Economic Valuation in the Lake Basin Management Decision Making Process : Lessons from Bhoj Wetland, India*

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Presentation Structure

- Need for the Project
- Site Description
- Ecosystem Services from Bhoj Wetland (BWL)
- Stakeholders Identification
- Threats to the Wetland
- Interventions by Management Agency
- Need for Understanding Economic Values of the Wetland
- Need for Prioritisation of Interventions
- Lack of Payment Mechanism for Maintenance
- Understanding BWL Ecosystem through Ecosystem Modelling
- Economic Valuation Across Different Stakeholders
- Recommendations -Technical and Policy Institution based Interventions
- Lessons Learnt


Pic: View of Bhoj Wetland from Shymala Hills

Pic: View of Bhoj Wetland from IIFM campus

WETLANDS

"Areas of marsh, fen, peatland or water whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, depth of which at low tide does not exceed six meters" and may include *"riparian and coastal zones adjacent to the wetlands or islands or bodies of marine water deeper than six meters at low tide lying within* **(IUCN 1971)**

Pic: Panaromic View of Upper lake from Shyamala Hills
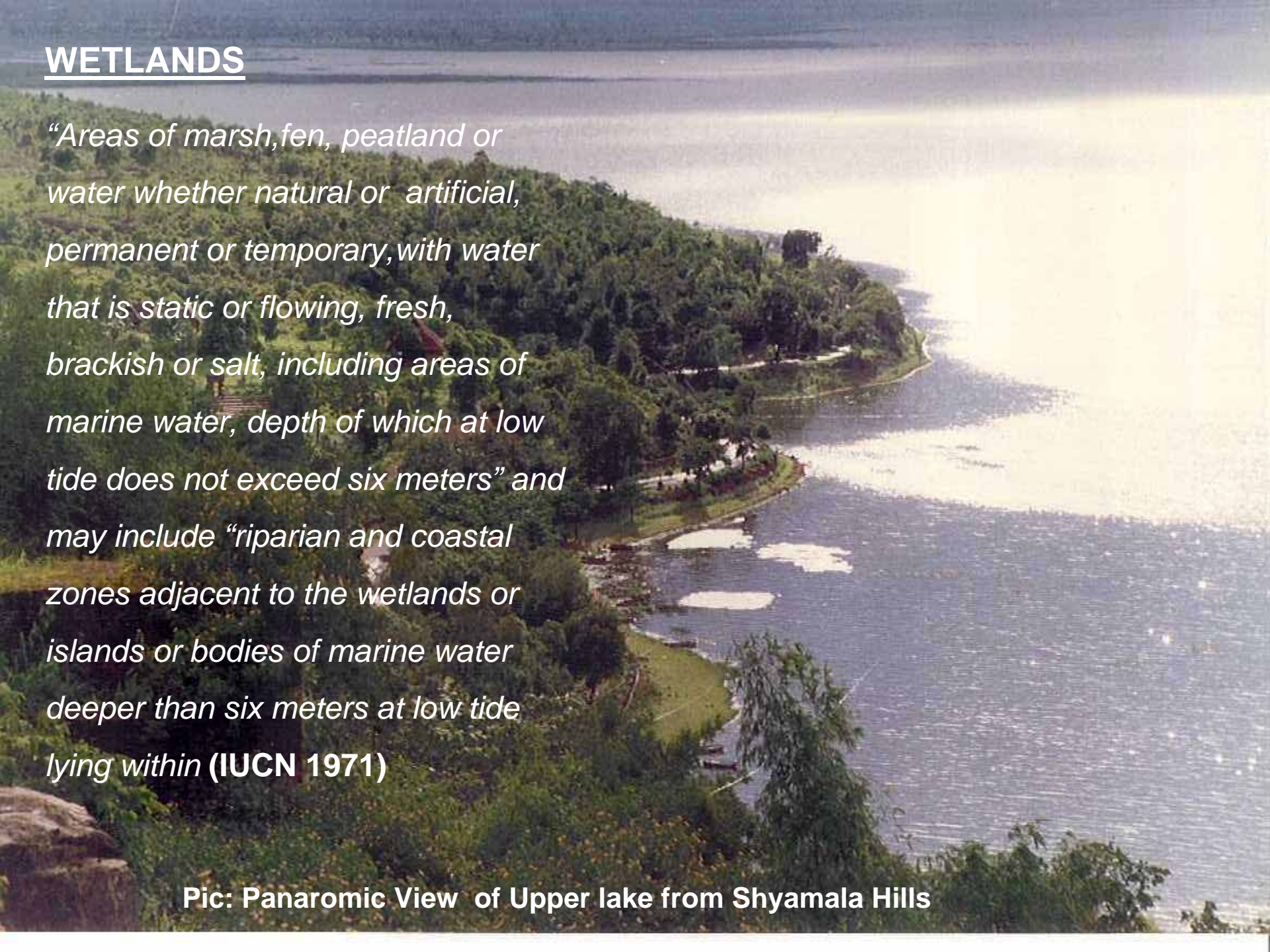
BHOJ WETLANDS (BWL)

*ONE OF THE 16 WETLANDS OF NATIONAL IMPORTANCE UNDER NLCP(1986)

* RAMSAR SITE SINCE DECEMBER 2002

* FRESH WATER LAKE COMPRISES OF UPPER AND LOWER LAKE

UPPER LAKE

* EARTHEN DAM WAS BUILT ACROSS RIVER KOLANS IN 11TH CENTURY BY RAJA BHOJ

 * CATCHMENT AREA OF 361 Sq. km

 * WATERSPREAD AREA OF 31 Sq. km

LOWER LAKE

*CREATED IN 18TH CENTURY

* CATCHMENT AREA OF 9.6 Sq. km

 * WATERSPREAD AREA OF 1.29 Sq. km

* FED BY SEEPAGE FROM UPPER LAKE AS WELL AS SEWAGE FROM 8 DRAINS

Pic: Yatch Club in the Upper lake in 1961

Pic: Portrait of Yatch Club

Maps of the Bhopal City (habitation area in blue, partial boundary of lake shown in black in the west of the city) since the formation of the Upper Lake one thousand years back

1010 - 1200 AD   1201-1800 AD   1801-1850 AD   1891-1930 AD
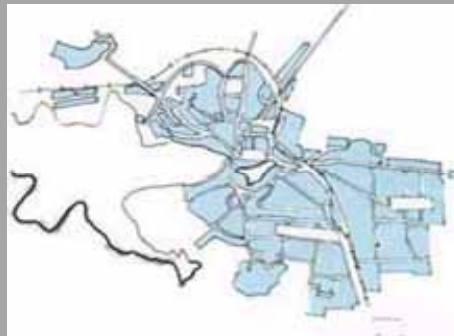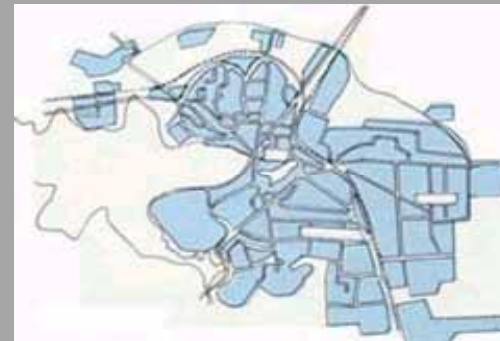

1931-1950 AD   1950-1972 AD

1973-1981 AD   1981-1991 AD
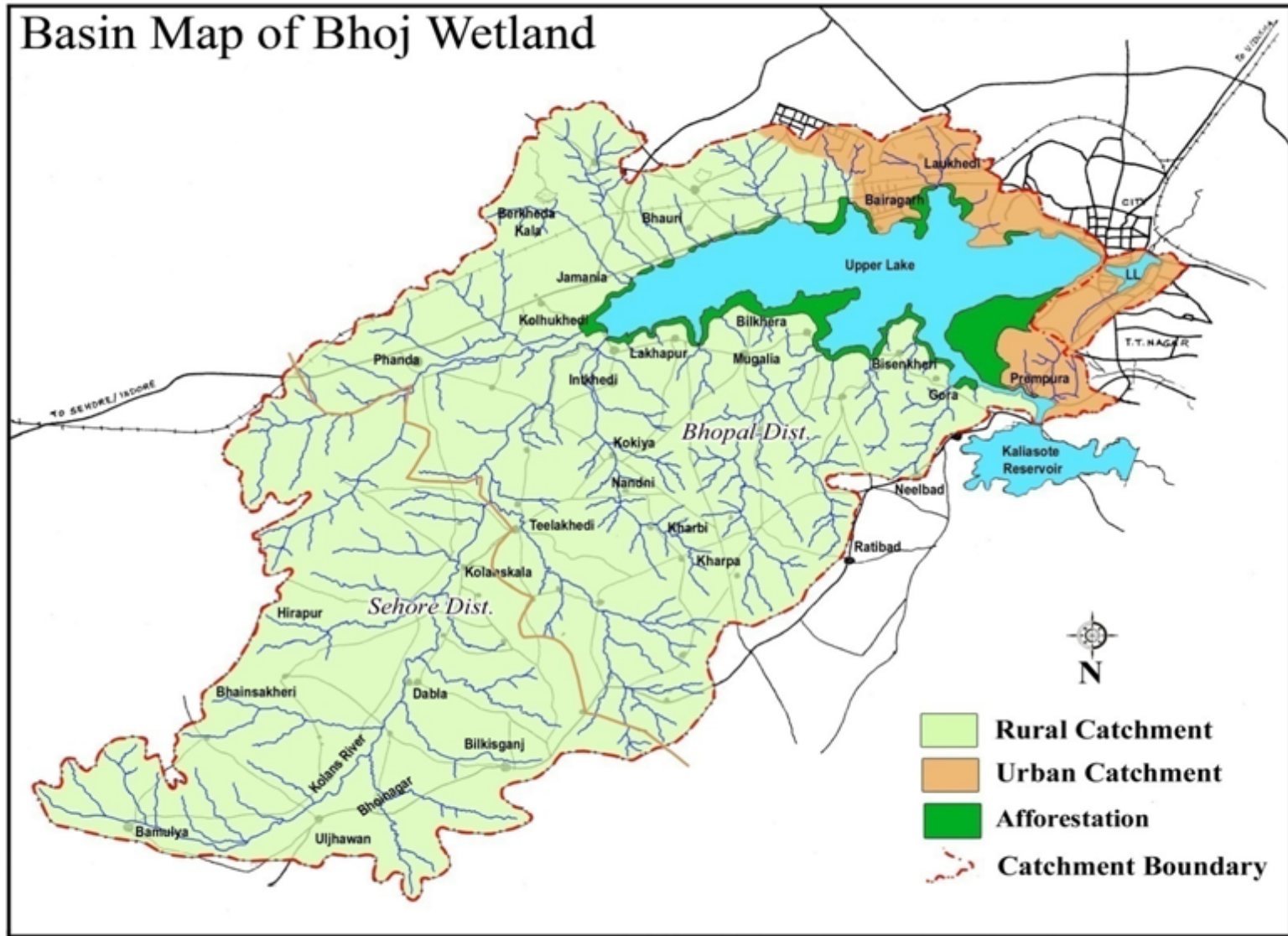
Source :Lake Conservation Authority (LCA), Bhopal

ECOSYSTEM SERVICES PROVIDED BY THE BHOJ WETLAND

A.CONSUMPTIVE

(Substractible)

- **DRINKING WATER**

- **FISH, CHESTNUT PRODUCTION**

- **MICROCLIMATIC   STABILISATION**

- **NUTRIENT CYCLING**

B. NON CONSUMPTIVE

(Non Substractible)

- **RECREATION**

- **BIODIVERSITY**

- **AESTHETIC**

- **EDUCATION**

Pic: Island in the middle of the lake

Pic: Boating activity in the upper lake.

STAKEHOLDERS OF THE BWL

A. PRIMARY

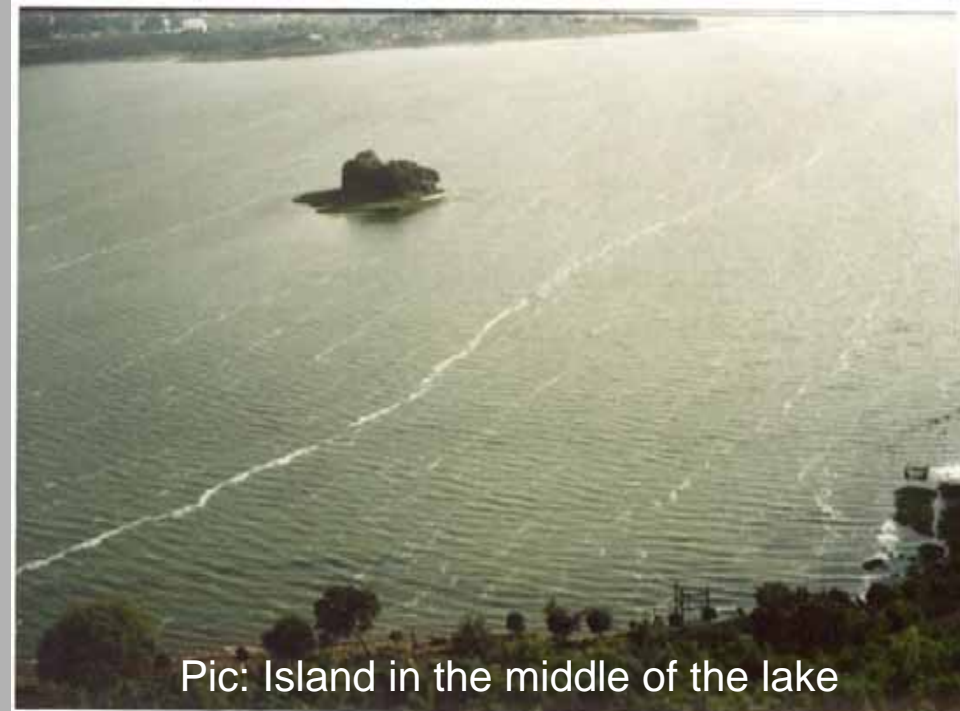- Enttre population of Bhopal city
- Municipal wards around the lake
- Farmers in the catchment
- Lake front property owners
- Washermen
- Fisherman
- Water chestnut cultivators
- Vendors
- Visitors

B. SECONDARY

- Water Supplying Agencies
- Bhopal Muncipal Corporation (BMC)
- Department of Housing & Environment (DOHE)
- Sports Authority of India (SAI)
- Van Vihar National Park (VVNP)
- Madhya Pradesh Tourism Development Coeporation (MPTDC)
- Ministry of Environment & Forest (MOEF), Govt. of India
- Photographers, Film makers. Bird watchers, Students population, Researchers.

C. 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
- Inter National Organisations IIED, WII, WWF, RFF, CSERGE, ILEC, JBIC, JICA,WI, Various Universities
- International Societies on Ecological Economics & Ecosystem Health

PIC : DUCKS NEAR THE BOAT CLUB

THREATS TO THE WETLAND

❧ SILTATION

❧ SOLID WASTE POLLUTANTS

❧ SEWERAGE

❧ WASHING ACTIVITIES

❧ TRAPA CULTIVATION

❧ ENCROACHMENT

❧ INCREASING POPULATION

❧ WEEDS & EUTROPHICATION

❧ BOATING

❧ AGRICULTURAL RUNOFF

❧ IDOL AND TADJIA IMMERSION

❧HOSPITAL WASTE

Pic: Flow of sewage & siltation from adjoining colonies.

Pic: Bathing at the idol immersion bank.

MAJOR INLETS OF POLLUTION AND SILT TO THE UPPER LAKE

SILT & SEWAGE INFLOW

REDUCTION IN CAPACITY & PROLIFERATION OF WEEDS

DETERIORATION OF WATER QUALITY

UPPER LAKE

LL

Lower lake is the source of raw water

•VERY HIGH DENSITY ABOVE 400 PERSONS/HA
•HIGH DENSITY 250-400 PERSONS/HA
•MEDIUM DENSITY 125-250 PERSONS/HA
•LOW DENSITY 25-125 PERSONS/HA
•VERY LOW DENSITY UPTO 25 PERSONS/HA
•RURAL AREA

SEWAGE INFLOW
SILT INFLOW
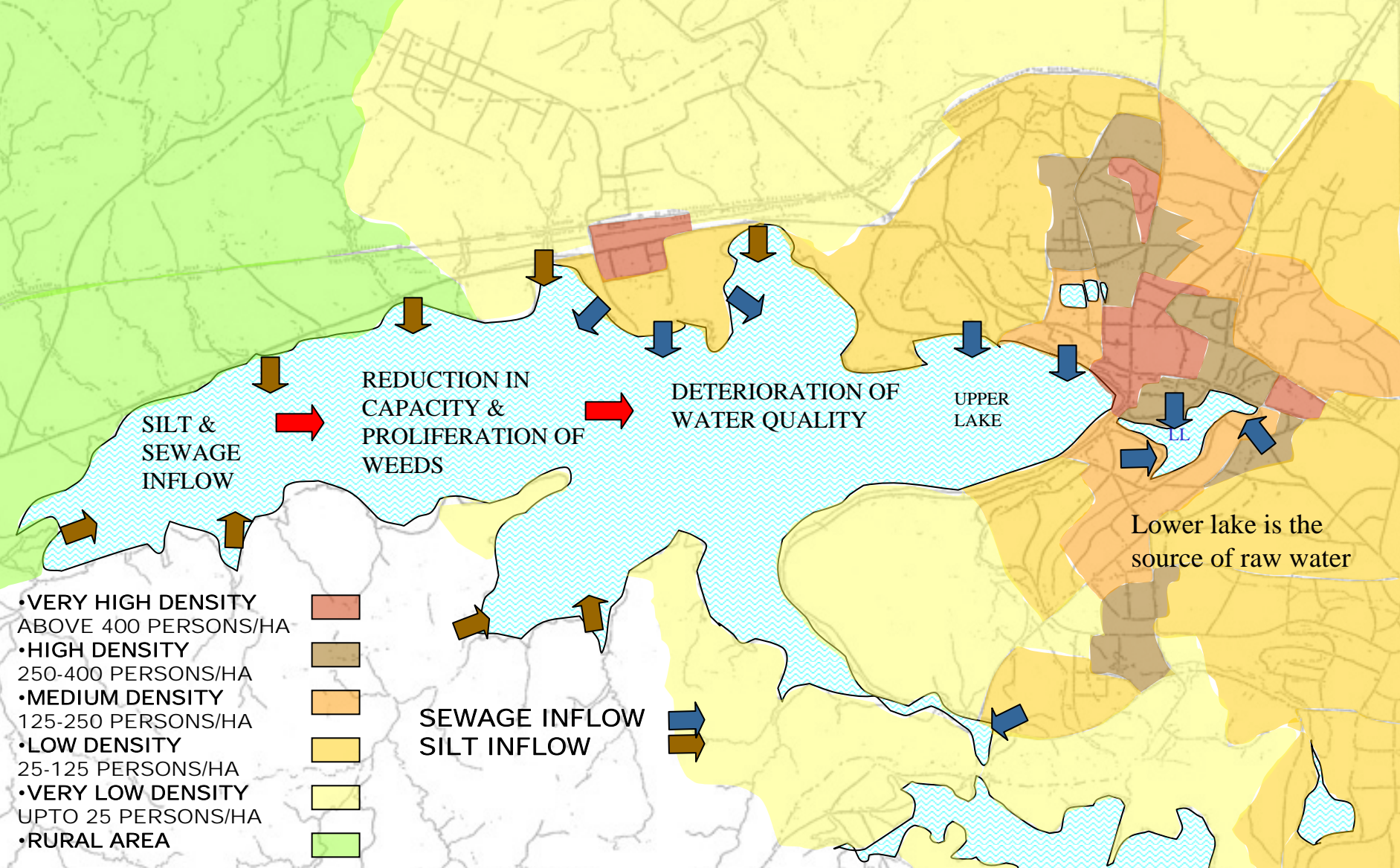
Source : Lake Conservation Authority (LCA), Bhopal)

Implementation of Bhoj Wetland Project by Govt of Madhya Pradesh, India with JBIC Support (1st April 1995 to 12th June 2004)

Project Outlay : Rs. 247.03 Crores

Activities Proposed to be Undertaken by the year 2000

- DESILTING AND DREDGING WORKS
  - Desilting and dredging of lakes
  - Deepening and widening of the spill channel
  - Restoration of the takia island
- CATCHMENT AREA TREATMENT
  - Afforestation, creation of buffer zones
  - Construction of check dams, silt traps, toe walls
  - Construction of garland drains around lower lake
- SHORELINE AND FRINGE AREA MANAGEMENT
  - Retghat Lalghati Road (Buffer Zone)
  - Solid Waste Management
  - Prevention of Pollution From Dhobi Ghats
- WATER QUALITY MANAGEMENT
  - Deweeding
  - Monitoring of water quality
  - Installation of floating fountains, ozonisers
 - Aquaculture

Sequence of Activities

Till 1999 mostly defensive interventions like installation of floating fountains, ozonisers 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 various stockholders/ beneficiaries were not involved in the planning and implementation process.

Future Planning and Payment Mechanism

By 2000, no future planning regarding maintenance of various engineering structures was done by the BWL agency after 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

Keeping in mind the status of the JBIC supported BWL project, the study attempted 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

• Provide feedback to management agency for appropriate interventions
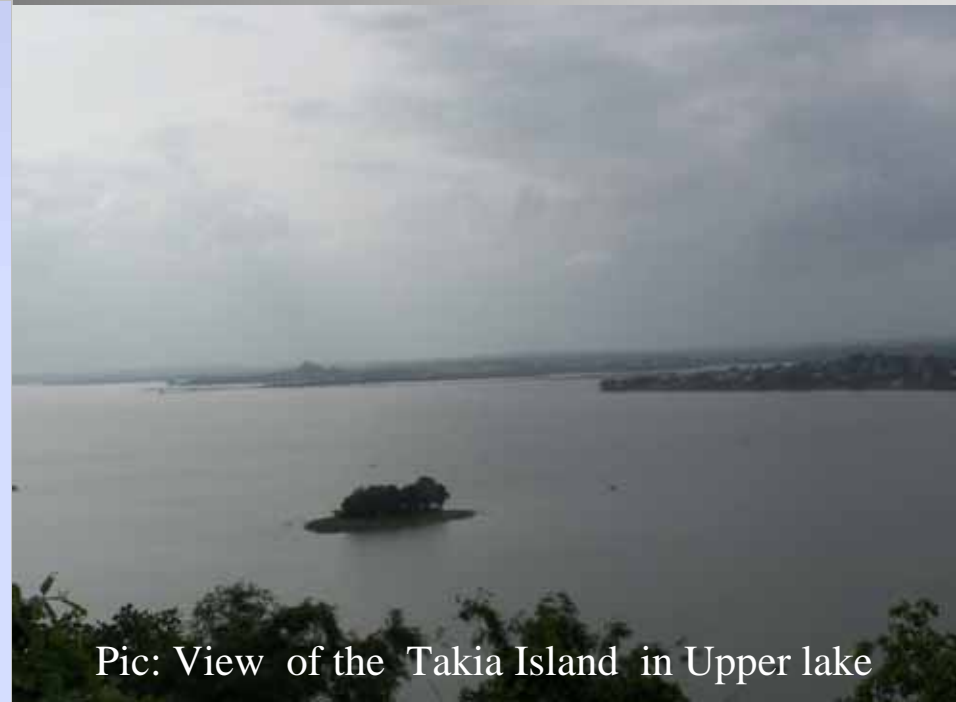
Pic: View of the Takia Island in Upper lake

Pic: The Upper Lake in the back drop of old Bhopal City.

Major objectives of the Economic Valuation Project

1. To value fully wetland benefits/resources for appropriate allocation of wetland uses and funds

2. To help planners and policy makers to develop a socially acceptable, environmentally sound and financially feasible strategy for wetland management.
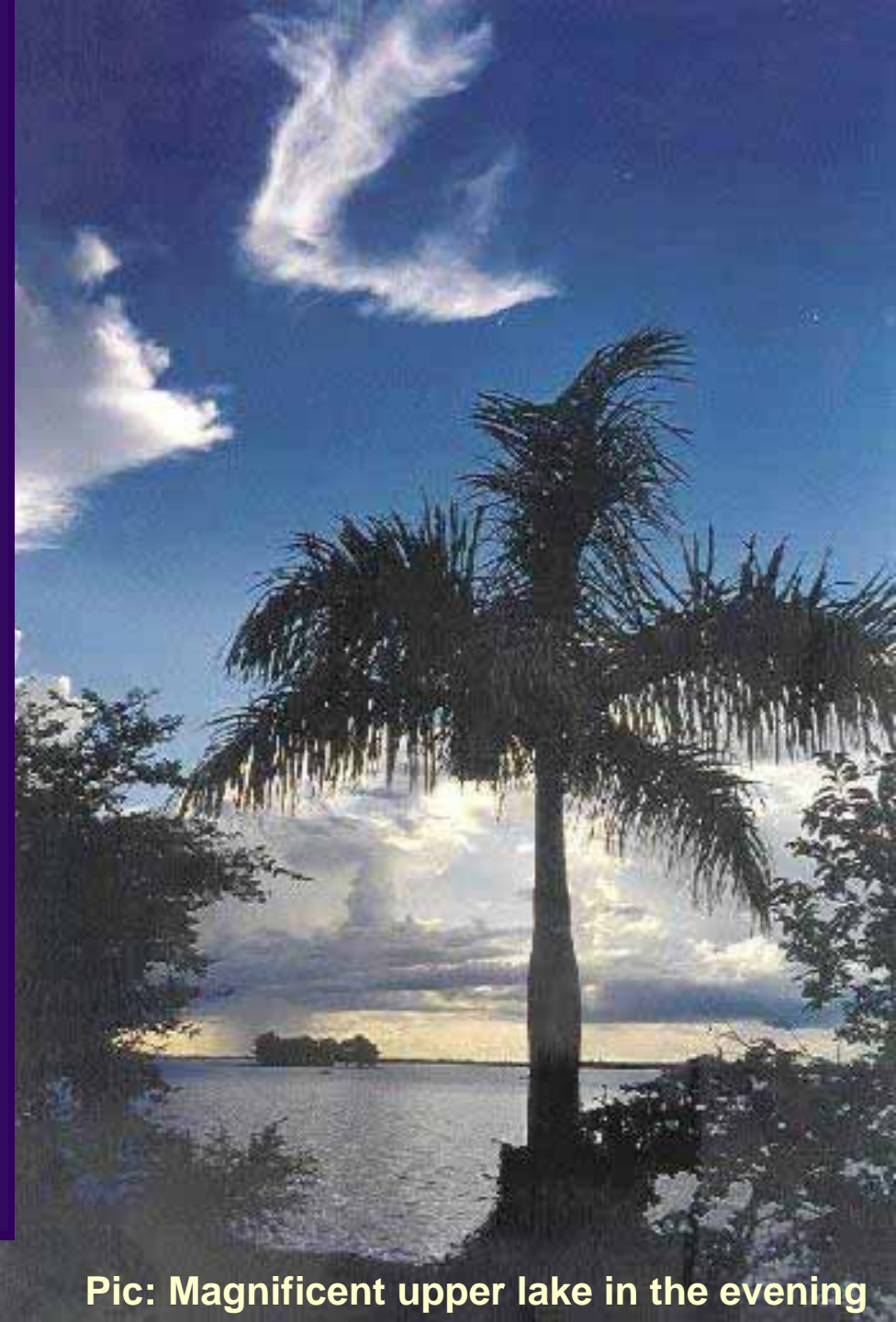
Pic: Magnificent upper lake in the evening

METHODOLOGY

♦ Literature Review

♦ Site Visits

♦ Stakeholders Consultations

♦ Focused Group Discussions

♦ Secondary Data Collection

♦ Stakeholders Workshops (All primary and secondary stakeholders plus the Corporators)

♦ Expert Consultations

♦ Round table Discussions

♦ Ecosystem's Modelling

♦ Primary Data Survey

♦ Data Analysis

♦ Recommendations

Pic: Water chestnut cultivation in the upper lake.
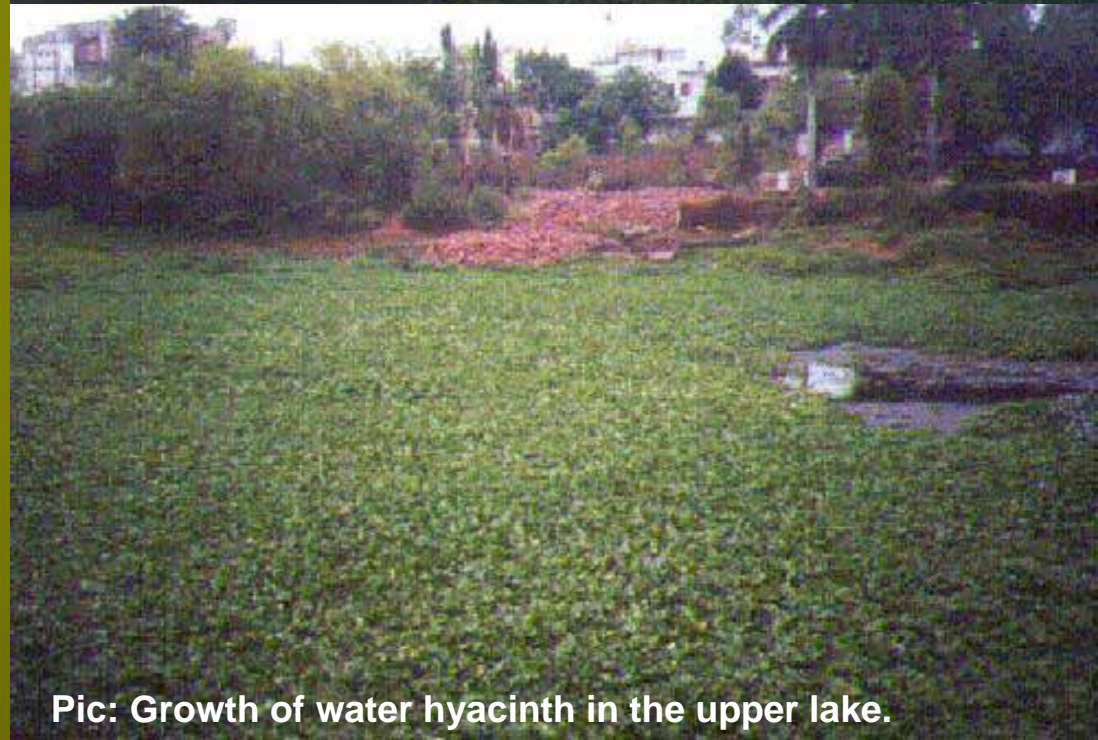
Pic: Growth of water hyacinth in the upper lake.

ECOSYSTEM MODEL FOR BHOJ WETLAND

(Based on water quality parameters from eight representative monitoring stations)

A. MODEL VARIABLES

* Turbidity

*Ph

*Total Dissolved Solids

*Phosphate

*Hardness

*Dissolved Oxygen

*Biochemical Oxygen Demand

*Bacteria (Mpn)
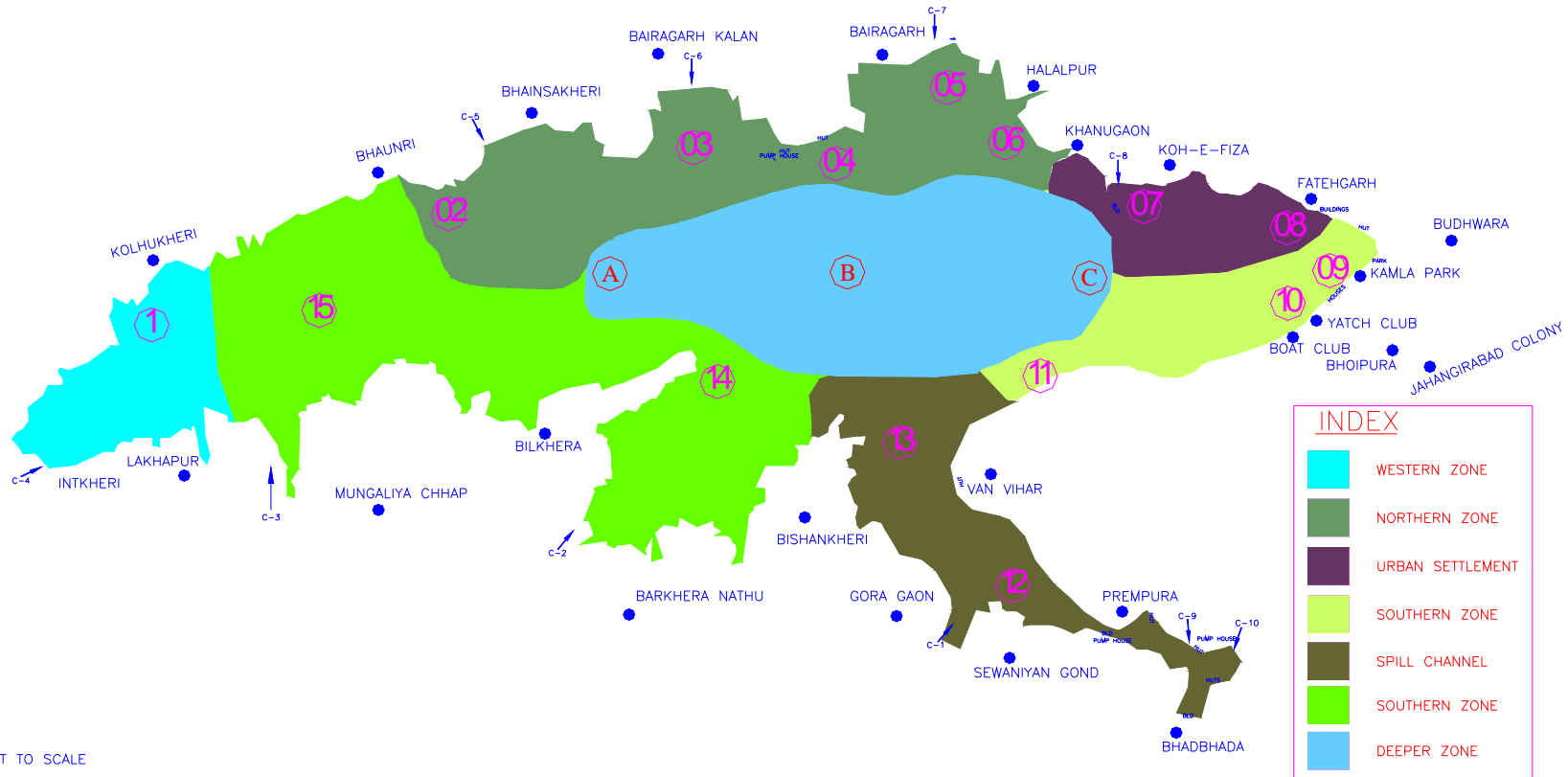
*Weed Area

*Population

*Sewage

Pic: View from IIFM campus

B. INTER LINKAGES OF MODEL VARIABLES and MODEL DEVELOPMENT- Estimation of Elasticity Coefficients, Setting up Model Using Coefficients, Absolute values of variables and Setting up of Base Model using STELLA Software (Systems Dynamics Model)

C. ASSESSMENT OF IMPACT OF ONGOING RESTORATION ACTIVITIES THROUGH SIMULATION RUNS

ZONES AND SAMPLING POINTS OF THE UPPER LAKE

NOT TO SCALE

INDEX

- WESTERN ZONE
- NORTHERN ZONE
- URBAN SETTLEMENT
- SOUTHERN ZONE
- SPILL CHANNEL
- SOUTHERN ZONE
- DEEPER ZONE

S1 – Kolans   (Upper Lake)
S2 - Bairagarh   (Upper Lake)
S3 - Kamla Park   (Upper Lake)
S4 – Spill Channel   (Upper Lake)
S5 – Deeper Zone   (Upper Lake)
S6 – Boat House   (Lower Lake)
S7 – Deeper Zone   (Lower Lake)

Table 1: Compound Growth Rates of Selected Parameters in 1991 using1985 as base year (for the Upper Lake)

Sl.No.	Variable	Units	CGR	Base Year (1985)	Final year 1991
1	Population	Number	0.0338	109187	133287
2	Sewage	Million Liter /Day	0.0101	31.3927	33.344
3	Weeds	Km2	0.3046	0.7	5.875 (1993)
4	BOD	Mg/l	0.0417	2.5545	3.28
5	Bacteria	Counts/100ml	0.1098	358	670
6	PH		0.0051	8.7	9.0
7	Total Dissolved solids	Mg/l	0.0608	86	122.55
8	Total Hardness	Mg/l	0.0351	88	108.24
9	D.O	Mg/l	0.0324	4.0	4.84
10	Phosphate	Mg/l	0.5838	0.01	0.1578
11	Turbidity	NTU	-0.0188	4.0	3.57

Table 2: Compound Growth Rates of Selected Parameters in 1999 using1993 as base year (for the Upper Lake)

|	Variables	Units	CGR	1993	1999 (Average)
1.	Turbidity	NTU	0. 2704	9.5	39.93
2.	p H		-0.0109	9.0	8.426
3.	TDS	mg/l	-0.0009	128	127.302
4.	Phosphate	mg/l	-0.0053	0.4	0.3874
5.	Hardness	mg/l	0.0075	86	89.968
6.	D.O	mg/l	0.0280	7.6	8.968
7.	BOD	mg/l	0.1933	2.1	6.066
8.	Bacteria	counts/100 ml	0.1604	2400	5858
9.	Weed area	Km2	0.3046	5.875	0.7 (1985)#
10.	Population		0.0338	142471	185931*
11.	Sewage	Million Liters/ Day	0.0458	44.92	58.77

* Projected for 2001 (From Detailed project report of Solid Waste Management subproject, BMC)
**# No Data for 1999**

Table 3 : Elasticity Matrices of Ecological Parameters of Pre-Restoration stage (Upper Lake)

Sl.No.	Population	Sewage	Weed area	B .O. D	Bacterial Count	pH	Dissolved Solids	Hardness	D. O	Phosphate	Turbidity
CGR	0.0603	0.0101	0.3046	0.0417	0.1098	0.0051	0.0608	0.0351	0.0324	0.5838	-0.0188
Population	1.000	0.1675	5.0514	0.6915	1.8209	0.0846	0.3051	0.5821	0.5373	9.6816	-0.3118
Sewage	5.9703	1.000	30.1584	4.1287	10.8713	0.5049	1.8218	3.4752	3.2079	57.8019	-1.8614
Weed area	0.1979	0.0322	1.000	0.1369	0.3605	0.0167	0.0604	0.1152	0.1064	1.9166	-0.0617
B .O. D	1.4460	0.2422	7.3046	1.000	2.6331	0.1223	0.4412	0.8417	0.7770	14.000	-0.4508
Bacterial Count	0.5492	0.0919	2.7741	0.3798	1.000	0.0464	0.1676	0.3197	0.2591	5.3169	-0.1712
PH	11.8235	1.9803	59.7255	8.1765	21,5294	1.000	3.6078	6.8824	6.3529	114.4706	-3.6863
Dissolved Solids	3.2772	0.5489	16.5543	2.2663	5.9674	0.2772	1.000	1.9076	0.5329	9.6020	-0.3092
Hardness	1.7179	0.2877	8.6781	1.1880	3.1282	0.1453	0.5242	1.000	0.9231	16.6325	-0.5356
D. O	1.8611	0.3117	9.4012	1.2870	3.3889	0.1574	1.8765	1.0833	1.000	18.0185	-0.5802
Phosphate	0.1033	0.0173	0.5218	0.0714	0.1881	0.0087	0.1041	0.0601	0.0555	1.000	-0.0322
Turbidity	-3.2074	-0.5372	-16.2021	-2.2181	-5.8404	-0.2713	-3.2340	-1.8670	-1.7234	-31.0532	1.000

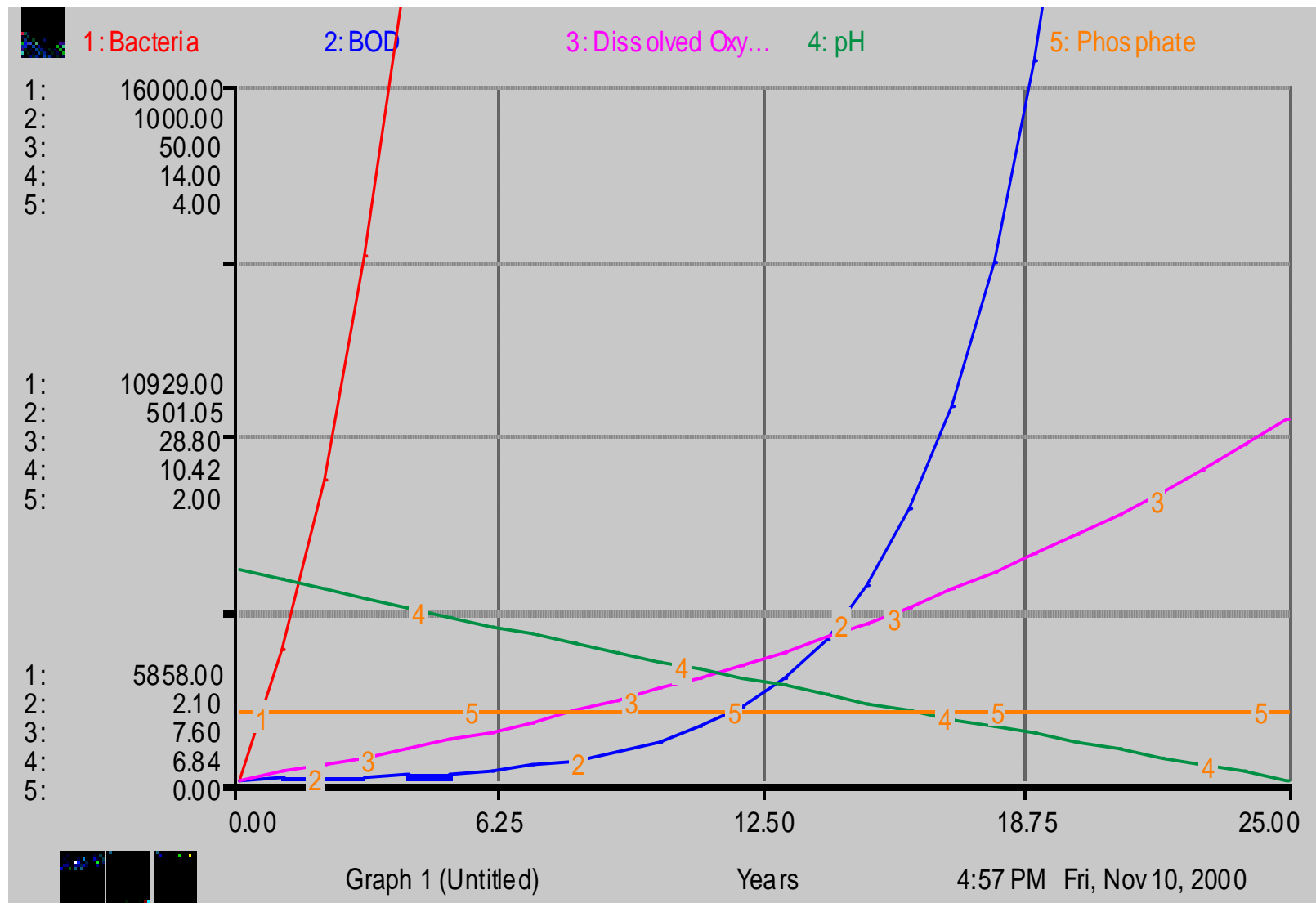Figure 1: Ecosystem Model for Bhoj Wetland Using Water Quality
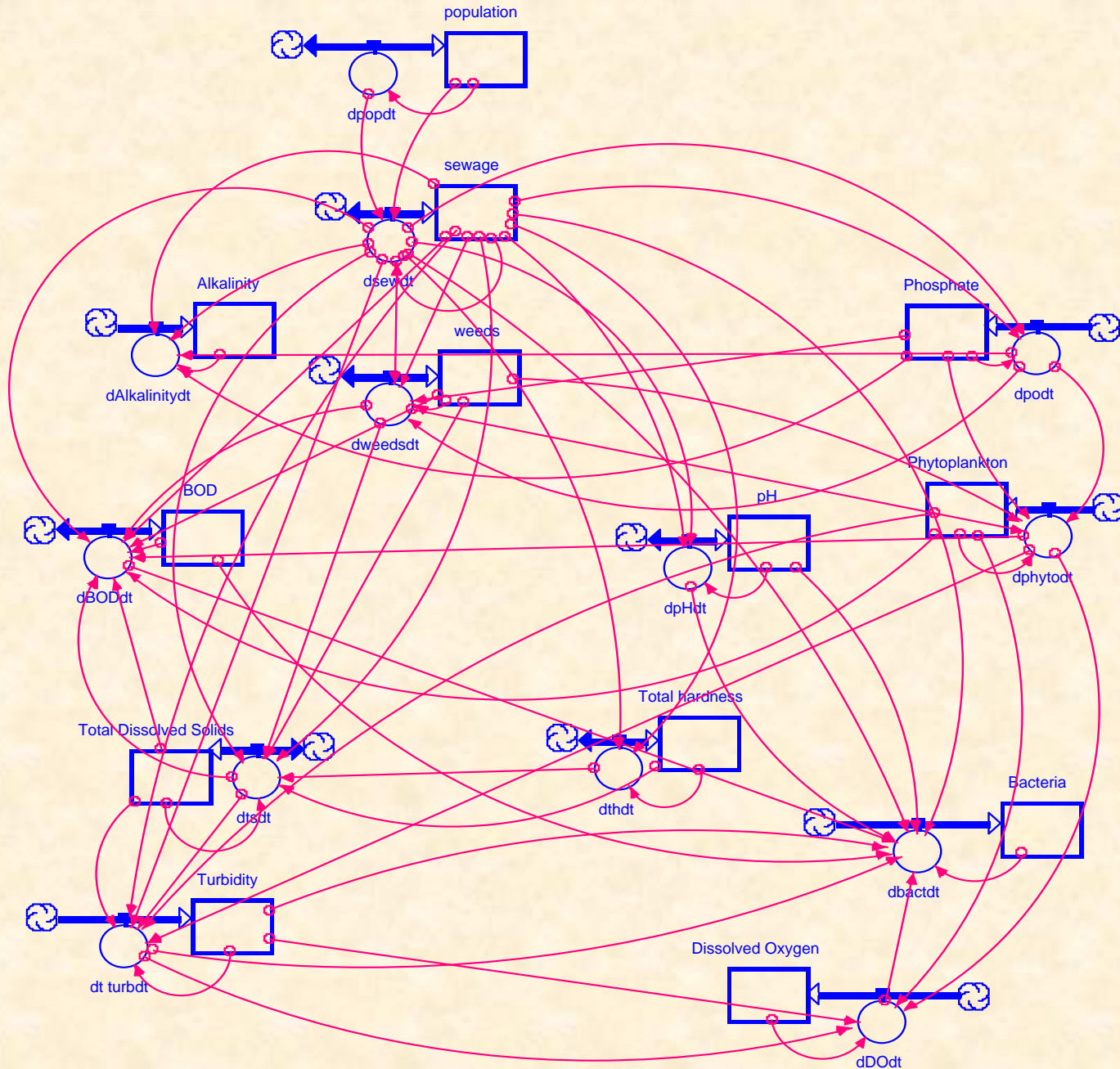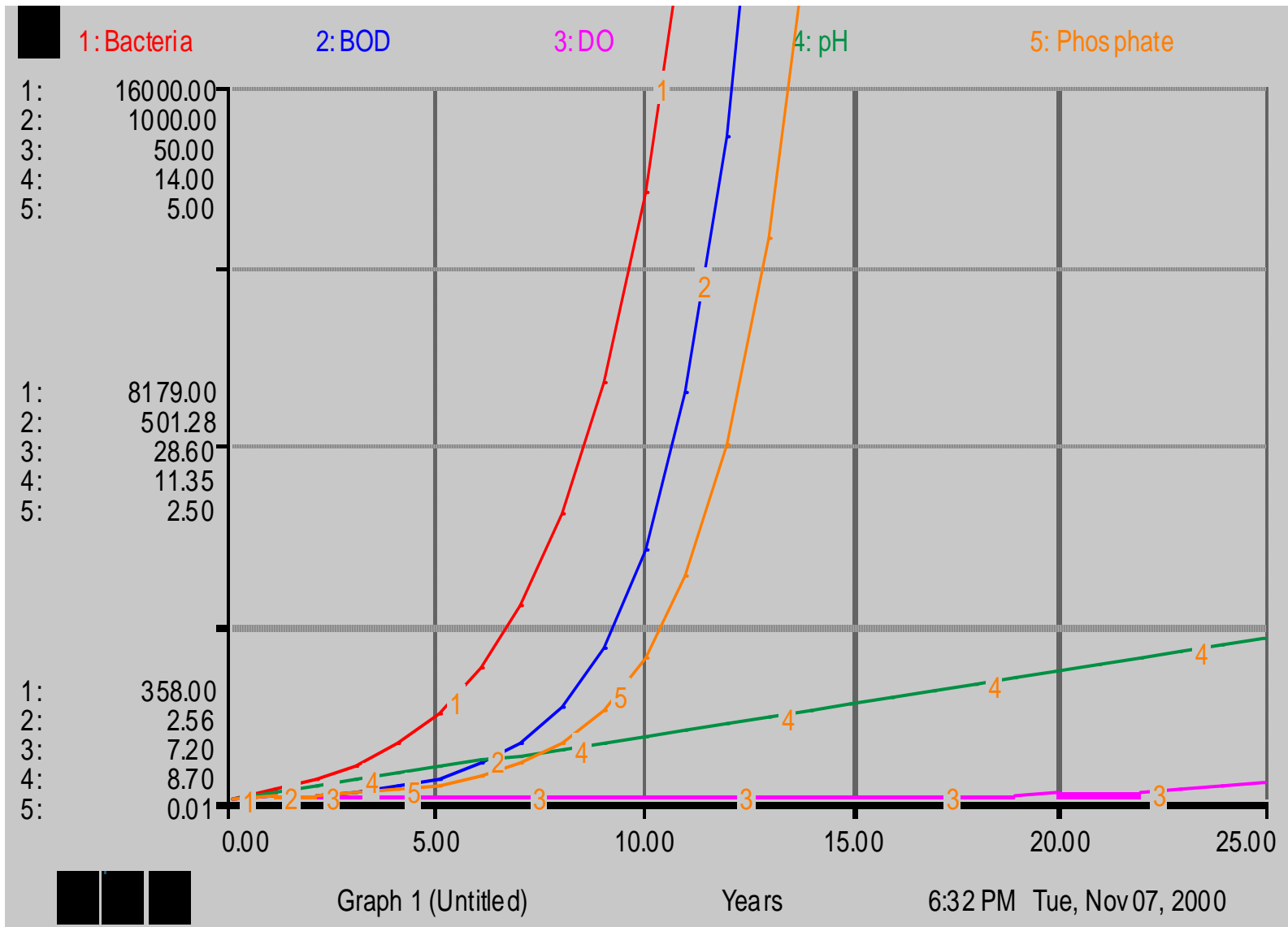
Graph Showing Changes in Various Limnological Parameters in Pre restoration Conditions of Bhoj Wetland – Upper Lake (cont.)
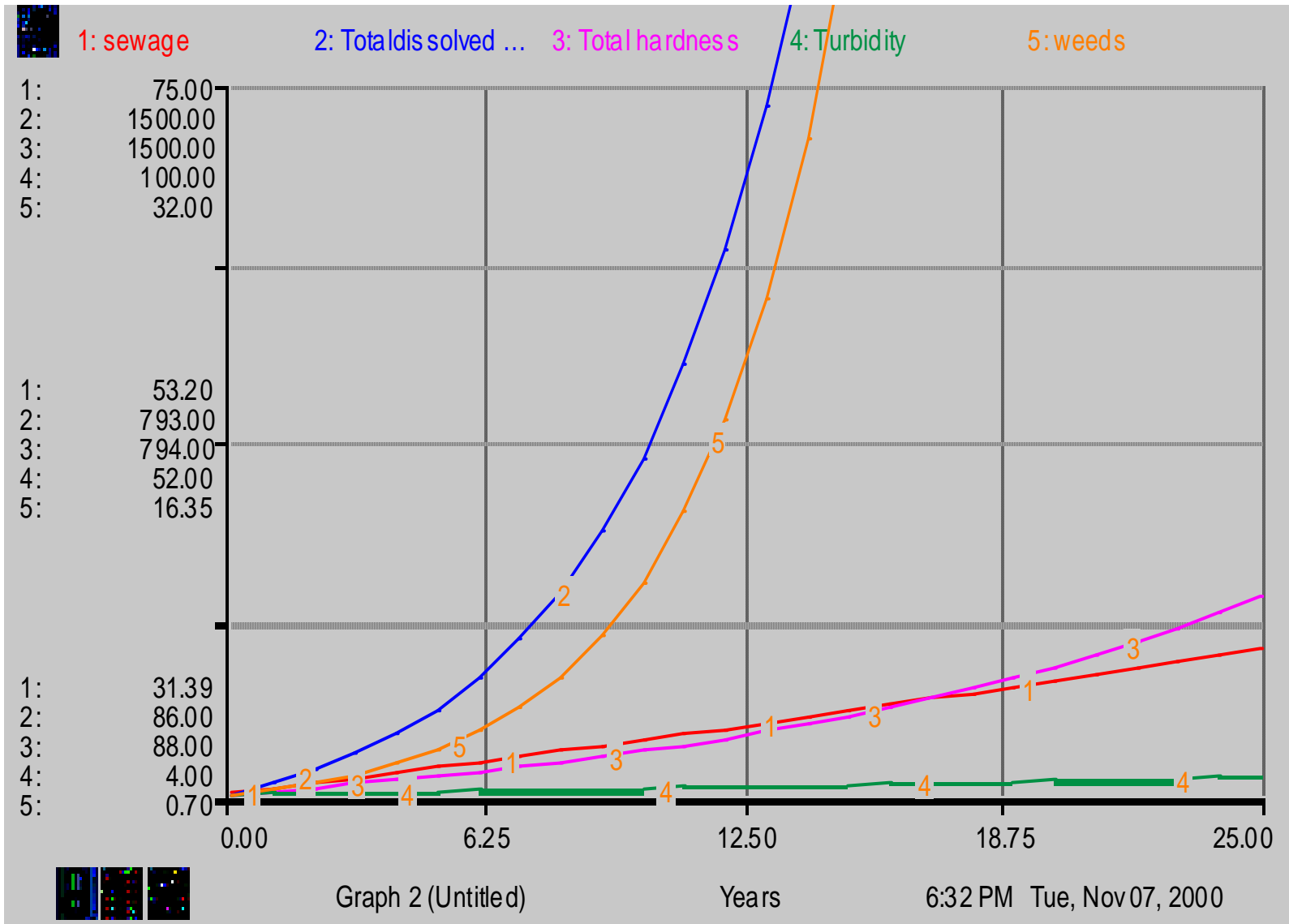
Graph Showing Changes in Various Limnological Parameters in Pre Restoration Conditions of Bhoj Wetland – Upper Lake

Graph showing Changes in Various Limnological Parameters of Ongoing Restoration Activities In Upper Lake (Cont.)
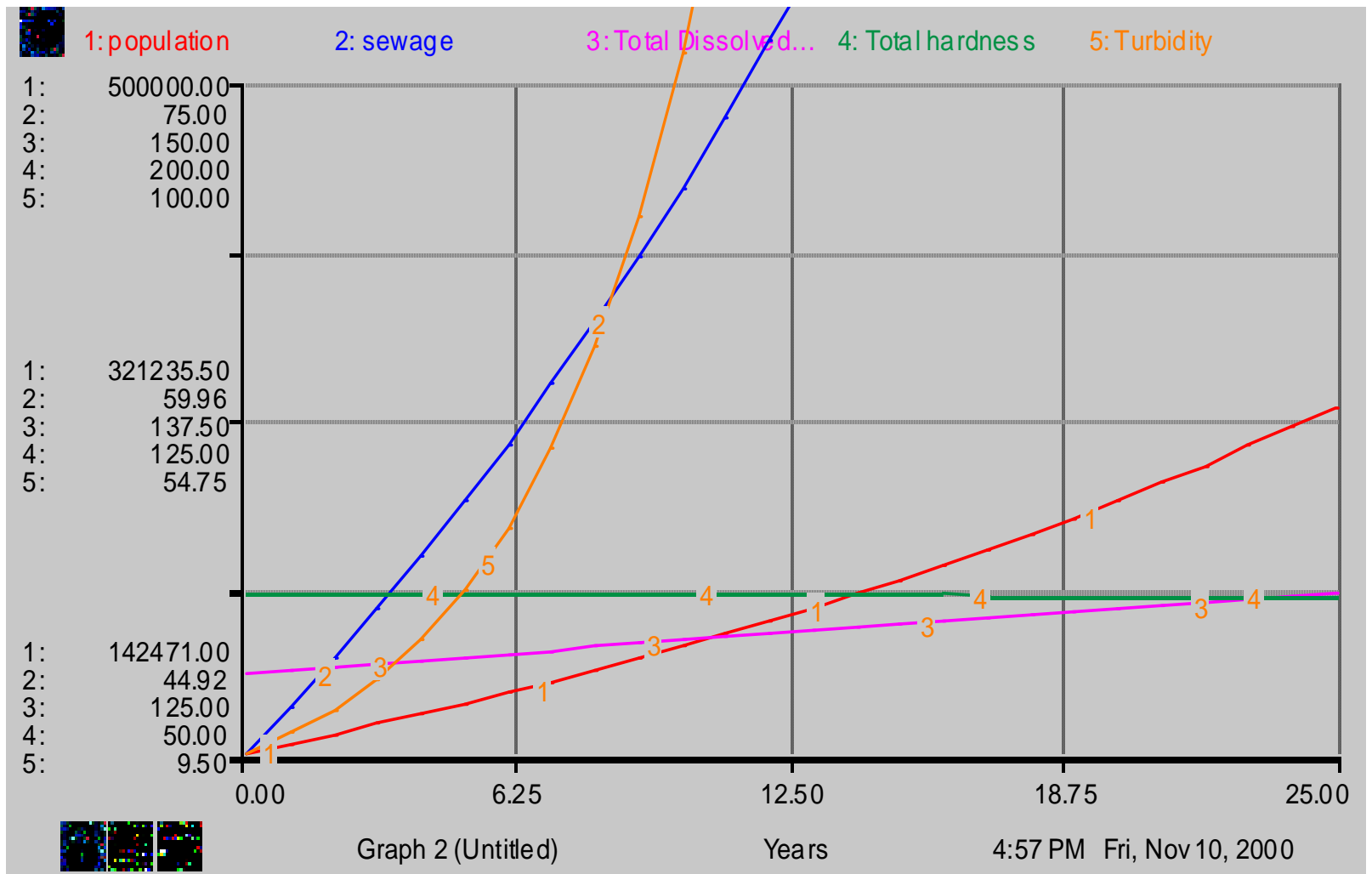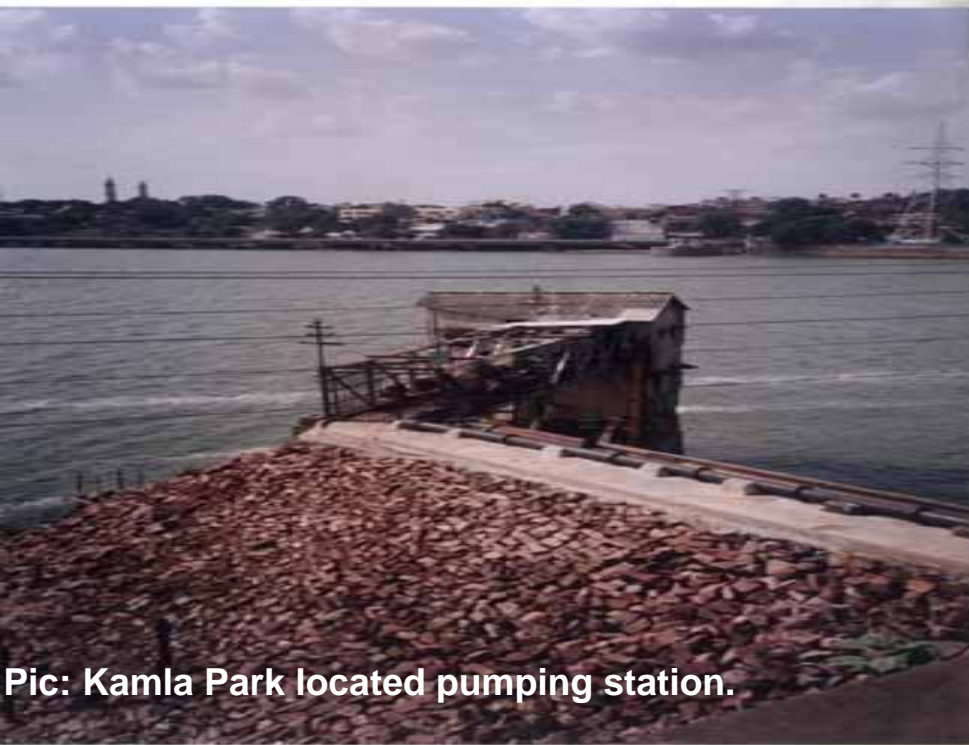
Graph showing Changes in Various Limnological Parameters of Ongoing Restoration Activities In Upper Lake

Pic: Upperlake against beautiful sunset.

VALUATION METHODOLOGIES USED

1. DIRECT VALUATION THROIGH MARKET PRICE APPROACH

2. COST OF ILLNESS & PREVENTIVE COST APPROACH

3. CONTINGENT VALUATION METHOD

4. HEDONIC PRICING

Pic: Kamla Park located pumping station.

Pic: Fishing Activities in Lower lake

RESULTS OF VALUATION EXERCISE

VALUE OF THE DRINKING WATER SUPPLY

Rs 9,54,13,962 or US$ 2,120,310 (assuming US$ 1 = Rs 45/-)

MPTDC REVENUE

Rs 387330 or US$ 8607

INCOME TO FISHERMEN

Rs 80,00,000 or US$ 177,778

INCOME TO BOATMEN

Rs 24,37,880 or US$ 54,175

INCOME TO TRAPA CULTIVATORS

Rs 50,000 or US$ 1111

INCOME TO WASHERMEN

Rs 36,00,000 or US$ 80,000

INCOME TO ROADSIDE VENDORS

Rs 14,16,000 or US$ 31,467

COST OF ILLNESS APPROACH

Rs 12,00,254 or US$ 26,672

TOTAL HOUSEHOLD COST OF WATER PURIFICATION

Rs 1,24,35,876 or US$ 276,353

WTP OF THE PEOPLE AS A VOLUNTARY CONTRIBUTION ANNUALLY

Rs 4,84,68,956/- or US$ 1,077,088

WTP OF THE PEOPLE AS TAX ANNUALLY

Rs 59,32,922/- or US$ 131,843

Pic: Washing Activity at Lower Lake.

DESCRIPTION OF MAIN VALUATION METHODS

I.CONTINGENT VALUATION

A. Questionnaire

*Attitudinal Question

*Scenario Building

* Valuation

*Payment Vehicle

Voluntary Payment to BWL Maintenance Society

#Compulsory Tax To Govt.

B. Sample Size

 * 1500 Households out of Total No. of 2,01,116 (0.74 %)Households   constituting 1.5 Million Population of Bhopal City

•Samples from all 66 wards in proportion to their share in total population
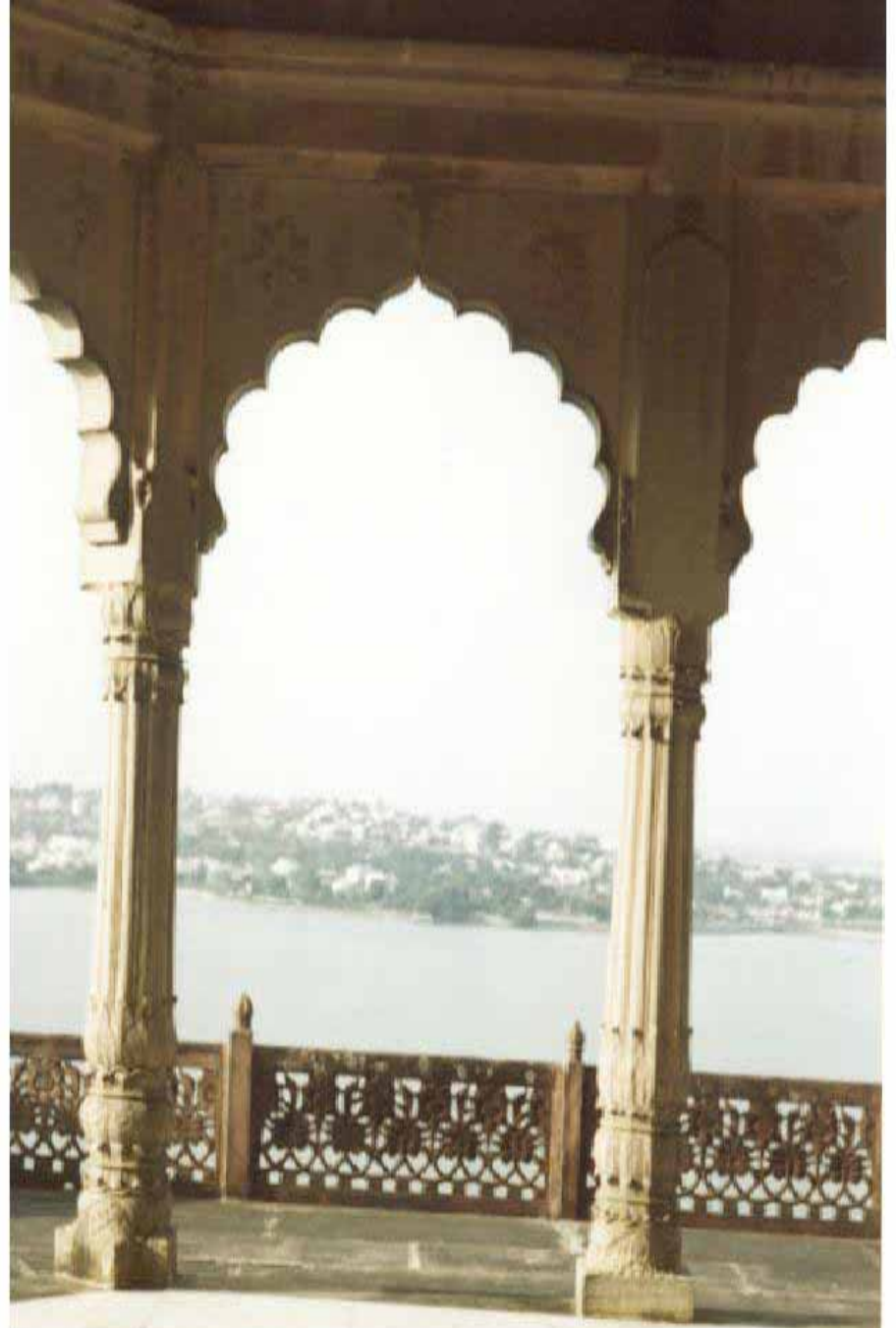
Pic: View of the Upper lake & old Bhopal City from the Arches.

A. Picture Cards showing Bhoj Wetland with High Water Quality and High Aesthetic Value

Plate 1: Sea beach like view of the upper lake as seen from Shyamala Hills Photo Courtesy: Central Color lab Bhopal for the Bhoj Project, IIFM
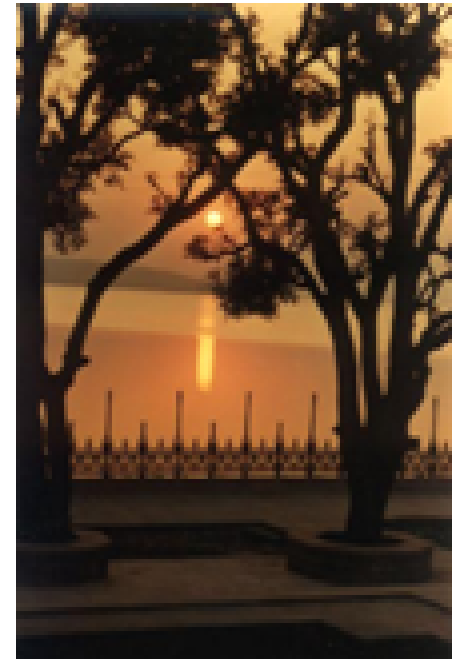

Plate 2: Sunset as seen from VIP Road Photo Courtesy: Central Color lab Bhopal for the Bhoj Project, IIFM

B. Picture Cards showing Bhoj Wetland with Low Water Quality and Low Aesthetic Value


Plate 3 : Sewage and debris directly going in to Upper lake

Plate 4 : water Hyacinth in Upper lake

Extrapolated Willingness To pay (WTP) for Entire city

Median FINVOL per household per annum = Rs 241.00/- **(US$ 5.35)**	**Total Number of households in City = 2,01,116**	**Total Voluntary WTP per annum = Rs 4,84,68,956/-** **(US$ 1,077,087)**
Median FINTAX per household per annum = Rs 29.50/- **(US$ 0.65)**		**Total WTP as tax per annum = Rs 59,32,922/-** **(US$ 181,842)**
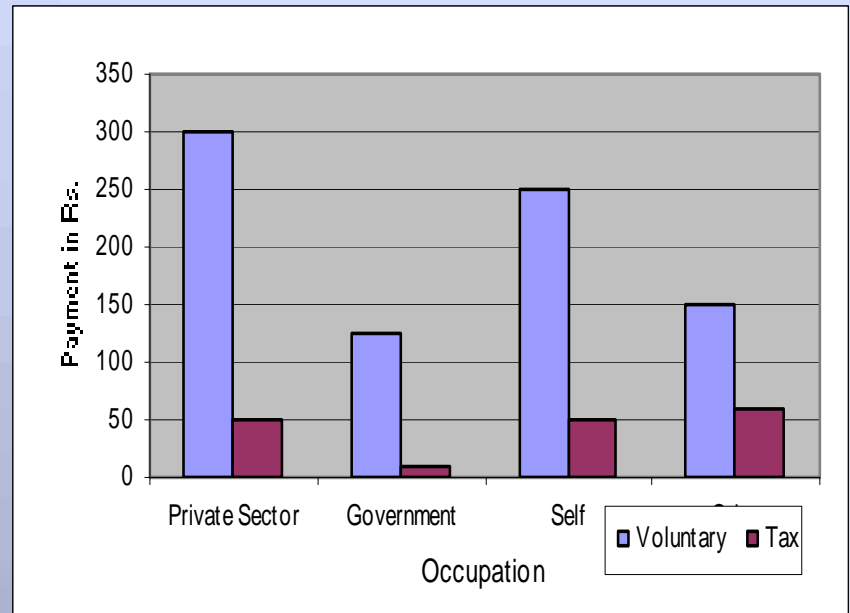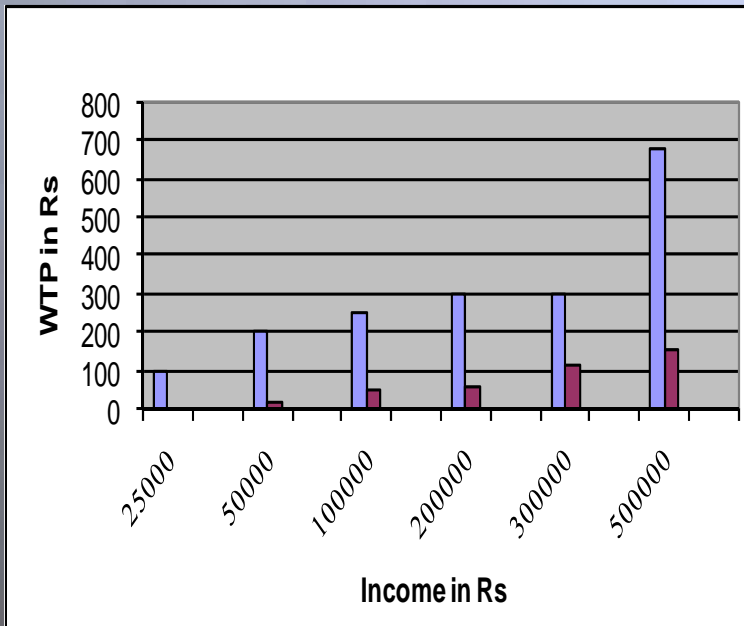
II. HEDONIC PRICING

Ranking Of Various Factors

Considered While Buying Property

S. No:	Factor	Scores
1.	Drinking Water	0.99
2.	Safety	0.94
3.	School	0.88
	Quality of	0.87
	Construction	0.87
	Hospital	
6.	Age of House	0.85
7.	Park	0.80
	Market	0.79
	Air Pollution	0.79
10.	Work Place	0.77
11.	Density	0.70
	Noise Pollution	0.70
13.	Lake	0.67
14.	Household Help	0.56
15.	Road	0.31

Estimation Results Of Hedonic Pricing

Dependent Variable = Price in Rs/sq.ft	Number of Observations = 27
R squared = 0.781	Package Used = SPSS 10.0

Variable	Coefficient	t - statistic
CONSTANT	-607.596	-3.883
NEIGHBOURHOOD	282.739	4.591
MARKET	-112.570	-1.661
ACCESS	101.902	1.575
LAKE	185.896	2.518
ENVIRONMENT	111.047	2.097
HOUSING DENSITY	-67.203	-1.379

Estimating partial correlation coefficient, 50% price differential was found in the lake front properties on account of amenity values of lake.

RECOMMENDATIONS

TECHNICAL

• 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


Pic: Current State of BWL at most of the points


Pic: Sunset view at Khanugaon area of BWL

Could Always be the Future State of Entire BWL

POLICY / INSTITUTIONAL RECOMMENDATIONS…..

* Use valuation exercise as basis for future management strategies

* Carry out detailed cost benefit exercise

* Prioritise restoration activities using

simulation runs of comprehensive ecological model

* Conduct detailed study of rural catchment
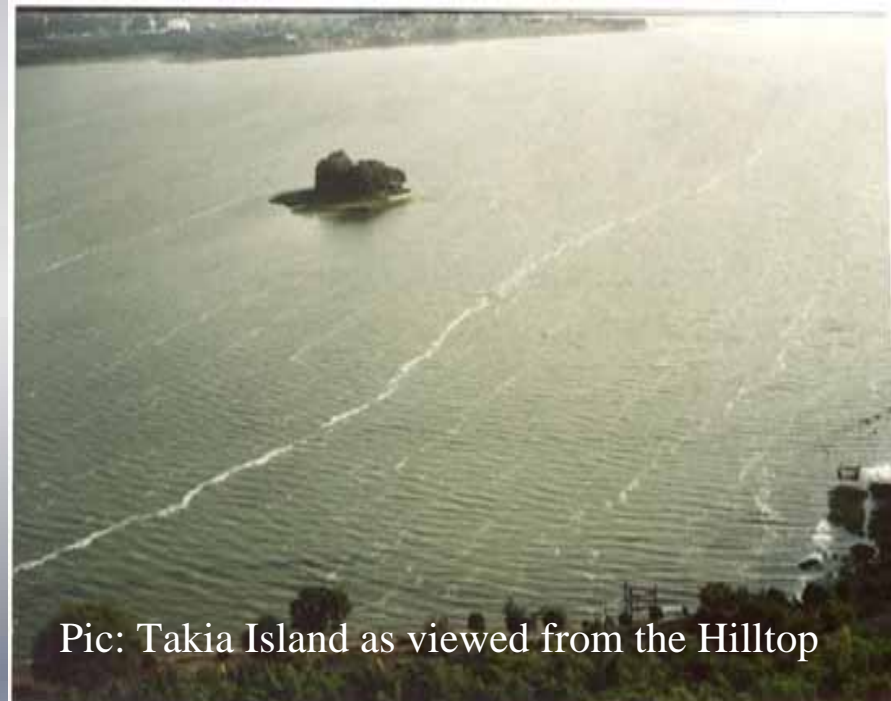
Pic: Takia Island as viewed from the Hilltop
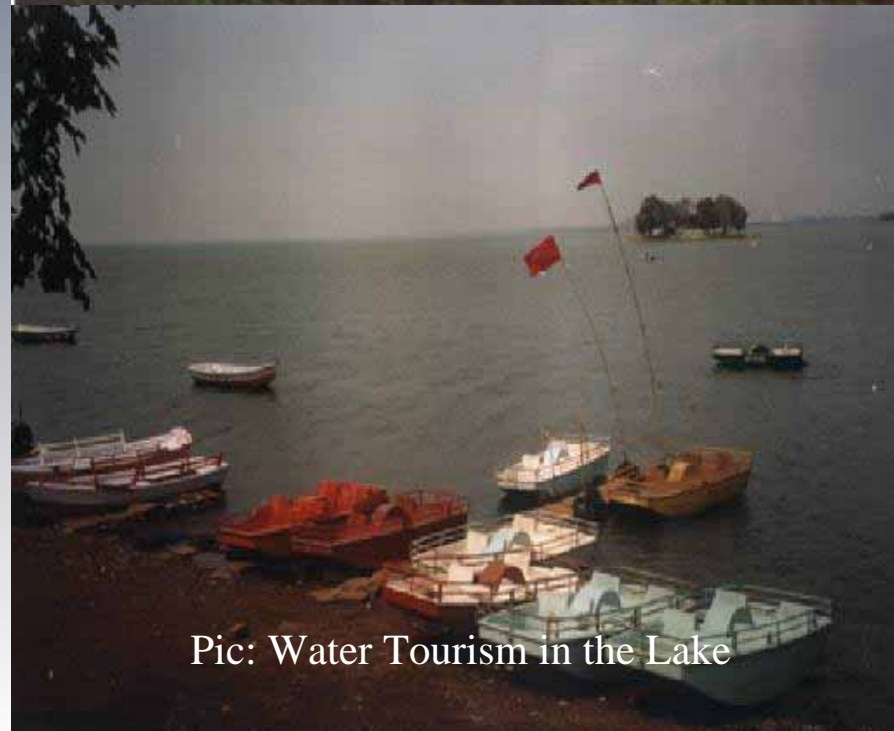
Pic: Water Tourism in the Lake

Bhoj Wetland Maintenance Society as Proposed under the IIFM Project

STRUCTURE

Representatives from Line Departments, Primary Stakeholders, Citizens, Research Institutions, NGOs, Media

FUNCTIONS AND ACTIVITIES

• Maintain Water Quality And Improve Lake Management

• Build Parks And Maintain Them

• Better Boating Facilities With Introduction Of Water And Adventure Sports

• Encourage Sport Fishing Using Rods

• Hold Summer Camps Fro Children And Youth For Water Related Recreational Activities

• Promote Eco-tourism By Encouraging Visitors To Learn About Lake's Ecosystem And Biodiversity

• Awareness To Decrease Water Pollution By Regulating Use Of Polythenes Etc And Water Consumption

• Develop View Points With Sitting And Refreshment Arrangements

• Introduction Of Dal Lake Kashmir Like House Boats

• Generate Awareness For Clean Lakes By Holding Annual Lake Festival, Distributing Souvenirs,

• Creating Consciousness To Save the Pride and Heritage of Bhopal City

Pic: View from Shymala Hills

Pic: Sunset view

Use of Project Findings Through Ecosystem Model and Economic Valuation Exercise in Lake Basin Management Decision Making Process Since 2000

A. By the BWL Agency now called as the Lake Conservation Authority (LCA) set up in 2004

The author submitted the report in multiple copies to the BWL agency in 2001, but was not called up for the presentation after two years of submission though she made many presentations in various cities of India and was invited for presentations to many agencies abroad.

Few recommendations have so far been considered by the BWL Agency like

• Increased public participation, intensification of preventive measures like sewage and silt control

• Interventions in the rural catchment by awareness building and capacity building for Organic cultivation

• Awareness building in the urban catchment through display of information

But

- 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

- Despite data availability for water quality, the agency did not take up intensive Ecosystem Modelling for various monitoring stations so as to make specific interventions

Pic: Panoramic View of Upper lake from Shyamla Hills

B. By Various National and International Organizations and Wetland Sites

In India

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 inJammu & Kashmir, Loktak lake in Manipur etc.

By International Agencies

- Ramsar website hosts a Photo gallery and project Findings since 2001

- IUCN has put up an 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 Mexico; at the Resources for the Future in Washington D.C. in USA.

- Ramsar Convention has provided with in Australia travel support to present Ecosystem Model in Brisbane.

- 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 authour did the livelihoods baseline and impact studies under the project.

Pic: View from the Top point of the city

Currently, ILEC has considered the study as a case for disseminating the use of Economic Valuation Techniques for Lake Basin Management process under JICA project

THANK YOU

Pic. Portrait of the then Yacht Club in the Lake

Sources of pictures : Dr. Madhu Verma & Research Team, IIFM Bhopal; Central Color Lab, Bhopal, & Individual collection from Mr. Prem Verma, Bhopal.