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RESTORATION AND CONSERVATION OF URBAN LAKES

MALLIKA SARAF[1], Dr. SINDHU J. NAIR[2]

Assistant Professor, Department of Civil Engineering, Bhilai Institute of Technology, Durg
Professor, Department of Civil Engineering, Bhilai Institute of Technology, Durg

Abstract: *The roots of Bharatiya culture are to be found on the banks of River Sarasvati. Saraswati River, adored in Indian Civilization from the days of the Rigveda, is not a myth but a reality, not a legend but ground-truth. The surface water resources broadly designated as lakes can be classified into (a) Natural lakes (b) Riverine impoundments and (c) Reservoirs impounded by taking advantage of topographical features. Urban lakes form vital ecosystems supporting livelihood with social, economic and aesthetic benefits that are essential for quality life. Lakes, ponds, tanks which are built to hold water must be protected. These water bodies only provide drinking water, support livelihoods and biodiversity. Despite knowing their environmental, social and economic significance, these water bodies are being continuously ignored. Because of unplanned urbanization, much of the landscape around the lakes has been covered by impervious surfaces. As a result, instead of rainwater, it is the sewage and effluents that are filling up urban water bodies. Considering this alarming situation of negligence urban water bodies, this paper intends to step ahead to the conservation of one such urban water bodies. A layout plan for a lake is designed for both recreational activities and maintains ecological integrity for long term restoration and sustainability.*

Keywords: *Lakes, wetlands, eutrophication, flooding, conservation, silting.*

I. INTRODUCTION

The landscape of India is dotted with large number of lakes, reservoir and wetlands. Among these surface resources, reservoirs are numerically most abundant and represent traditional wisdom of people inhabiting this region for centuries. Water bodies in the form of lakes, ponds, , *baolies*, tanks and sarovar are an integral part of the hydrological cycle. Unfortunately, in the last half of 20th century the lakes in the region underwent un-precedence environmental degradation on account of (a) Population explosion, (b) Large scale industrialization, (c) Chemical intensive agriculture and (d) Water intensive life styles. The factors that lead to degradation of lakes include Urbanization, Pollution of water due to sewage, nutrient rich agricultural run-off and industrial toxic liquid waste and reclamation leading to siltation and loss of morphometry. Today they are subjected to a great amount of ecological stress and strain in terms of pollution and ecocrisis. The rural lakes serve various purposes like biodiversity habitat, livelihood source (agriculture, fishing, and aquatic products.). As lakes transform from rural to peri-urban or urban areas, its environment, function, stakes, and all associated characteristics undergo a change. Firstly, the catchment gets transformed from agriculture/grassland to settlements with increased popullated area.

Rapid urbanization around many lakes, together with degradation of their catchments due to various anthropogenic pressures, has resulted in their gradual deterioration. The lake ends up becoming dumping yard of solid waste due to which the ground water recharge reduces. This further result in foul smell, mosquito breeding as well as, degrading water quality, and encroachment takes place resulting low death of the lake. Such loss of lakes in urban areas results in reduced ground water recharge, more frequent floods, water logging, etc, creating hazards.

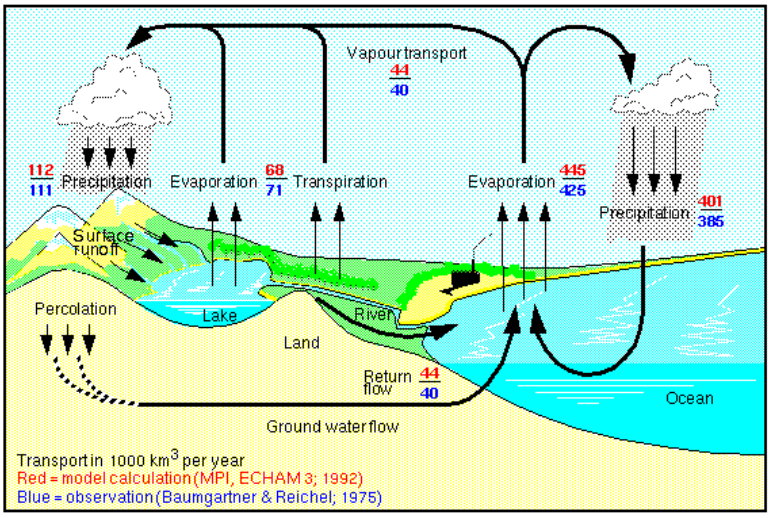

Fig. 1: Hydrlogical cycle

Pollution is the major threat to the life of a lake.

Lake conservation requires management of catchment as well as actual lake water. At catchment levels, prevention of pollution of storm water drainage as well sewerage is necessary. Chhattisgarh is the land of ponds and lakes. Durg is a city located in Chhattisgarh state, Central India. It is located just east of the Seonath River (Shivnath River) and is part of the Durg-Bhilai urban fascicle. The city is an agricultural market and is heavily engaged in milling rice and pigeon peas. Durg gained importance as an industrial centre after the establishment of a large steel plant at Bhilai. Industries include brass working and bell-metal working, oil pressing, mining, and weaving. It is the headquarters of Durg District, the third largest district of Chattisgarh.

Nature is very kind to Chhattisgarh in terms of rainfall as compared to several other states of the Union. Average rainfall in the state is around 1400 mm. and about 90% of the total rainfall is confined in the Monsoon season i.e. 15th June to 5th September. Mahanadi, Sheonath, Indravati, Arpa, Hasdeo, Kelo, Son, Rehar, and Kanhar are some of the main rivers in Chhattisgarh.

The lake is in Durg, Chhattisgarh called as “DAU KA TALAB” (21°10'59"N) by the local pond, are part of the watershed area. Durg area is located in Mahanadi basin Witch has 75858 sq- Km geographical area (56.2%).

A report has been prepared with a view to restore Dau Ka Talab, with a proposal of beautification of this pond in durg district, Chhattisgarh. The objective of this paper is to restore Lake Catchment. This is an attempt to create a balance between all the levels of Ecosystem.. The paper not only included cleaning and beautifying of the lake but also took steps for creating lake as the hub of economic activity, thereby providing an indirect source of live hood for many people and a recreational place.

Table 1: Designated Best Use Criteria for Surface Waters (Source: CPCB)

Designated Best Use	Class of criteria	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliforms OrganismMPN/ 100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20^{o}C 2mg/l or less
Outdoor bathing (Organized)	B	1. Fecal Coliforms Organism MPN/ 100ml shall be 2500 (Imax permissible), or 1000 (desirable) 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/ 100ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 to 8.5 Fisheries 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 to 8.5 Controlled Waste disposal 2. Electrical Conductivity at 25o C micro mhos/cm

Designated Best Use	Class of criteria	Criteria
		Max.2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l

Lake to urban lakesthreats: The anthropogenic pressures in the catchment itself has resulted in degradation of the catchment area due to deforestation, extensive agricultural use and consequent erosion and increased silt flows, which have vitiated the quality of water stored in the lakes. Most urban lakes and rural lakes have vanished under this pressure. Infrastructure development, housing pressure and encroachments have resulted in converting all urban lakes into hyper eutrophic state. In the lakes, which have survived, the drinking water supply has been substantially reduced or become totally non potable, flood absorption capacity impaired, bio-diversity threatened, and livelihood of fisher folks affected.

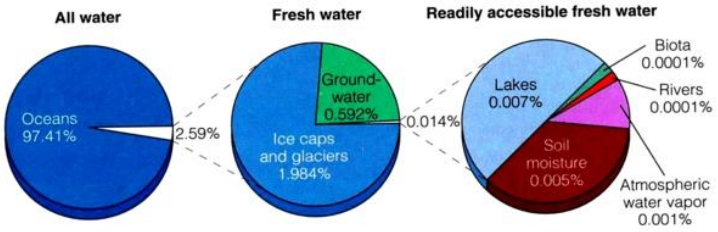

Fig. 2: Water Distribution on Earth

About three-fourth of earth's surface is covered by oceans.according to the UN estimate the total amount of water on earth is about 1385.5 Mm^3. 97.3% of total water available on earth is salt water, only about 2.7% is fresh water and about 75.2% of which is ice in polar regions and another 22.6% is ground water. The rest about 2.2% of the fresh water is available in rivers, lakes moisture, soil and vegitation.What is effectively available for comsuption and other uses is a small prportion of the quantity available in the rivers, lakes and ground water.

For the last decade urban waterbodies have been a victim to unplanned urbanization in India, because, of which they face several threats. These are pollution, encroachment, eutrophication, illegal mining activities, ungoverned tourist activities and cultural misuse. The water quality of urban lakes has deteriorated so much as to cause serious disturbance to the bio-diversity of the lake environment.

1.1 Problem faced by urban lakes

1. Urbanization / industrialization
2. Dumping of debris and garbage
3. Industrial effluents
4. Continuous flow of untreated waste water
5. Eutrophication
6. Change of land use
7. Cattle washing
8. Tampering inflow and outflow channel
9. Pollution due to idol immersion
10. Encroachments

1.2 Pollution in take Waste water

Table 1: Sources of pollution in lakes

Source	Type of problem
Point Soures	
Power plants	Combustion of fossil fuels emit nitrogen products into the atmosphere, which are carried down by rainfall and other processes, causing eutrophication in water bodies
Sewage Treatment Plants	Treatment process releases oxides of nitrogen and phosphorous in effluents, which drain into water bodies
Industrial Plants	Industrial processes release nitrogen and phosphorous products in effluents, which drain into water bodies
Non-Point Sources	
Agriculture	Farming practices, including use of fertilizers rich in nitrogen and phosphorous, deposit increased amounts of these nutrients in the soil. Run-off from these farms cause eutrophication in water bodies
Sewage	Direct discharge of sewage from domestic sources, not connected to treatment plants, will eventually make its way into water bodies

Fig. 4: Erosion

Fig. 5: Pollutants At Edges

Fig. 6: Cattle washing

Fig. 7: Idol immersion

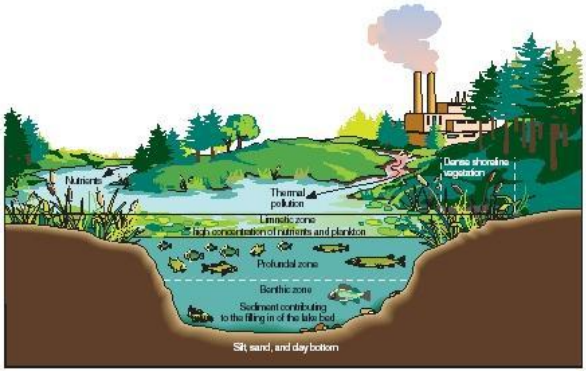

Fig. 8: Cattle washing

1.3 Key issues causing degradation of lakes

1.3.1 Pollution

For the last two decades, there has been an explosive increase in the urban population without corresponding expansion of civic facilities such as adequate infrastructure for the disposal of waste. Hence, as more and more people are migrating to cities the urban civic services are becoming less adequate. As a result, almost all urban water bodies in India are suffering because of pollution and are used for disposing untreated local sewage and solid waste, and in many cases the water bodies have been ultimately turned into landfills.

1.3.2 Encroachment

Encroachment is another major threat to waterbodies particularly in urban areas. As more people are migrating to cities the availability of land is getting scarce.. Hence, these urban water bodies are no more acknowledged for their ecosystem services but as real estate.. The dumping of solid waste, sewage discharge, and construction of new buildings such as a railway stations and a new road have shrunk this wetland to a great extend.

1.3.3 Eutrofication

Primarily being lentic water systems, lakes are almost closed ecosystems. Hence, a large part of the substances that enter in the lakes become a permanent part of the system as only a part of that can be removed depending on the water exchange system. As a result, the entry of nutrients through raw sewage become the part of lake system and cause various destructive changes in the waterbody such as prolific growth of aquatic weeds in lakes and ponds that ultimately disturb and kill the ecology of the waterbody. Bheels of Assam is a well known example of high growth of hyacinth due to pollution.

1.3.4 Siltation

Water flowing into a lake brings silt. Increased deforestation loosens the top soil, which finds its way into lakes. Some of the silt is washed out when the lake overflows. However, the outflow of silt does not always match the inflow and silt settles at the bottom of the lake.

1.3.5 Flooding

Traditionally tanks were created as a chain of water bodies to have a cascading system so that the inter-connectivity would retain flowing water, maintain it round the year, leaving little room for water to be wasted. Such a system is impacted for past some decades.

1.3.6 Unplanned Tourism Activities

Unplanned tourism activities without systematic planning and regulation proved to be another major threat to urban water bodies. Disturbance of wildlife, pollution, changes in local lifestyles and loss of cultural heritage are some of the impacts of tourism on the local environment. In the absence of garbage disposal facilities, the practice of dumping garbage into nearby water bodies has become quite common in recent years and has contributed to the degradation of many water bodies especially at the high altitude lakes, for examples, Dal Lake in Srinagar, Tso Morari and Pongsho Lakes in Ladakh where the unplanned and unregulated tourism has posed long-term negative impacts both on biodiversity of the area and as well as on the local environment.

1.4 Environmental Status of Lakes in India

The lakes and reservoirs, all over the country without exception, are in varying degrees of environmental degradation. The degradation is due to encroachments eutrophication (from domestic and industrial effluents) and silt. There has been a quantum jump in population during the last century without corresponding expansion of civic facilities resulting in lakes and reservoirs, especially the urban ones, becoming sinks for contaminants. The main causes for the impaired conditions of the lakes could be summarized as under.

1.4.1 Pollutants entering from fixed point sources

- Nutrients from wastewater from municipal and domestic effluents
- Organic, inorganic and toxic pollution from industrial effluents
- Storm water runoff.

1.4.2 Pollutants entering from non- point sources

- Nutrients through fertilizers, toxic pesticides and other chemicals, mainly from agriculture runoff.
- Organic pollution from human settlements spread over areas along the periphery of the lakes and reservoirs.
- Diversion of rivers feeding the lakes reducing their sizes.
- Competition for using lake water such as for drinking, irrigation, hydropower etc.
- Untreated or inadequately treated domestic and industrial effluents from point sources located all over the basin.

Present Scenario: "Dau ka talab" Durg

A layout plan for "Dau ka talab" is designed for both recreational activities and maintains ecological integrity for long term restoration and sustainability.

It is important to give priority to revive those lakes that would have lost without any form of intervention. A framework can be developed categorizing by the level of interventions required for prioritization as follows:

1.5 Prioritization of lakes

This report targets at selecting important degraded lakes in an any city which can be taken up for conservation.

Priority 1	Lakes that recover without any intervention
Priority 2	Lakes that can be restored close to their former condition to serve their earlier functions considering cost involved, technical review of the restoration plan etc based on the goals and objectives set
Priority 3	Lakes that cannot be restored to any agreeable degree

A pond is a body of water shallow enough to support rooted plants. Many times plants grow all the way across a shallow pond.

Water temperature is fairly even from top to bottom and changes with air temperature. There is little wave action and the bottom is usually covered with mud. Plants can, and often do, grow along the pond edge. The amount of dissolved oxygen may vary greatly during a day. In really cold places, the entire pond can freeze solid.

II. METHODOLOGY

The goals for conservation of lakes/pond have to be tailored to individual regions, specific to the problems of degradation and based on the level of dependence. This requires reconstruction of the physical conditions; chemical adjustment of both the soil and water; biological manipulation, reintroduction of native flora and fauna, etc. The interpretation of existing trends and scenarios in the process of conservation of lakes as presented in this report is based on interactions with limited key players namely government stakeholders, developers involved in similar projects and personnel involved in the field work. Hence, they are indicative of the situations prevalent at the time of conducting the study. The study is based on market information, whether from public and private sources, and it has been ensured to the best of its ability, the correctness and the validity of the same, by cross checking from various sources.

Fig. 9: Chhattisgarh

Fig. 10: Google image of Dau ka Talab

2.1 Principles for the Sustainable Lake Management

1. A harmonious relationship between humans and nature is essential for the sustainable use of lakes.
2. A lake drainage basin is the logical starting point for planning and management actions for sustainable lake use.
3. Policy development and decision making for lake management should be based on sound science and the best available information.
4. The management of lakes for their sustainable use requires the resolution of conflicts among competing users of lake resources, taking into account the needs of present and future generations and of nature.
5. Citizens and other stakeholders should be encouraged to participate meaningfully in identifying and resolving critical lake problems.
6. Good governance, based on fairness, Transparency and empowerment of all stakeholders, is essential for sustainable lake use.

2.2 Execution of Base line Work

Dau ka Talab is situated @ 21°10'59"N. This is surrounded by large and dence population. The Population of Durg District Chhattisgarh is in 2011 is 3343872 and Area 182 km².

Fig. 12: Pollutants At Edges

Lake/pond water samples were collected during –winter, summer and rainy seasons.

Table 2: Test result of the water sample of "Dau ka Talab" conducted in laboratory.

S. No.	Name of Experiments	Values(Sept)	Range(May)
	Temp.	**26°C**	**38°C**
1	pH Value	8.4	8.7
2.	Turbity	6.8NTU	6.2
3.	DO	6.9Mg/l	7.5Mg/l
3.	BOD 5 Days	9.5Mg/l	9.4Mg/l
4.	COD	19.7Mg/l	20.8Mg/l
5.	Hardness ($CaCO_3$)	188Mg/l	190.0Mg/l
6	Chloride	300.0Mg/l	303.0 Mg/l
7	Floride	0.5Mg/l	0.5 Mg/l
8.	Total Nitrogen	6.86Mg/l	6.44Mg/l
9	Phosphors	0.4 Mg/l	0.50Mg/l

Following element has been planned keeping in view of the present status for the effective restoration of the pond which is explained as below.

Theme of Proposed Concept Plan of conservation: Area: Dau ka talab 309996.45 Sq m^2

1. **The Vista** connecting the island to the main fountain near public entrance area. Thus enhancing the asthetics as well as attracting the local eco – tourism activities.
2. **Landscape garden**: The land scape garden on the main entrance, to lure the public thus bringing in the campus and educating them to restore the precious watre bodies left. Also the landscappe offers an invitation to the public. (By area: 2551.80 m^2).
3. **Ecological balance**: waste water to be treated by treatement plant installation and the treated water can recycle back thus maintain the pond water balance.
4. **Artificial Islands**: islands enhancing the biodiversity as the birds get attracted and come to take rest on such islands.
5. **Water Fountains**: Water needs to be aerated contantly naturally or artificially to maintain the DO level.
6. Facilities like jogging track around the periphery, landscape gardens, boat rides, benches, ghats in all sides; fountains etc increases the revival of lake and thus increase the nearby land value.

In order to implement and achieve above criteria proper plaaning should be done in terms of the measures listed below for the restoration of the Dau ka talab and nearby area from further getting it degrade and lost.

V. SUGGESTION AND DISCUSSION

Measures suggested for the resoration of Lake Front other than its beautification part:

1. Construction of RCC storm water inlets.
2. Landscaping and development of parks and play area and introducing fountains to Control of organic load. 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.
3. 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, deweeding.
4. Afforestation or development of suitable plant covers in the catchments especially those prone to erosion. Making separate drains to collect storm water a s well as to by pass the sewage coming from near by area .
5. Formation of peripherial bunds all along the lake.

6. Construction of Screen barriers to check the entry of floating objects.
7. Lighting all around the periphery of the lake.
8. Construction of localized treatment plant where ever necessary to maintain the lake water.

This paper not only included cleaning and beautifying of the lake but also took steps for creating lake as the hub of economic activity, thereby providing an indirect source of live hood for many people and a recreational place. Preparation of biodiversity plans for the city should integrate Lake Ecosystem. At the end it is more important to safeguard the lake ecosystem which will help in holding rain water, recharge ground water, treating the wastewater, and maintain local healthy micro-climate instead of converting into commercial and recreational activities.

Fig. 13: Beaytification of the lake

Discussion: The fundamental problem of the lake restoration is an economic mismatch: those who cause the problem do not benefit sufficiently from the remediation. On the other hand, the beneficiaries of the lake restoration are not those who caused the degradation.

Lake Conservation and management should support ecology, socio-cultural activities and users who have the dependency on the lake. Lakes should not be handed over to the private companies since, lakes are the public spaces, and thus the strategies should not consider the uses and users of the lake along with the active participation of the community, NGOs, and different institutions. Lake Development should be done considering the lake catchment, community and the use of the lake for all class of the community.

VI. CONCLUSION AND FUTURE SCOPE

Environmental & Social impact of lake restoration: Each lake is unique, and each management process is as complex as the concerns it addresses. But the ecological, social, and economic benefits of a well-managed lake can span generations. Effective, long-term lake conservation plan is a complex undertaking that must deal with sociology as well as biology. The decision to restore or protect a particular lake has to be based on a thorough study of the lake, its watershed, and the commitment of time and money necessary for long-term management. The study recommends that all lakes be assessed for their chemical and physical properties.

FUTURE SCOPE: In the study, there are various parameters, subjects, issues which are interconnected and need to be studied and designed individually for any suistanabile development. It includes design of eco zone, green belt, water treatement plant based on the density and volume of the water, a proper solid waste collection and treatement system, rehabilitation of the socity dwelling near by.

REFERENCES

1. “Principles of Environmental Engineering and Science”, Mackenzie L.Davis and Susan J.Masten
2. Anupam chakravartty, “ In Srinagar’s Footsteps:Raipur”, Down To Earth,16-31 january, 2015
3. Anurag Vishwakarma, Avinash Hemrom, “Status of Terrestrial and Wetland Birds in Kawardha, Kabirdham District in Chhattisgarh, India”, International Journal of Scientific and Research Publications, Volume 4, Issue 10, October 2014 ,ISSN 2250-3153.
4. Conservation and Management of Lakes-An Indian Perspective (2010), Ministry of Environment and Forests, New Delhi.
5. EW RG Centre for Ecological Sciences, Indian Institute of Science, Bangalore, “LAKE 2014: Conference on Conservation and Sustainable Management of Wetland Ecosystems in Western Ghats”, Parisara Auditorium, Sirsi, 13th -15th November 2014.
6. G k bhat and karan shah, “Urban Lake Restoration”, Terra Green, vol 8, issue 1, April 2015.
7. Hemant Joshi and Anil Kumar, “Role of Non-Governmental Organizations in Restoration and Management of Freshwater Ecosystems”, Proceedings of Taal 2007: The 12th World Lake Conference, Pp 1880-1884.
8. http://ces.iisc.ernet.in/energy
9. http://ces.iisc.ernet.in/energy/water/proceed/proceedings_text/section9/paper5/section9paper5.htm
10. http://lakes.chebucto.org/lakerest.html
11. http://www.heraldgoa.in/Goa/South-Goa/Sappu-and-Nayaband-lake-issues-to-be-challenged-in-NGT-/89014.html

12. http://www.newindianexpress.com/cities/bengaluru/Foaming-Bengaluru-Lake-Matter-of-Serious-Concern-CSE/2015/05/03/article2795561.ece
13. https://www.rockefellerfoundation.org/blog/restoring-indores-lakes-create/
14. http://www.ijser.org
15. http://www.ijser.org/viewPaperDetail.aspx?M010194
16. http://www.indiaenvironmentportal.org.in/news/top/
17. http://www.mapsofindia.com/maps/india/lakemap.htm
18. http://www.moef.nic.in/sites/default/files/nlcp/Content.htm
19. J. Pandey and Anuya Verma, "Ecosystem Level Attributes of a Freshwater Tropical Lake in Relation to Microbial Biomass at Land Water Interface", Proceedings of Taal2007, The 12th World Lake Conference, pp 34-43.
20. M.S. Kodarkar, "Conservation and Management of Lakes Case Studies from India", Proceedings of Taal2007, The 12th World Lake Conference, Pp 1442-1445.
21. Patil Snehal, Padalia Unnati, "Challenges Faced and Solutions towards Conservation of Ecology Of Urban Lakes.", International Journal of Scientific & Engineering Research, Volume 3, Issue 10, October-2012, ISSN 2229-5518.
22. Protection and Management of Urban Lakes in India, CSE, 2013.
23. R.J. Rao, "Status and Conservation of Aquatic Species Diversity in Certain Water Bodies of Madhya Pradesh", proceeding of of Taal, The 12th World Lake Conference: 1993-2000, 2008.
24. http://ramsar.rgis.ch/cda/en/ramsar-pubs-cop11-cd/main/ramsar/1-30-582_4000_0_
25. Ranjan jayesh, and reddy K S," Coservation of urban lakes in Hydrabad Development area, andra Pradesh, water and energy issue 2, volume 18 , 2008,Pp44, ISSN 0021-1672.
26. Sarika bahadur, "Sustainable approach for conserving and managing for urban water bodies" , proceeding of the international conference on Global business , , economics, finance and Social science (GBI4 Chennai conference) ISBN: 978-I-941505-14-4, Chennai, india, 11-13 july 2014 ,paper ID : C455
27. Sushmita sen gupta, "sunset over Udaisagar:Rajasthan", Down to Eart ,1-15 feb,2015
28. Sushmita sengupta, ":Saving City Lakes: karnataka", Down To Earth,1-15 march, 2015
29. Sushmita sengupta, "Left To Dry: Ahmedabad", Down To Earth,16-31march ,2015
30. Sushmita sengupta,"Dry cleaning Hussainsagar –hydrabad" lake conservation, ", Down To Earth,16-30 april ,2015
31. The Lake and Reservoir Restoration Guidance Manual, first edition, United States Environmental Protection Agency EPA, EPA 440/5-88-002, February1988.

