

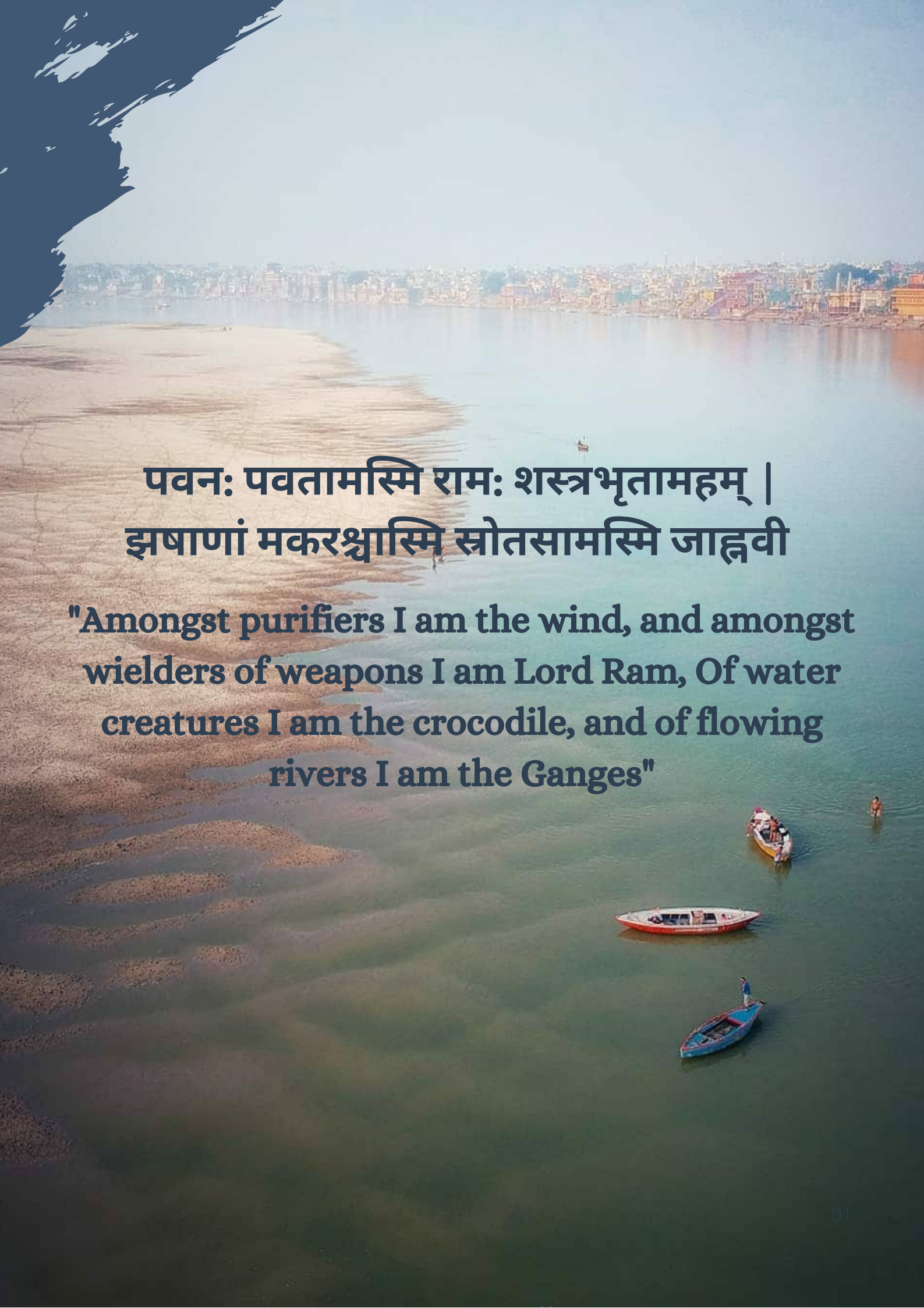


# Re-imagining Urban Rivers

*Sponsored Thesis Competition*








पवनः पवतामस्मि रामः शस्त्रभृतामहम् ।  
झषाणां मकरश्चास्मि स्रोतसामस्मि जाह्नवी

"Amongst purifiers I am the wind, and amongst  
wielders of weapons I am Lord Ram, Of water  
creatures I am the crocodile, and of flowing  
rivers I am the Ganges"

A scenic view of a river at sunset. The sun is low on the horizon, casting a warm, golden glow over the scene. In the foreground, several small wooden boats are moored along the riverbank. The riverbank is lined with stone steps (ghats) where a few people are visible. In the background, there are multi-story buildings and a tall street lamp. The water reflects the sunlight, creating a shimmering effect.

**“There is a need for new thinking for ‘River Cities’. Cities should be responsible for rejuvenating their rivers. It has to be done not just with the regulatory mindset but also with developmental and facilitatory outlook.”**

*Hon’ble PM, Shri Narendra Modi during chairing the first National Ganga Council Meeting on 14th Dec 2019*

# Acknowledgement

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Hitesh Vaidya, Director, National Institute of Urban Affairs

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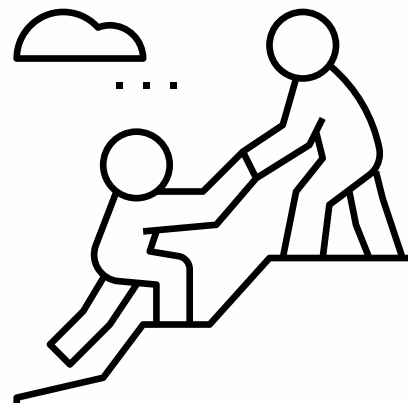
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# CONTENT

- Introduction
- Brief on Thesis Competition
- Detailed Summary of Projects
  - Project 1 - *Enhancing the Urban Water Experience- Rejuvenating Kaliasot River, Bhopal*
  - Project 2 - *Reviving the Traditional Water System Through Cultural Heritage Conservation Based on Traditional Knowledge Systems: Kunds of Govardhan*
  - Project 3 - *conservation strategies for historic town sultanganj, Bihar*
  - Project 4 - *The somber case of an odd triad – Dolphin, Man and Zoonoses*
  - Project 5 - *Planning for Integrated Sustainable Tourism Development: Case of Ayodhya*
  - Project 6 - *Reconnecting the City to its Riverfront- A case of North Kolkata*
  - Project 7 - *Economic appraisal through effective riverfront development- role of rivers in mitigation of urban heat island and climate change, Case of Yamuna bank, Delhi*
  - Project 8 - *Ecologically reclaimed natural levees: Spatial design for socio- cultural and ecological reconnect in Patna and beyond*







## *Few Thoughts: Re-imagining Urban Rivers*

Managing urban rivers is an emerging paradigm in India, which requires new models of thinking, planning, and implementation. NMCG, in association with the National Institute of Urban Affairs, has initiated significant work on this front since 2018. However, there is plenty of room for blue sky and innovative thinking, something that is vital for holistic and integrated urban river management. This thesis competition on “Re-imagining Urban Rivers” was organized for precisely this purpose—to tap into the intellect and creativity of young minds from academia to arrive at unique solutions for re-imagining the outlook and management of rivers that flow through cities.

It was very encouraging to see the project ideas that were shortlisted, which ranged from river rejuvenation, to river-related economy, to valuation of ecosystem services, to enhancing the river-city connect, among others. This document presents a succinct summary of each of the project ideas, highlighting the conceptual structure as well as the overarching outcomes.

While one of the purposes of the initiative was to encourage students to inculcate river-sensitive thinking in their project work, NMCG and NIUA also had the opportunity to learn new and distinct aspects of urban river management from the work of the students. Clearly, it was a win-win situation for everyone involved. The enthusiasm and support received from the students’ institutions was overwhelming, which paved the way for smooth implementation of the research.

I congratulate all students for their exemplary work, which is inspiring and in so many ways a ‘torchbearer’ for further work in this domain. I also congratulate my team from NMCG and NIUA for conceptualizing this initiative, and implementing it with aplomb.

*Rajiv Ranjan Mishra*  
*Director General,*  
*National Mission for Clean Ganga*

## Introduction

Ganga is one of the most revered rivers in India. The Ganga River basin is one of the largest River Basins of the world. The river itself, which flows through the Indo-Gangetic plains before merging in the Bay of Bengal through the largest Delta of the world, is a source of livelihood and economic generation for millions of people. However with the rising development activities within the basin, the river has been facing critical issues related to pollution, flooding, loss of biodiversity, depletion of water resources and shrinking citizen-connect with the river. These issues, directly contributed by the ongoing anthropogenic activities along with the added impacts of climate change, have emphasised the need for appropriately planned interventions related to rejuvenation and management of urban rivers and their associated resources.

Namami Gange is a flagship programme of the Government of India, is handling the task of rejuvenation of river Ganga and its tributaries. In order to achieve this, the National Mission for Clean Ganga (an implementing authority under this program) has developed a comprehensive approach incorporating different aspects like wastewater management, solid waste management, abatement of industrial pollution, riverfront development, biodiversity conservation, afforestation schemes, planning for urban river management and wetland conservation.

Cities have often been described as engines of growth and the driver of them urbanization but what empowers 'River cities' further is a natural symbiotic relationship a city shares with the River in their midst. From sustaining a habitat, to the social, economic connotations garnered through people interactions, the river has played a multifaceted role for cities. However, River cities continue to expand and develop, creating an additional load for water extraction and pollution on rivers. Much of the current undesirable state of the River Ganga can be attributed to these disruptive anthropogenic activities, which somehow are more prevalent in urban areas (cities). Therefore, any improvement in the river health cannot be achieved without first addressing the issues and drivers in urban areas. Cities in the Ganga River Basin, hence, will have a central role to play in the rejuvenation and replenishment of the River Basin.



Under this integrated mission for conservation of river Ganga and its tributaries, the National Institute of Urban Affairs is implementing a project on planning for urban river management, titled 'Addressing Urban Drivers of Human Health in the Ganga River Basin'.

This student competition has been conceptualised jointly by the National Mission for Clean Ganga (NMCG) and the National Institute of Urban Affairs (NIUA) under the afore-mentioned project, to get a fresh perspective over addressing the concerns regarding rejuvenation and management of urban rivers. Young minds often have the unique ability for blue-sky thinking, which may just be what is required to address such a complex phenomenon.

National Mission for Clean Ganga (NMCG) and the National Institute for Urban Affairs (NIUA) organised this 'Re-Imagining Urban Rivers', a national level thesis competition in September 2020, under a joint project that the two organizations are implementing to promulgate river-sensitive development in our cities. This is a first of its kind initiative to engage young minds to research and envisage solutions for urban river issues. The purpose of this sponsored thesis competition is to tap into the intellect and creativity of students to arrive at innovative solutions for re-imagining the outlook and management of rivers that flow through cities and their associated features. The competition had three themes - Re-imagining water bodies and/or wetlands, developing eco-friendly riverfront projects and Promoting River tourism.

### **Objective of the competition?**

The purpose of the this sponsored thesis competition is to tap into the intellect and creativity of students to arrive at innovative solutions for re-imagining the outlook and management of rivers that flow through cities and their associated features. This competition provides an opportunity for students with relevant academic background to align their academic thesis research with the themes of the competition described in the next section.

#### ***Theme 1: Re-imagining water bodies and/or wetlands***

Water bodies and wetlands are intrinsically linked to rivers. Many wetlands are located near rivers, and act as a natural buffer to protect the river from pollution. They also serve as sinks when the water level in the river rises. Similarly, well maintained water bodies are an excellent avenue for groundwater recharge, which can complement the water supply in a city and reduce the stress on the river. However, in most cities water bodies and wetlands are in a sorry state. The first step for reversing this trend is to create a value for these features. And what we value, we usually care for.

#### ***Theme 2: Developing eco-friendly riverfront projects***

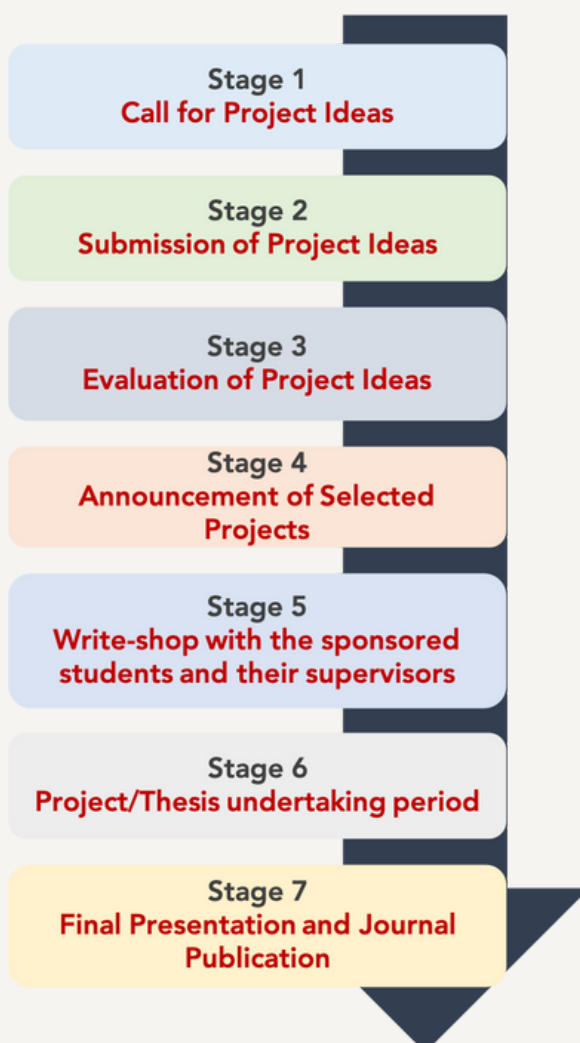
Riverfront projects add both aesthetic and economic value to the river. It serves as a medium to bring the rivers to the forefront. It is also a major avenue for recreational opportunities. In doing so, riverfronts become a wonderful instrument to connect citizens to the river, which is missing in many cities today. Riverfront projects are often envisaged as large projects such as shopping plazas, condominiums, promenades, etc but such projects can be implemented at much smaller scales as well in the form of ghats, biodiversity parks, gardens, etc.

### **Theme 3: Promoting river tourism**

In many parts of the world, river tourism has made considerable contribution to the city's economy. It supports the livelihoods of different sections of society, and therefore contributes to the overall development of the town. As a result, there is an inherent respect for the rivers among its citizens. The river tourism potential in Indian cities is relatively untapped. If harnessed in a sustainable and eco-friendly manner, it can go a long way in creating a tangible value for the rivers.



### **Timelines of the Competition**



After receiving a number of entries from across the country, and thorough assessment of proposal ideas from the students by external experts, 8 students were shortlisted for the sponsorship. Through the 6 months of their thesis duration, constant support from NMCG and NIUA were provided to the shortlisted students. A writeshop was also organized for the students to sensitize them of the River City concept and also the different new concepts introduced and worked upon by NMCG, NIUA and other partners. The purpose of this Write Shop was to help students in further fine-tune their project ideas, discuss data requirements for the thesis, familiarize themselves with the urban river management planning framework developed by NMCG and NIUA and have interaction with urban river management practitioners and experts.

The competition concluded with a final presentation before the eminent juries who were experts from the field on river rejuvenation components in the presence of Secretary, MoHUA, Shri Durga Shankar Mishra, Director General, NMCG, Shri Rajiv Ranjan Mishra and Director NIUA, Shri Hitesh Vaidya. These 8 finalist students from leading institutes across the country presented their thesis in the grand finale of the competition on 19th Aug 2021 at Indian Habitat Centre, New Delhi.

This competition provided an opportunity for students with relevant academic background to align their academic thesis research with the themes of the competition. The first prize went to Manju Rajeev Kanchan, School of Planning and Architecture, Vijayawada for “The somber case of an odd triad – Dolphin, Man and Zoonoses”, Deepanshi Singh, School of Planning and Architecture, Delhi, won second prize for her thesis on “Revitalizing Sultan Ganj Ghat” and third prize went to Rajorshi Banerjee, Sushant University for “Reconnecting the city to its riverfront – A case of Kolkata”. Students from more than 17 architecture and planning institutes in India participated in the competition. Eight best entries were shortlisted for final round.

The competition provided students with an opportunity to design blue sky and innovative solutions for re-imagining the outlook and management of rivers that flow through Indian cities.





*Sh. Durga Shanker Mishra, Secretary, MoHUA presenting 1st prize to Ms.Manju Rajeev Kanchan, School of Planning and Architecture, Vijayawada*



*Sh. Rajiv Ranjan Mishra, Director General, NMCG presenting 2nd prize to Ms.Deepanshi Singh, School of Planning and Architecture, Delhi*



*Sh. Hitesh Vaidya, Director, NIUA presenting 3rd prize to Mr. Rajorshi Banerjee, Sushant University*

## Eight Shortlisted students for sponsorship

1. Aman Sharma, SPA, Bhopal, “Reviving the traditional water system through cultural landscape conservation based on Traditional Knowledge System Approach: Kunds of Govardhan”
2. Saurav Kumar, CEPT University, “Ecologically reclaimed natural levees: Spatial design for socio- cultural and ecological reconnect in Patna and beyond”
3. Alvina Habib Khan, Jamia Millia Islamia, New Delhi “Enhancing the urban water experience – rejuvenating Kaliasot River”
4. Deepanshi Singh, SPA, Delhi, “Revitalizing Sultan Ganj Ghat”
5. Ritu Sharma, SVNIT, Surat, “Economic appraisal and mitigating urban heat effect through effective river-front development”
6. Rajorshi Banerjee, Sushant University, “Reconnecting the city to its riverfront – A case of Kolkata”
7. Manju Rajeev Kanchan, SPA Vijayawada, “The somber case of an odd triad – Dolphin, Man and Zoonoses”
8. Muddukrishna A. S., SPA, Delhi, “Planning for integrated sustainable tourism development: case study of Ayodhya”



### *8 Finalists*



An aerial night photograph of a river festival. The scene is filled with vibrant lights reflecting on the water. A large, dense crowd of people is gathered on the riverbanks and on a bridge. The bridge is illuminated with red and blue lights. In the background, a tall, illuminated tower stands prominently. The overall atmosphere is festive and lively.

*Detailed Summary of  
Shortlisted Projects*



# Project 1

## *Enhancing The Urban Water Experience- Rejuvenating Kaliasot River, Bhopal*

*Alvina Habib Khan,  
Jamia Millia Islamia,  
New Delhi*



Presence of waterbodies in an urban environment plays critical role in enhancing the quality and development of urban spaces. But often, non-perennial rivers are misinterpreted as drains due to impacts of urbanisation and anthropogenic activities, also because they represent a limited source of water that is renewed unpredictably. They are generally considered less valuable and worthy of conservation than their perennial counterparts.

Kaliasot river, Bhopal, a tributary of the River Betwa in the Ganga River Basin is on such urban river that flows through densely populated area and highly modified surrounding landscape, experiencing some intense interactions between its bio-physical and social realities. Due to its non-perennial nature and narrow width, it is neglected by the city and is considered a “Nala” drain by most of its residents, as a result it is merely a sink for solid waste and wastewater, what flows in the river throughout the year is untreated sewage poured into the river by the nallas and solid waste from the households. Encroachments also continue to threaten the health of this river.

For it to reclaim its values, it needs to restore its flow, the water quality, enhance its ecology, and provide a clean, aesthetic, green, public space through a sustainable rejuvenation and revitalisation project.

## **SITE**

The site is a approx. 3 Km Stretch of Kaliasot River, covering an area of 42.5 Acre (0.17 Sq Km) and varies 5-30m in width across the site. The stretch is surrounded by urban development (Damkheda Slums, Sarvardharam Colony Sector A, Sarvardharam Colony Sector B till Mandakini colony) predominantly residential housing one side and a city forest (Swarnajayanti Park) sprawling over 2 sq. Km on the other.



*Figure - Kaliasot River location in Madhya Pradesh and Bhopal*



## CHALLENGES

Right from its origin, river can be witnessed as a victim of urbanisation, subjected to pollution and degradation by the city dwellers. There is a 6-8-meter steep drop from the road to the riverbed, rendering the site inaccessible. Kaliasot dam in the upstream, controls the discharge of water into the river. Thus, rendering the river dry. Significant number of outfalls from discharge untreated sewage, along with storm water directly into the rivers, converting the river into a polluted 'drain'. There is a lack of sense of community, lack a sense of belonging and identity. Households adjacent to the river use it as their dump yard to throw solid waste into the river. River is subjected to pollution from anthropogenic activities like defecation, bathing, washing clothes, etc.

Climate change in the past few years have led to excessive increase in rainfall leading to flash floods due to opening of sluice gates of Kaliasot Dam and Bhadbahada Dam, this has led to loss of land and have rendered the structures adjacent to the river prone to danger of collapsing.

The river due to its non-perennial nature acts as a wetland for most part of the year and houses variety of plants, birds, fishes, etc. but due to the insensitivity of the residents towards river and ecology, increase in pollution is resulting in water which is unfit to support any aquatic life flows through the river in non-monsoon seasons resulting in migratory birds not visiting. Rivers is underutilized and neglected. Over the time, the river has been transformed into a polluted drain that the city has turned its back to.

## APPROACH AND VISION

In addressing the above issues, an urban solution to conserve the Kaliasot river is by rejuvenating the river and developing waterfronts which seeks to connects people to the water and provide habitat for species, enabling them to co-exist.

They are also essential to rectify the decades of neglect to the river by adding value to the same through an Ecological Approach. Vision is to create an ecologically sensitive, resilient, recreational space along the Kaliasot river, which is accessible with clean water flowing through the river.



## OBJECTIVES

The objectives to negate the negatives of this site are:

- To uplift the Soci-Economic, Recreational and Ecological value of the River.
- To activate the river edges through multifunctional zones.
- To preserve the ecology of the site
- To curb the pollution and sewage flowing into the river
- To minimize risk and impact of seasonal flooding on the neighbourhood.
- To retain the water in the river throughout the year
- To enhance accessibility and connectivity
- To instil a sense of belonging and sensitising citizens about their roles and responsibility the river

## PROPOSAL

A comprehensive survey based on questionnaires and interviews was carried out before the master plan was developed to ensure a community-based design. The ultimate goal is to establish frameworks to bridge the gap between urban and ecological fabric through a series of

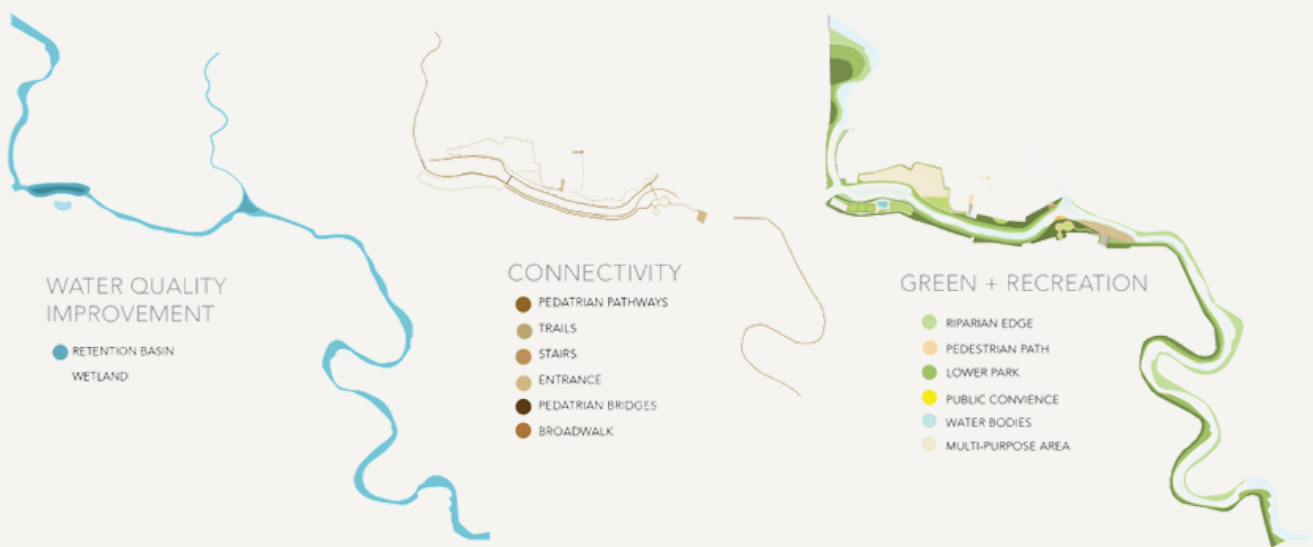


Figure - Zoning on Site

large and small-scale interventions that balance notions of site, context, its ecology and gaining back its value.

The site is divided predominantly into 4 zones based on their typology, topography, ecological value and strategic location to activate the edges of the river. Different activities and programmes are introduced in each zone. Each zone will serve as an opportunity to catalyse discussions for ecological, recreational and educational dynamics. Also improve the socio-economic conditions of the neighbourhood dwellers.

The proposal establishes the site's former identity as a river and introduces a resilient, multi-layered recreational and social destination that connects its community to nature, the river, and each other.



## ECOLOGICAL INFRASTRUCTURE

1. Existing streams, wetlands, and low-lying land are all integrated into ecological purification system linked by the river, forming a series of water retention ponds and purification wetlands with different capacities. This approach increases the base flow to sustain river water flow after the rainy season.
2. The river edge was defined to revitalize the riparian ecology and maximize the river's self-purification capacity.
3. Multifunctional zones and recreational pockets are introduced along with continuous promenades to contain pedestrian and bicycle paths increasing access to the riverfront. These corridors integrate the urban recreation and ecological spaces.
4. The proposal blends waterfront development and river restoration. The ecological infrastructure will catalyse urban renewal efforts, enhances urban vitality.



Figure - Zone 1



Figure - Zone 2

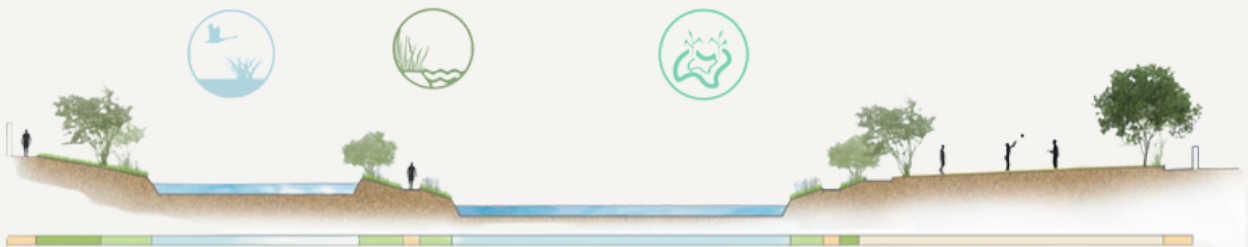


Figure - Zone 3

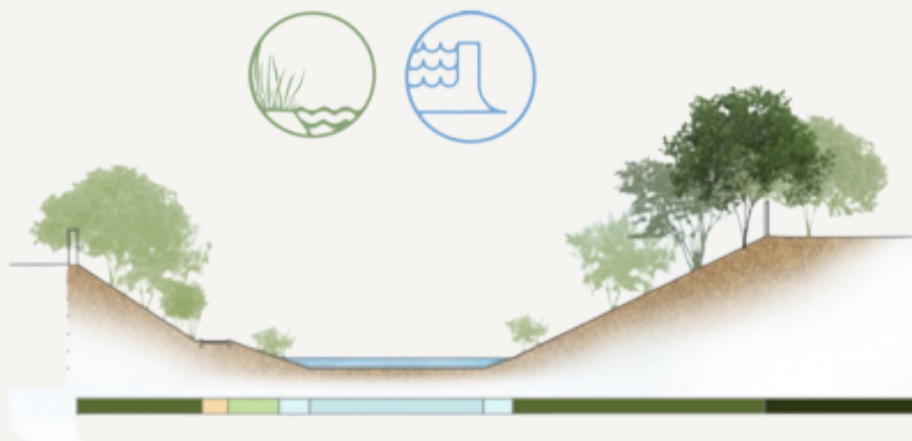


Figure - Zone 4



**Filter Strip/  
Swales**



**Floating Wetlands**



**Riparian Buffer**



**Constructed Wetlands**



**Aeration Fountains**



**Retention Basin/  
Holding Ponds**



**Nala Bund/  
Check Dam**

## **PHASING**

The implementation of the project can take place in phases, individual phase bringing a significant impact on the river health, ecology, and its relationship with its urban setting.

1 - River Cleaning, Edge Protection and Sewage Treatment, 2 - Water Retention, 3 - Landscaping, 4 - Public Accessibility, 5 - Public Amenities.

## **IMPACT**

The proposal is low-maintenance, ecologically functional, and active. It will not only provide a recreational place for the communities but also rebuild ecological health leading to the recovery of biodiversity and native habitat around it, as it become an attraction for the whole city of Bhopal.

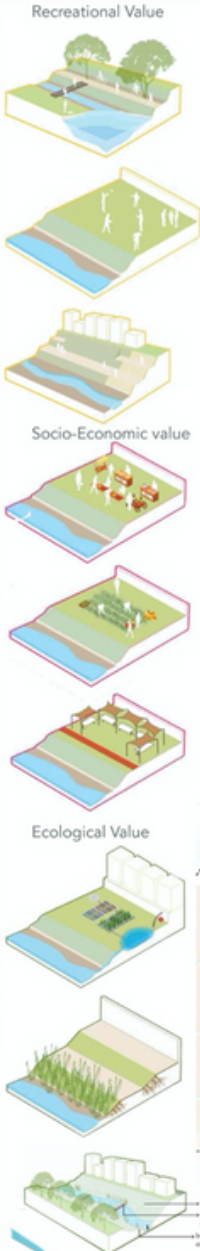
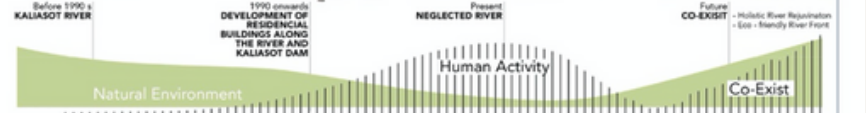
Through this project, the deteriorated urban river - Kaliasot and its floodplain can be successfully transformed into a high-performance and low maintenance front yard, which will retain water, clean contaminated water, provide public access to high quality open space, restore native habitats for biodiversity, and attracts residents and tourists.

This waterfront can act as a catalyst in connecting the community to their context and sensitising them to become aware of the great potential this has for their future development, also stimulating a positive change towards the immediate environment.

Sponsored Thesis Project Competition on  
"Re-imagining Urban Rivers"

ENHANCING THE URBAN WATER EXPERIENCE-  
REJUVINATING KALIASOT RIVER, BHOPAL

Name: Alvina Habib Khan  
Discipline: M. Arch (Recreation Architecture)



Kaliasot river, Bhopal, a tributary of the River Betwa in the Ganga River Basin. River is non perennial in nature. Origin- Kaliasot Dam at Bhopal, MP as overflow of the dam and flows south-east, joins River Betwa at Bhojpur, traveling 29 Kms. The site length is approx. 3 Km Stretch of Kaliasot River, covering an area - 42.5 Acre (0.17 Sq Km) and river varies 5-30m in width across the site. The stretch is surrounded by urban development predominantly residential housing on side and a city forest sprawling over 2 sq. Km on the other.

ISSUES

- Degradation of Ecological Value
- Danger to the structures due to flood
- Loss of land due to flooding
- Untreated Sewage Discharge
- Solid Waste Disposal
- Open Defecation, washing and bathing
- Lack of Accessibility
- Lack of values, Sense of Belonging
- Unkempt and Deserted

VISION

- PROTECT
- CLEAN
- CONNECT
- REJUVINATE
- Water Management
- Improve Water Quality
- Vegetation
- Improve Habitat
- Access to Water
- Recreation: Fishing, Walking Trail, Cycling Road

- Existing streams, wetlands, and low-lying land are all integrated into ecological purification system linked by the river, forming a series of water retention ponds and purification wetlands with different capacities. This approach increases the base flow to sustain river water flow after the rainy season.

- The river edge was defined to revitalize the riparian ecology and maximize the river's self purification capacity.

3. Multifunctional zones and recreational pockets are introduced along with continuous promenades increasing access to the riverfront. These corridors integrate the urban recreation and ecological spaces.



1. Entrance



2. Trails and Decks



3. Pathways and Riparian Edge



4. Pedestrian Bridge



5. Entrance Plaza



6. Lookout Tower

WATER QUALITY IMPROVEMENT

- RETENTION BASIN
- WETLAND

CONNECTIVITY

- PEDESTRIAN PATHWAYS
- TRAILS
- STAIRS
- ENTRANCE
- PEDESTRIAN BRIDGES
- BROADWALK

GREEN + RECREATION

- RIPARIAN EDGE
- PEDESTRIAN PATH
- LOWER PARK
- PUBLIC CONVENIENCE
- WATER BODIES
- MULTI-PURPOSE AREA

The proposal blends waterfront development and river restoration. The ecological infrastructure will catalyze urban renewal efforts, enhances urban vitality.



**Project 2**  
**Reviving The Traditional Water System**  
**Through Cultural Heritage**  
**Conservation Based on Traditional**  
**Knowledge Systems: Kunds of**  
**Govardhan**

*Aman Sharma*

*Master of Architecture (Conservation)*

*School of Planning and Architecture,*

*Bhopal*



Water has long been a critical concern of people. Water is often considered to be a purifier in many religions. Traditional knowledge has been created in India in water collection and management of many types. Not just cultural relevance but also long-term protection was provided to water structures through religious associations. Many of these systems are still functional in many regions and provide services to the community but are under continuing threat due to declining traditional water bodies, unrestricted urbanization, and pipeline-based water facilities.

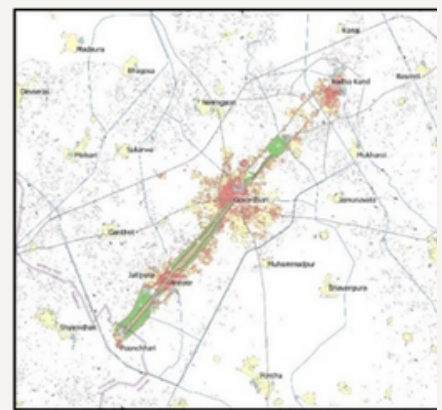
The Sacred-Cultural Landscape of Govardhan is in 'Braj Bhoomi' (a cultural region spanning across Mathura, Bharatpur, and Hodal). It is sprawled around the Govardhan hill (also called 'Giriraj ji'), is a long, low ridge of an ancient quartzite part of the Aravalli Mountain range and is the largest in this region, which extends altogether for about 8.1 km, rising not more than 30 m above the surrounding plain. Govardhan hill is located in the Mathura district of Uttar Pradesh, and a small fraction of the southwest tip of the hill lies in the Bharatpur district of Rajasthan. The study area is in the Govardhan and Mathura tehsil in Mathura district of U.P, and a small fraction of southwest lies in the Deeg Tehsil of Bharatpur district of Rajasthan. It comprises 7 villages Poonchari; Anyore, Jatipura, Sakitara, Govardhan Brahman, Govardhan Gorwan, Radha Kund Rural; Govardhan and Radha Kund Nagar Panchayat. Considering the census data, the area has a population of 46,000 people and is visited by approximately one crore pilgrims annually.



Location of Uttar Pradesh in India



Location of Mathura District in Uttar Pradesh



The study region

Undulating topography around the hill allows rainwater to get collected into natural depressions, resulting in ponds, lakes, and wetlands formation. These also act as natural groundwater recharge zones. These natural phenomena make this region suitable for water-centric cultural developments, and it has been so since ancient times - taking place in mythology and history. As a geographic feature, Govardhan Hill has innate connections to the river system of the Yamuna, which is also the biggest tributary of the Ganga, and Govardhan lies in the Yamuna middle sub-basin. Due to the natural alignment of the terrain, many seasonal streams pass and originate from Govardhan, which eventually get connected to the Yamuna River.

Govardhan hill is a long,  
low ridge.

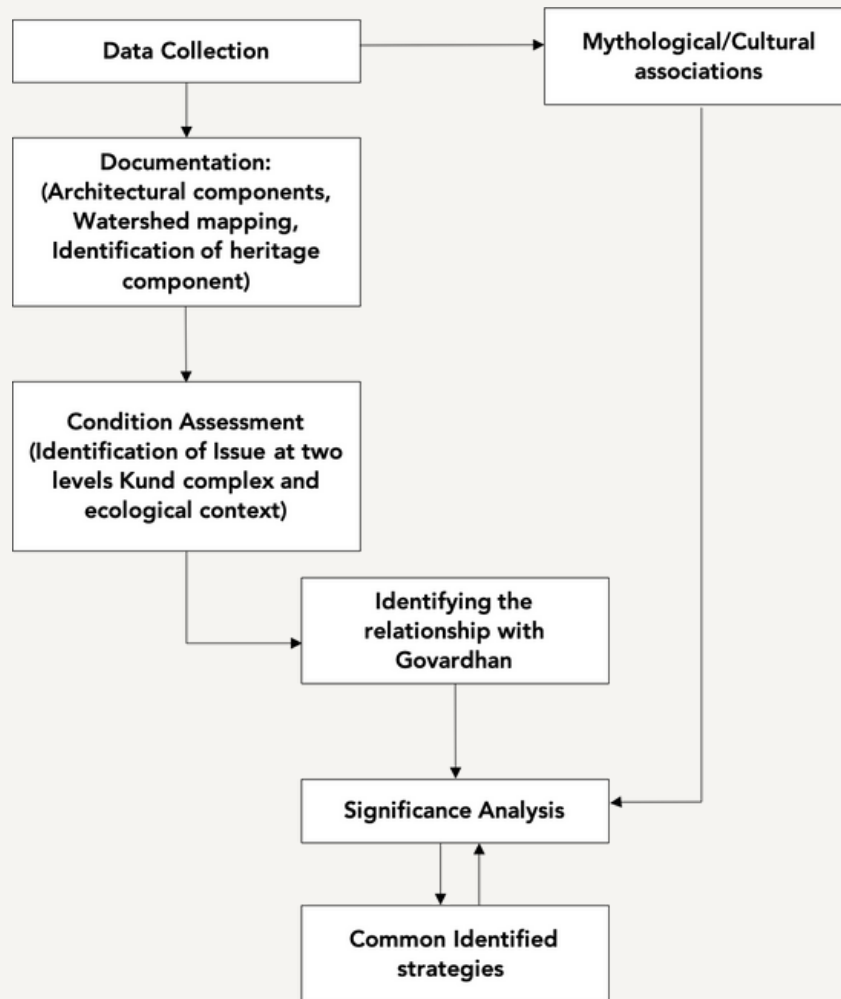


Govardhan Hill looks like a  
huge collection of small  
rocks due to metamorphosis  
of the sandstone.



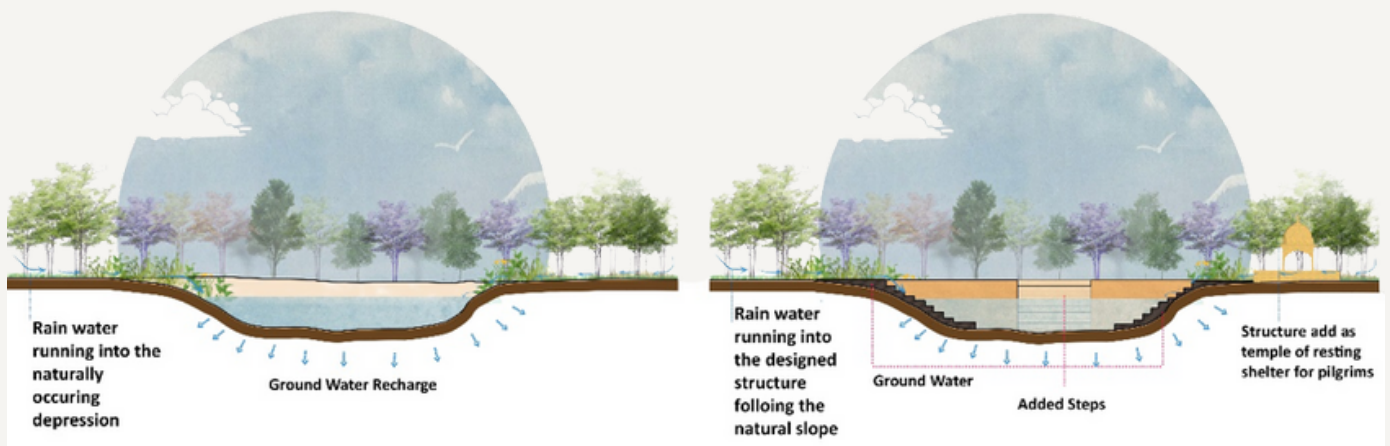
During the thesis, background studies have been done to understand Govardhan's architectural, ecological, and mythological context. The parikrama, kunds, vans, how the synthesis of nature and culture has come into existence, and the water system's role in forming this cultural landscape have been studied. Data collection, documentation of various components, and the broad-level condition assessment have been done to understand the built and unbuilt fabric of the kunds. Mythological and cultural associations in terms of Braj, Govardhan, and the larger Krishna mythos establish the relationship of the built component - eventually forming an analysis of significance, which have helped in strategizing the guidelines moving forward.

The methodology to document kunds entails the primary process of data collection, documentation of various components and the broad-level condition assessment to understand the built and unbuilt fabric of the kunds. Along with this, mythological and cultural associations in terms of Braj, Govardhan and the larger Krishna mythos establish the relationship of this built component - eventually forming an analysis of significance, which would help in strategizing the guidelines moving forward. The perspective through which kunds are observed and studied are broadly divided into three heads - architecture, water, and geography.



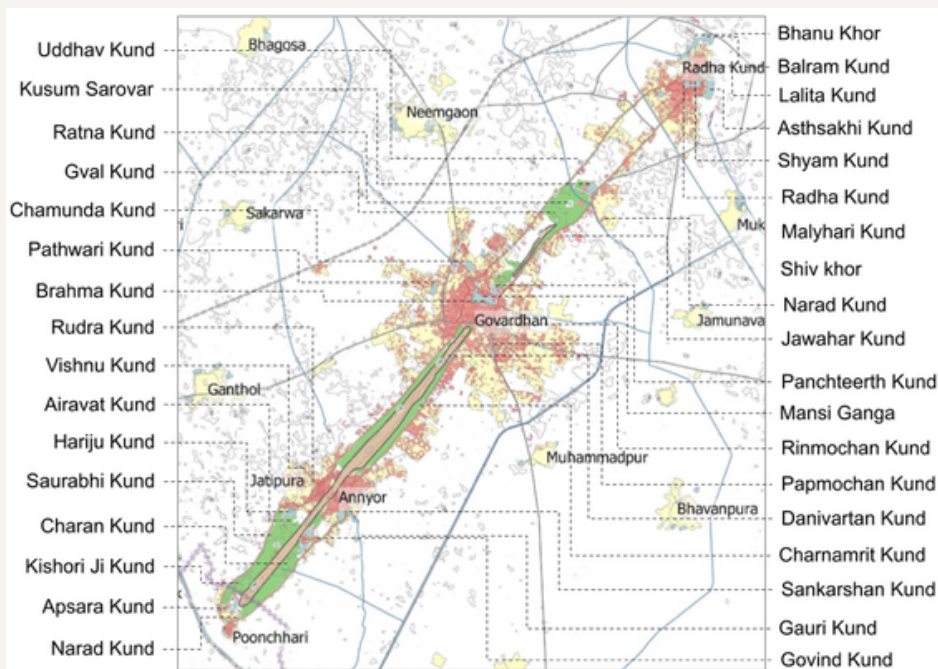
Govardhan is one of the most recognizable features in Krishna mythology wherein Krishna lifts the entire hill to shield the entire village from the wrath of the rain god Indra eventually becoming part of Hindu mythology. Govardhan takes an important part in multiple origin stories where the hill is bought from other sacred places and is finally placed in this geographic region, giving it an air of divine nature. The pilgrims and people living in the area constantly connect to its natural feature. The divine nature of the Himalayas sometimes even becomes parallel to mount Kailash itself, so naturally, everything around this feature becomes sacred or essential to the people. In the second chapter of the Vrndavan-khanda of the Garg-Samhita, Sri Gargacaraya describes Govardhan's Avirbhav, or arrival in this world, and the receiving of the name "Giriraj."

The combination of the river basin slope and the rainfall happening in regular intervals creates an environment in equilibrium, an essential and unique ecological setting, and a stage for a unique setting for flora, fauna, and human growth. The Kunds naturally become a source of sustenance for the settlements in and around the Govardhan. Kund is a stepped tank of a particular architectural design, is a perfect example of a cultural landscape system. Kunds are like architectural devices designed with the combination of nature, which allows the human's interaction with ecology and acts as an interface to connect with the divine. Kunds also provide essential services to communities like drinking water, are a source of harvesting rainwater, and as a flood control system.



Typical Kund design approach adopted in this region (a) In a natural setting where rainwater is getting collected into the depression and naturally occurring flora and fauna. (b) Designed architectural device creating space for human interaction with the ecosystem. Source: Author

The kunds are part of the mythic narratives of Braj and Govardhan, as an archetypal setting of imagined cultural landscapes. These are also a significant piece of built component, as it is a signature of long-lasting, rooted, and culturally thriving environments, as well as markers of history. Kunds are also a significant part of a route of cultural and religious significance throughout the cultural landscape and are essential to ensure the continuum of the parikrama. These water systems help the sustenance of people, flora, fauna, and associated living systems and the continuation of agricultural practices. At present time, there are Govardhan approx. Forty-nine kunds of different shapes and sizes are found in and around the seven kos (mile) or 21 Km parikrama of Govardhan hill and Radha Kund.



Kunds sprawled in the Cultural Landscape of Govardhan

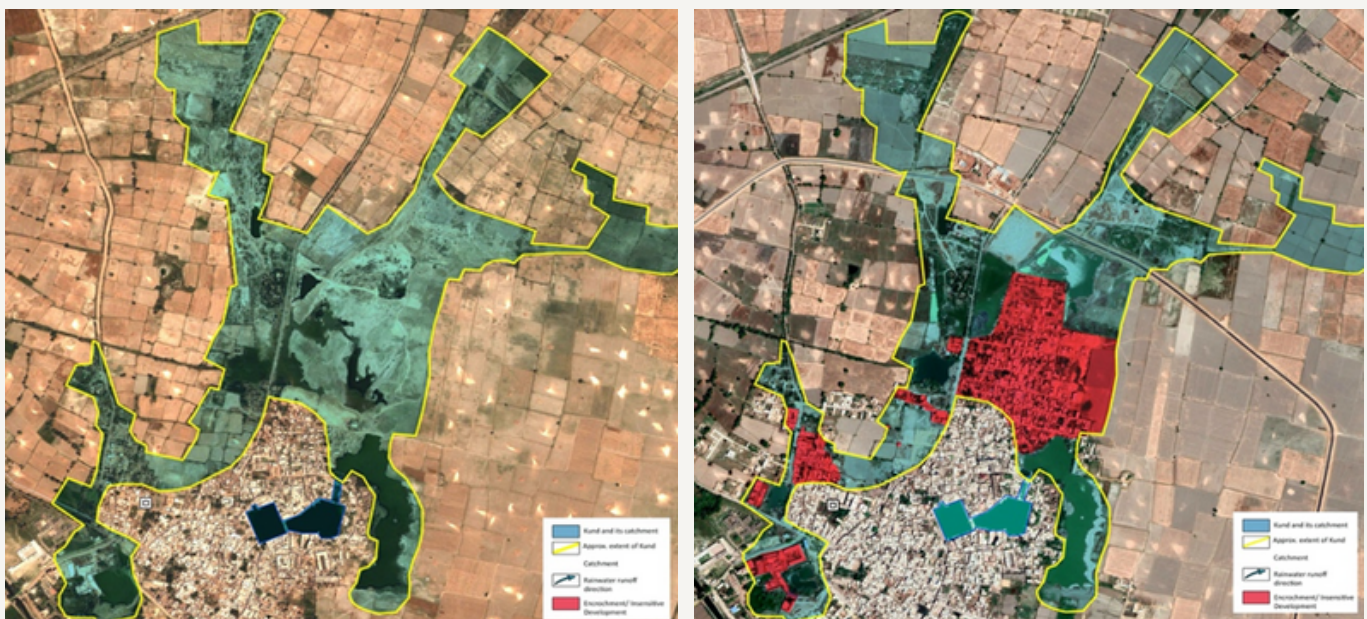
Change in the cultural value system distanced the community from traditionally community-owned water bodies, resulting in negligence of this water heritage, ecological disruption, and loss of traditional knowledge systems.

पाली पाडल नीमगांव, पानी नांय तीन गांव।

"Three village Pani Paalad and Nemgaon do not have water at all."

It expresses the pain and difficulties faced by communities in these three villages of Govardhan about water availability. This colloquial phrase represents water scarcity in this region despite the presence of such a rich traditional water conservation system and being part of rich environment conservation-based mythology.

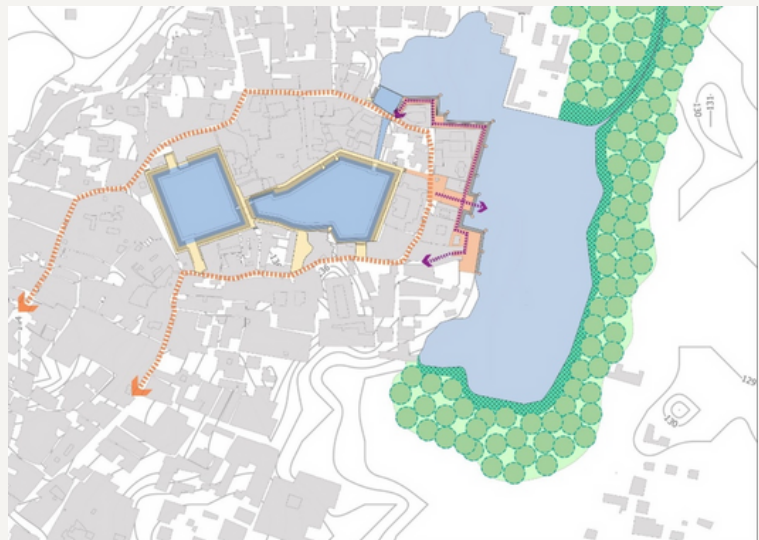
Urban sprawl and encroachments frequently reduce the size of these water bodies and disrupt the natural network of water bodies, causing a flood-like situation in town. Catchment areas usually have sacred groves or vans that are an integral part of the ecosystem are now vanishing and causing soil erosion during rainfall. It results in mixing a high amount of silt, mud, and pollutants in the kund surface, reducing the percolation of water into the groundwater and making it hazardous for usage. Many of the kunds used for dumping solid waste and any remaining water is filthy and algae-laden. Such kunds are therefore not used traditionally, nor can they provide any service to the communities. Religious association to these water bodies leads to interpretation-based restoration in isolation in a non-scientific way; excessive hard surfaces are being constructed around these sacred and ecologically sensitive sites. The symbiotic relation between heritage, ecosystem, and community has been disrupted. Pilgrimage rituals and activities further stressed them, and due to the hazardous quality of water, their health is also at risk.



Radha Kund has a wider extent than the kund as can be seen in satellite image (a) of April 2003, it's very evident in the image (b) of April 2020 the pokhar/wetland around the kund has encroached

To protect and conserve these water systems, it is necessary to visualize kunds as a system of multiple elements coming together - water, architecture, ecology, continuum of cultural practices, and how all these aspects come together should be taken into consideration. This thesis proposes to use a nature-based approach to conserve the natural and water heritage of Govardhan and to explore its applications pertinent to the present needs, their use for groundwater recharge, improving groundwater quality, and rainwater harvesting. In this cultural landscape, a heritage conservation-based approach is adopted as a tool for water conservation and ecological rejuvenation. Along with common conservation strategies, an integrated conservation framework has been developed where ecological conservation strategies and architectural conservation play hand in hand. Many components between architectural and ecological conservation can be interrelated. Radha Kund and connected kunds like Shyam kund, Lalita kund, and others that are part of a single water system have been chosen for a detailed demonstration project. It has the potential to become a multiplier model for kund conservation due to its highest cultural significance not only in Govardhan but in all of Braj.

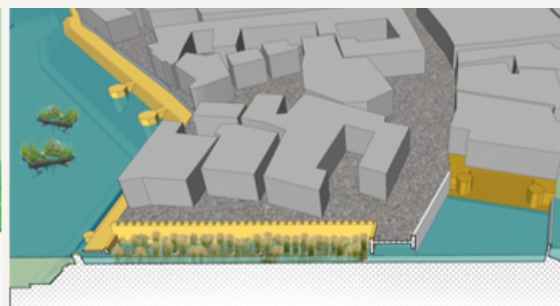
Water systems are an essential part of our living systems. If we protect these systems, we protect our mechanism of life and address a serious problem plaguing our nation's water availability. Traditional knowledge involved in creating these water systems is an essential component in designing and constructing these kunds and water systems. Hence, it is not enough to have a conservation process but to integrate them into the larger design framework.



Proposed Plan Radha Kund



Section AA

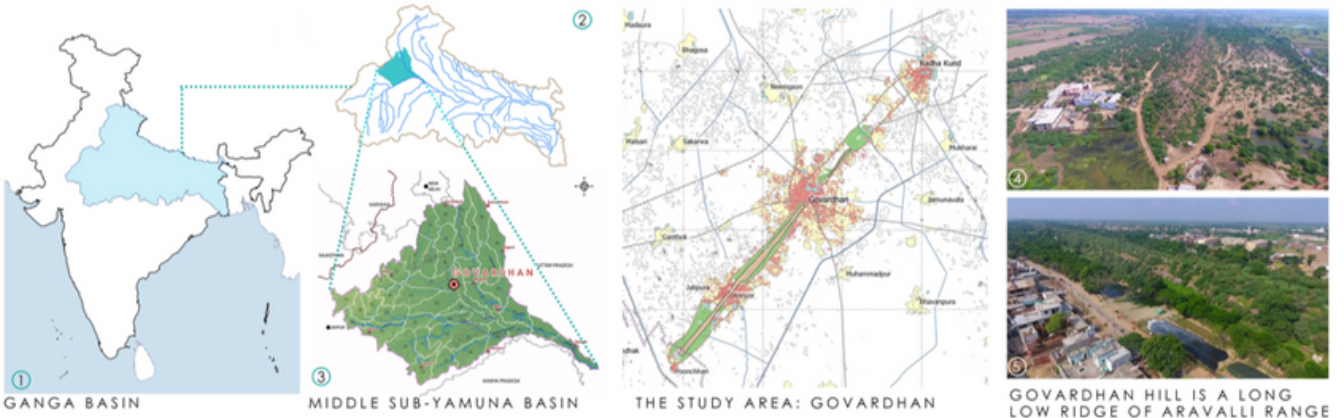


Existing Canal to be used as Bioretention Area

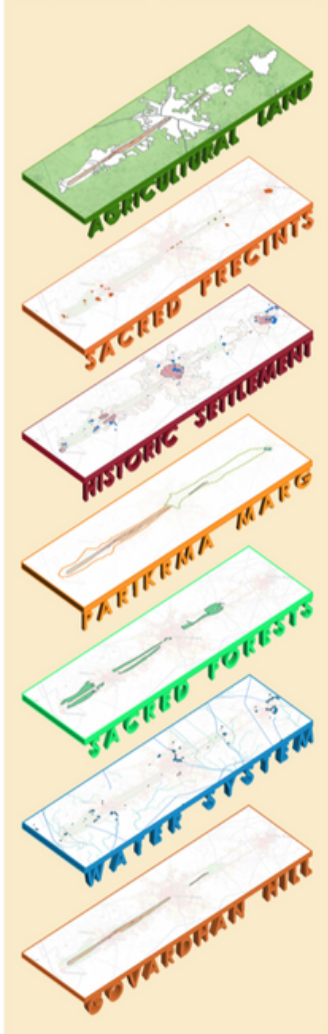
Sponsored Thesis Project Competition on  
"Re-imagining Urban Rivers"

Reviving the Traditional Water System through Cultural Heritage Conservation based on Traditional Knowledge Systems: Kunds of Govardhan

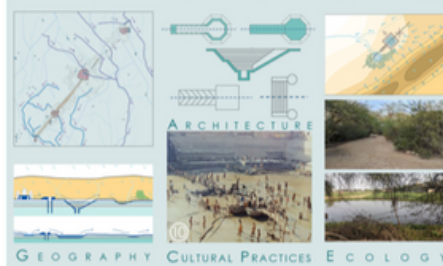
Student Name: **Aman Sharma**  
Course Discipline: Master of Architecture (Conservation)



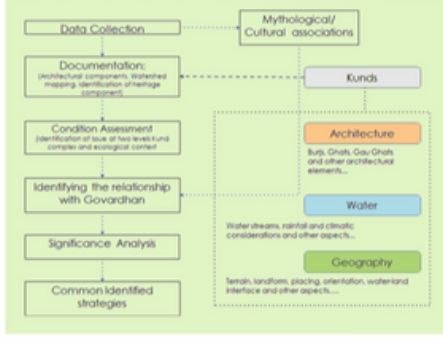
GOVARDHAN CULTURAL LANDSCAPE



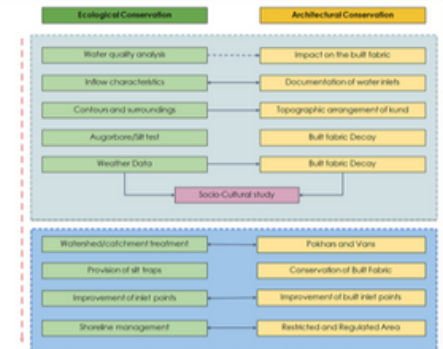
TRADITIONAL KNOWLEDGE



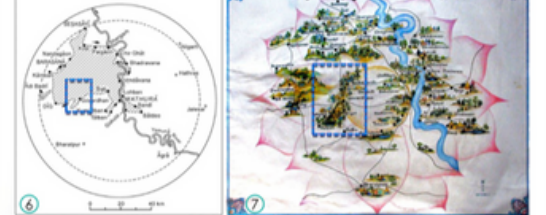
METHODOLOGY



INTEGRATED CONSERVATION FRAMEWORK



GOVARDHAN IN BRAJ MANDAL



RELIGIOUS SIGNIFICANCE OF GOVARDHAN



IDENTIFIED ISSUES AND CONDITION OF KUNDS



PROPOSAL DEMONSTRATION SITE: RADHA KUND

IMAGE SOURCES:  
1. <https://a-maps.com>  
2. <https://mission-ganga.thewaternetwork.com/>  
3. [http://117.252.14.242/Gangakosh/Hydrological%20Units/yamuna\\_middle.htm](http://117.252.14.242/Gangakosh/Hydrological%20Units/yamuna_middle.htm)  
4. Mathurā Mandala: Territory and Sacrality Rana P.S. Singh and D.P. Dubey  
5. <https://www.britishmuseum.org/>  
6. <https://www.britishmuseum.org/>  
7. <https://www.holydham.com/sri-vraja-mandal/>  
8. <https://www.britishmuseum.org/>  
9. [https://commons.wikimedia.org/wiki/File:Govardhan\\_Puja.jpg](https://commons.wikimedia.org/wiki/File:Govardhan_Puja.jpg)



# Project 3

## Conservation Strategies for Historic Town of Sultanganj, Bihar

*Deepanshi Singh*  
*M. Arch. (Architectural Conservation)*  
*School of Planning and Architecture,*  
*Delhi*



## ***“Bringing People to the River and River to the People”***

Rivers are the precious commodities for the human. All the necessities of human life are hooked onto availability of water and thus water bodies became the important locations for human settlements. Historically, riverfront cities have emerged through conditions developed by mutuality between land and water. But in today's scenario the relationship between water and land has become less apparent. Rapid urban developments have replaced ecological components. This process causes the issues like loss of natural breathing spaces, imbalanced urban ecosystem, changes within the micro-climate. One possible thing to balance this haphazard development within the populated areas is to see back and conserve the prevailing natural areas.

The case is same with Sultanganj; due to urbanization the city has lost its natural water bodies. This thesis aims to conserve, rejuvenate & develop an eco-friendly riverfront for the Sultanganj town. This thesis also aims to conserve the heritage trail which was leading towards the Ajgaivinath temple. Riverfront design and redevelopment has been greeted as a panacea for newer urban evolution which consists of challenges as well as opportunities. The goal of this study is to make recreational spaces of good quality along the riverfront of the Ganga River and connect them with numerous destinations there.

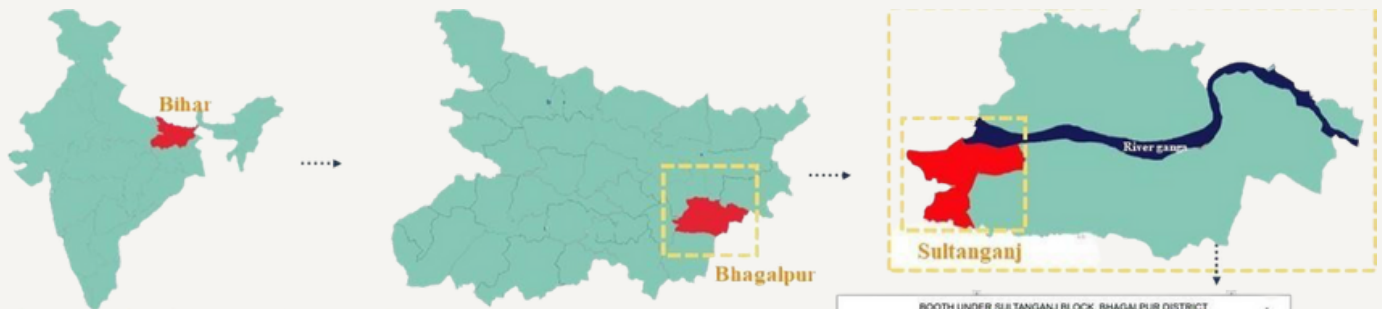
### **INTRODUCTION**

Sultanganj town is also known for its Ajgaivinath temple and north direction turn of River Ganga. The precinct of Ajgaivinath temple is also known as Swayambhu temple of Shiva which was built before 7th century C.E. Sultanganj town is a small settlement in district of Bhagalpur. It is nearly 31 km from Bhagalpur and 211 km from Patna, Bihar which is well connected by airways and railways with the rest of India.

### **Bhagalpur and Sultanganj town**

Bhagalpur, the silk city of Bihar is one of the major trade cities of the Bihar. It is also an important administrative, industrial and business center of Bihar. Earlier this region was under the rulers like Pala, s, Gupta, s and Mughal, s. Later Britishers made this region as a major trade route from Patna (Bihar) to Farraka (West Bengal). At the time of independence, it was a center of politics. Post-independence, it was in a state of decline in every aspect of trade and political presence. Sultanganj is one of the most important pilgrimage sites of central India. In Sultanganj, the biggest fair takes place which lasts for about 45 days.

Sultanganj is also an important site being the regional religious center. It is also one of the strategic locations due to geological aspects along the river Ganga i.e. availability of fertile soil, having future scope of growth of town along river, sacrosanct value of place due to north direction of river Ganga. Sultanganj is associated with the Ajgaivinath temple along with the ghat named as Balu Ghat-1. This area has a high historic significance due to the presence of temples which are associated to the social practices of this region.



Location Map Sultanganj, District – Bhagalpur, Bihar

Sub Divisions (3)-Urban	(Bhagalpur Sadar, Kahalgaon & Naugachhia)
Blocks (16)	Goradih, Jagdishpur, Nathnagar, Sabour, Shahkund, SULTANGANJ, Kahalgaon, Pirpainty, Sanhaura, Bihpur, Gopalpur, Ismailpur, Kharik, Narayanpur, Naugachhiya, Rangrachowk
Municipal corporation (1)	Bhagalpur
Municipal Council (1)	SULTANGANJ
Nagar Panchayat(2)	Kahalgaon, Naugachhia
Population (Census 2011)	52,892
No. of Panchayats	242 (Total)



Map of Block Sultanganj showing villages (Source: Bhagalpur.nic.in)

## Significance of the Sultanganj, Bihar Archaeological and Historical Significance

- Sultanganj is rich in its history and has been a witness to various historic events and personalities. Many important personalities have lived or visited this place. Many travellers also visited to admire its picturesque landscape and its religious significance. It has been centre of constant struggle among different rulers in history. It was ruled by a long line of rulers and dynasties. The River Ganga flowing through the district greatly contributed to the historical significance of Bhagalpur.
- One of the major archaeological sites in the town is railway station from where the largest substantially complete copper Buddha statue was excavated. The statue is dated back to between 500 and 700 AD. It is 2.3 m high and 1 m wide and weighs over 500 kg.

## Religious and Cultural Significance

- Religiously , Bhagalpur has always been a highly significant place. It was one of the major centers of Buddhism. The ruins of Vikramshila university authenticate this claim. It was the medieval centre for the conservation and propagation of Buddhist education.
- Among all the culturally significant things of the district, the language Angika, is the main language of Bhagalpur. The language Angika is one of the oldest languages of the world. It was known as Aangi during ancient times. Angika is spoken by more than 30 million Indians and 50 million population worldwide.

## Natural and Ecological Significance

- Sultanganj is highly significant in terms of ecology of the region. Apart from the rich diversity of plant life in the district, Bhagalpur is known for two most important components of fauna which are in the endangered list. They are Gangetic River Dolphins and the Garuda bird.

- Here, River Ganga has more than 7 ghats, each one of them is dedicated to the historical belief and intangible value.
- The presence of Ganga contributes immensely to house the Gangetic River Dolphin (Susu) which is India's national aquatic animal. Sultanganj is the starting point of Gangetic Dolphin Wildlife Sanctuary which was started in 1990. The length of this sanctuary is 2.5 km.

### **Architectural Significance**

- The architecture of Sultanganj is the reflection various socio cultural and socio- political developments that have happened here over the years. The rulers as well as the common people built several structures, which still stand today as testimony to the glorious history.
- One of the important architectural ensembles is the main temple of Sultanganj "Ajgaivinath temple". This temple is quite ancient (about 7th century). This temple is made on stones and 'Swaymshambhu – shiv avtaar' related symbols are ornamented as stone carvings. It has been studied that these carvings belong to Pala period. Few of these carvings are in endangered condition.

### **Economic significance**

- Sultanganj is a religious town and a centre to start religious yatra in the festival times. Pilgrimage footfall of about 1 lakh / day has been recorded as per available data. 265 days of a year are celebrated here and lots of tourist come here from outside every day. This fact requires Sultanganj to grow with the time to welcome and cater the tourists in succeeding festival seasons. This will in turn increase the value of the place in economic terms.

### **Proposals**

Considering the existing issues, various different parameters are identified in this thesis. These parameters are required to be addressed while designing the proposals at different levels. Further, while designing the proposals - the needs of the region, settlement, community heritage is to be addressed also.

### **Precinct Level**

There are different precinct level proposals as highlighted below in the existing precinct map. These proposals are as follows:

- Conservation of heritage structures, Ajgaivinath temple, Mosque etc.
- To mark the precinct boundary and make a buffer zone between settlement and ghat by making stone walls or by plantation according to the need of the place.
- Removal of encroachments & implementation of the building guidelines of the precincts areas for the development of the new structures.
- Designing spaces for community, visitors and pilgrims.
- Public amenities.
- Formal interventions need to be taken for the flood control measures.
- Conservation & Redevelopment of the historic Ghats : Balu Ghat 1, Seedi Ghat,

- Zhanda Ghat, Naval kishore ghat. This will also include conservation & redevelopment of Ajgaivinath temple, Gauri Shankar temple and historic structures which are in the delineated area and the construction of plinth protection, retaining wall & embankment wall as per the proposed plan.

### **Settlement Level**

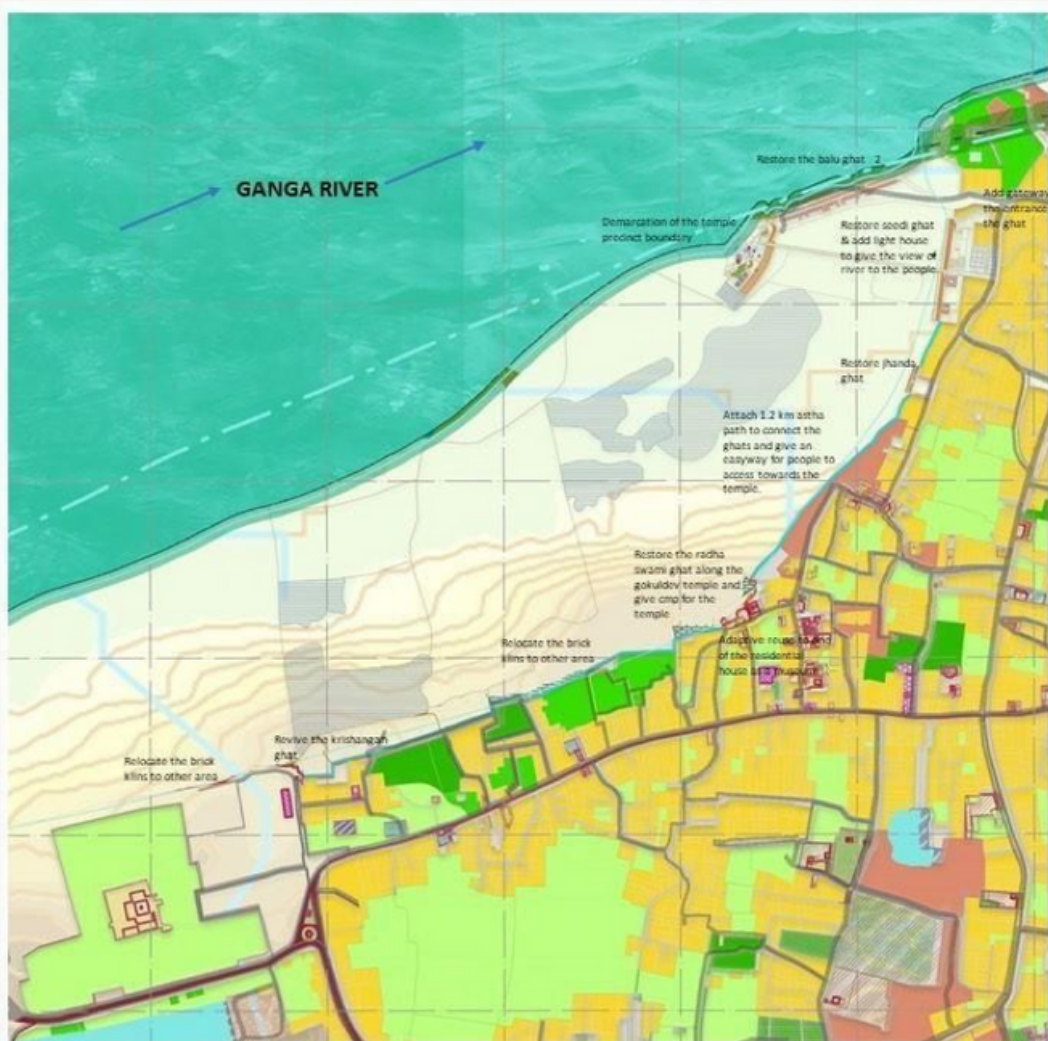
- With the pressure of modernisation and development, several modern structures i.e. RCC structures are built in the town which are deteriorating the character of the town. These structures are not only diminishing character of the town but also the traditional knowledge of the vernacular construction system. This is resulting in loss of community pride associated with vernacular construction system. This is due to three major reasons. First reason is lack of proper building construction guidelines that is a management issue. Second reason is lack of education and information regarding the benefits of traditional architecture which is an issue related to awareness. Third one is that the existing heritage structures though are not abandoned by the community but are an incompatibly managed, conserved and developed states by the community members or the individuals in the town.
- These issues have been addressed by providing guidelines for the construction systems addressing management working/ conservation of existing structure. These guidelines also take care regarding the needs of heritage structure of the town.
- There also exist number of infrastructure issues in the town as well as on ghats and temple (Ajgaivinath temple), non-functioning street light, lack of dustbins, open drainage system ending into the river Ganga. Hence resulting in the major ecological issues related to public hygiene. On ghats, there are no changing rooms and toilets which are required to be addressed.

### **Management Practice & Traditional Knowledge System.**

- Lack of proper building guidelines are resulting in the loss of character of the settlement and hence loss of community pride. With the change in construction system of the settlement, traditional knowledge system of vernacular architecture is also diminishing.
- ·There is lack of public amenities & public infrastructure.
- ·Open Spaces. -Degraded open spaces and construction of individual dwelling resulting in lack of community activities. The lack of open spaces is resulting in diminishing of green spaces around the dwellings in settlements.
- ·Cultural mapping & social mapping is required to understand about the community and to involve them in the conservation of the existing structures.
- ·To install all the public infrastructures which are needed to be available on the sites, including signages, lighting facility etc.,

## Regional Level

- At this level the main issues are related with the awareness of the communities and visitors. Different individuals signages have been provided. Guidelines are provided for infrastructure required for the community and visitors like parking, toilets, changing rooms etc. All the signages and interpretation board with the information in bilingual language i.e., Hindi and English. Since Hindi is a regional language whereas English is helpful for visitors from pan India and abroad. Lack of information on tourist web sites and no brochure leads to less awareness amongst visitors about the town. Hence, brochure has been made regarding the heritage and tourist sites present in the region and wooing visitors to visit them.
- Conservation and revival of traditional knowledge of water systems (Ahar-Pyne System).
- Awareness about the sites.
- Lack of signages & interpretation to be addressed at the region, settlement & monument level.
- Available signages and interpretation boards are only in Hindi language.
- Lack of information about the sites on the websites.



Proposal plan for the tow

**'BRINGING THE PEOPLE TO THE RIVER, AND RIVER TO THE PEOPLE'**

Sponsored Thesis Project Competition on

**"Re-imagining Urban Rivers"**

**CONSERVATION STRATEGIES FOR HISTORIC TOWN  
SULTANAGANJ, BIHAR**

Student Name: DEEPANSHI SINGH  
Course Discipline: M. Arch. (Architectural Conservation)

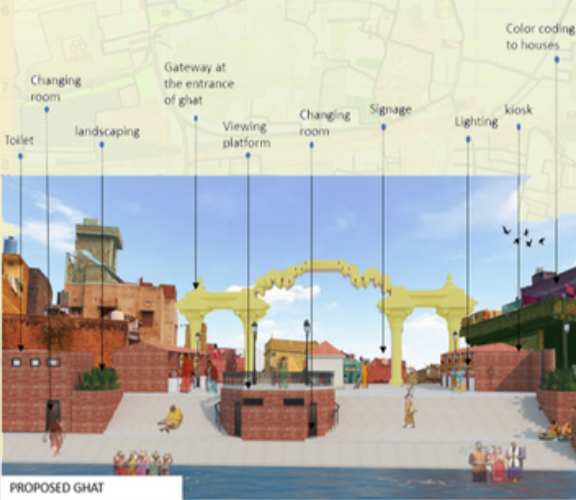
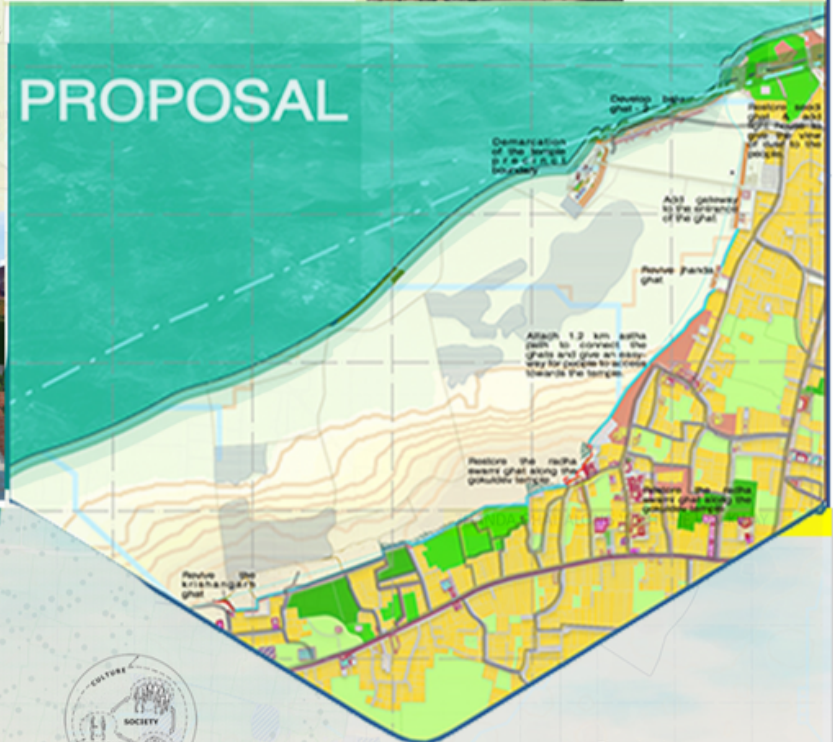
**LOCATION**



**ANALYSIS**

1. No embankments are provided for the flood protection and the prone area.
2. Ghats are not developed as per the footfall of the area..
3. Pokhars are polluted, Traditional water knowledge system has lost with the time.
4. No proper walkways and public convenience are there..

**R**evitalize  
Rehabilitate  
Rejuvenate  
  
Conserve and preserve  
Make management plans



**"RECONNECTING A CITY WITH A RIVER"**

**Project 4**  
**“The somber case of an odd triad –  
Dolphin, Man and Zoonoses”**

*Manju Rajeev Kanchan,  
School of Planning and Architecture,  
Vijayawada*





## PROJECT BACKGROUND

The proposed thesis project titled 'The somber case of an odd triad- dolphin, man and zoonoses' deals with the revitalisation and revival of the Vikramshila Gangetic Dolphin Sanctuary (VGDS), Bihar - a part live Central government project proposal under the Gangetic dolphin conservation project by NMCG, NIUA, WWF, and other prestigious organisations towards developing an eco-touristic region that allow the Indian Gangetic Dolphins (*Platanistagangetica*) to coexist with other species of nature while creating a perfect atmosphere for the human community to exercise their riparian rights in a sustainable fashion with the right awareness about their local biodiversity in addition to providing the right ambience for students and researchers to observe and study the key indicator faunal species behaviour. The forlorn scenario of the degrading fisheries in Bhagalpur, the devastating attempt at survival of the Gangetic Dolphins they try to live another day and the desperate measures the local predominant fishing community need to resort to as they end up with zero catch to meet their needs and the present zoonotic pandemic – all this played a role in helping me conjure this title. In accordance with the competition guidelines, the project falls under the theme 'Theme 2: Developing eco-friendly riverfront projects.

## INTRODUCTION

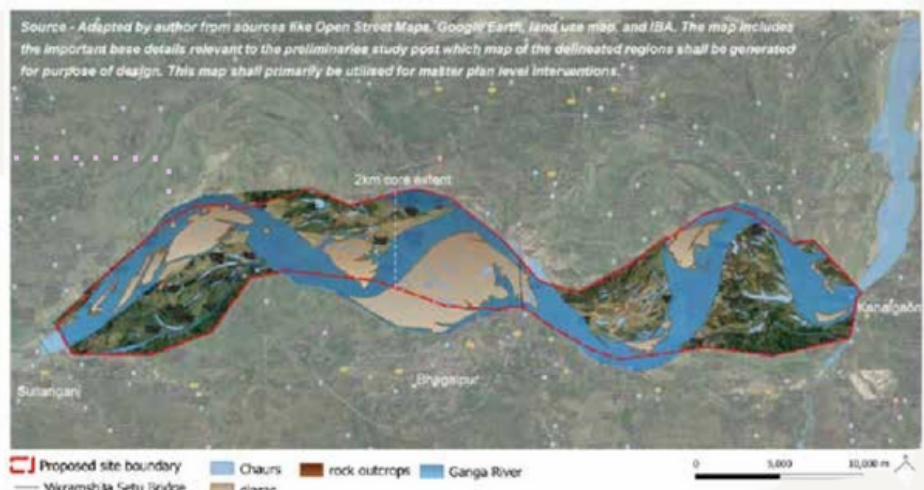
Riverine ecosystems have been around since the dawn of time, acting as the arteries that pump more than just clear freshwater. They form the very foundation for civilisational evolution that we see today or are a part of. Likewise, microbial transfer too has been around since time immemorial, contributing to the emergence of numerous renowned plagues, epidemics and pandemics. But today with increased urbanisation and the human quest to conquer the various natural realms in the name of development, the lines of equilibria sanctum between the natural ecosystems and human domains have slowly started to blur resulting in a domino effect of catastrophes such as the covid19 pandemic. Almost 60 – 80% of the documented infections that affect man today are zoonotic (animal origin) and this is slowly turning into a predominant cause of concern. Studies relate the causal drivers of zoonoses to factors such as habitat fragmentation, biodiversity loss, agri- culture etc. however very few studies actually have attempted to draw a link between them and the discipline of landscape architecture. Research done within the domain of veterinarian sciences, medical epidemiology etc. may have mentioned an occasional link here and there but nothing in depth or in a proper correlation as to what landscape architects can do to resolve this predicament has been explored. Therefore, this research is an attempt to explore the same as it strives to understand how zoonotic resiliency can be achieved in a riverine landscape within an urban contextualising the case of Vikramshila Gangetic Dolphin sanctuary, Bhagalpur, Bihar. Comprising a diversity of landscape typologies that are a result of the braided river character of Ganga in this region, the actual extent of Vikramshila Gangetic Dolphin Sanctuary covers an area that has a radius of 10 km from the river edge. However, keeping in mind, the academic time constraints, this project shall only address the core of the sanctuary which is basically all that area at a distance of 2km from the river edge; with a figurative value of around 5000 ha (12355.27 acres).

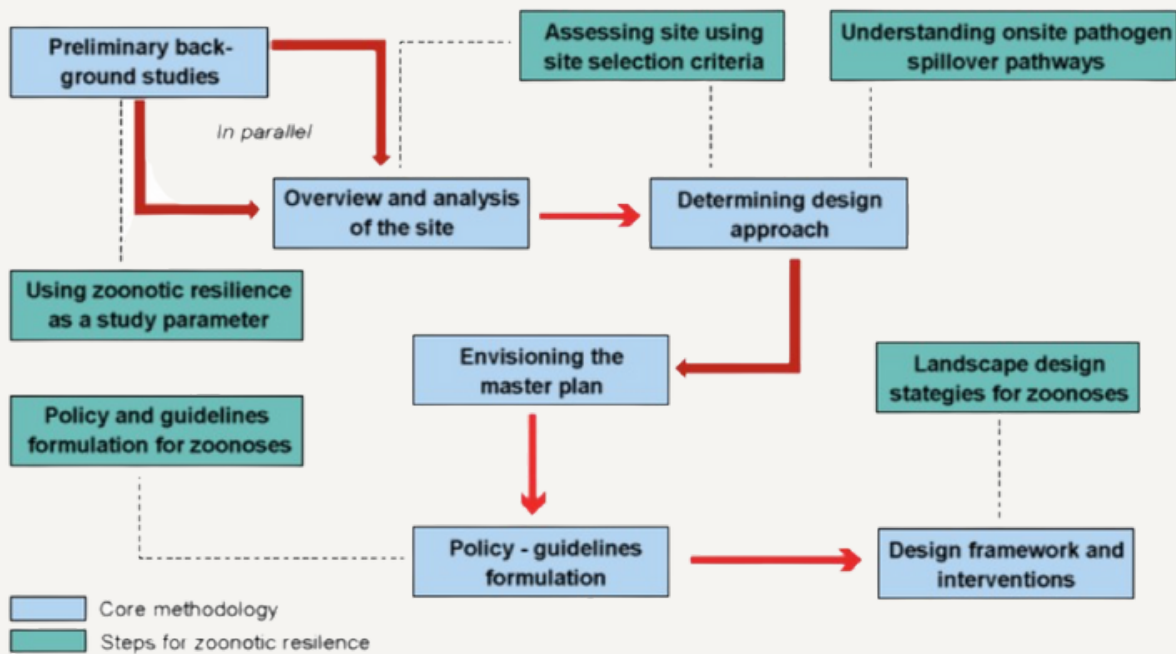
## DESIGN OVERVIEW AND METHODOLOGY

The project proposal functions at two phases- research and design. On the design front, the project shall place a need full emphasis on how the proposed design can be zoonotically resilient, thereby generating a healthy ecosystem for both human sand other species; to be achieved via means of master plan development, policies and guide- lines while the research aspect attempts to understand and mitigate the impacts of zoonoses prevalent in lotic river- scapes of India using the riverine stretch of Ganga within the VGDS as an example, while simultaneously developing a sanctum for the dolphins. With regard to the academic thesis timelines and the large site area in addition to the project novelty, the project shall address the issues of concern at a macroscopic level primarily by functioning as a demonstration prototypic model for zoonotic resilience and healthy waterbodies within an ever developing urban- scape with an added touristic angle that ensures the safety of all stakeholders involved to the best possible means.



\* Not to scale. Figure meant for representation purposes only





The above images show- case a contextual understanding of the proposed site along with a flow chart of the design methodology followed. Steps undertaken to develop an ecologically sustainable design solution were also followed alongside the steps to achieve a zoonotically resilient riverine landscape.

## PROJECT RELEVANCE

River Ganga is considered one of the most sacred rivers of India; sustaining a population of perhaps more than 400 million people that reside near its banks. However, floodplain Indian rivers such as Ganga are diverse socio - ecological systems that today are competing with human interests to sustain a diverse riverine ecology as seen in the degrading river quality. More importantly, the Gangetic river system are the only known major habitat of the Gangetic river dolphins; whose count has drastically decreased over the years due to the un-ecological anthropogenic interferences.

Vikramshila Gangetic Dolphin Sanctuary is the only notified river dolphin sanctuary in India for Gangetic dolphins in addition to being an IUCN Category IV and IBA site. Yet for reasons such as industrial and agro pollution, rapid urbanisation, poor river health etc., the count here too is dwindling. This is a huge concern as the Gangetic river health is closely linked to their survival. Also, as a region that holds a diversity of gregarious faunal species, there holds an immense possibility for a zoonotic spillover. Therefore, by revitalising the river stretch, not only will bio- diversity thrive but simultaneously the project shall also help the tourists and locals understand their relevance as well. This can help to develop a prototypic zoonotic resilient landscape model where humans, faunal species (both wild and domesticated) and flora can coexist within the same environment without fear of a pathogenic spillover. On the research front, a blue - green project site such as VGDS stretch, that is subject to a plethora of natural and anthropogenic interferences in addition to being a sensitive ecosystem with a potential scope of being a pathogenic reservoir landscape offers a great potential to test waters on the idea of zoonotic resilience.

## **THE ROUTE TO SOLUTIONS**

“Sometimes not intervening is also landscape architecture.” –

By author

The above quote signifies the approach chosen so as to combat the prevailing issues of the proposed site extent. Ganga is a dynamic river with a personality that is strong, fluid and expressive as any other species might. Allowing her to express herself to the fullest is perhaps the best way to ensure that natural equilibrium is restored in the region. Ganga river adopts a braided river character from Bhagalpur (Bihar) to Jangipur (West Bengal) and it is along this stretch that VGDS lies. Braided river ecosystems are unique and fragile ecosystems whose sustenance is heavily dependent on the proper equilibrium with which the associated ecological processes such as abrasion, siltation, erosion etc. take place. Making room for the river is the ideal way to ensure the proper sustenance of the braided river ecosystem and to minimize extensive loss of life and property during floods.

The design proposal therefore pitches forth the concept of rewilding - a package theme comprising of 3 sub themes - Renaturalisation, Revive + Recover and Rediscover. Rewilding is innovative yet quite a simplistic approach of resolving perhaps the most complex of problems prevalent in the region. The biggest advantage of the same being the fact that the proposed idea is scalable and can be adapted along the other stretches of Ganga or anywhere in the world. Rewilding focuses on allowing the natural ecological processes to take over and etch the destiny of the fluvial landscapes as a result of which the braided river ecosystem shall thrive and prosper. Further this shall also help tackle and therefore resolve practically all the urban challenges the proposed site extent faces while creating aesthetic yet functional open spaces to be used in harmony by both humans and other species prevalent in the region - therefore a win - win situation for all.

Each of the proposed sub themes strategically target the prevalent challenges associated, thereby effectively revitalizing the sanctuary extent. Additionally, this proposal adopts an indirect approach towards establishing a sanctum for the Gangetic dolphins as sometimes the key to resolving multiple problems might lie in fixing just one instead of trying to find solutions for all. Rather than purely focusing on developing just the dolphin habitat, the design proposal focuses on restoring the habitat of key indicator species and those species that these dolphins depend upon such as bottom feeders which are a major prey source for these dolphins. This way the river health also improves while simultaneously improving the quality of life for all the species in question.

## **PROJECT IMPLEMENTATION SCHEDULE AND STAKEHOLDERS**

The proposal envisages three major phases in line with the 3Rs concept so as to achieve an output for the holistic health and functioning of the VGDS. To exhort the fullest site potential, the entire proposal has to be executed in a strategic and careful manner on the basis of annual monitoring, evaluation, and implementation of key lessons learnt.

The strategies proposed as part of the design proposal are also aligned with the SDGs proposed by the UN which is an added benefit as well. The main areas of work that shall be addressed as a result of this proposal include: -

- River health protection, environment preservation and landscape conservation
- Recreation , religion and sustainable tourism
- Local livelihood and awareness
- Management and organisation

The proposal further visualizes the setting of Programme Steering Committee (PSC) at both national and state level. The holistic project however shall be governed by NMCG and NIUA who shall follow their own pre-established mechanisms of governance and if need arises may constitute its own monitoring and steering committee for overseeing the project. At a micro level, the local communities need to be made a part of the entire project execution for it is only their involvement that determines the success or failure of this project. Active involvement by the local communities can help conserve the natural landscapes through means of best practices to be incorporated as part of their livelihood routines in addition to being active role-players in imparting awareness of the local biodiversity to the visitors accessing the river.

The implementation of this project proposal as designed and incorporated in the DPR is of 5 years. The maintenance costs however shall spillover post the 5 years duration. Some of the proposed guidelines are meant to be achieved on a short-term notice that covers a span of maximum a year while the others are to be executed over a long-term period of 5 years. However, there are certain proposed guidelines that may or may not fall within the 5-year span. The latter primarily includes acts such as research and development, material innovation, etc. As discussed above, a comprehensive landscape development master plan based on the 3Rs concept has been conceived along with a design program that decides the permissible and proposed activities within the sanctuary extent.

1. Core strategies proposed as part of Renaturalisation:-
2. Establishing a designated active floodplain region
3. Restoring and daylighting the natural hydrological connections to the main river channel along with riverbed naturalisation across the Ganga stretch within the site extent.
4. Conservation, preservation and diversification of the natural mid channel islands or diaras.
5. Establishing riparian corridors with effective soil erosion control and bank stabilisation strategies.
6. Introducing subtle modifications of faunal habitats of species such as smooth coated otters, fishes etc.

**Core strategies proposed as part of Revive + Recover: -**

1. Installing trash boom barriers at the mouth of the meeting points of lower order water channels with the main river channel to counter solid waste accumulation.
2. A series of remediation glades, riparian buffers and natural and constructed wetlands with phytoremediation abilities to counter issues like arsenic and fluoride poisoning.

1. Designated No fishing zones and natural hatchery ponds on diaras in an attempt to develop sustainable fisheries in the region.
2. A scientific design oriented approach to control prevalent zoonoses in the region through strategic planting and interventions such as urban forests, flower fields and pollinator fields based on the 2 core concepts – zoo- prophylaxis and introducing floral species with higher sugar level content.

Core strategies proposed as part of Rediscover: -

- Modified Ghats design
- Eco sensitive nature trails and floating foot bridges
- Ferry points
- Watch towers
- Innovative signages as part of species awareness programme.

## **BUDGETING AND FUND FLOW MECHANISM**

The overall financial support for the execution of this proposal may be provided by NMCG, MoWR RD&GR, GoI under its priority programme of Namami Gange. The budget allocation for the overall project may be prepared upon further discussion with the State Government of Bihar and local urban bodies governing the proposed site extent. Further other innovative yet informal means of budgeting may also incorporate such as crowdsourced funding etc. Techniques for circular economy in addition to ensuring a cyclic flow of funds may be adopted from the IUCN guidelines for Tourism and Visitor use management in Protected Areas. The highest emphasis shall be oriented towards the restoration and establishment of natural landscapes however budget control may be achieved as the design proposal is based on ideologies like adaptive reuse and retrofitting of the natural environment owing to which the strategies proposed are majorly cost cutting in character through measures such as incorporating native regional species majorly etc.

## **CONCLUSION**

The proposed study and findings are a result of a deep and intensive study of the natural ecological conditions of the VGDS site extent keeping in mind the socio-economic - cultural scenario as well. Therefore, the solutions so proposed also majorly focus towards the ecological river sustenance and its associated systems and biodiversity which indirectly shall help promote a better quality of life for humans as well. This research strives to develop a prototypic design approach and framework that may be adapted into any manner of waterscapes across the nation or lay a foundation for advancements at a global scale. A cemented understanding of the fact that landscape architecture is indeed capable of curbing zoonosis at the initial phases itself is also an added and inevitable outcome of the research. However, a combination of design interventions, proactive planning upon consultation with experts from various fields and policy formulations is needed for success to prevail.

Mimicking the natural environment to the best possible is the core strategy to keep zoonotic spill over at bay. Strategic and prioritised calls need to be taken in addition to ecological interventions that complement the conventional interventions for attaining higher success rates. In the light of the ongoing covid19 pandemic, it is high time that we start to work towards river sensitive urban development with core focus on zoonotic resilience.

Further as discussed in the executive summary earlier, the stretch of Ganga that passes within VGDS extent is of braided character. Effective sustenance of such ecosystems is possible only when the natural ecological processes happen in the way it should be. Also, most of the issues experienced in the proposed site extent is a result of a multitude of activities that occur both upstream and downstream which is why if the proposed site is to truly tap into its potential, it is imperative to resolve those issues such as damming rivers, sewage influx into the rivers, construction of barrages on rivers such as Farakka barrage etc. prior to dealing with the proposed site challenges. Moreover, it is now more important than ever to look at alternative solutions to existing solutions so proposed as a means to resolve current problems as for each intervention so proposed, there may be issues that may be arising somewhere outside of the intervened zone.

Last but not the least the key to protecting the Gangetic dolphins through development of a sanctum lies in the holistic revitalization of the region to support the key indicator species of the region as this will indirectly help sustain the habitat of the Gangetic Dolphins by ensuring that the factors essential for their survival such as clean river water, necessary amount of fish supply, residential areas such as river meanders etc. are present. This is a classic case of hitting multiple birds with a single stone or rather motive in this case.

Sponsored Thesis Project Competition on  
"Re-imagining Urban Rivers"

The somber case of an odd triad - dolphin, man and zoonoses

Student Name: Manju Rajeev Kanchan  
Course Discipline: M.Arch (Landscape )



EXISTING

# गंगा नदी

**EVERYTHING IS CONNECTED**

## RENATURALISATION

- Designated Activated flood plain region
- Restoration and daylighting water nexus
- River bed naturalisation and restoration
- Conservation of diara islands
- Establishing riparian edges and wildlife corridors

## REVIVE + RECOVER

- Remediation landscape interventions
- River bank stabilisation and soil erosion control strategies
- Sustainable fisheries & faunal habitat modifications
- Agro ecological landscapes
- Zoonotic resilience features

## REDISCOVER

- Revamped river ghats
- Trails and floating bridges
- Signages and wayfinding
- Surveillance watch points
- Ferry docking

PROPOSED

# REWILDING



# Project 5

## Planning for Integrated Sustainable Tourism Development: Case of Ayodhya

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*Master of Planning (Urban planning)*  
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Tourism across the globe has evolved as an activity that was viewed from a preview of leisure to a tool of comprehensive development, attributing its role towards achieving 17 SDGs. However, the sector has transformed its approach drastically over the past few decades from an issue-based approach that ponders on a principle that addressing existing infrastructural gaps would automatically develop tourism. Only to be challenged by the Thematic approach, which gained the forefront in the post-modern era. It came to the forefront of a thought process that the theme/character of the destinations holds the highest gravity in people's decision to visit, acknowledging that addressing infrastructural issues/gaps in destination development is not just a need but a necessity.

Although the approach of developing tourism based on character/theme established a broader tourist base instilling greater market capitalisation. The approach failed to encompass the social and environmental dimensions of the destination, bringing in a need for an inclusive, sustainable approach that collates 5A's (Accessibility, Accommodation, Attractions, Activities, Amenities) and travel trade of Tourism through an integrated approach to envision destination development through tourism veraciously. Based on which the concept of integrated sustainable tourism has been derived and applied to the city of Ayodhya.



Zonal profile of Ayodhya

**Ayodhya Core** - previously administered as Ayodhya NPP (Nagar Palika Parishad) encompassing High-density Low-Rise development. And consist of major and majority tourist spots and heritage structures.

**Faizabad** - Previously administered as Faizabad NPP consisting of High-density medium Rise development. It encompasses major Islamic shrines, commercial spaces and heritage structures of Awadhi style.

**Sarayu plains**- The area previously not being under development area, it consists of rural landscapes along with wetlands and is the most sparsely populated out of all. Alongside incorporating majorly consists of Flood plains sub classified HFL, LFL. with some village settlements.

Cantt with restrictive entry being permitted with all rights reserved with the army. The zone encompasses touristic places of religious & cultural significance with serene landscapes.

Outer zone- The area previously under ADA (Ayodhya development authority), is newly added to ANN is majorly Agricultural in character and prominently encompasses Commercial industrial uses across transits.

**Analytical framework**- The components with active and passive correlation to the aspect of tourism were identified with an intent to capture the destination's profile. In terms of challenges, potential opportunities and gaps through comprehensive integration (cross-analysis of components) underlining the concept of sustainability in approach.

**Land use analysis** -A qualitative analysis based on Ideal developable area % (URDPFI) was done wherein the impact of tourism on urbanization and required land-use intervention was derived inferring –

- Wetland degradation across Sarayu plains.
- Limited recreational use and expanding user base spurred by internal causal tourists drawn from sub-regional scale provides in an excellent potential to increase recreational use.
- Need for expansion specific land use to conserve core heritage zones.
- Gradually declining water bodies with the city being known for traditional water conservation practices existing in the forms of kunds. A critical need Kund rejuvenations, reconstructions adding environmental benefits along socio-cultural was described.

Geophysical character - An objective analysis was done based on Geophysical components, which has a passive impact on the city's ecological and touristic character encompassing elevational analysis, state of thermal discomfort, along with an overview on solar potential and rainfall trends to derive sustainable strategies to cater to drastic demand which is predicted to emerge. It majorly inferred –

- Major tourist spots at a lower elevation are prone to flood especially proliferated by the Sarayu river's changing path.

- High temperatures and humidity during April to June with peak raising up to 43 C aligning with the tourist season (Ram Navami, Hanuman Jayanthi, Holi, causing thermal discomfort.
- Thermal comfort and tourist influx timeline were analysed to have a mutual relation where tourist influx depleted during months with higher temperature bringing in the need for Dynamic shading and heat proofing techniques.
- Higher Potential to tap solar energy attributing to its sun hours up to 240 hours
- A decreasing trend of rainfall and excess exploitation of groundwater has been observed.

**Administrative analysis-** Functional profile of administrative organisations involved in Ayodhya's touristic development was profiled wherein crucial issues pertaining to Administrative, Organisational, Financial cohorts were inferred to be -

- Excessive dependency on grants due to lower own revenue generation. Need for newer revenue-generating models/revenue mobilisation strategy.
- Absence of zonal regulations on heritage site.
- Land acquisition issues & the need for dynamic pricing models
- Interdepartmental coordination issues and limitations of PMU (Project management unit) were pointed out.

**Demographic & Tourist trends** -The above analysis captured based on census and UP tourism data shows the drastic growth rate of local and floating population perpetuated by tourism reflecting potential which exists in terms of international tourists. Activity-based strategy for tourist redistribution and quantum of challenges which would be emerging in future. The above analysis based on census and UP tourism data reflected that -

- A steady rise in population up till 2011 and an expected rapid increase in the upcoming years attributing to rapid urbanization perpetuated by Socio-economic factors.
- Steady growth of 8.2% can be observed in tourists from 2009 to 2019, peaking to 2 crores prior to covid followed by a dip in 2020. UP tourism has projected the expected tourist influx to be clocked at 3.65 crores (i.e., 1 lakh tourists per day post-2024)
- But with International tourists consisting of less than 0.2% of the total tourist, the tourism is entirely propelled by domestic tourists driven by religious purpose but with an average rise of 11.1 % across the recent years adds on a vast potential to expand.

**Tourist destination profile** -Destinations were profiled with respect to the zone in the line of intracity travel pattern. The places were characterised with respect to zones based on - Nature of the place, Issues Potential opportunities. It was noted through a lens on how tourism centres around the Sarayu river attributing to the socio-cultural character of Ayodhya and not river just being a component in city's tourism.

**Non-mainstream places-** It was noted that with greater influx comes greater challenges henceforth which redistribution should be adapted as a strategy for destination development wherein- Many of these non-mainstream places were derived through primary surveys, which were left out in a mainstream tourist itinerary. There exists an excellent potential to redistribute and retain tourism to ensuring social and economic sustainability, simultaneously acting as a tool for conserving heritage and boost tourism.

**Sarayu characterisation-** The river Sarayu's characterisation in Ayodhya's city stretch was analysed with components consisting of: Activity mapping, Cultural approach towards water conservation, Issues caused by tourism on the river (Solid waste -majorly plastic, sewerage etc.), Landscape assessment through a lens of tourism potential which exists. Navigational profile analysis. A catchment area profile has been done to derive conservation strategies. Flood lines (which are changing rapidly and a need to stabilize the course of flow)

**Accessibility-** A detailed profile of existing connectivity used in Ayodhya in terms of modes and routes consisting of Personal transport, IPT encompassing Vikram autos (Diesel-powered), General auto-rickshaws (CNG), E-Rickshaws, Walking were analysed, wherein characterisation and issues of each mode were identified, through primary surveys and secondary analysis consisting of; Isochronal network Analysis, Walkability assessment.

**Accommodation** -State of tourist accommodations was picturized in terms of –Affordability, Occupancy, Resource management, Water consumption, sewerage. Solid waste considering the impact of this sub sector of tourism, contributes to the major unsustainable practices affecting the land and water ecosystem. Wherein it was inferred that –

- Affordability - Establishments are mostly non-starred, and budget in nature, with ashrams and dharmshalas remaining universally accessible to all, mostly charging nil or nominal remains most affordable.
- Occupancy - Average occupancy lies between 25% to 50% during lean, going more than 75% to 100% during peak.
- Resource management -an aspect that leaves a major footprint in Ayodhya's environmental profile–
- Water consumption ranges from 50KL to 300KL per month, majorly dependent on groundwater.
- Mostly dependent on self-cleaning of the soak pit, sewerage remains a point of concern.
- Solid waste majorly consisting of plastic bottles and kitchen waste. Contributes to the major unsustainable practices effecting the land and water ecosystem.
- Around 5000-6000 units of electricity remain average consumption increasing during summers wherein source needs to be decentralised and diversified through sustainable clean energy to cater increasing demand.

**Tourist characterisation** - Tourist's profile was captured through cross-analysis from primary survey data, which encompasses – Nature of a tourist, Prospective, Issues. It was observed that

- A major proportion of first-time visitors were to be seen.
- There exists a Potential for regional integration.
- Need for redistribution to tackle congestion
- Solid waste sensitization issues
- Need for promotion of non-mainstream attractions, activity induction as the willingness to explore persists but the information doesn't.

**Service quality assessment** - A perception-based Service quality assessment was done to identify the criticality in services were in issues pertaining to Footpath, Signages, Parking facilities, public toilets were identified to be concern among others.

**Local resident characterisation** -A local resident survey was conducted across different zones to reflect – Influence of tourism on quality of life—core characterisation of Ayodhya through Must catalogue, factors of likes, dislikes and Issues.

**Image intensity analysis**- Image intensity analysis was done in order to understand the psychological footprint of imageability of spaces & places in Ayodhya. The city's tourism is characterised at a stage between development and consolidation on butler's scale; there is a higher potential to utilize the places by mapping the unmapped places in people's minds. It frames as a basis to formulate redistribution as a tool towards sustainability to tackle congestion alongside enhancing user experiences.

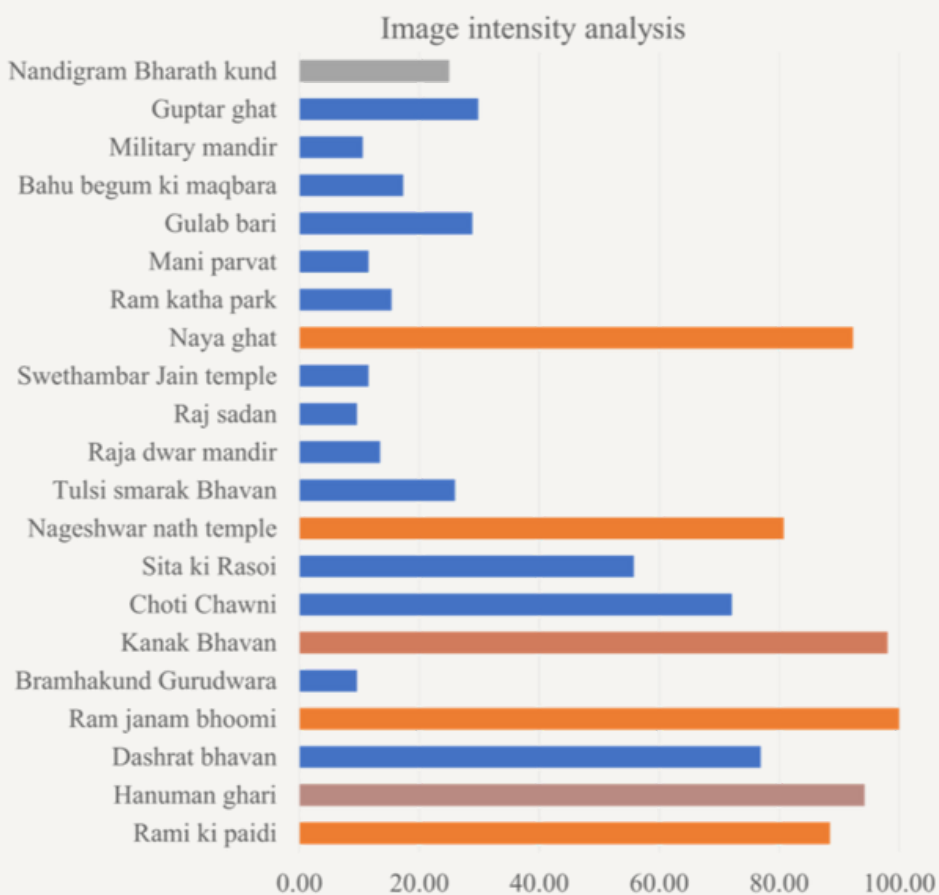


Image analysis=Recall frequency\*100/sample size

**Non-participant survey**- identifying potential tourists (outside Ayodhya) -A Non-participant survey was conducted to analyse and extract the issues faced by the potential tourists based on the psychological paradigm. The terms were captured in terms of – Awareness, Perception, Preferences.

**Commercial establishments/ travel trade-** Micro profiling of tourist markets and tourism products were made to derive –Issues and Opportunities.

**Amenities** - Amenities of sewerage, storm water drainage, water supply, solid waste were individually assessed to capture – Existing status and contribution of tourism to demand, Gaps, Potential.

**Proposals-** A detailed proposal was derived based on the inter-relational analysis on the lines of

**Administrative at the city level-** Targeting the issue of A joint Coordination committee consisting of representatives appointed by the line department and headed by the commissioner is formed under Section 5, The Uttar Pradesh Municipal Corporation Act, 1959. The existing Project management unit is promoted in its hierarchical placement under Joint Coordination Committee expanding its scope. By the creation of subunits on; Project Management monitoring, Issue Management, Data management, Tourism & Heritage cell, Environment & Disaster management cell, R & D.

Betterment charges proportionate to land value is leaved on non-agricultural land as a source of revenue mobilisation strategy as a Land value capture tool.

**Spatial in river abutting zones (Attractions & Activities)-** An extended buffer of 500m width and 10km length towards the offside/Northern bank of Sarayu is proposed, which would be a riparian buffer where reforestation caters to the local ecosystem and flood mitigation. Wherein the Funding drive would be undertaken through CAF (Compulsory afforestation fund) along with modelling of Sarayu's riverscape developing scope for open space sports activities. A voluntary participatory model can be adopted in the creation phase as a part of Service to Ayodhya in coordination with other major stakeholders

Open sports park of 330m\*1500 forming 111 acres is proposed to promote ancient and modern sports. The sports park shall consist of modern and ancient divisions to promote contemporary sports and to conserve and display ancient sporting culture. It is recommended to upgrade Three docks (Naya ghat, Guptar ghat, Raj ghat and construct two new docs (where Buffer view and open sports park) is proposed.

Ram ki Paidi design intervention - soft scaping of Ram ki paidi is proposed wherein shades and shelters are developed to tackle scorching temperature. Keeping in consideration that coherent design is inclusive of women and specially-abled through changing rooms, ramps, audio-visual signages, braille tactile signages.

Normal poles to be replaced by smart poles in the major tourist destinations. It would act with facilities such as wifi Hotspot, Charging port, CCTV monitoring. Dynamic billboards on tourist places.

A special heritage zone is delineated in the Ayodhya core (abutting to the river) to conserve heritage structures. Supervised building destruction and construction permits to be given. Special Area heritage plan has to be prepared to promote adaptable reuse of heritage structures. Ex-Deteriorating and abandoned heritage buildings can be conserved and used as heritage accommodation in the PPP model.

Rejuvenation of 7 kunds identified with a vision to revive ancient water conservation techniques. Adding both socio-cultural and environmental value

**Accessibility**- To develop boating as not just leisure but also to connect Sarayu plains, Guptar ghat and offside once activities are induced.

It is proposed to Convert current diesel-powered boats to solar in association with TERI under CSR, similar to Varanasi. The promotion of E- Public vehicles through subsidising policy needs to be considered.

**Accommodation** -It is recommended to mandate solar installation as a part of the permit. Commercial Accommodations with kitchens structures should be mandated with a Kitchen waste composter along with decentralized wastewater treatment (such as Anaerobic baffled reactor, planted gravel filter).

**Amenities** - Loolets under PPP can be induced similar to Rameswaram, where tourists, vendors can avail themselves at minimal costs to access toilets, bathrooms and food. Rainwater harvesting for new building design approval for any new property beyond 1200 sq.ft is proposed to effectively cater for the rapid demand.

Enforcement of strict plastic bottle ban in phased manner slowly replacing with earthen pot/bamboo/brass bottle. In the chronology of accommodations, restaurants and street vendors replacing in phases.

Wherein the impact of the proposal's essence is both active and passive in nature. The proposals lay on the principle of "Preclusion of issues through inclusion" – bringing in integration, "Address the issue at the source, by predicting its future course" – inducing sustainability.

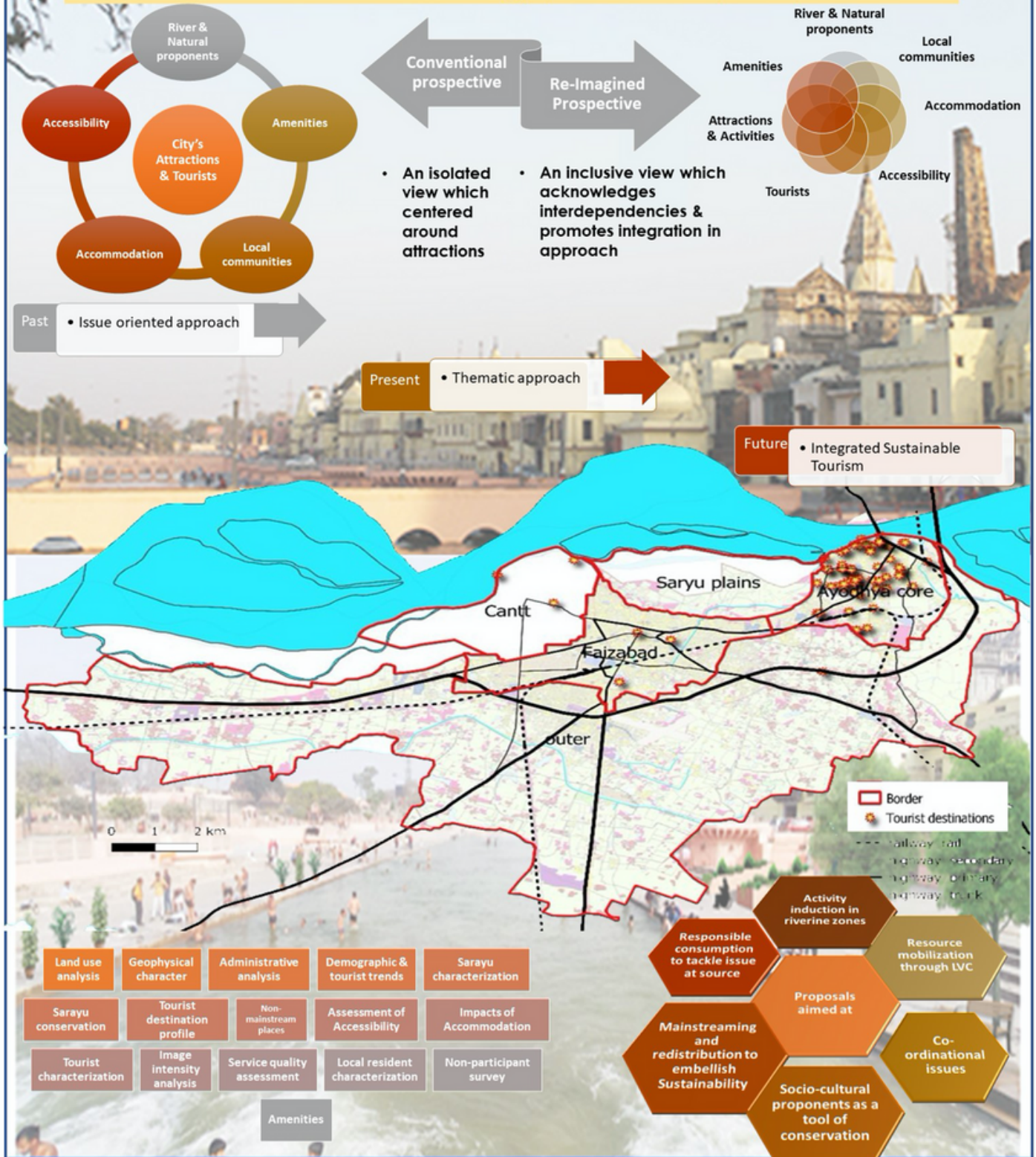


Sponsored Thesis Project Competition on  
"Re-imagining Urban Rivers"

Planning For Integrated Sustainable Tourism  
Development : Case of Ayodhya

Student Name: Muddukrishna A S  
Course Discipline: Master of Planning ( Urban )

"It's not just about river adding value to tourism in the city, it is also about tourism adding component of resilience to the river in turn inducing proponent of sustainability to the city."



# Project 6

## Reconnecting the City to its Riverfront- A case of North Kolkata

*Rajorshi Banerjee,  
Sushant University*



## Introduction

Rivers have great significance in the evolution of many civilizations and their sustenance, becoming an essential element of the urban life- as an identity, a visual and cultural resource, the life system, and a corridor of endless tales. Along with time, it becomes a memorandum capturing several impressions along its banks throughout its life, a reference for the future of humankind. It behaves to be a ground for recreation, an entire biological ecosystem, or an endless resource. Diverse opportunities of everyday life are created along the river. Despite its cultural importance, the cities have sometimes retaliated in an undesired manner. This project is entitled to the social issues of addressing the urban concern for finding a suitable solution or method to revive the lost values of an urban river by strengthening its existing social bonds with the city. An instance focussed upon the case of North Kolkata where the Hooghly River passes by an urban edge with multiple expressions of defining a 'place', acting within a mutual platform with different forms of perceptions and activities. But, delusions within the sacred bond of the riverfront and the social lifestyle have been manifested within the spirit of this place.



The riverfront is on the verge of losing its social recognition to the people of the city. The deteriorating bonds with the tales of the city's glorious past and the grounds for being the epicentre for the urban growth of a present metropolis, initially developing from these very specific river-edges, now appear to be in a state of neglect and indifference, physically and within the minds of its city people. The ecological value of the river is hence ignored, and its edges have become the backyard for the city. Though the roots of its intangible bonds have kept it attached to the city but with significant low standards. The old city parts of Kolkata showcase a lot of storylines within itself, especially the stretch extending from the Circular Canal till the Burrabazaar region, comprising the neighbourhoods of Bagbazar, Sovabazar, Kumurtuli, Ahiritola and Nimtala within it.

But could these stories act in favour of becoming an urban catalyst to restore faith in the riverfront and bring back its life? How could the Hooghly riverfront be better reconnected with the city of Kolkata through its cultural & social bonds??

## Goals

The project deals with the revival methods for the riverside precincts into a newly transformed riverfront development to reconnect it with the city socially and culturally by enhancing the structure of livelihood within the associated urban fabric with a new programme to become a city magnet, further boosting socio-economic development of the neighbourhoods and rejuvenating the cultural bonds with the Hooghly River.

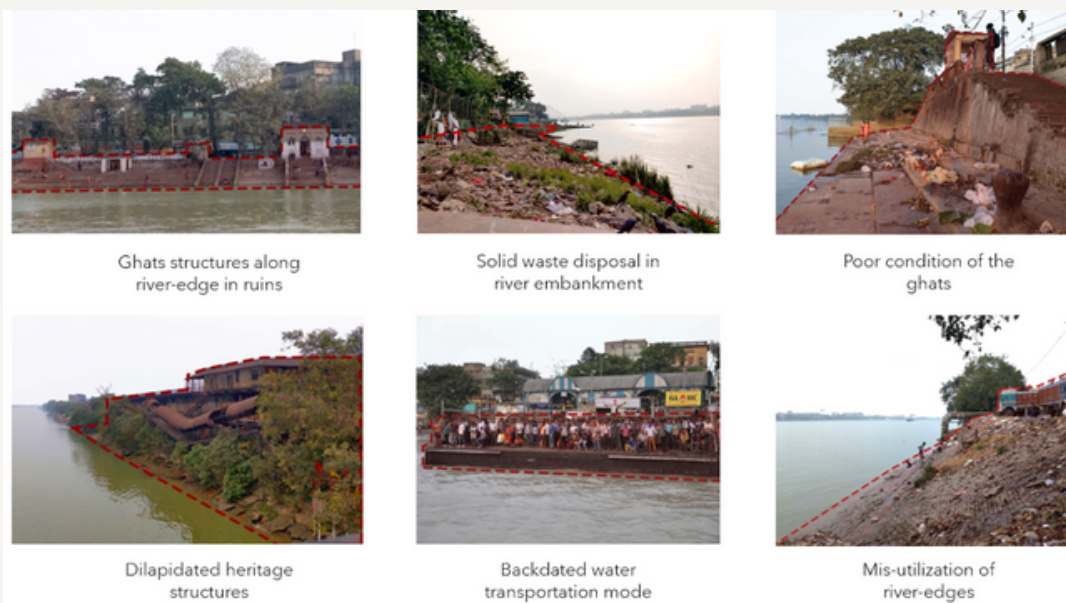
## Background image of the stretch

The dense morphology of north Kolkata relates back to the times when the city was emerging as a trading capital for the country and an administrative power. People from all around the state and beyond, flocked within these areas in hope for an economic opportunity. The steep rise in the influence of trade generated a high demand in infrastructure by the riversides. Its trade-oriented functionality left over the river banks with an explicatory commercial frontage opening immediately by the river. The cityscape got its shape from these activities with construction of colonial warehouses, docking ports and ghats by the river line. These places were the central focal point of economic boost for the whole city. The Hooghly River served as the basin for connecting the people and the goods to different parts of the country and the world. The riverfront forms a storyline with the old and new parts of the city interacting with the river in very different forms and ways, exhibiting various characters along it. Looking back at the past of the urban growth of the city, this part of the urban form played an important role as the initial forms of civic settlement among the three villages (Sutanuti, Kalikata and Govindapur) which later formed Calcutta along with urban expansion.

The riverfront has played a major role in trade influences for becoming the interface of the city form with the river. Also, the colonial rule which pushed the native population towards these northern precincts of the city, and an extremism of the British rule influenced these places to adapt and cultivate upon its own unique character of the place with a rich socio-cultural background, architectural style, and the way of livelihood.



Mixed-use developments along with small scale industries with an influence of the artisans' community evolved within this dense fabric. Communities evolved with similar form of occupation within inclusive societies. Their daily activities with the river in tangible or intangible forms have kept alive the social spirit of the place even today. It attracts visitors from the city and beyond but is maintained in a very dilapidated condition. Along with formation of disposal grounds on the river embankment and formation of unsocial pockets along the stretch, the local neighbourhoods even turned their back and made the riverfront only a backyard of the city. Its recognition within the city has come to stake. The social interpretation about the landscape of the city riverfront have become a regular form of visualisation with "dilapidated ruined structures lining upon a river edge with polluted ghats and unattended solid waste dumping grounds". The river edge which is supposed to be the face of the city, is no more. The Burrabazaar regions that grew as a commercial city node with its strategic location by the Hooghly River and opposite the Howrah railway terminal, houses dilapidated warehouses by the river edge, which were once the most ideal place for the trade, adjacent to the dockyards. But under the present circumstances, these built places do not serve to their potential of a healthy city space, being an edge of a metropolis by an urban river.



### Site analysis

The viability to achieve an enhanced qualitative public realm grabs the attention towards the enduring built precincts which appraises a sequence of heritage value but ironically is being used in an inferior state. A multitude of activities performed efficiently stage the functionality of a wide range of activities, in these places within a synchronised pattern. The project considers to rethink and develop these deteriorated places that restrict the river fronts to be utilised to its full potential. Efficient utilisation of spatial configurations along the ghats that are used presently in a dilapidated conditions could become an opportunity for showcasing the glorious heritage value of the place along with ecological conservation that will further benefit the diverse communities of the local neighbourhoods. It implies an urgent need to address the issue of reviving the identity of the place with emphasis laid on integrating it with the local context, and engaging itself with the rejuvenation plans that can essentially revive the riverfront for recreational, economic, and ecological benefits.

## Concept

The initial studies, observations and their analysis show a potential need to strengthen the immediate bond within the local level, which will eventually act as a catalyst to further connect the riverfront with city core. Upgrading the social connections with the city people will further nurture a strong linkage for the urban fabric to respond to the necessities of highlighting the ecological value of the Hooghly River.

The project considers reconsidering the ecological value of the Hooghly River, strengthening its social and cultural bonds with the people of Kolkata. It could be achieved by socially uplifting the value of the river by engaging the local communities to extract means of livelihood from the river and exhibit their skills in the form of promoting the folk cultural through new means within the riverfront precincts within a transformed public realm. The urban interventions aim to deal with the present physical settings, considering its characteristics and the potentials involved within these regions, along with finding scope for associating the river to the needs of the neighbourhoods, in an inclusive and unified manner to become an economic booster, resource platform and promotional ground.



The development of the proposed is expected to deal under three layers:

- Developing the river-edge to characterize the riverfront as an open city exhibition ground portraying the essence of the city and its heritage.
- Stitching the activities of adjacent neighbourhoods to the riverfront to exploit as a social- economic supportive platform boosting its social inclusiveness.
- Upgrading the social and physical linkages with the city.



The stretch could be developed in a node-based configuration, where major nodes that form the approach to the riverfront distinguishes the character of development into fragmentation of the stretch. These fragments of the stretch could then better respond to its present physical characteristics and its potential to deal with the needs of the localities as an economic resource platform and promotional ground. Different platforms for various activities within a fusion of each overlapping with each other would enhance the vitality of the place to become a vibrant environment for pedestrian activities along with recreational grounds, thus, making it a magnet for the city.

The northern most fragment of stretch along the Bagbazar region is proposed as an eco-retreat corridor for the city. The natural embankment of the river edges could serve as the resource for selective wood-based handicrafts industries and the platform to extract the river siltation for making clay items.



The adjacent neighbourhoods are proposed to extract natural resource from the riverfront where communities are to be exposed to the eco-friendly sustainable industries which would represent and promote regional Bengali folk cultural handicraft industries, such as clay idol making from Krishnanagar, baked earth or terracotta items from Bishnupur and bamboo and cane artefacts from Coochbehar. Home based industries indulging the locals could be developed to help in the economic upgradation of the livelihood nearby. As a basic resource ground for the locals the riverfront is expected to be maintained by them as well. This inclusive nature of interdependency on the locals with the riverfront would enhance the social integrity of the place and help revival of the value of the river. The Sovabazar-Ahiritola region is proposed to be developed with multi-dimensional utility purpose of the spaces with urban landscape depicting the city's heritage style with the unique Bengali style of architectural elements. Different platforms for various activities within a fusion of each overlapping with each other would enhance the vitality of the place to become a vibrant environment for pedestrian activities along with recreational grounds, thus, making it a magnet for the tourism.

experience culture in new way

### CULTURAL RESEARCH HUB



### An ECO-RETREAT TO THE CITY



WATER PURIFYING ISLANDS WITH ECONOMIC BENEFICIAL PLANTATIONS

WIDE GREEN WALKWAYS WITH VENDORS & SOCIAL POCKETS

HERITAGE BUILT FRONTAGE

Different tales of act is also expected at different times of the day as each space is for multi-dimensional purposes.

### HOME-BASED INDUSTRIES

ALONG THE RIVER



self-help groups



women power



LOCAL MICRO-FINANCE UNITS

### vocal for Local CULTURAL EXHIBITION ALONG THE RIVER





These places which are proposed to foster huge amount of visitor footfall, would be used as an exhibition ground for the local small industries and the folk handicraft industries. New sustainable home-based industries could be developed within the precincts. It would boost the local economy in the adjacent neighbourhoods.



Furthermore, exposure and promotion through community walks and dedicated theme streets, are would bringing more interest and curiosity within the whole region, to be explored upon by the visitors. Local economic beneficiary strategies could be implied. Further, local level developmental strategies such as shifting of the warehouse activities, conservation and restoration of heritage properties, establishment of a new Bengali cultural research and educational hub, and improving the approach street network.



The region when created as a recreational magnet with the streets forming the network into a new dimension of storyline to explore, an exploration into the glorious past, the city's culture and a sustainably developed livelihood for the morals of the future, within these river edges, will create a deep impression in the bonds of the city people with the river. A change in the perspective of looking towards the river, could hence, be envisaged with a much stronger attachment to it.

### **Phases of Development**

The whole project could be considered to develop in three stages. Firstly, the river-edges as an initial ground for creating the platform for resources. The physical and social linkages could be further promoted. Then, through the help of awareness programmes, the locals could be educated to be obtain the benefits out of the riverfront precincts and taking over its responsibility through local associative bodies of playing the role of guardianship. The social linkages within the neighbourhoods would then definitely get a boost to comprehensively work upon uplifting the status of the riverfront.

### **Conclusion**

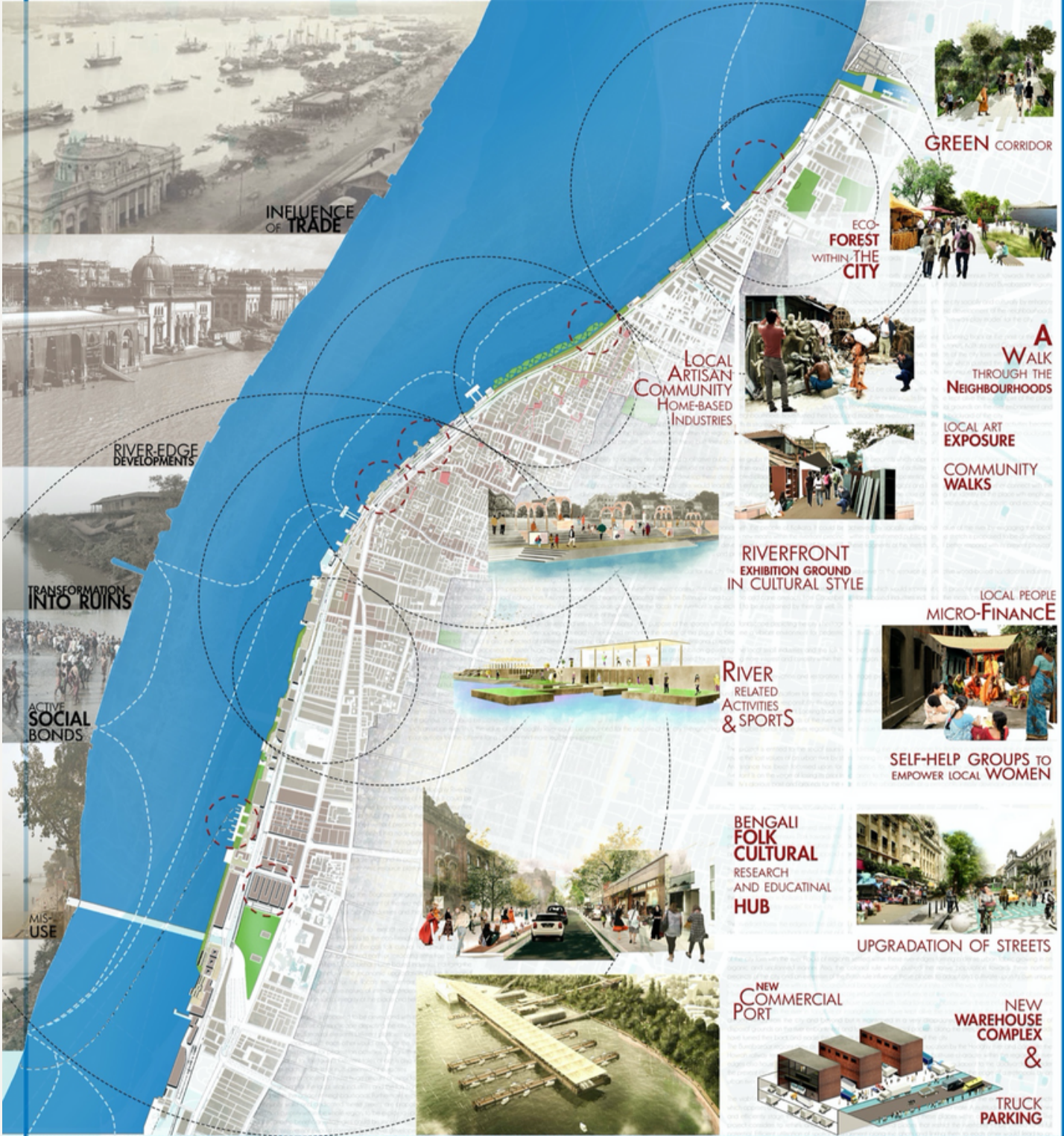
Looking back at the traditional outlook of the importance of the river that had been a part of the glorious past could be achieved through such a social upliftment of the riverfront precincts; hence socially strengthening the intangible bonds of the river with city, which would eventually impact in the revival of the ecological health of such an urban river. Thus, the value of the Hooghly River could be improved for the people of the city by strengthening the intangible bonds of the river, retaining its societal value for the human settlements in a more sustainable manner and get the prior outlook of the citizens for a cleaner and more legible environment along the urban river.



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# Sponsored Thesis Project Competition on "Re-imagining Urban Rivers"



A proposed thesis on  
**"Reconnecting the City to its Riverfront-  
 A Case of North Kolkata"**

Student Name : Rajorshi Banerjee  
 Course Discipline : Master of Architecture  
 (Urban Design)  
 Institute Name : Sushant School of Art and  
 Architecture, Sushant University

# Project 7

## ‘Economic appraisal through effective riverfront development- role of rivers in mitigation of urban heat island and climate change

### Case of Yamuna bank, Delhi

*Ritu Sharma,  
SVNIT, Surat*



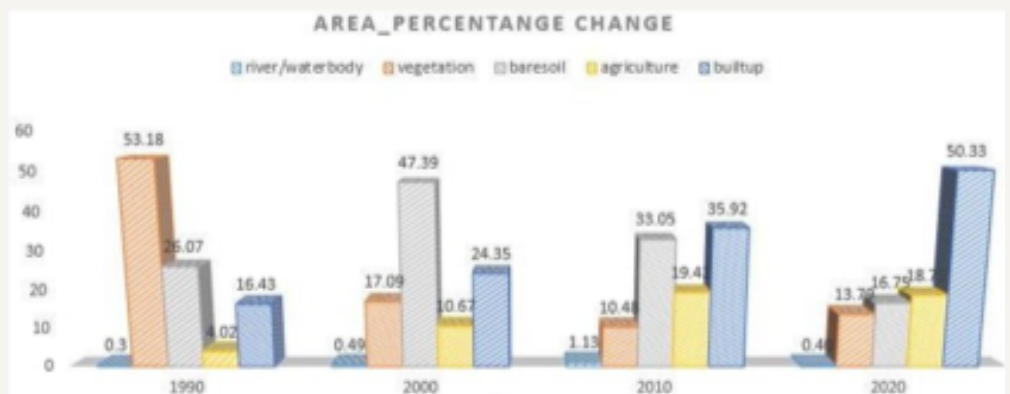
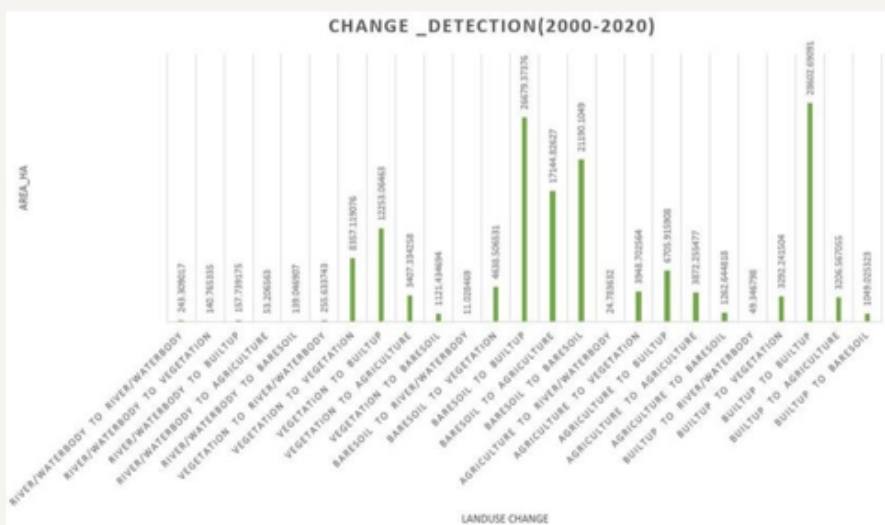
Human settlements from ages have been strongly linked and evolved around the rivers. The ancient civilizations such as Egyptian, Mesopotamia, etc. all flourished near the rivers. But, due to anthropogenic activities, rivers are drying and moving towards extinction. It is very important to identify the crucial role of rivers, in sustaining the wellbeing of humans as well as other bio diversities. The declining state of rivers is not an isolated process and is very closely related to Climate change. Climate change is a phenomenon resulting from human and natural activities. But in recent years, anthropogenic activities have contributed a lot in intensifying it. The globe is warming because of an expansion in the centralisation of CO<sub>2</sub> levels in the atmosphere, because of which different changes at the neighbourhood level are taking place altering the microclimate in turn affecting the lives of all the living organisms. The increase in CO<sub>2</sub> is caused by various activities such as deforestation, excessive use of non-renewable resources, pollution by industries, vehicular emissions etc. The implications of such events are responsible for increasing food insecurity, unemployment, poverty and largely ecological imbalance which leaves us with an unsustainable future. The events witnessed at the macro-scale have their roots embedded in the micro-scale. For example, the growing CO<sub>2</sub> emissions and global warming is a manifestation of the unsustainable lifestyle of the individual at the city level. The unhealthy cities and various challenges which we see in our environment such as increasing poverty, rising slums, untreated waste from the cities, polluted rivers, etc. are the results of an unplanned distribution of resources and failure of planning approach and management strategy by the government. The growth of cities near rivers with the fast pace of urbanisation has put immense pressure on the limited natural resources like land, forests, rivers, etc. The continuous depletion of resources has outpaced the regenerative capacity which has disturbed the natural healing process of nature and is leading to the phenomenon of Climate change. The fast-changing landcover due to urbanisation is responsible for Urban Heat Island effect.

The study aims to analyse the rivers' role in the urban environment for maintaining ecosystem balance and proposes the design for effective riverfront by addressing the challenges faced by the urban rivers' that helps in reducing the Urban Heat Island (UHI) implications in the cities in general and for the study area in particular. The study area is part of Ganga river basin and is located on the Yamuna banks in the Capital city, Delhi. The focus of the research is to identify the causes of deterioration in the context of rivers and suggest an approach by addressing all the factors that will help in making an ecological riverfront and will serve as the developmental model for other cities. Here, in the context of the river, the study is carried out to understand the role of rivers in reviving cities.

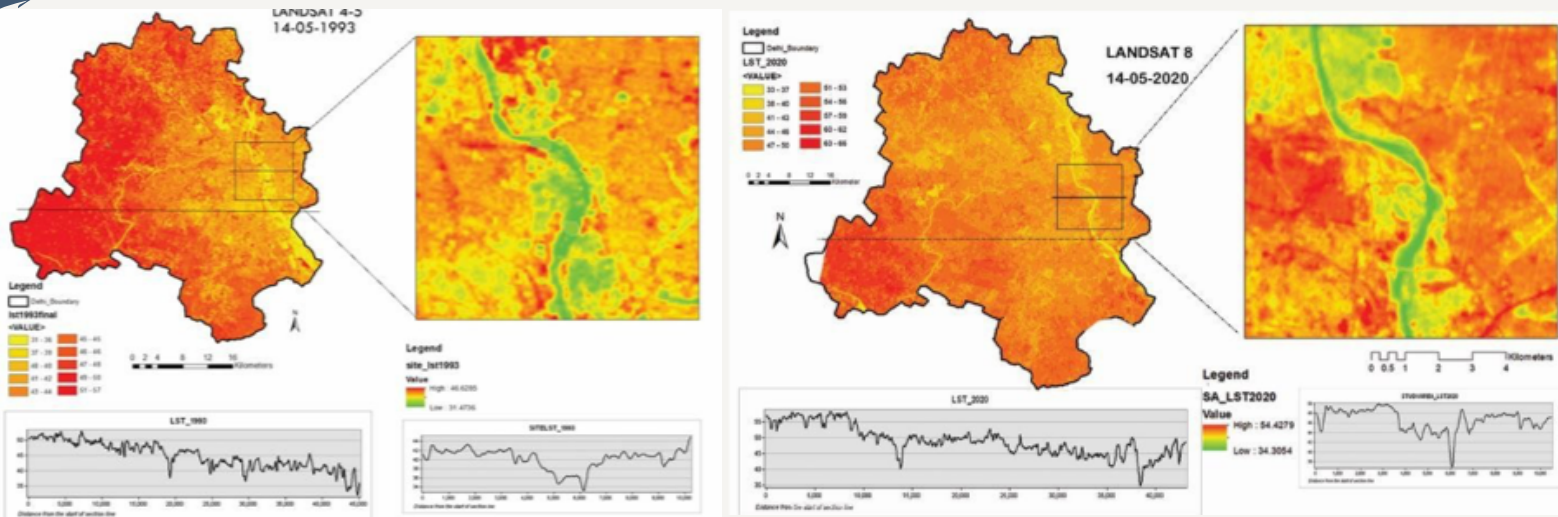
The research was carried out at two Macro-scale and Micro-scale. At , the research problem was focused on understanding the waning condition of the river and various other factors responsible for causing it, in the context of river Yamuna, covering the whole Delhi region.



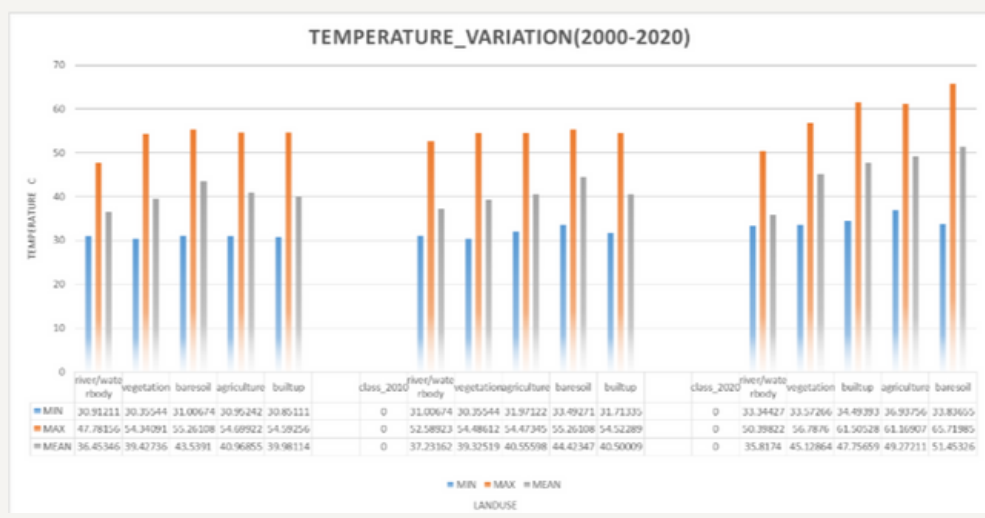
The data was collected for the past 20-30 years to understand the climate behaviour by analyzing the UHI effect, rainfall pattern, heat index, landcover change, Air pollution and several deaths due to it, UHI and its correlation with artificial cooling to understand the major issue concerned with runoff, flood, heating of the area at the micro scale, it was addressing the forgotten and detached riverbank by proposing a regenerative strategy covering a radius of about 5 km (area of 25 sq. km) from the site. To understand the scenario at the macro level, the satellite images were used for analyzing the land cover change, preparation of land surface temperature (LST) maps and detecting UHI and overall change of temperature across different land use, flood mapping, NDVI, NDVI maps, etc. To perform analysis at the micro scale, formal and informal surveys were conducted, site analysis was done, land use map was prepared, and analysis like computational fluid dynamics was observed for this location. The Macro-analysis shown below indicates the Landcover and LST change from 1990-2020.



The built-up activity from the 1990s to 2020s increased from 16.43% to 50.33% for overall Delhi. The Vegetation area decreased from 53.18% to 13.79% in 30 years. The agriculture activity increased from 4% to 18%. This suggests divergence of vegetative land for built-up and agriculture activities.



The LST results shows an increase in minimum, maximum and mean temperature for the last 30 years due to land cover change. For the River the temperature change in Celsius are 31 -33 (min), 47-50 (max), 35.4 -35.8 (mean). For built up, the temperature change observed are 31- 34 (min), 57-61 (max), 43-47 (mean). For vegetation, the temperature change observed are 31- 33 (min), 55-56 (max), 43-45 (mean). For Agriculture, the temperature change observed are 31-36 (min), 52-61 (max), 41-49 (mean). For Baresoil, the temperature change observed are 32-33 (min), 54-65 (max), 47-51 (mean).



The Urban Heat Island occurring in urban areas is responsible for flood-related disasters, food scarcity, disease spread, etc. which leads to death.

To understand the change, it is crucial to understand the role played by the environment in balancing the ecological systems. The climate comprises the multitude of components in the encompassing and their relationship with one another assume a significant part in adjusting the biological system and supporting human prosperity. It is very known that human beings (part of the large community) are the small part of the Ecosystem in a biome which in turn is a part of the largest biosphere that helps in maintaining the ecological balance. The river connects the culture, livelihood, environment, economy to the people and creates value. This study gives us a relation between the changing land cover and carbon sink which is an important factor in the discussion of climate change.

The study aimed at analyzing the role played by the rivers in the urban environment and for maintaining ecosystem balance and proposing the design for effective riverfront development by addressing the challenges faced by the rivers in urban areas and help in reducing the UHI implications in the cities in general and for the study area in particular. Here, in this research study, a similar attempt has been made to analyze the macro-micro scale environment in the context of Delhi and understand the implications of UHI to propose a regenerative strategy at the micro scale by selecting an influence zone from the site within a radius of 2.5 km to understand the interrelationship of rivers and urban architecture around it. The riverfront development was conceived as a form that will help in promoting the cool breezes from rivers to the city core and help in establishing connection which is not merely economical, but also has social, environmental, the climatic value attached to it.



The 3d visual of the site explains the BAU scenario of concretized development and the consequences leading to river degradation. But if the site is developed as a ventilation corridor as shown in the figure above, it helps in propagating the cool river breezes towards the core of the city. The cool breezes from the river help in connecting the river to the city physically and mentally by establishing a social connection. The ecological approach for the riverfront development further helps in realizing environmental, cultural, economic value.

The survey was carried out to understand the perception of the people living nearby the Yamuna river site in the Delhi region. The response recorded shows that they were not able to relate to the river as a river but as a drain. The perception of 70% of them was in favour of rethinking riverfront development. The survey also tried to capture the facilities they are looking forward to Riverfront in this area. Also, the survey showed that 79.6% of people felt thermal comfort near rivers as compared to the city due to greener areas in its vicinity. The response from the people also pointed towards the existing problems of flooding, Sewerage, foul smell, mosquito breeding which needs urgent attention.



The 100% of people demanded a formal space for their informal activities that will help in the maintenance of the area as well. For designing effective riverfront development, the approach was to establish a connection by addressing climatic, environmental, economic, socio-cultural and aesthetic factors catering to water sensitive design principles. The theme for the riverfront development was thought on the religious lines, to give it a character, where people can connect to it with the architecture and the stories and tales of Yamuna and Lord Krishna. The motive was to capture the responsible behaviour of people through religious sensitisation and increase awareness towards the maintenance of the ecosystem and environment.

The final proposal for regenerative strategy was proposed keeping in mind the potentials of the site. The macro and micro-level analysis in GIS software, further helped in the determination of existing water streams, head waters in the site which plays an important role in water storage, maintaining a continuous flow of water in rivers. The concept was to establish a connection by addressing Climatic, Environmental, Economic, Cultural and Aesthetic factors which addresses a Water sensitive based regenerative strategy. The proposal will help in mitigation of the UHI effect by building a ventilation corridor (the RFD is conceived as a form that will help in promoting the cool breezes from rivers to the city core and help in establishing a connection). The water streams helped in identifying ideal locations for urban squares, water squares and other landscape activities around it. The design has been proposed keeping into consideration the strategies of master plan Delhi 2041 and differentiation proposed by DDA around rivers in the sensitive, protected and interactive zone and accordingly activities are proposed. The site falls under Zone O and interactive zone as a recreational zone for development. The proposal addresses the 'No Water' scenario in the river and proposes a strategy for recharging water by designing a Water square/Kunds that would act like an aesthetic, socio-cultural, environmental element by retaining water in the ground water table, which will immensely help in reviving of rivers in long-term. The proposal evaluates the design for economic appraisal by adding monetary value to ecosystem services received through nature, making it economically as well as environmentally viable to the government to visualize its long-term benefits. The economic appraisal shows that the model in the initial 2- years only have the potential of creating a value up to approximately 60 Cr/-, which is very rare in Investment models returns. The other ancillary, tangible and intangible benefits such as employment generation, improvement in air quality, ecosystem maintenance have not been included over here, if all this is added its value will further increase. Further, the valuation of ecosystem services will create awareness amongst the people and will motivate them to promote and adapt to such development models in future. If such a development prototype is further implemented on a large scale, the tangible and intangible benefits to people would be 10 times more than estimated. Such modelling in future will help in debating the development vs environment on the environment side by balancing development objectives, achieving SDG goals 2030. Thus, the overall regenerative strategy will help governments across different states to understand and adopt an ecological riverfront development model which can be replicated according to the different contexts and wherein the environment is not sacrificed for attaining economic prosperity



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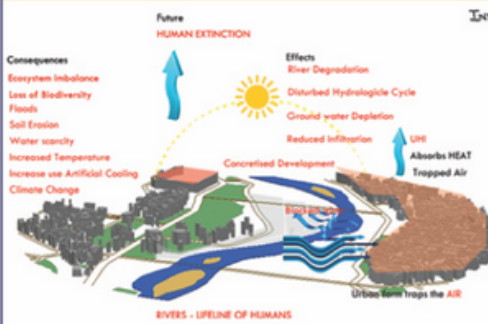


# Sponsored Thesis Project Competition on "Re-imagining Urban Rivers"

**"ECONOMIC APPRAISAL THROUGH EFFECTIVE RIVERFRONT DEVELOPMENT -ROLE OF RIVERS IN UHI AND CLIMATE CHANGE MITIGATION A CASE OF YAMUNA BANK, DELHI"**

**NAME : RITU SHARMA**  
**COURSE DISCIPLINE: M.TECH (URBAN PLANNING)**

## MAIN IDEA: WATER SENSITIVE DESIGN STRATEGY



## WAY FORWARD

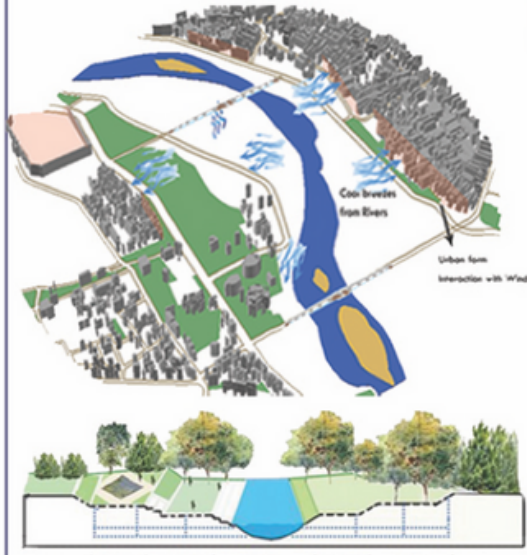
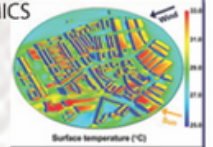
COMPUTATIONAL FLUID DYNAMICS

INTANGIBLE BENEFITS

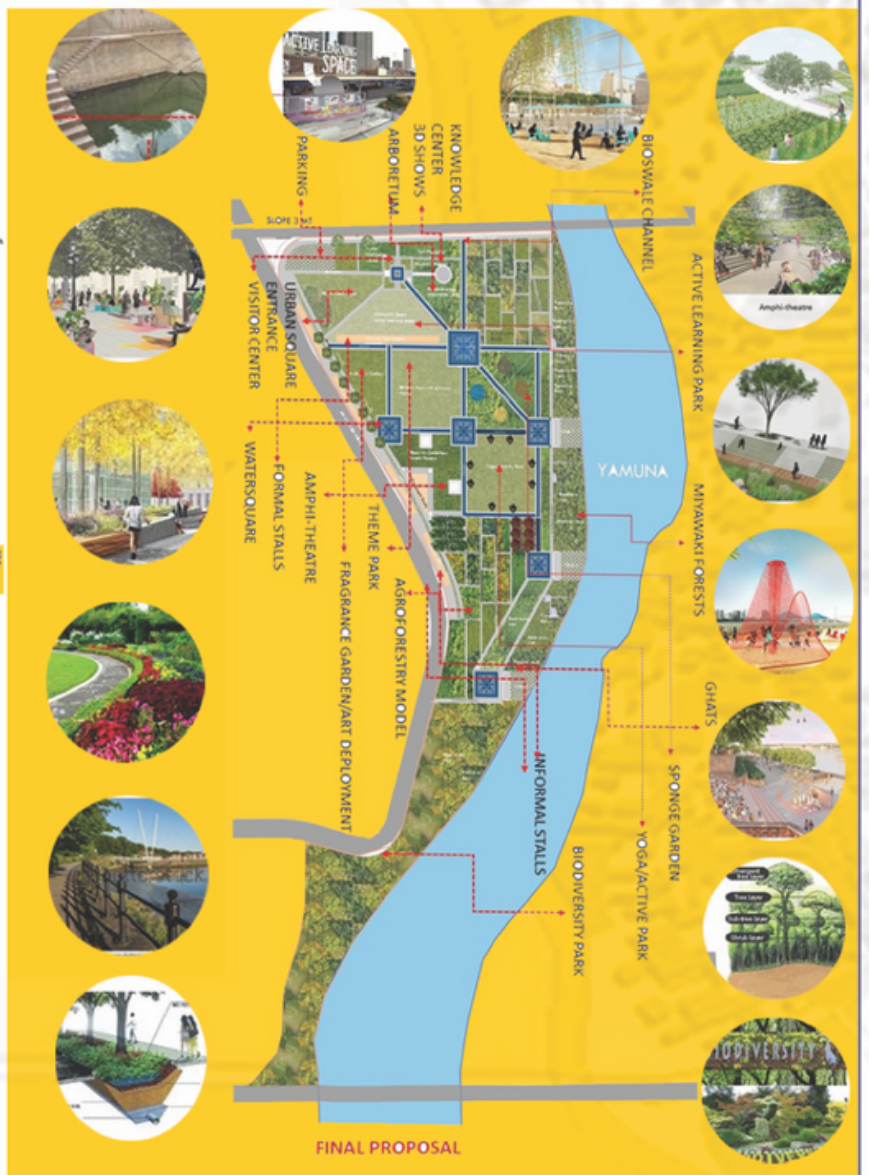
- Employment Generation
- Air Quality Improvement

TANGIBLE BENEFITS

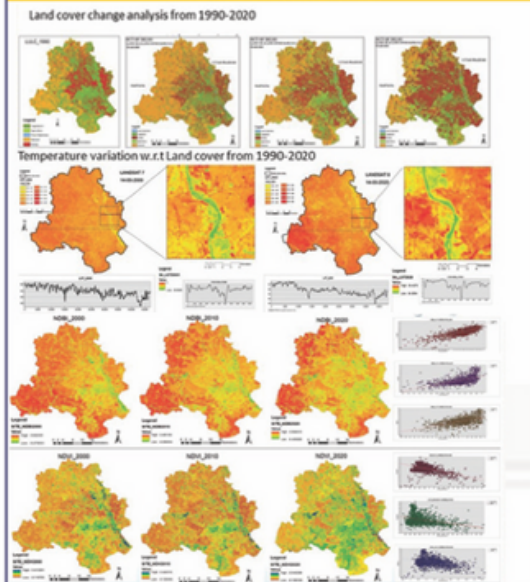
- Value created of approximately 60 Cr/- in 2-4 years
- Environmental, Socio-cultural, Climatic, Economic, Aesthetic value added.
- It will help in achieving SDG Goals 2030.



## PROPOSAL: REGENERATIVE STRATEGY - ECOSYSTEM VALUATION



## ANALYSIS: ROLE OF RIVERS IN UHI AND CLIMATE CHANGE MITIGATION



# Project 8

## Ecologically reclaimed natural levees: Spatial design for socio- cultural and ecological reconnect in Patna and beyond

*Saurav Kumar,  
CEPT  
University*



There is a unique, heterogeneous and complex relationship between the city and the river. This relationship is an important source for almost all major cities. The urban structure of the city, rigid in nature very different from the natural fluid form of the river. Rivers influence the transformation of river edge and city expansion. As a reason, river cities are an important case for studying how natural processes determine the transformation of the spatial morphology of the cities.

The Ganga Basin is home to more than 450 million people and shelters 118 Class I towns. This research intends to study the city along the main stem of the river Ganga. Patna is the third most populous town in Bihar and has been selected as a research locale. It has a rich cultural history of being a seat of power for over two millennia. Thorough research is needed to understand the changing urban structure, river profile and cities over decades.

Many efforts have been made through acts, programmes, and schemes to prevent the degradation of the ecosystem. Wetland (Conservation & Restoration) Rules, Namami Gange, and NPCA are some specific acts and programmes on the riverine system. This makes Ganga cities an interesting case to analyse the “socio-ecological systems” function in the transfiguration of the cities. In an urban context, the ecological and social systems are interdependent across spatiotemporal scales; they can be indicated as socio-ecological systems. Also, the “UN SDG to 2030”, the conservation and regeneration of marine ecosystems is supported by SDG6, the integration of sustainable use of freshwater ecosystem into national and local planning is one of the targets SDG15 calls for.

An extensive literature review was used to posit the characteristics of the urban structure. As a result, it has been observed in case of Patna that despite the cultural bonding, the transformation of the city's spatial composition and configuration has over time transformed the river from an engaging front to its backdrop. Residential communities and large institutional buildings are the 9 km urban structure which, in turn, has influenced the visual connection and access to the river. Visual disconnection has guided to a diminished sense of ownership of the river system in the area, resulting in encroachment and waste dumping. Research Question & Objectives

Drawing on the lines of the conceptual framework of three worlds of ‘River–City–People’, the study aims to explore that, “How edge character influences the connect with the river and in turn how this connection influences the urban structure of the city?”

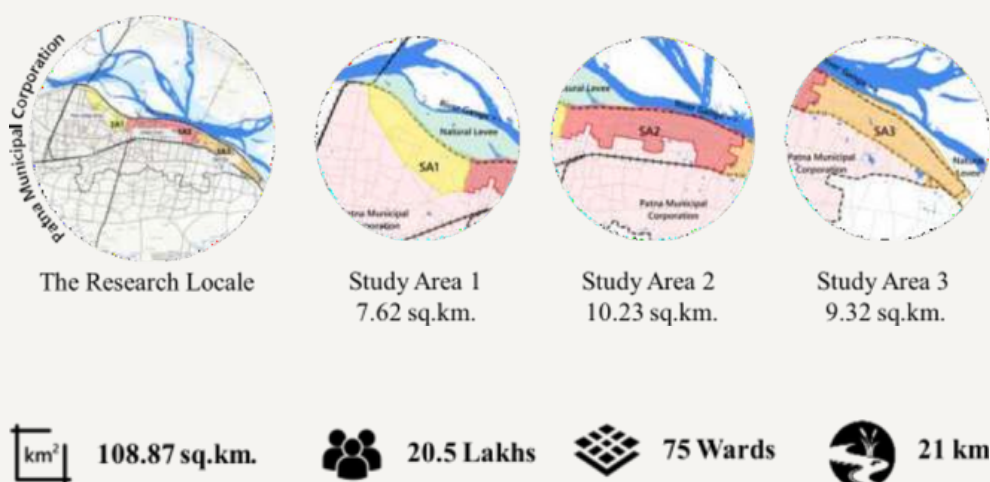
In order to answer this research question, these objectives have been formulated.

- To analyze the change in urban spatial structure.
- To analyze changing sense of place and interaction of the river and the city.
- To suggest planning interventions.

### **City Profile and Study Area**

Patna, as a doab, grew and flourished along either side of the main arterial, the Asoka Raj Path Which runs east to west a ridge almost parallel to the southern bank of the river Ganga.

Along its length, the city measures about 21 km. Patna Municipal Corporation have an area of 109 sq.km. The total population of the Patna municipal area is 1684297 (Census, 2011). Air, rail, and well-developed national and state highway networks like NH31 & 22 connects the city with other parts of the state and region. Patna Junction and Rajendra Nagar Terminal are two major railway terminals from where trains operate regularly in all parts of the country. The urban economy of the city is primarily based on the tertiary sector, comprised of “administration, trade and commerce, health, education and recreational facilities”. While, the rural areas involve majorly in primary activities, like agriculture, fruit farming and fishing (Rodgers et al., 2012). The existing city can be divided into three discrete zones based on their functions and physical characteristics, hence the study area selected were categorized as the Eastern Zone (SA1), the Central Zone (SA2) and the Western Zone (SA3).



According to the findings of the study of urban structure components, spatial variations in rental value changes indicate a clear negative correlation between prices and population density. Similarly, the land use mix has a close relationship with the availability of an open and interconnected network, as well as direct interaction points to the water. The perception survey reveals that there is a need to connect with the water to stimulate socio-ecological connect with the river.

The findings of this study indicate that there is a close relationship between the availability of water along the city's edge, a strong network, and recreational activities, both of which provide compelling reasons for people to reconnect to their river's edge. As a result, further policies and interventions in this sector will help to improve river city integration.

Interpretation of the models, analysis of urban structure and samples concerning water presence in the selected city, concludes that the influence of river has not resulted in the transformation of urban structure. The obtained result showed that the unplanned development practices along the river edge have resulted in weakening the river-city connect.

The study concludes that there is a need to relook the land use mix configuration in Study Area 3. Also, to enhance river-city connect with people, a zone has been identified in Study Area 1 which is a natural levee developed in the floodplain. Therefore, proposals have been devised in line with the Patna Master Plan 2031. The detailed proposals aligned with Master Plan recommendations been devised under these broad categories:

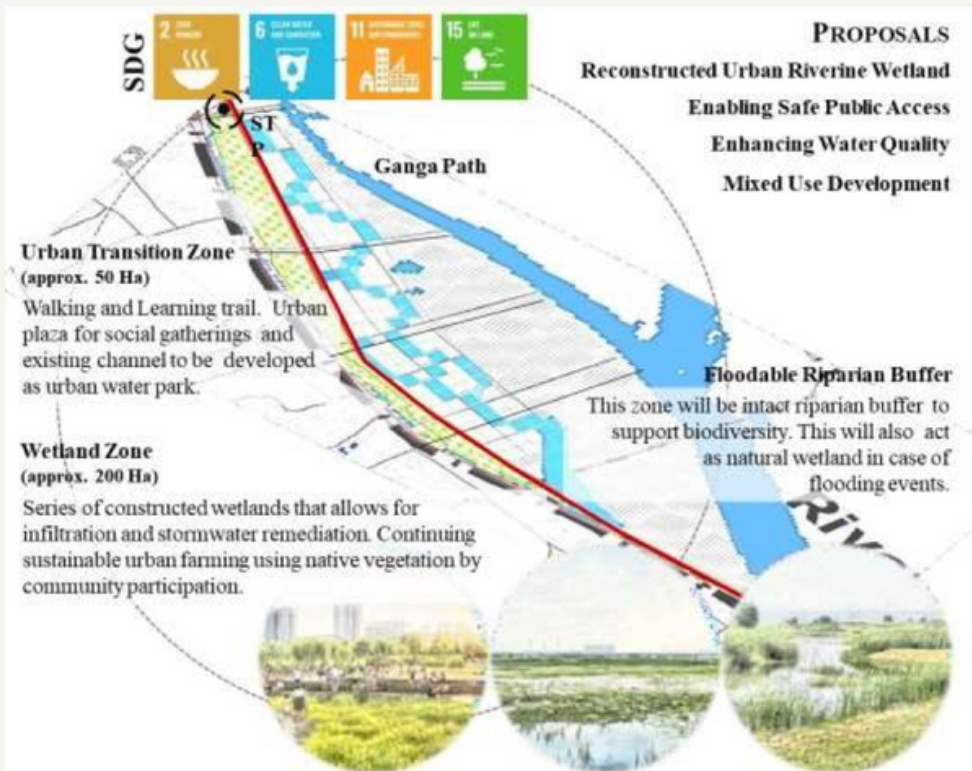
- **Enable Safe Public Access:** To have a safer and ease of access to the river, it is recommended to provide for a walkway and a dedicated biking lane with a green buffer, on all roads immediately leading to the river edge. Urban runoff management practices to be incorporated within the access paths with bio-swales/ vegetated ditches. It is recommended that the non-motorized transit be given top priority when planning for streets in the river corridor.
- **Promote Mixed-Use Development:** The promotion of mixed land use redevelopment and the mixing of intensity-based use categories is advised. To ensure maximum use of an adequate mix, the area of high intensity should be developed along the main corridor. A moderate density zone with more residential mix pockets should follow. To maintain the tranquility of the river edge, a small strip of commercial and industrial with light manufacturing provisions should be provided along with low-intensity residential use to achieve property values appreciation and visual efficiency. The incentives in the form of TDR and additional FAR should be encouraged to stimulate the rejuvenation of the area.
- **Enhance Water Quality:** To extending the city back to the river while conserving the levee area in the floodplain of the Ganga, strategies have been devised based on available literature and guidelines. Different layers of zoning have been envisioned based on function and spatial location. Urban wetland systems, transitional zone betwixt terrestrial and open-water systems also act as a critical component in ecosystem reintegration. It also helps in water management, water remediation, contribution to the economy and citizen engagement.
- **Restore a Functional Riparian Ecosystem:** The ecological enhancement of riparian zones could be achieved with bio-engineering. by restoration of precious floodplain habitats.



Illustration of key issues for which proposals have been devised to achieve following outcome



A conceptual framework for reconstruction of urban riverine wetland



Proposed wetland system design

Zone 1 (approx. 50 ha) is an area envisioned as an urban transition zone between Ganga Path and the city's active edge. It will comprise a walking and Learning trail for all age group. Urban plaza for social gatherings and Existing Canal to be developed as an urban water park.

Zone 2 (approx. 200 ha) is an intermediate zone with a series of constructed wetlands that allows for infiltration and storm water remediation. To preserve the water level in the wetlands, the treated water can be diverted from Digha STP (100 MLD). Currently, urban farming is being practiced which can be continued more sustainably within identified patches on a rolling basis with community engagement.

Zone 3 (Riparian Buffer) is a buffer zone envisioned as a floodable zone acting as a natural wetland in case of flooding events.

### **Way Forward**

The discussion suggests that there is a wide scope for further research to understand the spatial, built, social and economic characteristics of Old city area in order to facilitate the on ground workable solutions for Redevelopment and land use reconfiguration. Also, to implement the proposed strategies in levee area detailed geo technical study of the area is to be done and feasibility study to be performed to obtain the understanding of economic and financial return from the project.





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## Sponsored Thesis Project Competition on "Re-imagining Urban Rivers"

### "RECONNECTING THE CITY WITH THE WATER" A CASE OF PATNA

Saurav Kumar | Master of Planning (Urban Planning)

#### INTRODUCTION & BACKGROUND

Evolution of urban morphology has impacted the visual connect and accessibility to the river and turned to backyard from active front over the time. The course of expansion and structure of a city is related to the size and amount of the water present, its abundance and morphology of the surrounding terrains.

Analysis of the urban factors and its distance in relation to the gravitation focus towards the line of the water enables the integration of water presence with urban structures.

#### RESEARCH QUESTION

"How edge character influences the connect with the river and in turn how this connection influences the urban structure of the city?"

#### OBJECTIVES

- To assess the change in urban spatial structure.
- To analyze changing sense of place and interaction of the river and the city.
- To suggest planning/design interventions.

#### KEY ISSUES



Access to Water



Water Quality



Riparian Buffer

#### CHARACTERISTICS



#### OUTCOMES



Safe public access to water



Enhanced water quality



Recreational space enhancing green index



Landmark



Livelihood

Aquatic Zone

Floodable Zone

Filtration Zone

Ganga Path (Under construction)

Urban Transition Zone



The Research Locale



Study Area 1  
7.62 sq.km.



Study Area 2  
10.23 sq.km.



Study Area 3  
9.32 sq.km.

108.87 sq.km.

20.5 Lakhs

75 Wards

21 km

Urbanization



Patliputra



Shershah's (16th Century)



1812



1922



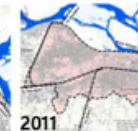
1957



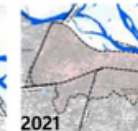
1991



2001



2011



2021

SDGs



#### PROPOSALS

- Reconstructed Urban Riverine Wetland
- Enabling Safe Public Access
- Enhancing Water Quality
- Mixed Use Development

#### Urban Transition Zone (approx. 50 Ha)

Walking and Learning trail, Urban plaza for social gatherings and existing channel to be developed as urban water park.

#### Wetland Zone (approx. 200 Ha)

Series of constructed wetlands that allows for infiltration and stormwater remediation. Continuing sustainable urban farming using native vegetation by community participation.

#### Floodable Riparian Buffer

This zone will be intact riparian buffer to support biodiversity. This will also act as natural wetland in case of flooding events.





Picture Credit - Jessica Furtney



**GNAMAMI  
GANGE**



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