The Quasi-Existence Value of Forest Biodiversity: A Theoretical and Empirical Overview*

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Abstract

The conventional definitions of *existence value* and *resource* limit the users (Recreationists) of the forests from holding 'existence' type of values. It can be argued that a recreationist's total value of a resource can be composed of various combinations of use-values and non-use values and hence it is plausible that the willingness to pay of the recreationist for protecting the biodiversity of the forest can be of *quasi existence* nature. A novel concept named *Quasi-existence value* (QEV) of forest biodiversity is discussed in this paper both theoretically and empirically which overcomes the above mentioned constraint of economic valuation framework. Theoretical part proves the existence of QEV while the empirical part reaffirms it. This concept may prove more acceptable in cost benefit analysis framework compared to Existence value as inclusion of QEV would not swamp other categories of costs and benefits. It can have immense policy implications as it can minimize the ill effects of failure of market mechanisms for this public good in question if considered with other economic values.

Introduction

The existence value can be defined as a nonuse value limited to the existence of a resource (Fredman, 1995) or it is the value that people place on mere knowledge that something exists, even if they will never use it. In converse, option value is the value that people places on having the option to get utility from the resource in the future, although they may not currently use it. These definitions preclude the users of the resource from holding 'existence' type of values but can have different interpretations as the definition of the 'resource' is getting changed. Taking the case of a forest recreationist, he/she can be defined as a '*user*' of the resource i.e. *the tropical forest* in its entirety, as he/she derives utility by viewing the aesthetic beauty or the wildlife but at the same time a '*non-user'* of the *biodiversity of the forest* as a resource. Hence his willingness to pay (assuming a positive WTP) to conserve the biodiversity[1] of forest can be of 'quasi-existence' character.

This argument can be placed in a different way also. Segregating different non-market values of the forest held by recreationist to several sources like Use values (This can be consumptive (Hunting) or non-consumptive (Wild life viewing) use values) and non-use values (Option and Existence values), it can be argued that a recreationist's total value of a resource can be composed of various combinations of the above. Hence it is plausible that the willingness to pay of the recreationist for protecting the biodiversity of the forest can be of quasi existence nature. A simplified representation of these points of view is shown in Figure 1.

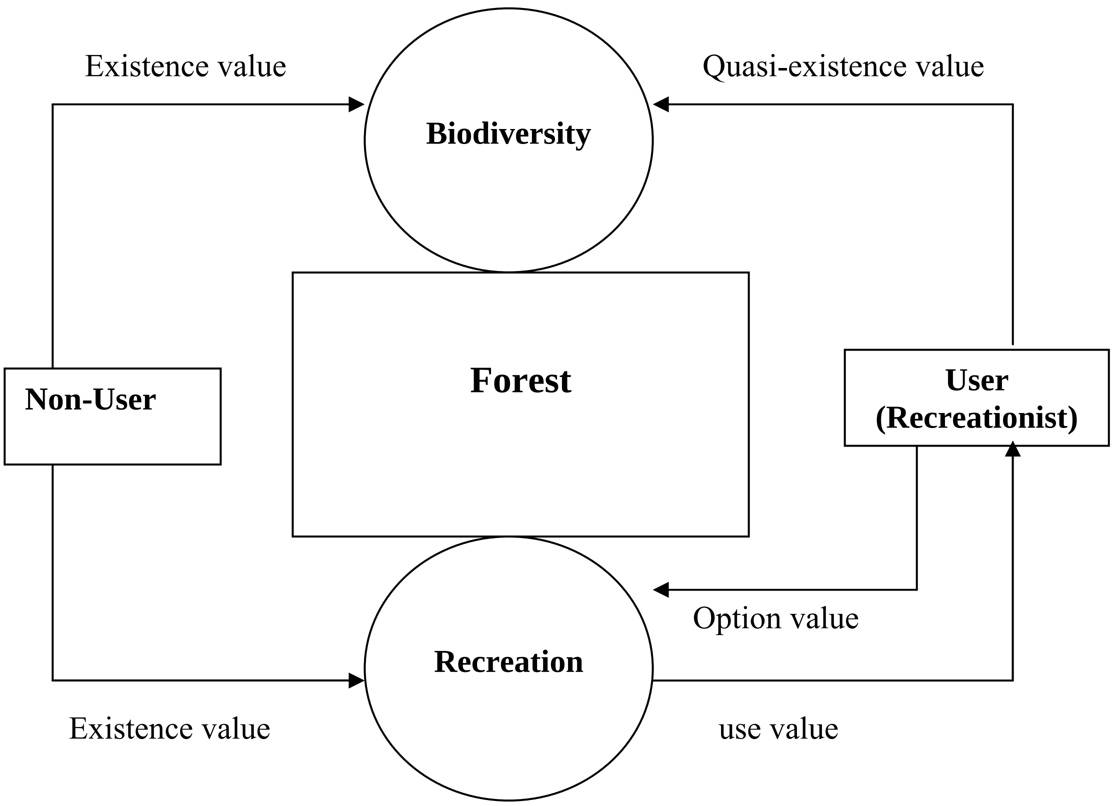

Figure 1: Quasi-existence value of biodiversity and other value dimensions from both users (recreationist) and non-users point of view

[1] Represent biodiversity in general. Not classified as plant/animal biodiversity

Theoretical Overview

Before explaining the 'quasi-existence value', concepts of use value (UV) and existence value (EV) can be examined briefly. In order to decompose the total economic value (TEV) in to its use and non use components, consider a utility model for the public good in question. If utility (U) depends on income (Y) and a public good (FT= forest), then utility (U = U (FT, Y) increases when FT and Y increases.

Use value

Assuming that one wants to visit the forest recreation site once (R=1), the use value can be defined by comparing the utility functions,

$U(FT, Y \mid R=0) = U(FT, Y-UV \mid R \geq 1)$ ……………………….(1)

Equation (1) says that utility with out a trip to visit the site and the entire income, $U(FT, Y \mid R=0)$, is equal to the utility with trips and the use value from the recreation trip subtracted from the income, $U(FT, Y-UV \mid R \geq 1)$ i.e. he /she is indifferent between these two situations. UV is the willingness to pay for the trip(s).

Existence value

While defining the use value, it is assumed that if she/he does not want to take any trip (R=0), the consumer surplus from the good is

$U(FT_2, Y \mid R=0) = U(FT_1, Y - CS_{R=0} \mid R=0)$…………….(2)

Where

FT_1 – Initial state of the forest

FT_2 – Final state for the forest ($FT_1 \geq FT_2 \geq 0$)

In this equation, it is assumed that $CS_{R=0}$ is equal to zero. How ever, this assumption is not necessarily true. Many people want to save the forest even though they never intend to take a trip to the forest recreation site. In this case, the equation (2) becomes,

$U(FT_2, Y \mid R=0) = U(FT_1, Y - EV \mid R=0)$…………….(3)

In the equation (3), the existence value is positive or equal to zero ($EV \geq 0$). The utility function on the left hand side of (3) indicates that either the forest does not exists or it is degraded ($FT_1 \geq FT_2 \geq 0$) and he/ she does not take any trips to them. The right hand side of the utility function specifies that the forest do exist in the original state and one is not taking any trips to visit them. Hence the existence value can be defined as 'the willingness to pay to avoid a change from the initial state (FT_1) of the forest to the final state (FT_2)' by the people who do not even visit them.

The quasi-existence value

Even though the concept of *existence value* covers only the 'non-user' group, the user group (Recreationists) also can hold 'existence' type of values. Let us assume that biodiversity (BD) of the forest at an initial level 'p' is getting reduced to a lower level 'q' due to anthropogenic disturbances, which does not affect the recreational opportunities, the utility function can be,

$U\ (FT_2, Y\text{-}UV\text{-}CS_{BD=q} \mid R \geq 1, BD = q) = U\ (FT_1, Y\text{-}UV\text{-}CS_{BD=p} \mid R \geq 1, BD = p)$ …..(4)

In this equation, it is assumed that $CS_{BD=q} = CS_{BD=p} = 0$.

This assumption can not be always true. The recreationists can have a positive willingness to pay to prevent a reduction in bio-diversity of the forest even though the anthropogenic activity caused the reduction does not affect future recreational opportunities. In this case, the equation becomes

$U\ (FT_2, Y\text{-}UV \mid R \geq 1, BD = q) = U\ (FT_1, Y\text{-}UV\text{-}QEV \mid R \geq 1, BD = p)$ ……….…....(5)

In this case, the quasi existence value (QEV) is positive or equal to zero ($QEV \geq 0$).

The utility function in the left hand side of (5) indicates that the forest exist with high biodiversity and one is ready to undertake trips to visit it, while the left hand side indicates that forest exist with lower biodiversity and one does takes trips to visit it. QEV is the willingness to pay by the recreationists to avoid a decrease in biodiversity of the forest from the initial level (p) to final level (q).

Empirical Proof of Quasi-Existence Value

A theorem or hypothesis concerning values, which individuals might place on non-market goods, is operationally meaningful only if we can conceive of an experiment whereby the hypothesis might be refuted (Cummings and Harrison, 1995). So an empirical study is presented to test the hypothesis that QEV exists and it is positive (QEV≥0).

Research scenario and location

Athirappally forest, a part of Western Ghat[2] forests, India, is bestowed with magnificent waterfalls. The height of the biggest fall is 42 meters and width is 220 meters. The *Athirappall*y forest range extends over 14850 ha and consists of tropical wet evergreen, semi-evergreen and moist deciduous forest types. One special feature of the forest is that part of the forest is less than 300 Meters above Mean Sea Level (MSL) and it is mostly of riparian type. There are hardly any forests in the whole of *Western Ghats* at such a low altitude. The Govt of Kerala, India approved construction of a dam, if materialized, will submerge 104 ha of forest at the upstream end of the Chalakudy River. The Government promised that the dam will not be closed during the day time in order to ensure the water flow to the waterfalls and preserve their beauty. Hence the primary objective of the recreationists i.e. enjoying the beauty of the waterfall or forest is not harmed while the decision may affect the biodiversity of the forest. This is an ideal situation to test the hypothesis that there exists a quasi existence value for biodiversity.

Methodology

A double bounded dichotomous choice contingent valuation was used to estimate the willingness to pay of the recreationists for conservation of biodiversity in Athirappally forest. This method was first suggested by Hanneman (1985). The double bounded dichotomous choice (DBDC) format supplements the initial question (specific monetary amount and the

[2] The Western Ghats situated in peninsular India is one of the biodiversity hotspots of the world

respondent is asked whether he/she is willing to pay that amount for the good in question) with a follow-up question. Thus this approach gives more information on underlying WTP than single dichotomous choice question (Hanneman et al , 1991).

Since no previous studies were conducted in these forests, there was no *apriori* base to determine the bid structure. Hence, bid structure was designed by a pilot survey and the bids of DBDC format were designed to accommodate values from Rs[3].0 to Rs.1200.

A double bounded Logit model was employed to analyze the data. For double bounded model, two dichotomous variables can be observed, i.e. the answers to the first question and to its follow up question. This method produces four possible outcomes i.e. 'YES-YES' (YY), 'YES- NO' (YN), 'NO-YES' (NY) and 'NO-NO' (NN).

Following Hanemann et al (1991), the following response probabilities (P_i) were obtained for the Logit model.

$P_i^{YY} = 1/ (1+ e^{-(\alpha +\beta \text{ HIGH BID})})$

$P_i^{NN} = 1 - 1/ (1+ e^{-(\alpha +\beta \text{ LOW BID })})$

$P_i^{YN} = 1/ (1+ e^{-(\alpha +\beta \text{ HIGH BID})}) - 1/ (1+ e^{-(\alpha +\beta \text{ FIRST BID})})$

$P_i^{NY} = 1/ (1+ e^{-(\alpha +\beta \text{ FIRST BID})}) - 1/ (1+ e^{-(\alpha +\beta \text{ LOW BID})})$

Where

FIRST BID – Starting Bid value

LOW BID –Follow-up lower bid if the answer to the first bid is 'NO'

HIGHBID – Follow-up higher bid if the answer to the first bid is 'YES'

The double bounded log-likelihood function is of the form

$$LDB = \sum_i I_i^{YY} \log P_i^{YY} + \sum_i I_i^{YN} \log P_i^{YN} + \sum_i I_i^{NY} \log P_i^{NY} + \sum_i I_i^{NN} \log P_i^{NN}$$

i = 1,2………… 102.

Where Ii indicated the response category of i^{th} respondent.

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[3] The prevailed exchange rate was US$ 1= Rs.49.00 during the study period

Hanemann et al (1991) showed that the mean willingness to pay (WTP*) could be estimated using the formula

$$WTP^* = \alpha / |\beta|$$

Where,

$|\beta|$ is the absolute value of bid coefficient and α denotes the grant mean excluding the bid variable. Referendum CVM programs (GAUSS) written by Cooper (1999) was used to estimate the double bounded Logit regression.

Bockstael and Strand (1987) have emphasized that the parameter estimates used to calculate welfare measures (α and β) are themselves random variables. So construction of confidence interval is essential for the estimates being plausible. Krinsky Robb confidence intervals estimation procedure as suggested by Park et al (1991) was employed in the study.

Data: The required data for the study were collected from 102 visitors to the forest/waterfall using the personal interview method. The sample was chosen randomly and data were collected using a pre-tested interview schedule developed for the purpose.

Results

The results of double bounded Logit regression are presented in table 1. The coefficient of bid (β) was significant and negative, which was as per expectations about the respondent's behavior. Coefficient of education was positive and significant, implying that educated visitors were more aware of the importance of biodiversity and its conservation. The value of Log likelihood function was high at -118.99. The point estimate of WTP worked out to Rs.206.17 from the DB Logit model (Table 2).

Table 1: Double bounded Logit model results

Variable	Regression Coefficient	Standard error	t value
Constant	-2.086	1.351	-1.544
Bid	-0.00522**	0.000816	-6.391
Age	0.01495	0.01747	0.8561
Education	0.2266*	0.107	2.118
Income	0.00000596	0.00003478	0.1714
Log likelihood = -118.99			

**Significant at 1 percent level
* Significant at 5 percent level

Mean willingness to pay (unrestricted) with Krinsky and Robb confidence intervals are presented in table 2.

Table 2: Mean WTP and Confidence Intervals (Double bounded logit model)

Krinsky-Robb confidence intervals using 1000 repetitions	
95% confidence interval	Rs.111.1 to Rs.277.37
Unrestricted WTP point estimate	Rs.206.17

The total willingness to pay of conserving the biodiversity by the recreationists (Quasi existence value) of Athirappally forest was estimated from the unrestricted point estimate of WTP derived from double bounded logit model, considering the average annual visitation rate (two visits per person) and the payment vehicle (one time payment to the biodiversity conservation fund). The total QEV was worked out to Rs.65.7 Million.

Discussion and Conclusion

The current study has theoretically and empirically proved the existence of the 'quasi existence value of biodiversity (QEV-BD) of the forests. It is the willingness to pay, by the users of the forest resource (Recreationists) to protect the biodiversity of the forest, that he/she places on mere knowledge that it exists., even though he/ she may not use it. The 'QEV-BD' concept can have immense policy implications as Forest ecotourism is a fast developing sector especially in developing countries and the recreationists can have a positive 'willingness to pay' for protecting *the biodiversity* of the forest that they visit even though they would not be using this resource at all.

Widening the scope of economic valuation is the need of the hour because of the increasing institutional tendency to implement the developmental activities based on its costs and benefits. Considering QEV in cost benefit analysis (CBA) with other economic values of the forest can minimize the ill effects of failure of market mechanisms for this public good and lead to more acceptable policy decisions. QEV concept can have more acceptability compared to Existence value in CBA as inclusion of QEV would not swamp other categories of costs and benefits. Limitation of this concept is the difficulty of separating this value from option value of recreation in the cases where the recreational opportunities are also affected by anthropogenic activities that causes the reduction in biodiversity of the forest.

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Appendix 1

Contingent valuation question:

SECTION D: Willingness to Pay for Biodiversity Protection

Background information on Athirappally forests

The Athiarappally forests in Thrissur district of Kerala is famous for its waterfalls and virgin forests. Approximately 3.2 lakh people visit this site every year. The *Athirappall*y forest range extends over 14850 ha and consists of tropical wet evergreen, semi-evergreen and moist deciduous forest types. One special feature of the forests is that part of the forest is less than 300 Meters above Mean Sea Level (MSL) and it is mostly of riparian type. There are hardly any forests in the whole of *Western Ghats* at such a low altitude. There is a proposal with state government to construct a hydroelectric project, which may lead to submergence of a part of this unique piece of forestland.

According to a study by Tropical Botanical Garden and Research Institute (TBGRI), Kerala; the submergible area hosts 329 flowering plants, which includes 24 endemic and 10 rare and endangered species of the Western Ghats. The occurance of *Pothos crassipedunculatus* is a distributional record, which is hitherto known only from Agasthyamala region. The same report mentions about 215 species of animals which includes threatened species like Asiatic elephant, the wild dog, the mouse deer, the Nilgiri langur and endangered species like great Indian horn Bill and Monitor Lizard. Butterflies like southern birdwing and Budha peacock are the threatened species of butterflies in this area. Broad-billed roller, a rare bird was also recorded in the TBGRI study conducted in this area.

18. Assume that a Non Governmental Organization creates a special fund to raise enough money to protect the Athirappally forest and all the donations to this fund go directly towards preserving the biodiversity of this forest and preventing irreversible developments.

Would you be willing make a one-time donation of
Rs. …………………………..**to this fund?** **Yes / No**

IF YES

Would you be willing to contribute Rs. …………………….. Yes / No
(1.5 times the original amount)

IF NO

Would you be willing to contribute Rs. …………………….. Yes / No
(Half the original amount)

(REMEMBER THIS IS A ONE TIME PAYMENT)

Appendix 2

Bid structure of double bounded dichotomous choice contingent valuation

Type of question and Number of respondents posed the question	First WTP question. Are you willing to pay Rs.X If yes go to a If No go to b	Are you willing to pay Rs.Y (High bid, Low bid)
Question 1		
13	Rs.50	a.Rs.75 b.Rs.25
Question 2		
12	Rs.100	a.Rs.150 b.Rs.50
Question 3		
12	Rs.200	a.Rs.300 b.Rs.100
Question 4		
10	Rs.300	a.Rs450 b.Rs.150
Question 5		
10	Rs.400	a.Rs.600 b.Rs.200
Question 6		
11	Rs.500	a.Rs.750 b.Rs.250
Question 7		
12	Rs.600	a. Rs 900 b.Rs.300
Question 8		
11	Rs.700	a.Rs.1050 b.Rs.350
Question 7		
11	Rs.800	Rs.1200 Rs. 400