Draft Urban River Management Plan- Chapra

January 2026

Deliverable 3: Preparation of Urban River Management Plan for Chapra city, Bihar

Submitted to -

National Mission on Clean Ganga

National Institute of Urban Affairs

State Government of Bihar

Chapra Nagar Nigam

Project Consultants - Consortium of

All India Institute of Local Self Government

ICF Consulting, India Private Limited

ACKNOWLEDGEMENTS

This report is a collaborative effort of NMCG and NIUA along with Chapra Nagar Nigam, for preparation of the Urban River Management Plan for cities in Bihar.

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Publication Year – 2026

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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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
DO	Dissolved Oxygen
DPR	Detailed Project Report
FPZ	Flood Plain Zoning
MoEF&CC	Ministry of Environment, Forest & Climate Change
MoHUA	Ministry of Housing and Urban Affairs
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
UWD	Urban Water Diagnostics
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 through initiatives like the River Cities Alliance and Urban River Management Plans (URMPs). Under NMCG's guidance, the National Institute of Urban Affairs (NIUA) is preparing URMPs for 60 cities, including six in **Bihar; Bhagalpur, Buxar, Chapra, Gaya, Munger, and Muzaffarpur** to restore river health, enhance resilience, and promote water-sensitive development. Urban rivers, once vital to culture and ecology, now face severe degradation, threatening livelihoods, public health, and biodiversity. The Bihar URMPs will address challenges such as flooding and loss of natural drainage through governance reforms, community engagement, sustainable infrastructure, and financial integration. Aligned with national and state missions, the plans propose phased interventions: short-term actions for waste and pollution control and medium-term measures for structural improvements like wastewater treatment, floodplain zoning, and riverfront revitalization ultimately institutionalizing integrated urban river governance and long-term resilience.

Chapra, the district headquarters of Saran district in Bihar, occupies a strategically significant location at the confluence of the Ganga, Ghaghra, and Gandak rivers. This unique hydro-geomorphological setting renders the city hydrologically complex and highly susceptible to recurrent flooding. The urban area extends over approximately 16.96 sq. km and supports a population of about 2.37 lakh as of 2025.

Functionally, Chapra serves as an important regional center for trade, education, administration, and cultural activities. The city benefits from strong multimodal connectivity through national and state highways, an extensive railway network, and its proximity to National Waterway-1, collectively enhancing its role as an emerging economic node within the region.

Chapra is also characterized by a rich cultural and religious landscape, with numerous heritage and pilgrimage sites and the large-scale observance of festivals such as Chhath Puja. While these cultural practices contribute significantly to the city's socio-economic vitality, they also intensify seasonal pressures on riverine systems and associated urban infrastructure, particularly along floodplains and riverfront areas.

Chapra's strategic location with strong road, rail, and waterway connectivity, coupled with ongoing infrastructure projects, positions it for economic growth, while its status as a district headquarters ensures better institutional capacity. Existing wastewater infrastructures like the 32 MLD STP and urban water bodies offer opportunities for pollution control, aquifer recharge, and recreation, and its cultural and religious sites provide significant tourism potential. However, river health faces challenges such as flood vulnerability due to dynamic river morphology and lack of floodplain zoning, pollution from untreated wastewater and solid waste, riparian buffer loss, and neglected ponds suffering from eutrophication and waste accumulation. Weak governance fragmented institutional roles, low citizen engagement, and underutilized economic opportunities further hinder integrated river management and sustainable development.

The Urban River Management Plan (URMP) for Chapra provides a structured, evidence-based framework to address these issues through integrated planning, floodplain zoning, waterbody rejuvenation, riparian restoration, wastewater reuse, and community engagement. By embedding these strategies into the city's master plan, URMP offers a pathway to improve river health, enhance resilience, and leverage cultural assets for sustainable development.

Summary of key interventions proposed by Chapra 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.

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, Chapra Nagar Nigam	UDHD Bihar, State funding	NA
1.2	Techno-Feasibility study for construction of embankment along the proposed 21km riverfront road	Road construction Department (RCD) Minor Irrigation Department BUIDCO	Central Road Fund NMCG	~ 1 cr (Consultancy fees +ground study)

Objective 2: Pollution Free River

	Intervention	Responsible agency	Potential Funding Source	Estimated budget
2.1	Developing river pollution control strategy for the city	Chapra Nagar Nigam	SBM-U 2.0, NMCG,	₹ 51- 60 Cr
2.2	Decentralized wet waste management strategy for the city (Pilot)	Chapra Nagar Nigam (BPCB guidelines)	SBM-U 2.0, NMCG,	₹ 4- 7 Cr

Objective 3: Rejuvenation of inland water bodies

	Intervention	Responsible agency	Potential Funding Source	Estimated budget
3.1	GIS-based waterbody inventory and assessment using Urban Waterbody Diagnostic Tool	Chapra Nagar Nigam (Lead), WRD Bihar (Support)	City's Annual Budget CSR	₹ 26- 35 lakh
3.2	Construction of boundaries and water edge treatment for 5 ponds in the city	Chapra Nagar Nigam	Jal Jeevan Mission CSR funds City's annual budget	₹ 60 – 70 lakh
3.3	Rejuvenation of priority waterbody	Chapra Nagar Nigam (Lead),	Namami Gange, Jal Jeevan Hariyali Mission, Forest Department	₹ 85- 90 lakh

Objective 4: Enhancing Riparian Buffer

	Intervention	Responsible agency	Potential Funding Source	Estimated budget
4.1	Riparian stretch development for Tel River	Chapra Nagar Nigam (Lead), with technical support from Forest Department	CAMPA Funds, Chapra Nagar Nigam (own fund), Forst department	₹ 20 lakh

Objective 5: Increased Reuse of Treated Wastewater
Objective 6: Maximum Good quality return flow

	Intervention	Responsible agency	Potential Funding Source	Estimated budget
5.1	Strategy and guidelines for Re-use of treated wastewater strategy	BUIDCO Pollution Control Board	NMCG policy component or AMRUT 2.0 city action plans	₹ 61 lakh
5.2	Re-use of treated wastewater within 3 km buffer zone and government buildings (PHASE-1)	Chapra Nagar Nigam BUIDCO, Irrigation Agriculture, Forest Department Pollution Control Board	City's own Fund,	₹ 6 CR
5.3	Real-time water quality monitoring stations	Chapra Nagar Nigam BUIDCO	Urban Local body Bihar Pollution Control Board	₹ 50 lakh

Objective 7: Eco-friendly Riverfront Projects
Objective 8: Leveraging Economic Potential of the River

	Intervention	Responsible agency	Potential Funding Source	Estimated budget
7.1	Development of a Eco-Ghat Connector for Chapra	UDHD and NMCG	NMCG (Policy Component), UD&HD Bihar, AMRUT 2.0 Tourism department	₹ 17 – 20 Cr
72	Upgradation and management of Tel River	Chapra Nagar Nigam, State Tourism Department, UDHD NMCG	NMCG, UD&HD Bihar, State Tourism Department,	₹ 8 -10 Cr
7.3	Eco-Ghat Design Guidelines and Riverfront Regulations	UDHD and NMCG	NMCG (Policy Component), UD&HD Bihar, AMRUT 2.0	₹ 45–65 lakh

Objective 9: River Sensitive Behaviour among Citizens
Objective 10: Citizen engagement in river management

	Intervention	Responsible agency	Potential Funding Source	Estimated budget
8.1	River sensitization program for the city	Chapra Nagar Nigam	NMCG Swachh Bharat Urban, CSR fund	₹ 31.4 lakh
8.2	Installation of signages and murals: - Made of plastic waste/ fishing nets - Design competitions - In On protected areas of the riparian edges	Chapra Nagar Nigam District Tourism Department (Support)	City's own fund	₹ 10 lakh

INTRODUCTION

2. INTRODUCING URBAN RIVER MANAGEMENT PLAN FOR CHAPRA

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 Chapra 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 Chapra.

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.

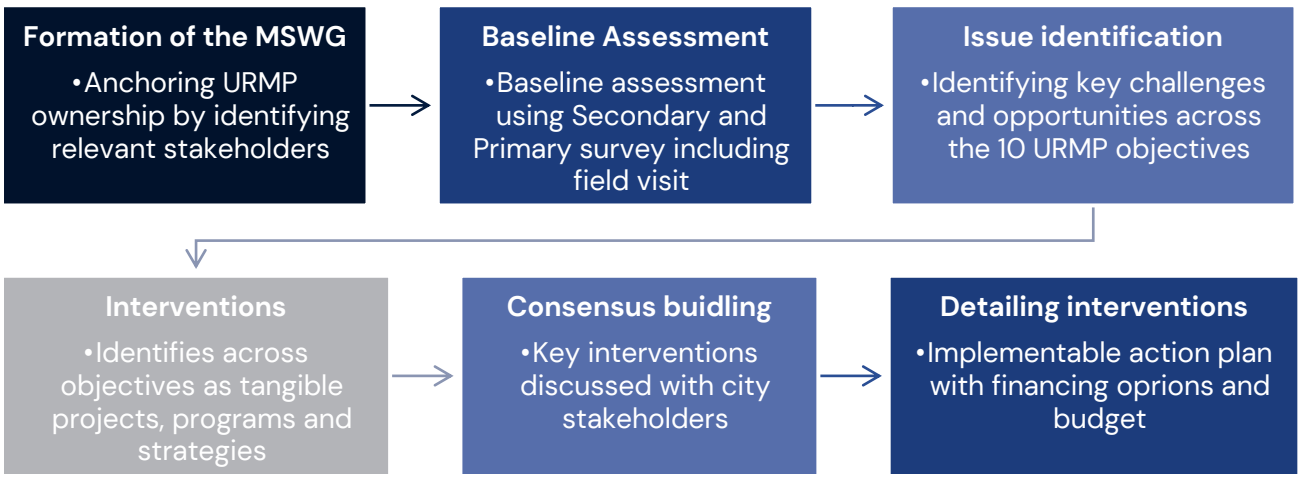
Figure 2 : Objectives across the 3 elements of the URMP Framework

2.2. Process for preparation of URMP Chapra

Following process was followed for the preparation of URMP Chapra:

- **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 the 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 Chapra



2.3. URMP Chapra- Working Group

The preparation of the Urban River Management Plan (URMP) for Chapra was spearheaded by the District Collector and Municipal Commissioner, 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 Saran Collectorate, Chapra Municipal Corporation, BUIDCO, Bihar State Pollution Control Board and Forest. As an initial step, an in-person inception meeting of the working group was convened at the Collectorate Office in Chapra on 16th July 2025. This meeting, chaired by the District Magistrate, Saran 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 Sambhajinagar. The working group shared details of ongoing projects related to river rejuvenation and expressed commitment to adopting the URMP framework for Chapra.

Figure 4: First MSWG Meeting held on 16th July 2025

Discussions during the first MSWG meeting helped shape the vision for the Chapra URMP, which serves as the foundation for evaluating related challenges and identifying opportunities across thematic areas. Chapra is expected to develop primarily as a residential zone with a focus on environmental sustainability, religious and cultural tourism, and economic development linked to the National Waterway. Improving the quality of life was emphasised as a central theme for the URMP

VISION

Enhance Religious and Cultural Tourism, Economic Development and the Overall Quality of Life

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 Observations made and Challenges Identified:

- **Chapra's Vision as a Twin City to Patna:** Chapra is envisaged as a future twin city to Patna, driven by improved regional connectivity and its strategic location along the Ganga. Neighbouring ULBs such as Revelganj are emerging as complementary growth nodes.
- **River Management:** The city faces multiple river-related challenges, including shifting river course, recurrent monsoon flooding, siltation, and bank erosion.
- **Environmental Challenges:** Urban waterbodies and river-adjacent areas are increasingly vulnerable to pollution, encroachment, and hydrological disconnect from the river system.
- **Underutilisation of STP and Reuse Potential**: The existing 32 MLD STP is significantly underutilised relative to its capacity due to solid waste and sedimentation deposits blocking the network. There is also an absence of a structured reuse framework for treated wastewater.
- **Tourism and Urban Development Initiatives:** Riverfront development initiatives are at varying stages of conception and implementation, including:
  - Ghat development in Chapra and Revelganj (Telpa–Inai stretch).
  - The **Loknayak Ganga Path / Marine Drive**, a 21 km corridor along the Ganga, intended to decongest traffic, improve regional connectivity, and create a public-facing river promenade.
  - Ideas for a **new township along the Marine Drive** using land pooling and value capture mechanisms are being explored which indicate growing development pressures along the river edge.
- **Solid Waste Management Gaps:** Solid Waste Management systems remain fragmented, with only about 60% of primary collection centres functional.

Based on the key issues identified, interventions were developed across the 10 objectives aligning with the URMP framework in close consultation with NIUA.

CHAPRA URMP – BACKGROUND

3. Chapra URMP- BACKGROUND

3.1. City Profile

Chapra is the district headquarters of Saran district in western Bihar and is strategically located at the confluence-influenced reach of the Ganga river system. The city lies in close proximity to the Ghaghara (Saryu) and Gandak rivers, making it one of the most hydrologically complex urban centers in the Middle Ganga Plain. Historically, this riverine setting has supported fertile agriculture, river-based trade, and cultural exchange, while also exposing the city to recurrent flooding, sedimentation, and erosion-related risks.

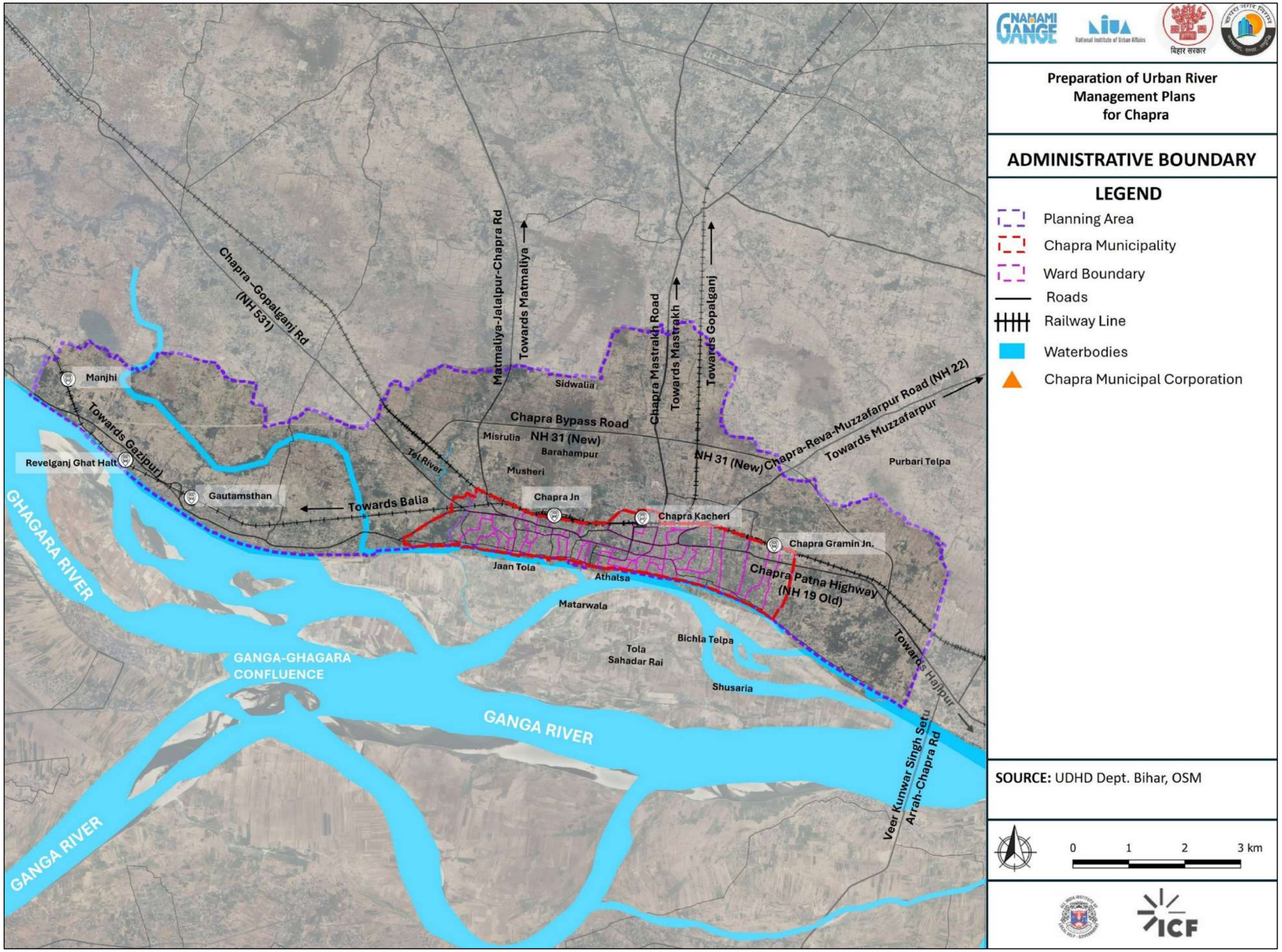
Chapra functions as an important regional node linking North Bihar with eastern Uttar Pradesh and serves as a key administrative, commercial, educational, and cultural center. The city has strong historical significance, having featured in ancient texts, Mughal-era administrative systems, colonial trade networks, and India's freedom movement. It is also the birthplace of Dr. Rajendra Prasad, India's first President, reinforcing its cultural and national prominence.

The city is located approximately 70 km northwest of Patna and is well connected by major transport corridors including NH-19 and NH-31. Rail connectivity is anchored by Chapra Junction, a major rail hub with services to Delhi, Kolkata, and other metropolitan centers, currently undergoing redevelopment. Recent and ongoing infrastructure project including the Digha–Sonpur rail-cum-road bridge, a four-lane Ganga bridge under construction, and a proposed modern bus terminal, are expected to significantly enhance regional mobility, logistics, and economic integration.

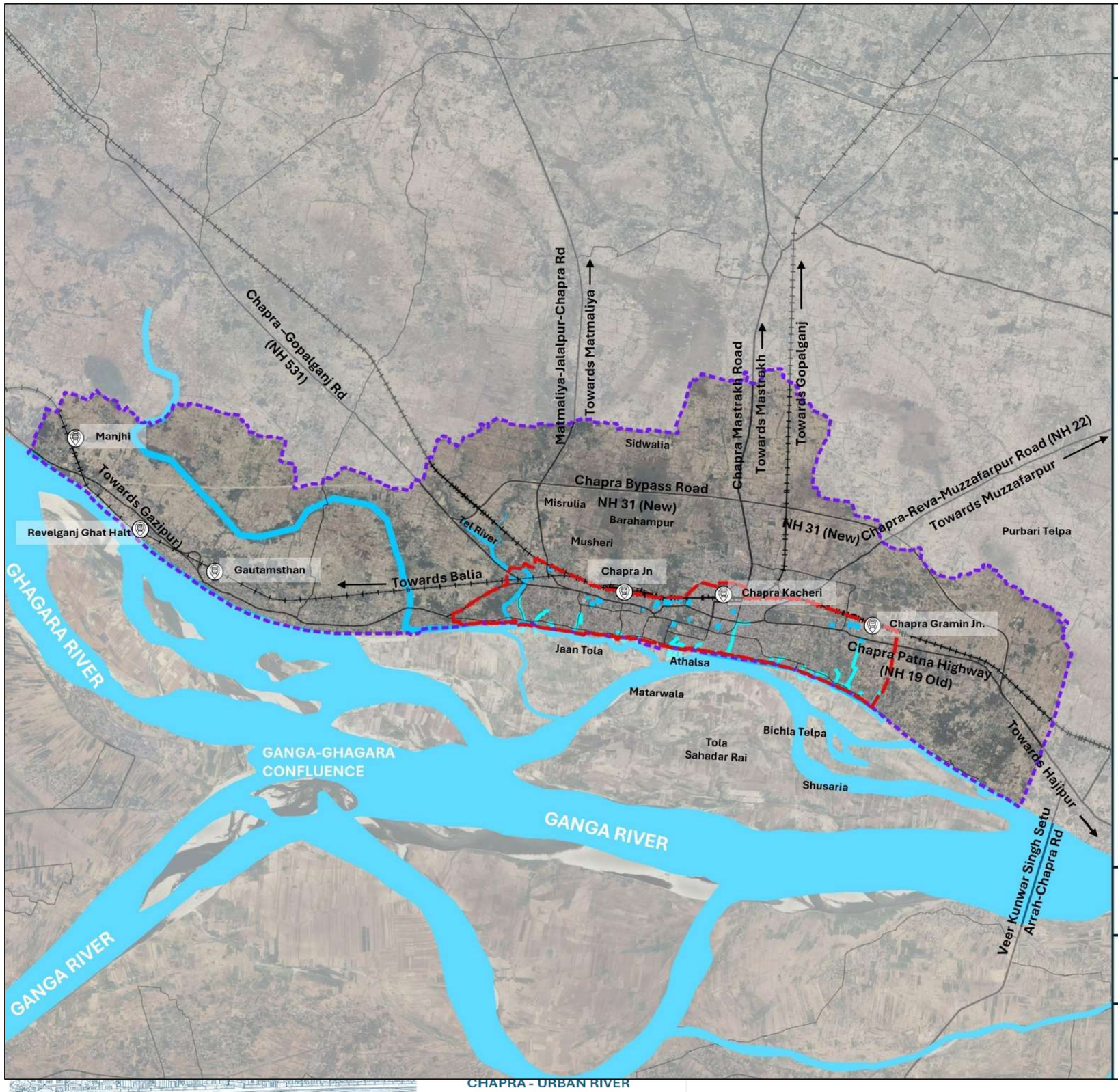
Chapra Municipal Corporation covers an area of approximately 16.96 sq km and lies at an average elevation of about 36 m above mean sea level. The city is bounded by the Ganga and Ghaghara rivers along its southern and western edges, with the Tel River skirting the south-western periphery. Internally, a network of man-made drains and historic ponds shapes the city's drainage and flood risk profile. The municipal area currently comprises 45 wards, with ongoing discussions at the district level regarding expansion of municipal and planning boundaries. The Master Plan for the Chapra Planning Area (approximately 101 sq km) is presently under preparation by the Town Planning Department, Patna.

Chapra's riverfront sustains a wide range of small-scale livelihoods linked to agriculture, fisheries, small trade, religious tourism, and transport. Numerous ghats along the Ganga and in nearby Revelganj serve as focal points for ritual bathing, cremation, fairs, and festivals. Events such as Chhath Puja, Kartik Purnima, and Semariya Mela attract large seasonal influxes of pilgrims, reinforcing the city's socio-cultural identity while placing considerable pressure on riverbanks, sanitation systems, and water quality.

Map 1 Administrative Boundary– Chapra municipal corporation and Planning area



Map 2-Chapra Water Bodies and River



Preparation of Urban River Management Plan for Chapra

RIVERS AROUND CHAPRA

LEGEND

- Planning Area
- Chapra Municipality
- Roads
- Waterbodies
- Railway Line
- Chapra Municipal Corporation
- Major Drains

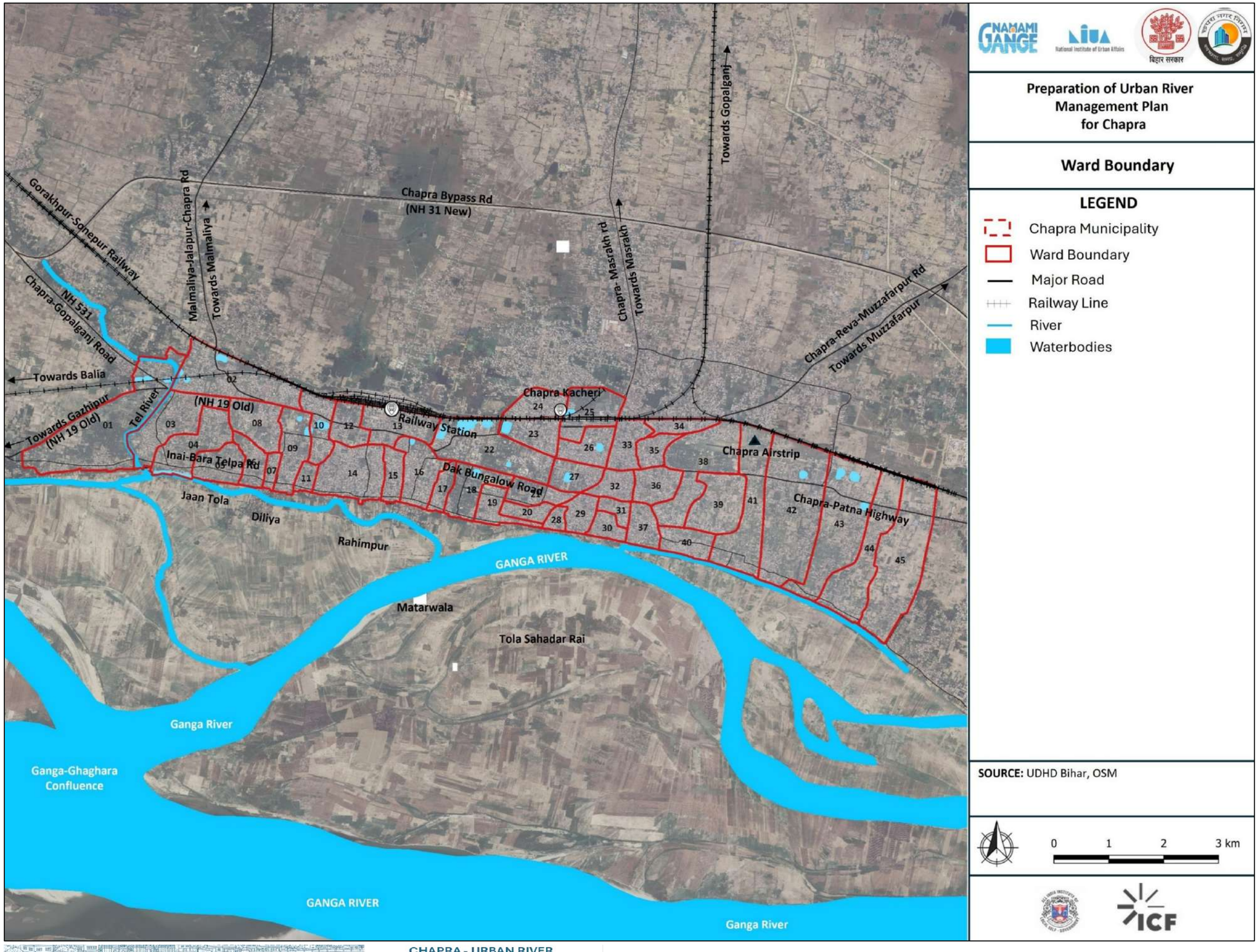
SOURCE: UDHD Dept. Bihar, OSM

0 1 2 3 km

CHAPRA - URBAN RIVER MANAGEMENT PLAN

अविरल जलधारा, समृद्ध छपरा

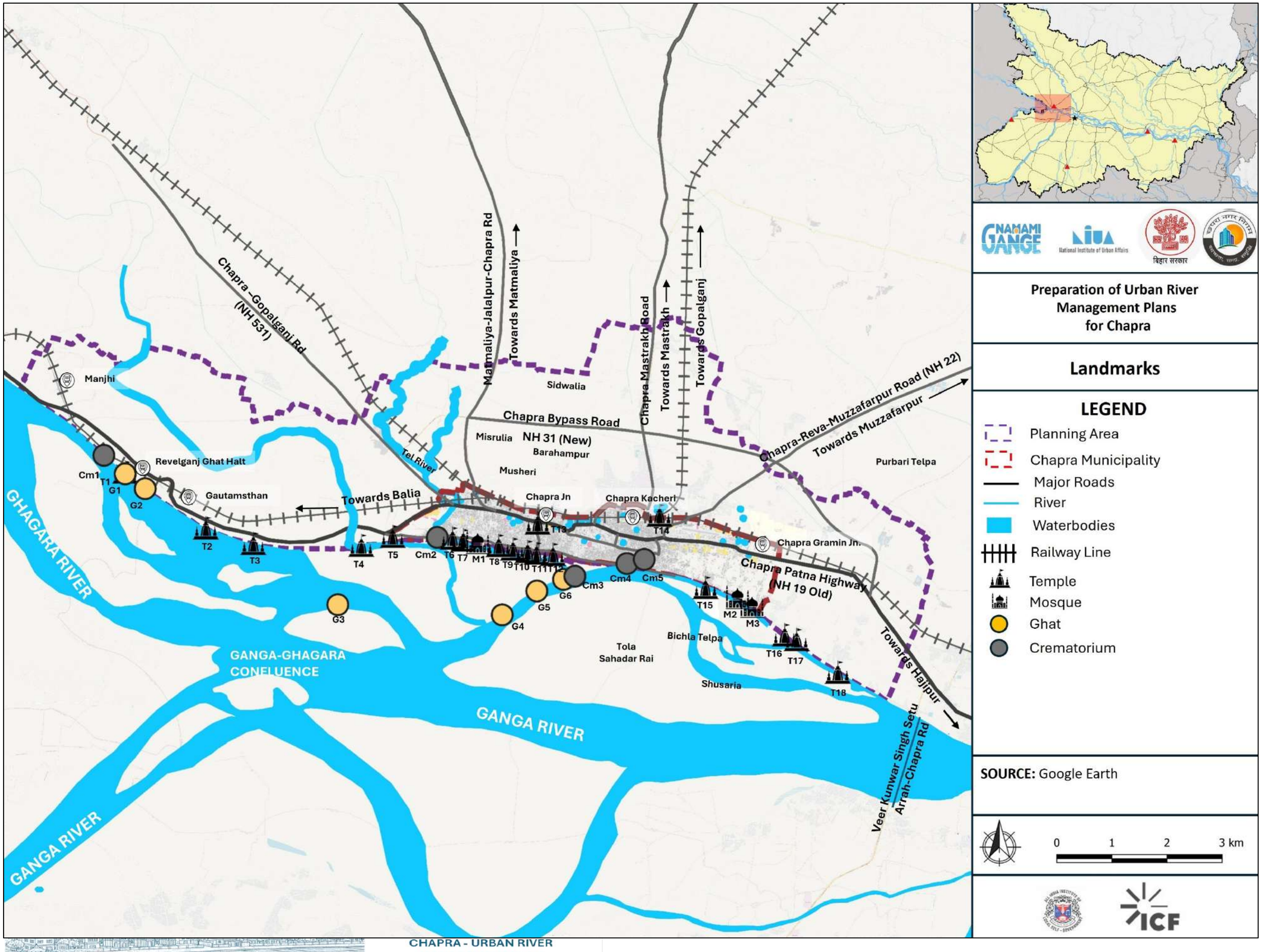
Map 3 Administrative ward boundary-Chapra city



CHAPRA - URBAN RIVER MANAGEMENT PLAN

अविरल जलधारा, समृद्ध छपरा

Map 4 Major Landmarks



Key cultural sites within the city

Dharmanath Mandir, Chapra .

Rajendra Sarovar

Key cultural sites within the Planning Area

Semariya Mela, Revelganj

Maharishi Dadhichi Umanath Mandir, Revelganj

Cremation Ground, Revelganj

Nath Baba Ghat, Revelganj

Gautam Sthan

Manjhi Ghat

3.2. Chapra and its relationship with Ganga and Ghaghra

The relationship between the Ganga and Chapra is deeply intertwined, shaping the city's geography, economy, culture, and vulnerabilities. The Ganga River flows across Bihar for a total stretch of approximately 445 km, entering the state at Chausa (Buxar) and passing through major urban centers including Patna, Munger, and Bhagalpur. Chapra lies along a highly dynamic stretch of the river system, downstream of multiple major Himalayan tributaries. The Ghaghara (Saryu) joins the Ganga just downstream of the city, while the Gandak meets the Ganga further east near Hajipur. Together, these rivers deliver extremely high seasonal discharges and sediment loads, creating a complex confluence-driven geomorphic environment around Chapra.

Figure 5: The Environmental, Economic and Social Value of Ganga for Chapra

ENVIRONMENT

- **River confluence dynamics** (Ganga–Ghaghara–Gandak) drive frequent channel shifts and sediment deposition, increasing flood risk.
- Monsoon floods regularly **inundate low-lying wards** (e.g., Collectorate Road, District Court).
- **Untreated wastewater** from urban drains (Little Gandaki, Sondhi Nala, Jharahi) degrades river water quality.
- Loss of riparian buffers & neglected ponds **reduces ecological resilience** and worsens flooding.

ECONOMIC

- Historically supported agriculture and riverine trade; today offers potential for eco-tourism, heritage tourism, and river-based livelihoods (fishing, boating).
- **Flooding disrupts** urban infrastructure and economic activities, causing financial losses.
- **Pollution impacts** fisheries and limits recreational use of riverfronts.

SOCIAL

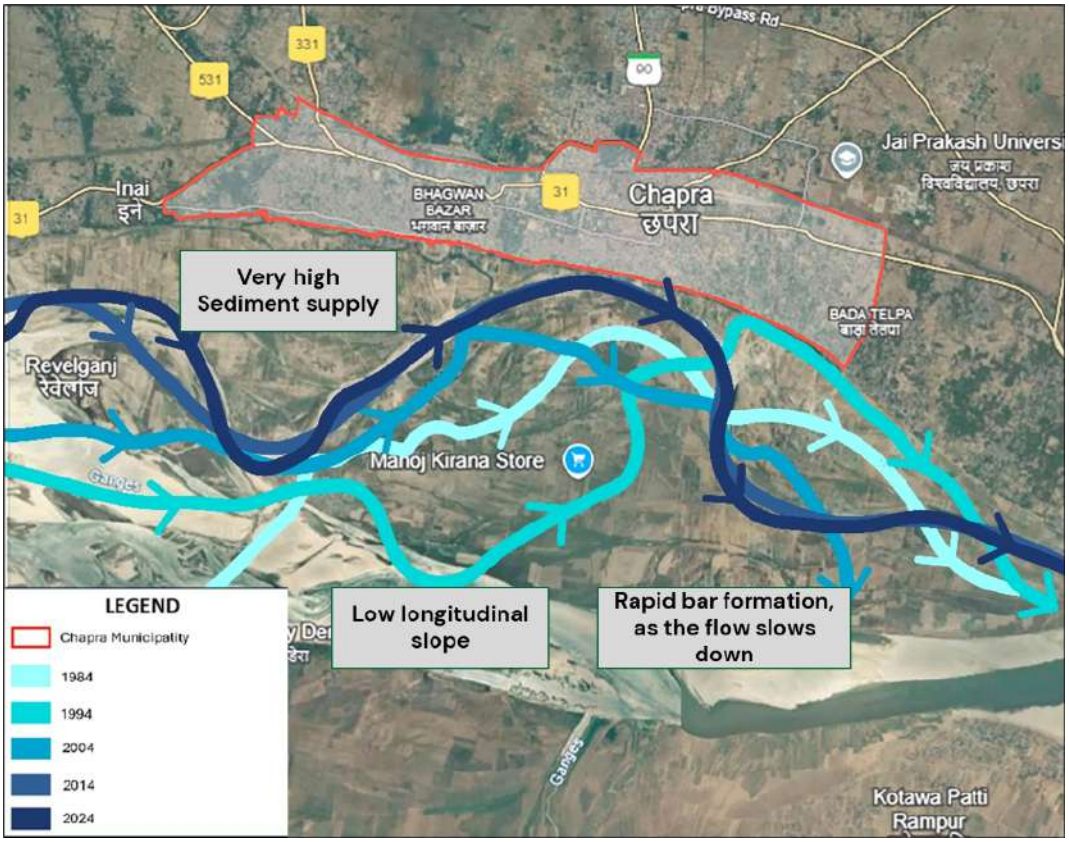
- The Ganga is central to Chapra's cultural identity and spiritual life.
- Major festivals like Chhath Puja and fairs such as Semariya Mela attract thousands to river ghats.
- **Prominent religious sites**: Dharmnath Mandir, Kalpeshwar Nath Mahadev Mandir, Gautam Asthan; ghats like Rajendra and Mahavir strengthen river-city connect.
- Ritual activities and pilgrim influx increase solid waste generation and pressure on riverbanks.
- Despite cultural significance, citizen engagement in river conservation is low; structured awareness programs are lacking

Satellite imagery and historical analysis indicate that the Ganga–Ghaghara confluence near Chapra is characterized by channel bifurcation, lateral migration, sandbar formation, and progressive shoaling of former channels. Over the past four decades, the active river channel has shifted northwards toward the municipal boundary, increasing sedimentation pressure along the city's river edge and heightening flood risks in low-lying wards. During peak monsoon conditions, when river levels cross danger marks, ghats and riverfront settlements are routinely inundated, and backflow conditions cause waterlogging within the urban core. At Chapra the river planform shows a characteristic bifurcation and re-joining behaviour: a prominent branch (or channel lobe) just northward, touches or skirts Chapra's floodplain and then rejoins the main Ganga channel downstream. Satellite time-series and Google-Earth imagery indicate that, over the last four decades, these two flow threads have been widening laterally, and their mid-channel zone has

progressively filled with sand and silt—creating extensive braid bars and narrowing active thalwegs[1]. The net effect has been a shift of active flow toward the city margin, progressive shoaling[2] of the former channel, and enhanced local flood risk when the combined tributary and Ganga discharges coincide[3].

Map 5 Historic Analysis of the river's confluence at Chapra

Map 6 Morphometric analysis of Ghaghra-Ganga confluence stretch at Chapra



[1] **Thalweg**: *The line connecting the deepest points along a river channel, which usually corresponds to the zone of fastest current and principal flow.*

[2] **Shoaling** (in river science and coastal geomorphology) refers to the process by which a water body becomes shallower due to the accumulation of sediment (sand, silt, gravel). It reduces the depth of the channel and can redirect or slow down the flow.

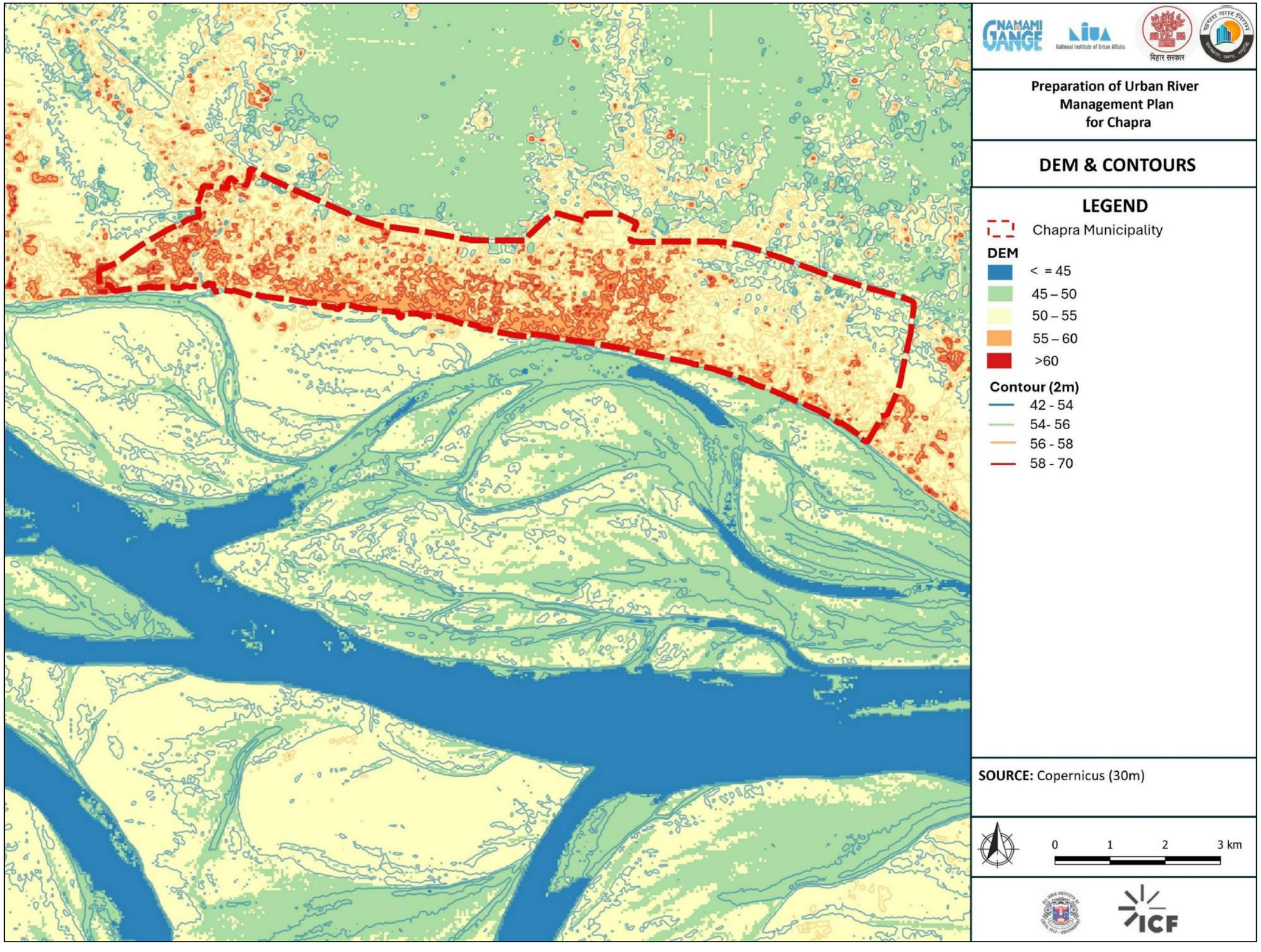
[3] Gautam, P. K., Singh, D. S., Kumar, D., & Singh, A. K. (2024). Quantitative Assessment of Channel Migration in the Ghaghara River, Ganga Plain, India. Journal of the Geological Society of India, 100(7), 919-935. https://doi.org/10.17491/jgsi/2024/173935

Several processes explain why the Ghaghra–Ganga confluence is so morphodynamically active in this region:

- **Very high sediment supply**: the tributaries deliver large suspended bed-load sediment owing to steep upstream slopes and glacier/snow-melt regimes. This leads to rapid bar formation and channel aggradation in the low-slope plains.
- **Low longitudinal slope in the middle and lower Ganga**: the gentle gradient of the alluvial plain reduces stream power, encouraging deposition and lateral migration rather than incision.
- Reduced non-monsoon flows and upstream abstractions: lower base flows in the dry season reduce the river's sediment-transport capacity and promote in-channel deposition during low flow periods.
- **Human interventions and embankment**s: levees, barrages, local mining and sand extraction, and river training works can alter flow distribution, concentrate erosion in some areas and promote siltation in others, increasing the likelihood of avulsion.

This confluence area makes Chapra especially vulnerable to floods during monsoons, when water levels cross the danger mark and spill into low-lying wards. In August 2025, the city experienced severe flooding when the water levels of the Ganga, Gandak, and Ghaghra (Sarayu) rivers rose beyond the danger marks—the Ganga was reported to be about 72 cm above the danger level at key measuring points. This led to water inundating critical urban areas including Collectorate Road, the District Court complex, and the Municipal Corporation offices.

Map 7 Elevation and Contour, Chapra



Chapra's relatively flat terrain and low elevation limit natural drainage capacity. While natural levees provide localized higher ground, much of the city lies within active floodplain deposits shaped by centuries of sedimentation. Embankments and flood control structures offer partial protection, but also alter natural flow patterns, sometimes intensifying erosion and siltation elsewhere. Human interventions—such as sand mining, encroachment on floodplains, and infrastructure construction—have further modified river dynamics.

Urban wastewater discharge and unmanaged ritual activities represent significant stressors on the river system. Untreated sewage from drains and direct disposal of solid and organic waste at ghats contribute to declining water quality and localized ecological degradation. While sewerage and drainage infrastructure projects are planned under state programs, interim pollution control and riverfront management measures remain limited.

Chapra's riverfront functions as a vibrant socio-economic and cultural interface, shaped by its location near the Ganga–Ghaghara confluence and its long-standing religious significance. The river edge is lined with multiple formal and informal ghats in Chapra and nearby Revelganj, which become focal points of intense activity during festivals such as Chhath Puja, Kartik Purnima, and large riverfront melas. These ghats support ritual bathing, cremation practices, seasonal fairs, fishing, and small-scale commerce, reinforcing the river's central role in everyday urban life.

The presence of National Waterway-1 along the Ganga stretch near Chapra underscores the city's strategic importance as an inland water transport corridor linking Patna, Varanasi, and downstream ports. With year-round water availability and proximity to major tributary confluences, Chapra holds strong potential for water-based passenger and cargo movement. Existing informal landing points, along with proposed jetties and terminals under the Inland Waterways Authority's development plans, enhance prospects for river-based connectivity and logistics. Collectively, these attributes position Chapra's riverfront as both a cultural anchor and an emerging economic asset, with significant scope for structured riverfront management and sustainable water-linked development under the URM.

Key Challenges

- High flood vulnerability due to confluence-driven river dynamics and low-lying urban areas
- Channel migration, erosion, and sedimentation along the urban river edge
- Untreated wastewater discharge and pressure from ritual uses at ghats
- Solid waste accumulation along riverbanks and water bodies
- Underutilised riverfront potential despite strong cultural and economic significance

Map 8 Riverfront Activity Mapping

Preparation of Urban River Management Plan for Chapra

Riverfront Activities

LEGEND

- Chapra Municipality
- Ward Boundary
- Major Road
- Railway Line
- River
- Waterbodies
- Temple
- Mosque
- Ghat (Softscape)
- Crematorium
- Recreational
- Public-Semi Public

Landuse

- Religious
- Agricultura/Grazing
- Tree Cover
- Settlement
- Mango Farms

SOURCE: Google Earth

0 1 2 3 km

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Due to large distance, river edge is only active during festivals

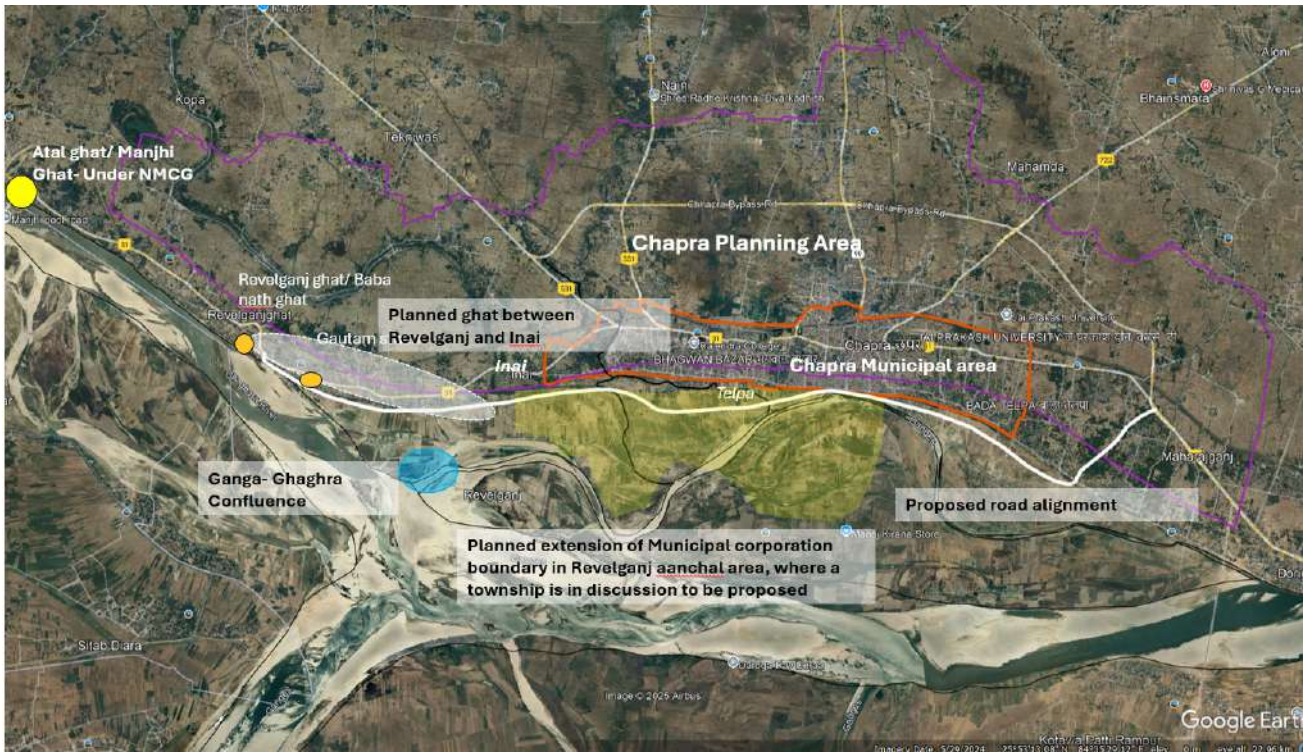
Riverbed during dry season - no activity. Cattle grazing is highly practiced

<u>Proposed/ Planned riverfront projects- Chapra City</u>

During the Multi-Stakeholder Working Group (MSWG) discussions, it was highlighted that Chapra is actively working to boost its socio-cultural tourism and unlock economic opportunities through major infrastructure projects. Key initiatives include developing ghats in Revelganj and Chapra to create vibrant riverfront spaces, and constructing the 21-km at grade Marine Drive (Ganga Path) to ease traffic, improve connectivity to Patna and Uttar Pradesh, and serve as a scenic promenade. A new township is also

proposed along this corridor using land pooling and value capture financing. Additionally, the city plans to promote **tourism at the confluence of the Ganga and Ghaghra rivers,** a site of cultural and natural significance. Collectively, these projects aim to revitalize the riverfront, attract visitors, generate employment, and strengthen Chapra's identity as a socio-cultural hub while ensuring long-term economic resilience.

Figure 6 Consultant's interpretation of the planned riverfront projects in the city



Source: Primary consultations. Alignment of the road is as received from the Road and Construction Department

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
ENVIRONMNETAL	Regulation of activities in Floodplain • **Flood plain management score**	1	No enforceable floodplain zoning or development controls despite high flood exposure. Urban expansion and settlements continue in flood-prone areas.	
	Pollution Free River- • **Net Dissolved Oxygen score**	5	DO levels remain within desirable limits due to high river flows, though untreated wastewater and ritual activities create localized pollution pressures.	
	Rejuvenation of Waterbodies • **Waterbody revival score**	1	Urban ponds and wetlands are largely degraded due to encroachment, siltation, and waste dumping, with limited restoration efforts.	
	Enhancing Riparian Buffer • **Riparian Buffer score**	3	Riparian vegetation exists in parts but is discontinuous and poorly protected, remaining vulnerable to encroachment and degradation.	
	Increased Reuse of Treated Used Water • **Wastewater re-use score**	1	Treated wastewater reuse is negligible; the 32 MLD STP remains underutilised, and reuse mechanisms are absent.	
ECONOMICAL	Ecofriendly Riverfront Projects • **Ecofriendly riverfront score**	0	No dedicated eco-friendly or nature-based riverfront projects implemented; interventions remain largely infrastructure-driven.	
	Leveraging Economic Potential of River • **River economy score**	4	The river supports fisheries, agriculture, religious tourism, informal trade, and emerging inland water transport under NW-1.	
SOCIAL	River Sensitive Behaviour Among Citizens • **Citizen sensitization score**	2	Awareness activities are limited and largely festival-driven, with no sustained behaviour change programs.	
	Engage Citizens in River Management • **Citizen Management score**	2	Citizen participation is informal and episodic, with minimal involvement in planning, monitoring, or decision-making	
	TOTAL	**19**		

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

URM Index = (1+5+1+3+1+0+4+2+2) /9* = 19/9 = 2.1

URM Index for Chapra city = 2.1

Elementary level urban river management

Basic actions required to ensure urban river management are evident. However, there are still major gaps and serious concerns with regards to almost all dimensions of urban river management.

Overall, Chapra's baseline assessment indicates a city at a **critical inflection point**: one where ecological risk, if left unmanaged, could intensify rapidly, but where strategic planning, regulatory clarity, and integrated investments could unlock significant environmental, economic, and social gains under the URMP. Chapra's score profile highlights a **high-risk, high-opportunity city**. With targeted interventions in floodplain zoning, wastewater reuse, waterbody restoration, and structured citizen engagement, the city has the potential to significantly improve its URM performance in subsequent assessment cycles.

Figure 7: Urban Flooding In Chapra in August 2025

4.2. SWOT analysis

Based on the baseline assessment and stakeholder consultations, the following SWOT analysis has been prepared for the Ganga and associated water bodies in Chapra. The analysis is structured across the **environmental, economic, and social** dimensions to guide the prioritisation of URMP interventions.

STRENGTHS

Environmental

- Strategic location along the Ganga with proximity to major tributaries (Ghaghara and Gandak), ensuring year-round river flows.
- Presence of multiple inland ponds and wetlands that function as natural flood buffers and groundwater recharge zones.
- Existing STP infrastructure (32 MLD) providing a foundational asset for pollution abatement and future reuse.
- Remnant riparian vegetation along select river stretches supporting bank stability and biodiversity.

Economic

- Location on **National Waterway-1**, positioning Chapra as an emerging inland water transport and logistics node.
- Strong river-linked livelihoods including fisheries, small-scale trade, agriculture, ferry services, and seasonal grazing.
- Ongoing and proposed infrastructure investments (Marine Drive, bridges, rail redevelopment) enhancing regional connectivity.
- High footfall at ghats and riverfront areas, supporting religious tourism and informal economic activity.

Social

- Deep socio-cultural association with the river, reflected in festivals, rituals, and daily practices.
- Strong religious identity with multiple prominent ghats and pilgrimage sites in Chapra and Revelganj.
- Active involvement of local communities in river-based activities, indicating high potential for stewardship.
- Administrative importance as a district headquarters, enabling convergence across departments.

WEAKNESS

Environmental	Economic	Social
• Absence of enforceable floodplain zoning and development control regulations despite high flood exposure. • Severe vulnerability to riverbank erosion, sedimentation, and channel migration due to confluence dynamics. • Underutilisation of the STP and lack of a structured wastewater reuse framework. • Widespread solid waste dumping into drains, ponds, and riverbanks, particularly during festivals. • Degraded condition of several urban ponds due to encroachment and poor maintenance	• Predominance of informal riverfront activities with limited value addition or formalisation. • Lack of planned riverfront infrastructure to support safe, organised tourism and economic uses. • Economic dependence on flood-prone zones, exposing livelihoods to recurrent climate shocks. • Limited integration between waterway investments and local employment or urban development planning.	• High concentration of vulnerable populations and informal settlements in flood-prone riverfront wards. • Inadequate sanitation and waste management infrastructure during peak religious and cultural events. • Citizen participation largely restricted to clean-up drives, with minimal role in planning or monitoring. • Limited awareness of long-term ecological impacts of ritual practices and riverbank encroachments.

OPPORTUNITIES

Environmental	Economic	Social
• Adoption of floodplain zoning, buffer delineation, and nature-based flood management solutions. • Rejuvenation of ponds and drains as blue–green infrastructure for flood mitigation and water quality improvement. • Expansion of decentralised wastewater treatment and reuse for non-potable applications. • Restoration of riparian buffers and abandoned channels to enhance flood resilience and biodiversity.	• Leveraging NW-1 for passenger ferries, eco-tourism circuits, and local freight movement. • Structured redevelopment of ghats integrating sanitation, waste management, and livelihood support. • Riverfront-based cultural tourism linked to confluence sites, melas, and heritage trails. • Value capture and land pooling mechanisms along major river-adjacent infrastructure corridors.	• Formalising community stewardship through river committees, volunteer networks, and citizen reporting platforms. • Integrating festival management plans with solid waste, sanitation, and river protection measures. • Enhancing public access to safe, inclusive riverfront spaces to improve quality of life. • Capacity building of local institutions and NGOs for sustained river-sensitive behaviour change.

THREATS

Environmental	Economic	Social
• Intensification of flooding and erosion due to climate change and increasing monsoon variability. • Continued channel migration bringing the active river closer to dense urban areas. • Cumulative pollution load from untreated wastewater, ritual waste, and urban runoff. • Loss of remaining riparian buffers due to unregulated development and encroachment.	• Risk of infrastructure-led riverfront development without ecological safeguards, leading to maladaptation. • Disruption of livelihoods due to flood events, erosion, and regulatory enforcement without alternatives. • Underperformance of waterway investments if not integrated with city-level economic planning.	• Recurrent displacement and asset loss among riverfront communities. • Public resistance to regulation of traditional practices if not supported by participatory planning. • Institutional fragmentation limiting effective implementation of URMP recommendations. • Erosion of cultural assets and public trust if river degradation continues unchecked.

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

Chapra City lies at an approximate distance of 2-3 km from the Ganga River during the dry season, as observed through satellite imagery. As a result, the city does not have a clearly defined or active riverfront for most of the year. The land between the city and the river falls largely within the jurisdiction of Revelganj Panchayat/Anchal and is recorded as privately owned in revenue records. Despite this ownership pattern, development activity close to the river remains limited.

Topographically, the city and the adjoining riverine areas are largely flat, with minimal elevation difference between the urban edge and the riverbed. This geomorphology is a direct outcome of sustained silt deposition caused by the proximity of the Ganga–Ghaghra confluence near Chapra. The absence of a pronounced gradient limits natural drainage and increases the city's susceptibility to inundation during high-flow periods.

Figure 8 Riverine Flooding

Flooding of the settlements at the southern boundary of the Chapra city

Flooding within the city edge, demonstrating the inundation of the flood. Inundation of Manjhi ghat

Chapra experiences both riverine and urban flooding. Riverine flooding is primarily associated with monsoon-driven overflows of the Ghaghra River, compounded by the city's location near the confluence of two major river systems, which introduces hydrological uncertainty. Urban flooding, on the other hand, results from intense rainfall, overflow from local water bodies, and an undersized and poorly planned drainage network. Field observations indicate that floodwater often penetrate deep into the city, with waterlogging persisting for three to four months. Drainage infrastructure frequently fails due to inadequate capacity, reverse gradients, narrow streets, and solid waste accumulation.

Figure 9 Urban Flooding in Chapra City

Water logging dye to improper planning of drains

Narrow street with solid waste, block the openings of drains

Storm water drain capacity overwhelmed during river flood

The Tel River (locally referred to as a nalla) forms part of Chapra's western boundary and functions as a key natural drainage channel. Its flow direction reverses seasonally, draining toward the Ganga in the dry months and moving landward during peak monsoon conditions. The river regularly overtops during heavy rainfall, causing localized flooding. An embankment and a barrage constructed by the Minor Irrigation Department attempt to regulate flows, while the river also supports fishing-based livelihoods. Slum clusters and informal encroachments along its banks further heighten exposure to flood risk.

5.1.2. Floodplain Characteristics and Land Use Dynamics

Chapra's floodplain is shaped by dynamic river behavior, seasonal hydrological variability, and weakly enforced land-use controls. During the dry season, urban settlements remain several kilometers away from the Ganga, but during peak monsoon conditions or high Ghaghra discharges, floodwaters extend into the city core, submerging large areas for extended periods. Recorded High Flood Levels and Danger Levels underscore the narrow margin of safety during monsoons.

High Flood level : 54.59m Danger level : 53. 68m

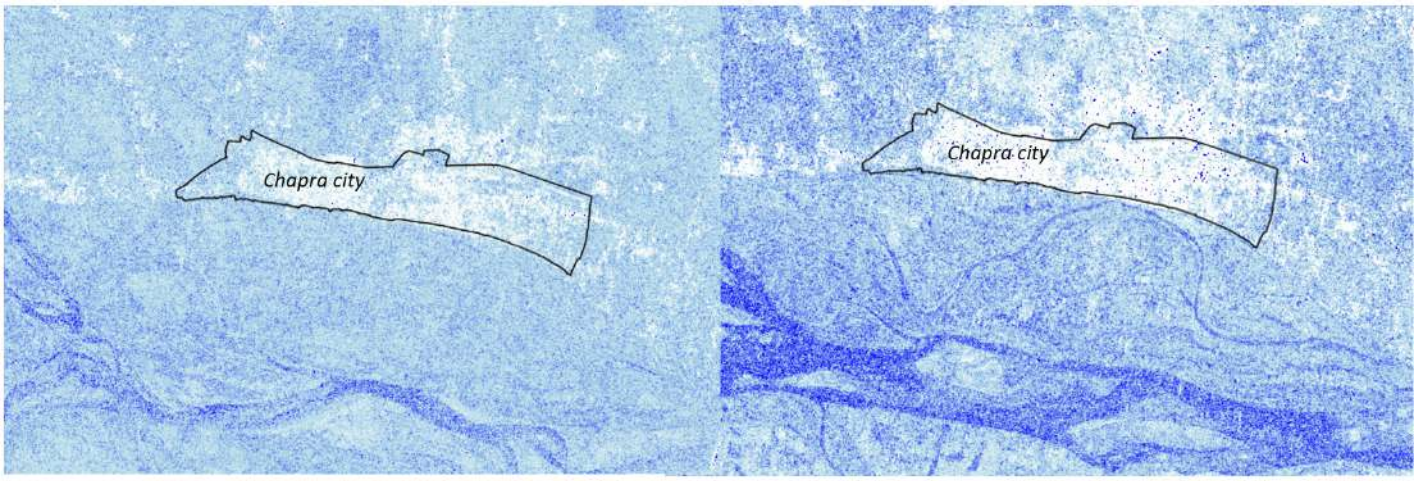
The Ganga River buffer in Chapra functions as an active floodplain, serving both as an ecological corridor and as an informal space for livelihoods and seasonal activities. During the dry season, the city's built-up edge lies nearly 4 km away from the river; however, in peak monsoon months or during high flows in the Ghaghra, floodwater extends deep into the urban area, with inundation persisting for three to four months. Recorded High Flood and Danger Levels indicate that the city operates very close to critical thresholds during monsoon periods.

In the absence of a formal embankment, the river edge has been delineated using satellite imagery, supported by historical topographic evidence. In line with NGT and CWC guidelines, a 100 m no-development zone and a 500 m regulated zone have been identified along the Ganga. Field surveys confirm that both zones are fully submerged during the monsoon and are predominantly under agricultural use, mainly paddy cultivation. Given the shifting river course over time, the southern historical riverbed, particularly within the Revelganj Panchayat area, has been adopted as the planning reference for defining the river edge.

For the Tel River, which forms part of the city boundary, a 100 m buffer has been mapped based on observed inundation extents of 50–100 m during high rainfall events. These buffers reflect the river's seasonal behaviour and have been defined to align with NGT guidelines for riverfront protection.

Land use within the floodplain remains largely low-intensity and seasonal, including agriculture, grazing, fishing, informal boating, recreation, and religious activities. Permanent structures are limited and include temples, cremation and burial grounds, playgrounds, and scattered residential buildings, typically constructed with raised plinths to accommodate floodwaters. While overall built-up growth within the buffer has been modest over the last seven years, incremental expansion at the city edge and the emergence of informal settlements indicate rising development pressure. Proposed riverfront projects such as ghats, an elevated riverfront road, tourism facilities, and a new township are all located within the active floodplain and will interact directly with these dynamic flood processes

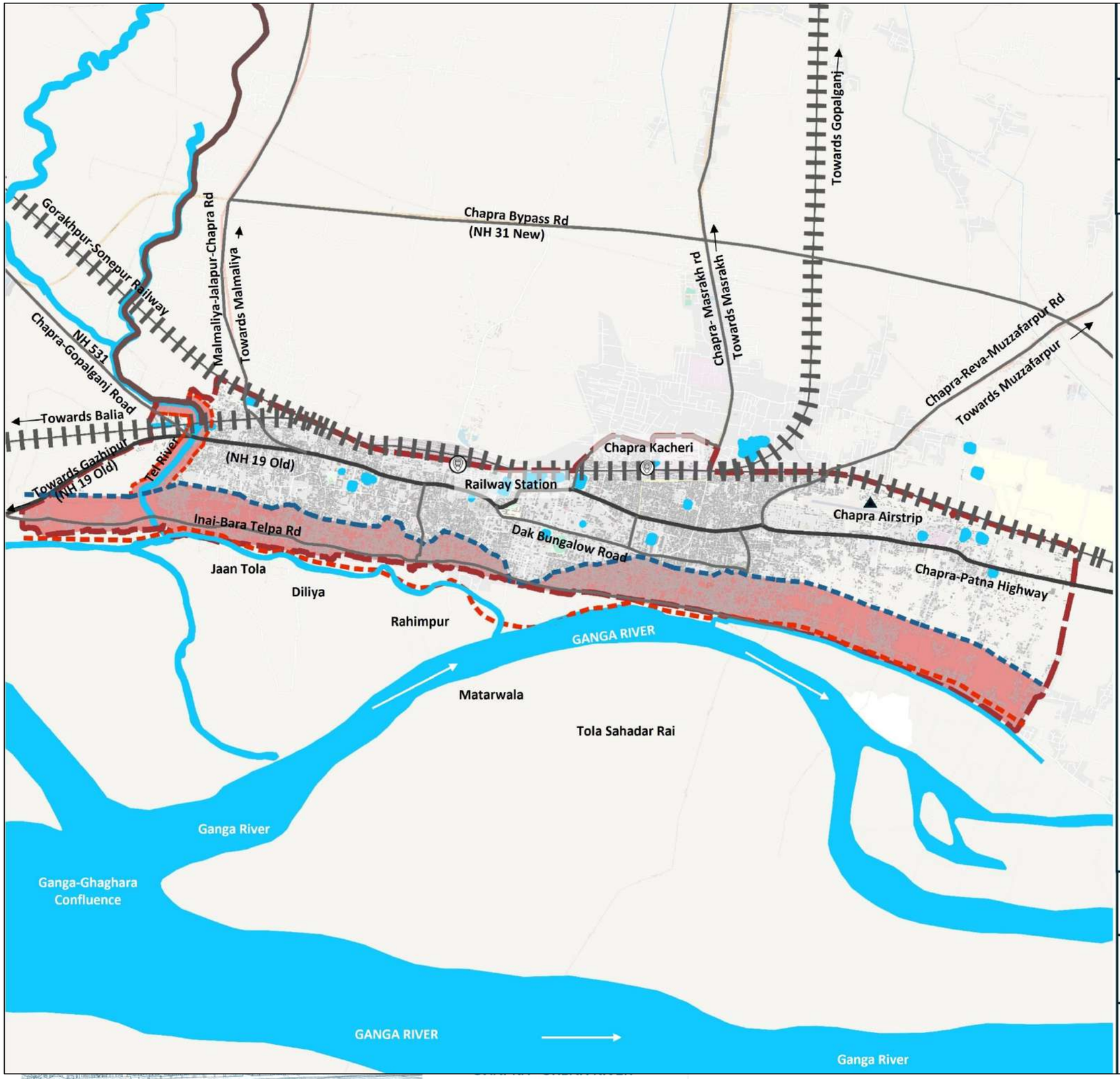
Figure 10 : NDWI Analysis, Chapra



Normalized Difference Water Index is a remote sensing tool using satellite imagery to map water bodies and vegetation moisture, calculated by comparing green and near-infrared (NIR) light (for water bodies). Helps monitor drought, manage water resources, and track changes in open water, with higher values indicating more water.

NDWI analysis clearly demonstrates the surface water content in ground post monsoon, indicating flooding in the southern part of the city and along Tel river and north-east .

Map 9 River buffer zone defined along the River Edge



Preparation of Urban River Management Plan for Chapra

River Buffer Zone

LEGEND

- Chapra Municipality
- Ward Boundary
- Major Road
- Railway Line
- River
- Waterbodies
- 500m Buffer
- 100m Buffer
- WRD Embankment
- River Buffer Zone

SOURCE: Embankment: WRD, Bihar.
River edge/Boundary: Open Government Data Portal

0 1 2 3 km

MANAGEMENT PLAN

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Key Gaps

The floodplain in Chapra is characterized by several structural and regulatory gaps that increase long-term flood risk. The absence of a notified floodplain zoning framework and clearly demarcated river edges limits effective control over land use in an actively inundated landscape. Private ownership of floodplain land under Revelganj Panchayat, combined with fragmented institutional responsibilities, has weakened enforcement and enabled unplanned and informal development in high-risk areas.

At the same time, physical and service-related gaps exacerbate flood impacts on the ground. Inadequate drainage capacity, poor solid waste management, and the discharge of treated wastewater into floodplain channels degrade water quality and intensify urban flooding. Proposed riverfront infrastructure and expansion of municipal limits lack integrated flood-risk safeguards, while limited affordable housing options continue to push vulnerable populations to reside within low-lying, flood-prone areas

5.1.3. URMP Score

Flood Management Score

As per the URMP frameworks parameters for the regulation of activities in flood plain, Chapra city scores 14/100 that translates to Flood management score -1. This is mainly due to absence of a master plan that defines permissible and non-permissible uses in the flood plain and absence of a river edge/ boundary. Further, new development in the river buffer was observed, that remained flooded in peak season.

5.1.4. Interventions

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

The Master Plan for Chapra is currently under proposal stage and does not specifically have any measures/ proposals for the Ganga and Ghaghra river protection and the floodplains. Currently the Chapra stretch of Ganga or Ghagra do not have any embankments or ghats as flood protection measure and is mostly natural. .

Figure 11: 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

Suggested Logic:

permissible activities, on the non-embanked side) as the base planning layer.

- 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.**

Flood Zone	Flood Frequency	Planning Intent
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

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 (100 m)	Regulated Development Zone (500 m)
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

Activity Type	No Development Zone (100 m)	Regulated Development Zone (500 m)
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

In case of Chapra, where congestion and high built density is major issue that leads to urban flooding, regulations wrt to guidelines and setback to be done based on the width of road as mentioned in the Building Bye laws.

-Identifying and earmarking ground water recharge zones as well as the drain and catchment areas

-Setback based on road widths

-Mandatory buffers around drains and water bodies and mandating as "no solid waste zone"

- Having differential DCRs on plinth height for construction in the flood plain/ river zones

Step 3: Physically Demarcate the floodplain Boundaries

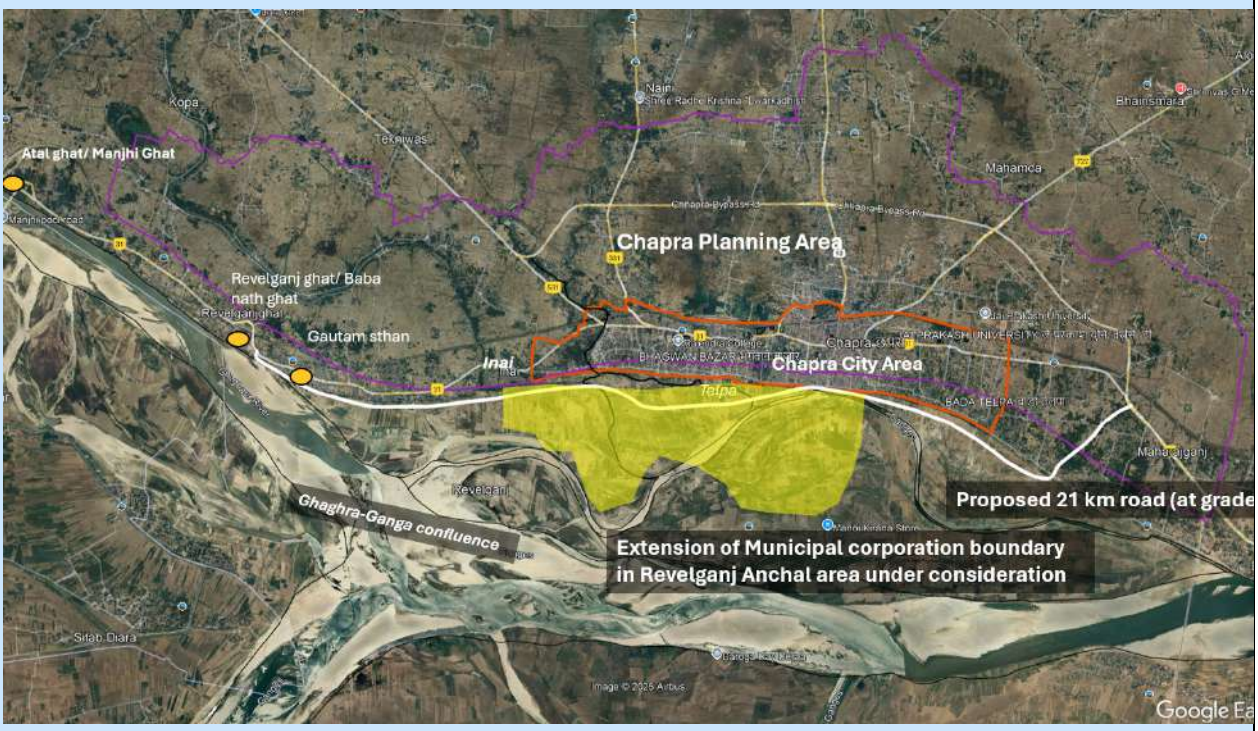
Once the floodplains are demarcated, they should be physically demarcated, as done in the case of the Bandh road, to improve on-ground enforceability. This can be done via:

- 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.

Institutional Responsibilities and Coordination

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

Regulating the expansion of Chapra Municipal Corporation



In case of Chapra, the city is planning to expand its Municipal Corporation area towards the river, southern area and develop a township. Additionally, the city has also proposed a 21 km road as a bypass. Both these developments are highly susceptible to flood. Due notice and care should be taken to regulate activities within this flood plain.

Recommendations include:

Regulation of activities:

A lot of agricultural activities are being carried out in river flood plains and river islands formed during the summers. The city needs to look into regulating agricultural activities, especially in floodplains and river islands. Following are some recommendations to be implemented by District Agriculture Department-

- Regulation on type of crops produced in the floodplain and river islands (recommended
- and non-recommended crops considering water consumption, native or invasive species,
- biodiversity etc)
- Promoting native species with economic benefits for farmers like millets, Camel Grass
- (Vetiver), oilseed cultivation with subsidies and incentives etc.
- Promoting less use of chemicals (phasing out of chemical use)
- Capacity building of farmers

Planning Strategies:

- Master Plan could have a clearly defined land use/ use zone category for the river and its floodplains, within the existing and proposed land use tables. The river and its floodplain could be clearly marked in the land use plan as well, under the appropriate land use/use zone category.
- Demarcate the 'no development zone' and 'regulated zone', for regulating all development within the flood plain of Ganga-Ghagra river
- STPs should not be constructed close to the riverbed, preferably there should be a distance of 500 m plus from the edge of the river (NGT, 2017)
- A buffer of 75 m buffer as "No Development and Construction Zone" to be maintained around waterbodies (lakes / ponds), as per the revenue records. The minimum size of water bodies/lakes applicable in this context to be decided by local stakeholders.
- A buffer of 50 m for primary, 35 m for secondary and 25 m for tertiary drains (measured from the edge of drains) to be maintained.
- Enlist the prohibited, regulated, and permissible activities within each of these zones

Intervention	Responsible Agency	Intervention type
Floodplain Zoning Integration into the Master Plan	Bihar State Town & Country Planning Dept.	Policy & Regulatory
Estimated Budget	**Potential Funding Sources**	**Timeline**
N/A	State Planning Funds	Long-term

Intervention 1-2: Techno-Feasibility study for the construction of an embankment for flood protection along the proposed 21 km road

Since Chapra experiences recurrent riverine flooding every year, leading to loss and damage of property, and infrastructure stress; it is important to propose a flood control measure in the southern side of the city to prevent flooding within the city. The map below also highlights the observed flood line during peak monsoon, demonstrating that the built infrastructure is highly vulnerable to flooding. Since the District is already planning a 21 km road on its southern edge, this could be leveraged to implement soft embankment measures along it, to prevent flooding and siltation.

Figure 12: Map displaying the alignment of the proposed 21 km road in Chapra

As per discussion with the Road Construction Department, currently land acquisition phase for the road is nearing completion and no detailed design of the road has been prepared. Currently the design is proposed to be 1 meter above the High Flood level. This provides an opportunity to develop a flood resilient road design.

Since the inspiration to construct the "Marine drive" road is drawn from Patna, capital city of Bihar state, it would be crucial to draw in learnings and challenges from the existing Marine drive road of Patna and explore nature-based solutions for embankment.

Case of J.P path, Patna- as a potential embankment solution

Patna Marine Drive Road (Loknayak Ganga Path)- a flood protection measure for the city - the road's design makes it a dual-purpose infrastructure project, providing essential connectivity while simultaneously acting as a significant shield against the river's aggressive nature during high floods

Design and function as Flood Embankment

- **Elevated Structure:** The expressway is built on a high embankment that physically separates the low-lying areas of the city from the river. This elevated design is the primary mechanism for preventing floodwaters from inundating Patna.
- **Embankment Reinforcement:** The project involved transforming a once flood-prone riverfront into a robust structure. The construction technique and material is intended to be a long-term, firm defence against rising water levels.
- **Integrated Flood Control Strategy:** The use of embankments is a common structural measure for flood control in Bihar. The Marine Drive project integrates this established flood protection strategy with modern urban infrastructure development.
- **Urban Planning Integration:** Besides flood control, the project includes additional features like riverfront development, tree plantations, and proper drainage systems, which collectively contribute to environmental protection and the management of water runoff, reducing pollution and soil erosion.

Given the unique nature of the flood plain in Chapra, with the river forming levees and sand bars and level elevation difference between the city and the river, location to construct the embankment would need further investigation. Further, since the flow of Ganga river is very high sometimes during the year, bund solution are susceptible to being damaged. Hence a composite engineering +nature-based solution would be feasible to plan for any embankment solution for the city.

CONSTRUCTION OF LEFT AFFLUX BUND AT JOSHIYARA BARRAGE On Alaknanda River, Uttarakhand[4]

Joshiyara Barrage is located on the river Alaknanda in the state of Uttarakhand. The barrage is designed to divert water into a head race tunnel to generate electricity through a power station. Due to rapid flow fluctuations, the entire stone pitching over the left afflux bund was disturbed leading to the erosion of the bund. The height of bund was another issue pertaining to the increasing threats of flooding of the adjacent/nearby areas in HFL conditions.

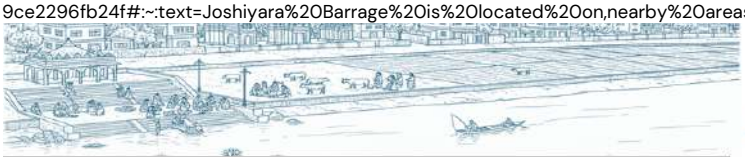
The main purpose was to provide a permanent and flexible solution which can easily withstand the rapid flow fluctuations and can counter the flooding of nearby areas in high flood conditions.

For this the solution system provided was intended to: (a) Prevent the toe instability. (b) Prevent the bund from surficial erosion. (c) Prevent the scouring at toe. (d) Prevent the adjacent/nearby areas from flooding. (e) Prevent the countryside slope of the bund from surficial erosion.

Solution:

Providing a gabion wall over the already present RCC toe wall followed by a gabion mattress and a reno mattress as a revetment over the gabion wall for the surficial protection and a gabion mattress

[4] https://storage.googleapis.com/maccaferri-2-storage/5c8e76d7-233b-4804-af5b-9ce2296fb24f#:~:text=Joshiyara%20Barrage%20is%20located%20on,nearby%20areas%20in%20HFL%20conditions.



just below the gabion wall and in front of the RCC toe wall, for protection against scouring at toe for the river side. A similar pattern was adopted for the countryside facing of the bund. The solution included a considerable increase in the height of the bund upto the required HFL with safe free board for prevention against flooding of the adjoining areas.

Eroded Afflux Bund

Eroded Afflux Bund

Afflux Bund during construction

Gabion filling during construction

Complete structure- river side

Complete structure city side

Figure 13: Examples of embankment solutions to prevent flood water from inundation



Intervention	Responsible Agency	Intervention type
Techno-Feasibility study to provide flood embankment solution for Chapra	Road Construction Department. Chapra Road Construction Department. Chapra Irrigation department Forest department (regulatory)	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~1 cr (consultancy fees)	Central Road Fund, NMCG	Long-term

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

Liquid Waste Management

Chapra currently has a STP plant of 32 MLD I&D that connects major drains and secondary drains in the city. STP plant is located outside municipal boundary in Sherpur. The primary contributor to city's sewage is storm water, surface run-off, domestic waste and waste from the city market areas/ commercial establishments. Some amounts of black water are also discharged within the sewage systems informally through slum areas and surface run-off. No Faecal Sludge Plant is present in the city. Industrial wastewater is minimal, as the city has no major industrial base[5].

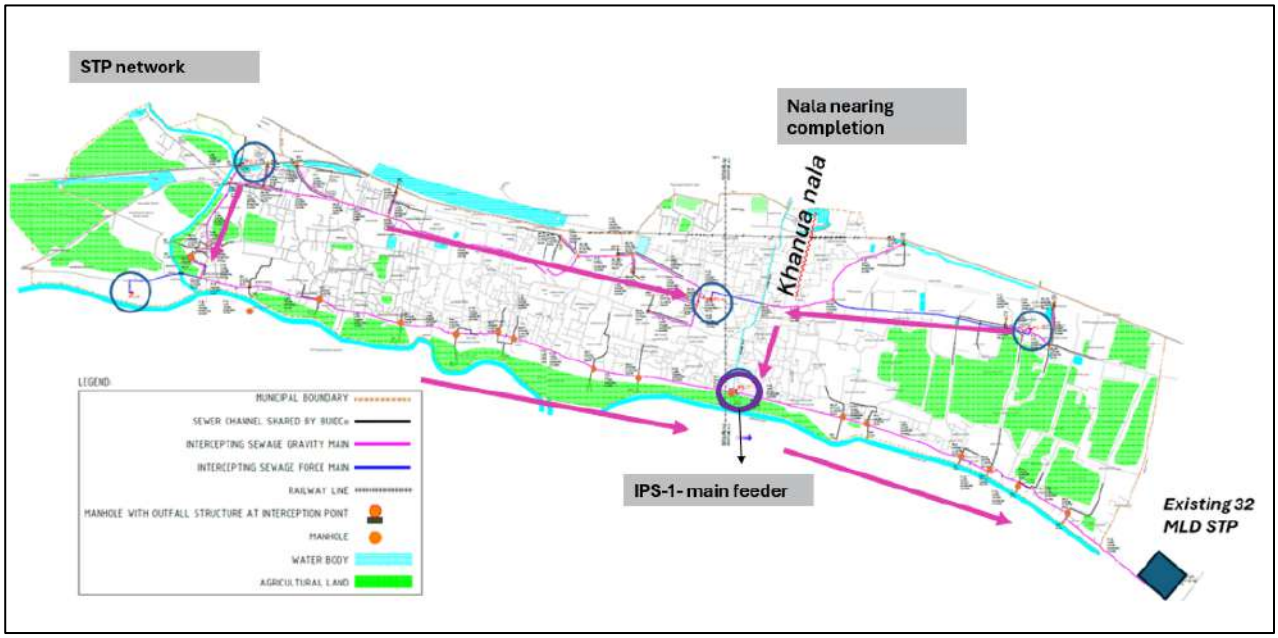
Before the construction of the STP, the city was dependent on *Khanua nala* to carry the sewage. The total sewage/wastewater discharge through aforesaid drain was 4.87 MLD and had the outfall in the Ghaghra river.[6] The water quality entering the river was highly organic and unsafe (pH:7.57 ; BOD:32 mg/L COD:120 mg/L ; TSS:68 mg/L) This can be used as a proxy to understand the current quality of water in drains, and hence establishing a need to monitor, regulate and control the mixing of untreated drain water with the river

Existing Infrastructure and Gaps

Chapra's sewerage infrastructure under NMCG funding includes a 32 MLD (Interception and Diversion) Sewage Treatment Plant (STP) operated by BUIDCO, supported by an Interception and Diversion system, five intermediate pumping stations, eight online pumping stations and 39 primary drains managed through SCADA. The stormwater network spans 176 km of drains across 38 catchment areas, with outfalls discharging into the Ganga-Ghaghra, Tel River, and inland water bodies. Despite this setup, STP operates at nearly half its capacity, treating only about 15 MLD daily—due to the absence of household connections to the drainage network and challenges with the existing network. While proposals to link households and expand the sewerage system are in process, untreated wastewater through surface runs off and enter rivers, especially during floods, posing serious environmental and health risks.

[6] Action Plan for restoration & conservation of Ganga, 2021, DoEFCC, Govt. of Bihar

Figure 14 Existing 32 MLD STP (I & D) network (as per DPR)- Chapra city

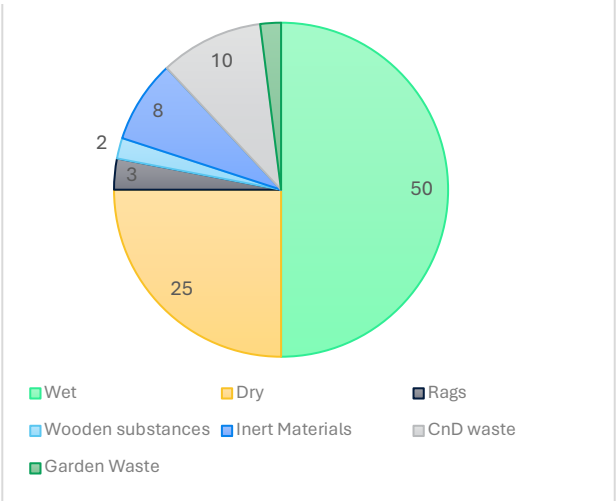


Source: Chapra BUIDCO. AIILSG and ICF Analysis for URMP Bihar, Baseline Report, 2025

Field inspections highlight additional gaps, including backflow during peak floods that force STP shutdowns, persistent waterlogging in congested markets due to blocked drains, and prolonged inundation lasting months in some areas. Delays in implementing network expansions and poor maintenance exacerbate these issues. Environmental degradation from untreated waste mixing with solid dumps remains a critical concern. To address these challenges, BUIDCO is reviving the historic Khanua nala to improve flood resilience and exploring treated wastewater reuse as a sustainable solution. However, stronger institutional coordination and timely execution of proposed projects are essential to optimize existing infrastructure and safeguard urban water systems.

Solid Waste Management

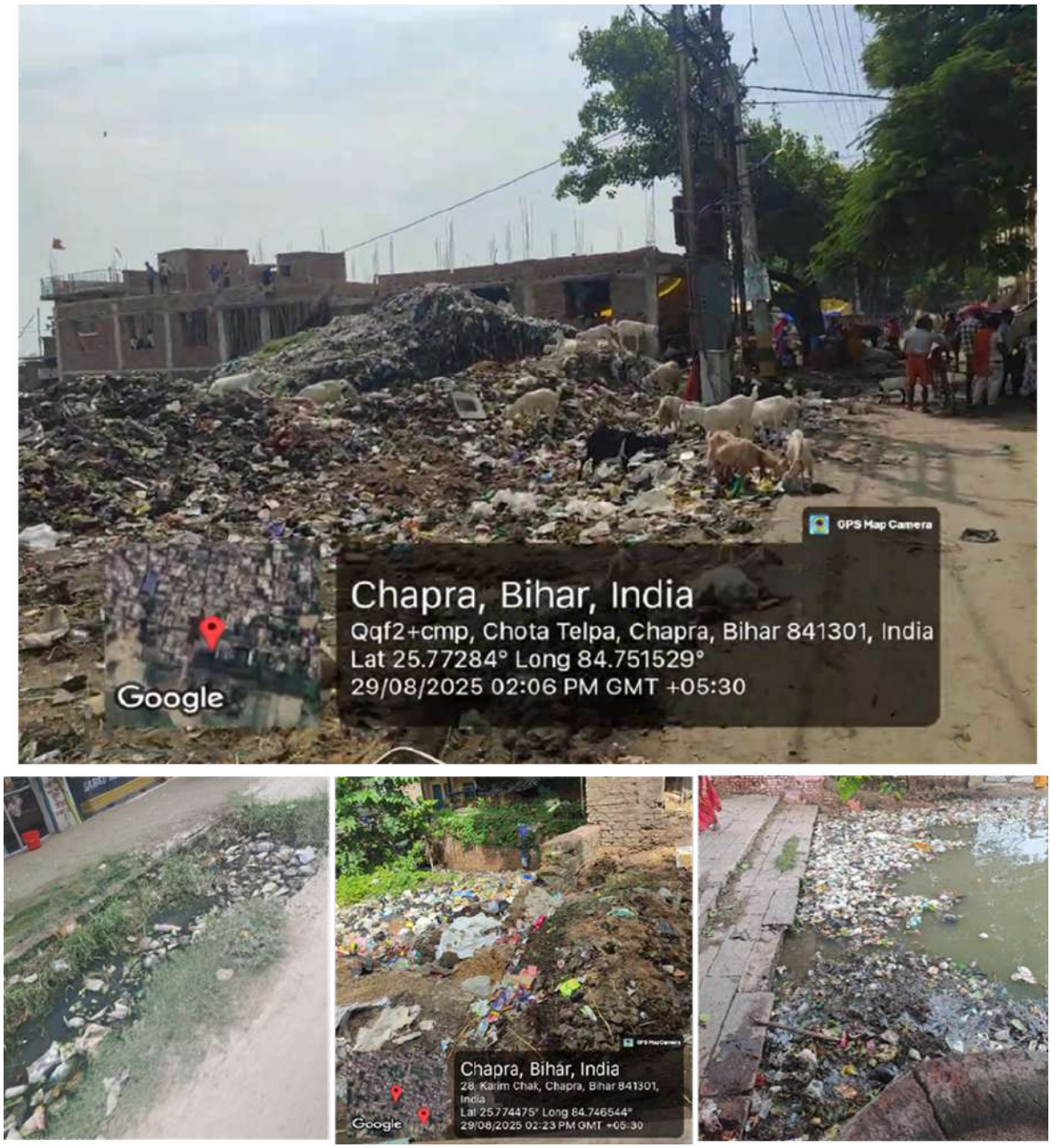
Figure 15 : Composition of solid waste in Chapra city



End-to-end solid waste management within the city is managed by the Chapra Nagar Nigam. It is responsible for collection, transfer and dumping of solid waste, with complete operations and maintenance. As per the SBM-MIS data, the city practices 100% door to door collection of solid waste across the city. There are site-level garbage bins placed throughout the city on points of public interest including public parks and important markets. Chapra city generates around 87 MT of solid waste per day. Populating with the projected population of 2025 (237,000 E). This indicates the pressure due to urbanization trend. Multiple spots of open dumping were observed in the city. Shyam Chak -a transfer station within the city has now become a dumpsite and has around 20,486 MT of legacy waste, within the city. Complaint redressal related to solid waste is currently being managed by Akansha enterprise, and NGO. A study undertaken in 2024 in Chapra municipal

corporation indicated that the wet waste formed more than 50% of the total waste generated in the city. The other physical components were the dry waste, garden waste, amongst others. This indicates that largely domestic and market waste ate the highest generator of waste . (Report on Solid waste management in Chapra, 2024)

Figure 16 Solid waste dumps in city; around ponds, nalas and drains



Pollution Hotspot Analysis

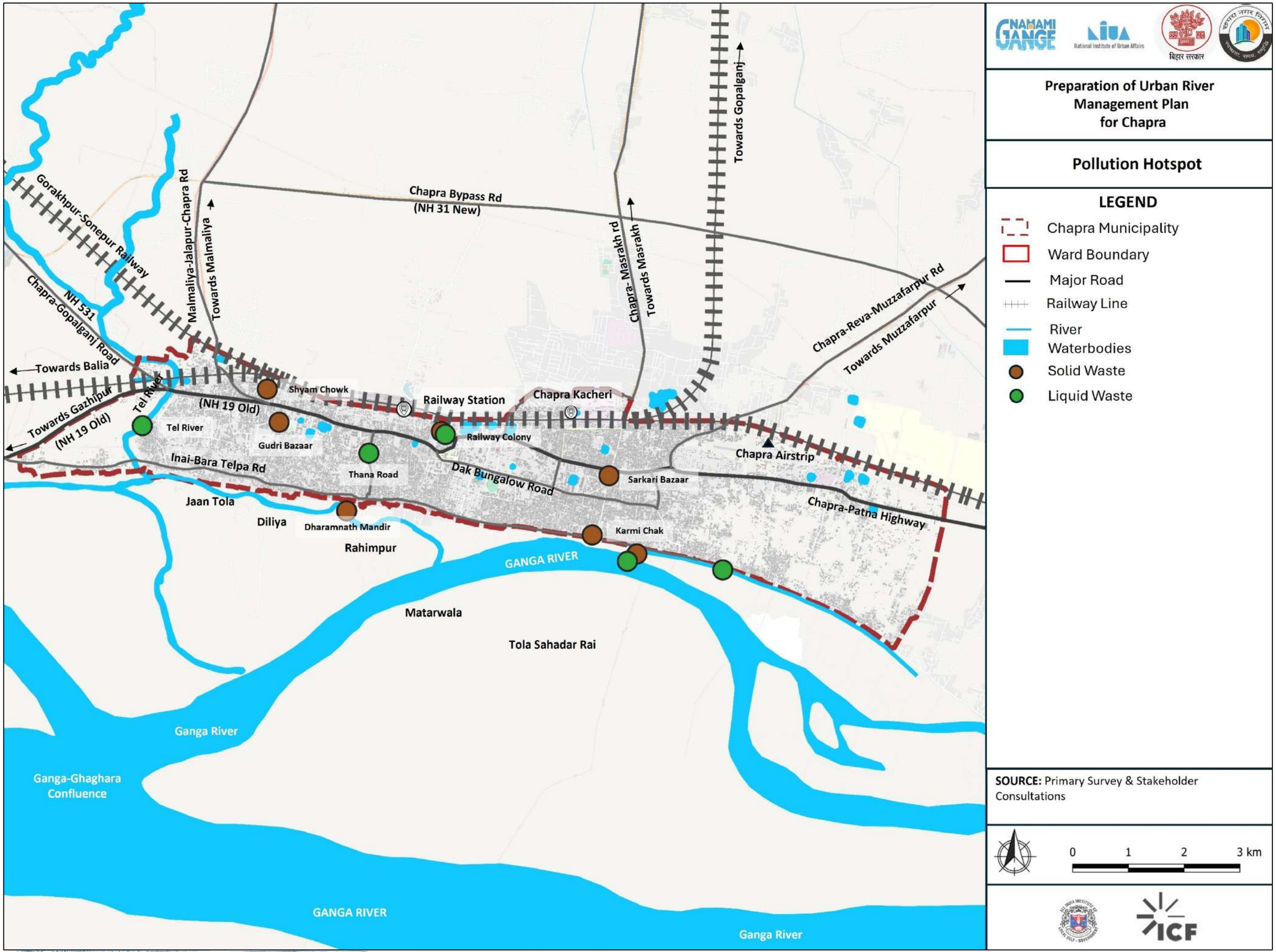
An integrated assessment of pollution hotspots in Chapra reveals concentrated zones where mismanagement of solid and liquid waste is severely impacting urban water bodies and the Ganga River. These hotspots form spatial clusters, indicating systemic infrastructure and governance gaps rather than isolated issues. Congested areas such as Thana Road, Bhagwan Bazaar, Sarkari Bazaar, and

stretches like Jail Road, Gudri to Ramlia Mathia, Karim Chawk, Shyam Chak, Chota Telpa, and the Tel River corridor are critical zones identified through field surveys and consultations with Nagar Nigam officials. Shyam Chak functions as a secondary transfer station, accumulating tonnes of garbage daily without containment, posing risks of disease outbreaks and groundwater contamination. Karim Chawk faces a dual challenge where untreated effluents mix with dumped refuse, further degrading aquatic ecosystems despite STP operations.

These conditions highlight deeper systemic gaps, including inadequate waste segregation and collection systems in high-density areas, limited sewerage and drainage coverage, and poor enforcement of environmental regulations. Flood vulnerability worsens the situation, as waterlogging disperses waste into natural water bodies. The cumulative impact is severe environmental degradation—affecting soil, water, flora, and aquatic life—while creating long-term public health risks. Addressing these challenges requires integrated urban planning, robust waste management infrastructure, and targeted interventions in hotspot zones to restore ecological balance and improve resilience.

Figure 17 Liquid and solid waste dumps around the city

Map 10 Liquid and Solid Pollution Hotspots



Key Gaps

- **Liquid Waste Management:** Household and domestic wastewater remains largely disconnected from major drains, resulting in limited treatment coverage. The city lacks a dedicated faecal sludge treatment plant, and desludging services are not formally contracted or monitored by the ULB. Southern stream corridors, particularly those running parallel to Chota Telpa, exhibit stagnant water and extensive solid waste dumping, causing seepage, groundwater contamination, and progressive environmental degradation.
- **Sanitation and Public Health:** Toilet coverage is inadequate, especially in high-footfall areas, and there is no real-time system for monitoring operations and maintenance. No Public toilets present in the city, however proposal in in pipeline. In addition, the city lacks standardised sanitation protocols for festivals, including provisions for enhanced waste collection, temporary toilets, and bio-remediation measures at ghats.
- **Solid Waste Management:** The Sherpur dumpsite functions without scientific planning, particularly in managing leachate and its environmental impacts. The Shyam Chowk transfer station within the city has emerged as a major solid waste hotspot, adversely affecting public health and groundwater quality.Source segregation is weakly enforced, municipal bye-laws suffer from poor implementation, and available incentive mechanisms are underutilised. Field observations indicate a high proportion of wet waste mixed with plastic waste across the waste stream.
- **Pollution Hotspot Management:** Solid waste accumulation along narrow streets, market areas, and around the Shyam Chowk transfer station remains a persistent challenge. Low-lying settlements are especially vulnerable due to inadequate drainage, poor sanitation infrastructure, and the absence of alternative or decentralised waste disposal services.

Figure 18 : Impact of wet waste on river health

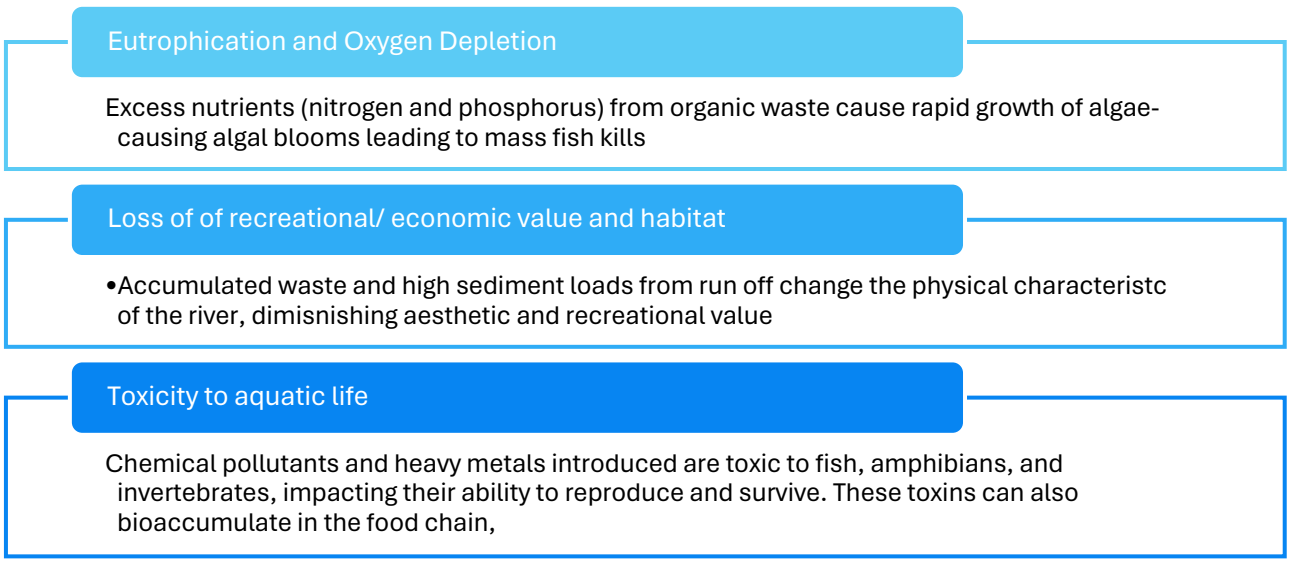
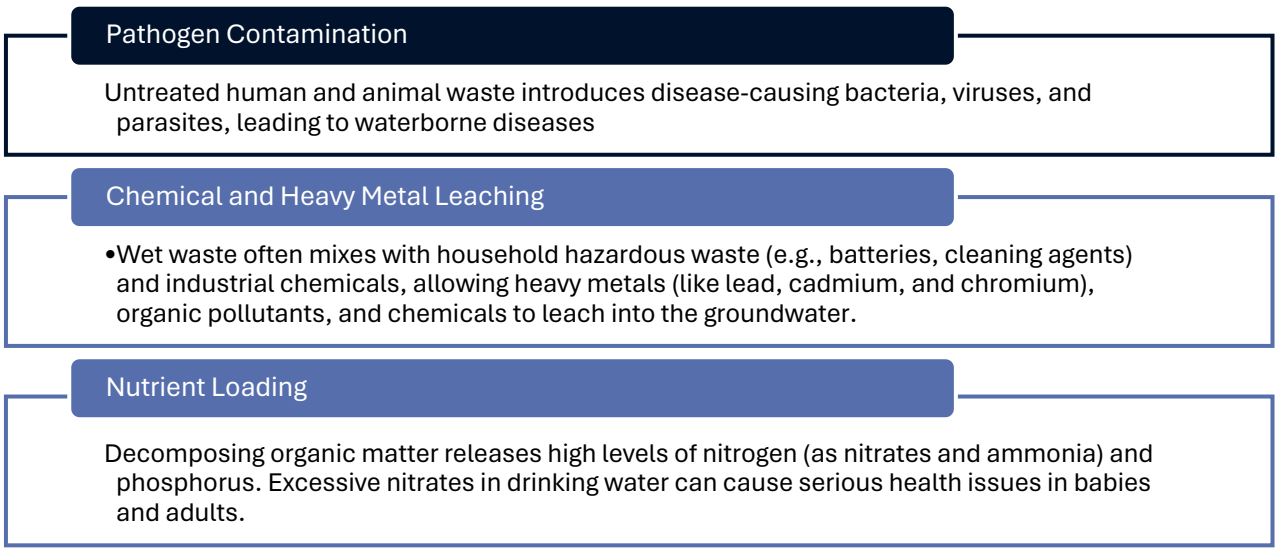


Figure 19: Impact of wet waste on Ground water



5.2.2. URMP Score

As per URMP framework to understand the pollution levels in the river the Net Dissolved Oxygen Score is measured. Since the SPCB- Bihar has published data of DOs, there are 2 monitoring stations in Chapra. For this stage, inlet is considered at the confluence of Ganga and Ghaghra and the outlet is considered as the Ara bridge in Ganga (due to data availability). The net DO is DO outlet (-) DO inlet / DO inlet x 100. DO difference is 2.6, indicating very high score of 5. This may not show the true nature of the water quality due to the high flow rate of water; the water quality is diluted.

5.2.3. Interventions

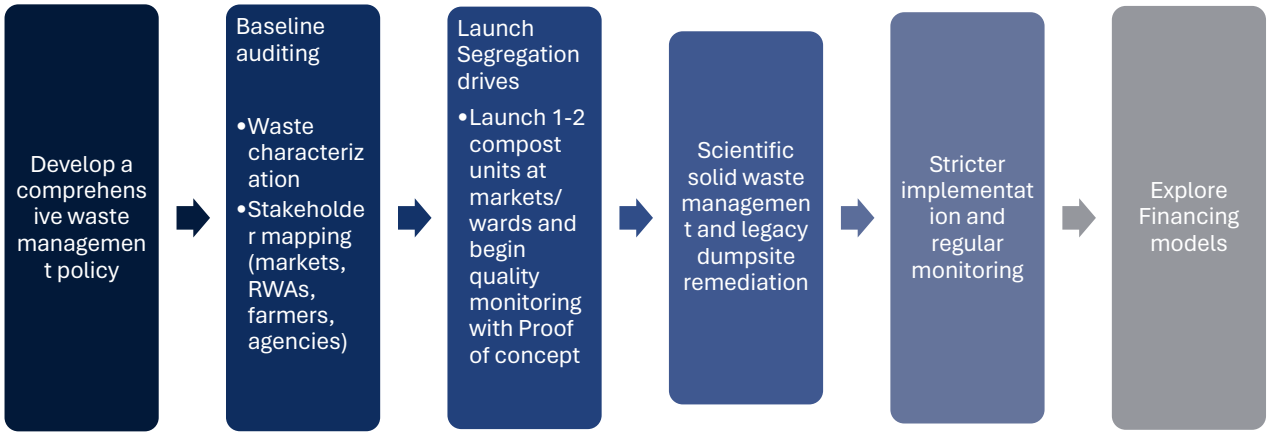
5.2.3.1. Intervention 2-1: Developing river pollution control strategy for the city

The river is burdened with substantial pollution from both solid and liquid waste originating within the city. Although household waste collection is reportedly universal, it remains poorly regulated and inconsistent. The transfer station at Shyam Chak has amassed a significant volume of legacy waste, creating serious threats to public health and the river ecosystem. This situation also endangers the groundwater aquifer—the city's primary drinking water source—raising the risk of severe contamination. Pollution is further exacerbated by incomplete and open drains that channel waste into the river. Solid waste accumulation in these drains hampers their capacity, reducing wastewater flow to the STP and causing frequent infrastructure failures and interruptions in pumping operations. During floods, prolonged waterlogging—sometimes lasting over two months in congested areas—leads to unhygienic conditions and surface run-off into ponds and rivers. These challenges underscore the urgent need for a comprehensive solid waste management strategy to safeguard public health, water resources, and urban resilience.

Since the city has already planned for a Material Recovery Facility to manage the dry waste, the URMPs focus would be to manage the wet-waste load as it forms 60% of the waste generated. Following is the

roadmap or Chapra to adopt for an integrated waste management strategy for the city, that will ensure prevention of pollution entering water systems of the city and positively improve sanitary conditions of the city.

Figure 20 : Roadmap for Chapra Nagar Nigam to manage waste and control river pollution



- **Developing a comprehensive waste management strategy for the city**:
  This document will serve as a comprehensive guide, outlining standard operating procedures and best practices for effective waste management in the city. It will include strategies for waste prevention and minimisation, emphasising reuse and recycling. The plan will be supported by an institutional framework that clearly defines roles and responsibilities across the entire waste management value chain—from collection to final disposal. It will also propose ways to engage communities, adopt suitable technologies, and implement viable financing models. Additionally, the strategy will detail the required infrastructure and logistics plan for the city. A three-tiered approach will be introduced, targeting individual households, community-level waste from markets, establishments, retail outlets, and government offices, as well as organic waste from agriculture, parks, and gardens. The document will further outline measurable goals and targets to ensure accountability and progress.
- **Baseline auditing**
  Independent study to be undertaken to identify the character and types of waste generated by the city and its components by source. Waste generation by each ward and area also to be mapped. A thorough study to understand the behaviour of waste dumping practices by individual households or establishments especially located near the riverfront and drains. Mapping the existing available infrastructure, manpower and its accessibility. This study is to be taken by a third-party agency.
- **Launching waste segregation and IEC drives**
  Absence of scientific method of segregation and its complexity of the existing legacy waste necessitates to practice segregation at source involving citizens and communities. Involving the local experts, swacchta mitra, educational institutions at riverfronts/ lakes/ ponds, markets, involving local leadership and students would provide effective platform to induce citizen sensitivity to practice waste segregation at source.

- **Legacy wate dumpsite remediation at Shyam Chak***

  It addresses two critical challenges: (i) remediation and closure of the existing Shaym Chak transfer station (now a 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. The remediation process to be strictly undertaken as per the CPCB Guidelines on Legacy Waste Biomining Guidelines. [7]

- **Stricter implementation and regular monitoring**
  Implement technology-driven systems to monitor daily waste collection, segregation, processing, and disposal at the household level. Introduce stricter penalties for littering and dumping waste near ponds and lakes. Sensors to monitor the quality of water bodies within the city. The city should roll out a QR code-based grievance redressal platform to record complaints related to littering, missed collections, and other solid waste issues for efficient tracking and resolution. Additionally, enforce a mandatory schedule for drain cleaning to prevent waterlogging, particularly during the monsoon season. The city should also impose higher fines for littering around water bodies

- **Financing and operating model:**[8]
  Solid waste management requires sustained financing across the entire value chain—collection, transportation, processing, treatment, and disposal. Cities typically adopt a combination of public funding, private investment, and cost-recovery mechanisms to ensure long-term operational and financial sustainability. The major financing models used globally are outlined below.

[7] CPCB, Legacy waste bioremediation Guidelines

[8] https://earth5r.org/10-cities-leading-indias-waste-management-revolution-an-earth5r-deep-dive/

1. **Municipal Budget–Funded Model**
   In this model, SWM is financed through municipal revenues such as property taxes, sanitation taxes, grants from state or national governments, and general budget allocations. This approach ensures universal service coverage but often faces challenges due to limited municipal fiscal capacity and competing urban priorities. Eg: Revenue from **sale of compost, bio-CNG, and recyclables** helps partially offset operational costs, reducing the burden on public finances.
2. **User Fee–Based Model**
   Households, commercial establishments, and institutions pay user charges for waste collection and management services. Fees may be flat, volumetric, or linked to waste generation levels. This model improves cost recovery and accountability, especially when combined with service-level benchmarks.
3. **Pay-As-You-Throw (PAYT) Model**
   Waste generators are charged based on the quantity or type of waste disposed. By internalizing waste management costs, this model incentivizes waste reduction, segregation, and recycling while generating predictable revenue streams for municipalities.
4. **Public–Private Partnership (PPP) Model**
   Under PPP arrangements, private players design, build, finance, operate, or maintain waste management infrastructure. Revenue is generated through a mix of tipping fees, service payments from municipalities, and market-based income. PPPs help leverage private capital and technical expertise while sharing risks. Eg: private operators invest in composting or biomethanation facilities and recover costs through **tipping fees, compost sales, bio-CNG sales, and carbon credits**. Municipalities ensure feedstock supply and long-term offtake guarantees. This model reduces upfront capital pressure on cities while improving efficiency.
5. **Community-Based and Cooperative Model**
   Waste management services are delivered by community groups, cooperatives, or informal sector organizations, often with municipal support. Financing comes from service fees, sale of recovered materials, and local government grants. This model promotes livelihood generation and cost-efficient service delivery.
6. **Extended Producer Responsibility (EPR) Model**
   Producers are made financially and operationally responsible for post-consumer waste, particularly for plastics, e-waste, and packaging. Funding flows from producers to waste collection and processing systems, reducing the financial burden on municipalities.
7. **Viability Gap Funding (VGF) and Grant-Based Model**
   Capital-intensive SWM projects are supported through government grants, subsidies, or viability gap funding to improve project bankability. Operational costs are partially recovered through service charges and efficiency gains.
8. **Green Finance and Climate Finance Model**
   SWM projects access funding through green bonds, climate funds, carbon markets, and sustainability-linked finance. This model aligns waste management with climate mitigation goals and attracts long-term, low-cost capital.
9. **Hybrid or Blended Finance Model**
   Most successful SWM systems use a combination of municipal funding, private investment, user fees, grants, and market revenues. Blended finance improves resilience, spreads risk, and enables scale while maintaining affordability.

Evaluating Indian case studies on financing and managing various solid waste management models in urban areas

Case studies
• **Indore, Madhya Pradesh :** Driven by Municipal will, the city has a "zero-landfill waste policy". The city processes 100% of the daily 1900 MT of waste. Its massive biomethanation plants convert organic waste into enough bio-CNG to run over 150 city buses,. The city also earns crores in revenue from selling compost and carbon credits. • **Ambikapur, Chandigarh :** The city's success is its Solid & Liquid Resource Management (SLRM) model. The system is not run by a large corporation, but by 470 women from local Self-Help Groups (SHGs). These women manage 17 SLRM centers, where they meticulously sort the city's waste into an astonishing 156 different categories. This ensures that every possible item, from specific grades of plastic to different types of metals, is sold to recyclers for its maximum value. city's 16-acre landfill, once a toxic dump, has been completely remediated and transformed into a lush public park. The SHGs generate significant monthly revenue from selling recyclables, making the entire system economically self-sustaining. • **Pune, Maharashtra** : city's waste management is co-managed by SWaCH (Solid Waste Collection and Handling), a cooperative that is India's first wholly-owned enterprise of self-employed waste-pickers. • **Navi Mumbai, Maharashtra** : Navi Mumbai's success lies in its stringent enforcement of source segregation, resulting in clean, bin-free commercial areas and high citizen participation. A key research point is its successful biomining and remediation of its old dumpsite in Turbhe, reclaiming acres of valuable land.

Institutional framework:

The Solid Waste Department of Chapra Nagar Nigam will act as the nodal agency responsible for overseeing this strategy. For monitoring and maintaining water quality in inland water bodies and rivers, the Bihar State Pollution Control Board, Water Resources Department, and BUIDCO will serve as the key implementing agencies. Enforcement of stricter penalties and cleanliness drives will be led by the Honourable Mayor in coordination with the city councillors.

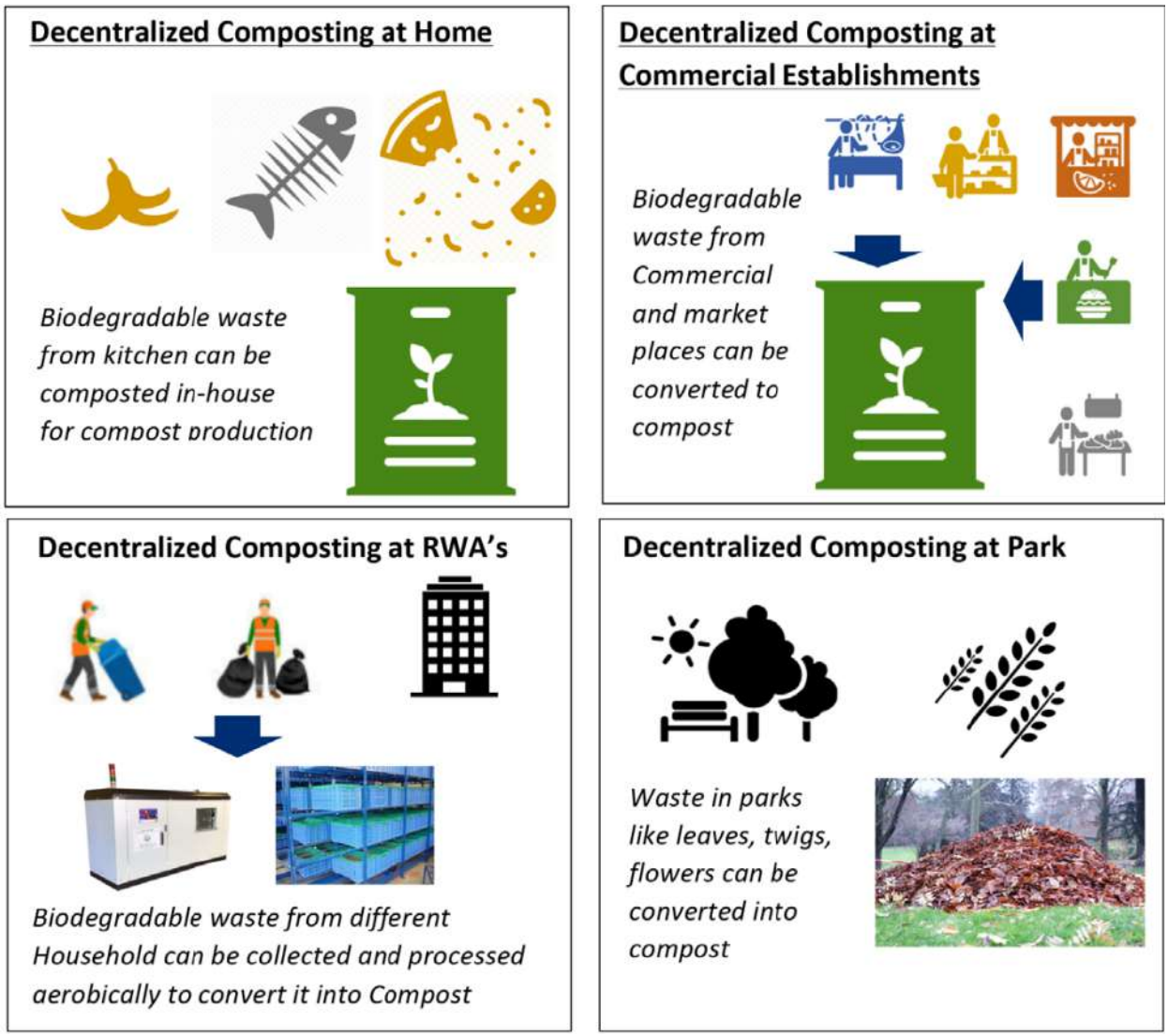
Intervention	Responsible Agency	Intervention type
River Pollution control strategy for the city	Chapra Nagar Nigam, (support), BUIDCO (Technical Support); BSPCB (Regulatory Oversight); District Administration (Land & Enforcement)	Program/ Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~51 - 60 cr	SBM 2.0	Long term
Refer Annex 7.1 for detailed BOQ		

5.2.3.2. Intervention 2-2: Decentralised organic waste management of the city

Chapra city currently produces around **67 MT of wet waste per day** of the total 87 MT total waste. The Shyam Chak (dumpsite) within the city has 20,484 MT of legacy waste stored in the city that is a potential source for leachate to enter ground water.

Wet waste significantly impacts groundwater and river health by releasing a toxic liquid called **leachate** which contaminates water sources with pathogens, heavy metals, excess nutrients, and other harmful substances. When wet (organic) waste is improperly disposed of in landfills or open dumps, rain filters through it, creating leachate. This toxic liquid then seeps down through the soil layers and into underground aquifers, which are a primary source of drinking water for many communities.

Figure 21: Advantages of Decentralised composting, SBM Urban Guidelines



SBM Urban Decentralised composting guidelines

- **Level 1 : Household level composting**

Backyard Composting: Done in recycled plastic drums. Approx- 200 litres for a household of 4 persons. Household with space for a small garden for placing the drum and use of produced compost. Onetime expense- Rs 600-800

Mulching of biodegradable waste (or terrace gardening) : Daily kitchen waste can be used, requires open terrace with sufficient day light. Mulching involves use of dried leaves, grasses, thatch to be mixed with kitchen waste

- **Level 2 : Community based**

Suggested to be installed at parks/gardens, private agriculture land through incentive mechanisms), vegetable market areas

Box Composting (Bins) by group of residents: Usually small-scale (80-100 members) and are integrated with a residential waste collection service. Feedstock is either sorted at source, or it is sorted after collection. It requires sufficient land parcel to store and process the compost. Also requires appointment of manpower for transfer, and maintenance of the household waste to the pit site. Capacity to handle 50 kg per day and typically takes 30-45 days , producing approximately 60 lit of compost (manure) or 200-300 kg [9]. Approx cost for infrastructure- shelter creation, storage etc requires investment is ~ Rs 2.5 - 3.5 lakh per ton of processed waste per day (small to medium sized schemes). Supported by manpower cost of at least 5 staff. Can be completely re-used for Gardening purpose.

Vermi composting : Two numbers of broad mouth fibre basin 25 litre capacity each or one fibre basin of 50 litre capacity with a partition at the centre (minimum thickness of the fibre body 3mm. Waste treated per ay 2.5 to 3 ton , production per day 800 kg – 1 tonn . Processing time 45 days. maintenance of temperature and moisture content is essential for the survival of earthworms. Costing dependant on land, infrastructure (sheds, tanks), machinery (shredders, sieves), raw materials (cow dung, farm waste), worm culture, and labor.

[9] Box composting features

Level 3: City level wet waste composting

Suggested to be installed at Shyam Chak dumpsite

Windrow Composter: Aerobic waste processing unit designed to convert the organic fraction of municipal solid waste—typically comprising **50–55%** of the city's total waste—into nutrient-rich soil conditioner. The process begins at a paved **impermeable concrete yard** where segregated wet waste is formed into long, trapezoidal piles known as **windrows**, generally measuring **1.5 to 2 meters in height** and **3 to 4 meters in width**. To facilitate aerobic decomposition and prevent foul odors or methane generation, these piles are mechanically turned every **7 to 10 days** using specialized windrow turners or front-end loaders, ensuring optimal aeration and maintaining internal temperatures between **55°C and 65°C** to neutralize pathogens. The facility integrates a leachate collection system to prevent groundwater contamination and utilizes a series of **trommel screens** (typically 25mm for pre-sorting and 4mm for finishing) to remove inerts like plastic and glass. After an active composting period of **4 to 6 weeks** followed by a stabilization/curing phase, the final product is a stabilized, dark-brown organic fertilizer that complies with the **Fertilizer Control Order (FCO)** standards, significantly reducing the city's dependence on landfills while promoting circular economy principles in urban agriculture.[10]

- Biodegradable waste treated per day: 200 tonnes
- Compost production per day: 30-35 tonnes
- Usage of biogas: Sold to farmers and Fertilizer companies
- Selling price of compost: Rs. 1000/tonne (if sold in loose) & Rs. 2500+packaging & transportation cost (otherwise)[11]

Figure 22: Windrow composter plan

Windrow Composting

[10] Windrow Composter features

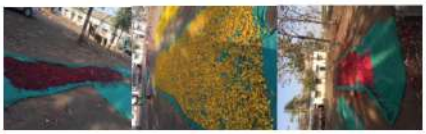
[11] SBM Urban Decentralised composting guidelines

Rotary Drum Composter: Aerobic composter, 1-7 days' time for processing. By comparison, large-scale systems use drums that are significantly longer (i.e., 30 to 80 m). The drums are positioned on a slight incline (less than 5%) and rotate at between 0.5 and 5 rotations per minute (rpm). The combination of the drum's rotation and incline, with gravity, results in materials tumbling down the drum in a corkscrew manner from the upper in-feed end to the lower discharge end. With composting times this short, the material emerges without having completed the active composting step and needs further treatment. Compost production per day is 10- 12.5 tonnes, and cost of the plant is 2.5 cr for each drum composter.

Financing, Marketing and branding of the waste compost by establishing market linkages

- Partnership with farmers to buy the organic waste generated by the city
- Selling off to nurseries
- Partnership with Agriculture/ Forest department's Horticulture division
- Flower based/ marigold waste composting – Creating Agarbatti's by SHGs/ CSRs
- Branding of the generated compost/ manure

Case of Agarbatti making from temple flowers by Self-Help Groups, in Shirdi Maharashtra- Boosting economy

Collection of Pooja Flowers	
Pre-processing & Segregation of Petals	
Drying of Flower Petals	
Pulverisation of Flower Petals	
Agarbatti Making Preparation of mix	

Institutional mechanism:

The Solid Waste Department of Chapra Nagar Nigam will act as the nodal agency responsible for overseeing this strategy. For monitoring the quality of compost generated, the agriculture department would be key agency. Partnership with local NGOs, FPOs, SHGs, Forest department, Agriculture Department, Agriculture Universities would be crucial to establish market linkages and scale up the efforts to make it viable.

Intervention	Responsible Agency	Intervention type
Pilot for decentralised wet waste management in the city	Chapra Nagar Nigam, BPSB (support), WRD (support	Program/ Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
INR 4 – 7 cr	SBM 2.0	Long term
Refer Annex 7.2 for cost estimate **does not include the revenue from sale of compost*		

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

Rationale: Objective 3 aims to restore the ecological, hydrological, and social functions of Chapra's inland waterbodies. With the city's high population density and extensive built-up areas, its limited waterbodies are under significant development pressure, making their protection and conservation critical. Additionally, Chapra lacks adequate open and recreational spaces. Therefore, rejuvenating selected ponds to serve a dual purpose—enhancing environmental health while providing citizens with recreational areas—will be the core strategy for the city.

5.3.1. Existing Situation

Chapra features several natural and man-made pokhras (ponds) interspersed within the municipal area, reflecting both ecological and cultural significance. Many serve as ritual sites during Chhath Puja, marriage ceremonies, and local festivals, while others are used for daily leisure, aquifer recharge, and public recreation. Field observations indicate that while a few ponds such as Shishu Park Pokhra and Rajendra Sarowar are well maintained and integrated into community spaces, others like Rauja Pokhra and Dudhai Pokhra are visibly degraded with algal bloom, aquatic weeds, and absence of boundary protection. Encroachment pressures and solid waste dumping were noted at several sites, reducing both water quality and community accessibility.

Functionally, many ponds continue to act as stormwater buffers, but their role is increasingly threatened by siltation, unchecked solid waste, wastewater discharge, and loss of ecological integrity.

5.3.1.1. Condition of Waterbodies and Key Gaps

A preliminary list of inland waterbodies in Chapra was compiled from the Water Census 2024. The eight ponds in this list underwent a detailed assessment, representing both functional and degraded typologies.

From survey findings, it is observed that nearly 50% of Chapra's ponds exhibit significant signs of degradation. Key issues include algal bloom, proliferation of invasive aquatic plants (e.g., water hyacinth, castor oil plants), and inadequate protection measures. At the same time, some ponds have high demonstration value for rejuvenation, already supporting recreational spaces, water recharge, and social-cultural activities. For Detailed Water Body Inventory. *see Annexure 5.*

Figure 23 : Condition of inland waterbodies, Chapra city

Shilpi Pokhra

Jatahi Pokhra

Shishu Park

Sah Banwari lal Pokhra

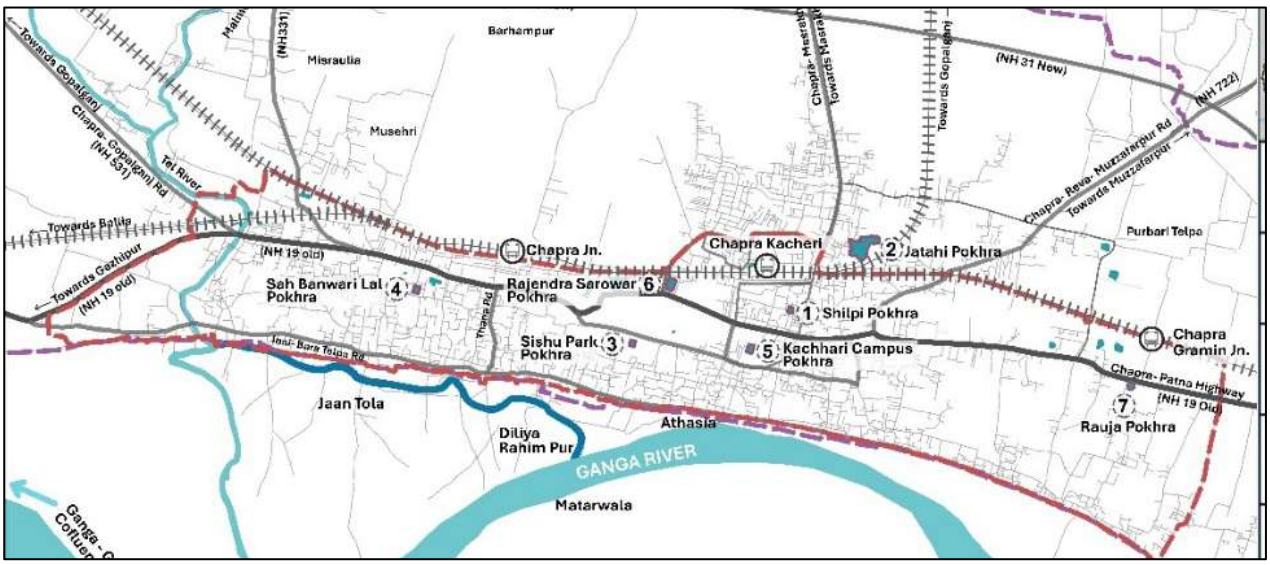
Kachari Campus – algal bloom

Rajendra Sarovar Pokhra

Rauja Pokhra- Eutrophication

Dudhai Pokra- Eutrophication

Tel river in post monsoon



Map 11 Major Water Bodies in Chapra

Preparation of Urban River Management Plan for Chapra

Major Waterbodies

LEGEND

- Chapra Municipality
- Ward Boundary
- Major Road
- Railway Line
- River
- Waterbodies

SOURCE: Google Earth

0 1 2 3 km

Existing and Planned projects for rejuvenation of waterbodies:

- Shishu Park Pokhra has been developed with fencing, pathways, and a water pump system, indicating potential as a demonstration site.
- Limited formal rejuvenation projects were noted, with ongoing path construction works at Shilpi and Sah Banwari Lal Pokhra.
- City has planned development of Shilpi and Rajendra Sarovar ponds, however no visible progress is observed

Institutional Framework for Waterbodies Management

Chapra Nagar Nigam is formally responsible for pond maintenance; however, fragmented mandates across departments (public works, religious affairs, tourism, fisheries) hinder holistic management. In practice, certain temple-attached ponds are maintained directly by local trusts. Stronger convergence with Namami Gange, Jal Jeevan Mission, and AMRUT 2.0 is required.

Condition of waterbodies & Key Gaps

Chapra's ponds suffer from fundamental information and governance gaps, most notably the absence of a comprehensive, GIS-based live inventory and a regular water quality monitoring system. Solid waste pollution, including plastics, cloth, wrappers, and thermocol, is widespread, reflecting weak enforcement of existing bans. Wastewater inflows into ponds such as Rauja Pokhra and Jatahi Pokhra further degrade water quality, leading to eutrophication in Rauja and Dudhai Pokhra due to unchecked nutrient loading.

Physical protection and land management around ponds remain inadequate. Except for Shishu Park, most ponds lack fencing or defined boundary protection, leaving them vulnerable to dumping and encroachment. Peripheral constructions and proximity of housing, particularly around Jatahi Pokhra, are not being systematically addressed, allowing gradual encroachment and loss of pond area. These gaps collectively undermine the ecological function of ponds and limit their role in urban flood mitigation and environmental health.

5.3.2. URMP Score

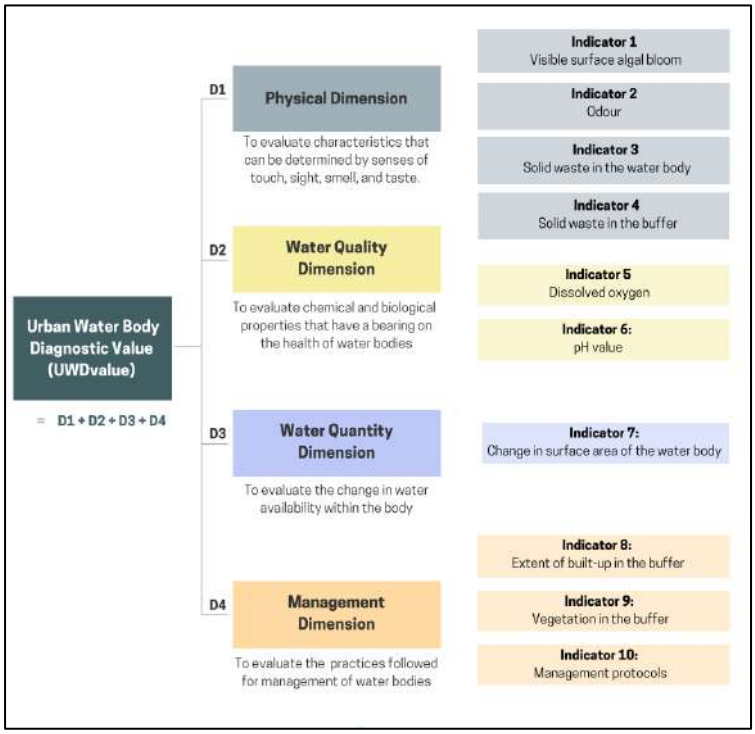
Water body revival score = (Total number of water body in "acceptable" condition/ Total number of water bodies) X 100 . Out of the 8 water bodies evaluated, 3 were in acceptable condition scoring 37.5 as per the parameters defined in the framework. As per URMP, if water body revival factor is <40, then water body revival score is 1.

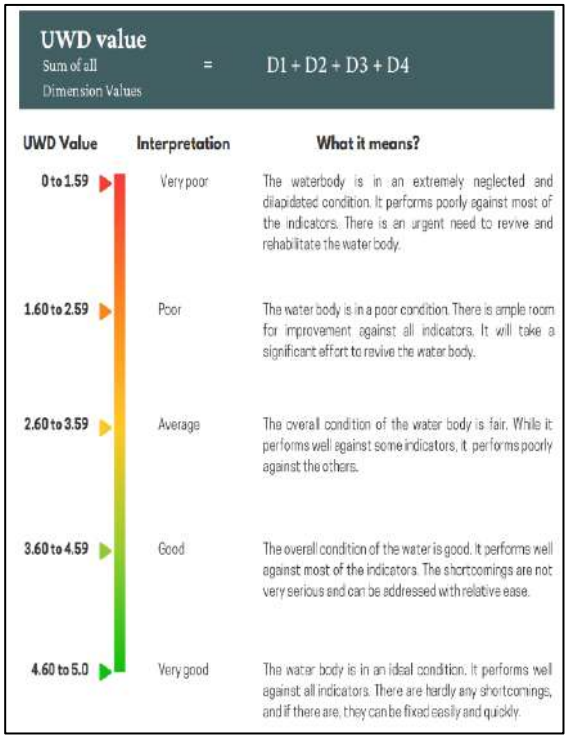
5.3.3. Interventions

5.3.3.1. Intervention 3-1: Establish a GIS-Based Inventory of water bodies and integration with the 'Urban Water Body Diagnostic Tool"

To manage water bodies effectively, it is crucial to first assess their current condition. The city should develop a GIS-based inventory of all its water bodies, incorporating details on general, physical, chemical, and ecological characteristics to monitor river's and water body's health. These parameters are to be aligned with the standards outlined in the "Urban Water Body Diagnostic Tool" created by NIUA and NMCG. This tool serves as a decision-support system, enabling cities to make informed choices for the sustainable management of water bodies within their jurisdiction.

Figure 24 : Dimensions and Indicators of the Urban Water Body Diagnostic tool





Source: UWDA tool Manual

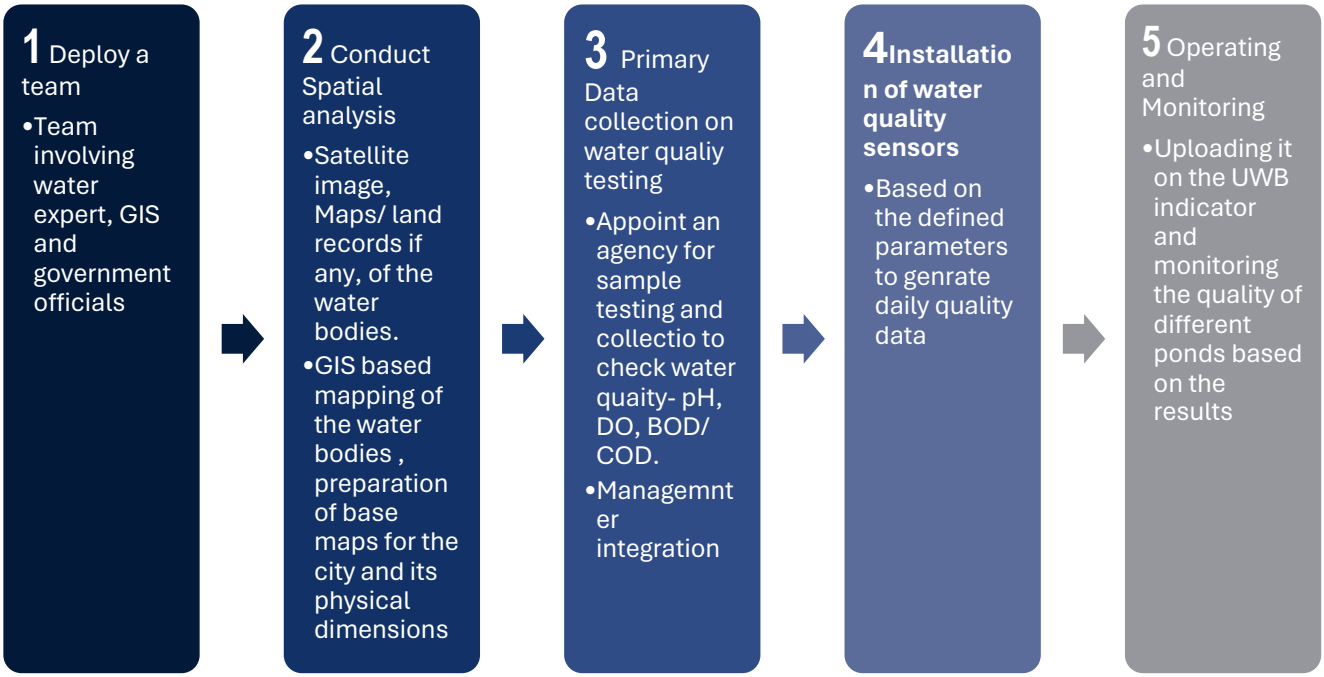
Each of the Indicator is given different weightages for scoring, a cumulative UWD value is arrived at by individually adding the 4-dimension value. The city may hire an agency on a yearly contract to undertake the primary survey of all the water bodies and integrate with the GIS based system.

The other component is developing a GIS based interactive interface where this data may be added to generate report and analyse trends over a period of time.

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.

Additionally, since flooding is a key issue in Chapra, monitoring the level of water across all the water bodies will support in urban water balance. Level sensors will support in identifying location for diversion of water during flood season and also to re-use the treated used water from the existing STP.

Steps involved:



The table below shows some parameters against which information may be documented to create the database. An external agency may be appointed to undertake the GIS based exercise and primary survey

Sno	Aspect	Information
1	General	Name Location Ownership Land Use/use zone as per Master Plan Neighbouring land use category as per master Plan Existing neighbouring land use Classification (natural or artificial) Type of recreational activities (if any) Revenue Generation (if any) Livlihood dependency (if any)
2	Physical	Boundary Average depth Water sources Water use(if any) Elevation above mean sea level Presence of solid waste (Y?N) Width of buffer (if existing
3	Chemical	Dissolved oxygen pH Temperature Faecal Coliform
4	Ecological	Type of trees and plants surrounding water body Presence of algal bloom (Y/N) Type of aquatic species present

Intervention	Responsible Agency	Intervention type
GIS-Based Inventory and integration with the 'Urban Water Body Diagnostic Tool"	Chapra Nagar Nigam (Lead), WRD Bihar (Support), Bihar Pollution Control Department	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~26.4 lakhs	Namami Gange, Jal Jeevan Hariyali Mission, City's Own budget, CSR	Short term (1 year)
Refer Annex 7.3 for Cost estimation *Integration with UWD is optional, and monitoring could be done through different Dashboards.		

5.3.3.2. Intervention 3-2: Install fencing and water edge treatment for boundary protection

A natural/ composite material boundary fencing will be constructed to protect all water bodies from encroachment. Adequate access points will be provided to ensure that the citizens are able to access the water bodies. Of the 8 water bodies considered for the city- 5 water bodies have no or semi-permanent boundaries.

Total perimeter of 5 waterbodies estimated at ~ 2000 meters

Fencing cost = INR 2000/m

Total cost = INR 40,00,000

Pond edge treatment /Edge protection : Many of the ponds have broken edges, leading to soil erosion and highly prone to storm water surface run-off. Solutions like sandbags around the water spread area and stone pitches at the water edge will help prevent the water quality for pond.

- Perimeter for 5 water bodies estimated ~ 1500 meters
- Stone edge treatment cost = INR 850/ m
- Total cost = 12,75,00 INR

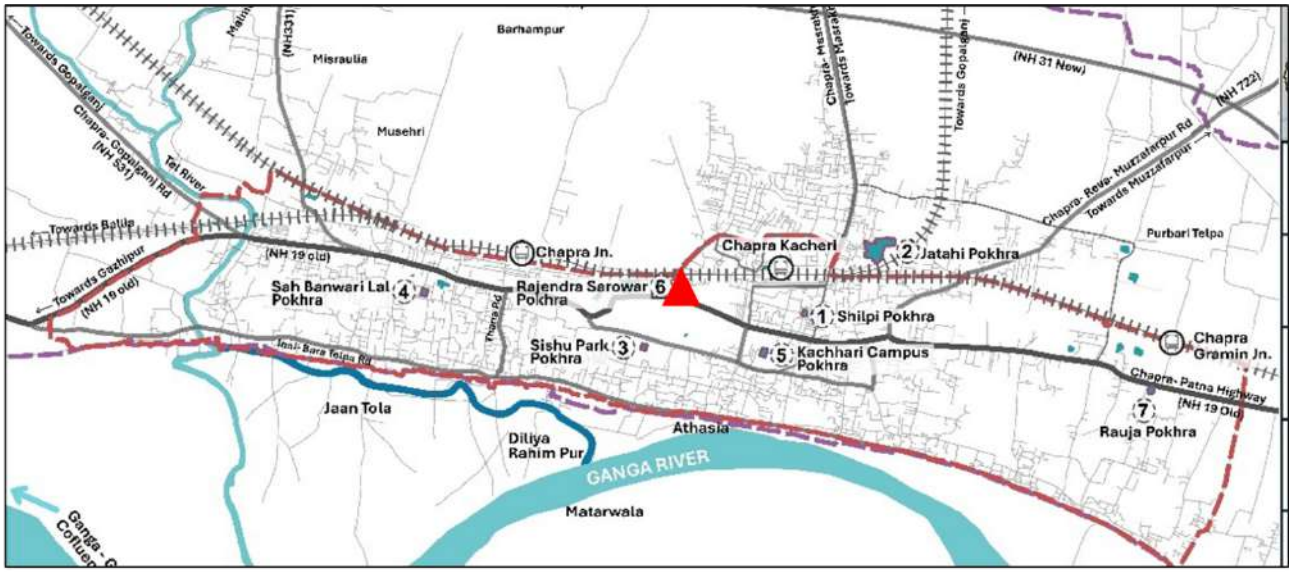
Additional labour, cleanliness of ponds and contingency cost will be added

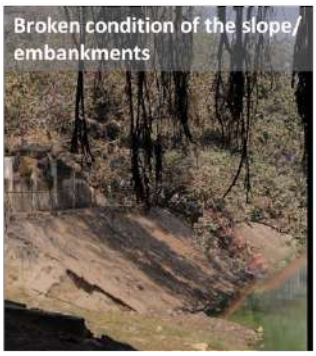
Intervention	Responsible Agency	Intervention type
Cast iron fencing for boundary protection of water bodies	Chapra Nagar Nigam (Lead),	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~60 to 70 lakh	Jal Jeevan Urban mission, Jal Shakti Abhiyan	Short term (1 year)

5.3.3.3. Intervention 3-3: Rejuvenation of Rajendra Sarovar Pond

Rajendra Sarovar Pokhra in Chapra city serves as a vital city-level recreation space and an important ecological asset. Enclosed by a protected boundary and featuring a gated entry, it functions as a common hub for citizens to relax, exercise, and enjoy morning and evening walks. The presence of a temple within the premises adds a cultural dimension, making it a mixed-use space that blends spirituality with leisure. Ecologically, the pond plays a crucial role in groundwater recharge and supports large fish species, which are currently under threat due to surrounding run-off and deteriorating water quality. It also becomes an active centre during the Chhath festival, hosting prayers and offerings, which further enhances its cultural significance. However, the site faces significant challenges, including visible solid waste dumping and frequent algal blooms, which compromise its environmental health. A plan for its redevelopment and improvement is already in the pipeline by the city; however, no progress has been made so far. Ensuring that this development is carried out in a nature-centric manner is essential to preserve its natural ecosystem, create a sustainable recreational space for the city, and improve the quality of life for its citizens.

Figure 25: Existing Condition- Rajendra Sarovar



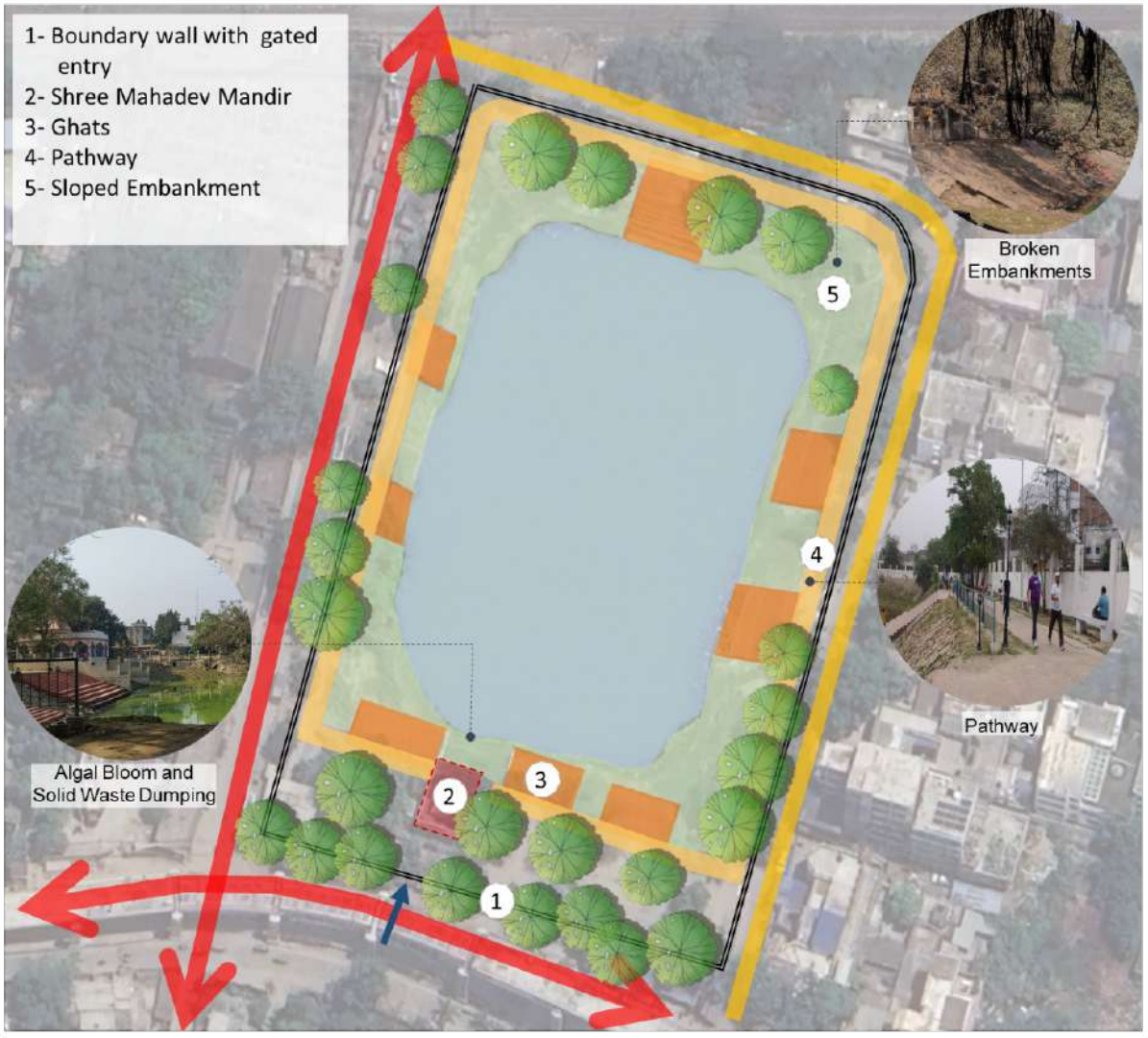

Broken condition of the slope/ embankments


Multiple tress- rich biodiversity


Activation during Chhat Festival


Temple in the premises
Visible algal boom and solid waste dumping


Common place for the citizen for morning walks and exercise. Existing form of edge treatment


1- Boundary wall with gated entry
2- Shree Mahadev Mandir
3- Ghats
4- Pathway
5- Sloped Embankment
Broken Embankments
Pathway
Algal Bloom and Solid Waste Dumping
1
2
3
4
5

Rejuvenation Strategy for Rajendar Sarovar

The proposed strategy for rejuvenation of Rajendra Sarovar demonstrates

Health Park for the city	Due to its central location and in the city and an active footfall of citizens for morning and evening walks and yoga, a health park is proposed to be developed. A sensory garden with meditation area is also proposed
Reducing the hardscape	The current premises are protected by high-rise compound walls and wide concrete pathways. There is also a stone embankment around the existing lake. Strategies to use permeable paving's, green treatment on compound walls such as creepers/ climbers to be explored
Respecting the socio-cultural importance	Retaining the and improving the condition of constructed ghats as its is used during festivals, especially during Chhat
Preserving and improving the biodiversity	The lake is surrounded by multiple trees and presence of different aquatic life. Strategies will focus on improving the health of the pond to sustain aquatic life throughout the year and as an attraction for the city
Nature based solutions to prevent degradation of the lake	• Floated Wetlands paired with aerators: To maintain the Absorb nutrients directly from water, provide microbial surfaces for pollutant breakdown and reduce algal growth • Vegetation along the edges: Buffer plantation around the pond with native grasses and shrubs to reduce nutrient run-off • Reed plantation along the edges to absorb pollutants • Support aquatic life within the pond
City centre on knowledge sharing and awareness building	Installation of signages and educational boards on native plants
Small retail outlets	To generate revenue and make part of the park's maintenance sustainable

				
Sensory Path	Green compound wall	Stone edge treatment	Trash booms to collect religious waste	Reed plantation

Figure 26 : Proposed concept for rejuvenation of Rajendra Sarovar Pond

1. **Compound wall with creepers** 2. **Walking and Jogging Track** 3. **Sensory Path** 4. **Floating treatment wetlands (FTWs)-** Flower / aromatic zone in the pond to attract biodiversity 5. **Stepped embankment planted with flowers and shrubs, constructing broken embankment.** **6. Stone/ gravel edge treatment to filter runoff.**	**7. Provide basic infrastructure: Lighting, Seating, Waste bins, Signages, Drinking water spot** **8. Designated immersion tank with trash barriers** **9. Water lilies –to control algal growth** **10. Decks for yoga** **11. Kiosk focused on sports and health, and Kids Play area**

Figure 27: Reimagined Rajendra Sarovar Pond

Suggested species of plants/ shrubs:

Emergent Plants (grow in shallow edges, help filter nutrients and reduce run-off)

- **Typha (Cattail)** – Excellent for nutrient absorption and stabilising edges.
- **Cyperus spp. (Umbrella sedge)** – Helps in reducing nutrient load.
- **Saccharum munja (Wild sugarcane)** – Native and good for bank stabilisation.

Floating Plants (control sunlight penetration, reduce algal bloom)

- **Water lilies (Nymphaea spp.)** – Provide shade and oxygen, aesthetically pleasing.
- **Trapa natans (Water chestnut)** – Native, reduces light penetration, supports fish habitat.

(Avoid invasive species like Eichhornia crassipes – water hyacinth – as it can choke the pond.)

Submerged Plants (oxygenate water, essential for fish survival)

- **Hydrilla verticillata** – Native oxygenator, supports fish breeding.
- **Vallisneria spiralis (Tape grass)** – Improves water clarity and oxygen levels.

Figure 28: Suggested plantation for the pond rejuvenation

Typha (Elephant Grass)

Saccharum munja (Wild sugarcane

Water lilles

Vallisneria spiralis (Tape grass)

Intervention	Responsible Agency	Intervention type
Rejuvenation of the Rajendra Sarovar as a Health park for the city	Chapra Nagar Nigam Forest Department	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~ 86 to 90 lac	City's Own budget, CSR	Medium term
Refer Annex 7.5 for Cost estimates		

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

In the Chapra Planning Area Ganga and Ghaghara rivers dominate the hydrological system, with wide, meandering channels and extensive floodplains. Riparian buffers, highlighted in green, mark critical ecological zones that coexist with agricultural and built-up land. Settlements such as the Chapra City and Revelganj are located in close proximity to these river systems, while the confluence of the two rivers emerges as a key geographic node.

Existing Sectional Profiles

The **indicative sections of the riparian buffer** highlight critical ecological and urban dynamics along two major rivers—**Tel** and **Ganga**

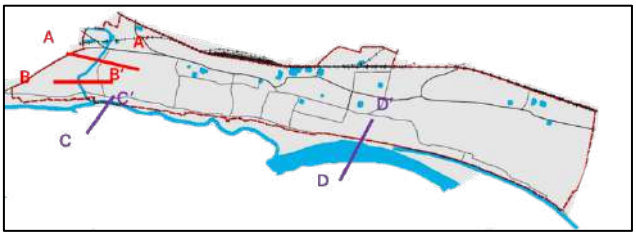
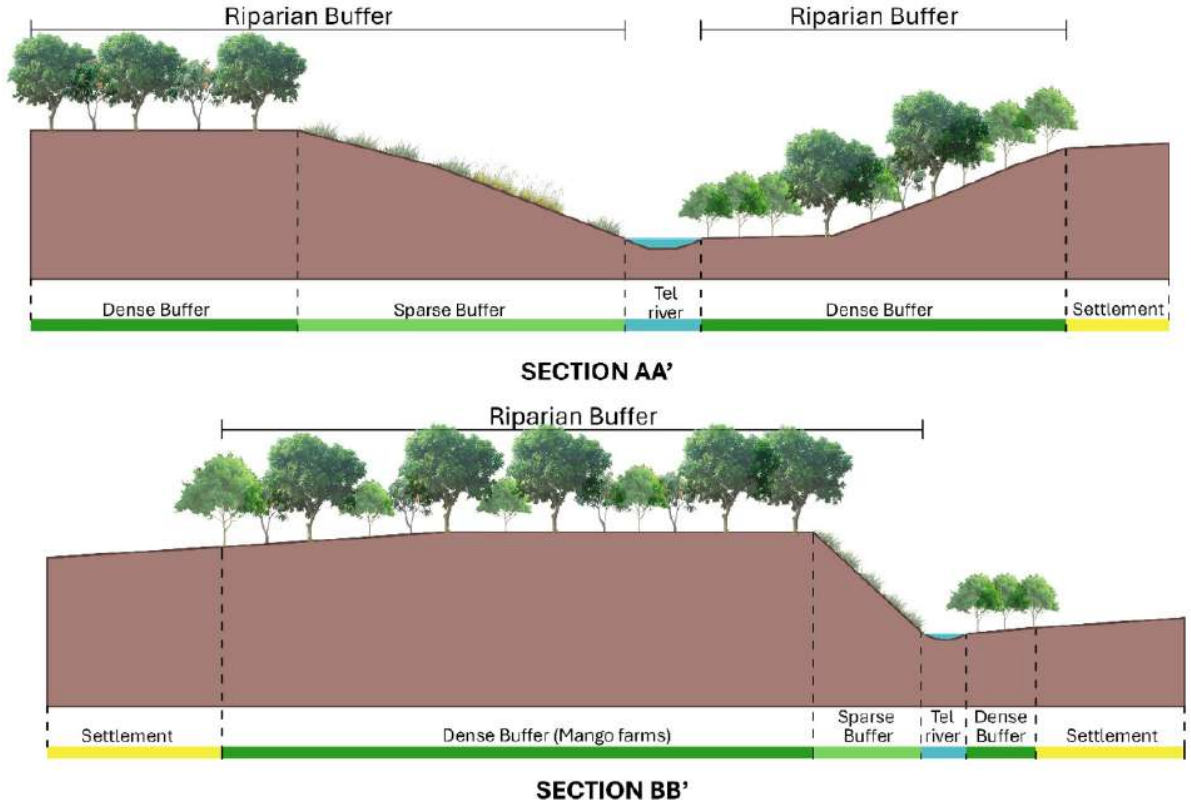


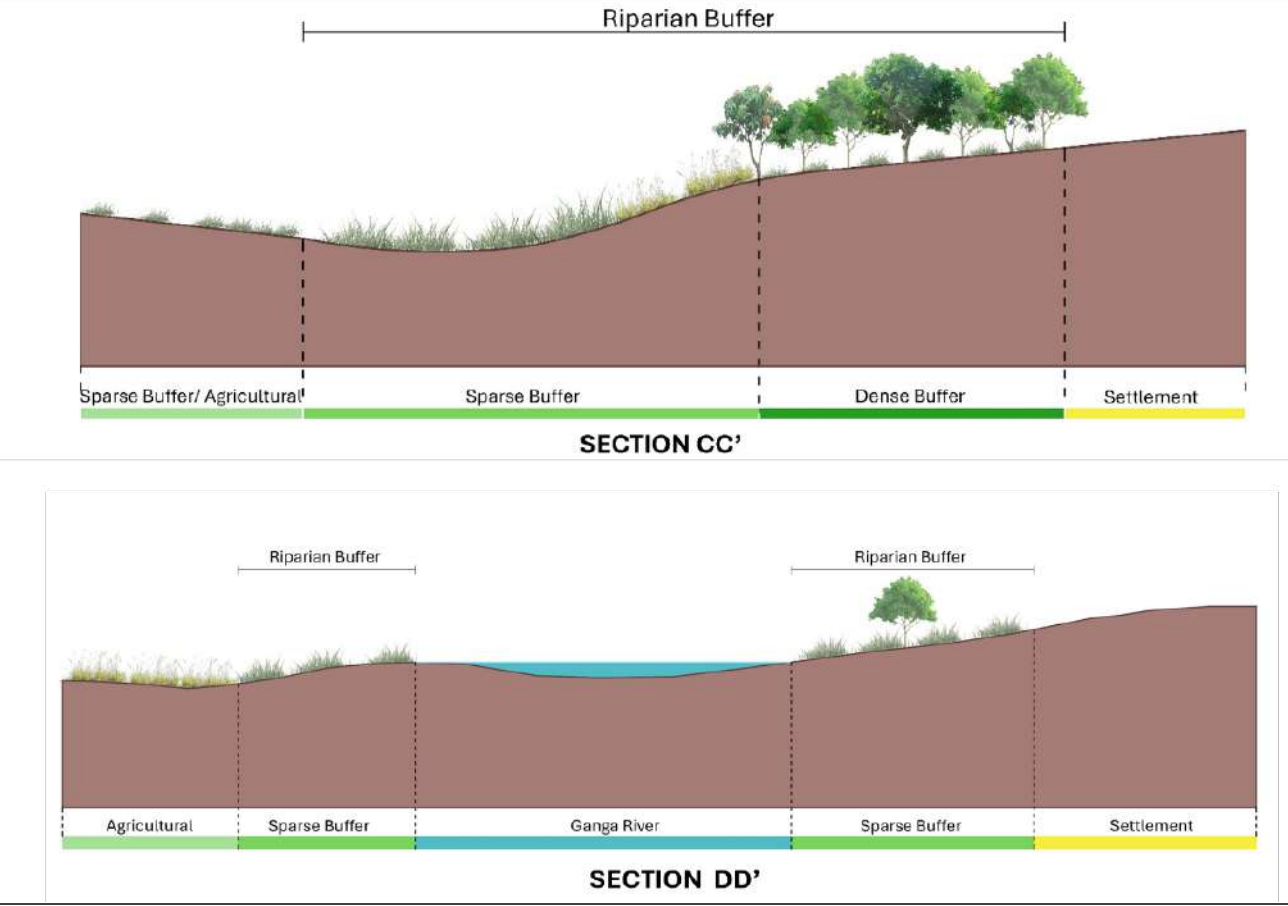
Figure 29: Illustrative sectional profile riparian buffer- Tel River



- **Sections AA and BB (Tel River):**: These segments exhibit **dense vegetation**, including mature trees, shrubs, and grasses, forming a robust natural buffer. However, the presence of **sewerage outfall points** into the Tel River underscores the need for **stringent water quality management** to prevent degradation of the riparian ecosystem.

Notably, the **gentle slope on one bank** increases susceptibility to **encroachment by informal settlements**, posing a risk to both ecological integrity and urban planning efforts.

Figure 30: Illustrative riparian buffer section- Ganga River



Sections CC and DD (Ganga River):: In contrast, these areas are characterised by **sparse grass cover**, minimal tree density, and a **flat terrain**. The land adjacent to the river is **seasonally utilised for agriculture**, especially during dry periods, indicating a **multi-functional landscape** that blends ecological and livelihood considerations

Map 12 Existing Riparian Buffer

Preparation of Urban River Management Plan for Charpra

RIPARIAN BUFFER

LEGEND

- Chapra Municipality
- Major Road
- Railway Line
- River
- 500 m Buffer
- 100 m Buffer

Riparian Buffer

- Dense Vegetation
- Sparse Vegetation
- Sand Bars
- Cross Profile

SOURCE: Google Earth 2025

0 1 2 3 km

CHAPRA - URBAN RIVER MANAGEMENT PLAN

अविरल जलधारा, समृद्ध छपरा

NDVI Analysis

Satellite-based NDVI analysis (2017–2025) shows consistently low vegetation values along Chapra's Ganga riverfront, indicating exposed sandbars, active floodplain conditions, and the absence of sustained riparian planting. Comparative assessment reveals an approximate 15–20% decline in healthy green cover across the riverfront and adjoining urban areas, while isolated pockets around parks and institutional zones remain largely unchanged.

Biodiversity Profile

The Ganga–Ghaghara system hosts rich biodiversity, including over 61 fish species dominated by carps, catfishes, and perches, along with iconic fauna like the Gangetic Dolphin, Gharial, freshwater turtles, and more than 87 waterbird species. Its riparian zones feature grasses such as Saccharum and Typha, woody plants like Acacia and Ficus, and aquatic flora including lotus, water lilies, and submerged grasses, which stabilize banks, filter pollutants, and sustain food webs. These ecosystems act as biodiversity corridors, regulate water quality, and mitigate floods, making riparian buffers vital for urban resilience. However, in cities like Chapra, these areas face threats from encroachment, pollution, and infrastructure expansion, necessitating strategies like protected zoning, buffer enforcement, and eco-sensitive design to preserve ecological integrity and reduce flood risks.

Key Gaps

A major gap lies in the absence of a continuous riparian buffer along the river corridor, which should ideally be 7.5–15 meters wide, especially in urban core areas. Current practices lack systematic use of native vegetation suited to local soil and hydrological conditions—such as Saccharum spp., Typha, Vetiveria, and woody species like Acacia and Ficus—that are essential for soil stabilization and pollution filtration. Encroachments and unmanaged solid waste further degrade these buffers, while embankment vegetation management and zoned planting strategies (grasses at river edge, shrubs in the middle, and canopy trees farther away) remain largely unimplemented.

Institutional and monitoring gaps also persist. Multi-agency coordination between urban local bodies, forest departments, and irrigation authorities is weak, and annual satellite-based NDVI monitoring to track vegetation health is not integrated into planning. Riparian restoration goals are missing from city master plans and climate resilience strategies, and funding opportunities through CAMPA, Namami Gange, Jal Jeevan Mission, and CSR remain underutilized for plantation, fencing, and bioengineering works. Addressing these gaps is critical for ecological integrity and flood risk mitigation.

5.4.2. URMP Score

Riparain Buffer for Ganga river = 63.46 % of the total length abutting the city

Riparian Buffer for Tel river = 99.23% of the total length present on the city

Adding the cumulative scores of the two the Riparian buffer factor is 67.19, translating to a score of 3 as per URMP framework

5.4.3. Interventions

5.4.3.1. Develop riparian zones along Tel River and southern streams

This intervention proposes the development and enhancement of riparian buffer zones along the Tel River and selected southern streams within the Chapra municipal boundary, with selective extension along priority stretches of the Ganga riverfront where space and land ownership permit.

Intervention	Responsible Agency	Intervention type
Develop riparian zones along Tel River and southern streams	Chapra Nagar Nigam (Lead), with technical support Forest Department	Policy
Estimated Budget	**Potential Funding Sources**	**Timeline**
20 Lakh	Forest Department, District, State Disaster Mitigation funds	Short-term (0–2 years)

Key Planning Interventions

The Riparian buffer along the Ganga, the Tel river and important streams will be developed and enhanced using case-specific vegetation pallets. Pockets have been Identified in Map 13 that require riparian enhancements. These pockets have further been classified based on the type of vegetation required as detailed out in Table 6. Further the city may also explore to develop a Riparian Design Guidelines to inform ecological repair of Urban waterways. .[12]

Length of river/ streams within the city boundary and the existing riparian buffer length:

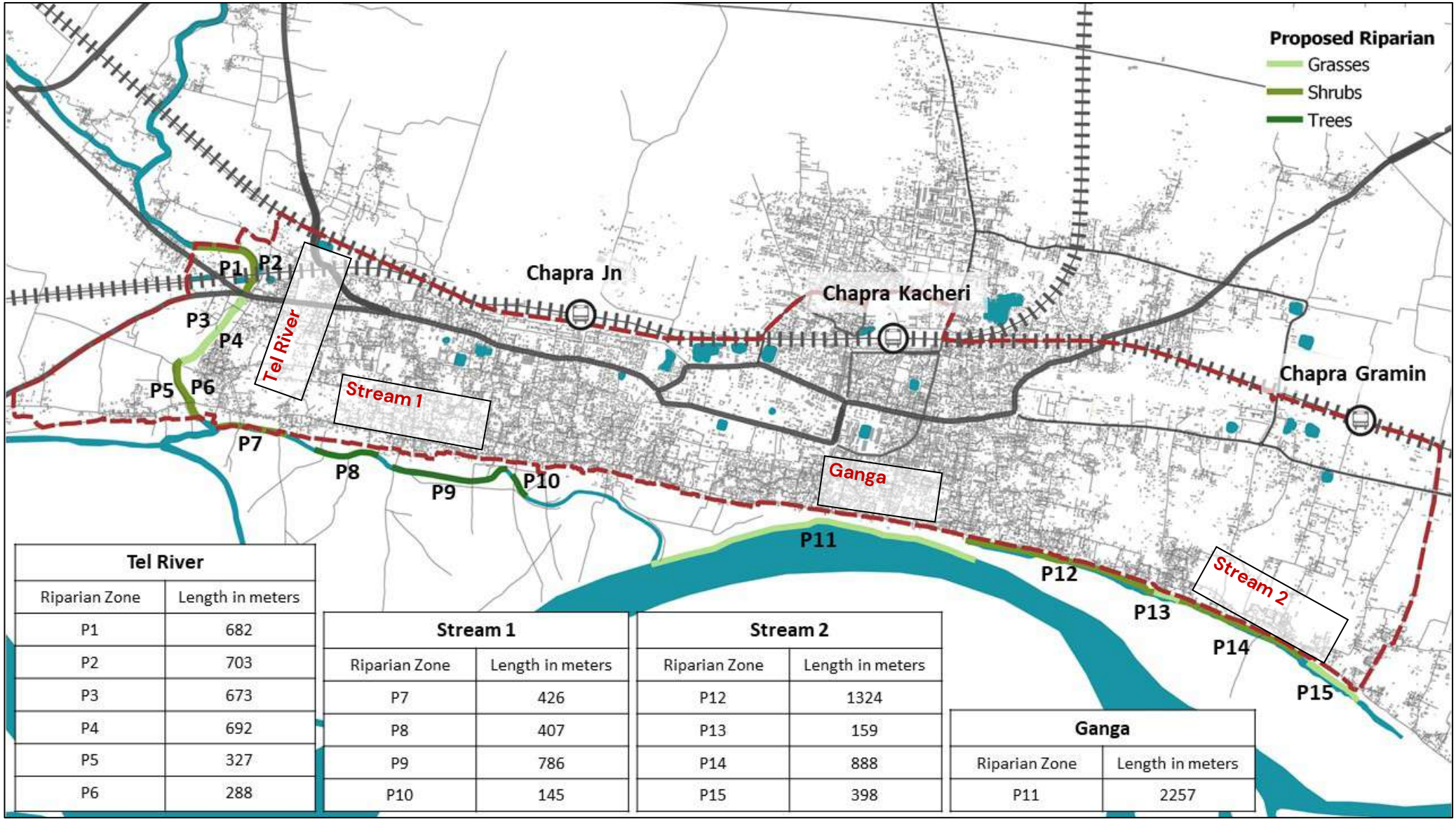
- Tel river – 1.8 km (90% riparian buffer along the length)
- Stream 1 – 3.3 km ((40% riparian buffer along the length)
- Stream 2 – 2 km (50% riparian buffer along the length)
- Ganga river stretch between the streams

Spatial Coverage

- Tel River: Combined focus on strengthening existing buffers, gap filling, and protection
  Six pockets (P1–P6) . ***This will be combined under the Tel upgradation intervention.***
  Length range: 288 m – 703 m
- Stream 1: Focus on establishing continuous buffers where only partial cover exists
  Four pockets (P7–P10)
  Total length: ~1.76 km
- Stream 2: Focus on stabilisation, pollution filtration, and encroachment prevention
  Four pockets (P12–P15)
  Total length: ~2.77 km
- Ganga River: Focus on initiating riparian planting and soft floodplain treatment
  One major pocket (P11)
  Length: ~2.26 km

[12] Riparian Design Guidelines- ecological repair of Urban Water ways, Water sensitive Cities. Org.

Map 13: Proposed Riparian Zones



Tel River	
Riparian Zone	Length in meters
P1	682
P2	703
P3	673
P4	692
P5	327
P6	288

Stream 1	
Riparian Zone	Length in meters
P7	426
P8	407
P9	786
P10	145

Stream 2	
Riparian Zone	Length in meters
P12	1324
P13	159
P14	888
P15	398

Ganga	
Riparian Zone	Length in meters
P11	2257

Source: Consultant analysis through satellite imagery

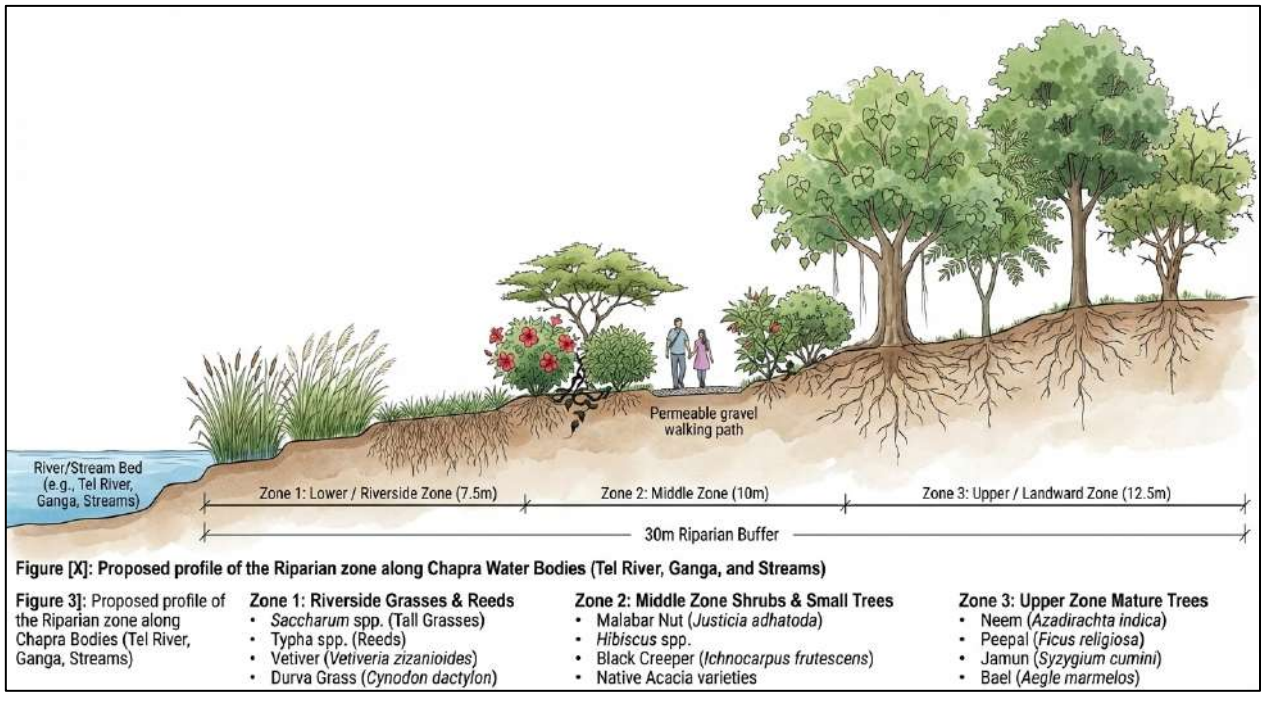
Riparian Buffer Design Framework:

A 30 m wide riparian buffer from the river/stream edge is proposed where feasible, adapted to local land availability and floodplain conditions. The buffer will be structured into three functional zones, consistent with ecological repair principles.

Table 3: Details of suitable plant species for the riparian buffer in Chapra Water Bodies

Zone	Function	Vegetation	Indicative Species
Zone 1: Lower / Riverside Zone	Bank stabilization, sediment trapping, habitat creation	Grasses, reeds, herbs	• Saccharum spp. • Typha spp. • Vetiver (Vetiveria zizanioides) • Cynodon dactylon
Zone 2: Middle Zone	Pollutant filtration from surface and subsurface flows	Shrubs and small trees	• Justicia adhatoda • Hibiscus spp. • Ichnocarpus frutescens • Native Acacia varieties
Zone 3: Upper / Landward Zone	Groundwater protection, canopy formation, microclimate regulation	Large native trees	• Neem (Azadirachta indica) • Peepal (Ficus religiosa) • Jamun (Syzygium cumini) • Bael (Aegle marmelos)

Figure 31: Proposed profile of the Riparian buffer



Source: Consultant's interpretation

Other Measures:

- Removal of invasive species and phased plantation using coloniser species followed by moisture-dependent natives
- Fencing and demarcation of riparian buffers where encroachment pressure is high
- Creation of riparian sponges—shallow floodplain depressions and wetlands to trap and infiltrate floodwaters
- Bioengineering of eroding banks using live staking and vegetated geogrids
- Management of stormwater and sewer outfall points to prevent direct discharge into riparian zones
- Pilot anchored floating gardens in low velocity stretches to enhance pollutant uptake and habitat diversity

Institutional Responsibilities

This intervention is under the jurisdiction of multiple agencies from the land ownership perspective. The agency owning the land parcel would have to propose riparian zone development and bear the expenditure. Considering this, Forest Department, Chapra Municipal Corporation, Water Resources Department, and Irrigation Department can either independently or jointly develop land for the proposed plantation. Further the city may also explore to develop a Riparian Design Guidelines to inform ecological repair of Urban waterways. .[13]

[13] Riparian Design Guidelines- ecological repair of Urban Water ways, Water sensitive Cities. Org.

5.5. Objective 5: Reuse Of Treated Wastewater and Objective 6: Good quality return flow

Objective 5 Rationale: Cities consume vast amounts of freshwater and release most of it back as wastewater. If untreated, this becomes a pollutant; if treated and reused, it becomes a vital resource. Reusing wastewater reduces the stress on rivers, lowers dependence on groundwater, and supports a circular water economy. It also ensures environmental flows in the river are not sacrificed for urban consumption. Promoting reuse can bridge the gap between growing demand and finite freshwater supply

Objective 6 Rationale: Objective 6 seeks to ensure that Chapra 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 Chapra, 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.

5.5.1. Existing Situation

At present, Chapra lacks a formal wastewater reuse framework. Most treated wastewater is discharged into the Ganga River, with no organized plan for its reuse in irrigation, landscaping, or industrial use. Water for domestic use is drawn from ground water. Drinking water from the river is not currently used.

Chapra city operates a 32 MLD Sewage Treatment Plant under the Interception and Diversion framework of the National Mission for Clean Ganga, with implementation and operation overseen by BUIDCO. The system integrates primary and secondary drains and is supported by a SCADA-enabled network covering seven intermediate pumping stations, eight online pumping stations, and the main treatment facility. Household wastewater is not yet formally connected to the STP, though informal discharge into major and secondary drains contributes to inflow, leading the plant to operate at about 50 percent of its designed capacity. Monitoring data from September 2025 show that the treated effluent meets CPCB standards across key parameters, indicating effective treatment performance.

Despite this compliance, field observations indicate that the treated effluent quality is compromised downstream of the outfall, which is located away from the main river channel and exposed to surface runoff, solid waste, and domestic effluents before reaching the river. This weakens the intended benefits for river health and ecosystem restoration. At the same time, Chapra has significant potential to reuse nearly 16 MLD of treated wastewater for non-potable applications such as peri-urban agriculture, irrigation of urban green spaces, groundwater recharge of water bodies, and small-scale industrial and construction uses. Realising this opportunity will depend on developing decentralised distribution infrastructure, building community and farmer confidence, and maintaining strong water quality monitoring systems.

Key Gaps

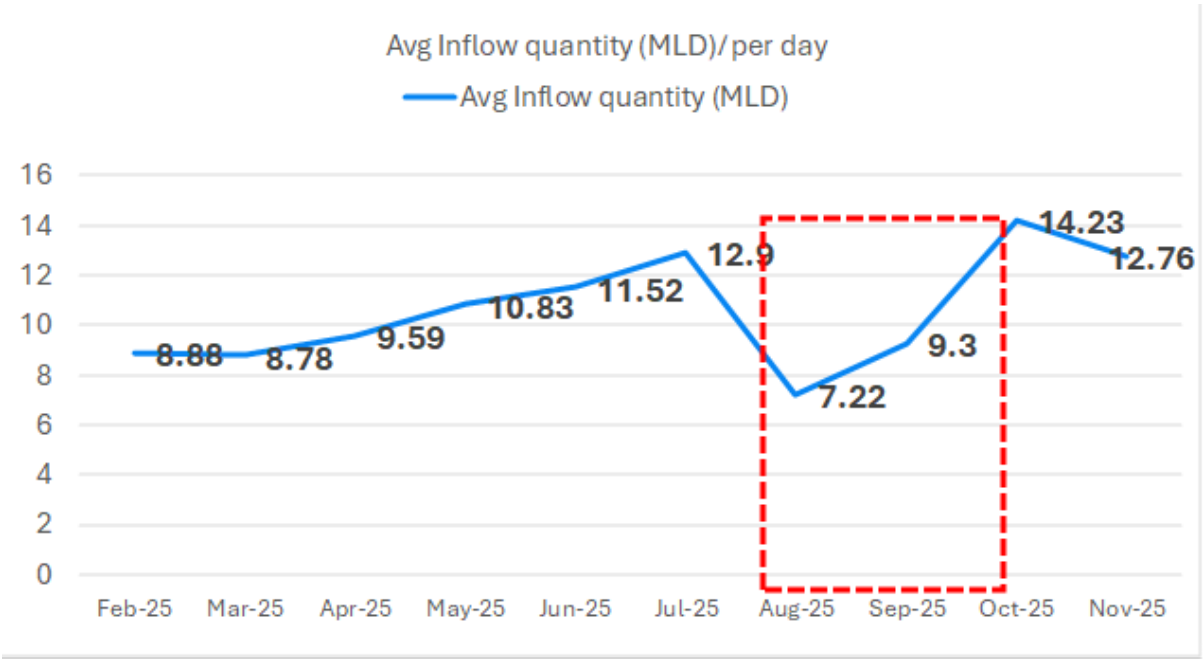
Key gaps in Chapra's wastewater management and reuse framework include the absence of integrated planning to align treated water reuse with urban green spaces, agricultural areas, industrial zones, and water bodies, resulting in missed opportunities for resource optimisation. Urban drains remain largely disconnected from natural drainage systems such as the Tel River and city ponds that play a role in aquifer management, thereby constraining groundwater recharge and ecological functions.

Key issues pertaining to the STP infrastructure:

- The STP intercepts 39 engineered primary drains, which receive inflow from unengineered secondary drains carrying a mix of household sewage and stormwater due to informal connections.
- **Incomplete Infrastructure:** Khanua Nala, a major primary drain linked to IPS-1, is still under construction, preventing water from reaching the STP. Further HH are also not connected
- **Secondary Drain Challenges:** Unengineered drains face heavy siltation, sedimentation, and are often open, leading to encroachment, solid waste dumping, and even animal carcass disposal—impacting IPS functionality.
- **Flood Vulnerability:** IPS-1, located in a flood-prone zone, gets submerged during peak monsoon, causing backflow and complete operational failure.
- **Dual governance in managing the drains:** While BUIDCO is responsible to construct and operate the STP, the responsibility of cleaning the drains lie with the Municipal corporation, which is already stretched with it capacity. This often creates mismanagement leading to ineffective functioning of drains.

Treated water availability for reuse:

Table 4 : Average inflow of wastewater at the Sherpur STP



Source: BUIDCO Chapra

- Due to the existing network and infrastructure challenges, the STP's treatment capacity remains largely underutilized. The month-wise inflow data indicates that against a design capacity of 32 MLD, the plant currently operates well below potential. During peak monsoon, backflow and infrastructure failures further restrict inflow, while in dry months, daily averages range between 8–11 MLD. **With the completion of Kahnua Nala and assuming the STP operates at 50% capacity, there is a potential to make 15 MLD of treated water available for reuse each day**

Figure 32: Issues with the existing STP infrastructure in the city

High siltation- leading to infrastructure failure

Recurrent blockage of secondary drains- Open drains carrying solid waste

IPS-1 completely submerged in water during peak flood. Backflow issues

Solid waste accumulated at outfall points towards river

STP is monitored through a central SCADA system and a dashboard that is reported on NMCG portal. The current treatment fulfils the CPCB standards of treated water quality and is fit for repurpose for multiple reuses. The STP treats 99.99% of inlet water it received. Following is the treated water quality

Parameter	Unit	Raw Sewage (Inlet)		Outlet		
		Design Value	Actual Value	Design Values as per Original Contract	Design Value	Actual Value
Ph	-	5.5-9.0	7.25	6.5-9.0	5.5-9.0	**7.48**
BOD at 3days (05/09/2025)	mg/l	150-300	50	<=30	<=10	**6**
COD	mg/l	300-500	96	-	<=50	**32**
TSS	mg/l	75-600	72	<=100	<=10	**9**
Fecal Coliform	MPN/100ml	NA	NA	Desirable/ Permissible 100/230	<=1000	**140**

Source: BUIDCO Chapra, details for 16th August 2025

5.5.2. URMP Score

Objective 5-Water Re-use Score :

The city formally does not reuse the treated wastewater (<20%).

Hence the water reuse score is 1 as per URMP framework.

5.5.3. Interventions

The focus of the intervention is potentially reusing the treated waste water treated by the Sherpur STP for different purposes. STP operates **at ~50% capacity**. Around **15 MLD (avg) available per month** for re-use (this is expected to increase once the repair works are done - f*ull capacity 26 MLD*). The District Collector has directed to allot a parcel of land near Sherpur STP to the irrigation department for re-use. The land parcel is, however, encroached and is in the process of clearing.

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

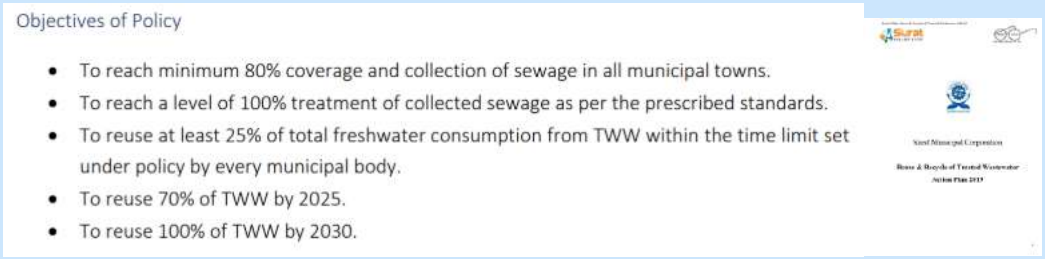
The interventions for treated wastewater re-use for Chapra is to leverage the existing available capacity and establish forward linkages to its potential re-use avenues across public and private sector. Both for commercial and domestic re-use. This will also explore potential avenues of revenue generation for the city through suitable models of private partnerships. This has to be supported by a robust treated wastewater re-use strategy for the city to operate and implement different projects under this objective.

Case study: Gujarat Wastewater Reuse Policy, 2018 & Surat Municipal corporation's reuse and recycle of treated wastewater action plan, 2019
Gujarat's Wastewater Reuse Policy, launched in 2018, aims for 100% reuse of treated wastewater by 2030, viewing it as an economic resource to reduce freshwater dependence, promoting mandatory reuse for industries and agriculture within 50km of treatment plants, and setting targets for increased sewage collection and treatment, making it a leader in water resource management.

Key Aspects of the Policy

- **Vision:** Maximize sewage treatment and reuse to reduce freshwater reliance.
- **Targets:** 70% reuse by 2025, 100% by 2030 (superseding the 2017 policy).
- **Mandatory Use:** Industries and agriculture within 50km of Sewage Treatment Plants (STPs) must use treated wastewater.
- **Economic Resource:** Promotes treated wastewater as a valuable resource, not just waste.
- **Implementation:** Includes plans for technology, financing, private sector involvement, and sludge management.

SURAT MUNICIPAL CORPORATION'S -Reuse and Recycle of Treated wastewater ACTION PLAN



This intervention recommends preparing a dedicated **Treated Wastewater Reuse Strategy** to enable a reuse of treated water in Chapra city. Based on the toolkit for preparation of City Action Plan for Reuse of Treated used water published by NMCG, following assumptions and guidelines have been followed.

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.

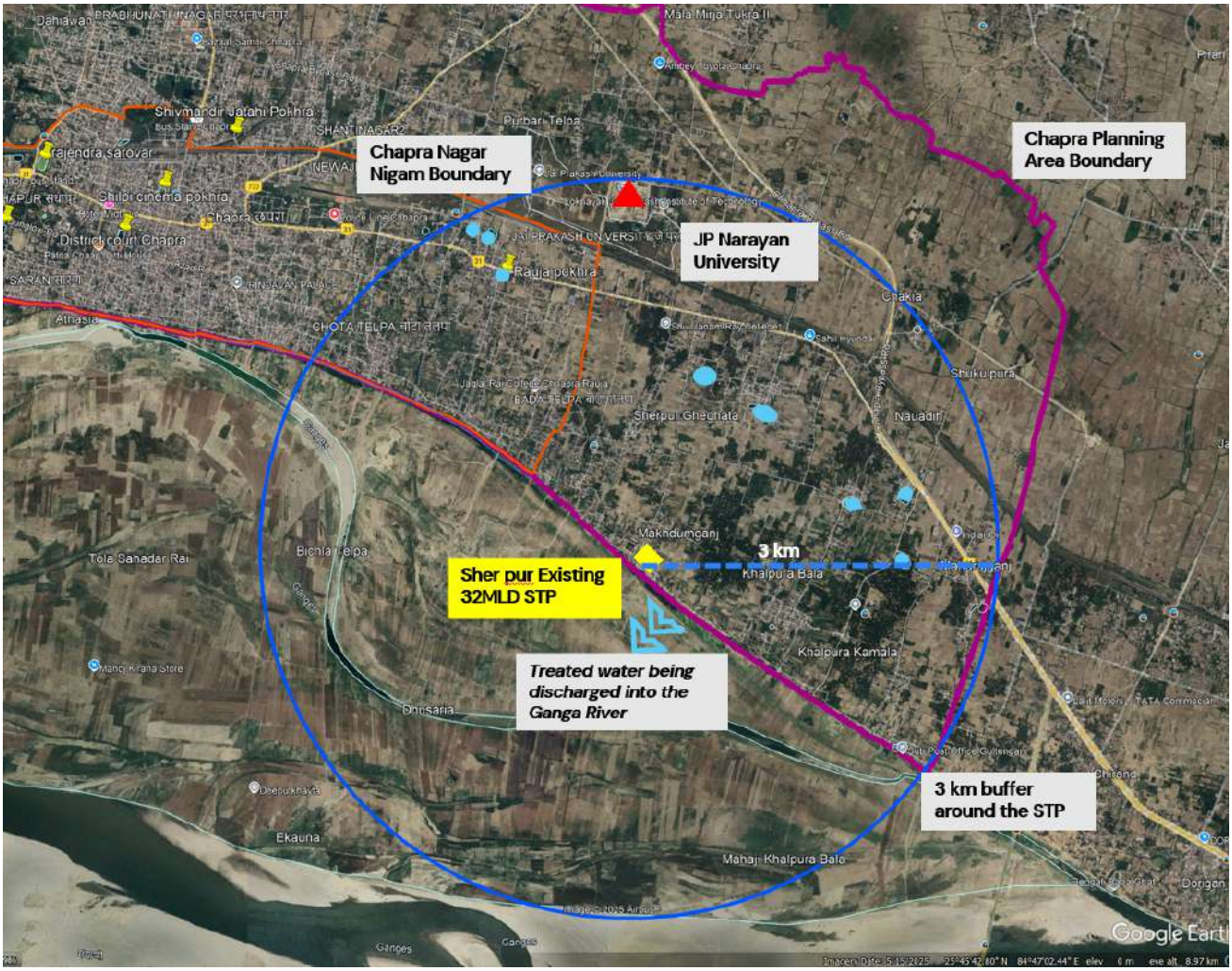
Intervention	Responsible Agency	Intervention type
Preparation of a City-Level Treated Wastewater Reuse Strategy	Chapra Nagar Nigam (Lead), with technical support from state	Policy
Estimated Budget	**Potential Funding Sources**	**Timeline**
~ INR 61 lakh	NMCG policy component or AMRUT 2.0 city action plans	Long-term (5–10 years)

Detailed cost estimate mentioned in Annex 7.6

5.5.3.2. Intervention 5-2 Reuse of treated wastewater within 3 km buffer zone of the STP

The table below shows the approximate details of all parks and water bodies within 3 km of individual STPs, and the map below shows their spatial representation. There are no constructed Half of the 3 km buffer of the STP falls into the flood plan and riverbed zone. Since the STP is located in rural area, there are no constructed parks / gardens. However, there is The Jai Prakash University along 1 stadium and 2 sports ground, that do require amount of water for re-use. Further the STP site itself has provision of around 1200 sqm of area that could potentially be under landscape.

Map 1 : 3 km buffer around the STP Sherpur



Total water requirement of all parks (~359,000, sqm within 3 Kms of the STPs is 897,500 litres = 0.89 MLD. . This is contingent to the factor of forming a commercial/ non-commercial *MoU with the JP Narayan University* to use the treated wastewater provided. This quantity is negligible compared to availability of water. Hence strategies to scale-up for irrigation use, is to be addressed. The treated wastewater will be transported to the parks and gardens through tankers. The horticulture demand in the vicinity of the STPs is a very small fraction of the total treated wastewater available. Therefore, it is important to examine other large-scale uses of this treated wastewater. One such large-scale use is for reviving water bodies. The table below indicates that there are about 12 water bodies in the vicinity. Other potential uses include the reuse of treated wastewater for construction activities, agriculture/ irrigation, industrial sector, airport, among other activities.

Phase 1- Re-use within 3 km distance of the STP (Pilot)				
STP	**Estimated wastewater availability**	**Waterbodies status within 3 km buffer distance of STP**	**Park Status within 3 km of STP distance** **(water 25,000 lit/ ha)**	**Other potential use**
Sherpur 32 MLD	16 MLD/ day	12 water bodies, ~63,000 sqm Approx volume	No gated / constructed parks present Landscape Park area in the STP site (2500 sqm- 0.25 Ha), water required = 6,250 lit JP Narayan campus landscape ~ 350,000 sqm). (25 Ha)- water required ~875,000 lit = Parks within the city area (~ 6500sqm) – 0.65 Ha = 16250 lit	Large area of land under agriculture- high potential for irrigation reuse.

Action to be undertaken MOU with JP university

Cost Analysis: Scenario involving a Memorandum of Understanding (MoU) with JP University for the reuse of wastewater in gardening and landscaping applications. Only the transport cost to supply the water has been added in the budget. Assumption, each tanker to hold 20,000 litre of water with 2 trips daily and rent @INR 8,000/ day. Tanker required is 23 per day. Rental cost for tankers per year (365 days)

Independent feasibility study to be undertaken.

Intervention	**Responsible Agency**	**Intervention type**
Re-use of treated wastewater within 3 km distance-Phase 1	Chapra Nagar Nigam BUIDCO	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~6 CR	CSR City's own fund	Short term
Note: Water saving cost has not been deducted. Water saving will bring down the cost considerably.		

5.5.3.3. Intervention 5-3: River Health and water bodies Monitoring and Public Reporting System

This intervention recommends **Institutionalising a robust, transparent, and repeatable river-health monitoring system for Chapra 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.

This intervention can be developed and integrated with intervention - Develop GIS based inventory of all water bodies and integration with UWD tool

Intervention	Responsible Agency	Intervention type
River Health Monitoring and Public Reporting System	Chapra Nagar Nigam Water Resource department (Monitoring) BPSB (regulatory)	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
50 Lakh	Chapra Nagar Nigam (own fund)	1-2 years

Key Strategy Components:

Defined Monitoring Network

- Establish a **citywide river-health monitoring network** with clearly demarcated locations covering:
  - **River inlet and outlet points** at city boundaries (for Net DO assessment)
  - Major ghats and streams
  - finalisesFix monitoring locations jointly with **BSPCB** to ensure regulatory consistency.

2. StandardiseMonitoring Parameters

- Monitor a core set of **URMP-aligned parameters**, including:
  - Hydrological: river flow / stage (seasonal)
  - Physical: temperature, turbidity, TSS, TDS, electrical conductivity
  - Chemical: pH, DO, BOD, COD, nutrients (as applicable)

3. Integration with SPCB and Digital Platforms

- Align city monitoring protocols with **SPCB laboratory standards and QA/QC procedures**.
- Integrate data streams into:
  - SPCB dashboards
  - URMP city monitoring framework
  - Nagar Parishad's internal MIS for pollution control and enforcement

4. Annual "River Health Report Card"

- Publish a consolidated **River Health Report Card** annually, jointly issued by Buxar Nagar Parishad and Bihar State Pollution Control Board

5. Public Disclosure and Citizen Engagement

- Make monitoring results publicly accessible through:
  - Nagar Parishad website
  - Display boards at major ghats
  - Public meetings and District Ganga Committee reviews
- Use simplified visuals (scorecards, colour-coded trends) to build **citizen trust and accountability**.

5.6. 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 Chapra 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 context of Chapra- city

5.6.1. Existing Situation

Chapra city lies about 4 km from the Ganga River and lacks a direct riverfront, though floodwaters occasionally enter its urban boundaries. The broader planning area, including Revelganj Panchayat and Manjhi, has direct frontage along the Ghaghra River. For this study, a detailed riverfront assessment was conducted at the city level, with a high-level review for the planning area to understand economic activities and ongoing or proposed projects.

Chapra's riverfront features diverse cultural and functional spaces. Predominantly agrarian, the floodplain supports seasonal cultivation of rice, pulses, vegetables, and mango trees. Grazing is common post-monsoon, as cattle rearing remains a traditional occupation. Religious activities occur near the Ganga during festivals like Chhath, with temples such as Nath Baba and Manokamna being locally significant. Recreational spaces include informal playgrounds and a sports maidan; while fishing and boating are practiced during floods. Residential areas consist of privately owned houses with raised plinths, and schools and colleges are also present along the riverfront.

Figure 33 Activities at Riverfront- Chapra City

Cattle grazing during dry/ lean season on the river bed/ flood plain (dry season)

Settlements submerged during floods and informal boat docking areas.

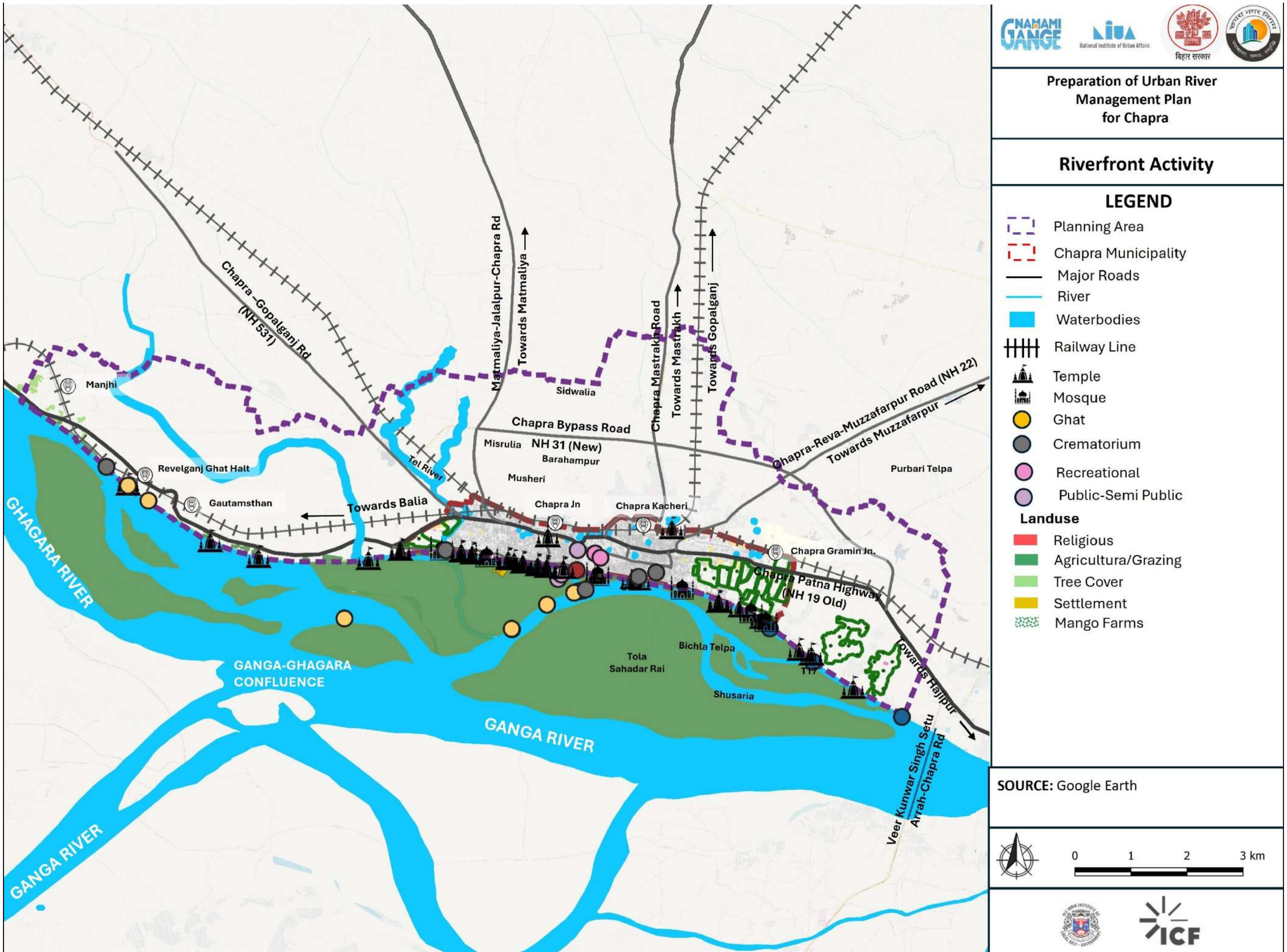
RN Singh college- submerged during flood

Solid Waste Dumping

Maharshi Dadhichi Umanath Mandir.

Manokamna Nath Mandir

Map 14 Riverfront Activity-Planning Area



Map 15 Riverfront Activity-Chapra CIty

Preparation of Urban River Management Plan for Chapra

Riverfront Activities

LEGEND

- Chapra Municipality
- Ward Boundary
- Major Road
- Railway Line
- River
- Waterbodies
- Temple
- Mosque
- Ghat (Softscape)
- Crematorium
- Recreational
- Public-Semi Public

Landuse

- Religious
- Agricultura/Grazing
- Tree Cover
- Settlement
- Mango Farms

SOURCE: Google Earth

0 1 2 3 km

Chapra city currently lacks formally designed ghats within its municipal limits. 2 constructed ghats 1 at Revelganj 2nd Atal Ghat in Manjhi (outside Planning area boundary) under development by NMCG in Manjhi. Offer formal access to the riverfront. Baba Nath Temple Ghat, developed by district authorities in the city and located at a relatively higher elevation, offers some protection against floods and serves as a major cultural and religious hub. It becomes particularly vibrant during festivals like Semariya, Kartik, and Sawan Mela, attracting large crowds and boosting local tourism and economic activity through temporary stalls and vendors. However, the surge in visitors during these events leads to significant solid waste accumulation, mainly flowers and plastic which threatens aquatic ecosystems and diminishes the site's aesthetic appeal. The riverfront is mostly sandy in nature with the banks eroded in parts along the proposed path. During non-flood season the water recedes, such that people do access the riverbed where religious fares are hosted. It also hosts the semariya -kartik pornima mela, where thousands of devotes gather for the holy dip.

Figure 34: The Ghat stretch during the semariya mela and other festivals

The Ganga River in Chapra is a critical cultural and economic resource, yet its potential remains largely underutilized. At present, river-linked economic activities are limited to subsistence agriculture, small-scale fishing, and occasional boating. Agriculture relies heavily on river and groundwater for irrigation, with crops like rice, wheat, and pulses grown mainly for local consumption. Fishing is confined to the Tel River within city limits and lacks formal oversight by the fisheries department. Religious tourism provides seasonal economic boosts during festivals at ghats such as Baba Nath and Gautam Sthan, attracting thousands of pilgrims and supporting ancillary businesses like flower vendors and food stalls. However, these events also lead to congestion and pollution at riverfront areas.

Commercial boating and freight opportunities remain untapped, despite Chapra's proximity to National Waterway-1. Planned riverfront development projects including ghat improvements, the Marine Drive elevated corridor, and enhancements at the Ghaghra-Ganga confluence are expected to improve connectivity, attract tourism, and create jobs, but they are still in the pipeline stage. Beyond the riverfront, Chapra's inland water bodies and open spaces, such as Sah Banwari Lal Pokhra and Shishu Park, offer significant potential for recreational development. Thoughtful interventions like parks, gardens, and water-based activities could diversify the city's economy and enhance its cultural appeal. For long-term success, these initiatives must prioritize eco-sensitive design, proper spatial planning, and regular maintenance to ensure cleanliness, accessibility, and safety, fostering community engagement and aligning with Urban River Management Plan goals

Key Gaps

Chapra currently lacks a functional riverfront framework that integrates cultural heritage, ecological integrity, public accessibility, and economic development, limiting its ability to foster meaningful river-citizen interactions. While multiple riverfront projects are proposed, they remain vulnerable to seasonal flooding due to inadequate incorporation of flood-resilient infrastructure. Existing ghats within the planning area also lack comprehensive design guidelines to address inundation, making them underutilized during high-water events . Furthermore, public spaces suffer from deficient waste management and poorly maintained sanitation facilities, particularly during festivals, leading to pollution and a compromised visitor experience.

In addition, the riverfront offers limited recreational and community spaces such as promenades, parks, and cultural lawns, restricting opportunities for leisure and inclusive urban living. Chapra's rich cultural and natural assets remain underleveraged due to insufficient focus on eco-tourism and heritage promotion, resulting in missed economic opportunities. Unplanned commercial activities like informal boating lack zoning and operational guidelines, creating conflicts between livelihoods and ecological sustainability. The absence of smart and safe infrastructure—such as surveillance, interpretive signage, and eco-friendly lighting—further diminishes visitor safety and engagement. Lastly, there are no pilot projects for green corridors or linear parks to connect the riverfront with the urban fabric, which are essential for enhancing green cover, walkability, and climate resilience.

5.6.2. URMP Score

Objective 7: Eco friendly Riverfront project score

Since there are no riverfront projects under Chapra Municipal corporation's jurisdiction, the defined parameters, Chapra scores 20/100, that translates to a score of 1.

Objective 8: River Economy Score

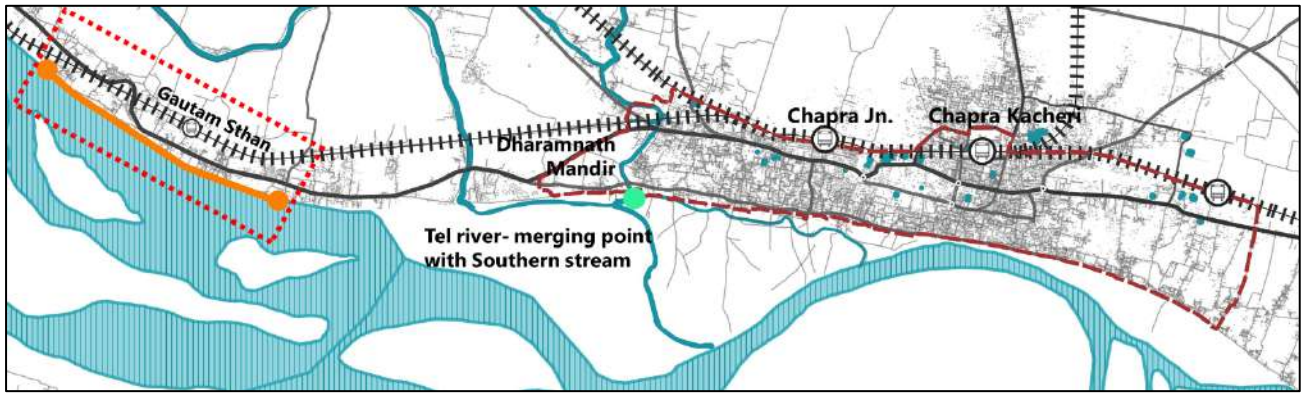
Total river economy score is calculated by considering the number of economic uses that city utilizes the river for. As per URMP framework, if the river has 4 economic use, then the score is 5

5.6.3. Interventions

5.6.3.1. Intervention 7-1: Development of Eco-Ghat from Revelganj ghat to Gautam Sthan

Currently, the city lacks an active riverfront as the main river lies approximately 2–3 kilometres beyond its boundary. Given that several cultural events such as Semariya Mela and Chhath Puja are held in Revelganj, the concept envisions connecting Revelganj Ghat to Gautam Sthan through an eco-walkway. This walkway will incorporate a rich Riparian buffer and provide spaces for relaxation and recreation. The proposed design will be flood-resilient and submersible, ensuring durability during high-water events. Positioned along the Ghagra River, this stretch will offer uninterrupted scenic views of the river throughout the day. This also the location where Chapra and Ganga River meet.

. Figure 35: Proposed stretch of the Proposed eco-ghat connector for Chapra



Length of the proposed eco-ghat connector ~3.8 km

Proposed concept and intent of the eco-ghat connector:

- Recreational pace for the city
- Boosting economy of the region by providing employment opportunities
- Supporting tourism opportunities
- Increasing the open-accessible space for the planning area
- Preserve/ develop riparian buffer along the eco-walkway

- 2 Zones- Eco and Recreation zone proposed

Design Objectives:

- Create a **continuous eco-friendly walkway** along the Ghagra river, integrating cultural, recreational, and ecological functions.
- Provide **safe pedestrian access** for festivals (Chhath Puja, Semariya Mela) while promoting daily leisure activities.
- Enhance **riparian ecology** and improve water quality through green infrastructure.

Figure 36: Proposed concept and program for the Ghat connector

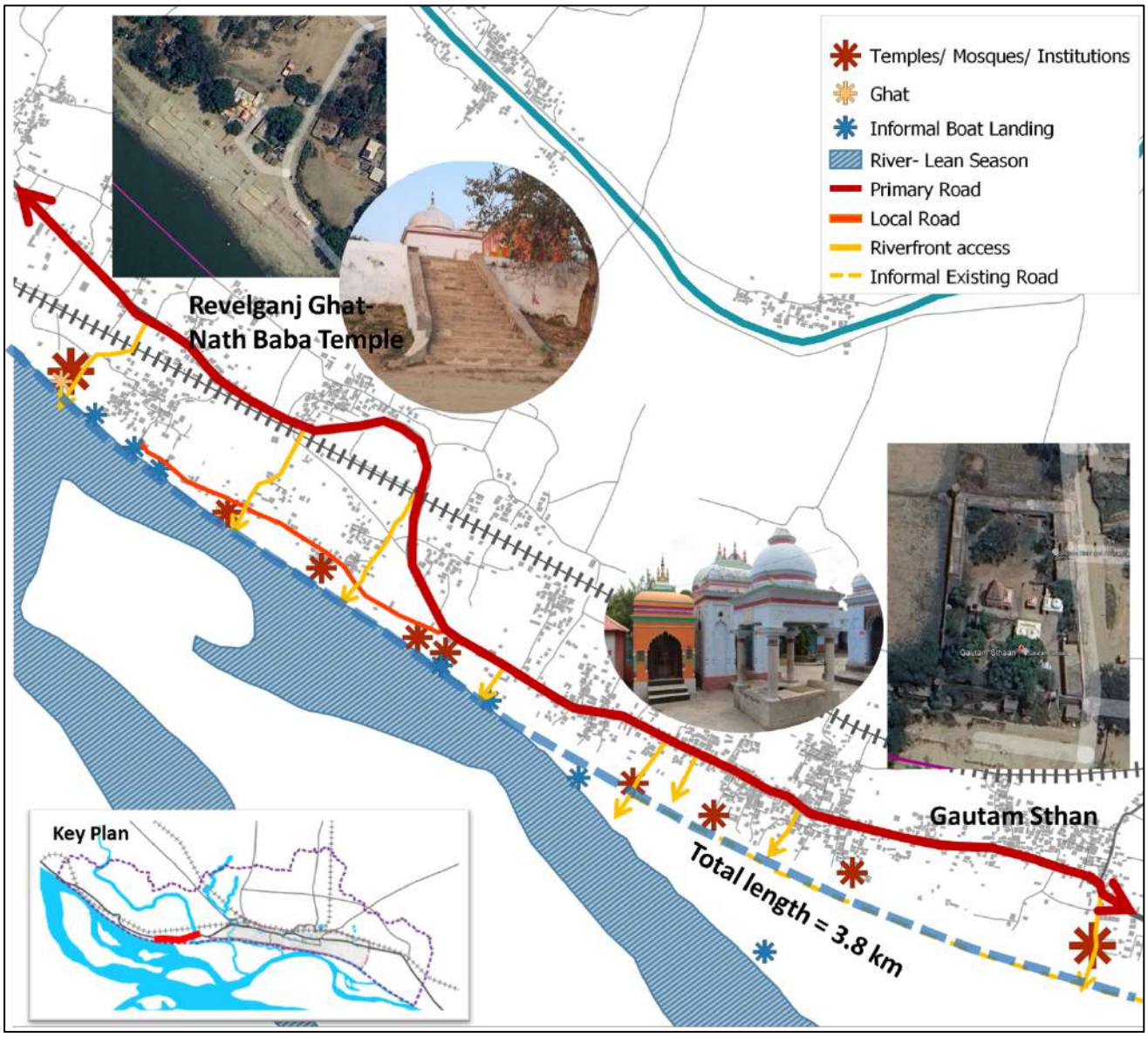
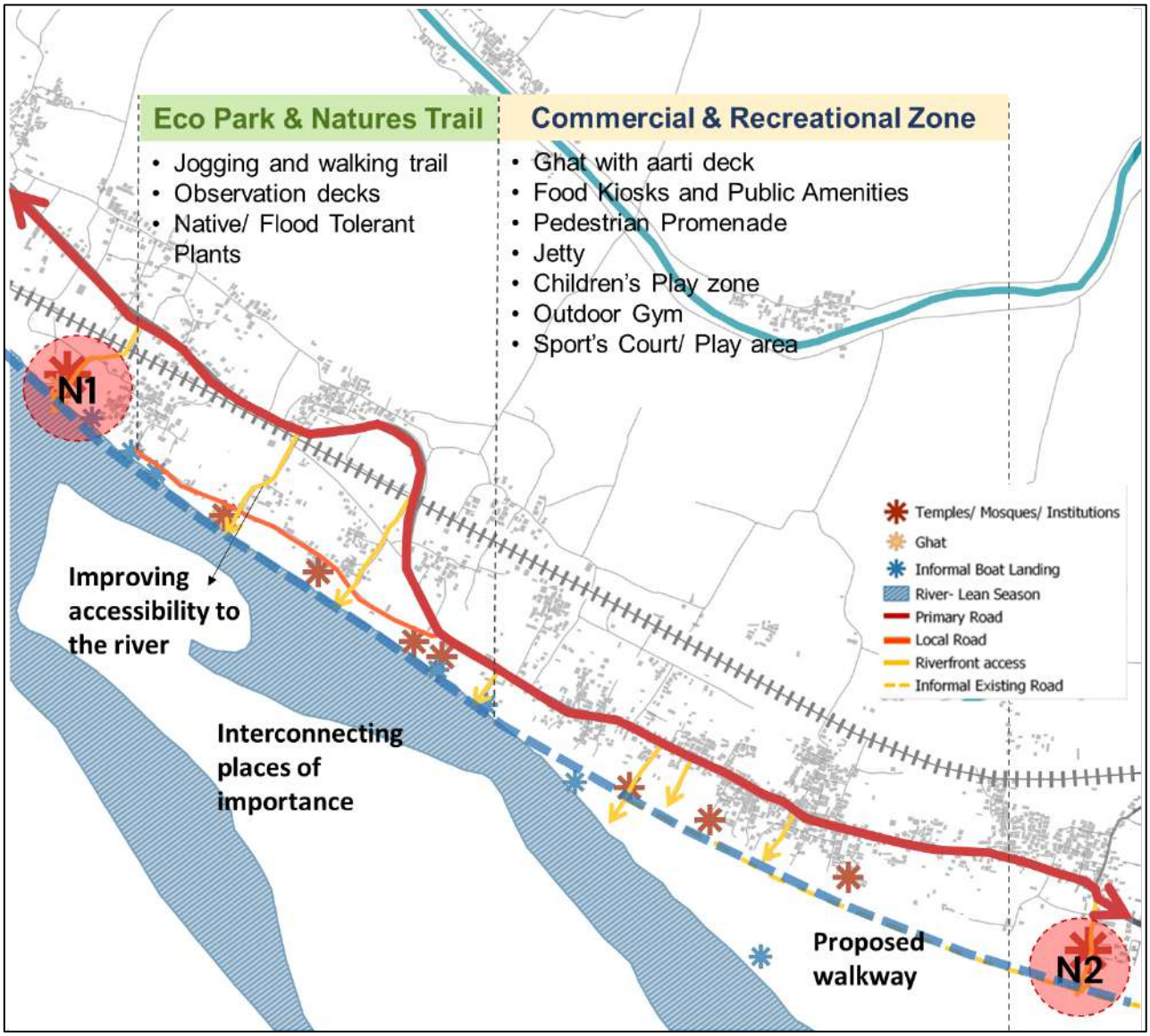


Figure 37: Riverfront Proposed Strategy and Zoning



The approach focuses on defining the river edge and improving connectivity by opening narrow lanes to the main road, linking key religious sites to the riverfront pathway. Two distinct zones are proposed to offer varied experiences for visitors and tourists. As the river shifts away from the mainland, the sandy land parcels will be utilised for hosting city fairs and processions. Gautam Sthan, which already hosts the Semariya Kartik Mela, will be integrated into this plan. The proposed infrastructure will primarily use natural materials and be designed to be submersible and resilient to flooding

Node 1 – ECO ZONE

N1-Eco Ghat. Nath Baba Mandir- Revelganj Ghat

1. Nath Baba Temple
2. Revelganj Ghat inaccessible during floods submerged during flood season.
3. Open area near the temple used during Semariya mela and festivals.
4. Presence of informal boat landing nearby
5. The ghat also has public toilets (not functioning)

Proposed program

1. Refurbishment of Ghat
2. Multistory ghat Structure with public amenities- Toilets, changing rooms and retail to ensure access during floods
3. Ritual Waste Collection and Treatment – bio treatment
4. Dedicating River Bed for Religious Activities
5. Pedestrian walkway Connecting to Eco-park and Nature's Trail.
6. Native Vegetation Buffer

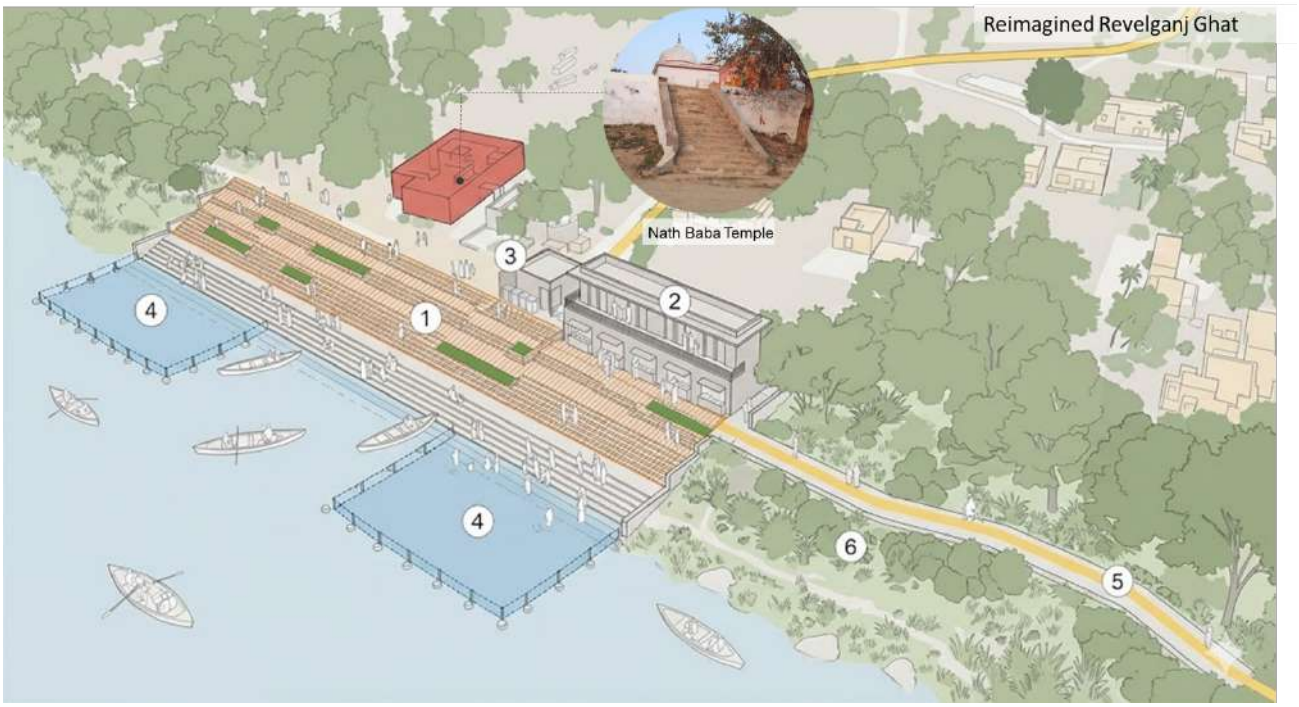


Figure 38: Nature trail path- proposed

Proposed nature trail with viewing deck, tiered walkways, water edge treatment with stone to prevent bank erosion and dense riparian buffer plantation

Considering the turbulent flow of the Ganga and Ghagra rivers, a wide stone edge treatment will be implemented along the slope, reinforced with a strong base for stability. Reed plantations will be introduced to enhance water quality by supplying essential nutrients. The proposed eco-park will serve as a nature walk, offering citizens a serene space for daily recreation. A dense riparian buffer combined with bioswales at surface runoff entry points will further improve the quality of water entering the river.

N2 Gautam Sthan – Recreational and commercial zone

Existing Conditions:

1. Sandy flood plains
2. Existing informal pathway
3. Gautam Sthaan

Proposed program for commercial / recreational zone

1. Ghat with aarti deck
2. Food Kiosks and Public Amenities
3. Pedestrian Promenade
4. Jetty
5. Sport's Court/ Play area, Outdoor Gym, Children's Play zone
6. Native Vegetation

Attract tourists, generate jobs and informal employment

Sustainability design parameters considered for the Eco-ghat connector:

a) Walkway alignment

- Length: Approx. 4 km stretch connecting Revelganj Ghat to Gautam Sthan.
- Width: 3–4 metres for pedestrian and light cycle movement. (for 3 km stretch)
- Surface: Permeable paver blocks or stabilised earth to allow infiltration and reduce runoff.

b) Flood-Resilient Design

- Submersible Sections: Use reinforced concrete base with stone pitching on slopes for stability during floods.
- Raised Platforms: At key congregation points for rituals and seating.

c) Riparian Buffer

- Vegetation: Dense native species (vetiver, bamboo, neem, jamun) along the river edge for erosion control.
- Reed Beds: Planted near waterline for nutrient absorption and water purification.

d) Bioswales and Runoff Management

- Entry Points: Install bioswales at surface runoff entry zones to filter pollutants before reaching the river.
- Rain Gardens: Integrated at low-lying areas for stormwater retention.

e) Activity Zones

- Cultural Nodes: Platforms near ghats for rituals and gatherings.
- Recreational Spaces: Seating areas, shaded pavilions, and small play zones.
- Nature Walk Sections: Interpretive signage on local flora, fauna, and river heritage.

f) Connectivity and Access

- Entry Points: At Revelganj Ghat and Gautam Sthan with signage and lighting.
- Linkages: Connect to nearby roads and public transport for accessibility.

g). Materials and Sustainability

- Locally Sourced Stone and Timber for structures.
- Solar Lighting along the walkway.
- Rainwater Harvesting Pits integrated into landscape.

h). Safety and Amenities

- Benches and Viewing Decks at scenic points.
- Drinking Water Stations and bio-toilets at intervals.
- Emergency Access for maintenance and flood response.

i). Implementation Phases

- Phase 1: Site clearance, slope stabilisation, and riparian plantation.
- Phase 2: Walkway construction and bioswale installation. Improve accessibility. gates
- Phase 3: Cultural and recreational node development.
- Phase 4: Lighting, signage, and community engagement.

Institutional structure: The project will be driven by the Tourism department, in close consultation with Revelganj Panchayat and BUIDCO**.**

Intervention	Responsible Agency	Intervention type
Eco Ghat connector Revelganj ghat to Gautam Sthan	Revelganj panchayat, State Tourism Department, UDHD NMCG	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
₹ 17-20 CR	NMCG, UD&HD Bihar, State Tourism Department,	Medium-term 3-5 Years

Refer Annex 7.6 for Cost estimates

5.6.3.2. Intervention 7-2: Tel river upgradation project

The Tel River, locally known as the nalla, forms the western boundary of Chapra city and serves as a crucial drainage channel for managing urban floods. Its width varies along its course within the city. Two road bridges and one railway bridge span the river, and a defunct barrage remains on the stretch as a heritage feature. The western section of the river is flanked by agricultural land, while the eastern side is bordered by built-up areas, separated by a dense riparian buffer. However, development pressure along its edges is increasing.

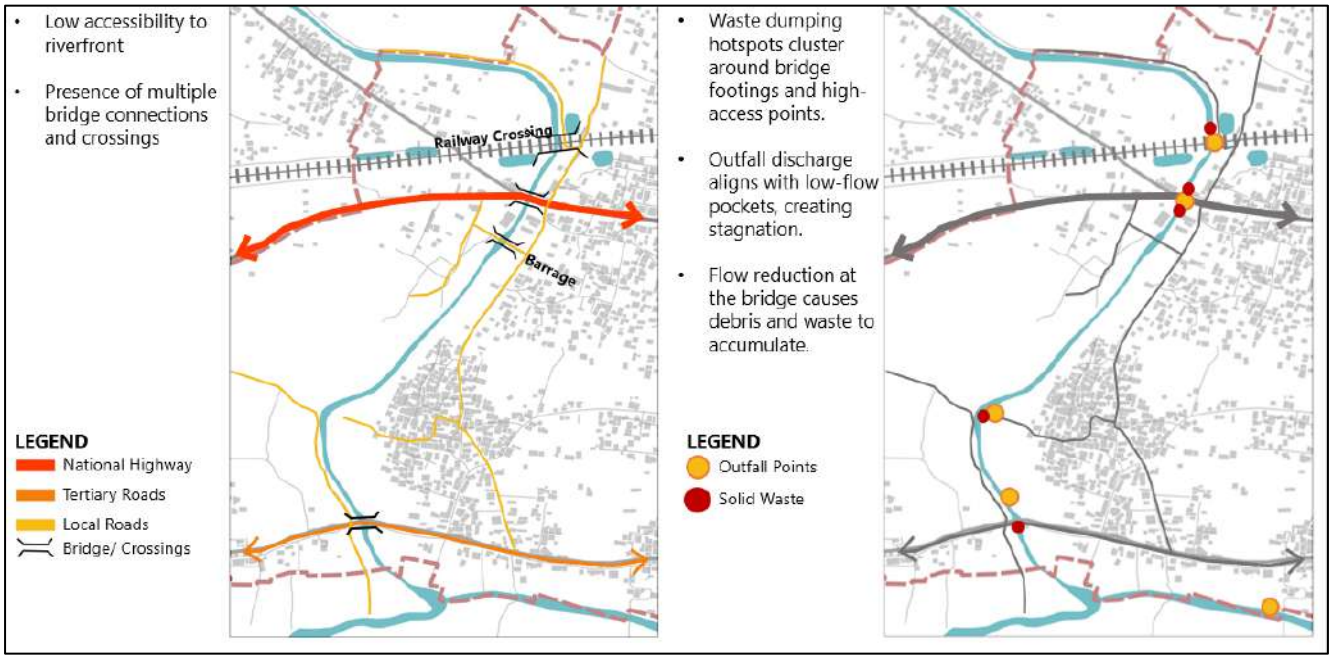
The river is vulnerable to surface water and stormwater runoff due to its lower elevation compared to road levels. Solid waste dumping is commonly observed along its slopes, particularly during summer, and some sections dry up completely in the dry season. The stormwater drainage network reveals around four outfall points within the city, which act as hotspots for both solid and liquid waste discharge. Reduced water flow is noticeable where the river narrows and beneath the bridges.

Intervention	Responsible Agency	Intervention type
Tel river upgradation project	Chapra Nagar Nigam	Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
₹ 8 to 10 CR	City's own fund, NMCG, UD&HD,	Medium-term 3-5 Years

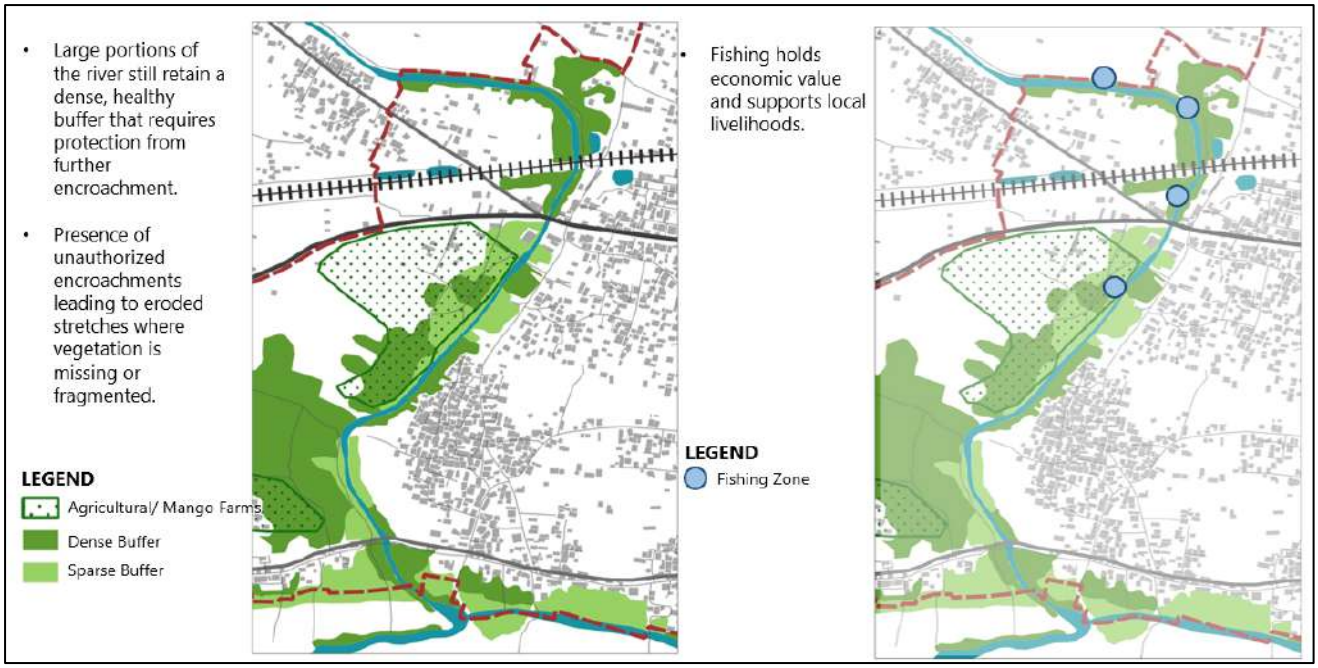
Refer Annex 7.7 for Cost estimates

Figure 39: Tel River -existing condition

The river flows south to north in peak monsoon and north to south in dry season. It dries up in summer and is highly susceptible to solid waste dumping in certain stretches. It inundates/ floods very minimally.



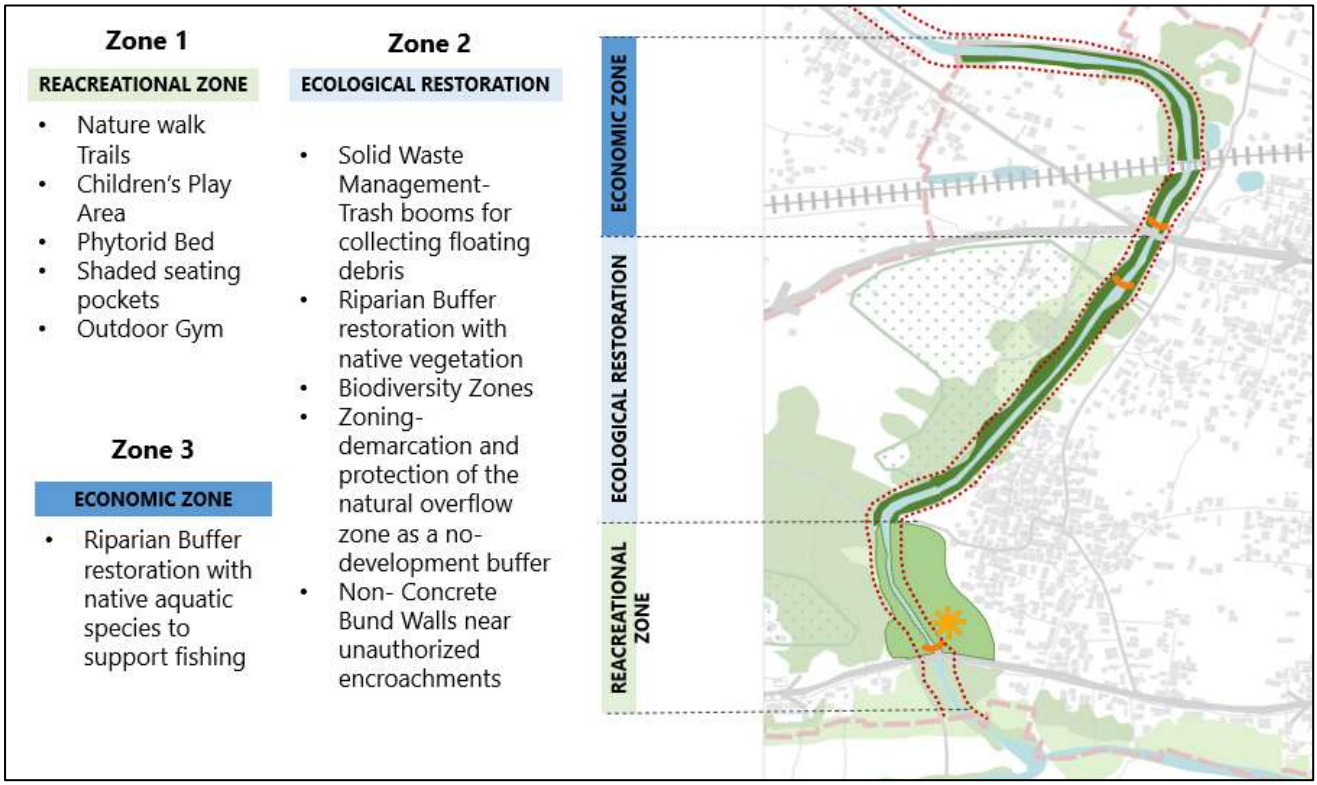
3 bridges- Southern to Revelganj, Northern- Brahampur Bridge and a Railway bridge. There is also a defunct, British made barrage present in the city/ During lean season, where the flow of water is less, the area below these bridges acts as pollution hotspots. The stormwater drain network also has 4 points in the Tel river. The slope of the river is highly susceptible to solid waste dumping and encroachments. The level difference between the water body and development has prevent it.



Tel river Naturally has a thick riparian buffer ~99% of the length has riparian buffer. Commercial fishing is also practiced at the northern zone.

PROPOSED CONECPT

Figure 40 : Proposed concept for Tel River upgradation



Zone 1- Recreational Zone

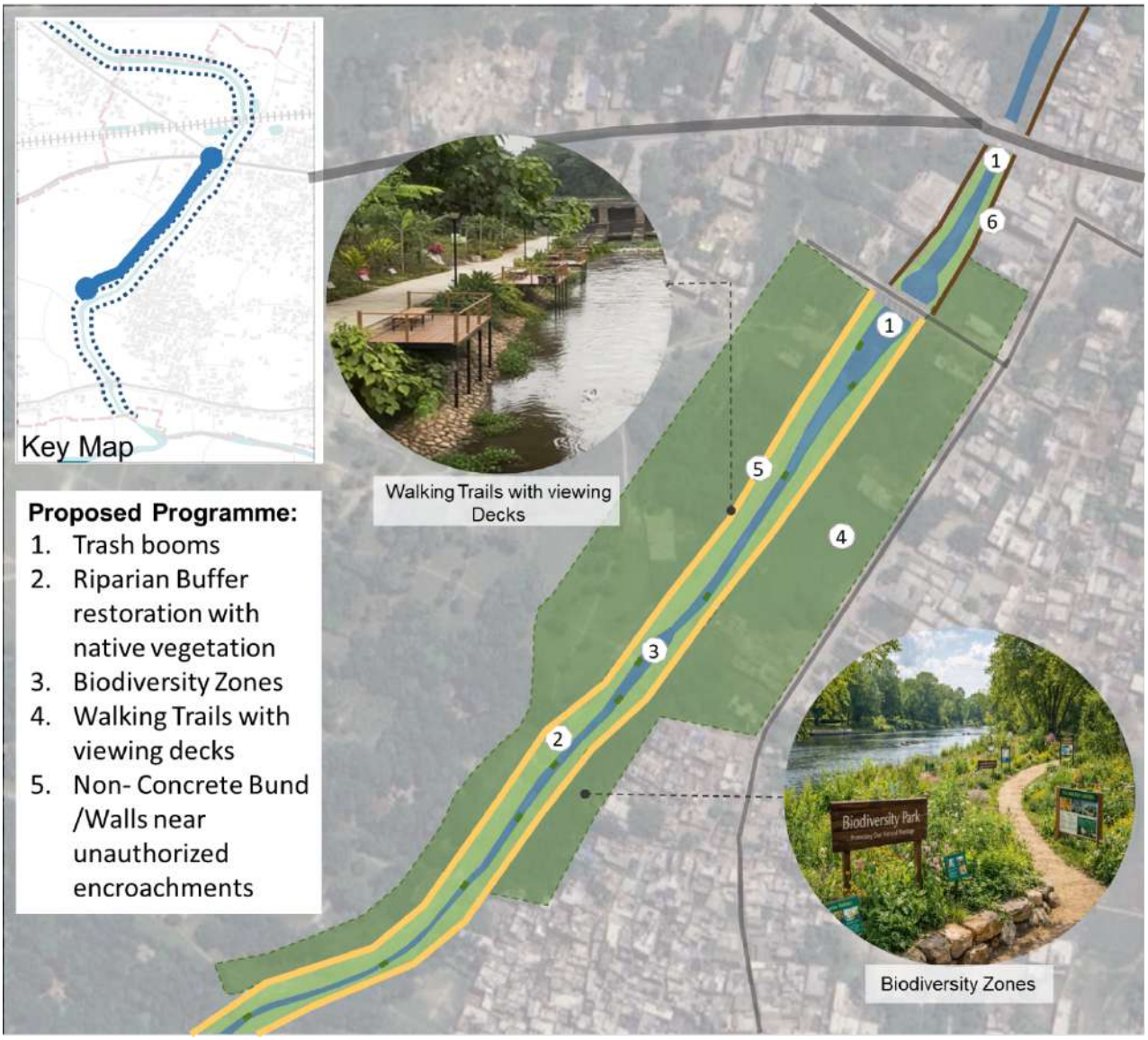
Proposed Programme:

- Nature walk Trails
- Children's Play Area/ Sports Park
- Shaded seating pockets
- Outdoor Gym
- Green Areas
- Riparian Buffer with native vegetation
- Solid Waste Management- Trash booms for collecting floating debris (installed below the bridge)

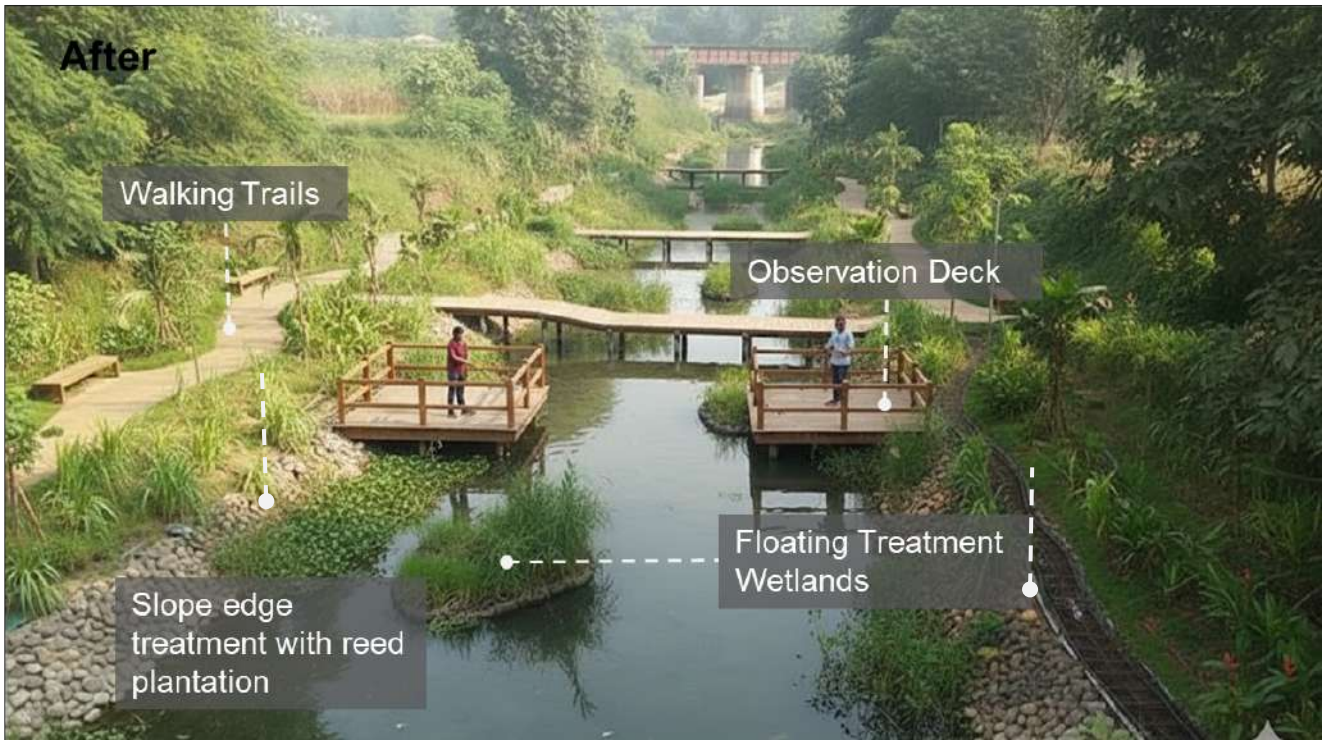
Figure 41 : Proposed Recreation zone -Tel river

Zone 2: Ecological Restoration

Figure 42 : Proposed concept of the ZONE 2 Ecological Restoration, Tel river




Aman Utsav
Before
Google Maps


After
Walking Trails
Observation Deck
Floating Treatment Wetlands
Slope edge treatment with reed plantation

ZONE 3 : Economic Zone

Restoring and maintaining the health of the stretch to support aquatic life . This zone will be a protected zone, with minimum human-interface, lessening pollution load.

Figure 43 : Proposed concept of Z3-Economic Zone Tel River

5.6.3.3. 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.

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 3 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

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)

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5.7. 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.

5.7.1. Existing Situation

Although Chapra city lies at a considerable distance from Ganga, direct citizen interaction with the river is minimal and largely seasonal. Engagement typically occurs during major religious festivals or when floodwater reaches the urban area. Key locations such as Revelganj Ghat and Gautam Sthan serve as active points of connection, especially during events like the Semariya Mela on Kartik Purnima, which draws large crowds for ritual bathing and temporarily transforms the riverfront into a vibrant cultural hub. The river also plays a vital role in Chapra's agrarian economy, supporting irrigation, livestock care, and groundwater recharge, while temples along the riverfront reinforce its socio-cultural significance through regular religious activities.

Currently, citizen engagement in river management is limited and mostly informal. The Urban Local Body (ULB) operates a grievance portal and mobile app for complaints related to drainage and waste at ghats, though the app is non-functional and a dedicated grievance center is only proposed under the 2025–26 budget. Initiatives under the Jal-Jeevan-Hariyali Abhiyan involve maintenance of urban water bodies, with occasional citizen participation in desilting and plantation drives. Public art campaigns by the Nagar Nigam, featuring river-themed murals and waste management messages, aim to raise awareness. However, NGOs and trusts in Chapra have not launched river-centric programs, and citizen-led efforts are mostly confined to cleanliness drives during festivals like Chhath Puja and Ganga Snan. Temple trusts maintain their immediate surroundings but lack capacity for flood and pollution management, highlighting the need for stronger institutional support.

Key Gaps

Key gaps in river engagement and governance in Chapra include the absence of a dedicated river engagement cell to design and sustain river-specific awareness programmes beyond episodic or seasonal campaigns, alongside limited use of digital and multimedia tools such as mobile applications, interactive platforms, and social media to reach youth and urban residents. River ecology is not meaningfully embedded in school education, with conservation themes missing from curricula and eco-club activities remaining irregular and weakly structured. There is also no formal mechanism to include citizens in river management committees or decision-making processes, constraining shared ownership and accountability. These gaps are further reinforced by the lack of structured stewardship models such as Adopt-a-Ghat initiatives, underutilisation of religious and cultural influencers to promote environmentally responsible practices, and the absence of institutionalised river celebration events that could build civic pride and reinforce river heritage.

Institutional and financial limitations compound these challenges, with no dedicated or sustained budget for river-specific information, education, and communication activities, which are typically treated as add-ons within broader programmes. In parallel, the city lacks citizen-led monitoring systems, including

structured training and accessible tools for community participation in water quality and biodiversity monitoring, resulting in weak feedback loops between the river's ecological condition and public action.

5.7.2. URMP Score

Citizen sensitization Score (Objective 9):

Based on baseline assessment, site visits, and stakeholder consultations, Chapra achieves a very low level of citizen sensitization, with a points of 27 out of 100., translating to a score of 2 . Citizen sensitization in Chapra remains limited, with minimal awareness and participation in activities such as clean-up drives, plantation programs, and river conservation events. While an NGO has been engaged by the municipal corporation to employ local workers as "safai mitras," broader public involvement in sustainability initiatives is lacking.

Citizen Engagement Score (Objective 10):

Chapra receives a high citizen engagement score of 2. Citizen engagement in Chapra is currently low but holds significant potential for improvement. Formal integration of citizens into decision-making processes and committees is absent, limiting long-term ownership and accountability. Structured platforms such as digital reporting tools, participatory forums, and institutional partnerships can help bridge this gap. Exploring Public-Private Partnership (PPP) models with corporate funding can bring financial and technical resources while creating opportunities for local communities, youth groups, and NGOs to co-implement projects alongside corporate partners.

5.7.3. Interventions

5.7.3.1. 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	Chapra Nagar Nigam	Policy/ Program
Estimated Budget	**Potential Funding Sources**	**Timeline**
32 lakhs	NMCG, Nagar Nigam	1-2 years

Refer Annex 7.8 for Cost estimate

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.

1. Household-Level Engagement

- Door-to-door "River Health Campaigns" focusing on:
  - Eliminating drain-dumping
  - Scheduled desludging awareness
  - Safe septic maintenance
  - Source segregation (wet–dry–ritual waste)
- Street-level champions ("Ganga Mitra volunteers") for each ward.

2. Community & Neighbourhood Platforms

- RWAs, ghat committees, market associations trained in:
  - Festival waste protocols
  - Maintaining eco-ghats
  - Monitoring drains & waste hotspots
  - Organic farming sensitization for floodplain farmers
- Dedicated "Ward River Watch Groups" for hotspot zones

3. Citywide Awareness Campaigns

- Monthly "Clean Nala, Clean Ganga" drives in polluted microsheds.
- Media, temples, schools, and anganwadis as behaviour-change multipliers.
- Festival-specific IEC:
  - Chhath: waste-free ghats
  - Holi/Kartik Poornima: colour & plastic restriction
  - Shraddh rituals: eco-friendly offerings

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.

5.7.3.2. Intervention 9-2: River Day "नदी दिवस मनाएं, गंगा को बचाएं – हमारी संस्कृति, हमारी जिम्मेदारी!"

Celebrating **नदी दिवस (River Day)** in Chapra can serve as a powerful intervention to foster community awareness, cultural pride, and environmental stewardship. Chapra, with its strategic location along the Ganga and Ghaghra rivers, has immense potential to leverage River Day as a platform for sensitization and engagement. Activities such as clean drives, plantation along ghats, heritage walks, and cultural programs can create a sense of ownership among citizens. Schools and colleges can organize essay competitions, art exhibitions, and street plays focused on river conservation, while municipal authorities can use this occasion to launch digital reporting tools and citizen feedback platforms. By integrating River Day into Chapra's urban development agenda, the city can align with URMP objectives and promote sustainable riverfront planning.

Learnings from River Cities

Several cities in India have successfully used River Day celebrations to strengthen river-citizen connections. For instance, **Varanasi** organizes cultural festivals and Ganga Aarti events combined with awareness campaigns under the **Namami Gange** program. **Pune** celebrates **Mula-Mutha River Festival**, featuring cycling rallies, art installations, and clean-up drives to promote eco-consciousness. Similarly, **Indore**, known for its cleanliness initiatives, conducts river rejuvenation activities during River Day, engaging schools, NGOs, and corporate partners through Public-Private Partnerships (PPP). These examples demonstrate that River Day can go beyond symbolic celebration—it can become a catalyst for sustained citizen engagement, eco-tourism promotion, and heritage-led development. For Chapra, adopting such models will not only enhance its socio-cultural identity but also ensure long-term ecological resilience and economic growth.

River Day Intervention Components

Awareness Campaigns

- Street plays, art exhibitions, essay competitions in schools and colleges
- Social media drives and local radio announcements

Clean-Up Drives & Plantation

- Community-led ghat cleaning and tree plantation along riverbanks
- Involvement of NGOs and youth groups

Cultural & Heritage Activities

- Ganga Aarti, folk music, and traditional performances
- Heritage walks showcasing Chapra's riverfront history

Public-Private Partnerships (PPP)

- Corporate sponsorship for events and infrastructure
- Co-implementation with local communities and NGOs

Eco-Tourism Promotion

- Guided tours at Ganga-Ghaghra confluence
- Local craft and food stalls during celebrations

Intervention	Responsible Agency	Intervention type
River Day "नदी दिवस मनाएं, गंगा को बचाएं – हमारी संस्कृति, हमारी जिम्मेदारी!"	District Ganga Planning Committee & Chapra Nagar Nigam	Program
Estimated Budget	**Potential Funding Sources**	**Timeline**
5-10 Lakh[14]	NMCG	Short Term

5.7.3.3. Intervention 9-3: Waste to Art Program: "Turning River Waste into awareness"

Chapra can introduce an innovative initiative called **"Waste to Art"**, where solid waste collected from river clean-up drives is repurposed into sculptures and creative installations. This intervention serves a dual purpose: reducing waste pollution and using art as a medium to sensitize citizens about river cleanliness. The collected plastic, metal, and other non-biodegradable materials can be transformed into symbolic sculptures depicting themes like "Clean Ganga, Green Future" and installed at prominent locations such as

[14] https://jjm.up.gov.in/Content/ngdashboard/pdf/Namami_G-12-09/Letter%20of%20approval%20Annual%20Plan%20UP%20C&PO%20UP%202023-24.pdf

Baba Nath Ghat, parks, and the upcoming Marine Drive corridor. These installations can include QR codes linking to educational content on waste management and river conservation, making them interactive and informative. Additionally, workshops can be organized for schools and colleges to involve youth in creating smaller art pieces, fostering community ownership and creativity.

Key Components:

- **Collection & Segregation:** Organize clean-up drives along Chapra's ghats to collect plastic, metal, and other non-biodegradable waste.
- **Artist Collaboration:** Engage local artists, art colleges, and NGOs to design sculptures using the collected waste.
- **Public Display:** Install these sculptures at prominent locations like Baba Nath Ghat, municipal parks, and near the proposed Marine Drive corridor.
- **Awareness Campaign:** Use these installations as conversation starters during River Day celebrations, with QR codes linking to educational content on waste management and river conservation.
- **Community Engagement:** Conduct workshops where citizens, especially youth, participate in creating smaller art pieces from waste.
- **Tie up with educational institutes-** Schools and colleges

Figure 44 : Installations of Waste sculptures at public places

Intervention	Responsible Agency	Intervention type
Waste to Art Program: "Turning River Waste into awareness"	District Ganga Planning Committee & Chapra Nagar Nigam	Program/Project
Estimated Budget	**Potential Funding Sources**	**Timeline**
~Rs 2-8 Lakhs	NMCG/SBM	Short Term

6. Ongoing / planned projects:

Proposed relevant projects/ items relevant to the URMP projects in the Annual Budget

बजट सारांश 2025-26	छपरा नगर निगम
प्रारंभिक राशि	605,103,564
कुल प्राप्ति	3,499,511,232
कुल भुगतान	4,085,816,345
अंतिम शेष	18,798,451
कुल बजट 4 अरब 8 करोड़ 58 लाख 16 हजार 345 रु मात्र	

Summary budget (2025-26)	Chapra Nagar Nigam
Opening Balance	605,103,564
Total Revenue	3,499,511,232
Total Expenditure	4,085,816,345
Balance	**18,798,451**
Total Budget- **Four billion, eighty-five million, eight hundred sixteen thousand, three hundred forty-five**	

This budget displays a strong capacity of the city to undertake large infrastructure projects

Table 5: River related projects in Annual Budget

No	Project/ Item	Budget	Update
1	Tel River- improvement and development	(20 cr)	No progress
2	Inland water bodies/ pond improvement	Chapra nagar nigam annual budget	One pond refurbished. 2 pending
3	Rainwater harvesting and water conservation	(1.50 cr)	No progress
4	Construction of landfill site	11 cr	No update
5	Multistorey toilet	Chapra nagar nigam annual budget (2 cr)	No progress
6	Road and nala construction	Chapra nagar nigam annual budget (99 cr proposed. Paver block roads- 11 cr)	In progress
7	Green Park	3.3 cr	No update
8	Jal jeevan hariyali -	2 cr	No update

9	Crematorium	5 cr	No update
10	Special festivals	2 cr	During Chhat festival
11	Solid waste management and garbage clearance	16 cr 50 lakh	In progress
12	Repair works	18 cr	No update

Figure 45: Snippets from the Chapra Nagar Nigam's Annual Budget

तेल नदी सौन्दर्यीकरण: तेल नदी सौंदर्यीकरण परियोजना का उद्देश्य नदी को स्वच्छ, सुंदर और पर्यावरणीय रूप से समृद्ध बनाना है। इसके अंतर्गत नदी की सफाई, जल संरक्षण नदी तट का विकास (जैसे पाथवे लाइटिंग, पौधारोपण) और स्थानीय समुदाय की भागीदारी से सौंदर्यीकरण किया जाएगा। यह परियोजना पर्यटन को बढ़ावा देने और जल स्तर सुधारने में भी सहायक होगी।

आयोग के अनुशंषा के आलोक में छपरा नगर निगम क्षेत्र में बारिश के पानी का संचय का व्यवस्था भी इस बजट में किया गया है ।
इसके आलावा निगम क्षेत्रो के तालाबो के उड़ाही एवं सफाई, तालाबो के सौन्दरीकरण, तालाब के किनारे टूरिज्म पॉइंट बनाना एवं बच्चो के प्रतिभा को निखारने हेतु बच्चो के लिए निगम क्षेत्र के तालाब के किनारे बच्चो के खेलने का स्थल का निर्माण का प्रावधान भी इस बजट में रखा गया है ।

❖ **जल-जीवन हरियाली योजना**: जल जीवन हरियाली योजना के अन्तर्गत पौधा रोपण, सोखता का निर्माण, तालाब का उड़ाही करण एवं जल सोंतो का संचयन के लिए **2 करोड़ रूपए** का उपबंध किया गया है।

❖ **श्मशान घाट / कब्रिस्तान के सौन्द्रिकरण** : नगर क्षेत्र में श्मशान घाट के निर्माण तथा इसकी मरम्मती किये जाने का प्रस्ताव है। इसके लिए **5 करोड़ रूपए** का प्रावधान किया गया है।

❖ **लैंड फिल साईट :** निगम का कोई लैंड फिल साईट नही है जबकि इसका होना अपरिहार्य है अतः इसके लिए **11 करोड़ रूपया** का प्रावधान किया गया है जो सरकार से प्राप्त होने वाले अनुदान से किया जाएगा।

❖ **विशेष त्योहारों हेतु अनुमानित खर्च:** होली, दीवाली,छठ ईद एवं अन्य त्योहारों पर कुल **2 करोड़ रुपये** का प्रावधान किया गया है।

- अन्य बुनियादी सुविधाओं (एसेट्स) की मरम्मत एवं रखरखाव
- कुओं एवं तालाबों का मरम्मत, सौंदर्यीकरण और रखरखाव
- कार्यालय भवनों की मरम्मत एवं रखरखाव
- वाहनों की मरम्मत एवं रखरखाव
- फर्नीचर एवं स्थिर संरचनाओं की मरम्मत एवं रखरखाव
- जनरल कार्यालय उपकरणों की मरम्मत एवं रखरखाव
- अन्य आवश्यक मरम्मत एवं रखरखाव कार्य

❖ **SWM(कचरा सफाई) NGO सहित Garbage Clearance:** इस मद में कुल 16 करोड़ 50 लाख अनुमानित व्यय का प्रावधान किया गया है।

Infectious Diseases

Projects under other state schemes:

Below is a list of key infrastructure projects currently being implemented by city and state authorities to strengthen Chapra's urban systems. While these initiatives are moving in the right direction, the involvement of multiple agencies often results in confusion and overlaps. There is a pressing need for an integrated approach to comprehensively design and coordinate the city's services

NO	Name of project	Agency responsible	Status
1	Extension of STP -Interception and Diversion (I&D) and STP project under Namami Gange	BUIDCO	Approved
2	Khanua Nala- Storm water drain Renovation	BUIDCO	Ongoing-nearing completion
3	Urban Drinking Water Supply Project. AMRUT	BUIDCO	Ongoing
4	Double decker flyover from Gandhi Chowk to Nagarpalika chowk	BRPNNL	Ongoing
5	Storm water drain	RWD	Ongoing
6	Road construction (NICHLI SADAK + Elevated Road proposal)	RWD	Proposal stage
7	Lane drains	Municipal corporation	Proposal stage
8	Utility corridor project	BUIDCO	DPR
9	RURBAN Drainage plan	District-Planning authority	Ongoing

Source: Utility corridor DPR, BUIDCO, Chapra 2025

7. M&E Plan

7.1. Purpose and Rationale

The Monitoring and Evaluation (M&E) Plan for the URMP for Chapra 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 Chapra to assess its performance over time and benchmark progress against baseline conditions established under this study.

7.2. Monitoring Framework and Approach

Monitoring under URMP Chapra 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.

Implementation progress under URMP Chapra 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 6 :URMP Progress Monitoring indicator for URMP Chapra

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

7.3. Baseline Development and Data Sources

For Chapra, 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 (riverfront projects) becomes operational.

Primary data sources include:

- Water quality monitoring stations (DO, BOD, COD);
- GIS-based spatial datasets (floodplains, riparian buffers, waterbodies);
- 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.

7.4. Institutional Roles and Responsibilities

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

- **Chapra Nagar Nigam**: Nodal agency for overall M&E coordination, data consolidation, and reporting.
- **BUIDCO**: Providing technical support in provision of services for infrastructure project s
- **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.
- **Agriculture department:** monitor the quality of organic manure, compost produced by the city
- **Tourism and Fisheries Departments**: Tracking river-based economic activities.
- **Ward Committees and Community Groups**: Inputs for citizen engagement and sensitisation indicators.

7.5. Outcomes of the Monitoring and Evaluation Framework

The URMP Chapra 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.

8. Annexures

Annexure 1: Policies Governing Floodplains in Chapra

National Policies and Judicial Orders

1. Model Bill for Flood Plain Zoning, Central Water Commission, 197515: 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 7: 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

[15] *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 2025[16]

- ***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 8: 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

[16] 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 9: 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. viii. 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.

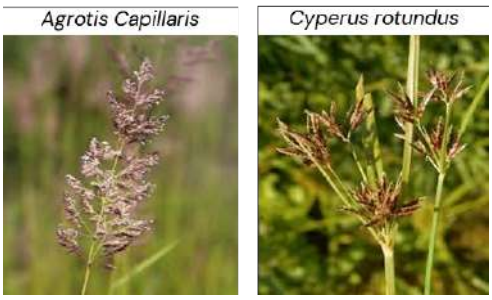
1. Bihar State Pollution Control Board (BSPCB) Directives: regulate effluent discharge, sand mining, and solid waste in floodplain-adjacent wards, but enforcement capacity is thin in smaller cities like Buxar
2. State Disaster Management Plan (2015, updated 2021): Identifies flood-prone districts and 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

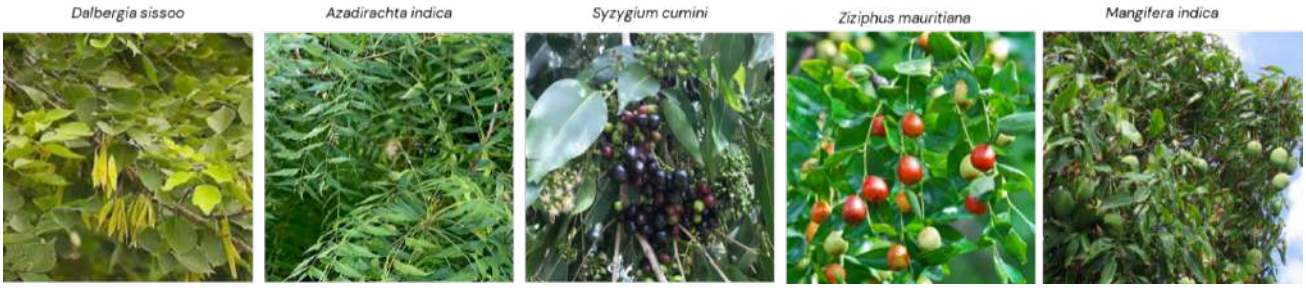
Annexure 2: Common Native Species List

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.


Asian Jumping Mantis


Indian Red Scorpion


Peacock Pansy


Indian Grey Hornbill


White-throated Kingfisher


Red-naped Ibis


Red-crested Pochard


Pallas's Gull


Taiga Flycatcher


Zitting Cisticola


Brown Shrike


Great Crested Grebe


Turmeric


Water Morning Glory


Surattense Nightshade

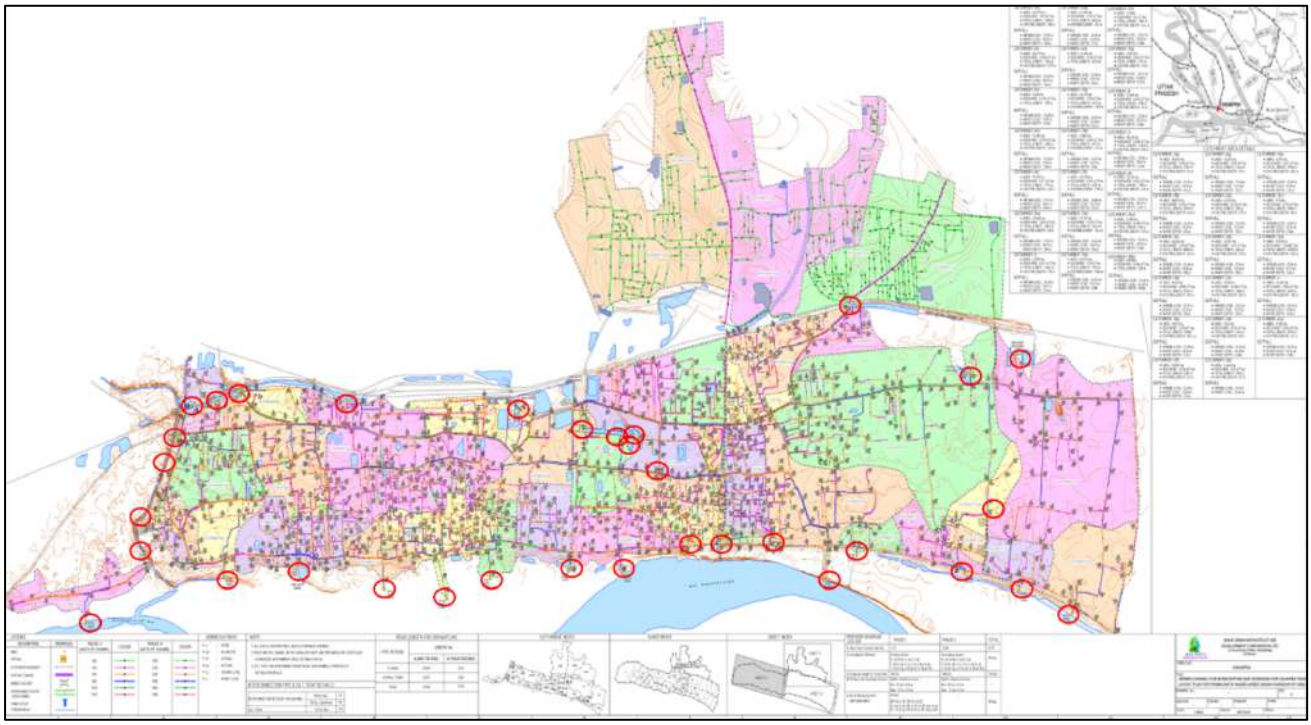

Subtribe Phaseolinae

Annexure 3: 32 MLD (I&D) STP, Sherpur report on quality and quantity of water treated per day

32 MLD SEWAGE TREATMENT PLANT AND I&D Chhapra						
Date of Work 08.09.2025						
Total Incoming Sewage. **15.49 MLD Per Day**		**Outlet:- (15.48 MLD)**				
Parameter	**Unit**	**Raw Sewage (Inlet)**		**Outlet**		
		Design Value	**Actual Value**	**Design Values as per Original Contract**	**Design Value**	**Actual Value**
Ph	-	5.5-9.0	7.25	6.5-9.0	5.5-9.0	**7.48**
BOD at 3days (05/09/2025)	mg/l	150-300	50	<=30	<=10	**6**
COD	mg/l	300-500	96	-	<=50	**32**
TSS	mg/l	75-600	72	<=100	<=10	**9**
Fecal Coliform	MPN/100 ml	NA	NA	Desirable/Permissible 100/230	<=1000	**140**

Source: BUIDCO-Chapra, 2025

Annexure 4: Detailed Storm water drainage layout with catchment areas (as constructed) - Chapra



Proposed Sewerage System	Phase I	Phase II	Total
a. Apx Area Covered (sq.km)	3.51	12.68	16.19
b. Catchments (38 Nos)	Primary drains: (C-1a to 1m, C-2a to 2d, C-3a to 3d, C-4, C-5,C-6 to 6C C-7a to 7g, C-8 to 10, C-11a&11b	Secondary Drains: (C-1a to 1m, C-2a to 2d, C-3a to 3d, C-4, C-5,C-6 to 6C C-7a to 7g, C-8 to 10, C-11a&11b)	38 No
c. Proposed Length of Drains (kms)	38.317	138.334	176.65
d. Primary and Secondary Drains	Width X Depth of drain Min - 0.3m X 0.3m Max – 1.3m X 3.0 m	Width X Depth of drain Min - 0.3m X 0.3m Max – 1.3m X 3.0 m	-
e. No. of disposal points with Name (Nos)	38 Nos (OF-1a to 1m, OF-2a-2d, OF-3a to 3d, OF-4, OF-5, OF 6a to 6d OF-7a to 7g, OF-8 to 10, OF-11a&11b)		38 nos

Annexure 5: Water Body Inventory of Chapra City

Table 10 :Water body inventory for Chapra City

No	Water Body Name	Water Body Ownership & Nature	Area (Sq km)	Volume/ Capacity (m^3)	Current Use	Solid Waste Presence	Untreated Wastewater Discharge	Boundary Protection	Eutrophication / Aquatic Plants
1	Shilpi Pokhra	Public	0.223	100	Currently unused	Significant (plastic, paper, thermocol)	None	Path under construction; no fencing	Algal bloom; castor oil plant growth
2	Jatahi Pokhra	Public	1.3	5800	Groundwater recharge	Some Plastic waste along periphery	Possible inflow	Road access on one side only, no path	Water hyacinth and rushes
3	Shishu Park Pokhra	Public	0.114	1050	Water show, children's park, recharge, leisure	None observed	None	Fencing provided	Fresh water; no algal bloom
4	Sah Banwari Lal Pokhra	Public	0.19	1600	Religious, Groundwater recharge, fishing, leisure	Minimal waste at periphery	None	Fencing present	Clear water; no algal bloom
5	Kachhari Campus Pokhra	Institutional	0.229	2000	Groundwater recharge, leisure	Minimal waste at periphery	None	Fencing Present	Invasive plant growth at periphery
6	Rajendra Sarowar Pokhra	Public	0.66	4800	Religious rituals, leisure	Some solid waste along edges	None	Defined path present	Clear water; algal bloom
7	Raja Pokhra	Public	0.418	3600	Groundwater recharge	Significant (plastic, food waste)	Inflow observed	No path or fencing	Severe algal bloom; aquatic plant cover
8	Dudhai Pokhra	Public	0.83	4750	Religious use (Chhath Puja)	Some plastic waste along periphery	None	Stairs on one side only	Algal bloom; aquatic plant cover

Figure 46 Major Water Bodies in Chapra

Eutrophication and solid waste, Shilpi Pokhra

Eutrophication and solid waste, Jatahi Pokhra

Shishu Park Pokhra

Redevelopment, Sah Banwari Lal Pokhra

Algal Bloom, Kachhari Campus Pokhra

Religious Hardscaping, Rajendra Sarowar



Eutrophication, Rauja Pokhra



Eutrophication and Solid Waste, Dudhai Pokhra

Annexure 7: Detailed BOQs

7.1 Cost estimate- River pollution Waste management strategy for Chapra city

No	Items	Cost (in INR)
1	Hiring of a 3rd party agency for preparing the waste management strategy	15,00,000
2	Survey and on-ground fee for baseline phase	1,00,000
3	Installation of GIS, GPS based tracking devices	10,00,000
4	Installation of water quality monitoring sensors	8,00,000
5	IEC and awareness drives	1,00,000
6	Additional / salary to staff	9,00,000
7	Shyam chak dump site- bioremediation and transfer of waste as per CPCB and NGT Guidelines	50,00,00,000
	Total	**50,44,00,000**

7.2 Cost estimate- Decentralized wet waste management for Chapra City

No	Items	Cost in INR)
1	Publication of handbook to manage wet waste at home for citizens (consultant fees+ distribution of copies to citizens)	20,00,000
2	Installation of 20 box composters at site in the city (hotels, market laces, government offices)- requires a shelter @2.5 -3. 5 lac to process 1 ton of wet waste Construction and site preparation ~ 2 lac per site ~ 5 ton of wet waste to be processed	35,00,000
3	Vermicomposting plant at one site (to be suggested by agriculture department) ~ waste to be processed garden and parks ~10 ton[17] @15,00,000 initial fixed cost (land, construction, preparation, machinery and storage) @operation cost @ INR 7,000 per ton/ month= (raw materials, worm culture, water, equipment, utilities, admin)	30,00,000
4	Installation and operation of Rotary drum composter at the Shyam Chak site. **Pilot With 1 drum** to process ~ 20 ton of waste	2,58,40,000

[17] https://www.kviconline.gov.in/pmegp/pmegpweb/docs/commonprojectprofile/Vermicompost.pdf

	CAPEX @ Rs 2.5 cr per drum to process ~20 ton of waste[18] Operation cost ~ 2.5 lac / 3 lakh per month	
5	Land development cost	1,00,00,000
6	Deployment of staff (technical + storage) (10 staff @ 15,000 pm x 12)	18,00,000
7	Operational cost (~5%)	17,42,900
	Total	**3,96,00,900**

7.3 Cost estimate- GIS based inventory for water body and assessment based on UWD tool

Item	Components	Amount (In INR)
	Capex cost:	
1	Water body mapping and creation of GIS based database (city map, with satellite imagery, secondary sources- WRD, Water census with specified attributes)	1,50,000
2	Primary- Water quality testing for ~12 water bodies in Chapra (primary) (for Uwd tool) - GPS tracker - DO meter - pH meter - Other water quality testing apparatus	1,20,000
3	Integration into the UWD tool**/ Central Dashboard for monitoring	2,00,000
4	Integration into a mobile app - SMS alerts to the nodal officer/ Collector if the water quality level drop	10,000
5	Integration with the Water quality dashboard and testing (intervention 5.2.3.1)	3,00,000
6	Installation of signages and boards at every water body	3,60,000
	Operational cost	
7	Agency fee (every quarter- 4 time a year)	8,00,000
8	Maintenance fee	5,00,000
9	Contingency/ Reserved fund	2,00,000
	TOTAL	**26,40,000**

[18] SBM Urban, Advisory on decentralised composting

7.4 Cost estimate for Rejuvenation of Rajendra Pokhra

S.No	Item	Unit	Quantity	Rate (NPR)	Cost (NPR)	Notes
Path and Surrounding Areas						
1	**Compound Wall with Creepers**	meters	523	2,200[19]	1,150,600	Bihar BCD SOR (brick masonry + plaster + trellis)
2	**Jogging track/ walkway**	Sqm	1483	700[20]	1,038,100	Bihar BCD SOR (paver blocks on Sand Bed)
3	**Sensory path**	meters	115	800[21]	9200	Compact path for access and O&M with stone edging at critical points.
4	**Street Lights @ every 10m**	No.	39	18,000[22]	702,000	Basic solar LED park lights for safety and visibility.
5	**Benches @ every 15m**	No.	24	20,000[23]	480,000	RCC/metal benches at key viewing and rest points.
6	**Waste bins**	No.	8	7000[24]	56,000	Paired dry–wet litter bins near entries and seating areas.
7	**Collection points for flowers & puja waste**	No.	1	6000[25]	6000	Simple masonry/metal receptacle to avoid direct dumping into water.
8	**Signage, IEC boards & pond rules display**	Lumpsum	1	35,000[26]	35,000	Awareness boards explaining functions and Do's/Don'ts.
9	**Trees to be planted on compound wall edge**	No.	80	517[27]	41,360	Mixed native trees including soil preparation and early maintenance.
10	**Yoga Decks (7.2m X 3.6m)**	No.	5	₹35,000[28]	175000	Municipal rate (RCC platform 7.2m x 3.6m)
11	**Small kiosks (2.5m X 1.5M)**	No.	4	60000[29]	240,000	Bihar BCD SOR 2023 (foundation, walls, roof slab, plastering)
12	**Kid's Play Area**	Sqm	400	2500[30]	1,000,000	Bihar SOR civil works plus market-rate play equipment
Water Spread Area						
13	**Floating treatment wetlands (FTWs)**	No.	3	30,000[31]	90,000	Low-cost bamboo/HDPE raft modules with macrophytes for in-situ polishing.

[19] https://www.scribd.com/document/667044219/BCD-SOR-2023

[20] https://www.scribd.com/document/667044219/BCD-SOR-2023

[21] https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf

[22] [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2O2425%20English(7June2024).pdf][4]

[23] https://www.tendertiger.co.in/global-keyword/chain-linked-fencing-tenders

[24] [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2O2425%20English(7June2024).pdf][4

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

[26] [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2O2425%20English(7June2024).pdf][4]

[27] https://www.cseindia.org/constructed-wetlands-wastewater-treatment-systems-6215

[28] https://www.civilshape.in/2024/05/bihar-bcd-sor-2024-updated-schedule-of-rates-by-building-construction-department-bihar.html

[29] https://www.scribd.com/document/667044219/BCD-SOR-2023

[30] https://www.scribd.com/document/781213310/PMC-Garden-2023-2024-Garden-Department-DSR

[31] https://www.indiawaterportal.org/governance-and-policy/governance/islands-float-delhi-lake

14	**Floating aerators (solar/electric)**	No.	3	90,000[32]	27,000	Small aerator to support dissolved oxygen and circulation in stagnant pockets.
15	**Immersion Tank**	Sqm	275	500[33]	137500	Base rates for RCC works, earthwork, plastering and waterproofing
Water Edge						
16	**Sloped embankment repair**	Sqm	695	800	556,000	Bihar BCD SOR (stone pitching 230mm)
	Sloped embankment vegetation	Sqm	3,550	250	887,500	Swachh Bharat Mission (grass planting)
17	**Repair & cleaning of existing ghat steps**	Lumpsum (Sqm)	1355	120	160,200	Patch repair, re-pointing and cleaning of existing steps.
18	**Stone/ gravel edge treatment**	meters	277	350	96950	Bihar BCD SOR (stone pitching 230mm)
19	**Total Annual CAPEX**	**6,888,410**				
Additional cost						
20	15% Contingency Cost	1033300				
21	10% reserved for events	688,900				
	Total Cost	**8,610,610**				

7.5 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 Chapra Nagar Nigam.
- 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 &	LS	1	8,00,000	8,00,000	Initial data collection, ULB consultations, secondary data	NMCG DPR inception norms https://nmcg.nic.in/writereaddata/fileupload/12_City%20SRTW

[32] https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf
[33] https://nmcg.nic.in/writereaddata/fileupload/43_MoM%2042nd%20EC.pdf

S. No.	Item	Unit	Quantity	Rate (INR)	Amount (INR)	Notes	Source
	stakeholder mapping					review on existing STPs and demands.	%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 km² 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 framework design	LS	1	5,00,000	5,00,000	Role clarity for Nagar Parishad, STP operators, user groups; pricing/incentive models.	NMCG policy development costs https://nmcg.nic.in/writereaddata/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

S. No.	Item	Unit	Quantity	Rate (INR)	Amount (INR)	Notes	Source
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

7.6 Cost Estimate for Ghat Connector – Revelganj to Gautam Sthan Ghat

S.No	Item	Unit	Quantity	Rate (NPR)	Cost (NPR)	Notes
N1- Revelganj Ghat						
1	Refurbishment of Ghat	Sqm	3760	6000[34]	22,560,000	Steps repair, paving, railings, lighting, landscaping
2	Multistory Ghat Structure	Sqm	384	6500	2,496,000	Includes 2 levels, flood resilience to HFL+2m, SS railings
3	Waste bins	No.	4	7000[35]	28,000	
4	Collection points for flowers & puja waste	No.	1	6000[36]	6000	
5	Compost pit (Natural ritual waste)	No.	1	35,000[37]	35,000	Brick-lined with aeration vents, sloped base for leachate, thatch roof
6	Signage	Lumpsum	2	35,000[38]	70,000	
Eco Park						
7	Trail	meters	2167	800[39]	1733600	Compact path for access and O&M with stone edging at critical points.
8	Native Vegetation/ Riparian Buffer	Sqm	104061	517[40]	53,799,537	Mixed native trees, shrubs and grasses including soil preparation and early maintenance.
9	Benches at every 25m	No.	86	20,000	1,720,000	
10	Interpretive Signages	No.	2	35000	70,000	
Commercial & Recreation Zone, N2						
11	Ghat with aarti deck	No.	2	16,00,000[41]	32,00,000	Includes foundation piles for flood-prone Ganga banks, SS

[34] https://affairscloud.com/nmcg-executive-committee-approved-9-projects-worth-rs-1278-crore-for-pollution-abatement-in-ganga-basin-and-ghat-development/

[35][https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC202425%20English(7June2024).pdf][4

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

[37] https://nmcg.nic.in/pdf/NMCG%20BOOKLET%20FILE.pdf

[38][https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC202425%20English(7June2024).pdf][4]

[39]https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf

[40] https://www.cseindia.org/constructed-wetlands-wastewater-treatment-systems-6215

[41] https://documents1.worldbank.org/curated/en/510601468252652037/pdf/SFG1326-EA-P119085-PUBLIC-Disclosed-8-28-2015-Box393194B.pdf

						railings, and ritual lighting
12	Food Kiosks and Public Amenities	Sqm	10,877	2,200	23,929,400	
13	Pedestrian Promenade	km	1.5	8000/m	12,000,000	
14	Sport's Court/ Play area, Outdoor Gym, Children's Play zone	Sqm	50,744	2500	1,26,860,000	
15	Native Vegetation	Sqm	71815	517	37,128,355	
16	Jetty	No.	1	300,000	300,000	12m concrete ramp (₹2.5 lakh/meter equivalent) including safety railings and edge protection
	Total Annual CAPEX	**155,846,892**				
Additional cost						
17	15% Contingency Cost	23,377,033				
	Total Cost	**179,223,925**				

7.7 Cost estimate for Upgradation of Tel River

S no	Item	Unit	Quantity	Rate (NPR)	Cost (NPR)	Notes
Zone 1- Recreational Zone						
1	Nature walk Trails	meters	980	1200	1,176,000	Bihar SOR (paver track 1.5m wide)
2	Children's Play Area/ Sport's Park	Sqm	3,480	2,500	8,700,000	Bihar SOR civil works plus market-rate play equipment
3	Shaded seating pockets every 50m	No.	20	4500	90000	Bench + tree shade (SBM rate)
4	Outdoor Gym	Sqm	840	1800	1512000	Multi-station equipment
5	Green Areas	Sqm	18,479	350	6,467,650	Turfing + shrubs (SBM)
6	Trash booms	No.	1	15,000	15,000	Fixed bar screen / trash rack to capture floating solids.

S no	Item	Unit	Quantity	Rate (NPR)	Cost (NPR)	Notes
7	Riparian Buffer with native Vegetation	Sqm	13,912	517	7,192,504	
Zone 2- Ecological Restoration						
8	Trash booms	No.	2	15,000	30,000	Fixed bar screen / trash rack to capture floating solids.
9	Floating Treatment Wetlands every 100m	No.	10	30,000	300,000	Low-cost bamboo/HDPE raft modules with macrophytes for in-situ polishing.
10	Biodiversity Zones	Sqm	41,262	600	24,757,200	Native Plantations +sand paths
11	Walking Trails with viewing decks	meters	815	2500	2,037,500	Elevated wooden decks
12	Non- Concrete Bund Walls	Meters	281	1800	505,800	Gabion/vegetated
13	Riparian Buffer with native vegetation	Sqm	6,424	517	3,321,208	
Zone 3- Economic Zone						
14	Riparian Buffer restoration with native vegetation	Sqm	24,348	517	12,587,916	
15	Edge Treatment	meters	1,110	350	388,500	Stone+Gravel Lining
16	Boat Landing	No.	1	2,50,000	2,50,000	Concrete ramp+Steps
Overall						
17	Soft River Boundary	meters	2500	800	2,000,000	Bamboo Crib wall
18	**Total Annual CAPEX**	**71,081,278**				
Additional cost						
19	15% Contingency Cost	10,662,191				
	Total Cost	**81,743,469**				

7.8 Cost estimate for River based sensitisation program

No	Item	Budget (yearly)
1	Citizen awareness campaigns (*Designing and printing posters, venue arrangements, awards, certificates)* (1 every quarter)	2,00,000
2	Youth mobilization- *Organizing programs, clean-up drives and workshops in colleges/ Institutions/ communities. Reward with certificates* *(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	Reserved fund	10,00,000
	TOTAL	**31,40,000**

END OF REPORT