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Environmental Valuation for Decision Making: A Literature Review

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Abstract
Lake in the centre of city is a source of recreation and other ecosystem services of its dwellers. Hatirjheel Lake is a prime source of entertainment and an indispensable part of flood regulation systems of Dhaka city. But recently, it is polluted by its visitors, residents, and industries. To save this lake for achieving the sustainability of its ecosystems, a waste management plant is supposed to be built closed to the Lake. So, it is necessary to analyze the costs and benefits of such project before its implementation. But, there is no direct market value of its recreational benefits.
In this paper, a literature review is performed to find a suitable method of valuation of the Lake to evaluate how much investment would be suitable to save this lake from being further polluted. This analysis analyzed prior studies and reveals the validity and reliability of Travel Cost Method that can be used to measure the recreational value. The practical implementation aspects have been suggested based on the prior studies. Proper application of the method helps the policy makers to take development and maintenance decisions of the lake and charge entry fee to generate revenue.
Keywords: *Environmental Pollution, Environmental Valuation, Travel Cost Method, Hatirjheel Lake.*

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I. Introduction

Hatirjheel Lake is the biggest recreational site of Dhaka, a densely populated city of Bangladesh was inaugurated in 2013 covering 302 acres facilities. This site is located closed to Tejgaon industrial area and major residential areas such as Gulshan, Banani, Mohakhali, Badda, Baridhara, Rampura etc (Fig. 01 and Fig. 02 of Appendix-II). Due to locating at the heart of the city, a huge number of people are visiting the lake and throwing the wastage in the lake water (Fig. 03 of Appendix-II). Again the industrial wastage emitted from the Tejgaon industrial areas worsens the situation further that the number of people visiting the lake is sharply declined and residents near to the lake are annoyed due to poor air quality with unpleasant smell (Daily Sun, 2017). So, a Waste Management Plant is to be established just near to Hatirjheel Lake to provide safeguard against such damages and to ensure the waste refineries. The plant is jointly established by the Rajhdhani Unnayan Katripakkha (RAJUK) and Dhaka Water Supply and Sewerage Authority (DWASA). The plant will ensure the clean water and fresh air which will increase the biodiversity and recreational value of the site.

The objective of this report is to evaluate the non-market recreational value of the lake to support the decision making of the policy maker. Here, the Travel Cost Method is critically assessed for such non-market environmental valuation. The ecosystem services matrix has been used to analyze the different ecosystem services, the relevant stakeholders and the impacts thereon. The theoretical validity of Travel Cost Method along with its practical aspects, robustness and reliability and its impact on decision making has been derived from critically analyzed extensive literature review. The report is concluded with expressing a way of valuing the non-market recreational use value by overcoming any limitation.

II. Ecosystem Service Framework

Ecosystem services are values extracted from consuming the environmental goods and services. The values derived from the environment can be ‘use value’ and ‘non-use value’. UK National Ecosystem Assessment classifies ecosystem services align with the Millennium Ecosystem Assessment (MA) into provisioning services; regulating services; supporting services; cultural services. The proposed waste management plant will ensure the biodiversity of the Hatijheel Lake which provides ecosystems services to the different relevant stakeholders (Table-01).

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Table-01: Ecosystem Service Matrix for Hatirjheel Lake

Services	Environmental Outputs	Potential Damages	Stakeholders
Provisioning	Fresh Water	Water Contaminated	Visitors, Residents Aquatic Life
	Fresh Air	Bad Smell in Air	
	Fishes	Fishes Diminished	
Regulating	Water Regulation	Sewerage Systems dampened.	RAJUK DWASA Local People Government
	Health Regulation	Breathing and Lung Problems	
	Flood Regulation	Flood during rain.	
Cultural	Aesthetic	Natural viewing destroyed	Visitors Fishers Tourism industry Local Business Local People
	Recreational	Swimming, Fishing, Boating opportunity lost	
	Eco-tourism	Visiting rate will be decreased	
Supporting	Transportation	Link-roads between lakesides	Transportation Industry
	Biodiversity	Total biodiversity lost	

III. Ecosystems Services: Changes, Impacts And Implications

The establishment of waste management plant in Hatirjheel Lake will significantly change the value systems of the Lake that affects the stakeholders. The major impacts of developing the plant are on visitors and residents due to the recreational opportunity (Table-02).

Table-02: Changes in Ecosystem Service due to Economic Activity

Stakeholders	Changes in Ecosystems Services due to Waste Management Plant	Level of Impacts
Visitors	-Visitors will get recreational benefits i.e. fresh air, fishing, boating and swimming facilities. -Visitors' rate will be increased.	Significant
Residents	-Residents close to lake will get fresh air. -Breathing and Lungs problem will decrease.	Significant
Aquatic Life	-Clean Water will help to grow aquatic life.	Significant
RAJUK	-Contribution to Sustainable Development.	Insignificant
DWASA	-Sewerage conditions will be increased.	Insignificant
Government	-Achievement of Sustainable Development Goals by 2030.	Insignificant
Transportation Industry	-Driving through the link roads will reduce traffic congestion.	Significant
Local Business	-Increased visitors will increase the local business revenues.	Significant

The most significant change in ecosystem services is the recreational benefits derived from the lake. The local businesses and transportation industry depend on the visitors who come to this lake for recreation. And visitor's satisfaction depends on the air quality, scenic area, water quality, parking and traffic facility and sanitation (Hossain *et al.*, 2017). So recreation value is the dominant factor for developing the plant. But there is no direct way to derive the value of recreation facilities. So, we have to use a proxy system to calculate the value to provide information to the policymaker to take policy decisions. This report describes the travel cost method, a revealed preferred method of economic valuation that can be used to calculate the value of recreation facilities of Hatirjheel Lake. Travel cost method is based on the actual behavior of the people of how much travel cost a person is actually paid to come to enjoy the recreation facilities of the lake. It is widely accepted and one of the most successful available non-market valuation methods (Smith, 1993).

IV. Application of Travel Cost Method

4.1 Theoretical Validity

Hatirjheel Lake is primarily for tourist purpose. Visitors come to the lake as it provides opportunity to escape from their stresses of modern life. So the city dwellers are placing greater values for the recreational benefits of this lake. But recreational benefit does not have any direct market value. So, the travel cost method can be used to measure its plausible value of the benefits. Harold Hotteling (1947) first introduced the travel cost method by using the demand schedule to measure the total benefits derived from parks visitors that was rigorously implemented by Clawson (1959). Since then, travel cost method is used to measure the non-market value of recreation using visitors' revealed preference of visiting the sites. As the visitors come to the sites to enjoy the leisure period, it is obvious that they prefer to travel from a long distance if the sites provide them the maximum benefits. So, the extensiveness of benefits has a significant impact on the travel costs and distance a visitor is willing to incur and travel to visit the sites. Alternatively, in travel cost method it is assumed that the higher the travel cost, the higher the recreational values of a site. The travel cost method is based on the theory

of consumer surplus that means consumers subject to their budget maximize their utility of consuming goods or services (Gravelle and Rees, 2004).

There are three different methods of measuring this travel cost. The zonal travel cost method (ZTCM) classifies the survey areas into different zones and collect the data for each zone considering the respondents of same zone having same geographical and demographical characteristics. In Australia, Pitt (1992) used this method for NSW North Coast and Fleming and Cook (2008) used it for Lake McKenzie, Fraser Island. But, in reality it may not always be possible to have same geographical characteristics within the zone. This problem can be solved by using the individual travel cost method (ITCM) where every respondent is separately considered. Sohngen, Lichtkoppler and Bielen (1999) used this method to explore recreational value of Lake Erie Beaches. In Australia, this approach was used by Blackwell (2007) to value a recreational visit of Moolooba Beach and in Nepal, it was used by Thapa (2013) for Fewa Lake. Due to the advancement of information technology and inclusion of more socio-economic characteristics, ITCM is preferred to ZTCM (Bateman, 1993). Individual Travel Cost Method is very useful when data is limited (Parsons, 2003) and it is widely applicable and flexible method (Garrod and Willis, 1999). But, the visitors may visit the sites for various purposes and they may also visit different sites at a time. So, it may always not be possible to collect the information for a specific site if the respondents visit multiple sites and stay overnight. The random utility approach can be used where data for different sites about different uses of random respondents collected. The choice of approach depends on the cost and availability of time. The zonal approach and individual approach are popular in practice as they are simple and less costly than random utility approach and also provide approximate estimates.

4.2 Practical Aspects

In Practice, the travel cost method is popularly used to appraise the non-market value of a site. The prior implementations (Table-3, Appendix-I) suggest the following steps to be followed;

4.2.1. Selection of Method: There are three approaches of implementing travel cost method. In zonal method, data is collected based on zone. The whole survey area is classified into small zones based on distance. It is assumed that, the respondents within each zone has the same demographic characteristics and incur the same cost of travel and travel the same distance to reach the recreational site. Fleming et al (2008) implemented this method to measure the recreational value of Lake McKenzie, Fraser Land. In Individual Travel Cost Method (ITCM), the data is collected individually irrespective of the zone. It is observed that ITCM is popularly used in practice. This method was used by Sohngen, Lichtkoppler and Bielen (1999) for measuring the recreational value of Lake Erie Beaches, USA, by Blackwell (2007) for Mooloolibа Beach, Australia, by Paul (2011) for Ngoe Beach, Cameroon and by Thapa (2013) for Fewa Lake, Nepal and. In Bangladesh, the ICTM was used by Islam and Majumder (2015) and Alam, Chowdhury and Hossain (2017) to measure the recreational value of Foy's Lake, Chittagong. But, Lamsal et al. (2016) used both Zonal TCM and Individual TCM for measuring the value of Ghodhaghodhi Lake, Nepal. On the other hand, in Random Utility Approach of travel cost method, it is assumed that the users usually use the site as part of their life style with many other recreational activities. So, random data including the studied site visitation information collected to analyze the recreational value of a site. This method is rarely used in practice.

4.2.2. Data Collection: Data can be collected using various methods i.e. personal interview, questionnaire survey, mail, email, focus group discussion, telephone interview, personal observation and online survey from primary sources. Some data such as total population size can also be collected from different secondary sources through searching to or seeking from the relevant entities. Maximum prior researcher used the on-site interview with a structured questionnaire (Table-3, Appendix-I) to collect the data except Lamsal et al. (2016) used the focus group discussion before interview. The pilot testing can be implemented before conducting actual survey to increase the data quality. The sample size of data collection depends on the available time, cost and response rate. The observed sample size in prior studies is from 50 (Thapa, 2013) to 430 (Fleming and Cook 2008). Random, Stratified, Cluster and other sampling techniques can be used to define the respondents. It is observed that most of the prior studies used the random sampling method (Sohngen, Lichtkoppler and Bielen, 1999; Fleming and Cook 2008; Paul, 2011; and Thapa, 2013; Islam and Majumder, 2015; Lamsal et al. 2016) except Blackwell (2007) used both random and stratified sampling and Alam, Chowdhury and Hossain (2017) used the systematic sampling. The data can be collected in different time of day, different months, different seasons, and even in different years for ensuring more reliability. In addition to travel cost, travel distance and no. of trips, other variables such as age, income, employment, occupation, education, hometown, gender, time spent and satisfaction data (Table-3, Appendix-I) can be collected to find out the other significant impacts of traveling the site.

4.2.3. Data Analysis: After collecting data, statistical techniques are used to analyze data. The data should be normalized by removing any extreme value and data error by using box plot, qq-plot or line/scatter diagram. Different regression analysis including linear regression used by Fleming and Cook (2008) and Thapa (2013), ordinary least square used by Blackwell (2007) and Paul (2011) and Lamsal et al. (2016) and multiple regression used by Islam and Majumder (2015) can be used to analyze the data. Multicollinearity and Autocorrelation used by Thapa (2013) can be checked to enhance the reliability of the result. The consumer surplus can also be calculated through using the demand function (Sohngen, Lichtkoppler and Bielen, 1999).

4.2.4. Findings Analysis: The demand function and regression analysis provide the base of the decision making. The positive consumer surplus observed in prior studies (Fleming and Cook 2008; Paul, 2011; and Thapa, 2013; and Alam, Chowdhury and Hossain, 2017) indicates that the policy maker can invest in improvement and maintenance of the ecosystems services of the sites. The regression analysis indicates mixed results. Blackwell (2007) found beach recreation value higher than forest recreation value validated by Sohngen, Lichtkoppler and Bielen (1999) by indicating lake as valuable public resources. Though parameters are strongly correlated, the R squared is poor in Islam and Majumder (2015) and Lamsal et al. (2016) studies.

4.3 Robustness and Reliability of derived estimates

The R square value indicates the reliability of the model which can be justified by the F-value and P-value at a predetermined significance level. The coefficient of each independent variable indicates its impact on the dependent variable. The T-value and P-value of each coefficient is considered to measure their statistical significant. The finding is relevant for decision making when the independent variables can statistical significantly explain the dependent variables subject to data quality test and residual analysis. The travel cost method does not consider the multiple visits or overseas visits and it is not practical to consider the same cost and distance and demographic characteristics for respondents within the same zone. Though having some limitations of valuing these non-market recreational services, the travel cost method uses the expenses the respondents actually pay to enjoy the site. And the people usually travel even from long distance if the site is beautiful like London Bridge or Niagara Falls. That means, people care the utilities of the sites while spending for travelling to the site. So, if the data and analysis is done perfectly, the policy maker can undoubtedly rely on the estimates derived by this method.

V. Impacts on Decision Making

The perfect decision can be taken when the information is available in hand. There is high chance of making bad decision under ambiguous situation. The ecosystem services of Hatijheel Lake have no direct market value. So, travel cost method is used as a proxy valuation of this non-market services that can be used by policy maker, beach managers and other relevant individuals. The consumer surplus calculated by this method is useful to take decision for charging an entrance fee to visitors and decision for annual budget of lake management and improvement. Khan (2004) used this method in Pakistan and based on consumer surplus suggested a park entrance fee of Rs.20 per person could raise annual revenue of Rs.11 million that can be used for park management and improvement and Alam, Chowdhury and Hossain (2017) found recreational benefits of Foy's Lake, another major city lake in Chittagong, Bangladesh, of US $ 40.2 million. If the cost of any policy implementation is less than the consumer surplus, then the policy implementation decision will be profitable. The policy maker should not only think recreational values of the lake, they should also think about the biodiversity and other benefits derived from it. Multiple regression method for analyzing different factors including lake attributes helps the decision maker to identify the vital factors affecting visitor's rate and areas of improvement. The policy maker can invest more in the factors that significantly affect the increase of number of visitors that will affect the annual revenue that can be used to improve the budget of waste management plant of the lake.

VI. Conclusion

Hatirjheel Lake, Central City Lake in Dhaka, is crucial to manage the biodiversity and livable conditions to provide ecosystems services to its respective stakeholders. A waste management plant can save this lake from recent pollution that can be established based on the value of benefits derived from it. The policy maker can use a valid and popular Individual Travel Cost Method to measure the value of the most significant recreational ecosystem services of the lake. The project should be started if its cost is less than the value derived from the lake. The other factors such as local communities' attitudes, the impact of the lake on house price derived by Hedonic Pricing Method, the health impact of pollution derived by Dose Response Approach and avoidance opportunity of water logging situation in Dhaka city during rainy season can also be taken into kind consideration of the respective policy maker before taking final decision.

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Appendix-I

Table-3: Application of Travel Cost Method: Evidence from Literature

Author(s)	Method Used	Study Area	Sample size and method	Data Collection Method	Variables	Data Analysis	Findings
Alam, Chowdhury and Hossain (2017)	Individual TCM	Foy's Lake, Bangladesh	-120 visitors -Systematic sample	-On site interview	-travel cost -age -income	-Regression (Zero Truncated Poisson) -consumer surplus	-Annual recreation benefits US $ 40.2 million
Blackwell (2007)	Individual TCM	Mooloolaba Beach, Australia	-250 visitors, Random and Stratified	-On-site interviews	-Fuel cost -Travel cost -Income -Employment status	-Regression (OLS, TP,TNB)	-Consumer surplus is line with the international literature -Beach recreation value is higher than forest
Fleming and Cook (2008)	Zonal TCM	Lake McKenzie, Fraser Island	-430 visitors -Random	-questionnaire survey	-Travel cost -Hometown -Age -Education -Income	-Linear regression -Linear-log, log-linear, log-log,	-Consumer surplus $1462 per person per trip
Islam and Majumder (2015)	Individual TCM	Foy's Lake, Bangladesh	-200 visitors -random	-Structured questionnaire interview	-Travel Cost -Age -Education -Income -Family size -Satisfaction	-Multiple Regression	-Not Good Model (R Square .084)

					-Joint visit		
Lamsal *et al.* (2016)	Individual TCM and Zonal TCM	Ghodhaghodhi Lake, Nepal	-128 visitors -random	-Focus group discussion -Interview	-Age, -Marital Status -Household size -education -Income -Occupation -Time spent -Travel cost	-Ordinary Least Square (OLS)	-Significant Parameters but poor R Square
Paul (2011)	Individual TCM	Ngoe Beach in Kribi, Cameroon	-242 vistors -random	-on-site questionnaire	-Travel cost -Age -monthly income -education ,employment -gender -nationality	--Regression (OLS, TP,TNB)	-Consumer surplus (€2.56-€41.51) -suggested access fee €2.0
Sohngen, Lichtkoppler, and Bielen (1998)	Individual TCM	Lake Erie Beaches, USA	-394 visitors -random	Questionnaire	-distance traveled -no. of trips -income -average recreational expense, beach attitudes	-Demand Function -Regression -consumer surplus	-valuable public resource
Thapa (2013)	Individual TCM	Fewa Lake, Nepal	-50 visitors -Random	-Closed ended questions	-Traveling cots, Income -Age -Education -Location	-Regression -Multi-collinearity - Autocorrelation	-Consumer surplus US $ 0.16 per person per trip

Sources: Developed by Author from Prior Studies

Appendix-II

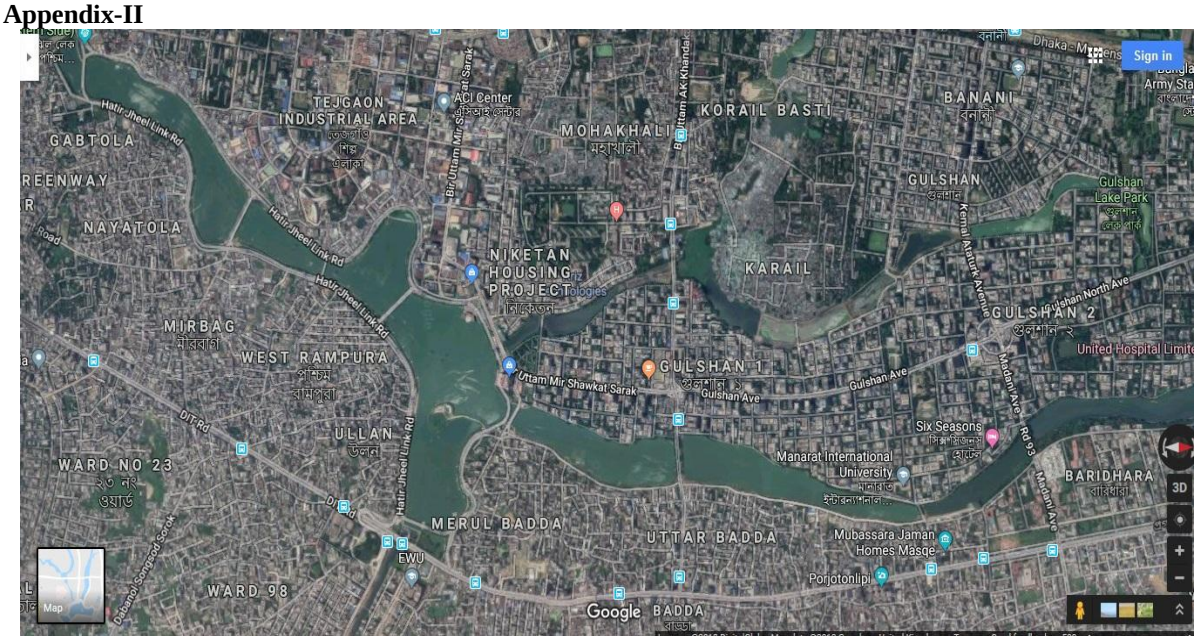

Fig. 01: Site Layout of Hatirjheel (Sources: Goggle Satellite Map)

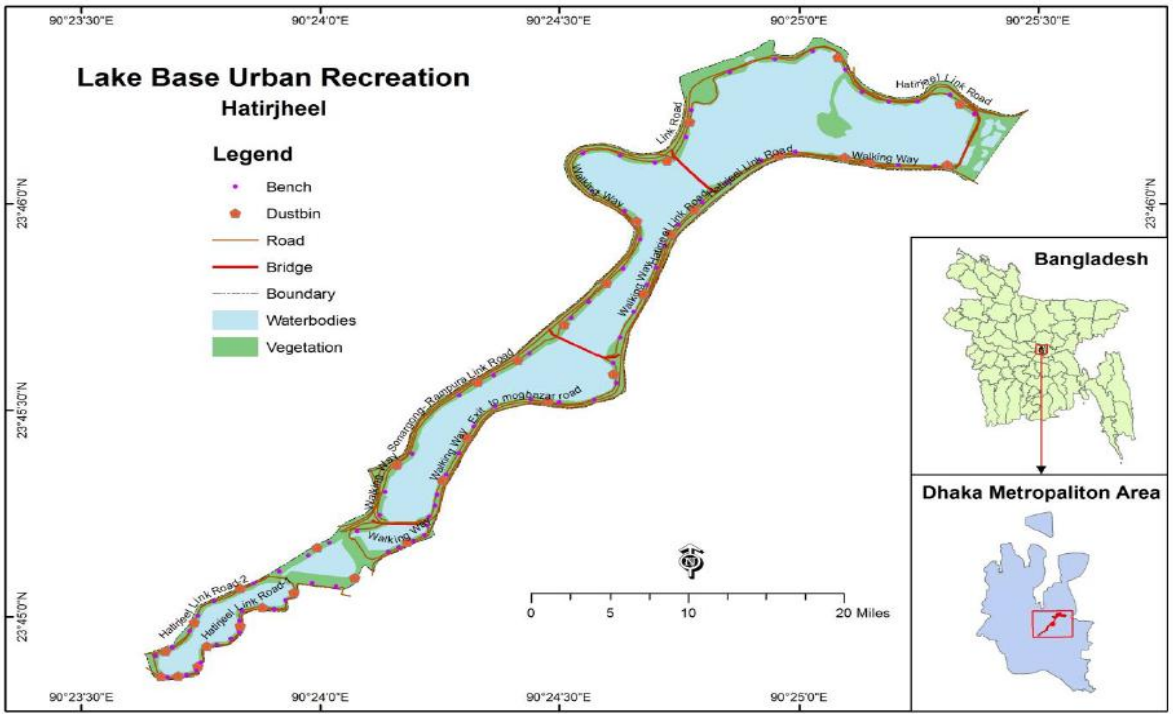

Fig. 02: Hatirjheel Lake Area (Hossain et al. 2017)

Fig. 03: Waste Materials in Hatirjheel Lake (Daily Sun, November 20, 2017)

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