

Maps, lakes and citizens

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URBANIZATION is increasingly emerging as one of the most significant drivers of global environmental change.¹ The impacts of city growth are especially noticeable in India, where urban landscapes have grown at unprecedented rates over the last two decades, converting a predominantly rural population to one which is rapidly becoming dominated by city dwellers. Bengaluru, India's third largest city with a population of over six million and a decadal growth rate of 38% between 1991-2001,² is a case in point, providing a characteristic example of rapid expansion at the expense of natural ecosystems.

While Bengaluru has undoubtedly experienced an explosion in growth in recent decades, the settlements around the city have a recorded history that dates at least as far back as the 5th century CE.³ Urban settlements, however, made their first appearance only in the 16th century when it was established as the capital

of the local king Kempe Gowda's kingdom.⁴ These settlements, along with the surrounding agricultural landscape that sustained their presence, required the availability of a continuous supply of fresh water. However, unlike many other old settlements, the city of Bengaluru was located in the rain shadow of the Deccan hills, and lacked the presence of a large river to provide fresh water.⁵ Fortunately, the undulating topography of this region gives rise to a number of small streams, which were dammed to form a multiple series of tanks throughout the larger region.⁶ Inscriptions found near the lakes indicate that some of them date at least as far back as the 5th century.⁷

Indeed, for those of us living in concrete dominated city environments today, the network of lakes in the Bengaluru area was unimaginably

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1. N.B. Grimm and S.H. Faeth, N.E. Golubiewski, C.L. Redman, J. Wu, X. Bai and J.M. Briggs, 'Global Change and the Ecology of Cities', *Science* 319, 2008, 756-760.

2. H.S. Sudhira, T.V. Ramachandra and H.S. Bala Subrahmanya, 'City Profile: Bangalore', *Cities* 24, 2007, 379-390.

3. B.L. Rice, *Epigraphica Carnatica Volume IX: Inscriptions in the Bangalore District*. Mysore Government Central Press, Bangalore, 1905.

4. B.L. Rice, *Mysore: A Gazetteer Compiled for Government*, revised edition, volume II – Mysore, by districts. Archibald Constable and Company, Westminster, UK, 1897(b).

5. B.L. Rice, *Mysore: A Gazetteer Compiled for Government*, revised edition, volume I – Mysore in General. Archibald Constable and Company, Westminster, UK, 1897(a); S. Srinivas, *Landscapes of Urban Memory: The Sacred and the Civic in India's High-Tech City*. Orient Longman, Hyderabad, 2004.

6. B.L. Rice, 1897(a), *ibid*.

7. B.L. Rice, 1905, *op cit.*; T.V. Annaswamy, *Bengaluru to Bangalore: Urban History of Bangalore From the Pre-historic Period to the End of the 18th Century*. Vengadam Publications, Bangalore, 2003.

dense. In 1830, for instance, a mind boggling 19,800 lakes were recorded in the surrounding region of Mysore.⁸ The surface water provided by these lakes earlier constituted over 50% of the water supply of Bengaluru.⁹ Yet this lake network now lies disrupted and in decay, with many lakes converted to urban land uses, and others polluted and choking with waste, or completely dry and weed infested.

Over the past three years, we have been engaging with the Greater Bengaluru Municipal Corporation, or the Bruhat Bengaluru Mahanagara Palike (BBMP), in an effort to understand how lakes can be managed and restored for urban use, while still maintaining their significance for conservation. An examination of the traditional uses of these lakes, their ecology, and structure is helpful in understanding how it may be possible to develop urban oriented, yet ecologically and socially inclusive, lake restoration plans.

The original network of lakes in Bengaluru was created by checking the flow of rainwater through earthen embankments along a topographic gradient, such that the outflow of water from a lake at a higher level supplied water to the lakes at a lower level through canals.¹⁰ Lakes were linked through a web of canals or *kaluves*, connected to the surrounding agricultural wetland landscape. They ranged in size from small ponds (*kuntas* or *donnes*) less than a hectare, used for cattle washing and drinking, to extensive large lakes (*keras*) of hundreds of hectares in area, used for agriculture,

fishing, drinking water and domestic uses.¹¹ All were rain fed. The small and medium tanks were seasonal; only large tanks were perennial.

Lake ecologies were connected to and maintained by human management in a closely linked social-ecological system. Wetlands, orchards and agricultural fields surrounded the lake, and were in turn irrigated by water from open wells that were dependent on the groundwater table recharged by nearby lakes. Water was used for drinking, for domestic purposes such as washing, and to replenish the groundwater table. In the monsoon, rain water overflowed from lakes into adjacent wetlands, and was used for agriculture. When water levels began to recede, cattle grazed on the wetlands, which were largely designated as *gomala* – common property wetlands where community grazing took place. There was extensive fishing in the wetlands and lakes. Idols were immersed in the tanks during festivals.

The wetland-agricultural-grazing-orchard landscape surrounding the lake acted as a natural watershed basin to recharge the lake with fresh precipitation. Since most lakes were seasonal, and pollution levels were low, it was easy to control siltation. The silt was extracted annually in the smaller lakes, and every few years for the large lakes in the dry season, for use by local communities as inputs into agriculture.¹² These lakes also constituted important sacred spaces, and many important local religious

festivals were initiated or concluded at local lakes.¹³ Critical for conservation, lakes also supported a range of important local flora and fauna, including a rich diversity of birds, insects and aquatic life.

As the city began to import piped water from the Cauvery river in the early 20th century, lakes lost their importance as suppliers of fresh water, and instead started being blamed for a host of ills such as flooding and malaria. Many of the city's lakes were drained and converted to other land uses, including bus stands, golf courses, malls and residential areas.¹⁴ With urbanization, much of the wetland agricultural landscape around lakes has been converted to impervious concreted surfaces. Instead of rainwater precipitation, sewage and effluents fill the few lakes that remain, converting them from seasonal to perennial ecosystems and drastically altering their biodiversity. Most surviving lakes are heavily polluted with sewage and industrial waste and have significantly reduced water levels. Due to the disruption of this previously well-planned and maintained extensive network into a few isolated and disconnected lakes, significant flooding is often reported in the monsoon season.¹⁵

The change from agrarian to urban land use has moved in parallel with changes in lake management and administration. Historically, lakes were managed by the village communities living adjacent to the lake, sometimes with financial support from the kings.¹⁶ Specific families and

8. B.N. Sundara Rao, *Bengalurina Itihasa (A History of Bangalore)*. Vasanta Sahitya Granthamala, Bangalore, 1985.

9. S.U. Kamath, *Karnataka State Gazetteer: Bangalore District*. Lotus Printers, Bangalore, 1990.

10. B.L. Rice, 1897(a), op cit.

11. F. Buchanan, *A Journey From Madras Through the Countries of Mysore, Canara, and Malabar*. Volume I, reprinted in 1999. Asian Educational Services, New Delhi, 1807.

12. F. Buchanan, 1807, *ibid.*; BBMP, *Namma Bengaluru Nisarga: An Action Plan for Development of Bangalore's Lakes*. Bruhat Bangalore Mahanagara Palike, Bangalore, 2010.

13. S. Srinivas, 2004, op cit.

14. K. Gowda and M.V. Sridhara, 'Conservation of Tanks/Lakes in the Bangalore Metropolitan Area', *Management of Environmental Quality* 18, 2007, 137-151; BBMP, 2010, op cit.

15. BBMP, 2010, op cit.

communities were designated to maintain lake canals, bunds and desilting, and specific groups were given permission to use the lake for fishing, collection of fodder, agriculture, washing of clothes and so on.¹⁷ These specialized, locally varying and adaptive roles played by different communities were gradually replaced by formal governance structures imposed by the Mysore princely state and British government agencies.¹⁸ Later, a bewildering array of government departments became involved with aspects of lake management, with overlapping jurisdictions. These included the Department of Minor Irrigation, Department of Fisheries, Ecology and Environment Department, Karnataka Forest Department, Lake Development Authority, Karnataka State Pollution Control Board and the Bangalore Development Authority.¹⁹

In 1983, in response to increased public concern about the condition of lakes in the city, the state government constituted an expert committee to investigate this issue. The recommendations of this committee, popularly known as the Laxman Rao Committee, led to the transfer of administration of most of the city's lakes to the Karnataka State Forest Department.²⁰ While this resulted in the survey, fencing and protection of several of the city's lakes, the situation continued to deteriorate.

In 2002, the Lake Development Authority was constituted as an autonomous body responsible for the maintenance and restoration of lakes in Bengaluru.²¹ The LDA attempt to

implement new public-private-partnership (PPP) approaches to lake management met with widespread resistance from civil society, environmentalists and activist groups, and resulted in a number of public interest litigations which have for the time being arrested this process. Currently, lake governance is in the process of being consolidated, with the BBMP assuming responsibility for the maintenance of a majority of the lakes within city limits, along with the LDA and BDA which continue to manage a small number of lakes.

Currently, there are about 210 lakes located within the administrative boundary of greater Bengaluru.²² Given the terrible condition of most of these lakes, the BBMP and BDA are planning large-scale restoration and rejuvenation programmes. These need to be carefully designed. Although these lakes are of human origin, they have over centuries acquired natural characteristics and become nature preserves. Yet their transformation into urban landscaped spaces is perhaps the most significant change in their recent history. While these lakes are undoubtedly critical sources of water supply, and important nature preserves, they also form vital social spaces in a cramped, concrete dominated city environment.

Given the high levels of socio-economic, cultural and linguistic diversity in the city, lakes can become contested public spaces, especially in locations such as Bengaluru, whose historic use and design have changed over time. For instance, for many of the earlier inhabitants of the city, lakes continue to have a significant role in religious and sacred rituals²³ – but with

increasing urbanization they also play a new role as urban recreational spaces, and locations for reconnecting with 'nature' in the city.²⁴

Although lake restoration programmes have been undertaken in the past, they have not only been expensive but lake condition has often deteriorated soon after in many cases. Restoration has often been piecemeal – one lake is treated, but the upstream and downstream lakes remain polluted, and *kaluves* continue to be blocked, so the lake soon returns to its original polluted condition. Lake dredging is largely based on considerations of engineering and cost, with lakes dredged in a u-shaped bowl. Yet most of these lakes have a completely different profile, with deep water storage areas near the downstream bund, and shallow water storage in the upstream areas.

Waterspread areas of the lake have been encroached upon to create water intensive, ornamental gardens and play areas, and extensive plantations of water hungry species such as *Acacia auriculiformis*, casuarina, eucalyptus and silver oak have been planted around several lakes, drying up the water table. There is a clear need to treat each lake as a unique individual entity, with its own appropriate method of restoration based on the size of the lake, its drainage pattern with reference to the sub-watershed in which it is located, the land use and vegetation in the periphery, the biodiversity, and current patterns of human use.

A number of urban researchers, naturalists and concerned citizens have engaged in extensive discussions with the BBMP over the past three years, seeking to develop guiding

16. B.L. Rice, 1897(a), op cit.

17. F. Buchanan, 1807, op cit.; B.L. Rice, 1897(a), op cit.

18. S.U. Kamath, 1990, op cit.

19. K. Gowda and M.V. Sridhara, 2007, op cit.

20. Ibid.

21. Ibid.

22. BBMP, 2010, op cit.

23. S. Srinivas, 2004, op cit.

24. J. Nair, *The Promise of the Metropolis: Bangalore's Twentieth Century*. Oxford University Press, New Delhi, 2005.

principles for lake restoration and management that are geared towards conservation in urban environments, while paying attention to the need for urban recreation, social inclusion, maintenance of cultural diversity, and providing space for traditional livelihoods and the urban poor.

In one lake in Bengaluru, the Kaikondanahalli lake, which is located on Sarjapur road at the south-eastern periphery of the city, a group of interested and committed local citizens formed the Kaikondanahalli Kere Abhivruddhe Samasthe (the Kaikondanahalli lake development organization), interfacing with the BBMP to develop an integrated plan for lake restoration that incorporates attention to conservation, water rejuvenation, urban recreation, and socio-economic requirements of a wide strata of society. This group not only includes a diversity of representation from original inhabitants of peri-urban villages around the lake and from recently built high-end apartments and residential layouts, but also incorporates considerations of engineering, ecology, education, communication, and governance.

Once heavily polluted with sewage from nearby residential areas, this lake has now been restored by dredging the basin to remove silt, diverting sewage, restoring the bund, and planting a rich variety of locally suited, biodiversity friendly trees and plants around the periphery. Based on inputs from this group, the lake waterspread area has been maintained during rejuvenation to the maximum possible extent without uprooting existing trees, and a walkway created around the lake which avoids the marshy, biodiversity rich southern end.

Taking into account the requirements of cattle owning households from the nearby peri-urban villages,

a separate path has been created to allow cattle to approach the lake for a wash. At the western end, a children's playground has been designed in a location adjacent to a nearby school for children from less wealthy, peripheral city areas. This play area will serve a dual purpose, with the children from the school utilizing it during weekdays, while enabling access to lake visitors during mornings, evenings and weekends.

Based on this experience, the group has also developed guidelines to facilitate a larger rejuvenation programme aimed at restoring and conserving a network of lakes in south-eastern Bengaluru. What are the guiding principles that we can follow? Lakes have different uses and benefits, and there are synergies and trade-offs between these factors. Instead of valuing one benefit, e.g. water recharge, or bird diversity, above all other factors, an integrated approach needs to be followed that incorporates a proper consideration of all these different factors.

Groundwater recharging constitutes probably the most critical use of lakes in water-starved Bengaluru. In addition, however, lakes act as green spaces, lung spaces and areas for micro-climate control. Consequently, many previous lake restoration programmes have converted part of the waterspread area into islands, gardens and tree parks – a well-meaning exercise that unfortunately results in reduction of the primary benefit of the lake as a body for storage of fresh water.

Lakes also act as an important refuge for birds, insects, amphibians, reptiles, fish, planktons, and other water and wildlife. Over 140 species of birds, 66 forms of phytoplankton, 62 forms of zooplankton, 16 species of amphibians and 41 species of fish inhabit Bengaluru's wetlands.²⁵ For

proper biodiversity support, it is important that lakes provide as many micro-habitats as possible. Thus, lakes should not be dredged in a u-shape, as happens in most current restoration programmes, but with a sloping basin having a deep and a shallow end, such that species adapted to different water depths can be supported.

In urban areas, given the serious dearth of large open spaces for exercise and recreation for both adults and children, paths have been provided around the lake periphery for walking, jogging and exercise, and with play areas for children. Unfortunately, this development of recreational areas has usually been at the expense of conservation. Thus, recommendations have been made that protection for the lake biodiversity be provided by keeping a buffer distance of 150-300m to separate the walkways, play areas and other areas of human use from lake habitat, and screening these areas from the lake by planting trees, bamboo, and tall shrubs. The marshy and shallow water section of each lake, where biodiversity levels are maximum, should also be separated from human disturbance, without walkways or play areas. Boating also creates severe disturbance to bird life, and should not be allowed.

Unfortunately, most lake restoration programmes pay little or no attention to the traditional and current uses of lakes by local residents and the urban poor. While lakes constitute a public commons and should be accessible to all, several of the lakes

25. M.B. Krishna, B.K. Chakrapani and T.K. Srinivasa, *Water Birds and Wetlands of Bangalore: A Report on the Status, Water Quality, Plankton and Birds of the Lakes in and Around Bangalore and Maddur, Karnataka, India*. Birdwatchers' Field Club of Bangalore and Bangalore Urban Division, Karnataka State Forest Department, 1996.

in the city are now surrounded by private landowners and lack public access. Traditional uses of lakes include idol immersion, irrigation, domestic use, grazing, washing of cattle, and silt extraction. Lakes also constitute important religious and sacred spaces. Thus, sacred trees like the banyan and peepal should be protected where present around lakes. Further, there should be provision for washing of clothes and cattle washing in a confined upstream enclosure, without polluting the lake. Controlled harvesting of grass for grazing should be permitted at the marshy end, as this will prevent the lake from being encroached by grass.

Finally, governance processes for lake maintenance need to be clearly formulated. Lake monitoring and maintenance should involve local communities, elected representatives, government officials, schools and colleges, researchers and NGOs, and disadvantaged groups. Regular monitoring of water condition, pollution and biodiversity needs to be conducted across all lakes, and nearby schools and colleges should be involved in such studies, resulting in greater local awareness and involvement, as well as in building local scientific capacity.

Conservation in urban settings requires concerted, committed action from a number of sectors that takes into account principles of ecology, along with a proper recognition of the role played by nature in an urban setting, where recreation, access to greenery, and considerations of technical and economic feasibility must simultaneously incorporate the requirements of citizens from varied socio-economic and cultural backgrounds. Consequently, the challenges of urban conservation remain severe. Collective action by a number

of sectors, including the government, local citizens, researchers, NGOs, and business is required to make effective progress towards sustainable ecological and environmental planning. Yet, this is hard to achieve in the context of life in an urban environment, where the social, cultural, and linguistic heterogeneity, coupled with economic inequalities, make it particularly challenging to create social capital and facilitate collective action.

A series of 'design principles' outlining conditions that can facilitate successful collective management of natural resources were formulated by Elinor Ostrom.²⁶ These include the need for the people affected by management of natural resources to provide some inputs into making rules related to their management; for regular monitoring of the resource and prompt punishment of offenders; and for people who maintain the resource to have the assurance that they will continue to have rights of management over the long-term. None of these hold true in the Indian city context.

Yet, the experiences in Bengaluru, and some other Indian cities indicate that sustained engagement by citizens can result in change. While the progress achieved may not be optimum or ideal, it does represent a step forward, and the social capital and potential for collective action that has been built can be capitalized on for future urban conservation initiatives. After many decades of neglect, lake management in Bengaluru shows some signs of hope. If citizens of Bengaluru can mobilize the administrative and political will to sustain these programmes at a larger scale, then there is truly some hope for a green urban future.

26. E. Ostrom, *Understanding Institutional Diversity*. Princeton University Press, Princeton, New Jersey, 2005.