# Economic Valuation in the Lake Basin Management Decision Making Process

## Lessons from Bhoj Wetland, India

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### Wetlands and the Urban Ecosystems

Urban areas interact with the natural features of the environment in many significant ways. Urban construction materials like concrete, asphalt, brick, stone and steel; sewage and solid waste from urban population and effluents from industrial activities leading to eutrophication, weed growth replace soil and vegetation in modern urban landscape. And terrain and plant cover are often highly altered. They are the places within the city limits where water and soil mingles. They range from 'remnants' of ponds or creeks that once existed on sites where buildings now stand, to drainage ditches resulting from inadequately planned or engineered development.

These wetlands extend numerous economic, environmental and social benefits in terms of recharging ground water table, maintenance of soil moisture, microclimatic effects like temperature and moisture control, control of floods, maintenance of flora- fauna relationship and maintenance of biodiversity, provide recreation to local people and the visitors and offer educational aspect. Further they are the direct source of livelihood of various communities like fishermen, washermen, boatmen, trapa cultivators and indirectly provide earnings to various road side petty traders. Urban wetlands have been utilized as natural cleansing agents to mitigate the additional pollutant levels introduced within the urban landscape. They absorb large amounts of point source pollutants like sewage, solid waste, industrial waste and from washing of vehicles and also those which 'runaway' from their source like agricultural fields, hospitals, open garbage dumps in rainwater. The typical runoff from cities carries iron, lead, copper, as well as the other heavy metals, toxins, phosphorous, nitrogen and hydrocarbons, acids.

Wetlands could be found in many urban areas in India and such urban wetlands have been the lifeline of most cities in India. Cities of Bhopal, Bangalore, Chennai, Udaipur, Hyderabad, Indore, Sagar, Raipur are a few examples to quote. Once upon a time, these urban wetlands maintained a steady supply of water for the city, recharged the groundwater, cooled the city, and prevented flood as they were a natural drainage system. Over the years, these very tanks and wetlands have been neglected, encroached upon either to accommodate more houses or to dump waste. This has caused large-scale water crisis and monsoon flooding and water logging, leading to misery and diseases. Thus the very existence of the wetlands is in danger. These wetlands have often been used as open access resources as easily accessible source of various resources and 'wastelands' as most convenient and costless dumpsites. Various uses have been extracted without making any investment for maintenance and restoration of these wetlands.

### Need to Estimate Multiple Use Values of Urban Wetland

These multilateral ecosystems through their numerous functions provide substantial benefits to society. However despite their important role in maintaining the ecology and economy of the regions, almost all wetlands in India are endangered by lack of appreciation of their role. A few of the country's wetlands, which have a great deal of biological wealth are protected under the wildlife protection Act, whereas others which may not be as biologically rich do not share the same protection, and are easy target of developers. Considered wastelands, wetlands are the obvious choice when land is needed for development. However more often than not these benefits are recognized and undervalued, as they fall outside the domain of the markets. People have well understood the uses of wetlands but not their use values. There has not been much effort in the past to assign the use value or a price tag to various extractives and non-extractive uses of the wetland such that it can be sustainably managed. People in the urban areas must learn to live in harmony with nature in their own habitat. The wetlands, the green belts, and the flora and fauna of these areas have to be preserved for urban areas to survive and remain healthy. Bhoj wetland being located in the urban area of Bhopal city is one such example of degradation of wetlands ecosystem account of excessive use by the fast increasing urban population comprised of multiple stakeholders. For this wetland also various benefits are either under priced or not priced at all and are not considered in the existing lake basin management decision making process.

## Location and main features of the Bhoj Wetland (BWL) - The Study Site

The Bhoj Wetland, which consists of the upper and the lower lakes is located in the city of Bhopal, the state capital of the state of Madhya Pradesh. The City occupies an area of some 286 sq. km and is divided into 66 administrative wards of which 22 wards surround the Bhoj Wetland. The Ministry of Environment & Forests (MoEF) of the Government of India has declared the upper and the lower lakes as wetland of national importance in the year 1988 as one of the sixteen wetlands in the country and in 2002 the wetland was declared as a Ramsar site. The upper lake is the highly diminished remains of the large lake constructed by the then ruler Raja Bhoj, in the 11th century. The seasonal river Kolans, originating from Sehore district, some forty eight kilometres from Bhopal, and several small feeder streams at the western side of the lake, form the source. It has a catchment area of 361 km$^2$ and a waterspread area of 31 km$^2$. The lower lake also known as the Chotta Talab or Small Lake, is situated towards the east end of the Upper Lake and is almost fully surrounded by built-up areas. It has a small catchment area of 9.60 km$^2$ and a waterspread area of 1.29 km$^2$. Bhopal as a city has been growing rapidly especially in the last few decades. As per 1981 census, it grew at the decadal rate of 125% , in 1991, 58% and in 2001 41 %. As per the increasing population demands, there have also been significant changes in the land use patterns of the city which has put immense pressure on the lake's ecology.

## The Stakeholders of BWL

They can be categorized as (i) Primary - compromising of the entire population of Bhopal city, municipal wards around the lake, farmers in the catchment, lake front property owners, washer men, fisherman, water chestnut cultivators, vendors, visitors; (ii) Secondary - water supplying agencies, Bhopal Muncipal Corporation, department of Housing & Environment, Sports Authority of India , Van Vihar National Park, Madhya Pradesh Tourism Development Corporation, Ministry of Environment & Forest, photographers, film makers. bird watchers, students population, researchers; (iii) Tertiary- funding agencies like the World Bank, JBIC & State Govt., international agencies of Wetland Conservation like Ramsar Bureau, IUCN, organisations in India like CSO, MOSPI, CSE, TERI , international Organisations like IIED, WII, WWF, RFF, CSERGE, ILEC, JBIC, WI, various universities, international societies on Ecological Economics & Ecosystem Health.

## Benefits from the wetland

Multiple stakeholders mainly comprise of local population get multiple benefits from the wetland like *Drinking Water* - nearly 40% of the city's drinking water supply comes from the upper lake and this is the most important use of the wetland as far as the welfare of the citizens is concerned.

Altogether some 28 MGD of water is provided to the city of Bhopal from the upper lake; *Employment* - to various communities like the fishermen, washermen, boatmen, vendors and so on. Approximately, 300 families are engaged in fishing and *trapa* cultivation while some 100 washermen also make their living from the Wetland. There are some 50 boatmen whose livelihood is dependent upon the wetland. Because of the many visitors to the lake, a number of roadside vendors selling maize cobs, and other food items and snacks, have their stalls next to the lakes and earn incomes; *Microclimate stability* - in terms of moderating effects on temperature and humidity; *Recreation*- people enjoy the aesthetic beauty of the wetland.

## Threats to the wetland

Being an urban wetland, the Bhoj Wetland is in fact more fragile as the level of human interference is very high. Thus it faces various threats such as siltation @ 1 cm to 2.58 cm per year on an average and sedimentation rate from the catchment area is in the tune of 3.67 ha.m/100 km$^2$/ year; flow of pollutants from the adjoining 17 municipal wards which directly drain into the lake is nearly 7,500 m$^3$/ day of sewage water and 360m$^3$/day of animal liquid discharge; flow of high quantity of detergents, chemicals and furnace ashes into the lake on a daily basis.; trapa cultivation leads to contamination and addition of biomass to the wetland; encroachment by urban slum dwellers and agricultural invasions is very rampant along the fringe areas of the wetland; weeds and eutrophication in large area of around 33.78 sq. km (severe weed infestation in the entire fringe area). The weeds found are mainly of three types: Shoreline (rooted) - *Trapa bispinosa, Nelumbium sp.*; Emergent - *Ipomoea aquatica, Polygonum glabrum*; Floating - *Eichhornia crassipes, Lemna minor*; and Submerged - *Potamogeton sp., Chara sp. Hydrilla verticillata*, etc.; boating - mainly the Motorboats; flow of agricultural waste from the rural catchment; idol and tadjia immersion - during the Hindu and Muslim religious festivals, lots of idols and *tadjias* are immersed in water, which leads to siltation on quite a large scale besides releasing heavy metals like cadmium, chromium, lead zinc and other extremely harmful chemicals, and also harbouring bacteria in the biodegradable matter, dumping of hospital waste from the adjoining hospitals. Above all the ever increasing population of the city aggravates the above threats further. The eventual impact had been on both water quality and quantity as well as on the biodiversity and aesthetic beauty of the lake.

## Interventions by the BWL agency since 1995

To conserve and manage the Bhoj Wetland which was subjected to severe environmental degradation due to pollution and to ensure availability of water from the upper lake which was one of the major sources of water supply to the city of Bhopal in an increased quantity and satisfactory quality, the Japan Bank for International Co-operation (JBIC) provided Rs 209.97 crores as loan for

the implementation of BWL restoration project. The total project cost is 247.02 crores in which the State Government contribution was Rs 37.05 crores. The restoration activities comprised of desilting and dredging works, catchment area treatment, shoreline and fringe area management and water quality management.

## Objectives of the Research Study

Though the BWL project commenced in 1995 but till 1999 mostly defensive interventions like installation of floating fountains, ozonisers, deweeding, dredging were taken up first instead of addressing the main problem of flow of sewage to the lake, hence the net effect of other interventions seem to be either nil or negative. Above all various stockholders/ beneficiaries were not involved in the planning and implementation process thus citizen of Bhopal could not have had any sense of belongingness in the project actually meant for them. Further by 2000, no future planning regarding maintenance of various engineering structures was done by the BWL agency once the project is over and no mechanism was evolved for generation of payments from the beneficiaries to pay back the loan amount from JBIC amounting to Rs. 220 Crores. Looking to the above scenario, a proposal was submitted by the author titled 'Economic Valuation of Bhoj Wetland for Sustainable Use' to the World Bank's Environmental Management Capacity Building Program (EMCaB) in 1998 to analyze factors causing BWL degradation, estimate nature and extent of injury to the wetland, quantify impact of degradation on benefits, find out cost borne by the stakeholders, use feedback from various impacts to revise management policies, envisage participation of stakeholders, generate values of various uses, know the WTP of people to conserve the BWL and provide feedback to management agency for appropriate interventions. The major objectives of the IIFM's project were (i) to value fully the wetland benefits / resources for appropriate allocation of wetland uses and (ii) to help the planners and policy makers, to develop a socially acceptable, environmentally sound and economically feasible strategy for wetland management.

## Methodology

The methodology comprised of literature review, site visits, focused group discussions, secondary data collection, workshops involving the various stakeholders cutting across ranks and positions to gain insight into the use and management problems as well as conflicts arising at various levels, expert discussions and detailed primary survey. The process begun with stakeholder - wise identification of values and management issues for which a pilot survey was done wherein it was found that three major issues viz. sewage and waste disposal, fishing and washing activities and recreational activities need to be addressed and understood as per the perception of the stakeholders. This was followed by a multi stakeholder workshop to identify the problems, alternatives, information gaps and to get the

response of concerned line departments in such issues. All concerned stakeholders as classified above were invited and were initially explained about the objectives and methodology of the project and then divided into three heterogeneous groups. 'Sticky Cloth and Paper' method was used to facilitate the discussion. At the end all three groups presented their findings and then through open discussion recommendations were made for follow-up strategy for sustainable management of the wetland. Consultations with a number of international & national experts were made regarding the methodology followed. To understand the ecosystem of the lake, an ecosystem model was developed which was followed by economic valuation exercises for various stakeholders. A detailed household survey of some 1500 households covering households from all 66 wards was done to seek their willingness contribute towards conservation of the wetland. Data analysis was done using various economic and statistical tests and the results were arrived at and compiled in the form of a project report.

## Development of the Ecosystem Model Using Water Quality Parameters

The main objective of the Ecosystem Modeling of Bhoj Wetland was to understand the physical characteristics of the Bhoj Wetland so that the stakeholders have better understanding of the resource which is to be valued. Initially a conceptual model using the economic, social, technological and ecological variables with their impacts and required restoration and control strategies was developed but owing to lack of overtime data on all such variables the modeling exercise was limited to only water quality parameters. First the model was developed to study the current status of the lake, followed by changes in the water quality parameters over the last few years and to project the status of the Upper and Lower Lakes in the future, based on past data and information from the restoration activities currently being carried out. The basic ecological parameters brought under the purview of the conceptual model for Bhoj Wetland are sewage and weeds on account of increasing population. The initial parameter is taken as population and its impact on sewage outflow and its subsequent impact on weeds were studied. The other related water quality parameters like dissolved oxygen (DO), biochemical oxygen demand (BOD), pH, total hardness, total alkalinity, phosphate, turbidity, total dissolved solids (TDS) and bacterial count were taken and then linkages were studied through the modeling exercise. Using the data pertaining to water quality parameters at seven quality monitoring stations of the wetland representing different kinds of pressures on the upper and lower Lake, an advanced ecological model was developed using a system's dynamics software package STELLA. Based on 1985, 1991-92 and 1999 data of these parameters, compound growth rates have been determined and elasticities between various variables have been worked out so as to establish linkages between them. Having established significant linkages, a model was

developed representing the base scenario and simulation runs have been performed first by using 1985 and 1991-92 data to find out what would be the status of the lakes if such trends continued (without restoration and prevention activities, i.e. pre restoration management activities) and then they are compared with another set of simulation runs using 1991-92 and 1999 data (after the commencement of restoration activities).

## Use of Ecosystem Model for Economic Valuation Exercise

The goal of management is to balance the uses of lake with conservation measures to sustain ecosystem services over time. Lake degradation is a syndrome with multiple causes. Because lake degradation has multiple causes, lake restoration usually requires multiple interventions. The scenarios so obtained actually represent the health of the lakes ecosystem and stress the need to value the impact of changing health of the lake on economic system. They further throw light on prioritization of future policy interventions, which shall be required, if the lake is to be managed sustainably. The scenarios so obtained through ecosystem modeling exercise were represented through various complex graphs. These graphs were then converted into picture cards for easier explanation of status of the lake to the respondents in the survey. For example for the graph which represents excessive weed growth due to continuous flow of sewage, a picture of that region of lake which had excessive weed

growth was used. Similarly if the scenario run represents a clean lake with values of the related parameters declining, picture showing aesthetic beauty of the lake was shown to the people. Then the valuation exercise comprising of mainly four techniques was carried out using model data and findings as base.

## Economic Valuations of Wetland Benefits Through Multiple Valuation Techniques

Having attempted the ecosystem modeling and knowing the extent of degradation & threats, valuation was undertaken so as to cover the extent of monetary benefit or loss to various stakeholders in case benefits are directly or indirectly marketed or people's perception for conservation of wetland resource was sought in the absence of any such markets. As the uses are multiple it was difficult to capture one single value for all of them together, hence a spectrum of valuation techniques have been used to capture economic value of various uses. The major techniques of valuation were used to capture varied values to multiple stakeholders are (i) Direct Valuation, (ii) Cost of Illness Approach and Defensive or Preventive Costs (iii) Contingent Valuation Method (CVM) and (iv) Hedonic Pricing. Different kinds of values accrue from the Bhoj Wetland to different stakeholders living around as well as away from the lake. The values so estimated using various valuation techniques are summarized in the following table:

**Table 1.    Estimation of Economic Values of Bhoj Wetland (Annual for 1999-2000)**

| Uses / Impacts | Stakeholders | Valuation Techniques | Value (in Rs) |
|---|---|---|---|
| A. Drinking Water | Water supplying agencies | Supply Cost | 9,54,13,962 |
| B. Fish Production | Fishermen | Market Price of Existing Production | 80,00,000 |
| C. Boating | Boatmen | Income Estimation | 24,37,880 |
| D. Trapa cultivation | Trapa (water chestnut) Cultivators | Market Price of Existing Production | 50,00,000 |
| E. Washing of clothes | Washer men | Income Estimation | 36,00,000 |
| F. Secondary Activities | | | |
| i. Maize cob selling | i. Maize Cobb sellers | i. Income Estimation | i. 1,44,000 |
| ii. Sugar cane juice selling | ii. Sugarcane juice sellers | ii. Income Estimation | ii. 2,73,600 |
| iii. Snacks & cold drink stalls | iii. Individual owners | iii. Income Estimation | iii. 2,06,400 |
| iv. Horse rides | iv. Individual owners | iv. Income Estimation | iv. 7,92,000 |
| v. MPTDC | v. MPTDC | | |
| a. Cafeteria | | a. Revenue Generation | a. 18,00,000 |
| b. Boating | | b. Revenue Generation | b. 6,74,635 |
| G. Water borne Diseases | Population using lake's water | Cost of Illness | 12,00,254 |
| H. Quality water | Population using lake's water | Purification Costs | 1,24,35,876 |
| I. Recreation | Entire population of the city | CVM | |
| | | (i) As Voluntary Payment | 4,84,68,956 |
| | | (ii) As Compulsory tax | 59,32,922 |
| J. Increase in property prices | Lake front property owners | Hedonic pricing | 50% difference in property prices |

*Source:    Complied under the IIFM study, 2000*

It is evident from the table that the drinking water, recreation, property attributes command high values from lake whereas other income based values are important to specific sections of the people. All the values so estimated have not been aggregated as same stakeholder use the lake for multiple values and such overlapping could not be avoided. Further other important values like biodiversity, microclimatic effects have not been estimated due too lack of availability of data. But the undertaken exercise does give a good insight of multiple values which have not been considered so the extent possible in the current management activities. The major findings were high dependence of primary stakeholders for their livelihood; premium on lake front properties and willingness of the citizen of Bhopal city to conserve the Bhoj wetland. But they showed more willingness to pay to the society where all stakeholders have representation than paying additional tax to the Bhopal Municipal Corporation. Further even if one is able to collect the revenue through what people were willing to pay in the from of voluntary payment to the society (Rs. 4,84,68,956 per annum) or in the from of tax to the government (Rs. 59,32,922/- per annum) the amount so collected would be much more than the existent estimated cost of maintenance of various subprojects of the BWL agency (Rs. 80,70,00/- per annum, as stated in the year 2000) if the collected revenue is from voluntary payment and reasonably collects 74% of the amount through taxes.

## Recommendations

Finally using the results that have emerged from the entire project, a set of technical and policy/ institution related recommendations have been developed in order to provide a firm basis for future activities concerning the Bhoj Wetland. It was felt that the restoration and prevention activities have not been taken up in sequential manner. Thus it is necessary to follow stepwise physical interventions to restore the status of both the lakes of the Bhoj Wetland. The following recommendation were made for effective implementation of the restoration subprojects:

**Technical:** Intervention through preventive measures before implementation of the corrective measures mainly sewage and silt flow to the lake in the urban catchment and agriculture nutrient s to the lake from the rural catchment; develop view points around the lakes & promote Ecotourism.

**Policy / Institutional:** Seek people's participation, generate effective co-ordination between all line departments' evolve transparent system of management, set up Bhoj wetland maintenance society, set up system to collect payments / voluntary contributions from people to improve recreational facilities, set up management fund for maintenance of lake , use valuation exercise as basis for future management strategies, carry out detailed cost benefit exercise, prioritize restoration activities using simulation runs

of comprehensive ecological model and conduct detailed study of rural catchment.

## Impact of Economic Valuation Exercise on the Lake Basin Management Decision Making Process

The author submitted the report in multiple copies to the BWL agency in 2001, but was not called up for the presentation even after two years of submission though she made many presentations in various cities of India and was invited for presentations to many agencies abroad. Only a few recommendations have so far been considered by the local BWL Agency like (i) increased public participation, intensification of preventive measures like sewage and silt control (ii) interventions in the rural catchment by awareness building and capacity building for Organic cultivation (iii) awareness building in the urban catchment through display of information. Instead of recommended society for the future management of the BWL, an agency called as the Lake Conservation Authority (LCA) was set up at the state level in 2004 to manage lakes of various cities of the state of Madhya Pradesh and comprises of 21 members who are mainly the politicians or bureaucrats and few representatives from NGOs and academia. It also has Local Level Lake Management Committees (LLMCS) comprising of Citizen Advisory Committee (CAC) - forum for citizens and stakeholders for discussing lake management issues, suggestions and advocacy to improve overall environmental and ecological conditions of the lake and to make recommendations to the LLMC about plan priorities; Cultural Heritage and Recreation Advisory Committee (CHRAC) - to suggest about potential cultural heritage and eco tourism initiative process and Education and Outreach Advisory Committee (EOAC) - Advise on awareness programs and communication with stakeholders on emerging existing public issues and plan implementation actions. Though the committee exists on paper but has not been regular in meetings and implementation of its activities. Thus the net effect on the lake on account of massive restoration project and set of recommendations made available free of any cost to the government by the IIFM's project, seems to be zero and negative to be more precise.

Further as recommended in the study the detailed Cost Benefit Analysis of individual sub-projects is yet to be done; no mechanism of generation of finance for maintenance has been developed by the LCA , thus the already burdened taxpayer of the state shall have to pay for the loan provided by JBIC; the payment mechanism suggested through CVM exercise of IIFM project from the beneficiaries is yet to be implemented. Thus despite availability of various useful suggestions the report has been partially used by the local management agencies and though having considerable data for water quality, the agency did not take up intensive Ecosystem Modeling for various monitoring stations so as to make specific area wise interventions.

Though the intense exercise of modeling and valuation did not find much place in its own turf but has been widely accepted by various national and international organizations and wetland sites. In India the study has been adopted as a model study for valuation, Cost Benefit Analysis and development of management plan for Lakes of Hyderabad and referred for lakes of Bangalore in Karnataka, Nainital lake in Uttarakhand, Dal lake in Jammu & Kashmir, Loktak lake in Manipur etc. International agencies like Ramsar hosts a Photo gallery and project findings since 2001 on its website, IUCN has put up the executive summary on its Website since 2001, the author has presented the study findings at the conference of the International Society for Ecosystem's Health in Australia; conference of the International Society for Common Property in Oaxaca, Mexico and has given findings seminar at the Resources for the Future in Washington D.C. in USA, the think tank institute of the Government of USA. Further looking to the importance of the work, the Ramsar convention provided with in Australia travel support to the author to present Ecosystem Model of the lake in Brisbane; the International Institute for Environment and Development (IIED), UK and Winrock International, India (WII) considered the study to select the BWL site as one of the two sites in India as a component of six country study for introducing incentive based mechanisms for livelihoods protection services in the rural catchment and the author did the livelihoods baseline and impact studies under the project.

## Final Alarm

Though not much effort was made by the BWL management agency and existing LCA to protect the basin of BWL and other water bodies around Bhopal, but the government is now brining water from Narmada river which flows 60 Kms. away from Bhopal city and the citizen of Bhopal are asked to pay "Narmada - cess" to make the project functional (as per news on 25.03.2008).

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