

Building Block for

Riverfront Development

Dr. Shyamli Singh Prof. Vinod K. Sharma

**GNAMAMI
GANGE**



सत्यमेव जयते



Handbook for Urban Local Bodies Officers

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An improvement in the framework for Nirmal Ganga would require the fullest cooperation from the public at large and generating greater awareness through dissemination of best practices from cities situated on river banks.

- Shri Narendra Modi





FOREWORD

The 74th Constitutional Amendment marks a landmark moment in India's realm of urban local self governance, creating urban local bodies (ULBs) constitutional entities with the authority to provide better governance and more effective delivery of civic services to communities.

It is therefore important for the states to devolve greater responsibility, power, and resources to the ULBs through the devolution of finances and officials envisioned in the Twelfth Schedule to the Constitution. Indian Institute of Public Administration, New Delhi has developed a complete training program under the project "Blended Capacity Building Programme for Stakeholders of River Ganga under Namami Gange ". The modules have been developed in a clear and easy-to-understand manner for the Urban Local Bodies Officers.

Though mostly based on missions of Namami Gange and state governing municipal administration, it lends itself to customization to meet the special needs of other states and river bodies. The modules cover a wide range of topics, including perspectives of ULBs, their constitution, and organisational structure, as well as comprehensive lessons on ULB working.

Amidst unparalleled economic growth and a rapidly increasing population, India is faced with a series of difficult decisions regarding its future. With a 7.4 percent average annual growth rate during the previous decade, the country will become the world's fourth largest economy in approximately two decades. As a result of growing urbanisation and resource scarcity, as well as high poverty levels, this hopeful outlook is not without its obstacles.

This module on Riverfront Development talks about gaps, needs and framework on introducing perspectives for urban local body officers. Further to bring a change in the city development dynamics for sustainable and economical efficiency. I am hopeful that this training module will significantly help to improve the skills of regulatory authorities across the country.

A handwritten signature in black ink, appearing to be 'S.N. Tripathi'.

S.N. Tripathi IAS (R)
Director General, IIPA

PREFACE

Cities and communities rely on rivers for survival. Several civilizations have grown up around rivers throughout antiquity. Harappa and Mohenjodaro civilizations arose around the Indus, Sutlej, and ancient Saraswati rivers. Civilization grew up around the Krishna, Kaveri, and Godavari rivers in the country's south. Rivers have traditionally been regarded as mothers for maintaining the lives of those who live along their banks. The Ganga Basin stretches for 2525 kilometres from its source and is home to 40% of India's population.

In today's world, Indian towns are expanding at an unprecedented rate, posing a threat to river health. The government is implementing a number of river cleaning programs, with a focus on the health and renewal of urban river systems.

The National Mission for Clean Ganga has made tremendous progress by launching a number of programmes and regulatory frameworks to assist state governments with integrated management. The project Blended Capacity Building for the stakeholders of river Ganga under Namami Gange Indian Institute of Public Administration, New Delhi has designed modules as a strategic step toward enhancing the ability of urban managers in cities. We are pleased to observe that the progress made in this direction has been chronicled as a step-by-step guide structure in these volumes. Team IIPA is confident that the module toolkit will motivate communities to reimagine their urban areas as part of the city's integrated vision and urban planning process. We look forward to collaborating with state governments and concerned citizens to protect these natural resources.

Vinod K. Sharma *Shyamli Singh*

Prof. Vinod K Sharma | Dr. Shyamli Singh
Faculty, IIPA

60%

reduction in per capita water availability from 200 levels by 2050

Ministry of water Resources

53,898
MLD

sewage generated in India

19,826
MLD

sewage treated

CPCB 2013

4.8

billion litres

sewage from 118 Ganga towns and cities flows into Ganga everyday

NMCG -2017

80%

sewage is untreated in India and flows directly into nation rivers

Centre of Science & Environment

10.8
million

people depend on riverine fishes in India

SANDARP 2012

Rivers

Complex gross landforms that drains surplus surface water and discharge into oceans/lakes and form an important component of hydrological cycle that regulates our climate and weather patterns.

Changes in the river systems have also been contributing to climate change .

Ganga at Rishikesh Triveni Ghat



What do river do?

During their course across the landmass, they give rise to a wide range of landforms that supports rich biodiversity and generate a wide range of ecological services. Without water there is no life on the planet and rivers are source of water for humans; great human civilizations were flourished along the rivers and also perished when the rivers were dead or degraded.



Riverfront development: A perception.....

Real estate developers

Riverfront development refers to development of housing complexes along the riverfront.

Tourist promoters

Riverfront development means setting up of tourist resorts along the riverfront

Industrialists

Riverfront development is the space available for setting up of industries, particularly power plants that require large quantity of water and discharge effluents

Urban planners

Riverfront development is the space available for the development of urban infrastructure and housing

Common Public

Riverfront development is a safe public space for engaging in social, cultural and economic activities alongside rivers

For some, the riverfront is the space outside the embankment of channel/natural levees of the river; for others it is upland close to the embankments of the river. According to NGT, It is outside the embankments of the river, i.e. outside the floodplains






From ecological point of view.....

The outcomes of riverfront development projects in India are ecological disasters/ beside the following adverse ecological and environmental impacts of riverfront development.

- 1 In the name of riverfront development, the rivers are trained and made to flow between two walls and all the floodplains area used for concretization.
- 2 Untreated sewage also destroys aquatic ecosystems, threatening human livelihoods, when the associated biological oxygen demand and nutrient loading deplete oxygen in the water to levels too low to sustain life. Yamuna River front at Vrindavan
- 3 Despite environmental regulations that protect the quality of streams, lakes, and wetlands, solid waste in the form of trash, litter, and garbage often ends up in the river waters. In urban areas, trash and litter (general terms for dry solid waste) often are transported by stormwater runoff. In both urban and rural areas, these items sometimes are illegally dumped directly into a waterbody or wetland, or deposited along riverbanks or lakeshores.



ROLE OF URBAN RIVERS

- 1 IMPROVEMENT IN AIR QUALITY** is likely to be observed due to denser vegetation and the transport of fresh air along the river corridor. 
- 2** Water bodies can have a cooling effect on their local area and so mitigate Urban Heat Island effect, ensuring **MICRO-CLIMATE REGULATION**. Also, wetlands and ponds that might be created through river restoration along with soils and vegetation can store carbon.
- 3** Through their contribution to surface water drainage and regulating flows, healthy river ecosystems can help **REDUCE SEVERITY AND INSTANCES OF URBAN FLOODING**. Restoring rivers, i.e. re-meandering them and establishing vegetation, creating wetlands, slows the flow and increases water storage capacity. 
- 4** River landscapes are one of the most attractive landscapes, and this **AESTHETIC QUALITY** provides many benefits by drawing people to the area.
- 5** A clean view of waterfront or greens adjacent to water can lead to significant **PROPERTY VALUE RISE**. With the continuous decrease in open spaces within cities, the value of available prominent ecosystem spaces also sees a positive impact.
- 6** A healthy river ecosystem also serves in **HABITAT PROVISION** for the aquatic, terrestrial as well as avifauna species. It is also a suitable habitat for riparian flora. River restoration has been shown to improve the quality of water and biodiversity habitat.
- 7** Depending on the characteristics of the catchment area, **GROUNDWATER RECHARGE** is usually observed within the river catchment zones
- 8** Reconnecting people to the natural environment can be achieved by restoring natural landscapes in urban settings and making them **ACCESSIBLE FOR RECREATIONAL AND CULTURAL ACTIVITIES**. This also increases the possibility to use them as educational resources, cultural/ traditional links, adventure activity areas, increased social activities, etc. 

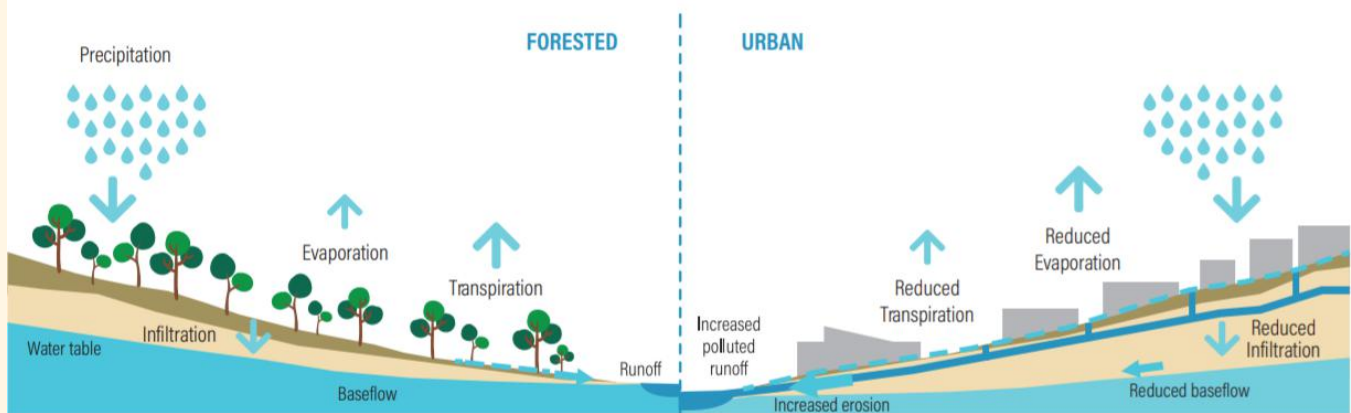
ROLE OF URBAN RIVERS

- 9 Landscapes with water are perceived as more restorative than those without. Water bodies have been found to be particularly significant in **IMPROVING MENTAL HEALTH AND WELLBEING** of people (by increasing happiness levels). They provide attractive stimulating features that have the ability to restore attentiveness and inspire creativity. Views of water and the sound of water have been shown to alleviate stress more effectively than other types of natural setting.
- 10 Urban rivers **ENSURE SOCIAL COHESION AND CITIZEN CONNECT**. The improved community participation at lively open spaces having active involvement of citizens, is likely to increase the social connections between people living in the area. A sense of ownership of these community spaces further ensures upkeep of these facilities by the community itself.
- 11 Rivers in an urban area also provide some indirect **ECONOMIC BENEFITS**. Improved sales - high quality environments lead to an increase in money spent in the local businesses and also encourage businesses to settle in that area Employment - settlement of businesses in an attractive area can increase the local employment rate



Today's urban riverfronts

In India, urban riverfront development has thus far been restricted to commanding and managing river waters, as well as exploiting floodplains for people's usage and convenience, as well as economic profits from real estate development. The Sabarmati riverfront development in Ahmedabad, which entailed a grey infrastructure-based development spanning a stretch of roughly 10 km, gave birth to the current concept of urban riverfront development in India.



Stormwater infiltration changes over undeveloped and developed areas. Image Credit: Melbourne Water

Several other urban riverside development proposals were approved as a result. The Godavari Riverfront Development Project in Maharashtra, the Patna Riverfront Development Project in Bihar, the Dravyavathi Riverfront Development Project in Rajasthan, the Gomti Riverfront Development Project in Lucknow, and other similar riverfront development projects across India are included in this list.

However, as more studies show the wide range of benefits of urban riverfront development projects, river management techniques have switched to river protection and degraded area restoration. Cities are increasingly recognising the benefits of natural river (course) biological services such as flood control, groundwater replenishment, and so on. Natural river functions (such as flood storage, water purification and supply, wildlife habitat, and safe fishing and enjoyment) are exceedingly expensive to rebuild if they are lost or damaged. The costs of reproducing these ecological services can be greatly reduced by incorporating river protection measures into URFDs.

Today's urban riverfronts

Today's urban riverfronts must provide a variety of services, including enjoyment, economic activity, and ecological purposes. When done correctly, urban revitalization along riverfronts can help communities rejuvenate core city areas and revitalise commercial and economic districts. Furthermore, individuals are increasingly demanding closer contact to rivers in order to enjoy biodiversity, participate in recreational activities, and learn about the cultural and natural history of rivers. The efforts to revitalise urban rivers are matched by fast development across the watershed, which affects water quality by increasing runoff and allowing untreated sewage to enter waterways. As a co-equal goal with economic and local regeneration activities, urban riverside developments must safeguard and promote river quality.



The above visual showing recently constructed riverfront area at Prayagraj

Evolution of waterfront development



PHASE I Emergence of waterfronts



Trading



Transportation



PHASE II Growth of waterfronts



City and settlements



Trading and manufacturing



PHASE III Decline of waterfront



Water industries



Non-water industries



PHASE IV Rediscovery of waterfronts



Stage I: Flood control development
(grey infrastructure)



Stage II: Parks and recreational development



Stage III: Ecological development

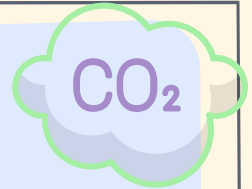
Evolution of waterfront development. Image adapted from (Redzuan & Latip, 2016)

Challenges for River Management in Cities

1 Restriction of natural/ storm water channels

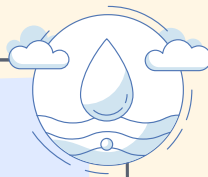
Rivers require room to carry out their natural duties, including acting as a sponge to avoid flooding. Unplanned construction and encroachment along riverbanks, on the other hand, have severely limited the natural channels in many communities.

2 Pollution



Pollution, unarguably, is one of the most severe concerns in Indian rivers, especially in the Ganga River Basin. Pollution from various sources- domestic sewage; industrial effluents; agricultural runoffs; solid waste dumping; among others - are taking a toll on the rivers

3 Over abstraction of water



As the rate of urbanization in cities increases, the stress on water resources to meet the rising demand also increases. In peri-urban areas, agricultural water demand particularly aggravates the situation. As a result, rivers and aquifers are fast depleting, causing changes in hydro-morphology and the natural hydrological regimes of water channels.

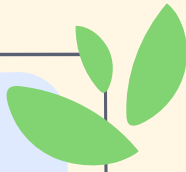
4 Degrading water bodies / wetlands

Lakes, ponds and wetlands are important features that help stabilize the groundwater levels, in addition to providing various social and environmental benefits. They serve as an important source for groundwater recharge, augmenting groundwater levels, and thereby reducing the stress on river water resources.

Challenges for River Management in Cities

5 Depleting green cover

Green cover is very important from a river management point of view. On riverbanks, it serves as an erosion control mechanism. In other areas, it helps augment groundwater levels, and provides a habitat for biodiversity to thrive. Unfortunately, the cities today have been trapped in a vicious green-grey debate



6 Weak citizen-river connect

Citizen-river connect is very important to establish the identity of the river, giving it a societal value. This value helps inculcate a sense of ownership of the river among the residents, which is beneficial in the long run. While this is still prevalent in some cities, somehow many cities (especially larger cities) have lost their connect with the river

7 Piecemeal governance

Holistic river management requires concerted and coordinated efforts from diverse government agencies related to irrigation and flood control, groundwater, pollution control, tourism, public works, horticulture, forestry, and others. Unfortunately, in most cities there is hardly any communication and coordination among these stakeholders, which leads to a "silos" approach of management.

8 Vulnerability to climate change

Water bodies and water channels are vulnerable to rising temperatures and fluctuating precipitation levels. Due to anthropogenic factors, the frequency and intensity of these changes in climatic conditions and extreme weather events have increased. This has a tendency to increase the risk of catastrophic floods, increased droughts, etc...



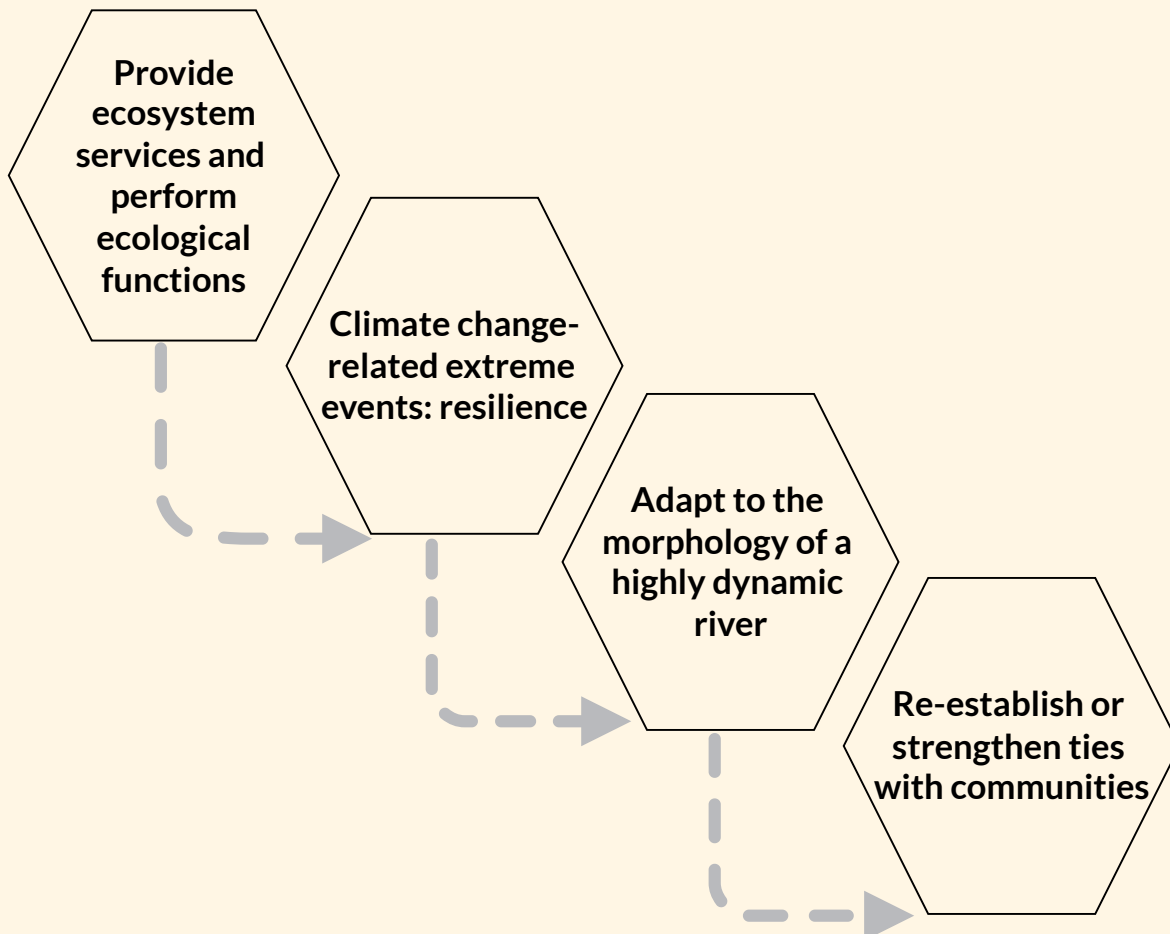
Principles of Ecologically Sound Riverfront

This section below is derived extensively from “Ecological Riverfront Design: Restoring Rivers, Connecting Communities by Betsy Otto, K McCormick, and M Leccese of the American Planning Association” The following principles can be considered as guiding pillars or anchors to evolve guidance for urban river front development.

Changes in stream hydrology resulting from urbanization include the following (Caraco 2000):

- Increased peak discharges compared to predevelopment levels
- Increased volume of urban runoff produced by each storm
- Decreased time needed for runoff to reach the stream, particularly if extensive drainage improvements are made
- Increased frequency and severity of flooding
- Reduced streamflow during prolonged periods of dry weather due to reduced level of infiltration in the watershed
- Greater runoff velocity during storms due to the combined effects of higher peak discharges, rapid time of concentration, and the smoother hydraulic surfaces that occur as a result of development.

These principles are for the fundamental purpose of creating environmentally sound river front developments and lists the critical functions that the urban river front should perform in the context of intense and rapid urbanisation and climate change scenarios. To translate these guiding principles into planning and design strategies and actions on ground the planning objectives and design objectives mentioned below will be useful.



Principles of Ecologically Sound Riverfront

Planning objectives based on the guiding principles

Plan for a larger scale: Plan for a scale larger than the riverfront to include immediate microwatershed and integrating streams/rivulets flowing into the river

Use development regulations: Ensure spatial connectivity with city's open spaces
Provide for public access, connections, and recreational

Connect to green network: Provide for public access, connections, and recreational uses

Enable public access: Manage river resources which are directly accessed by communities through participatory stewardships

Participatory stewardship: Plan for a scale larger than the riverfront to include immediate micro watershed and integrating streams/rivulets flowing into the river

Formal management authority: Establish and formalise management bodies within the urban local body and community/neighbourhood

Design objectives based on the guiding principles

Unique characteristics: Demonstrate characteristics of the city's unique relationship to the river in the riverfront design

Pollution removal: Design for filter strip and gross pollutant traps at the city side of RFD

Low impact design: Adopt low impact design and construction measures like bio-engineering and landscape interventions to restore natural riparian

Non-structural alternatives: Use nonstructural alternatives to manage water resources

Reduce hardscape: Reduce hardscape within the RFD area

Manage stormwater: Manage stormwater on site and use nonstructural approach such as retention ponds, swales and wetlands

Inundation sinks: Design for inundation sinks to carry or hold any inundation from the river

Use development regulations: Ensure spatial connectivity with city's open spaces

Ghat design: Design ghats which are not continuously built along the banks at intervals

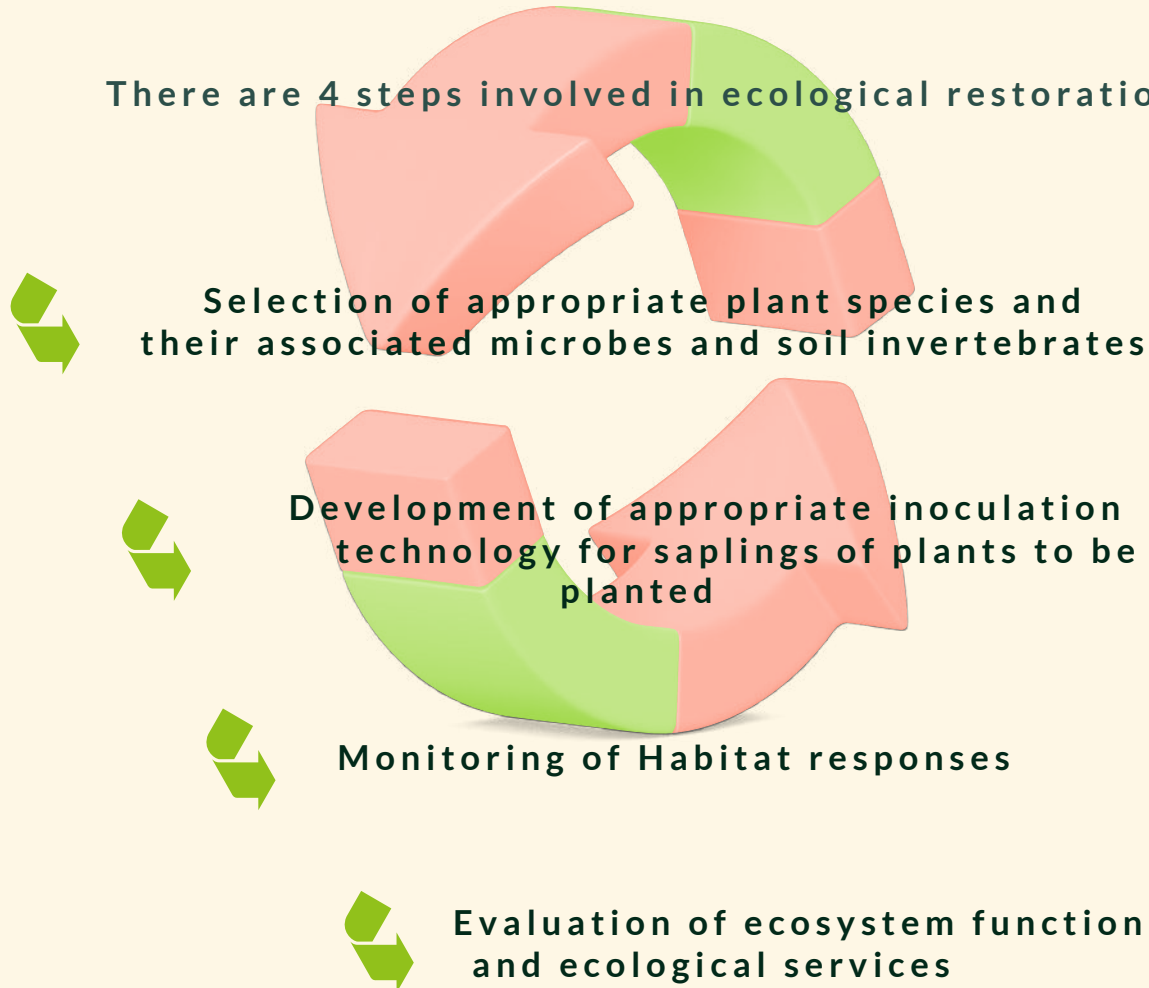
Natural and cultural history: Incorporate information about a river's natural resources and cultural history into the design of riverfront features, public art, and interpretive signs

Restrict river channelisation: Do not channelise the river at the RFD stretch by continuously running walls

WHAT IS ECOLOGICAL RESTORATION

Ecological Restoration refers to bringing back the dead or degraded ecosystem to its original state that will have biotic and abiotic threshold to make it function on sustainable basis.

There are 4 steps involved in ecological restoration



Any riverfront development activity must take into account the cognizance of ecological sensitivity of River Ecosystems.

This can be achieved by the development zone and river system zone. These buffers provide the ecological integrity and allows the sustainability of both the systems.

Urban River Management Plan

an integrated approach to manage the
river and its associated elements in a city
sustainably

*"a unique framework, first of its kind, attempting
river-centric urban management"*

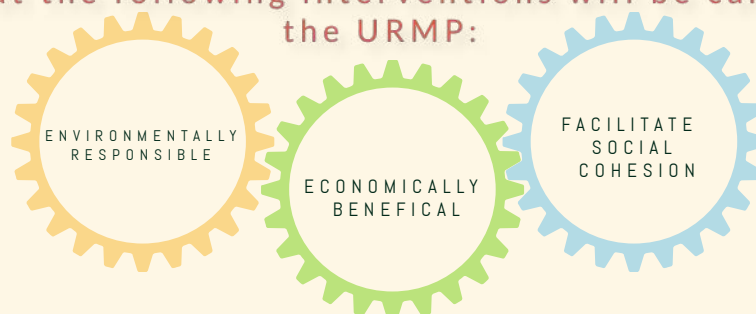
What is URMP?

It's a plan that takes a holistic and systematic approach to river management, addressing a wide range of issues.

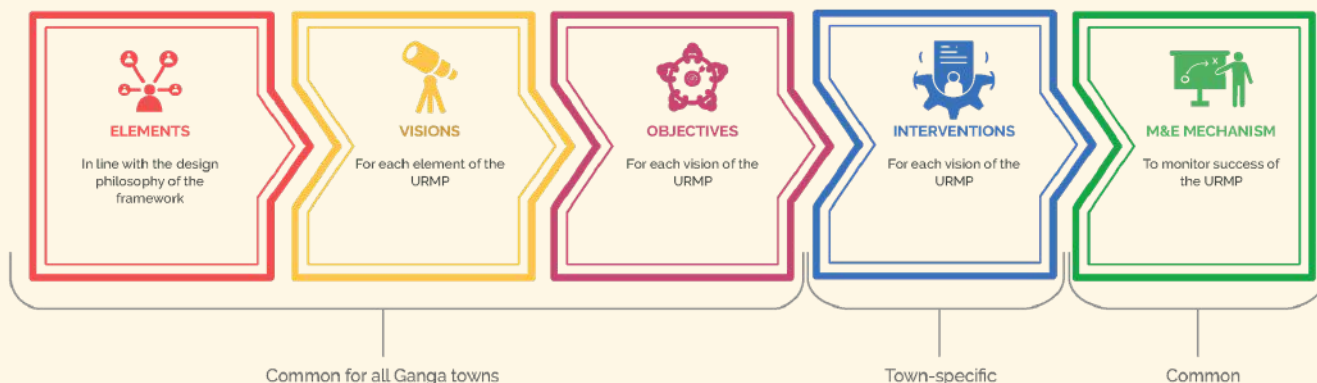
A group of seven IITs (Indian Institutes of Technology) was charged with developing the Ganga River Basin Management Plan and came up with the concept of URMP. According to the plan, all 97 Class 1 towns along the Ganga's main stem will establish their own URMPs.

This project has created a standard framework for the URMP to help these municipalities. The framework is remarkable in that, despite being generic, it captures features that are unique to each community. This is a groundbreaking piece of work in that it is the first time a framework (similar to a decision support system) for managing metropolitan regions within a basin has been devised.

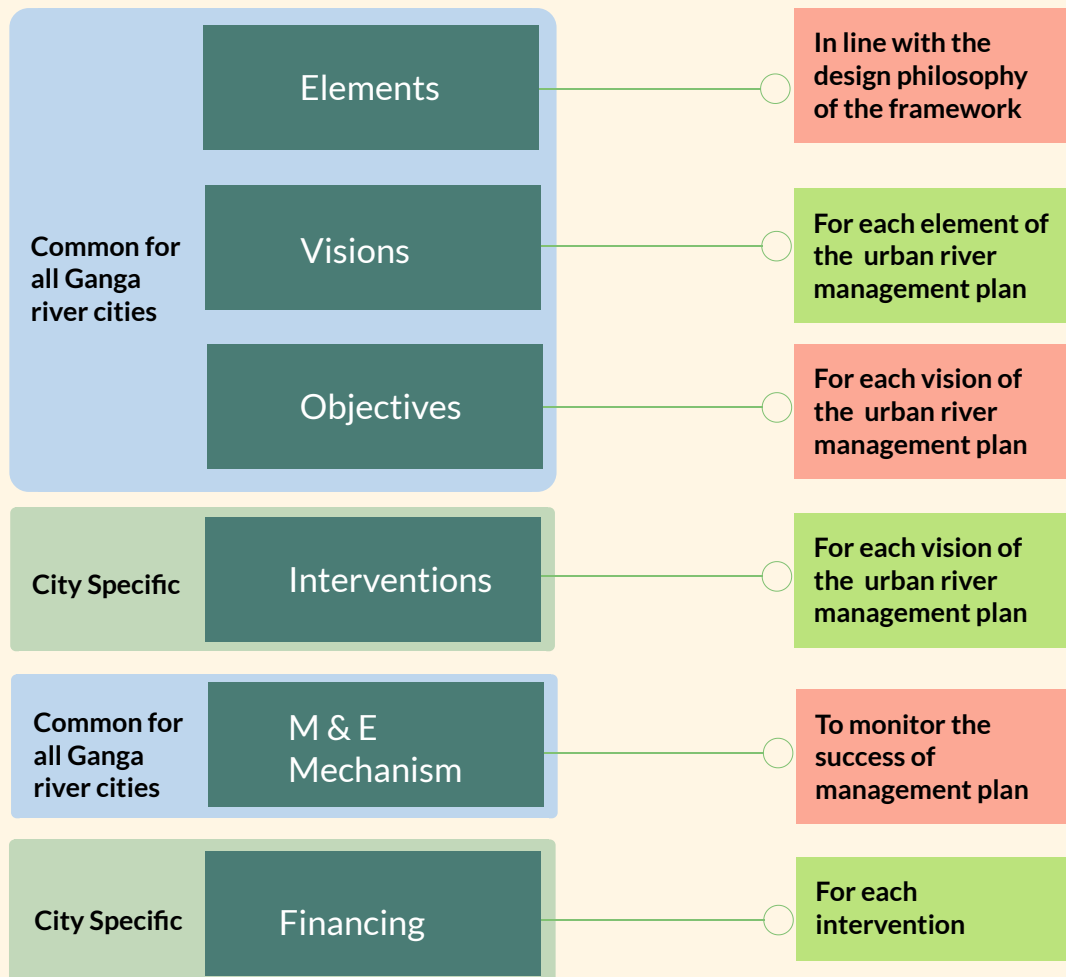
The URMP framework is built on the economic, social, and environmental pillars of sustainable development. As a result, it is anticipated that the following interventions will be carried out under the URMP:



This URMP framework is applicable in all river towns, with its generic half containing the elements, visions, aims, and M&E mechanism that are universal to all Ganga towns, and its town-specific part containing the interventions required to attain the objectives. In order to fulfil the common goals, these communities have the option to adopt relevant actions that suit their particular situation.



Overview of the Urban River Management Plan



The framework has two distinct parts as presented in Figure , represented by two colored boxes. The first, corresponding to blue boxes, is the generic part that is applicable to all river cities in the Ganga River Basin. This is so that all the river cities have common elements, visions, objectives, and a monitoring and evaluation (M&E) mechanism in order to ensure that all river cities act as interconnected units to collectively contribute to the overall basin-scale management of the river.

The second, corresponding to green boxes, is the city-specific part that comprises interventions and financing for the interventions. The purpose of this second part is to provide cities with the option to decide on the best possible interventions and as well as financing streams based on their local context and conditions.

Hence while all river cities have common objective, they have the flexibility to decide on the appropriate actions required to achieve the objectives.

The background image shows a wide river with a small boat in the foreground. The boat is green and red with a pink patterned canopy. A person is sitting in the boat. To the right, there is a stone structure with steps leading down to the water. The sky is clear and blue. A large, semi-transparent white circle is overlaid on the image, containing text.

River Sensitive Urban Planning

strategic guidance to help cities
mainstream river thinking into long-
term city planning

*"seeking a paradigm shift, with river-sensitive
urban planning"*

Mainstreaming River Management into a city's Master Plan

Currently, India's river-sensitive approach is understood in pieces, notably through River Basin Management Plans and short-term River Management and Development Projects.



However, in order to handle city-specific river concerns, the urban planning framework must be strengthened. In addition, any river city's long-term thinking must be reshaped to be more river-centric. This can be accomplished by including Urban River Management into the Master Plan of a city. This ensures that existing urban planning frameworks be leveraged rather than a new set of plans being created as a burden for these river cities. The primary concept is to put urban rivers at the centre of urban design.

WHY MASTER PLANS?



These are statutory instruments aimed at controlling, directing and promoting rational development of urban areas, while achieving maximum economic, social and aesthetic benefits.



These documents are prepared by organizations reporting to the state and rivers are a state subject. Thus the Urban River Management has a natural complementarity with the Master Plans of cities.



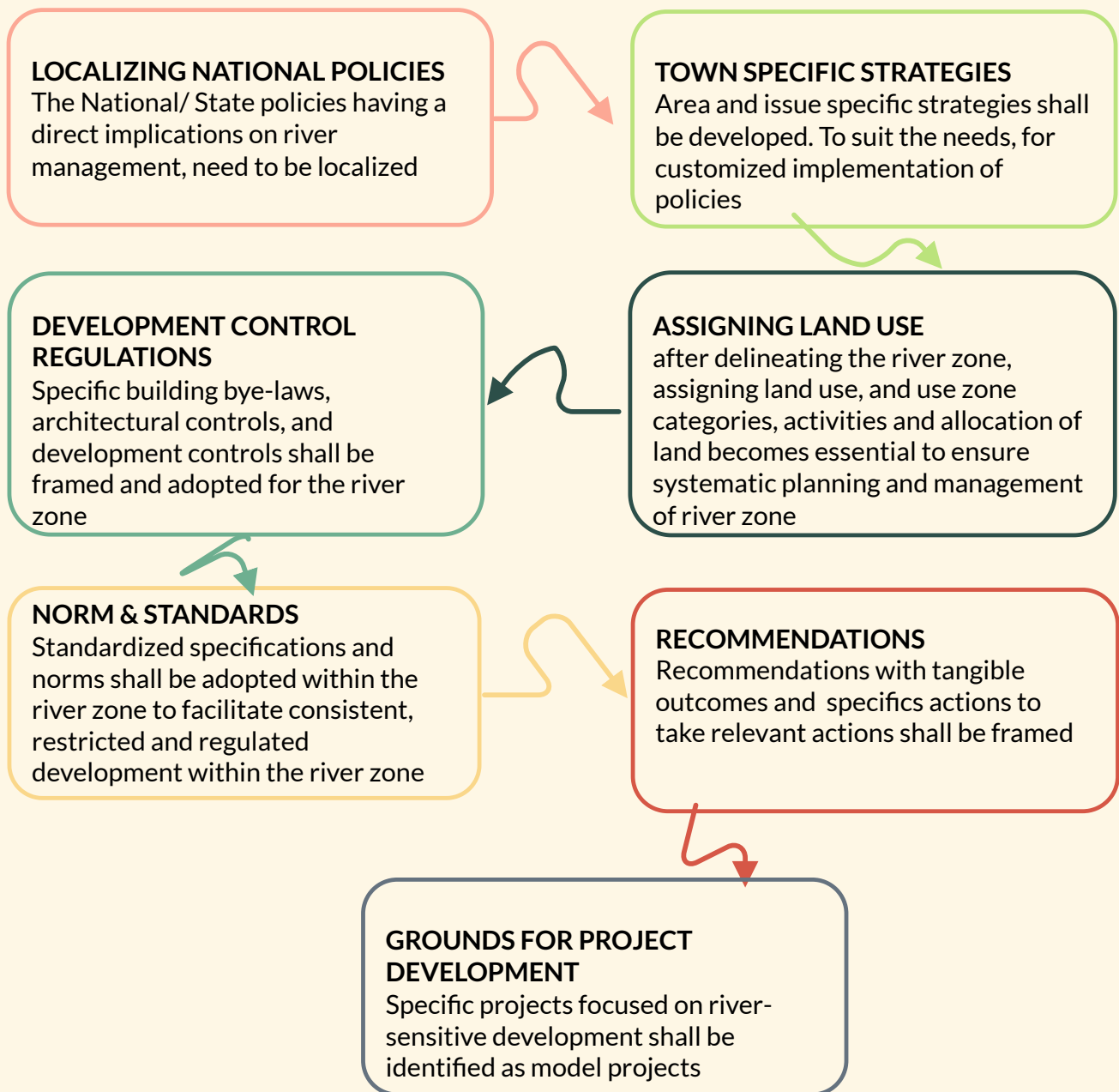
These are legally binding documents, having an enforcement mandate and a statutory backing, making the authorities accountable for their actions. Leveraging on these plans for river development initiatives would thus mean more action-oriented planning.



The scope of these documents entails the capability of resolving social/ economic/ cultural/ environmental conflicts, that is essential for restoring the wholesomeness of rivers within cities.

ROLE OF PLANNING TOOLS IN ADDRESSING URBAN RIVER MANAGEMENT

Using certain planning techniques to include river thinking into Master Plans is a good idea. Each city can properly generate individual solutions for their urban river concerns using these seven tools. These tools are an attempt to reflect on the planning methodologies that fall under the purview of Master Plans.



Existing Environmental and Social Regulatory Framework:

Polices and Regulations with influence on Riverfront Development

Currently, river management is not empowered by an Act or Policy that focuses on it exclusively. Having said that, there are several acts and policies aimed at regulating and managing many of the environmental and social components of a river system

Act/ Rules	Purpose	Applicability	Authority
2017 Jal Jeevan Mission (URBAN), 2021	This mission's primary objective is to provide universal coverage of water supply across 4,378 statutory towns in accordance with United Nations Sustainable Development Goal 6. This mission takes an integrated approach and recognizes that rejuvenation of water bodies and sustainable aquifer management will be critical to augment sustainable fresh water supply	Urban green spaces and sponge cities will mitigate flood impact and support development of urban water assets (surface and groundwater) through circular practices for recycle and recharge of treated wastewaters.	Ministry of Housing and Urban Affairs, urban local bodies
River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016	This order is for the purpose of effective abatement of pollution and rejuvenation, protection and management of the River Ganga, maintain ecological flows through its entire length, impose restrictions as required on industries and processes abutting River Ganga and to make provision for inspection of premises, plants, machinery, etc., to assess their impact on the river	This Order shall apply to the states comprising the River Ganga Basin and its tributary rivers and streams and will guide during plan, implementation and evaluation phases.	Ministry of Jal Shakti, State Ganga Basin Authorities
National Water Policy, 2012	The National Water Policy, 2012 is envisioned as a framework law that can support essential legislation on water governance at State and Union level. This law enshrines the value that water be considered as element that sustains life and ecology and not merely as a scarce resource that has to be divided among various competing uses.	Section 8 about Conservation of River Corridors, Water Bodies and Infrastructure' details the value of urban rivers. Section 8.2 elaborates: Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed. Restoration to the extent feasible should be undertaken and maintained properly.	Government of India, State governments, Ministry of Jal Shakti, Ministry of Housing and Urban Affairs

Act/ Rules	Purpose	Applicability	Authority
Environment (Protection) Act, 1986	To protect and improve overall environment	As all environmental notifications, rules and schedules are issued under this umbrella act.	Ministry of Environment, Forests and Climate Change, DoE, State Govt. Central Pollution Control Board, State Pollution Control Boards
Coastal Regulation Zone (CRZ) Notification 1991 (2011)	Protection of fragile coastal belts.	If project location is located along coastal belt.	-
Land Acquisition Act, 1894 (as amended)	Sets out rules for acquisition of land by government.	Applicable in case of acquisition of land.	Revenue Department, State Government
Environmental Impact Assessment Notification 14th Sep-2006 (as amended)	Mandatory environmental clearance to a certain category of new development activities following environmental impact assessment.	Applicable in case built up area of the project is more than 20,000 sq.m and the total construction area is more than 1,50,000 sq.m	State Pollution Control Boards, State Environment Impact Assessment Authority
Wildlife (Protection) Act, 1972	To protect wildlife in sanctuaries and national parks.	This act is applicable if any sanctuary/ national park exists within 10 km radius of project site. This act will be applicable, if there are any points of protected wildlife crossings in proximity to project locations like River Dolphin, which is a schedule-I animal.	Chief Conservator Wildlife, Wildlife Wing, State Forest Department, Ministry of Environment, Forests and Climate Change
Air (Prevention and Control of Pollution) Act, 1981	To control air pollution by controlling emission of air pollutants as per the prescribed standards	This act will be applicable during construction phase and may be applicable during operational phase (for e.g., if the project has any diesel generator set of more than 15 kVa capacity or a crematorium).	State Pollution Control Boards
Water Prevention and Control of Pollution) Act, 1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards.	This act will be applicable during construction phase and may be applicable during operational phase	State Pollution Control Boards
The Noise Pollution (Regulation and Control) Rules, 2000	The standards for noise for day and night have been promulgated by the MoEF&CC for various land uses.	This act will be applicable during construction phase.	State Pollution Control Boards
National Forest Policy, 1988	To maintain ecological stability through preservation and restoration of biological diversity.	This policy will be applicable if any eco-sensitive feature exists in and around the project.	Forest Department, State Government and Ministry of Environment, Forests and Climate Change
Central Motor Vehicle Act, 1988	To check vehicular air and noise pollution.	This policy will be applicable if any vehicles in and around the project.	Motor Vehicle Department



National River Conservation Directorate (NRCD)

Under MoEF&CC - the objective of NRCD is to improve the water quality of the rivers, which are the major water sources in the country, through the implementation of pollution abatement works (NRCD 2014)



National Green Tribunal (NGT)

A special judicial entity equipped with the necessary expertise to handle environmental disputes involving multi-disciplinary issues. They also have power to issue orders in cases where legalities and regulations are compromised or are not abided by individuals or entities including government agencies (NGT 2016)



City and Regional Land use plans and Building regulations

They are local-level development management mechanisms, under the purview of Development Authorities and the respective State-level Town Planning Departments along with the urban local bodies.

These land use regulations, building regulations and activity regulations have the greatest role in influencing the condition of the river and its watershed in the long-term.



Projects under SPVs and national Missions such as HRIDRAY, PRASAD, SMART CITY, AMRUT

These are the development plans and projects which target towns, cites, and tourist hubs/corridor, and religious hubs. If the location of these proposed projects are along or near a river these projects will need to look at river front development guidelines to inform their project proposals to avoid any conflict(HRIDAY, n.d.), (AMRUT, n.d.), (Ministry of Tourism 2016)

Monitoring and Evaluation

Monitoring and Evaluation (M&E) is a vital element of the URMP. It provides a mechanism to evaluate the progress of implementation of the URMP vis-à-vis its objectives.

The Monitoring and Evaluation mechanism shall be applied separately for every river flowing through the city.

Monitoring Indicators

The implementation of the URMP shall be monitored through 10 indicators, one for each objective of the URMP framework. These indicators shall collectively culminate into an index called Urban River Management Index (URMindex). The URMindex is measured on a scale from one to five, and is useful to paint a snap shot of the situation, which can be used to monitor the implementation of the URMP, and develop overall strategies and policies for enhancement. The interpretation of URMindex is presented in Table

URMindex	Interpretation	what it means
<1.5	Poor level of urban river management	The city is incapable of meeting the basic requirements for effective urban river management. The river is neglected and used indiscriminately without proper planning and management. There are serious concerns for all dimensions of urban river management.
1.6-2.5	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
2.6-3.5	Average level of urban river management	The city has a satisfactory urban river management system. However, some dimensions of urban river management are still a cause of concern
3.6-4.5	High level of urban river management	The city is well-placed with most of the dimensions of urban river management. The dimensions may not be at par with each other, but the overall situation is still nonetheless satisfactory.
4.6-5.0	Ideal level of urban river management	The city is an ideal example of urban river management. There are evidences of exemplary actions against every dimension of urban river management, suggesting that the plans and policies in regards to urban river management are working well.

Monitoring and Evaluation

The implementation of the riverfront projects shall be monitored through following 10 indicators;

Indicator 1: Floodplain management

Objective: To ensure adequate regulation of activities in the floodplain.

Indicator 2: Net Dissolved Oxygen (DO)

Objective: To keep the river free from pollution.

Indicator 3: Water body revival

Objective: To rejuvenate waterbodies and wetlands in the city

Indicator 4: Riparian buffer

Objective: To enhance the riparian buffer zone along river banks.

Indicator 5: Wastewater Reuse

Objective: To adopt increased reuse of treated wastewater

Indicator 6: Return flow

Objective: To ensure maximum good quality return flow from the city into the river.

Indicator 7: Eco-friendly riverfront

Objective: To develop eco-friendly riverfront projects.

Indicator 8: River economy

Objective: To leverage on the economic potential of the river

Indicator 9: Citizen sensitization

Objective: To inculcate river-sensitive behavior among citizens

Indicator 10: Citizen engagement

Objective: To engage citizens in river management activities

Calculating the URM index

Each indicator has a value between one and five. An average of all the indicators will yield the URMindex.

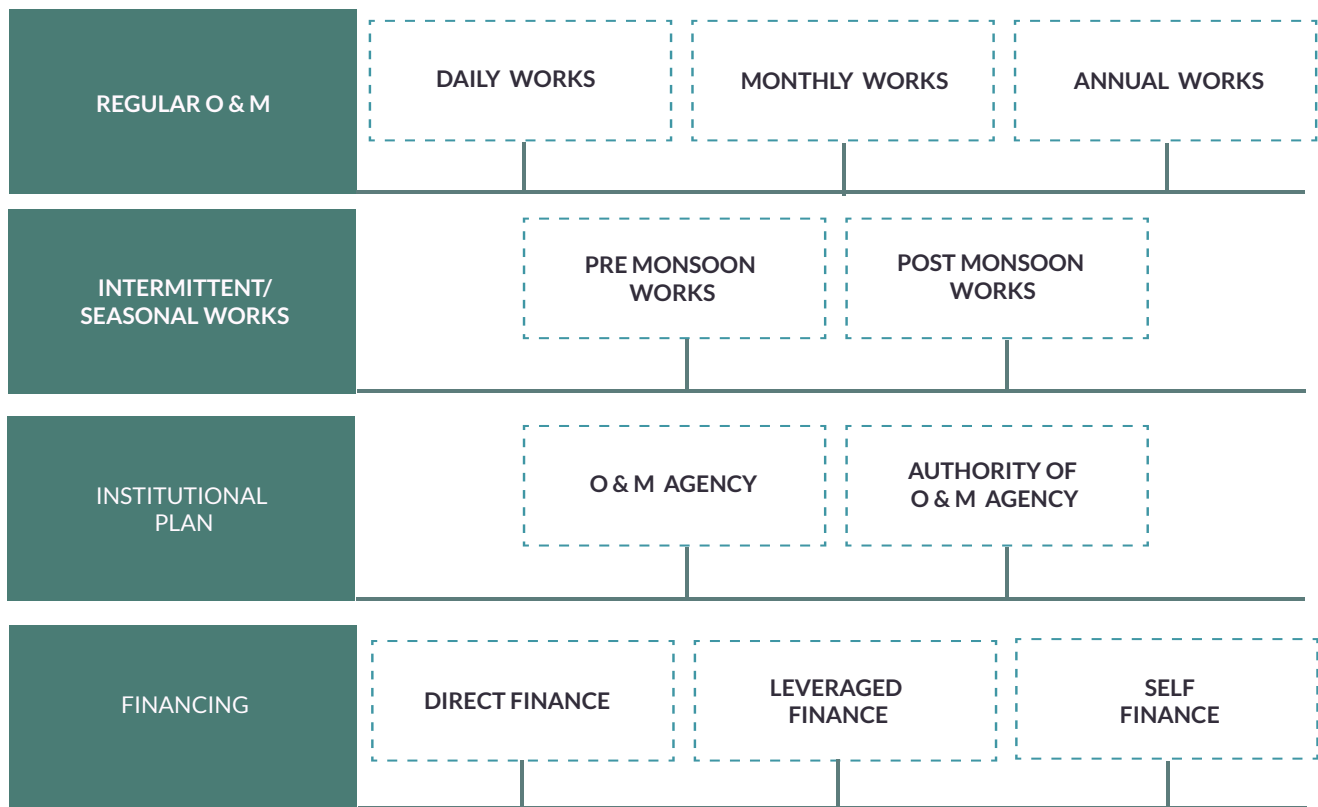
$$\text{URMindex} = (I1 + I2 + I3 + I4 + I5 + I6 + I7 + I8 + I9 + I10) / 10$$

From this calculation, it is apparent that each indicator has equal weightage in calculating the URMindex

Operation and Maintenance Framework

A successful urban riverside project will rely heavily on operations and maintenance (O&M). An O&M strategy should ideally be formed during the design and planning stages, so that design and construction facilitate O&M work later on and protocols are established early on in the project.

The O&M strategy must explicitly identify the responsible authority and provide protocols for routine (daily, monthly, and annual) maintenance. In addition, a specific set of rules for pre- and post-flooding activities must be followed to maintain the riverside development's long-term viability.



Alongside a pre-defined O&M plan, adequate and long-term funding must be allocated for O&M efforts. These funds must be allocated/ disbursed to the agency in charge of project management. There are multiple avenues from which funding can be ascertained and these can be divided into 3 categories:

- Direct Finance
- Leveraged Finance
- Self-financing

Operation and Maintenance Framework

DIRECT FINANCING:

All money handed directly to urban local bodies (ULBs) by state or national governments, or leveraged by ULBs through grants or loans to create urban infrastructure, shall be referred to as direct finance. Urban local governments might include construction and operating and maintenance costs in their budget forecasts alongside water and sanitation, roadways, and public health. The riverside projects would be considered another public-benefit initiative conducted by the ULB.

- ULB budget: money allocated by the local government in their annual budget for the URFD, which is treated as a public amenity akin to public roads or water supply and sewerage systems
- Grant or seed money: provided by initiatives such as Namami Gange/ SMART Cities/ AMRUT/ NRCD
- Loans: from infrastructure banks or development agencies

LEVERAGED FINANCING:

Given the growing challenges that ULBs face to secure financing for projects and for O&M, a range of innovative financial mechanisms have been attempted across cities. While most of these mechanisms are new to India, a few of them have been used to support infrastructure works such as city road improvements and water supply and sewerage projects. ULBs could look to these innovative mechanisms to leverage funds for O&M works. The financial tools are as follows:

- Municipal Bonds/ Green Infrastructure Bonds: wherein financially viable ULBs are able to tap into market capital by issuing bonds (Vaidya and Vaidya 2010)
- Tax Credit Programs: allows ULBs to raise capital by accepting contributions from private entities, usually businesses, and providing tax credits/ tax breaks to these entities in return Business Improvement Districts/ Community

SELF FINANCING:

Furthermore, ULBs executing riverside projects can seek to self-financing strategies to reduce their reliance on ULB budget volatility and/or external funding sources. Under self-financing systems, assets on the project site can be used to produce money. Rents on locations such as conference centres, auditoriums, and other venues, as well as advertising fees, are two possible self-financing techniques.

The background image shows a wide river with a wooden structure in the foreground. The structure consists of three vertical wooden poles of varying heights, connected at the base by a horizontal wooden beam. Three birds are perched on the top of the poles. The water is calm, reflecting the structure and the sky. In the distance, there is a shoreline with some buildings and trees. A large, semi-transparent circular graphic is overlaid on the image, containing the text.

RIVERFRONT DEVELOPMENT

*case
studies*

Case Study 01

Patna Riverfront Revitalization

Patna Riverfront Revitalization project is a *Public space and Landscape restoration initiative* at the Old City in Patna. Engaging a historic stretch along the river, the proposed development includes 6m wide promenade, 4 community, education and recreational public building, public toilets, change rooms, lifeguard and first aid, food kiosks, way-finding and upgraded network of access streets. Physically the ever-expansive urban settlements have lost the relevance and reverence of water along with a connection to the ebb and flow of the river systems.

Travel across Indian cities, you will find not only a disregard to this natural edge but also an exploitation – garbage dumping, toxic wastes and sewerage discharge. Their importance has been brought to fore by many environmental writers, activists and governmental schemes. The completed project has provided the much needed Public Space to the residents of the City (5 million population) with thousands using the walkway at various times daily. Close to 1 million people use the walkway and restored Ghats during the local festival of Chatt (Oct_Nov). The festival is based on the ancient tradition of nature worship with reverence to Sun and Water.



The continuum of pedestrian walkways along the Chandi Ghat of the Patna Riverfront Development, India. Photo by National Mission for Clean Ganga (NMCG)



The World Bank and National Mission for Clean Ganga/ NMCG and BUIDCO

Nilaa Architecture and Urban Design

The project benefits a population of 3 million persons in the riverine zone including Residents with new public space and health benefits, Fisherman with new toilets and improved boat mooring capacity, Low income communities have access to a new community hall and a new electric crematorium for the city. Additional benefits are attributed towards the 1 million religious tourists who visit for the Chatt festival in Oct- Nov for a week with improved access, safety, night lighting (festival ceremony happens at dawn) and way-finding. Night Lighting of the entire 7km edge has made the area safe and improved perception of residents. The improved public space provisions have greatly modified the perception of the Riverfront as a dangerous and dirty place. The project has reframed the public opinion about its natural heritage. Vegetable vendors (the majority who are women) are able to access supplies in boats and walk to the nearest vegetable mandi at Anta Ghat area next to the Patna University. The development of Electric Crematoria (2 pyres with a capacity for 30 a day) at Gulvi Ghat will help in reducing the wood consumption and next it would give more burning facilities. The project also envisages to improve interceptor drains to capture the sewage getting directly disposed to Ganga from the building along the ghat and then finally dispose them off at a city sewer manual to divert the same to an STP. A total of 8 such interceptor drains are being constructed. Several national-level campaigns have been held at the project site including physical trash skimming of the water surface, creation of sewerage treatment plants along the river to manage the direct discharge of sewerage.

FEATURES

Edge, Paths and Connections

A new Civic Identity: Creating an active Urban Edge

Urban Typology and Heritage

Urban Architecture: Ghats

Urban Acupuncture: Buildings as an extension of ghat typology

Case Study 02

Sabarmati Riverfront Development

The city of Ahmedabad is defined by the banks of river Sabarmati. The land is about 200 hectares. It is one of the true cities across the world and this river became Ahmedabad's lifeline for centuries, as this was the only source of water but also provided with informal recreational space for the city. As time passed, the river was polluted by the flow of unrestricted waste from the industrial and domestic. This made it so difficult for the people living around the river. The Sabarmati riverfront development project has been under implementation since 1996, retaining walls provided on either side that are rigid which is used to support the soil laterally. Sabarmati is always been very important to the people in Ahmedabad as it was not just a source for drinking water but also a place for recreation, a place to gather, a place for the poor to build their homes, places for the Dhobis to earn an income, and a place to hold the traditional market. The concept and method proposed were to generate revenue, to prevent erosion of the river banks, and to reduce the burden on the government. This project doesn't just help with the protection from flooding but also with the reclamation of land. Since the Sabarmati river is seasonal, water is channeled into the river from the Narmada canal, this intersects the river. More than 80 percent of the land is used for all the free and public spaces. This area has a nice walkway and is the central part which connects to the various parts of the city. The place has a lot of lush greens which attracts people and this now becomes a space for people to have a nice evening walk.



Sabarmati riverfront development a tale of urban transformation India.
Source: www.re-thinkingthefuture.com



Sabarmati Riverfront Project among the most innovative in the world
 Source: www.narendramodi.in

**Sabarmati Riverfront
 Development
 Corporation Ltd.
 (SRFDCL)**

HCP design, planning,
 and management.

A well-organized Dhobi Ghats facilities for all the washermen incorporating about 168 formal washing spaces, state of art laundry campus and unique of its kind in the country, and a riverfront. They have provided a diaphragm wall which helps in aligning the smooth profile of the waterway and for the protection to retain earth and anchor slab used to anchor the diaphragm wall with RCC key to provide a walkway in the proximity of the waterbody. They have provided the existing bridges with pier protection which prevents the structure from being hit. They worked on the sewerage network to stop the flow of the sewage and keep the river clean. To prevent the untreated sewage flowing into the river, two sewage interceptor lines with the new pumping stations have been constructed along with the reclaimed spaces at the banks. Also made sure that the people working along for the projects have been relocated to “pucca” this is a solid structure made of brick, stone, concrete, or timber which are dwellings designed permanently. Diversion of sewage to the east and the west bank. The place was improved, environmental interceptor sewer system ensuring clean water in the river, retention of water in the river almost for a whole year. They also recharge the groundwater aquifers of the city. Plantation of about more than 20,000 trees and development of garden and parks and other green areas. They also celebrate the kite festival and various other gatherings like cyclotrons, marathons, Navaratri festivals, and more. The city and the river with time have developed. All the illegal housing in the flood-prone areas has now been shifted to formal housing under the direct supervision of the high court of Gujarat. This project is self-financial and cost-effective; they have tried and made this as sustainable as possible. They also worked on the rehabilitation of the slums wherein more than 1000 families residing in the riverbed/ affected by the project. They are now safe from the flood-prone areas and have a better life which improves the social and economic well-being of them.

FEATURES

- Reclaiming land and building flood protection wall
- Improving access to river
- Building public promenades, gardens and playfield
- Building public facilities and financing the project

Case Study 03

Yamuna Biodiversity Park

The Yamuna Biodiversity Park, which has become the capital's most visited public space and a prominent centre for learning and understanding the environment, is home to a diverse range of forest communities, biologically rich wetlands, grassland communities, a wide range of fruit-bearing species, and an abundance of medicinal herbs. The Park also has natural flora and fauna that formerly existed but have since been extinct in the area. It also serves as a natural conservation site for a number of endangered species. The Yamuna Biodiversity Park is currently spread out over 457 acres in Wazirabad hamlet on the western bank of the Yamuna River.

The park is divided into two zones: a visiting zone and a nature reserve zone. The Domesticated Biodiversity Zone is a 220m southern and 140m northward segment of the Yamuna Biodiversity Park with a 20-30m width from the main access gate. It is surrounded by a poplar hedge and contains species such as Ailanthus, Butea, and Bauhinia, which provide year-round appeal due to their extended flowering periods. Multi-colored climbers like Jasmine and Quisqualis clasp the outer iron fencing, alluding to the same concept of unending luxury.



Deep Wetland area of Yamuna Biodiversity Park
Source: www.delhibiodiversityparks.org



Shallow Wetland area of Yamuna Biodiversity Park
Source: www.delhibiodiversityparks.org

Delhi Biodiversity
Foundation DDA

A Three snack shops, a drinking facility, and three resting areas are located near the main entrance, on the southward end, and are covered by native plant vines. A "Welcome Rock facet" just past the entry pocket on the right represents the Ganga and Yamuna's origins and merging at Allahabad.

The Bambusetum, the Nature Interpretation Centre, the Conservatory of Fruit-Bearing Species, the Migratory Duck Wetland, and the Nature Reserve area are all accessible along the route. On the left, the landscaping includes two shallow valleys that symbolise rangelands, as well as ten mounds that depict various ecosystems found from the Himalayan foothills (Siwaliks) across the Yamuna basin to the Yamuna-Ganga confluence. Rangeland 1 has an exclusive *Sporobolus diander* dominance, but Rangeland 2 has a variety of natural tropical grasses such *Dichanthium*, *Chrysopogon*, *Vetiveria*, and *Bothriochloa*. A serpentine trail runs between these two rangelands. Rangeland 1 is connected to the Herbal Garden, Sacred Grove, and Rangeland 2, while the opposite loop leads to the Butterfly Conservatory and Amphitheatre. On this circle track, one may encounter bouncing hares and have the opportunity to observe red-wattled lapwings and other grassland species. The Butterfly Conservatory's exit leads to the Sacred Grove and the Gene Bank of Petro- and Oil-yielding and other plants through the Bamboo Bridge, from which one can see the resident ducks' marsh and a variety of fish. The trail on the Welcome Rock Facet leads to the Nature interpretation Centre, a beautiful classical building with elegant lighting, a red carpet floor, attractive interior designs, panels depicting various biodiversity levels, touch screens, and visual-aids that provide an insight into the basic concepts of biodiversity.

FEATURES

Open-air laboratory for a range of students and researchers. Education on environment, sustainable development and conservation

opportunities for people to learn and adapt the ways and means by which they may live in harmony with nature

Positive impact on environment quality and conservation ethics



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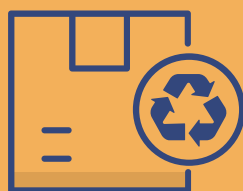
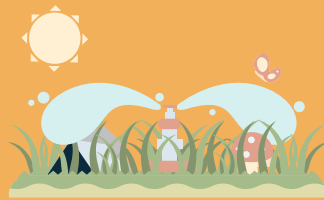
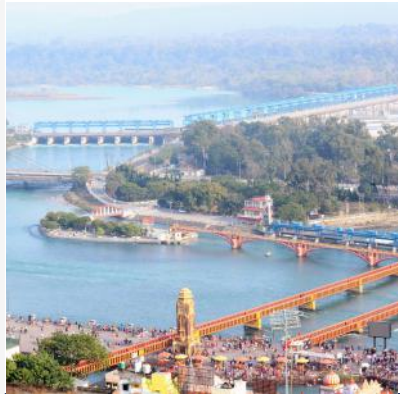
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