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By

Simanti Banerjee & Asish K Ghosh

Abstract

Urban wetlands have great significance owing to the various services they provide to individuals living in their close vicinity. However, they are under substantial pressures owing to developmental activities, encroachment and unsustainable use in different parts of the city. Jodhpur Park Lake is one such wetland, which is vulnerable owing to the presence of a slum on its southwestern banks. In such a situation the objective of this study is to test whether the local residents- the stakeholders of the lake would be willing to pay a part of their incomes towards the creation of a corpus fund which will be used by the local municipality for maintenance and operation of the lake ecosystem in an improved state. A valuation study has been executed using the Contingent Valuation Method to elicit values of Willingness to Pay (WTP) for entry fees and swimming club memberships. Information regarding the various services, which might be provided, within the lake premises has also been collected and ranked in order of popularity. These rankings and WTP values serve as important tools for policy makers. If the total value generated, a proxy of which is given by the population WTP value, is greater than the cost of maintenance and operation, then the lake ecosystem may be transformed into a conditional access one run by the 'stakeholders'/ 'beneficiaries' funds. If costs exceed the value then a combination of funds of the beneficiaries and the local self-government may be effected to operate the lake. Public awareness campaigns may be generated to increase the level of awareness, which would increase the WTP and might lead to an increase in the actual payments for the lake in the future. This would allow the gradual phasing out of the role of the municipality to turn the lake ecosystem into a self-sustaining provider of amenity services.

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An Environmental Valuation of an Urban Wetland: A Case Study of the Jodhpur Park Lake in Kolkata

Simanti Banerjee and Asish K Ghosh

I. Introduction

1.1 The environment

The environment is the primary source from where all living beings on earth draw resources for survival. This involves a demand on its biotic and abiotic components. Also given the multi-dimensional role of the environment- its ability to act as a provider of energy and raw materials, amenity and sink services- there is at all points of time a conflict regarding how to utilize a particular resource derivable from the environment. As an example we can think of an open space, which can be put to use for setting up housing or for the establishment of a recreational facility, say a park. Here there is a clear conflict between the utilization of the environment for production of services, which have both use value as well as exchange value or to extract amenity value. With reference to this conflict, two concepts - absolute and relative scarcities may be defined.

Absolute scarcity comes into existence when all demands on the environment for its services are increasing, simultaneously (Daly, 1991). Relative scarcity is felt due to the existence of the aforesaid conflicting demands. However attempts to correct this scarcity can be made by installing a correct set of relative prices.

Thus given that all environmental resources and services are subject to scarcity of either nature it is a likely conclusion that they may be treated to demand and supply analysis which leads us to the possibility of finding a value for the resource and service under consideration. These value figures provide the information that is imperative for environmental management and policy formulations.

Here in we encounter an obstacle. Most environmental goods are not traded on the market. Actually by nature many of these goods are such that the two main features - excludability and rivalry in consumption, which make private or group ownership possible, are absent in them. Again market forces, many a time cannot be relied on, to

attach a proper value to many of the resources, which reflects their true social value. Nor can the institution succeed in allocating these resources to their most optimal and/or most highly valued use.

It is under such a state of affairs that the concept of non-market valuation gains importance. Non-market valuation techniques enable economists to devise value figures for these resources and services, which facilitate policy formulation. On the basis of these policies better resource management and judicious use has the potential of generating substantial gains for the economy.

1.2 Open spaces

Open spaces include wetlands, grasslands etc all of which contribute to the overall well being of the citizens in terms of health and quality of life. Lakes, rivers, grassland areas provide recreational services like fishing, boating, camping and also essential services like bathing, washing, and a steady source of drinking water supply. Water bodies help in climate control and maintenance of temperature of a given region.

1.2.1 Utilities from wetlands

The Conservation Foundation, USA in its report on wetlands has given an exhaustive list of functions to which wetlands confirm.

i. *Flood conveyance*: Riverside wetlands and floodplains often form natural flood ways through which floodwaters are passed to downstream points.

ii. *Barriers to waves and erosion*: Especially relevant for coastal wetlands and those adjacent to large lakes, these wetlands reduce the impacts of storm tides and waves before they reach upland areas.

iii. *Flood storage:* Inland wetlands may store water of floods and downpours and slowly release it to the downstream areas lowering flood peaks.

iv. *Sediment control:* Wetlands reduce flood flows and the velocity of floodwater. Thus they are useful in reducing erosion and causing floodwaters to release sediment.

v. *Fish and shellfish:* Wetlands are important spawning and nursery areas and provide sources of nutrients for commercial and recreational fin and shellfish industries particularly in coastal areas.

vi. *Habitat for waterfowl and other wildlife*: Both coastal and inland wetlands provide essential breeding; nesting, feeding and predator escape habitats for many forms of waterfowl and other birds and mammals and reptiles.

vii. *Habitat for endangered species:* Almost 35% of all rare and endangered animals species are either located in these areas or dependent on them even though the total land area covered by wetlands is hardly above 5% of the total landmass of the nation's lands.

viii. *Recreation:* These land areas provide grounds for hunting, fishing, observing animal and plant life, and other recreational activities like boating swimming.

ix. *Water supply*: Wetlands areas are increasingly gaining importance as a source of ground and surface water with the growth of urban centres and dwindling ground and surface water supplies.

x. *Food production:* Because of their high natural productivity both tidal and inland wetlands have unrealised food potential for harvesting marsh vegetation and aquaculture.

xi. *Timber production:* Under proper management forest wetlands are an important source of timber despite the physical problems of timber removal.

xii. *Historic and archaeological value*: Some wetlands possess considerable historical and archaeological interest, which make them important not only to researchers but also to tourists.

xiii. *Education and research:* Tidal, coastal, and inland wetlands provide educational opportunity for natural observation and study.

xiv. *Open space and aesthetic value:* Both tidal and inland wetlands are areas of great diversity and beauty and provide open spaces for recreational and visual enjoyment.

xv. *Water quality:* These lands contribute to improvement of water quality by removing excess nutrients and many chemical contaminants. They are sometimes used in tertiary treatment of wastewater.

The existence of these functions points to the fact that if these areas are made amenable to valuation exercises they will yield positive values. Secondly, as these services are not allocated through markets they are virtually free. This is the strongest reason for their mismanagement and eventual destruction. Also the fact that they are by nature common property resources, they are susceptible to pollution and human mismanagement.

What is important in the context of Kolkata is that the current trend of its urbanisation is realised by increasing the vulnerability of wetlands through degradation and eutrophication (the process of algal overgrowth), filling up and other maladies, many of which are irreversible in nature.

The present study deals with one of many such water bodies in the heart of the Kolkata metropolis - the Jodhpur Park Lake.

1.3 Historical overview of the Jodhpur Park and the Lake

Jodhpur Park falls under Ward 93 of the Kolkata Municipal Corporation (KMC), earlier known as Calcutta Municipal Corporation (CMC). The area was originally a low-lying swampy land, which was used as a polo ground. In the 1950s the *Bengal Co-operative Housing Society* developed the area to establish a well-planned settlement. As per the plans laid down by the Society, the area was divided into residential sectors, with a provision for a market place, a health centre, separate educational institutions for boys and girls, and an institution for social occasions. A lake area was developed with an intention of establishing a lakeside park for recreational and aesthetic purposes in the heart of the locality. All the members of the society contributed to the initial development through the membership fees as well as the price of the lands, which were sold off to the individuals on a lottery basis, and the society has a commitment to contribute funds for the future upkeep. The society was in charge of the area until it was handed over to the Calcutta Municipal Corporation.

However, the lake deteriorated due to lack of proper management. In the early 1980's the water body was cleaned, the lake premises fenced off and the Department of Forests landscaped the adjoining green zone. By this time the civic system of the area was handed over to the Calcutta Municipal Corporation, which in turned settled a small colony of workers on the southwestern corners of the lake. This colony has burgeoned from a 3 to a 58 family settlement. Over time this colony has reclaimed a considerable

portion of the banks for their habitation. Dwindling funds as well as use of the water body for domestic purposes has lead to the gradual deterioration of the landscape and eutrophication of the water.

1.4 Present status of the lake

In 2001 the Asian Development Bank provided the Kolkata Municipal Corporation with a fund to the tone of Rs 1200 crores in the form of debt funds to be utilized under the aegis of the Kolkata Environment Improvement Programme (KEIP) for the up gradation of water supply and sanitation facilities as well as the improvement of major drainage canals of the city. In addition to this a small part of the corpus fund was allocated for the improvement of water bodies within selected park areas. A list of 20 water bodies was made by the KMC in which the Jodhpur Park Lake figured as one of the many wetlands, which would be tackled in the first phase of development.

The KMC decided on the manner of improvement of the lakes, which includes cleaning up of the lake water, proper landscaping, garbage disposal, illumination of lake premises, and improvement of embankments amongst others. The ADB however organised the consortium of 3 consultants, Consulting Engineering services, Ghosh Bose Associates, and Stup Consultants for the purpose who in turn sub-contracted the entire workings to another party. The programme however does not provide any funds for the eviction and subsequent rehabilitation of the slum colony on one of the banks of the lake.

When this study was undertaken no action towards upgradation had been undertaken. But over the course of the study, concerted efforts on the part of the KMC and the ADB has indeed lead to the improvement of the environs in and around the lake. All objectives have been fulfilled. Owing to the fact that the embankments are made of brick, they have been provided with a number of wee holes, which allows the water to stay in continuous contact with the soil and hence avoid the possibility of eutrophication. But in spite of all these positive actions the illegal encroachment by the slum dwellers have to large extent defeated the purpose of upgradation of the lake.

1.5 Justification and objective of the valuation exercise

The present valuation study was conducted with the purpose of investigating whether the residents- the beneficiaries of the Lake and who already pay a proportion of their incomes as civic taxes would be willing to pay out a further chunk of their incomes towards the maintenance of the lake ecosystem, a result which would be available from the results of the WTP analyses. The KEIP drive only reinforces the significance of the study. In an improved set up it might be expected that the willingness to pay will be higher than if the Lake environs were to remain in its dilapidated state, as will be the level of involvement of the local residents to engage in the maintenance of the Lake premises.

The funds available for the improvement of the lake environs from the ADB comprise of a one-time lump-sum investment. However given the existence of the slums the lake ecosystem is under constant pressure. The utilization of its water for household activities and that of the lake for unabated waste disposal continues even under the present improved setup. In such a situation it is suspect that the upgraded condition of the lake ecosystem will not be sustained well into the future. Furthermore the absence of any fund source for operation and maintenance makes the situation even grimmer.

A solution in this respect is the transformation of the lake into a conditional access from an open access one. This will to a substantial degree relieve the pressures on this fragile ecosystem. This transformation may be realized through the implementation of a payment structure for the utilization of the services provided by the lake environment. The funds generated through these payments may be devoted towards maintenance of the lake and its services.

However introduction of payment structures is contingent on the existence of preferences for the lakes services on the part of the local residents. The fact that in the year 2000 when the entire lake surface was covered with weeds many responsible local residents contributed towards a fund which was utilized for weed removal, indicates that the amenity does figure in the utility functions of the residents.

From here follows that valuation exercises will definitely lead to computation of value figures, which are approximations of the values, which Jodhpur Park residents place on the lake. It is expected that these figures will have great policy significances,

as they will give an appropriate idea about the residents' preferences for the environmental amenity and the values they are willing to attach to it.

These value figures help in the computation of total economic value from the wetland. Teamed with a valuation study an attendant cost analysis which in this case would entail computing the costs of maintaining the lake ecosystem and environs, may be utilized for devising an efficient payment structure which if put into place will ensure a flow of funds for a sustained maintenance of the ecosystem well into the future.

II Valuation: Theoretical framework of the Contingent Valuation Method

2.1 Methodology of Valuation

The Contingent Valuation Method is one of the stated preference methods of valuation. Devised by Davis in 1963 it finds implementation in cases where there is a possibility or certainty of a proposed change in any characteristic of the environmental good. Another important aspect of the CVM is that it may not be utilized for valuation of amenities, which have already been institutionalised through entry into the market. The present case confirms to both these aspects, which justifies the adoption of the CVM for the valuation exercise.

2.2 The Framework of the Contingent Valuation Method

Value determination through this route has the following five steps. A brief description of each is given below.

Step I. Construction of the hypothetical market & selection of buyers

Since environmental goods and services are non-marketable the first step towards valuation is setting up of a hypothetical market in which these goods and services can be envisaged to be traded. The establishment of the market requires information on the following counts. Respondents have to be made aware of the status quo, the proposed change, the impact of the change as well as the size and socio-economic composition of the payees. The respondents have to be convinced that no proceedings can be undertaken in the absence of funds even though nothing is being changed at present.

Hypothetical buyers have to be identified who in fact are those individuals who derive values from the environmental good/service and would have actually purchased the environmental good or its services had it really been on the market.

Step II. Collecting bids

In a CVM study, the values are enumerated on the basis of a willingness to pay (WTP) or a willingness to accept (WTA) question. WTP represents the minimum amount the consumer would agree to pay to secure a favourable change or the maximum amount that the agent would agree to pay to block an undesirable change. WTA on the other hand represents the maximum amount of compensation that an agent would be willing to accept for any debilitating change in the characteristics of the good under consideration. The National Oceanic and Atmospheric Administration (NOAA), agency of the U.S. Department of Commerce, advocates the enumeration of the WTP for the computation of economic value.

Once the hypothetical market has been outlined along with the participating buyers, the WTP figures are elicited through the adoption of various techniques.

⇒ *Closed ended referendum*

Here a single payment value is suggested to the respondents to which the individuals reply with a yes or a no. This method is known as the Dichotomous Choice method and the responses are known as dichotomous choice responses. A yes response is indicative of the fact that the payment $p \leq$ max WTP. A no indicates that $p \geq$ max WTP.

In the two-tiered Dichotomous Choice method devised by Hanneman, the consumer is faced with two bids. If the response is a 'yes' a higher bid is offered and the answer to this response is marked. When the response is no on the other hand then a lower bid is offered to which the respondent can reply either in the affirmative or negative. However no exact estimate of the value can be obtained as yet.

⇒ *Open-ended referendum*

Three methodologies can be grouped under this approach. In all cases through repeated questioning the respondent is made to come up with a figure for WTP and/or WTA. The three methods, which can be, followed are:

- *Payment cards:* Here a range of values, indicating the expenditures by a typical representative household are revealed to the respondent who then chooses any one of the values as his/her WTP and/or WTA. This method facilitates respondents to calibrate their replies.
- *Bidding games*: In this method values are suggested to the respondents who if agree to them, then the values are increased and if they disagree then the values are reduced, until in any of the above cases a no and a yes are reached respectively.
- *Open-ended questions:* Here the respondents are asked to suggest an amount that they would be willing to pay or willing to accept. Surveys following this method are not always very accurate as the respondents in the context of a hypothetical market find it difficult to suggest WTP and/or WTA values.

Step III. Estimation of mean and marginal WTP and/or WTA

The WTP, WTA values are differently arrived at for the closed and open-ended referenda. In case of open-ended methods the values can be obtained by arithmetic mean or median as exact information about the above is available. With lower bids more likely than higher ones the means are found to fall short of the median measures.

In the closed ended dichotomous choice method analysis is different. Here the hypothetical nature of the change or the partial observability creates hurdles in the estimation procedure. It is assumed here that the researcher is unable to observe the well-defined preferences of the individuals. Thus for working purposes a random utility model is constructed to model the choice of the respondents. Here the probability of a yes or a no is obtained with the use of logistic estimation technique.

Let the utility function of the i^{th} respondent be $U_i = U(Y_i, Q_0)$ where Y and Q have usual meaning. U_i is not completely observable to the researcher. Thus say V_i is the observable part while ε is the stochastic component of utility having zero mean. Thus,

$$U_i = V_i + \varepsilon_i \qquad \text{where } V_i = Q_0 + \beta Y_i,\ i = 1,2,3\ldots n \qquad (1)$$

A_i represents the bid amount for say an increase in environmental quality from Q_0 to Q_1. The yes and no responses that are obtained can attain two values 1 and 0 respectively. Thus if R_i be the binary dichotomous variable, then for the model:

$$\begin{aligned}\text{Prob}\,[R_i=1] &= \text{Prob}\,[(Q_1+\beta(Y_i-A_i)+\varepsilon_I \geq (Q_0+\beta Y_i+\varepsilon_0)]\\ &= \text{Prob}\,[(Q_1-Q_0)-\beta Y_i \geq (\varepsilon_0-\varepsilon_I)]\\ &= \text{Prob}\,[\eta \leq \theta-\beta A_i] \text{ where } \eta=(\varepsilon_0-\varepsilon_I) \text{ and } \theta=(Q_1-Q_0) \qquad (2)\end{aligned}$$

η is a linear function of random error terms and hence is a random variable with a logistic distribution. Now the cumulative density function F of η gives:

$$\begin{aligned}P_i &= F_\eta(\theta-\beta A_i) = 1-F_\eta(-\theta+\beta A_i)\\ &= 1-(e^{-\theta+\beta Ai})\,(1+e^{-\theta+\beta Ai})^{-1}\end{aligned}$$

$$\therefore \log[(1-P_i)/P_i] = -\theta+\beta A_i \qquad (3)$$

R_i is regressed on A_i to estimate θ and β, and in this process the estimated regression equation can be used to find out the probabilities for any given bid A_i. The right hand side quantifies the changes in the value of V_i following changes in environmental quality. This change is delinked from Y_i changes and so is free of income effect. In the next step this binary fitted model is utilized to develop a method to estimate the average WTP and/or WTA. For a consumer with income Y_i, the quantity W_i is of importance, which is actually a point on the person's indifference surface. Thus

$$\begin{aligned}&U(0, Y_i+W_i) = U(1.Y_i) \qquad \text{where } W_i = \max WTP_i\\ &\Rightarrow Q_0+\beta(Y_i+W_i)+\varepsilon_0 = Q_1+\beta Y_i+\varepsilon_I\\ &\Rightarrow W_i = (Q_1-Q_0)/\beta+(\varepsilon_1-\varepsilon_0)/\beta = \theta/\beta-\eta/\beta \qquad (4)\end{aligned}$$

Thus W_i is also random and partially observable. Now the

Average WTP, $W^* = E(W_i) = \theta/\beta$, since $E(\eta)=0$ (5a)

The figure is referred to as mean WTP as it is computed as a figure to be paid on an average by all the households. Also it is sometimes known as the marginal WTP as it is a figure that defines the value of a change of the environmental amenity at the margin.

In CVM surveys since lower bids are more common that higher ones the median WTP as an indicator of majority preference may also be computed. This is because the lower bids make the distribution of responses positively skewed and in this case the median comes out as a better measure as it is less susceptible to extreme observations than the mean.

In a more generalized setting the presence of other determining factors other than bid value can be considered. As a result of extensions of the model the W* expressions takes a new form which is given by

$$W^* = E(W_i) = [\theta + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4] / \beta_1 \qquad (5b)$$

Here β_1 is the coefficient of the independent variable $\mathbf{X_1}$ that represents the value of the bid, β_2 is the coefficient of the independent variable $\mathbf{X_2}$ that represents the family size. Similarly β_3 is the coefficient of the variable representing length of stay in the locality which is denoted by X_3 and finally β_4 is the coefficient of the last of the selected statistically significant independent variable X_4 which represent highest educational attainment of the family. θ is the constant obtained from the regression. It is also to be noted that all italicised expressions in the formula represent arithmetic means of the corresponding variables.

Stage IV: Estimating bid curves

The bid curves can be computed with the W_i series to obtain total WTP and/or WTA. This W_i can be regressed on income Y_i and other socio-economic variables S_i and the environmental quality enjoyed by the consumers. Thus the estimated bid function is given by

$$WTP = f(Y_i, S_i) \quad i=1,2,3\ldots n$$

Stage V: Aggregating Data

In the final stage of the survey the population WTP is estimated. The value of average population WTP, W_p is obtainable by substituting the Y_i, Q_i, S_i by the corresponding population figures. Thus as a result of the CVM survey the (W_p, N)-mean WTP of the population of a size N is obtained. While negotiating this step three issues have to be kept in mind.

- *The choice of the relevant target population:* This has to be decided on the onset of the survey drawing the sample units from that group of people who will be significantly affected by the change in the environmental quality.
- *The procedure to follow for moving from sample statistic to population parameter:* Amongst the different alternative that have been proposed one involves multiplying the sample mean by the population size N. this however might be a biased measure and so to improve on this population values of various influential factors pertinent to the survey might be taken and the population mean can be calculated by plugging these values into the bid curves.
- *The last choice to follow is that of the period over, which the benefits from the change are to be aggregated:* This decision is dependent on the circumstances in which the entire exercise has been conducted. If the present value of the environmental benefits is very high then the benefits are discounted. With an irreversible damage as a result of the change present value is calculated by taking perpetuity. All these cases involve use of current preferences to measure future ones.

III. General information about the surveyed households

3.1 The Sample

During the tenure of the survey the residences of the families living in closest proximity to the Jodhpur Park Lake were visited. Two classes of stakeholders of the lake were identified:

- Group A households, which comprises of the survey units, which live in the immediate vicinity of the lake. 59 such houses were visited.
- Group B households which are those which live in the near vicinity of the lake compared to all other residents of Jodhpur Park, but not in the lake's immediate neighbourhood.

The number of houses under the second category added up to 61 bringing up the total of 120 houses visited.

The above classification is done on the grounds of investigating whether there were differences in the preference pattern of the various household groups towards the lake.

Below follows a description of the general information of the surveyed households.

3.2 Nature of Tenure

The surveyor visited a total of 120 households during the tenure of the survey. The results of the same revealed that 95 families (79 percent of the sample households) live in own houses while the remaining 25 families (21 percent) inhabit the rental quarters.

The surveyor exempted from visiting those establishments, which have been completely taken over by commercial enterprises. This can be attributed to the fact that any information regarding the valuation of the water body would be available from the residents of the locality who are the actual stakeholders of the property.

Irrespective of the nature of tenure of the households, all households expressed their desire to see some positive action being taken towards the beautification of the open space given their permanent stay in the locality.

3.3 Length of stay

The majority of the households covered in the survey have resided in Jodhpur Park for long periods of time. The distribution of length of stay is bimodal with a maximum of 17 households in the ranges of length of stay 11-15 years and 26-30 years in the locality.

Length of stay (in years)	*No of households*
>1	5
1 – 5	7
6 - 10	14
11- 15	17
16- 20	16
21- 25	11
26- 30	17
31- 35	12
36- 40	12
41- 45	6
46- 50	2
51- 55	1

The next highest number (16) is for the families, which have made Jodhpur Park their locality of residence for 16 to 20 years. There are a total of 12 families falling in two classes 31 to 35 years and 36 to 40 years. Of the households surveyed it was found that 14 units have been staying the locality for 6 to 10 years. There are 11 families who have resided in the locality for 21 to 25 years. There are very few observations falling in the higher classes beyond 40 years. The same applies for the first two classes, that is, less than 1 year and 1 to 5 years, which have 5 and 7 observations each.

The third class from the end indicates those families living in the locality for 41 to 45 years; this class has 6 observations falling under it. In the penultimate class there are 2 families. These are the ones who have resided in Jodhpur Park for 46 to 50 years. There is only a single family who has resided in the locality for more than half a century.

Given the long residency of most of the families in the locality a majority of the respondents were aware of the history of the area as well as that of the lake and past efforts to re-innovate it. Moreover being direct stakeholders of the water body they expressed their desire to see some positive action being taken towards the beautification of the open space.

3.4 Educational attainment of the household members

During the survey data regarding the educational attainment of the members of the family units was elicited. For facilitating interpretation of the responses, three

categories of educational attainment have been considered: (a) Pre-graduation, (b) Graduation, (c) Post-graduation.

Educational level	*No of respondents*
Pre-Graduation	62
Graduation	193
Post-Graduation	85

Out of the responses that were available it is evident that the majority of the residents of the locality are literate. The majority of the residents of the locality have attained their Graduation degrees (193 individuals) and there are 85 individuals in the 120 households who have proceeded beyond their Bachelor's degree to obtain Master's degrees, CA degrees, PhDs. The 62 individuals who belong to the class of Pre-graduates chiefly consist of children in school, those at the Plus Two level, students currently pursuing their graduation degrees as well as adults who have not pursued their education beyond the Secondary or Higher Secondary Levels. The survey revealed that the adults who had not attained their graduation degrees are the senior most citizens of the locality. The survey has not accounted for young children attending kindergarten.

3.5 Age profile of family units

During the survey information on the age profile of the family members of the stakeholders of the lake was recorded and it was reported here, for the ease of interpretation in ten years class interval.

Age in years	*No of respondents*
1-10	25
11-20	23
21-30	40
31-40	54
41-50	60
51-60	56
61-70	45
71-80	25
81-90	8

The data reveals that the area closest to the lake has families with a pre-dominance of senior citizens and individuals in the middle ages. The survey experience has revealed that the family units belonging to Group A have a predominance of both working and retired individuals.

There are a total of 60 individuals in the class 41-50 years and this is the modal class. The classes 31-40 years and 51-60 years have 54 and 56 responses respectively. There are 40 individuals who belong in the class 21-30 years and 45 who fall in the class 61-70 years. 25 individuals fall in the class representing the first decade i.e. 1-10 years and 23 in the class representing the second decade. On the other end of the age spectrum there are 25 individuals falling in the age group 71-80 years and a total of 8 persons in the penultimate decade i.e. 81-90 years. It can thus be concluded that most of the observations are clustered towards the centre of the classification between the ages of 31 and 60.

This classification has been effected to give an idea about the age profile of the area in general. This representation may play a constructive role in effective policy formulation. With most of the residents who are in their young or middle age, it might be expected that their willingness to pay a fee for the maintenance of the lake will be positive and higher so that such a payment mechanism may in fact be introduced.

3.6 Family size

One of the chief parameters recorded in the survey was family size. It is of significance here as this number is one of the determinants of the demand for the water body. The survey revealed that the neighbourhood around the lake has a pre-dominance of nuclear families. There are 33 three-member families and this is the modal class. The second largest class is that of families with two individuals and they are 28 in number. There are 23 sample units that fall in the fourth class and 16 families, which have a total of 5 members. There are not many large families in the locality. There are 3 families each with 7 and 8 members and 2 units with 6 members. There are 2 households with 9 members and only a single one with 10 members. 9 individuals were found to live singly. The figure reveals that the distribution of family size is more or less negatively skewed with joint families (those with a size of 5 and above) forming only about 24.7 percent of the total observations.

Family size	*No. of families*
1	6
2	22
3	29
4	20
5	15
6	1
7	3
8	3
9	2
10	1

3.7 Monthly income

The survey of the chosen households of Jodhpur Park gives conclusive evidence of the fact that the majority of the residents of the locality are in a financially stable position. Most of the surveyed families reported monthly incomes lying between the values of Rs. 10001 and Rs. 20000 making this the modal class with 34 observations. The second highest observations were obtained for the next class i.e. Rs. 20001 to Rs. 50000 which contained 29 observations. The survey recorded a total of 15 households with an average monthly income above Rs. 50000. 12 families were found to have incomes ranging from Rs. 5001 to Rs.10000. Only 3 households fall in the first class with income below the sum of Rs. 5000.

Monthly family income(Rs)	*No of families*
0-5000	3
5001-10000	12
10001-20000	31
20001-50000	29
50001 & above	15

Survey experience revealed that these few families consist of the elderly whose only source of income is their pension earnings. Responses could be obtained from 90 households only. The remaining units refrained from responding.

IV. Valuation-Exercise, Findings and Policy Implications

4.1 Methodology of the survey

The maintenance cost approach is one way of approaching the valuation of an environmental service. In this methodology attempts are made to elicit the payments that the people of the area under consideration would be willing to pay to maintain the quality of the environmental service at the given level or to maintain the environmental utility in an improved state.

In the present context the latter approach has been adopted to bring out the payments that the residents of Jodhpur Park would be willing to make towards the maintenance of the area within and around the lake. WTP values for entry into the park surrounding the lake have been computed. It is envisaged that the funds generated through this mode of payment, which has been considered as a per-person fee, will contribute considerably towards the maintenance of the environmental utility. Boating and swimming pool facilities have also been considered. This is in keeping with the reality that the organisation, which manages the lake and its environs, are in the process of deciding on the introduction of these facilities in order to ensure a steady flow of funds for maintenance, well into the future. The *dichotomous choice method* has been utilized to elicit the bid values on the basis of which logistic regression analyses have been carried out.

The choice of variables out of the entire pool of factors which may effect WTP- monthly income, nature of residency, highest educational attainment of the family, tenancy, length of stay in the locality, family size and bid values- has been made on the grounds that this combination of parameters yield the most statistically significant coefficients.

4.2 Computation of an Entry Fee

As per the rules guiding a Logistic Regression the dependent variable is a dummy variable taking the values 1 and 0 depending on whether responses to WTP questions are affirmative or negative. The independent variables considered include the bid values for the proposed services, highest educational attainment of the family, tenancy, length of stay in the locality, and family size.

A summary of the results is represented in the table below. A total of 117 observations have been considered which consists of households who live in buildings facing the lake and in the neighbourhoods, closest to it.

The Mean WTP, W* is calculated on the basis of the following formula represented in Equation (5b) in Section II.

$$W^* = E(W_i) = [\theta + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4] / \beta_1$$

The results of the regression analysis are schematically represented in Table 1.

Table1: Regression on Computation of Entry Fee

Method of Regression	Binary Logistic Regression
Number of observations	117
Dependent variable	Response to WTP Question
Independent variables	Bid value, Family size, Length of stay and Educational attainment.
-2 Log-likelihood	135.208
R- square	Cox & Snell: 0.121, Nagelkerke: 0.167

Variable name	*Value of coefficient*	*Standard error*	*t-statistic*	*Expected value of coefficient*
Bid value	-0.256	0.073	3.506	0.774
Family size	-0.109	0.117	0.931	0.897
Length of stay	-0.012	0.017	0.705	0.988
Educational attainment	0.065	0.099	0.656	1.067
Constant	1.853	1.733	1.069	6.380

The values of R-square observable from Table-1 are indicative of the fact that the predictive power of the model is not on the higher side. However all the chosen variables are statistically significant with appropriate signs expected in explaining the nature of relation between the dependent and the independent variables.

It is noted further that there exists a negative relation between the Bid value and the explained variable. This is to be expected as an increase in the bid amount portends towards an increase of the fee, which is to be paid for the consumption of the environmental service, and this will bring down the demand for the consumption of the same and reduce the willingness to pay for the services.

The negative bearing of family size on the dependent variable may be explained along the vein that a rise in the number of members consuming the environmental services increases the overall expenditure made towards the lake. This brings down the demand for the service. Thus it may be expected that when family size increases, bid value has to fall in order to maintain equilibrium. Thus as family size rises there is a fall in the willingness to pay.

With respect to length of stay, a negative sign of the coefficient may be interpreted as an anomalous result, we would like to believe that as length of stay in the locality increases accountability towards the local environment will increase which will have a positive effect on the WTP. However in this case the relation is just the opposite. This may be explained by focusing on the age distribution of the sample households. If this sample is taken to be representative of the general age distribution of Jodhpur Park then it implies that most of the residents are above the age of forty. In case of these individuals accountability towards the lake may be less due to their perception regarding their seniority and future life expectancy. Survey experience has revealed that in a large portion of the households, which are inhabited by senior citizens, the responses to WTP questions have been in the negative.

Lastly, focussing on the final explanatory variable- education, the sign of the coefficient is positive which is to be expected. As educational level increases awareness about the local ecosystem, regarding its benefits and importance rises. This has a positive bearing on the willingness of residents to maintain the lake and as a result their willingness to pay increases.

Mathematical analysis according to the above formula yields a value of Rs. 8.87 as an entry fee per individual, which might be, levied on a per entry basis. It is to be appreciated here that this figure has a very large upward bias. However it serves an important role of a ceiling value giving the upper bound of WTP values. Any value less than or equal to this computed figure will be acceptable to patrons and visitors as a plausible entry fee levied for every person entering the lake premises.

4.3 Computation of a fee for swimming facilities

Logistic regression analysis has been carried out in order to compute the WTP for swimming facilities, which might be provided by the lake. While considering the

different variables, which affect the value of the dependent variable, the explanatory variables- Bid value, Length of stay in the locality, and Family size are found to be statistically significant. The following table gives the result of the analysis.

Table 2: Regression for computation of a fee for swimming facilities

Method of Regression	Binary Logistic Regression
Number of Observations	88
Dependent Variable	Response to WTP Question
Independent Variables	Bid value, Family size, Length of stay.
-2 Log-likelihood	116.673
R- square	Cox & Snell: 0.034, Nagelkerke: 0.046

Variable Name	*Value of Coefficient*	*Standard Error*	*t- Statistic*	*Expected value of coefficient*
Bid Value	-0.005	0.004	1.250	0.995
Family Size	0.100	0.124	0.806	1.106
Length of Stay	-0.023	0.018	1.277	0.977
Constant	2.065	1.349	1.530	7.886

The predictive powers of the model are not very high but the signs of the statistically significant coefficients are in the expected directions. Bid values bear a negative relation to the willingness to pay as can be expected. A rise in the bids will bring about a reduction in the WTP (Table 2)

The coefficient representing the relationship between family size and WTP is positive. In order to explain this relation it is important to look into the composition of the families. Larger families are indicative of a greater number of children whose willingness to join a local swimming facility is much higher than that of old and middle aged individuals who are incapable of doing the same owing to deteriorating health and busy work schedules. In such a situation larger families will have a higher willingness to pay and it is expected that with an increase in the family size the willingness to pay will also go up.

As in the case of entry fee, here also length of stay in the locality bears a negative relationship with the WTP. This can be explained in a similar manner, that as length of stay increases, age of the resident rises, which in turn has a negative impact on the

desire to take out a swimming club membership. Consequently there is less or no incentive to maintain the lake for the said facility and it may be expected justifiably that WTP will fall. In fact the household survey revealed that most senior citizens and people beyond their middle ages did not want a swimming pool in the locality.

Mathematical analysis according to Formula 5b yields a value of Rs. 380.60, which will be levied in the form of a quarterly payment payable for every person who is a member of the facility. This figure is a plausible one given the pertinent fact that the majority of the residents of Jodhpur Park are in the higher income brackets.

4.4 Demand for services

At the onset it should be mentioned that while eliciting responses from the households the respondents opined that a sustainable supply of any particular facility would not be possible in the absence of slum rehabilitation, strict security measures and discipline on the part of the individuals visiting the lake.

Out of the 120 households that were visited all except six i.e. 114 households expressed their desires in being provided with sitting facilities inside the premises of the refurbished lake. One respondent opined that entry should be completely prohibited into the premises of the lake.

119 households expressed their approval on any sort of landscaping exercise to beautify the surroundings inside the lake premises. Many respondents also suggested to the author that a landscaping professional could be engaged in order to restore the aesthetic beauty of the place.

A concerned respondent emphatically opined that the landscaping exercise should not prove deleterious to the greenery of the surroundings. Another proactive respondent expressed her willingness to donate her expertise in landscape architecture for the re-innovation of the vicinity if any project is pursued in the future.

The other two services, which met with complete approval from the respondents, were that of providing garbage disposal bins inside the lake premises and bright lights to illuminate the roads around the lake.

Table 3: Individual voting for the various facilities

Utilities/Services	*Number of observations*	*Rank*
1. Litter bin	120	I
2. Lights	120	I
3. Landscaping	119	II
4. Benches	114	III
5. Playing equipment	102	IV
6. Boating	94	V
7. Swimming	93	VI
8. Cafeteria	87	VII
9. Zoo	76	VIII
10. Angling	75	IX
11. Renting out for social occasions	59	X
12. Others	34	No rank has been given

Of all the services, which were suggested, the above two were the ones, which were met with most optimism especially from those living in houses facing the lake. On being asked the reason they maintained that in the absence of proper garbage disposal facilities and lights the roads in question had become filthy, insect infested as well as unsafe for local residents after dark due to anti-social activities. One family also reported that the decomposed heap of garbage inside the lake premises gave out noisome gases.

Coming to the next facility on the list, the suggestion of introducing boating services was met with mixed responses. Out of the 120 households, 94 were in agreement, but the remaining 26 respondents emphatically maintained that they did not want any sort of recreational facility in Jodhpur Park. When asked the reason behind such an opinion, the individuals expressed their dislike towards commercialisation of the property that would follow, if boating were to be introduced. Another reason, which explains the negative response is the size of the lake, which the residents felt, is too small for any boating to be feasible.

On the other hand, the individuals who expressed their desires in having the facility introduced, opined that it would be one of the more popular means of ensuring a steady source of income for the maintenance of the lake and its premises. One of the other reasons that prompted the affirmative response (mostly from families with young

children) was the fact that a boating concern in the locality would eliminate the need of going to other locales of the city for the enjoyment of the same service, this not always being possible on a regular basis given time and transport costs.

On the basis of actual information available about the establishment of a swimming-club in the locality, which was on the list also, affirmative responses were obtained from 93 households only. Out of these units some expressed their belief that such a service would be a novel venture for Jodhpur Park while others held that a swimming facility near home would save up on transportation costs, which have to be incurred on every trip to the swimming clubs.

Survey experience revealed that the main reason, which led the remaining 27 households to respond in the negative, was the fact that most of these households were members of other clubs in the city where the fee for the swimming facility is included in the yearly membership payment. Also another cause for negation was that some of the respondents were the senior residents of the locality who did not feel the need for the introduction of the feature in the area.

The next utility under consideration is an eating joint of indeterminate size inside the premises of the lake. Only 87 respondents agreed to its establishment the others denying its necessity on the grounds that it would lead to unnecessary littering, cluttering of people inside the premises as well as a seat for the consumption of alcohol and narcotics. Conversely the households who did want this utility, held that a cafeteria would serve as an appropriate place for social interactions and also eliminate the need of visiting shops on the main road for refreshments after a rigorous evening or morning stroll. Some respondents also specified the size of the café-small.

Survey of 120 households led to the acquisition of the information that only 75 wanted the introduction of angling facilities. These affirmations were mainly from respondents who said that they were indifferent to the introduction of the same. The respondents who actually expressed strong desire for this utility were mostly retired senior residents.

On the other hand some residents who form the group of 75 said that they would agree to the utility only if it were introduced for limited periods for example some days of the week i.e. the weekends only. As in the case of boating facilities, a chief reason

for affirmative responses here was the avenue for constant revenue generation through the establishment of the utility.

Provision for playing equipments for the young children of the locality is another utility for which responses were elicited. Positive responses could be obtained from 102 households only with the rest disagreeing to the establishment of the same on three grounds. First, with the existence of two children's park in the locality with one of them situated facing one side of the lake near the Jodhpur Park Institute, another one would be superfluous. Secondly, a few of these 18 households refused as they dubbed it unsafe for children to be near the water-body. Lastly, respondents felt that a children's park would turn out to be a place of social interaction for the household maids who tend the children. This is one practice that the families wanted to discourage very strongly as it may lead to dereliction of duty on the part of the maids.

The survey yielded that 44 households refused the idea of setting up a small zoo inside the lake premises. Only 2 respondents disagreed on the grounds that they did not feel comfortable with the idea of caging living beings. The others refused as they felt that care for living creatures would prove to be too great a responsibility. Also another reason for rejection was the littering of the premises that the presence of animals could lead to. On the other hand the 71 households from whom positive responses could be obtained felt that if the space constraint could be managed then a zoo would be nice as it would provide an added attraction for the people, especially the children visiting the lake.

The last facility on the list was the option of the lake grounds being rented out for social gatherings. Maximum number of refusals was obtained from the respondents when they were broached with the suggestion of introducing this service on the grounds of commercialisation, sound pollution, littering and existence of boisterous partygoers. Only 59 households agreed on this facility many of them having the opinion that such access should be restricted to the locals only and not to residents of other localities, everything being organised under strict security. The principle reason for agreement on this service was that the respondents felt that it would be a likely means of revenue generation. Of all the respondents only 1 person emphasized that any partying facility should be ecologically friendly.

The list of desirable services included a provision for the respondents to suggest any other service that they would like to be provided with. The majority of the residents felt that the list of utilities was exhaustive. However 34 respondents did provide some other suggestions like walk trails, a story telling corner and a shelter for children and the elderly for protection from the rain and the sun. A conscientious citizen also suggested that the park could provide employment to the interested senior citizens of the locality.

Here it is worthwhile to construct a ranking of services on the basis of their popularity among the surveyed households.

As the information displayed in Table 3 suggests there are two utilities tying in first place and this indicates the importance and necessity of introducing them in the locality. In the present circumstances it should be mentioned that in the post-improvement scenario streetlights have been installed in the roads surrounding the lake but there are still too few garbage bins inside the lake premises. Second in line is the introduction of landscaping in the premises to give the entire area a more aesthetic appearance. This service has also been rendered. Under the improvement drive benches have been installed inside the premises. This is the third utility on the list and it should be mentioned that there maybe scope for installation of a few more under proper vigilance. None of the other utilities have been introduced as of yet. Here lies the importance of the above statistics as they provide us with a ranking which will give the policy makers the order in which services/utilities may be introduced in the lake system for generation of funds for operation and maintenance of the lake ecosystem.

That the preference exists for such a gamut of services implies that towards the provision of one or more of these services the local residents may be willing to pay. These payments may be utilized towards the maintenance of the lake system.

4.5 Policy implications

The positive values of willingness to pay as has been generated in the regression analyses conducted may be utilized to calculate the total economic benefit from the lake. At this point however a cost analysis is desirable which is unfortunately beyond the scope of this study.

This cost analysis would provide valuable estimates of cost, which would be incurred towards maintenance of the lake in its improved state. Comparing the cost and the benefit figures policy formulators may arrive at two conclusions both of which will lead to two different policy formulations.

One, if benefits exceed costs then it is implied that funds generated from the citizens are adequate for operation and maintenance of the lake and its environs with the various utilities it provided. However if costs exceed benefits then it implies that consumers' preferences are not strong enough to generate high values for this environmental amenity. In such cases funds raised from the residents may be utilized by the local self-government to support the environmental drive.

At the same time awareness campaigns could be undertaken in the locality, to sensitise the local people to the important features of a wetland and pave the path towards an increase in willingness to pay and actual payments in the future. This may in turn lead to a gradual phasing out of the role of the local self government and confine its role to that of an overhead authority supervising the maintenance of the lake from outside to make the lake a self-sustaining utility with funds from the patrons and the visitors.

One significant point to notice here is that people's participation cannot be disregarded and should be ensured from the very onset. Here it is imperative to mention that in the recent past various local citizens groups and organisations have undertaken awareness drives in the locality with the help of local resource persons, the WWF and the media. These endeavours as of now are quite isolated but extensive citizens group meetings organized by bodies like the Jodhpur Park Residents Association, the Jodhpur Park Institute or Jodhpur Park Society will add considerably towards developing a positive feeling of ownership and stake for the lake on the part of the residents. This will ensure intensified people's participation and pave the path for sustained maintenance of the Jodhpur Park Lake.

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