

Willingness to Pay for Offsetting Carbon Programs by Vehicle Owners in Sunsari District, Nepal

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Abstract:

The objective of this study was to assess the willingness to pay (WTP) of vehicle owners for carbon offsetting programs. This study could potentially assist local governmental institutions to take further steps in environmental conservation programs. A contingent valuation method was used. Open-ended questionnaire surveys were conducted with 181 respondents. The results revealed that WTP was dependent on several demographic variables including educational level, occupation, gender, and residential area. However, only occupation and educational level significantly affected the WTP of the respondents. The total WTP was 600 NRs.

Key Words: WTP, Community forest, Carbon offsetting programs, Kyoto Protocol, REDD

Introduction

The 1992 Earth Summit raised socio-political awareness of climate change and its potentially adverse effects. The Kyoto Protocol of the United Nations Framework Conventions on Climate Change is a treaty whereby industrialized countries commit to reducing greenhouse gases within a period of four years. Three programs were developed during the first phase of the Kyoto Protocol: the International Emission Trading (IET) program, the Clean Development Mechanism (CDM) program, and the Joint Implementation (JI) program. IET and JI were developed for developed countries to reduce emissions through emission trading quotas. CDM was developed for developing countries to reduce emissions through carbon dioxide sequestration. With the Kyoto Protocol, several voluntary emission reduction programs have been developed in Europe and other developed countries.

Community-based forestry regimes have restored denuded landscape and created opportunities to produce diverse forest products and services for several stakeholders groups, including in local and international communities. The 2007 Bali Action Plan allowed developing countries such as Nepal to participate in forest carbon financing opportunities

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through the reduction of emissions from deforestation and forest degradation. However, there are many issues that need to be addressed, including the number of individuals who depend on forest for their livelihoods. Community forestry reduces deforestation and degradation in the Himalaya region of Nepal.

From a climate perspective, community forestry has contributed to enhancing natural sink capacity. Voluntary carbon offsetting programs provide further incentives for sustainability strategies. In voluntary carbon offsetting programs, environmentally-conscious individuals and governments compensate for their greenhouse gas emissions by purchasing carbon credits from offset providers. Offset providers subsequently invest in carbon emission reduction projects. In Nepal, the condition of the forests, especially in hill areas, is improving. However, local people do not obtain significant benefits from purchasing carbon credits. Voluntary carbon offsetting programs should therefore be more effective in allowing public participation in sustainable forest management. Certain changes should be implemented in the voluntary carbon offsetting programs whereby wealthier people, who contribute to carbon emissions, pay for those individuals who are environmentally-conscious and aim to conserve the environment.

The purpose of the study is to encourage local governments to initiate programs that ensure benefits for individuals and communities that conserve forests. A hypothetical scenario was developed whereby in the near future the municipality of Dharan announces carbon offsetting programs that can reduce and offset gas emissions. Based on the program, the municipality of Dharan requests a monetary contribution from vehicle owners, who supposedly contribute more carbon emissions than non-vehicle owners. The willingness to pay (WTP) and contribute to carbon offsetting programs was evaluated in a group of vehicle owners. The results of this study may assist local governments in the implementation of local carbon offsetting programs that provide benefits to the local community forest and help in the protection of the environment.

Materials and Methods

Contingent valuation method

A contingent valuation method (CVM) is defined as a “stated preference method”. The CVM is a method that allows individuals to tell researchers directly and through surveys what they are willing to pay for environmental services and/or improvements including potable water services (use value) and biodiversity and carbon offsetting programs (non-used value). A survey was designed to facilitate face-to-face interviews to assess the WTP from respondents. CVM relies on referendum formats using the dichotomous-choice method and the bidding game approach. The dichotomous-choice method tends to overestimate WTP, especially in low income countries. Additionally, obtaining statistically reliable results from a dichotomous-choice survey requires a very large sample size. Therefore, an open-ended questionnaire survey, which is the most common and simplest CVM format, was used to assess WTP.

Questionnaire design

Questionnaire design is the first and most important step; an effectively designed questionnaire can provide useful information on WTP. In the design of the questionnaire, three major points were taken into consideration: the questionnaires consistently gathered the same type of information, were provided by experts on the subject, and were easy to understand by the average respondent. Experienced researchers were consulted prior to conducting the surveys to improve questionnaire design, provide understandable description of carbon offsetting services, and allow feedback from the respondents. The questionnaire had six sections (Carson et al, 2001):

- The first section introduced the purpose of the survey.
- The second section provided a clear and detailed description of the valued good. It also included a section where the surveyor recorded the attitudes of the respondents towards the valued good.
- The third section introduced the contingent valuation scenario. It also included the current or baseline situation (i.e., status quo) and possible future natural resources in the case that the proposed policy was not implemented. This included the institutional context in which the valued good was going to be provided and the form of payment.
- The fourth section, i.e., the elicitation section, asked the respondents for their maximum WTP to obtain the valued good and for their minimum WTA for giving up the valued good.
- The fifth section asked the respondents to verify the answers provided.
- The sixth and last section was devoted to debriefing questions on the socio-demographic characteristics of the respondents.

Survey administration

The method by which surveys are administered constitutes another important step. Survey administration is performed on the basis of the population, survey mode, sampling approach, and sample size. Public surveys may be performed through several methods, e.g., mail, telephone, in person (i.e., face-to-face interviews), or internet. Face-to-face interviews were chosen because the other methods were not practical for the purposes of this study.

A random sampling approach was used to select the respondents. In the city, surveyors looked for parked vehicles and interviewed the vehicle owners. Sample stratification is usually performed with sample clustering based on age or gender. However, in this study the parked vehicles were chosen and sample stratification was performed while analysing the data.

The interviews were conducted during the evenings of work weeks so that individuals were not in a rush. During the holidays, interviews were conducted during the day. On average, each interview lasted approximately 15–20 minutes.

Result and Discussion

This study was conducted to assess the WTP by vehicle owners for carbon offsetting programs using a CVM. This method can sometimes overestimate results. Carbon offsetting programs might be developed in the municipality of Dharan in the future. This study, which consisted on a hypothetical scenario to assess WTP, was therefore conducted in the municipality of Dharan. A summary of the socio-economic and demographic characteristics of the respondents is shown below.

Table 1: Socio-demographic characteristics of the respondents

S.N.	Respondent characteristics	Number	%	S.N.	Variables	Number	%
1	Number	181		4	Residential area		
2	Age (y)			4	Sunsari district	109	60.2
	<18	0			Adjoining districts	46	25.4
	18–30	61	33.70		Other districts	26	14.4
	31–43	61	33.70	5	Educational level		
	44–56	59	32.60		Secondary	96	53
>56	0		Bachelor’s degree		58	32	
3	Gender			Master’s degree	27	15	
	Male	141	77.9	6	Occupation		
Female	40	22.1	Business		72	39.8	
					Service	71	39.2
					Student	38	21

In this study, 200 individuals were recruited. However, 19 individuals refused to respond to the questionnaires, thus 181 respondents participated in the survey. Each age group (i.e., 18–30, 31–43, and 44–56 years of age) had approximately the same number of respondents (i.e., 33%). The number of male respondents was >80%. More than 50% of the respondents lived close to the study site (i.e., Sunsari district). Other respondents (25%) lived in nearby districts whereas 14% of the respondents came from other parts of the country for business or personal reasons.

Most of the respondents only had secondary education. Thirty two percent of the respondents had a bachelor’s degree and fifteen percent of the respondents had a Master’s degree. The survey was conducted with vehicle owners; thus most of the respondents were business men, followed by service personnel and students.

Descriptive statistics

In this study, male respondents had a higher WTP ($1,027 \pm 416$) than female respondents (860 ± 380). The reason for this discrepancy could be attributed to certain demographic differences (e.g., education level and residential area). In general, WTP increased with educational level. In respondents with Master's and Bachelor's degrees, the WTP was $1,148 \pm 410$ and $1,014 \pm 397$, respectively. Less educated respondents had the lowest WTP (927 ± 414). Business men expressed a higher WTP than service personnel or students. The mean WTP was $1,225 \pm 363$ in business men, 872 ± 395 in service personnel, and 766 ± 310 in students.

The respondents who lived in the district where the study was conducted (i.e., Sunsari district) expressed the highest WTP. On the other hand, the lowest WTP was obtained from respondents who lived in other parts of the country. The average WTP was $1,013 \pm 414$ from respondents from the Sunsari district, 996 ± 428 from respondents from nearby districts, and 885 ± 383 from respondents from other parts of the country.

Multiple regression results

A multiple regression model was used to assess the effects of the demographic characteristics (e.g., gender, residential area, educational level, and occupation) on the respondents' WTP. The demographic characteristics were the independent variables whereas WTP was the dependent variable. Assuming that K independent variables are related to the dependent variable, a multiple regression model can be represented by the following equation:

$$Y = \beta_0 + \beta_1' x_1 + \beta_2' x_2 + \beta_3' x_3 + \beta_4' x_4 + \dots + \beta_k' x_k + \varepsilon$$

Where Y is the dependent variable; x_1, x_2, \dots, x_k are the independent variables; $\beta_1, \beta_2, \dots, \beta_k$ are coefficients; and ε is the error variable. In this study, the multiple regression model was the following:

$$WTP = \beta_0 + \beta_1 \times gender_i + \beta_2 \times residential\ area_i + \beta_3 \times educational\ level_i + \beta_4 \times occupation_i + \varepsilon$$

A summary of the multiple regression model is shown in Table 2. The coefficient of determination, R^2 , was 0.259. This means that 25.9% of the variation in WTP could be explained by the four independent variables, whereas 74.1% of the variation remained unexplained. The adjusted R^2 means that R^2 had been adjusted to take account the sample size and the number of independent variables.

Table 2: Multiple regression model results

Model Summary								
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.509 ^a	.259	.242	359.84597	.259	15.353	4	176

a. Predictors: (Constant), Sex, Education_status, Residence, Occupation

The coefficient of determination and the F-value were analysed to assess how the multiple regression model fit the data. The adjusted R² was 0.242, which implies that there was some variation in WTP. The variation in WTP could be explained by the multiple regression model equation. A small F-test value was indicative that most of the variation in WTP remained unexplained. The rejection region allowed us to determine whether the F-test value was large enough to reject the null hypothesis. In this study, the null and alternative hypotheses were:

$$H_0: \beta_1 = \beta_2 = \dots = \beta_k = 0$$

H_A: At least one β is not equal to zero

The test rejection region is where $F > F_{\alpha, K, n-k-1}$ assuming $\alpha = 0.05$. In this study, the F-test value was 15.352 and the F-critical value was 2.37 (at $\alpha = 0.05$); thus, 15.352 (F-test value) > 2.37 (F-critical value). Therefore, the statistical analyses revealed that the multiple regression model was useful and that the independent variables should be included in the analysis of WTP because they have a significant effect on WTP.

Table 3: WTP coefficient

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1381.791	136.066		10.155	.000
	Residence	1.441	37.316	.003	.039	.969
	Occupation	-283.449	42.307	-.520	-6.700	.000
	Education_status	124.163	36.212	.224	3.429	.001
	Sex	-107.884	75.713	-.109	-1.425	.156

a. Dependent Variable: WTP_Amount_NRS

The coefficient of regression reveals the nature and magnitude of the relationship between the different independent variables. A positive coefficient of regression from the t-test is expected because the F-test value only explains the magnitude of the relationship between the variables. Based on the t-test, the intercept (β₀) was 1,381.71; this is the WTP value when the independent variables are equal to zero.

The relationship between WTP and residential area was assessed by the coefficient β_1 , which had a value of 1.44. Therefore, assuming that the other independent variables are held constant, the residential area variable increases WTP.

Testing the coefficients

There is more than one independent variable in a multiple regression model. We can test whether there is a linear relationship between each independent variable and the dependent variable. The null and alternative hypotheses in this study were:

$$H_0: \beta_i = 0$$

$$H_A: \beta_i \neq 0 \text{ (where } i = 1, 2, 3, \dots, k)$$

Based on the statistical analyses, $t\text{-test} = -6.70$ $t\text{-critical} = 1.65$ at $\alpha = 0.05$; thus, $t\text{-test} > t\text{-critical}$. Therefore, the null hypothesis was rejected and we concluded that there was a significant effect of occupation on WTP. Furthermore, the $t\text{-test}$ results revealed that educational level was significant at $p < 0.05$; $t\text{-test} (3.429) > t\text{-critical} (1.65)$. The null hypothesis was rejected and we concluded that there was a significant effect of educational level on WTP. The p -value of the two other independent variables (i.e., residential area and gender) was higher than 0.05; thus, the null hypothesis was not rejected. Both residential area and gender had no significant effects on WTP based on the multiple regression model.

In summary, an individual with high educational level and economic status would be more willing to pay a high amount of money to reduce carbon emissions and thus improve the environment. On the other hand, gender and residential area had no effect on WTP.

WTP curve

From the data, we created a WTP curve to reveal the percentage of respondents willing to pay for carbon offsetting programs. WTP ranged from 500 to 2,000 NRS. These amounts were divided into 16 WTP points. The percentage of respondents falling into each of those 16 WTP points was calculated and plotted (Figure 1).

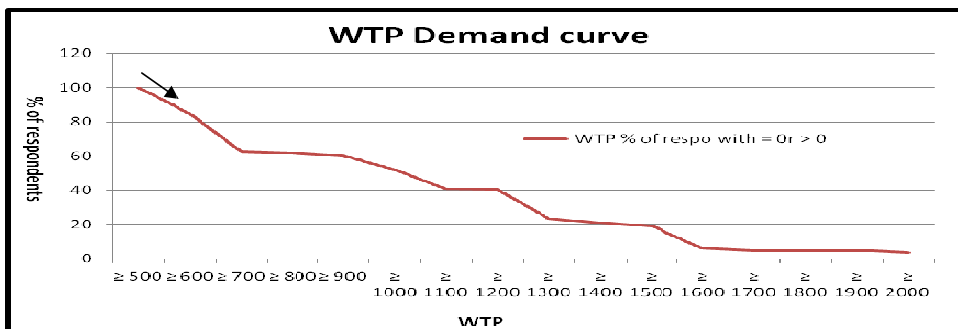


Figure 1: WTP curve

Based on Figure 1, the total WTP can be calculated by the area under the curve:

Total WTP = $2,000 \times 3.9 + 1,900 \times 1.1 + 1,800 \times 0 + \dots + 600 \times 22.7 + 500 \times 14.5 = 99,234.92$ NRs

The average WTP was 548.26 NRs. But the demand curve shows there was a sharp decrease in the number of respondents who are willing to pay between 600 and 700 NRs. Therefore the highest amount that the respondents were willing to contribute was 600.

Conclusions

The purpose of study was to assess the WTP by vehicle owners for carbon offsetting programs in an attempt to assist local government institutions and stakeholders take some important steps forward on environmental conservation. The statistical analyses revealed that educational level was a key factor contributing to WTP and thus, environmental conservation. In addition to educational level, occupation was another contributing factor. The results of this study clearly revealed the businessmen would be more willing to pay a higher amount of money for carbon offsetting programs.

The study only evaluated the WTP on an annual basis. Further studies should focus on fuel consumptions and emissions by different vehicles. Furthermore, the carbon sequestration of the community forest should be assessed for a more thorough understanding of the current situation.

To the best of our knowledge, this is the first study conducted in Nepal on the WTP for carbon offsetting programs. The results obtained in this study can stimulate other researchers to conduct further studies. The number of individuals who participated in this study was quite small. Therefore, these results might not be applicable for problem-solving and decision-making. However, this study might bring awareness to stakeholders including community forest user groups, municipalities, and district development committees, among others.

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