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ECONOMIC VALUATION OF A WETLAND BY USING STATISTICAL METHOD: A CASE STUDY ON CHALAN BILLABONG, NORTH-BENGAL, BANGLADESH

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Abstract - *Wetland is an important element of ecosystem for the sustainable environment both for present and future generations. Wetlands are used for various purposes, and it has a vital role in the livelihood of the local people in a country like Bangladesh. For the research a particular wetland was selected named "Chalan Billabong" in Rajshahi Division of the northern part of Bangladesh for the purpose of finding out 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 billabong 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 and long term effective management of wetland of North-Bengal.*

***Key Words*: Wetlands, Economic Valuation, Non-use values, Contingent Valuation Method (CVM).**

1.INTRODUCTION

Wetlands have a crucial importance on sustainable ecological system, improving habitat of different flora and fauna, enhancing surrounding livelihood options and restoring hydrological resources. These Wetlands are described both as "the kidneys of the landscape". (Brander et al., 2006). 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 billabong and streams, freshwater lakes and water storage reservoirs. The livelihoods of the people of surrounding area are mostly depended on this wetland resource (Kostori, 2012). Additionally, a large source of fresh water fish and aquatic resources keep ecological systems in balance. The haors, baors, beels, and jheels are of fluvial origin and are commonly identified as freshwater wetlands (Ghosh, 2010). Among the wetlands of Bangladesh, Chalan billabong is the largest, most important watershed in the North Central Bangladesh, and covers an area of about 375 km^2 during the monsoon season. The population of Bangladesh don'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 for present and in near future (Cameron, 1992). The most crucial issue of Bangladesh is the rural poverty causing the intensive exploitation and depletion of the wetland resource base of the country. The current practice of wetland management is mainly regulated by direct economic profitability without considering proper ecological benefits and uses of wetlands (Billah, 2003). The study focused on the estimation of the economic value of Chalan billabong with the help of Contingent Valuation Method (CVM). Therefore, the total economic value of Chalan billabong wetland has been estimated by taking into account the non-use attributes of the billabong which help to formulate resource management strategies in future for better conservation of this valuable wetlands.

2. METHODOLOGY

The Chalan billabong is situated between 24.35° to 24.70°N and between 89.10° to 89.35°E [Fig. 1]. (Google earth, 2018). It presently spreads over only 10 upazilas, however, including Singra, Gurudaspur, Boraigram, Chatmohar, Bhangura, Faridpur, Shahjadpur, Ullapara, Tarash and Raigonj, in the three districts of Natore, Pabna and Sirajgonj(BBS, 2013).

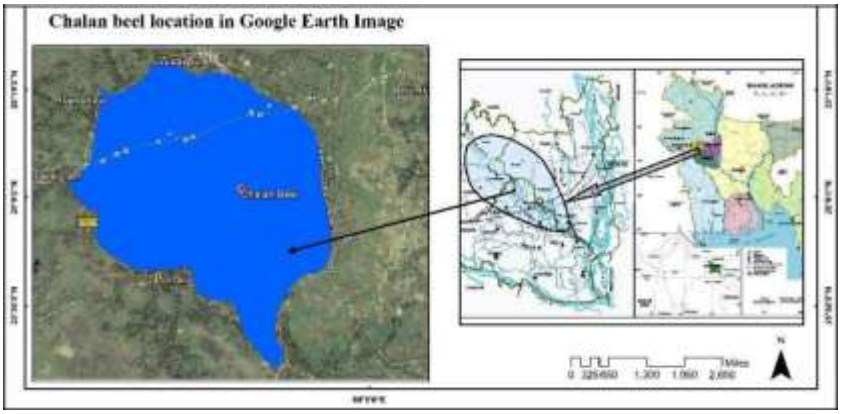

Fig.1: Location Chalan Beel

The CVM is a mostly applied method in estimating the non-use values of a wetland which estimate values 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 Chalan Billabong covered natore district Data was collected from questionnaire survey, key informant interview and focus group discussion. Disproportionate stratified systematic random sampling of 300 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). Natore District consists of 6 Upazila, 120, 60,38,32,30 and 20 samples were collected from Natore Shadar Singra Upazila, Gurudaspur Upazila Baraigram Upazila, Lalpur Upazila , and Bagatipara Upazila respectively. Samples size distributions varies according to the number of population present in the Upazila. 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 8-10 persons with homogeneous mixture. During FGDs, people of the Chalan Billabong area chosen the payment vehicle for the CV survey and identified the non-use attributes of Chalan Billabong. 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. This 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 Chalan Billabong and USR denotes variable for non-user individuals (Ghosh, 2010). The logit model

$$= X_{i1} + X_{i2} \quad (2)$$

Where, L_i which is called Logit, is the log of the odd ratios. Pi 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 (Ghosh, 2010).

3. RESULTS AND DISCUSSION

3.1 Economic Value of Chalan beel at Present state for non-Use attributes

The characteristics of survey respondents need to be demonstrate for establishment of Economic Value of Chalan Billabong at Present state for non-Use attributes. 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 72.3% men and 27.7% 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 (41.2%) 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 29%, also 29% respondent are illiterate because they are mainly farmers and fisherman [Fig.2].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. 4001-5000 [Fig.4]. 35% and 55% people households were 1-10 km and more than 10km from Chalan Billabong respectively and 82% people visit Chalan billabong area for different activities.

The present study has adopted the ranking method to estimate the present non-use value of Chalan Billabong. In estimating the present total non-use value of the Billabong, protest responses who think the wetland are in 'bad' condition has been eliminated from the data collected to estimate willingness to pay (Mitchell and Carson, 1989). So, from the table it is found that the present non-use value of Chalan Billabong is 13% of the total non-use value estimated for the proposed state of the Chalan Billabong (Table 1). It is found that the total annual average non-use value of Chalan Billabong for the proposed state is Tk. 93.48 million. Therefore, the total annual average non-use value of the Chalan Billabong for the present state is Tk. 12.15 million.

3.1 Economic Value of Chalan beel 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. Females are 4.623 times more likely to say 'yes' to a WTP question than males. This indicates that females 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 Chalan Billabong, the lower the probability of WTP 'yes' saying. Finally, the result of the logit model shows that almost 68% 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).

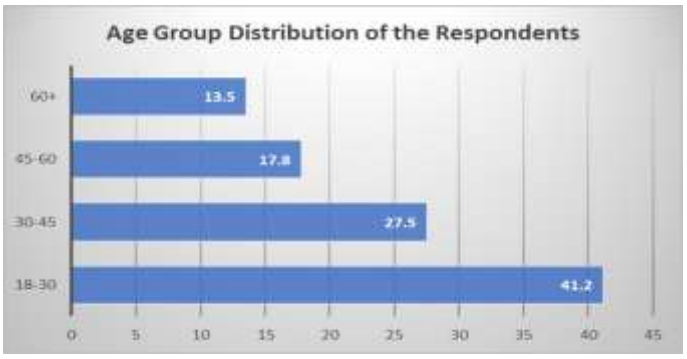

Fig.2: Age group distribution of the respondents.

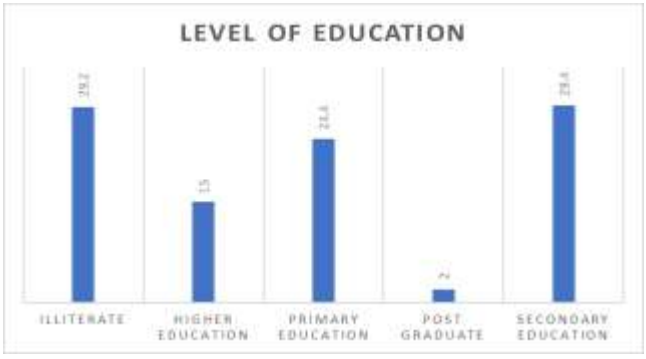

Fig.3: Education Status of the respondents.

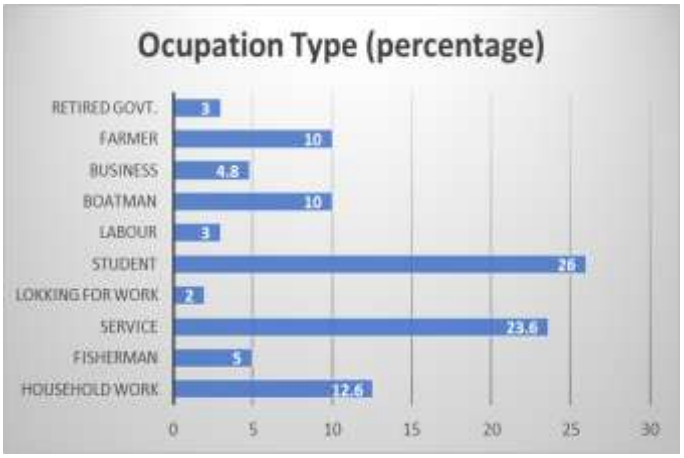

Fig.4: Occupation Pattern of the respondents.

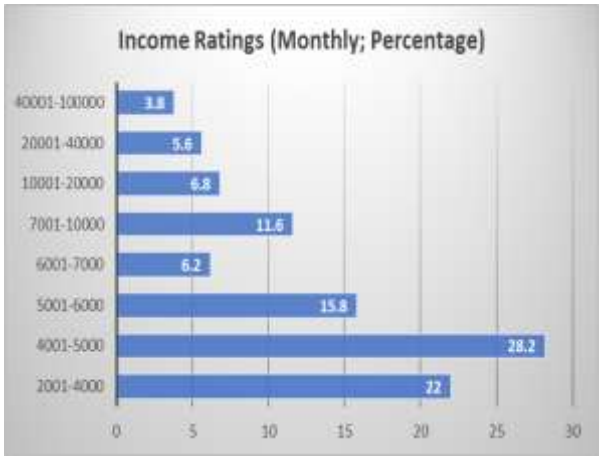

Fig.5: Distribution of household income.

Table -1: Ranking of the present state of Chalan Beel

Present environmental state based on non-use value	Score	Present non-use value as percent of the proposed state non-use value
Very bad	-1	4%
Bad	-2	13%
Neither good nor bad	0	23%
Good	1	35%
Very good	2	25%

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 Chalan Billabong 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 (46%) is lower than the logit model (68%). 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 Chalan Billabong.

Explanatory variable	Coefficient	Standard error	Wald statistic	Odds ratio
Sex	1.902	0.545	11.777*	5.321
Income	1.639	0.483	8.322*	2.978
Education	1.523	0.215	8.520*	1.789

Distance	-0.708	0.294	5.196*	0.403
User	1.303	0.421	6.238*	3.841

Note: R^2 = 0.68; *Significant at the 5% level

Table -3: Results of multiple regression model for non-use values of Chalan Billabong.

Explanatory variable	Coefficient	Standard error	t-statistic
Age	-1.203	0.793	-1.501*
Education	2.231	0.983	2.230*
Income	2.010	0.523	3.502*
Distance	-1.436	0.673	-1.713*

Note: R^2 = 0.46; *Significant at the 5% level

Table -4: Non-use components value of the 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 exists(Existence value)	1.5	20	3.10
The wetland exists so that it's value can be enjoyed in future (Option value)	2.5	35	4.60
The wetland exists so that future generations can enjoy the value and can be used for research, education etc. (Request value)	3	68.5	10.30
Total non-use value (Tk./month)	7	123.50	18

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 Chalan Billabong, 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.

Category of characteristic	Value
Total number of households in Natore District at present	423875
Household's average WTP value per month (Tk)	16.36
Proportion of households willing to contribute money (percent)	69.23
Annual average value of respondent's money contribution (million taka)	57.60 million
Household's average WTP value per month for willingness to contribute time (Tk)	27.58
Proportion of households willing to contribute time (percent)	21.57

Annual average monetary value of respondent's time contribution (million taka)	30.25 million
Total annual average value of the non-use attributes of the Chalan Beel (million taka)	93.48 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 4980 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. 27.58/month/household. The annual average total economic value of the non-use attributes of Chalan Billabong for the proposed state is estimated to be Tk. 93.48 million and shown in Table 5. From above analysis it is found that the non-use value of Chalan Billabong is not very high at present state (Tk.12.15 million). This is due to the fact that non-use value of the billabong 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 billabong is insignificant because the billabong is in bad condition in terms of its fauna and flora resources.

4. CONCLUSION

The present study estimate the economic value of Chalan billabong wetlands with the help of non-use attributes which will be helpful for wetland resource management and valuation of wetlands in decision making.The estimation of the Chalan billabong wetland is done both for present state as well as proposed state using CVM method. The results of the CV estimates have shown that the annual average non-use value of the Chalan Billabong for the present state is about Tk. 12.15 million, while the annual average value for the proposed state is about Tk. 93.48 million which is much greater than the present non-use value of the Chalan Billabong. This non-market benefit of Chalan Billabong 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.If better management is adopted for chalan billabong wetland the economic value of this wetland will be increase six times from the present economic value. The estimated economic value in the present study is only an approximation and not the true value. The value of the billabong is underestimated because value of all functions of the billabong was not possible to estimate. So, if the developed strategies are adopted for better management of Chalan Billabong, a significantly healthier outcome will be achieved from the billabong in terms of economic and environmental perspectives and this progress will promote Chalan Billabong management towards sustainable resources management in future.

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