

## **USING CONTINGENT VALUATION METHOD TO DETERMINE ECONOMIC VALUE OF PADMA RIVER WETLAND IN RAJSHAHI DISTRICT, BANGLADESH**

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### **ABSTRACT**

Wetland is a valuable ecosystem for the sustainable environment both for present and future generations. Wetlands are used for multiple purposes, and it has significant role in the livelihood of the local people in riverine country like Bangladesh. A particular wetland was selected named "Padma River" in Rajshahi district of the northern part of Bangladesh for the purpose of estimating the economic value. Wetlands possess a high economic value. The economic value of wetland includes both use and non-use values. Wetland use values are associated with a diverse and complex array of direct and indirect uses. Wetland direct use values/benefits are those which can be consumed directly from wetland such as food, water supply, recreation, transport, timber etc. whereas indirect uses benefited people indirectly and arises from the functions occurring within the ecosystem, such as water quality, flood control, ground water recharge and other such functions. Therefore, the objectives of the present study were to estimate the total economic value of non-use attributes of the River at the present with the help of Contingent Valuation Method (CVM). CVM is one of the important methods in environmental valuation, which gives empirical estimates of both use and non-use values of environmental resources. Data collected from questionnaire survey, key informant interview and focus group discussion. The results of the study show that the proposed annual economic value is greater than the present annual economic value. This study would guide the government in identifying the sectoral priorities regarding conservation of wetland and to formulate strategies for the short term as well as the long term effective management of wetland of Rajshahi Division.

**Keywords:** Wetlands; Economic Valuation; Non-use values; Contingent valuation method (CVM); Rajshahi District

### **INTRODUCTION**

Wetlands are surrounded by the Earth's most productive ecosystems. These Wetlands are described both as "the kidneys of the landscape". Because of the functions wetlands perform in the hydrological and chemical cycles, and as "biological supermarkets" because of the widespread food webs and amusing biodiversity wetlands sustenance. (Barbier et al., 1997). The nation's wetlands play a dynamic character in our social and economic well-being. Wetlands provide services such as amended water quality, groundwater restoring, shoreline securing, natural flood control, and support a diverse variety of fish, wildlife, and plants (Lupi et al., 1991).

Bangladesh has the vast area of wetlands including rivers and streams, freshwater lakes and marshes, haors, baors, beels, water storage reservoirs, fish ponds and estuarine systems with extensive mangrove swamps. The haors, baors, beels, and jheels are of fluvial origin and are commonly identified as freshwater wetlands. (Ghosh, 2010). Among the wetlands of Bangladesh, Padma River is an important wetland in Rajshahi City Corporation area under Rajshahi District which now experiences a threat of

resource degradation. Our country doesn't pay much consideration for the economic value of the use and non-use attributes of this wetland in present days. But an understanding of such values is vital for the better management of the wetland resources. Most of the studies about wetland valuation focused on total economic valuation which describes suitable management system of various wetlands for present and in near future (Lupi et al., 1991).

The study focused on the estimation of the economic value of Padma River with the help of Contingent Valuation Method (CVM). Therefore, the total economic value of Padma River wetland has been estimated by taking into account the non-use attributes of the River which help to formulate resource management strategies in future for better conservation of this valuable wetlands.

## METHODOLOGY

Rajshahi town (City Corporation) stands on the bank of the river Padma. The area of the Rajshahi City Corporation is 96.72 sq. km. The total area of the rivers and rivulets within the boundary of the district is about 96.80 sq km. which is about 03.99 % of total area of the district (BBS, 2013). The Padma River [Fig 1] is located between latitude 24°20' and 24°22' N and longitude 88°32' and 88°34' E (Google earth, 2018)

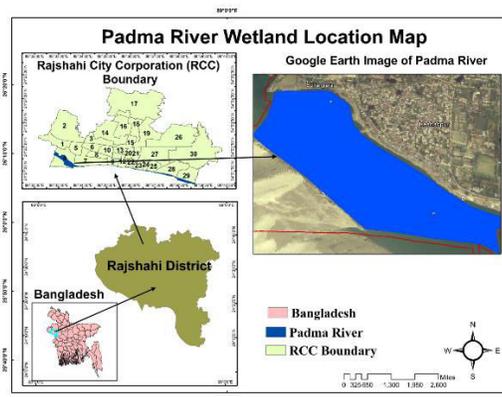


Fig.1: Location of Padma River

The CVM is a mostly applied method in estimating the non-use values of a wetland for valuing changes in the provision of nonmarketable goods and services. The CVM is a survey-based methodology which relies on obtaining monetary estimates for the economic value of a specified change in the provision of the environmental good of interest, which typically is not traded in the conventional markets. Monetary estimates are obtained either as individual's Willingness to Pay (WTP) or Willingness to Accept (WTA). WTP measures the amount of income a person is willing to contribute in exchange for an improved state of wetland goods and services (Marta-Pedroso et al., 2007). To evaluate the economic value of Padma River situated in RCC area the Data was collected from questionnaire survey, key informant interview and focus group discussion. Disproportionate stratified systematic random sampling of 200 households was conducted in the CV survey. The size of sample is considered to be reliable because based on a simple statistical tolerance formula, sample size between 200 and 2500 are probably appropriate (Mitchell and Carson, 1989). Rajshahi City corporation (RCC) area consists of 4 thana which includes Rajpara, Matihar, Shah Mukdum and Boalia Thana. 90 samples were selected from Boalia Thana, 58 samples were selected from Rajpara Thana, 32 samples were selected from Matihar Thana and 20 samples were selected from Shah Mukdum thana. Samples size distributions varies according to the number of population present in the Thana. Key Informant Interview (KII) was conducted with boatmen, Businessmen, Students, Wetland experts, livestock experts, agriculture officials and Planners. Focus Group Discussion (FGD). Three FGDs were conducted with each group consisting of adult men and women (age belongs to 18 or above) considering gender issues. Each FGD took time about one hour to

two hours. Each FGD consisted of at least 6-8 persons with homogeneous mixture. During FGDs, people of the Padma River and RCC area chosen the payment vehicle for the CV survey and identified the non-use attributes of Padma River. Different statistical analyses have been performed to analyze the gathered quantitative data. The WTP responses have been analyzed using two statistical models, such as logit model and multiple regression model. These models have been analyzed using SPSS software. The logistic probability or logit model has been used to separate those respondents who are willing to pay from those who are not (Langford and Bateman, 1993). Subsequently, the multiple regression model indicates the relationship between the explanatory variables and the stated amount of money for those who were willing to pay. Mathematically, the WTP can be written in the form of Eq. (1):

$$WTP = f(R_s, R_a, Y_i, R_e, DIST, USR) \quad (1)$$

where, WTP refers to the amount of money a household is willing to pay monthly for the wetland resource management,  $R_s$  denotes respondent's sex,  $R_a$  denotes respondent's age,  $Y_i$  denotes household income,  $R_e$  stands for individual's education level, DIST denotes distance of the respondent's residence from the Padma River and USR denotes variable for non-user individuals. The logit model for the present study written in the form of Eq. (2):

$$L_i = \ln \frac{P_i}{1-P_i} = X_{i1} + X_{i2} \quad (2)$$

Where,  $L_i$  which is called Logit, is the log of the odd ratios.  $P_i$  is a probability that has a probability of 1,  $X_{i1}$  is a set of explanatory variables while and  $X_{i2}$  are an intercept and a set of coefficients to be estimated corresponding to a logistic distribution.

## RESULTS AND DISCUSSION

### *Economic Value of Padma River at Present state for non-Use attributes*

For establishment of Economic Value of Padma River at Present state for non-Use attributes characteristics of survey respondents need to be demonstrate. During the CV survey, different socio-economic characteristics of the respondents were asked and recorded. The responses of the respondents have been analyzed using frequency table. The sample consisted of 68.2% men and 31.2% women. The distribution of age of the respondents [Fig.2] was heavily skewed towards the younger generation with the majority of people being between 18 and 30 years old (37%) and this was mainly due to the fact that young people were willing to participate more in the CV survey. The majority of the respondents have attended up to or continue Bachelor degree of education i.e. almost 37% [Fig.3], while the majority of the survey Participants in the study area were student (Fig.3). In addition, the majority of income group for the survey households was Tk. 10001-20000 [Fig.4]. 45% and 40% people households were 1-10 km and more than 10km from Padma River respectively and 89% people visit Padma river area for different activities.

The present study has adopted the ranking method to estimate the present non-use value of Padma River. In estimating the present total non-use value of Padma River, protest responses are eliminated from the data collected to estimate willingness to pay (Mitchell and Carson, 1989). The result obtained from the CV survey shows that all of the respondents think that the wetland is in 'bad' state in terms of its availability of fauna and flora species. So, from the table it is found that the present non-use value of Padma River is 7% of the total non-use value estimated for the proposed state of the Padma River (Table 1). It is found that the total annual average non-use value of Padma River for the proposed state is Tk. 1.06 million. Therefore, the total annual average non-use value of the Padma River for the present state is Tk. 0.0742 million.

### *Economic Value of Padma River at Proposed state for non-Use attributes:*

The Contingent Valuation Method (CVM) of estimating values for non-market goods in terms of Willingness to Pay (WTP) has gained widespread acceptance in the world. The results of the logit model are shown in Table 2. Gender is found to be statistically significant at the 1% level and the sign is positive. Therefore, the finding suggests that males are 5.321 times more likely to say 'yes' to a WTP question than females. This indicates that males are more aware of the environment. In case of education,

Income level and user the result of the logit model indicates that the higher the education, Income level and User the higher the probability of WTP 'yes' saying. For the variable distance, it is found that the longer the distance of the residence from Padma River, the lower the probability of WTP 'yes' saying.. Finally, the result of the logit model shows that almost 76% of the respondents have correctly allocated (i.e., percentage of correctly predicted values) to predict WTP either 'yes' or 'no' in the model which indicates a relatively good fit to the CV data and model (Ghosh, 2010).

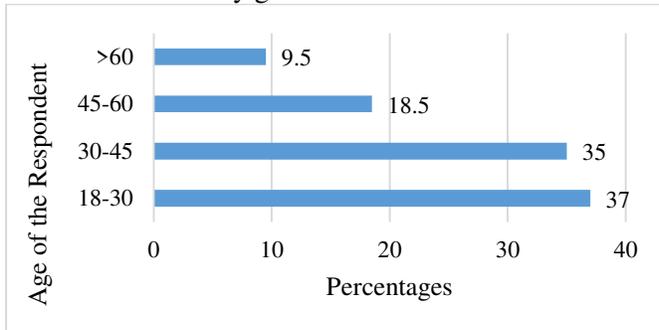


Fig.2: Age group distribution of the respondents

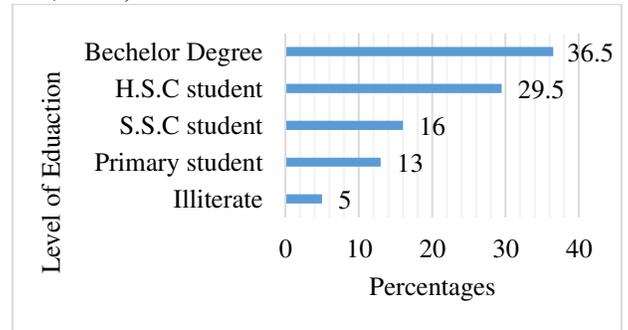


Fig.3: Education status of the respondents

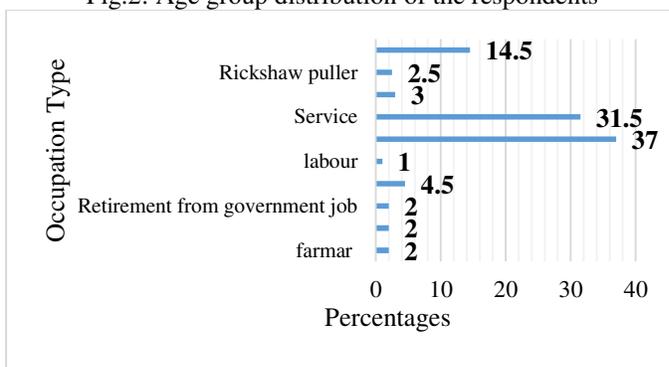


Fig.4: Occupation pattern of the respondents

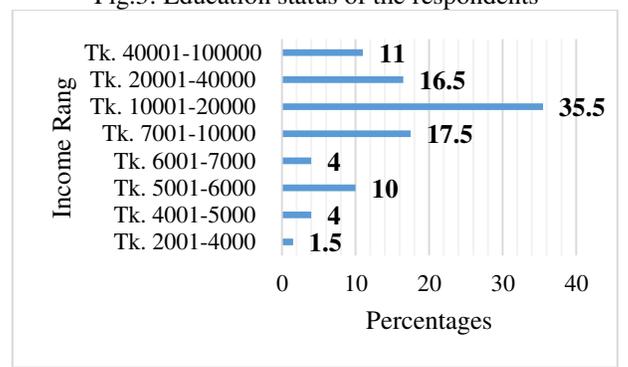


Fig.5: Distribution of household income

Table 1: Ranking of the present state of Padma River

Present environmental state based on non-use value	Score	Present non-use value as a percent of the proposed state non-use value
Very bad	-1	3%
Bad	-2	7%
Neither good nor bad	0	28%
Good	1	42%
Very good	2	20%

The results of the multiple regression model are shown in Table 3. The age of a respondent has a negative influence on the mean amount of money to pay. So, the WTP decreases as age increases. As a result, younger generations are more willing to contribute money than older ones because younger generations are more aware of the environment. The coefficient of education appears to be significant at the 5% level which indicates that the higher educated people are more willing to contribute money compared with the lower educated people. Income level value indicates that WTP increases with the increase in income. So, the people having more money are willing to contribute money more for management of the Padma River resources (Table 3). In the present study, the respective  $R^2$  values for the logit model and the multiple regression model have been obtained. But the  $R^2$  value of the multiple regression model (57%) is lower than the logit model (76%). This is due to the fact that the increment of the values of WTP was very small which makes it difficult for a model to precisely determine each individual figure.

Table 2: Results of logit model for non-use values of Padma River

Explanatory variable	Coefficient	Standard error	Odds ratio
Sex	2.102	0.445	4.371
Income	1.536	0.383	2.567
Education	1.672	0.205	1.709
Distance	-0.908	0.221	0.403
User	1.423	0.321	2.841

Note:  $R^2 = 0.76$ ;

Table 3: Results of multiple regression model for non-use values in Padma River

Explanatory variable	Coefficient	Standard error	t-statistic
Age	-1.672	0.781	-1.321*
Education	2.601	0.973	2.170*
Income	2.120	0.503	2.902*
Distance	-1.987	0.623	-1.523*

Note:  $R^2 = 0.57$ ; \*Significant at the 5% level

Table 4 Non-use component values of Padma River

Non-use component	Minimum WTP (Tk./month)	Maximum WTP (Tk./month)	Average WTP (Tk./month)
Fauna and flora resources do not weaken and Padma river simply continue to exist (Existence value)	2.5	15.50	3.12
The wetland exists so that its value can be enjoyed in future (Option value)	1.5	33.50	4.47
The wetland exists so that future generations can enjoy the value and can be used for research, education etc. (Bequest value)	3.5	63.50	7.10
Total non-use value (Tk./month)	7.5	112.50	14.69

In the present study, the total non-use values divided into three component values which are shown in Table 4. From the table, it is found that the bequest value is higher than the option value which is followed by the existence value. For Padma River, wildlife value is not the largest of all non-use values or as a proportion of the total non-use value. This difference in the present study is due to the fact that the majority of the people in the study area are not aware of the environment.

Table 5 Estimated annual average non-use value of Padma River

Category of characteristic	Value
Total number of households in Rajshahi City Corporation at present	99549
Household's average WTP value per month (Tk)	11.67
Proportion of households willing to contribute money (percent)	73.57
Annual average value of respondent's money contribution (million taka)	854689.7858 Lakh (0.85 million)
Household's average WTP value per month for willingness to contribute time (Tk)	35.96
Proportion of households willing to contribute time (percent)	17.36
Annual average monetary value of respondent's time contribution (million taka)	207380.4768 Lakh (0.21 million)
Total annual average value of the non-use attributes of the Padma River (million taka)	1062070.263 Lakh (1.06 million)

The respondent's contribution of time is monetized to estimate total WTP for the wetland resource management. The total time that the respondents wanted to contribute is 4541 minutes and people

contribute more time for recreational activities. The monthly monetary value of time contribution is shown in Table 5 and the respondent's average monetary value of willingness to contribute time is estimated to be Tk. 35.96/month/household. The annual average total economic value of the non-use attributes of Padma River for the proposed state is estimated to be Tk. 1.06 million and shown in Table 4. From above analysis it is found that the non-use value of Padma River is not very high at present state (0.0742 million). This is due to the fact that non-use value of the River is not confined only in the locality and people of the area are not aware of the environment. Therefore, the non-use value is an underestimated value. The non-use value at the present state of the River is insignificant because the River is in bad condition in terms of its fauna and flora resources.

## CONCLUSIONS

The present study focuses the wetland resource management which is damaged day by day. To estimate the economic value of Padma river wetlands, CVM has been adopted. The CVM method has been applied to estimate the non-use value of Padma River. Based on the developed strategies, the non-use value of Padma River at the proposed state has been estimated. The results of the CV estimates have shown that the annual average non-use value of the Padma River for the present state is about Tk. 0.0742 million, while the annual average value for the proposed state is about Tk. 1.06 million which is much greater than the present non-use value of the Padma River. This non-market benefit of Padma River at the proposed state indicates that there is a public fund (i.e., peoples' WTP) towards a better wetland resource management and it is possible to implement the management strategies in the area. Results of the study also suggest that the estimated economic value in the present study is only an approximation and not the true value. The value of the river is underestimated because value of all functions of the river was not possible to estimate. So, if the developed strategies are adopted for Padma River management, a better outcome will result from the river in terms of economic and environmental perspectives which will promote Padma River management towards sustainable resources management.

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