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Exploring Farmer's Willingness to Pay for the Protection of Ecosystem in Karnataka

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Abstract

In the last few decades there has been a lot of exploitation of resources and degradation in the ecosystem which results in landslides and erosion especially in Kodagu and Chikkamagaluru districts of Karnataka due to excessive human intervention. One of the causes for this exploitation is agro-ecotourism in the study area. The present study was conducted to determine the willingness to pay for the protection of ecosystem by farmers. We used contingent valuation method to analyse the willingness to pay. The study is based on primary data from 40 farmers. Results found that income of the household, number of family members and organizational participation were the factors affecting the willingness to pay for protection.

Keywords : Willingness to pay (WTP), Agro-ecotourism, Contingent valuation method

Agro-eco-tourism is the latest concept in the Indian tourism industry normally occurs on farms which can be defined as the symbiotic association of farming sector, tourism industry and farm business along with ecosystem services and also the economic activity that occurs when people link travel with agricultural products, services or experiences to cater to the needs of mutual demands (Barbuddhe and Singh, 2014).

Agro-eco-tourism entails visiting a working farm or any agriculture, horticulture or agribusiness operation, for the purpose of leisure, education or active involvement in the activities of the farm or operation. It provides an opportunity to experience rural life, taste the local food and get familiar with the various farming tasks during the visit. This provides visitors with an escape from the daily hectic life in a peaceful rural environment. Some eco-tourism destinations in Karnataka include Chikkamagaluru, Madikeri, Dakshina Kannada, Karwar, Sirsi, Mysuru etc.

Concentrating on agro-eco-tourism will reinforce the employment potential of the agriculture along with tourism sector through increased local hiring and sourcing and significant opportunities in tourism oriented toward local culture and the natural environment. In agro-eco-tourism subsector, increasing the involvement of local communities, especially the poor, in the tourism value chain can contribute to the development of local economy. This can include the local supply of products, labour and tourism services. Further, considerable importance is given to conserve the natural ecosystem of the place. This has positive impact on farmer's life through supplement income and additional employment. On the other hand this also causes negative impact on environment resulting in degradation, pollution and other natural calamities due to excessive human intervention. It's our responsibility to protect the environment. Therefore, the main focus of the current study is to determine the willingness to pay of farmers to protect the ecosystem.

Methodology

The study was carried out in Chikkamagaluru and Kodagu districts of Karnataka during the year of 2020-21. Purposive proportionate sampling technique was employed for selection of farm households. Data was collected from 40 farmers using pre-tested well-structured schedule through personal interview method.

Economists are interested in assigning a monetary value to non-marketed goods and measuring benefits of government policies, including non-use values

(Hanemann *et al*., 1991) and they commonly use methods like hedonic pricing, travel cost method and the contingent valuation method (Carson *et al*., 2001). The contingent valuation method aims to estimate, contingent upon the hypothetical market situation, the willingness to pay (or accept) for change in the provision of some goods or services (Lopez-Feldman, 2013). Contingent valuation can be carried out using several methods the most commonly used are open-ended questions, bidding game, single-bound or double-bound dichotomous choice question and choice experiments and the most robust are discrete choice methods, double-bound or single bound, because they make decision-making easy for the respondent. In open-ended questions, the respondent is asked directly to state, contingent upon the hypothetical market, what they would pay for a product or service. The open-end question method is criticized because it requires respondents to think too much about the range of utilities and alternatives and arrive at a suitable price. In the discrete choice format, also called the single bound discrete choice contingent valuation method, a pre-decided bid value is offered to the respondent and they are asked whether they would pay the amount (Yes / No - discrete choice). The discrete choice format is preferred because it closely mimics the real-life scenario of purchase decisions, where the price of the product is listed and one buys it or goes without. But in this method neither the 'yes' nor the 'no' response is bounded, if the responder agrees to pay the bid amount say, 'X' we can infer only that his true willingness to pay exceeds X. This limitation can be overcome by asking a follow-up question and this method, known as the double-bound contingent valuation method, is more robust and less affected by bias (Kanninen, 1995). This study follows the doublebound contingent valuation method. As a test, we asked farmers an open-ended follow-up question: what would they pay to protect the ecosystem.? The key to the success of the contingent valuation method lies in developing a hypothetical market situation for the product or service in question and in eliciting the willingness to pay contingent upon it (Carson *et al.*, 2001; Hanley *et al*., 2001 and Tinch *et al*., 2015).

This study estimates farmer's willingness to pay for protection of ecosystem. Before presenting the bids, the enumerator explained that if any procedure to collect the payment and utilization of it for the protection by non-governmental organization. Each respondent is offered a random bid amount and asked whether they are willing to pay at that rate; a dichotomous variable captures the response (yes / no). If the farmer responds yes, the enumerators raises the bid by INR 250, when they ask the second dichotomous choice question; if the farmer responds no, the enumerator lowers the bid by INR 250, Depending on the answer, we have information on two bids and yes / no responses, which distinctively improve the accuracy of the estimates of farmers' willingness to pay (Hanemann *et al*., 1991 and Gao *et al*., 2010) and we can use this information to estimate the willingness to pay econometrically.

Econometric Estimation of the Willingness to Pay

Let t_1 and t_2 be the two bid amounts and the two variables capturing the response be, respectively, Y_{1i} and Y_{2i}. Farmers can respond (Yes, No), (Yes, Yes), (No, Yes) or (Yes, No).

1. (Yes, No) : The farmer is ready to pay the initial bid amount ($Y_{1i} = 1$) but they reject the second bid amount ($Y_{2i} = 0$). The probability of this response is

$$Pr\ (Y, N) = Pr\ (t_1 \leq WTP < t_2) \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

if the willingness to pay (WTP) depends on a set of explanatory variables, *i.e.,* WTP $(Z_i, u_i) = Z_i\beta + u_i$, where Z_i is the vector of explanatory variables and β represents corresponding coefficients. Assuming that the error term is normally distributed with 0 mean and standard deviation of ó, we can rewrite Equation 1 as

$$Pr\ (Y, N) = \phi \left[\frac{t_2 - Z_i^I \beta}{\sigma} \right] - \left[\frac{t_1 - Z_i^I \beta}{\sigma} \right] \quad \ldots.(2)$$

2. (Yes, Yes): Here, $Y_{1i} = 1$ and $Y_{2i} = 1$ and probability can be written as

$$Pr\ (Y, Y) = Pr\ (t_1\ t_2) \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Applying Bayes' rule of probability and rearranging,

$$\Pr(Y, Y) = 1 - \phi \left[\frac{t_2 - Z_i^I \beta}{\sigma} \right] \quad \ldots.(4)$$

3. (No, Yes): In this case, $Y_{1i} = 0$ and $Y_{2i} = 1$

$\Pr(N, Y) = \Pr(t_1 > WTP \leq t_2)$……..(5)

$$\Pr(N,Y) = \phi \left[Zi \frac{\beta}{\sigma} - \frac{t_2}{\sigma} \right] - \phi \left[Zi \frac{\beta}{\sigma} - \frac{t_1}{\sigma} \right] \quad \ldots.(6)$$

4. (No, No): $Y_{1i} = 0$ and $Y_{2i} = 0$

$\Pr(N, N) = \Pr(t_1 < WTP < t_2)$…….. (7)

$$\Pr(N, N) = 1 - \phi \left[Zi \frac{\beta}{\sigma} - \frac{t_1}{\sigma} \right] \quad \ldots.(8)$$

Equations 2, 4, 6, and 8 can be expressed in likelihood functions as

$$\sum_{i=1}^{n} \left[d_i^{yn} \ln \left[\phi \left[\frac{t_2 - Z_i^I \beta}{\sigma} \right] - \left[\frac{t_1 - Z_i^I \beta}{\sigma} \right] \right] \right]$$

$$+ d_i^{yy} \ln \left[1 - \phi \left[Z_i^I \frac{\beta}{\sigma} - \frac{t_1}{\sigma} \right] \right]$$

$$+ d_i^{ny} \ln \left[\phi \left[\left[Z_i^I \frac{\beta}{\sigma} - \frac{t_2}{\sigma} \right] \right] - \left[Z_i^I \frac{\beta}{\sigma} - \frac{t_1}{\sigma} \right] \right]$$

$$+ d_i^{nn} \left[1 - \phi \left[Z_i^I \frac{\beta}{\sigma} - \frac{t_2}{\sigma} \right] \right]$$

where d_i^{yn}, d_i^{yy}, d_i^{ny} and d_i^{nn} are indicator variables which takes value zero or one depending on the respective response. From the estimates, we can compute the WTP: WTP on mean = β_0 * Constant + $\Sigma_{j=1}^{k}$ (Mean value$_j$ * β_j), where j = 1. . . k represents the control, variables used in the analysis review (Ravi & Umesh, 2018 and Divya, 2015). Suitable controls (Table 1) were selected based on the theoretical expectations and literature. From this estimate, it is difficult to quantify the impact of different variables on the willingness to pay, but it is possible to predict for each respondent by making use of the coefficients of maximum likelihood estimation. The determinants of the willingness to pay for protection of ecosystem were analysed using as dependent variable with a set of explanatory variables.

TABLE 1

Description of the control variables used in the analysis

Variable	Unit	Description
Land	Acres	Total land cultivated by farmer
Income	Rupees	Total income of farmer from agro-eco-tourism
Age	Years	Age of the respondent
Gender	Dummy	Equal to 1 if the respondent is male, otherwise 0
Marital status	Dummy	Equal to 1 if respondent is married, otherwise 0
Education	Years	Years of education
Household size	No.	Number of family members
Organizational participation	Dummy	Equal to 1 if the farmer is member/ office bearer of any agency, otherwise 0
Indebtedness	Dummy	Equal to 1 if the farmer is indebted, otherwise 0

Logistic Regression

To elucidate the factors affecting the willingness to pay (WTP) for protection of ecosystem, logistic regression was employed. The regression was run with willingness to pay as dependent variable with value 1 for the respondents who are willing to pay and 0 for the respondents who are not willing to pay.

The basic form of the logistic function is,

$$p_i = p_i \left(Y = \frac{1}{X_1, X_2, X_3, X_4, \ldots\ldots X_k} \right) = \frac{e^Z}{1 + e^Z} = \frac{\exp(z)}{1 + \exp(z)} \quad \ldots.(9)$$

Where, Z = $\beta_0+\beta_i X_i$ and X_i are set of predictor variables.

$$\frac{Pi}{1-pi} = e^{Zi} \text{..... (10)}$$

$$L_i = \ln\left(\frac{p_i}{1-p_i}\right) = z_i = \beta_0 + \beta_i X_i \text{ ..... (11)}$$

The quantity $\frac{p_i}{1\text{-}pi}$ is called the odds and hence, ln $(\frac{p_i}{1\text{-}pi})$ is Logit. The coefficients β_i are logit regression coefficients. Odds ratio was computed using these coefficients. In the case of a dichotomous independent variable, the odds ratio can be interpreted as the increased odds of a positive outcome on the dependent variable for the affirmative category (X=1) over the negative one (X=0). Logistic regression commands in the Stata 14.2 version software was used to analyze the data.

Tobit Analysis

A sample in which information on the dependent variables are available only for some observations is known as a censored sample and in such cases tobit is used (Gujarati, 2004). In view of the fact that the actual willingness to pay was zero for few farmers, tobit model was estimated to find the factors affecting the actual WTP. Censored tobit regression commands in the Stata 14.2 version softwarewere used to find the maximum likelihood estimation of the independent variables.

$Y_i = \beta_0 + \beta_i + u_i$ if RHS > 0 and $Y_i = 0$, otherwise..... (12)

The following model was used,

WTP (Rs.) = $\beta_0 + \beta_1 (X_1) + \beta_2 (X_2) + \beta_3 (X_3) + \beta_4 (X_4) + \beta_5 (X_5) + \beta_6 (X_6)$

X_1 - Land
X_2 - Income of the household
X_3 - Age
X_1 - Land
X_2 - Income of the household
X_3 - Age
X_4 - Education
X_5 - Household size
X_6 - Organizational participation

Results and Discussion

The data was analysed from the primary survey (designed in double-bound contingent valuation format). The landholding size of the respondents was found to average 19.40 acres. Most of the farmers were literate with the average age 46.8 years (Table 2). In contingent valuation method studies, it is important to consider the distribution of initial bid amounts to overcome the 'initial bid bias'.

Table 2

Summary statistics of respondents

Variable	Unit	Average value
Farmer's age	Years	46.8
Land owned	Acres	19.40
Education	Years	15.50
Gender	Dummy=1 if Male, 0 otherwise	0.87
Household size	No.	4.17
Marital Status	Dummy = 1 if Married, 0 otherwise	0.87
Indebtedness	Dummy = 1 if indebted, 0 otherwise	0.37
Organizational participation	Dummy = 1 if household has Organizational participation, 0 otherwise	0.42
Income from agro-ecotourism	Rupees	3807564

Eight initial bids were priced between INR 500 and INR 2,250 to match the amount payable for protection at different rates. Farmers charge average of 2000

Table 2

Distribution of initial bid

Initial bid	Frequency
500	6
750	6
1000	6
1250	5
1500	5
1750	6
>1750	6
Total	40
Mean WTP	1031.25

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TABLE 3

Distribution of initial bid and corresponding answers

Bid	500	750	1000	1250	1500	1750	>1750	Total
No	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (20%)	2 (33.40%)	2 (33.40%)	5 (12.50%)
Yes	6 (100%)	6 (100%)	6 (100%)	5 (100%)	4 (80%)	4 (66.60%)	4 (66.60%)	35 (87.50%)
Total	6	6	6	5	5	6	6	40

Note: Percentage figures in parentheses indicate percentage of total

per person per day to stay in their place. We selected bid amounts starting from INR 500 and randomized the bids using a computer program and minimized the bids above INR 2,500 as they were too high for farmers (Table 3). As the price of a good increases, its demand decreases and as the bid amount increases the probability of a 'no' response is expected to increase; we employ this 'price test', as it is termed in the contingent valuation method literature (Carson *et al*., 2001), by tabulating the initial bid and the corresponding response (Table 4). The 'no' responses rose as the bids increased from INR 500 to INR 1,750 and above.

The maximum likelihood estimation method was used to estimate the willingness to pay (Table 5). To improve the accuracy of estimation we use as control the variables related to age, gender, education, organizational participation, household size, indebtedness and income from agro-eco tourism. The coefficients of these control variables (presented in the first part of the table) are positive and significant, and these indicate a positive relationship between a 'yes' response, but the magnitude of influence cannot be inferred from the coefficient. Land holdings and income of the household were the two factors that increase the probability of a 'yes' response to the bid, were the two main indicators of the ability to pay for protection; both have a positive coefficient, in line with the expectation. Farmers having more number of family members were reluctant to pay for the protection as indicated by negative coefficient. Members or office bearers of any institution showed positive relationship with payment to protect the ecosystem.

TABLE 5

Extent of farmer's willingness to pay for the protection of ecosystem

Variable	Co-efficient	P value
Land	4.16	0.80
Income of the household	0.0002 *	0.00
Indebtedness	-86.94	0.61
Age	2.03	0.79
Gender	-70.21	0.75
Education	85.79	0.32
Household size	-108.71 ***	0.07
Organizational participation	424.41 ***	0.01
Constant	815.02	0.05

Note: * Significant at 1%; ** Significant at 5%; *** Significant at 10%

Income of the household, household size and organizational participation had a significant effect on the farmer's willingness to pay. If the income of farmer increases by one unit then the WTP increases by 0.0002 units.

Logistic regression model was used to analyse the factors determining the farmer's willingness to pay (Table 6). Pseudo R^2 value was 0.65 indicating that 65 per cent of the variation in WTP is explained by the explanatory variables included in the model. The overall model was significant at one per cent (P > chi-square = 0.009). Results revealed that income of the household and organizational participation have positive significant effect on willingness to pay. Most of the farmers were highly educated with degree but the result didn't show significant effect on willingness to pay. The house

TABLE 5

Factors affecting willingness to pay for protection of ecosystem

Variable	Co-efficient		P value	Exp (B)	1/ Exp
Land	0.34		0.10	0.71	1.40
Income of the household	0.01	***	0.04	1.80	0.55
Age	0.34		0.69	0.96	1.03
Education	9.77		0.99	1.75	0.57
Household size	-0.60		0.47	0.54	1.83
Organizational participation	3.76	***	0.07	0.23	4.34
Constant	-143.98		0.99	0.00	0.00

Note: chi-square=0.009, Pseudo R^2= 0.65, ***Significant at 10%; ** Significant at 5%

hold size of the respondent showed negative non-significant effect on willingness to pay.

Protection of ecosystem plays a vital role in sustainable development by regulating the degrad ation of natural resources. Agro - ecotourism involves conversion of forest land into agricultural land and also for the infrastructure development incudes roads, buildings for home stays leads to rise in more exploitation. This causes decline in the value of ecosystem services. To curtail this we must protect our ecosystem from ill effects of agro-ecotourism. The present study was conducted to explore the willingness to pay of farmers to protect the ecosystem. We found that income, household size and organizational participation were the main drivers to pay for the protection of ecosystem. Government has already taken several measures to protect theenvironment but it's our responsibility to take care of god nature with co-operation.

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