

Research paper

Challenges Faced and Solutions towards Conservation of Ecology Of Urban Lakes.

Patil Snehal¹, Padalia Unnati¹

¹Department of Microbiology, K.J. Somaiya College of Science and Commerce, Mumbai - 400 077, India.

Abstract: A lake is the most beautiful and expressive feature of a landscape. It is often described as the “Eye of the Earth “. Urban lakes form vital ecosystems supporting livelihood with social, economic and aesthetic benefits that are essential for quality life. The nutrient-poor, oligotrophic lake is oxygen saturated and has a low microbial population; whereas nutrient-rich, eutrophic lake has a bottom sediment layer and can have an anoxic hypolimnion. As microbial biomass increases with nutrient level, light penetration gets depleted. Thus the lower parts may receive poisonous gas like H₂S released by anaerobes. The sewage and agricultural waste may increase the percentage of Nitrogen and Phosphorous into the lake waters. This in turn can cause bloom of algae, bacteria and plants in the epilimnion zone. Cyanobacteria in oligotrophic fresh water can cause algal bloom. It has been noted that if both Nitrogen and Phosphorus are present, Cyanobacteria competes with algae. Toxic blooms, as well as bacterial contamination and heavy metal pollution, may significantly impair all the water uses and represent a health risk of the urban population. Thus, in the last years, a growing public awareness has developed regarding the quality of urban lakes and special management plans in several urban areas have been augmented worldwide to restore the hygiene, maintain the recreational value and to avoid sanitary problems arising from the deterioration of their water quality. Urban lakes can be saved if we manage to:

Plan Purposefully,

Proceed Positively,

And

Pursue Persistently!

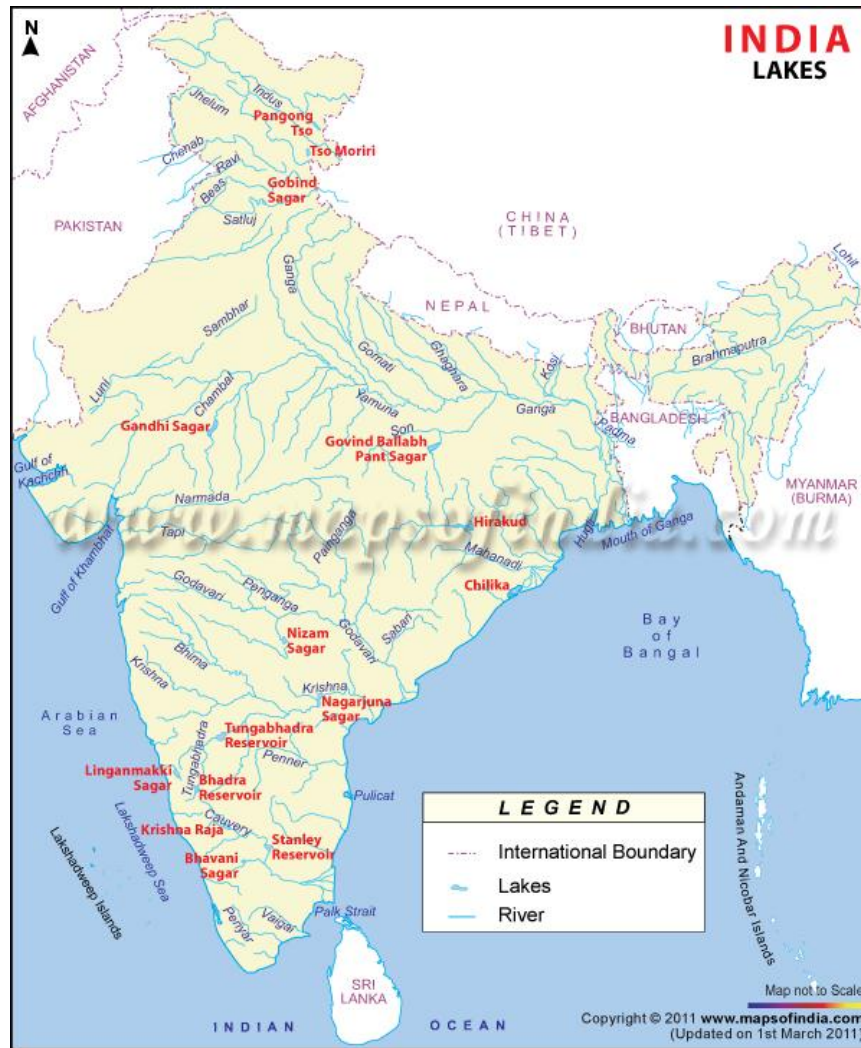
(Keywords: Urban ecology, Toxic blooms, Cyanobacteria).



Introduction: Lakes (natural / manmade) better called water bodies are reservoirs of water; serve as source of drinking water. Urban lakes play a pivotal role in maintenance of the homeostasis in the system. Most of the lakes, especially near urban or residential areas, are found to be polluted at different levels because of anthropogenic activities. Some examples of such lakes from India are: Bada Talab near Bhopal city, Hussain Sagar Lake in the heart of Hyderabad city, Dal Lake in Srinagar, all affected by organic pollution. The traditional uses of the lake have been disturbed due to deterioration of lake water. Today they are subjected to a great amount of ecological stress and strain in terms of pollution and ecocrisis. The urban lakes are important in maintaining the surface and ground water balance, in maintaining urban ecosystem apart from its uses for different purposes namely recreational, water supply, fishing etc.

The paper is on the changes at the interface of social and ecological system dynamics, more specifically between urban lake systems and the urbanization processes.

Fig 1: Lakes in India ^[01]



Indian Lakes Classification:

The several classifications into which the lakes in India can be classified are:

- Urban Lakes
- Non-Urban Lakes, which include Sacred Lakes/Tanks, Inland Fresh water and Inland Brackish water
- Ephemeral Lakes
- Coastal Estuarine lakes.
- **Dal Lake**: Lying in the Kangra district of Himachal Pradesh, Dal Lake is situated at an altitude of about 1,775m. Covering 10 square miles of area, the lake has a length of 6.4 km and width of 4 km. The most fascinating feature of the Dal Lake is the beautiful ‘Shikara’ and the ‘wooden Houseboats’ with boating facilities. The lake has four parts, Lokut Dal, Bod Dal, Nagin and Gribal.

- **Pushkar Lake:** Nestled within hills and deserts, the beautiful Pushkar Lake is in Rajasthan is located in close proximity to the Pushkar town. Covering an area of 5 km, this sacred river of the Hindus, has 52 palaces, 52 ghats and 400 temples. The Pushkar Lake is visited by numerous pilgrims all throughout the year. It is believed that a dip in the holy water of the lake would lead to Moksha.
- **Pichola Lake:** The panoramic Pichola Lake is in Udaipur and is abounded by bathing ghats, hills, temples and palaces. Both the banks of Pichola Lake nearly touch each other. The islands on the lakes, located at regular distances consist of pavilions and palaces. Among the famous islands are- Jag Niwas and Jag Mandir. This massive lake is 4km long and 3km wide, with a depth of about 30 feet. The best time to watch this lake is during the winters, when the lake is at its best.
- **Bhimtal Lake:** Located in the small town of Bhimtal, in the Uttarakhand District, Bhimtal Lake is the largest lake in the region and is at an altitude of 1370 meters. There is an island on the lake which is considered to be one of the exquisite gems. Nestled within the lush Kumaoun Hills, the Bhimtal Lake serves as a popular tourist destination, where boating facilities are also available.
- **Hussain Sagar Lake:** Asia's largest manmade lake, Hussain Sagar Lake, is in Hyderabad. The lake came into existence to cater to the water requirements of the region. The cities of Secunderabad and Hyderabad are connected by this 24km long Hussain Sagar Lake. The chief attraction of this Lake is a statue of Buddha which is 16 m tall. This single stone statute is considered to be India's largest statue.
- **Vembanad Lake:** Covering an area of 200 square km, Vembanad Lake is Kerala's largest brackish lake. It is situated in Kumarakom that is 15 km from away from Kottayam district in Kerala. This beautiful lake serves as a backwaters destination with facilities for fishing, boating and sightseeing.
- **Chilka Lake:** The huge and beautiful Chilka Lake is located on eastern coast of Orissa. India's largest brackish lake, Chilka Lake has a length of 70km and width of 32km. Two popular islands on the Chilka Lake are Rambha and Barkul. One fascinating feature about the lake is its rich collection of floral system. It is home to distinct variety of aquatic plants and wildlife. The lake is also a spot for eco tourism.
- **Roopkund Lake:** Roopkund Lake is in the Chamoli district of the state of Uttaranchal. Located at a height of 5029 m, the Lake is a location for Raj Jat Yatra. It is well-known as a mysterious lake, because in the summers, the surface ice of the

lake melts thereby presenting a ghastly sight of human skeletons floating on the waters. The lake happens to be a trekking spot.

- **Dumboor Lake:** Dumboor Lake is located at a distance of 58 km from the city of Udaipur. Three major places, Udaipur, Gomati and Agartala are connected by this lake. Every year Poush Makar Sankranti Fair takes place in the banks of this lake. Dumboor Lake has an area of 41 square km and 48 islands. Many sorts of migratory birds can be seen here.
- **Chandartal Lake:** Enjoy life at its best at the Chandartal Lake amidst the beauty of the Himalayas. The lake is immensely beautiful and very popular for trekking activities. While some people prefer to trek, others come down to view this lake by Jeep. Whatever be the case, this lake is surely a must visit for every tourist.

Ecology: The Lake Ecology section is intended to provide a general background to Lake Access by introducing the basic concepts necessary to understand how lake ecosystems function. It is divided into three general sections shown above, which describe the fundamental physical, chemical, and biological characteristics of lakes. While there is a logical sequence to the chapters shown in the index, each chapter stands alone. ^[02]

Understanding Lake Ecology Index	
PHYSICAL	BIOLOGICAL
Formation	Lakezones
Variability	Food Webs
Light	Primary Producers
Density Stratification	Chlorophyll
Watersheds	Algal Succession
CHEMICAL	Consumers Decomposers
General Lake Chemistry	Trophic Status
Dissolved Oxygen	Eutrophication
Nutrients	Ecoregions
	Biological Differences

[Fig2: Understanding Lake Ecology Index.](#)

According to Krebs's (2001) definition, "Ecology is the scientific study of the interactions that determine the distribution and abundance of organisms .^[03] Fecal contamination and toxic Cyanobacteria blooms may deteriorate the ecological value of these environments and transform them in a potential risk for human health, which may require costly management and restoration plans.^[04]

Rejuvenation: Most of our rivers are highly polluted as well as our lakes, ponds and other water bodies. Objective- Polluted water is a serious health hazard and it is desirable to clean up rivers, lakes and all water bodies from the water borne organic wastes generated from the pollutants and sewage so that waste is converted to wealth by producing more fish and thus increasing the per capita income of fishermen.^[05]

Restoration & Conservation of dying lakes^[06, 07, 08]

- Check the process of eutrophication.
- Regulate the use of insecticides/pesticides in the catchment areas to check lake pollution from agriculture run off.
- Ban any agricultural practice in the lake basin.
- Sewage must be diverted away from the lakes.
- Check the overgrowth of aquatic weeds like *Eichhornia*, *Azolla*, and *Alternanthera* etc. through Manual operations.
- Undertake in depth study of Lake Hydrology (flow of water, through inlets, outflow pattern, evapo-transpiration) for maintaining optimum physico- chemical characteristics & water levels.
- Socio-economic studies & land use planning in & around the lakes can help in providing Ecological basis for improving the quality of lakes.
- Encroachment of lake beds by unauthorized /authorized agencies must be immediately stopped.
- Aquatic plants greatly aid in retarding the eutrophication of aquatic bodies; they are the sinks
For nutrients & thereby play a significant role in absorption & release of heavy metals. Therefore, knowledge of the ecological role of aquatic species is necessary for lake preservation.
- Lastly environmental awareness programmes can greatly help in the protection of the water bodies.

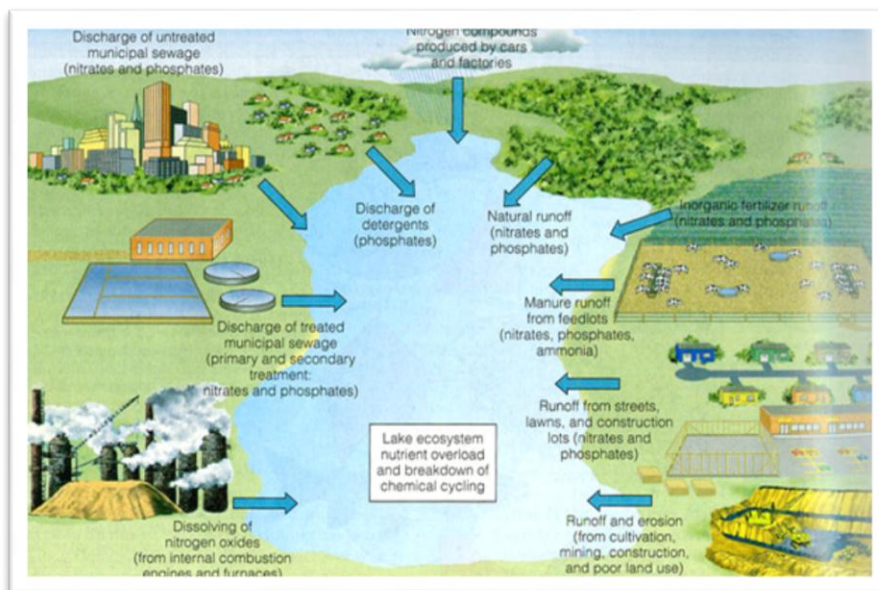


Fig 3: Sources of cultural Eutrophication



Fig 4: Removal of wastes from Lakes.

Technology: Throughout the world, lakes, both natural and manmade have suffered degradation because of urban, industrial, agricultural and other impacts. During the past 50 years or so, extensive research effort has gone into the approaches to control and reverse degradation of lakes worldwide. Many methods have been used and technologies developed for lake restoration. Restoration of lakes for improvement in H₂O quality requires interventions that address both the factors responsible for an increase in nutrient load and the accumulated nutrients. [09, 10, 11]

1) Control of the nutrient inputs from the catchment into the lakes. [09, 12]

Nutrients enter the lakes from point sources with the discharge of the sewage or storm water chains. Nutrients inputs from nonpoint sources can be reduced by,

- a) Afforestation or development of suitable plant covers in the catchments especially those prone to erosion.
- b) Development of vegetation buffer belts around the water bodies.
- c) Adopting agricultural practices that reduce the use of fertilizers and pesticides and/or their loss from the fields.

2) Removing the nutrients from the lakes [13, 14]

- Flushing with nutrient-poor wastes.
- Deep water abstraction.
- On-site-P-elimination by flocculation/flotation with water backflow, or floating plant NSSIE with adsorbents.
- On-site algae removal by filters and P-adsorbers.
- On-site algae skimming and separator thickening.
- Artificial mixing/Destratification (permanent or intermittent).
- Harvest of fishes and macrophytes.
- Sludge removal.



Fig 5: Harvester collecting Water Hyacinth

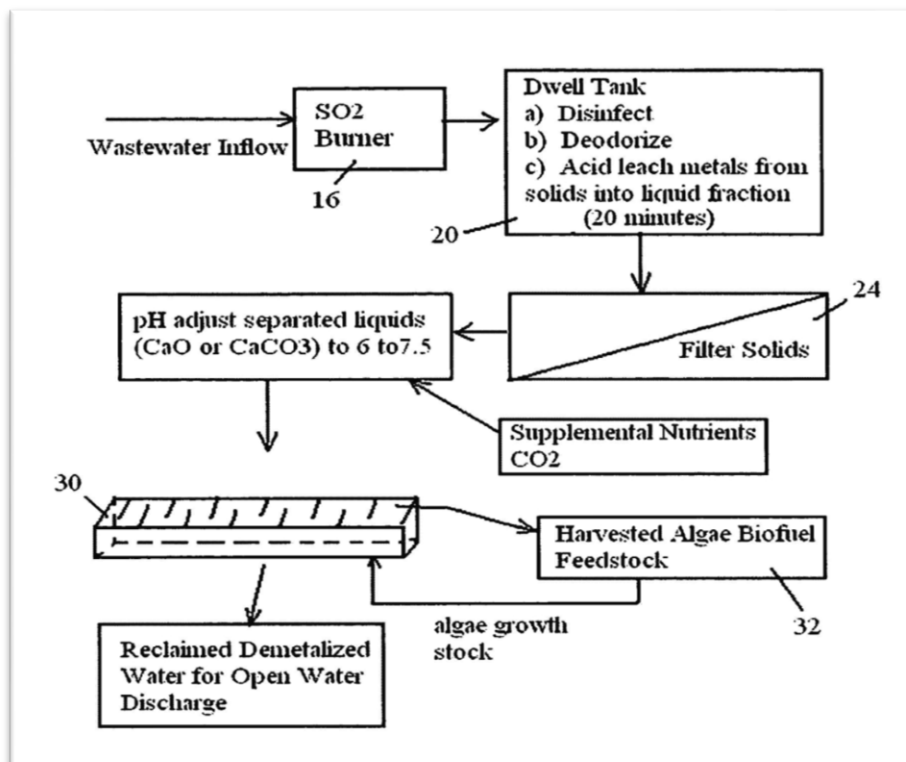


Fig 6: Algae skimming and separation



Fig 7: Sludge removal.



Fig8: Removal of Algal blooms.

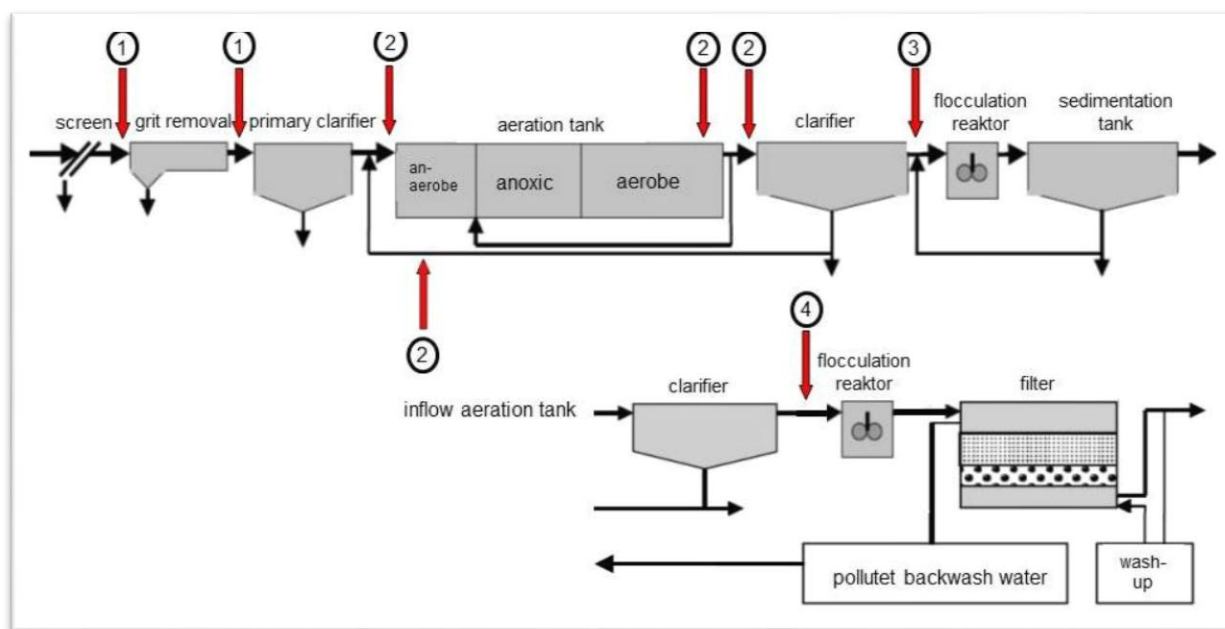


Fig 9: Removal of wastes by Flocculation.

3) Bio-manipulation (Food-web manipulation) [15, 16, 17]

Besides various physical and chemical methods, several biological methods have also been tried for controlling/reversing eutrophication with variable changes of success in different countries. The use of vegetation and constructed wetlands for removing nutrients and various pollutants from the waste waters has already been mentioned earlier. The fish can help decrease the plankton by directly feeding on zooplankton that feed on phytoplankton. Bio-manipulation is more effective if nutrient loads are reduced.

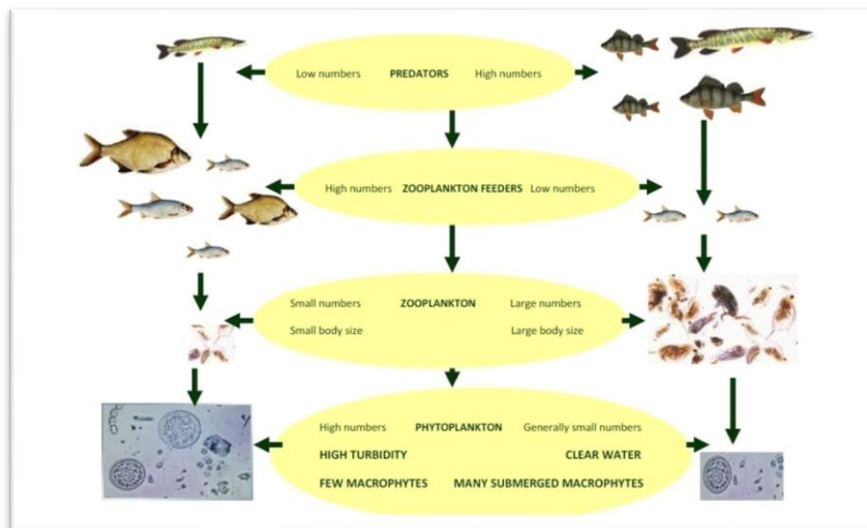


Fig 10: Bio-manipulation.

2) Control of organic load.

High organic matter content leads to oxygen depletion and production of toxic substances (H_2S , Ammonia) with consequent foul smell and fish kills. Aeration of the water column with the help of a variety of aerators and diffusers using small amounts of oxygen as well, are generally used to reduce the organic content of the water column. In recent years, a combination of various micro-organisms has been developed for targeting the organic matter through a process referred to as bio-remediation. It is also facilitated by the use of aeration in conjunction with the microbial formulations. ^[09]

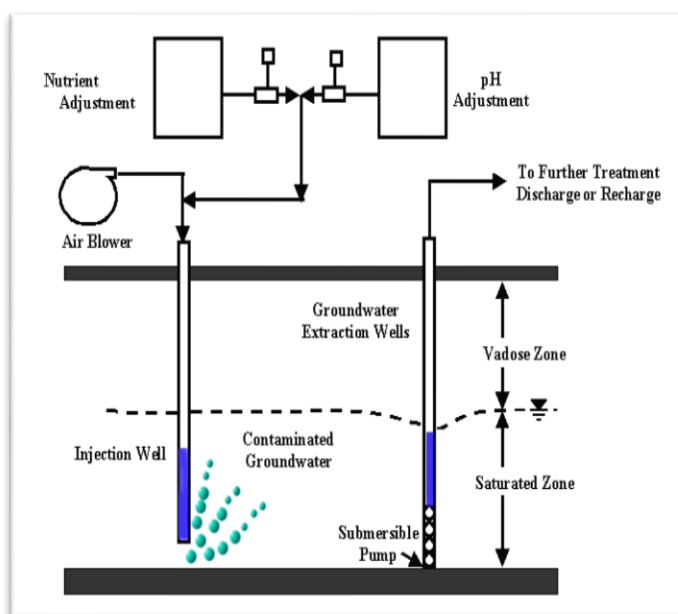


Fig11: Bio-remediation.

Discussion: Water, the elixir of life, is the most precious resource on the planet earth. Life originated and evolved in water before it appeared on the land. The unit of life whether on land or water is the living cell, the major bulk of which is water itself. Ultimately it is the delicate balance of chemicals within the cellular water that determines the quality of life and forms a fragile barrier between life and death itself. No wonder, water as an element and water bodies in general have been revered as holy by traditional human societies all over the world. Recent times, sadly enough, have witnessed a drastic change in our attitude towards water and water-bodies, the reverence towards which is more becoming a matter of ritualism. Water is being used with gay abandon and water-bodies are being destroyed for alternative uses or have turned out to be receptacles of filth and pollutants including of life threatening chemicals and deadly pesticides. These pollutants through the process of bio-magnification have turned out to be major threats to the very fabric of life on the planet.

The study recommends that all the lakes be assessed for their chemical and physical properties. Moreover all the lakes should be conserved and protected from further degradation. It is also necessary to implement the laws that exist to protect the lakes. The municipal authorities will need to work towards cleaning up of the existing lakes and encourage the adjacent dwellers to use and manage the ecosystems sustainably.

Acknowledgement: I thank Mrs.(Dr.)Unnati Padalia for her sustained support in our research.

References:

1. Lakes in India: Natural Charm and Serenity Exemplified! November 26, 2010, mapsofindia1. (www.mapsofindia.com).
2. LAKE ECOLOGY OVERVIEW, chapter 1, Horne, A.J. and C.R. Goldman. 1994. Limnology. 2nd edition, McGraw-Hillco., NewYork, USA.
Source: (<http://www.lakeaccess.org/ecology/lakeecologyprim5.html>)
3. Moore. M.L. 1989. Nalms management guide for lakes and reservoirs. North America Lake Management society, P.O.
4. Urban Lakes: Ecosystems at Risk, Worthy of the best care. L.Naselli-Flores., Department of Botanical Sciences, University of Palermo, via. Archirafi 8, I-90123. Palermo, Italy.
5. Restore eco-system of rivers lakes cost effective manner and increase livelihood of water uses.

6. Conservation and Management of urban lakes (Water bodies): Concerns and Strategies. Dr.R.R.Rao, FNA, FASc., FNASc. CSIR Emeritus Scientist. Central Institute of Medicinal and Aromatic Plant, Banglore-560065. (Source: http://wikipedia.org/wiki/lakes_in_Banglore).
7. Cooke, G.D., E.B. Welch, S.A. Peterson and P.R. Newroth. 1993. Restoration and management of lakes and reservoirs. 2nd edition. Lewis Publishers, Boca Raton, FL.
8. Kimmel, B. and A.Groeger. 1984. "Factors controlling Primary Production in Lakes and Reservoirs." In Lake and Reservoir Management. USEPA 440-5-84-001.pp.272-278.
9. Conservation and management of lakes. – An Indian Perspective. National River conservation Directorate, Ministry of Environment and forests (MOEF) Government of India. New Delhi (110003).
10. Ramachandra.T.V, N.Ahalya and C.Rajasekara Murthy (Editors) 2005. Aquatic Eco-systems- Conservation, Restoration and Management. Capital Publishing Company, New Delhi.
11. Ramachandra.T.V, C.Rajasekara Murthy, N.Ahalya (Editors). 2001. Restoration of Lakes and Wetlands. Proceedings of Lake.2000 Centre for Ecological Sciences, Indian? Institute of Science, Banglore-12.
Source: (http://144.16.194/energy/water/proceed/proceedings_text/).
12. Beklioglu, M., O. Ince and I.Tuzun. 2003. Restoration of the eutrophic lake Eymir, Turkey, by Biomanipulation after a major external nutrient control. Hydrobiologia 490:93-105.
13. Caraco D., 2001. Managing Phosphorous Inputs into Lakes 3. Evaluating the Impact of Watershed treatment. Water Protection Techniques 3(4): 791-796.
14. Ruley J.E. And Rush K.A., 2004. Development of a simplified phosphorus management model for a shallow, subtropical, urban hypereutrophic lake. Ecological. Engineering 22:77-98.
15. Donk, E.Van, R.D.Gulati and M.P.Grimm.1989. Food web manipulation in Lake Zwemlust: positive and negative effects during the first two years. Hydrobiological Bulletin 23:19-34.
16. Benndorf, J.1987. Food web manipulation without nutrient control: a useful strategy in lake restoration? Schweiz. Zeitschrift fur Hydrologie, 49:237-248.
17. Benndorf, J. 1980. Conditions for effective Biomanipulation, conclusions derived from whole-lake experiments in Europe. Hydrobiologia 200/201:187-203.

18. www.sparktherise.com/projectdetail.php?pid=5472.

Thank You.....