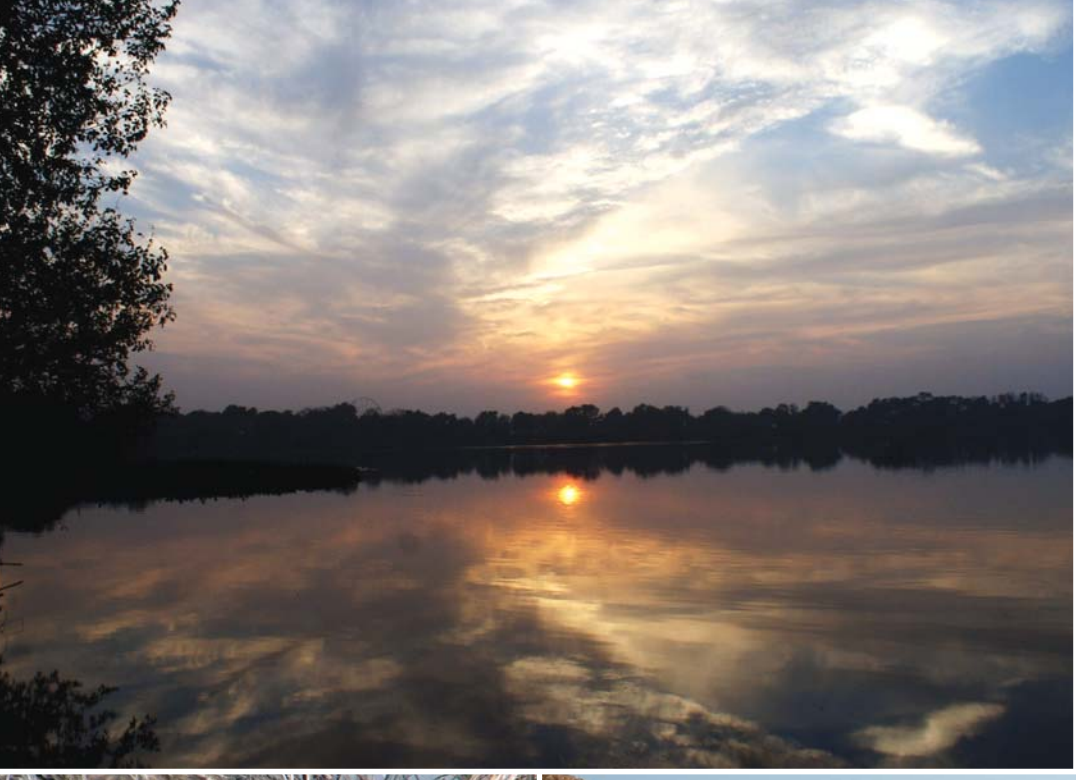
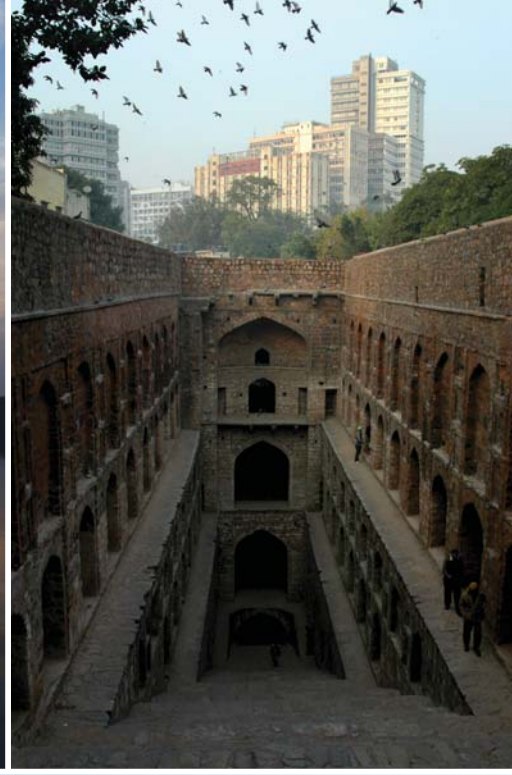
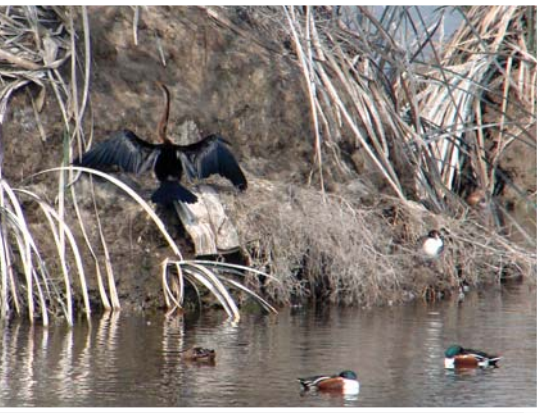
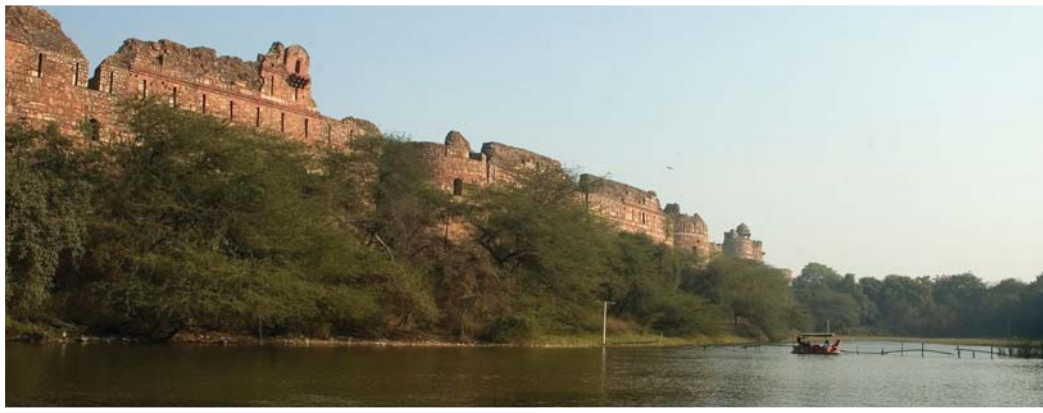










Safeguarding
Urban Freshwater Bodies

FICCI

EARTHWATCH INSTITUTE





Safeguarding
Urban Freshwater Bodies



Foreword



Water has defined the survival and growth of the Indian civilization. Historically towns and cities have flourished on the banks of rivers and water bodies. Ancient manuscripts highlight that communities were keen observers of the environment and were aware of water conservation methods.

Freshwater in form of surface and ground water sources have met the increasing water demands of the growing population. Of late there has been a decline in the quantity and quality of freshwater sources. Anthropogenic activities have been largely responsible for this decline.

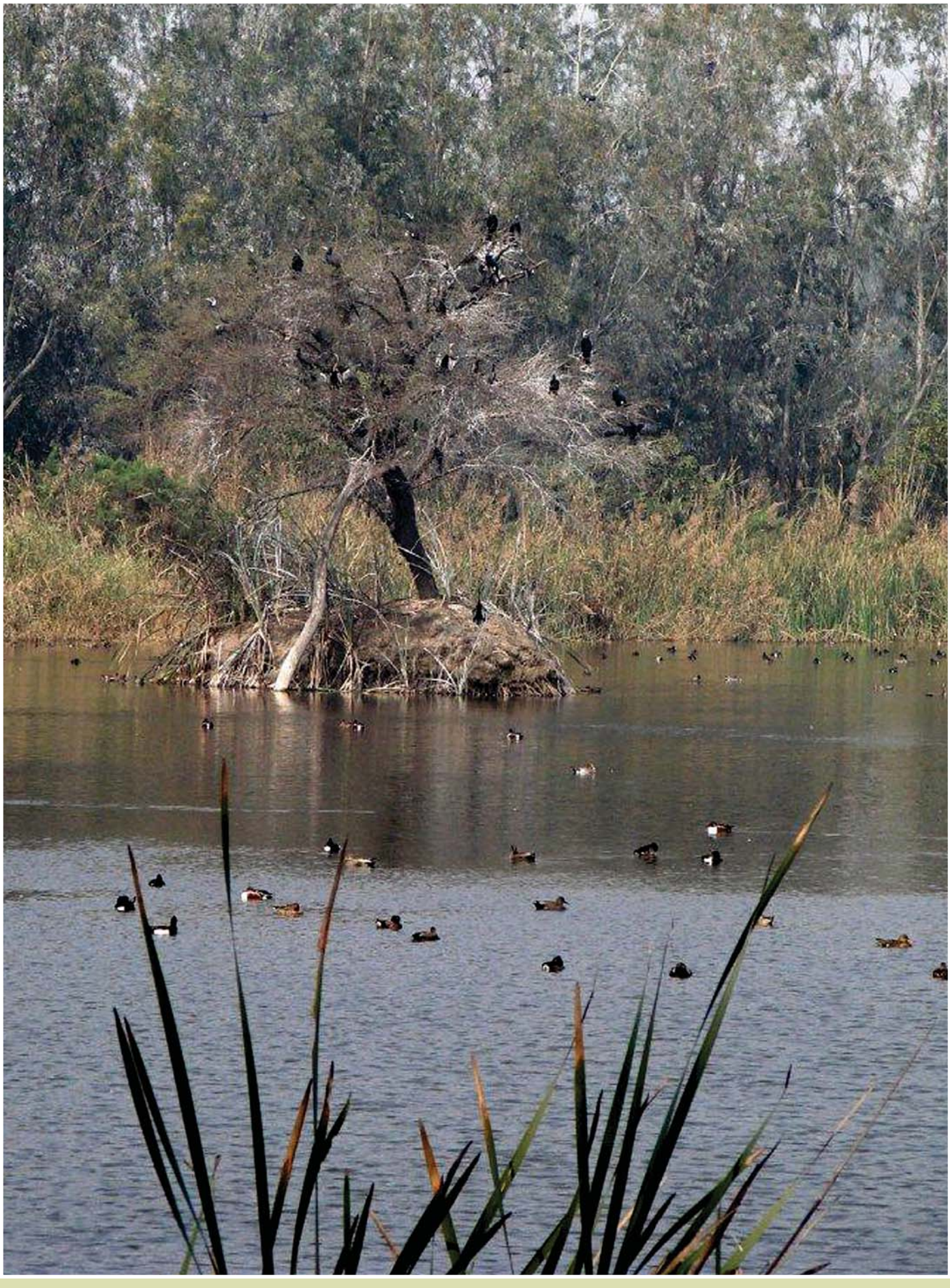
Water bodies, mainly in form of lakes dotted the urban landscape across several cities in India. Cities like Bengaluru, Delhi, Udaipur and Kolkata had a rich legacy of urban freshwater bodies. These water bodies function as freshwater ecosystems and perform vital ecological functions, in addition to providing essential environmental services. They also provide much needed recreational and aesthetic space to the residents of our towns and cities. Rapid and unplanned urbanization has impacted the survival of urban water bodies. Construction of roads and buildings, disposal of untreated waste and neglect have led to the decline, making many lakes disappear.

FICCI and Earthwatch Institute India are coming together to promote and facilitate citizen's actions towards conservation and protection of urban water bodies. This initiative is aimed at creating opportunities for citizens and corporate executives to be able to contribute towards a meaningful water conservation programme.

This booklet on Urban Freshwater highlights the importance of these water bodies in maintaining the ecosystem of our towns and cities. It enumerates the growing threats and lists out measures which can be employed by various citizen groups for conserving and saving our urban water bodies.

I hope that the booklet will serve as a useful source of knowledge and guide its users in doing their bit to save our scarce water resources. My best wishes to the team at Earthwatch Institute India and FICCI.

Naina Lal Kidwai
President, FICCI
Country Head HSBC India and Director HSBC Asia Pacific



Message

Water, known as the 'elixir of life' is fundamental for human sustenance. Water bodies have played an important role in the development of our towns and cities. In addition to maintaining the ecosystem and providing a source of freshwater, these water bodies have provided recreational spaces to the city dwellers. However, anthropogenic activities have impacted the existence of our freshwater bodies. A large number of water bodies across different cities face the threat of extinction due to neglect and apathy. Once a source of relaxation, these water bodies have now either become invisible or are an eye-sore.

FICCI Water Mission was launched to promote water conservation across FICCI membership and beyond. Through a programme of research and advocacy, the Mission is working to make people more responsive in managing our scarce water resources.

It is with this objective that FICCI Water Mission has joined hands with Earthwatch Institute India to work on a programme on citizen's action for conservation and protection of urban water bodies. We realise that as residents of our towns and cities, there is a role for all of us to play in conserving the lost heritage of our freshwater bodies through a scientific programme. We plan to reach out to corporate India and the citizens through this programme towards a meaningful engagement on freshwater conservation.

Romit Sen
Senior Assistant Director
FICCI Water Mission

Water is the basis for all living ecosystems. It is one of the most important natural resources upon which social and economic activities and ecosystem functions depend. The importance of water resources for sustainable development and its impact on the quality of life cannot be overemphasized.

The role of water in cities and the effects of urbanization on the hydrological cycle and water resources are crucial in addressing the challenges of freshwater management. The aquatic habitats in urban areas provide a wide range of key ecosystem benefits to cities and citizens. Some of these water bodies harbour great diversities and concentration of bird species. Thus freshwater resources are vital for meeting basic needs of living beings. Inadequate protection of the quality and the supply of freshwater can set important limits to sustainable development.

Conservation of water resources and its wise use needs to become mainstream in our 'hearts' and 'minds'. It is in this context that FICCI and Earthwatch Institute India are working together to promote the importance of public engagement in understanding the significance of freshwater and inspire people to help conserve freshwater bodies, close to their homes and workplaces. We are delighted at the opportunity of working with FICCI - the largest and oldest apex business organisation in India. It is an important partnership programme on urban freshwater issues.

To build a sustainable society that cares for its natural resources, we need to establish a new paradigm for the wise use and conservation of water resources. We do hope you will join FICCI-Earthwatch programmes as 'Citizen Scientists' in our collective quest for healthy and sustainable freshwater ecosystems and resources. Together, we can leave a positive legacy for the future generations.

Raghuvansh Saxena
Country Director
Earthwatch Institute India

Safeguarding
Urban Freshwater Bodies



Rationale

Water is one of the most used and valued chemical substance on earth. Scientifically known as H_2O, it is essential for our survival and often called the 'elixir of life'. It also plays a very important role in the economic development and country's overall growth. Several studies indicate that changing climatic conditions may increase the intensity of rainfall, and yet cause scarcity. This, in turn, will impact a wide variety of sectors including water resource management, urban planning, agriculture and industries.

In India, the total water available in the form of precipitation amounts to 4000 km^3, out of which only 28 per cent (1123 km^3) is available as utilizable water in the form of surface (690 km^3) and groundwater (433 km^3). There are wide variations in the availability of water across the country with the drier regions having greater fluctuations in rainfall thus increasing the vulnerability of people to water scarcity. The water demand is increasing, while the water availability is declining over the years (Kumar *et al*, 2005).

Thus, there is a need for an effective water resource management system to conserve / protect our natural water resources including the river basins and help sustain critical ecosystems, industries and communities that depend on such resources.

Freshwater bodies world over are degrading rapidly due to various reasons. This is predominantly due to the impacts of human activities. Some of the related perturbations are unstable water levels, sedimentation, contaminant and nutrient inputs and invasions by exotic plants and animals. Wetlands are a typical case in point. They are important sources of freshwater and as riparian areas they link aquatic and terrestrial habitats, support species-rich bird communities in addition to other biodiversity and integrate terrestrial and aquatic processes. Wetlands are accordingly widely recognized as highly important ecosystem and biodiversity hotspots.

The gradual loss of wetland habitats and degradation has caused decline in flora and fauna. It is therefore imperative to conserve freshwater bodies including wetlands on a priority basis. This document highlights the predicament faced by wetlands and other water bodies in several locations across India. Valuable information about initiatives by some States and the context for strengthening community interventions on preventive management is also set through the inclusive and need based framework of the Earthwatch Institute. Information support and capacity building are central to the success of such initiatives and the present effort is to flag these emerging trends to enable and sustain development.

Legacy of Urban Water Bodies

Human settlements have historically developed around water bodies with centres located near rivers or at the coast. Habitations were planned providing services such as water to drink, public and private baths, sewerage through underground drains built with precisely laid bricks, and an efficient water management system with numerous reservoirs and wells.

Water bodies in areas of human habitation have been constructed and maintained over centuries. Historical evidences indicate that areas around these bodies met the needs of the people and recharged groundwater and in addition provided recreational spaces. The Sudarshan Lake in Gujarat is recorded as the oldest man-made lake in India (See Box 1).

The largest artificial lake of India was created by Raja Bhoj at Bhojpur, near Bhopal by constructing a vast embankment across two hills.



The lake, which covered an area of 650 sq.km received water from as many as 365 streams. Today, the lake is the major source of drinking water for the city of Bhopal with a daily abstraction of 99 million litres.

There are numerous water bodies dotting the city landscapes across the country (See Table 1). These can either be natural or man-made. Most urban water bodies in India are either lakes, ponds, marshes or mangroves. Rapid urbanisation has affected the condition of these water bodies. Several of them face the threat of being lost due to use of the areas under water bodies for construction. Pollution due to disposal of untreated waste is another major issue.

Urban Water Bodies as Ecosystems

Urban water bodies function as freshwater ecosystems, perform vital ecological functions and provide essential environmental services. The major functions of urban water bodies include:

- **Provide drinking water:** as freshwater sources and for other uses across many towns in India. In cities like Bhopal, Chennai, Hyderabad, Mumbai and Udaipur, water from the lakes constitute the bulk as part of the city water supply system.
- **Control urban flooding:** by absorbing large quantities of storm water run-off therefore reducing the incidence of flooding of nearby areas. Diversion of storm water through concrete manifestations reduces the quantum of water needed for basis sustenance.
- **Support biodiversity:** by providing habitats/ nursery grounds for the juveniles of aquatic and semi-aquatic organisms. These are also rich in aquatic floral vegetation that maintain the micro environment necessary for the health and well-being of the fauna.
- **Recharge groundwater aquifers:** in addition to their role as a store house in their zone of influence thereby enhancing water availability. Infiltration and natural groundwater recharge through these water bodies may be reduced through surface sealing.
- **Provide recreational place:** that confer socio-cultural and recreational benefits, some of which translate into direct

Box 1: Oldest man-made lake

Sudarshan Lake in the Girnar region (present day Junagadh district in Gujarat) is perhaps the oldest man-made lake in India. The origin of this lake dates back to 300 BC. The rock edict of Rudradaman at Junagadh, inscribed in 150 AD, speaks about the Sudarshan lake of Junagadh, built originally by the Mauryan emperors. The edict of Skand Gupta also speaks about repairs by the Gupta king in 455-456 AD. This lake supplied water to the nearby areas for over a thousand years until it finally collapsed in the 9th century AD.

Source: Article, Daily News & Analysis, Dec. 3, 2010

Table 1: Water bodies across major towns/cities	
City & State	Water Bodies
Ahmedabad, Gujarat	There are 645 documented water bodies within the Ahmedabad Urban Development Area.
Bengaluru, Karnataka	Once known as "The City of Lakes" with over 262 water bodies the city now has only about 81. Only 34 are of these are known to be active lakes. This has directly affected the water spread reducing it to less than 35%, a sharp fall of over 8%. In Urban Bangalore, 5% of the land area has been covered by water bodies, over the years.
Chennai, Tamilnadu	IIT Madras enumerated about 650 water bodies in the Chennai region about 2 decades ago. More than half of them were located south of River Adyar. At present, most of the waterbodies within the city have vanished and only a few remain in the immediate periphery. According to records of the Water Resources Department (WRD), the area of 19 major lakes has shrunk from a total of 1,130 hectares to nearly 645 hectares and hence reduced their storage capacity.
Delhi	As per the national inventory of MoEF, the total wetland area in Delhi is about 2556 ha; that is nearly 0.86 per cent of the geographic area. The major wetland types are river/stream (1116 ha), tanks/ponds (518 ha), waterlogged areas (natural/ man-made) accounting for 23.2 percent of the wetlands (577 ha) and reservoirs (230 ha). The inventory also states 11 natural lakes and 352 man-made ponds/tanks of a total of 573 lakes/wetlands in Delhi. However, according to the revenue records, the total number of water bodies in Delhi is 800; whereas, as per the Delhi Government it is 629. INTACH's blueprint for water augmentation (reported 1998) identified 44 lakes and 355 village ponds as major sites for water storage and recharge locations.
Guwahati, Assam	The city has 8 major water bodies namely Deepor Beel, Silpukhuri, Dighali Pukhuri, Jorpukhuri, Borsola Beel, Bondajan Beel, Sorusala Beel and Silsako Beel. These water bodies have been identified as tourist spots by Tourism Department and their restoration is in progress.
Hyderabad, Andhra Pradesh	Among 3000 lakes identified by the government, several have disappeared entirely because of rapid change in land-use pattern due to developmental activities. Most of the 934 tanks (lakes) in and around Hyderabad (as per 1973 records) have disappeared and the geographical area covered by water bodies (in 1964) has reduced to less than 1.5 percent. In 1996, the area under water bodies diminished by 8 sq.km and about 18 water bodies of over 10 hectare size and 80 tanks of below 10-hectare size were lost over the period 1973 – 1996 in the Hyderabad Urban Development Authority area.
Kolkata, West Bengal	3,874 water bodies as reported by Kolkata Municipal Corporation in 2006; 8,731 water bodies reported by National Atlas and Thematic Mapping Organisation in 2006.
Mumbai, Maharashtra	129 water bodies identified from Google Earth, 70 physically reported.
Pune, Maharashtra	Pune, which once boasted of having major rivers and water bodies, including Dev Nadi, Ram Nadi, Mula Mutha, Dhanori and Pashan lake, has been losing its sheen over the years owing to various factors.
Udaipur, Rajasthan	Udaipur has faced water scarcity from its inception, due to its geographical location. The Hindu monarchs who ruled the city built an array of artificial lakes to ensure regular water supply for their subjects. Udaipur is known as the city of lakes, and the four large water bodies, Pichhola, Swaroop Sagar, Fateh Sagar and Badi, remain its lifelines. But the condition of the lakes have deteriorated over the years. Currently there are 8 lakes in the city.

Sources

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Mumbai - Report on Study of Lakes in Mumbai, WWF, 2009

Udaipur - Udaipur Tourism

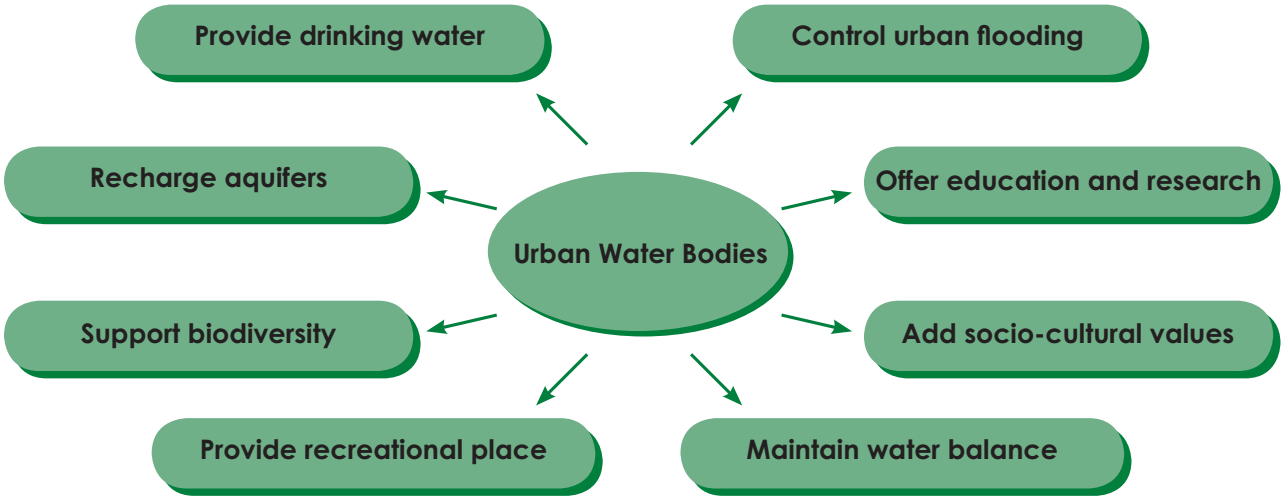


Figure 1: Role of urban water bodies

economic benefits through tourism. They provide nesting areas for migratory birds. Aesthetic enhancement of the landscape cannot be assed in monetary value but is of significance.

- **Education and research:** is possible through the setting they provide.
- **Socio-cultural:** Water is an integral part of Indian culture. Water bodies – particularly rivers such as Ganges, Yamuna, Krishna, Brahmaputra, etc. draw mythological and religious connotations. Water bodies have been considered sacred for various reasons & uses and their presence have been ingrained in the socio-cultural ethos.

State of a few Urban Water Bodies

The state of urban water bodies across towns and cities presents a state of concern. The major reasons for the degradation of these water bodies are anthropogenic which range from growth of aquatic weeds due to disposal of untreated sewage; land-filling for construction; disposal of industrial wastes and immersion of idols. Degradation of catchments in form of clearing of vegetation, obstruction of water channels and diversion of water impact the availability of freshwater thereby impacting the health of the water bodies. Depleting groundwater levels at times impacts the water level of these water bodies.





The degradation of water bodies can have multiple impacts on the local ecosystem. The most pronounced being increased incidences of urban flooding. In addition to this, deterioration of water quality, decline in the number of aquatic species (in some cases extinction) and loss of aesthetic and recreational spaces are some of the impacts of degradation of urban water bodies. Growth of algal blooms and eutrophication presents the biggest challenge to the health of the urban water bodies.

The section below presents a snapshot of some cases of major water bodies across India, building on the aspects stated in Table 1.

A. Naini Lake

The lunar shaped Naini lake is a natural freshwater lake situated in Nainital, district headquarter town in Uttarakhand. The drain is fed by the Balia Nala along with 26 major drains (CSE, 2012). Nainital is a major tourist destination and receives a large floating population of tourists. This tourist – based pressure is coupled with the impacts due to a growing population that inhabits the city. These interferences have increased consumption of water from the lake in the process of meeting the needs of the town.

Reports indicate that the water level in Naini Lake reduced by 16 ft during the summer of 2012. Rapid siltation of the lake to meet the construction needs of the city also poses a major threat to the survival of the lake. The depth of lake which was 29 m in 1871 has reduced to 13 m in 2007 (CSE, 2012).

Inflow of sewage into the lake has increased the organic load in the lake over a period of time. This has starved the lake of oxygen, increasing the biological oxygen demand (BOD) by over 20 folds over a 10-year period. The BOD in 1981 was 15.5 parts per million (ppm). It has increased to 357.23 ppm in 1991. Similarly, the concentration of free carbon dioxide in the lake which depends on the population of aquatic organisms and the types of waste added to the water ecosystem has increased by 670 per cent over the same period (CSE, 2012).

B. Dal Lake

Dal Lake is located in the heart of Srinagar, the summer capital of Jammu and Kashmir. It is the largest water body of the city. This lake is located on the east and north eastern part of the city, on the right bank of River Jhelum. It is fed by the Arrah River that flows in a north extremity through a dark and deep channel called Tel Bal or river of oil.

The lake faces a growing threat due to the



disposal of untreated effluents. A report by Alternate Hydro Energy Centre, University of Roorkee states 15 major drains disposing their wastes in the Dal; thereby impacting the water quality and aquatic life. The area of the water body which was 1,538 ha in 1971 shrunk to 1,305 ha in 2008.

Dal Lake is unique in providing shelter to 50,000 people living in the marshy areas alongside the lake. There has been a growth of the built-up area due to hotels and restaurants in and around the lake. This has increased solid waste being dumped into the lake; that stands at about 9,000 metric tons on an annual basis (Shahab Fazal *et al*, 2011).

C. Powai Lake

Powai Lake also known as Anglers Paradise was built in 1891 when the then Mumbai Municipality constructed a 10 m high masonry dam between two hillocks across



Powai basin to conserve rainwater for drinking purpose. The total catchment area of the lake is 6.61 sq. km. and water spread when the lake is full is of the order of 2.10 sq. km. (Salaskar P.B *et al*, 2008).

Accelerated growth of residential, industrial and commercial complexes in the nearby areas has led to the deterioration of the lake. The disposal of untreated sewage and garbage from nearby residential and slum colonies has affected the quality of the water. The lake has also seen excessive growth of weeds such as Ipomea and water hyacinth.

Dissolved Oxygen level at the bottom of the lake has dipped to 0.71 mg/ltr, while the maximum has been 4.11 mg/Ltr. (Govt. Maharashtra). The catchment of the



lake has also been affected badly due to unplanned quarrying activities. It is estimated that 3000m^3 of silt has been deposited at the lake as a result of which the level of the river bed has risen. During the time of independence the lake reported 37 varieties of fish. This has dropped to 10 varieties and with scanty population by 1991 (Salaskar P.B *et al*, 2008).

D. Hussain Sagar Lake

Hussain Sagar Lake links the twin cities of Hyderabad and Secunderabad. It was built in 1562 by Quli Qutub Shah to meet the irrigation and drinking water needs of the Old City. Water from Hussain Sagar has not been used for drinking since 1930. It is estimated that industrial effluents and domestic sewage in the order of 150 million litres per day is discharged into the lake (CSE, 2012). The high level of nutrients has led to algal blooms.

The lake is also threatened by encroachment because of which the lake is shrinking in size by 40 per cent in the last four decades. Despite efforts to conserve the lake, pollution in the lake has not reduced. Data released by the Andhra Pradesh Pollution Control Board (APPCB) indicate that the average pH level in Hussain Sagar Lake prior to 2006 was not more than 8. It has subsequently risen to 9 in 2011 (Ranjan Jayesh *et al*, 2008).



E. Deepor Beel

Deepor beel (beel is the vernacular name for lake in Assamese) is a fresh water lake located southwest of Guwahati. It serves as the major storm water storage basin for the city. The Sola Beel and the swampy areas of Pandu connected the lake to the Brahmaputra River. However, due to developmental activities the link to the river is disrupted.

The area around the lake has seen large scale residential construction, development of railway lines and highway impacting the health of the lake. The area of the beel is currently approx. 9.27 sq km but the actual water body is about 4.1 sq m; while the depth of the beel ranges from 1.5 - 6 m. (Planning Commission, 2008).

The presence of a landfill site and disposal of untreated sewage pose a threat to the

quality of the lake which is rich in aquatic and avian diversity.

F. Surajkund Lake

Surajkund Lake is located 30 km from central Delhi within the limits of Faridabad district in Haryana. It hosts the well known Surajkund traditional crafts fair every year.

Surajkund is a man-made lake in the shape of a semicircular embankment constructed by Tomar king Anang Pal in 1020 AD to collect rainwater from the Aravalli hills. The lake also helped in recharging groundwater in the region.

However, unsustainable mining activities in the catchment have led to the degradation of the lake making it completely dry.

G. Okhla Barrage

Okhla barrage, on the river Yamuna in south Delhi, is an important site for breeding and wintering of thousands of water birds in winter. The dominant feature of the site is a large lake formed after the creation of a barrage on the river in 1986. Yamuna at Okhla and marshes surrounding it have been a favourite spot for bird watchers. The Okhla Bird Sanctuary, spread over four sq km. on the Yamuna river, has been identified as an important Bird Area by Birdlife International, a non-government organisation that works for the conservation of birds and their habitats globally.

Historical records from fieldwork since 1989, and other recent records have been combined to produce a list of 302 species for the site and its immediate area. Species recorded since 1992 include three Vulnerable species (Baer's Pochard - Aythya baeri, Indian Skimmer - Rynchops albicollis and Bristled Grassbird - Chaetornis striatus) and six Near Threatened species (Ferruginous Pochard - Aythya nyroca, Black-bellied Tern - Sterna acuticauda, Darter - Anhinga melanogaster, Black-headed Ibis



- Threskiornis melanocephalus, Painted Stork - Mycteria leucocephala and Black-necked Stork - Ephippiorhynchus asiaticus). The Okhla Bird Sanctuary, being located on river Yamuna is highly polluted. The Central Pollution Control Board has recorded the water quality to be of 'E' Class.

H. East Kolkata Wetland

East Kolkata Wetland, a multi functional wetland ecosystem, located on the eastern fringes of Kolkata city (West Bengal), is a large assemblage of sewage fed fish ponds spread over an area of 12,500 ha. These water bodies sustain a very unique integrated resource recovery system based on a combination of agriculture and aquaculture.

East Kolkata Wetland was recognised as a wetland of international importance by the Ramsar Convention in the year 2002.

I. Neela Hauz

Neela Hauz is a system of inter-connected water bodies in the Vasant Kunj - Sanjay Van area of South Delhi. These natural and artificial ponds in the rocky Aravalli hills have been severely polluted by outfalls of sewage from the newly-developed colony of Vasant Kunj as well as the urbanized villages of Kishangarh, Massoodpur and Mehrauli. Their catchments have been incorporated into housing projects and academic/research institutes, reducing ingress of fresh water into the ponds.

This reduction of fresh water and continuous ingress of sewage has eutrophied the Neela Hauz cascade such that it can no longer sustain aquatic life and related fauna and flora. Being at the



head of the cascade, pollution in the Hauz affects a series of ponds downstream, located in Sanjay Van, that are the only source of water for birds and animals in this protected forest. This is also critical for groundwater recharge in the forest and maintaining its biodiversity. The ponds form a wetland ecosystem of considerable size and importance with multiple functions.

J. Sultanpur

Sultanpur was the biggest village (covering 52,000 bighas of land) under Farrukhnagar and many of the present day villages around it have originated as 'dhanis' i.e. temporary farmer's shelters within the boundary of Sultanpur. It is named after Sultan Singh, who occupied it in 1474 Vikram Samwat. The region around Sultanpur was called Dhundhoti. Sultanpur was the centre of salt production for use in Delhi and the United Provinces till the late 19th century exporting annually 250,000 quintals (680,000 maunds) over the Rajputana-Malwa Railway. The railway train service was started in 1873; and at Sultanpur there were a couple of railway sidings for loading salt into the train wagons.

Legal and Regulatory framework

In India, lakes and wetlands are not covered by any specific single legal statute but several legislations enacted have provisions for conservation of lakes and water bodies. Some of these include the Fisheries Act (1857), Wildlife Act (1972), Water (Prevention & Control of Pollution) Act (1974), Forest Conservation Act (1980), Environment Protection Act (1986), Coastal Zone Regulation (2001), National Water Policy (2002) amongst others. The National Environment Policy (NEP), 2006 calls for setting up a regulatory mechanism for lakes and wetlands for their conservation. In 1983, a National Wetland Conservation Programme was launched in which lakes and wetlands were considered for conservation.

However, a need was felt to develop a separate programme for conservation of lakes and urban water bodies and thus the Ministry of Environment and Forests, Government of India launched the National Lake Conservation Plan (NLCP) in 2001. This was to encompass conservation and management of polluted and degraded lakes in urban and semi-urban areas. The major objectives of NLCP include encouragement and assistance to state governments for sustainable management and conservation of lakes. Funding pattern in the beginning of the programme was in form of 100 per cent central grant. This was subsequently changed to a cost sharing mechanism of 70:30 between the Centre and State in February 2002.

Information available in the website of National Lake Conservation Plan indicates that under the NLCP, projects for restoration of 56 lakes across 14 states have been undertaken with a total sanctioned cost of ` 1028.19 crore. Figure 2 indicates the States

Figure 2: Lake Conservation Projects across States		
S. No	**State**	**Number of projects undertaken**
1.	Andhra Pradesh	1
2.	Jammu and Kashmir	1
3.	Karnataka	16
4.	Kerala	1
5.	Madhya Pradesh	3
6.	Maharashtra	14
7.	Nagaland	1
8.	Odisha	1
9.	Rajasthan	6
10.	Tamil Nadu	2
11.	Tripura	3
12.	Uttarakhand	5
13.	Uttar Pradesh	2
14.	West Bengal	4
Source: National Lake Conservation Plan		

and the number of projects/ lakes taken up for restoration.

In addition to the National Lake Conservation Plan a few states have also developed lake conservation plans/ set up authorities for protection of urban water bodies through enactment of laws.

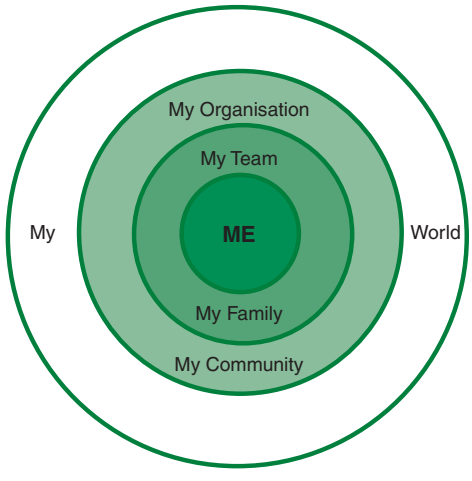
- The Government of Maharashtra (GoM) in 2006-07 initiated a State Lake Conservation Plan (SLCP) through which it shares 70 – 90% of the total project cost. The rest is borne by local bodies depending upon their financial status.
- The Government of Assam enacted the Guwahati Water Bodies (Preservation and Conservation) Bill, 2008 to help conserve water bodies of the city and convert them into eco-tourism spots in the future. There is also a provision by which encroachers can be imprisoned for up to three years.
- The Government of Karnataka set up the Lake Development Authority (LDA) in 2002; headed by the Chief Secretary of the State. The LDA is an autonomous regulatory, planning and policy body for protection, conservation, reclamation, restoration, regeneration and integrated development of natural or man-made lakes
- The Government of Madhya Pradesh in 2004 set up the Lake Conservation Authority of Madhya Pradesh (MPLCA). The MPLCA is under the Housing and Environment Department and is responsible for the conservation and management of lakes, ponds, reservoirs and other surface water bodies.

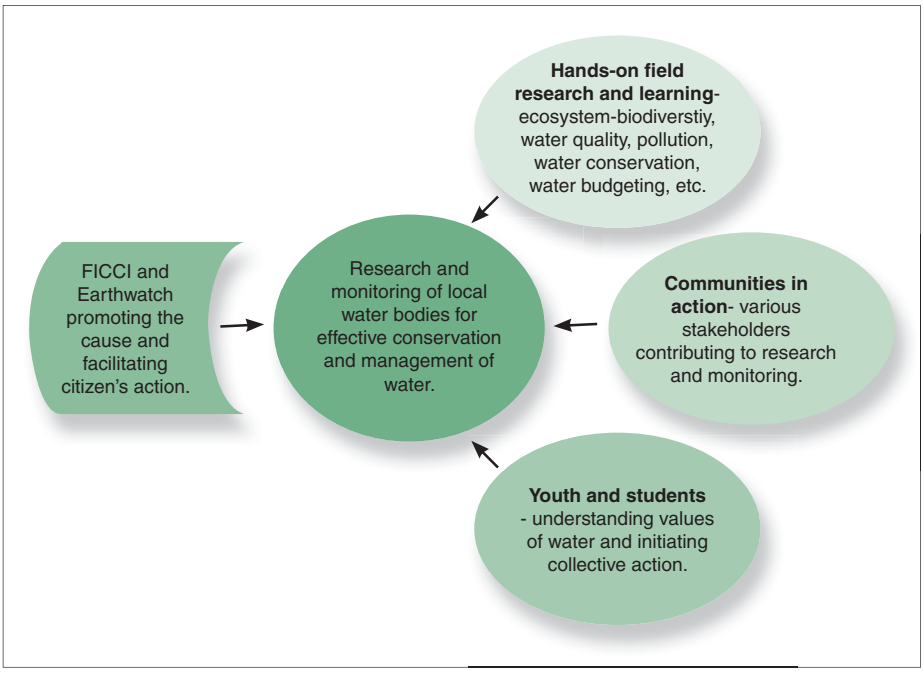
Promoting 'Citizen Science' approach for the conservation of Urban Freshwater Bodies

FICCI and Earthwatch Institute India are coming together to promote the concept of 'citizen science' for conservation and protection of urban water bodies. This initiative aims to create opportunities for citizens and corporate executives to contribute to water conservation. Besides corporations, this initiative encourages individuals to adopt proactive roles at the personal and professional levels for fresh water conservation at places of their work and dwelling.

This collaboration aims to develop environmental leaders who integrate environmental considerations into their everyday decision making. It is based on scientific field research and education approaches to promote understanding and action necessary to create a sustainable environment.

This collaboration between FICCI and Earthwatch Institute India aims to engage people at large, youth and students, industries and large corporate entities to understand local and global challenges facing freshwater ecosystems through experiential learning and collecting scientific data. The high quality data generated could feed into national research





in this area enabling effective policy decisions. The key focus of the participatory study will be to understand –

- Temporal and spatial variability of water quality in lakes and ponds;
- Local ground and surface water quality and its impacts on eco-systems and biodiversity; and
- Impact of pollution on the health of water bodies.

This will help the participants in developing and understanding the importance of these freshwater bodies in the ecosystem and their lives.

The experiential learning model

This model is a unique way of building the human capital of the country. This programme is aimed at developing environmental leaders who will mainstream environmental considerations into their everyday decision making both at personal and professional levels.

The overall objective is to equip participants with the knowledge, plans and support to play an active role in championing sustainability and tackle climate change-related issues. The programme therefore serves to build conservation capacity - the capacity of individuals to become conservation leaders of the future and inspire them to be effective stewards of India's rich and irreplaceable biodiversity. In order to educate people and develop them as environmental leaders with zeal and enthusiasm, it is essential that they become environmentally literate. It is through environmental education, that environmentally literate individuals emerge.

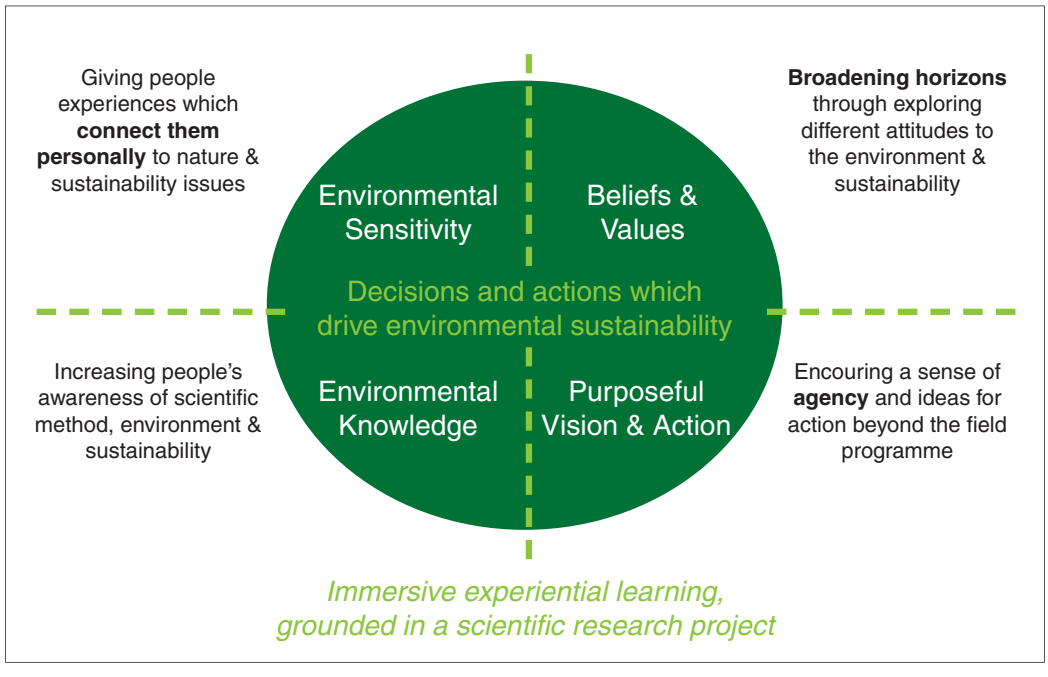
This initiative has the potential to enable lasting transitions in people's attitudes, beliefs, decisions and actions regarding environment and sustainability. To do so, this framework for learning sets out a number of criteria around which we look to create experiences and opportunities to support learning and development for citizens and volunteers.

1. Knowledge

- Environmental Knowledge: learning about science and scientific methodology; research programme/project participants are part of; relevant research area; environmental general knowledge, social movements, government policies etc.

2. Sensitivity

- Environmental Sensitivity: (re) connecting with the intrinsic value of nature; (developing) an empathetic view of the environment. Understanding the process of influencing others and creating change in the participant's daily context at work / home / local community.



3. Values and Beliefs: Encouraging participants to explore their own and others' values and beliefs in relation to the natural world.

4. Purposeful Vision and Action: Encouraging participants to explore their personal vision for a sustainable world and identify actions / build an action plan for themselves to implement after their return from the field programme. Participants' action plans are built across their various spheres of influence – personal actions, influencing family/team, influencing their community/organization etc.

The Head, Heart and Hand approach

This programme combines volunteering on an outdoor environmental field research project that is relevant to sustainability issues, often in remote and inspiring locations, with sessions designed to increase understanding of environmental issues and enable sustainable change. This unique model is capable of impacting participants' hearts and minds – inspiring enthusiasm and commitment and turn ideas into plans for action.

This approach transforms people by enabling them to step out of their normal surroundings onto an experiential learning opportunity on a research project. The 'citizen science' model of engagement strives to be a catalyst to create lasting change in participants' attitudes, beliefs, decisions and actions regarding the environment and environmental sustainability.

Citizens' action

This 'citizen science' based initiative is creating opportunities for Citizen Scientists — members of the public who voluntarily help scientific studies — make a real difference to scientific research and make positive contributions towards developing a sustainable world.

Realizing the potential of 'citizen science', it is attempted to bring people and science together at the field level and empower them with knowledge, understanding and conviction to build conservation efforts. Creating and developing an effective 'citizen science' model that fosters partnerships between people, science and scientists is a significant step towards this end.

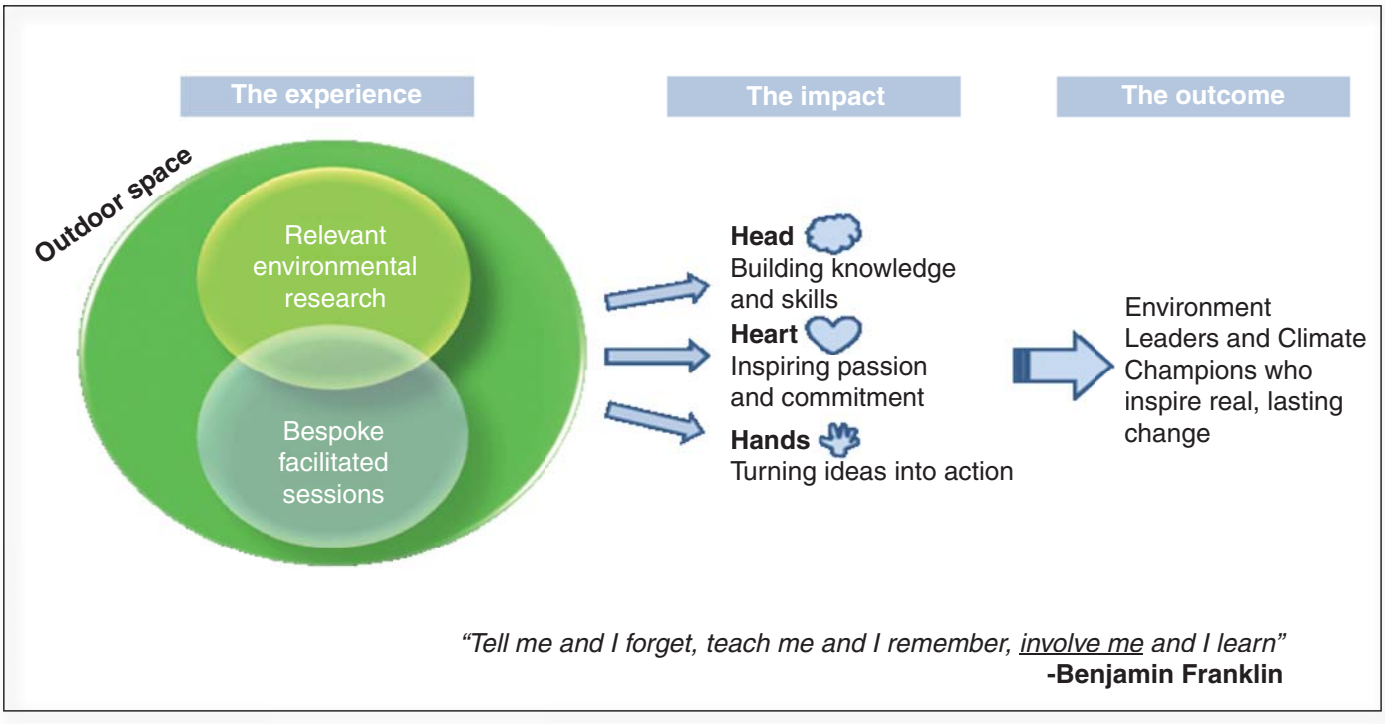
It is anticipated that such programmes will inspire people to get increasingly involved in conservation and sustainable development priorities—in the field and at home. Through these initiatives it has encouraged the participants to share their experiences with others, to transfer their skills and enthusiasm to environmental conservation efforts at workplace, at communities and at home. The knowledge, inspiration and insight they take back to their own communities could influence the lives and attitudes of those around them for years to come.

Individual actions

- Monitoring and research
- Awareness and outreach
- Movement

Key focus of the research:

- Nutrient dynamics in a specific catchment area
- Temporal and spatial variability of water quality in ponds and pools
- Local ground water quality and its impact on eco systems and biodiversity
- Impact of pollution on large bodies of freshwater





These four areas will be critically studied in order to understand the intricacies of ecosystem functioning such as how environmental drivers impacting water quality, benefits of restoration activities and licks between water quality and quantity with local biodiversity.

Methods

Participants will work to answer questions that proceed in a stepwise manner from visual observation to characterization of water chemistry to integrative thinking about the roles played by watershed/ land use and climate in water availability/quality, etc.

The sequence of questions and parameters of interest would be as follows:

1. Visual, and Physical observations

a) General ecosystem conditions will be measured, Lake/river level, flow will be examined

b) Qualitative and/or quantitative analysis of water can be done by studying water colour, floating cyanobacteria mats, Phytoplankton pigments, chlorophyll, phycobilin, etc.

c) Buffer zone characteristics width vegetation type, invasive or non-invasive will be studied

d) Negative activities, trash presence will be identified

e) Wetland extension/vegetation health as well as Buffer zone characteristics width vegetation type, invasive or non-invasive will be studied



2. Study of Bio/Chemical parameters

a) Species collection and identification - phytoplankton, invertebrates and small fish

b) P, N, conductivity, alkalinity, faecal matter, cyanobacteria biomass, chlorophyll a, phytoplankton assemblage

c) pH, salinity, Cyanotoxins, COD, DO, pH, Temp, Conductivity, redox, salinity Turbidity, euphotic depth, CDOM, chlorophyll, particulate load, etc.

d) Nutrients - ammonia, nitrates, nitrites, phosphate,

The value of these volunteers extends

beyond data collection. Scientists find that they generate enthusiasm and offer a fresh perspective on research projects. For volunteers, joining a research project can be a life-changing experience, a wake-up call to the environmental challenges facing the planet. The knowledge, inspiration and insight they take back to their own communities could ripple through the lives and attitudes of those around them for years to come.

Impact of 'citizen science' based action

Such projects bring together institutions and individuals to understand and inform critical environmental issues by combining world-class scientific field research with experimental learning programmes that inspire a lasting change. We believe that the future decisions regarding the environment must be based on objective science. We also believe that by involving a diverse range of people in scientific research and education, they gain the knowledge, skills and motivation needed to take responsibility for the environment.

It is apparent that the world is, or will soon be, facing an unprecedented challenge when it comes to freshwater systems. The historic struggle to cope with water access is now magnified by global change to societies, economies and the climate.

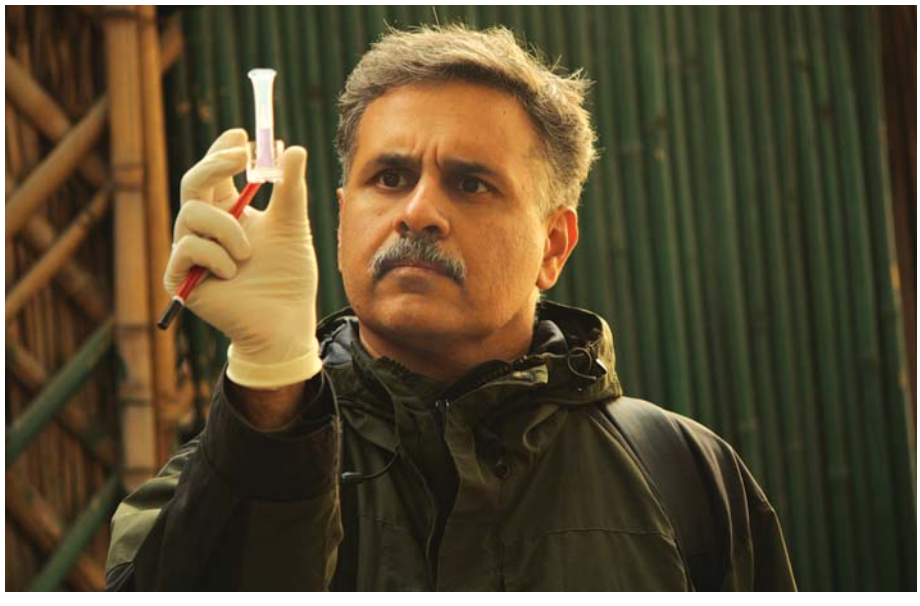
The effects of climate change on water systems are very uncertain and are unlikely to be the same across the world. However, it is certain that more droughts and flooding will affect the more vulnerable most significantly.

Not only is climate change likely to reduce the availability of freshwater resources in some regions, but may exacerbate many of the additional consequences associated with climate change. For example, heavy rainfall increases soil erosion, adding more sediment to watercourses, and in



urban areas results in greater volumes of urban run-off containing contaminants into rivers. Lower environmental flows will result in higher concentrations of pollutants in water bodies. The extent of climate change and its impacts on the human and natural world will depend on the mitigation measures adopted and the adaptations made. In developed nations, adaptation to changing conditions in water availability and demand has always been at the core of water supply services. Historically, water management has concentrated on meeting the increasing demand for water.

The future trends for freshwater will be influenced not just by climatic factors but also by policy decisions, the actions of millions of individuals, the type of and access to water infrastructure and services, changes in technology and affluence (and a whole host of other factors).



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For programme details, please contact:

Mr. Romit Sen, Senior Assistant Director, FICCI Water Mission, romit.sen@ficci.com and
Dr. Pranab J Patar, Research Manger, Earthwatch Institute India, ppatar@earthwatch.org.in

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Pranab J Patar, Prashant Mahajan, Sudha Iyer



Earthwatch Institute India

Earthwatch Institute India
Augusta Point (Level 4), Sector 53
Golf Course Road, Gurgaon 122002, India

T: +91-124-435 4248, Email: info@earthwatch.org.in

Federation of Indian Chambers of Commerce and Industry (FICCI)

Water Mission, FICCI
Federation House, Tansen Marg
New Delhi 110001, India

T: +91-11- 23738760-70 Email: ficci@ficci.com

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