Asian Journal of Water, Environment and Pollution, Vol. 8, No. 2 (2011), pp. 83-92.

Monetizing the Environmental Welfare Impact of Deforestation in Ogun State, Nigeria: The Contingent Valuation Approach

L.O. Okojie* and J.A. Akinwumi[1]

Department of Agricultural Economics and Farm Management
University of Agriculture, P.M.B 2240, Abeokuta, Nigeria
[1]Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria
✉ lukeokojie@yahoo.com

Received August 15, 2007; revised and accepted March 19, 2010

Abstract: This paper investigates the economic valuation of alternative uses of rainforest land using the contingent valuation approach. Multi-stage sampling technique was used in the collection of the 260 respondents in the data from the four Ogun State Agricultural Development zones used for the study. Data were analysed using descriptive statistics and the dichotomous-choice contingent valuation method that terminated into the logit model. Food crop cultivation accounted for 66.4% of deforestation. The households yearly willingness to pay/hectare (WTP/ha) for rainforest protection was N16,186.76. This translated to N0.60 billion for the average 36,817.62 hectares/year deforested for food crop cultivation. The key determinants of the likelihood to pay for rainforest protection were the bid, rainforest visitation, and immigrant status that had the coefficient of –0.0074, –0.11 and -0.71, and were significant ($p<0.01$) for bid and ($p<0.05$) for the others. In addition were the income, educational status and food crop producer status that had the coefficients of 0.13, 0.0063 and 0.00012 and were significant ($p<0.01$). Lower cost of rainforest protection as indicated by the WTP would lead to further deforestation and the consequent environmental impacts for a long time. There is therefore the urgent need for environmental sensitization through education to arrest deforestation.

Key words: Willingness to pay, bid, rainforest protection, environmental service functions, agro forestry.

Introduction

Economic growth and development in many countries have carried along with them a lot of deforestation with the accompanying concerns of environmental sustainability. The tropical rainforests in Nigeria have been badly damaged in this process. This has been especially so as the negative externalities caused by deforestation are not economically valued to apply the "polluter pays principle". This has equally been responsible for the numerous oil spillages in the country with the concerned companies failing to carry out their corporate social responsibilities. This has resulted in the recommendation of the contingent valuation method of the referendum type for practical setting by the "Blue Ribbon" panel set up by the National Oceanic and Atmospheric Agency in the USA at the instance of the Prince William Sound Oil Spill in Alaska (NOAA, 1993).

FAO (1995) defines the forest as the ecological system with a minimum of 10% crown covering of trees. Gillis (1996) refers to the complete destruction of forest cover for whatever human activity in the development process as deforestation. Forest degradation according to the source only alters the ecology of a forest parcel but does not destroy all forest cover. The consequences of these phenomenon disrupt the productive capacity of the forest

*Corresponding Author

and bring along with it the issue of environmental sustainability. The World Commission on Environment and Development (1987) in the Brundtland report titled "Our Common Future" gives the definition of environmentally sound and sustainable development as "meeting the needs of the present without compromising the ability of the future generation to meet their own needs". This is succinctly explained from economic point of view by Mayor (1988) who attests that "it means living-off the earth's interest without encroaching on the capital" or "investing to sustain and enhance resource and ecological capital so that future dividends can be ensured and enlarged".

Problem Statement

Tisdell (1993) on the concern for the excessive deforestation and the consequent productive and environmental services loss in development has questioned whether economic growth and development can continue as in the past or whether it is even desirable. Solow (1991) in this direction asserts that sustainability requires that we leave a legacy so that it may gain a level of utility in the future equal to that of the current generation. Castle (1996) though argues on the ability to make actual comparison of utilities across generational gap yet agrees that the goal as advanced by Solow does have a conceptual value. In essence, developmental processes have accentuated deforestation and have been imperative in the problem of disenabling the forests from accounting appropriately for its environmental service functions.

These highly valuable environmental services include watershed protection, climatic control especially in the control of rainfall, the absorption of albedo (reflectivity of the sun's rays) and the ability of the rainforest to store sizeable proportion of the world's carbon. In addition, is the depletion of biodiversity in flora and fauna components especially with respect to the medicinal value of the tropical forests that Treben (1986) describes as "God's own pharmacy". Furthermore, is the threat to the forests in furnishing essential foods, clothing and implements to a lot of indigenous forest people. Finally, the forest is denied its function of acting as "sinks" to heat trapping "green house gases" especially carbon dioxide (CO_2), sulphur dioxide, nitrous oxide, methane and the chlorofluorocarbons thereby leading to "global warming". Equally, is the loss of eco-tourism potentials and scenic beauty, excessive flooding and surface run-offs leading to the loss of fertility.

FAO (1995) estimated that 15.4 million hectares or 0.8% of deforestation occurred on an annual basis in the tropics. The source asserted 4.1 million ha or 0.7% of forest area loss per annum. In addition, it was 0.6 million ha or one percent of forest loss per annum in West Africa. In Nigeria, the deforestation situation is intense. WWF (1989) claimed that over 90% of natural vegetation was cleared annually. NEST (1991) asserted that up to 350,000 ha. of forest and natural vegetation were cleared annually over the whole country. Okojie (1998) asserted this to be 400,000 ha of deforestation and 30,000 ha of reforestation thereby leaving an annual deficit of 370,000 ha. In the study area, Omotayo (2003) claimed that of the 1,327 km^2 of available disturbed forest in 1976, only 193 km^2 was saved from deforestation by 1995. He claimed that 610 km^2 of it had been converted through agricultural uses to secondary bush and 270 km^2 of it had been converted to intensive food crop production with only 270 km^2 of it turned to teak plantation. Yet Ogun Slate continues to quote unchanging areas of forest reserves from year to year. These are the Omo-Oshun (136,806 ha), Olokemeji (5.888ha), Ilaro (4,608 ha), Ohunbe (4,608 ha), Aworo (21,299 ha), Eggua (4,147 ha), Meko Games (95,488 ha), Edun Stream (7,900 ha) and Arakanga (239 ha).

On the international level, deforestation has been linked to higher prices for agricultural products (Angelsen and Kaimowitz, 1991; Barbier and Burgess. 1996; Angelsen, Shitindi and Aarrestad, 1998). Other causal variables have been identified as population growth, debt problem, growth rate, terms of trade (ratio of export to import prices) (Kant and Redantz, 1997). From the view point of economic valuation or the monetization of the environmental services loss when deforestation is effected, Kramer et al. (1995) had made attempts in this direction but from a developed country's perspective. They investigated the willingness to pay of United States citizens to protect 5% of rainforest in addition to the 5% that is already being protected in the developing countries. Whittington et al. (1992) equally made attempts in economic valuation from the perspective of the developing world in East and West Africa but their area of emphasis was on water vending. This paper therefore will explore appropriate policy formulations to effect the "polluter pays principle" and enhance the life support system that an intact forest provides for human existence.

In this light, this paper sets to examine the following objectives.

i. Assess the forestland use changes (deforestation) accounted for by the major alternative land use.
ii. Determine the willingness to pay associated with deforestation.

iii. Establish relationship between willingness-to-pay and the factors that affect it.
iv. Based on the findings of the study, make recommendations for effective protection of the rainforests to enhance its environmental welfare functions.

Conceptual Framework

The conceptual approaches for the economic valuation of environmental goods are based on the non-market technique from which the contingent valuation of the referendum type has however become the method of choice in practical setting for environmental valuation. This is since the National Oceanic and Atmospheric Agency (NOAA) "Blue Ribbon" panel report recommended it in preference to other methods of economic valuation of environmental goods (NOAA, 1993).

Contingent valuation is a method of estimating the value of a good that a person places on it. The approach asks people to directly report their willingness-to-pay (WTP) to obtain a specified good, or willingness-to-accept (WTA) to give up a good rather than inferring them from observed behaviours in regular market places. The principal use of contingent valuation survey data is to produce a mean or median estimate of WTP to mitigate (abate) the individual's welfare benefit that would be lost in environmental quality emanating from forestland use changes to other uses in the development process. The mean or median WTP added across every household in the study area will give the total WTP. This reflects the environmental welfare services loss as a result of other uses of forestlands.

The four main approaches in contingent valuation method include the open ended survey format, bidding, payment card and the close ended approaches. The first and last approaches are used in this paper. In the open-ended contingent valuation (CV) survey, the respondents are asked the maximum amount of money they would be prepared to pay for the environmental commodity. The mean or the median responses gave the mean WTP. In the close-ended survey, specified amounts for the given environmental good were elicited to which the respondents were expected to answer "yes" or "no" to. Bid amounts are randomly varied across respondents. The only information obtained from each individual respondent will determine whether his maximum WTP is above or below the bid offered (Bishop and Heberlein, 1979; Bowker and Stoll, 1988). The open-ended contingent valuation survey as used in the pilot survey was to enable the derivation of the upper and the lower bounds of bids to be used in the actual close-ended dichotomous-choice contingent valuation method (DC-CVM) survey.

The theoretical framework for the empirical valuation of rainforest protection is based on welfare concepts of economics. A fundamental assumption of environmental economics is that the neo-classical concept of economic value based on utility maximization behaviour can be extended to non-market goods. In this sense, an individual or household should demand greater or lesser quantities of an environmental amenity if a variable price of the amenity exists. It therefore stands that if the shadow price for the amenity can be estimated and a demand curve traced out, the familiar concept of consumer surplus can be used to assign economic value.

Consumer surplus is the difference between aggregate WTP and aggregate actual payments (Hirsholeifer, 1984). Koutsoyiannis (1979) defines it as the difference between the amount of money that a consumer actually pays to buy a certain quantity of a commodity and the amount that he would be willing to pay for this quantity rather than do without it. In summary, it is the result of subtracting what the consumers pay from the maximum they would be willing to pay.

The value of the surplus can be measured or estimated using the area under the demand curve. The concept can be extended from the individual demand to the market demand curve. It is a measure of changes in environmental welfare associated with deforestation for alternative land use. In effect, the area under the demand curve provides a realistic aggregate monetary measure of the welfare effects of a price change. The easiest way to think about the estimation of WT'P using the close-ended approach is to model the DC-CVM data obtained from the cross-sectional survey as a demand function with the bid levels elicited for WTP modelled along the horizontal axis and the probability of saying "yes" along the vertical axis following the method of Ryan et al. (1997). This implies modelling the demand for the environmental good in question (rainforest protection) at a given price. Mean WTP is estimated as the area under this curve. This area shows the proportion, of the population who would consume the good at each price level and their associated utility. Estimating mean WTP within this framework relies on making some assumptions about the upper and lower elicited bid limits, that is knowing the bid amounts at which the probability of saying "yes" is zero and the probability of saying "yes " is one. The cumulative density function that represents the probability of a "yes" response as represented by the area under the demand curve is assumed to be logistic

(Hanemann, 1984; Turcin and Giraud, 2001). The logit model is therefore applied to analyse the relationship between the respondents' acceptance probability to the bids offered and the relevant independent variables. Ardilla et al. (1998) asserted that when it is assumed that individuals will not seek rainforest protection intervention if they receive disutility from it, negative WTP can be ruled out and zero used as the lower limit (i.e. WTP is truncated at zero). This paper adopts this approach.

Research Methodology

Study Area

The study area Ogun State lies between longitude 2°45′E and 3°55′E and latitude 7°0′N and 7°18′N about 16,085 km^2 (see Figure 1). It has a population of 3.25 million (Omotayo, 2003). The rainforest is the largest ecological belt running through the centre of the state from the east to the west. The fresh water swamp with mangrove forest is in the southeast and the woody Guinea savannah is in the northwest. There are two main seasons the rainy season (middle of March–late October) and the dry season (November–February). Rainfall is between 1600 mm (forest areas) and 900 mm (woody Guinea savannah). The temperature is between 28°C and 35°C and humidity is between 85% and 95%.

Sources of Data and Collection

The data for this study were derived from primary and secondary sources. The primary data were from the contingent valuation based cross sectional survey administered questionnaire. This provided the data for the valuation of the environmental services functions of rainforest protection. The secondary data were obtained from the records of Ogun State Ministries of Forestry and Agriculture, the Bureau of Land and Survey, the National Population Commission, and the Forest Management, Evaluation and Coordinating Unit (FORMECU) of the Federal Department of Forestry.

There was an open-ended contingent valuation format pre-test survey that helped to work out the bid amounts elicited in the actual dichotomous-choice contingent valuation method cross-sectional survey. The goal was to ask how much the respondents were willing to pay to ensure loss resulting from forest land use changes were abated (mitigated). The respondents were shown two sets of imageries in photographs. The first set depicted deforested environmental scenes and the second showed "lush" green rainforests and they were told of the environmental welfare loss resulting from such deforestation. This was to properly inform them on what they were being expected to value through the elicitation of their WTP following McCollum and Boyle (2005). The forest-reserved areas in their individual ones were used as the reference points. The verbal protocol and retrospective reporting following Lazo et al. (1992) was adopted. This involved recording the respondents' communication into a tape recorder continuously as to how much they were willing to pay as they looked at the two sets of imageries presented of the two scenarios of forestland uses and as they responded to additional predetermined prompts.

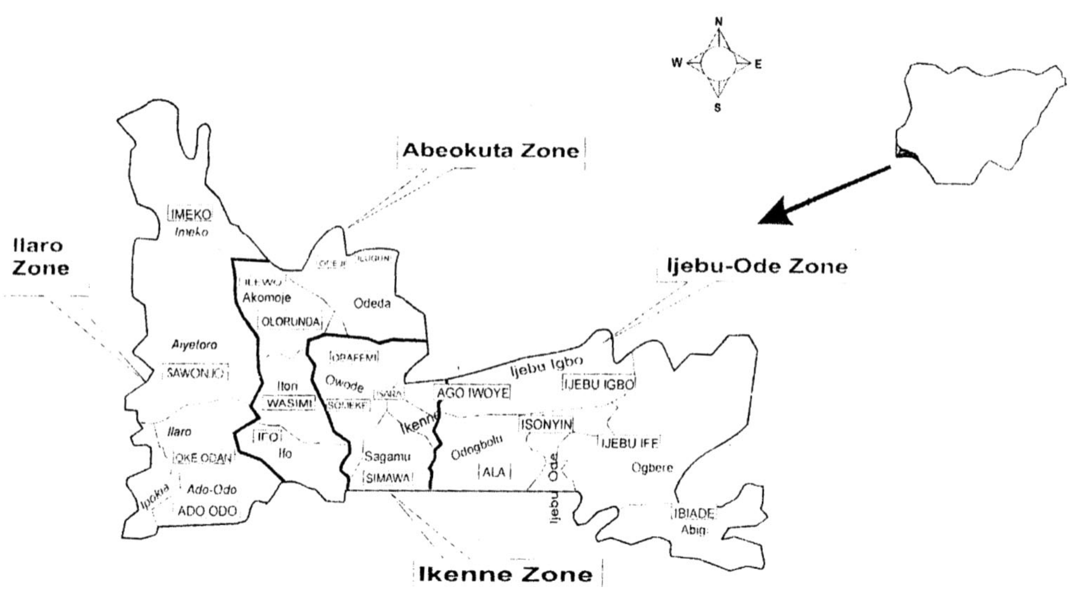

Figure 1: Map of Ogun state showing the study zones.

The data so generated were used to work out the bid vectors ($b, b_2 ..., b_m$). The Bergland et al. (1987) approach was used in selecting the unique bid amounts ($b, b_2 b_m$) to be used in eliciting willingness-to-pay in the DC-CVM survey. This involved the choice of unique bids based on equal log linear increments between the upper and lower bound bids of the pre-test open-ended contingent survey data. This resulted in the choice of 10 unique bid amounts to be used in the actual DC-CVM survey. This agrees with the 10–15 bid amounts that have always been used in such studies (Cooper, 1993).

In order to work out the optimal sample allocation to the selected bids, the pre-test open-ended contingent valuation survey generated bid amounts were grouped into ten groups with each of the chosen 10 bid amounts in each group. The proportion of respondents with the acceptance probability to the bids elicited in each group was found of the total participants of the survey in all groups. These various fractions in each group of the total sample size (N) in the actual DC-CVM survey gave the various optimal sample allocations to the various chosen bids (i.e. $b^*_1 n^*_1, b^*_2 n^*_2 ..., b^*_2 n^*_2 ....., b^*_m n^*_m$).

The bid amounts so selected were used in the actual DC-CVM survey. This survey was carried out by administering randomly the various unique bid amounts among the various respondents in the 26 sampled extension cells in the study area following the worked out sample allocation to each bid value. The administered bid amounts elicited the respondent willingness to pay (yes/no) for rainforest protection. The known areas of forest reserves in each zone of study that could easily be visualized were used. These were then prorated to the deforested areas for the extensive food crop production as acquired from the remote sensing data derived from the project carried out for FORM ECU of the Federal Department of Forestry by Geomatics of Canada for the period 1976–1995. This was augmented by the data from the FAO projection of forest areas converted to the major alternative land use of food crop production in study area to obtain the value up to 2004.

Sampling Techniques and Sample Size

The multi-stage sampling technique was used in selecting the 260 respondents in the cross-sectional survey. The first stage involved stratifying the study area into four zones – Abeokuta, Ijebu Ode, Ikenne, and llaro – based on the zonal structure of the Ogun State Agricultural Development Programme (OGADEP). The second stage involved the random selection of a number of blocks based on probability proportionate to size, in the sense that, three blocks were randomly selected where there were six or more in each zone while two were randomly selected where five or less existed in each zone. These resulted in 26 extension cells. Ten respondents were randomly drawn from each cell to bring the total sample size (N) for the DC-CVM component of the cross-sectional survey to be two hundred and sixty (260) respondents.

Analytical Procedure

The analytical procedures used were descriptive statistics and the dichotomous-choice contingent valuation method (DC-CVM) that terminated into the logit model. The descriptive statistics involved the calculation of the proportion (in percentage) of forest land conversion to its major alternative use – food crop production.

The DC-CVM was used in estimating WTP of the respondents for rainforest protection. The maximum likelihood estimation of the logit regression coefficients provided the data for the computation of the mean WTP and coupled with the household population data helped to determine the total WTP for rainforest protection. The logit model was equally used to postulate the relationship between the socio-economic and environmental attitudinal variables of respondents and their acceptance probability of bids elicited for rainforest protection and by implication of the WTP.

The valuation task encompassed by DC-CVM involves the respondents stated preference for environmental welfare change resulting from deforestation for the other major land uses. As a result of the dichotomous-choice response to the DC-CVM survey questions, an indirect WTP was quantified and its mean calculated. Hanemann (1984) expressed this mean as:

$$E\,(\mathrm{WTP}) = \int_{\circ}^{\infty} (1 - F(b)\partial b) \qquad (1)$$

where $F(b)$ = cumulative density function that represents the probability of a "no" response.

∂b = various bids elicited for "no" response.

Alternatively, equation (1) can be presented as

$$E\,(\mathrm{WTP}) = \int_{\circ}^{\infty} (F(bi)\partial bi) \qquad (2)$$

where $F(bi)$ = cumulative density function that represents the probability of a "yes" response.

∂bi = various bids elicited for "yes" response.

The mean WTP that is based on the cumulative density function of "yes" response – $F(bi)$ was calculated from the Hanemann (1984) approach as used by Turcin and

Giraud (2001). Hanemann (1984) utility difference equation states that if cumulative density function ($F(bi)$) is logistic, the parameters estimate to calculate $F(bi)$ is as shown:

$$F(bi) = \text{Prob}(\text{WTPi} \leq bi) = \left[1 + \exp^{1(a+\beta bi)^{-1}}\right] \quad (3)$$

The problem with this model is that the left hand of the equation is in probability form that is specified between 0 and 1 while the linear predictor on the right hand side can take any real value. There is, therefore, no guarantee that the predicted values will be in the corrected range unless complex restrictions are imposed on the coefficients. The simple solution was to transform the probability, to remove the range restrictions and model the transformations as a linear function of the covariates. This was done by moving from the probability F(bi) which is also represented as Pi to the odds (i.e. odds ratio).

$$\text{Pi}/1 - \text{Pi} = \left[1 + \exp^{1(a+\beta bi)^{-1}}\right] \quad (4)$$

The results for this are represented as 1:k. This indicates a floor restriction of I to any positive value without a ceiling restriction. The floor restriction was removed by taking the log odds that resulted in what is called the Logit (Li) as the dependent variable.

$$\text{Li} = \frac{1}{\left[1 + \exp^{1(a+\beta bi)^{-1}}\right]} \quad (5)$$

When the socio-economic and environmental attitudinal variables that affect the choice of response are considered, the equation then becomes:

$$\text{Li} = \frac{1}{\left[1 + \exp^{1(a+\beta bi)^{-1}}\right]} \quad (6)$$

where

Li = Respondents acceptance probability to the bid offered (WTP)

Xi is the vector of the covariates including the bid amount, which has been expressed as bi. This vector is defined as follows:

X_1 = bid (Naira)
X_2 = Income (Naira)
X_3 = Educational level in school years attained (Years)
X_4 = Household size (Number)
X_5 = Sex dummy (1 = if male, 0 = female).
X_6 = Tropical deforestation dummy (1 = deforestation awareness, 0 if not).
X_7 = Rainforest visitor dummy (1 = visitations to the forest, 0 if not).
X_8 = Intergenerational equity dummy (1 = support rainforest protection for future generations, 0 if not).
X_9 = Cost sharing dummy (1 = support for developed countries sharing from the cost of rainforest protection in developing countries, 0 = if not)
X_{10} = Immigrant status dummy (1 if migrant, 0 = non migrant)
X_{11} = Food crop producer dummy (1 = non-food crop producers, 0 = food crop producers).

Logit in this sense maps probabilities from the range (0, 1) to the entire real line – that is from –∞ as probability approaches 0 to + ∞ (i.e., as probability approaches 1). The model determines the maximum likelihood coefficient estimates.

The unrestricted mean WTP (P^+) according to Cooper and Loomis (1992) is calculated from the coefficients derived by the model as follows:

$$P^+ = a/|\beta| \quad (7)$$

As this has the possibility of producing the undesirable negative WTP, the restricted WTP (P^+) adopted for this study is shown as:

$$P^- = 1/|\beta| * \ln(1 + \exp^a) \quad (8)$$

where a = intercept and β = coefficient of bid.

Results and Discussion

Food crop cultivation accounted for 66.4% of deforestation when forestland use changes were considered for the various vegetation types (Table 1). The households yearly WTP/ha for rainforest protection was N16,180.76 which translated to N0.60 billion for the average 36,817.62 hectares/year deforested for the major alternative land use of food crop production in the study area (Table 2). This is low when compared to the value of N1.93 billion/year (Okojie, 2007) derivable when the forestland is left in its alternative use of food crop production. This opportunity cost of forestland use with respect to food crop production as compared to the WTP for rainforest protection is on the multiple of 3.2. This is likely to encourage further the phenomenon of deforestation with the associated environmental welfare change.

The key determinants of the likelihood to pay for rainforest protection were the bids elicited in the contingent valuation survey, rainforest visitation and the immigrant status that had the coefficients of –0.0074, –0.11, and –0.71 respectively and were significant (P<0.0I) for the bid and (P<0.05) for the others (Table 3). The bid

Table 1: Dominant Vegetation Types and Forest Land Use Changes to Food Crop Production (1976-2004)

Vegetation type and Land Use - 1976	*Area (Ha)*	*Forest Land Use Conversion to Food Crop Production (Ha)*			
		1995 (Ha)	*Proportion of Conversion in 1995 (%)*	*2004 (Ha)*	*Proportion of Conversion in 2004 (%)*
Disturbed Forest	132,700	27,000	20.35	29,378	22.14
Guinea Savannah	112,800	-	-	-	-
Undisturbed Forest	25,100	-	-	-	-
Riparian Forest	29,500	27,900	94.58	27,936	94.70
Intensive Food Crop Agriculture	1,162,300	1,006,900	86.63	1,010,397	86.93
Others	146,300	-	-	-	-
Total	1,608,700	1,061,800	66.00	1,067,711	66.37

Source: Compiled from the original calculations of changes in Land Cover for the entire country as done for FORMECU, Federal Department of Forestry, Nigeria by Geomatics of Canada using the 1976 Satellite Imageries as compared to that of 1995, Omotayo (2003) and from FAO (1995). Projection from the Resources Assessment 1990 of Deforestation for Agricultural Expansion in tropical countries.

Table 2: Total Willingness to Pay Estimates Associated with Forest Land Use Conversion To Food Crop Production

Study Area	*Mean Willingness -to-Pay (MWTP) (N/ Household/ Month)*	*Total House-hold*	*Total WTP (N /Year)*	*Total Forest Area (Ha)*	*WTP/Ha for Protection of Forest Reserved Area (N/Year)*	*TotalForest Land Use Conversion to Food Crop Production (1976-2004) (Ha)*	*Total WTP Associated with Forest Land use Conversion to Food Crop Production in 1976-2004 (N)*	*Total WTP/Year Associated with Forest Land use Conversion to Food Crop Production in 1976-2004 (N)*
All Zones (Ogun State)	552.50	666,909	4,421,606,670.00	273,162.00	16,186.76	1,067,711.00	17,282,781,000.00 (17.28 billion)	555,,957,989.90 (0.60 billion)
Zone 1 (Ijebu-Ode)	51.31	131,842	81,177,756.24	136,806.00	593.38	279,031.87	165,571,931.00 (165.57 million)	5,709,376.93 (5.71 million)
Zone 2 (Abeokuta)	157.47	200,064	378,048,937.00	6,127.00	61,702.13	245904.80	15,172,849,000.00 (15.17 billion)	523,201,722.00 (523.20 million)
Zone 3 (Ikenne)	4.99	118,835	7,115,839.80	1111.00[a]	6,404.90	262,468.34	1,681,083,471.00 (1.68 billion)	57,968,395.55 (57.9 million)
Zone 4 (Ilaro)	32.80	216,168	85,083,724.80	130,229.00	653.33	280,305.99	183,134,921.70 (183.13million)	6,314,997.30 (6.31 million)

[a] = The 1111 ha is not a forest reserved area but the Remo Rubber plantation area which tend to serve forest beneficial functions in the zone.

Source: Computed from Field Survey Data, Data from National Population Commission, Ogun State Ministry of Forestry.

being negative and significant agrees with the theory that the higher the price of a commodity, the lower the demand. The visits of the respondents to the forests were inimical to rainforest protection objective. This is unexpected as one would have thought the more the respondents visited the rainforests to derive beneficial functions, the more they would be willing to pay for rainforest protection. The migrants to the study area contributed immensely to deforestation as they were generally the timber loggers and contractors. In addition, the income, educational level and food crop producer status that had positive coefficients of 0.13, 0.0063 and 0.00012 were significant ($P<0.01$). These imply that income enhancement will favour rainforest protection. The results also indicate that high educational attainment will tend to sensitize rainforests protection awareness.

Table 3: Maximum Likelihood Estimations of Responses to Willingness-to-Pay (WTP) Questions and Estimation of Mean WTP

	Study Area and Its Zones				
Variables	*All Zones (Ogun State) Coefficient and Z-Value*	*Zone 1 (Ijebu - Ode) Coefficient and Z-Value*	*Zone 2 (Abeokuta) Coefficient and Z-Value*	*Zone 3 (Ikenne) Coefficient and Z-Value*	*Zone 4 (Ilaro) Coefficient and Z-Value*
Constant (β_0)	0.18	0.70	-1.83	-1.95	-1.94
	(0.19)	(0.43)	(-0.86)	(-0.44)	(-0.50)
Bid (β_1)(X_1)	-0.0074***	-0.011***	-0.0053***	-0.14***	-0.02***
	(-7.35)	(-3.84)	(-3.41)	(-2.79)	(-2.65)
Income (X_2)	0.13***	0.00020***	0.000033*	0.00014	0.00032**
	(3.33)	(2.98)	(1.84)	(1.53)	(2.28)
Educational Level	0.0063***	0.37	0.18**	0.42**	0.30
(Dummy) (X_3)	(3.40)	(0.39)	(2.23)	(2.36)	(1.45)
Household Size	0.0066	-0.10	0.17	0.24	0.35
(Dummy) (X_4)	(-0.084)	(-0.56)	(0.15)	(0.76)	(0.86)
Sex 1 (Dummy) (X_5)	0.31	-0.11	0.26	-1.64	2.39
	(0.44)	(-0.14)	(0.29)	(-1.20)	(1.60)
Tropical Deforestation	-0.13	0.95	-0.08	-0.0029	1.90
(Dummy) (X_6)	(-0.36)	(1.04)	(-0.13)	(-0.002)	(0.94)
Rainforest visitor	-1.16**	-0.27	-1.26	-0.26	-2.01
dummy (X_7)	(-2.18)	(-0.21)	(-1.23)	(-0.21)	(-0.70)
Intergenerational Equity	0.87	-1.17	2.67**	0.61	-
dummy (X_8)	(1.40)	(-0.82)	(1.98)	(0.26)	-
Cost sharing dummy (X_9)	1.17	1.37	-0.78	-	-
	(1.11)	(1.26)	(-0.93)	-	-
Immigrant status	-0.71**	-0.86**	-0.62**	-2.44*	-2.89*
dummy (X_{10})	(-2.00)	(-1.04)	(-0.99)	(-1.74)	(-1.49)
Food crop producer	0.00012***	0.014***	0.0032***	.00047**	0.0023***
dummy (X_{11})	(3.05)	(2.85)	(3.26)	(2.01)	(2.93)
Number of observations	260	80	80	50	50
Goodness of fit	Pseudo R^2 = 0.45	Pseudo R^2 = 0.48	PseudoR^2 = 0.28	Pseudo R^2 = 0.61	Pseudo R^2 = 0.71
	LR X^2 = 47.55***	LR X^2 = 47.55***	LRX^2 = 29.86***	LRX^2 = 38.67***	LR X^2 = 47.23***
Mean Willingness to Pay	N552.50/ household/month	N51.31/ household/month	N157.47/ household/month	N4.99/ household/month	N32.80/ household/month

Dependent variable is the yes/no responses to the offered bid amounts
*** Significant at 1% level
** Significant at 5% level
Source: Computed from Field Survey Data, 2004

Food crop producers favoured deforestation. Otherwise, it would have meant paying their way out of their business of farming.

Conclusion

In this paper, the WTP for rainforest protection and by implication the associated welfare change was valued. Food crop production was the major alternative land use for which deforestation occurred. The yearly WTP/ha for rainforest protection (N0.60 billion) was lower than what was the yearly realizable benefits from the alternative land use of food crop production (N1.93 billion). This is in the multiple of 3.2. This implies that deforestation will continue to be emphasized in the study area. Environmental awareness in terms of the populace not properly understanding the life support system the rainforest plays in human existence was found to be prevalent. The bid, rainforest visitation, immigrant status were found to be the major determinants of WTP for rain forest protection. In addition, were the income, educational level and the respondent being a food crop producer or not.

There is the urgent need to put an educational system in place that will inculcate and emphasize environmental component in the school curriculum within the study area. Efforts at income policies that will enhance wage increase need to be effected. Co-existence of food and forest crops in the same land management unit, e.g., agro forestry needs to be encouraged. This will go a long way in ensuring rainforest protection while at the same time allowing for food crop production, the major alternative land use for which deforestation occurs. Economic valuations of non-market services necessary for human existence provided by natural resources like rainforests should always be carefully undertaken to enable governments weigh their policy options in planning conservation programmes especially when there is the need for subsidy in the face of competition arising from more profitable alternative land use options.

References

Angelsen, A. and D. Kaimowitz (1991). Rethinking the causes of deforestation: lessons from economic models. *The World Bank Research Observer*, **114(1):** 73–98.

Angelsen, A., Shitindi, E.F.K. and J. Aarrestad (1998). On the economics of deforestation with regional panel data: evidences from Tanzania. Workshop Paper 0498, University of Bergen, Department of Economics, Norway.

Ardilla, S, Quironga, R. and W.J. Vaughan (1998). A review of the use of contingent valuation methods in project analysis at the Inter-American Development Bank, Environment Division. Working Paper ENV 126, Inter-American Development Bank.

Barbier, E.B. and J.C. Burgess (1996). Economic analysis of deforestation in Mexico. *Environment and Development Economics*, **1(2):** 203–239.

Bergland, O., Musser, W., Musser, I. and K. Terry (1987). Optimal sampling intensities in close-ended contingent valuation methods. Draft Paper, Department of Agricultural Economics, Oregon State University, Corvallis, Oregon.

Bishop, R. C. and T. Herbelein (1979). Measuring values of extra market goods: Are indirect measures biased? *American Journal of Agricultural Economics*, **61:** 926 – 930.

Bowker, J.M. and J.R. Stoll (1988). Use of dichotomous-choice non-market methods to value Wooping Crane. *American Journal of Agricultural Economics*, **70:** 372–381.

Brudtland Report, 1987. Oxford University Press.

Castle, E.N. (1996). Pluralism and pragmatism in the pursuit of sustainable development, W.L. Adawomicz, P.C. Boxall, M.K. Luckert, W.E. Phillips and W.A. White (eds.) *Forestry, Economics and Environment.* CAB International. 1–9.

Cooper, J.C. (1993). Optimal bid selection for dichotomous-choice contingent valuation surveys. *Journal of Environmental Economics and Management*, **24:** 25–40.

Cooper, J.C. and J. Loomis (1992). Sensitivity of willingness-to-pay to bid design in dichotomous-choice contingent valuation models. *Land Economics*, **68(2):** 211–224.

FAO (Food and Agriculture Organization) (1995). *World agriculture towards 2010, an FAO study.* N. Alexandratos (ed.) FAO, United Nations and John Wiley and Sons.

FORMECU (1995). The assessment of land use and vegetation changes in Nigeria between 1976 and 1993/95. Report of a Study submitted by Geomatics International, Ontario, Canada, 55–56.

Gillis, Malcolm (1996). Tropical deforestation. Paper Presented by the President, Rice University at the 1996 Rice Environmental Conference, Rice University Held on Friday, February 2.

Hanemann, W.M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. *American Journal of Agricultural Economics*, **66:** 332–341.

Hirsholeifer, Jack (1984). *Price Theory and Applications.* 3rd Edition, Prentice Hall International Inc.

Kaimowitz, D. and Arild Angelsen (1996). Economic models of tropical deforestation: A Review. Bogor, Indonesia: Centre for International Forestry Research.

Kant, Shashi and Anke Redantz (1997). An econometric model of tropical deforestation. *Journal of Forest Economics*, **3(1):** 51-86.

Kramer, R.A., Mercer, E. and N. Sharma (1995). Valuing tropical rainforest protection using the contingent valuation method. W.L. Adawomicz, P.C. Boxall, M.K. Luckert, W.E. Phillips, W.A. White (eds). *Forestry, Economics and Environment.* CAB International. 181–194.

Koutsoyannis, A. (1979). *Modern microeconomics.* 2nd ed. London: Macmillan.

Lazo, J.K., Schulze, W.D., McClelland, G.H. and J.K. Doyle (1992). Can contingent valuation measure non-use values? *American Journal of Agricultural Economics*, **74(5):** 114–120.

Mayor, Federico (1988). Geographical information system for managing sustainable development: The UNESCO approach. *ITC Journal*, **4:** 1988.

McCollum, D.W. and J.K. Boyle (2005). The effect of respondent experience/knowledge in the elicitation of contingent values: An investigation of convergent validity, procedural invariance and reliability. *Environmental and Resource Economics*, **30(1):** 23–33.

National Oceanic and Atmospheric Administration (NOAA) (1993). Natural resources damage assessments under the Oil Pollution Act of 1990. *Federal Register*, **58(10):** 4601–4614.

NEST (1991). Nigeria's threatened environment: A national profile. Ibadan: Nigeria Environment Study/Action Team (NEST).

Okojie, J.A. (1998). Once upon a forest: The master piece of creation. First Inaugural Lecture, Abeokuta: University of Agriculture.

Omotayo, A.M. (2003). Biological implications of Fulbe pastorialism in Southwestern Nigeria. *Land Degradation & Development*, **14:** 445–457.

Ryan, M., Ratecliffe, J. and J. Tucker (1997). Using willingness to pay to value alternative model of antenatal care. *Social Science and Medicine*, **44(3):** 371–380.

Solow, R.M. (1991). Sustainability: An economist's perspective. J. Seward Johnson Lecture, Woods Hole Oceanographic Institution, Marine Policy Centre, Woods Hole, MA.

Tisdell, C.A. (1993). Environmental economics: Policies for environmental management and sustainable development. Edward Elgar Publishing Ltd.

Treben, M. (1986). Health through God's pharmacy: Advice and experiences with medicinal herbs. Ennsthaler 899, Austria.

Turcin, Branka, Giraud, Kelly (2001). Contingent valuation willingness to pay with respect to geographically nested samples: Case study of Alaskan Steller Sea Lion. 2001 W-133 Western Regional Project Technical Meeting Proceedings.

Whittington, D., Smith, V.K., Okorafor, A., Okorie, A., Lium, L. and A. McPhail (1992). Giving respondents time to think in contingent valuation studies: A developing country application. *Journal of Environmental Economics and Management*, **22:** 205–225.

World Commission on Environment and Development (1987). *Our common future: The Brudtland Report*. Oxford University Press.

WWF (1989). Cross National Park, Oban Division: Plan for developing the park and its support zone. Goldaming: World Wide Fund for Nature.