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## Working Paper

# Healthy urban rivers as a panacea to pandemic-related stress: How to manage urban rivers

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**ADB Working Paper Series**

**HEALTHY URBAN RIVERS AS A PANACEA  
TO PANDEMIC-RELATED STRESS:  
HOW TO MANAGE URBAN RIVERS**

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**Asian Development Bank Institute**

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**Abstract**

During the lockdown imposed due to the first wave of the coronavirus disease (COVID-19) pandemic, there were several media reports of citizens flouting the lockdown rules in the United States. Upon closer investigation it was found that the rules were flouted mostly so that people could spend time outdoors in natural environments. This exemplifies the role of the natural environment as a panacea to the mental stress created by pandemics. River ecosystems are perhaps the greatest natural feature of any city. Efficient management of urban rivers, therefore, is strongly correlated to crisis management during pandemics like COVID-19.

However, urban rivers, today, are facing multiple challenges, such as river pollution, drying up of river stretches, encroachment of rivers into floodplains, and biodiversity losses. These can be attributed to the various urban development activities, due to which cities have inadvertently short-changed the rivers. Managing an urban river, especially a degraded one, requires several transformational solutions that may have to be implemented over long and sustained periods in order to reap the optimal benefits. Many such solutions are often started with great enthusiasm but get derailed over time because of the lack of a long-term institutional mechanism required to support the overall outcome. A Master Plan is a good instrument to address this challenge.

This paper describes a set of tools and avenues within Master Plans that can be used to address typical river-related challenges in Indian cities. It also showcases the example of the Urban River Management Plan for Kanpur city, where these tools and avenues have been used to inform the Master Plan of the city.

**Keywords:** master plans, governance, India, pandemic, planning, pollution, urban rivers

**JEL Classification:** I12, R11, Q53, Q56

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## 1. INTRODUCTION

In 2018–2019, the coronavirus disease (COVID-19) pandemic literally brought the world to a standstill. The rate at which the pandemic spread prompted many governments across the world to impose stringent lockdowns, including curfew-like situations (e.g., India). Given the uncertainty of the damage that the pandemic would cause, and that there was no immediate cure at hand, the initial response of citizens was to religiously follow the lockdown rules. However, over time, when there seemed to be no clear way forward, there were several media reports of citizens flouting the lockdown rules. In the United States, upon closer investigation, it was found that the rules were flouted mostly so that people could spend time outdoors in natural environments, such as hiking in forests or taking a stroll beside a river. Bustamante et al. (2022) highlighted that among urban residents, depression and anxiety were inversely associated with the number of neighborhood parks. Their analysis in the United States revealed that diverse engagement in green spaces boosted physical, mental, and social well-being. In the United Kingdom (UK), Cui et al. (2022) reported that public parks and gardens were most frequently visited during the lockdown period. A similar situation was found in India as well. Bherwani et al. (2021) suggested that access to urban open and green spaces with suitable precautionary measures such as social distancing and personal hygiene would have improved individuals' resilience during the pandemic.

Literature is, thus, abound with examples that exemplify the role of the natural environment as a panacea to the mental stress created by pandemics such as COVID-19. River ecosystems are perhaps the greatest natural feature of any city. The rate of disease outbreaks (including pandemics) is likely to increase because of climate change (Stewart-Ibara 2022; Alcayna et al. 2022; Pley et al. 2021; Sadeghieh et al. 2021, among others). Hence, the efficient management of urban rivers, therefore, is strongly correlated to crisis management during pandemics and outbreaks of diseases like COVID-19. However, the state of urban rivers in many countries, especially the developing world, is declining because of development pressures. Reversing this trend through long-term management approaches is vital to ensure that urban rivers continue to offer an avenue for the alleviation of pandemic-induced stress.

Historically, rivers have been widely considered the cradle of civilization. They have been at the center of human settlements, mostly because the availability of water for drinking, agriculture, navigation, and other basic requirements. Almost all the great civilizations developed and flourished along rivers. These include the Mesopotamian civilization along the Tigris and Euphrates Rivers, the Egyptian civilization along the Nile River, the ancient Chinese civilization along the Yangtze River, and the Indus Valley civilization along the Indus River. It made good sense for these civilizations to settle along the banks of rivers. After all, at that time, agriculture was the primary form of activity for sustenance, for which water from rivers was a vital requisite. Gradually, the river became the heart of all domestic, economic, social, cultural, and religious activities in these civilizations. The situation changed with improvements in technology, and it became possible to transport water to locations away from the rivers through structures like canals and aqueducts, something that the Roman civilization demonstrated impressively. Somewhere down the line, the options of livelihoods also changed. With the advent of the iron age and the bronze age, river-based livelihoods began to take a backseat. All these factors somehow led to the estrangement of rivers and cities, which is evident in so many places even today.

Cities and rivers are interdependent on each other in various ways. In addition to several social and religious advantages, rivers provide cities with a wide range of ecosystem services that in turn provide a means of sustenance for many people. Some of these ecosystem services include assured water supply for residential, commercial, and agricultural uses; riverine resources such as fish; flood mitigation; carbon sequestration; etc. (Li et al. 2022; Basak et al. 2021; Kaiser et al. 2020; etc.). However, it is equally important for cities to follow good practices for rivers to maintain their natural profile and character and to be able to continue to provide ecosystem services. While rivers have upheld their role in this relationship, cities have not always been able to keep up with their responsibilities. This can lead to the indiscriminate exploitation of rivers, without any thought for their carrying capacity.

Rivers, today, are facing multiple challenges, such as river pollution, drying up of river stretches, encroachment of rivers into floodplains, and biodiversity losses. These can be attributed to various urban development activities, due to which cities have inadvertently short-changed the rivers (e.g., Yin et al. [2021]). For instance, a small stretch of 22 km of the Yamuna River in Delhi contributes to 70% of the total pollution in the river (Patel et al. 2020). Similarly, the last 120 km long stretch of the River Sabarmati, before its confluence with the Arabian Sea, consists of only liquid waste and sewage from the industries in Ahmedabad and other nearby towns.

Thus, it is evident that the health of a city is interdependent on the health of its rivers. It is, therefore, imperative that cities must incorporate the rivers in their development plans, ensuring that their natural properties and functions are not disturbed. This will benefit the rivers in the long term and help in extracting their optimal advantages socially, economically, and sustainably.

## **2. CHALLENGES FOR RIVER MANAGEMENT IN INDIAN CITIES**

### **2.1 Urban Flooding because of the Restriction of Natural/Storm Water Channels**

The restriction of river channels and natural drains is mostly due to encroachment caused by extensive development within the floodplains. This is a classic problem found in many Indian cities. What happens when a water channel is encroached? A river needs some space to spread laterally as it flows for it to perform its natural functions. There are several functions, but the most relevant one in the context of this paper is the regulation of fluvial flooding. When cities attempt to encroach this lateral space, also called floodplains, the ability of the river to regulate flooding is severely compromised. This usually results in a loss of both life and property. Furthermore, channelization and excessive concretization in the river zone confine the river, which disturbs the entire geomorphology and ecology of the river.

### **2.2 Pollution**

Pollution is perhaps the most severe concern for Indian rivers. Pollution from various sources, be it domestic sewage, industrial effluents, agricultural runoffs, or solid waste dumping, is taking a toll on the rivers (Patel et al. 2020). Floral offerings and waste generated by religious activities add to the problem. In many cases, large stretches of rivers have literally turned into flowing sewers. As cities heavily depend on these rivers,

river pollution poses serious health issues. More importantly it is not just rivers but the entire riparian ecosystem that is heavily affected.

### **2.3 Over-Abstraction of Water**

As cities grow, they need more water to meet the various demands. The problem is that in the quest to satisfy these demands, cities often bite the hand that feeds them. In other words, they indiscriminately exploit rivers and underground aquifers to the point where these resources become critically endangered. In some cases, irreversible damages are caused leading to undesirable changes in the hydro-morphology and the natural hydrological regimes of the water channels.

### **2.4 Degrading Lakes, Ponds, and Wetlands**

Water bodies such as lakes, ponds, and wetlands not only offer social and environmental benefits but also help in maintaining groundwater levels. They are an important source for groundwater recharge, supplementing groundwater levels and, thus, reducing the stress on rivers. However, pollution and encroachment has led to their dilapidation in many cities (e.g. Neelavannan et al. [2022]; Kumar et al. [2018]). Increasing urbanization has negatively impacted these already vulnerable ecosystems. It has resulted in a decline in the number of catchment basins, depletion in the water quality, and loss of natural flora and fauna.

### **2.5 Depleting Green Cover**

Green cover is critical vis-a-vis the management of rivers. It helps in preventing the erosion of riverbanks as well as augmenting groundwater levels. Moreover, it serves as a thriving habitat for biodiversity. Unfortunately, this green cover is depleting due to the vicious green-gray debate in cities and the ever-increasing built-up spaces (e.g., Dinda et al. [2021]).

### **2.6 Weak Citizen-River Connect**

In the early days, rivers were the epicenter of society with regard to religion, culture, recreation, and livelihoods. The connection between citizens and rivers is imperative to provide an identity for the rivers, assigning them a societal value. It infuses a sense of ownership of the rivers in the citizens, with several long-term benefits. This citizen-river connect is still strong in some cities; however, large cities seem to have lost this connect.

### **2.7 Piecemeal Governance**

It is important for various government agencies, such as pollution control, irrigation and flood control, groundwater, forestry, horticulture, public works, and tourism, to coordinate and work in tandem with each other for the holistic management of rivers. Similarly, NGOs, religious bodies, citizen groups, and other non-state actors must also contribute to the same. Regrettably, there is a severe lack of coordination and communication among these stakeholders, who display a “silos” mentality.



## 2.8 Vulnerability to Climate Change

Climate change has undoubtedly affected water bodies and water channels. Increasing temperatures, varying levels of precipitation, and extreme weather events have increased the risk of floods, droughts, and cyclones. This has led to the drying up of several streams and a surge in waterborne diseases. Therefore, climate resilience must play a critical role in urban river planning.

## 3. SIGNIFICANCE OF MASTER PLANS FOR URBAN RIVERS IN INDIA

A Master Plan is a dynamic long-term planning document that provides a conceptual layout to guide the future growth and development of a city. It can play an important role in determining the shape of the urban environment.

Restoration of riverine ecosystems in cities is a complex, multi-sectoral, multi-stakeholder, and multi-disciplinary endeavor. Most of the time, cities display a reactive attitude for the restoration of ecosystems, which means acting after the problem has already occurred. However, in the urban context, a proactive attitude is what is required, i.e., finding preventative measures for problems, beforehand. For this, the planning stage is the most feasible place to begin. River-sensitive urban planning is a panacea for most of the critical challenges faced by rivers and the most efficient way to restore the citizen-river connect. Asnake et al. (2021) argue that integrating river restoration initiatives into legislation, proclamations, urban planning practices, and other working documents is crucial for the long-term success of river restoration operations.

The following are the reasons why Master Plans are most relevant in this regard among the various plans implemented by the Indian system.

- Most of the issues faced by rivers can be attributed to the anthropogenic activities taking place in cities. Hence, the actions taken by cities are vital for the preservation and rejuvenation of rivers. Master Plans are developed for cities and outline the long-term strategy that a city aspires to take.
- The restoration of degraded rivers is not a quick process. It requires sustained efforts over a long period of time. Hence, Master Plans, which are typically designed for a 20–30-year period, are ideal solutions for the implementation of long-term actionable items aimed toward the management of rivers.
- The various stakeholders concerned with river management usually operate with a silo mentality. However, they need to work in a coordinated and concerted manner for the holistic management of rivers.
- A Master Plan is designed for the entire city and includes the various planning sectors. It has the ability and authority to bring together different agencies to work toward a common goal.
- The citizens of a city are encouraged to not only support but also have a say in the development of a Master Plan. This inculcates a sense of responsibility among citizens to protect and rejuvenate the rivers.
- Master Plans are legally binding, which makes the implementation of river-related interventions easier.

## **4. MASTER PLANS AND URBAN RIVER MANAGEMENT**

Conventionally, the Master Plans of cities have been primarily associated with land-use planning, making the connection between built and open spaces, social settings, and their surrounding environments. However, in recent years Master Plans have begun to move away from being a purely land-use based plan to emerge as a strategic enabler to influence the direction that a city will take to make it more vibrant, livable, and productive. For example, the Los Angeles General Plan (2035) has marked “Significant Ecological Areas” to conserve genetic and physical diversity within LA County by designating biological resource areas that can sustain themselves in the future. Kim et al. (2019) highlights the role of Master Plans in shaping a city’s thermal environment in the age of climate change. Likewise, the Andhra Pradesh Capital Region Perspective Plan (2050) talks about a shift toward renewable energy, green certifications for buildings, and zero waste philosophies, among other conventional content. From these examples, it is quite clear that the far-reaching implications of land use are finally being recognized, making it necessary to expand the role of a traditional, narrowly focused tool to encompass biodiversity, energy use, climate change, human health, food security, and water security.

### **4.1 Creating a Supporting Environment for River Consideration in Master Plans**

A precursor to integrating river consideration into a Master Plan is creating the required supporting environment through two aspects. The first is to clarify the ambition of the city in this regard by setting out a broad vision of how the city views its connect with the river, within the plan period. The second is to create a robust knowledge and information baseline of the river and its interaction with the city, which will help inform river-specific strategies. After creating this supporting environment, the Master Plan instruments and tools can be used to mainstream sustainable river health management into the city’s larger long- term vision.

#### **4.1.1 The Master Plan Vision for the River**

The first step in developing river-sensitive Master Plans for a city is to define and clarify the city’s vision for the river and how it perceives the river in its development landscape. This will help in creating value for the river in the Plan. As the adage goes, “What we value, we take care of.” Hence, creating value for the river sets the stage for river-specific considerations in the Plan, which can include aspects such as the management of water quality, provision of public access to the river to strengthen the citizen-river connect, protection of cultural values associated with the river, sustainable utilization of the river-tourism potential, management of risks associated with natural hazards, as well as conservation of the natural ecosystem. From experiences around the world, an ideal visioning exercise is thoroughly inclusive, reflecting the needs and aspirations of different stakeholders, particularly including those that have traditionally been side-lined and marginalized. This helps in making river management a “people’s mandate” and helps build collective ownership around river-related initiatives. For example, the Master Plan for New Orleans (2030) envisions New Orleans as “a city that celebrates its relationship with water and uses water-management strategies to provide amenities to neighborhoods wherever possible”.

It is also vital that the Master Plan acknowledges that an urban river stretch is a part of the larger river basin. Given that most river basins have some form of plans (e.g., a river basin management plan or integrated river management plan), it is crucial

for the planning strategies of the city Master Plans to forge synergies with these overarching plans.

#### 4.1.2 Developing the River Baseline

Developing a baseline for the river essentially involves ascertaining the “status quo” of the condition of the river, its interaction with the city, and its contextual setting within the region. The objective is to have a sound understanding of the ground reality—including the issues and challenges—which will then help in devising specific strategies to address the shortcomings. The regional context is particularly important because rivers do not follow administrative boundaries. Hence, a city which is located downstream may suffer from impacts caused by upstream cities. As part of the baseline preparation, such aspects that will help in identifying the relevant planning interventions need to be investigated thoroughly.

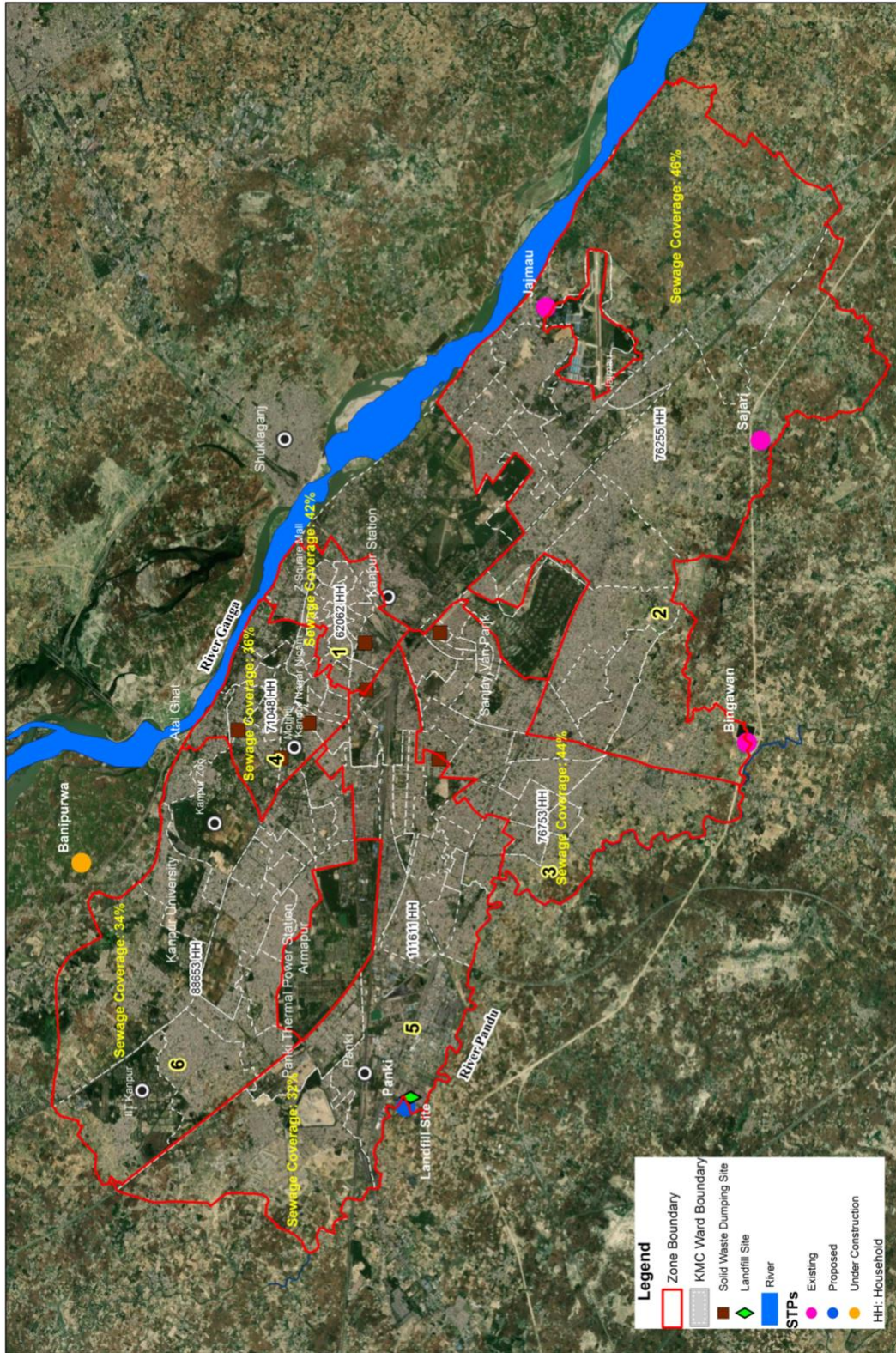
In addition to the regional context, it is also important to study the various urban sectors that have an impact on the river. These include sectors such as agriculture, industry, tourism, transport, water supply and wastewater management, and solid waste management, among others. This will help in understanding the interactions of the river with these sectors and highlight those aspects that would need to be addressed through the Master Plan.

Ideally, the contents of the river baseline should include the following aspects:

- Regional context: upstream implications for the river
- Physical features: length and direction of the river course (both current and historic); existing land cover adjacent to the river (ideally in 1 km on each side); width and depth of river, groundwater depth, soil type and condition; etc.
- Topography: contours, gradients, river zone delineation, floodplain delineation, drainage pattern in the city, etc.
- Demography: spatially disaggregated population density; location of unauthorized/slum settlements; demographic profile of the city; etc.
- Physical infrastructure: locations of sewerage infrastructure, sewered and non-sewered areas, community/public toilets, solid waste collection centers, water supply systems, sewage outfall, solid waste dumping sites; etc.
- Spatial planning: planning zones; ward boundaries; land use; use zones/use premise; etc.
- Stakeholder mapping: agencies involved with river management; functions and responsibilities of these agencies; ownership of land in the river zone
- Environmental assets: area and location of water bodies, forests, wetlands, parks, protected areas/eco-sensitive zones, flora, and fauna, etc.
- Social aspects: religious and cultural establishments, especially along the river; crematoria; dhobi ghats; boating locations; river-front access locations; other recreational areas; etc.
- Economy: details of water use sectors; river- related economy; etc.

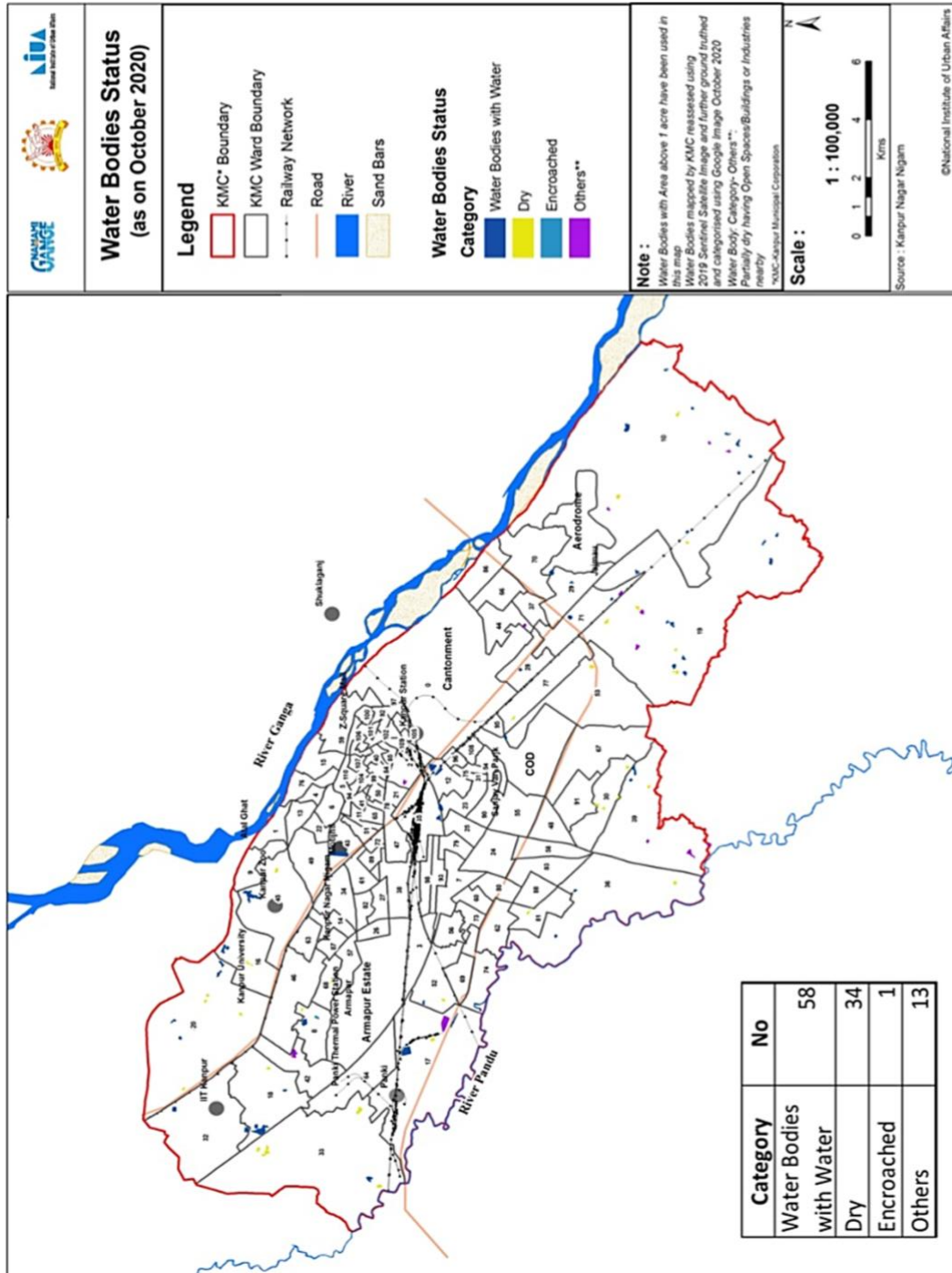
In line with contemporary needs, it is best to develop the baseline on a GIS platform to ensure that the baseline can be updated periodically and be made widely available on a digital platform to a wide range of stakeholders. For example, Figure 1 presents the baseline of the sewage and sanitation situation in the city of Kanpur, while Figure 2 presents the status of water bodies in the city.

Figure 1: Baseline for Sewage and Sanitation Management in Kanpur City, India



Source: NIUA and NMC (2021).

Figure 2: Baseline for Water Bodies in Kanpur City, India



Source: NIUA and NMCG (2021).

## 4.2 Master Plan Tools and Instruments for River Management

A city prepares its Master Plan once in 20–30 years, typically through an inclusive process. This Plan defines the development trajectory of the city, and includes those elements and features that are of most importance to the city. Given the significance of a river for a city, it is imperative that this is acknowledged in the Master Plan and is supported by strategies to integrate this significance in the overall development landscape. There are several planning instruments and tools within a Master Plan that can be used for this purpose.

This section highlights these tools, along with practical examples of how these have been used in the Urban River Management Plan for Kanpur City in India (which feeds into the draft Master Plan for Kanpur, 2041).

### 4.2.1 Localizing National Policies and Initiatives

Policies set the framework for directing development in line with the overall vision and objectives of the planning document. Strong planning policies ensure controlled development that is carefully designed without deteriorating the existing landscape while ensuring that the local needs are well addressed. The policies in turn lead to specific strategies and projects for different areas.

Several national and state policies in India have direct implications on river management aspects. Some of these allied policies/supporting policies include the National Policy on Faecal Sludge and Septage Management (2017, for sanitation waste management); Swachh Bharat Mission (2014, for toilets and solid waste management); Jal Shakti Abhiyaan (2019, for water bodies rejuvenation, water conservation, afforestation, and groundwater recharge); Draft National Forest Policy (2018, for forest management); Draft National Water Policy (2012, which has considerable river-related clauses); National Water Mission (2011, for climate change-related implications); Street Vendors Act (2014, for riverfront markets); Draft National River Policy (2011); and National Biodiversity Action Plan (2019); among others. The state-level interventions include the River Regulation Zone policy by different states.

The Master Plan should devise specific localized strategies for customized implementation of these policies at a city scale, wherever possible. For example, the National Water Policy (2012) advocates that “Conservation of rivers, river corridors, water bodies and infrastructure should be undertaken in a scientifically planned manner through community participation”. This policy direction may be directly adopted in Master Plans.

Likewise, the massively popular initiative called “Catch the Rain” under India’s National Water Mission propagates forward-looking reforms, such as large-scale rainwater harvesting, creating a GIS-based database of water bodies, preparation of scientific water conservation plans, and urban wastewater reuse, among others. Master Plans must leverage these progressive directions and align their strategies accordingly.

The Urban River Management Plan for Kanpur (2021) recommends the following directions from the various national plans and policies for the proposed Master Plan of Kanpur-41.

- Rainwater harvesting structures to be mandatory for all new construction with a plot area of 300 square meters or more.
- All existing groundwater users—commercial, industrial, infrastructural, and bulk users—to be charged based on the quantity used, for limiting its use.

- Prohibition on the pollution of ponds, rivers, wells etc.; ban on direct recharge from open areas into aquifers for pollution monitoring.
- Commercial, industrial, infrastructural, or bulk users withdrawing ground water above a determined threshold limit to be mandated to recycle water for purposes as may be suitable.
- Revival and rejuvenation of rivers, ponds, and wells, etc.

#### **4.2.2 Town-Specific Sectoral Strategies**

In addition to localizing national/state policies, cities may also consider developing their own policies/strategies that are not necessarily covered under other policy instruments. In such cases, a city has all the flexibility to decide on the nature, scope, and extent of these strategies in line with its indigenous requirements. Examples of such strategies include citizen engagement strategy, blue-green continuum strategy, and strategy for urban forestry, etc. A specific strategy for development of a riparian stretch all along the river (wherever possible) may form a part of the Master Plan as well. Likewise, given the urgent need to address climate change concerns, sectoral strategies could also include proliferating the use of ecosystem-based adaptation under the larger ambit of nature-based solutions in order to achieve the dual objective of river management as well as climate change adaptation.

The Urban River Management Plan for Kanpur (2021) advocates an elaborate strategy for enhancing the riparian buffer along both the rivers in the city (Ganga and Pandu) to be included in the proposed Master Plan for Kanpur-41. The strategy includes the following:

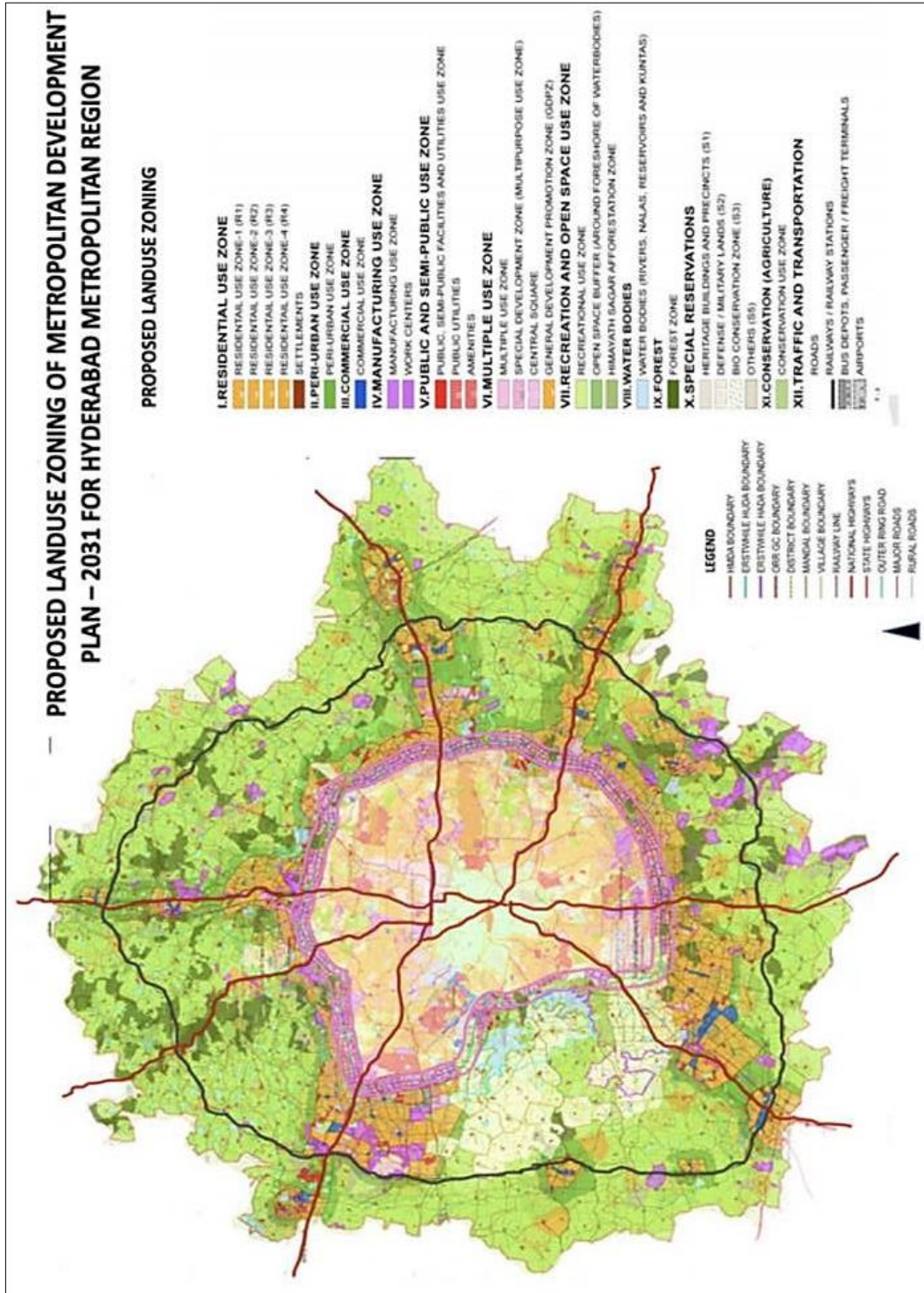
- Earmarking a fringe of 15–30 meters for the buffer, wherever possible
- Assigning an appropriate land use for the riparian buffer
- Clarifying land ownership in the buffers
- Direct the concerned agency to develop a riparian planting action plan using the native species, as per the profile shown below

#### **4.2.3 Land Use Assignment**

Land use planning has traditionally been the core function of the Master Plan. With improvement in knowledge about the tangible and intangible benefits that the environmental assets of a city can provide, it is important that the land use planning also reflects this. For example, the (Draft) National Land Utilization Policy (2013) states that “land is required for development of essential infrastructure and for urbanization, while at the same time there is also a need to protect land under environmentally sensitive zones and land which provides ecosystem services”. When it comes to river cities, spatial planning of the waterfront can directly help protect the ecological, amenity, economic and cultural values.

In almost all states of India, a Master Plan is a statutory land use plan, approved and adopted by the local authority, with precise and definite proposals notifying the way land parcels are affected. These Plans have enough control over land through various associated techniques like land acquisition, land pooling, land reservations, Transferable Development Rights (TDRs), and guided land developments, etc. These can direct the physical development of a city by ensuring the best possible use of each land parcel. For all river cities, the land use planning within the river’s zone of influence, without disturbing the natural ecology of the area, is of utmost importance.

Figure 3: Land Use Map for Hyderabad City, India



Source: UNESCO and UNESCO i-WSSM (2021).



Land use planning involves allocating different land use types within the city to allow for systematic urban development. Each land use category can be further sub-divided into land use zones. Land use zones can be further divided into land use premises. Land use premises can be permitted across different land use zones. Finally, for each use premise, there are certain use activities that can be permitted. Figure 3 presents a typical land use map

For proper management of the land adjacent to a river, a complete exercise of delineation of the river influence zone must be undertaken. Appropriate land uses and use zones must be assigned for this delineated area within the Master Plan, with a focus on maintaining the natural sanctity of the area. Specific eco-sensitive areas can be earmarked for conservation. A clear identification of permissible and restricted activities is also required, for regulating controlled use of the river space without disturbing its natural character. In addition, the definitions, and parameters for delineation of the river space, as well as allocation of various use zones with use restrictions (permitted, conditionally permitted, or prohibited) must also be clearly specified within the planning document.

The Urban River Management Plan for Kanpur (2021) recommends the following for the proposed Master Plan for Kanpur-2041:

- A clearly defined land use category for the river and its floodplains, within the existing and proposed land use tables.
- Both the Ganga and Pandu rivers and their floodplains could be clearly marked in the land use plan as well, under the appropriate land use category.

#### **4.2.4 Development Control Regulations**

Development control regulations (DCRs) are intended to limit the type and extent of development in a particular area. Regulations like height restrictions, floor area ratio (FAR), minimum setbacks, ground coverage, etc. are a part of the Master Plans in the form of building by-laws or architectural controls. For river cities, once the river zone or floodplain is demarcated, specific development controls should be identified for the sub-zones falling within this eco-sensitive area. There can be different considerations for restrictions within that zone. For example, in an area liable to flooding, there can be regulations on minimum plinth levels, prohibition of the construction of basements, and minimum levels of approach roads, among others. Likewise, in the belt adjacent to the river, there can be regulations on FAR and ground coverage to ensure that the visual corridor to the river is maintained.

The Urban River Management Plan for Kanpur recommends the following DCRs for the proposed Master Plan of Kanpur-2041:

- Any new development/re-development of the area must follow the Development Control Regulations for the River Zone
- A phased strategy for restoring the river zone to be prepared by the concerned agency
- Demarcate the “no development zone” and “interactive zone”, for regulating all development within the flood plains of both the rivers
- Enlist the prohibited, regulated, and permissible activities within each of these zones
- Devise a phased strategy for the relocation of prohibited activities

#### 4.2.5 Norms and Standards

Norms are used as a tool to ensure consistency in planning. Norms for standardized development within the river zone can help facilitate restricted and regulated growth within the area. For example, there are norms for minimum buffers within river zones, minimum required environmental flows, and the permissible extent of channelization, etc.

Standards, from a river point of view, are tools to ensure the quality of the riverine resources do not suffer because of urban development activities. Standards could be quantitative or qualitative values. For example, there are standards for river water quality, groundwater quality, and the richness of riparian biodiversity, among others.

The Urban River Management Plan for Kanpur (2021) makes the following recommendations for the proposed Master Plan for Kanpur-2041:

- A buffer of 75 m as a “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 is 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.
- Alternatively, the Plan may direct a competent authority to identify and establish adequate buffer standards (as per requirement and land availability analysis) for water bodies and drains within the city.

#### 4.2.6 Recommendations and Directions

The Master Plan is also very well placed to make recommendations on current and emerging aspects that need to be addressed. It has the authority to provide tangible directions to various agencies to act in this regard. For example, climate change is likely to alter river flows, thereby disturbing the ecology that depends on them. Similarly, in view of depleting rivers and groundwater, it is becoming increasingly evident that water demand management is the only way forward for large urban areas to meet their water demand. In river cities, specific recommendations for the floodplains should be framed with a focus on conservation of the natural river environment. Recommendations could also be along the lines of strengthening the cultural connect with rivers, given that historically rivers have been the center of cultural and religious activities.

The Urban River Management Plan for Kanpur (2021) makes the following recommendations for the proposed Master Plan for Kanpur-2041:

- Complete prohibition of the dumping of solid waste in or around the river zone or any other eco-sensitive sites by imposition of strict penalties through local bodies
- Strengthening of waste collection system from unauthorized sector along the rivers
- Promotion of public awareness campaigns

#### 4.2.7 Special Projects

Master Plans have the authority to propose special projects that have high impact and are necessary for the city. They also help in enhancing the land value of adjoining properties. For such projects, it will be important to detail the modalities related to the implementation, administration, management, and funding. Special projects related to the river include ghat development, clean-up projects, the development of eco-recreational sites, installing eco-tourism infrastructure, flood protection measures, and artificial recharge structures, among others. Such projects can be identified within the Master Plans along with an action plan for implementation while directing agencies for developing the Detailed Project Report.

The Urban River Management Plan for Kanpur (2021) makes the following recommendations for the proposed Master Plan for Kanpur-2041.

- Rejuvenation of the existing fly ash pond in the river zone and its re-development after adequate treatment (for recreational or other uses)

## 5. CONCLUSIONS

The COVID-19 pandemic has unexpectedly highlighted the significance of urban rivers in the overall coping strategy for alleviating the stress created by the pandemic. Even before the pandemic, green spaces (typically found near river banks) were instrumental in alleviating mental distress, anxiety, and depression and led to greater wellbeing and healthier cortisol profiles (Barton and Rogerson 2014). The pandemic has only accentuated this view. As Bustamante et al. (2022) suggested, the therapeutic potential of outdoor and greenspaces should be considered for interventions during future epidemics. Given that the frequency and occurrence of such instances is likely to increase in the future, considering climate change concerns, it is important to have robust and sustainable measures for managing urban rivers.

Managing an urban river, especially a degraded one, requires several transformational solutions that may have to be implemented over long and sustained periods in order to reap the optimal benefits. Many such solutions are often started with great enthusiasm but get derailed over time because of a lack of a long-term institutional mechanism required to support the overall outcome. A Master Plan is a good instrument to address this challenge. This paper has described a set of tools and avenues within Master Plans that can be used to address typical river-related challenges in cities.

It is important to highlight that the challenges faced by urban rivers are dynamic in nature and will change from time to time. One such example is to manage a river under changing climate regimes. It is well established that water is the primary medium through which the effects of climate change are manifested. Therefore, by their very nature, rivers are vulnerable to climate change impacts, such as changes in the flow, biotic quality, and the sediment load. Master Plans will need to account for these anticipated changes in the future, and provide adequate planning responses. Likewise, there are several rivers that have changed their natural courses in recent years. For example, the Ganga River stretch near the city of Patna in India has deviated by almost a kilometer from its natural course. Under such a circumstance, it becomes challenging to demarcate the floodplain and provide the necessary regulations.

A practical perspective in urban river management is to naturalize the immediate vicinity of the river zone, especially if it is heavily concretized. This essentially means moving toward nature-based solutions as a means to complement (if not replace) hard infrastructural options. Some of the naturalizing elements include soft scaping, creating green buffers, the removal of unnecessary concrete, and adopting green infrastructural solutions. To a large extent, this approach will require reforms in development control regulations, such as restrictions on FAR, ground coverage, and height restrictions on buildings. It is vital that the land ownership in these areas is carefully ascertained (which incidentally is a challenge in several cities) to avoid legal complications while the Plan is being implemented.

Next, it is vital that river-sensitive Master Plans create an enabling environment for introducing (or re-igniting) the human and water relationship (e.g., through concepts like biophilic design). Historically, natural river edges have been detached from citizens because urban planning has failed to adequately consider them (Redzuan and Latip 2016). However, in the current age, a core indicator of success for riverfront projects is public access to the water edge (Timur 2013).

Finally, the implementation of the Master Plan is not always in sync with the directions provided in the Plan. It is important that ground realities are factored in with the help of a mechanism that allows for course correction at periodic intervals. Usually, Master Plans are reviewed every 5 years, which can offer an ideal opportunity for these course corrections to be adopted. River cities are special. The planning of such cities needs to reflect this aspect so that these cities continue to remain special in future as well.

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