

## Cost Benefit Analysis of Environmental Protection Initiatives



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### Introduction:

Our relationship with the environment has undergone several changes. During primitive times, we lived in complete harmony with nature. Nature was, in fact, worshipped. We considered ourselves as an integral part of nature. However, the period of industrialization witnessed increasing mastery of man over nature. Further, technological advances during the twentieth century resulted in increased materialism and consumerism, but without concern for nature leading to environmental disturbances.

Fortunately, a change has been observed in the attitude of mankind towards environment since the last three decades, thanks to the efforts of grass-root community initiatives. Now, we live in a world which is aware of environmental issues, at least to some extent. Over a period of time, natural resource management or environmental management has emerged as a major worldwide concern. In this quest, environmental economics plays a pivotal role, as it enables us to address and tackle environmental challenges. It acts as a channel between the traditional techniques of decision-making and environmentally sensitive approach.

Environmental goods, services or amenities hold the characteristics of public goods/ services, i.e., they are non-excludable and non-rivalrous goods. With increasing thrust on the concepts of environmentalism and sustainable development, the valuation of environmental resources and its inclusion in benefit-cost analysis of projects has gained prominence (Munasinghe, 1993). It has been widely acknowledged that environmental amenities hold opportunity cost, which is neither 'traded' nor priced by the market mechanism. This is due to the fact that environmental goods have imperfect markets, wherein price mechanism does not exist.

Valuation of environmental amenities supports estimation of values of costs and benefits, which is essential for sizing the changes in individual welfare from alternative uses of these resources. As the framework of cost benefit analysis (CBA) requires imputing monetary values on all the benefits and costs, valuation of environmental resources becomes very important.

One of the most popular methods for valuing natural resources is the contingent valuation method (CVM). CVM, as it is popularly called, is a survey-based method, applied to estimate the use as well as the non-use value of public goods/ services. CVM is being more widely used in appraising natural resource damages and decision-making.

The present paper attempts to estimate the monetary value of cost and benefits of environmental protection initiatives of a grass-root organization - Hariyali. The researchers applied CVM to elicit the monetary value of benefits of Hariyali's environment protection (EP) services.

The profile of respondents has been studied in respect of age, gender, income and occupational profile.

A large number of respondents belong to the young age groups of 25 to 50 years. The sample consists largely of female respondents. As per classification of respondents on the basis of income, a large number of households earn a monthly household income in a range of Rupees 10,000 to Rupees 20,000 and majority of them are employed in services sector.

At the outset, this paper presents the objectives of the study. Section 2 discusses the role of grass-root organisations in protecting environment, with special reference to Hariyali. The significance and application of CVM is detailed in Section 3. Sections 4 and 5 present the hypotheses and methodology of the research study, respectively. Findings of statistical analysis are presented in Section 6. At the end, researchers share concluding remarks and policy implications.

## **1. Objectives of Study:**

Following are the objectives of the study:

- Estimating and comparing the monetary value of cost and benefits of environment protection activities of Hariyali
- Identifying factors determining the value of willingness to pay

## **2. Role of Grass-root Organisations in Environment Protection, with reference to Hariyali:**

Grass-root organisations play a key role in environmental conservation and protection. Hence, several Indian intellectuals and activists have played an active role in setting up various voluntary organizations to address environmental concerns. They have efficiently gained the support of media at times.

<sup>1</sup> Non excludable and Non-rivalrous goods provide benefits that no one can be excluded from enjoying. These services can be consumed simultaneously by many people. Moreover, the additional consumption of these goods by one more individual does not impose additional marginal costs to its production

Activists like Sunderlal Bahuguna (wrtio led Chipko/ save the Himalay movement and anti-Tehri dam movement), Medha Patkar (who led Narmada Bachao Andolan), Rajendra Singh (who led Tarun Bharat Sangh for watershed development in Rajasthan) and Birbhadra Mishra (who led the Sankar Mochan Foundation of Varanasi to clean Ganges) have succeeded in putting pressure on the state authorities to reconsider policies through their intense campaigns and scholastic writings.

The environmental organisations in India are engaged in several micro and macro environmental movements, aiming at not only building environmental awareness among the people and restoring the ecological order but also at establishing confidence among the people on their indigenous mode of resource consumption. Moreover, other aims of these grass-root organisations have been to ensure stakeholders' participation in local development projects, leading to their empowerment.

The environmental movements in India such as, Chipko in Uttaranchal, Silent Valley in Kerala, Apiko in Karnataka, Narmada Bachao Andolan in Madhya Pradesh, Save Gandhamardan Hills in Orissa, Koel-Karo in Ranchi, Protest against Kaiga nuclear plants in the Western Ghats, Anti-draught and desertification movement in dry areas of Maharashtra, Karnatak, Rajasthan, Chilika Bachao Andolan in Orissa have all been led by voluntary organisations (Jain, 1997). These movements have not only been indicative of people's concerns about their environment and natural resources but have widened association between voluntary organisations and people. Similarly, at the micro level, smaller voluntary organizations have been actively involved in issues such as protection of forest, afforestation, water pollution, health, etc. (Panda and Pattnaik, 2005).

Hariyali is an action-oriented grass root organisation, engaged in constructive work and activities aimed at protection and restoration of environmental conditions. The main thrust areas of Hariyali are large-scale afforestation, water conservation and generation of environmental awareness, especially among youth. Emphasis is on self-reliance and execution of numerous activities, through the participation of students and nature-loving citizens. It was established in the year 1996 and is registered under the Societies Registration Act 1860, Bombay Public Trusts Act, 1950 and S. 80G of the Income tax Act, 1961. Hariyali was selected for this study as it enjoys larger public participation in its initiative and popularity. It has done commendable work in and around Thane district.

### **3. Contingent Valuation Method - A Tool for Imputing Economic Value for Environmental Initiatives:**

There are various techniques used for imputing the value of willingness to pay or willingness to accept compensation, such as iterative bidding, payment cards, dichotomous choice model, revealed preference theory, travel cost method, random utility approach, hedonic pricing method, etc.

CVM is one such tool, which is applied for estimating economic values for all kinds of ecosystems and environmental services. The method allows valuation of a variety of non-market goods and services, thus, is flexible.

It can be used to estimate both use and non-use values, and it is the most widely used method for estimating non-use values.

CVM involves directly asking people to state, through a survey, their willingness to pay (WTP) for specific environmental services. In some cases, people are asked to state the amount of compensation they would be willing to accept (WTA) to give up specific environmental amenity. It is called 'contingent' valuation as people are asked to state their willingness to pay, contingent on a specific hypothetical scenario and description of the environmental services.

The CVM is also referred to as a 'stated preference' method, because it asks people to directly state their values, rather than inferring values from actual choices, as the 'revealed preference' methods do. It circumvents the absence of markets for environmental goods by presenting consumers with hypothetical markets in which they have the opportunity to pay for the good in question. The hypothetical market may be modeled on the basis of a private goods market or a political market.

### **Contingent Valuation: Stepwise Procedure**

#### **Step 1:**

Define the valuation problem, which would include determining exactly which services are being valued, and the relevant population.

#### **Step 2:**

Making preliminary decisions about the survey, sample size, determining budget, etc.

#### **Step 3:**

Conducting the actual survey design, which usually commences with initial interviews and/or focus group discussions, followed up with drafting and pretesting CVM questionnaire.

#### **Step 4:**

The next step is the actual survey implementation through questionnaire.

#### **Step 5:**

The final step is to compile, analyse and report the results.

From the analysis, the researchers can **estimate the average value of WTP or WTA** for an individual or household in the sample, and **extrapolate** this to the relevant population in order **to calculate the total benefits of environmental amenity**.

### **4. Hypotheses:**

The study tests following hypotheses:

- i. Income is positively related to WTP.
- ii. Respondent's awareness about Hariyali's activities is positively related to WTP.
- iii. The open-ended and double-dichotomous contingent valuation formats yield comparable WTP estimates.
- iv. The broad hypothesis for the study is the cost of Hariyali's activities is much lesser than the benefits that accrue from its activities.

## **5. Methodology:**

The methodology of implementing CVM is already discussed in Section 3". It is discussed in greater detail below.

### **5.1 Setting up a Hypothetical Scenario:**

For setting up a hypothetical scenario for the ecological services provided by Hariyali, open-ended and double-dichotomous questionnaires were prepared. While administering the questionnaires, we showed the respondents a note on the work of Hariyali and also were presented with an outline of the fast ecological degradation of Thane area, consequent health problems suffered by the residents, and also the apathy of Thane Municipal Corporation in this regard. Thus, we invited their attention to the urgent need to pay attention to environmental Protection of Thane area.

Further, they were asked to assume that there is a proposal to set up an Environmental Protection and Conservation Fund (EPF) for sustaining and extending Hariyali's environmental protection and conservation activities and each household was asked to contribute to the fund, how much they would agree to pay each month, in terms of contribution to the fund.

### **5.2 Questionnaire Design:**

As noted earlier, we developed two types of survey questionnaires. What distinguished the two types of the questionnaires was the way of imputing the WTP. The open-ended questionnaire (OE) asked the respondents to state the monetary value, they would be willing to pay to EPF. This type of questionnaire avoids the starting point bias, as it does not give any benchmark value to start with and so, reduces the chances of the respondent being influenced by that value.

The second type of questionnaire contained the double dichotomous (DD) type question to elicit the WTP. This method initially asks the respondents, whether they will be willing to pay a particular sum (Rs.100 in our survey). Then depending on their 'yes' or 'no' replies, they are asked what will be the highest or lowest they will be willing to pay above or below that particular sum. This method yields more information as compared to the simple dichotomous method of imputing WTP, which just asks for yes or no to a particular sum.

### **5.3 Sampling Procedure:**

The survey was conducted through personal interviews in mainly Thane city. We could administer the open-ended questionnaire (OE) to 140 respondents, while the double-dichotomous questionnaire (DD) to 114 respondents. Both questionnaires are included in Appendix.

## **6. Statistical Analysis:**

The following techniques were applied to test our hypotheses, stated in Section 4:

- Frequency distribution of WTP for the OE, DD, and total sample.
- Means of WTP for OE, DD and total sample.

- Pearson's product moment coefficient of correlation\_for all the important variables, such as WTP, income, education, awareness of Hariyali's activities, number of family members and number of earning members in the family.
- Multi-variate regression to determine independent variables, affecting the value of WTP.

### 6.1 Frequency Distribution of WTP:

We obtained the frequency distribution table, showing values of WTP and their respective frequencies in the total sample, OE sample and DD sample. We have deliberately made non-uniform class-intervals to highlight those values of WTP having higher frequencies, for example, we made the class-interval of 50-51 as there were 20 observations in this range and merging it with 25-50 would not have revealed this fact. Same is applicable for the class- interval of 100-101.

**Table 1**  
**Frequency of WTP for Entire Sample**

WTP (in Rupees)	Number of Respondents		
	Entire Sample	OE	DD
0	67	34	33
0-15	39	34	5
15-25	10	6	4
25-50	21	18	3
50-51	20	13	7
52-99	8	7	1
100-101	67	14	53
102-249	5	4	1
250	4	2	2
300	2	2	0
400	1	0	1
500	7	3	4
1000	2	2	0
5000	1	1	0
<b>TOTAL</b>	<b>254</b>	<b>140</b>	<b>114</b>

### **6.1.1 Frequency of WTP for Entire Sample**

Table 1 highlights the following:

Table 1 shows that the frequency of WTP 0 is 67, while it is 5 for 102-249 range of WTP. The frequencies taper off for WTP values of Rupees 300, 400, 500, 1000, and 5000.

Similarly, we find further that the frequency distribution of WTP is bi-modal for the entire sample and the two modal values are 0 and 100.

### **6.1.2 Frequency of WTP for OE Sample**

As seen from Table 1, the frequencies disperse from 34 to 0. The distribution is bi-modal for ranges are 0 and 0-15.

### **6.1.3 Frequency of WTP for DD Sample**

Here, we see that only two values of WTP are important and they are 0 and 100. In these two values also, 100 is the most frequent having highest frequency of 53. Thus, almost half of the values are 100, while slightly less than one-third are 0. This clearly seems to be the case of 'starting point bias.' The contribution of Rs. 100 mentioned in the questionnaire has influenced the answers given by the respondents to DD survey and thus, seems to have distorted the true value of contribution. However, in the total sample this bias is lessened because of the inclusion of OE sample in which there is no scope for such bias.

## **6.2 Mean Willingness to Pay:**

We computed the arithmetic mean of WTP for the OE, DD and the total samples and obtained the following results:

**Table 2**  
**Mean WTP Per Month (in Rupees)**

TOTAL SAMPLE	90.13
OE SAMPLE	100.01
DD SAMPLE	78.02

The mean WTP for the entire sample is Rs.90.13 per month, while for OE sample, it is Rs. 100.01 per month and for DD sample it is 78.02 per month as shown in Table 2.

The two estimates of WTP for OE and DD differ insignificantly. Thus, our third hypothesis that 'OE and DD choice formats of contingent valuation yield comparable results' is found true on the basis of our data.

Since DD sample showed clear starting point bias in WTP values, it is advisable to use mean WTP of entire sample or OE sample for the purpose of estimating the monetary value of the activities of Hariyali.

As seen earlier, WTP depends on a large number of factors. Some of these factors are income, education, family size, the number of earning members in the family, and the awareness regarding Hariyali's contribution. We found significant correlation between WTP and these factors.

### 6.3 Correlation Analysis:

We computed Pearson's coefficient of correlation,  $r$ , between WTP and all the possible important variables, which can influence WTP. These are income, education, occupation, designation (hierarchy), age, family size, the number of earning members, awareness of Hariyali's work, duration of residence, hobbies pursued, and environmental problems faced.

We found significant correlation of WTP with only some of the above variables. Our findings are as below.

**Table 3**  
**Pearson's Coefficient of Correlation**

	Y	EDU	NFM	NEM	AWA
WTP	0.07*	0.04*	-0.003*	0.005*	0.02*

\* Significant at 1 percent level.

The definitions of the variables are given below:

WTP : Willingness of respondent to pay per month

Y : Income of the Respondent

EDU : Education of Respondent

NFM : Number of Family Members

NEM : Number of Earning Members

AWA : Awareness regarding Hariyali

As seen from Table 3, WTP is positively correlated, at 1 percent level of significance, with variables such as income, education, and the number of earning members in the family and the awareness for Hariyali's work.

The correlation between WTP and the number of family members is negative and significant at 1 percent level. This is expected as higher the number of members in the family, greater the claims on family income and thereby, lesser the amount which can be contributed to environmental purposes.

Our first hypothesis that WTP is positively correlated with income is valid as seen from the positive correlation coefficient between Y and WTP, significant at 1 percent level.

Our second hypothesis that WTP is positively associated with the awareness regarding Hariyali's work is also supported by the facts. The Pearson's coefficient of correlation 0.02 is positive and significant at 1 percent level.

The positive and significant correlation between WTP and education indicates that greater the spread of education, higher would be the amount people may be willing to contribute for environmental protection.

## 6.4 Regression Analysis:

The value which the respondents state as their willingness to pay for a particular natural resource or amenity is influenced by several factors such as income, information given to the respondents about the resource being valued, the payment vehicle chosen for the CVM.

To find out the determinants of WTP, we decided to fit a regression model. The choice of independent variables was made after studying their correlation with WTP. We included those variables which were found to be significantly correlated with WTP and these variables are income, education, number of earning members, awareness regarding Hariyali and ED\_Y (multiplicative interaction between education and income).

Further, we also included variables which were extracted from factor analysis and were found to be having statistically significant correlation with WTP. These variables were wtp-y-afre, wtp\_y\_other, wtpjVTTp/ wtp\_n\_un and wtp\_n\_other. Table 4 describes all independent variables, which are included in the regression model.

The multiple regression equation is as follows:

$$WTP = f(Y, EDU, NEM, AWA, ED_Y, wtp-y-afre, wtp_y\_other, wtp\_n\_np, wtp\_n\_un \text{ and } wtp\_n\_other)$$

**Table 4**  
**Variables Incorporated in Regression Analysis**

Variable Title	Description of Variable
WTP	Willingness to pay
Y	Monthly household income
EDU	Education of respondent
NEM	Number of earning members
AWA	Awareness of Hariyali
ED_Y	A multiplicative interaction between education and income
wtp-y-afre	A variable created by clubbing components - WTP YES_AFFORDABILITY and WTP YES_COST PER HOUSEHOLD
wtp_y_other	A variable explaining WTP due to reasons other than those cited in the questionnaire
wtp_n_np	A variable derived by clubbing components - WTP_NO_CAN NOT AFFORD TO PAY and WTP_NO_WOULD SPEND MONEY OTHERWISE
wtp_n_un	A variable created by combining components - WTP_NO_COULD NOT DETERMINE A MONEY AMOUNT and WTP_NO_NOT ENOUGH INFORMATION
wtp_n_other	A variable explaining unwillingness to pay (WTP=0) due to reasons other than those cited in the questionnaire

The results of the multiple regression analysis are as follows:

R = 0.40  
 RSquare = 0.16  
 SEE = 117.24  
 N = 254

**Table 5**  
**Multiple Regression Analysis**

Variables	Standardized Coefficients	T Values
Constant	54.65	0.86
Y	-20.57	-1.00
EDU	-6.07	-0.34
NEM	-3.25	-0.30
AWA	10.44	0.64
ED_Y	9.33	1.78*
Wtp_y_afre	2.67	0.28
Wtp_y_other	49.29	0.98
Wtp_n_np	-39.03	-1.86*
Wtp_n_un	-28.36	-1.48**
Wtp_n_other	1.80	0.05

\* 5% level of significance

\*\* 10% level of significance

It can be seen from Table 5 that there is significant and positive relationship between WTP and ED\_Y (multiplicative interaction between education and income). While Variable Wtp\_n\_np has negative and significant relationship with WTP. It is significant at 5 per cent level.

Similarly, variable Wtp\_n\_un has negative and significant relationship (at 10 per cent level of significance) with WTP.

The remaining variables used in the equation, such as income, education, number of earning members, awareness regarding Hariyali, wtp-y-afre (created by clubbing components - WTP\_YES\_AFFORDABILITY and WTP\_YES\_COST PER HOUSEHOLD), wtp-y-other and wtp-n-other, were found to be insignificant in determining WTP.

## 6.5 Aggregating the Data:

We need to obtain the monetary value of the activities of Hariyali from the mean WTP estimates obtained from the total sample. The mean WTP of the total sample is Rs.90.13 per month per household.

If we assume the average size of household in Thane city as 5 people and the population of Thane City is reported to be around 18,18872, as per Census of India 2011. If we divide the number of households by 5, we get the approximate number of households in Thane. It is 3,63,774. We multiply the number of households by the mean WTP per month per household, which gives us the monetary value of Hariyali's work per month. It is Rs.3,27,86,950.

As per the Annual Reports of Hariyali, the establishment and activities expenditure of Hariyali is much lesser than the monetary benefit of its activities.

The estimated monetary value of Hariyali's activities is an indicator of the benefits people derive from Hariyali's activities. Since this amount is much greater than the cost of Hariyali's activities, our fourth hypothesis that the cost of Hariyali's activities are less than the benefits derived from them is valid.

## 7. Findings and Implications:

- i. Our first hypothesis states that income is positively related with WTP. This hypothesis is true since correlation coefficient of these two variables is significant at 1% level and positive.
- ii. There is a positive and significant correlation between variables AWA (awareness regarding Hariyali) and WTP. Thus, our second hypothesis that respondent's awareness about Hariyali's activities is positively related to WTP is valid.
- iii. Our third hypothesis which states that the open-ended and double dichotomous contingent valuation formats yield comparable WTP estimates is true. This is because the difference between WTP values, in our study, yielded by these two formats is minimal.
- iv. The estimated monetary value of Hariyali's activities is an indicator of the benefits people derive from Hariyali's activities. Since this amount is much greater than the cost of Hariyali's activities, our fourth hypothesis that the cost of Hariyali's activities are much less than the benefits derived from them is valid.
- v. We found significant relationship between WTP and ED\_Y (multiplicative interaction of variables education and income). Variables wtp-n-np and wtp-n-un are negatively and significantly related to WTP.
- vi. Factor analysis enabled us to extract two components, viz. WTP\_YES\_AFFORDABILITY and WTP\_YES\_COST PER HOUSEHOLD. The eigen values were 8.835 and 1.129, respectively.

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## APPENDIX

### Questionnaires

Suppose that there is a proposal to set up an Environmental Protection and Conservation (EPC) Fund for extending Hariyali's environmental protection and conservation activities and each household is asked to contribute to the Fund,

Please think about:

Your current family income,

Your current family expenses and

Other possible uses of your family income

### Open-ended

Keeping these factors in mind, what is the most that you would agree to pay each month or one-time in terms of Contribution for EPC Fund?

### Double Dichotomous Choice

Keeping these factors in mind, would you agree to pay Rs. 100 per month in terms of contribution for EPF Fund? (Tick on your option and follow the instruction?)

1. Yes (Go to A)

2. No (Go to B)

A. Will you be willing to pay anything higher than Rs. 100?

B. Will you be willing to pay anything lower than Rs. 100?

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