

Revival of Hauz Khas Lake in Delhi: Approaches to Urban Water Resource Management in India

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Abstract

The decline of urban water bodies in India needs to be arrested for sustainable water management in rapidly expanding Indian cities. Reuse of water after partial recycling can reduce environmental stress. Delhi, the Indian capital, has a number of surviving water storage structures built by successive rulers over centuries to tackle water shortage in the summer. In modern Delhi, a fourteen million plus city, water is supplied through technological networks, hastening the decline of the old water storage structures. The old lakes are choked with filth and the step-wells are heaps of rubble. The Indian National Trust for Art and Cultural Heritage (INTACH) and the Delhi Development Authority (DDA) have undertaken a project to revive a 700 year-old water body, lying dry for decades, the Hauz Khas Lake, with treated sewage water. The idea was to raise the groundwater table and restore the natural environment of the lake, a past habitat for water birds. This paper attempts to evaluate the immediate impact and the long-term sustainability of the effort through discussions with technical personnel, field observations and interviews with local residents. Manuals and progress reports of the concerned organizations are used as secondary sources. The paper also examines the views of government officials and NGOs regarding the role of other similar projects in alleviating Delhi's water shortage.

Keywords: Sustainability Matrix, urban renewal, water resource management, sustainable water management, treated sewage water, Lake Restoration, ground water recharge

1. Introduction

There is a growing concern in many quarters that the world is running out of water. According to the United Nations Development Programme (UNDP) Human Development Report 2006, for over a billion people around the world, water access is unreliable, unsafe or beyond their purchasing power (UNDP, 2006). Growing urban impediments, use of natural storm water channels for sewage disposal, reclamation for other purposes and polluting human activity on the shoreline are the characteristics responsible for the decline of urban water bodies. Sustenance of urban water bodies is an essential component of urban environmental plans in order to augment raw water availability and nourish depleted aquifers. In addition, there is a need to recycle urban wastewaters to curtail environmental stress caused by dumping waste into natural eco-systems.

Though close to a perennial source of water, the river Yamuna, Delhi, the capital of India, lies in a semi-arid zone. The present modern city is located at the site where seven cities flourished in different periods of Indian history (Verma, 2001). The climate of Delhi is extreme, with severe summers and harsh winters. The low rainfall meant that the flow of the Yamuna dwindled in summer. Thus, rulers of Delhi over centuries have attempted to ensure an adequate water supply through diversion canals, tanks, wells etc. Delhi has a number of surviving ancient structures like baolis (stepwells), small check dams and tanks that display the traditional wisdom of storing water where it falls. In modern Delhi, a fourteen-million-plus city, households are supplied water through technological networks, thus hastening the decline of the old water storage structures. Delhi is now an expanding mega-city and faces a regular water crisis that aggravates in summer. All stakeholders agree on the inadequacy of Delhi's current water supply. Many government and non-governmental agencies e.g. the Central Ground Water Board and Centre for Science and Environment now agree that revival of old water storage structures can prove to be the city's future lifeline (Nasr, 1999).

2. Scope of the Study

This study has been conducted on the Hauz Khas Lake Restoration Project executed in Delhi by the Natural

Heritage Division of the Indian National Trust for Art and Cultural Heritage (INTACH) and the Delhi Development Authority (DDA). The project uses recycled water from the neighbouring sewage treatment plant to fill up the 700 year-old Hauz Khas Lake, which had been lying dry for forty years. The study attempts to evaluate the immediate impact and the long-term sustainability of the effort, as well as the possibility of its application to other old water bodies/water storage structures in the city. While evaluating the impact of the project on the groundwater table, it examines the revival of the surrounding natural environment of the lake—including the renewed presence of water birds consequent to its filling up. The study also records the views of some government officials and NGOs regarding the role of other similar projects in alleviating the water shortage in Delhi.

3. Methodology

3.1 Data Collection

Secondary data was obtained from manuals, progress reports and monitoring reports of the organizations involved in the project i.e., INTACH and DDA, Delhi. To gather primary data, interviews were conducted with the concerned officials at INTACH, DDA, EnviroWay Bio-Science Pvt. Ltd. and JM Enviro-Technologies (at the time of project inception) with the help of a questionnaire containing both close-ended as well as open-ended questions. Discussions were held with technical personnel regarding the design aspects of the project. The residents of the nearby Hauz Khas colony and urban village were also interviewed. Several visits were made to the lake and people visiting the park, like morning walkers, picnickers etc. were also interviewed. An attempt was made to understand why the project was undertaken and the sustainability plan of the project, with the help of the Sustainability Matrix.

3.2 Data Evaluation—Sustainability Matrix

Sustainability assessment methods are primarily aimed to evaluate Project sustainability on global, national or state scales. A common method used to assess is a matrix (Clayton et al., 2005). The Sustainability Matrix is a tool that provides a comprehensive assessment of sustainability implications of a project by balanced scoring of environmental, economic and social criteria. The balanced scoring of 1/3 environmental, 1/3 economic and 1/3 social is called “triple bottom line assessment”. One of the axes must contain the core sustainability goals and the other axis contains the core elements of the topic to which one wants to apply the sustainability objectives. The Matrix is a quick way to evaluate the environmental and community benefits arising from a development project. It also helps to identify any negative economic, social and environmental impacts. Obviously, no project can measure up to the ideal score. Nevertheless, the Triple Bottom Line Assessment matrix (Clarke, 2001) indicates how well a project has performed relative to the sustainability and community goals contained in the project plan, and helps identify areas where improvement is desirable and possible. There are different kinds of matrices in use depending on the kind of development project or industry which needs to be evaluated (Lee et al., 1975). In this project we have developed our own matrix on the lines of the one developed in Santa Catarina University, Brazil to assess coastal management (Saldanha et al., 2007).

4. The Project

4.1 The Hauz Khas Lake: Introduction

The Hauz Khas Lake was built in 1295 by Sultan Allauddin Khilji, the then ruler, for the inhabitants of Siri, one of the seven cities of Delhi. It was originally called Hauz Alai after Allauddin but the name was changed to Hauz Khas (“royal tank”) by Firoz Shah Tughlaq, who had it de-silted in 1305 (Stephan, 2002). The lake, covering an area of 58515 sq.m and with an effective depth of 2.20 m, dried up a few decades back because the stormwater drains that fed it were diverted due to construction work. A shrinking catchment area because of urban development and new residential colonies added to its misery. Though the lake used to fill up during the monsoon season, July-September, it could not hold the water for long.

4.2 Project Details (DDA-INTACH, 2003)

New Delhi based non-governmental organization (NGO) Indian National Trust for Art and Cultural Heritage (INTACH), along with the Delhi Development Authority (DDA), which controls most of urban governance in the city, came up with a plan to revive Hauz Khas Lake with treated sewage water. Treated water would be taken from a nearby Sewage Treatment Plant (STP), cleaned further through biological processes, and be transported to the dry lake.

In 2003 about 2.5 million litres/day of water from the Kishan Garh Sewage Treatment Plant (STP) in Vasant Kunj were diverted at an expense of Rs. 50 lakh by means of a 3.5 km long pipeline to a nearby forest area where two lagoons were created to clean the water further by “Duckweed Pond Technology”. It is a viable, cheap

and natural way of treating domestic wastewater. Wastewater is allowed to settle for 1-2 days in a settling tank and passed through a series of ponds that can hold water for at least a week while aquatic plants like water hyacinth and duckweed absorb the organic matter. Bamboo cubicles (5 x 5m) are provided in the duckweed pond to prevent wind drifting of weeds. The fast growing aquatic plants used have the ability to bio-accumulate nutrients. They reduce dissolved solids, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), suspended solids, and bacterial pathogens of waste water to a safe level. Water quality improves as the water moves from one pond to the next. However, the plants pose a problem as they grow fast and need to be harvested. In the Hauz Khas project, arrangements were made to compost the plants and make manure out of them as they doubled in a fortnight. Finally, the DDA brought the treated water from the forest to the Hauz Khas Lake through a pipeline (by the gravity flow technique) to avoid further contamination from villages and residential colonies on the way.

According to the officials interviewed, initially, it was not easy to convince the residents who lived near the lake about the benefits of the project. Though everyone welcomed the plan to have a big brimming lake, they turned up their noses the moment they realized treated sewage water would be used for it. The resistance multiplied once the project took off. People wrote to local government officials and complained to the media. Some of their complaints included unpleasant odour, dirty water and mosquito breeding. Morning walkers were the most offended as the lake emitted a foul smell. INTACH and DDA introduced a series of innovative measures to sort out these issues as described below.

When the project started, 4000-5000 million litres of water were pumped into the lake but leaked away continuously due to low groundwater table. Water continued to seep through the lake flooring for almost a year leading to a 3-4 m rise in the ground water level underneath the lake flooring. Later, the seepage slowed down as the water table came up to the lake floor. However, there were problems of smell, algal growth and increase in mosquitoes. To tackle the problems, a number of fish species were introduced to keep the water clean by consuming algae and feeding on mosquito larvae. The fish included gambusia that feed on mosquito larvae, Indian carps—rohu, catla and mrigala—that eat up organic matter and an exotic fish imported from China—the grass carp. Since the lake had been dry for many decades, trees had sprung up from its bed. Their branches and leaves would fall and rot due to which it was difficult to keep the lake clean. In order to tackle this problem the DDA posted six people to clean up the lake and ensure that no one threw any waste into it. It also introduced eleven aerated floating fountains to prevent water from stagnating (Bhatnagar et al., 2006, 2008). Splash Aerators from Italy have recently been introduced to oxygenate the Hauz Khas Lake. According to the officials interviewed SPLASH is an aerator which cascades large quantities of water like a fountain @200 m³/hr and moves it bottom to top and into the atmosphere. It requires very little maintenance, strip off volatile organics from waste water and provides good mixing (Interviews with DDA officials, 2008-2015).

4.3 Sustainability Matrix of the Project

Table 1. Hauz Khas Lake Project: Sustainability Matrix

	Objectives	Measures	Initiatives	Performance Indicators
Economic	<ul style="list-style-type: none"> - Long term financial sustainability - Bringing down cost of water supply including tankers and borewells 	<ul style="list-style-type: none"> - Recovery of capital cost - Cost of water supply - Life cycle cost 	<ul style="list-style-type: none"> - Using existing STP as water source - Using natural gradient of land to reduce pumping costs - Using cascade aerators to reduce electricity costs 	<ul style="list-style-type: none"> - Capital cost recovery within short period due to reduced cost of water supply - Annual maintenance cost recovery in terms of health and recreation
Environmental	<ul style="list-style-type: none"> - Restoration of lake and surrounding environment - Recycling of water - Raising of Groundwater Table 	<ul style="list-style-type: none"> - Water Quality (CPCB norms) and Quantity - Ground Water Level - Per Capita Water availability - Revival of lake ecosystem 	<ul style="list-style-type: none"> - Using treated water from STP as a continuous water source - Frequent water testing by CPCB - Additional bioremediation of water - Composting of collected waste - Introduction of fish to tackle algae/weeds - Using aerators 	<ul style="list-style-type: none"> - Permanent presence of water in the lake - Water Quality in accordance with CPCB norms for lakes - Rise in groundwater table - Ease of watering in adjacent parkland - Reuse of waste as compost - Presence of variety of water birds
Social	<ul style="list-style-type: none"> - Increasing water availability - Enhancing aesthetic value - Creating recreational space - Improving public health 	<ul style="list-style-type: none"> - Better household water supply - Aesthetically pleasing surroundings - Number of visitors - Air and water quality 	<ul style="list-style-type: none"> - Development of adjacent parkland - Provision of boating - Creation of walkways and shelters - Introducing moving fountains in the lake - Spraying insecticides for mosquito removal - Public discussions to explain benefits 	<ul style="list-style-type: none"> - Increased satisfaction with domestic water supply - Increase in visitors in the surrounding areas - Increase in morning walkers - Increase in photographers and birdwatchers - Visitor satisfaction

The long-term financial sustainability of the project may be worked out as follows (presuming that the capital cost is written off over 10 years):

Table 2. Financial viability of Hauz Khas Lake Project

EXPENDITURE	AMOUNT
Total project cost	Rs. 50 lakh
Annual cost written off	Rs. 5 lakh
Annual maintenance cost	Rs. 8-10 lakh (approx. Rs. 2 lakh/ year for duckweed technology and Rs. 6 lakh/ year for cascade aeration)
Total cost per annum	Rs. 15 lakh
SAVING	AMOUNT
Cost of Water tanker supply per annum @ of Rs. 800-1,000/ tanker	Rs. 80 lakh

Note. The initial cost of sewage treatment has not been taken into account in the above calculations since the sewage treatment plant was already in place.

Source: The data in the above table has been taken from the INTACH report with necessary updates from the DDA officials.

5. Research Findings (Field Visits, 2008-2014)

Borewells in the locality, which had run dry, have started functioning, eliminating the need for supplying water through tankers. As evident from the calculations, the project seems to be very attractive financially, since the cost of the projects has been recovered in the first year, i.e. the payback period is less than one year.

The lake has water throughout the year now, the quality of which conforms to the Central Pollution Control Board (CPCB) norms for lakes. The CPCB carries out frequent checks to ensure water quality. The project reuses treated sewage water, setting an example of recycling urban wastewater. As per the local authorities interviewed, corroborated by local residents, the groundwater in the Hauz Khas village has gone up by 10-15 feet and wells that had dried up have revived due to percolation of water into the aquifers. This has also resulted in fewer cases of waterborne diseases as per some residents. It is estimated that nearly 1,000 million litres of rainwater and 750 million litres of treated sewage water have been recharged to the aquifer since the project began. The rise in water table is evident as far away as Munirka and Safdarjung area, about 5 km from the lake. Before the project, the golf course at Saket nearby had a maintenance problem due to inadequate water supply and out of their twelve bores, only five were working. Now that the water table has risen the golf course is working fine.

The presence of water in the lake has caught the attention of water birds like spot bill ducks, pochards, mallards, shovellers, grebes, gadwall goose, black-winged stilts and pintail ducks. The Delhi Bird Group, which had earlier only found birds like warblers and birds of prey in the locality, now reports many more winged visitors including pintail ducks, which fly over from Siberia. The presence of the birds has added further appeal to the now lush green surroundings. The number of visitors to the lake and park has increased including morning walkers and birdwatchers. Those practicing early morning yoga have also started frequenting the park since the air quality improved. The Hauz Khas village holds its council meetings in a hut near the lake. The visitors to the neighbouring Deer Park now make it a point to visit the lake, which they earlier used to avoid because of the foul smell of stagnant water.

In 2012, a 3.5 feet long catfish was discovered in the Lake. This discovery marked a major progression in the revival of the lake. Though residents still complain of foul smell from a part of the lake but its biochemical oxygen demand, an indicator of pollution levels, has dropped from 11mg/l to 6 mg/l in a span of six months.

The National Green Tribunal (NGT) shut down all eateries in Hauz Khas village for five days after it discovered that these high-end restaurants and eateries did not have consent to operate and were discharging their waste without proper treatment. According to guidelines issued by Delhi Pollution Control Committee, which monitors pollution in the national capital, the eateries in the Hauz Khas village were required to set up a common effluent treatment plants (CETPs) along with oil and grease traps. Twenty six out of these restaurants were allowed to open after their owners appeared before a tribunal and promised to do so. During an inspection, South Delhi Municipal Corporation (SDMC) found that twelve of these were still operating without any of the clearance mandated by a Delhi High Court order of May 2013 and were shut down on Jan 9, 2014.

6. Conclusion

Though the project scores well on all three fronts viz. economic, environmental and social, there is scope for improvement, particularly on the social front. There should be better publicity of the environmental benefits of the project, enhancing environmental awareness, especially of the local community. By publicising and explaining the water, quality parameters it may be possible, in time, to completely remove the mental block that many residents have against recycled wastewater. Some residents also complained that the number of mosquitoes have actually gone up since the revival of the lake. However, others contradicted them. Since the site combines history and nature, it can be projected as a major tourist spot of the city. The floating fountains, which were abandoned because of some snags, may be revived to make the place more attractive. Boating could also be reintroduced.

The maintenance and further restoration of the Hauz Khas Lake has subsequently been handed over to The Braj Foundation, through a memorandum of understanding (MoU) signed with DDA in 2014 (Bhasin et al., 2014). The Braj Foundation is a non-profit organization, established in December 2005 to restore and revitalize the environmental and cultural heritage of Braj Bhoomi (land of Braj), which falls within the Golden Triangle of Delhi, Jaipur & Agra (Braj Foundation, 2016). In Aug 2015, Braj foundation was still assessing the Hauz Khas Lake situation (Singh, 2015). When interviewed, Mr. Rajneesh Kapur, Secretary Braj Foundation said, "We have been chosen by the DDA to do the restoration of this lake but the Detailed Project Report (DPR) has to be approved by the DDA and then the work shall start. Till then the routine maintenance of the water body shall be done by the DDA." (Kapur, 2016)

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