ECONOMIC VALUATION OF CONSUMPTIVE NON-TIMBER FOREST PRODUCTS: EVIDENCE FROM ROMBO DISTRICT USING CONTINGENT VALUATION METHOD

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ABSTRACT

Over the past two decades there has been an increasingly appreciation and measurement of non-market value of NTFP in many parts of the world. This is motivated by the fact that many of these NTFP especially in the tropics are increasingly being degraded mainly because of their undervaluation due to the lack of proper market for them. In valuing NTFP economists have used both revealed and stated preference depending on whether the good/services being valued have market or do not have market value. In this study we estimate WTP for NTFP using contingent valuation method among rural residents adjacent to half mile strip in Rombo district. A total of 5 villages were sampled out of 20 villages adjacent to the half strip mile (the buffer zone). The results from the open ended question indicate that the mean willingness to pay for consumable NTFPs is TZS 6,460 per annum. In addition to that businessmen, wage earners and farmers are willing to pay TZS 7,080/=, TZS 6, 977/= and TZS 6,197/= per annum respectively. The differences of willingness to pay among these groups however, are not statistically significant. Further econometric analysis using a probit model suggests that household's income, distance to the forest, marriage, forest conservation, being a businessman and respondent being a wage earner explains households' willingness to pay for NTFP.

Key words: contingent valuation, Non-timber forest products, bootstrapping and willingness to pay.

JEL Classification Numbers: Q2, Q5

INTRODUCTION

Forest resources play a vital role on human life as they provide eco-services which contribute to human welfare even though the services do not necessarily obtain any market price. Non-timber forest products include all goods and services derived from the forests except timber. These products include fuel wood, charcoal, honey, resin, spices, and raw materials for handcrafts from rattan, vines, bamboo, grasses, and wildlife products such as bones and skins for rituals and ornaments purposes. Services function including grazing, watershed protection, provision and management of wildlife habitat, and tourism (Perman 2003; MNRT 1998). NTFPs have greater contribution to the society than the cash income generated from commercial logging (FAO 1995). These resources have been widely used by human beings as a source of food, shelter and clothing as well as non-consumptive uses in rural and urban homes, and are traded in local, regional, and in international markets.

Economists as well as environmentalist have been interested in the value of

biodiversity, forest conservation, watershed protection, carbon sequestration as well as other environmental functions that are provided by tropical forests and have impact to the welfare of the society (Randall and Evan 1997; Kulindwa 2004; and Lokina, *et al.* 2006.). There is also a growing biomedical research being done in the forests in relation to plant uses, harvesting as well as processing by the indigenous people who use them traditionally (Delali *et al.* 2001). These have resulted from recognition of diverse ecosystem and diverse investments which are basis for sustainable economic development of any nation.

Value of forests resources is composed of direct, indirect, option, and existence values.

Valuation is done in order to ensure that whenever there is damage or improvement to the environmental resources it can be accounted for in the society. Economists' attention is based on market value of forest resources where by price is obtained directly from the market in which forces of demand and supply operate. Whenever the price of the good is not obtained directly from the market we use hypothetical market approaches to elicit individual willingness to pay for the goods or services. Currently, non-market values of environmental resources are now increasingly being appreciated and measured in monetary terms worldwide. Studies on non-market values of forest resources have been undertaken in many countries in order to understand the linkages between ecological and economic values. Crucial information has been found from various studies showing the structure, function as well as other roles of ecosystem in improving human welfare.

Empirical studies which have been undertaken in many parts of the world have shown that individuals have recognized the values of forests resources in their daily life. Randall and Evan (1997) used contingent valuation in a national survey to assess the value U.S. residents place on tropical rain forests protection. They found that on average, respondents were willing to make a one-time payment of approximately $ 21 – 31 per house-hold to protect an additional 5 percent of tropical forests. In another research, Maraseni *et al.* (2008) applied the contingent valuation method (bidding game) to estimate the average willingness to pay (WTP) of asparagus collectors in Makawanpur District, Nepal. They found that the average WTP of collectors ranges between 4.4 - 8.35 NR[3]/kg. However, Hamid *et al.* (2006) estimated WTP for existence value of north forests of Iran (NFI). Using maximum likelihood estimation they found the mean WTP for existence value of the forests was US$2.51 for a household/month or annual value of US$30.12 for a household. In addition to that, it was also found that about 65.8% individuals were willing to pay for the existence of NFI. Sattout and Caligari (2007) used contingent valuation method to obtain the Willingness to Pay (WTP) for a scenario to conserve cedar forests in Lebanon. Results showed that the difference in the individual WTP value for users and non-users was approximately US$20 per household for both villagers and city dwellers and the frequency of the zero WTP value was higher for nonusers. The total WTP for the surveyed sample was US $ 42.43.

Contrary to the previous studies Chopra, 1993 used a mix of market and non-market approaches which includes loss of productivity in alternative use, cost of alternative technology for fuel was used and opportunity cost of labour time in collection was used in valuing NTFPs from tropical deciduous forests in India. It was found that total present value of

[3] US$1 = 77 Nepalese rupees

NTFPs available from the forests ranges from a minimum of $ 4034 to a maximum of $ 6662 per hectare, if use, option and existence value are all taken into account. Costanza and Folke in 1997 estimated the value of the world's ecosystem services and natural capital. It was found that the yearly value of ecosystem services to be USD 969 per ha. In the case of ecological services they found that the beneficiaries of the service should be willing to pay up to $50 for it. In addition to timber production as forests offer non-marketed, aesthetic, existence and conservative value of $ 70, then those receiving the un-marketed benefits should be willing to pay up to $ 70 for it.

Other empirical studies have been done in valuing forest resources some have tried to use choice modeling to value forest goods and services. Raul et al, (2006) used this methodology in valuing afforestation programme in the Northeast of Spain. The results from a random parameter logit model reveal that, on average, individuals would annually pay an average of 11.79 euros for the forests to sequester 68,000 tones of CO2. In addition to that individuals were willing to pay an average of 12.82 euros for picking mushrooms in the forets. In realation to this study Kahyarara (2000) used choice Experiment to determine charcoal makers' willingness to participate in a PES scheme and the compensation necessary to make them give up their destructive – but vital income generating – forest activities, mainly charcoal production. He found that willingness does exist, especially if other cash generating alternatives offered. However he concluded that PES alone will not be sufficient to halt the destruction of the Coastal Forests if nothing is done to curb the growing urban demand for charcoal.

Another study by Lokina *et al.* (2006) was carried out to analyse household's willingness to pay for improved water services domestic and irrigation use in Rufiji water basin. Results from non-parametric estimates showed that households in the lower category were willing to pay TZS17,000 per annum for water environmental services. For upper boundary category they were willing to pay about TZS47,500 per annum. The study revealed that households in the rural areas have the ability to attach value to the resources that they use. In another research, Kulindwa (2004) used CVM to investigating households WTP for water environmental services in Pangani basin so as to establish the right price of water. The purpose of this study was to elicit household WTP for consumable NTFPs using CVM. In addition to that it is intended to assess respondent's willingness to pay for NTFPs as well as identify key factors affecting the respondent's willingness to pay for NTFPs

Description of forest resources in the Half Mile Strip (Rombo)

There are about 107,828 ha of forest reserve around the mountain of which most of them lie near the boundary between Tanzania and Kenya (Lovet and Po'cs 1993). Within the forest reserves there are 75,353 hectares (ha) of National park in which there is a wide band of beautiful montane forests whereby about 90% of water originates from it. The catchment area includes forest belt on the slopes of Mount Kilimanjaro between 1800 and 2700m but in some areas it has extended as far as 1240m. Much of the rain that falls is absorbed in the forests thick carpet of leaves and percolates through the soils and porous lava rock to re-emerge via springs in the lower lands. The water has been used in irrigating banana farms, sugar cane and coffee plantations as well as for domestic uses. It plays greater role in the existence of Pangani river system in which is the major sources of two power stations.

The buffer zone which covers about half mile strip is a forest belt which was established during the colonial era for intention of providing access to the household with variety of NTFPs. In 1984, Native Authority Forest Reserve in Rombo region was given full authority of managing the buffer zone. Households were allowed access to the buffer zone as a measure to control encroachment into the forest reserves as well as in the catchment area. Though the perceived idea of having a buffer zone was a good measure, they were weakness in the way the access to the buffer was implemented. There was no clear regulations regulation on how the access to the buffer zone can be managed, as results it was considered as open access leading to unsustainable harvesting of the resources. Households are not allowed to access forest resources from the National park as well as catchment area. This area has been placed under forest reserve as a result no any economic activities can be allowed to be carried in this area except in the plantation forest, About 12% of the forest reserve is plantation; within this area they practice *Taungya* system, which allows local farmers to inter-crop annual agricultural crops with tree seedlings in forest plantation areas until the third year of tree growth (Christopher 2003). This system has implication on the use and management of NTFPs, as farmers have incentive to protect the forests.

Within the forest area there is high number of rare and endemic plants/flora occur (Lovet *et al.* 1993). Some of the vegetation that can be identified in the area include: savannah bush land of which lies between 700 - 1,600 m, sub-montane agro-forest, the montane forest zone which circles the mountain between 1,300 m to 2,800 m and about 2,500 plant species are found around the mountain (Lambrechts *et al*. 2002). The area around the mountain is occupied mainly by the Wachagga and there are about 20 villages near the half mile strip.

METHODS

The Contingent Valuation Method

In economics it becomes easy to estimate economic worth of the good when markets for goods exist. But when markets for goods do not exist, a hypothetical market for the good can be created; this is done by asking individuals the amount of money they would be willing to pay for the good or service. Some of the environmental goods and services lack markets as a result there has been a need of assigning an economic value to a non-market resource. Different techniques have been used by economists being direct or indirect. Direct method is based on using a well structured questionnaire which intends to evaluate household's subjective valuation resulting from change in consumption pattern. Among the direct method is the use of contingent valuation and conjoint analysis. CVM is considered very flexible and adaptable to some valuation tasks that alternative economic valuation technique cannot handle. It can deal with both use and non–use values not only that but also WTP questions go directly to theoretically correct monetary measures of utility changes. It is a survey based method in which respondents are asked to state their preferences in hypothetical or contingent markets, allowing analysts to estimate WTP for goods or services that are not traded in the market (Mitchell and Carson 1989).

CVM approach elicits stated preferences from a sample of consumers using either open-ended questions that ask direct for WTP, or referendum (closed ended) questions that present a bid or a sequence of bids to the individual and ask for yes/no vote on whether each bid exceeds the individual's WTP. The method uses a questionnaire based approach in which a clear description of an environmental improvement is communicated to a sample of individuals, followed by questions

about respondent's WTP for realization of improvement (Hanemann *et al.* 1991; Lokina *et al.* 2006). Carson and Machina, 1999 argued that the closed - ended single bounded format is incentive compatible when a survey is perceived by respondent as a potential source of influence on policy decision making. While Hanemann *et al.* (1991) suggested that the use of double bound model does allow correction of a poor choice of the initial bids. The use of sequential bids approach has been criticised as it tends to result in starting point bias as well as causing respondents to get irritated, as a result they tend to give responses which are not truthfully. In addition to Hanemann *et al.* (1991) arguments about double bounded model, Hanemann *et al.* (1991) suggested that the use of double bound model does produce efficient as well as less biased estimates in comparison with the single bound.

CVM has been used in valuing environmental amenities and it has been promoted for valuation of endangered species and wilderness areas whose value comes from existence rather than direct use. NOAA panel recommended face-to-face interviews, the use of WTP questions and the use of a dichotomous choice question that asks respondents to vote for or against a particular level of payment vehicle. Welfare measure of WTP is obtained by introducing a statistical model Probit which links responses to the dollar amounts that were used in the survey (Hanemann and Kanninen 1999). Generally, household willingness-to-pay for environmental amenity is the maximum amount that can be taken from the household without reducing his or her expected utility that s/he derives from environmental resources (Perman *et al.* 2003).

Contingent valuation tool

The contingent valuation has been one of the effective methodologies that is used in estimating consumers' compensated variations in dollar amounts in exchange of their utility gains usually from the non marketed goods (Mitchell and Carson 1989). A properly framed CVM tries to achieve the above measurement by surveying a sample of utility maximisers, frequently through in-person interviews recording to their WTP for the proposed welfare improvement in the society.

In conducting the survey the main target was heads of household or their wives living within the same household or someone above 18 years who could speak on behalf of the family. Most of the households visited, women and children were the ones participating in much of NTFPs collections and we considered them as a reliable source of information in relation to types, part of plant which is harvested and uses of NTFPs they collect from the Buffer zone.

We used a well structured questionnaire to obtain socio-economic, demographic characteristics of the household living adjacent to the buffer zone as well as other information about NTFPs in the study area. Open-ended questions, bidding games, and closed ended was used. In open-ended questions households were confronted with questions such as "What is maximum amount would you be willing to pay for NTFPs? In case of closed-ended questions, there was a double-bounded question, which was done by first presenting a bid then respondent had to answer yes or no, then if the respondent answered yes was presented with a bid which has a higher value than the previous, if the response was no then respond was presented with bid that has lower value. Prior to the field work the survey questionnaire was tested to improve or eliminate questions which were ambiguous. Out of 20 villages which are adjust to the buffer zone. 5 villages were sampled randomly which represent 25% of the total villages. The interview was

conducted during the month of January and February, 2009 and 10% of the households from each sampled villages were interviewed. Households to be interviewed were selected randomly from the cluster of units to ensure diversity of households in the sample and avoid systematic bias. Using cluster of units results in saving travel costs and time hence more households were interviewed. Number of household to be interviewed depended on the total population in the cluster as well as targeted sample to be interviewed. In this study a total of 357 household were interviewed.

WTP Estimation

In analysing the dichotomous choice question from the study a Probit model derived from a linear Utility Differential Model suggested by (Hanemann, 1984) will be used, to identify household characteristics that are likely to predict positive WTP bids. Let, V_{ij}, utility of household *j* with non timber forest products in the state *i* = 1 (i = 0 without forest resources) is the function of attributes of the existing forest resource and the household's socioeconomic characteristics:

$$V_{ij} = V_i(Y_j, \beta_j, x_j, \varepsilon_{ij}) \quad (1)$$

where Y_j Y is the j^{th} household's discretionary income, β_j Bj is the bid amount, x_j x is the vector of household characteristics and attributes of the resource, and ε_{ij} εis error term.

Logarithmic utility model will be employed in order to derive welfare measures. The random utility model is assumed to be linear in income so do other social economic variables. The use of logarithmic utility function allows the marginal utility of income to vary across utility states as income changes (Pham *et al.* 2004). The model to be used in this study has been adopted from the one which was used to evaluate individual responses in demand for improved water services using CVM and choice experiment (Pham *et al.* 2004). Where by the dependent variable was binary and independent variables included bid value, household's socio-economic and demographic factors.

We would not include bid amount in the first estimation of the determinants of willingness to pay rather it will be included in the restricted model to determine the mean and median willingness to pay (Perman *et al.* 2003).

Therefore the probability of an individual responding 'yes' to the proposed scenario is as given as[4]:-

[4] The model has been adopted from Haab and McConnell, 2002

$$P\left[Yes_j\right] = P\left[(\alpha - \beta B_j + \lambda_j x_j + \rho \ln(Y_j) + \varepsilon_{1j}) \geq (\alpha - \beta B_j + \lambda_0 x_j + \rho \ln Y_j + \varepsilon_{0j})\right] \quad (2)$$

or $$P\left[Yes_j\right] = P\left[(\alpha - \beta B_j + \lambda x_j + \rho \ln Y_j + \varepsilon_j \geq 0\right] \quad (3)$$

Assuming the random variable ε_j is distributed normally with mean zero and variance σ^2, we have the standard normal probability of a 'yes' response:

$$P\left[Yes_j\right] = \Phi\left[\left(\alpha - \beta B_j + \rho \ln Y_j\right)/\sigma\right] \quad (4)$$

WTP for environmental amenities is related to income level of households, demographic and socio-economic factors, (see for example, Gunatilake *et al.* 2002), Pham 2004,and Lokina *et al.* 2006).

$$WTP_j = \alpha - \beta B_j + \lambda_j x_j + \rho \ln Y_j + \varepsilon_j \quad (5)$$

where B_i represents random bids offered to the respondents, x_j is a vector of household characteristics, $Y_j$is the income of the respondent and ε_j is the random error.

The mean willingness to pay (WTP) was calculated following Hanemann's (1984) and Perman *et al.* (2003) approach. The restricted model was estimated by setting all the λ's and ρ equal to zero, the constant term and bid term were left in the model. Restricted model parameters were estimated via maximum likelihood and they were used to compute mean WTP given by the formula $-\hat{\alpha}/\hat{\beta}$,where

$\hat{\alpha}$ is the constant term and $\hat{\beta}$ is the coefficient of the bids. We need to multiply by negative sign if the bids have been entered positively (Perman *et al.* 2003). According to Perman *et al.* (2003), median WTP is preferred to mean because it is less affected by the presence of outliers or inclusion of additional variables.

In order to calculate the confidence intervals, standard errors and p-values for test statistics of the welfare measure bootstrapping (popular resampling method) was used, (Wooldridge 2004; McConnell *et al.* 2002). Bootstrap and jack-knife simulate the distribution of the dependent variable and other independent variable from the actual number of sample chosen for study. Multiple data sets are created when performing bootstrap, each formed by sampling N times with replacement from the actual data. While jack-knife creates N simulated data set, each formed by dropping one observation from the actual data. They apply maximum likelihood to the simulated data to obtain new coefficient from which the welfare measure can be computed (Efron and Robert 1993).

Empirical Findings

Descriptive Statistics of model variables

Table 1 presents descriptive inferences for the variables used in estimating household's willingness to pay for NTFPs. Offer amounts are based on open ended WTP questions in a pilot study as well as the existing fees for various NTFPs. In relation to this 56% are male and 44% are female. Within the study sample 75 % are married heads of households while the remaining 25% are not married. Only

6.9% agreed to collect NTFP for commercial purpose. The average household's size is 5.3; this is slightly above the district average, which is 5.19 (NBS 2002) suggesting that there is an element of an increase in the household size in the sampled areas. Of the surveyed households only 8% of the households have not attended school, 56.15% have primary education, and 30.28% have secondary education while 6.31 have attained university education. Of those who attended school only 79% of them managed to complete their studies while 21% did not. Some of the reasons given include lack of school fees, parents influence, and death of parents who were financing the studies, mental disabilities and child desire for business. The average years of study from the sampled population are 8 years. Out of the surveyed households 10% of female and 6% of male respectively have not attended school. An important finding in relation to education is that there is some element of gender equality in accessing education facilities in the study area. . Of the surveyed household's 63% have studied forest topics in their curricular during their schooling time. With regards to access of other social services about, 86% have access to tap water the remaining household's access water from rivers. In Table 1 we observe that 92% of the household's use fire wood as a major source of cooking energy, the results is slightly above the national average which is estimated to be 90%. Income variable constitutes household's income generated either from formal employment or informal. We computed confidence interval at 95% for each variable presented in Table 1 and we found that the mean of the variables was within the reasonable range under normal distribution. The results can be used for further analysis.

Table 1 Descriptive statistics of the variables used

Variables	Description	Mean	Std Dev.	Min	Max
Gender	= 1 male, 0, otherwise	0.56	0.49	0	1
Age	Age of respondent	44.8	13.8	18	78
Marriage	= 1 if married, 0 otherwise	0.75	0.42	0	1
Religion	= 1if Christian, 0, otherwise	0.80	0.39	0	1
Education	= 0 if attended school up to standard seven, 1 above	0.92	0.27	0	1
Income	Household's monthly income	66,791	55834	15,000	500,000
Economic env	= 1 if they perceive economic environment is good 0, otherwise	0.47	0.49	0	1
Radio/tv	=1 if they listen/watch environmental programmes 0, otherwise	0.74	0.43	0	1
Distance	distance to the forest	2.28	1.34	0	8
Collection	= 1 if collection is for business, 0 otherwise	0.069	0.25	0	1
Forest Subject	=1 if happened to be taught forest subject, 0 otherwise	0.63	0.48	0	1
Cooking	= 1 if fuel wood, 0, otherwise	0.92	0.26	0	1
Water Source	= 1 if they have tap water, 0, otherwise	0.86	0.35	0	1
Participation	=1 if participate in conservation, 0 otherwise	0.92	0.24	0	1
Business	=1 if household is businessman 0, otherwise	0.15	0.36	0	1
Wage earner	=1 if household is wage earner 0, otherwise	0.14	0.35	0	1
Household size	Number of people in the household	5.34	2.23	1	14

Source: Author's computation (2009)

Model estimation

The maximum likelihood estimates of the models are presented in Table 2. In analyzing the results we are concerned much with the sign of the coefficient and not the magnitude of the results. Marginal effects of the model are interpreted as the increase (decrease) in probability that the household would be willing to pay for NTFPs, given one more unit of explanatory variable with the other variable held at their mean. Majority of our explanatory variables are statistically significant determinants of households WTP for NTFPs.

Table 2 Marginal effects of the Probit regression model

Variables	Dy/dx	Std Error	p-value
Gender	0.0036	0.060	0.952
Age	-0.0048**	0.002	0.028
Marriage	0.2138**	0.075	0.004
Religion	0.1038	0.076	0.172
Education	0.0167	0.094	0.860
Income	1.34e-04*	0.001	0.082
Economic environment	0.102*	0.054	0.063
Radio/tv	0.140**	0.066	0.035
Distance	-0.049**	0.021	0.017
Collection intention	0.042	0.103	0.679
Participation	0.269**	0.113	0.017
Business	0.176**	0.066	0.008
Wage earner	0.230***	0.058	0.000
Household size	-0.009	0.012	0.448
LR chi2 (14)	70.95***		0.000
R2	0.181		
Observation (N)	316		

Note *, **, *** are significant at 10%, 5% and 1% significant levels

Performance of socio-economic and demographic variable

Respondent's *age* is statistically significant and theoretically it has the expected sign indicating that as the respondent get older his probability of paying for NTFP decreases. The sign of the age coefficient is consistent with that of Pham (2004) and Lokina *et al.* (2006) suggesting that a percentage increase in age of the respondent from its mean value will reduce the probability of willingness to pay for NTFPs by approximately 0.5%. The possible reason for this could be that the older households tend to assign less value to the varieties of consumable non-timber forests products in relation to the scenario proposed. In addition to this, older heads of households are expected to have shorter planning horizon than younger ones. The proposed project intends to increase availability of NTFPs and it will be realized in the long term this might influence them to refrain from being willing to pay.

The results of the estimation shows that respondent's willingness to pay for NTFPs is positively related to *income* and is statistically significant. As expected, people with higher income were willing to pay more for NTFPs. More than 60% of household's income is from farming

activities. A 1% increase in household's income is likely to increase the probability of household's willingness to pay by 0.0013 from its mean value TZS 66,791. People tend to increase the amount they are willing to pay for NTFPs once they are assured of the increase in the quantity and quality of the forest resources and if they can increase their harvest. The findings were consistent with the once of Gunatilake *et al.* (2002) as well as prior-expectation suggesting that as income increases the households willingness to pay also increase.

The result shows that *religion* variable is insignificant in the Probit model suggesting that the WTP for NTFPs does not depend on once religious belief. The results are consistent with the findings of Lokina et al, 2006. Readers would expect people in one group of religious worship and cultural background to have less willingness to pay for NTFPs which are considered as gift from God, hence no need to pay for them. The element of the resources being public good could also be viewed from religious perspective as God is the sole creator of everything hence there is no need to pay for the resources.

Estimation results show a positive, statistically significant relationship between *marital status* and WTP for non-timber forest products. This is due to the reason that a household with married people is likely to have sustainable source of income, financed by the husband/wife or both. As a result they have a higher probability of willing to pay for NTFPs than unmarried/single parental family. *Education* plays greater role in influencing a rational decision maker in the society. However the variable is insignificant in explaining WTP perhaps is due to the fact that there is no much variation in education as majority (92%) from the surveyed sample had acquired only primary education.

Furthermore the results shows that the longer the *distance* households have to travel in search for NTFPs and the benefit they get from the use of NTFPs in the half mile strip the less likely that they will be willing to participate in the programme. The variable has a negative sign and is statistically significant in explaining WTP for non-timber forest products. A 1% increase in distance from the mean value 2.3 kilometres decreases the probability of household's willingness to pay by 4.9%. The results are in accordance to the priory expectation as it was found during interview households living near the forest spend more time in gathering NTFPs, compared to those residing far away.

Household's *occupation* influence WTP for non-timber forest products in the study area. The results in Table 1 show that there is a positive and significant relationship between WTP and occupation.. The two variables were statistically significant and had a positive sign indicating that if the household is employed or businessman increases his/her willingness to pay for the proposed scenario. The plausible explanation for this is that the employed and business people in most cases they get their NTFP needs from the market, and hence are used to paying for them unlike farmers who are likely to be obtaining their NTFPs from their own farm or from the forest free of charge.

Similarly, the results show that increase in the *size of the household* from the mean value of 5 decreases the probability of willingness to pay by 0.9%. Large households are less likely to contribute because of highly dependence over those ones earning a certain income. Generally higher family size results in more labour available for NTFPs gathering. Large family can allocate more labour for forest resource harvesting. The results concur with the prior expectation as well as the ones of Gunatilake *et al.* 2002 whereby there is a negative relationship between

household size and willingness to pay for non-timber forest products.

Performance of resource and perception variables

Household's perception of *economic environment* is positive and statistically significant. This is not surprising because households are likely to support the proposed scenario if it could increase availability of NTFPs as a result they would benefit more from the resources. The results confirm that the respondents who are aware of the existing economic environment are more affected by environmental changes in the study area. The findings suggest that as economic environment gets better the more the household's are willing to pay.

The variables *collection intension* and *household's participation in forest conservation* has a positive sign. Participation variable is significant in explaining household's WTP for non-timber forest products while collection frequency is insignificant.

Bootstrapping results for Probit model

Bootstrap is an intensive computationally technique for making statistical inference which was introduced by Efron (1979). It differs from traditional parametric approach as it employs a large number of repetitive computations to estimate the shape of a statistic's sampling distribution, rather than using strong distributional assumptions and analytic formulae. It enables some one to compute the degree of bias of the results [$\text{Bias}(\hat{\beta}) = \beta - E(\hat{\beta})$]. Efron (1982) suggest that when the ratio of the estimated bias to the standard error is less than 0.25, then the bias of β is not a serious problem. We found that the estimated results from the bootstraping were consistent with economic theory (results are available upon authors request).

Estimating the mean willingness to pay (MEAN WTP)

The study is intending to calculate mean WTP for non-timber forest products and assessing the factors affecting respondents WTP. Household's maximum WTP is the monetary value s/he has explicit agrees to contribute. For instance, if the household answer no to TZS5, 000 and yes to TZS2, 500, then the maximum monetary value would be TZS 2, 500. Household's who are willing to pay a given price for NTFPs are also willing to pay any lower price for the products. If respondent answer yes to TZS5, 000, they are also willing to pay any price lower than TZS5, 000. Contrary to that, respondents who are not willing to pay a given price are also unwilling to pay any higher price. Respondents in the study were asked how much they would be willing to pay for NTFPs. After responding to two direct pricing questions (double bound DC), all were asked to state the highest price they are willing to pay.

From the surveyed households, 36% are willing to pay the second bid asked, (TZS10,000) and 70 % are willing to pay the first bid asked (5,000 /=) and Only 10% are willing to pay more than TZS10,000 while 10.1% are not willing to pay any amount.

In order to obtain mean WTP from closed ended question we run a restricted model with two variables, where WTP is the dependent variable and Bid value is the independent variable (Perman *et al.* 2003). The mean WTP, μ, is equal to α/-β. For the open ended question we had to sum up the stated amount and divide by the total number of respondents in the study sample who are willing to pay for NTFPs. Results for the restricted model are presented in Table 3

Table 3. Restricted model for estimating WTP

Probit results		Bootstrap results	
Wtp	Coefficient	Wtp	Coefficient
Bids	-0.00014***	Bids	-0.00014***
Constant	0.51034***	Constant	0.51034***
Number of observation	316	Number of observation	316
Pseudo R2	0.1614	Pseudo R2	0.1614

Source: Author's computation (2009)

Note ***, **,* indicate significance level of 1%, 5% and 10% respectively

From Table 3 the slope coefficient, β, is equal to -0.0001441 whereas the intercept, α, of the Probit model is equal to 0.5100034. In this case the mean WTP = 0.5100034/-(-0.0001441)= TZS 3,540. Thus the mean WTP per household in the villages surrounding the half mile strip is TZS 3, 540 per annual. Results from the open ended question showed that the mean willingness to pay for NTFPs is TZS 6, 460. We find these results to be reasonable as is within the household's reach. We found that the mean household income is about TZSs 67,000 per annum. Thus the mean WTP is about 5% of the household annual income. We went further by analysing willingness to pay for businessmen, wage earners and farmers from open ended question. We found that they were willing to pay TZS 7,080/=, TZS 6, 977/= and TZS 6,197/= respectively though there was no statistically significant difference in the amounts they were willing to pay ($p>0.1$). Revenue generated from the project that involves household's WTP for non-timber forest products in the study area is estimated to be about TZS 68, 704, 320 per annum and for the open ended question is estimated at about TZS 125, 375, 680 per annum. This revenue generated can be apportioned in forest conservation projects in order to ensure proper management of forest resources and for community development.

DISCUSSION

Economic valuation of NTFPs is essential for projects appraisal and policies affecting the use of forest resources. Under-valuation of NTFPs can bias land use policies in directions which are not consistent with maximizing economic welfare. Proper understanding of the economic value of consumable NTFPs, types, uses and availability has implication on any forest policy to be formulated and management decision.

The study sought to estimate household's willingness to pay for NTFPs collected from the half mile strip. Surveyed household were 357, selected randomly from the villages chosen for the study we had three main clusters, businessmen, employed ones and farmers. Analysis of WTP for non-timber forest products was evaluated using a restricted Probit model. Dependent variable was WTP while independent variable included age, marital status, religion, education level, perceived forest benefits and households support of conservation activities. In addition to that several factors were found to have significance influence in the household's willingness to pay for NTFP; this included income, distance to the forest, marriage,

economic environment environmental perception, forest conservation, being a businessman and if respondent is a wage earner.

The study revealed that about 89% in the surveyed sample were willing to pay for NTFPs. In analysing willingness to pay for NTFPs we found that households in the villages surrounding the half mile strip were willing to pay TZS3, 540 per year for closed ended questions and TZS6,460 for open ended questions. In addition to that we found that businessmen, wage earners and farmers were willing to pay TZS 7,080/=, TZS 6, 977/= and TZS 6,197/= respectively though there was no statistically significant difference in the amounts they were willing to pay ($p>0.1$). The figures are quite substantial in relation to the economic situation of the study area, and if used properly can help in forest conservation thus improving the quantity and quality of NTFPs. One of the issues raised during the field study was on management of funds after contribution. Many felt that the management of the fund should be at the village level with proper auditing of income and expenditure accounts when financial year ends by an independent board from parliament.

A key policy implication from this study is that policymakers can opt from a set of scenarios, such as types of NTFPs, uses, harvesting process and WTP estimates for forest resources, to improved forest conservation and any other project that intends to establish forest plantations. Policymakers need to consider the quality and quantity of NTFPs and the amount households are willing to pay for them. In addition, policymakers need to be aware that socio-economic characteristics which influence the household's willingness to pay for NTFPs. This is useful whenever there is any programme to be implemented within the forest areas.

Economic valuation of forest resources is a challenging one because of its multiple functions catering from man's socioeconomic needs, ecological functions and cultural heritage. Contingent valuation is one of the methodologies used in valuing forest resources to economists. The use of Double bounded DC in estimating willingness to pay is more efficient than single bounded. Generally CVM gives opportunity in valuing complex environmental goods. Varieties of studies have been done in valuing NTFPs being changes in forest quality, forest restoration and conserving forest. Estimation of WTP is useful in cost-benefit analysis of forest ecosystem protection programmes. However the methodology used has a number of shortcomings. WTP measures are inherently affected by wealth. According to Carson et al., 2001 this limitation is offensive to many who believe that government decision making should not base to any extent on the ability to pay.

In addition to that valuing environmental amenities using CVM usually suffer from several biases like strategic bias, amenity mis-specification, starting point bias and hypothetical bias. Strategic bias centres on getting the respondents to answer honestly as they perceive what the analyst intends to do, but they provide response which is not a true WTP. A person pays less than what a public good is worth; a person is taking for granted that other individual will pay enough to provide the good. According to Perman *et al.* 2003, the use of close ended (dichotomous choice) questions are less subjected to bias. Also a well designed survey with extensive pre-testing and the use of focus group discussion reduce strategic bias. Amenity mis-specification, occurs when environmental commodity is perceived as being of concern by the respondent but respondent differs from what is intended by CVM analyst. This can be reduced by well structured questionnaire as well as

clear elaboration of the questions to the respondent. Starting point bias is usually reduced by pretesting of the questionnaire before the actual study.

Bias that arises from hypothetical bias a follow up certainty questions in the form of "definitely sure" and "probably sure" is usually used or a 10-point scale with 10 very certain. They successfully eliminate hypothetical bias from estimates of WTP. We are looking at how certain respondents are in doing what they say they would actually do. This calibration is based on the idea that individual has a value for the good and compares the distributions of values to the price offered.

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