Revival of the Sahibi River- an Approach to Landscape Design based Cultural Ecology in India

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Abstract

Cultural and ecological resources are under pressure in the rapidly urbanizing areas of India's capital city, New Delhi. This study aims to analyse and make recommendations for preserving and enhancing the cultural resources in addition to restoring ecology of a selected stretch of the Sahibi River in Delhi.

Sahibi River originates from the semi-arid areas of the Aravalli and flows through Delhi. It is a major tributary of the Yamuna River. It is nearly 41 kilometres long and is fed by 22 smaller feeder drains. The Sahibi River is also referred as Najafgarh Drain or Najafgarh *nallah* (*nallah* in Hindi means rivulet or stormwater drain). The drain once attracted a wide range of migratory and local bird species and served as a natural habitat for various small mammals (Bhatnagar, Kumar and Chaudhary 2021). Sahibi River has resulted in becoming a major contributor of pollutants to the Yamuna River (Vaid, et al. 2022). Monsoon runoff from upstream areas has also led to the deposition of silt, reducing the river's capacity to carry water.

This paper examines approaches for the revival of the cultural ecology of the river. It begins with a survey, analysis and assessment of the existing master plans and regulations, along with the study of physical parameters that include urban studies and existing view sheds, that have a bearing on the land use, connectivity, and hydrology.

Based on this assessment, a set of strategies are explored to improve the river's ecology, which includes the implementation of a comprehensive plan for landscape development including connecting communities, providing facilities for the neighbourhood; grading, drainage, and planting along the river and its banks.

The paper further examines strategies for the revival of the socio-cultural fabric by creating active and accessible spaces for the community. The paper concludes with specific proposals for the improvement of the river's water quality and for landscape redevelopment on both banks.

Introduction

Delhi, the National Capital of India, has a unique watershed system stretching over 350 kilometres long network formed by five natural drainage catchments, with Najafgarh as one of them (DUAC 2014). With a complex history in terms of its governance, this system has been destroyed and modified several times spanning over 1300 years of recorded history.

Najafgarh waterway was misclassified as a drain in the colonial era, though it is a continuation of the Sahibi River and an elongation of the Najafgarh *jheel* (lake) (Wetland

Authorities of Haryana and NCT Delhi 2021). Before 1960's, the rain-fed Sahibi River, originating in Rajasthan, entered Delhi near Dhansa and spilled its overflow in the Najafgarh Lake basin. This overflow created a seasonal lake; an area of more than 300 square kilometers, which continued to flow on the other side, forming a tributary of the River Yamuna. The floods of 1964 and 1977 were the two key turning points that changed the fate of the Sahibi river and the Najafgarh Jheel (DUAC 2015).

Post-independence industrialization accelerated the river degradation, as factories, infrastructure projects, and residential and commercial developments along riverbanks, turned them into dumping grounds for sewage, industrial effluents and solid waste (Wescoat 2019). Najafgarh drain has become the largest sewage-carrying drain in Delhi taking care of the water discharged from rural and urban areas of Delhi (TERI 2005; DUAC 2015). Despite the state of the stormwater drain, it continues to be a significant ecological site, a habitat for a diverse biodiversity and a bird sanctuary with endangered and migratory birds.

The Najafgarh Riverfront development project was established in 2020 by the Irrigation and Flood Control Department, Govt. of NCT of Delhi. This initiative will aid in enhancing water quality and facilitating groundwater recharge. Moreover, the project works towards the restoration of native vegetation, wetlands, and riparian buffers to strengthen biodiversity, supporting the habitat for aquatic and terrestrial wildlife.

Objective

i. The objective of this project is to improve the ecology of the 27-kilometre stretch of Sahibi River formed by the Najafgarh canal while enhancing the cultural heritage of the riverside communities.

ii. A major focus of this study is on improving the river's hydrology through pollution control, flood mitigation, and stormwater management.

iii. This study also shows how the riverfront serves as an inclusive space for socio-cultural activities ensuring equitable access.

Background and Literature Review

Though Delhi has been planned (Delhi Development Authority 1962; 2001; 2021a; 2021b), the poor condition of its waterways highlights the neglect of the ecological assets of the city. The culture around rivers is ingrained in Indian society since pre-historic times, evident through scriptures, literature, customs and traditions (IIT 2013). Rivers also held a significant role in urban planning, architecture and landscape design. In the cities of Agra and Shahjahanabad in Delhi, riverfronts were densely covered by buildings, pavilions, and lush gardens.

Colonial rule in India was marked by a noticeable shift in the institutional practices and cultural values associated with rivers. With the introduction of piped water systems and sanitation reforms several river-based activities were banned (Nagendra and Mundoli 2023). Natural streams were co-opted into this sanitation system that prioritized the removal of waste and drainage of stormwater, converting them into *'nallahs'* or drains. The term *'nallah'* which originally referred to small streams or rivulets, became associated with pollution and filth during this period (Wescoat 2019).

The contemporary urban planning practices in India followed the colonial sanitation model, which emphasizes “cleaning up” cities by diverting waste into the rivers. This approach sidelines traditional community-based river management systems, favouring large-scale, centralized, government-controlled projects resulting in many urban rivers and water bodies to be heavily polluted and neglected (Wescoat 2019).

The awareness of managing waterways in current times has evolved beyond just ecological challenges to include socio-cultural issues. Hunter's Point South Waterfront Park is a transformative urban project in New York embracing a ‘soft’ approach to flood protection through the design of a "green" engineered causeway protecting water habitat that was once a contaminated peninsula of landfill. It increases flood storage capacity by approximately 557,800 gallons, accommodating up to a 6-ft storm-surge flood event. Moreover, the design of permeable pavers and a bio-filtration swale intercepts, infiltrates, and evaporates 73% of average annual rainfall (DuRussel and Singh 2018).

The Hoosic River restoration project in Massachusetts displays the shift from a concretised engineered flood control strategy to re-establishing the river’s historic floodplain connection. It utilises natural processes for flood mitigation allowing nature to inform the design (Sasaki, 2025). The project improves riparian habitats, water quality, and river access while enhancing North Adams’ cultural and recreational identity.

The Cheonggyecheon Restoration Project in Seoul is another urban project reviving the lost connection of the society with an abandoned waterway. This project revitalized the neglected stream by removing parts of an outdated highway. This increased the flood protection level to 200 years, exceeding the urban standards of 50 years. Polluted water was treated through a double-channel system, avoiding large wastewater treatment plants. This project resulted in a 76% increase in pedestrian activity, a 4.5% reduction in the urban heat island effect, and a 10.3% reduction in air pollution (Robinson & Myvonwynn, 2011).

These projects stand as clear evidence that the design of urban waterways informed by ecological, social and cultural factors can reinforce connection with the natural environment, catalyse economic development, and improve the quality of urban life.

Method and Data

While Najafgarh Canal spans a stretch of 45 kilometres, the waterfront development is proposed for a stretch of 27 km. The waterfront development covers a total expanse of land and waterway that equates to 1,535 acres.

This study briefly assessed the physical aspects of the riverfront and the social conditions of the neighbouring communities. Key aspects analysed include accessibility, edge conditions, water quality, drainage capacity, and vegetation. Surveys were conducted on existing bridges and circulation plans for accessibility of pedestrians and cyclists. A study of the current state of the wetland ecosystem, existing stormwater outfalls and pollution levels in the Najafgarh drain was also conducted.

Category	Details/Values
Pollution Sources	Secondary drains; subsidiary channels
Water Quality in Najafgarh Drain (BOD Level)	53 mg/l (January 2023)
Acceptable water quality (BOD Level)	3 mg/l
Wetlands Classification for Najafgarh Drain	Category ‘‘D’’ (Central Pollution Control Board 2005)
Contribution to Yamuna Pollution	60% of polluted wastewater from Delhi originates from Najafgarh runoff
Issues in Adjacent Areas	Gradient directs flow towards waterway, lack of water treatment and drainage adds pollution

Figure 1. Summary of data collected and analysed for the water quality in Najafgarh Drain *(ARCOP; IDISPL 2021)*

Based on the data assessment, this Najafgarh riverfront development proposal focuses on two key aspects: ecological revival and cultural integration through landscape development.

Results

The analysis reveals that Najafgarh Waterway holds significant ecological value and potential for public engagement. The riverfront development would address the numerous challenges faced by the Najafgarh drain and its neighbouring communities which includes - limited accessibility and infrastructure, threat to biodiversity, severely polluted river and urban flooding and reviving the belongingness of the community with the river.

The Najafgarh riverfront development will enhance accessibility by integrating the riverfront with the city through a network of bridges at every kilometre and parallel connections along the river for pedestrians and cyclists to transition through the varying elevations.

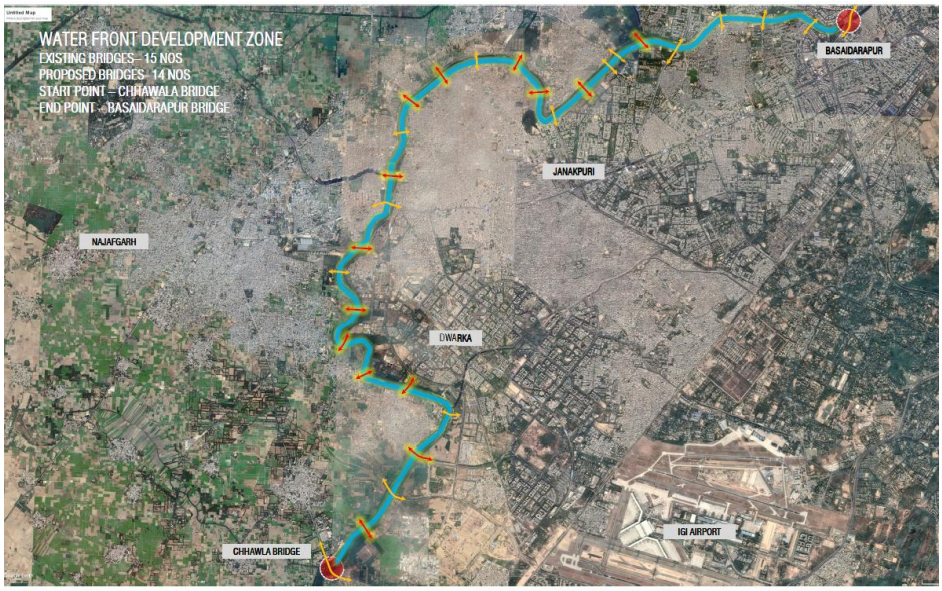

Figure 2. Proposed bridges across the river *(ARCOP; IDISPL 2021)*

A biologically diverse network of green spaces is designed that includes herb gardens, colour gardens, tree bosques, and reflexology parks; enhancing the biodiversity, ecological resilience and experiential quality for residents and visitors.

To restore the ecological health of the Sahibi River, a multi-faceted approach is implemented, focusing on improving hydrology, restoring the vegetation, and promoting sustainable land use. Water quality is improved through three treatment strategies - a vertical sewage treatment plant processing 10 million gallons per day, aerated wetlands using aquatic plants for natural filtration, and floating wetlands with bamboo rafts and aerators to improve oxygenation.

Along with this, the project prioritizes conservation and new plantation of trees based on their ecological value. The ecological value of a tree is assessed based on its impact on soil, nutrients, water conservation, wildlife, and habitat creation. This approach highlights the broader, long-term importance of the ecosystem beyond just its immediate native value. 2,11,000 new trees with medium to high ecological value will be planted. Additionally, invasive species like the 'kikar' (Prosopis juliflora) will be managed through a targeted strangulation strategy - where their canopy is trimmed, then creepers are planted to block sunlight, eventually killing the tree and allowing indigenous species to thrive.

TOTAL NO OF TREES EXISTING AT SITE	**63784**
TREES TO BE TRANSPLANTED UNDER ROAD WIDENING	**258**
Kikar & Eucalyptus	217
Other trees	41
TREES TO BE TRANSPLANTED UNDER PROPOSED BRIDGES	**286**
Kikar & Eucalyptus	235
Other trees	51
TOTAL TREES TO BE TRANSPLANTED	**544 (0.85%)**
Kikar & Eucalyptus	451 (0.71%)
Other trees	93 (0.15%)
TOTAL NO OF NEW TREES PROPOSED	**2,11,000**
Medium-large trees	88,500
Small trees	1,22,500

Figure 3. Trees proposed and transplanted *(ARCOP; IDISPL 2021)*

The Najafgarh drain's water capacity will be increased by redesigning a 29.9 km stretch to remove the undulations, while for the rest of the stretch, the bed level is lowered deepening the river by 0.6 meters. A 7.5-meter-wide buffer on each bank has been reserved for future expansion. The implementation of these strategies resulted in a 39,08,700 cubic metre increase in drainage capacity adding to the original capacity by 19%; with the potential to increase it by 31%, if required in future.

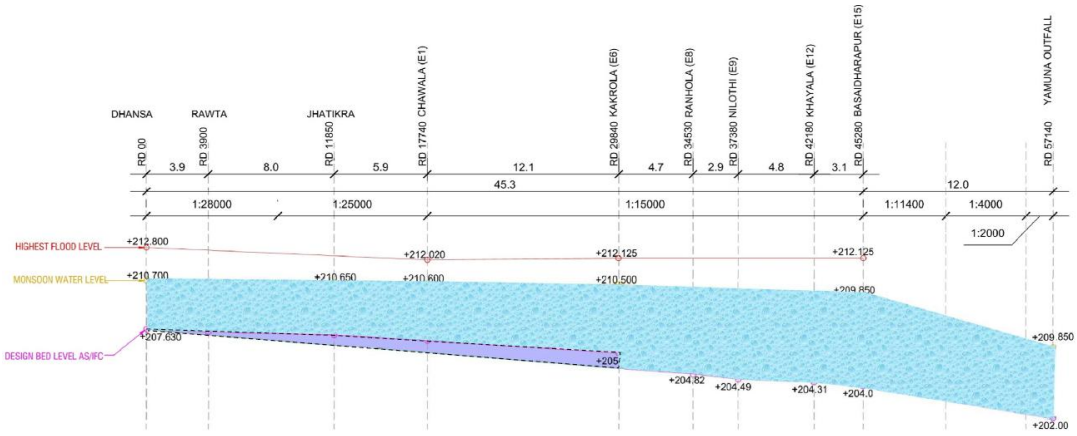

Figure 4. Redesign of existing design bed from Ranhola towards Dhansa's existing invert level (9% increase in capacity) *(ARCOP; IDISPL 2021)*

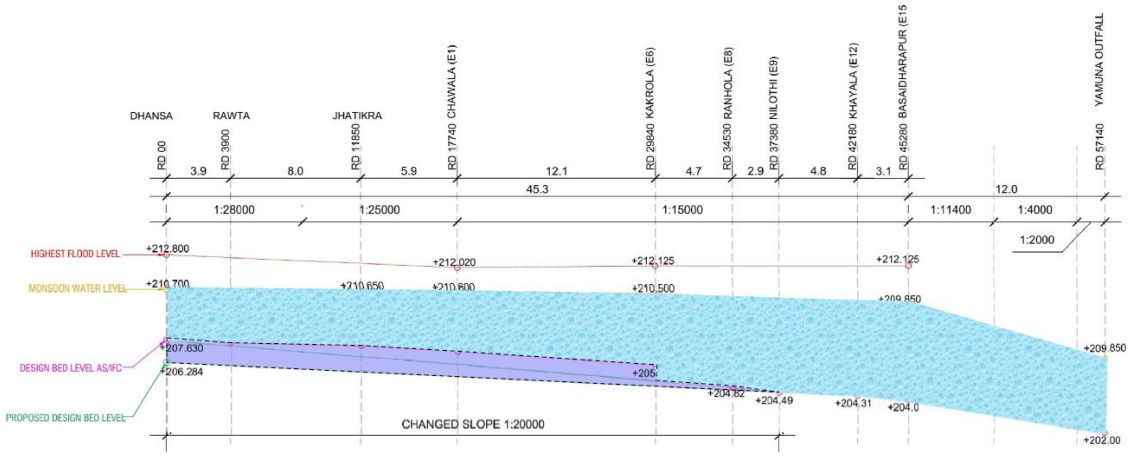

Figure 5. Further reduce bed level to acceptable slope of 1:20000 from Nilothi to Dhansa (Additional 10% increase in capacity) *(ARCOP; IDISPL 2021)*

	DHANSA TO BASAIDARAPUR		BASAIDARAPUR TO YAMUNA OUTFALL	
AVERAGE WIDTH OF DRAIN	90	MTS	50	MTS
SECTIONAL AREA OF DRAIN (DERIVED FROM L SECTION)	192743.89	SQM	62203.923	SQM
CURRENT VOLUME OF DRAIN (DERIVED FROM L SECTION)	17346950.1	CUM	3110196.15	CUM
TOTAL VOLUME OF DRAIN (DERIVED FROM L SECTION)	20457146.25	CUM		
REMODELING OF DESIGN BED (BETWEEN DHANSA & RANHOLA)				
STEP – 1 : BY SLOPE CORRECTION				
LENGTH OF DRAIN	29.9	KM		
AVERAGE DEPTH INCREASED	0.7	M		
INCREASE IN VOLUME	**1883700**	**CUM**	9%	INCREASE IN CAPACITY
STEP -2 : BY REDUSING THE BED LEVEL AT DHANSA				
LENGTH OF DRAIN	37.5	KM		
AVERAGE DEPTH INCREASED	0.60	M		
INCREASE IN VOLUME	**2025000.00**	**CUM**	10%	INCREASE IN CAPACITY
TOTAL INCREASE IN VOLUME	**3908700**	**CUM**		
	19%	INCREASE IN CAPACITY		
STEP – 3 : BY INCREASING DRAIN WIDTH				
TO INCREASE TOTAL 50% CAPACITY OF THE DRAIN, ADDITIONAL 31% CAN BE ACHIEVED BY KEEPING 7.5 MTS OF BANK SPACE FREE OF ANY PERMANENT STRUCTURE ON BOTH THE BANKS TO INCREASE THE DRAIN CAPACITY IN FUTURE.				

Figure 6. Total increase in drain capacity through the three strategies *(ARCOP; IDISPL 2021)*

Sustainability efforts will extend to waste management, with an annual collection of 50 tons of leaf litter, composted into 18 tons of nutrient-rich fertiliser for the riverfront ecosystem.

Culture and community engagement are central to the project. A network of open-space corridors has been designed to incorporate sports complexes, cultural hubs, open-air theatres, food plazas, and recreational zones. Hybrid urban lighting in these spaces will enhance safety and minimize energy consumption promoting sustainable technologies.

These strategies have been seamlessly integrated into four major zones spread along the river, each incorporating targeted interventions to enhance the area's ecological health and cultural vibrancy.

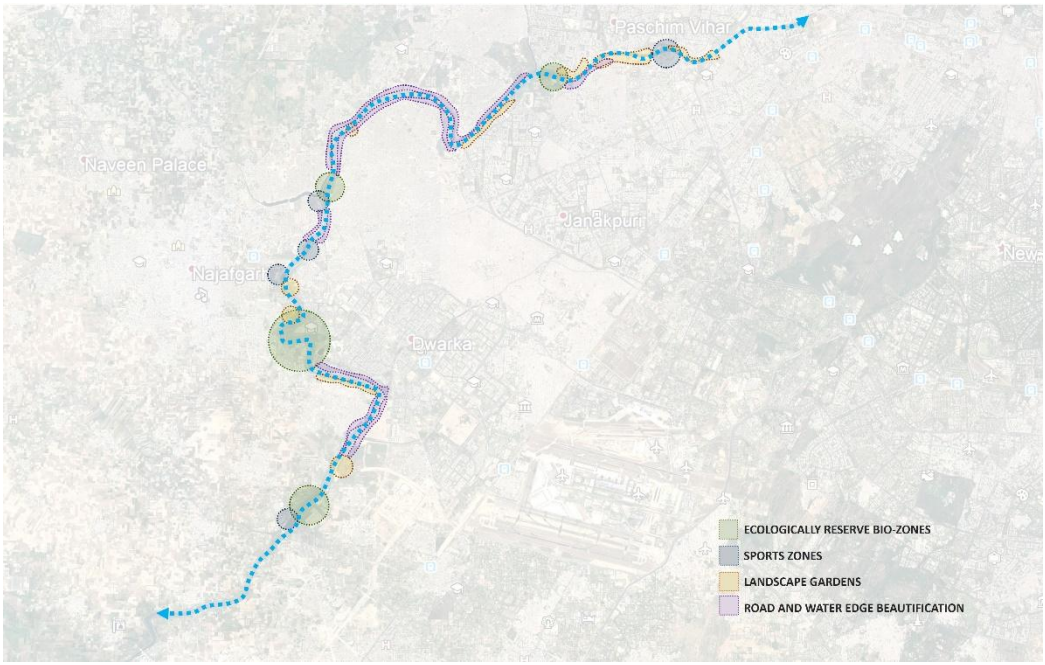

Figure 7. Four major zones planned along the river's edge *(ARCOP; IDISPL 2021)*

1. The narrow riverbanks in Chhawla Village and Dwarka have been transformed into vibrant, accessible pathways with stepped seating along the river edge. These pathways are incorporated with dynamic and multifunctional urban pauses.

Figure 8. Before and after images showing the transformation into accessible and vibrant pathways *(ARCOP; IDISPL 2021)*

2. Nine zones with diverse landscaped gardens have been designed in 30-75-meter-wide areas identified as a mix of dense greens with ample open space. It features recreational spaces, themed gardens and biodiversity reservoirs. The median green island has been designed as an experiential walkway offering opportunities for bird watching and fishing.

Figure 9. Typical plan for an area in the zone for landscape gardens *(ARCOP; IDISPL 2021)*

Figure 10. Before and after situation showing the active landscape gardens *(ARCOP; IDISPL 2021)*

3. Ecological zones have been strategically planned as green buffer zones at four locations marked with dense green cover and a width of more than 45 meters. These zones are aided with public utilities to accommodate various recreational waterfront activities.

Figure 11. Revitalisation of the ecology of the Najafgarh Riverfront *(ARCOP; IDISPL 2021)*

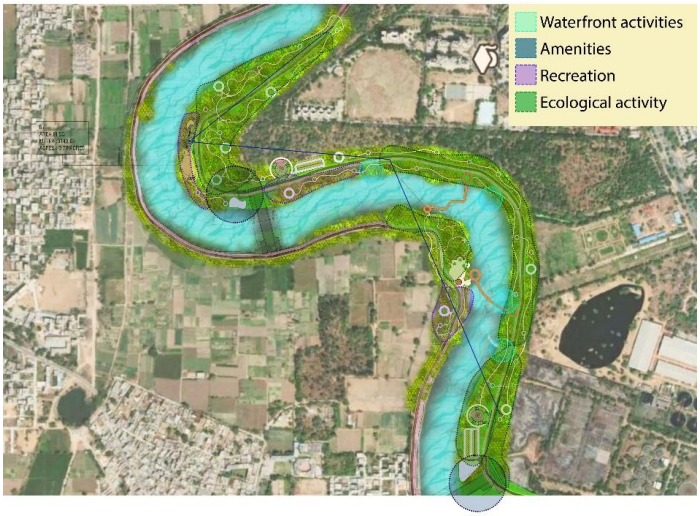

Figure 12. Typical plan for an area in ecologically reserved zone *(ARCOP; IDISPL 2021)*

4. Five sport zones, spanning 22 acres have been planned near the dense residential settlements along the river with an open space over 75 metres wide to allow for a substantial play radius. It includes areas for recreation and social gatherings, supported by bridges and a continuous network of urban thoroughfares for seamless access.

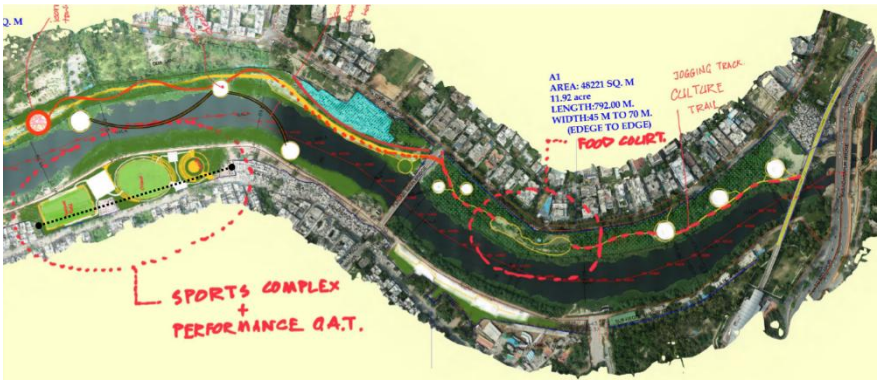

Figure 13. Typical plan for an area in the sports zone *(ARCOP; IDISPL 2021)*

Conclusion

This process of revival of the Sahibi river incorporates strategies designed through a cultural ecology approach, planned into four distinct zones that respond to the physical attributes of the riverbanks and the distinct needs of the surrounding communities.

The planned urban connections enhance the area's aesthetic appeal and accessibility, diverse activities could be planned enabling active engagement between the neighbourhoods across the riverbanks. Landscaped Gardens help the visitors to learn about the indigenous species of plants and create a visually stimulating environment that attracts pollinators like bees and butterflies, supporting the local biodiversity. The ecological zone enhances wildlife habitats, support plant communities, and aid in erosion control, stormwater management, and mitigating the urban heat island effect. Sports Zones drive economic growth and enhance the overall development of the local community in terms of social, vocational, physical, and

intellectual skills. Overall, the project helps the community to revive back their connection with nature and local biodiversity.

Through this study, it can be concluded that the 'decolonisation' of the river—by reintegrating the cultural practices and values of local communities—can effectively address the ecological challenges faced by the urban rivers. The cultural ecology approach restores the ecological balance and fosters a deeper sense of ownership and responsibility among urban inhabitants for their environment.

A resilient future is not solely about implementing advanced, environmentally sustainable strategies; it is equally about recognising, reviving and enhancing the cultural connection of communities with their natural surroundings, creating a holistic model for environmental stewardship that endures across generations.

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