



Urban River Management Plan– Buxar (Draft)

December 2025

Submitted to –



National Mission
on Clean Ganga



National Institute
of Urban Affairs

Project Consultants – Consortium of



All India Institute of
Local Self Government



ICF Consulting, India
Private Limited

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This report is a collaborative effort of NMCG and NIUA along with Buxar Nagar Parishad for preparation of Urban River Management Plan for cities in Bihar.

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Disclaimer: The interventions proposed in this Draft URMP document (Version1) are prepared in consultation with the city stakeholders, NIUA and NMCG as project concepts. For its implementation, a Detailed Project Report (DPR) needs to be prepared.

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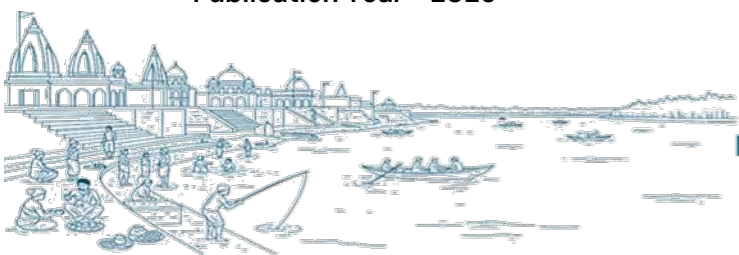
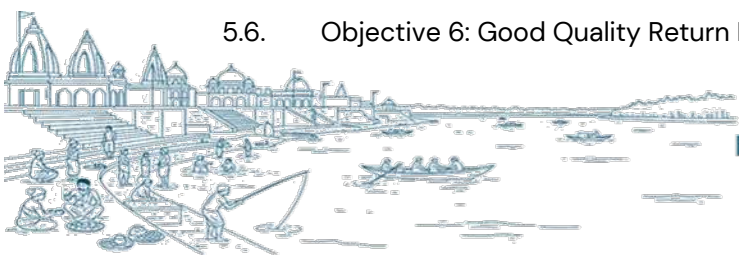
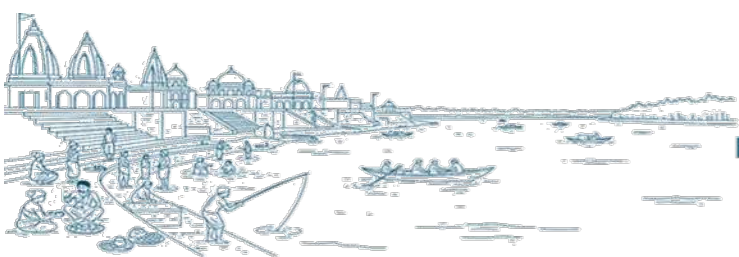


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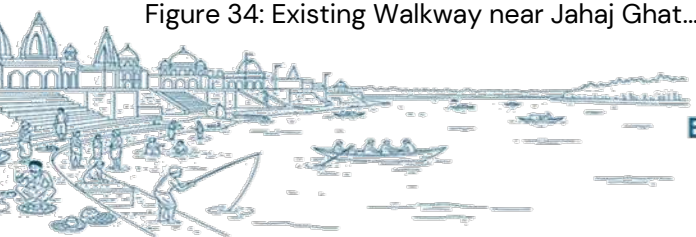


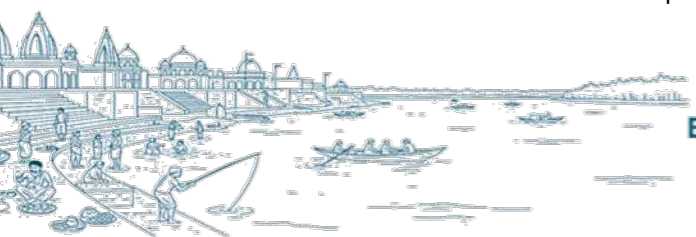
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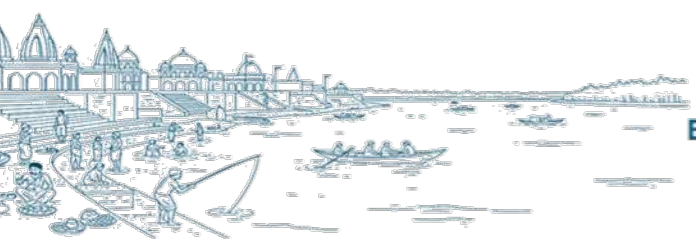
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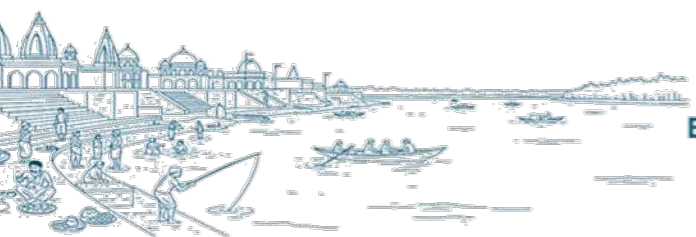
GLOSSARY

Abbreviation	Full Form
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BOD	Biochemical Oxygen Demand
BSDMA	Bihar State Disaster Management Authority
BSPCB	Bihar State Pollution Control Board
BUIDCO	Bihar Urban Infrastructure Development Company
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CPHEEO	Central Public Health and Environmental Engineering Organization
CPCB	Central Pollution Control Board
DGCs	District Ganga Committee
DEP	District Environment Plan
DEWATS	Decentralized Wastewater Treatment System
DO	Dissolved Oxygen
DPR	Detailed Project Report
EO	Executive Officer
FPZ	Flood Plain Zoning
MoEF&CC	Ministry of Environment, Forest & Climate Change
MoHUA	Ministry of Housing and Urban Affairs
MSL	Mean Sea Level
MSWG	Multi-Stakeholder Working Group
NDVI	Normal Difference Vegetation Index
NGT	National Green Tribunal
NIC	National Informatics Centre
NIUA	National Institute of Urban Affairs
NMCG	National Mission on Clean Ganga
NWIC	National Water Informatics Centre
OHT	Over Head Tank
PHED	Public Health and Engineering Department
RCD	Road and Construction Department
SBM	Swachh Bharat Mission
STP	Sewage Treatment Plant
UDHD	Urban Development and Housing Department
ULB	Urban Local Bodies
URMI	Urban River Management Index
URMP	Urban River Management Plan
WRD	Water Resource Department





EXECUTIVE SUMMARY



1. EXECUTIVE SUMMARY

The National Mission for Clean Ganga (NMCG) is integrating river protection into urban planning and city development through initiatives like the River Cities Alliance and Urban River Management Plans (URMPs). Urban rivers, city drains, groundwater and waterbodies once vital to culture and ecology, now face severe degradation, threatening livelihoods, public health, and biodiversity. The URMPs will address challenges such as flooding, loss of natural drainage, and depleting water quality through sustainable infrastructure augmentation, governance reforms, community engagement, and financial integration.

A river and a city share a symbiotic relationship. While urbanization has contributed to the degradation of river ecosystems, cities also have a central role in their rejuvenation. The URMP for Buxar aims to establish a dedicated, city-level strategy to manage the Ganga river stretch in Buxar and associated urban water elements (drains, ghats, ponds, lakes, wetlands, and ground water), in an efficient and sustainable manner. This plan follows the **Strategic Framework for Managing Urban River Stretches: URBAN RIVER MANAGEMENT PLAN** developed by National Institute of Urban Affairs (NIUA) under the guidance of National Mission for Clean Ganga (NMCG) and is being prepared by the consortium of AILSG–ICF who have been appointed as consultants for preparing URMPs for six cities in Bihar

Buxar, often referred to as the “*Mini Kashi*” of Bihar, has a culturally significant riverfront with numerous ghats and heritage sites along the banks of river Ganga. The baseline assessment highlights persistent issues of untreated sewage, solid waste, encroachments in riparian buffers, and the need to enhance citizen stewardship. These findings inform the URMP’s focus on pollution abatement, riparian restoration, eco-friendly riverfront projects, and structured community engagement.

The city’s composite URM Index is assessed at ~3.1 out of a total possible score of 5.0 (average level of river management), reflecting strengths in river-linked economy and growing citizen initiatives, alongside gaps in floodplain regulation, river pollution management, stress on riparian buffers, degradation of inland water bodies, drains and canals. This provides a clear starting point for prioritized improvements.

URMP-Buxar is organized around the ten-point URMP agenda, translating baseline insights into tangible and practical actions. Interventions range from planning/ policy measures (zoning, guidelines, institutional arrangements) to on-ground projects which can be implemented by various agencies. Actions are phased as short-, medium-, and long-term to enable pragmatic delivery while building institutional capacity.

The proposed interventions for Buxar focus on holistic river management under the ten-point agenda. Floodplain regulation and riparian buffer protection is proposed to be enforced through clear mapping, zoning, and nature-based stabilisation to prevent encroachments. To achieve a pollution-free river, the plan calls for expanding and optimising treatment infrastructure such as STPs, faecal sludge management, and bioremediation systems, designing interceptor sewers for major drains discharging into the Ganga, and establishing an integrated water quality and quantity monitoring system with mandated discharge standards. Rejuvenation efforts will restore riparian buffers, urban ponds, wetlands, and natural drains as functional blue-green assets that support flood mitigation and biodiversity and add social space to the city. A citywide strategy for reusing treated wastewater for the proposed STP and proposed FSTP will be developed for urban greens, peri-urban agriculture, and waterbodies complemented by eco-nalas—bio-engineered return-flow corridors. Eco-friendly riverfront projects will include an Eco-Heritage Riverfront with continuous pathways, jetties, eco-parks, natural habitat augmentation, and heritage site improvements; alongside using Eco-Ghat Design Guidelines which promote permeable surfaces, local materials, sensitive lighting, ritual waste management, and inclusive amenities. Economic leveraging will focus on heritage-centric tourism through curated river-linked livelihood opportunities, artisanal markets, tourism-based opportunities and cultural programming that celebrate Buxar’s unique identity while



safeguarding ecology. Finally, citizen sensitisation and engagement will be scaled up through formal platforms such as youth clubs, digital reporting tools, and regular clean-up and plantation drives, transitioning from ad hoc efforts to structured community stewardship.

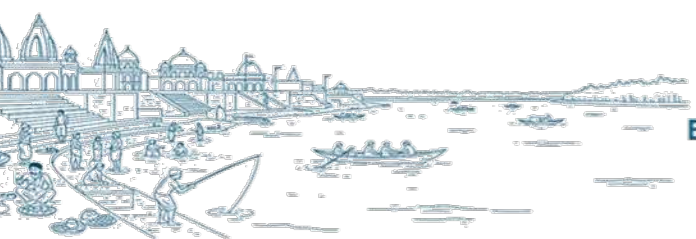
Each intervention carries a defined phasing (short/medium/long term) with responsible agencies (e.g., BUIDCO, Buxar Nagar Parishad, Pollution Control Board, Forest, Agriculture, Disaster, Fisheries, Tourism, Urban Development PHED, NMCG) specified for delivery, enabling alignment with funding, approvals, and DPR preparation.

URMP-Buxar is a living document and will guide downstream implementation and the improvements in URMP index will be the matrix for M&E

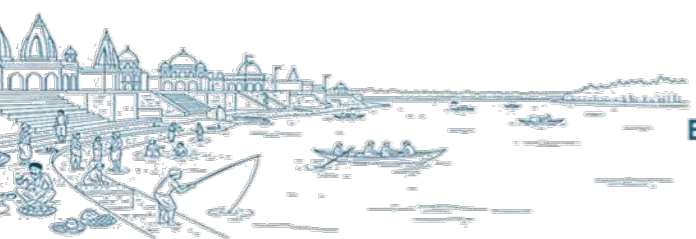
Summary of key interventions proposed by Buxar URMP

Following is the key summary of interventions prepared based on a detailed baseline assessment, identification of issues and challenges and aligning with the objectives of URMP framework and city's vision.

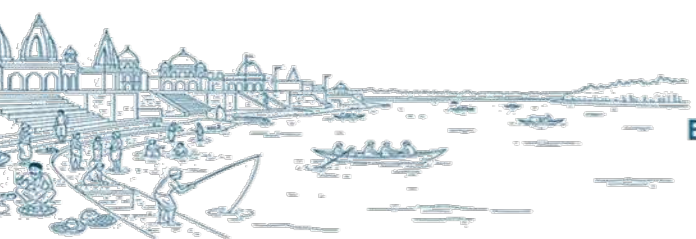
1 REGULATING FLOODPLAIN ACTIVITIES Objective 1: Regulation of Activities in the Floodplain				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
1.1	Floodplain Zoning Integration into the Master Plan	Town and Country Planning Department, UDHD-Bihar, Buxar Nagar Parishad	UDHD Bihar, State funding	Negligible
1.2	Assign the Role of Floodplain Management to the Nagar Parishad	Nagar Parishad Buxar (Lead), WRD, Town & Country Planning Dept.	UDHD Bihar, Nagar Nigam	Negligible
2 POLLUTION FREE RIVER Objective 2: Pollution Free River				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
2.1	Interim Faecal Sludge and Septage Management (FSSM) Strategy	BUIDCO	SBM-U 2.0, NMCG, 15th Finance Commission, Bihar UD&HD	₹12–18 crore
2.2	River Health Monitoring and Public Reporting System	Buxar Nagar Parishad	Nagar Parishad	₹75 Lakh
2.3	Scientific Solid Waste Management and Legacy Dumpsite Remediation	Buxar Nagar Parishad (Lead); BUIDCO (Technical Support); BSPCB (Regulatory Oversight); District Administration (Land & Enforcement)	SBM-U 2.0; 15th Finance Commission Tied Grants; State Urban Development Funds; NMCG	₹55–75 crore



3  REJUVENATE WATERBODIES AND WETLANDS	Objective 3: Rejuvenation of inland water bodies			
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
3.1	GIS-based waterbody inventory and monitoring system	Buxar Nagar Parishad (Lead), WRD Bihar (Support)	State Urban Planning Funds, NMCG technical assistance	₹40–60 Lakh
3.2	Rejuvenation of priority waterbodies	Buxar Nagar Parishad (Lead), WRD Bihar (Support)	Namami Gange, Jal Jeevan Hariyali Mission, Forest Department	₹65 Lakh
3.3	Development of Eco-Nalas	Nagar Parishad Buxar (Lead), WRD Bihar	NMCG	₹25–40 crore
3.4	Community stewardship for waterbodies	Buxar Nagar Parishad (Lead), Ward Committees, Local NGOs	State Urban Planning Funds	Clubbed with Intervention 9–1
4  ENHANCE RIPARIAN BUFFER	Objective 4: Enhancing Riparian Buffer			
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
4.1	NDVI-Based Riparian Buffer Monitoring and Management Dashboard	Buxar Nagar Parishad (Lead), with technical support from state	Buxar Nagar Parishad (Lead), with technical support from state GIS agencies	₹ 10–15 Lakh
4.2	Integration of Riparian Buffer Regulations into the Master Plan	Nagar Parishad Buxar, Proposed floodplain management cell	State Planning Funds, NMCG technical assistance	Negligible
5  INCREASED REUSE OF TREATED WASTEWATER	Objective 5: Increased Reuse of Treated Wastewater			
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
5.1	Preparation of a City-Level Treated Wastewater Reuse Strategy	Buxar Nagar Parishad (Lead), with technical support from state	NMCG policy component or AMRUT 2.0 city action plans	₹61 Lakh

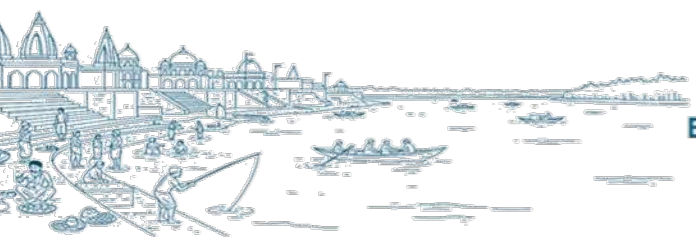


6 MAXIMUM GOOD QUALITY RETURN FLOW	Objective 6: Maximum Good quality return flow			
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
6.1	Integrated Monitoring and Regulation of Return-Flow Quality and Quantity	Buxar Nagar Parishad (Lead), BSPCB, WRD Bihar	NMCG (main), AMRUT 2.0, BSPCB	₹1.2–1.8 crore
7 ECO-FRIENDLY RIVERFRONTS PROJECTS	8 LEVERAGING ECONOMIC POTENTIAL OF THE RIVER	Objective 7: Eco-friendly Riverfront Projects Objective 8: Leveraging Economic Potential of the River		
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
7.1	Integrated Eco-Heritage Riverfront Development	Buxar Nagar Parishad, State Tourism Department, UDHD NMCG	NMCG, UD&HD Bihar, State Tourism Department,	₹85–120 crore
7.2	Eco-Ghat Design Guidelines and Riverfront Regulations	UDHD and NMCG	NMCG (Policy Component), UD&HD Bihar, AMRUT 2.0	₹45–65 lakh
9 CITIZEN AWARENESS ON RIVER SENSITIVE BEHAVIOUR	10 ENGAGE CITIZENS IN RIVER MANAGEMENT ACTIVITIES	Objective 9: Citizen Awareness on River Sensitive Behaviour Objective 10: Citizen engagement in river management activities`		
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
8.1	River sensitization program for the city	Buxar Nagar Parishad	NMCG Swachh Bharat Urban, CSR fund	₹32 lakhs
8.2	“Namami-Gange-Buxar” mobile application development	Buxar Nagar Parishad District Tourism Department (Support)	City’s own fund	₹10 lakhs





INTRODUCTION



2. INTRODUCING URBAN RIVER MANAGEMENT PLAN FOR BUXAR

2.1. Concept, Vision and Pillars of URMP

The core concept of the URMP is to integrate river-sensitive thinking into mainstream urban planning and governance. Rather than treating the river as a residual drain or a standalone beautification project, the URMP positions the river as a living ecological system and a shared urban asset that supports biodiversity, livelihoods, cultural practices, and city resilience. The framework promotes a shift from fragmented, project-based interventions to a holistic, basin-aware, and outcome-oriented approach that aligns with existing statutory plans such as the Master Plan, City Sanitation Plan, and City Development Plan. Importantly, the URMP is designed as a living document, allowing cities to monitor progress, learn from implementation, and recalibrate actions over time.

The Urban River Management Plan (URMP) for Buxar city has been prepared with an intent to manage the Ganga river and the other associated water systems within the city, in a sustainable manner. The URMP framework prepared by the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG), has been followed for preparing the URMP Buxar.

The URMP is anchored in the three pillars of sustainable development: Environmental, Economic, and Social. These pillars collectively guide the vision, objectives, and interventions proposed under the plan.

Figure 1: Elements of the URMP Framework



The Urban River Management Plan envisions a future where urban rivers function as healthy ecological systems, support sustainable economic activities, and are valued and celebrated by citizens. The vision emphasizes river-sensitive urban development that enhances environmental resilience, urban liveability, and socio-economic productivity while maintaining the ecological integrity of the river.

The URMP operationalizes this vision through ten objectives covering environmental, economic, and social dimensions. The URMP's vision shall be achieved through a set of ten objectives, six of which are environmental, and two each for the economic and social visions. Each objective is unique and addresses a niche aspect of urban river management.

It is important to note that the URMP is a living document that shall evolve over time as more knowledge and resources become available. The URMP also indicates a phase-wise (short term, medium term, long term) implementation plan for these interventions.

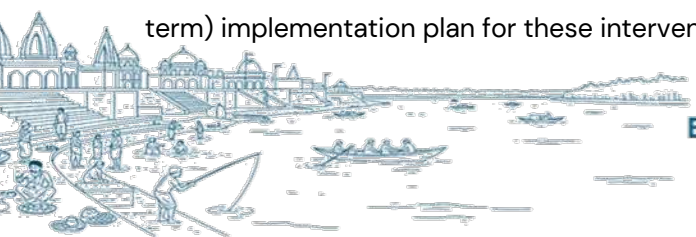


Figure 2 : Objectives across the 3 elements of the URMP Framework

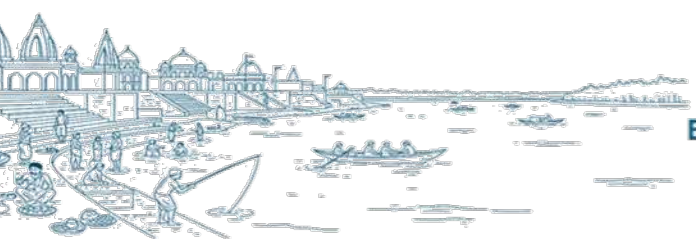
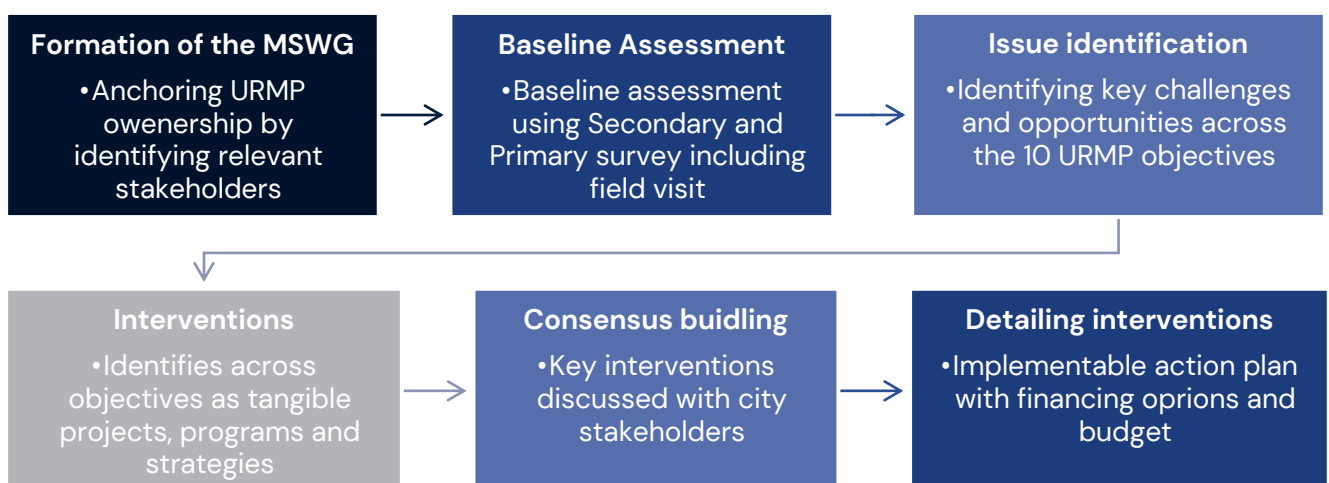


2.2. Process for preparation of URMP Buxar

Following process was followed for the preparation of URMP Buxar:

- **Step 1** – Setting up a core working group of relevant stakeholders to anchor the ownership of the URMP
- **Step 2** – Conducting a thorough baseline assessment of the relevant parameters to establish current status and the baseline score
- **Step 3** – Identifying key challenges and issues and preparing SWOT
- **Step 4** – Identifying tangible interventions for each objective of the URMP framework
- **Step 5** – Consensus building on the interventions via stakeholder workshops with City officials
- **Step 6** – Preparation of detailed plan for prioritised implementation of the interventions, and linking each intervention to probable institutional and financing option, along with a monitoring framework

Figure 3 : Steps for preparation of URMP Buxar



2.3. URMP Buxar- Working Group

The preparation of the Urban River Management Plan (URMP) for Buxar was spearheaded by Buxar Nagar Parishad, with active support from BUIDCO, PHED, and other relevant line departments. The process was guided by the National Mission for Clean Ganga (NMCG) and National Institute of Urban Affairs (NIUA).

To ensure stakeholder participation and collaborative planning, a URMP Working Group was constituted, comprising representatives from Buxar Nagar Parishad, BUIDCO, PHED, Forest, Agriculture . As an initial step, an in-person inception meeting of the working group was convened at the Buxar Nagar Parishad office on 18th June 2025. This meeting, chaired by the Executive Officer, and focused on identifying key river-related challenges faced by the city. Members were introduced to the concept of urban river management and the URMP framework, along with insights from similar initiatives in other cities such as Kanpur, Ayodhya and Chhatrapati Sambhajnagar. The working group shared details of ongoing projects related to river rejuvenation and expressed commitment to adopting the URMP framework for Buxar.

Figure 4: First MSWG Meeting held on 18th June 2025

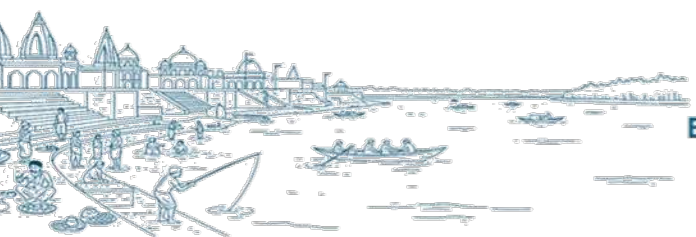


Discussions during the first MSWG meeting helped shape the vision for the Buxar URMP, which serves as the foundation for evaluating related challenges and identifying opportunities across thematic areas.

VISION

Heritage Conservation and River-Centric Tourism, which will emphasize Buxar's significance as a prominent Historical and Religious Tourism hub

This was followed by Baseline assessment phase that involved intensive on-ground data collection, stakeholder consultation and review of available project reports on various initiatives related to managing the river and urban water bodies health including key issues and potential.



Key Challenges Identified

Following key challenges associated with the rivers and waterbody systems in Buxar were identified during field visits and various stakeholder consultations. These challenges form the backdrop for the Buxar URMP and form the basis for developing proposals and interventions

Liquid Waste

- Significant discharge of untreated wastewater into drains, nallahs, ponds, and ultimately the Ganga river.
- Delay in commissioning of the Sewage Treatment Plant (STP) and associated network, creating an urgent need for interim measures.

Solid Waste

- Absence of a comprehensive Solid Waste Management (SWM) plan, resulting in widespread pollution across drains, nallahs, ponds, and riverbanks.

Riverfront

- Riparian buffers and flood-prone areas remain highly vulnerable to encroachments.
- Riverfront potential remains underutilised, with heavy footfall at ghats but inadequate amenities.
- Heritage value of the riverfront is largely untapped.

Waterbodies

- Urban ponds and wetlands are severely impacted by pollution and face increasing risk of encroachment.

Based on the key issues identified, interventions were developed across the 10 objectives and aligning with the URMP framework in close consultation with NIUA. Followed by on-ground feasibility check and consensus building amongst the key stakeholders in Buxar. The 2nd MSWG meeting was held on 2nd December 2025.

Figure 5: 2nd MSWG meeting and site reconnaissance on 2nd –3rd December 2025



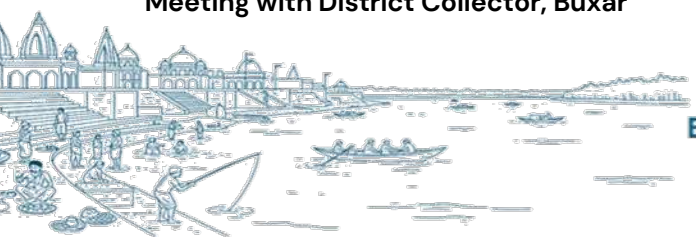
2nd Multistakeholder Working Group meeting held on 2nd December 2025



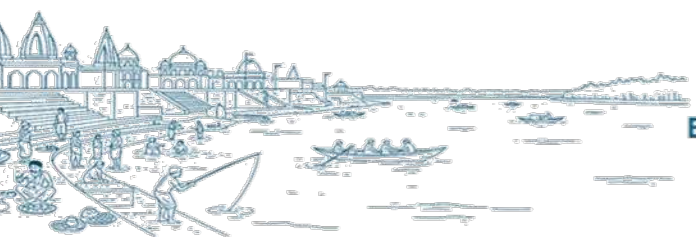
Meeting with District Collector, Buxar



Site reconnaissance

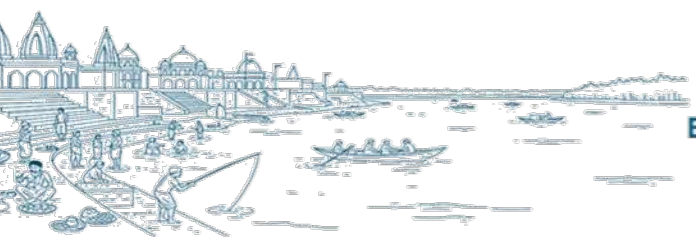


Meeting with Hon. Director General, NMCG Shri Rajeev Kumar Mittal on the proposed interventions for Buxar on 11th December 2025





BUXAR URMP – BACKGROUND



3. BUXAR URMP- BACKGROUND

3.1. City Profile



Buxar is an urban local body in south-western Bihar on the Ganga river and is a border city with Uttar Pradesh. Located along the banks of the Ganga, Buxar holds tremendous historical, cultural, and ecological importance in Bihar. The city, often dubbed “Mini Kashi”, is the district headquarters and a regional hub for governance, commerce, and religious tourism. River Ganga has defined Buxar’s identity over centuries, serving as a spiritual emblem, economic lifeline, and ecological support system. Devotee activities, ritual bathing on ghats, and frequent cultural fairs such as the Shravan melas anchor the city’s socio-cultural rhythms. The river also nurtures local agriculture, fisheries, and biodiversity, making its health and preservation central to Buxar’s future resilience.

Buxar is located approximately 190 km west of the capital city of Patna. National Highway 922 (Buxar-Arrah-Patna highway) is an important connector from Uttar Pradesh to Patna. NH 124C passes through the city center. Buxar railway station is an important railway station in the district having major connectivity to all parts of the state. Buxar is a border city and holds significant importance in road-rail-water connectivity with Uttar Pradesh. It is a vital modern trade and cultural hub, linking Bihar with neighboring Uttar Pradesh via the Ganga waterway and infrastructure developments such as the new six-lane bridge.

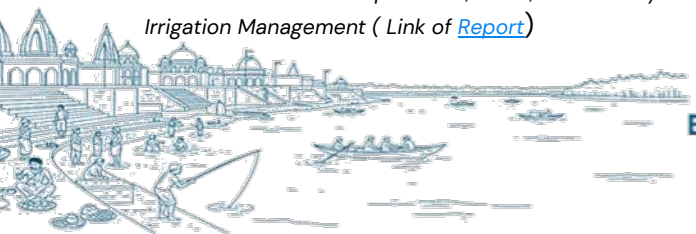
Buxar city is the administrative center for Buxar district which has 11 Blocks, 2 Nagar Parishads, 3 Nagar Panchayats, 1,142 villages with a population of 17,06,352. (Census 2011). Buxar municipality (Buxar Nagar Parishad) covers approximately an area of 23.64¹ sq km and lies at an elevation of 55m. The municipality currently comprises 42 wards, with ongoing urban expansion and integration of peri-urban blocks. The city does not have any regulatory development plans, and this is under preparation by the TCPO-Patna. The planning area is ~394 sqm which is ~16.5 times the city area.

The Ganga River forms the western boundary of the city. The city is divided into three parts by the Sone Canal and Police Canal located centrally in the city limits and the Thora River forming the western boundary of the city. The Sone River is one of the main tributaries of Ganga flowing through Madhya Pradesh (MP), Uttar Pradesh (UP), Jharkhand and Bihar. The canal system irrigates agricultural land in the region². Buxar also has a rich ecosystem of inland ponds and lakes within the city that shape its landscape and social fabric.

Buxar’s riverfront sustains livelihoods in pilgrimage/tourism, small commerce, fishing/boating, and seasonal grazing on exposed floodplains. The riverfront hosts 32+ ghats with associations to Ramayana, the historic

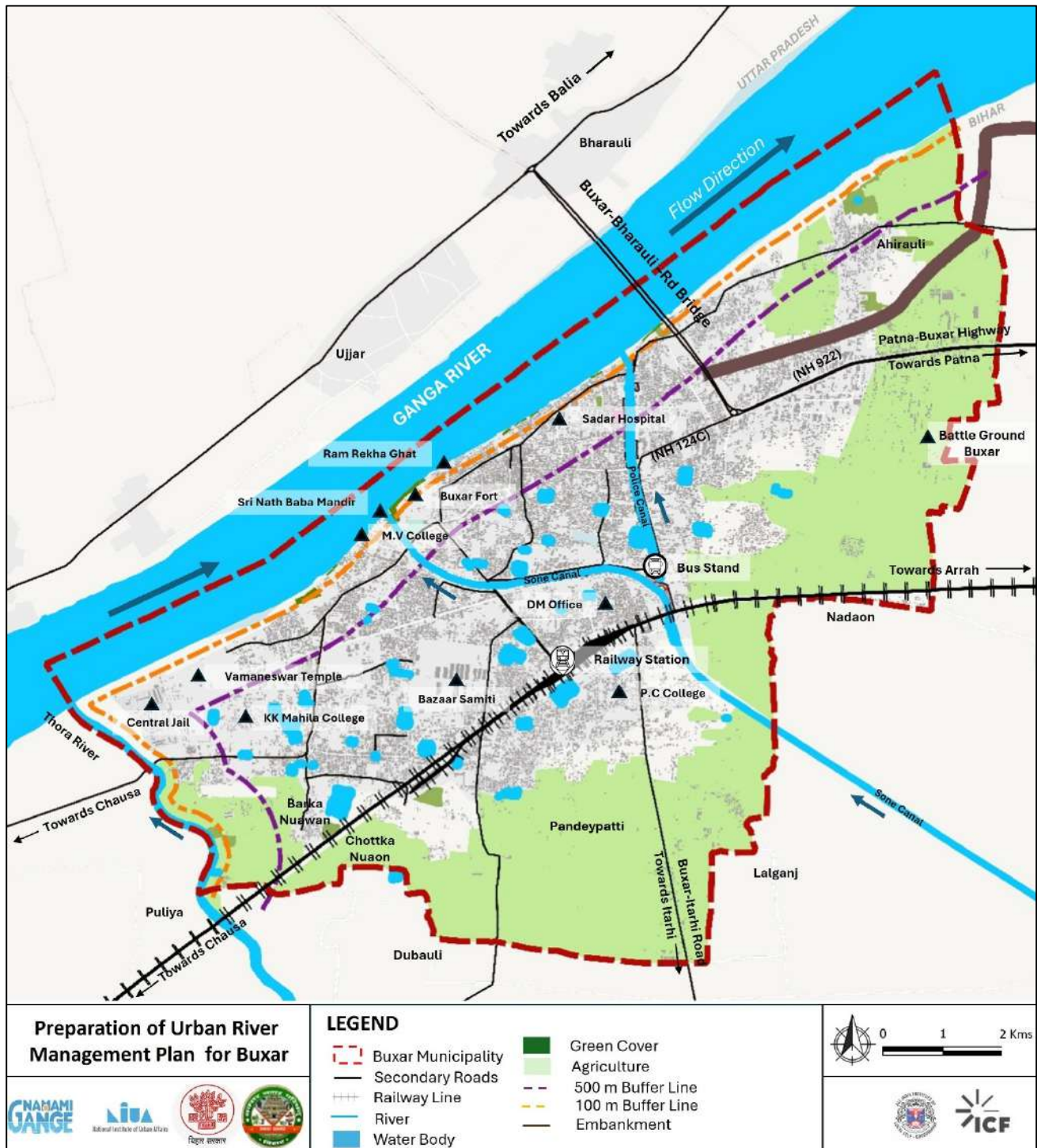
¹ Town planning department, UDHD, Bihar

² Water Resources Department, Bihar, National hydrology project, Development of Sone Canal Asset Management System for Irrigation Management (Link of [Report](#))

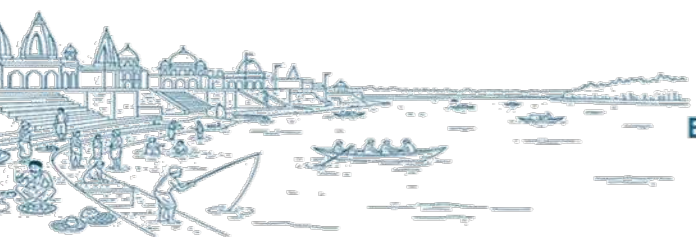


battle fields of Buxar, and nearby Chausa (where Sher Shah Suri defeated Mughal Emperor Humayun, marking a turning point in History of India). Major landmarks include Shri Nath Baba Temple, Ram Rekha Ghat, Gola Ghat, Chaitravan Muktidham (Sage Vishwamitra undertook penance here). Additionally, Buxar also experiences influx of religious tourist during Panchkosi Mela- a five-day procession that concludes at *Kila Maidan* in Buxar, Shivratri (February) Kartik Purnima (November), Shraadh, and Chhat Festival (November). Heritage-centric identity ("Mini Kashi") underpins opportunities for eco-tourism and cultural programming.

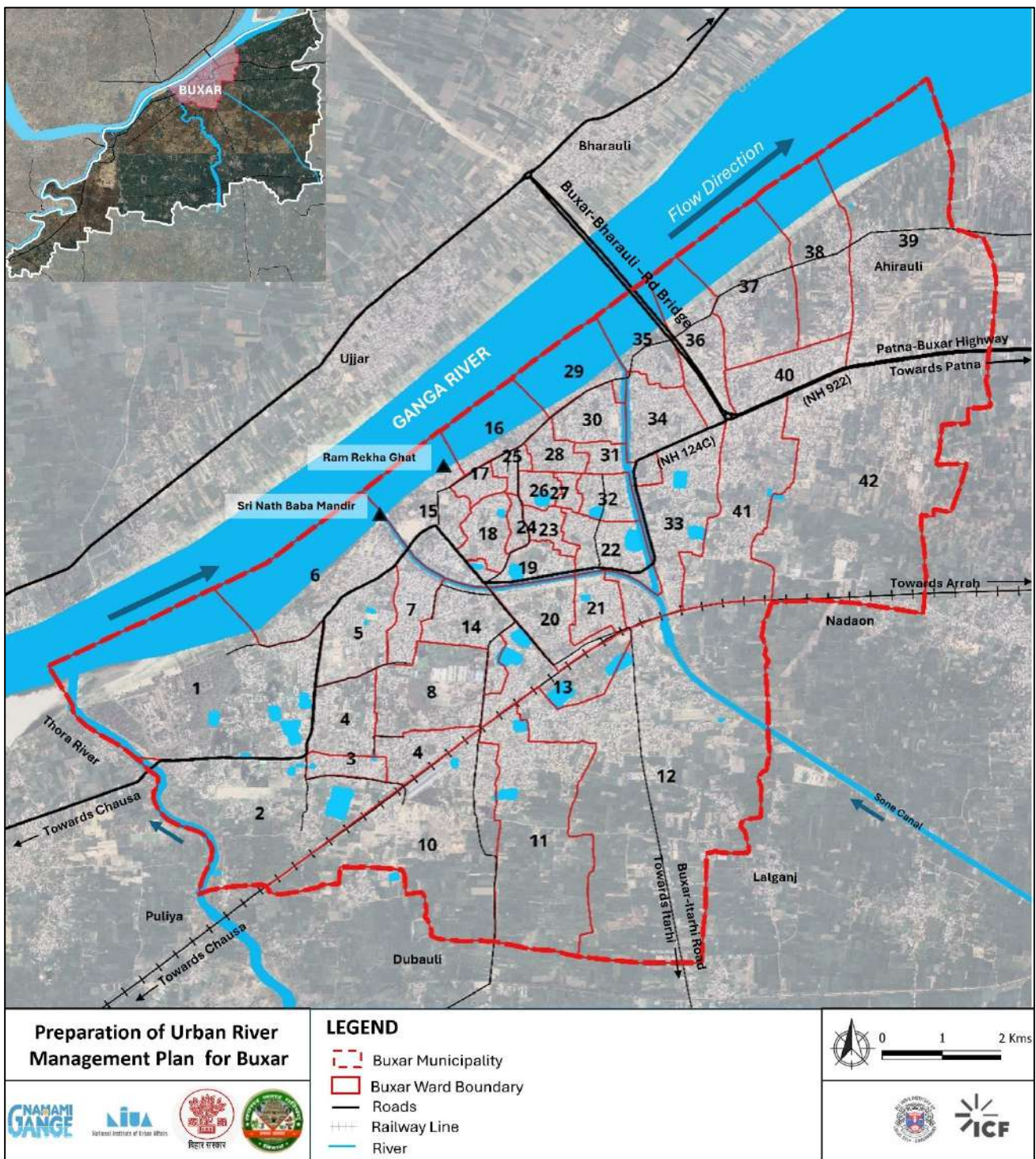
Map 1: River and water features in Buxar



Source: Google Earth & OSM

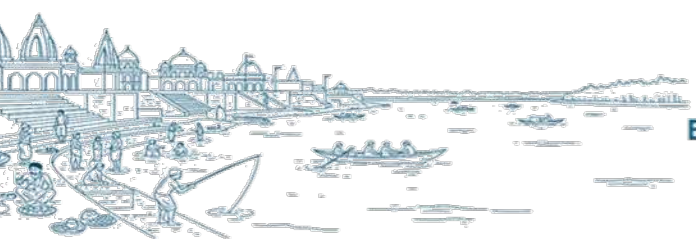


Map 2: Administrative boundary of Buxar

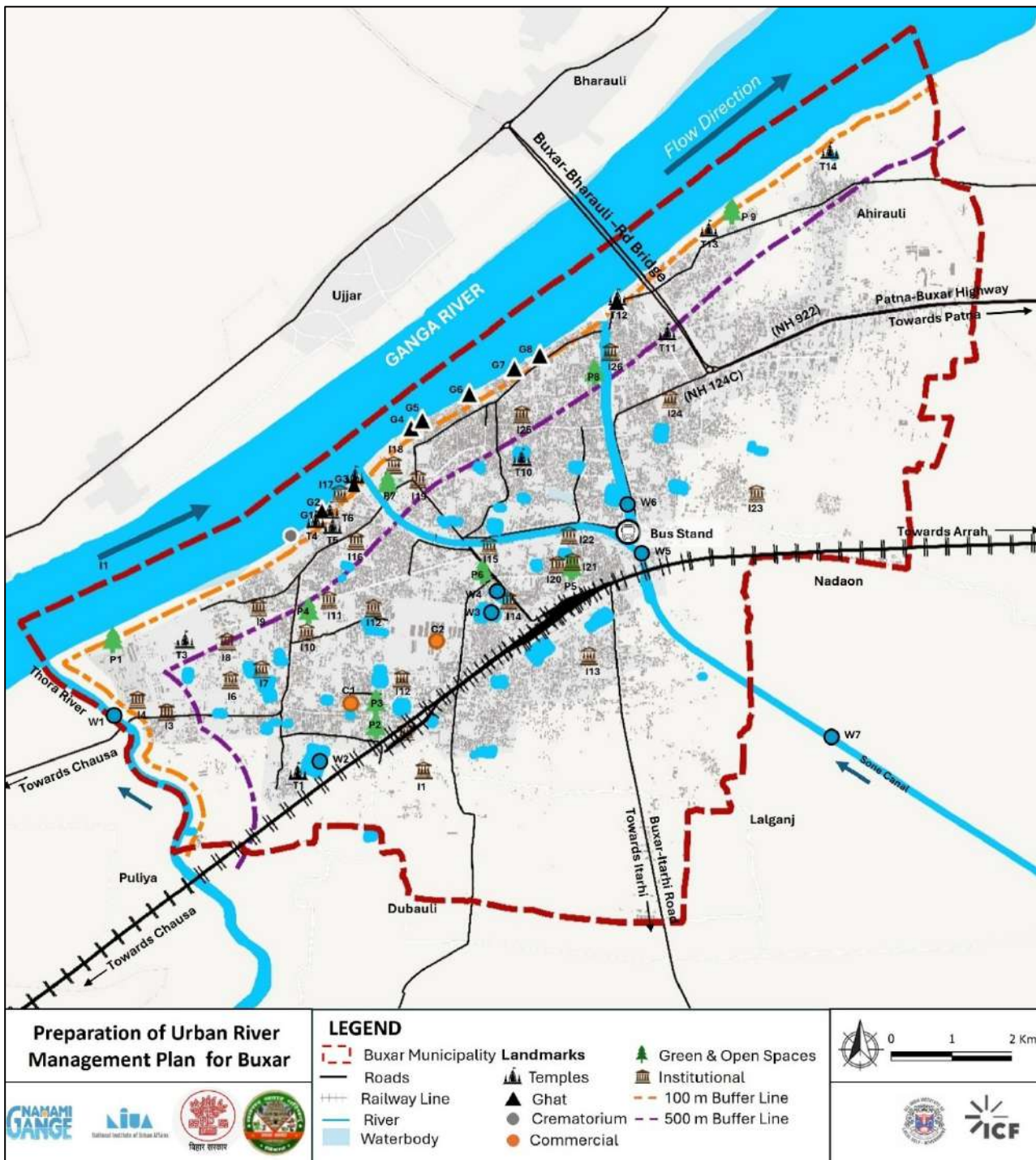


Source: UDHD & OSM

Map showing the Planning area Boundary (~394 sq km) for which the Master Plan is currently under preparation by the Town and Country Planning Department- Patna, UDHD. The Buxar Municipality area is ~23 sq km

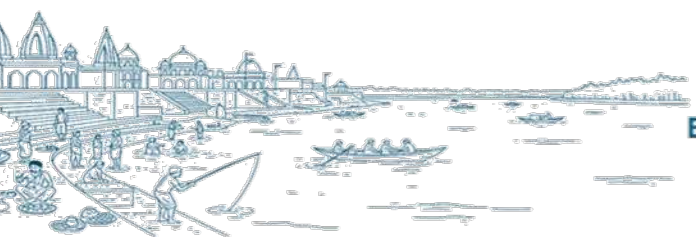


Map 3: Important Landmarks- Buxar City



Source: ICF & AILSG analysis

Map showing important landmarks –Ghats, places of worship, water bodies, and river system in Buxar city.





1. Buxar Fort



2. Gola ghat



3. Ram Rekha Ghat



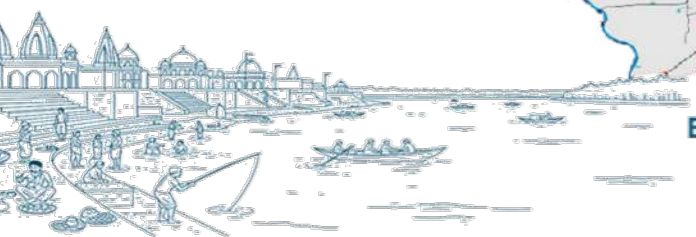
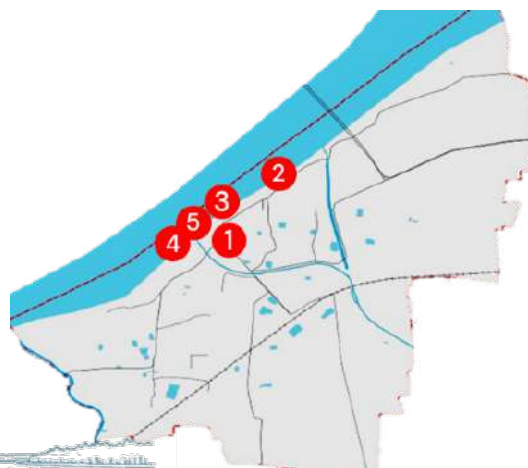
4. Chaitravan Muktidhaam



5. Baba Nath Mandir



3. Ram Rekha ghat during Chhat Festival





6. Police Canal



7. Sone Canal



8. Thora River



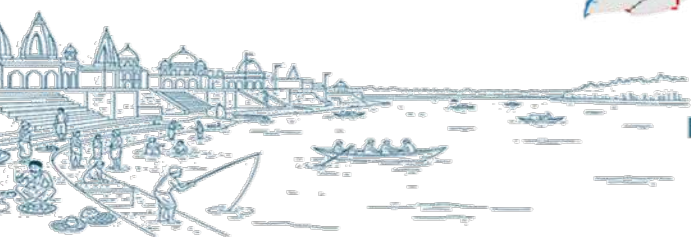
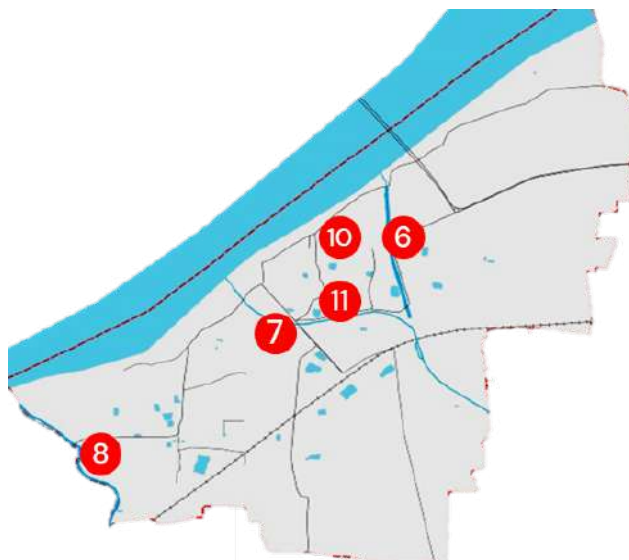
9. Buxar Ahirauli-UP bridge



10. Gauri Shankar pond



11. Mahipal Pokhra



3.2. Buxar and its relationship with Ganga

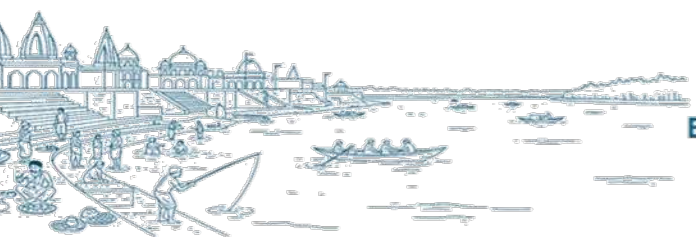


In Bihar, the Ganga River flows across northern India from west to east for a total stretch of 425 km in Bihar, entering at Chausa (Buxar) and passing through major cities such as Patna and Munger before leaving the state at Kahalgaon (Bhagalpur). Around 8.4 km of the Ganga river stretch abuts Buxar city. Several small rivers and irrigation canals flow into the Ganga within Buxar, most notably the Thora River, and branches of the Sone Canal System, alongside urban drains such as Nath Baba, Tadka, Sati Ghat, Bangla Ghat, and Saripur drains.

The city sits at an elevation of 55 meters above mean sea level (MSL). As per the Digital Elevation Model prepared for Buxar city, the high points are along the river front in the central areas and the city slopes towards west, south and east. Its old city central area is elevated and flood proof which is why this area had military and historic significance. The highest elevation point in central area of the riverfront is around 75m and slopes both north and south side up 64m-60 m. This slope pattern supports moderate natural drainage, in spite of its vicinity to Ganga River instances of urban flooding are limited within the city. The ghats, however, are inundated during peak monsoon season.

The riverfront has embankments as flood protection and erosion control measures in the form of constructed ghats, sandbag treatment and land terracing. When the Ganga swells during the monsoon, breaching the danger level (60.32 m) it inundates all 32 ghats, low-lying city wards, and several riverside villages. The riverbank in Buxar has altered over decades and has different features from engineered stone ghats and embankments in central areas to informal settlements, encroachments, sandy edges, and cultivated land elsewhere; erosion and silt deposition, resulting in both stable and severely threatened stretches.

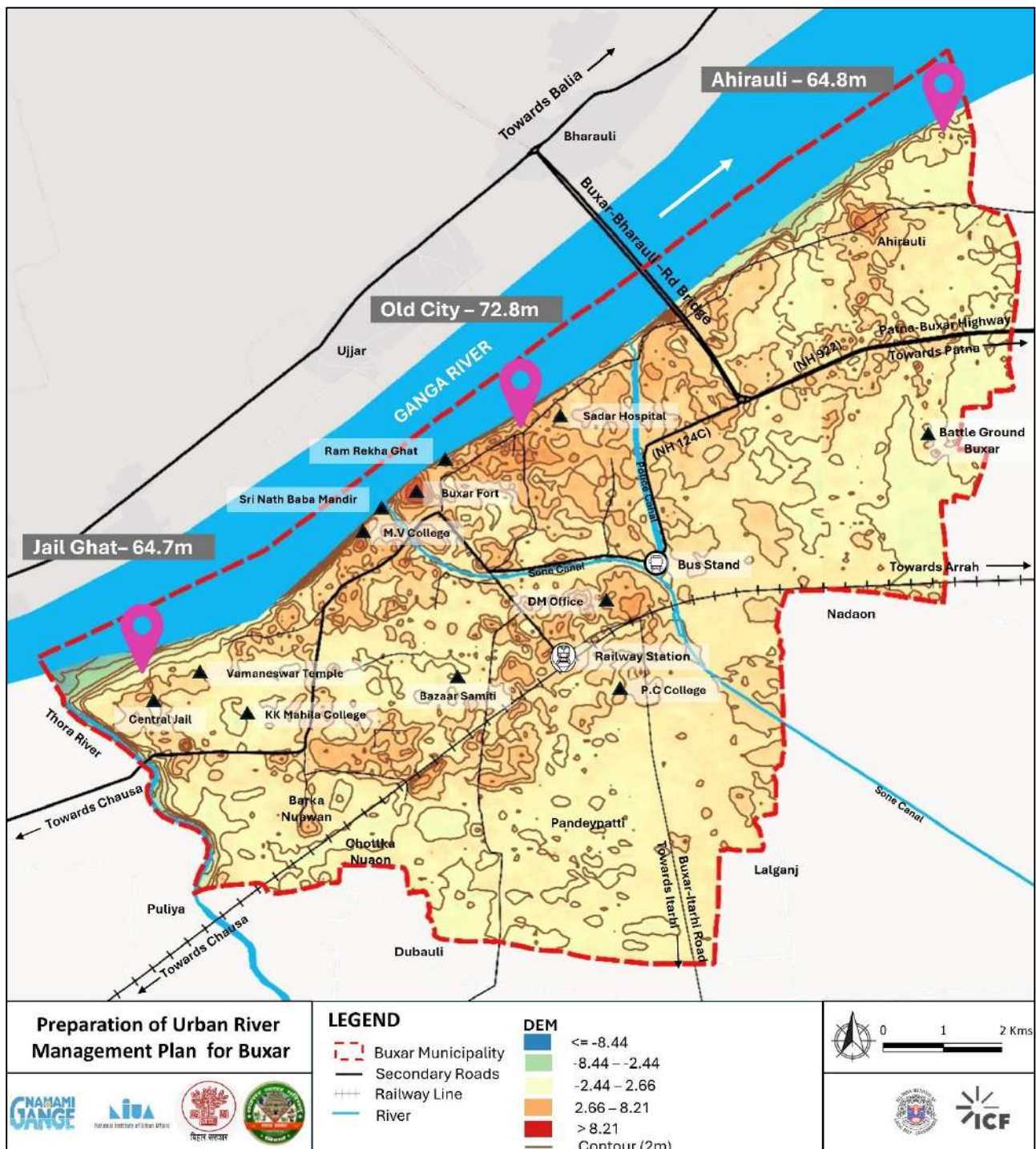
Untreated sewage from multiple drains (Police and Sone Canal being the major ones) currently flows into the Ganga river, posing a major pollution challenge. The city currently does not have any operational sewage treatment plant nor an engineered drainage system although these are being planned by BUIDCO. Inadequate solid waste management practices result in dumping at drains, ponds, and riverbanks, making improved collection, transfer systems, and segregation of ritual waste at ghats a priority. The city's riparian zone shows mixed riparian vegetation in outer belts and hard-scaped ghats in core areas.



Key Challenges

- Untreated wastewater and weak drain interception
- Solid waste management gaps causing littering/dumping in blue-green areas and ghats
- Incremental riparian buffer encroachment and floodplain vulnerability
- Under-provided riverfront amenities despite heavy footfall
- Degraded ponds/wetlands and biodiversity pressures

Map 4: Elevation and Contour, Buxar city



Source: CARTOSAT DEM (Bhoonidhi)

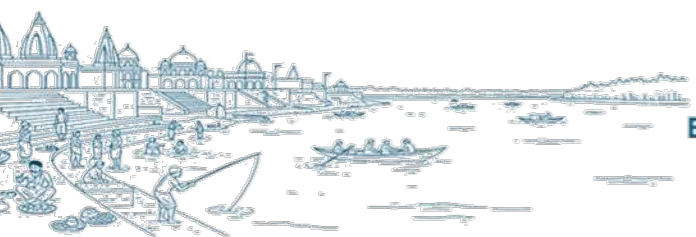


Figure 6 : Illustrative representation of the flood levels at Buxar's Ghats



The Gangetic Dolphins³

The Buxar stretch of the Ganga is a critical habitat for the endangered Gangetic Dolphin. This section of the river maintains a strong year-round flow, serving as a vital corridor for dolphin movement downstream. Dolphins thrive in deep-water stretches linked to shallow areas, meanders, confluences, and mid-channel sandbars. Their preferred habitats feature unique eddy-counter current systems formed by sediment deposits and point bars, often near sandbars, bridges, and irrigation canal mouths. Breeding occurs primarily from January to June, though studies indicate calf births throughout the year, highlighting the river's suitability despite growing biotic pressures. High dolphin densities are observed near confluences, shallow stretches, and areas with weaker currents, making these zones ecologically significant. Seasonal floods allow dolphins to access tributaries, while lean periods confine them to the main Ganga channel.

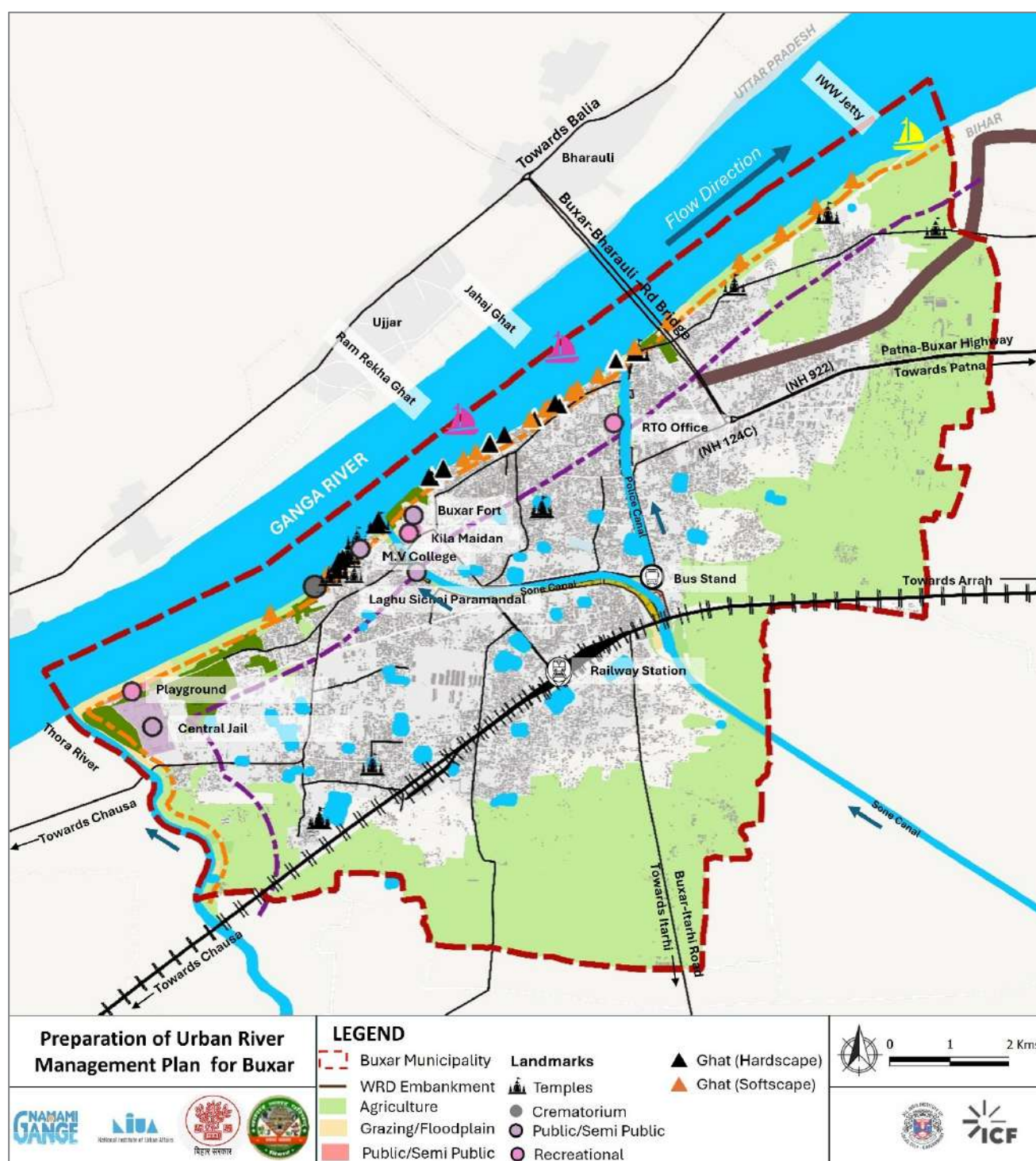


However, this delicate balance faces severe threats: human-dolphin conflict through poaching, accidental entanglement in fishing nets, and commercial use of dolphin oil; developmental pressures such as dam and barrage construction disrupting flow; excessive water extraction for irrigation; sedimentation reducing depth; and pollution from fertiliser runoff killing prey species. Riverbank vegetation, crucial for prey breeding and nutrient cycling, is also under stress. Preserving dolphins in Buxar is not just about protecting an endangered species—it safeguards the integrity of the Ganga's ecosystem, maintains biodiversity, and sustains the ecological services vital for local communities

³ https://nmcg.nic.in/writereaddata/fileupload/34_GangeticReport.pdf

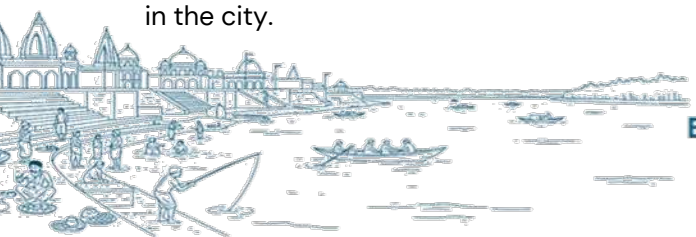


Map 1: Riverfront activity map-Buxar



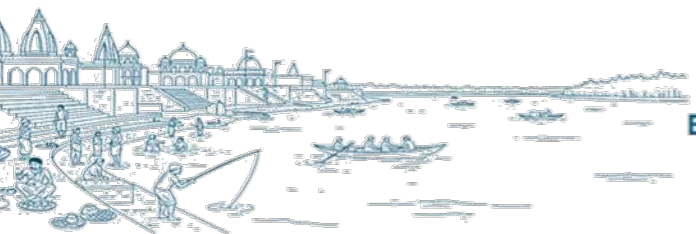
Source: AILSG & ICF Analysis

Buxar's riverfront is a hub of dynamic economic activity, driven by its rich socio-cultural heritage and strategic value. The map highlights over 38 formal and informal ghats that contribute to the city's vibrancy, particularly during festivals such as Chhath Puja. The presence of National Waterway 1 along this stretch underscores its significance as a key transport corridor. With year-round water availability, Buxar offers strong potential for water-based connectivity. Existing jetties at Ramrekha Ghat and Jaahaj Ghat, along with a planned jetty by the Inland Waterways Authority, further enhance the prospects for water transport in the city.





BASELINE ASSESSMENT - SUMMARY



4. BASELINE ASSESSMENT-SUMMARY

4.1. Baseline score and interpretation

Table 1: URM Baseline assessment score- Ganga in Buxar

	URMP Objective	Score Achieved	Interpretation	Current Status
ENVIRONMENTAL	Regulation of activities in Floodplain • Flood plain management score	1	No “regulatory” provision of flood plain management. Absence of Master Plan. 50% River edge has embankment	
	Pollution Free River- • Net Dissolved Oxygen score	3	Net DO level at Ganga’s inlet and outlet of the city shows negligible change but slightly above permissible limit	
	Rejuvenation of Waterbodies • Waterbody revival score	3	Of the 5 water bodies surveyed, 3 were in desirable condition	
	Enhancing Riparian Buffer • Riparian Buffer score	4	Of the total river edge in Buxar city, 82% is covered in some form of riparian buffer	
	Increased Reuse of Treated Used Water • Wastewater re-use score	1	Currently there is not STP within the city, hence water treatment is not present	
ECONOMICAL	Ecofriendly Riverfront Projects • Ecofriendly riverfront score	3	The Ram Rekha Ghat is a flagship project in the city.	
	Leveraging Economic Potential of River • River economy score	5	The river currently has 4 distinct economic uses- local fishing, inland water transport, cultural tourism, support agriculture.	
SOCIAL	River Sensitive Behaviour Among Citizens • Citizen sensitization score	4	Multiple IEX activities have been undertaken within the city, including existing awareness programs in schools and colleges	
	Engage Citizens in River Management • Citizen Management score	4	Of the listed 6 modalities in the URMP framework, citizens are only engaged through citizen groups river clean-up activities	
	TOTAL	28		

Note: *Score for Objective 6- Good quality return flow, is not valid in the case for Buxar city

$$\text{URM Index} = (1+3+3+4+1+3+5+4+4) / 9^* = 28/9 = 3.1$$

URM Index for Buxar city = 3.1



Average Level of river management

The city has a satisfactory urban river management system. However, some dimensions of urban river management are still a cause of concern.

Based on the baseline assessment for all the indicators, it is observed that Buxar city has done a fair task in managing its rivers however there is a need for a holistic approach to be adopted city-wise to improve its river management.

Buxar benefits from a natural levee along the Ganga River and additional embankments that offer protection against flooding. Urban flooding is generally confined to low-lying areas lacking embankments. Despite this natural advantage, the absence of robust regulations and enforcement mechanisms results in a low score for floodplain management.

The city faces significant challenges with solid waste disposal and inadequate liquid waste treatment, particularly concerning discharge into river streams. The average Dissolved Oxygen (DO) score reflects moderate water quality, signalling the need for stricter pollution control measures to preserve the river ecosystem.

The score for water body revival remains average, indicating the necessity for basic interventions such as boundary protection and prevention of encroachments. Inland water bodies serve as natural aquifers and play a vital role in groundwater recharge, making their conservation essential.

Currently, Buxar does not treat wastewater and hence, there is no reuse of treated wastewater, resulting in a low score for this objective. Strategic policy and project-level initiatives could help improve this metric and support sustainable groundwater management.

Buxar has a healthy density of natural riparian buffers along the riverbanks. However, these are under threat due to unregulated solid waste dumping and encroachments. These buffers are crucial for preventing soil erosion and siltation, and they support diverse flora and fauna, underscoring the need for their protection.

Given the cultural and religious significance of Buxar and the Ganga River, the city attracts pilgrims and tourists year-round. In response, several riverfront development projects have been undertaken, including ghat construction and sand banking, which support local commerce without obstructing the river's flow. Nonetheless, improper waste disposal persists, requiring stronger enforcement. Consequently, the riverfront management score is average. The riverfront also sustains various economic activities such as fishing, boating, and grazing during dry seasons, contributing to a high score for riverfront economy.

Citizen participation in Buxar is moderate but growing. Initiatives like clean-up drives, plantation efforts, and awareness campaigns are supported by grassroots organisations such as Jeevika and youth clubs. However, the lack of formal citizen involvement in decision-making processes limits long-term stewardship. With the introduction of structured platforms, digital reporting tools, and institutional collaborations, Buxar has the potential to achieve higher scores in future assessments. Currently, the city scores relatively well in objectives 9 and 10.

4.2. SWOT analysis

Based on the baseline assessment and consultations with city stakeholders, the following SWOT analysis has been prepared for the Ganga and its associated water bodies in Buxar. This provides a diagnostic basis



for identifying intervention areas under the URMP. across the three pillars-Environmental, Economic and Social. The SWOT will position Buxar-URMPs approach to align with the vision as well as provide a forward-looking strategy for interventions.

ENVIRONMENTAL

Key focus: Treatment of wastewater, groundwater quality improvements, trunk infrastructure creation, flood plain management, pollution control, rejuvenation of inland water bodies and drains

STRENGTHS	Low Urban Flooding Riparian Buffer Floodplains Respected
WEAKNESS	Untreated Wastewater No Operational STPs Solid Waste
OPPORTUNITIES	Nature-Based Solutions Urban Agriculture
THREATS	Agricultural Run-off Arsenic Contamination



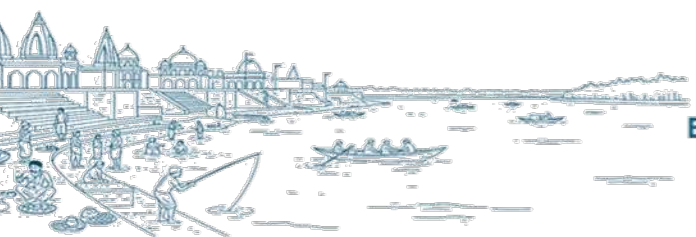
ECONOMIC

Key focus: Leveraging the economic potential of the riverfront and other economic activities

STRENGTHS	Successful Projects
WEAKNESS	Low Revenue Generation Informal Sector is Unregulated
OPPORTUNITIES	Green Jobs Riverfront and Pond Redevelopment
THREATS	Over-commercialization Maintenance Costs & Efforts by ULB

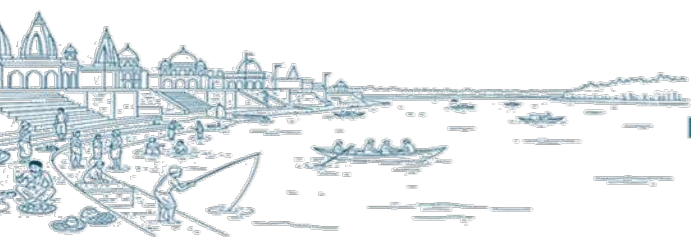


SOCIAL



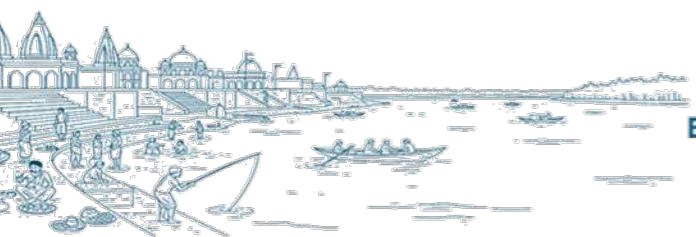
Key focus: Citizen sensitization and awareness on the importance of the river and mobilisation of community led efforts in managing river's health

STRENGTHS	Rich Heritage Value of Ganga Proactive Municipality Engaged Citizens
WEAKNESS	No Riverfront Plan Poor Heritage Management
OPPORTUNITIES	Eco-Tourism & Heritage Circuits
THREATS	Competing Development Pressures





INTERVENTIONS



5. INTERVENTIONS

5.1. Objective 1: Regulation Of Activities in Floodplains

Rationale: Objective 1 focuses on regulating activities within the river floodplain to safeguard riverine ecology, reduce flood risk, and align urban growth with river-sensitive planning principles. While Buxar's floodplain continues to perform essential ecological and hydrological functions, it does so in the absence of a coherent regulatory framework at the city or state level.

5.1.1. Existing Situation

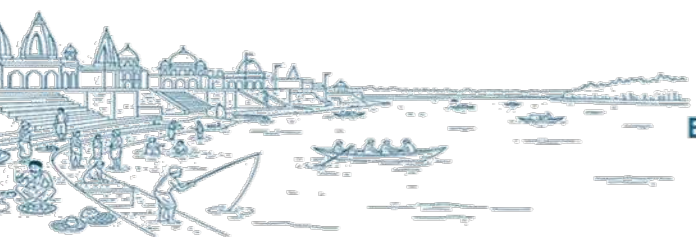
Floodplain governance in Buxar is shaped by a layered policy environment spanning national statutes, judicial directives, state-level departments, and municipal actions, as given in Annexure 1.

For **Buxar**, the floodplain has been demarcated based on an interpretation of the **WRD Bihar Flood Plain Zoning Notification (March 2025)**, wherein a **500-metre zone on the non-embanked side of the river** is treated as a *Prohibited Zone (with permissible activities)*. In addition, relevant **NGT directions (July 2017)** prescribing a **100-metre no-development buffer** and broader environmental safeguards up to **500 metres** from the river edge have been considered as planning guidance. Accordingly, the 100 m and 500 m buffers have been applied as an interim planning framework. This interpretation of the national and state notifications has been prepared for Buxar to suggest an interim strategy for flood plain demarcation, until such time as the WRD's floodplain demarcation is completed. This interim demarcation could be adopted and integrated into the statutory Master Plans being prepared by TCPO after due further studies.

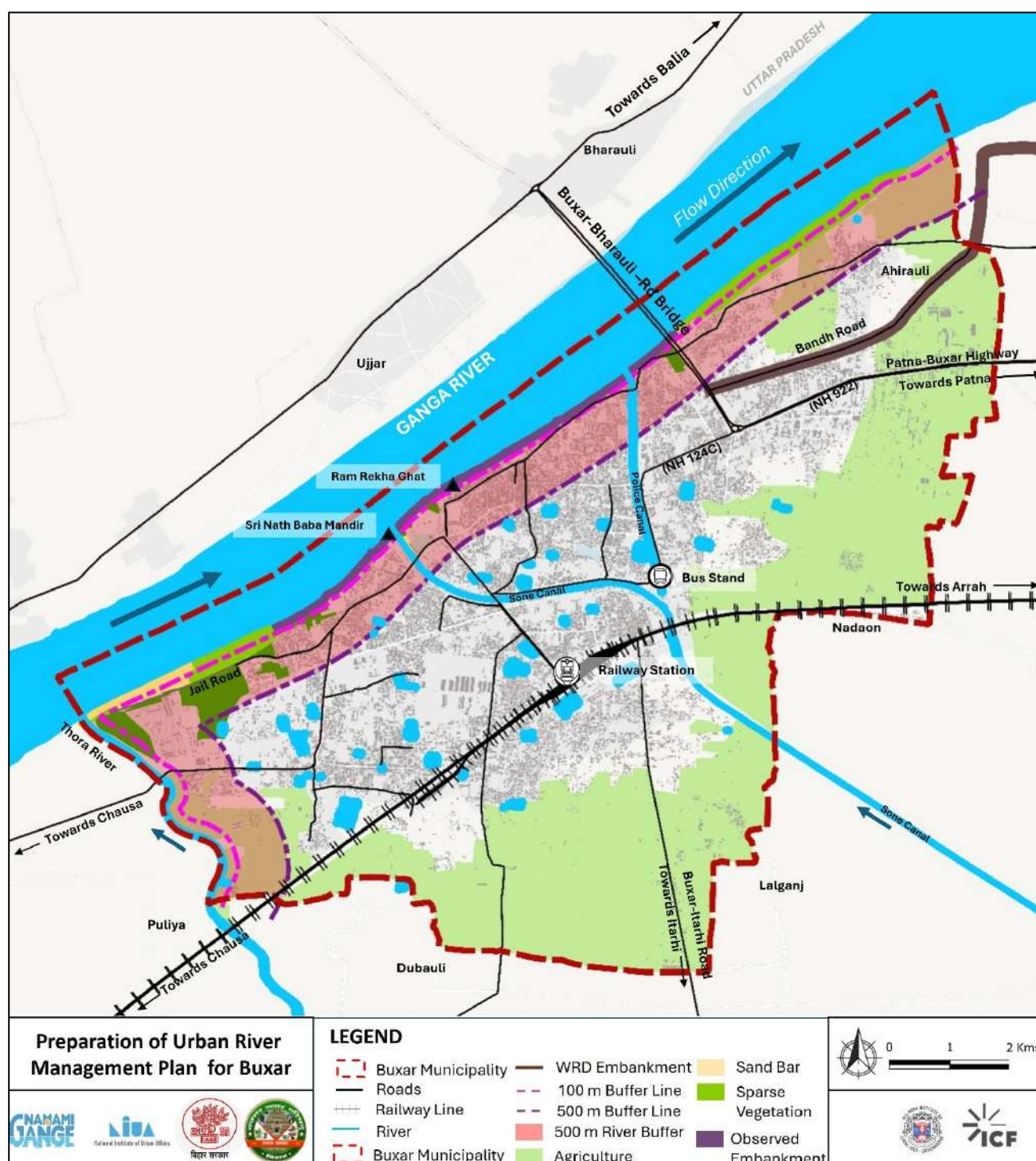
Figure 7: Characteristics of the Buxar Floodplain



Source: AIIISG and ICF Site Visits

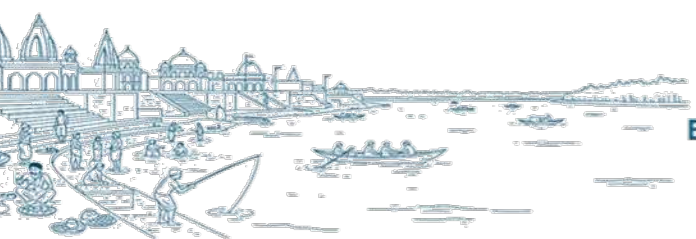


Map 5: Embankments and river buffer zone along the River Edge



Source: AILSG and ICF Analysis

At the national level, strong intent exists through instruments such as the *River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016*, NGT orders mandating floodplain demarcation based on the 1:100-year flood line, and advisory guidelines from the Central Water Commission and NDMA advocating non-structural flood management measures. **However, these provisions have not been translated into enforceable city-level planning controls.**



At the state level, Bihar has not yet notified a Floodplain Zoning, resulting in a regulatory vacuum between embankment-based flood protection and land-use control. While the Water Resources Department (WRD) regulates embankments and is in the process of creating a statistical model-based floodplain line across the state; and the Bihar State Pollution Control Board (BSPCB) regulates pollution-related activities, neither agency has a mandate to control land use or development intensity within the embankment & river's interface.

Municipal instruments are also limited: Buxar is in the process of creating a Master Plan at the moment but meanwhile lacks any Development Control Regulations (DCRs) that incorporate floodplain zoning or river buffers. As a result, floodplain management in Buxar is predominantly structural rather than regulatory.

5.1.1.1. Floodplain Characteristics and Land Use Dynamics

The Ganga floodplain in Buxar extends along the north-western edge of the city, with a physical embankment (made of sandbags covered with nets) covering approximately 50% of the river stretch between the Bharauli Bridge and Shamshan Ghat. Southwards, near the Thora River confluence, the embankment is intermittent or absent, leaving large tracts exposed to seasonal inundation, especially between the Jail road and the river.

In the north side of the Bharauli bridge, the WRD has designated an embankment line called the Buxar-Koilwar Ganga embankment. This area was initially classified as rural but was absorbed into the city boundaries in 2022 with the inclusion of new wards within the city boundary. This embankment line is physically marked by a road called the Bandh road and, as per WRD advisory guidelines, construction is not to be done between the river and this road. In recent years, encroachments in this area have been observed.

The floodplain exhibits strong seasonal variability with extensive inundation of low-lying tracts during monsoon and exposed sandbanks used for grazing, cultivation, and informal activities during summer.

Land-use analysis conducted within the 500 m river buffer indicates a gradual but consistent increase in built-up area (57 hectares over seven years), particularly in peri-urban stretches such as Jail Road. While current encroachment levels remain modest, construction of large residential structures in flood-prone areas signals emerging development pressure. At the same time, the floodplain supports critical socio-cultural functions:

- Over 25 ghats, including high-footfall sites such as Ramrekha Ghat and Nath Baba Temple.
- Cremation ground and religious structures.
- Seasonal agriculture and grazing, including pilot organic farming clusters under the Jaivik Kheti Yojana.

5.1.1.2. Key Gaps

A preliminary study reveals that there are a few interrelated structural weaknesses that undermine effective floodplain regulation in Buxar. The absence of a formal floodplain zoning framework, including the non-availability of delineated red and blue flood lines or river zones is the most pressing challenge.

Enforcement and monitoring mechanisms within the floodplain are weak and fragmented, allowing incremental encroachment and land-use change to occur with limited regulatory oversight. The lack of an updated, city-level database on existing land use within the floodplain and the absence of integration between floodplain considerations and statutory planning or development approval systems worsens this situation.



Institutional responsibilities for floodplain management are unclear and at the same time, dispersed across multiple agencies including the WRD, Disaster Management authorities, and the Nagar Parishad, without a clearly defined coordinating mechanism, resulting in diluted accountability.

5.1.2. URMP Score

Flood plain management score

The floodplain management assessment indicates weak overall performance and implementation of regulated activities in the floodplain, with only **24 out of 100** points achieved, placing the city in the lowest category under URMP criteria.

Flood plain management points <30 translates to **1** score as per URMP framework

5.1.3. Interventions

The interventions under Objective 1 focus on transitioning Buxar from **embankment-led flood control** to **regulation-led floodplain management**, aligned with national guidelines and NGT directives.

5.1.3.1. Intervention 1-1: Floodplain Zoning Integration into the Master Plan

This intervention recommends the **systematic integration of floodplain zoning and river-sensitive planning provisions into the statutory Master Plan and Development Control Regulations (DCRs) of Buxar**, with the objective of converting currently fragmented floodplain controls into coherent and enforceable planning guidance. The intent is to translate existing national and state-level floodplain guidelines and judicial directions into enforceable planning controls at the city level.

Intervention	Responsible Agency	Intervention type
Floodplain Zoning Integration into the Master Plan	Nagar Parishad Buxar (Lead), WRD, Town & Country Planning Dept.	Policy & Regulatory
Estimated Budget	Potential Funding Sources	Timeline
N/A	State Planning Funds, NMCG technical assistance	Short-term (1–2 years)

Figure 8: Process for Floodplain Zoning Integration into the Master Plan



Key Planning Components:

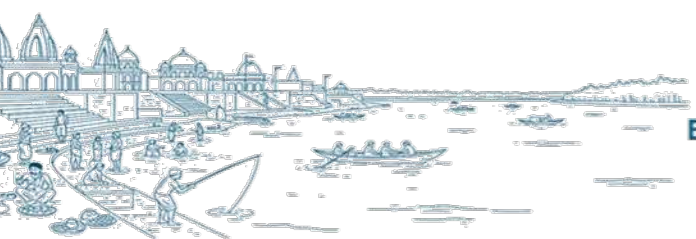
Step 1: Delineate and Zone the Floodplain

Approach:

- Adoption of the WRD-notified floodplain extent (including the 500m Prohibited Zone with permissible activities, on the non-embanked side) as the base planning layer.

Suggested Logic:

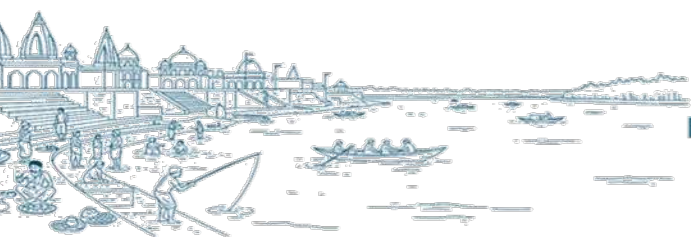
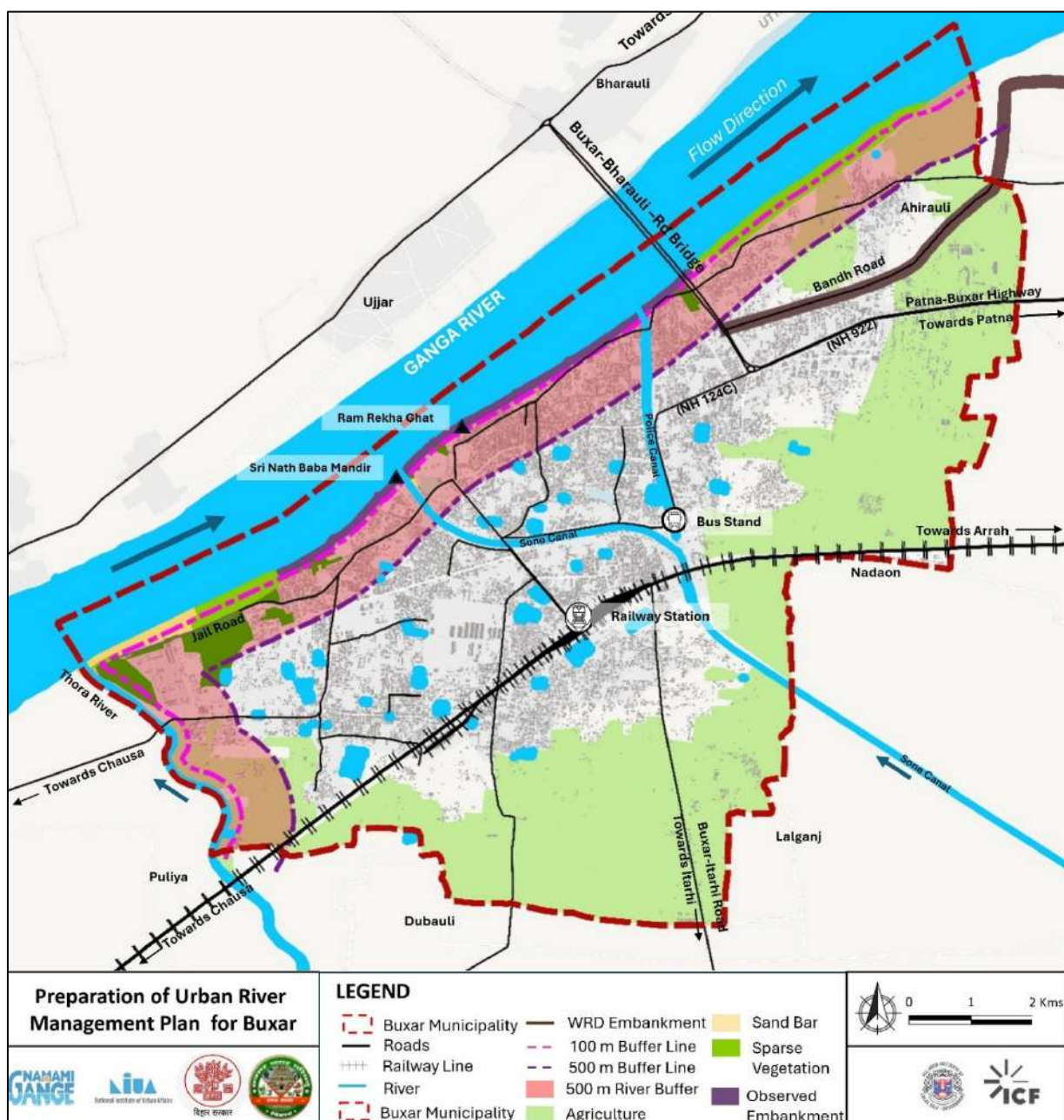
Flood Zone	Flood Frequency	Planning Intent
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- Application of a 100 m no-development buffer from the river edge as an interim regulatory safeguard, guided by NGT directions.
- Progressive refinement through delineation of 10-, 25-, 50-, and 100-year flood lines using hydrological data, observed high-flood levels, embankment alignments, and topographic analysis. This would eventually be done through the statistical model for floodplains under development by the state.
- Integration of floodplain layers with cadastral and planning base maps to guide land-use zoning and development **permissions**.

No Development Zone (NDZ)	100 m river buffer	Preserve active floodplain; prohibit permanent construction
Regulated Development Zone (RDZ)	500 m river buffer	Permit limited, flood-resilient uses with conditions

Map 6: Map of river showing the NDZs, RDZs, riparian buffer



Step 2: Modify relevant Development Control Regulations (DCRs)

The DCRs accompanying the Master Plan should clearly articulate land-use controls within each floodplain zone. A list of suggested activities for each zone is given below. They are derived from applicable national and state policy frameworks on floodplain management and river-sensitive planning. These include the Model Bill for Flood Plain Zoning (CWC, 1975); relevant NGT orders, including the order dated 13.07.2017 in *M.C. Mehta vs Union of India*, which mandates no-development buffers and prohibits waste dumping and large-scale construction in floodplains; the Draft River Regulation Zone Notification, MoEF&CC (2016); the Technical Guidelines on Flood Plain Zoning issued by CWC (2025); and the Flood Plain Zoning Notification of the Water Resources Department, Government of Bihar (March 2025). A detailed summary of these orders is given in Annexure 1.

Table 2: Suggested Permissible Activities in the NDZ and RDZ

Activity Type	No Development Zone	Regulated Development Zone
Permanent residential housing	✗ Prohibited	✗ Prohibited
Agriculture (organic / natural)	✓ Permitted	✓ Permitted
Chemical-intensive farming	✗ Prohibited	△ Strongly discouraged
Grazing / pasture	✓ Permitted	✓ Permitted
Religious activities (Chhath, rituals)	✓ Permitted (temporary, non-monsoon)	✓ Permitted
Permanent religious structures	✗ Prohibited/ △ Regulated	✗ Prohibited
Ghats (eco-sensitive design)	✓ Permitted	✓ Permitted
Cremation grounds	✓ Permitted	✓ Permitted
Parks, open spaces, playgrounds	✓ Permitted	✓ Permitted
Commercial / industrial activity	✗ Prohibited	✗ Prohibited
Solid waste dumping / landfills	✗ Prohibited	✗ Prohibited
STPs / river conservation works	✗ Prohibited	△ Strongly discouraged

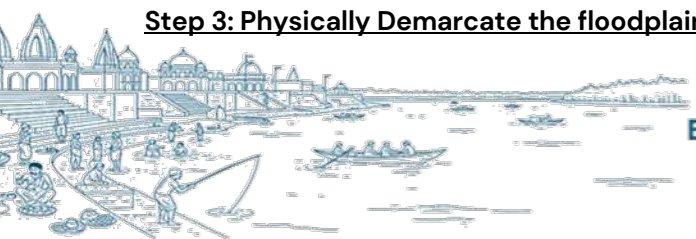
Legend:

✓ Permitted △ Regulated / Conditional ✗ Prohibited

The following **should be permitted across zones**, subject to safeguards:

- Bridges, embankment repairs, flood protection works
- Water supply pipelines, power transmission lines
- Outfalls, river conservation works under NMCG

Step 3: Physically Demarcate the floodplain Boundaries



Once the floodplains are demarcated, they should be physically demarcated, as done in the case of the Bandh road, to improve on-ground enforceability. This can be done via:

- Installation of boundary pillars, signage, and visual markers along NDZ and RDZ edges.
- Use of embankment crests as reference lines where embankments exist, supplemented by signage clarifying regulatory status.
- Periodic verification of demarcation using GIS and field surveys.

Step 4: Riparian Buffer Integration and Ecological Design

The Master Plan should incorporate a continuous riparian buffer of approximately 7.5–15 metres, as suggested under the URMP guidelines, along the river edge, to be notified as an ecological buffer zone. Design recommendations for this buffer are given in Intervention 4-2 and a list of approved native species, and commonly found flora and fauna is given in Annexure 2.

Institutional Responsibilities and Coordination

The implementation of this intervention should, ideally, be led by the Nagar Parishad Buxar, with technical and regulatory coordination from the Town and Country Planning Department and the Water Resources Department.

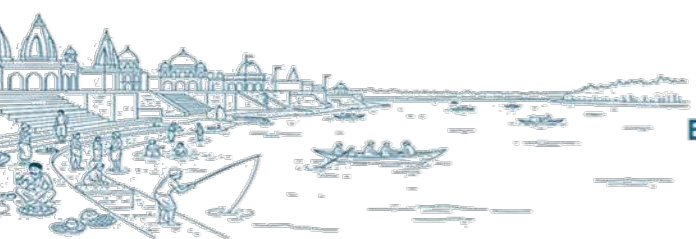
5.1.3.2. Intervention 1-2: Assign the Role of Floodplain Management to the Nagar Parishad

This intervention recommends the **formal assignment of floodplain management responsibilities to the Nagar Parishad Buxar**, with structured coordination and reporting linkages to the District Ganga Committee (DGC). The objective is to address the current fragmentation of institutional roles across agencies and to establish a single, accountable city-level authority responsible for monitoring, enforcement, and coordination of floodplain-related activities. This intervention complements regulatory measures proposed under Intervention 1-1 by ensuring that floodplain zoning provisions are implemented and enforced on the ground.

Intervention	Responsible Agency	Intervention type
Institutionalization of Floodplain Management	Nagar Parishad Buxar (Lead), District Ganga Committee, WRD	Institutional & Governance
Estimated Budget	Potential Funding Sources	Timeline
Negligible	State Urban Development Funds, NMCG institutional support	Short-term (1–2 years)

Institutional Responsibilities and Coordination

The Nagar Parishad Buxar should act as the lead implementing agency, with technical inputs from the Water Resources Department and regulatory coordination with the Bihar State Pollution Control Board. The District Ganga Committee should provide oversight, inter-departmental coordination, and strategic guidance to ensure that floodplain management actions are aligned with district- and basin-level river rejuvenation objectives.



Key Components

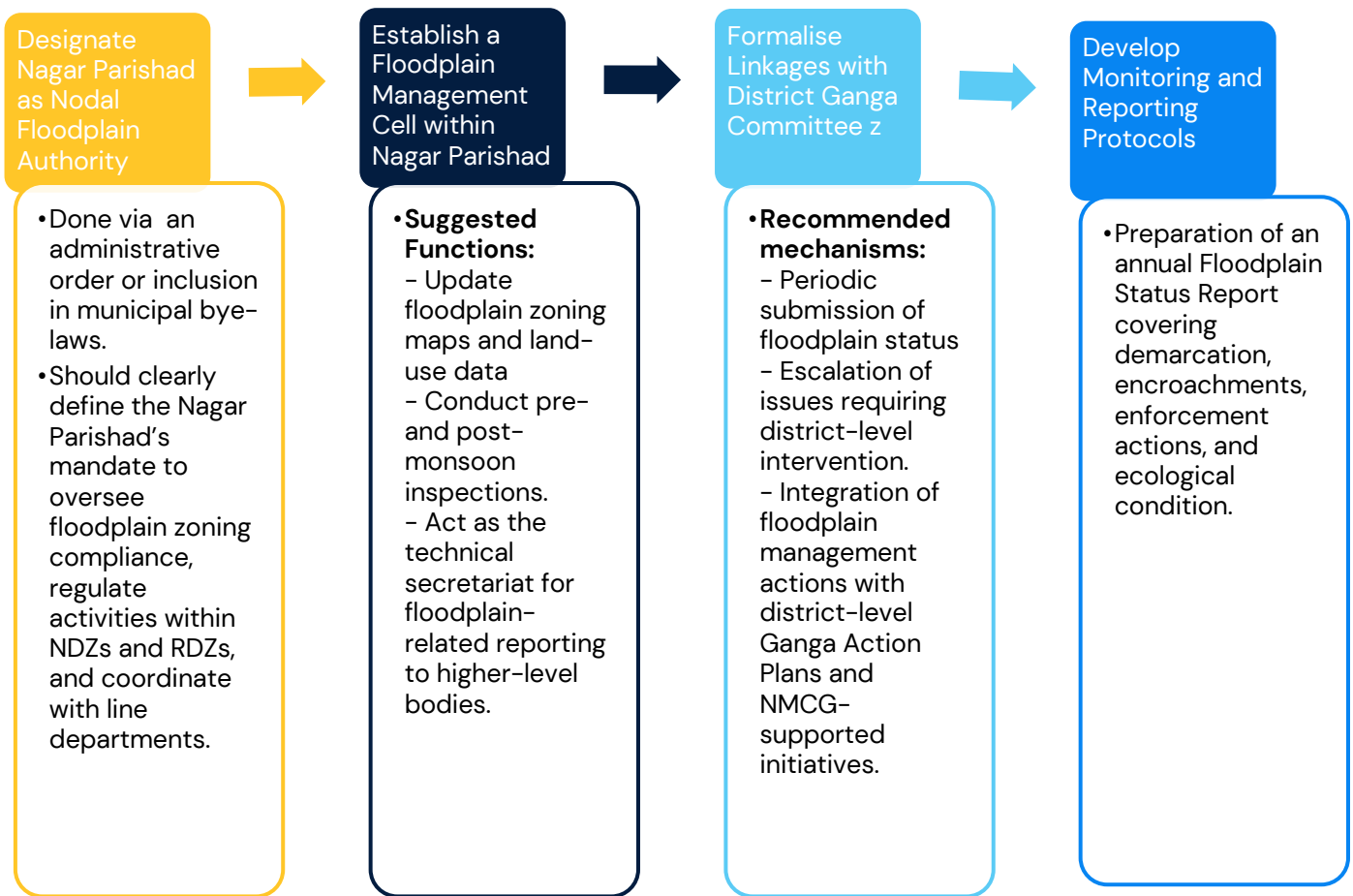
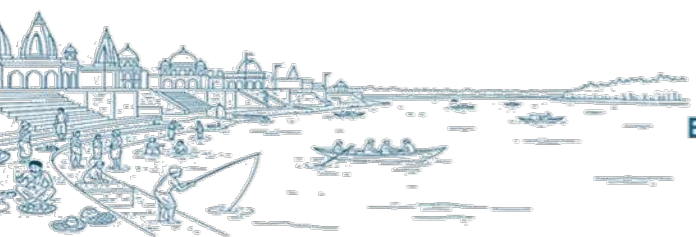
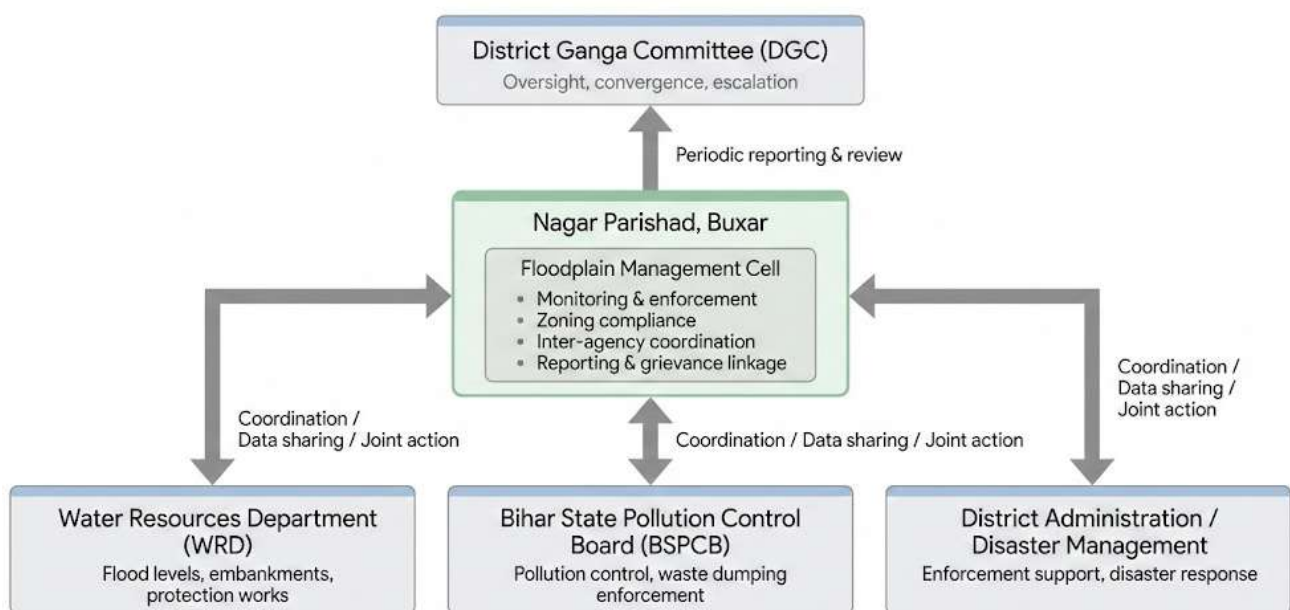


Figure 9: Institutional Framework for Floodplain Management in Buxar



5.2. Objective 2: Pollution Free River

Rationale: Objective 2 aims to assess and address the sources of pollution affecting the Ganga within Buxar's municipal limits by examining the city's liquid and solid waste management systems in an integrated manner. The central premise of this objective is that, at a minimum, the quality of water exiting the city should not be inferior to that entering it.

5.2.1. Existing Situation

Buxar currently discharges almost its entire wastewater load untreated into the Ganga through a network of major and minor drains. The city generates approximately 31.55 MLD of wastewater, primarily domestic, which flows through the Sone Canal, Police Canal (Mrityu Neher), and five other nalas. Water quality monitoring indicates high BOD, COD, and TSS levels, confirming severe organic pollution at drain outfalls and ritual ghats.

Only ~14.5% of households are connected to a sewer network, and no STP is operational. Most households rely on septic tanks that discharge into open drains, while scheduled desludging and faecal sludge treatment systems are largely absent. Mixed sewage–stormwater drains frequently overflow during monsoons, causing local flooding and pollutant accumulation.

Solid waste management shows relatively high collection efficiency but very low segregation and processing, with most waste disposed at the un-engineered Katkauli dumpsite or dumped informally along drains, ponds, and the riverbank. Together, untreated sewage, weak FSSM, and unscientific solid waste disposal create multiple pollution hotspots along the riverfront and nalas.

Pollution pressures are spatially concentrated at:

- Major drain outfalls (Sati Ghat, Tadka Drain, Police Canal)
- Ritual and cremation ghats (Ram Rekha, Sati, Shamshan Ghats)
- Low-lying settlements adjacent to nalas
- Katkauli dumpsite and informal dumping zones

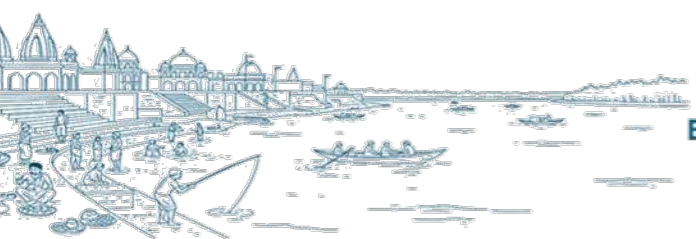
These locations are prioritised for intervention due to their direct impact on river water quality.

5.2.2. URMP Score

Dissolved Oxygen Score

The central premise of this indicator is that at the very least, the city should strive to ensure that the quality of water leaving the city is the same as that entering the city,

The URM score for **objective 2 – pollution free river** is **3/5**. indicates low to moderate performance across key pollution-related indicators, primarily due to the absence of operational STPs, limited sewer coverage, weak faecal sludge management, and inadequate scientific processing of solid waste. Although seasonal dilution maintains acceptable river water quality during parts of the year, persistent drain-based discharges and episodic pollution spikes at ghats constrain improvements in Net Dissolved Oxygen and overall river health.



5.2.3. Interventions

5.2.3.1. Intervention 2-1: Interim Faecal Sludge and Septage Management (FSSM) Strategy

This intervention proposes a citywide **interim FSSM system** to rapidly reduce sewage loads entering the Ganga while the sewerage network and STPs are under construction. The STPs of capacity 67 MD are expected to become operational by 2030. Recognising that large-scale sewerage and STP infrastructure will take time to become fully operational, the strategy prioritises **interim and parallel solutions**, such as Faecal Sludge and Septage Management (FSSM), decentralised treatment, and drain-level controls, to achieve immediate reductions in pollutant loads. These are complemented by medium- and long-term investments in treatment infrastructure, scientific solid waste processing, and legacy waste remediation to ensure sustained compliance with river water quality objectives.

Intervention	Responsible Agency	Intervention type
Interim Faecal Sludge and Septage Management (FSSM) Strategy	BUIDCO	Policy
Estimated Budget	Potential Funding Sources	Timeline
12–18 crore	SBM-U 2.0, NMCG, 15th Finance Commission, Bihar UD&HD	Short-term (1-2 years)

Approach



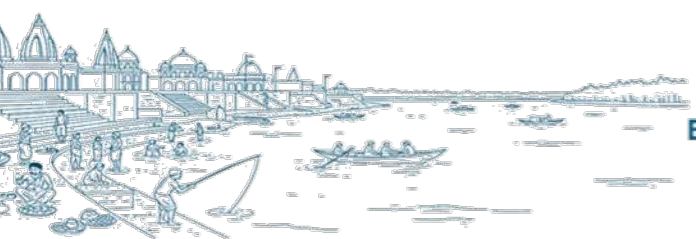
Step 1: FSTP Capacity

The first step of the strategy was to determine the amount of faecal waste being generated in Buxar. Using industry standards, it was calculated that for a city of 2lakh population, the wastewater and septage generation is equivalent to 126 KLD

Table 3: Wastewater and Septage generated in Buxar

Item	Formula	Result
Total sewage generation (MLD)	$2,00,000 \times 135 \times 0.8 \div 1,000,000$	21.6 MLD
Annual septage generation (m ³ /year)	$2,00,000 \times 0.23$	46,000 m ³ /year
Average daily septage (KLD)	$46,000 \div 365$	≈ 126 KLD

Based on this it was determined that there is a need of 2–3 50 to 100 KLD modular Faecal Sludge Treatment Plants. To ensure integration of FSTPs with the upcoming STPs, co-treatment approach would be taken



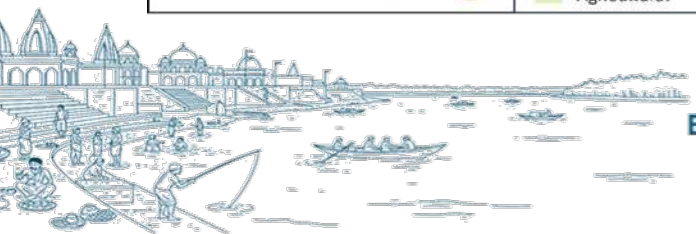
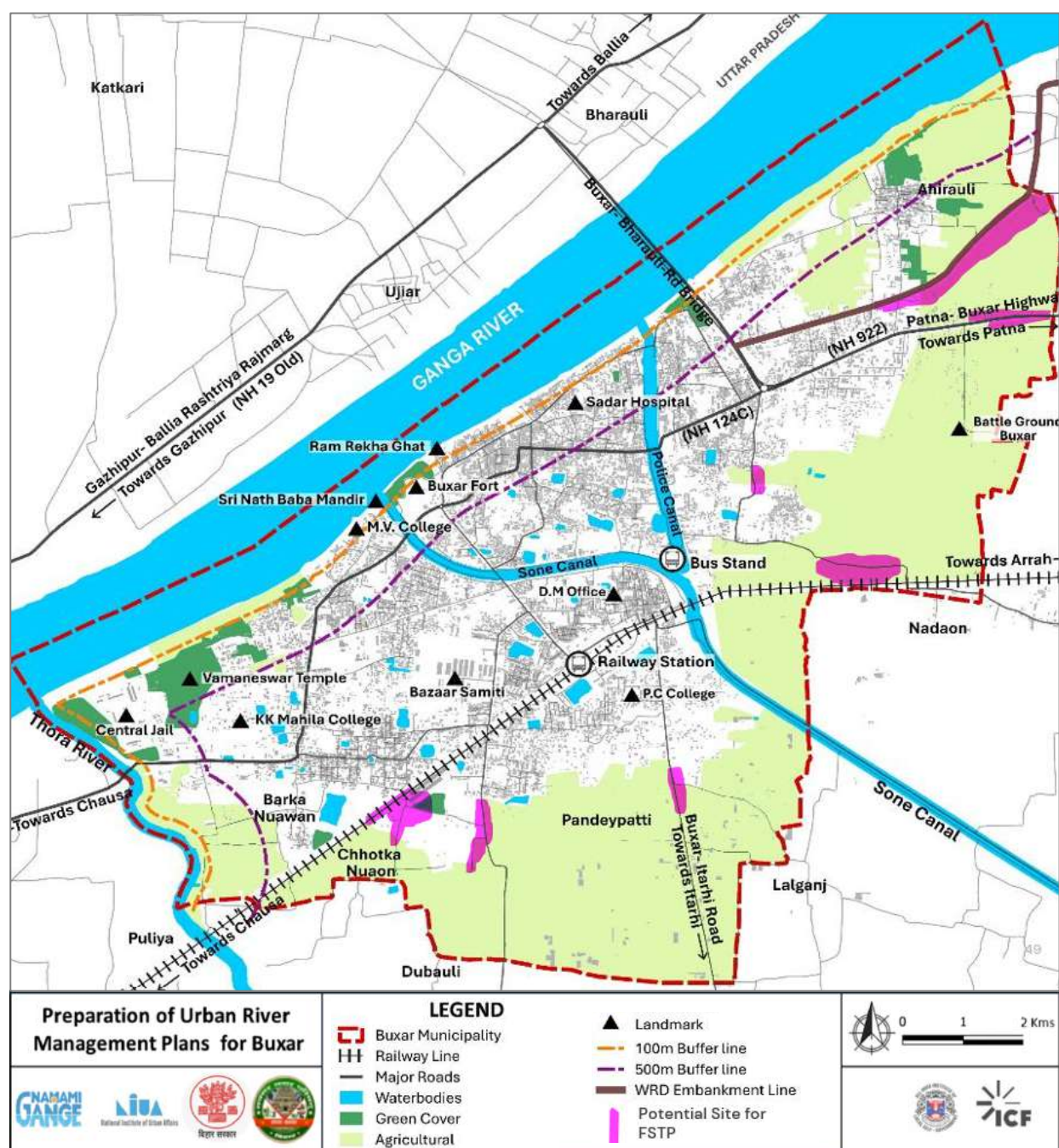
Step 2: Location of FSTP

As a co-treatment model should be adopted, the location of the FSTPs would be where the upcoming STPs are located. In case that area is inadequate or a larger area for the FSTPs is required, a scientifically guided site selection should be done as suggested:

Step 2a) Identify FSTP locations using **GIS-based multi-layer analysis**, overlaying Water bodies and drainage networks, Digital Elevation Model (DEM) and sub-basins and Built-up areas and road accessibility.

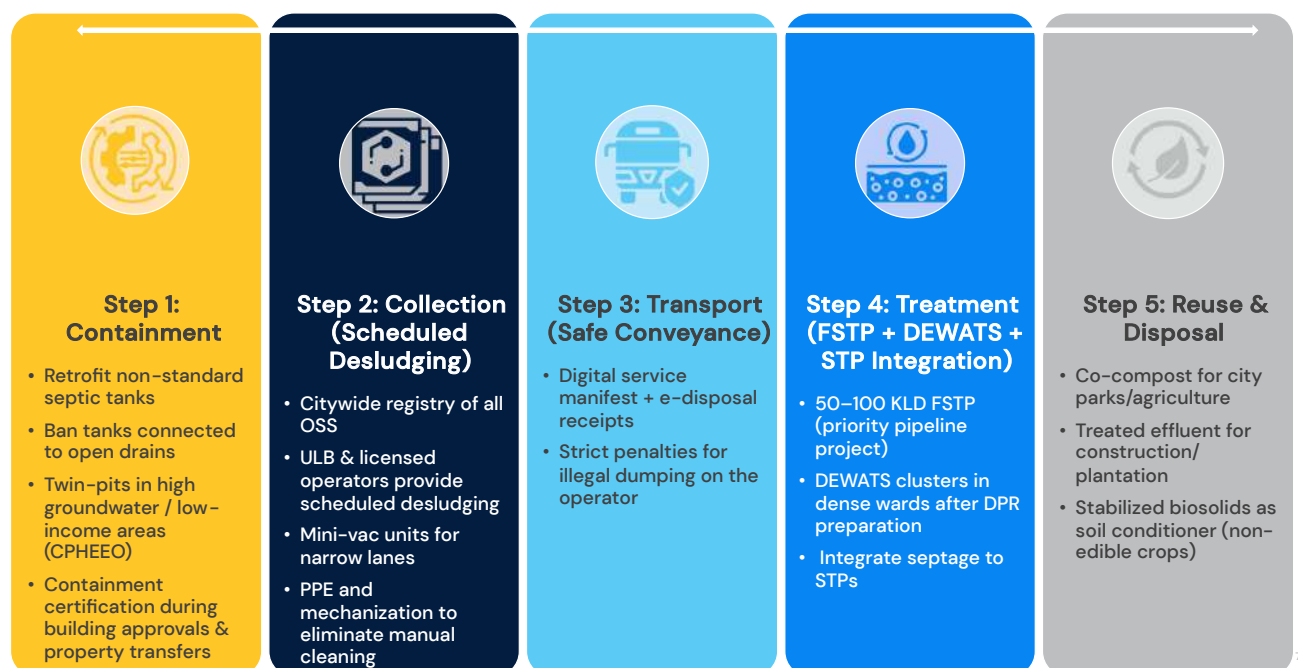
Step 2b) Apply site selection criteria: Non-flood-prone, elevated land, Away from dense residential zones, Near arterial roads for desludging vehicle access, Preference for government-owned land to reduce implementation delays. Based on this site selection, a few sites in Buxar were selected.

Map 7: Sites Identified for locating the FSTPs



Once the FSTP locations are identified, the end-to-end value chain of Buxar's faecal sludge management needs to be improved along the following principles:

Figure 10: End to end value chain of the FSSM Strategy



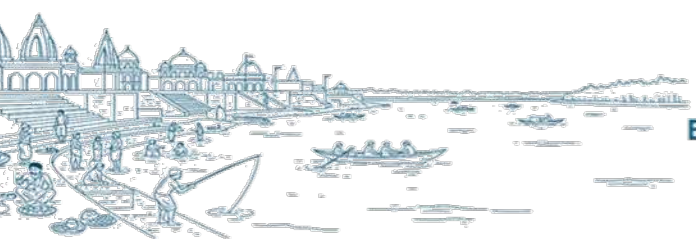
- Enforcement of **safe containment standards** (BIS/IS 2470 compliant septic tanks) and elimination of direct septic overflow into drains.
- Introduction of **mandatory scheduled desludging** (every 3–5 years), coordinated by the Nagar Parishad through licensed operators.
- Creation of a **citywide OSS registry** and desludging schedule managed by Nagar Parishad
- Deployment of **mini-vacuum desludging vehicles** to serve narrow lanes and dense core wards.
- Safe transport, treatment, and regulated reuse/disposal of treated sludge (co-compost, soil conditioner for non-food uses).

Cost Estimate

The cost estimate of ₹12–18 crore covers GIS-based site selection for 2–3 modular FSTPs (50–100 KLD each, ₹4–6 crore total), procurement of 4–6 mini-vacuum desludging vehicles (₹2–3 crore), OSS registry and desludging scheduling software (₹1–2 crore), enforcement of BIS-compliant septic tanks through bye-laws and IEC (₹2 crore), and 3-year O&M including co-treatment integration with upcoming 67 MLD STPs. This aligns with SBM-U benchmarks for small cities (₹3–5 crore per 100 KLD FSTP + ₹40–50 lakh per desludging vehicle) and NMCG FSSM pilots.

5.2.3.2. Intervention 2-2: River Health Monitoring and Public Reporting System

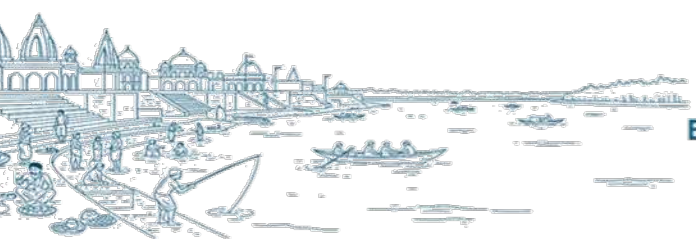
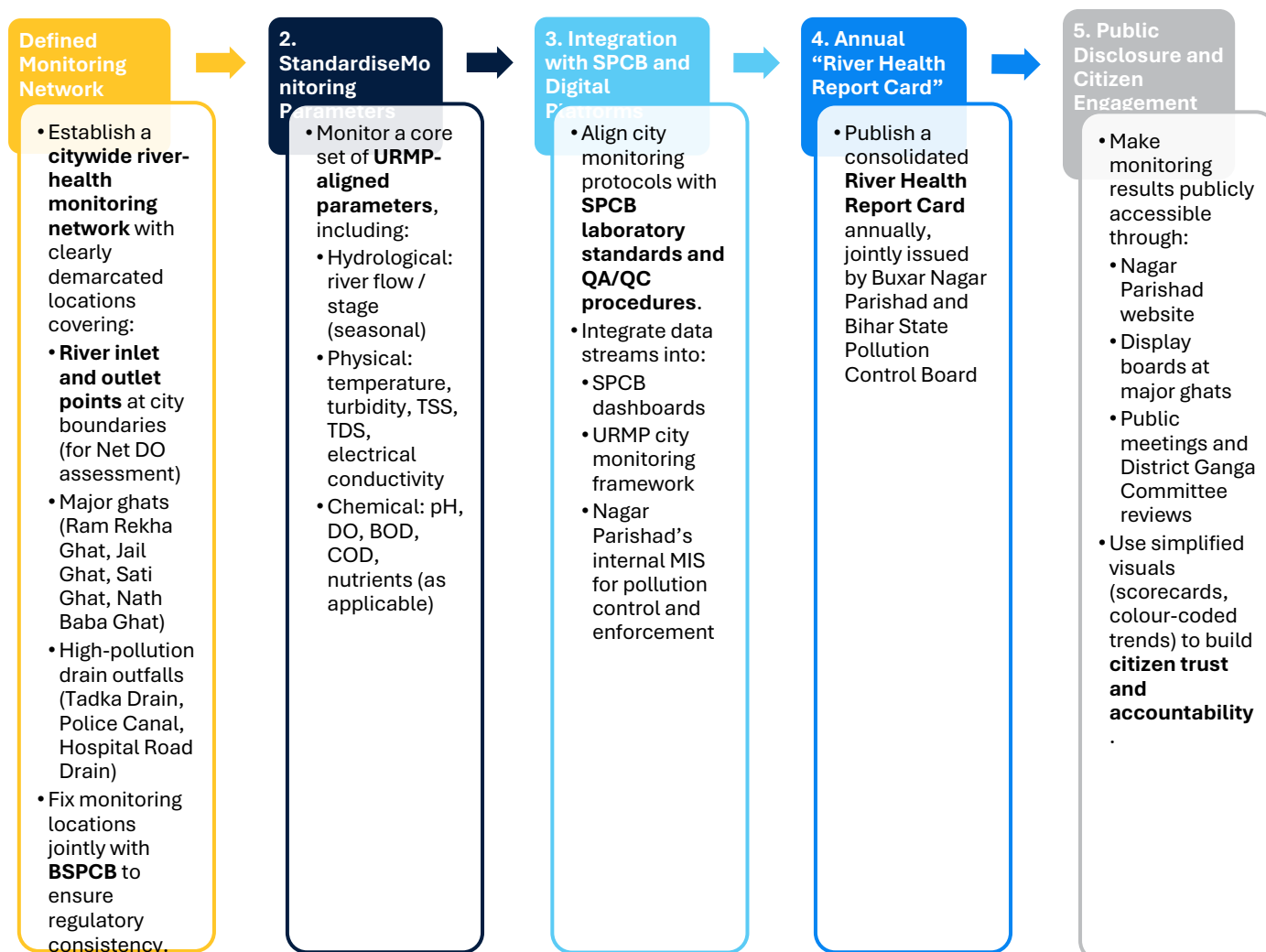
This intervention recommends **Institutionalising a robust, transparent, and repeatable river-health monitoring system for Buxar that enables evidence-based decision-making, strengthens regulatory enforcement, and tracks long-term improvements in river water quality through an annual River Health Report Card.**



Water quality monitoring in Buxar is currently **fragmented, infrequent, and agency-driven**, with limited integration into city-level planning and decision-making. Existing SPCB datasets are not systematically translated into actionable indicators for the ULB or communicated to citizens. Absence of a consolidated monitoring framework weakens enforcement, delays corrective actions at pollution hotspots, and limits the city's ability to demonstrate improvement under URMP **indicators**, particularly Net Dissolved Oxygen, Water Quality, and Eco-friendly Riverfront scores

Intervention	Responsible Agency	Intervention type
River Health Monitoring and Public Reporting System	Buxar Nagar Parishad	Institutional
Estimated Budget	Potential Funding Sources	Timeline
75 Lakh	Nagar Parishad	1-2 years

Key Strategy Components:



5.2.3.3. Intervention 2-3: Scientific Solid Waste Management and Legacy Dumpsite Remediation

This intervention focuses on eliminating solid waste–related pollution pathways that directly and indirectly affect the Ganga by transitioning Buxar from unscientific dumping to a scientifically managed, regional solid waste management system. It addresses two critical challenges: (i) remediation and closure of the existing Katkauli dumpsite, which currently acts as a persistent non–point pollution source, and (ii) scaling up scientific waste processing capacity to reduce the volume of waste reaching landfills, drains, nalas, and the riverfront.

Solid waste pollution in Buxar contributes to river degradation through leachate runoff from the Katkauli dumpsite, direct dumping along nalas and ghats, and blockage of drains that leads to wastewater stagnation and overflow during monsoons. Without systematic remediation and processing infrastructure, gains achieved through wastewater and FSSM interventions risk being undermined.

Intervention	Responsible Agency	Intervention type
Scientific Solid Waste Management and Legacy Dumpsite Remediation	Buxar Nagar Parishad (Lead); BUIDCO (Technical Support); BSPCB (Regulatory Oversight); District Administration (Land & Enforcement)	Project
Estimated Budget	Potential Funding Sources	Timeline
INR 55–75 crore	SBM–U 2.0; 15th Finance Commission Tied Grants; State Urban Development Funds; NMCG	Medium– to Long-term (3–5 years)

Key Strategy Components

a. Biomining and Closure of Katkauli Dumpsite

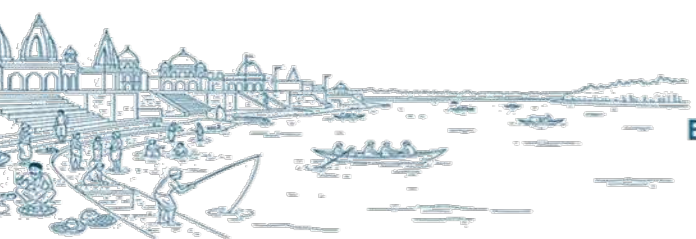
The existing Katkauli dumpsite, with an estimated legacy waste stock of nearly 40,000 tonnes, shall be remediated through biomining and bioremediation techniques. This includes excavation, mechanical segregation, recovery of recyclables and RDF, scientific disposal of inert rejects, and stabilization of the site with soil cover and vegetation. Post-remediation, the site shall be closed in accordance with CPCB guidelines and repurposed as a green buffer or non-sensitive urban use, ensuring zero leachate runoff into nearby drains and water bodies.

b. Development of a Regional Scientific Waste Management Facility

A new regional solid waste management facility shall be developed outside dense urban areas, incorporating:

- Material Recovery Facilities (MRFs) for dry waste,
- Composting and/or biomethanation units for wet waste,
- Engineered landfill cells restricted only to inert and process rejects,
- Leachate collection and treatment systems, weighbridges, and internal access infrastructure.

This regional approach reduces pressure on urban land, improves operational efficiency, and ensures long-term environmental compliance.



c. Scaling Scientific Processing Capacity to ≥60%

Processing capacity in Buxar shall be scaled to achieve at least 60% scientific processing of municipal solid waste through:

- Expansion of centralized composting/biomethanation capacity,
- Decentralized processing units near markets, ghats, and high-waste-generation zones,
- Strengthened dry waste aggregation and recycling linkages,
- Reduction of landfill dependency to below 40% of total waste generated.

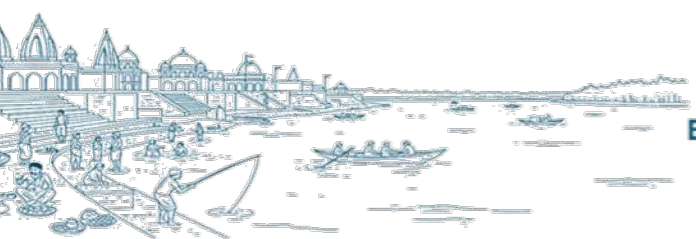
d. Strengthening Source Segregation and Collection Systems

The intervention reinforces segregation at source through bye-law enforcement, improved IEC campaigns, and integration of collection contracts with segregation-linked performance indicators. Special emphasis shall be placed on ghat areas, riverfront zones, and festival periods, where waste loads are seasonal but environmentally sensitive.

e. Drain, Nala, and Riverfront Protection Measures (Expanded in intervention 3-3: Eco Nallahs)

To prevent solid waste from entering waterways, the intervention includes:

- Installation of trash traps and waste booms at major nalas,
- Regular mechanical desilting and drain cleaning schedules,
- Dedicated ghat-level waste collection and ritual waste management systems,
- Enforcement against informal dumping along riverbanks and floodplains.



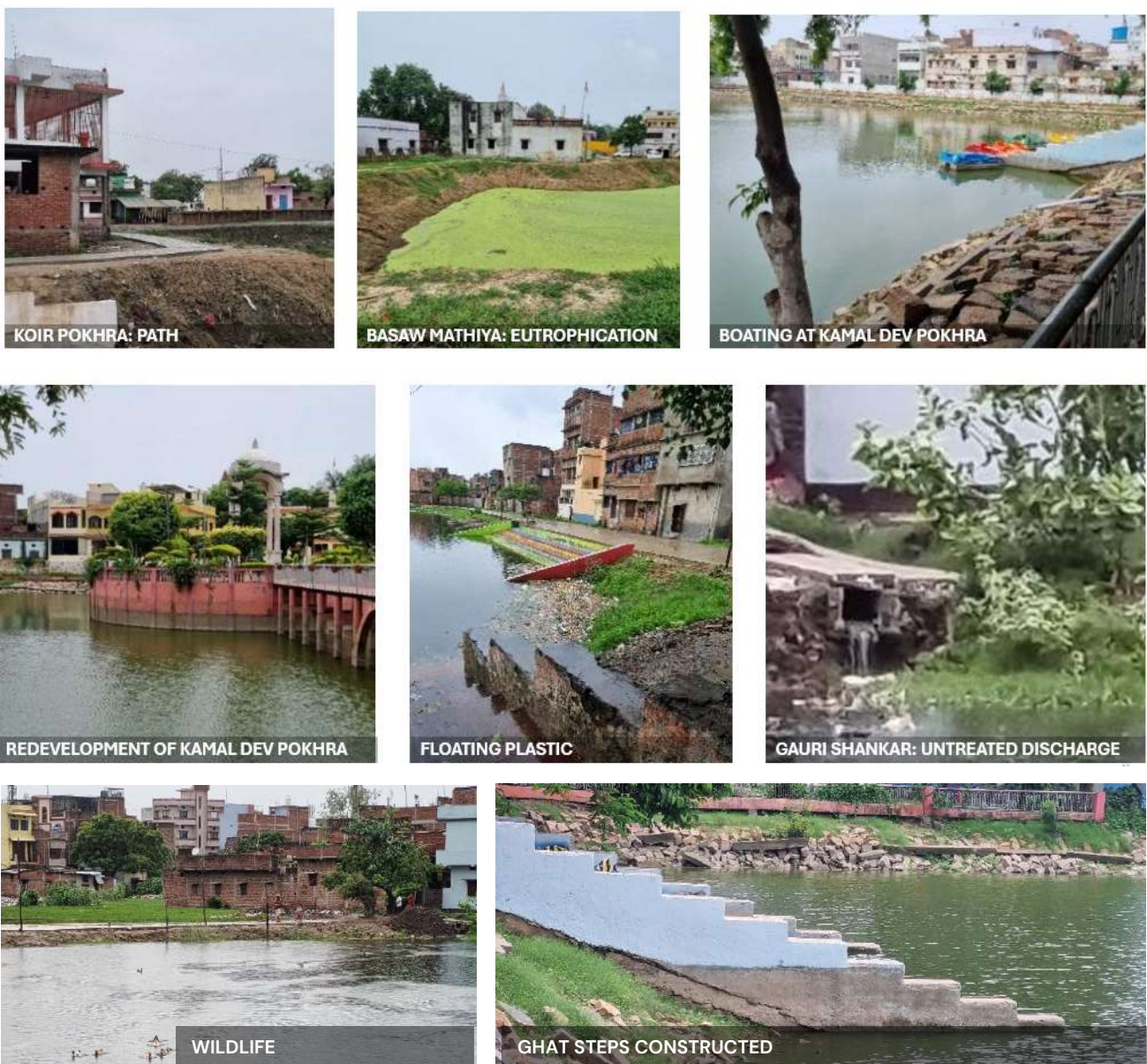
5.3.Objective 3: Rejuvenation Of Waterbodies and Wetlands in The City

Rationale: Objective 3 focuses on restoring the ecological, hydrological, and social functions of inland waterbodies in Buxar. The baseline assessment indicates that while the city has a dense network of ponds and canals with significant latent storage and recharge potential, over 60% are degraded due to siltation, sewage inflows, solid waste dumping, encroachments, and damaged inlet–outlet structures. **The proposed interventions fall under both Objective 3 and 6. They adopt a system-wide approach, combining data-driven prioritisation, physical rejuvenation using nature-based solutions, and community stewardship.**

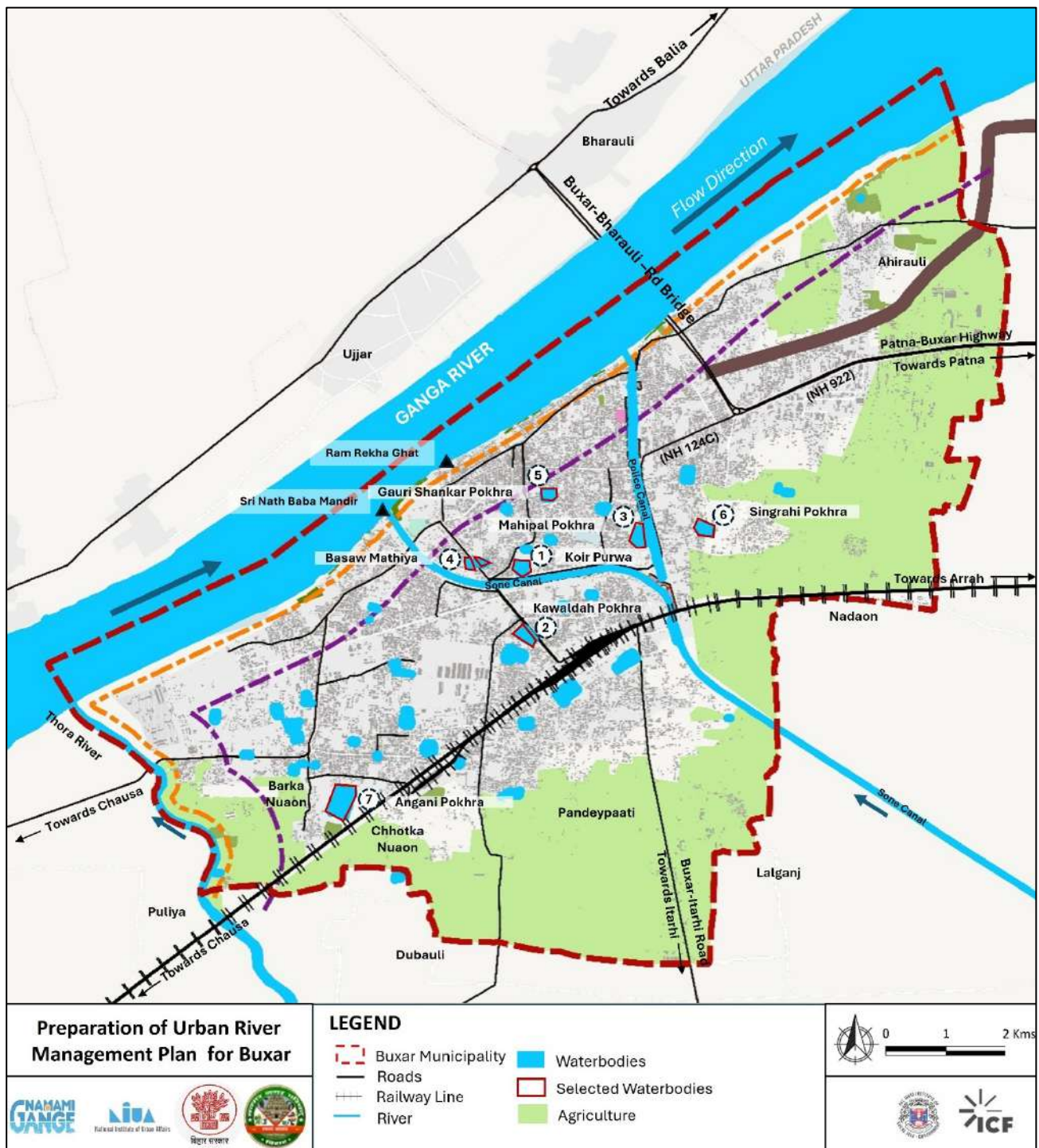
5.3.1. Existing Situation

Buxar city has network of inland waterbodies comprising of mostly natural and semi-engineered ponds and canals. These waterbodies remain closely linked to the health of the Ganga through surface drainage and groundwater interactions.

Figure 11: Existing Conditions of Waterbodies in Buxar

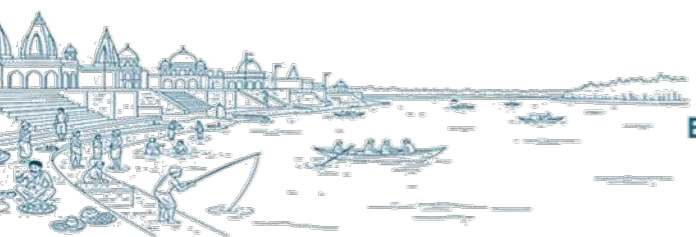


Map 8: Major Water Bodies and Canals in Buxar



Source: AILSG & ICF Analysis

Functionally, most urban ponds in Buxar support domestic activities such as bathing, washing, and livestock care, while others are used for informal aquaculture and pisciculture. During religious festivals such as Chhath Puja and local melas, waterbodies become important ritual spaces for bathing, idol immersion, and congregational activities. In addition, many ponds historically functioned as local stormwater detention areas, temporarily storing runoff during monsoon periods and thereby reducing surface flooding in surrounding wards.



From a hydrological perspective, these waterbodies represent a significant but underutilised asset. Based on the Water Census 2024 and field validation, Buxar's waterbodies have an average water spread area of approximately 6,800 m², with estimated original storage capacities exceeding 4,000 m³ in several cases. This indicates substantial latent potential for flood buffering, groundwater recharge, and microclimatic regulation.

Ownership and management responsibilities are fragmented. Most ponds fall under the jurisdiction of the Nagar Parishad or private ownership, with limited involvement of specialised agencies except in select cases. For example, recreational boating and park development at Kamal Dev Pokhra are managed by the Forest Department, which also retains revenue rights. This fragmented institutional arrangement affects consistency in maintenance, enforcement, and long-term planning.

5.3.1.1. Condition of Waterbodies and Key Gaps

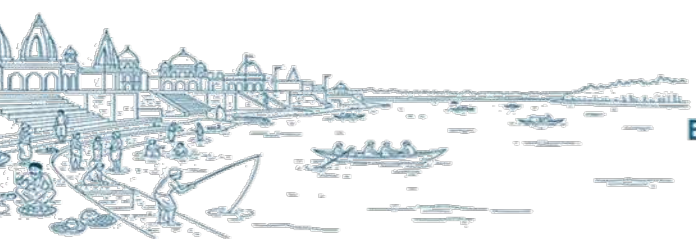
A detailed inventory of seven major waterbodies, selected from an initial list of 25 identified in the Water Census reveals a mixed and uneven condition across the city. Only three of the assessed waterbodies were found to be in an “acceptable” condition based on URMP qualitative parameters. These typically exhibit intact boundaries, limited sewage inflow, and ongoing use for recreation or pisciculture.

Over 60% of assessed ponds show clear signs of degradation. Common issues include visible solid waste accumulation, untreated wastewater inflows from nearby households, broken or incomplete boundary protection, and varying degrees of eutrophication. Several ponds exhibit excessive aquatic weed growth and algal blooms, indicating high nutrient loading. Siltation is a widespread concern, with an estimated annual accumulation of 10–15 cm of silt in many ponds. More than 65% of waterbodies face some form of encroachment along their edges, resulting in an estimated 15–20% loss in effective water spread area over time. Untreated sewage and solid waste discharge continue in a majority of ponds due to gaps in sanitation infrastructure and weak enforcement. Interception and diversion mechanisms are largely absent.

5.3.1.2. Urban Drains

Buxar currently discharges approximately 31.55 MLD of untreated municipal wastewater (of which 21 MLD is untreated sewage) into the Ganga through seven major urban drains, making these drains the city's primary pollution conduits. Measured BOD levels frequently exceed 60 mg/L, far above CPCB discharge norms (≤ 30 mg/L), indicating severe organic loading. Most drains are unlined, encroached, and poorly graded, resulting in stagnant pools, reduced conveyance capacity, and foul conditions.

Figure 12: Solid waste Dumping Observed in Ponds and Drains



5.3.2. URMP Score

Water body revival score

Based on the URM Index's Waterbody Revival Scorecard, Buxar achieves a waterbody revival score of 3 (60%, with 3/5 assessed waterbodies meeting the minimum criteria for "acceptable" condition). This score reflects partial compliance with qualitative indicators such as absence of solid waste, limited sewage inflow, boundary protection, and dissolved oxygen levels based on visual and proxy assessments.

5.3.3. Interventions

5.3.3.1. Intervention 3-1: Establish a GIS-Based Inventory and Water Quality Monitoring System

This intervention recommends the **creation of a city-wide GIS-based inventory and monitoring system** for all waterbodies within Buxar Nagar Parishad. The objective is to move from ad-hoc, reactive action to evidence-based planning and prioritisation of rejuvenation investments.

Intervention	Responsible Agency	Intervention type
GIS-based waterbody inventory and monitoring system	Buxar Nagar Parishad (Lead), WRD Bihar (Support)	Project
Estimated Budget	Potential Funding Sources	Timeline
~ ₹40–60 lakh ^{4,5,6,7} *	State Urban Planning Funds, NMCG technical assistance	Short-term (1–2 years)

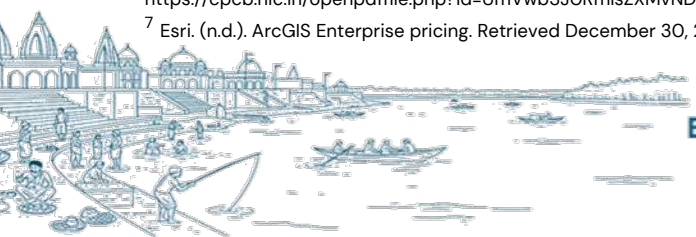
*If integrated with NIUA's Urban Water Body Diagnostic Tool, the cost would decrease drastically.

⁴ Ministry of Housing and Urban Affairs. (2021). Advisory on water supply and continuous services [PDF]. Retrieved from <https://mohua.gov.in/pdf/61d5760deef6fAdvisory-water-supply.pdf>

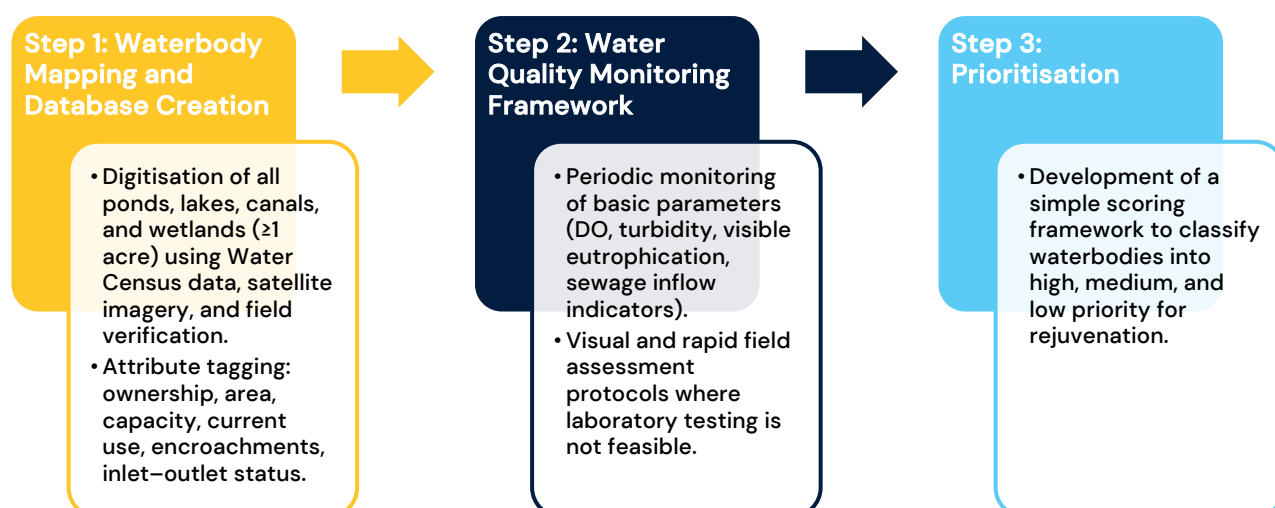
⁵ Directorate of Town and Country Planning, Government of Chhattisgarh. (2025). National Urban Information System (NUIS) guidelines [PDF]. Retrieved from <https://tcp.cg.gov.in/nuis/guidelines.pdf>

⁶ Central Pollution Control Board. Retrieved from <https://cpcb.nic.in/openpdf.php?id=UmVwb3JORmlsZXNmNDU5XzEIMDIxNjk5ODdfbWVkaWFwaG90bzI3OTAzLnBkZg%3D%3D>

⁷ Esri. (n.d.). ArcGIS Enterprise pricing. Retrieved December 30, 2025, from <https://www.esri.com/en-us/arcgis/products/arcgis-enterprise/pricing>



Key Components



5.3.3.2. Intervention 3–2: Prepare and Implement Rejuvenation Plans for Priority Waterbodies

This intervention recommends preparing **site-specific rejuvenation plans** for priority waterbodies, focusing on restoring storage capacity, improving water quality, preventing further pollution, and enhancing public usability. The approach builds on ongoing efforts under Namami Gange and recent city-led initiatives, scaling them into a structured program.

Intervention	Responsible Agency	Intervention type
Rejuvenation of priority waterbodies	Buxar Nagar Parishad (Lead), WRD Bihar (Support)	Project
Estimated Budget	Potential Funding Sources	Timeline
Rs ~ 65 Lakh A detailed break up of cost is given in Annexure 3.1	Namami Gange, Jal Jeevan Hariyali Mission, Forest Department	Medium-term (3–5 years)

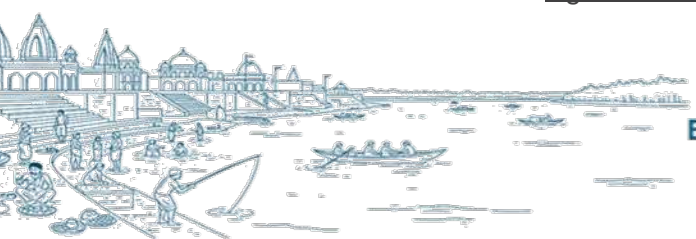
5.3.3.3. Illustrative Example: Rejuvenation of Koir Purwa Pokhra

Context and Existing Condition

Koir Purwa Pokhra is a partially developed but poorly maintained urban pond with a total plot area of approximately 1.91 acres (8,087 sqm), with an existing water spread of about 6,077 sqm. The pond is primarily used for local religious rituals and community events, making it socially significant despite its degraded ecological condition. The primary reason is a Mandir, located at the edge of the pond. Although the pond was renovated in 2022, the absence of a structured maintenance mechanism has resulted in renewed degradation.

The pond is affected by siltation, direct inflow of untreated greywater, and regular dumping of solid waste. Encroachments along the southern and western edges have reduced effective water spread and constrained access. The absence of fencing or gated entry points allows unrestricted use and misuse. While the Sone Canal lies in proximity, there is currently no functional hydrological linkage.

Figure 13: Existing Situation of Koir Purwa

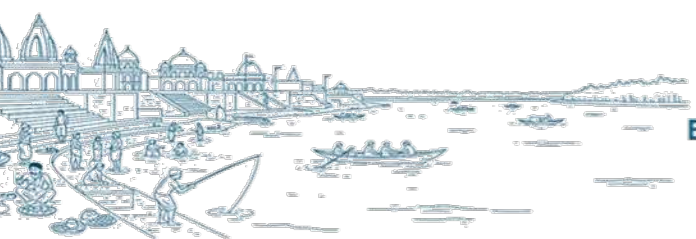




Rejuvenation Strategy

The proposed rejuvenation approach for Koir Purwa Pokhra demonstrates the application of nature-based solutions combined with basic urban design interventions, aligned with the broader URMP framework. The proposed strategy involves diverting untreated sewage desilting, inlet repairs, and implementing nature-based treatments to transform waterbodies into accessible recreational spaces with promenades and community amenities.

Figure 14: Concept Design for the Rejuvenation of Koir Purwa

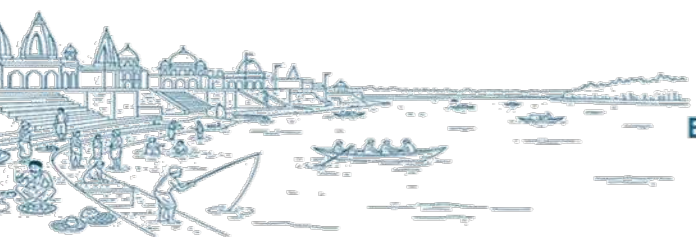




Source: AILSG & ICF Analysis

Key elements of the strategy include:

1. Physically marking boundaries using green, low-impact edges and limiting entry points.
2. Interception chambers would be installed at inlet points to divert greywater away from the pond. Where continuous flows exist, decentralized pre-treatment systems such as planted gravel filters would be introduced. Physical trash traps near outlets and road-facing edges, combined with signage and penalties, would address solid waste dumping.
3. Desilting the pond-bed and creating shallow zones (for macrophytes) and deeper refuge zones (for water retention in summer).
4. Installing constructed wetland edges and floating treatment wetlands (FTWs) for phytoremediation. Ensure planting of native species (e.g., Typha, Phragmites, Vetiver).
5. Creating reed beds along embankments to filter runoff.
6. Providing basic infrastructure: Lighting, Seating, Waste bins and Collection points for flowers and puja waste (near the mandir ghat steps). Have signages and penalties for littering.



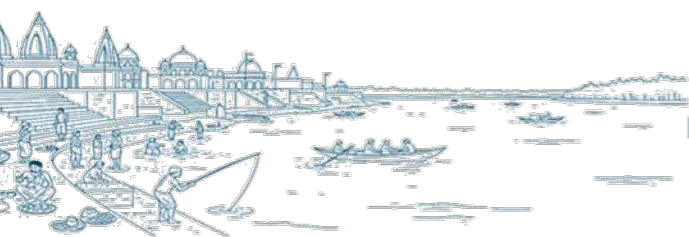
7. Creating a Boardwalk and defined paths around the pond to enable controlled community access without disturbing ecological zones.
8. Installing two aerators to increase dissolved oxygen.

Figure 15: Reimagined Koir Purwa after the design interventions



Outcome and Replicability

The Koir Purwa Pokhra example illustrates how moderately sized urban ponds in Buxar can be transformed into multi-functional blue-green assets that support water quality improvement, flood buffering, and community use. Importantly, the intervention relies on low-cost, locally maintainable measures rather than heavy civil construction. The approach is replicable across other priority ponds such as Mahipal Pokhra and Basaw Mathiya, with site-specific adjustments based on hydrology, land ownership, and community use patterns.



5.3.3.4. Intervention 3-3: Development of Eco-Nalas

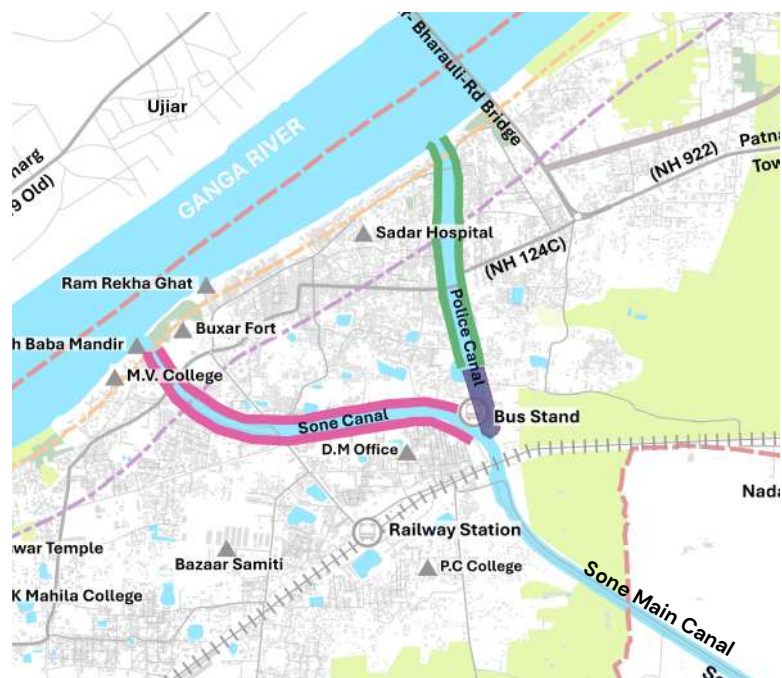
This intervention proposes transforming Buxar's major drains i.e. Sone Canal and Police (Dead) Canal **into Eco-Nalas or hybrid blue-green infrastructure corridors** that intercept, treat and moderate the urban discharge before it enters the Ganga. The approach integrates wastewater treatment, stormwater management, flood resilience, and ecological restoration, directly strengthening the quality of return flows. Unlike conventional drain beautification projects, Eco-Nalas are proposed as functional environmental infrastructure, and not just as aesthetic add-ons.

Intervention	Responsible Agency	Intervention type
Development of Eco-Nalas	Nagar Parishad Buxar (Lead), WRD Bihar	Project
Estimated Budget	Potential Funding Sources	Timeline
₹25–40 crore* A detailed breakup is given in Annexure 3.3	NMCG	Medium-term (3–5 years)

Background

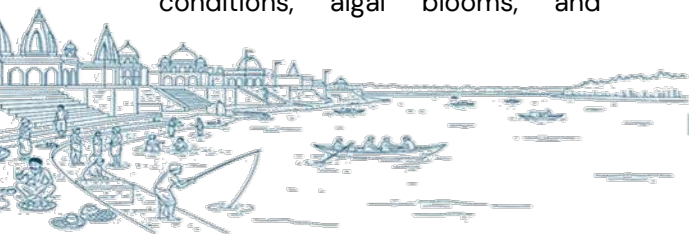
Historically, the Sone Canal and Police Canal functioned as natural irrigation channels, originating as a single canal, the Sone Main Canal, that bifurcates at the bus stop area. These two drains are the primary convergence channels for natural drains that could not discharge directly into the Ganga due to elevation constraints. The bifurcation zone, located beneath a bridge where the main Sone Canal divides into the Sone and Police canals, is currently used as an informal dumping area but offers sufficient spatial capacity for implementing NbS like constructed wetlands.

Map 9: Sone and Police Canal



In recent years, urban development around the bifurcation point have significantly reduced flows into the Police (Dead) Canal. The channel now carries limited water, characterized by stagnant conditions, algal blooms, and

Figure 16: Reduced flow to Police Canal due to Encroachments



eutrophication, with increased volumes only during the monsoon.

In contrast, the Sone Canal retains visible flow throughout the year. It has a U-shaped cross-sectional profile, and conveys comparatively higher volumes, and discharges into the Ganga near Nath Baba Mandir through an engineered canal system with locks, originally designed for boat movement. The canal edges near the mandir include a degraded park and ghat steps.

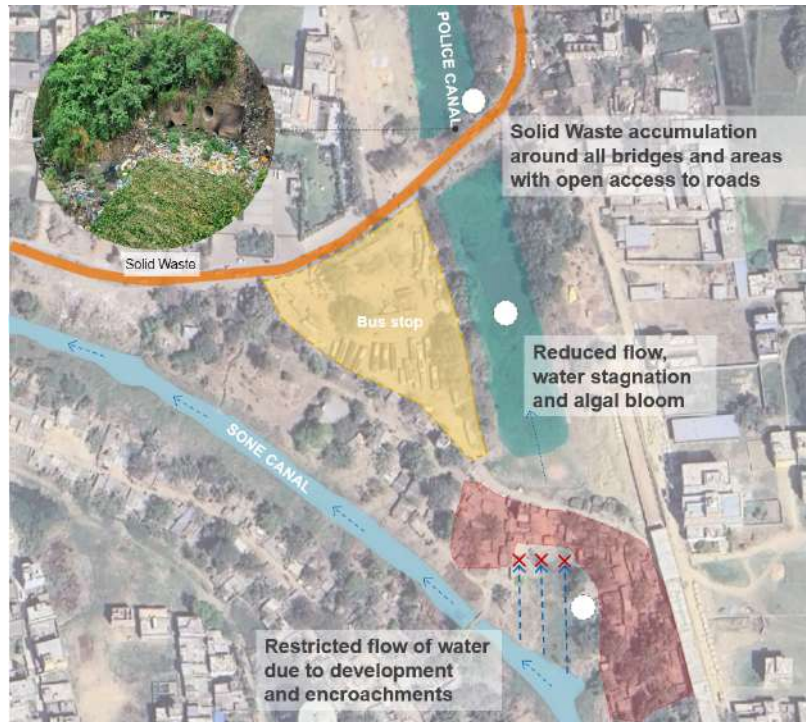


Figure 17: Major canals at various points in the city



Police Canal near the Bus Stop



Police Canal entering the Ganga



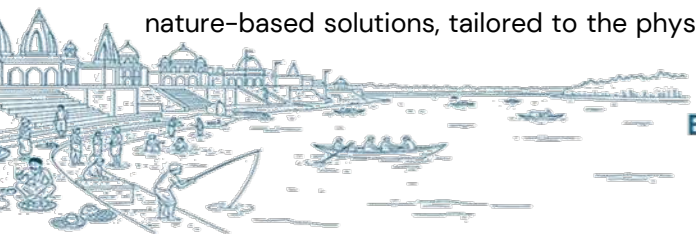
Sone Canal near the Bus Stop



Sone Canal with Encroachments on its channel

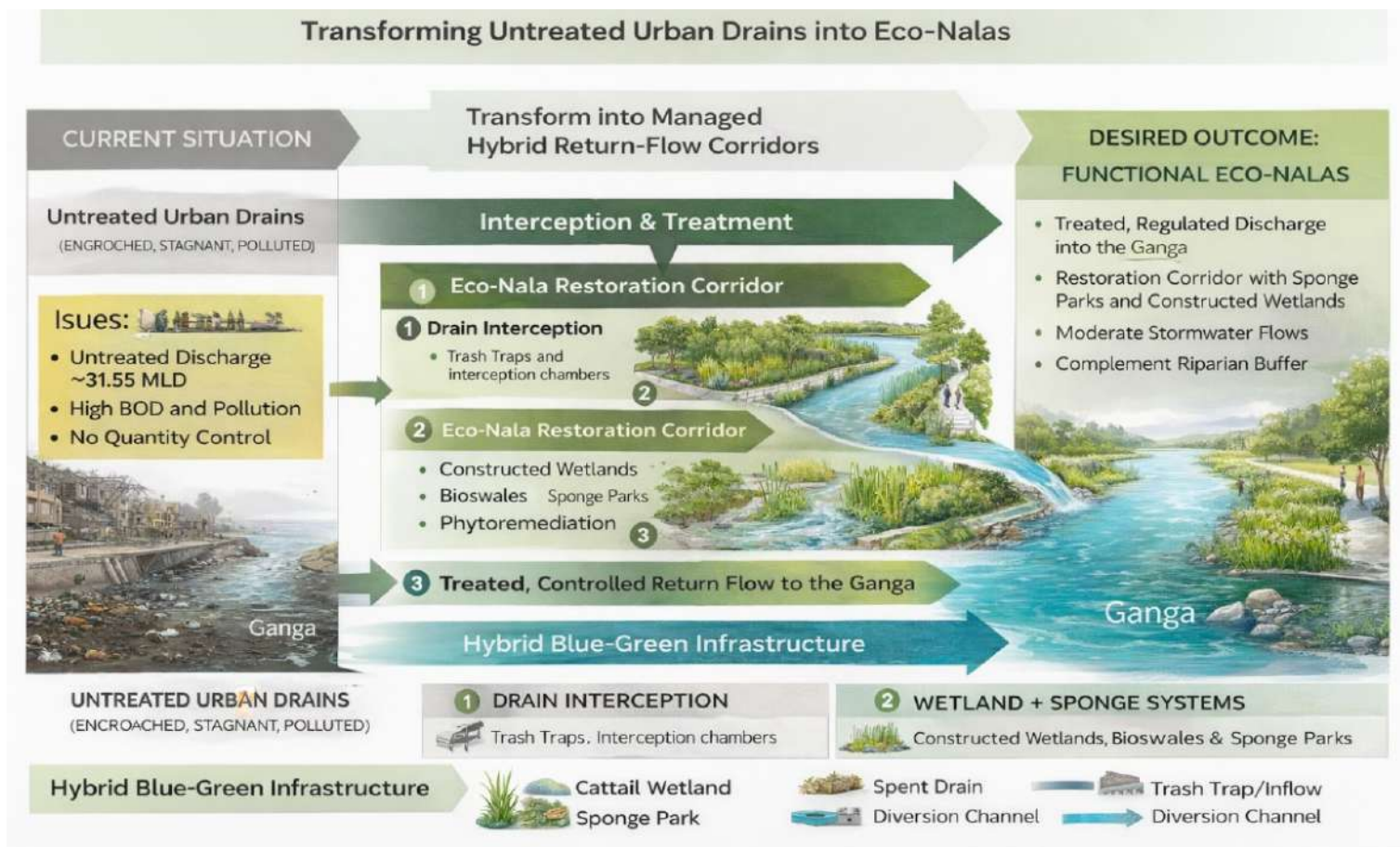
Approach:

Eco-Nalas are proposed to be developed through canal-based treatment systems, bioremediation, and nature-based solutions, tailored to the physical characteristics of the location (Sone Canal, Police Canal



and bifurcation point at the bus stop). The core principle behind this intervention is to treat wastewater as close to the source as possible. It aims to improve the quality of the discharge before it enters the river while linking drain management to the restoration of floodplains and riparian buffers.

Figure 18: Proposed Urban Water Balance Diagram



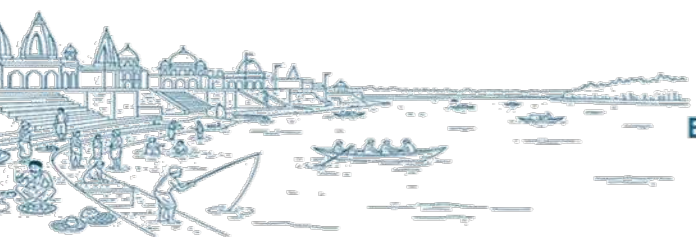
Location-Specific Strategies

The central drainage system of Buxar is proposed to be rejuvenated in three interlinked parts—Bus Stop Area, Sone Canal, and Police Canal—each performing a distinct but complementary hydraulic, treatment, and ecological function within a single integrated Eco-Nala system

1. Bus Stop Area (Drain Outfall Zone)

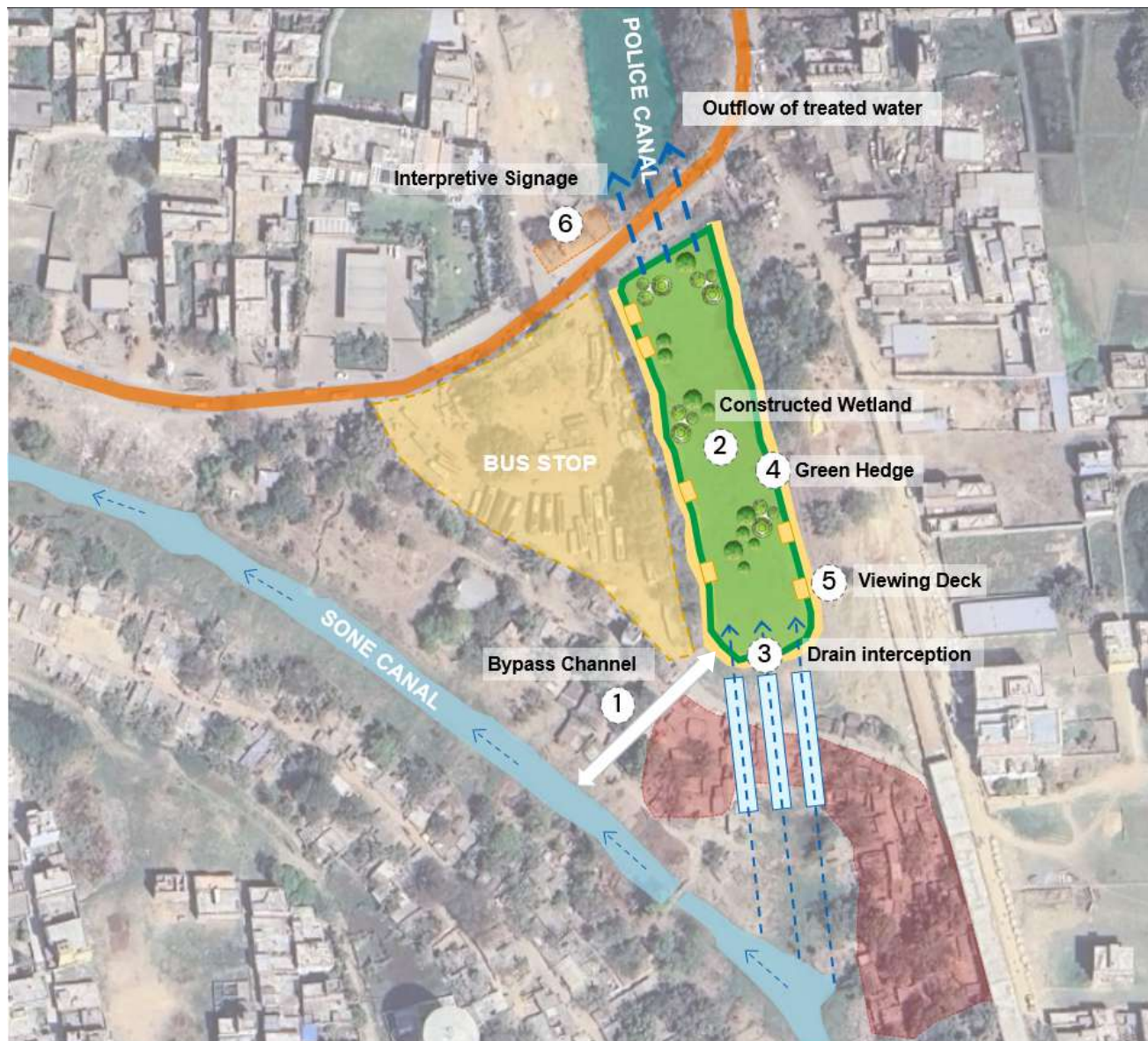
Originally, the Sone and Police canals functioned as an integrated hydraulic balancing system, with the Police Canal serving as a secondary arm that absorbed excess runoff during high-flow events in the Sone Canal. Over time, encroachments and unplanned development at the bus stand junction severed this connection, blocking inlet points to the Police Canal. As a result, the channel was deprived of regular inflows, leading to stagnant conditions, progressive ecological degradation, and its local characterization as the “Mrityu” or “Dead” Canal.

The central strategy of this intervention is to re-establish the hydraulic connectivity between the Sone and Police canals, restoring controlled inlet supply to the Police Canal. This would reinstate its original balancing function, enabling flow recovery, water-quality improvement, and long-term ecological rejuvenation.



This is proposed to be achieved through a **constructed wetland** at the bifurcation point between the 2 nalas, supported by upstream interception chambers and trash traps to remove plastics, cloth, and other floating waste. The area selected is currently part of the police nala and is owned by the ULB.

Figure 19: Proposed Design for the Bus Stop Area



To enhance monsoon resilience, a southern bypass channel and controlled valves would be provided to safely divert excess flows during extreme rainfall events. The canal edges are designed as soft, accessible, and safe interfaces using native hedges, bamboo railings, and earth berms, reducing erosion while improving visual and ecological quality. Public engagement would be integrated through walkways, viewing decks, and interpretive signage, enabling residents to understand and appreciate nature-based wastewater treatment processes while reinforcing the Eco-Nala's role as functional environmental infrastructure rather than a purely aesthetic intervention.

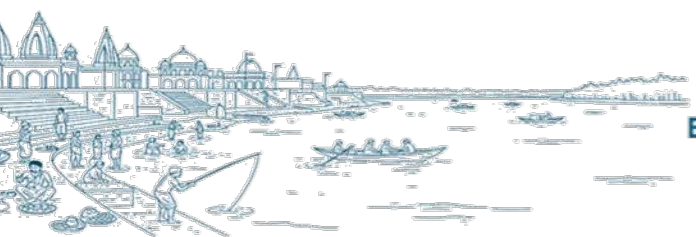


Figure 20: Reimagined Bus Stop after the Design Interventions

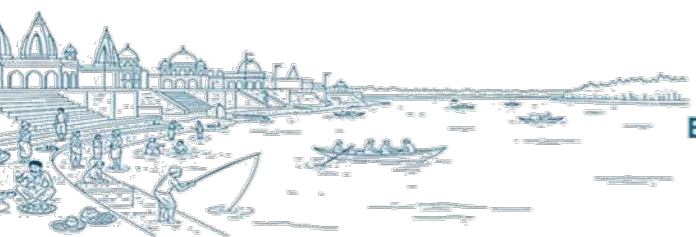
A: View of the proposed construction Wetland under the bridge



Before – Existing Drain



After – Eco-Nala with Constructed Wetland



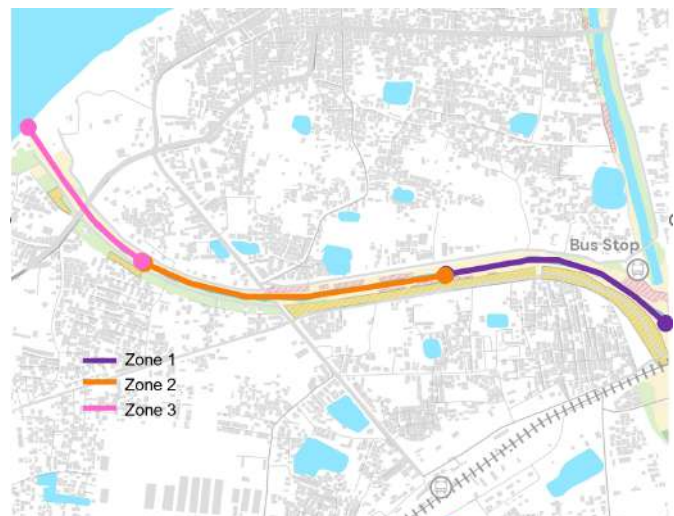
B: Views of the Linear Sponge Park on Police Canal connected to the Bus Stop



2. Sone Canal Corridor

The Sone Canal corridor is proposed to be redeveloped as a high-capacity Eco-Nala. Interventions would be divided into three zones. The project would prioritize removal of encroachments and demarcation of the existing natural buffer through soft landscaping to re-establish the canal's floodplain function. The canal would be desilted and de-sludged to restore flow capacity. Vegetated banks, phytoremediation belts, and floating wetlands would be introduced to improve water quality, supported by trash traps with defined collection and maintenance protocols. Low-impact recreational elements like benches would be integrated to activate the corridor while avoiding hardscaping.

Figure 21: Sone Canal Corridor Divided into 3 zones

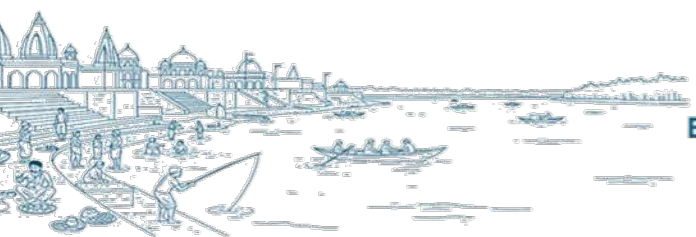


Map 10: Sone Canal Sponge Park: Zone 1- Up-stream: cleanup and flow restoration



Zone 1 would focus on restoring basic flow and environmental function through targeted de-silting and solid waste removal. Mechanical operations would remove accumulated sludge, plastic waste, and construction debris to re-establish channel capacity, while manual cleaning would be undertaken at critical locations such as bridges, culverts, and drain outfalls where waste accumulation is typically highest. All removed material would be segregated and disposed of in accordance with environmental and municipal solid waste management guidelines.

To prevent re-contamination, the zone would incorporate solid waste and drain management measures, including the installation of trash traps and interceptor structures at upstream drains and outfalls. These devices would capture floating debris and coarse solids before they enter the nala, enabling routine maintenance and reducing downstream pollution. Together, de-silting and interception would create a clean, controlled baseline condition for subsequent ecological and treatment interventions.



Map 11: Sone Canal Sponge Park: Zone 2- Mid-stretch: environmental treatment



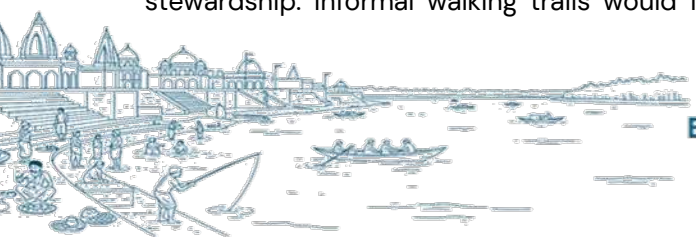
Zone 2 would focus on in-stream ecological treatment and water quality improvement using NbS. Edge-based constructed wetlands would be integrated within selectively widened canal sections, arranged as alternating wetland pockets at intervals of approximately 200–400 m to enable progressive treatment without obstructing flow. These wetlands would combine shallow free-water surfaces with subsurface planted zones to promote sedimentation, nutrient uptake, and biological treatment. In addition, floating treatment wetlands (FTWs) would be deployed near drain confluences and in low-velocity stretches to enhance pollutant removal where inflows are concentrated.

Complementing the treatment systems, phytoremediation and ecological planting would establish continuous vegetated belts along the canal. Native grasses and reeds would stabilize the water edge and support filtration, shrubs would be planted along mid-banks for slope protection and habitat creation, and trees would be set back on upper banks and buffer zones to provide shade, microclimate regulation, and long-term ecological structure without compromising channel capacity.

Map 12: Sone Canal Sponge Park: Zone 3- Downstream: polishing zone



Zone 3 would emphasise the previously restrained public interface focussing on access, awareness, and stewardship. Informal walking trails would follow the canal edge where space permits, using minimal



surfacing to retain a natural character. Seating would be provided at selected nodes and widened sections, complemented by small viewing decks overlooking wetland pockets. Interpretive signage would explain the Eco-Nala concept, constructed wetland functioning, and nature-based wastewater treatment, reinforcing the site's role as working infrastructure rather than a landscaped promenade. Being near the Ganga and the Baba Nath Mandir would ensure adequate footfall and the area would serve as a recreation area for the community.

Figure 22: Before and After of the Sone Canal, mid-section



3. Police (Dead) Canal Corridor

The Police Canal corridor is proposed to be a low-flow, high-treatment Eco-Nala, tailored to its reduced discharge and variable cross-sections. In narrow stretches, interventions would focus on desilting, bioswales, and trash traps to manage wastewater and surface runoff at source. In wider stretches, sponge parks would be developed to function as detention, filtration, and treatment zones, particularly during monsoon events when flows increase. These NbS would address stagnation, eutrophication, and pollution while restoring ecological function and improving flood resilience, repositioning the Police Canal as an active component of Buxar's blue-green infrastructure network rather than a residual drain.

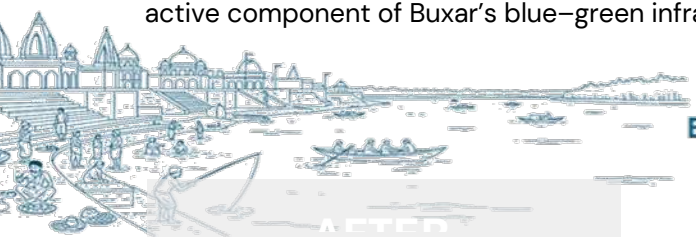


Figure 23: Proposed design for Police Nala

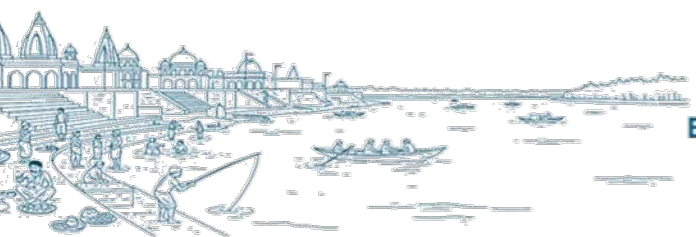
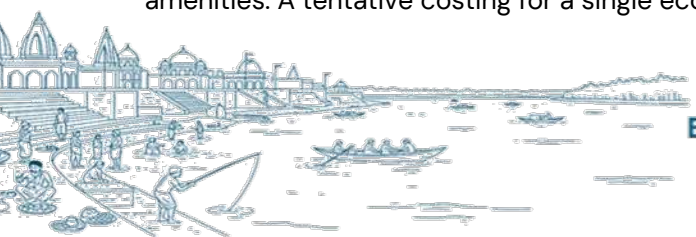


Figure 24: Reimagined Police Canal after the Design Interventions



Cost Estimate

Although the estimated budget for this intervention is being developed, a broad, estimate for developing Eco-Nalas along the Sone and Police canals (including the bus stop constructed wetland, in-channel NbS, and public interfaces) in Buxar is likely to fall in the range of roughly ₹25–40 crore, assuming about 4–5 km of canal length is treated with a mix of constructed wetlands, FTWs, desilting, landscaping, and basic public amenities. A tentative costing for a single eco nallah is given in Annexure 3.3

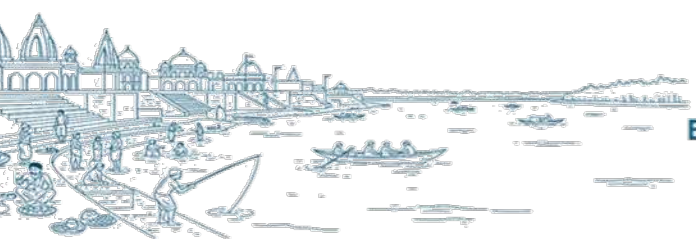
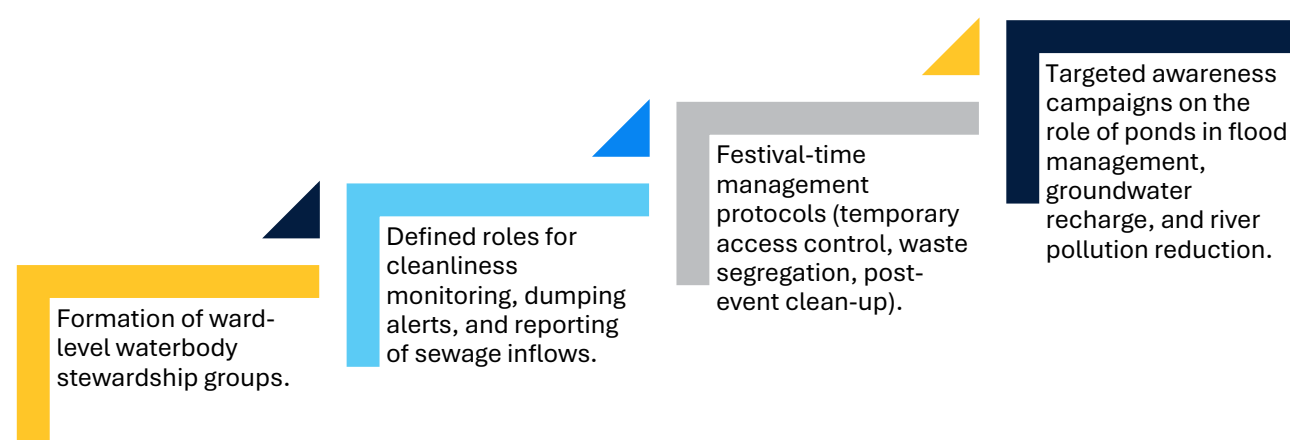


5.3.3.5. Intervention 3-4: Strengthen Community Stewardship and Local Management

This intervention recognises that long-term sustainability of waterbody rejuvenation depends on **local stewardship and behaviour change**, particularly given the cultural and livelihood use of ponds in Buxar.

Intervention	Responsible Agency	Intervention type
Community stewardship for waterbodies	Buxar Nagar Parishad (Lead), Ward Committees, Local NGOs	Community
Estimated Budget	Potential Funding Sources	Timeline
Clubbed with Intervention 9-1	State Urban Planning Funds	Short-term (1-2 years)

Key Components:



5.4.Objective 4: Enhancing Riparian Buffer

Rationale: Objective 4 focuses on strengthening riparian buffers along the Ganga riverfront in Buxar as a nature-based defence against erosion, flooding, and river pollution. While Buxar already benefits from a naturally evolved vegetative cover along its river edge, the absence of formal planning controls, ecological management, and monitoring has limited the effectiveness and long-term resilience of these buffers.

5.4.1. Existing Situation

Within the municipal boundaries of Buxar, the river edge extends approximately 8.43 km, of which nearly 6.98 km (≈83%) is currently accompanied by a vegetated riparian buffer. This relatively high coverage is primarily the result of natural regeneration rather than planned ecological restoration. The embankments along much of the river have been constructed using sandbags, which have allowed grasses and pioneer species to establish naturally, contributing to soil stabilization and partial erosion control.

However, the riparian buffer is highly variable in width, structure, and ecological quality across the river corridor. In newer and peripheral areas of the city, buffers are generally wider and less disturbed, while in the older urban core they are narrow, fragmented, and under pressure from encroachments, ghats, and infrastructure.

Map 13: Spatial variation of river front along the Riverfront

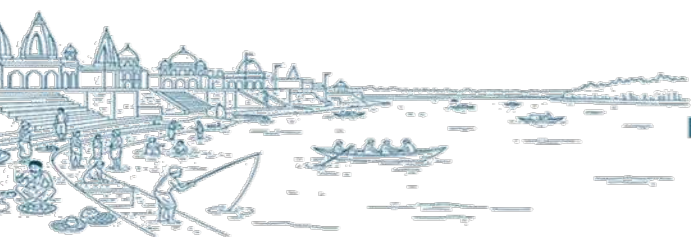
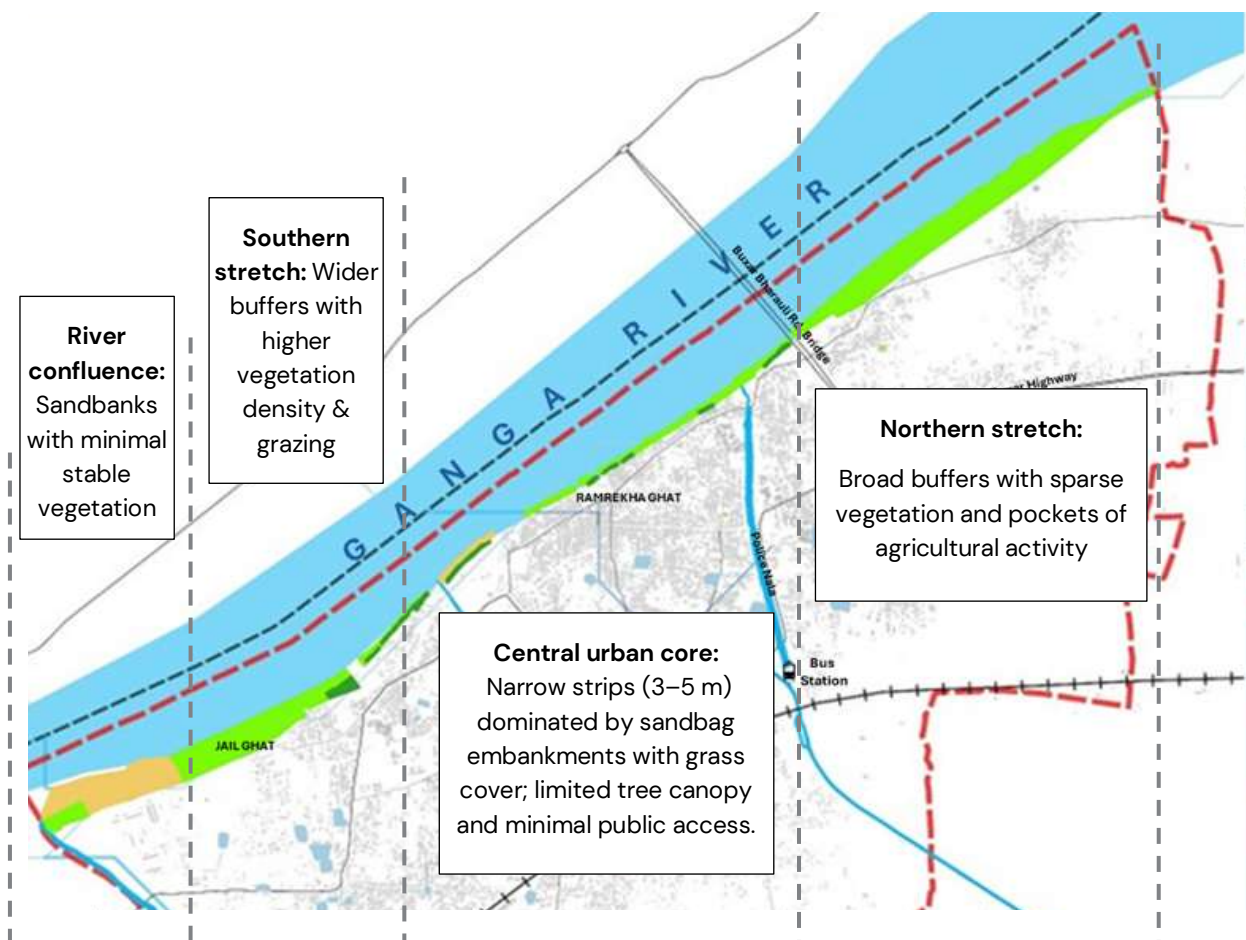
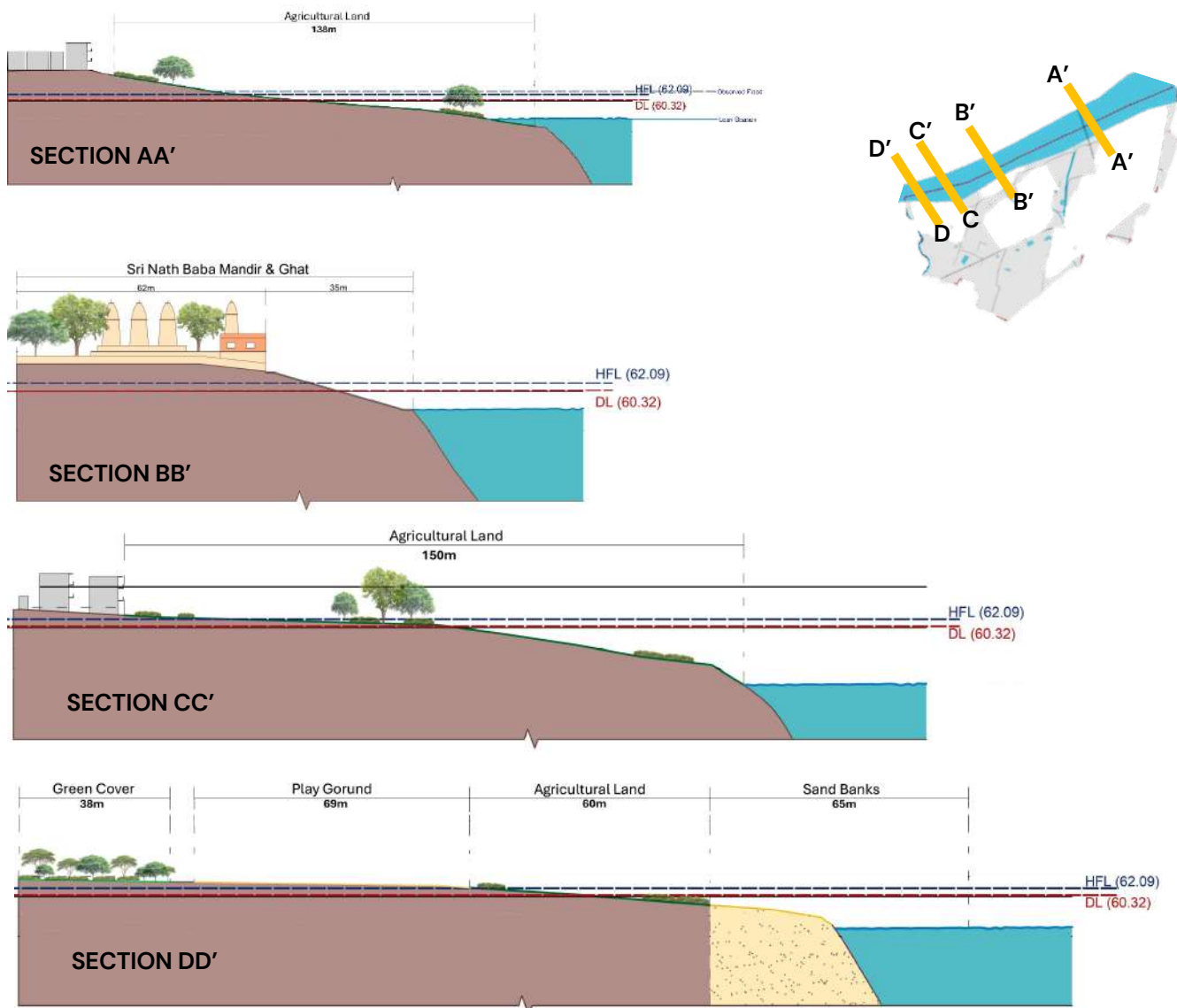


Figure 25: Cross-sections of the Riparian Buffer at various points in the city



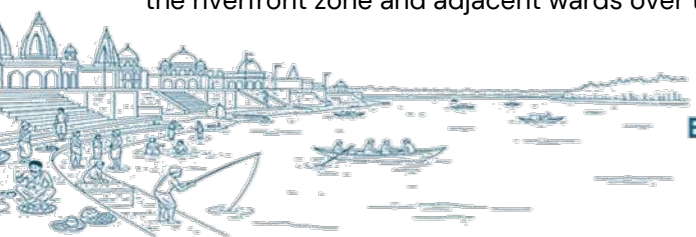
Vegetation and Physical Characteristics

Riparian vegetation in Buxar consists primarily of grasses, reeds, shrubs, and scattered tree clusters. Commonly observed tree species include **Shisham, Neem, Babul, and Peepal**, often concentrated near ghats, open grounds, and institutional land. Aquatic vegetation is present in shallow river edges, supporting fish and other aquatic fauna. A list of approved native species, and commonly found flora and fauna is given in Annexure 2

Soils along the riverbank vary from sandy alluvium near the waterline to silty loam further inland. While these soils support grasses and certain native trees, they are vulnerable to compaction and erosion in heavily used urban stretches.

NDVI Analysis and Trends

Satellite-based NDVI analysis (2017–2025) indicates a persistent low vegetation index along the immediate riverfront, reflecting exposed sandbanks, seasonal flood dynamics, and lack of structured planting behind embankments. Comparative analysis shows a 15–20% decline in overall green cover across the riverfront zone and adjacent wards over this period.



Institutional Context and Gaps

Currently, responsibility for riparian areas is shared between the Nagar Parishad (embankment and old city) and the Forest Department (newer wards), primarily focused on maintenance and desilting. However, there are no notified riparian buffer regulations, no standard planting palettes, and no routine ecological monitoring mechanism. As a result, buffers remain vulnerable to gradual degradation despite their apparent spatial extent.

5.4.2. URMP Score

Riparian Buffer Score

The URM Riparian Buffer Score assesses the proportion of riverbanks protected by vegetated buffers with a minimum width of 7.5 m.

Total river edge length: 8,430.46 m

Riparian buffer length: 6,982.78 m

Riparian buffer factor: 82.82%

Based on this assessment, Buxar achieves a **Riparian Buffer Score of 4 (≈83%)**, indicating strong baseline coverage but with gaps in continuity, width consistency, species composition, and long-term protection.

5.4.3. Interventions

Along with the intervention 4-1 and 4-2 mentioned below, Intervention 7-1: Integrated Eco-Heritage Riverfront Development has proposals for riparian buffer enhancements that impact this objective.

5.4.3.1. Intervention 4-1: NDVI-Based Riparian Buffer Monitoring and Management Dashboard

This intervention proposes the deployment of a **GIS-enabled, NDVI-based dashboard** to annually track the condition and continuity of riparian buffers along the Buxar riverfront. The objective is to move from one-time assessments to **continuous ecological monitoring**.

Intervention	Responsible Agency	Intervention type
NDVI-Based Riparian Buffer Monitoring and Management Dashboard	Buxar Nagar Parishad (Lead), with technical support from state	Project
Estimated Budget	Potential Funding Sources	Timeline
Rs 10-15 Lakh ⁸	Buxar Nagar Parishad (Lead), with technical support from state GIS agencies	Short-term (1-2 years)

⁸ <https://pmc.ncbi.nlm.nih.gov/articles/PMC10977749/>



Key Planning Components:

- Annual NDVI analysis of the river corridor using satellite imagery.
- Identification of buffer degradation, vegetation loss, and new encroachments.
- Integration with state-level green-cover datasets and URMP monitoring systems.
- Use of dashboard outputs to prioritise restoration and enforcement actions.

Cost Estimate

The estimated cost remains around ₹10–15 lakh since the setup primarily uses free satellite data, existing GIS infrastructure, and internal expertise, requiring only limited expenditure on integration, hosting, and capacity building.

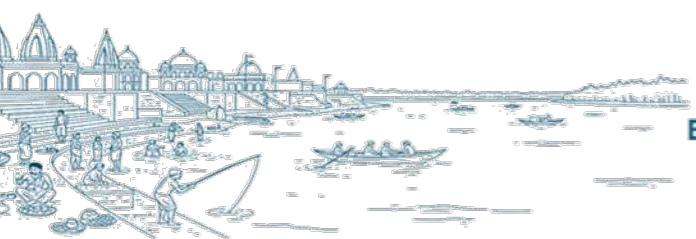
5.4.3.2. Intervention 4–2: Integration of Riparian Buffer Regulations into the Master Plan including Ecological Enhancement through Native and Zoned Planting

This intervention recommends **formalising riparian buffer protection through statutory planning controls within the Master Plan and Development Control Regulations**. This intervention is linked with intervention 1–1 and should be executed in tandem.

Intervention	Responsible Agency	Intervention type
Integration of Riparian Buffer Regulations into the Master Plan	Nagar Parishad Buxar, Proposed floodplain management cell	Policy
Estimated Budget	Potential Funding Sources	Timeline
N/A	State Planning Funds, NMCG technical assistance	1–2 years

Key Planning Components

- Mandate a continuous riparian buffer of 7.5–15 m along the river edge, with flexibility based on local context.
- Prohibit permanent construction within the buffer except for essential river-related infrastructure. A list of suggested permissible activities is given Intervention 1–1.
- Notify buffers as ecological protection zones linked to floodplain regulations. A list of suggested native species is given in Annexure 2 that should be included within the **native species planting palette** to be specified. The zoned planting strategy can be along the lines of:
 - **River edge:** grasses and reeds for erosion control.
 - **Middle zone:** shrubs for filtration and habitat.
 - **Upper zone:** canopy trees for shading, biodiversity, and microclimate regulation.
- Vegetation of embankments using bio-engineering techniques rather than hard landscaping.



5.5.Objective 5: Reuse Of Treated Wastewater

Rationale: Objective 5 aligns with national and state mandates to transition cities toward a circular water economy, wherein treated used water is recognised as a resource for non-potable applications such as irrigation, landscaping, groundwater recharge, and waterbody replenishment.

5.5.1. Existing Situation

At present, Buxar relies entirely on groundwater to meet its water demand and does not abstract water from the Ganga. Formal reuse of treated wastewater is not practiced, primarily due to the absence of operational sewage treatment plants (STPs) and, consequently, the non-availability of treated effluent. While the Sone Canal exhibits some degree of natural bioremediation, the water quality achieved is insufficient to be classified as treated wastewater suitable for planned reuse.

However, the baseline assessment highlights a **significant near-term reuse potential** driven by rapid investments in sewerage and treatment infrastructure under AMRUT 2.0. Based on the AMRUT 2.0 DPR (2024), Buxar currently has a water demand of approximately **35 MLD**, with wastewater generation estimated at **31.55 MLD**. By 2027, wastewater generation is projected to rise to **30–36 MLD**, assuming a return flow of 75–80 percent.

Three major STPs are under construction or tendered:

- 16 MLD STP using Sequencing Batch Reactor (SBR) technology under AMRUT
- 50 MLD STP using Sequencing Batch Reactor (SBR) technology under NMCG
- 1 MLD STP based on a nature-based solution under NMCG

Upon completion, Buxar will have a **total treatment capacity of 67 MLD**, exceeding near-term wastewater generation. This creates a strategic opportunity to divert treated effluent for reuse without compromising environmental flows to the Ganga.

5.5.2. URMP Score

Wastewater reuse score

Based on the URMP Wastewater Reuse Index, Buxar currently achieves a **reuse score of 1 (0–20%)**, reflecting the absence of formal reuse mechanisms.

Wastewater generated: ~31.55 MLD

Wastewater reused: 0 MLD

Reuse factor: 0%

5.5.3. Interventions

The focus of this intervention is to improve the quality of groundwater. Along with intervention 5–1, multiple interventions across objectives related to the riverfront development, urban inland waterbody rejuvenation and eco-nallas also impact this objective.

5.5.3.1. Intervention 5–1: Preparation of a City-Level Treated Wastewater Reuse Strategy

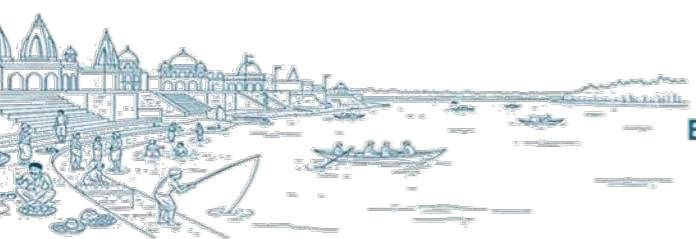
This intervention recommends preparing a dedicated **Treated Wastewater Reuse Strategy** to enable a planned transition from full discharge to structured reuse of treated effluent in Buxar. The strategy would translate the forthcoming STP capacity into a demand-linked reuse framework aligned with national and state reuse mandates.



Intervention	Responsible Agency	Intervention type
Preparation of a City-Level Treated Wastewater Reuse Strategy	Buxar Nagar Parishad (Lead), with technical support from state	Policy
Estimated Budget	Potential Funding Sources	Timeline
61 Lakh A detailed cost estimate is given in Annexure 3.4	NMCG policy component or AMRUT 2.0 city action plans	Long-term (5–10 years)

Key Planning Components:

- GIS-based reuse opportunity mapping within a 3–5 km influence zone of each STP proposed, covering:
 - Urban green spaces and public parks
 - Peri-urban agricultural areas (including Jaivik Yojana clusters)
 - Urban waterbodies and wetlands identified under Objective 3
- Demand–supply assessment, linking projected treated wastewater availability (30–36 MLD by 2027) with non-potable demand.
- Reuse suitability screening, addressing quality requirements, seasonal variability, salinity risks, and health safeguards.
- Phased reuse roadmap, prioritising low-risk, high-visibility municipal and irrigation uses in the short term.
- Institutional and regulatory framework, clarifying roles for the Nagar Parishad, STP operators, and user groups.



5.6.Objective 6: Good Quality Return Flow

Rationale: Objective 6 seeks to ensure that Buxar contributes actively to maintaining the ecological flow and water quality of the Ganga by returning adequate volumes of treated good-quality water to the river system.

Good-quality return flow is critical not only for dilution and self-purification of the river but also for sustaining aquatic ecosystems, reducing downstream pollution impacts, and maintaining resilience during lean-flow periods. In Buxar, this objective is particularly important due to the city's heavy dependence on groundwater, the absence of full sewerage interception, and the presence of multiple untreated drain outfalls directly discharging into the Ganga.

5.6.1. Existing Situation

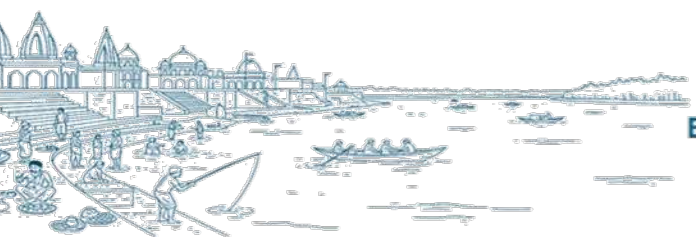
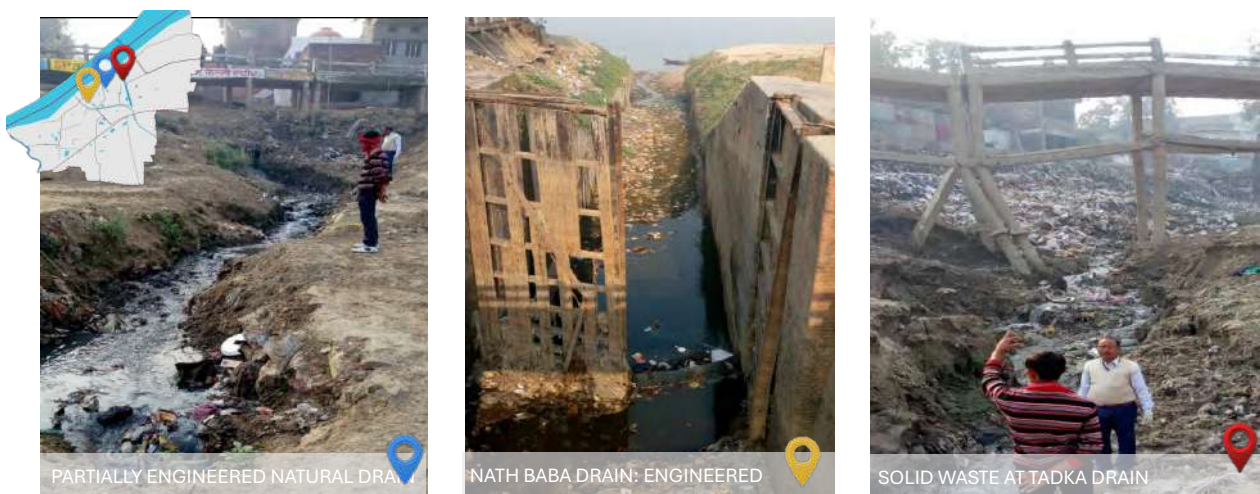
Buxar currently discharges approximately 31.55 MLD of untreated municipal wastewater into the Ganga through seven major urban drains, making these drains the city's primary pollution conduits. Measured BOD levels frequently exceed 60 mg/L, far above CPCB discharge norms (≤ 30 mg/L), indicating severe organic loading. Most drains are unlined, encroached, and poorly graded, resulting in stagnant pools, reduced conveyance capacity, and foul conditions.

Although periodic desilting is undertaken by the Nagar Parishad—primarily pre- and post-monsoon—drain management remains reactive and fragmented. Apart from limited bioremediation along the Sone Canal, no systematic interception, treatment, or polishing of drain flows is currently in place, allowing untreated sewage to enter the river throughout the year.

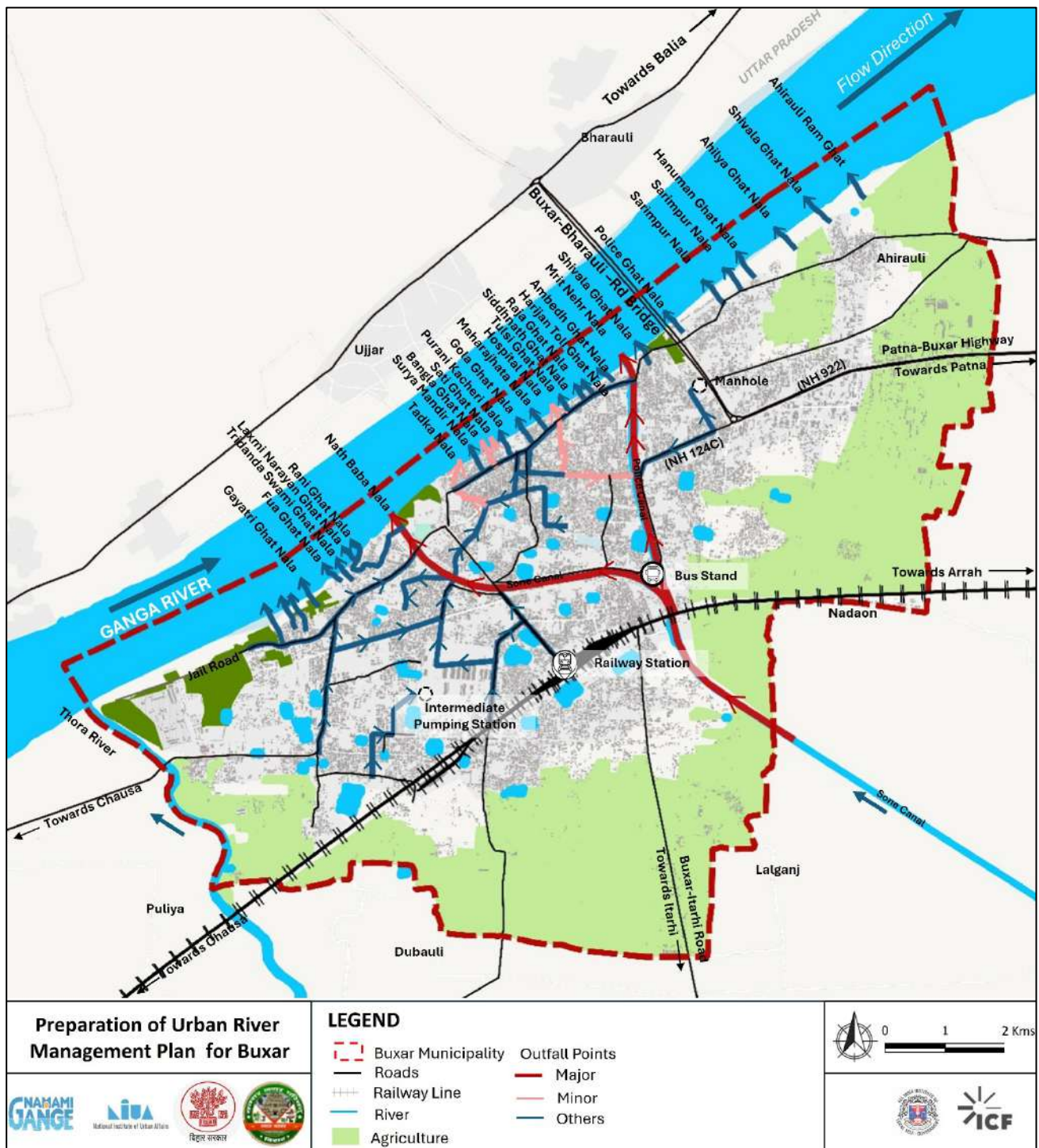
Buxar relies almost entirely on groundwater abstraction for its municipal water supply. Demand is projected to rise from 38.31 MLD (2027) to 82.19 MLD (2057). Monitoring data indicate a 0.2–0.4 m/year decline in groundwater levels, with an annual extraction–recharge gap of 7–10 MCM, pointing to increasing aquifer stress. The absence of a structured return-flow framework means that water abstracted from the environment largely re-enters the river system as pollution rather than ecological flow, undermining both river health and long-term water security.

Seasonal monitoring at Jail Ghat, Ram Rekha Ghat, and the Road Bridge indicates that while Dissolved Oxygen generally meets CPCB Class-B standards, values approach critical thresholds during pre-monsoon months due to concentrated drain inflows and reduced dilution.

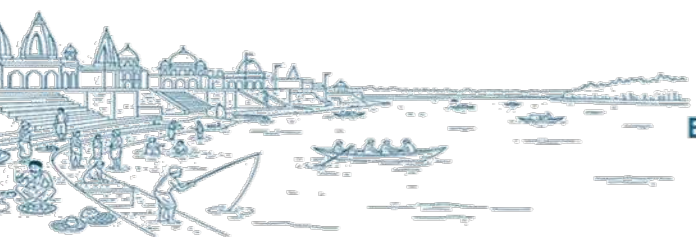
Figure 26: Existing Situation of Various Drains Across Buxar



Map 14 : Drainage Network Map with Major Outfalls



Source: AIIISG & ICF Analysis



5.6.2. Interventions

5.6.2.1. Intervention 6-1: Integrated Monitoring and Regulation of Return-Flow Quality and Quantity

This intervention focuses on establishing a city-level return-flow monitoring and regulatory framework to ensure that discharge into the Ganga meets minimum quality and quantity standards.

Intervention	Responsible Agency	Intervention type
Integrated Monitoring and Regulation of Return-Flow Quality and Quantity	Buxar Nagar Parishad (Lead), BSPCB, WRD Bihar	Institutional & Regulatory
Estimated Budget	Potential Funding Sources	Timeline
1.2–1.8 crore	NMCG (main), AMRUT 2.0, BSPCB	Short- to medium-term (1–3 years)

Key Components

- Flow and water-quality monitoring at major drain outfalls (BOD, COD, TSS, DO).
- Definition of **minimum discharge quality standards** aligned with CPCB norms.
- Integration with the city's **urban water balance**, linking abstraction, reuse, and discharge.
- Periodic reporting to the District Ganga Committee and State authorities.

Cost Estimate

The cost estimate of ₹1.2–1.8 crore for Intervention 6-1 adopts a phased, cost-optimised approach focusing on 7 major drain outfalls, including 7 continuous online monitors (₹10–12 lakh each for BOD/DO/flow combo units), basic SCADA integration with existing BSPCB networks (₹30–40 lakh), Nagar Parishad staff training (₹20 lakh), and simplified water balance dashboard development (₹20–30 lakh).

This configuration aligns with NMCG's scaled-down monitoring for smaller cities (₹80 lakh–1.2 crore hardware + ₹30–50 lakh software/integration), prioritising real-time BOD/DO/flow over full parameter suites, with shared O&M through BSPCB linkages and leveraging AMRUT 2.0 digital water management components^{9,10,11,12}

⁹ National Mission for Clean Ganga. (2024). *Minutes of 59th Executive Committee meeting*. https://nmcg.nic.in/writereaddata/fileupload/7_MoM_59th%20EC%20of%20NMCG_30.12.2024.pdf

¹⁰ National Mission for Clean Ganga. (n.d.). *City SRTW solution document – Panipat*. https://nmcg.nic.in/writereaddata/fileupload/12_City%20SRTW%20_Solution%20Document%20Panipat.pdf

¹¹ Ministry of Housing and Urban Affairs. (n.d.). *AMRUT 2.0 operational guidelines*. https://amrut.mohua.gov.in/uploads/AMRUT_2.0_Operational_Guidelines.pdf

¹² National Mission for Clean Ganga. (2021). *National framework on safe reuse of treated water*. [https://nmcg.nic.in/writereaddata/fileupload/32_SRTW%20Framework_Final_23_11_2021%20\(1\).pdf](https://nmcg.nic.in/writereaddata/fileupload/32_SRTW%20Framework_Final_23_11_2021%20(1).pdf)



5.7. Objective 7: Eco Friendly Riverfront Project & Objective 8: Leverage Economic Potential Of the River

Rationale: Objectives 7 and 8 are intrinsically linked in the context of Buxar. Eco-friendly riverfront development (Objective 7) provides the **spatial, ecological, and experiential foundation**, while river-based economic activation (Objective 8) leverages this foundation to generate **livelihoods, tourism revenue, and local enterprise**. Given the high degree of overlap in spatial geography, infrastructure requirements, and institutional responsibilities, the proposed interventions are framed as **common, integrated interventions** contributing simultaneously to both objectives.

5.7.1. Existing Situation

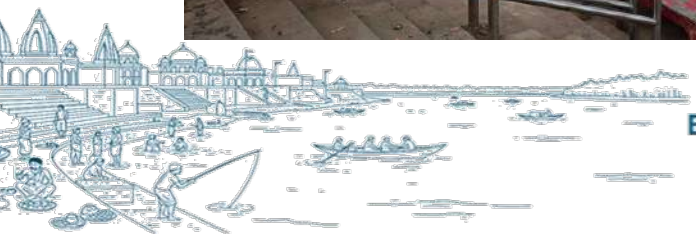
Buxar's riverfront is a culturally rich but operationally fragmented landscape, dominated by ghats, temples, crematoria, informal boat landings, dhobi ghats, and seasonal festival spaces. Activity mapping indicates that most social, religious, and economic interactions with the river are concentrated at a limited number of ghats, particularly Ramrekha Ghat, Nath Baba Ghat, and Ahilya Ghat. These nodes experience intense seasonal pressure during festivals such as Chhath Puja, resulting in crowding, solid waste accumulation, ritual waste discharge, and strain on basic infrastructure.

From an ecological perspective, most existing riverfront interventions rely heavily on hard engineering and concrete-intensive designs, with some use of permeable surfaces, native vegetation, or riparian augmentation. Waste management systems remain inconsistent, sanitation facilities are unevenly distributed, and informal commercial activities operate without clear zoning or environmental safeguards.

Economically, the river already supports multiple livelihood streams including religious tourism, vending, boating, fishing, and agriculture, yet these remain largely informal and low-value. Fisheries lack cooperative structures and cold-chain infrastructure; tourism is highly seasonal; and navigation remains limited to small passenger boats despite proximity to National Waterway-1. Governance is fragmented across the Nagar Parishad, Tourism Department, Fisheries Department, Forest Department, and NMCG, with no dedicated river economy coordination mechanism.

At the same time, significant investments are already in the pipeline, notably the Integrated Riverfront Plan prepared by BUIDCO (₹370+ crore), new ghats, walkways, parks, and jetties. This creates a strong opportunity to re-orient ongoing and proposed projects toward URMP principles, rather than introducing parallel or duplicative schemes.

Figure 27: Ram Rekha Ghat



Map 15: Activity Mapping along the River

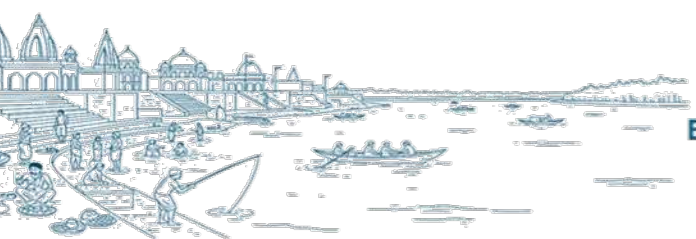
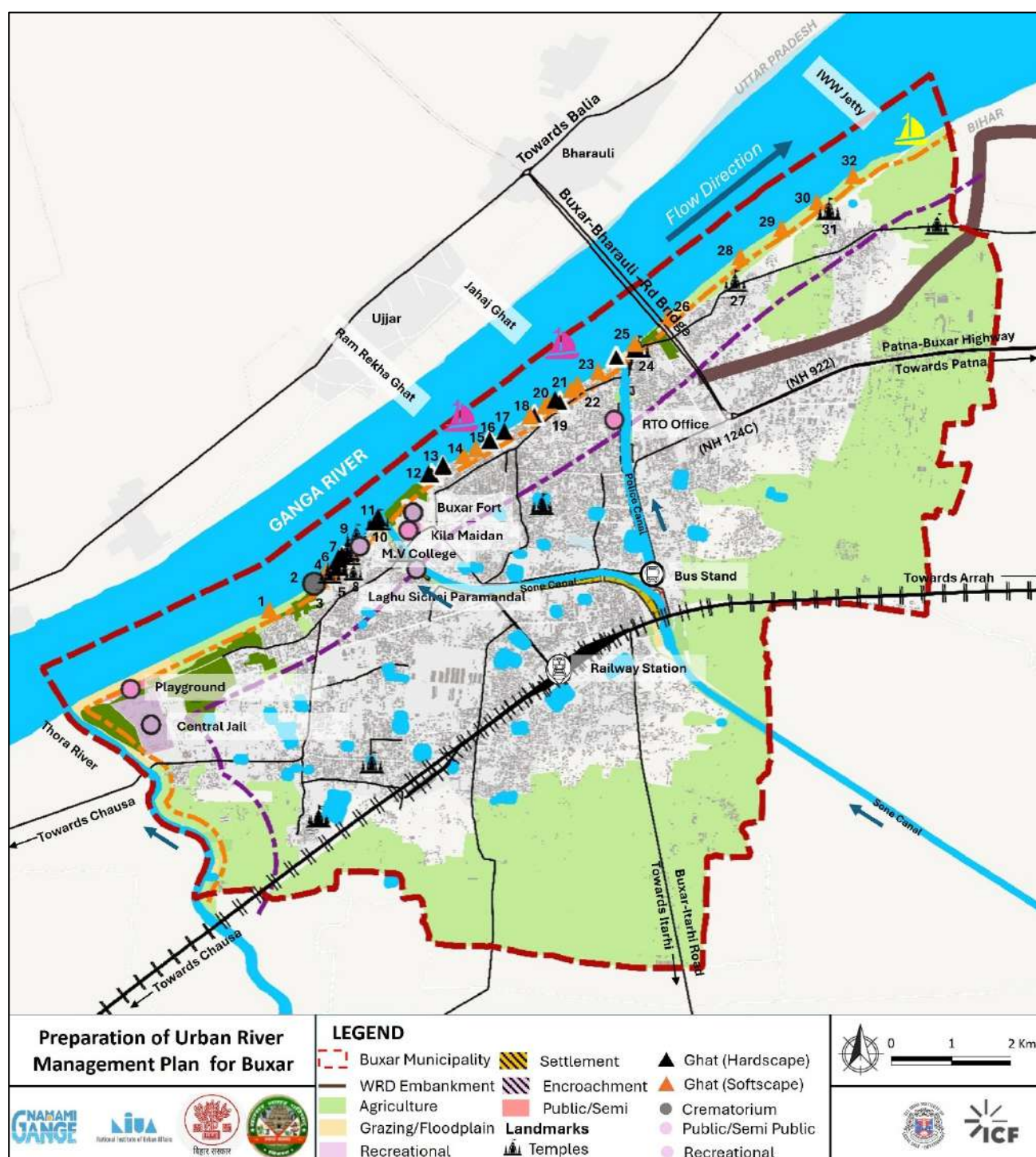


Figure 28: Activities observed at Ram Rekha Ghat

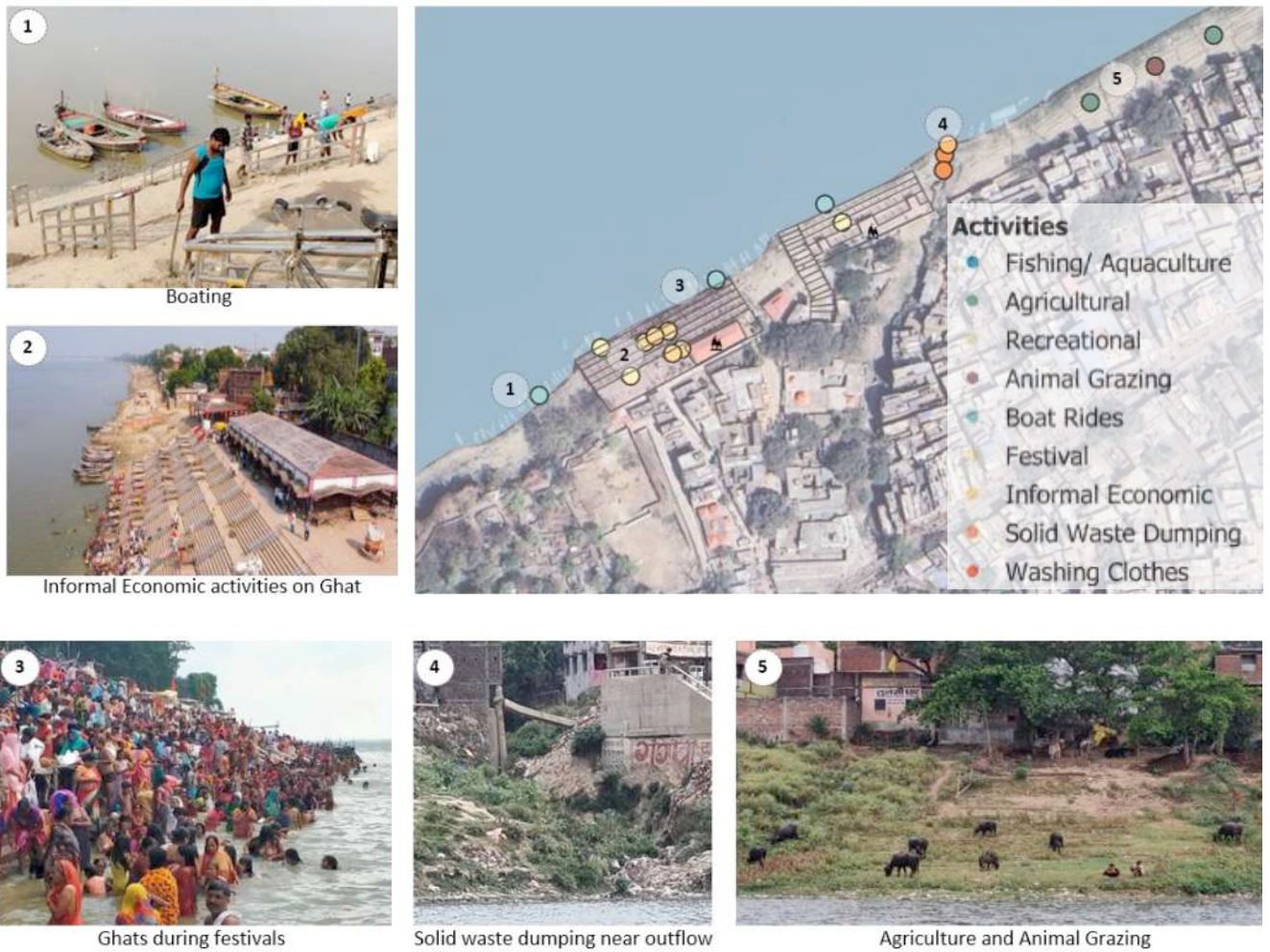
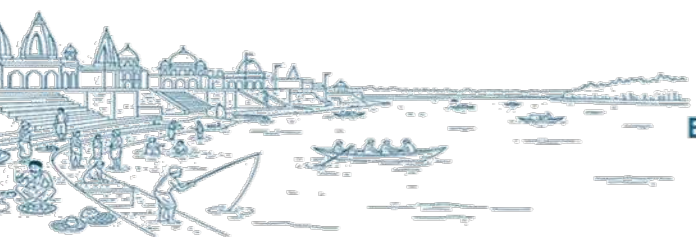


Figure 29: River-Edge Activities in other parts: Canal Outflows, Temples, Funeral Sites, and Agriculture



5.7.2. URMP Score

Ecofriendly Riverfront Score (Objective 7):

Buxar scores a **moderate 3/5**, reflecting high footfall and cultural relevance but weak performance on eco-materials, waste management consistency, and soft landscaping

River Economy Score (Objective 8):

Buxar scores a **high 5/5**. The river supports four distinct economic uses (religious tourism, agriculture, fishing, boating), but most remain informal and low productivity. This indicates high latent potential but low institutional maturity.

5.7.3. Interventions

5.7.3.1. Intervention 7-1: Integrated Eco-Heritage Riverfront Development

This intervention recommends implementing an **Eco-Heritage Riverfront Project** across the full 8.4 km riverfront, building upon the existing BUIDCO DPR while embedding URMP principles.

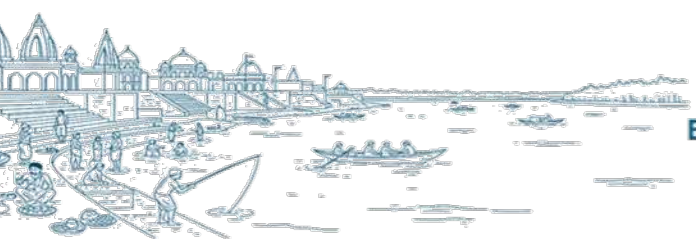
Intervention	Responsible Agency	Intervention type
Integrated Eco-Heritage Riverfront Development	Buxar Nagar Parishad, State Tourism Department, UDHD NMCG	Project
Estimated Budget	Potential Funding Sources	Timeline
₹85–120 crore	NMCG, UD&HD Bihar, State Tourism Department,	Medium-term 3–5 Years

Strategic Framework

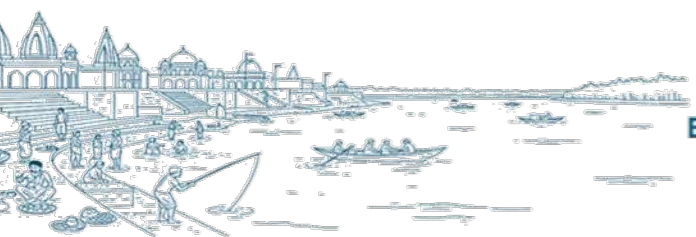
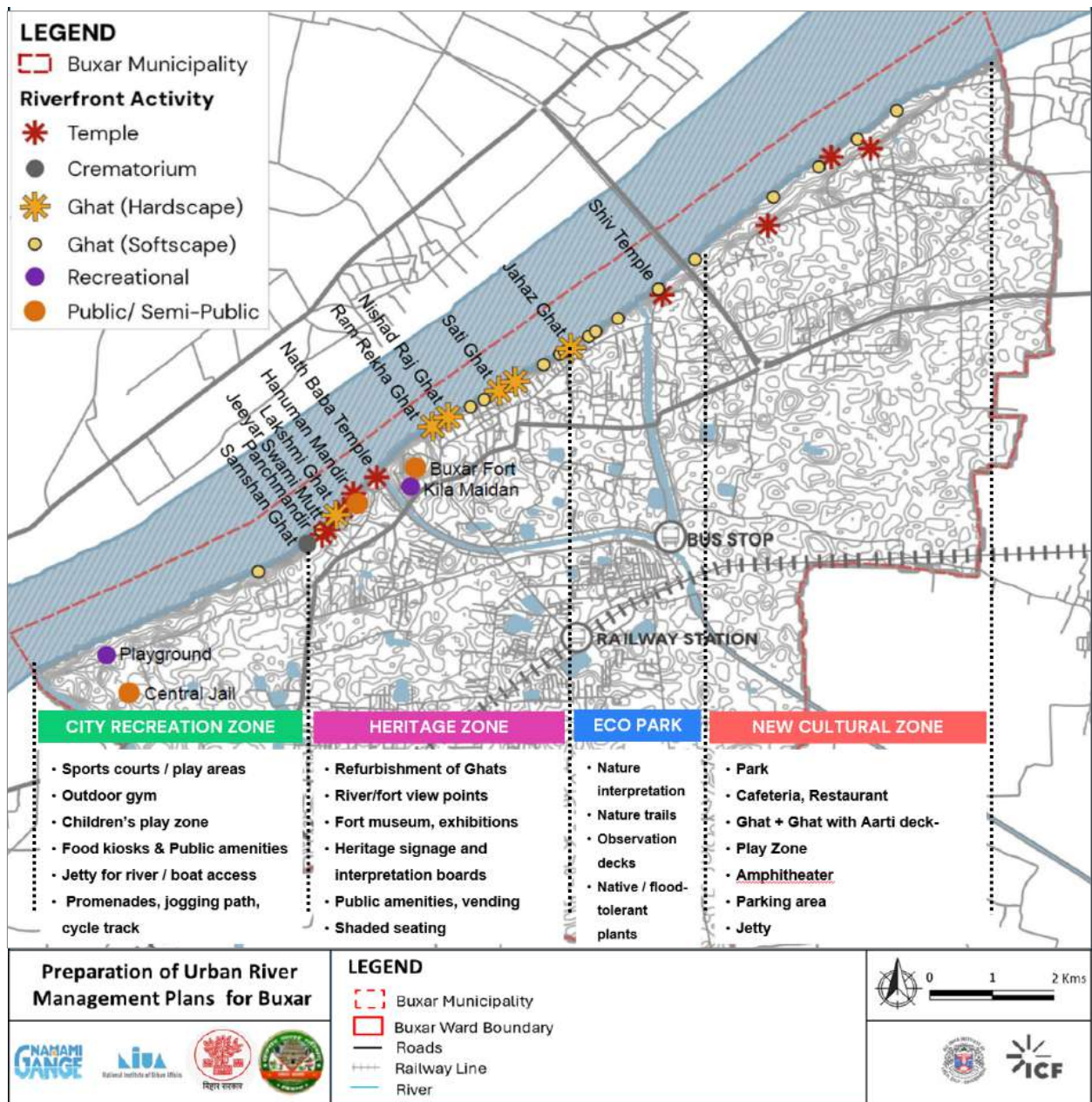
Strategy 1: Structuring the 8.4 km Riverfront into Functional Zones

The BUIDCO DPR is divided in 2 phases, the first phase spanning 2.8 Km and the second spanning 5.6 Km. Currently, no tender has been awarded for the construction of phase 1. This intervention aims to suggest river-sensitive elements/ suggestions the design of the first phase to ensure sustainable development. For Phase 2, this intervention proposes design strategies and principals.

Instead of treating the riverfront as a homogenous stretch, the intervention proposes four distinct yet connected zones as shown in Figure 28, based on existing land use, cultural intensity, ecological sensitivity, and flood behaviour. This rationalisation directly addresses the uneven pressures observed along the river.



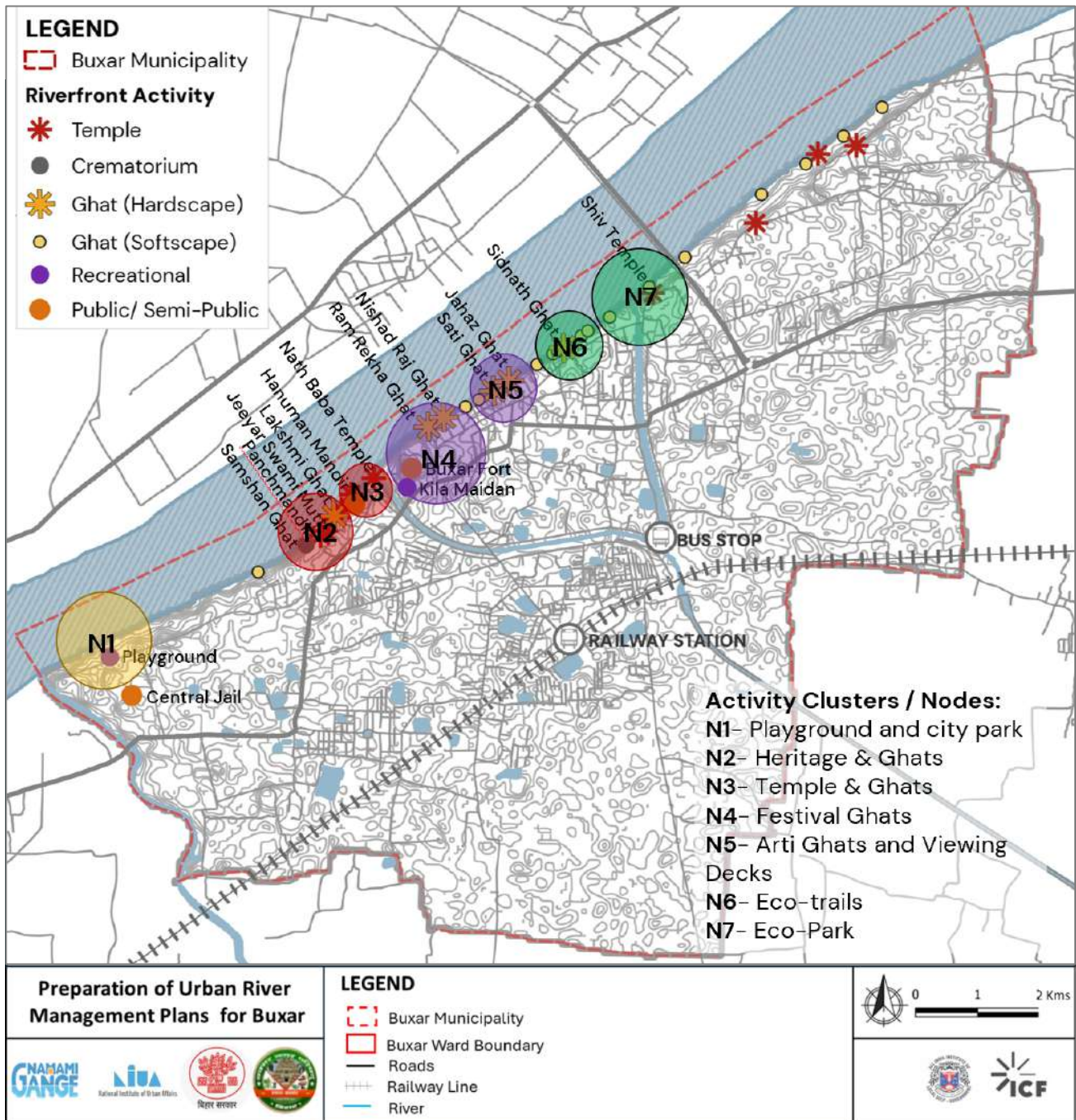
Map 16: Proposed Riverfront Zoning



Strategy 2: Clustering Activities into Clearly Defined Nodes

Unregulated linear development along the river often leads to sprawl, conflicts, and ecological degradation. This intervention instead adopts a **node-based planning approach**, where activities are **intentionally clustered** at selected locations, while intervening stretches remain ecologically soft.

Map 17: Riverfront Activity Nodes



Each node functions as a self-contained micro-district with its own design vocabulary, management needs, and carrying capacity. Some examples of the type of development possible in each node is given below:

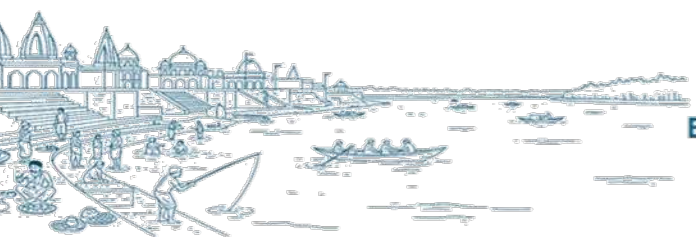


Figure 30: Proposed Design for Node 2

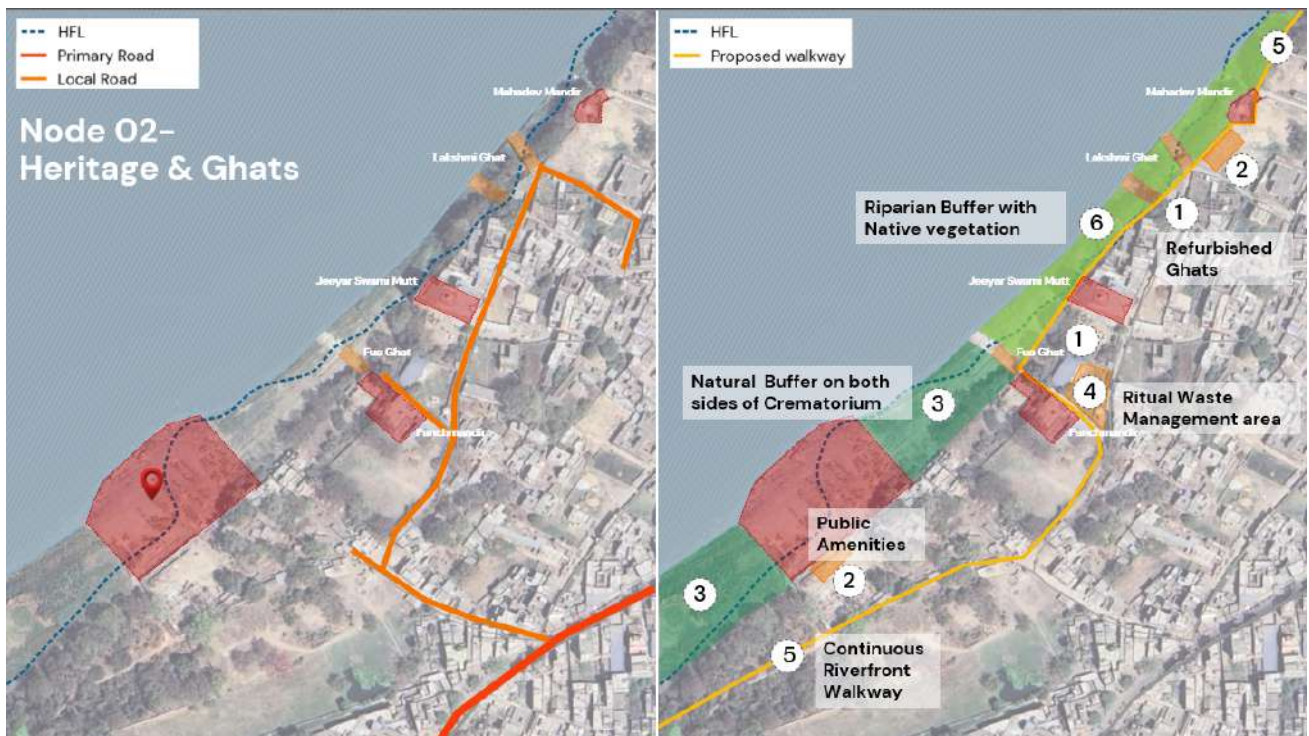
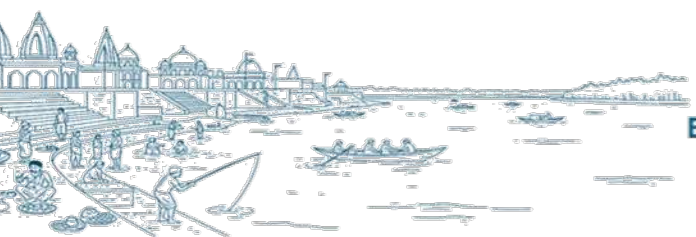
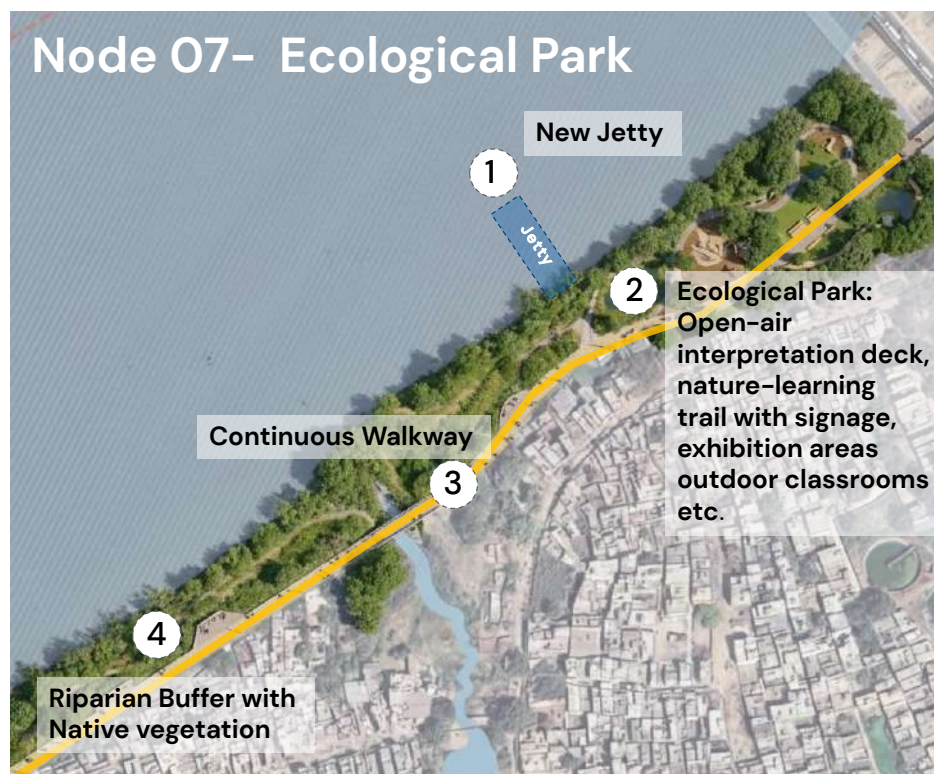


Figure 31: Proposed Design for Node 7



Strategy 3: Cleaning up of drains and outfall points

Riverfront development is explicitly linked to Objective 3 & 6 . All major drains and outfalls intersecting the riverfront would be treated through:

- Constructed wetlands
- Bioswales and buffer planting
- Soft-edge stabilization

Figure 32: Reimagination of Sati Drain after incorporating Design Elements



Strategy 4: Creation of Continuous walkways & water connectivity

A core value addition of the Integrated Eco-Heritage Riverfront intervention is the establishment of **continuous** connectivity along the riverfront, both on land and on water, ensuring that the river becomes a seamless public and economic corridor rather than a series of disconnected ghats.

On land, the proposal envisages a continuous pedestrian promenade extending across all riverfront zones, linking the City Recreation Zone, Heritage Zone, Eco-Park, and New Cultural Zone into a single, legible public realm. In flood-prone stretches, secondary elevated walkways are recommended to ensure year-round accessibility without disrupting natural floodplain processes. The use of permeable paving and soft landscaping is emphasized to reduce surface runoff, support groundwater recharge, and maintain ecological permeability, while also improving user comfort and safety.

Complementing this land-based network, the intervention strengthens water-based connectivity through a system of strategically located passenger jetties at Jail Ghat, Pul Ghat, Ahrauli, and the upcoming jetty at Ahilya Ghat. These jetties are proposed not merely as transport infrastructure, but as multi-functional nodes supporting tourism, pilgrimage movement, and local river-based livelihoods. Integrated with the heritage boat circuit and riverfront activity nodes, the water connectivity framework enables short-distance passenger movement, cultural tours, and recreational boating, reinforcing the river's role as an active mobility spine and economic asset for Buxar.

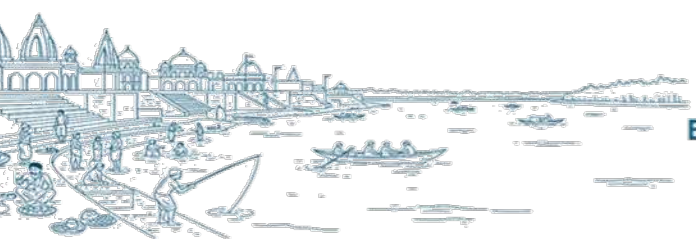
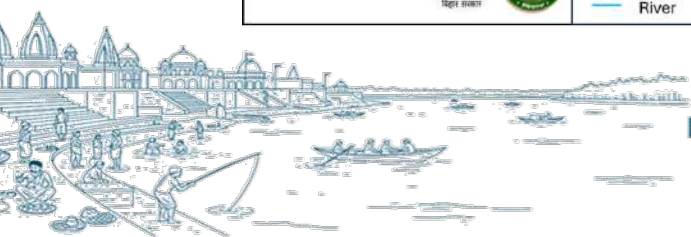
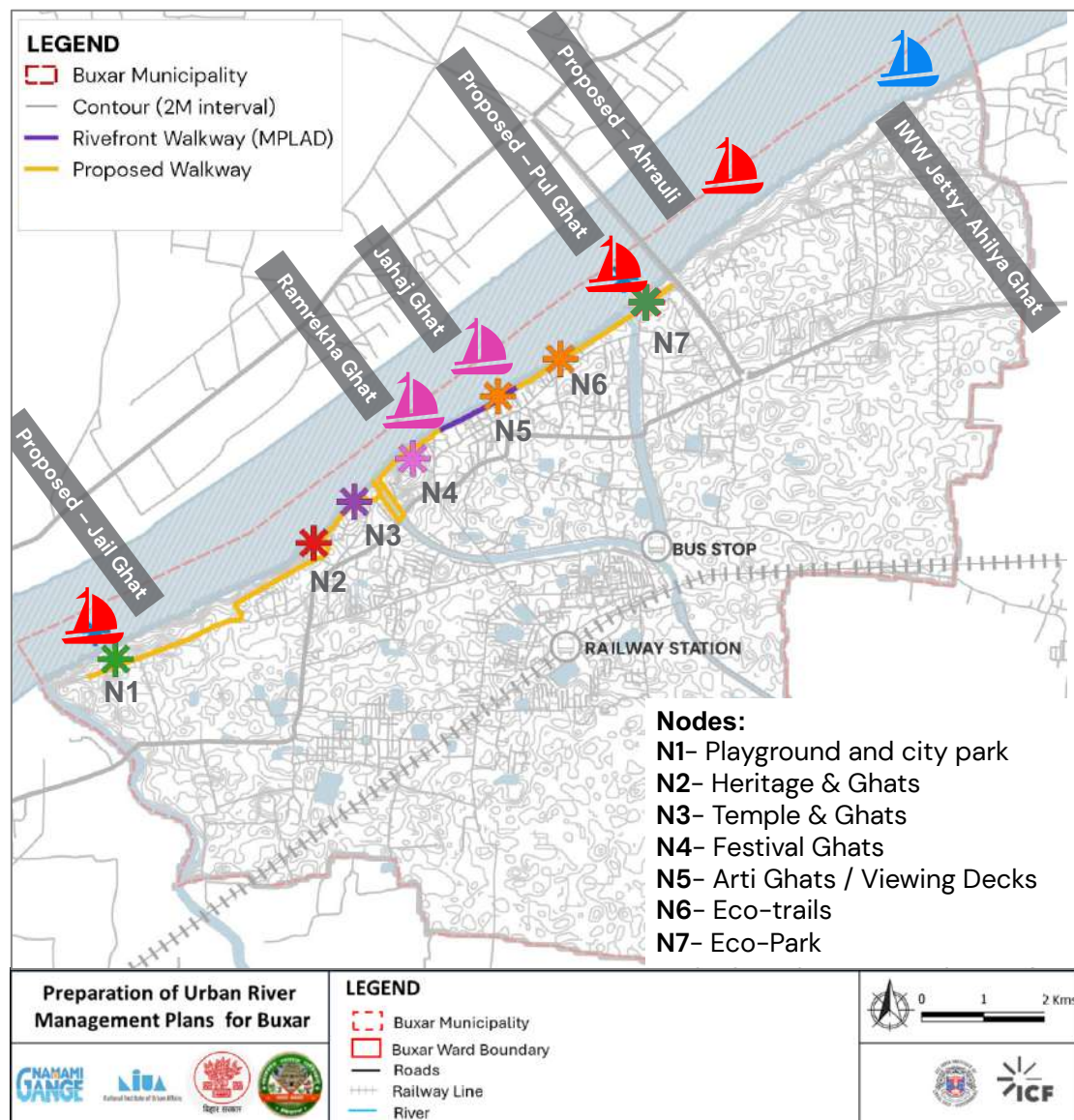


Figure 33: Existing Walkway near Jahaj Ghat



Map 18: Proposed Land and Riverfront Walkway



Strategy 5: Activating the Riverfront

Beyond physical redevelopment, the Eco-Heritage Riverfront intervention emphasizes activation through curated, repeatable experiences that encourage sustained public use, tourism, and local livelihoods. The intent is to move away from a static, infrastructure-heavy riverfront toward a living cultural and ecological corridor, where movement, storytelling, and seasonal programming become central to how citizens and visitors engage with the Ganga.

This strategy builds on three complementary experience layers:

- A land-based Heritage Walk
- A water-based Heritage Boat Circuit

Heritage Walk / Cultural Trail

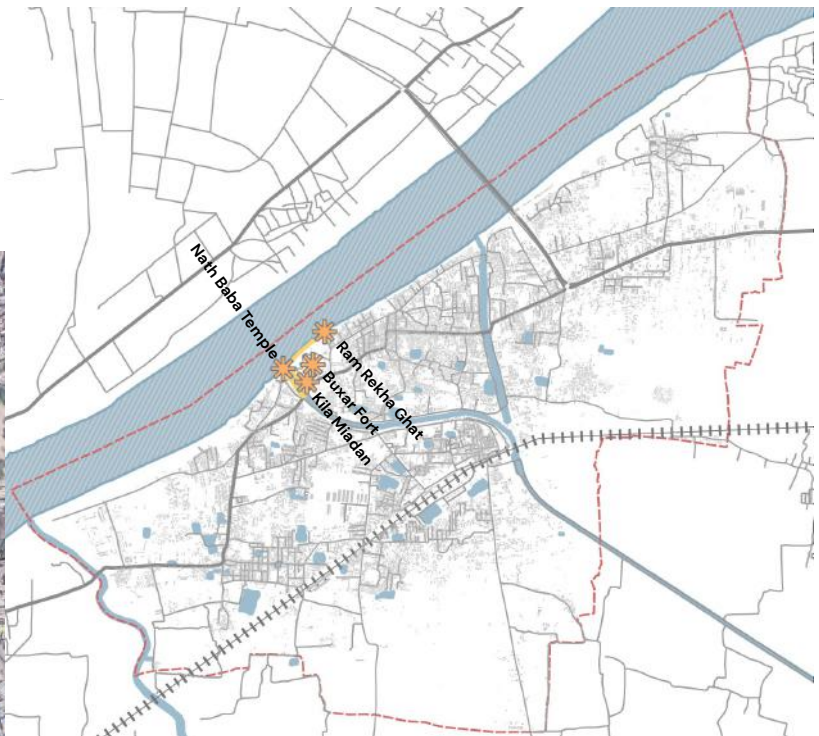
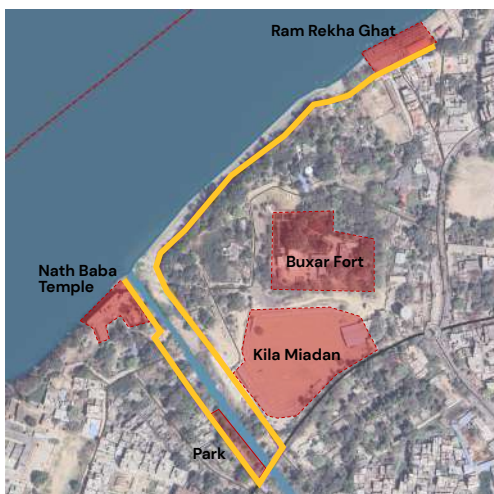
The Heritage Walk is proposed as a 2.5–3.0 km continuous pedestrian trail along the most culturally significant stretch of the riverfront. It is designed as a slow, interpretive experience linking religious, historical, and civic landmarks through shaded walkways, interpretive signage, and pause points.

Figure 34: Conceptual Plan of the Heritage Walk

Heritage Walk

Approx. Length : 1.5 Km

Major Landmarks: Ram rekha Ghat, Buxar Fort, Kila Miadan, Nath Baba Temple and Park



Key characteristics:

- **Route:** Ahilya Ghat → Ram Rekha Ghat → Buxar Fort → Nath Baba Ghat → Rani Ghat
- **Design approach:**
 - Permeable walkways with native tree cover
 - Interpretive signage narrating mythology, history, and river ecology
 - Seating, shaded rest points, and viewing decks at key nodes
- **Function:**
 - Supports daily recreation and walking

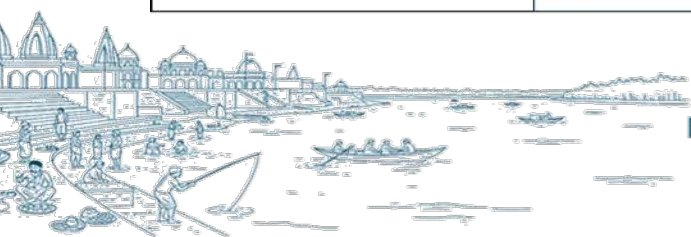
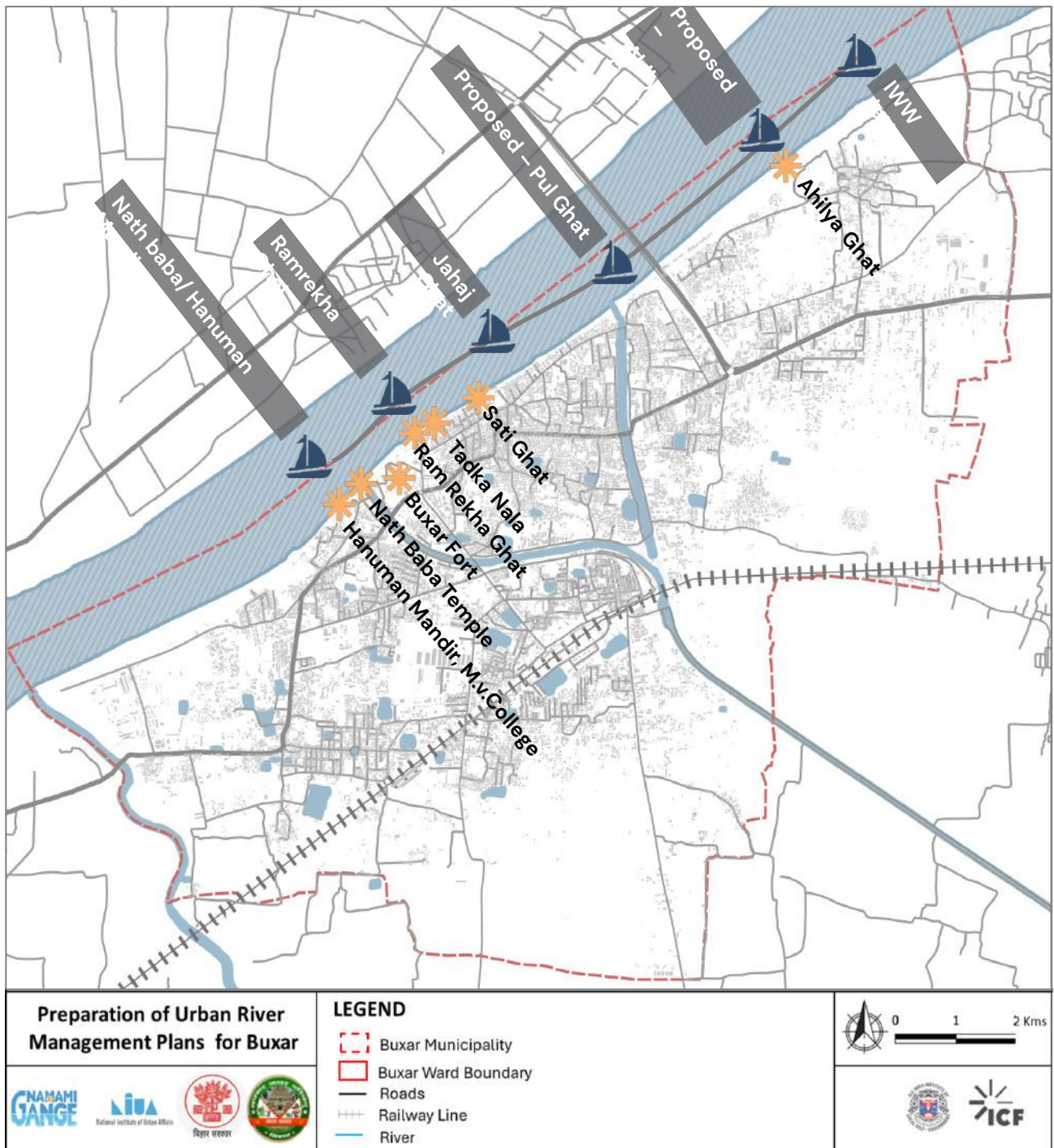


- Enables guided heritage walks and school visits
- Integrates festivals, aartis, and cultural events into a walkable circuit

Heritage Boat Circuit

Complementing the land trail, the Heritage Boat Circuit introduces a 45–60 minute water-based experience that activates the river itself as a cultural and economic asset. This circuit leverages clean, safety-certified boats and structured narration to transform short river journeys into immersive storytelling experiences.

Map 19: Conceptual Plan of the Heritage Boat Circuit



Key characteristics:

- **Duration:** 45–60 minutes per loop
- **Clean mobility:** Electric or low-emission boats, safety-certified and regulated
- **Narration model:** Audio guides and trained local guides (including women guides such as “Ganga Sakhis”)

Proposed stops and themes:

- **Ahilya Ghat:** Mythology and origin narratives
- **Eco-Park:** Biodiversity and river ecology interpretation
- **Ram Rekha Ghat:** Aarti deck and living cultural practices
- **Buxar Fort:** Museum access and historical exhibitions
- **Nath Baba Ghat:** Temple hub and pilgrimage narratives
- **City Park:** Recreation and urban riverfront life

The boat circuit supports **eco-tourism, local employment, and off-season economic activity**, while also distributing footfall and reducing pressure on a single ghat or node.

Cost Estimate

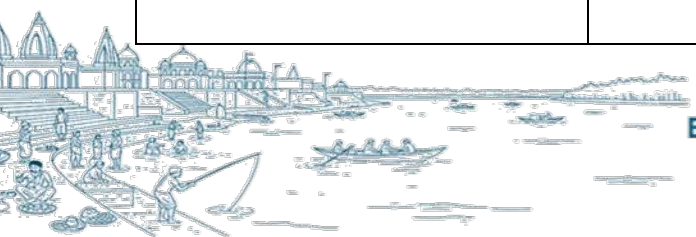
The cost estimate of ₹85–120 crore covers Phase 1 modifications (2.8 km, ₹25–35 crore) to integrate URMP eco-principles into existing BUIDCO DPR plus full Phase 2 development (5.6 km, ₹60–85 crore) across four functional zones with node-based activity clustering, drain treatment at outfalls, continuous permeable walkways (8.4 km), 4 passenger jetties, Heritage Walk (2.5–3 km), and Heritage Boat Circuit infrastructure. This aligns with NMCG riverfront benchmarks (₹10–15 crore/km for eco-sensitive developments vs. ₹20+ crore/km for hardscaped projects),

5.7.3.2. Intervention 7-2: Eco-Ghat Design Guidelines and Riverfront Regulations

This intervention proposes the formulation and statutory adoption of **city-level Eco-Ghat Design Guidelines and Riverfront Regulations**, applicable uniformly to all existing ghats, newly proposed ghats, jetties, promenades, and river-adjacent public spaces in Buxar. The core intent is to ensure that **riverfront development and economic activation occur within clearly defined ecological and flood-sensitive limits**, avoiding the piecemeal, concrete-heavy, and extractive approaches observed in many riverfront projects.

Rather than prescribing site-specific designs, these guidelines would function as a **regulatory and design framework** embedded within the city’s planning and approval processes, guiding all future DPRs, tenders, and investments along the river corridor.

Intervention	Responsible Agency	Intervention type
Eco-Ghat Design Guidelines and Riverfront Regulations	UDHD and NMCG	Policy
Estimated Budget	Potential Funding Sources	Timeline
₹45–65 lakh	NMCG (Policy Component), UD&HD Bihar, AMRUT 2.0	Short-term (1–2 years)



Key Design and Regulatory Provisions

The proposed guidelines are suggested to include the following provisions:

1. Materials and Surface Treatment

- Suggested use of permeable paving (stone setts, gravel grids, compacted earth) in all ghat forecourts, promenades, and access paths to reduce runoff and improve infiltration.
- Preference for local, low-carbon materials such as stone, brick, lime-based mortars, bamboo, and timber, avoiding extensive RCC surfaces except where structurally unavoidable.

2. Flood-Responsive Ghat Design

- Minimal-concrete access ramps and steps, designed to withstand periodic inundation without structural damage.
- Bamboo or timber railings, removable fixtures, and modular elements that can be repaired or replaced after floods.

3. Ritual Waste and Sanitation Management

- Mandatory provision of segregated ritual-waste collection systems at all ghats, including dedicated bins for flowers, organic offerings, and non-biodegradable waste.
- Designated zones for temporary ritual activities to prevent direct discharge into the river.
- Integration of bio-toilets or decentralised sanitation units, located outside flood-prone areas.

4. Gender-Responsive and Inclusive Design

- Adequate lighting, seating, and clear sightlines to improve safety, particularly during early morning and evening hours.
- Separate, well-maintained toilets for women, with child-friendly and elderly-friendly access.
- Shaded seating and resting areas to support inclusive use across age groups.

5. Riparian and Landscape Integration

- Mandatory integration of native riparian vegetation as a continuous design layer along ghat edges and promenades.
- Use of grasses, shrubs, and trees suited to floodplain conditions to stabilize banks, filter runoff, and soften hard edges.
- Prohibition of ornamental, water-intensive, or invasive plant species.

Cost Estimate

The cost estimate of ₹45–65 lakh covers preparation and statutory adoption of city-level Eco-Ghat Design Guidelines including consultant-led framework development (₹25–30 lakh), stakeholder workshops across 20+ ghats (₹10 lakh), legal drafting for UDHD notification (₹5–8 lakh), and dissemination/training for Buxar Nagar Parishad and developers (₹5–10 lakh). This aligns with AMRUT 2.0 policy framework costs for small cities and NMCG urban planning guidelines, comparable to similar regulatory documents prepared for Patna and other Ganga basin ULBs under state UD&HD technical assistance programs.

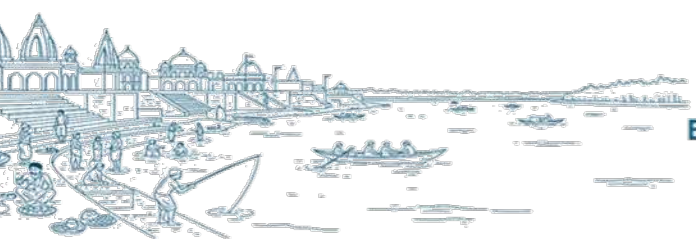
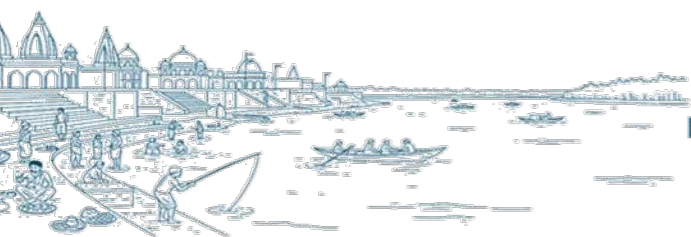


Figure 35: Reimagination of Buxar Riverfront if designed as per suggested Eco-Ghat Design Guidelines



5.8.Objective 9 & 10: River Sensitive Behaviour and Engage Citizen in River Management

Rationale: Objectives 9 and 10 collectively focus on cultivating river-sensitive behaviour and institutionalising citizen participation in river management. The focus is on building a shared culture of stewardship where citizens recognize the benefits of healthy rivers and their role in protecting them. Irresponsible waste disposal, overuse of water, and lack of awareness about river ecology all undermine formal efforts. Further, Objective 10 calls for citizens to become active participants in river management. Community groups, NGOs, and volunteers can be mobilized for monitoring, clean-up, and stewardship activities, which become critical for maintaining ecological assets in urban settings.

5.8.1. Existing Situation

The Buxar Nagar Nigam is largely responsible to implement IEC efforts in the region. However, this is mostly limited to messaging / painting on waste management and anti-littering. Programs under Swachh Bharat Mission, the city conducts mass messaging through broadcasting along with school awareness campaigns. ~₹1 crore spent on media and IEC campaigns within Buxar)¹³. At Ramrekha Ghat, visible public art with clear anti-littering messages has been installed, supporting respectful river use. The forest department has also undertaken afforestation programs and successfully planted over 500,000 trees across 136 panchayats within Buxar District with strong participation from youth and women. Further under the Community Mobilization for Sewerage Project (2013), awareness campaigns included sensitization meetings at temples, ghats, schools, and ULB officer trainings. Localised efforts in cleaning riverfronts and inland water bodies are undertaken by few temples committee, limited to their premises. There is active participation in clean-up drives, plantation, and awareness events, and grassroots groups (Jeevika, youth clubs) contribute to monitoring.

Key Gaps

Although several initiatives have been undertaken to raise citizen awareness, these efforts are largely confined to solid waste management and expressed through public art or messaging such as posters and paintings. However, there is a noticeable absence of any river-specific sensitisation or awareness programmes. Formal integration of citizens into decision-making processes and committees is absent, which constrains long-term ownership. While there have been isolated attempts at the district level, they remain fragmented. Further there is limited use of digital platforms to conduct any awareness programs. Buxar's riverfront has active riverfront for religious purposes however lacks homogenous awareness. There is no mandatory project level requirement to integrate IEC efforts within project (for eg: the 2013 BUIDCO Sewerage project had components of IEC), widening the gap.

¹³ Municipal Records (expenditure), 2023

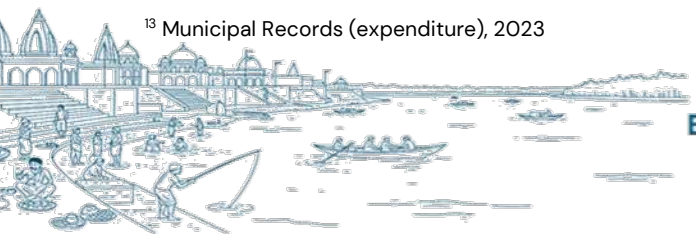


Figure 36: Various Citizen Engagement Activities conducted in Buxar



Community Mobilization Report Under the Sewerage Project

Public Art and Messaging at the Nagar Parishad Office Building highlighting Aquatic Life

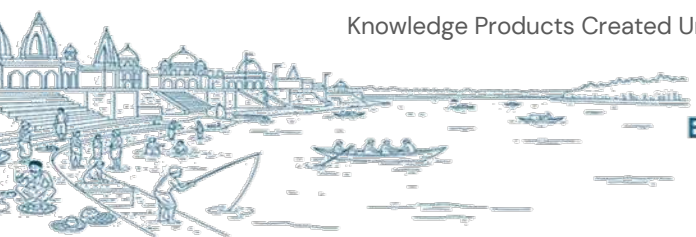


Water Sensitization activities in School

Waste Management Messaging at the Nagar Parishad Office Building



Knowledge Products Created Under the Buxar Sewerage Community Programme



5.8.2. URMP Score

Citizen sensitization Score (Objective 9):

Based on baseline assessment, site visits, and stakeholder consultations, Buxar achieves a high level of citizen sensitization, with a points of **58 out of 100.**, translating to a score of **4** . The city demonstrates strong use of traditional IEC tools such as murals, hoardings, and school-based awareness programmes, and river-related messages are partially integrated into broader sanitation campaigns. However, the absence of a dedicated, sustained river-specific IEC programme, lack of a city-level river information portal, and limited use of digital platforms constrain deeper behavioural change and long-term ownership

Citizen Engagement Score (Objective 10):

Buxar receives a high citizen engagement score of **4**. While community groups, youth clubs, SHGs, and schools actively participate in periodic clean-up drives and plantation activities, citizens are not formally involved in river health monitoring or decision-making processes. There is no structured mechanism for citizen representation in statutory committees or for systematic reporting and follow-up of river-related grievances, indicating a need for institutionalisation of engagement.

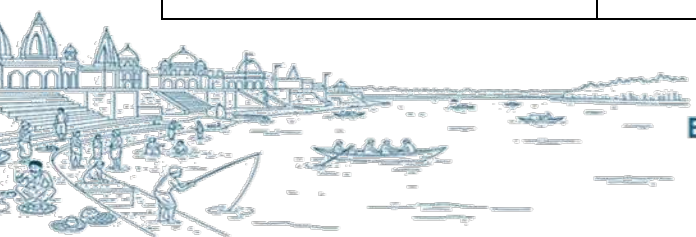
5.8.3. Interventions

5.8.3.1. Intervention 9-1: River based sensitisation program

An all-in-one sensitisation programme to manage all the water resources in the city, is the next step towards enhancing the existing sensitisation activities. While this holistic approach explores multiple avenues of public engagement, this shall also ensure involving different stakeholders like locals, youth, industrialists and farmers. Lastly, it is also essential to run these programmes for all water features in the city

This would be a yearly programme to be under the management of the City's- Solid waste department and NMCG nodal officer. The preparation of plan, management and execution would be undertaken in close coordination with District Ganga Planning Committee and would be submitted to them yearly as a part of the budget

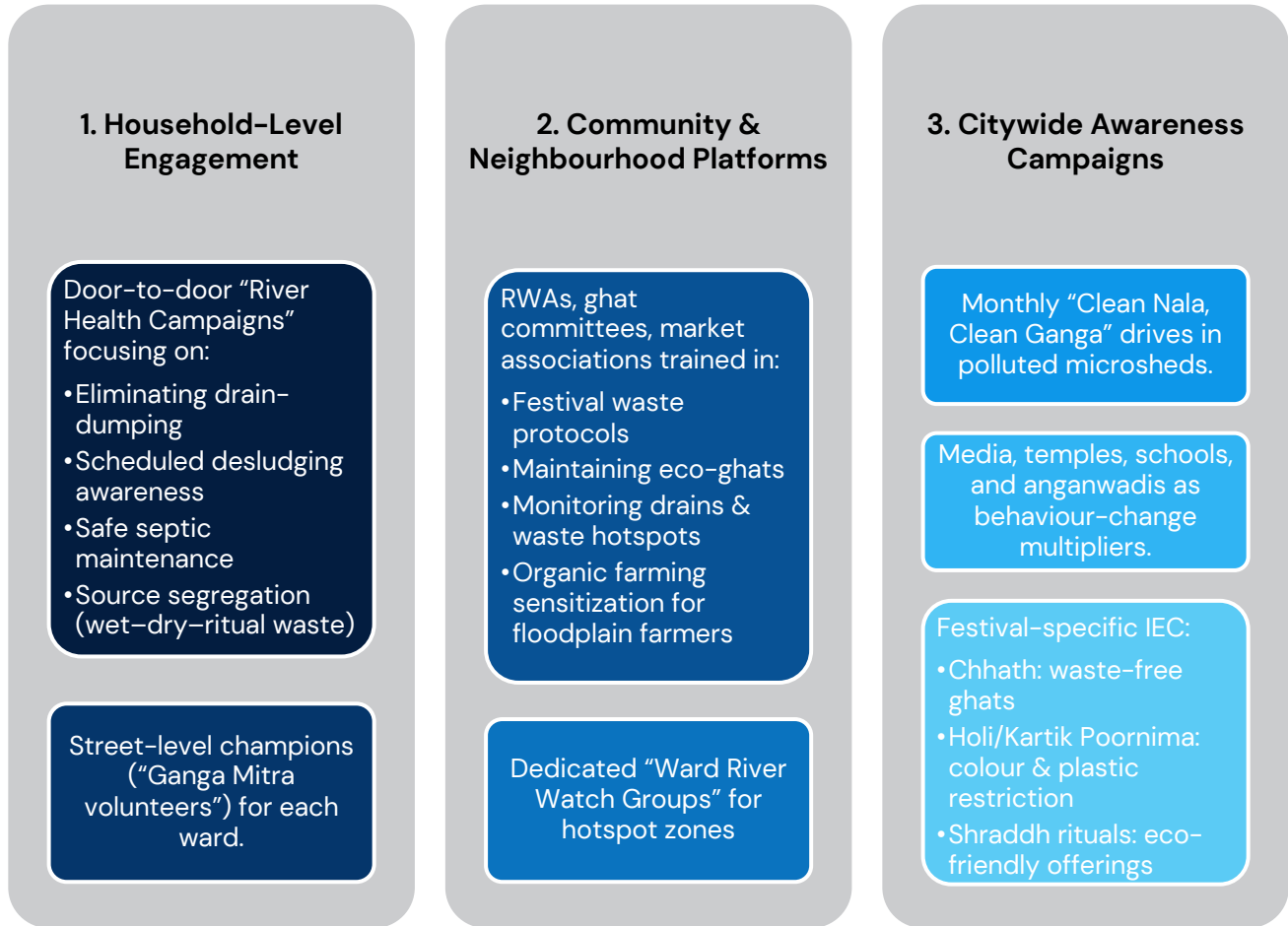
Intervention	Responsible Agency	Intervention type
River based sensitization program	Nagar Parishad	Policy/ Program
Estimated Budget	Potential Funding Sources	Timeline
41.4 lakhs	NMCG, Nagar Parishad	1-2 years



A detailed break-up of the cost is given in Annexure 3.2		
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Key Components:

A **three-tier citizen engagement framework** that systematically embeds river-sensitive behaviour at the household, community, and citywide levels. The framework recognises that sustained river protection cannot rely solely on infrastructure or enforcement, but requires continuous behavioural reinforcement across scales, particularly in a city where drains, ghats, and inland waterbodies remain closely interlinked with daily domestic and cultural practices.



At the household level, engagement focuses on addressing pollution at source through targeted door-to-door "River Health Campaigns." These campaigns would emphasise eliminating drain dumping, improving source segregation of wet, dry, and ritual waste, promoting scheduled septic tank desludging, and encouraging safe household wastewater practices. To ensure continuity beyond short-term campaigns, each ward would identify and train street-level champions or "Ganga Mitras," who would act as local points of contact for awareness, monitoring, and grievance reporting.

At the community and neighbourhood level, the framework leverages existing collective institutions—such as resident welfare associations, ghat committees, market associations, self-help groups, and farmer collectives—to translate awareness into coordinated action. These groups would be trained in festival waste management protocols, eco-ghat maintenance, monitoring of drain dumping and waste hotspots, and river-sensitive agricultural practices in floodplain areas. Dedicated "Ward River Watch Groups" would be constituted in pollution-prone zones to support periodic clean-ups, early reporting of violations, and liaison with municipal departments.



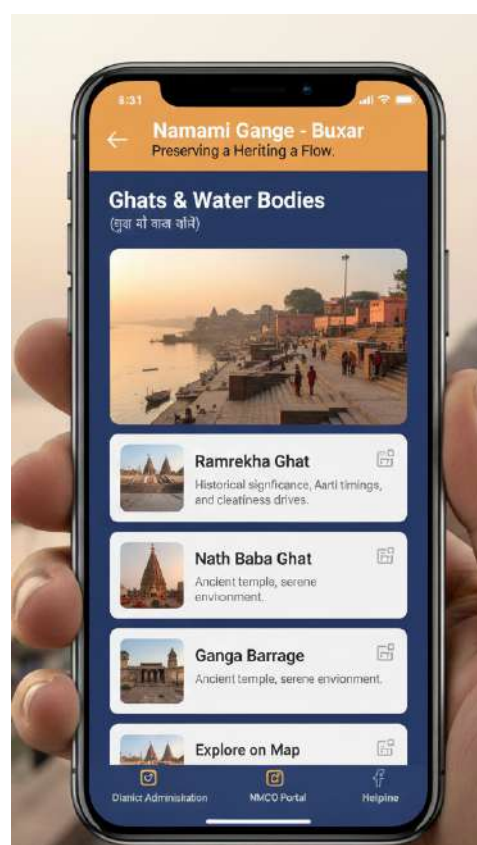
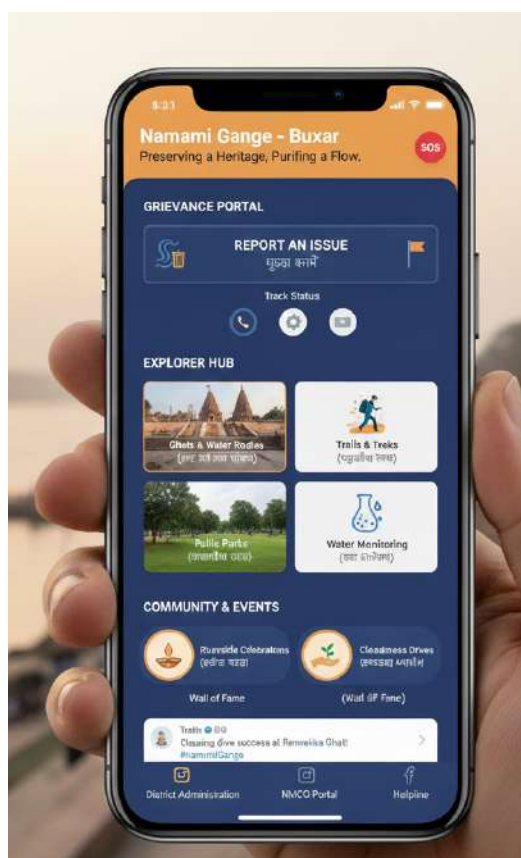
At the citywide level, periodic and thematic awareness campaigns would reinforce shared responsibility for river health and normalise compliance during high-impact periods. Monthly “Clean Nala, Clean Ganga” drives would be conducted in identified micro-watersheds, supported by coordinated messaging through media, temples, schools, anganwadis, and local institutions. Festival-specific IEC—such as waste-free ghats during Chhath, restrictions on plastic and chemical colours during Holi and Kartik Poornima, and eco-friendly offerings during Shraddh rituals—would target peak pollution windows.

5.8.3.2. Intervention 9-2: “Namami Gange-Buxar” app

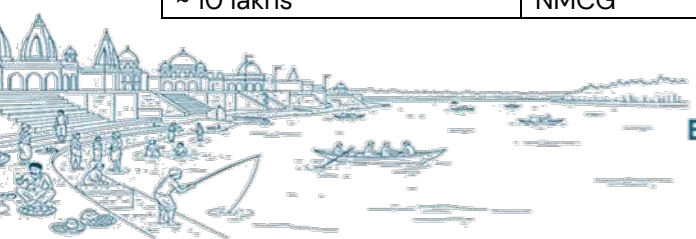
Design a ‘Namami Gange- Buxar’ mobile application to record and report grievances by citizens on river-related matters. These could include solid waste and liquid waste dumping, littering, damage to public infrastructure, issues regarding any service of agencies.

Apart from the above features, the application can host large amounts of information regarding the city’s water resources. Following information can directly be added to the app:

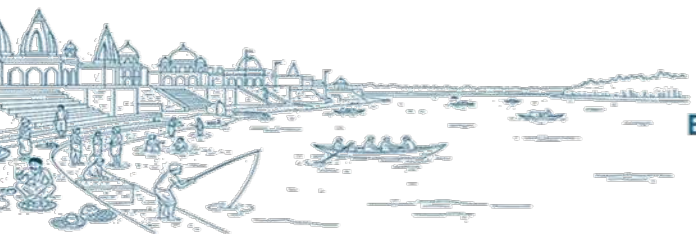
- Details of city’s water features
- Information about water features, Hiking trails/ treks, Public parks
- Water quality monitoring and waste dumping
- Details of public celebrations and drives for river management
- Links to social media



Intervention	Responsible Agency	Intervention type
Namami Gange-Buxar	District Ganga committee Buxar Municipal Council- Solid waste department for Grievance	Project
Estimated Budget	Potential Funding Sources	Timeline
~ 10 lakhs	NMCG	Short-term



	SBM	
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6. M&E Plan

6.1. Purpose and Rationale

The Monitoring and Evaluation (M&E) Plan for the URMP for Buxar establishes a structured mechanism to track implementation progress, assess outcomes, and guide adaptive management across all URMP objectives. The plan aligns with the URMP framework issued by NMCG and NIUA, and translates the framework's indicators into an actionable city-level monitoring system.

The URMP Index serves as the central evaluative tool, allowing Buxar to assess its performance over time and benchmark progress against baseline conditions established under this study.

6.2. Monitoring Framework and Approach

Monitoring under URMP Buxar follows a hybrid quantitative–qualitative approach, combining spatial analysis, infrastructure performance data, environmental monitoring, and institutional/process indicators.

Key principles guiding the M&E framework include:

- **Outcome-oriented monitoring**, focusing on improvements in river health and urban resilience rather than only asset creation;
- **Indicator-based assessment**, using standardized URMP indicators to ensure comparability;
- **Phased baseline development**, with initial baselines refined within the first six months of implementation; and
- **Adaptive governance**, enabling mid-course corrections based on monitoring results.

Monitoring will be undertaken at multiple temporal scales—monthly, annual, and multi-year—depending on the nature of the indicator.

6.3. URMP Indicators for Buxar

Implementation progress under URMP Buxar shall be monitored using the ten indicators prescribed in the URMP framework. These indicators collectively capture environmental, infrastructural, governance, and socio-economic dimensions of river management.

Table 4 :URMP Progress Monitoring indicator for Buxar

S. No.	Indicator	Basis of Assessment	Monitoring Frequency
1	Floodplain Management Score	Qualitative assessment of regulation, zoning, and enforcement in floodplains	Annual
2	Net Dissolved Oxygen (DO) Score	Difference in DO levels between upstream and downstream river stretches	Monthly
3	Waterbody Revival Score	Proportion of assessed waterbodies in acceptable ecological condition	Annual
4	Riparian Buffer Score	Length of riverbank protected by minimum-width vegetated buffers	Annual



5	Wastewater Reuse Score	Percentage of treated wastewater reused for non-potable purposes	Monthly
6	Return Flow Score	Quantity and quality of treated water returned to the river	NA
7	Eco-Friendly Riverfront Score	Qualitative assessment of social, ecological, and economic performance of riverfront projects	Annual
8	River Economy Score	Number and diversity of eco-friendly river-based economic activities	Annual
9	Citizen Sensitisation Score	Modalities and outreach mechanisms for river awareness	Annual
10	Citizen Engagement Score	Degree of community participation in river management activities	Annual

6.4. Baseline Development and Data Sources

For Buxar, baseline values for most indicators have been established as part of the URMP Baseline Assessment (2025). However, select indicators, particularly those related to **return flows**, **reuse**, and **river economy outcomes**, will require refinement once key infrastructure (STPs, Eco-Nalas, riverfront projects) becomes operational.

Primary data sources include:

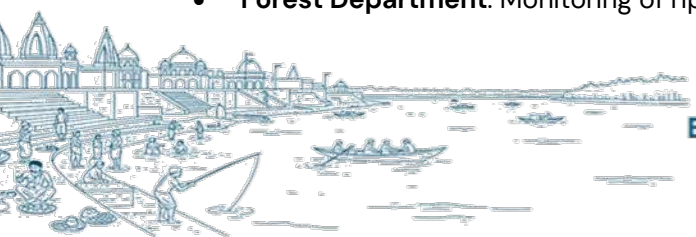
- Water quality monitoring stations (DO, BOD, COD);
- GIS-based spatial datasets (floodplains, riparian buffers, waterbodies);
- STP operational data and reuse volumes;
- Project progress reports from implementing agencies;
- Periodic field surveys and stakeholder consultations.

Satellite-based tools such as NDVI analysis will be used annually to track riparian vegetation health and detect degradation trends early.

6.5. Institutional Roles and Responsibilities

Effective monitoring requires clear institutional ownership. The following institutional arrangement is proposed:

- **Buxar Nagar Parishad:** Nodal agency for overall M&E coordination, data consolidation, and reporting.
- **District Ganga Committee (DGC):** Oversight, inter-departmental coordination, and escalation of issues.
- **State Pollution Control Board (BSPCB):** Water quality monitoring and compliance verification.
- **Water Resources Department / PHED:** Data on flows, drainage, and treatment infrastructure.
- **Forest Department:** Monitoring of riparian buffers, plantations, and ecological assets.

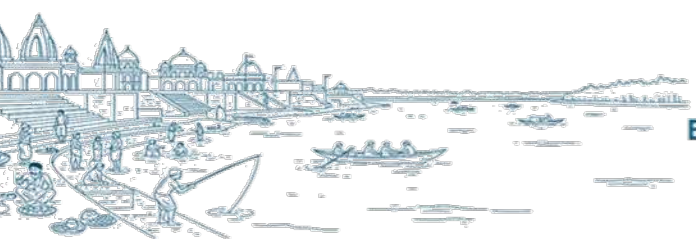


- **Tourism and Fisheries Departments:** Tracking river-based economic activities.
- **Ward Committees and Community Groups:** Inputs for citizen engagement and sensitisation indicators.

6.6. Outcomes of the Monitoring and Evaluation Framework

The URMP Buxar Monitoring and Evaluation Plan ensures that the city's transition from a pollutant discharger to a river steward is measurable, transparent, and accountable. By institutionalising regular tracking of environmental health, infrastructure performance, and socio-economic benefits, the framework enables Buxar to:

- Systematically improve river health outcomes;
- Demonstrate compliance with national river management goals;
- Strengthen inter-agency coordination; and
- Build a replicable model for medium-sized river cities in Bihar and beyond.



7. Annexures

Annexure 1: Policies Governing Floodplains in Buxar

National Policies and Judicial Orders

1. Model Bill for Flood Plain Zoning, Central Water Commission, 1975¹⁴: Proposed: proposed delineating the areas that are subject to flooding including classification of land with reference to relative risk of flood.
2. The National Green Tribunal (NGT) orders: Issued orders for demarcation and protection of floodplains, referencing standards such as the 1:100-year flood elevation plus contour buffers for accurate mapping and regulation. NGT has instructed Ganga basin states (including Bihar) to remove encroachments, regulate development, and ensure river rejuvenation. Some of important relevant orders are:
 - Order dated 13.07.2017 in the matter of O.A. No. 200 of 2014 – M C Mehta Vs Union of India : Established no-development zones (NDZs) within 100 meters of the river edge and prohibited waste dumping within 500 m of the Ganga and imposed environmental compensation. (note – NDZ provisions have not been notified for Bihar.)
 - Indian Council for Enviro-Legal Action vs NGRBA & Ors (2015): Mandated segment-wise rejuvenation of the Ganga (Bihar under Phase III/IV), with time-bound actions for drains, STPs, CETPs, and demarcation of floodplains.
3. Draft Notification for River Regulation Zones, Ministry of Environment, Forests and Climate Change (MOEF & CC), February 2016: intended to regulate developmental and industrial activities upto 5 kms from the banks of the river stretches having floodplains and an equivalent area for mountain/ hill stretches under three River Conservation Zones (RCZ) demarcated with reference to the Highest Flood Level (HFL) with a 100 year return period. Draft Notification for River Regulation Zones, Ministry of Environment, Forests and Climate Change (MOEF & CC), February 2016: Intended to regulate developmental and industrial activities up to 5 kms from the banks of the river stretches having floodplains and an equivalent area for mountain/ hill stretches under three River Conservation Zones (RCZ) demarcated with reference to the Highest Flood Level (HFL) with a 100 year return period. Further the river stretches and their tributaries are classified into three categories namely floodplain rivers, seasonal rivers and mountain rivers/hill streams.

Table 5: Defined flood plain zones , Draft Notification for River Regulation Zones, MOEF&CC, 2016

No	Demarcation	Zones	Flood frequency
1	RCA-PA	Prohibited Activity Zone – areas which are subjected to frequent flooding and are most vulnerable to adverse impacts of human activities. In case of the presence of embankments in the floodplain area, then this zone would extend from the riverbank to the present outermost	up to 500 meters from the highest flood level in past 50 years

¹⁴ <https://www.ielrc.org/content/e7503.pdf>



		embankment and further a 100m buffer is provided outside that embankment.	
2	RCA-RA I	Restricted Activity Zone – include the floodplain areas which are less frequently affected by the floods and lie farther from the river.	Outer limit of prohibited zone to 1 kilometre
3	RCA-RA II	Regulated Activity Zone – extends up to 3 km from the outer limits of the restricted activities zone. Certain activities will be permitted in this zone.	Outer limit of restricted zone to 3 kilometres

4. Technically guidelines on Flood plain zoning, Central Water Commission, Department of Water Resources, River Development & Ganga Rejuvenation, Ministry of Jal Shakti, July 2025¹⁵

- **Immediate** Restrictions: Until floodplain identification and demarcation are completed, no activity is permitted within 100 meters of the river edge, designated as a No-Development/Construction Zone. States and UTs may be given phased compliance, with exceptions permitted for essential infrastructure such as railway lines, bridges, and public utilities.
- Defining River's Edge: For enforcement purposes, the "river edge" may be determined by adopting either the maximum dry-season waterline or the maximum flood line recorded during the past five years

Table 6: Flood zones and prohibited activities, Technical Guidelines on flood plain zoning, Central water Commission, 2025

No	Demarcation	Flood frequency	Zones	Prohibited Activities
1	Protected Zone (both rural and urban areas)	Up to 1 in 5 years	Active flood zone and subjected to most frequent flooding.	i. All kinds of permanent construction including addition of floor area/elevation of any existing structure except Civil and Railways Infrastructures (Embankments/Bridges specifically for railway infrastructure with adequate safety measures, Flood/Bank protection works, but the construction of new embankments remain prohibited activity) ii. Any construction disturbing the natural course of the river channel except Essential Services and Infrastructure (gas/petroleum lines, power line transmission pylons, pipelines for water supply, bridges and barrages/construction of ghats, green-riverfronts, and jetties for navigation) and Temporary Structures (Defence establishments, disaster management activities due to natural calamities, religious and socio-cultural activities, recreational activities not requiring the erection of any permanent structures) iii. Dumping of solid waste/creation of landfills

¹⁵ https://nmcg.nic.in/writereaddata/fileupload/56_Tech%20Guidelines_Full.pdf



No	Demarcation	Flood frequency	Zones	Prohibited Activities
				iv. Storage of highly volatile, inflammable, explosive, toxic materials v. Establishment of large-scale commercial or industrial facilities except Sustainable Activities such as groundwater withdrawal by handpumps for non-commercial uses, traditional organic farming, traditional fisheries, grazing by animals and eco-friendly tourism and Permanent Utilities such as Parks, Playgrounds, Gardens, discharge of domestic wastewater after treatment.
2	Regulatory zone (both rural and urban areas)	Between 1 in 5 year and 1 in 25-year	Activities in this zone will be regulated. The severity of flood in this area will be lesser than that of the Protected zone	i) Residential settlement except Public Institutions, Government offices, Universities and Educational Institutions without residential facilities, public libraries, sewage treatment plants, community halls, subject to the condition that the Minimum plinth level of the building should be above the level corresponding to the 1 in 100 -year flood and subject to earthquake safety and the ground floors of such facilities can be utilized for non - residential purposes and controlled afforestation and conservation projects to enhance green cover without disrupting the natural flood flow of the river ii) Critical Defence Installations iii) Construction of basements
3	Warning Zone (only Urban areas)	Between 1 in 25 year and 1 in 100 year	Outermost zone in which most of the activities can be permitted by mapping their vulnerability so that that risk flooding hazards remain minimal	i) Hazardous Waste producing chemical industries except other industries, public utilities like hospitals, power installations, water supply, telephone exchanges, railway stations, airports, commercial centers, etc. subject to the condition that the minimum plinth levels of structures should correspond to 1 in 100-year flood. ii) Nuclear Plants

Note - Demarcation of floodplain corresponding to 100-year return period flood shall necessarily be done for both urban and rural areas

Governing policy-Governing policies / guidelines at State Level:

1. **Notification on Flood plain zoning, Water Resource Department, Bihar (March 2025):** Given that the State is currently in the process of determining the High-flood line (red and blue lines) and flood plain zones, it has directed temporary provisions to demarcate flood plain zones with uses as "prohibited zone". The current notification is Phase -1 and is applicable for cities with rivers having exiting embankment. Refer Annex 1 for the notification.

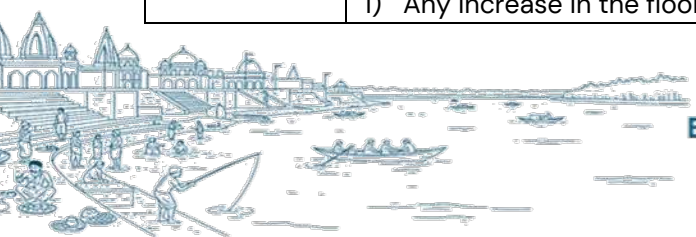
Defining "flood plain zones":



- For rivers with existing embankment on both edges, the embankment will be considered as the flood line, and the area in between will be considered as flood plain zone
- For rivers having embankment only on one side of the river, the area from the embankment including the width of the river and 500 meters from the river edge of the other side, will be considered as flood plain zone
- Flood plain zones area earmarked as “Prohibited zone”

Table 7: Permissible activities in the Flood plain zone, WRD Bihar Notification, 2025

Demarcation	Permissible activities in the Prohibited Zone
Prohibited Zones- Flood plain zones	i. Traditional organic and natural farming, in which no type of agricultural chemicals or heavy machinery is used. ii. Parks, playgrounds, gardens, recreational activities, etc., in which no permanent structure is constructed/installed. iii. Traditional fish farming, in which no chemicals, toxic substances, explosives, or electricity connections are used. iv. Pasture for grazing animals. v. Extraction of groundwater from hand pumps for domestic and other non-commercial uses. vi. Construction of temporary/mobile structures related to defence after taking permission from the concerned competent authority. vii. Construction of structures related to flood protection. viii. Construction for essential services such as gas/petroleum pipelines, power line transmission towers, water supply pipelines, bridges, and barrages. ix. Construction of temporary/mobile structures and housing for special situations like natural calamities and disaster management. x. Discharge of domestic wastewater from cities or towns after treatment as per prescribed standards. xi. Religious and socio-cultural activities (such as Kumbh Mela, puja rituals, etc.) and their related purely temporary/movable structures, but only during the non-monsoon season. xii. Construction of temporary/movable jetties and riverfront. xiii. Eco-friendly tourism activities, which do not involve the construction of permanent structures and include nature-friendly practices such as the use of non-diesel motorboats. xiv. Construction of new railway infrastructure like embankments/bridges with adequate protection. xv. Plantation of local trees/shrubs for commercial use. xvi. Permission for Regulated Sand/ Stone/ sediment/ river borne material mining as per the guidelines of Ministry of Environment, Forest and Climate Change, Government of India and rules laid down by the State Government from time to time. xvii. Essential repairs to buildings already constructed, but not including any expansion/new construction will be prohibited. - xviii. Works related to STP, Conservation and NMCG. xix. Construction of completely temporary/mobile buildings, dwellings and structures which can be unfolded or moved in their original form, keeping in view the existing riverbank, except for a distance of 250 metres from the riverbank. NOT PERMISSIBLE in Prohibited zone: i) Any increase in the floor area or height of any existing structure of any kind.

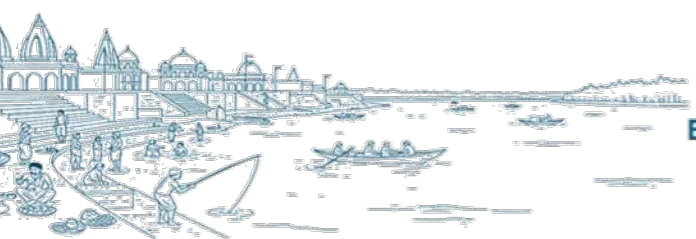


Demarcation	Permissible activities in the Prohibited Zone
	ii) Dumping of solid waste/creation of landfills. iii) storage of highly volatile, flammable, explosive, toxic substances. iv) Establishment of large-scale commercial or industrial facilities. v) Construction activities obstructing the natural course of the river channel, except those permitted.

1. [Bihar State Pollution Control Board \(BSPCB\) Directives](#): regulate effluent discharge, sand mining, and solid waste in floodplain-adjacent wards, but enforcement capacity is thin in smaller cities like Buxar
2. [State Disaster Management Plan \(2015, updated 2021\)](#): Identifies flood-prone districts and stresses non-structural measures, but implementation remains limited.
3. [Draft Floodplain Zoning Considerations](#): Bihar has initiated consultations for adopting a state-specific floodplain zoning act, but as of 2025, no legislation has been notified
4. [Jal Jeevan Hariyali Mission](#): Bihar's flagship program for water conservation and climate resilience, focusing on the rejuvenation of water bodies, check dams, rainwater harvesting, afforestation, and sustainable farming.

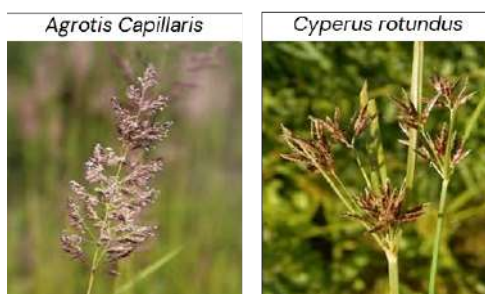
Local Level Provisions

- Buxar lacks a fully notified Development Plan or floodplain zoning overlay. A masterplan is currently being drafted.
- The Nagar Parishad has supported embankment construction in certain stretches but has not developed bye-laws on permissible activities



Annexure 2: Approved Native Species List for Buxar

A. Grasses and Sedges (Suitable for frequently inundated zones; erosion control)



B. Shrubs and Herbs (Suitable for moderately flooded zones; runoff filtration and biodiversity support)

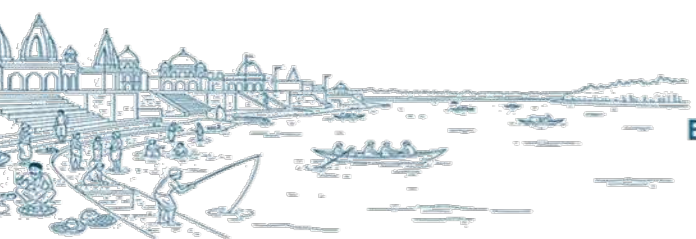


C. Trees (Suitable for higher floodplain edges; bank stabilisation and habitat)

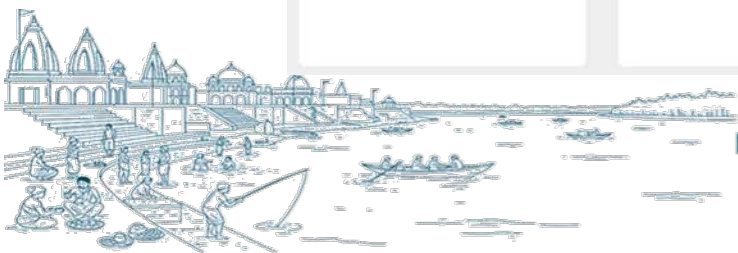
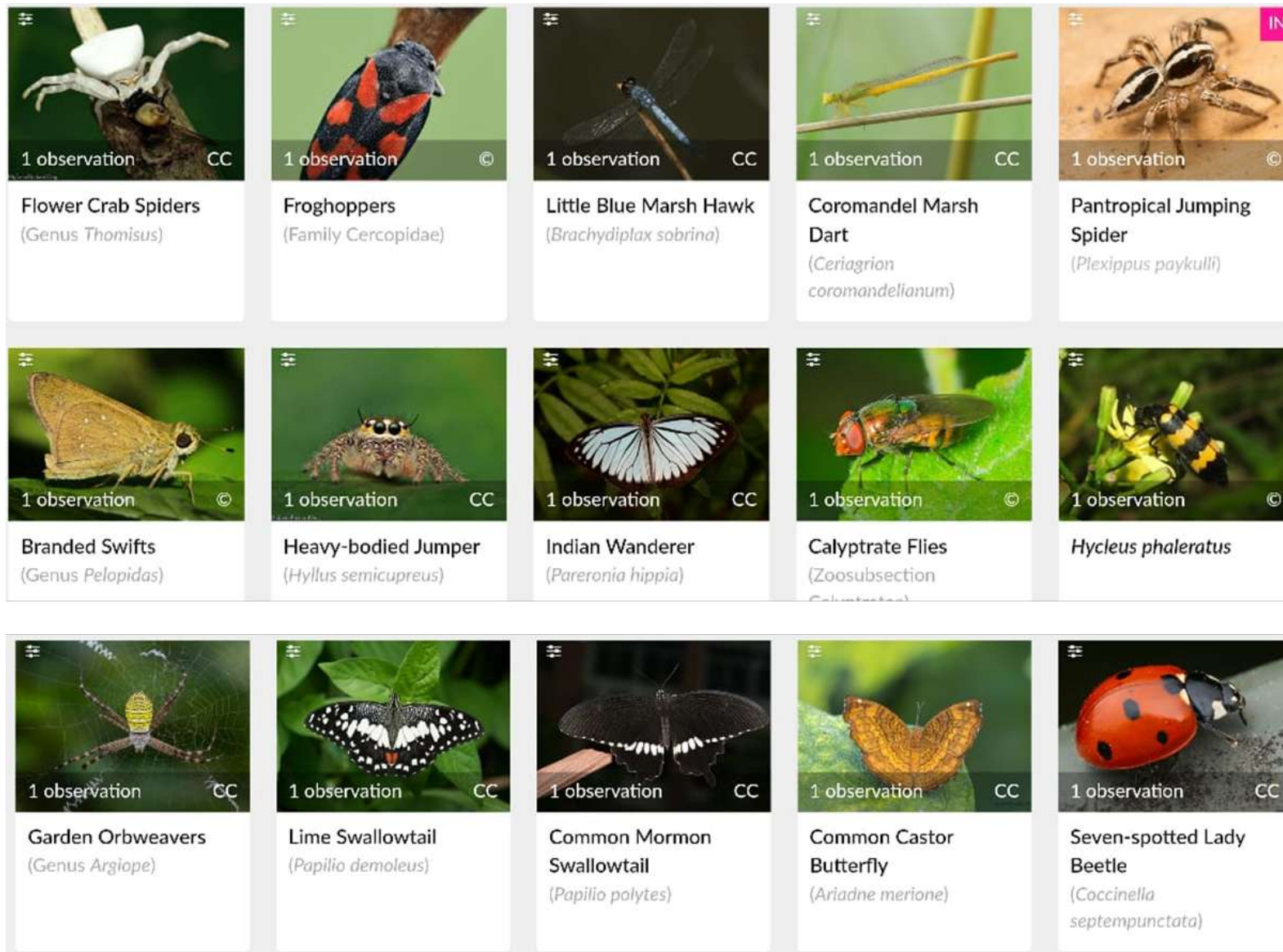


Using the **iNaturalist**(<https://www.inaturalist.org/>) website which is a global citizen science platform that allows users to record, identify, and share observations of plants, animals, fungi, and other organisms using photographs, sound recordings, and location data.

In the context of an Urban River Management Plan, iNaturalist can serve as a practical tool for building and updating ecological evidence at the river-corridor scale. Observations along the river and its floodplain can help document riparian vegetation, aquatic and semi-aquatic species, birds, insects, and invasive species, forming a baseline of urban river biodiversity that is often missing in conventional surveys. Spatial patterns from iNaturalist data can highlight ecologically sensitive stretches, degraded reaches, or biodiversity refuges that warrant protection or restoration. Over time, repeated observations can support monitoring of river health, assess outcomes of interventions such as riparian buffers or wetland restoration, and enable community participation in stewardship, strengthening both ecological management and public ownership of the river system.



Common Fauna



Common Flora



Golden Pothos
(*Epipremnum aureum*)



Cannabis
(*Cannabis sativa*)



Aroma
(*Dichrostachys cinerea*)



Giant Crepe-Myrtle
(*Lagerstroemia speciosa*)



Blue Pea
(*Clitoria ternatea*)



Indian Rosewood
(*Dalbergia sissoo*)



Orange Jasmine
(*Murraya paniculata*)



Popping Pod
(*Ruellia tuberosa*)



Bengal Quince
(*Aegle marmelos*)



**Night-flowering
Jasmine**
(*Nyctanthes arbor-tristis*)



Indian Banyan
(*Ficus benghalensis*)



Sacred Lotus
(*Nelumbo nucifera*)



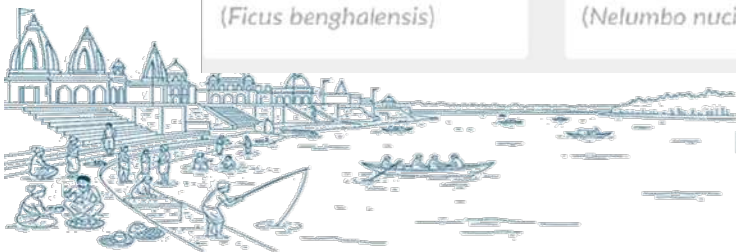
Bellyache Bush
(*Jatropha gossypifolia*)



Genus Pterygota



Grasses
(Family Poaceae)



Annexure 3: Costing

Annexure 3.1: BOQ for waterbody rejuvenation

S.No	Item	Unit	Quantity	Rate (NPR)	Cost (NPR)	Notes
Path and Surrounding Areas						
1	Low-height fencing / green hedge with entry gates	meters	362.9	350 ¹⁶	127,015	GI chain link fencing with hedge – Bihar construction standard rates
2	Stone/ Natural Path	meters	287.7	800 ¹⁷	230,160	Stone pitching/paving work – Labor + Material per Bihar rates
3	Solar lights @ every 10m	No.	35	18,000 ¹⁸	630,000	Basic solar LED park lights for safety and visibility.
4	Benches @ every 25 m	No.	15	20,000 ¹⁹	300,000	RCC/metal benches at key viewing and rest points.
5	Waste bins	No.	5	7000 ²⁰	35,000	Paired dry–wet litter bins near entries and seating areas.
6	Collection points for flowers & puja waste	No.	1	6000 ²¹	6000	Simple masonry/metal receptacle to avoid direct dumping into water.
7	Signage, IEC boards & pond rules display	Lumpsum	1	35,000 ²²	35,000	Awareness boards explaining functions and Do's/Don'ts.
8	Native Plantation	Lumpsum (Sqm)	290	517	150,000	Including saplings, soil, labor – Average 50–60 plants mix
TOTAL					INR 1,513,175	
Water Spread Area						
9	1st Desilting and sediment removal (incl. disposal)	Sqm	8,087	400 ²³	3,234,800	Mechanical / manual desilting, dewatering and safe disposal of sludge.
10	Drain interception chambers & diversion structures	No.	1	70,000 ²⁴	70,000	RCC chamber with diversion arrangement to route polluted flows through treatment.

¹⁶ <https://www.scribd.com/document/667044219/BCD-SOR-2023>

¹⁷ <https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf>

¹⁸ [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)

¹⁹ <https://www.tendertiger.co.in/global-keyword/chain-linked-fencing-tenders>

²⁰ [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)

²¹ https://swachhbharatmission.ddws.gov.in/sites/default/files/Technical-Notes/Compendium-on-LWM-Technologies_3.pdf

²² [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)

²³ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compedium-by-CDD.pdf>

²⁴ <https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf>



	Small-scale DEWATS / planted gravel filters	No.	1	240,000 ²⁵	240,000	Simple decentralised unit for polishing intercepted dry-weather flows.
	Physical trash traps at inlet / outlet points	No.	1	15,000 ²⁶	15,000	Fixed bar screen / trash rack to capture floating solids.
	Removal of invasive aquatic vegetation (initial cycle)	Sqm	8,087	70 ²⁷	566,090	Manual/mechanical weed removal to restore open water and habitat.
	Reed bed development	meters	294	700 ²⁸	205,800	Creation of shallow shelves with emergent vegetation for treatment and bank protection.
	Floating treatment wetlands (FTWs)	No.	3	30,000 ²⁹	90,000	Low-cost bamboo/HDPE raft modules with macrophytes for in-situ polishing.
	Floating aerators (solar/electric)	No.	2	90,000 ³⁰	180,000	Small aerator to support dissolved oxygen and circulation in stagnant pockets.
TOTAL					INR 4,601,690	
Water Edge						
	Stone pitching & edge stabilization	meters	294	850 ³¹	249,900	Protection of erosion-prone banks with stone pitching / rubble lining.
	Repair & cleaning of existing ghat steps	Sqm	344.6	120 ³²	41,352	Patch repair, re-pointing and cleaning of existing steps.
	Timber / composite boardwalk extending partially into pond	no.	1	120,000 ³³	120,000	Simple deck/viewing point to allow safe access and engagement.
TOTAL					INR 411,252	
Total Annual CAPEX					INR 65,26,117	

²⁵ <https://www.cseindia.org/cost-estimation-for-planning-and-designing-of-decentralised->

²⁶ <https://www.scribd.com/document/667044219/BCD-SOR-2023>

²⁷ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf>

²⁸ <https://www.cseindia.org/constructed-wetland-for-wastewater-treatment-at-indian-agriculture-research-institute-pusa-new-delhi-56>

²⁹ <https://www.indiawaterportal.org/governance-and-policy/governance/islands-float-delhi-lake>

³⁰ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf>

³¹ <https://bhel.com/sites/default/files/Revised%20SOR.pdf>

³² <https://www.cspdcil.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf>

³³ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf>



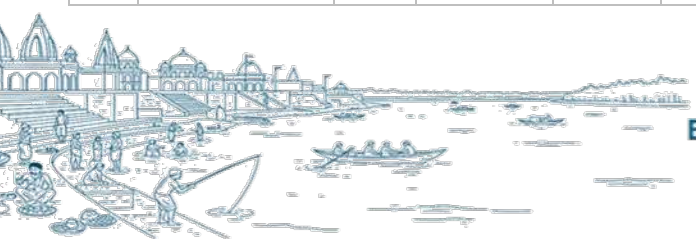
Annexure 3.2: BOQ for an Eco-nala Node

Assumptions:

- Water spread area $\approx 8,000 \text{ m}^2$ (0.8 ha).
- Treated water edge $\approx 290\text{--}360 \text{ m}$.
- Narrow access and landscape band $\approx 0.2\text{--}0.3 \text{ ha}$.
- Rates are indicative; final values to be adopted from prevailing SOR/market during DPR.

A. Path and Surrounding Areas

S. No.	Item	Unit	Quantity	Rate (INR)	Amount (INR)	Notes	Source
1	Low-height fencing / green hedge with entry gates	m	363	350	127,050	Simple barbed wire / angle posts with hedge planting along canal edge.	Bihar PWD SOR fencing items https://www.scribd.com/document/667044219/BCD-SOR-2023
2	Earthen / murrum path with stone edging	m	288	800	230,400	Compact path for access and O&M with stone edging at critical points.	PWD murrum path rates https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf
3	Solar lights @ ~20 m spacing	Nos.	18	18,000	324,000	Basic solar LED park lights for safety and visibility.	SBM solar lighting tenders [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf][4]
4	Benches @ ~40 m spacing	Nos.	10	20,000	200,000	RCC/metal benches at key viewing and rest points.	Smart city park bench rates https://www.tendertiger.co.in/global-keyword/chain-linked-fencing-tenders
5	Twin waste bins	Nos.	4	7,000	28,000	Paired dry-wet litter bins near entries and seating areas.	SBM waste bin procurement [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf][4]
6	Collection point for flowers & puja waste	Nos.	1	6,000	6,000	Simple masonry/metal receptacle to avoid direct dumping into water.	Ghat-side waste management https://swachhbaratmission.ddws.gov.in/sites/default/files/Technical-Notes/Compendium-on-LWM-Technologies_3.pdf
7	Signage, IEC boards & Eco-Nala rules	LS	1	35,000	35,000	Awareness boards explaining functions and Do's/Don'ts.	AMRUT/SBM IEC packages [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-

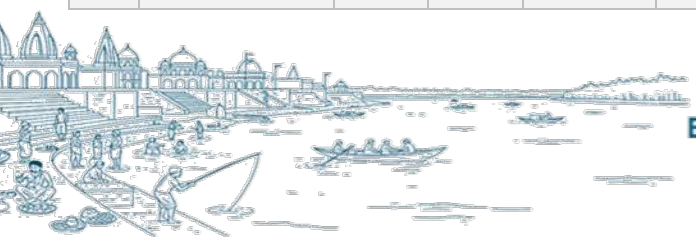


							25%20English(7June2024).pdf[4]
8	Native plantation (edge and buffer)	LS	1	120,000	120,000	Mixed native trees, shrubs and grasses including soil preparation and early maintenance.	CSE wetland planting https://www.cseindia.org/constructed-wetlands-wastewater-treatment-systems-6215

Subtotal A – Path & Surroundings: ₹1,070,450

B. Water Spread Area

S. No.	Item	Unit	Quantity	Rate (INR)	Amount (INR)	Notes	Source
9	Initial desilting and sediment removal (incl. disposal)	m ²	8,087	400	3,234,800	Mechanical / manual desilting, dewatering and safe disposal of sludge.	Lake rejuvenation earthworks https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf
10	Drain interception chamber & diversion structure	Nos.	1	70,000	70,000	RCC chamber with diversion arrangement to route polluted flows through treatment.	PWD RCC chamber items https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf
11	Small-scale DEWATS / planted gravel filter (~8 KLD)	Nos.	1	240,000	240,000	Simple decentralised unit for polishing intercepted dry-weather flows.	CSE DEWATS costs https://www.cseindia.org/cost-estimation-for-planning-and-designing-of-decentralised-wastewater-treatment-system-2073
12	Physical trash traps at inlet / outlet	Nos.	1	15,000	15,000	Fixed bar screen / trash rack to capture floating solids.	Drain project trash racks https://www.scribd.com/document/667044219/B-CD-SOR-2023
13	Removal of invasive aquatic vegetation (initial cycle)	m ²	8,087	70	566,090	Manual/mechanical weed removal to restore open water and habitat.	CDD lake weed clearance https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf
14	Reed bed development along edges	m	294	700	205,800	Creation of shallow shelves with emergent vegetation for treatment and bank protection.	IARI constructed wetland https://www.cseindia.org/constructed-wetland-for-wastewater-treatment-at-indian-agriculture-research-



							institute-pusa-new-delhi-56
15	Floating treatment wetlands (FTWs) – community-built modules	Nos.	2	30,000	60,000	Low-cost bamboo/HDPE raft modules with macrophytes for in-situ polishing.	Hauz Khas FTW pilots https://www.indiawaterportal.org/governance-and-policy/governance/islands-float-delhi-lake
16	Floating aerator (optional)	Nos.	1	90,000	90,000	Small aerator to support dissolved oxygen and circulation in stagnant pockets.	Lake aerator market rates https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf

Subtotal B – Water Spread Area: ₹4,482,690

C. Water Edge

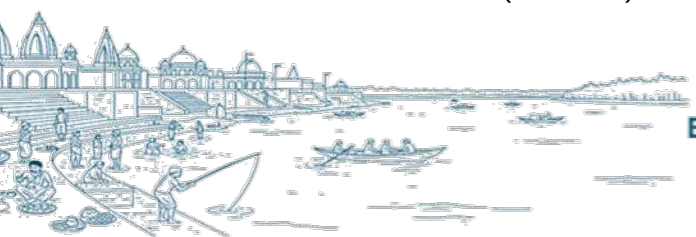
S. No.	Item	Unit	Quantity	Rate (INR)	Amount (INR)	Notes	Source
17	Stone pitching & edge stabilisation (critical stretches)	m	220	850	187,000	Protection of erosion-prone banks with stone pitching / rubble lining.	PWD stone pitching SOR https://bhel.com/sites/default/files/Revised%20SOR.pdf
18	Repair & cleaning of existing ghat steps (if present)	m ²	250	120	30,000	Patch repair, re-pointing and cleaning of existing steps.	Masonry repair rates https://www.cspdcil.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf
19	Small viewing platform / mini-boardwalk (~60 m ²)	LS	1	120,000	120,000	Simple deck/viewing point to allow safe access and engagement.	Lakefront viewing decks https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf

Subtotal C – Water Edge: ₹337,000

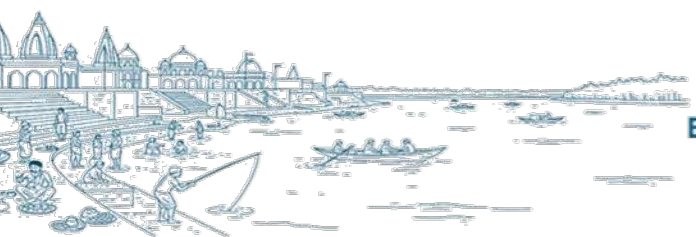
D. Summary of Tentative Costs for Single Eco-Nala Node

- Subtotal A – Path & Surroundings: ₹1,070,450
- Subtotal B – Water Spread Area: ₹4,482,690
- Subtotal C – Water Edge: ₹337,000

Tentative Construction Cost (A + B + C): ≈ ₹5,890,000 (₹0.59 crore)



For planning purposes, an additional provision of 5–7% may be considered for design, supervision and community engagement, and 10–15% for contingencies at DPR stage, while keeping the total node-level cost under approximately ₹0.75 crore.

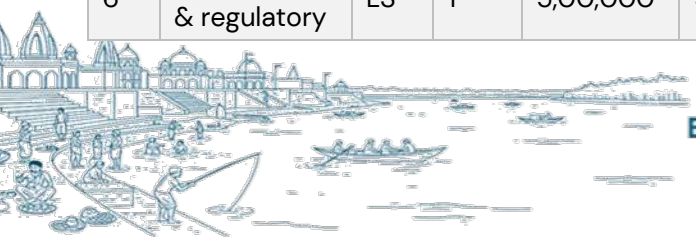


Annexure 3.3: Cost Estimate for City-Level Treated Wastewater Reuse Strategy

Assumptions:

- Scope covers GIS mapping for 3–5 km STP influence zones, demand–supply assessment for 30–36 MLD projected capacity, suitability screening, phased roadmap, and institutional framework for Buxar Nagar Parishad.
- Duration: 12–18 months, involving consultants, surveys, stakeholder consultations, and NIUA/NMCG toolkit-based methodology.
- Rates based on similar city-level SRTW plans and DPR preparation benchmarks under NMCG/AMRUT.

S. No.	Item	Unit	Quantity	Rate (INR)	Amount (INR)	Notes	Source
1	Project inception, baseline surveys & stakeholder mapping	LS	1	8,00,000	8,00,000	Initial data collection, ULB consultations, secondary data review on existing STPs and demands.	NMCG DPR inception norms https://nmcg.nic.in/writereaddata/fileupload/12_City%20SRTW%20_Solution%20Document%20Panipat.pdf
2	GIS-based reuse opportunity mapping (3–5 km STP zones)	LS	1	12,00,000	12,00,000	GIS layers for parks, agriculture (Jaivik Yojana), wetlands; satellite + ground-truthing for ~50–100 km ² coverage.	NIUA toolkit GIS component https://niua.in/waterandenvironment/wp-content/uploads/2024/01/Toolkit-for-Preparing-City-Action-Plans-for-Reuse-of-Treated-Used
3	Demand–supply assessment (30–36 MLD projection)	LS	1	10,00,000	10,00,000	Water balance modelling, non-potable demand estimation for municipal/irrigation uses to 2030–35.	NITI Aayog reuse strategy benchmarks https://www.niti.gov.in/sites/default/files/2023-08/Revised_Strategy-Paper-on-Reuse-of-Treated-wastewater-in-peri-urban-agricult
4	Reuse suitability screening & quality assessment	LS	1	7,00,000	7,00,000	Effluent standards analysis, salinity/health risk screening, seasonal variability study.	NMCG SRTW framework guidance [https://nmcg.nic.in/writereaddata/fileupload/32_SRTW%20Framework_Final_23_11_2021%20(1).pdf][2]
5	Phased reuse roadmap development	LS	1	6,00,000	6,00,000	Prioritised low-risk uses (parks, irrigation), investment phasing linked to STP commissioning.	City SRTW plans (Panipat model) https://nmcg.nic.in/writereaddata/fileupload/12_City%20SRTW%20_Solution%20Document%20Panipat.pdf
6	Institutional & regulatory	LS	1	5,00,000	5,00,000	Role clarity for Nagar Parishad, STP	NMCG policy development costs https://nmcg.nic.in/wr



	framework design					operators, user groups; pricing/incentive models.	itereaddata/fileupload/7_MoM_59th%20EC%20of%20NMCG_30.12.2024.pdf
7	Field surveys, sampling & primary data collection	LS	1	4,00,000	4,00,000	Site visits to potential reuse sites, farmer/municipal user surveys (~200 samples).	AMRUT baseline survey rates https://amrut.mohua.gov.in/uploads/AMRUT_2.0_Operational_Guidelines.pdf
8	Report preparation, workshops & validation	LS	1	3,00,000	3,00,000	Draft/final strategy document, 4–6 stakeholder workshops, NMCG/state validation.	Standard DPR validation costs https://nmcg.nic.in/writereaddata/fileupload/2_MoM_66th%20EC%20of%20NMCG_18.09.2025.pdf
9	Travel, logistics & contingencies	LS	1	2,00,000	2,00,000	Team travel within Buxar influence zone, printing, minor expenses.	NMCG project contingency norms https://www.pib.gov.in/PressReleasePage.aspx?PRID=2209732

Subtotal – Core Consultancy & Studies: ₹57,00,000

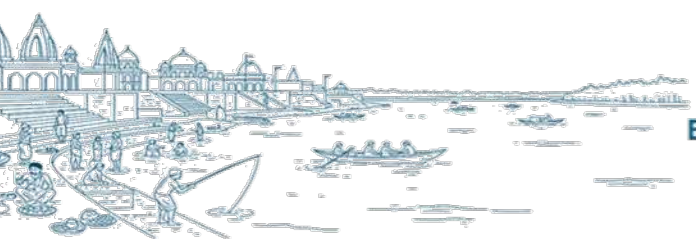
10	Third-party technical audit / peer review	LS	1	3,00,000	3,00,000	Quality check by NIUA/CPCB-accredited agency before final submission.	https://nmcg.nic.in/writereaddata/fileupload/7_MoM_59th%20EC%20of%20NMCG_30.12.2024.pdf
11	Design & printing of final strategy document	LS	1	1,00,000	1,00,000	Professional report (100–150 pages) + GIS maps + policy briefs.	Standard DPR documentation https://nmcg.nic.in/writereaddata/fileupload/32_English%20Annual%20Report%20of%20NMCG%202019-20.pdf

Subtotal – Audit & Outputs: ₹4,00,000

Grand Total: ₹61,00,000 (₹0.61 crore)

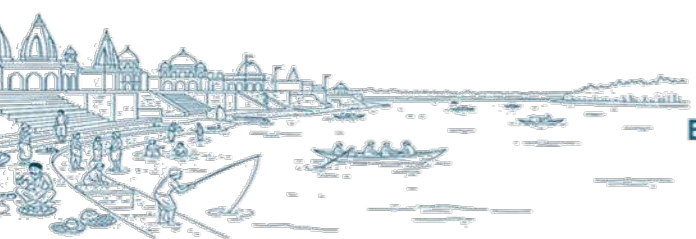
Notes on Feasibility:

- This aligns with NMCG city SRTW plans (~₹50 lakh–1 crore) and AMRUT master planning costs for small cities.
- Can be funded under NMCG policy component or AMRUT 2.0 city action plans



Annexure 3.4: BOQ for River based sensitisation program

No	Item	Budget (yearly)
1	Citizen awareness campaigns (<i>Designing and printing posters, venue arrangements, awards, certificates</i>) (1 every quarter)	2,00,000
2	Youth mobilization– <i>Organizing programs, clean-up drives and workshops in colleges/ Institutions/ communities. Reward with certificates</i> (2 programs in a year)	40,000
3	Youth mobilization– Internship program 3– month internship for 10 students from select universities of Buxar and students from underprivileged background (INR 5,000 per month/ student. Field monitoring + Reporting)	1,50,000
4	Organizing competitions/ river clean-up drives with citizen groups – Ward-watch committees: under the ward Councilor – Festival clean-up committees: Festival waste collection protocols – Temple committees – for inland water bodies – Young champions – school level – Tie-up with NGOs/ SHGs Each committee to undertake quarterly clean-up drives (5 committees x 4 =20 clean-up drives/ competitions)	50,000
5	Social media and marketing on suitable channel – Connect with Buxar-based influencers – Organise online polls, quizzes and citizen feedback – Minimum 15 posts per month – Fun facts (Yearly contract with an agency)	2,00,000
6	Other cost: – Office furniture – Printing cost – Transportation cost – Monitoring and reporting – Ad hoc labour cost	3,00,000
7	Yearly booklet cost – for household level and schools	2,00,000
8	Special fund during festival and processions	10,00,000
9	Annual River Day celebration	10,00,000
9	Reserved fund	10,00,000
	TOTAL	41,40,000



END OF REPORT

