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RESEARCH ARTICLE

ECONOMIC VALUATION OF REDUCING UPLAND FOREST RESOURCES DEGRADATION TO IMPROVE SOIL AND WATER CONSERVATION SERVICES: THE CASE OF UPLAND FOREST RESOURCES OF REKAME WATERSHED, HALABA SPECIAL WOREDA, SNNPR, ETHIOPIA

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ABSTRACT

In this study by using contingent valuation instrument an attempt was made to compute economic value of reducing upland forest resources degradation to improve soil and water conservation services in ETB and Labor Days contribution methods. The study is based on empirical data collected from 369 valid sample respondents living in the downstream communities vulnerable to the problems from the degraded upland forest area. Most respondents have given positive response for the project. In the study Probit and OLS models were used. Probit model was employed to estimate the parametric mean and aggregate WTP and also to determine factors affecting the WTP amounts from single bounded dichotomous choice format whereas OLS model was employed to determine factors affecting the maximum WTP amounts from the open ended question format. The mean WTP values were estimated using parametric and Non-Parametric approaches. The annual parametric mean WTP amounts were found to be ETB117.216 and 96.864 Labor days whereas the non-parametric mean WTP amounts were ETB110.4436 and 75.4478 Labor Days. Contrary to the mean WTP amounts from parametric approach, the mean WTP amounts from the non-parametric approach were from the households own feeling response and not affected by the disturbance term. Thus, the five years aggregate WTP amounts of this study were preferably ETB 6,951,871.2 and 4,749,060 Labor Days (equals ETB 56,988,720 by the conversion factor of 12.00ETB/worker/day). This shows that in rural areas labordays contribution is the most preferred over cash. From the Probit mode variables: age, income, education, family size, bid amount, landing holding, distance, degree of vulnerability, off-farm income and livestock have shown significant effects. From the OLS model variables: age, income, livestock, education, landholding, family size and bid amount have shown significant effect for both contribution methods. Almost all the explanatory variables have the same direction in both models. Moreover, higher WTP amounts are indicative of the households' willingness to reduce the upland forest resources degradation in the watershed system of Rekame. The estimated value represents only one part of the total economic values of the upland forest resources. There were no serious inconsistency problems between determinants from Probit and OLS models. This raises validity of this research work. Furthermore, integrating local communities' participation in reducing the upland forest resources degradation to improve soil and water conservation services is unquestionably essential.

INTRODUCTION

Healthy forests provide many ecological, social and economic contributions to the nation, simply by existing as natural ecosystems (Kolstad, 2000).

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Among others, forests provide benefits such as wood products, flood & erosion control, landslide control, prevention of land degradation & soil fertility loss, purification & regulation of air & water, carbon sequestration, & maintenance of biological diversity (Pereira, 1989; Lal, 1993). Contrary to their massive importance, natural forests ecosystems are degrading in devastating manner mostly due to human-induced factors and causing frustrating loss of lives & resources (Robert, Sven, José and Campos, 2002).

Though there are also many other factors to be raised, the non-marketable valuable attributes of forest ecosystem services are the major ones. Except for timber & some non-timber products, most of the ecosystem services have no marketable values (John, 2009). Environmental degradation can reduce welfare of the society through reduced quantity and quality of environmental resources, loss of long-term productivity, reduced future earning of the population, thereby jeopardizing economic development (WB, 1992). The recognition of these environmental problems brings the question of sustainable development, which is concerned with meeting the needs of present generation without compromising the needs of future generations into the picture (Georgiou, *et al*., 1997).

Moreover, forest ecosystem health in many parts of the world is deteriorating, in large because of an ever-expanding world population (Kolstad, 2000). On the other hand, depletion of forest resources and their degradation causes a threat to ecosystem diversity and a fundamental influence on the declining of standard of living of many households. As a result, ecosystem services of the forest resources are diminishing dramatically by causing a resultant out-of-hand effect on the general environment. Flash flooding observed in different parts of the country for the past few years causing loss of many lives & resources can be of crude evidence for these (EEPA, 1997). Environmental resources such as forests play a key role in the livelihoods of local people in developing countries like Ethiopia, where there are plenty of mountainous landscapes.

However, currently many dense forest resources are becoming history than observable facts despite the efforts made by the current government (Tadesse, 2008; Reusing, 1998). This is due to massive deforestation activities such as extensive allocation of forest lands for investors, population pressure, poverty, farm land expansion, resettlement, and open accessibility (EFAP, 1994). Moreover, in relation with some other factors rapid deforestation of natural forests, especially in upland areas, cause a high rate of flooding, soil erosion, sedimentation and other consequential problems like biodiversity loss, land degradation, soil fertility as well as productivity loss and so on (Fredrik *et al*, 2004). Above all, recently, it has been recognized that under-valuation or absence of valuation of the products and services of forests is one of the major factors for the degradation of forest resources (Nnaemeka and Chukwuemeka, 2008). Virgin forests are being cleared for the purpose of selling the standing timber as well as providing farmland (Kolstad, 2000). Therefore, estimating the total economic values of forests and understanding how plant resource use interacts with the incomes and welfare of rural households is a key step towards sustainable use and management of forest resources (Nnaemeka and Chukwuemeka, 2008).

Upland forest resource of Rekame watershed is located in Halaba Special Woreda, 19km far away from HalabaKulito town. It covers an area of 541 hectares. By now it is controlled and managed by Rekame Self-help Association (RSHA). The rural communities around Rekame upland forest area are renowned for their red pepper production for local and national markets like many of the rural areas in the Woreda. However, in these days there are plenty of problems they face due to degradation of the upland forest resources and hence its soil and water conservation services to the downhill local communities, mainly, by human induced factors (HSWARDO, 2013). As reported by the Halaba Special Woreda agricultural and rural development office, before 1986 there were around eight water springs within the upland forest resource which sheds water for the area & various species of fauna. And there had been also different indigenous species of flora that serve the surrounding rural community in terms of watershed protection through controlled flood, soil erosion, sedimentation on farmlands and water ponds, maintained biodiversity & overall ecosystem conservation. However after 1986 due to the drought and poverty problems in different parts of the Woreda, an organization called 'Food for the Hungry' (FH) started dealing with such problems. And hence it had helped many households to escape from the umbrella of food insecurity problem temporarily (Ibid). Although the program has helped the people in the area to escape from food insecurity trap as a transitory bridge to pass through, it is blamed for its partial natural forest clearing & replacement activities & the subsequent problems of open access situation, overexploitation, and hence decline of the forest biodiversity, severe seasonal flooding, soil erosion and sedimentation problems (HSWARDO, 2013).

Therefore, finding permanent solution for severe seasonal flooding, soil erosion and sedimentation which is caused by seasonal run-offs flowing from the degraded upland forest area towards the downstream communities and bringing back soil & water conservation services that the natural forest had been giving to them is incontrovertibly vital. In this context measuring the WTP of vulnerable rural households to reduce the upland forest resources degradation and hence bring back the lost soil and water conservation services is justifiable. Accordingly, the main objective of this study was estimating the economic value of reducing upland forest resources degradation to improve its potential to provide soil & water conservation services[1] for the downstream communities and understanding how wise use of natural forest resources interacts with the livelihoods and welfare of rural households are key steps towards sustainable resource management. Specific objectives are:

- To estimate parametric and non-parametric mean and aggregate WTP of households
- To identify determinants of households WTP

Theoretical and Empirical Literatures

Theoretical Literatures

Rationale and Role of Non-market Economic Valuation

According to Pearce and Markandya (1989) and Bergstrom (1990), the basic rationale for assigning economic values for non-marketed environmental benefits is that if they are omitted from appraisals, there is a strong risk that non-marketed goods will be under-supplied in the economy, and an equally strong risk that non-marketed bads will be over-supplied. Deciding how much of a good to supply, or how much of a bad to tolerate or abate, requires that the value of those goods and bads be brought into balance with the costs of providing the

[1] *In this study when we say 'soil and water conservation services', mainly, it is to mean that water regulation, soil protection, and sediment retention services that the downstream communities obtain from intact upland forest resources.*

good (or the cost of reducing the bad). This balancing exercise involves some form of economic valuation activities on selected non-marketed environmental benefits (Mishan, 1988). These rationales and the use of valuation cannot be understood without first understanding the theoretical basis for economic valuation. Therefore, economic valuation refers to the assignment of money values to non-marketed assets, goods and services, where the money values have a particular and precise meaning (Krieger, 2001). A forest resource can be used in many different ways. Each use can produce some on-site private, on-site public and global benefits, but obviously some trade-off between those benefits and the consequent opportunity costs for benefits foregone should also be considered (IIED, 1994).

However, many forestry and environmental services values are not automatically reflected in market prices, mainly because their public nature involves at least some elements of *non-excludability*and/or *non-rivalry*[2] (Michael, 1995). Their inadequate recognition and underestimation at the local, regional, national and global level is declared to be one of the main reasons for the widespread failure to practice sustainable forest management, as well as for deforestation and the transfer of forests to other land uses (UNCED, 1992). However, the difficulty of valuing such goods and services should not preclude at least an attempt to measure these values and include them in decision-making, to the extent possible they need to be explicitly assessed, quantified and incorporated into the decision-making process as an input for sustainable forest use and management (Adams, 1993).

Economic Values of Forest Resources

There are several ways of classifying economic values of environmental resources. Freeman (1979), Freeman (1993) and Mitchell and Carson (1989) have presented classifications of resource benefits from environmental improvements perspectives. Total economic value is, perhaps, the most complete measure to express the full range of value of benefits of both tangible and intangible types (Merlo and Croitoru, 2005). Forest resources provide a variety of goods and services to the users are valued for their current or future benefits or welfare and are said to have use values & non-use values (Merlo andCroitoru, 2005; Krieger, 2001). The use values arise from the direct and indirect use of environmental resources (like forest) whereas, non-use values are values that arise from the mere existence of the resource, and they are not associated with any specific use of the resources (Verma, 2000).

Non-Market Economic Values Measuring Techniques

In the environmental economics literature we have different valuation methods of non-market environmental benefits. These valuation methods are usually divided into two: direct methods (stated preference) and indirect methods (revealed preference) (Hanley, et. al., 1997). Direct methods seek to infer individuals' preferences for environmental quality directly by asking them to state their preferences for the environment. Indirect methods seek to measure estimates of individuals' willingness to pay for environmental quality by observing their behavior in related markets (Harris, 2006).

Revealed Preference (Indirect Valuation) Methods

Travel Cost Method (TCM): The method is based on the assumption that consumers' value environmental resource in terms of the cost of getting there, including all direct transport costs as well as the opportunity cost of time spent while travelling to the site (Hanley *et al*, 2002; Khandke, *et al.* 2001). It depends on observing actual behavior rather than on answers to hypothetical questions (Loomis, 2005). It measures the demand and the value of environmental assets. Particularly, it provides an opportunity to value the recreational opportunities provided by nature. The willingness to pay for visiting a recreational area may be estimated if there are enough data on how much money and time people spend for travelling to the area (Khandke, *et al*., 2001).

Hedonic Pricing Method (HPM)

HPM is commonly applied to variations in prices of marketable goods and services that reflect the value of local environmental resources.The price difference of marketable commodities, mainly, reflects the local environmental resources services (Birol *et al*, 2006). That is, based on the idea that environmental resources might play a role for property values, such as, disparity in housing prices between different locations with equal size. As a result, this method enables to extract the specific influence of an environmental amenity or risk from the market price of a good or service (Thomas andCallan, 2007; Hanley *et al*, 2002).

Stated Preference (Direct Valuation) Methods

Choice Experiment Method (CEM)

A choice experiment is a highly structured method of data generation, relying on carefully designed experiment to reveal the factors that influence choices (Birol *et al*, 2006). In this method, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set. Each alternative is described by a number of attributes or characteristics by incorporating price as one of the attributes along with other attributes of importance (Colombo *et al*. 2005; Birol *et al*., 2006). However, it is criticized for the more stringent assumptions that are not needed when using the CVM. Besides the application of choice experiment is expensive due to the need for thorough survey development (Birol *et al*, 2006).

Contingent Valuation Method (CVM)

Contingent valuation method is the most understandable approach to measure non-market environmental values through directly questioning individuals on their willingness-to-pay (WTP) (Mitchell and Carson, 1989). The term 'contingent' in CVM suggests that it is contingent on simulating a hypothetical market for the environmental good in question. This technique is referred to as a "stated preference" as it asks people to directly state their values (Rahim, 2008). CVM directly infers values by using surveys to ask people their maximum willingness to pay (WTP) to avoid environmental risk and/or minimum willingness to accept compensation (WTA) to tolerate environmental bads

[2] Non-excludability: difficulty or impossibility of excluding other individuals from the benefits of a given good or service; Non-rivalry: the consumption by one individual does not preclude consumption of the same good by one or more other individuals.

(Henn, 2000; Myers, 1998). Unlike other methods, it generates both market and non-market values of environmental resources. The approach is particularly important in situations where there is no market information about people's preference to an item. Accordingly, it is widely used in valuing changes in environmental quality (Mitchell and Carson, 1989; Henn, 2000; Myers, 1998; Randall, 1987). Moreover, the technique has great flexibility, allowing valuation of a wider variety of non-market environmental goods and services than is possible with any of the indirect techniques (Carson andHanemann, 2005). It is, in fact, the only method currently available for estimating nonuse values. In natural resources, contingent valuation studies generally derive values through the elicitation of respondents' willingness-to-pay to prevent injuries to natural resources or to restore injured natural resources (Duberstein and de Steiguer, 2004).

It is believed that CVM helps to elicit individuals' preferences for the changes in the quantity or quality of nonmarket environmental resources which have the characteristics of *non-excludability* and *non-divisibility* (Perman *et al*, 2003; Birol *et al*, 2006; Steven, 2006). CVM, despite its wide application, it suffers from a number of biases, such as hypothetical bias, information bias, strategic bias, sampling bias, starting point bias, instrumental bias, interviewers bias (Tisdell, 1993). However, well-designed and soundly executed CVM studies can provide high quality and policy relevant information (Whittington, 2002). Therefore, due to the advantages described and the feature of environmental benefit going to be measured, CVM is preferred and utilized for the analysis of this study.

Empirical Literature Review

Many research findings with CVM assured that conservation and/or reducing degradation of forest resources has many advantages. However, there are no many research works on upland forest resources soil and water conservation services in the context of Ethiopia that used contingent valuation method (CVM). Most of the research works accomplished by CVM were devoted to water resources and urban dry waste management. However, for the sake of methodological selection, the under stated studies are considered. Nnaemeka, *et al*, (2008) with CVM analyzed the determinants of the WTP of households in forest communities for systematic management of community forests for NTFP conservation in the rainforest region of Nigeria. The WTP elicitation format used was dichotomous choice with open-ended follow-up questions.

The analysis from a Tobit model showed that variables such as wealth category, occupation, number of years of schooling and number of females in a household were positively and significantly influenced WTP. KHEE, *et al*, (unknown date) analyzed WTP of households for preservation and conservation of hill recreational and services values in Malaysia. The CVM employed open ended question with OLS model. The study finds that hill preservation is important and the public is willingness to pay initiatives for initiatives to mitigate further degradation to this ecosystem.

The three explanatory variables which have significant effect on WTP are the user of the hill, gender and household income. Alemu (1997) applied CVM to community forestry in Ethiopia. For the survey, single-bounded dichotomous choice format with open ended follow-up questions were applied. The results proved that income, household size, distance of homestead to plantation, number of trees owned and sex of household head were important variables that explain WTP for the program. The results of the study suggested that community a forestation projects should consider household and site specific factors as determinants of success.

Fredrik *et al*., (2004) employed the CVM on community plantations project in the northern highlands of Ethiopia. The households WTP for a new plantation were elicited in two steps. First the respondents were asked a single-bounded dichotomous question about whether he or she would be willing to pay a specific sum of money for the establishment of the plantation. Close-ended question for a given threshold was followed by an open ended elicitation format. The result from probit model showed considerable variations between villages and analysis of bid functions showing underlying factors for the project success that can be used in project planning were made. Accordingly the responses of both spouses show that there are gender variations in the factors that affect the WTP for the bids. In the community where there is no plantation before, women were significantly interested than men for the new establishment.

The study concluded that the cumulative WTP diverge significantly between villages ranging between 1,301Birr to 8285Birr per ha/year indicating the need for good selection methods in targeting such plantation interventions. Zewdu & Yemisirach (unkown date) taking Netchsar National Park as a case, tried to measure people's (WTP) to protect the endangered environment and identify its determinants. Using dichotomous choice (CVM), it was found that the local community was willing to protect the park. The results show that the means for the WTP are Birr 28.34 and Birr 57.07 per year per household; and its determinants are primary economic activity of the households, dependency ratio and distance from the park.

Tegegne (1999), by using CVM, measured WTP of individuals for environmental protection in terms of both ETB and labour days contribution in Sekota District, Northern Ethiopia. The results showed that labour contribution method is preferred to monetary method contribution method. Education, age,sex and family size are the major determining factors for the WTP in labour days. Therefore, the above stated literatures assure that CVM is the most practical valuation method for the valuation of non-marketable environmental resource attributes. As a result, here on this study it is utilized as a major method to quantify rural households WTP for reducing upland forest resource degradation to improve its soil and water conservation services they obtain.

RESEARCH METHODOLOGY

Description of the Study Area

Halaba Special Woreda is one of the special Woreda's' in the SNNPR. It is located within the southern rift valley of Ethiopia. It is placed between Lake Shalla and BilateRiver. The Woreda's capital, HalabaKulito, is located 315 km south of Addis Ababa and about 85 km southwest of (SNNPR) state capital of Hawassa, along the main road to Arbaminch.

The upland forest resource is found in the upper tip of Rekame watershed, 19km away from the woreda's capital town, Halaba Kulito. The total area of the upland forest is estimated to be 541 hectare.

Data Sources, Methods of Collection, Sampling Procedure and Sample size

Though CVM research acquires most of its data from primary data sources, secondary data sources are also utilized, which include the data collected from books, documents and reports. The primary data is collected through duly prepared and pretested questionnaire using face to face interview of sample households. Face-to-face CVM survey with fully-structured questionnaire is the most appropriate method in rural areas where illiteracy and many other factors are pervasive. CV scenario and fully structured questionnaire was designed for the sample respondents.

In addition, focus group discussions (FGD) to assess economic status (paying ability) and key informant interview to generate qualitative information were used. Sample households were asked two consecutive questions on the CV scenario. Primarily, close-ended questions (Yes/No) for a fixed amount of bid value; and then the open-ended question which extracts the maximum WTP amounts in terms of ETB and in labor days contribution method. In this study, a multi-stage sampling technique was applied to select the required type of sample respondents. Firstly, out of the 79 PAs in the Woreda, 27 PAs that are found in the Rekame watershed system and exposed for recurrent flood, soil erosion and sedimentation problems from the degraded upland forest resource area of Rekame watershed are purposively selected.

Secondly, the selected 27 PAs are stratified into two depending on their degree of vulnerability to seasonal flooding, soil erosion and sedimentation problems in collaboration with the Woreda's agricultural & rural development office. Thirdly, from each stratum three representative PAs are selected randomly (i.e. a total of six PAs on aggregate). Finally, in order to give equal chance for the population of each PA, probability proportional to size random sampling technique wasemployed. The total sample size from the six representative PAs is selected by using the theories of Cochran (1977) and Enanoria (2007), which were 369.

Methods of Data Analysis

Both descriptive statistics and econometric models were used in the study. The descriptive statistics include mean, percentage and frequency of the willing and non-willing respondents for the proposed project. In addition, the analysis of survey responses obtained from single bounded and open-ended questions formats requires different econometric models (FAO Corporate Document Repository, 2007). Accordingly, the under specified econometrics models were used:

Specification of Econometric Model for the Single-Bounded Survey Responses

in the case of single bounded dichotomous choice, the random components of preferences cannot be known by the researcher rather he can only make probability statement of '**yes**' or '**no'** responses.

As a result, the probability that the respondent says '**yes**' is the probability that the respondent thinks that he/she is better-off by the proposed improvement program. For individual i the probability can be formed as:

$$P(Yes=1)=[U^1(Yj-\beta_i^*,Xj,\varepsilon^1 j)>U^0(Yj,Xj,\varepsilon^0 j)] \quad (1)$$

This probability statement provides an intuitive basis to analyze binary responses. Therefore, for dichotomous (yes/no) responses to the single bounded bid amount (βi*) neither the multiple linear regression model nor the tobit model is appropriate to estimate WTP function (Gujirati, 2004; Hill, *et al*., 1997).

However, this can be solved by using a more sophisticated model, such as, probit and logit (Amemiya, 1981; Johanson and Dinardo, 1997). Probit model follows normal cumulative distribution whereas logit model follows logistic cumulative distribution. That is, the conditional probability approaches zero or one at a slower rate in logit than in probit (Gujirati, 2004). The choice between the Probit and the Logit model is only for mathematical convenience. Assuming the normal cumulative distribution following Cameron and Quiggin, (1994), the Probit model can be expressed as follows:

$$Y_i^* = \beta' Xi + \varepsilon i \quad (2)$$

$$yi=1 \text{ if } Y^*i \geq \beta^* \text{ and } yi=0 \text{ if } Y^*i < \beta^* \quad (3)$$

Where: Y*i unobservable households' actual WTP for the improvement, β' is vector of unknown parameters of the model, Xi is vector of explanatory variables, yi is discrete response of the respondents for the WTP bid amount, β^* is the bid value assigned arbitrarily to the i^{th} respondent and εi is unobservable random component distributed N (0, σ).

The basic reason behind running probit regression is to calculate parametric mean WTP, aggregate WTP, and allow inclusion of influence of respondents' socio-economic factors and the disturbance term into the WTP function. Therefore, the mean willingness to pay (μ) was calculated using the formula (Haab and Mconnell, 2002) with the data obtained from probit regression for both contribution methods. Accordingly, the equation is written as:

$$\mu = -\frac{\alpha}{\beta} \quad (4)$$

Where, μ is parametric mean WTP, α is coefficient of the constant term from multivariate probit model regression whereas $\beta$is a coefficient for the amount of the bid that the respondent was asked to pay.

Specification of Econometric Model for the Open-Ended Survey Responses

In this case the use of binary response models such as the Probit or the Logit is not appropriate. As a result, censored Tobit model when discrete response for the dependent variable takes non negative values with some zeros or OLS model if the discrete response for the dependent variable takes none zero positive numbers is more appropriate (Siglman and Zeng 1999).

The survey result showed that for the open-ended question respondents expressed maximum WTP amount that exceeds zero for both contribution methods. Accordingly, OLS model is selected and utilized for analyzing the determinants of individuals' maximum willingness to pay for the proposed project. The general OLS models are defined as follows for each type of contribution methods:

OLS model for ETB contribution method

$$WTP = \beta o + \beta_1 SEX + \beta_2 MARSTAT + \beta_3 INCOMEH + \beta_4 TLU + \beta_5 EDUNAHH + \beta_6 HEDUNAH + \beta_7 FAMSIZE + \beta_8 BIDCASH + \beta_9 LANDHOLD + \beta_{10} DISTANCE + \beta_{11} DEGVUL + \beta_{12} MEMSHIP + \beta_{13} PARTCON + \beta_{14} OFFINCOM$$

OLS model for Labor Days contribution method

$$WTP = \beta o + \beta_1 SEX + \beta_2 MARSTAT + \beta_3 INCOMEH + \beta_4 TLU + \beta_5 EDUNAHH + \beta_6 HEDUNAH + \beta_7 FAMSIZE + \beta_8 BIDLABOR + \beta_9 LANDHOLD + \beta_{10} DISTANCE + \beta_{11} DEGVUL + \beta_{12} MEMSHIP + \beta_{13} PARTCON + \beta_{14} OFFINCOM$$

The variables in the model are defined in Appendix 5. For the open ended contingent valuation survey responses the non-parametric mean WTP and nonparametric aggregate WTP for the total households in the study area is calculated by using the following formula (FAO Corporate Document Repository, 2007)

Where, MWTP = Mean willingness for the whole households surrounding the resource, MWTPi = i^{th} individual mean WTP, ni = number of households that are willing to pay the i^{th} amount and N = total number of households within the resource area. Prior to the analysis of results from both models, all the necessary tests were made to detect if there are severe problems of multicollinearity and hetroscedasticity and there were no serious problems. M According to the findings of various studies on economic valuation of non-marketable environmental resources, the working hypotheses were structured (Appendix 5).

RESULTS AND DISCUSSION

This section deals with the analysis of the surveyed data which are mainly obtained by using the contingent valuation survey instrument. Interpretation of the analytical findings was done by using both descriptive and econometric analysis. The contribution of households is considered in ETB and labor days contribution methods. Considering both payment vehicles adds some steps on the development of a payment for non-market environmental services.

Descriptive Results

The sex composition shows that 244 (66%) respondents were males whereas the rest 125 (34%) were females for both types of contribution ways. From these 363 (98%) of the respondents were the household heads themselves, whereas the rest 6 (2%) of the respondents were other working members of the household. This might be assumed to increase the reliability of the response provided that the rural household head knows and manages most of the household income and resources. With regard to age, from a total of 369 valid responses the average age of the respondents was about 38.26 years with minimum and maximum ages being 21 and 68 years, respectively. The respective averages for willing and non-willing households for the pre-set cash bid value were 37.47and 39.90years, whereas for the pre-set labour bid value the respective averages were 37.44 and 40.06 years.

That is, younger household heads were more willing to pay than the elder heads. However, the mean age difference between willing and non-willing was not statistically significant for both contribution methods. Moreover, variable age was expected to have adverse impact on the valuation of soil & water conservation services from the reduced upland forest resources degradation. This is because, since investments on environment take longer to reply, aged respondents are expected to contribute smaller relative to the younger ones.

Table 1. Distribution of non-willing respondents across age categories

Age category	WTP (in ETB)		WTP (in labor days)	
	Non-willing (N=120)		Non-willing (N=109)	
	Frequency	Percentage	Frequency	Percentage
18-29	35	29.2	35	32
>=30	85	70.8	74	68
Aggregate	120	100	109	100

Source: Computed from own survey data, 2013

Table 2. Summary of household head and members within educational achievement

Variables	Educational status	Respondents			Percentage	Summary
		Male	Female	Total		
Education achievement of household head	Illiterate	146	69	215	58.3	Obs. 369
	Informal & Primary school	97	56	153	41.5	Mean 0.474
	Secondary school	1	-	1	0.2	Min. 0
	Tertiary school			-	-	Max. 10
	Total			369	100	Std. dev. 0.78
Highest Educational Achievement within Household	Illiterate	62	27	89	24.3	Obs. 369
	Informal & Primary school	93	52	145	39.3	Mean 4.6
	Secondary school	81	45	126	34	Min. 0
	Tertiary school	8	1	9	2.4	Max. 12+3
						Std. dev. 3.86
	Total			369	100	

Source: Own survey data, 2013

That is, as age rises the willingness to contribute of the respondent falls. And hence age of the respondent has negative relationship with the level of willingness to contribute/pay for reducing upland forest resources degradation to improve its services of soil & water conservation (Table 1). From 369 sampled households, a total of 1935 family members were recorded with a minimum of 1 person and a maximum of 11 persons per household. The mean family size for the total data set was 5.22, approximately, which was equal to the national average of 5.2 persons (CSA, 1995). For the bid value contribution which was asked in terms of cash the respective average family size for willing and non-willing respondents were 5.66 and 4.36.However, for the bid value which was requested in terms of labour days, the respective averages for willing and no-willing sample respondents were 5.6 and 4.3. That is, respondents having larger family size were more willing to contribute than respondents having smaller family size for the proposed project. The mean difference between willing and non-willing respondents is statistically significant at 1% level of significance for both types of contribution methods. Education increases households' ability to get, process, and use information in their day to day livelihood activities (Asrat *et al*., 2004). As a result, educational achievement was considered as major variable which determine the probability of rural households WTP for reducing upland forest resources degradation and hence improve its soil and water conservation services. For the purpose of isolation of the impact of 'education' of the

Table 3. Distribution of willing & non-willing respondents across different size of land holding

Land holding category (in ha)	Respondents	Response for the pre-set bid-value in cash		Response for the pre-set bid-value in person days	
		Willing	Non-willing	Willing	Non-willing
0.00 – 1.00	180	74 (41%)	106 (59%)	83 (36%)	97 (54%)
1.01 – 2.00	86	75 (87%)	11 (13%)	77 (89.5%)	9 (10.5%)
2.01 – 2.875	103	100 (97%)	3 (3%)	100 (97%)	3 (3%)
Aggregate	369	249	120	260	109

Source: Survey data, 2013

Table 4. Distribution of willing & non-willing respondents across income categories

Annual Income Category (in ETB)		Willing and Non-willing Response Across Income Categories								
		In ETB (N=369)				In Person Days (N=369)				
	Respondents	Willing	Share (%) from willing (N=249)	Non-willing	Share (%) from non-willing (N=120)	willing	Share (%) from willing (N=260)	Non-willing	Share (%) from non-willing (N=109)
<10,000	215	102	41	113	94	113	43.4	102	93.6
10,000 -24,999	79	79	31.6	0	0	79	30.3	0	0
25,000 -49,999	69	62	25	7	6	62	24	7	6.4
≥50,000	6	6	2.4	0	0	6	2.3	0	0
Overall	369	249	100	120	100	260	100	109	100

Source: Computed from own survey data, (2013)

Table 5. Descriptive summary of sample respondents WTP of pre-set random bid value

Contribution Methods & Response		Frequency	Mean	Std. Dev.	Min	Max
ETB	Willing	249	0.675	0.469	0	1
	non-willing	120	0.325	0.469	0	1
Total Obs.		369				
Labour Days	Willing	260	0.705	0.456	0	1
	non-willing	109	0.295	0.456	0	1
Total Obs.		369				

Source: Computed from own survey data, (2013)

Table 6. Multivariate probit regression results to compute parametric mean & aggregate WTP

Parameter estimates from multivariate probit model regression in ETB				Parameter estimates from multivariate probit model regression in Labor Days			
Variable	Coeff	Robust Std. Error	Z	Variable	Coeff	Robust Std. Error	Z
Bid cash	-0.5562054	0.1327	-4.19	Bid labor	- 1.214772	0.2636	-4.61
Constant	1.358126	0.7391	1.84	Constant	2.451485	0.8039	3.05
Observations	369			Observations	369		
Wald chi2 (15)	129.31			Wald chi2 (15)	143.71		
Prob> chi2	0.0000			Prob> chi2	0.0000		
Pseudo R^2	0.7577			Pseudo R^2	0.6790		

Source: from own data computation, 2013

representative household head & members within, it was analyzed in two groups. These are the highest educational achievement within the household by a member and educational achievement by the household head himself. Education level of household heads ranged from illiterate to Grade 10, with a mean value of 0.474, which means that the majority of the respondents were illiterate and primary school attendants (Table 2). About 215 (58.3%) of the respondents were illiterate, 153 (41.5%) respondents were primary school attendants (in grades 1 to 6 including those who were attending informal education and who can read and write).

Only one sample respondent has completed secondary school (grade 10). As a result, on aggregate about 99.8% of the respondents were illiterate and primary school attendants. This made the survey very difficult and to some extent demands more effort and intensive enumerator training, given that it was contingent valuation survey which needs high level of understanding about the hypothetical market scenario (Table 2). The greatest educational level attained within the household members ranged from illiterate to grade 12 + 3 (first degree), with a mean value of grade 4.66. Approximately, 23% of households were illiterate (there is no any household member attending or previously attended school), 40% had at least one household member attending primary school (in grades 1 to 6), 24.4% had a household member in grade 7 to 9, and 10% from grade 10, 11 & 12. About 1.5% of the households have at least one family member who had attended or completed 10 + 3 (college diploma) and only 1.1% of the households have at least one family member who had completed 12+3 (first-degree). These figures could have changed if only the household head with education was considered by ignoring educated family members. The total land holding of sampled respondents was also expected to have positive effect on the level of willingness to contribute for reducing the upland forest resources degradation to bring back its soil & water conservation services. Moreover, since the fate of downstream cultivable land has strong link with the upland forest resources, those respondents who have large land holding were expected to pay higher for the proposed project. Accordingly, the minimum and the maximum land holding of the sampled respondents were registered as 0.25 and 2.85 hectare, respectively.

The total sum of land holding of the 369 sample respondents was 518.875 ha. However, approximately, the average land holding status of sample households was 1.4 ha (Table 3). From Table 3 above, we can observe that when the trend of land holding increases from one category to the other, the rate of willingness to contribute of sample respondents also rises for both cash and labor day contribution methods. Contrarily, when the size of land holding increases, the rate of non-willing respondents for the proposed environmental change decreases steadily for both cash and labor day contributions. Therefore, the assumed direct relationship between size of land holding and the probability of accepting the pre-set bid-value was justified by the obtained data. Moreover, there is statistically significant average land holding difference between willing and non-willing respondents at 1% level of significance for both contribution methods.

The income data which was obtained from the sampled respondents is analyzed by categorizing households into four income groups: annual income group of below 10,000ETB, between 10,000 and 24,999ETB, between 25,000 and 49,999ETB, and 50,000ETB or more. The minimum and maximum annual incomes that the sampled rural households′ have obtained are recorded as 1,548 ETB and 54,589 ETB, respectively.

Table 7. Summary of parametric mean and aggregate WTP in different periods of payment

Period of Payment	Contribution Methods		
	ETB	Labor Days	Conversion to ETB by the conversion factor 12ETB/DAY
Mean WTP per week	2.442	2.018	24.216
Mean WTP per month	9.768	8.072	96.864
Mean WTP per annum	117.216	96.864	1162.368
Aggregate WTP per annum	1,475,632.224	1,219,420.896	14,633,050.752
Mean WTP per five years	586.08	484.32	5811.84
Aggregate WTP per five years	7,378,161.12	6,097,104.48	73,165,253.76

Source: own survey data, (2013)

Table 8. Summary of non-parametric mean and aggregate WTP in different periods of payment

Period of Payment	Contribution Methods		
	ETB	Labor Days	Conversion to ETB by the conversion factor 12ETB/DAY
Mean WTP per week	2.301	1.572	18.862
Mean WTP per month	9.204	6.287	75.448
Mean WTP per annum	110.444	75.448	905.373
Aggregate WTP per annum	1,390,374.24	949,812	11,397,744
Mean WTP per five years	552.218	377.239	4,526.866
Aggregate WTP per five years	6,951,871.2	4,749,060	56,988,720

Source: own survey data, (2013)

The respondents′ willingness to contribute is directly related to their annual income. Accordingly, lower annual income respondents were found to have lesser willingness to contribute. For the contribution in ETB, out of 120 non-willing respondents, about 113 (94.2%) of the respondents were found in the income group less than or equal to ETB 10,000. However, there was no non-willing respondent for the pre-established cash bid value from the income category of ETB 50,000 or above. On the other hand, for contribution in terms of person days, out of 109 non-willing respondents, about 102 (93.6%) were found to be below annual income of 10,000 ETB, whereas only 7 (6.4%)

of the respondents′ are found in the income group of 25,000 and 49,999 ETB. However, there was no non-willing respondent for the proposed person days bid value for the income categories of 10,000-24,999 and 50,000 ETB or above.

The results for both contribution methods were in line with the expectation. When income increases, the probability of willingness to contribute the pre-set bid amount also increases. Households WTP response for alternative contribution methods is explained as follows. With regard to single bounded response, of the 369 sample respondents, about 249 (67.5%) and 120 (32.5%) were found to be willing and non-willing to pay for the pre-established random bid value in terms of cash (ETB), respectively. On the other hand, about 260 (70.5%) and 109 (29.5%) were willing and non-willing to contribute the pre-established random bid value in terms of labor days, respectively.

However, with regard to maximum WTP from the open-ended questions of both contribution methods, all of the 369 respondents have decided to contribute at least a value which is above zero to assist for reducing upland forest resource degradation for the sake of obtaining improved soil and water conservation services from it.

Econometrics Model Results

Households' Parametric Mean & Aggregate WTP from the Single-Bounded Dichotomous

The Single-bounded contingent valuation model (i.e. probit model) is used to estimate the parametric mean & aggregate willingness-to-pay for both types of contributions. To estimate the parametric mean WTP amounts, two independent models were run - a bivariate model (i.e. WTP against the preset bid amount) and a multivariate model (i.e. WTP against all explanatory variables). The results from the two models were compared and the results from the second model were preferred.

The reason is that results obtained from the second model with multivariate will increase accuracy of the required value and incorporates marginal effect of all variables (Cameron and Quiggin 1994). Therefore, the mean willingness to pay (μ) was calculated using the formula of (Haab and Mconnell, 2002) (See equation 4). By using equation-4and coefficients in Table 6, the parametric mean WTP for reducing the upland forest resource degradation to improve soil and water conservation services from the single bounded probit regression for ETB contribution was estimated as 2.442ETB per week, whereas for the contribution in Labor Days was 2.018 Labor days per week per household.

Therefore, the estimated values for alternative contribution methods from the single bounded response are summarized in Table 7. Contribution in terms of labor days was much higher than the contribution in terms of ETB for proposed improvement in environmental quality.[3] This might be because rural people have shortage of cash and use their crop and livestock production for home consumption and hence give lower WTP in these types of contribution projects. Whereas, labor is relatively cheap in rural areas and because of the existence of disguised unemployment within household, they were willing to contribute more in labor. This was in line with the foundation of Solomon J. (2004).

[3] In the study area the minimum wage rate for unskilled labor was 12.00 ETB per day during survey time (personal communication)

Households Non-Parametric Mean & Aggregate WTP from the Open-Ended

In the open ended questions the sampled households were given a chance to state the maximum amount they would like to pay for improved soil and water conservation services from reducing the upland forest resources degradation. Accordingly, all interviewed households stated the amount of money or labor days which was above zero. To make the aggregation using the non-parametric mean WTP, first the class boundaries for maximum WTP were considered. From the total respondents, it was found that the vote for the resource improvement ranged from ETB 0.5 to ETB 9.00, which was computed from per week WTP of the survey instrument proposed for five years. On the other hand, for the WTP in Labor Days it ranged from 0.25 to 3.00 Labor Days per week. By using the basic Surge s rule of statistics, classes of the respondents WTP were calculated using equation 6 below:

$$\text{Classes– Required}(K) = 1 + 3.322 * (\text{Log}_{10}^{N}) \quad \ldots\ldots(6)$$

Where, K = number of WTP classes required, & N = the number of sampled respondents. Accordingly, the number of WTP classes required was approximated to be 10. However, the width of the class can be computed using the ratio of range to class. Since range is the difference between the upper limit of WTP and the lower limit of WTP, the respective width values for both contribution methods are 0.9 ETB and 0.3 Labor Days (as presented in column-1 of appendix1 and appendix2). The class mark average WTP amount shows the average WTP in both contribution methods within each class of intervals (column-2, 3, 4 of appendix 1 and appendix2).
Total number of households (column-7) is obtained by taking the product of the sample households proportion (%) falling in that boundary and the whole household size enclosed in the study area (i.e. 12,589). To find out each class of intervals non-parametric total WTP (column-8) the following formula was applied.

Class Intervals NonParametric Aggregate WTP
$$= \text{MWTPi} \quad \text{ni} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where: MWTPi = i^{th}class interval mean WTP (column-4) and ni = number (proportion) of total households willing to pay that amount (column-7). Therefore, the annual non-parametric aggregate WTP amount was computed by equation-8 below:

Total Households NonParametric Aggregate WTP

$$= \sum_{i=1}^{10} (\text{MWTPi} \quad \text{ni}) \ldots\ldots\ldots\ldots (8)$$

Where: $\sum_{i=1}^{10}(\text{MWTPi} \quad \text{ni})$ = the summation of each class of intervals non-parametric aggregate WTP under column-8 inannex1 & annex2, which equals 1,390,374.24 ETB and 949,812 labor days per annum. From these values, the five years non-parametric aggregate WTP amounts for the contribution methods of ETB and labor days are ETB 6,951,871.2 and 4,749,060 labor days, respectively. However, the general (all inclusive) non-parametric mean WTP amounts of the total households were estimated by using equation-9 of (FAO Corporate Document Repository, 2007) below:

Total Households NonParametric MWTP

$$= \frac{\sum_{i=1}^{10} (\text{MWTPi} \quad \text{ni})}{\text{N}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

Where, MWTP = Mean willingness for the whole households incorporated in the study, MWTPi = i^{th} class interval's mean WTP (column 4) in appendix 1 and appendix 2, ni = number (proportion) of total households that are willing to pay the i^{th} amount and N = total number of households incorporated in the study (i.e. 12,589). Accordingly, from the equation, total households non-parametric mean WTP amounts are ETB110.443581 ≈ ETB110.4436 and 75.4477719 ≈ 75.4578 labor days per annum per household (Table 8). As a result, for this study area the WTP amount expressed in labor days is much higher than the WTP in ETB. This might be due to cash constraint, labor abundance and disguised unemployment which are pervasive in rural areas of developing countries. Therefore, in rural areas, for such type of projects contribution in labor days are the most preferred contribution method to cash (ETB). This finding is consistent with the findings of Solomon (2004).

Multivariate Analysis of Determinants of Households' WTP

The respondents mean WTP for the improved soil and water conservation services from reducing the upland forest resources degradation of Rekame watershed was influenced by a number of socio-economic and demographic factors. As it was described in the methodology section for the econometric analysis multivariate probit and OLS models were used. Probit model was employed to analyze factors that determine households WTP for single bounded dichotomous choice survey responses, whereas OLS model was used to analyze factors that determine households maximum WTP for the open ended response. Moreover, results from the two models helped to detect if there is any severe discrepancy between determinants across probit and OLS models.

Multivariate Probit Model Analysis of Determinants of Households WTP

Measure of goodness of fit tells about the explanatory power of the models. Without any complicated computation, STATA statistical software regression easily provided the Pseudo R^2value of the two models. Accordingly, goodness of fit of the two models was reported as 0.7577 and 0.6790 for ETB and Labor days probit models. That is, this result indicates that our probit model for the WTP in cash explains about 75.77% of the variation, whereas the probit model for the WTP in labor days explains about 67.9% of the variation (Appendix 3). For ETB probit model, *age of the respondent (AGE-), income of the household (INCOMEH+), educational achievement of household head (EDUNAHH+), highest educational achievement within household (HEDUNAH+), family size (FAMSIZE+), pre-set bid amount in cash (BIDCASH-), land holding (LANDHOLD+), distance from the upland forest resource (DISTANCE-), degree of vulnerability of the household (DEGVUL+),* and*off-farm income status of the household (OFFINCOM-)* have shown significant effect with the expected signs. However, *sex of the respondent (SEX), marital status (MARSTAT), livestock holding in terms of tropical livestock unit (TLU) &households participation experience in conservation activities (PARTCON)* have shown unexpected negative sign; but insignificant. Household's *membership status in the existing upland forest resource association (MEMSHIP)* has shown the expected negative sign but insignificant (appendix 3).

For labor days probit model, *age of the respondent (AGE-), income of the respondent (INCOMEH+), livestock holding in terms of tropical livestock unit (TLU-), educational achievement of household head (EDUNAHH+), highest educational achievement within household (HEDUNAH+), family size (FAMSIZE+), pre-set bid amount in labor days (BIDLABOR-), landholding (LANDHOLD+), distance from the upland forest resource (DISTANCE-),* and *degree of vulnerability of the household (DEGVUL+)* have shown significant effect. However, *sex of the respondent (SEX), marital status (MARSTAT), & households participation experience in conservation activities (PARTCON)* have shown unexpected negative sign; but insignificant.

Household's *membership status in the existing upland forest resource association (MEMSHIP)* and *off-farm income status of the household (OFFINCOM)* have shown the expected negative sign but insignificant (appendix 3). When we compare the results from the two probit models, all the explanatory variables have the same direction for both contribution methods. However, *livestock holding in terms of tropical livestock unit (TLU)* is significant only in Labor days probit model, whereas *off-farm income status of the household (OFFINCOM)* is significant only in ETB probit model (appendix 3).

Multivariate OLS Model Analysis of Determinants of Households WTP

For ETB OLS model, *age of the respondent* (AGE-), *income of the household* (INCOMEH+), *livestock holding in terms of tropical livestock unit* (TLU-), *highest educational achievement within household* (HEDUNAH+), family size (FAMSIZE+), *land holding* (LANDHOLD+), *pre-set bid amount in cash* (BIDCASH+), *degree of vulnerability of the household* (DEGVUL+), and *membership status in the existing upland forest resource association* (MEMSHIP-) have shown significant effect up on level of willingness to pay whereas the remaining six variables (i.e. *sex of the respondent (SEX), marital status (MARSTAT), educational achievement of household head (EDUNAHH), distance from the upland forest resource (DISTANCE)*, *households participation experience in conservation activities (PARTCON) andoff-farm income status of the household (OFFINCOM)*) have shown insignificant effect (appendix 4).

On the other hand, for labor days OLS model, *age of the respondent* (AGE-), *income of the household* (INCOMEH+), *livestock holding in terms of tropical livestock unit* (TLU-), *highest educational achievement within household* (HEDUNAH+), family size (FAMSIZE+), *land holding* (LANDHOLD+), and *pre-set bid amount in labor days* (BIDLABOR+) have shown significant effect on the dependent variable (WTP) whereas eight variables (i.e. *sex of the respondent (SEX), marital status (MARSTAT), educational achievement of household head (EDUNAHH), distance from the upland forest resource (DISTANCE), degree of vulnerability of the household (DEGVUL), household's membership status in the existing upland forest resource association (MEMSHIP), participation experience in*

conservation activities (PARTCON) and off-farm income status of the household (OFFINCOM)) have shown insignificant effect (appendix 4).

In both ETB and labor days multivariate OLS models all the variables have the same direction. The only differences are*degree of vulnerability of the household* (DEGVUL)and *membership status of the household in the existing upland forest resource association (MEMSHIP)* having significant effect only on ETB. In addition, when we compare multivariate probit and OLS models of both contribution methods, all the explanatory variables have the same direction except *participation experience in conservation activities* (PARTCON), but insignificant in both models (appendix 3 and appendix 4).

Conclusion and Recommendations

Conclusion

The valuation result reveals that households have a positive willingness to pay to ensure the improved soil and water conservation services by reducing the upland forest resource degradation. Their maximum WTP amount is one of the indicators that the upland forest resources degradation is increasing and the resultant loss of soil and water conservation services from year to year. Therefore, their willingness to contribute in support of the proposed improvement can be used as potential revenue. For the contribution method in ETB, the estimated five years aggregate WTP amounts from the annual aggregate WTP of parametric and non-parametric approaches are ETB 7,378,161.12 and ETB 6,951,871.2, respectively. On the other hand, the estimated five years aggregate WTP amounts of parametric and non-parametric approaches were 6,097,104.48 and 4,749,060 Labor days, respectively. When we project the five years aggregate WTP amounts by unskilled worker local minimum wage rate of (ETB 12.00/day), the respective five years parametric and non-parametric aggregate WTP amounts were ETB 73,165,253.76 and ETB 56,988,720. This shows that as the contribution in Labor Days by far more valuable than the contribution in ETB for such kinds of projects in rural areas. This might be due to excess family labor (disguised unemployment) and cash constraint. Unlike parametric approach, there is no high risk of 'spill-over' effect for the estimation from non-parametric approach.

As a result, the aggregate WTP amounts for this resource improvement project are preferably estimated by extrapolating the non-parametric mean WTP amounts. Accordingly, the five years non-parametric aggregate WTP amounts are ETB 6,951,871.2 and 4,749,060 work days. And the converted 4,749,060 Labor Days amount in ETB equals ETB 56,988,720. Identification of major variables that determine households WTP amounts for the project helps to make more realistic valuation of the resource and hence to enable adjustments that are pro to the local communities′ demand.

For the multivariate probit regression, variables AGE, BID, DISTANCE INCOME, EDUNAHH, HEDUNAH, FAMSIZE, LANDHOLD and DEGVUL have shown significant effect on households participation decision (WTP) in both contribution methods. TLU has shown significant effect only on labor days multivariate probit regression whereas OFFINCOM has shown significant effect only on ETB multivariate regression. On the other hand, for the multivariate OLS regression variables AGE, INCOMEH, TLU, HEDUNAH, FAMSIZE, LANDHOLD and BID have shown significant effect for both contribution methods. However, DEGVUL and MEMSHIP have significant effect only on ETB multivariate OLS regression. As a comparison, almost all the explanatory variables in both models (Probit and OLS) for both contribution methods have shown the same direction except PARTCON. Therefore, these can be an illustration for as there is no serious inconsistency problem between the results from the two multivariate models.

Recommendations

Majority of the sample respondents realized that the upland forest resources of Rekame watershed is highly degraded, mainly, due to human activities and hence increase in environmental problems. Therefore, incorporating participation of the communities in rural areas in conservation of the resource is very important to achieve the proposed improvement. The conventional management (existing upland forest resource management) could not reduce the upland forest resources degradation as the decisions thus far made on this resource management poorly incorporated the non-market economic value of the resource.

Therefore, the decision-makers should incorporate the non-market economic value (soil and water conservation services value) of the upland forest resource as one of the major inputs for implementation of an integrated upland forest resources improvement and protection. In the study area contribution in Labor Days is more preferred to cash. Thus, conservation activities proposed by government or non-governmental organizations should have to consider the participation of households in terms of Labor Day contribution than cash while designing upland forest resources improving projects. Moreover, major determining factors of rural households' decision on environmental resources conservation should have to be duly examined prior to implementation.

Furthermore, the estimated value represents only the soil and water conservation services values of the resource; the other values like wood products, recreational, carbon sequestration and cultural values of the upland forest resources have not been estimated in this study. Therefore, it is important to estimate all the values (both use and non-use values) that give total economic value (TEV) of the resource for policies aimed at efficient and sustainable management of the upland forest resources of Rekame watershed.

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APPENDICES

Appendix 1: Non-parametric aggregate WTP amounts and expected revenue for the resource improvement plan for the WTP in ETB

Class Boundary of WTP (ETB)	Average WTP of the Class per week (Class marks) (in ETB)	Average WTP of the Class per month (Class marks) (in ETB)	Average WTP of the Class per Annum (Class marks) (in ETB)	Sample Distribution (in N°. & proportion)		Total No. of HHs in the area	Total WTP per Annum (ETB)	Sample HHs WTP at least that amount (in N°. & Proportion)		Total HHs WTP at least that amount (in N°.)	Total Revenue per annum (in ETB)
(1)	(2)	(3) [(2)x4]	(4) [(3)x12]	(5) N°.	(6) %	(7) [(6)x (11)	(8) [(4)x(7)]	(9) N°.	(10) %	(11) N°.	(12) [(10)x(11)]
0.00 - 0.90	0.50	2.00	24.00	79	21.40	2,695	64,680.00	369	100	12589	302,136.00
0.91 - 1.80	1.14	4.56	54.72	132	35.77	4,503	246,404.16	290	78.60	9895	541,454.40
1.81 - 2.70	2.27	9.08	108.96	60	16.26	2,047	223,041.12	158	42.82	5391	587,403.36
2.71 - 3.60	3.21	12.84	154.08	28	7.59	956	147,300.48	98	26.56	3344	515,243.52
3.61 - 4.50	4.25	17.00	204.00	16	4.34	546	111,384.00	70	18.97	2388	487,152.00
4.51 - 5.40	5.00	20.00	240.00	8	2.17	273	65,520.00	54	14.63	1842	442,080.00
5.41 - 6.30	5.81	23.24	278.88	16	4.34	546	152,268.48	46	12.47	1570	437,841.60
6.31 - 7.20	7.00	28.00	336.00	13	3.52	443	148,848.00	30	8.13	1023	343,728.00
7.21 - 8.10	8.00	32.00	384.00	12	3.25	409	157,056.00	17	4.61	580	222,720.00
8.11 - 9.00	9.00	36.00	432.00	5	1.36	171	73,872.00	5	1.36	171	73,872.00
Total	-	-	-	369	100	12,589	1,390,374.24	-	-	-	-

Source: computed from own survey data, (2013)

Appendix 2: Non-parametric aggregate WTP amounts and expected revenue for the resource improvement plan for the WTP in Labour Days

Class Boundary of WTP	Average WTP of the Class per week	Average WTP of the Class per month	Average WTP of the Class per Annum	Sample Distribution		Total No. of HHs	Total WTP per Annum	Sample HHs WTP at least that amount		Total HHs WTP at least that amount	Total Labour Days Contributed per Annum
(1) Labour Days	(2) Labour Days	(3) Labour Days	(4) Labour Days	(5) N°.	(6) %	(7) N°.	(8) Labour Days	(9) N°.	(10) %	(11) N°.	(12) Labour Days
0.00 - 0.30	0.25	1.00	12.00	10	2.71	341	4,092	369	100	12,589	151,068.00
0.31 – 0.60	0.50	2.00	24.00	81	21.95	2,763	66,312	359	97.29	12,248	293,952.00
0.61 – 0.90	0.75	3.00	36.00	10	2.71	341	12,276	278	75.34	9,485	341,460.00
0.91 – 1.20	1.00	4.00	48.00	50	13.55	1,706	81,888	268	72.63	9,143	438,864.00
1.21 – 1.50	1.40	5.60	67.20	54	14.63	1,842	123,782.40	218	59.08	7,438	499,833.60
1.51 – 1.80	1.75	7.00	84.00	23	6.23	784	65,856	164	44.45	5,596	470,064.00
1.81 – 2.10	2.00	8.00	96.00	11	2.98	375	36,000	141	38.21	4,810	461,760.00
2.11 – 2.40	2.25	9.00	108.00	28	7.60	957	103,356.00	130	35.23	4,435	478,980.00
2.41 – 2.70	2.50	10.00	120.00	43	11.65	1,467	176,040.00	102	27.64	3,480	417,600.00
2.71 – 3.00	2.90	11.6	139.20	59	15.99	2,013	280,209.60	59	15.99	2,013	280,209.60
Total	-	-	-	369	100	12,589	949,812	-	-	-	-

Source: computed from own survey data, (2013)

Appendix 3: Determinants of WTP from multivariate probit regression for reducing upland forest resources degradation to improve soil and water conservation services

Probit Regression Model 1 Estimated parameters and marginal effects of WTP in ETB					Probit Regression Model 2 Estimated parameters and marginal effects of WTP in Labour Days				
Variables (1)	Coefficients (2)	Marginal Effects (3)	Robust Std. Error of marginal effects (4)	P-value (5)	Variables (6)	Coefficients (7)	Marginal Effects (8)	Robust Std. Error of marginal effects (9)	P-value (10)
SEX [a]	-0.2462787	-0.0165375	0.0230307	0.421	SEX [a]	-0.1548454	-0.0178725	0.0310145	0.547
AGE	-0.0941796	-0.006768	0.0025491	0.000***	AGE	-0.0764522	-0.009162	0.0025101	0.000***
MARSTAT [a]	-0.0219132	-0.0015594	0.0192364	0.936	MARSTAT [a]	-0.0662709	-0.0077474	0.0287113	0.792
INCOMEH	0.000088	0.00000632	0.00000241	0.000***	INCOMEH	0.0000912	0.0000109	0.00000306	0.000***
TLU	-0.109066	-0.0078378	0.0076427	0.355	TLU	-0.1802149	-0.0215968	0.0102984	0.065*
EDUNAHH	3.625951	0.2605711	0.0947975	0.000***	EDUNAHH	1.752744	0.210047	0.0561745	0.000***
HEDUNAH	0.2488977	0.0178865	0.00728	0.000***	HEDUNAH	0.2156128	0.0258388	0.0075516	0.000***
FAMSIZE	0.3193217	0.0229474	0.011213	0.000***	FAMSIZE	0.2458198	0.0294588	0.0127844	0.001***
BIDCASH	-0.5562054	-0.0399705	0.0202115	0.000***	BIDLABOR	-1.214772	-0.145577	0.050802	0.000***
LANDHOLD	1.097793	0.0788905	0.0360714	0.000***	LANDHOLD	0.8665018	0.1038407	0.0402476	0.000***
DISTANCE [a]	-0.8949591	-0.044622	0.0224904	0.003***	DISTANCE [a]	-0.6991886	-0.0641373	0.0269448	0.011**
DEGVUL [a]	0.7114853	0.076731	0.0521985	0.039**	DEGVUL [a]	0.6581293	0.1065389	0.0573656	0.023**
MEMSHIP [a]	-0.0701351	-0.0050826	0.0215995	0.815	MEMSHIP [a]	-0.2647455	-0.0327984	0.0329276	0.328
PARTCON [a]	-0.1171229	-0.0082055	0.0204108	0.684	PARTCON [a]	-0.2146555	-0.0247965	0.0284629	0.381
OFFINCOM [a]	-2.302878	-0.3420736	0.087493	0.000***	OFFINCOM [a]	-0.4186803	-0.0552346	0.0544893	0.300
_CONSTANT	1.358126	-	-	0.066	_CONSTANT	2.451485	-	-	0.002
Observations = 369 Pseudo R^2 = 0.7577					Observations = 369 Pseudo R^2 = 0.6790				

*** Significant at 1%level of significance
** Significant at 5%level of significance
* Significant at 10%level of significance
([a]) Is for discrete change of dummy variable from 0 to 1

Appendix 5: Description of variables used in multivariat e probit and OLS regressions of determinants of WTP

Variable name	Description	Measure	Expected effect on WTP	
			In ETB	In Labor Days
SEX	Sex of the respondent	1 = Male	+	+
		0 = Female		
AGE	Age of the respondent	Age in years	-	-
MARSTAT	Marital status of the respondent	1 = Married	+	+
		0 = Unmarried		
INCOMEH	Income of the respondent	Annual income in ETB	+	+
TLU	Livestock holding of the respondent	Total livestock holding in TLU	+	+

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EDUNAH	Educational achievement of the household head	grades achieved in numbers	+	+
HEDUNAH	Highest educational achievement in the household	Grades achieved in numbers	+	+
FAMSIZE	Number of family members in the household	Family size in numbers	+	+
BIDCASH	Pre-set bid value assigned in Pre-set bid value in ETB cash		-	-
BIDLABOUR	Pre-set bid value assigned in Labour Days	Pre-set bid value in Labour Days	-	-
LANDHOLD	Size of the land holding by the respondent	Land size in hectare	+	+
DISTANCE	Respondent's homestead/farm distance from the upland forest area	1 = > 1km 0 = ≤ 1km	-	-
DEGVUL	Degree of vulnerability of the respondent	1 = High 0 = Moderate	+	+
MEMSHIP	Membership status of the respondent in the existing forest association	1 = Member 0 = Non-member	-	-
PARTCON	Respondent's participation history in conservation	1 = participated 0 = not participated	+	+
OFFINCOM	Off-farm income obtaining status of the respondent	1 = obtain 0 = not obtain	+/-	+/-

Source: own survey data, (2013)

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