	15% timber trees	30% timber trees	50% timber trees
4. Fee to be paid for local government per ha	No fee	1000 Rps.	2000 Rps.
5. Right to cut and sell timber	Have right	No right	

The existing scheme in the Sumberjaya case was: 25 years; 400 trees/ha; 30% timber trees; no fee; no right to cut and sell. If we consider the five attributes (with the levels attached to each attribute) in the table above we can generate 162 different scenarios. Then, with the help of conjoint method the different scenarios ca be evaluated.

Note: In the original Arifin et al. (2009) study, the number attributes were eight and 1296 different scenarios were generated.

Illustration 2:

This illustration was extracted from Stevens et al .(1999) on the cooperative management of private forested land in North-eastern of the United States. A table of the following type was created from the Stevens et al. study and participants were given detailed explanation on how conjoint methods could be applied such scenarios.

Attributes	Levels			
Extent of timber harvest	Harvest all	One-half	None	
Recreational trail system	Yes	no		
Preservation of rare species of fern	Protect all	One-half	None	
Management cost	$50	$250	$300	

Workshop/training session 2.

This session composed of two parts:

(1) For local stakeholders: On the basis of the general understanding in session 1 above, the focus of the first part of session 2 was on generating attributes, attribute levels, hypothetical land management scenarios etc. Besides attributes and scenario generations for conjoint analysis, participants were also introduced about contingent valuation (CV) of environmental goods and services. What is CV? CV is a stated preference method which produces values for non-marketed environmental services. The values are contingent upon the description of the good under consideration and the method of payment. Therefore, maximum efforts must be made to carefully define and clearly display the current and proposed levels of ecosystem services to the respondents. As an illustration for constructing markets for goods/services, participants were

introduced about constructing hypothetical markets by describing their features and payment mechanisms. For instance, enumerators (all of whom have at least completed their undergraduate studies) were introduced characterising computers by its different features and then asking individuals their maximum WTP.

Illustration:

This illustration was exclusive for enumerators and supervisors.

Describe a lap top TV by its attributes and ask the respondents their max. WTP Lap top

- *Lap top PC description1*: Dell, 40 GB, 512 memory, and 10 inch screen: what is the maximum amount of money that you will be willing to pay for this product? _____
- *Lap top PC description 2*: Dell, 40 GB, 512 memory, and 10 inch screen; price US$ 2000: what is the maximum amount of money that you will be willing to pay for increase in GB from 40GB to 80GB? _____ US $.

(2) For field enumerators and supervisors: part two of session was organized giving training for the enumerators. All enumerators and field supervisors were give detailed training on the content of the questionnaire and interview technique.

Appendix 3: Focus group discussion guide

Focus group discussion was based on the following guiding questions.

1. Key local environmental problems: What are the major environmental problems in your local area? Are these problems only local or having implication to wider society?
2. What are the main causes/drivers of these problems?
3. In general, how do you evaluate the state of the trends of environmental changes/conditions in your area over the last 20-30 years?
4. Which land use and agricultural practices deemed to be environmentally harmful? Which land uses or management practices do you perceive environmentally friendly for land and water resources?
5. How to tackle/reduce land degradation (building some physical structures? Changing land uses? Adoption new management practices? etc.). i.e., What are the feasible set of options to tackle the general environmental problems (water and land degradation)?
6. What are your environmental priorities?
7. In your view, what are the major benefits conserving/managing your environment?
8. What are your major constraints to adopting land use and management practices environmentally friendly?
9. How do you perceive reward mechanism for environmental services as an alternative remedial measure for the environmental problems?
10. What are your current/Previous soil and water conservation experience? Have you participated or practiced any natural resource and environmental management activity?
11. What are the limitations and strengths of your community as a group in terms of local natural resource and environmental management?

Appendix 4: Survey questionnaire

Conjoint and Contingent valuation survey questionnaire for assessing landholders' preferences for Kapingazi River basin land management contract and eliciting willingness to accept, Mt. Kenya East (October, 2009)

Commissioned by Pro-poor Reward for Environmental Services in Africa (PRESA-ICRAF)

Respondent's ID. (Random sample point)_____
Survey point_____
GPS Number:_____

Enumerator's name_____
Date of interview_____/_____/_____(date/month/yr)
Village (FDA) name_____
Checked by_____

PART A.

Section 1. Respondent's demographics and occupation

We would like to ask you some questions about your demographic and occupational information.

1. Name of the household head (Respondent)	2. Sex male…1 Female..2	3. Age (yr)	4. [Name's] main activity (code a)	5. Can [Name] read and write Yes..1 No…2	6. What was the highest level of schooling [Name] completed? [code b]	7. Household size (including [Name])	
						Adult (age >=15 yrs)	Children age <15 yrs)

Code (a) Main activity
Farmer = 10; off-farm self-employed= 11; public sector employee= 12; private sector employee= 13; disable/unable to work= 14; other = 15 , Specify _____

Code (b) level of education
Never any schooling = 20; Religious/traditional= 21; Primary school=22; secondary school= 23; Technical/vocational= 24; College/university= 25; Others = 26, Specify_____

8. How much net income (estimated value of consumed, sold, and in stock) did your household make in the last 12 months from the following sources?

8.1 From cropping activities: Ksh _____

8.2 From livestock activities (sale of livestock and livestock products): Ksh._____

8.3 From off-farm sources (such as self-employments, petty-trades, casual works, informal businesses): Ksh._____

8.4 From other sources (such as transfers, gifts, remittances, pension, interest income, etc.): Ksh._____

Section 2. Land and livestock

2.1 Land

1. Land owned by the household (in acres):

(a) Farmed land (land for farming activities) _____acres.

(b) Land for other uses (including grazing activities) _____ acres

2. What proportion of your land do you perceive as a poor quality land? Less than 1/3 =1; between 1/3 and 2/3 = 2; More than 2/3 =3. _____

3. Do you have access to any communal land (for grazing, forest products) other than the land you mentioned above? Yes=1; No=2 _____

4. Have you had any natural/environmental resource management practices on your private land? Yes= 1; No= 2 _____. If **Yes**, we would like to know the investment you made on your private land in the last 12 months on natural/environmental resource development. If **No**, give reason(s). [code b].

1. Type of activity or investment ***(code a)***	2. How much labour time and money (in Ksh.) did you spend?				3. If you haven't invested anything on natural resource development activities, what were the major reasons? ***(code b)***
	Family labour (days per year)	Hired labour (days per year)	Wage paid for hired labour (per year)	Money spent other than labour (per year)	

Code (a) type of investment

Terracing, stone band =1; water harvesting schemes=2; Fencing open areas=3; Forest restoration=4; Commercial plantations=5

Soil fertility improvement =6; others=7, Specify_____

(code b) reasons for not investing
Shortage of labour =1; Shortage of finance=2; shortage of land =3; Not profitable=4; Lack of awareness=5; Insecure land tenure=6; Free-rider (public good) problem=7; Others=8, specify_____

2.2 Livestock

1. Do you have livestock? Yes = 1; No = 2. _____ If yes, would you tell us your herd of livestock at present? If No, go to section 3.

2. Type of live stock	animal code	3. Number owned (present at your farm and away)	4. If you would sell [….] now, how much would you receive? (unit price in KSh)
oxen/bulls	01		
cows/heifer	02		
horses/mules	03		
calves	04		
donkeys	05		
Sheep	06		
goats	07		
camels	08		
chicken	09		
pigs	10		
Rabbit	11		

Section 3. Local membership/participation status and access

Are you a member of/ participating in any of the following organization?

	Yes=1	**No=2**
1. Farmers' co-operative/union ……	☐	☐
2. Producers' organization ……	☐	☐
3. Mount Kenya East pilot project (MKEPP) ……	☐	☐
4. Agro-forestry scheme……	☐	☐
5. Other organization or environmental initiative……	☐	☐

Specify_____.

6. Has your household got access to local financial institutes (credit and/or saving)? Yes = 1; No =2. _____

7. How do you evaluate the degree of your or your household access to market? Poor access = 1; Good access =2. _____

8. Do you have any prior information about market-based provision of environmental services? Yes = 1; No = 2. _____

10. Have you currently owed any debt liabilities to be paid? Yes = 1; No = 2. _____

_____End of Part A_____

Note to Enumerators

This is the end of Part A. Please tell the respondent that you have finished the first part of the questionnaire. Now, you are going to start the conjoint questionnaire (part B). Before you start part B, tell the respondent that in the second part of the survey you are interested in knowing the respondent's preferences for various hypothetical land management arrangements. Please, make sure that you have given sufficient introduction about the next activity and the respondent is ready to deal with part B. Now, you can move to Part B.

PART B

Conjoint survey

Section 1. Description of the situation

Please consider the following situation in which you own land currently under agricultural use. Please note that the land parcel you owned is part of the large Kapingazi River sub-ecosystem unit, where the environmental functions are interconnected. Effective ecosystem management requires planning on broad spatial and temporal scales beyond the bounds of individual private ownership. Co-operative land management wherein individual landowners collaborate to manage their land as part of a larger system is a key component in accomplishing management objectives. Management objective is to reduce downstream sedimentation of reservoirs, rivers and waterways, increase stream base flow, enhance water availability and improve livelihoods. You are specifically required to agree to set aside a certain proportion of your land as a riparian buffer zone or establish farm field buffer strip along the lower side your field boundary (water flow direction). Please consider the nine options, each of which is set of activities that can be implemented on your land committed to the scheme. Each arrangement has a reward based on the level of activity you undertake. Please consider and compare the arrangements presented and indicate how you would rate each on a scale of [1-5]. Use [5] for arrangements, if any, that you would definitely undertake. Use [1] for arrangements, if any, that you would definitely not undertake. If you are not sure, use [2 through 4] to indicate how likely you would be undertaking each option.

1= I would not undertake such an agreement under any circumstances
2= The agreement is not acceptable, but has one or two good points
3= I am indifferent to the agreement
4= The agreement is good and I would undertake it if one or two points were changed
5 = I would definitely undertake such an agreement

Attributes	**Levels**			
1. Land area to be committed	10% of your land	20% of your land	40% of your land	
2. Length of commitment period	5 years	15 years	30 years	
3. Right to harvest products (grass/fodder/beekeeping)	permitted	Partially permitted	Not permitted	
4. Reward scheme/incentive scheme	Provide and/or waive annual **water cost** for domestic use and/or irrigation per acre of land committed	Cover 50% of your annual **extension service fee** per acre of land committed	Provide **micro-scale electricity** and/or waive 50% of your annual electricity cost per acre of land committed	Direct annual cash payment of Ksh. 4500 per acre of land committed
5.Local scheme administering agent	Water Resource Users Association (WRUA)	Focal Development Area Committee (FDAC)	Community Forest Association (CFA)	
6. Required free labour contribution related to the contractual scheme (training, attending scheme meetings; etc) per month	1 day	2 days	3 days	

Section 2. Options and Ratings

The following page contains nine alternative scenarios or options. Each option is identified by a unique combination of values or labels it assumes for each of the six attributes that characterize the options. Please understand the specific feature of each option and indicate how you would rate on a scale of [1-5].

Note: Each respondent was give a different combination of scenarios. Since each possesses unique combination of attribute levels, scenarios were individually printed in a separate sheet and allocated to respondents randomly.

PART. C

Contingent Valuation Survey

1. The Contingent Valuation Scenario

Your community has got the opportunity to get involved in the production of watershed services and get compensated for the supply of the services. Consider the following situation in which you own land currently under agricultural use. Please note that the land parcel you owned is part of the large Kapingazi River sub-ecosystem unit, where the environmental functions are interconnected. Effective ecosystem management requires planning on broad spatial and temporal scales beyond the bounds of individual private ownership. Co-operative land management wherein individual landowners collaborate to manage their land as part of a larger system is a key component in accomplishing management objectives. Management objective is **to reduce downstream sedimentation of reservoirs, rivers and waterways, increase stream base flows, enhance water availability and improve livelihoods**. You are specifically required to agree to set aside a certain proportion of your land as a riparian buffer zone (if your land is located in riparian area) or establish farm field buffer strip along the lower side your field boundary (water flow direction).

Suppose that you are asked to participate in the community level co-operative management scheme for the purpose of managing your land as part of a larger unit. The major cost related to this activity is **loss of farm income from the land committed to this arrangement.** The decision to participate is on **voluntary** basis. We want to know if you are **willing or not willing** to participate in the scheme for which you will be compensated if you participate. The compensation will be made each year before your main harvest season. Compensation payments for the scheme will be in the form of direct cash transfer/payment channeled through your local banking at your nearest collection point.

Would you like to participate in the scheme? Yes = 1; No = 2. _____

If you get compensated Ksh. _____annually per acre of land committed, would you be willing to accept (WTA) the money? Yes = 1; No = 2. _____

Bid values: **[Ksh.1000 Ksh. 3000 Ksh. 6000 Ksh. 9000 Ksh.12000 Ksh. 15000]**. Choose any value randomly from the list given as starting point except the two extreme values and then increase the value/decrease the value on the basis of first response.

- If **YES**: ask the respondent **ONE LEVEL LOWER** value than the starting value. i.e. Ksh._____; 1 = Yes; 2= No. _____
- If **NO**: ask the respondent **ONE LEVEL HIGHER** value than the starting value. i.e., Ksh. _____; 1= Yes; 2 = No. _____

----------Thank you very much for your cooperation!----------

Appendix 5: Feedbacks from enumerators and field supervisors on CJ/CV survey

Would you please provide your feedback about the survey using the information in the box below as background or as starting points, please?

Survey questionnaire may not be exhaustive in terms of the relevant information needed for this study. From the discussions and meetings we have had through out the week, I am convinced that respondents might have shared with you their views, perceptions, opinions, and suggestions on various issues related to this study and I hope you have come across with a number of valuable information (not included in the questionnaire) while conducting the survey. Would you please jot down the key information (but not included in the questionnaire) you come across during the survey period (on the following points and any other issue you think important and relevant).

- ✓ On attributes/factors (included in the survey and not included but important in the process of farmers' participation decision and option ratings)
- ✓ The Key factors on which most the respondents you interviewed base the ratings
- ✓ Any other relevant issue(s)

I. *Feedback from the Kiriare Survey Team (Miriam Waweru, Thomas Yatich, Kennedy Njuki)*

Q1. On attributes/factors (included in the survey and not included but important in the process of farmers' participation decision and option ratings)

- The respondents did not strongly consider the local scheme administering agent as a critical attribute. This could attributed to lack of awareness of the existence of such local level institutions;
- The area committed-the units of measurement needed to be clear-e.g. 25ftx25ft (on both sides of the river
- Rights of use-the limits of permitted and partially permitted should have been defined;

Q2. The key factors on which most respondents base the ratings

- On the area committed for contracting, the respondents' willingness to participant was dependent upon the size of the land-farmers were considering the current value of their land and levels of productivity;
- The period of commitment was an issue
- The reward scheme was limited as in it did not provide a wide range of rewards;
- The level of financial reward both for conjoint and contingent valuation was low
- Right of use of the land was also formed a basis for rating

- Prior experience of the respondents with other conservation/livelihood experience-e.g. if a farmers has apportioned part of his farm to be used by MKEPP for planting trees, it may be difficult to have the same farmer apportion more land;

- Farmers required prior consultations with other members of the family especially the sons

- Size of the household vis-à-vis the size of the land-the smaller the land the more difficult it is for the head of the household to apportion land for the scheme

Q3. Overall evaluation of the survey process

- The time for data collection was adequate and we managed to interview the required number of households per day;
- Need for pre-testing of the questionnaire;
- Age and the level of education of the respondent influenced their ratings;
- The respondents should have been sensitized before the data collection (e.g. sending notifications through churches, chiefs' barazas, etc);
- The spatial sampling framework ensured that biases were avoided;
- The use of FDAC members to link the research teams to respondents was effective;
- The period of data collections matters a lot-towards the end of the second week of data collection, El Nino rains started and it was difficult to access some of the survey points. Despite this the team managed to complete the surveys in the 3 FDAs;
- On the ratings (for the conjoint survey) it was a bit difficult to different ratings 2 and 4;
- Double bounded contingent valuation-the levels of compensation were considered very low by the respondents;
- Logistical support was well done;
- Some respondents were a little bit uneasy with some questions e.g. on debt/liabilities;
- Some respondents found it difficult to estimate the levels of net income from various sources;

Q4. Any other relevant issue(s)

- Issues raised above should be negotiated with farmers during mechanism design and implementation;

II. *Feedback from kairuri Survey Team (Esther, Burnice)*

1. Attributes/Factors (included in the survey and not included but important in the process of farmers participation decision and opinion ratings)

- Specific Land Use to be Implemented: the farmers felt that it would have been good if they were given the intended land uses for them to place their preference
- Methods of channelling the rewards to the farmer: the farmers wanted to know how the rewards would be channelled to them.
- The farmers were not very much concerned about who would be involved in the administration of the project

2. The key factors on which most respondents base their ratings

The factors that farmers based their ratings are:

- The size of the land to be committed; Farmers were not comfortable with giving out higher percentage of their land. They felt that if the project takes a big piece of land, they may not have enough land left for them to cultivate
- The number of years: Some farmers felt that if they commit their land for a long period, they may die before the contract is over and this could lead to conflict in the household
- Permission: Most farmers were not comfortable with the restriction of access to the land. They said that even if they want to commit the land for soil and water conservation work, they would want to have access to the land i.e. they would like to benefit from this land such as fodder harvesting. They also felt that the restriction would result to conflict between the project and the farmers because at some point the farmer may feel pressed so much that he finds himself using the land for fodder while he is not supposed to.
- Reward: Some farmers felt that some rewards were very small compared to the land that one would commit. They said that if they retained the piece of the land in the current land use they would get benefits that are far much higher that the compensation

3. Overall evaluation of the survey process

The exercise was successful and we met our objective

4. Any other relevant issue

The spatial sampling used for this survey was a good approach and has the following advantages:

Minimized Biasness: It was observed that some possible biasness were eliminated using the spatial sampling method. This is because the survey points were randomly placed on the map without considering the characteristics of the interviewees in these locations. The bias can lead to an over- or under-representation of the corresponding parameter in the population. Some of the bias that was taken care of includes:

- ***Spatial bias:*** where only those who are easily accessible to vehicles are interviewed specifically on urban, tarmac and roadside
- ***Person bias:*** whereby articulate elites or direct users of services and those who are active are the only people interviewed or are over-represented relative to their numerical strength

Enhanced Receptiveness during the Survey: While carrying out the survey the enumerators uses a GPS to locate the Survey points and at the point the enumerator looks for the nearest household. At the household, the enumerator explains to the interviewee how he landed at the homestead. The conversation would take the following form ‘‘This household was not predetermined and this is the reason I had not sent a message that I was coming. I have been directed to your home by this GPS. I didn’t want your fellow community member whom I am with to direct me to her preferred household because she could be biased may be because of friendship, enmity, poverty level i.e. economic status etc.’’. This amazes the

farmer and the enumerator is welcomed very well as such the willingness of the farmer to share information is enhanced.

(Burnice):

On attributes/factors (included in the survey and not included but important in the process of farmer's participation decision and option ratings:

- **Reward scheme**: Ma be we should add farm inputs eg. Fertilizers in certain amounts. Some farmers would be willing to participate if fertilizer were included as a reward.
- **Right to Harvest**: Maybe we should clearly define the time in season in order to achieve the objective. i.e., when to harvest.

The key factor which most respondents based their ratings were: (a) Land to be committed, (b) length of commitment period; and (c) reward scheme

- **Overall evaluation of the survey**: Most farmers are willing to participate in the scheme but according to the farmers the compensation per year was too little compared to what hey would earn from the committed land but if the amount would be increased the scheme would be viable. I did not have difficulties obtaining information from the respondents except few cases. Navigating to the survey points with the help GPS was good apart from instances where there were step slopes.
- **Other relevant issues**: (a) Prior information about the scheme was important for decision making within households; (b) consider inflation where reward scheme is in for of cash payments. The figures should not be constant for committed land; and (c) consider conflicts within families regarding land allocation.

III. *Feedbacks from Mutathari survey Team (Fredrick, Makanga)*

The farmers were very receptive to the concept of the rewards for ecosystem services; the farmers were eager to know the time starting the project. The following observations were made.

Age: It was observed that the elderly (>=70) people were opposed to the longer contract periods i.e., more than ten years owing to the old age.

Land size: the farmers who have very small land i.e., 0.5-1 acres of land were feeling a little uneasy to the reward mechanism, because they felt that benefits from the scheme will be very small.

- **Sustainable land use options**: Most framers have started rearing pigs and rabbits as sustainable land use options. The introduction of bee-keeping will be very compatible land use to planting trees.

- **Water**: It was observed that rain water harvesting is not implemented by most farmers because of the available piped water supply systems to most homesteads. Underground water resources remain largely unexploited.

- The farmers who have zero grazing units form the majority of the respondents. These farmers can be engaged in biogas generation as renewable energy alternative.
- Some farmers felt that the reward options be expanded to include school fees and wealth insurance.
- The farmers wanted that the project/scheme considers the aspect of providing tree seedlings at the start of the project.
- Most farmers who had portions of their land that they deemed to be of poor qualities wanted to use their land for conservation.
- It was indicated that the farmers really preferred the water options especially if it will be available for irrigation
- Farmers felt that they would greatly appreciate any effects of to offer the following at subsidised rates or for free. (i) certified planting seeds, (ii) fertilizer
- Markets linkages: (i) For the farmers, their main hindrance towards economic growth is the presence of middlemen when marketing their products; (ii) if farmers are to be directly linked to the end market, then they would get more for their produce and thus positively motivated.
- Medical care scheme: This is essential for the aged and for those far from urban centres
- Environmental education: sensitising the farmers enables them to make sound practices when farming. Most of the farmers interviewed had prior sightings of the acronyms (IFAD, MKEPP, ICRAF, etc.) bt had no idea of what these organizations do.
- Key factors on which most respondents base their ratings: (a) Land: farmers with less land are not likely to dedicate more than 20% of the land towards environmental conservation; (b) contract length: Most of the farmers feel that 30 years is a long time to make a commitment. This is especially the case amongst young farmers (<40 years old) who have young children; (c) another factor affecting contract length is the proximity of the farm to urban areas. Those closer to urban centres prefer a shorter period (5 years) as opposed to 15 or 30 years scheme.
- **Right to harvest other products**: Most farmers were willing to undertake the scheme only if they were given a certain level of permission to land set aside for conservation. Some of the preferred rights were the right to harvest Napier grass and firewood.
- **Reward scheme**: (a) Water as a resource is scarce and mostly given preference especially in the Mutathatri FDA which is generally dry; (b) Electricity is a preferred reward but for those neighbouring the town.
- **Scheme administering local body**: Farmers did not mind who are to oversee their implementation to the scheme.
- **Free labour days dedicated**: Farmers were ready to undertake the scheme regardless of the number of free labour days they were required to dedicate for the scheme.

Appendix 7: Fieldwork Diary (Summary of tasks undertaken during the fieldwork)

05 October 2009

- ✓ Research team leave for Embu (i.e.. travel from Nairobi to Embu).
- ✓ Meeting to planning for focus group, CV, and CJ survey in Mt. East Kenya
  (Bedru B., Thomas Y., Esther Mbugua, Frederick Mokua)

Topics:

1. Focus group discussion: How to conduct focus group?

I three focal development areas (FDA 1, FDA2, FDA3) and 4 focus groups in each FDA,

- ✓ Women group
- ✓ Youth group
- ✓ FDA committees (leaders)
- ✓ PMCs (project management committees (leaders)

2. Description of the CV/CJ method (by Bedru to Thomas, Esther, Frederick)
   (CV to elicit WTA and CJ to assess the preference for various LUC/mgt contracts)

06 Oct. 2009

1. Meeting MKEPP officers at EMBU
2. Meeting community members and leaders at Kiriari
3. Running four focus group sessions in Kiriari (Youth, Women, FDAs, and PMC)

07 Oct. 2009

1. Meeting community members and leaders at Kairuri
2. Running four focus group sessions in Kairuri (youth. Women, FDAs, and PMCs)

08 Oct. 2009

- ✓ Focus group discussion in Mutathari FDA
- ✓ Design of the conjoint survey
- ✓ Preparing workshop documents for the local leaders

09 Oct. 2009

Stakeholders workshop at Izaak Walton Inn, Embu

1. Issues
   - ✓ General discussion on overall environmental problems in the study area
   - ✓ Identifying the most critical environmental problems in the area
   - ✓ Identifying feasible and effective land use change related activities for sediment mitigation and erosion control
   - ✓ Discussion on the general approaches of environmental valuation
   - ✓ Creating general understanding of environmental preferences
   - ✓ Creating conceptual understanding of contingent valuation and conjoint analysis
2. Participants
   - ✓ Representatives of farmers (3 farmers from each the three FDAs)
   - ✓ Government officers (2)
   - ✓ Experts: MKEPP SWC expert (1); two MSc students; ICRAF scientist

10 Oct. 2009

- ✓ Travel to Meru national park: This Park is one of Kenyan Wildlife Reserves for variety of wild life population. The park is located about 171 Km from the town of Embu and 71 km away from the town of Meru. Thomas, Bedru, Esther, and Kibe (the driver) visited the Park. Because of the recent drought in the country, we found the Park so dry with scarce vegetation cover. The drought also affected the wild life population. But the good thing about this park is that the Park has got rivers and streams crossing it. Most of the wild populations are concentrated along the river course in search of water and grass. Some of the wild population we visited include: buffalo; antelope; elephant; wild dog; giraffe; hippo; zebra; and various bird species.

11 Oct. 2009

- ✓ This was a very busy day. Bedru has to organize training materials for both the CV and CJ.
- ✓ Training was given to six enumerators. The enumerators were first degree holders degree in environmental sciences, business management; and two ICRAF hosted MSc students. The training consists of concepts on environmental management and economics; environment and livelihoods; issues in environmental valuations; the concept of conjoint analysis and contingent valuation.
- ✓ Training on the questionnaire: the questionnaire has got three sections. 1) demographic and socio-economic section; 2) conjoint survey section; and 3) contingent valuation survey section. To make sure that enumerators understand and implement the survey similarly and consistently, the training was very detail and each and every statement in the questionnaire was dealt with line by line till the enumerators understood clearly.

12 – 16 Oct. 2009

- ✓ Field data collection (124 sample households were surveyed). Six enumerators were deployed to the survey. Field survey was supervised by the principal investigator and two ICRAF researchers.
- ✓ Data entry (parallel to the field survey, data entry was also undertaken).