

Economic evaluation of Foy's lake, Chittagong using travel cost method

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Abstract

Background: Economic evaluation of non-market goods is challenging and can't be calculated using traditional method. In this study, Travel Cost Method (TCM) was used to evaluate the economic value of Foy's Lake of Chittagong.

Methods: A total of 200 respondents from the visitor of this lake were interviewed on the basis of day of visit (week day: 100, weekend: 100) using structured questionnaire. The collected data were analyzed using SPSS v 20 and R v 3.2.1

Findings: A multiple regression model was developed using the analysis which had a R^2 value of 0.084. Family size and Total cost of visitors were found significant with a p-value of 0.05. The estimated value for Foy's Lake for 2014 was worth 294165270 BDT (Bangladeshi Taka) (or 3792034.49 US \$).

Applications: By applying the model, derived from this study can be used to assess the economic value by revealed preference method of artificial lakes in this region.

Keywords: Economic Evaluation, Travel Cost Method, Revealed Preference, Foy's Lake

1. Introduction

Foy's Lake is one of the important man-made lakes in Chittagong, Bangladesh that was made by building a dam over the stream that descended from the slopes in the northern region of Chittagong in 1924. This artificial lake was created with an aim to provide water to the residence of railway colony [1]. But at present, to meet the increasing demand for recreational places it is used by the city dwellers of Chittagong and near areas as a favorite holiday resort [2]. In case of ecosystem goods or services related to water, the quality of water has a major role in determining economic value of it [3]. Ecosystem valuation is the mechanism of estimating a value for ecosystem goods or services [4]. Valuation of lake ecosystem is difficult by using traditional economic measures because the scenic beauty or use value of such amenities is not normally priced in markets [3]. Travel cost method (TCM) is thus applied for removing the difficulties and making economic valuation of ecosystem [4,5,6]. The prices of environmental goods such as ecotourism can't be measured like the prices of private goods in efficient markets. If measured only by direct costs such as entrance fees to parks, it will not reflect the actual scenario which goods are valued and this kind of inaccurate pricing can result in lower revenue or may underestimate the proper importance of that good [6]. The main premise of choosing the travel cost method is that the time and travel expense costs that individuals bring about to visit a spot represent the existing 'price' of access that particular site [3].

The main objective of this study was to evaluate the lacustrine ecosystem services of Foy's lake using travel cost method. The estimate will help to expand the limited empirical studies evaluating regional lake ecosystem services of Bangladesh.

2. Materials and Methods

2.1. Study area

Chittagong is a major coastal seaport and financial center in southern Bangladesh. The Chittagong Metropolitan Area has a population of over 6.5 million, making it the second largest city in the country. Foy's Lake is located in the northwestern part of Chittagong city at Zakir Hossain road, just opposite to the University of Science and Technology, Chittagong (USTC), Pahartoli. The lake encompasses an area of 135 hectare owned by Bangladesh Railway. Zoological garden is situated adjacent to the Foy's Lake, established in 1989 entirely with the private initiative in collaboration with the district authority [2].

2.2. Data collection

The study was done during December of 2014. Direct interview was performed with the visitor at study location using a structured questionnaire having open-ended questions for TCM. Questionnaire was designed with a care in order to get the maximum valid and reliable results. Thus to fulfill this criteria, a pilot test was carried in the study area with the pre-designed questionnaire to check the suitability of designed questions. Visitors of Foy's Lake were the targeted population for this study. As it was impossible and statistically not significant to include all visitors, a sample proportion of the overall visitors were needed. The total sample size was designed to take interview of 200 respondents in the study area. Half of this (100) respondents were interviewed in official working day of the week and the remaining half (100) respondents in holiday to remove biasness between working day & holiday. Visitors were interviewed at the main entrance gate and each visitor was selected to interview after 5 minutes interval of finishing the interview of first one. This ensures that the sample respondents were taken randomly from the total visitor.

2.3. Statistical analysis

The interviewee was asked question of their age, education, monthly income, family size, satisfaction of security facility provided by authority, travelling cost, visit to other site that day and number of visit in this site in this year. Number of visit is considered the dependent variable in this research which depends on other explanatory variables cited in Table 1.

Total cost that are expended by the visitor, is the economic value they prefer for this lake. Visitors' were asked questions like vehicle cost needed to come in the spot, entrance fee, food, tips, residential cost if they take so, etc. to estimate the total cost spent by them. The important variable that are extracted from the survey are summarized in Table 2.

Collected data were analyzed using IBM SPSS v 20 and R v 3.2.1.

Table 1. Definition of variables used in economic evaluation of Foy's Lake

NOVTY (Y)	Dependent variable, Number of visit to this site in this year
GEN (X ₁)	Independent variable, Gender of the respondent, 1 if male, 0 if female
AGE (X ₂)	Independent variable, Age of respondent
EDU (X ₃)	Independent variable, Education of respondent
INC (X ₄)	Independent variable, Income of respondent
FS (X ₅)	Independent variable, Family size of Respondent
SWSP (X ₆)	Independent variable, Satisfaction with security provided by park authority; 1 if satisfied, 0 if not
DYVOS (X ₇)	Independent variable, Visiting other site that day; 1 if visited, 0 if not
TC (X ₈)	Independent variable, Travelling cost (BDT) which includes entrance fee, fare, food, residence, tips, ride & etc.

Multiple linear regression model was used to find out the effect of independent variable over the dependent variable assuming that there was no multi-collinearity among the independent variable. The regression model used in this study is shown in equation (1) and estimated number of visits by the visitor (dependent variable) from the regression model is shown in equation (2).

$$Y = X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 \dots\dots\dots \text{[Equation: 1]}$$

$$\text{Estimated number of visits} = \alpha + a X_1 + b X_2 + c X_3 + d X_4 + e X_5 + f X_6 + g X_7 + h X_8 \dots\dots\dots \text{[Equation: 2]}$$

α is the intercept value of the model and a, b, c, d, e, f, g, and h are the parameter estimates of the regression model.

From the surveyed data, it is observed that there are variations in users' or visitors' preference to visit the lake due to the difference in preference.

Table 2. Summarization of variables effect on Lake Visit

Variable	Mean (n = 200)	
	Statistic	Std. Error
Y	1.69	0.071
X ₂	32.55	0.697
X ₄	34201.30	5583.773
X ₅	4.61	0.123
X ₈	1788.77	143.597

(For abbreviation please see Table 1)

It was found from Table 2. that the income of the visitor was highly irregular (higher std. error). The outcome of this study can be used for the investigation of lake benefit obtained by visitors. The investigation result can also be very useful to guide the local planning agency or private entrepreneur to locate plan to current and future policy for the lake service improvement.

3. Results and Discussion

The results presented here is based on the survey conducted at Foy's Lake of Chittagong mentioned in previous section. A total of 200 questionnaire survey were done from interview on site in the lake area. The sample was collected equally from week day and weekend as shown in Table 3.

Table 3. Distribution of samples collected considering day of visit

Park Location	Day of visit		Total
	Week day	Weekend	
Foy's Lake	100	100	200

In this study, number of visit to the lake was considered affected by the numerous independent variables like the income, age, gender, satisfaction with safety provided by authority, visit on other site, total cost. All these stated variables affect the number of visit to the lake by the users. Thus a multiple linear regression model was used to find out the effect of explanatory variables.

The model represents the coefficient of determination of R² on 0.084 and adjusted R² is 0.045. Due to this very low value of R², it can be said that the model is not a good fit to understand the explanatory variable [Table 4].

Table 4. Summary of regression model

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.289 ^a	0.084	0.045	0.987

a. Predictors: (Constant), Gender, Education, Total cost, Income, Visit on other site, Family size, Security, Age

Through this model, only 8% of the real world phenomenon can be described. Still economic value of the lake can be calculated using the revealed preferences of the visitors of this lake. The use of the stated preference model can be used to improve the quality of the estimates of the revealed preference but colinearity can be a significant problem in applications of revealed preference models, making it difficult to isolate the effects of attributes [7]. As the travel cost method works with the revealed preferences, this phenomenon can be occurred. Whilst the development of TCM during the last three decades has generated hundreds of research in the literature examining, criticizing and proposing refinements to all aspects. TCM can be used to estimate the economic benefits or costs resulting from changes in access costs for a recreational site, elimination of an existing recreational site, addition of a new recreational site and changes in environmental quality; however there are several limitations such as defining and measuring the opportunity cost of time is complicated as there is no strong consensus on appropriate measure. Substitute sites are only taken into account in the random utility approach to travel cost method, which uses information on all possible sites that a visitor might select, their quality characteristics, and the travel costs to each site [8].

The value of estimated coefficient for the multiple linear regression model used in this study is summarized in Table 5.

Table 5. Coefficient of multiple linear regression model for travel cost method

Explanatory variable	Unstandardized coefficient		t-statistic	Pr(> t)
	Parameter	Std. Error		
Intercept	$\alpha = 1.859$	0.488	3.813	0.000185 ***
GEN (X_1)	$a = -0.166$	0.150	-1.105	0.270503
AGE (X_2)	$b = 0.015$	0.008	1.921	0.056255
EDU (X_3)	$c = 0.402$	0.385	1.044	0.297736
INC (X_4)	$d = -5.865E^{-007}$	0.000	-0.647	0.518636
FS (X_5)	$e = -0.093$	0.042	-2.238	0.026385 *
SWSP (X_6)	$f = -0.305$	0.180	-1.687	0.093156
DYVOS (X_7)	$g = -0.243$	0.157	-1.552	0.122238
TC (X_8)	$h = -8.955E^{-005}$	0.000	-2.329	0.020902 *

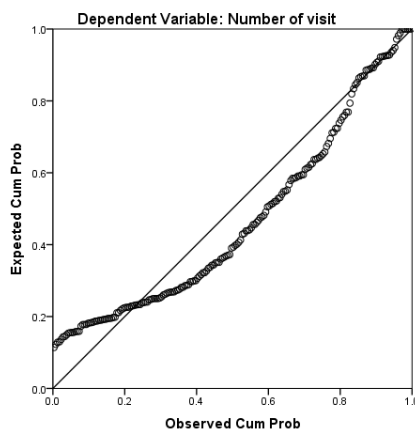
Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

(For abbreviation please see Table 1.)

Only the intercept value of this multiple linear regression model was found very highly significant with 1.859 parameter estimates. Family size and total cost spent, these two independent variable were found significant with a p-value of 0.05 but are negatively sloped. This signifies that with an increase in family size visitors will less visit the lake and it is also true for total cost spent variable. If there is increase in total cost, people are usually reluctant to visit places to enjoy scenic beauty and passing time. Gender, income, visit on other site variables were also found negatively sloped with no significant value. Age and education variables are only found positively sloped compared to all other independent variables. Thus it can be said that, if there is increase in age of a visitor then the probability of that visitor to visit the lake will be higher in number. Similarly, if a person is literate then there is much probability of that person to visit the lake in a higher number of visits.

The model used for the economic evaluation of Foy's Lake of Chittagong was found not a good fit. Normal P-P plot of regression standardized residual plot was found irregularly distribute over the expected distribution [Figure 1].

Figure 1. Normal P-P plot of regression standardized residual



The developed model to calculate the economic value of the studied lake was thus found using the model. The developed model is stated in equation 3.

$$\text{Estimated number of visit} = 1.859 - 0.166 X_1 + 0.015 X_2 + 0.402 X_3 - 5.865E^{-007} X_4 - 0.093 X_5 - 0.305 X_6 - 0.243 X_7 - 8.955E^{-005} X_8 \dots\dots\dots [\text{Equation: 3}]$$

Using equation 3, the economic value is calculated. To do so, estimated number of visitor in a year is needed. This information was collected through consulting with the lake authority as there was authority engaged to collect the revenue from entrance fee. The estimated visitor for the year 2014 was found 82,215 (*Field interview with authority*). The estimated economic value calculate using travel cost method is shown is Table 6. Average number of visit was found 1.69. For calculation approximate value was considered, thus average number of visit was considered 2. Total economic value was calculated using an equation which is shown in equation 4.

$$\lambda = \beta * \gamma * \delta \dots\dots\dots [\text{Equation: 4}]$$

In this equation (equation 4), λ is the total value in BDT (Bangladeshi Taka); β is the estimated number of visit; γ is the average travelling cost spent by visitor in BDT, and δ is the total number of estimated visitor in a year which was found from interview with the lake authority.

Table 6. Total economic value of Foy’s Lake of one year using TCM

Estimated visit (No.), (β)	Travelling cost (BDT), (γ)	Total number of visitor in year, (δ)	Total value (BDT), $\lambda = \beta * \gamma * \delta$
2 (approx.)	1789 (approx.)	82215 (approx.)	294165270 (approx.)

Total economic value for Foy’s Lake of Chittagong was found 294165270 BDT (Bangladeshi Taka) (or 3792034.49 US \$) approximately for one year during the study period.

4. Conclusion

Managing natural resources like artificial lake in a sustainable way is a multidimensional and difficult task which needs clear concept of present value and lots of other efforts. Travel Cost method is the widely used method to assess the economic value in revealed preference. The estimates found and model developed in this study should be of interest to assess the economic value in this region as stated preference provides more fruitful results. This model can be used to capture economic value of natural resources with a special focus to lacustrine ecosystem used for public recreation, as an integral part of designing economic incentives and proper allocation for better management.

This paper provides a brief overview of economic valuation of natural resources including a generalized overview with a case study from Foy's Lake, Chittagong, Bangladesh. The result indicates that present value of the lake has a significant attachment with the family size, total cost spent, age and education. If these increases, number of visits will be accelerated.

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