Socio-ecological System of Urban Lakes
Case of Jakkur Lake Precinct, Bengaluru

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Abstract

The study is focused on changing role and state of nature of urban ecological systems due to rapid urbanization. The research takes forward one of the eco-city dimensions in sustainable urban development - Water systems that play a key role in the formation and transformation of cities. The paper investigates the relationship of water with urban morphology in Bengaluru city. Bengaluru once known as the ‘land of thousand lakes’ is no longer the city of lakes. The city of Bengaluru is an example of how the harmonious relationship of people and water has been disrupted over the years. My exploration is on re-imagining the cascading lake system in Bangalore as a new green system, and prioritizing ecology as the underlying structuring and organizing element to city form. To re-instate nature in the mega city development for the garden city of Bangalore. To develop the city as a compact mix-use urban form that uses land efficiently and protects the natural environment, lake system and biodiversity. A holistic development of this manner will enable replenishing of water sources in an urban area and restores water balance in the city.

Keywords

Eco-city, Water sensitive urbanism, Sustainable Urban drainage strategies, urban lakes system

1. Introduction

1.1. Overview

“If one were to study the “water history” of a place then each city would have its own story to tell about its engagement with water through its historic revolution.”-Charles Moore

The research focusses on making cities urban development in response to the ecological systems and understanding the changing role and state of nature and urban ecological systems in the midst of urban sprawl and rapid urbanization. Rethinking the relationship between architecture, planning, urban design, water and man in a contemporary context. The current urban scenario of water and its changed association with people as a mere commodity has been one of the driving factors that has led to question its current state of desolation. Urban Lakes are one of the key elements responsible for environmental sustainability. It is brought about through various processes, like regulatory services- regulate the environment, supporting ecosystem services - provision of habitat for migratory birds and provisioning services for supporting livelihoods in the city.

There is need to integrate water systems within urban development in holistic way so that they can remain valuable community assets that enhance liveability and support the ecosystems that rely on them. Urban development along water system is an important interface between planning and ecology which demands environmentally responsive strategies. Urban patterns of development need to adopt itself in response to the natural environment. The lake system can revive where they co-exist with the urban form and guide urban morphology in response to ecological systems. Therefore, in this research.
the site for demonstrating a proposal for holistic development is chosen on the peripheral areas of the city where the interlinked lake system still exists, and new development can be shaped around the water system. The research is a step further in bridging the gap between theory and practice by incorporating models of water responsive urbanism to develop lake area development plan for interlinked lake system of Bangalore. My exploration is on devising sustainable urban design principles for eco city development in the city of Bangalore with its rich resource of lake system making ecologically based new urban development.

1.2 The Socio-Ecological System (SES) approach

A social-ecological system can be defined as a set of critical resources (natural, socio-economic, and cultural) whose flow and use is regulated by a combination of ecological and social systems. The concept of Social-ecological systems is based on the understanding that humans are a part of not separate from nature and emphasizing that humans must be seen as a part of, not apart from, nature. This concept, which holds that the delineation between social systems and natural systems is arbitrary and artificial, was first put forth by Berkes and Folke, and its theory was further developed by Berkes et al. The SES approach holds that social and ecological systems are linked through feedback mechanisms, and that both display resilience and complexity. This approach has been applied to the urban lake system of Bangalore city, to understand the relationship of community and water resources and develop a proposal for water sensitive urbanism. Recognizing that lakes have more than just aesthetic and recreational value to the people inhabited around it and there is the need to connect local communities back to water and their livelihood dependent on it.

1.3. Issue Articulation

Urbanization and rapid growth of population resulted in a high demand for housing and intensive land use. As Bengaluru is transforming from a metro city to a mega city, the worst hit sectors are the ecological assets-lakes which are being misused, causing water scarcity and loss of biodiversity in the region. An analysis of the land use change over the past four decades shows consistent decline in the number of water bodies and an increase in the built-up area. A city that constituted as much as 5% lake area is now being represented as a downward curve dropping down to as low as 0.53%.

Due to rapid growth in the city many lakes and tanks were dried up and converted into buildings and housing layouts damaging the chain of lakes. The marginal lands adjoining natural valleys, which were open spaces where the trunk sewers were laid are encroached by buildings and sewage are let out into the storm water drains constructed in these valleys. The loss of inter connectivity in the water bodies has resulted in the shrinkages of wetland area, reduction in water yield from the catchments and water holding capacity. In the absence of the channels that harvested flow of storm water along the natural slopes, water is now flowing away from Bengaluru.

This has affected the total rainwater harvesting mechanism and reduced capacity of Bengaluru lakes.

The city was built by Kempegowda I (feudatory ruler under the Vijaynagara Empire established Bengaluru as the capital of his erstwhile kingdom in 1537) in the 16th century on the lake system by impounding water in natural catchment areas serving as a source of water essential for its sustenance. People revered the lakes as they were essential for daily needs and recreational purposes. For over 300 years prior to the royal British encounter till the 19th century, the lake was the lifeline of the city, since it was its primary source of drinking water. It was called the ‘jeeva kere’ (lifeline) for this reason. (Nature in the city, Harini Nagendra 2016).
As the water demand increased, piped water supply from Hesarghatta lake began to be supplied and people forgot the importance of local sources of water. Hence this led first to the depletion of the surface water now moving towards the depletion of ground water. This has transformed centuries-long, strong relationship between people and nature. Unplanned and haphazard urbanization in the peri urban areas has caused exploitation and encroachment of natural assets in the city such as parks, water bodies and open areas.

Lack of preservation of the ecology and the natural valleys has led to development in the valley causing disruption to the flow and interlinkages. Urban patterns of adhoc development often make water systems and lakes inaccessible to adjacent neighbourhoods. Lack of access limits a community’s ability to reap the benefits of living so close to the water, whether through recreation or access to real estate.

2. Existing site Study

2.1. The Bangalore city

Bangalore once known as the ‘land of thousand lakes’ is no longer the city of lakes. The city of Bangalore is an example of how the harmonious relationship of people and water has been disrupted over the years. It’s to unearth the effects of urbanization on lakes in Bangalore and devise urban design principles for co-existence of ecology and urban form where the natural environment permeates the city’s spaces and embraces the city. The attempt of this paper is to come up with possible ways to re-establish the harmonious relationship of humans and water in contemporary times.

The focus is on water sensitive urbanism for the city of Bangalore. The study area is Yelahanka and the surrounding precinct near Jakkur, a suburb of North Bangalore in the state of Karnataka. The region has a rich history which is older than the Bengaluru city and has now overgrown into neighbouring areas engulfing many of its neighbouring villages and towns. Yelahanka New Town is a well-planned township which was developed during early 1980s by Karnataka Housing Board (KHB). The settlement of old town and new town are inhabited by different social groups and have varied social and cultural background. The fabric is fragmented due to the industrial development along the railway line.

The detailed study of Yelahanka and Jakkur region, analyzing networked lakes with settlements dependent on it for cultural, recreational, economic, religious and social aspects. The existing urban morphology and socio-economic background of the population near each of the lake is very different. It gives rise to different interactions with nature and constitute unique social and ecological interfaces.

This research study is focused on lakes of Hebbal Valley in the north - Yellamallappa Chetty lake series. The study area-Yelahanka has 5 interlinked lakes surrounding it: Old Yelahanka lake, Jakkur, Puttenhalli, Attur and Allalasandra.

2.2. History

The Yelahanka site chosen is on peripheral area of the Bangalore city which is witnessing rapid urban growth. As per some historic records, the old city of Yelahanka had been in existence prior to 12th century. Kempe Gowdas are the most acclaimed rulers among the numerous rulers of different dynasties who ruled with Yelahanka as their Capital. Some of the temples in Yelahanka like the Venugopala Swamy Temple bear testimony to its rich past. Even though the Fort’s remnant could not be traced yet, a street nearby the Venugopala Swamy Temple is still known as ‘Kote Beedi’ or ‘Fort Street’, indicating the presence of its heritage.

The site is in the northern peri-urban area with the Jakkur lake being one of the primary lakes and along the primary stream in the Hebbal Valley. The site is situated in the planning zone B with development regulations applicable for densifying the existing region. and it corresponds to planning district 20.
2.2. Demographics

Bengaluru is India’s fourth largest city. With a population of over 10 million cramped into an area covering 709.5 sq. km, the greater Bangalore metropolitan area experienced a massive growth spurt of 49% between 2001-2011. (Patil et al. 2015).

As per Census 2011, Planning District 20 has a decadal growth rate of 97.49% (2001-2011) and workforce participation rate of 42.09 % of the population. The gross density is 41.8 pph, whereas the average residential density is 271.90 pph. The gross density is highest in Yelahanka Satellite ward (86pph) and the least in Jakkur ward (22 pph). There are 55,728 households (2011), with an average household size of 4.1.

2.3. Ecological system of lakes evolution

With respect to the city’s topographic setting, the Bangalore region is situated in an ecologically sensitive area with respect to water resources. It is one of handful urban agglomeration in the world situated above 1000meter mark; the city is sited on a plateau with catchments in all directions draining away from the city. (RMP Bangalore 2031). The city’s undulating terrain divides the city into roughly three equal sized triangular valleys, each containing an interconnected network of lakes.

The city has a radial slope towards east and west with a smooth ridge running north to south forming valleys of Koramangala–Challagatta, Hebbal and Vrishabhavathi. Doddabettahalli. At 1,062 m (3,484.3 ft) Doddabettahalli is the highest point on this ridge. As a result of this topography the lakes forms a chain of reservoirs in each of these three valley systems. Each valley at the ridge top gives birth to small streams and low-lying areas into water bodies connected by this stream. These interlinked water bodies cascades down to form major stream systems in three valleys- Hebbal Valley, Koramangala & Challaghatta Valley and Vrishabhavati Valley. These valley systems are the repository of all the numerous lakes in Bangalore and these lakes themselves are interlinked to each other through a series of water streams giving a cascading effect to the whole system. This research study is focused on one chain of lakes in Hebbal Valley in the north - Yellamallappa Chetty lake series.

History of water tanks:

Artificial water bodies are built by throwing an earthen berm across a valley to store water for irrigation purposes. Most of Bangalore’s lakes are irrigation tanks, built over the course of many centuries which were built as tanks with high bunds to store water. In the 16th Century, Kempegowda, the then king-built tanks and irrigation wells as well. Traditionally these tanks were interlinked through a chain or cascade system and ensured water overflowed into the lower one.

Central Bangalore had 1960 open wells in 1885 but at present there are fewer than 50 (Harini Nagendra: Nature in the city, 2016). Bangalore lost many of its lakes and water bodies, because they were filthy breeding grounds for malaria, and subsequently encroached or converted to bus stands, malls, housing
layout, and other built spaces. According to government records, till 1960 there were 262 water bodies in Bangalore. Today the figures have declined to about 81 lakes of which only 34 are recognized as living lakes in the city. These figures denote a 35% reduction of water bodies while in terms of water spread area it shows a decrease of 8.6%. (Source: karnataka.gov.in)

The site selected for study is in the peri urban areas of Bangalore. A macro scale analysis of topography and slope analysis around Jakkur lake precinct is conducted to assess the vulnerable zones around the lake. The primary, secondary and tertiary streams and valleys leading to Jakkur lake and away from Jakkur lake to other lakes downstream were identified. Flora and fauna analysis was done to retain vegetation and forested area in the site to protect the biodiversity.

Due to lack of respecting existing natural topography and terrain present development pattern is happening in a haphazard manner and encroachment of ecologically sensitive areas.

![Figure 2 The connected lake system in the peri urban area of Yelahanka](image)

2.4. Transportation system

The site is bound by Airport expressway and national highway on west side. The proposed road network intersects with the existing buffer zone proposed by NGT and overlaps with the buffer zone at multiple points.

There is no proposal for integrating multiple modes of transport. Although railway station and proposed metro station lie in proximity to each other. The proposed multi mobility hub is in the low-lying area close to the lake.
3. URBAN DESIGN FRAMEWORK

3.1. Vision

The city as a compact, mixed-use urban form that uses land efficiently and protects the natural environment, lake system and biodiversity. The open spaces along the valley with seasonal water traversing majority of the area can serve as eco-mobility network within the city allowing for people to move safely. It will help to create an extensive network of alternative routes for pedestrians, cyclists and other NMT usage which is linked to city’s public transport system.

3.2. Design strategy

The primary focus should be on ecological processes that shape urban form, protection of the city’s natural water systems, priority to the development of conditions for non-motorized modes and human oriented development pattern.

Lake Precinct Development Plan

Re-imagining the lake as the new green system and organizing element to city form as the garden city of Bangalore in the peripheral areas of the city. The city as a compact, mixed-use urban form that uses land efficiently and protects the natural environment, lake system and biodiversity.

The objective is to develop an eco-sensitive planning and development model for sustainable lake area development that helps in replenishing water resources and restoring the water balance in the city. An eco city planning and design approach with priority to the development for non-motorized modes and human oriented development pattern

Stream development plan:

The water streams that are presently serving as drains need to be revived. As the sub-drain infrastructure is cleaned up and incorporated with blue green infrastructure, the sewage will be removed, and the drain will be filled monsoon water. Sustainable urban drainage strategies- detention, retention and infiltration along the streams and adjoining area need to be implemented. This will provide with an opportunity where diverse greenspaces and built spaces of essentially equal value spatially intertwine. The open spaces along the valley can serve as eco-mobility network within the city which can provide alternate mobility in the city interlinked to public transit nodes.

3.4. Urban Design Principles for lake area development

Urban Design principles to create lake area neighbourhood development plan by planning a highly walkable neighbourhood, promote compact high density mix use development, and create eco mobility network and public spaces.

Structure the overall neighbourhood area with a cohesive vision for future. Develop movement and integrated connections with the rest of the city and the open space network. Develop the NGT buffer as an open space network with NMT and eco mobility corridors. Lakes as social nodes in the neighbourhood i.e. they have social, cultural, environmental value to it as well. Develop ecological Infrastructure with respect to water systems and physical setting to guide future urban development in terms of – form, density and height, character, and scale. Revise zoning and design guidelines to promote mixed use integrated development.
Urban Design Guidelines for the 1km radius around Jakkur Lake:

- Vehicular Buffer: 500m
- Green spine to integrate the area spatially along the water body
- Social Infrastructure aligned along the green spine
- Landuse to be designated as public/ institutional/ green along the stream and water body
- Retain the lake edge as a public realm
- Integrate the traditional cultures and activities along the lake
- Promote plantation and agriculture in the area
- NMT network to be designed integrated to the public transit

Figure 3 Demonstration of a Structure plan for Lake area Development around 1km around the lake precinct.

3.5. Conclusion:

The research has focused on understanding the underlying natural processes and ecological systems in the region and framing key urban design principles and design-oriented dimensions that can be adapted for sustainable city development. The water linkages which generally acts as a buffer between the two demographics, can be used to stitch the communities together through a public spine that facilitates organization both laterally and longitudinally.

With this, all the existing lakes and storm water infrastructures of the city are better integrated in the public space of the city and made accessible for local people and their livelihood. The idea is to bring people closer to the water and water closer to people in the built environment and at the same time integrate water collection into the urban scheme.
4. References


