

What is the problem with Bangalore's lakes?

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- ❑ Lake problems are closely related to changing lake functions over time.
- ❑ Lakes are polluted by domestic sewage and industrial effluents; so, they no longer support functioning ecosystems or water for human use.
- ❑ Lakes are drying because they are increasingly disconnected from stormwater channels.
- ❑ Lakes have reduced ability to buffer floods because they are perennially full due to sewage inflows. Also, stormwater drains have been significantly modified.
- ❑ A major barrier to solving these problems is that there is no agreement among stakeholders on what the role of the lakes in the urban context ought to be.

This article is the first in a multi-part series on lakes that aims to provide a comprehensive overview of lake - related problems in Bangalore and approaches to address them. This article explains how these problems are closely related to changes in lake functions and the hydrology of the city over time.

WHAT IS THE PROBLEM WITH BANGALORE'S LAKES?

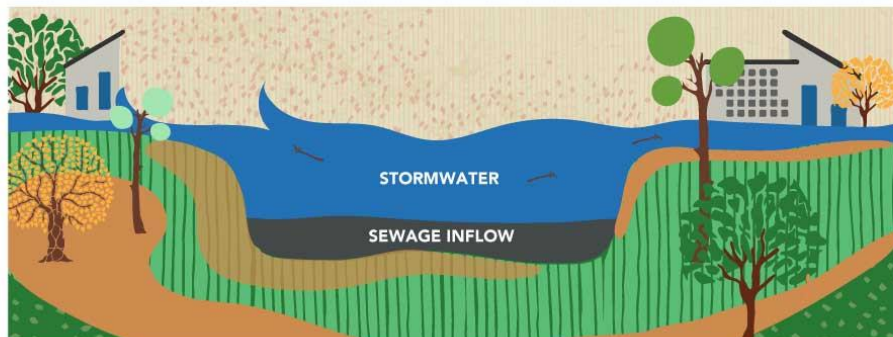
LAKES ARE POLLUTED



LAKES ARE DRYING UP



LAKES HAVE REDUCED ABILITY TO BUFFER FROM FLOODING



Credits: Sarayu Neelakantan

Lakes in Bangalore are either degraded or face an imminent threat of degradation. Many lakes are shrinking. Parts of the city face water-logging and floods.

Lake problems are closely related to changes in lake functions over time.

Despite their multiple benefits, lakes are at the receiving end of Bangalore’s rapid urbanisation. To restore lake health and manage lakes sustainably, we need to understand the problem comprehensively.

Bangalore’s lakes have multiple functions ranging from water storage and groundwater recharge to supporting ecosystems as wetlands (Figure 1). Over the decades, some of these functions have changed or been lost due to urbanisation.

There are visible signs that lakes are in trouble

Some of the clear signs of lake degradation are foul smell, algal blooms, fish deaths, frothing, and even occasional fires.

Water is polluted from untreated sewage and industrial effluents flowing into the lakes. Illegal dumping of municipal solid waste and biomedical waste adds to the problem.

On one hand, dry lake-beds even post-monsoon and shrinking lakes are visible signs that lakes are becoming disconnected from their water sources. On the other hand, floods in low-lying areas during heavy storms are a problem, causing damage to livelihoods and property, disrupting lives. But the connection between urban floods and lakes is often not recognised.

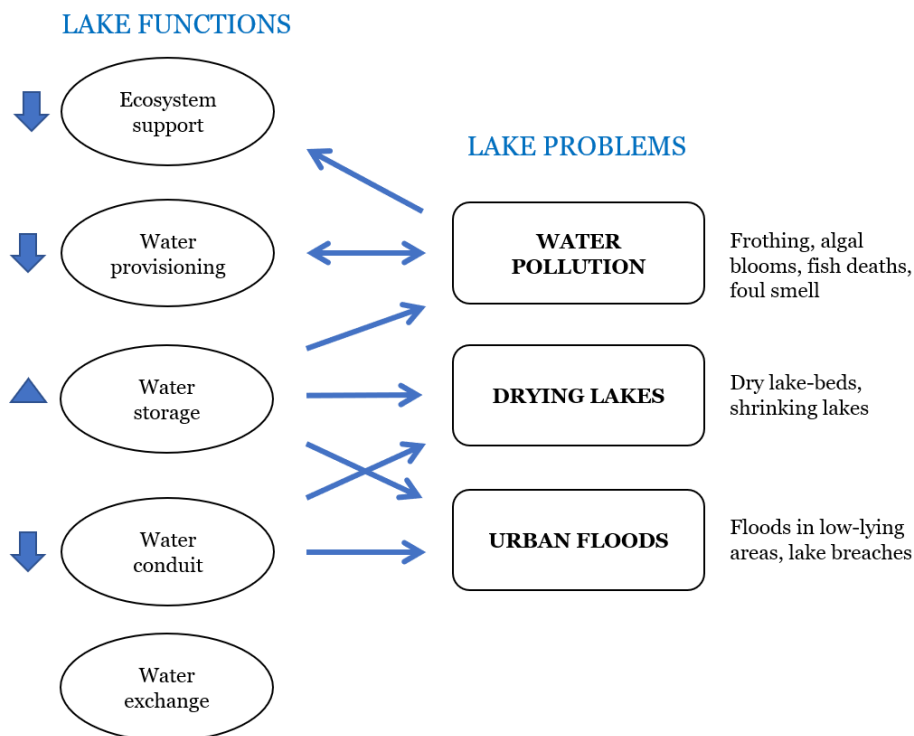


Figure 1: Lake problems are related to changes in lake functions



Apartment discharging wastewater into Bellandur lake's stormwater drain, 2017 [Photo Credit: Shashank Palur]

Understanding lake pollution

Lake pollution is both cause and effect of the reduced importance of lakes as water sources. Lakes are polluted primarily because raw or partially treated sewage inflows. This severely compromises lake health and adversely affects its ability to support biodiverse ecosystems.

Therefore, lake water is no longer directly usable [1]. Moreover, as Bangalore's water supply is now completely dependent on imported sources of water, there is lesser incentive to protect lake health.

Lakes are severely polluted with domestic sewage and industrial effluents.

Raw sewage flows into most lakes along with stormwater. Even in lakes with sewage treatment plants (STPs), the treated water is rich in nutrients such as nitrates and phosphates. Interventions such as constructed wetlands to control nutrients have not been very effective [2]; therefore, eutrophication continues to be a serious problem. Industrial effluents and heavy metal contaminants further decrease lake health.

In case of frothing and fires in lakes, competing hypotheses debate the processes behind these phenomena. There are no conclusive explanations yet.

Lakes no longer support functioning ecosystems.

Water pollution adversely affects the lakes' ability to support ecosystems. We see visible signs of lake degradation today through a decline in lake supported biodiversity and ecosystem services.

Healthy lakes support ecosystems of flora and fauna in their vicinity and contribute significantly to the larger ecosystem of the region. They provide livelihoods to fishermen, water and fodder for cattle and other animals, and various uncultivated plants for foraging to people. Lake ecosystems also serve as habitats for migratory birds [3].

In polluted lakes, nutrients cause excessive growth of plants and algal blooms. This leads to large daily fluctuations in dissolved oxygen in water, often causing fish deaths [4]. As a result, we observe a reduction in migratory birds visiting lakes. Water pollution also impacts the local groundwater quality and soil.

Additionally, the vast amounts of organic matter deposited in lakes have caused a substantial decline in their storage capacity over the years.



Cyanobacteria – harmful algal blooms at Rachenahalli lake, Bangalore, 2019 [Photo Credit: Shashank Palur]

Lakes no longer provide water for human uses.

With urbanisation and rapid growth, there has been a gradual loss in the lakes' provisioning function i.e. the lakes' ability to provide water for human needs. Lakes that once provided for domestic and irrigation needs are now filled with Bangalore's wastewater. With the advent of water imports into the city, we have eliminated the role of lakes as water sources and thus, disincentivised maintenance of lake health. Further, different agencies manage different aspects of the lake with little coordination amongst them.

Lakes in the region are human-made water bodies. They were historically designed to collect and store rainwater to meet domestic, livestock, and irrigation water needs during dry months. Only a handful of tanks (like Sankey tank) were built primarily for drinking water. With the growing population, however, the city's water needs are met by importing water from distant reservoirs – beginning first with the Hesaraghatta tank to the Krishnaraja Sagara reservoir on the Cauvery at present. In the process, the

function of lakes as domestic water sources has been lost [5]. One consequence of this is the missing urgency to protect lake catchments and prevent pollution.

Most lakes in the region were originally designed as irrigation tanks, many centuries ago. Taking advantage of the undulating topography of the area that is now Bangalore, the tanks were interconnected through *raja kaluves* or stormwater drains into cascading series that overflowed into one another.

Neergantis or watermen operated sluice gates to control the release of water for irrigation. Tank water was used for paddy cultivation in the “command area” downstream of the tank.

With urbanisation, the changing economy of the region and the rise of borewells, tank-fed irrigation declined and collapsed. Today, lakes no longer function as irrigation tanks; the sluice gates are all sealed. Even in rural areas near Bangalore, where agriculture is still prevalent, irrigation tanks only function as recharge structures; irrigated agriculture has become entirely groundwater based.

There is one exception. In peri-urban areas downstream of Bangalore, irrigated agriculture still uses water from lakes; but they are filled with Bangalore's untreated sewage and industrial effluents. Here, polluted water poses health risks to farmers and consumers [6]. As this occurs outside the city, we have made little effort to address this problem, despite occasional news articles documenting heavy metal contamination of vegetables and milk entering the city.

Understanding lake drying and shrinking

Today, lakes are increasingly disconnected from each other and from the drains. We witness the effect of this as lake drying/shrinking on the one hand and urban floods on the other.

Lakes are increasingly disconnected from stormwater channels.



Temporary diversion channel carrying stormwater and wastewater away from Bellandur lake towards Varthur, 2020 [Photo Credit: Sumita Bhattacharya]

In a functioning cascading lake system, lakes play an important role as conduits. In each series, water from an upstream lake flows into the downstream lake, via the stormwater drain. Urbanisation has changed this. Some drains that allow stormwater to flow into the lakes have been cut-off due to land conversion or encroachment.

More recently, we have diverted drains from some lakes to block wastewater entering lakes. This is because stormwater drains also carry sewage from non-sewered areas and from slums and apartment complexes. Ironically, this intervention has had a “throwing the baby out with the bathwater” effect in some lakes. These lakes remain dry even after

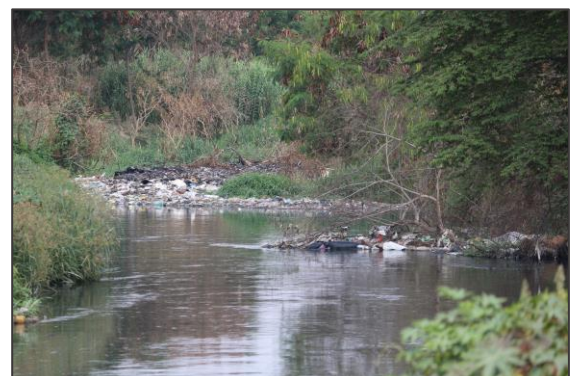
the monsoon season because very little stormwater enters the lake, even during heavy rains.



Dried parts of Bellandur lake due to temporary diversions, 2020 [Photo Credit: Sumita Bhattacharya]

Many lakes have been encroached or completely converted.

Over time, government policy has led to conversions of lake land into other urban uses. In the early stages of urbanisation, the government legally converted several lakes into public buildings, residential layouts, stadiums, and bus stands. Concomitantly, the survival of lakes was threatened by illegal land use conversions and lake-bed encroachments. This continues till date.



Garbage dumped along the drains of Bellandur lake, 2017 [Photo Credit: Shashank Palur]

Lake storage is further hampered by illegal dumping of construction and demolition

(C&D) and solid waste on the lake bed. As a result, water spread area and buffer area has reduced in many lakes.

Understanding urban floods

Urban flooding often occurs because lakes are filled throughout the year.

With urbanisation, the function of lakes as storage structures has changed. Lakes have transitioned from rainfed, freshwater bodies to rain and wastewater-fed, perennial water bodies.

In the past, lake catchments were predominantly rural with vegetation cover. Rainfed lakes were freshwater sources for the community. Downstream lakes received overflows from upstream lakes. Water storage in lakes was cyclic, with lakes being full during monsoons and partly drying out during summer months.

Today, lakes receive wastewater in addition to stormwater from rainfall. As the city's water consumption has grown tremendously, so has the wastewater generated [6]. Myopic planning and inadequate wastewater infrastructure have led to the perennial flow of wastewater into lakes. As a result, many lakes are full throughout the year and have no "room" to capture floodwaters.

Therefore, even in cascading lake series that are well-connected, lakes are unable to buffer against stormwater inflows during intense rainfall. As a result, we regularly witness lakes breaches and overflows into low-lying residential areas, contributing to the urban flooding.

Urban flooding also occurs because the channels carrying stormwater have become narrow or blocked.

The flow of water from one lake to another is adversely impacted by the reduced width of the stormwater drains and encroachments. The carrying capacity of drains is reduced by siltation and accumulation of municipal and construction waste. At the same time, during rains, lesser water infiltrates into the ground today as the city's green cover has made way to paved surfaces. So, excess stormwater has little space to flow into. The twin changes of reduced lake storage and drainage capacity along with increased stormwater run-off causes recurrent waterlogging and floods in the congested areas and low-lying regions near lakes.

Why do lakes continue to be in trouble?

Lakes in Bangalore face a "ladder" of problems. Over the past century, several lakes disappeared outright due to land conversions. This has slowed as consciousness on the role of lakes has grown. Of the remaining lakes, some are drying as they are being increasingly disconnected from their water sources. Others remain full throughout the year, are often polluted and face flood risks during intense rains.

Lakes receive the city's wastewater in addition to stormwater. In some lakes, the stormwater pathways are deliberately diverted to prevent the entry of raw sewage, this often cuts off the lake's water sources. Few lakes do receive treated water from sewage treatment plants, yet

this water is not scrubbed of nutrients that cause eutrophication and algal blooms.

The lake problem is the outcome of the rapid urbanisation of Bangalore. Despite much discussion on lake restoration, many questions remain unsettled.

First, we disagree on what their purpose should be. Should lakes should remain as seasonal freshwater storage structures (as they were originally designed) or be reimagined to accommodate the city's treated sewage?

Second, we disagree on what to do about both about current and historical (legacy) pollution, particularly lake sediments containing heavy metals and whether lakes should even be desilted and if so, how the sediment should be disposed of.

Finally, even where we agree on the goals of restoration (both on the broad objectives and targets for lake storage and nutrient levels), the “science of lakes” is not fully settled. Experts disagree on what the outcomes of different interventions would be as well as the costs and benefits, and potential unintended consequences.

In upcoming articles, we will discuss how to craft solutions around lakes, given these

divides and the incompleteness of the data available.

Acknowledgements

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Suggested Readings

[1] Karnataka State Pollution Control Board Bangalore region lakes water quality classification for April 2018 – September 2018.

[2] Bharath Joshi, 2016, Bengaluru's Jakkur Lake turns wasteland; redesign begins. *The Economic Times*.

[3] Seema Mundoli, Manjunatha B. & Harini Nagendra, 2018, Lakes of Bengaluru: The Once Living, But Now Endangered Peri-Urban Commons (Working Paper No. 10). Azim Premji University.

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