Draft District Ganga Plan
for Moradabad

August 2023

WWF-India

Development of model District Ganga Plan (DGP) for four districts of Ganga Basin, namely – Moradabad, Bareilly, Shahjahanpur (All from Uttar Pradesh) and Udham Singh Nagar (Uttarakhand) is a joint initiative of the World Wide Fund for Nature – India (WWF-India) and Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) under the aegis of National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Government of India.

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Contributions:

DGC Moradabad: Sh. Manvendra Singh (DM), Sh. Sumit Yadav (CDO), Sh. Suraj (DFO)

WWF-India: Dr. Mohammad Alam, Himanshu Bhardwaj, Suresh Babu, Nitin Kaushal, and Arjit Mishra.

NMCG: S. P. Vashishth, Brijesh Sikka.

SMCG UP: Rajesh Kumar Pandey, Mithilesh Mishra.

With contributions from: Rajesh Bajpai, Siddhartha Baidya, Neha Bhatnagar, Devanand MR and all the esteemed members of Moradabad District Ganga Working Groups formed at the district level for the development of the Moradabad District Ganga Plan (DGP).

Contents

List of Figures

List of Tables

Abbreviations used

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BCM	Billion Cubic Meters
BOD	Biochemical Oxygen Demand
CETP	Common Effluent Treatment Plant
cGanga	Centre for Ganga River Basin Management and Studies
CGWB	Central Groundwater Board
CPCB	Central Pollution Control Board
CWC	Central Water Commission
DEP	District Environment Plan
DGC	District Ganga Committee
DGP	District Ganga Plan
DO	Dissolved Oxygen
DoWR, RD & GR	Department of Water Resources, River Development and Ganga Rejuvenation
DWS	Ministry of Jal Shakti, Department of Drinking Water and Sanitation
ETP	Effluent Treatment Plant
FSTP	Faecal Sludge Treatment Plant
GPI	Grossly Polluting Industries
GRBEMP	Ganga River Basin Environmental Management Plan
GRBMP	Ganga River Basin Management Plan
IUCN	International Union for Conservation of Nature
MCM	Million Cubic Meters

MDA	Moradabad Development Authority
MLD	Million Litres per Day
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoHUA	Ministry of Housing and Urban Affairs
MoRD	Ministry of Rural Development
MSW	Municipal Solid Waste
NbS	Nature-based Solutions
NGT	National Green Tribunal
NHP	National Hydrology Project
NIUA	National Institute of Urban Affairs
NMCG	National Mission for Clean Ganga
NNM	Nagar Nigam Moradabad
NWA	National Water Academy
NWIC	National Water Informatics Centre
NWM	National Water Mission
NWP	National Water Policy
RBM	River Basin Management
RSAC-UP	Remote Sensing and Application Centre
RTDAS	Real-Time Data Acquisition System
SBM	Swachh Bharat Mission
SMCG UP	State Mission for Clean Ganga Uttar Pradesh
SSAP	State Specific Action Plan
STP	Sewage Treatment Plant

SWaRA	State Water Resources Agency
SWaRDAC	State Water Resources Data Analysis Centre
UPID	Uttar Pradesh Irrigation Department
UPPCB	Uttar Pradesh Pollution Control Board
UPSDMI	Uttar Pradesh State Disaster Management Institute
URMP	Urban River Management Plan
WII	Wildlife Institute of India
WRICE	Water Resources Institutional Capacity Enhancement
WRIS	Water Resources Information Systems
WRMS	Water Resources Management Systems
WROPS	Water Resources Operation and Planning Systems
WWF India	World Wide Fund for Nature India

Executive summary

This two-page summary provides an overview of the document titled "District Ganga Plan for Moradabad District." The document aims to address the key issues and challenges related to the Ganga River Basin in the Moradabad District and proposes a comprehensive plan for its management and conservation.

The "District Ganga Plan for Moradabad District" document provides a comprehensive analysis of the district's biophysical and non-biophysical characteristics, identifies key issues for the planning cycle, and proposes actionable solutions. The stakeholder engagement process to develop this plan and the detailed action points highlight the collaborative efforts essential for the successful implementation of the plan. For the development of this plan a Working Group was constituted by the Chair (District Magistrate) of the Moradabad District Ganga Committee. The Chair of the Working Group is the CDO (Chief Development Officer) of Moradabad District and all concerned Line Departments are part of this Working Group. This Working Group had series of meetings and deliberations to develop this plan. The efforts were coordinated by WWF India. This document serves as a valuable resource for policymakers, stakeholders, and organizations involved in the management and conservation of the Ramganga River Basin in the Moradabad District, ultimately benefitting the parent basin, i.e., Ganga River Basin.

Section A: Introduction

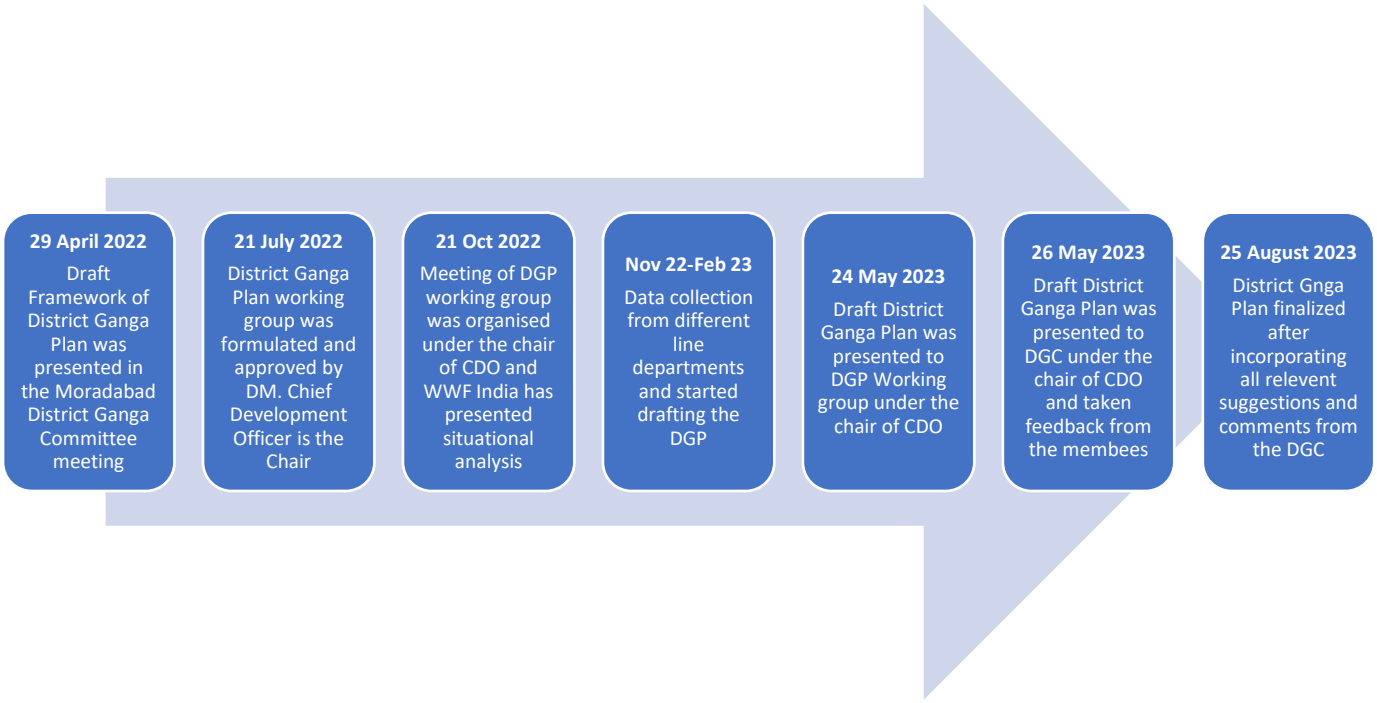
The document begins with a background on the Ganga River Basin Management Plan (GRBMP) and its vision. It highlights the importance of the District Ganga Plan directive and its interconnections with comparable initiatives. Additionally, it illustrates WWF's establishment of working groups to identify and prioritize pertinent issues. The vision and scope of the document are also outlined, emphasizing the need for a comprehensive approach to the management of the Ganga River Basin.

The vision of the District Ganga Plan for Moradabad aims to address core challenges related to the protection and conservation of the Ramganga River and its key tributaries (part of Ganga River basin). The plan prioritizes water management issues specific to the district and identifies existing programs and newer initiatives, aimed at resolving these challenges. The

fundamental objective is to ensure improved ecological health and vitality for all rivers within the district, guaranteeing long-term water security for the district and its freshwater ecosystems.

To achieve this vision, the plan leverages the methodology from the Ganga River Basin Management Plan (GRBMP) and incorporates two important Indian principles: *aviral dhara* (continuous flow) and *nirmal dhara* (unpolluted flow). It also considers the interdependencies and interconnectedness between different components of the river system, which directly affect river's overall well-being and value for the people and nature.

The approach to develop the Moradabad District Ganga Plan is illustrated in following figure.



Section B: Biophysical and Non-Biophysical Characteristics

This section provides an analysis of the district's physical resources, including an overview of the Ramganga basin and the Moradabad District. It explores the topography and drainage system, rainfall and climate patterns, available water resources, water quality, land use and land cover, agriculture and irrigation practices, floodplain and wetlands encroachment, industry, aquatic biodiversity, waste and sewage management, and other relevant factors. This

analysis forms the basis for understanding the current state of the district's water resources and their implications for the Ganga River Basin.

The Moradabad district is intersected by the Ramganga River, acting as the main watercourse, in which various tributaries merges in the district and in the upstream and the downstream. The hydrological system in the district consists of five distinct river catchments: Ramganga, Gaagan, Dhela, Kosi, and Aril. The district's hydrology is mainly shaped by the Ramganga River and its tributaries, dividing the district into two sections. The Moradabad district experiences an average annual rainfall of 992.9 mm. The normal monsoon rainfall from 1951 to 2000 amounts to 855.2 mm, while the normal non-monsoon rainfall stands at 137.2 mm. The region also exhibits significant temperature fluctuations during the winter and summer months, which ranges from an average minimum of 13.8°C in January and a maximum of 31.5°C in June.

The National Wetland Atlas reports a total wetland area of 7,174 hectares in the district. River/Stream is the dominant wetland type, covering 67% of the area. "*Hamre Talaab, Hamaree Dharohar*" campaign (to ascertain the state of wetlands in Moradabad city), conducted in 2014-15, found that 33 out of 80 wetlands have disappeared, indicating a rapid 41% loss of wetlands (3.9 hectares). The survey identified 10 new wetlands, bringing the total count to 57 (47 existing and 10 new).

In terms of groundwater availability, seven blocks in Moradabad District are safe, but some of the blocks, including Moradabad city are over-exploited due to high population density and substantial water extraction for various purposes. Groundwater data from 2017 and 2021 reveals a consistent and concerning decline, particularly in the city's western region with concentrated industrial activities. This downward trend is expected to worsen in the future due to increased water consumption.

During the monitoring conducted from March to June 2022 by WWF, a total of 52 species from 16 families were documented (Figure 45). Among these, Katghar had 18 species, while Agwanpur had 14 species. Out of the recorded species, four are classified as Threatened according to the IUCN List. *Cyprinus carpio* is an exotic species categorized as vulnerable, while *Chela laubuca* observed in both Agwanpur and Katghar is categorized as Near Threatened.

Section C: Situation Analysis of Key Issues for the Planning Cycle

This section outlines various strategies for effective water management in the Moradabad district. It includes developing comprehensive plans for managing domestic sewage, addressing pollution in the Dhela River, promoting sustainable agriculture water management, safeguarding floodplains and wetlands, implementing proper industrial water and waste management, enhancing capacity building at District Ganga Committees, and devising strategies for solid waste and E-waste management. Efforts will also focus on understanding and conserving key tributaries and ensuring Environmental Flows in the Ramganga River and its tributaries for ecological health and sustainability.

Section D: Stakeholder Process for Developing District Ganga Plan, Monitoring, and Implementation

This section focuses on stakeholder engagement in the development of the District Ganga Plan. It describes the stakeholder engagement process and highlights the role of "Ramganga Mitras" in implementing the plan. Currently over 4,000 dedicated volunteers ("Ramganga Mitras") are supporting various river conservation activities across the banks of Ganga and Ramganga rivers. This initiative is aimed to conserve the Ganga and Ramganga rivers by designing activities to mitigate threats, reduce pollution, and protect endangered species. Volunteers are trained in river and wetland health assessment and actively support conservation efforts.

A detailed action plan is also presented, outlining the specific steps and initiatives to be taken. Additionally, this section emphasizes the importance of monitoring and implementation, including a gender-sensitive outreach plan.

It is envisaged that, with the approval of Moradabad District Ganga Plan by concerned authorities (Moradabad DGC, UPSMCG, NMCG), some of the critical elements of the plan will enter implementation phase, thereby initiating the beginning of a crucial but complex journey of a healthy Ganga River.

Section A: Introduction

This part describes the rationale for preparing the plan, sets out the background to and process for developing the plan, and the structure of the document.

1. Background

1.1 The Ganga River Basin Management Plan (GRBMP) and its Vision

The Ganga River Basin Management Plan's (GRBMP) vision is to restore and revitalize the Ganga River and its tributaries and embodies a comprehensive vision aimed at the "Restoration of wholesomeness" of rivers within the Ganga Basin. The primary missions of GRBMP revolve around the attainment of *Aviral Dhara* (continuous flow) and *Nirmal Dhara* (clean flow) [1]. Besides this, there is another dimension, i.e., S*watch Kinara* (clean riverbank) which is also a critical one.

Establishing ecological health and implementing effective basin governance serve as fundamental frameworks for the multifaceted activities dedicated to the rejuvenation, protection, and management of the Ganga tributaries. At the local scale within respective districts, significant endeavours aligned with the basin-level vision are undertaken. The District Ganga Plan emphasizes river rejuvenation specific to each district, albeit with diverse goals, objectives, and outcomes. Nonetheless, these individual efforts collectively contribute to the overarching vision of restoring the Ganga River and its tributaries to their pristine or near-pristine condition.

1.2 District Ganga Plan Directive

The development of the District Ganga Plan is obligatory under the provisions stipulated in the River Ganga (Rejuvenation, Protection and Management) Authorities Order of 2016. Specifically, Clause 57 of the aforementioned order mandates the formulation of plans by District Ganga Committees (DGCs). Each DGC is required to prepare a comprehensive plan focused on the protection of the River Ganga, its tributaries, and the riverbed within the specified district. The prepared plan must be submitted to the National Mission for Clean Ganga for its approval. The plans crafted by the DGCs should encompass various key aspects, including:

- Activities intended to be executed by the DGC for the protection, control, and reduction of environmental pollution in the River Ganga, its tributaries, and their respective river bed areas.
- An estimation of the associated expenditure for implementing the proposed activities.
- Clear timelines delineating the planned activities and their corresponding milestones.

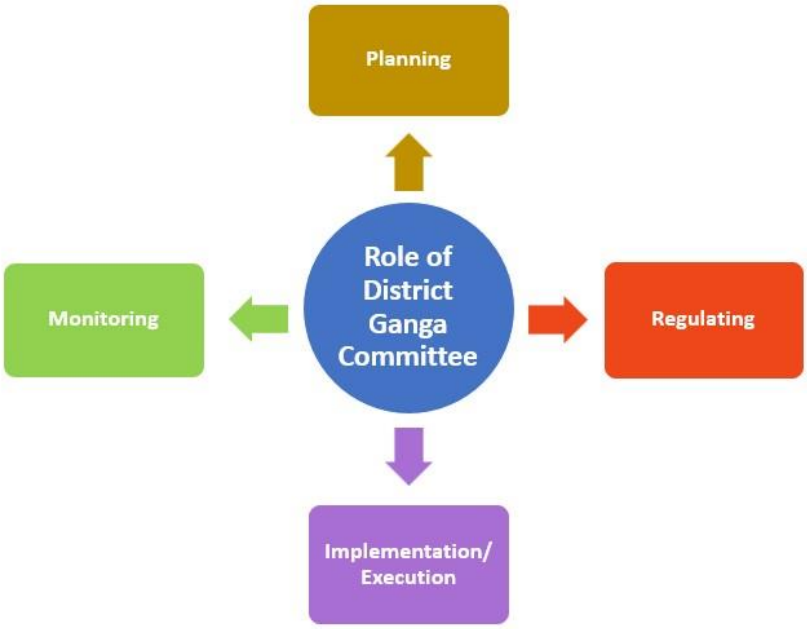


Figure 1 Role of District Ganga Committee (DGC)

Each district-level plan will centre its efforts on safeguarding and reviving pivotal rivers or river stretches located within the respective district. These comprehensive plans at the district level will play a vital role in fostering an integrated approach to river basin management.

1.3 Comparable Initiatives and their Interconnections with District Ganga Plans

Efforts towards the purification of the Ganga River have a rich history spanning over three decades. In 2014, the Government of India embarked on the ambitious 'Programme' to achieve effective pollution control, conservation, and rejuvenation of the Ganga through an integrated conservation mission. The implementation of this program falls under the purview of the National Mission for Clean Ganga (NMCG), established as the principal agency [2].

Initially, the focus primarily revolved around cleansing the main stem of the Ganga River. However, recognizing the substantial pollution burden in the tributaries as well, the scope of the program expanded to encompass the entire Ganga basin. Under the flagship of this

initiative, numerous programs have already been executed, accompanied by the formulation of plans and guidelines. During the development of District Ganga Plans (DGPs), it is imperative to seek synergies with these existing programs to prevent redundancy and unnecessary efforts [3]. Alignment with the sub-basin management plan, specifically the Ramganga Basin, and the comprehensive Ganga River Basin Management Plan (GRBMP) becomes crucial for DGPs [1][3]. The GRBMP, formulated by NMCG in collaboration with a consortium of seven Indian Institutes of Technology (IITs), sets the framework for basin-wide management [1]. While not all aspects of the GRBMP may directly impact the District Ganga Planning exercise, the fundamental principles of *Aviral Dhara* (uninterrupted flows), *Nirmal Dhara* (unpolluted flows) and *Swatch Kinara* (clean riverbank) must remain central themes in the development of District Ganga Plans. A significant amount of work has been undertaken within the Ganga Basin, and it is beyond the scope of this chapter to provide a comprehensive overview. Only selected activities directly relevant to the development of the District Ganga Plan are mentioned herein.

1.3.1 Action plans for the rejuvenation of tributaries

The Namami Gange Programme, implemented by the Union Government of India, is an integrated conservation mission with a substantial budget of Rs. 20,000 crores. Its primary objective is to effectively address pollution, promote conservation, and undertake rejuvenation measures for the National River Ganga. Noteworthy accomplishments under the Namami Gange Programme include the establishment of various sewage treatment facilities, riverfront development, river surface cleaning, biodiversity conservation, afforestation initiatives, and the organization of public awareness events, workshops, seminars, conferences, and numerous Information, Education, and Communication (IEC) activities aimed at mobilizing communities and raising public awareness. The program also entails rigorous monitoring of industrial effluents, the creation of Ganga Grams (Ganga Villages), and other significant undertakings [3].

In 2001, the State Water Resources Agency (SWaRA) was established in Uttar Pradesh to enhance the management, planning, and sectoral allocation of water resources among various agencies. The Uttar Pradesh Government further established the State Water Resources Data Analysis Centre (SWaRDAC), a Data Analytics Centre, to provide water-related data to SWaRA and all other central/state water plans about the state's river basins. Eight

comprehensive river basin assessments were conducted, leading to the formulation of basin plans for Gandak Basin, Ghagra Basin, Gomti Basin, Ganga Basin, Ramganga Basin, Rapti Basin, Sone Basin, and Yamuna Basin [4].

The Worldwide Fund for Nature India (WWF India) has developed a Ramganga River Basin Management Plan in collaboration with the Uttar Pradesh State Water Resources Agency (SWaRA). This document presents a comprehensive plan for the development, management, and conservation of the Basin, specifically focusing on the Ramganga River. The plan, while retaining the essence of GRBMP, aims to integrate a wide range of existing findings, recommendations, policies, plans, and activities, and strategically coordinate them to maximize the benefits derived from the basin while ensuring its long-term sustainability.

Aligned with a vision and goals set for the basin over the next 20 years, the plan outlines a strategy and a series of actions to be implemented within the next 5 years. These actions encompass both those already prescribed by other instruments, such as existing national and state policies and strategies, and those specifically formulated for the plan. The inclusion of these actions demonstrates their relevance to other activities within the basin and their contribution to the broader goals of the basin. Furthermore, this plan has been developed in alignment with the Ganga River Basin Management Plan (2015) to ensure consistency and coherence in the overall management approach.

In addition, the "Ramganga Mitras" is a dedicated volunteer group comprising over 4,000 individuals, actively supporting conservation activities along the banks of the Ganga and Ramganga rivers. This platform fosters discussions and debates to design initiatives for mitigating ongoing threats to the rivers. The initiatives encompass various aspects such as River Health Assessment (RHA), promoting the use of organic fertilizers, reducing reliance on harmful agrochemicals, advocating for organic farming, and implementing best management practices for sustainable agriculture, managing industrial and domestic water footprints, and raising awareness on several issues pertaining to river basin management. The group is also actively involved in a conservation program focused on safeguarding various endangered species found in the Ganga and Ramganga rivers, such as turtles, dolphins, and Gharials. Additionally, the volunteers have received training in River Health Assessment and Wetland Health Assessment, enabling them to develop a strong connection with the rivers and take

responsibility for their restoration. They are also committed to supporting relevant authorities in this endeavour.

1.3.2 Urban River Management Framework

The National Mission for Clean Ganga (NMCG) and the National Institute of Urban Affairs (NIUA) have collaboratively formulated the Urban River Management Plan framework (URMP) for the development of Urban River Management Plans (URMP) in all Ganga towns. This initiative aligns with the "Vision Ganga" published by NMCG in 2017 [5]. The primary objective of the URMP is to assist the cities situated along the Ganga River in enhancing the condition of the river within their respective stretches. The Urban River Management Plan (URMP) serves as a planning framework that enables systematic and comprehensive interventions to be organized by the Ganga towns, aiming to revitalize and sustainably maintain their rivers. The overarching goal is to improve the condition of the river within each city's jurisdiction. The underlying principle is based on the belief that enhancing the livability of these towns necessitates the preservation of healthy rivers. Each city's plan under the URMP will encompass three key components to create a holistic and balanced approach to urban river management, addressing environmental, economic, and social aspects for the sustainable development and preservation of the Ganga River in each city [5]. These components are aligned with the design philosophy of the URMP:

- **Environmental Component**: This component corresponds to the philosophy's emphasis on environmental responsibility and entails measures and strategies aimed at ensuring ecological sustainability and minimizing negative environmental impacts.
- **Financial Component**: Corresponding to the philosophy's focus on economic benefits, this component involves financial aspects and strategies aimed at generating economic value, promoting sustainable funding mechanisms, and ensuring the financial viability of the river management initiatives.
- **Social Component**: Aligned with the philosophy's commitment to social inclusivity, this component focuses on fostering community engagement, participation, and social equity. It encompasses strategies aimed at ensuring that the benefits of river management efforts are distributed equitably and that social cohesion is enhanced within the Ganga towns.

1.3.3 District Environmental Plan

The District Environment Plan (DEP) is expected to focus on comprehensive environmental protection and management measures that address various sources of pollution at the district level. It includes key action points such as conducting an inventory of water bodies, assessing the water quality in the district, implementing measures for the protection of rivers and lakes, identifying sources of water pollution, and rejuvenating groundwater resources. The development of the District Ganga Plan (DGP) aligns with the objectives and strategies outlined in the DEP, utilizing the information collected in Section C and the recommended actions provided in Section D, of this report. The relevant information has been organized and categorized based on the key issues identified for this specific DGP, ensuring a targeted and effective approach to addressing environmental concerns in the district.

1.3.4 District Plans

WWF along with the partnership of the Ministry of Jal Shakti has been working with respective District Administrations (Moradabad and Bareilly) on creating District Ganga Plans (DGPs) for Bareilly and Moradabad districts.

1.3.5 Flood and Disaster Management Plans

In 2011, the establishment of the Uttar Pradesh State Disaster Management Institute (UPSDMI) marked a significant milestone in the field of disaster management. Over the years, UPSDMI has played a crucial role in enhancing preparedness and capacity building by conducting a total of 89 training programs, workshops, seminars, and conferences, thereby imparting valuable knowledge and skills to more than 6000 officials from various departments and stakeholders. One of the notable contributions of UPSDMI has been its involvement in the development of disaster management modules for several probationary/in-service training programs in the state, including PCS Foundation, Medical Officer Foundation, Teacher's Training, and others. These modules serve as comprehensive resources to educate and equip individuals with the necessary tools and understanding to effectively respond to and manage disasters. To further support the dissemination of knowledge, UPSDMI has produced a multitude of training guides, manuals, and Information, Education, and Communication (IEC) materials in Hindi. These resources have been widely distributed to facilitate a better understanding and awareness of disaster management practices. In line with the establishment of District Disaster Management Authorities, all districts within the state

have successfully set up their respective authorities, ensuring a decentralized and coordinated approach to disaster management at the local level. Additionally, recognizing the importance of integrating disaster management into the education system, the state education board has taken the initiative to update its curriculum. This curriculum revision incorporates a dedicated disaster management component, ensuring that students are equipped with the necessary knowledge and skills to respond effectively to disasters and contribute to building a resilient society [6].

1.3.6 Development of Ramganga River Basin Management Plan by WWF India

WWF India has formulated the Ramganga River Basin Management (RBM) plan, which aligns with the Ganga RBM plan of 2015, outlining a strategic framework with vision, goals and Objectives for the development, management, and conservation of the Ramganga River basin over the next 20 years. The Ramganga RBM plan is grounded on fundamental concepts, namely *Aviral Dhara* (uninterrupted flow), *Nirmal Dhara* (unpolluted flow) and *Swatch Kinara* (clean riverbank), which serve as guiding principles throughout the plan. The plan encompasses four primary goals, each addressing distinct aspects of the basin's management and conservation. By addressing these goals and their associated objectives, the Ramganga RBM plan aims to promote the long-term sustainability and resilience of the Ramganga river basin, ensuring the well-being of both the ecosystem and the communities dependent on it.

- **River and basin ecosystem health**: This goal focuses on the physical state and condition of the river ecosystem itself, aiming to enhance its ecological health and integrity.
- **Social, economic, and cultural benefits**: This goal assesses the extent to which the basin provides societal benefits, encompassing various dimensions such as social well-being, economic prosperity, and cultural preservation.
- **Basin governance and stakeholder practices**: This goal pertains to the management of the basin and the practices of the stakeholders involved. It emphasizes the need for effective governance structures, stakeholder engagement, and sustainable practices within the basin.
- **Disaster and risk management**: This goal centres around reducing the risk, frequency, and severity of disasters, particularly floods and droughts, within the basin. It involves implementing measures and strategies to mitigate and manage such risks effectively.

2. Vision and scope

The vision of making the District Ganga Plan for Moradabad district is to effectively tackle the core challenges of the safeguarding, regulation, and mitigation of environmental contamination in the Ramganga River and its tributaries. Furthermore, it aims to prioritize the significant water management issues specific to the district and identify potential gaps in addressing them. Additionally, the initiative seeks to compile a comprehensive inventory of ongoing programs and schemes aimed at resolving the identified issues. The resolution of all these concerns will be undertaken through a systematic and organized approach and will be generally based on the vision for the Ramganga River Basin Management Plan and the Ganga River Basin Management Plan documents.

The fundamental objective of developing the District Ganga Plan (DGP) for Moradabad district is to realize a comprehensive vision where all rivers and river stretches within the district exhibit robust ecological health and vitality. This vision encompasses the long-term assurance of water security for the district and its associated ecological systems.

By leveraging the methodology employed in the Ganga River Basin Management Plan (GRBMP), the vision is grounded in indigenous Indian principles, namely *aviral dhara* (continuous flow), *nirmal dhara* (unpolluted flow) and *Swatch Kinara* (clean riverbank). In addition, it incorporates a contemporary comprehension of the interdependencies between various components of a river system, which directly impact its overall well-being and operational efficacy. The overarching vision encompasses the integration of four distinct dimensions of the river system, as outlined in the GRBMP. These dimensions are:

- ***Aviral dhara* (continuous flow)**: The preservation of optimal river flows during periods of low water availability is ensured. This entails the maintenance, restoration, or enhancement of longitudinal, lateral, and vertical connectivity within the river Ganga and its tributaries within the district. Furthermore, the identification, restoration, and protection of floodplains and floodplain wetlands are prioritized. Additionally, wetlands located within a 5 km buffer zone of Ramganga River are systematically mapped, their health condition is assessed, and rejuvenation efforts are initiated as deemed necessary. The promotion of sustainable agricultural practices is actively

encouraged, leading to increased crop water productivity and reduced freshwater extraction from ground water. Moreover, concerted efforts are made to improve the efficiency of domestic, agricultural, and industrial water usage.

- ***Nirmal dhara* (unpolluted flow)**: Efforts are undertaken to enhance the water quality within the river Ganga and its tributaries. This encompasses the implementation of measures to capture and treat all drainage systems that discharge into the river Ganga and its tributaries. Additionally, strict adherence to the pollution control norms established by the Pollution Control Board is expected from all industries operating within the district.
- **Basin Management and Governance**: A comprehensive five-year basin management plan, accompanied by a well-defined implementation roadmap, is formally endorsed by all relevant stakeholders while securing necessary investments for its execution. The District Ganga Committee undergoes capacity-building initiatives, focusing on key facets of river rejuvenation and conservation. Stakeholder ownership and active participation in river conservation efforts are fostered through a structured communication framework, as well as targeted campaigns for awareness, education, and outreach. Furthermore, annual river health report cards serve as crucial tools, providing vital insights for the formulation and adjustment of adaptive management strategies required for overall basin management.
- **Ecological Entity (Biodiversity and habitat management)**: Efforts are dedicated to enhancing the habitats of significant aquatic species, including Ganga River Dolphins, gharials, otters, and turtles. This involves targeted initiatives to improve the conditions and suitability of their respective habitats. Community-led conservation programs are implemented within crucial biodiversity hotspots, aiming to stabilize the population of these species. Furthermore, meticulous identification and protection measures are applied to safeguard key wetlands in the district that support diverse biodiversity.

These four dimensions are associated with the fundamental components that constitute a river ecosystem. They offer direction in terms of conserving:

- The flow regime, encompassing Environmental Flows (E-Flows), utilizing the concept of "continuous flow."
- Water quality and sediment chemistry, through the concept of "unpolluted flow."

- Habitat, represented by the physical structure of the river ecosystem, is referred to as the "geologic entity."
- River basin management while securing necessary investments for its execution.
- Aquatic and riparian biodiversity is collectively referred to as the "ecological entity."

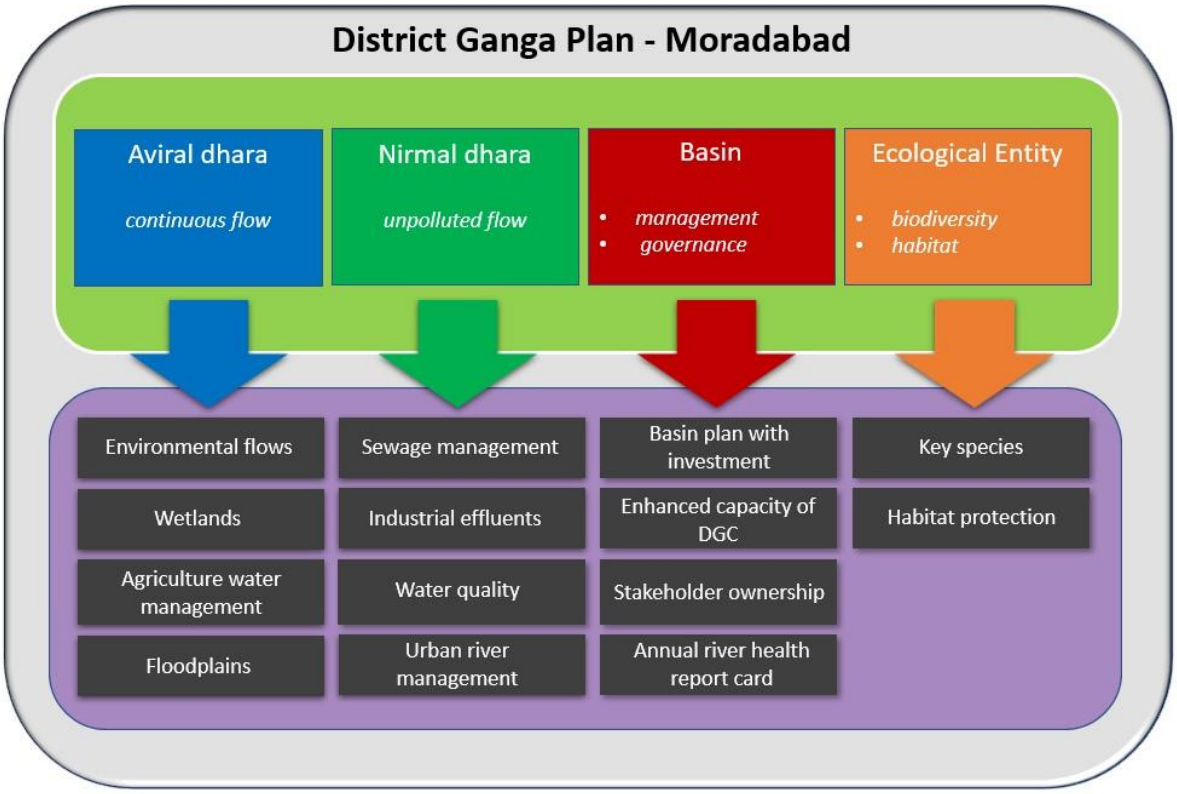


Figure 2 Vision and scope for the District Ganga Plan - Moradabad

3. Framework for District Plan: General approach and methodology

The National Mission for Clean Ganga, Uttar Pradesh State Mission for Clean Ganga, GIZ and WWF India have collaboratively devised a comprehensive framework that was employed by the District Ganga Committees (DGCs) to formulate District Ganga Plans. Initially, this framework is undergoing a trial phase in the districts of Moradabad and Bareilly. The primary objective of this framework is to assist DGCs in devising plans that ensure the safeguarding and rejuvenation of key rivers and river stretches within their respective district boundaries. The framework has been standardized to be utilized uniformly by all District Ganga Committees for planning purposes. However, it also possesses the necessary flexibility to accommodate local requirements and specifications.

To facilitate understanding and guidance for districts and stakeholders, the framework is presented in a comprehensible manner, supplemented with tables, templates, and examples. Additionally, efforts are underway to develop an online portal version of the framework, which will enhance data management, analysis, planning, and progress monitoring capabilities. The process of planning and implementation is based on a multi-stakeholder approach that emphasizes synergies, fostering dialogues, collaborations, and partnerships among various entities involved. Furthermore, the framework enables regular monitoring and evaluation of progress concerning the district plans.

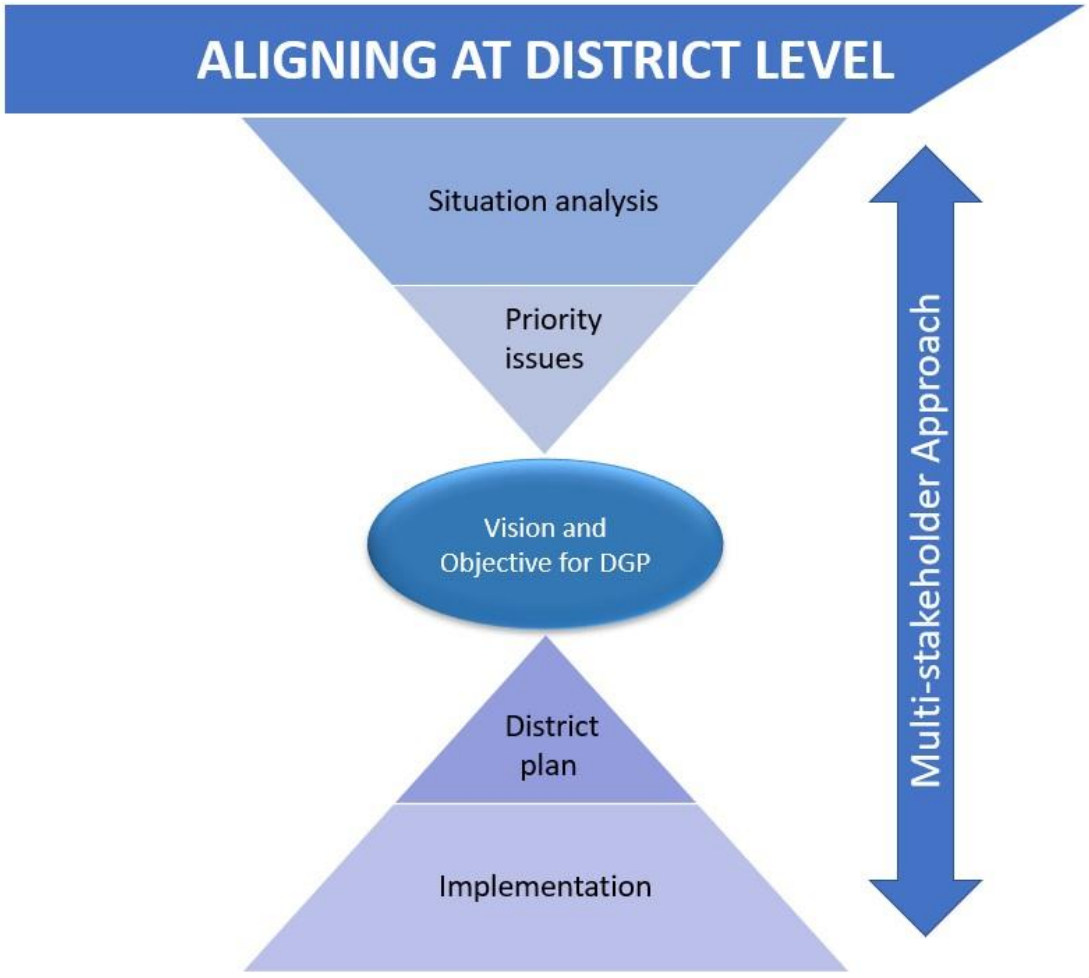


Figure 3 Approach for designing District Ganga Plan (DGP)

The key methodological principles and general principles for developing a District Ganga Plan entail ensuring alignment with the Ganga River Basin Environmental Management Plan (GRBEMP), Arth Ganga, and relevant State Policies. These principles encompass:

- *Aviral dhara* (Uninterrupted flow): Emphasizing the need for continuous flow of the river, and *Nirmal dhara* (Unpolluted flow): Prioritizing the maintenance of clean and unpolluted water flow.
- Acquiring a comprehensive understanding of the entire system to inform planning decisions.
- Taking proactive action, even in the absence of complete knowledge.
- Identifying and prioritizing immediate issues while adopting a phased and iterative approach to achieve long-term goals.
- Enabling adaptation to changing circumstances and acknowledging that basin planning is an inherently iterative process.
- Developing sectoral and thematic plans that are relevant and consistent with the overall basin plan.
- Addressing issues at the appropriate scale by integrating local plans within the broader basin plan.
- Engaging stakeholders to strengthen institutional relationships and ensure their participation in the planning process.
- Maintaining a steadfast focus on implementing the basin plan comprehensively throughout its duration.

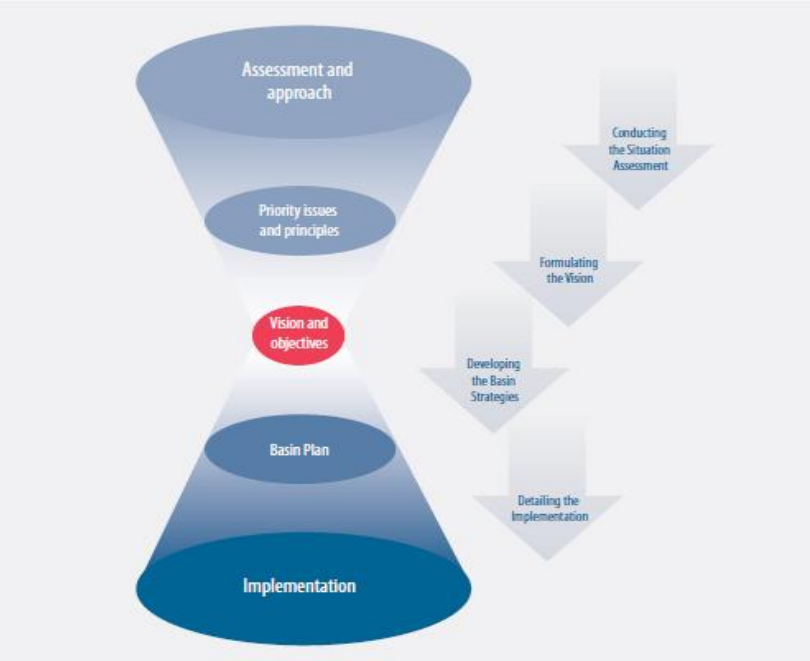


Figure 4 Key principles for designing a district plan comprehensively [7]

The Framework for the District Ganga Plan is specifically structured to provide comprehensive support and guidance throughout the entire planning process, encompassing initiation, implementation, and monitoring and evaluation stages. This ensures the continuous evolution and vitality of the district plan, transforming it into a dynamic and adaptable document that undergoes iterative cycles of planning.

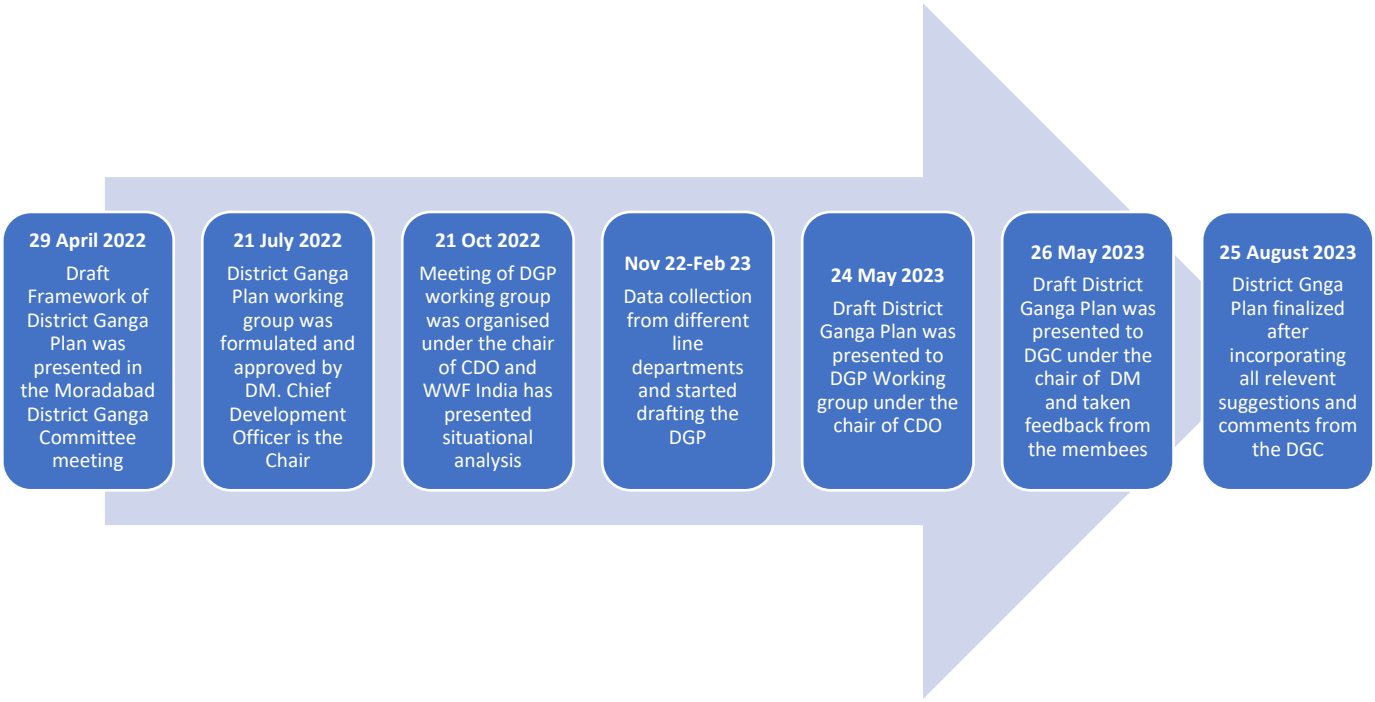


Figure 5 WWF's Process to develop the DGP with timelines

1. **Situation analysis**: The process of conducting a situation analysis entails the systematic collection of baseline data and assessment of the biophysical and ecological attributes of the rivers, along with identifying potential threats they face. This analysis also involves evaluating significant past and ongoing initiatives in the district about river conservation. Furthermore, a gap analysis is conducted to identify areas that require attention and improvement. Lessons learned from previous experiences are also incorporated into the analysis to inform future planning and decision-making processes.
2. **Prioritization of key issues**: The prioritization of key issues is carried out through a rigorous and iterative process, following the acquisition of baseline information through a comprehensive situation analysis. This prioritization process involves active participation from relevant stakeholders, ensuring their input and feedback are

incorporated. The iterative nature of the process allows for continuous refinement and adjustment of priorities as new information and insights emerge.

3. **District Ganga Plan**: After completing the participatory process of a situation analysis and conducting a thorough gap analysis, which involves collecting baseline data from various concerned line departments, the next step is to embark on a visioning exercise. This exercise serves as a guiding force in the development of a comprehensive plan. It allows for the effective mobilization of resources, ensuring that they are utilized in an efficient and targeted manner to achieve the envisioned goals and objectives.

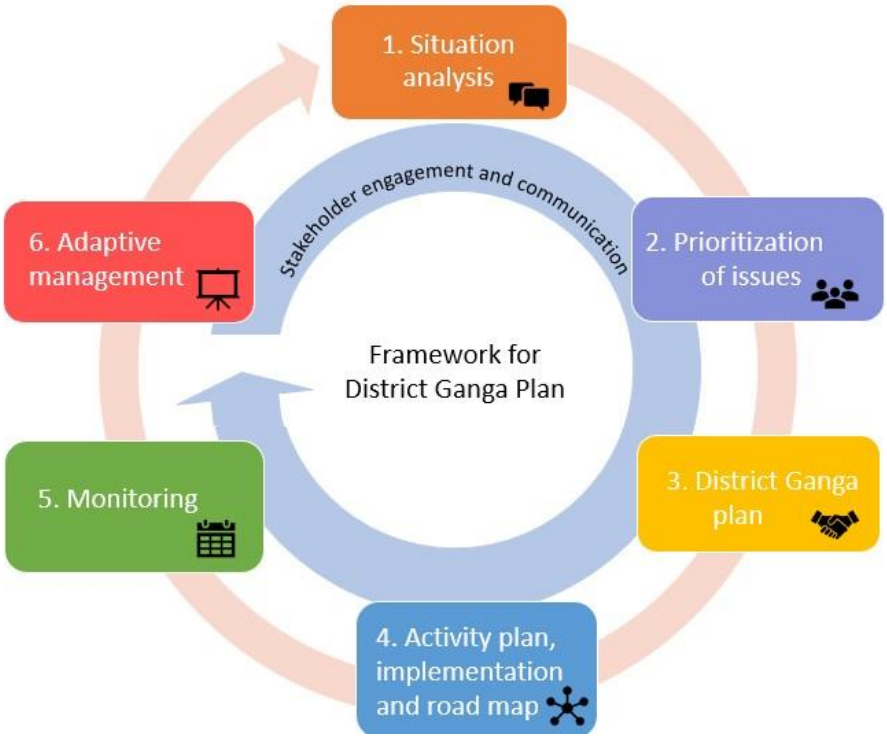


Figure 6 Framework for District Ganga Plan

4. **Activity plan, implementation and roadmap**: The formulation of activity plans and an implementation roadmap serves as an essential tool to provide clear guidance and direction to the relevant stakeholders regarding the path forward and the necessary actions to be undertaken. These plans outline specific activities, strategies, and timelines, enabling stakeholders to effectively navigate the implementation process and ensure the successful execution of the identified actions.
5. **Monitoring**: As the on-ground implementation commences, it is of utmost importance to engage in systematic and regular monitoring of progress. The process of continuous monitoring and evaluation enables the working committee and relevant stakeholders

to assess whether the implementation efforts are proceeding as planned and yield significant outcomes. By closely tracking the progress, potential deviations or areas requiring adjustments can be identified promptly, ensuring that the implementation remains on track and delivers the intended impact.

6. **Adaptive management**: By conducting regular monitoring, the progress can be diligently monitored, allowing for effective tracking of advancements. Furthermore, this monitoring process provides an opportunity for adaptive management, wherein adjustments and revisions to the strategy or plan can be made if the progress is not aligned with the desired trajectory. Such adaptability and responsiveness are integral elements of the iterative and participatory approach, ensuring that the implementation remains flexible and responsive to evolving circumstances and emerging insights.

The River Basin Management (RBM) Plan cycle follows a spiral process, wherein each cycle consists of several distinct steps. Given that Ganga rejuvenation is a collective and ongoing responsibility, the development of the District Ganga Plan (DGP) is perceived as a spiral process. This process involves the formulation and execution of plans, the review of new information, the receipt of feedback, the modification and refinement of priorities, and the adaptation of plans to changing circumstances. The RBM cycle approach is adopted in the preparation of this DGP, to repeat the cycle every five to six years. It is anticipated that each subsequent cycle of the spiral will demonstrate improved management compared to the preceding one, driven by evaluations conducted and lessons learned. Figure 6 visually illustrates the progression of different framework cycles of the DGP throughout the District Ganga Planning Cycle.

The District Ganga Plan also incorporates a gender-sensitive approach, recognizing that women comprise approximately 50 percent of the population. The plan must acknowledge and addresses their unique needs, perspectives, and participation. To ensure an inclusive process where the voices of women are heard, various tools such as surveys, focus group discussions, consultations, and dialogues should be utilized. These methodologies facilitate active engagement and input from women, fostering an environment that embraces their ideas and contributions.

Section B: Biophysical and Non-Biophysical characteristics

This part describes the status of the basin, its role in supporting human communities, and challenges and threats to the health of the basin. It also discusses current responses to these issues.

4. District's physical resources

4.1 The Ramganga basin overview

The river Ramganga has two separate streams known as the Western Ramganga and Eastern Ramganga, which flow independently. The Eastern Ramganga is a part of the Sharda Basin where it merges with the river Saryu at Rameshwar Ghat and subsequently converges with the river Sharda/Mahakali at Pancheshwar (Champawat district, Uttarakhand).

The Western Ramganga originates in the Doodha Toli ranges of the lower Himalayas near Gairsain (Uttarakhand). It originates at an elevation of approximately 3,100 m (Latitude 30°5'N, longitude 79°16'E) near the Lohba village in the Garhwal district of Uttaranchal. The river then flows through the Patli Dun of the lower Shivalik range, traversing Corbett National Park, Bijnor, Moradabad, Rampur, Bareilly, Budaun, and Shahjahanpur, before eventually joining the Ganga downstream of Farrukhabad [8].

The Western Ramganga River is a spring-fed river and the first major tributary to join the Ganga River. The river descends through the Corbett National Park and onto the Ganga floodplains (Figure 7). A monsoon-fed system, the river flows approximately 665 km, predominately in a southerly direction until it joins the Ganga at Tehra Ghat village. The basin has an area of approximately area 24,459 km^2. This represents around 2.8% of the total area of the Ganga Basin [9][10].

The basin is home to a population of around 16.8 million people, many of whom are dependent upon groundwater-irrigated agriculture. The mean annual regulated flow at the basin outlet is around 6.3 billion cubic meters (BCM) which is 2% of the total water resources of the Ganga. The total utilizable groundwater resource in the basin is approximately 5.6 BCM, and around 73% of that resource is presently abstracted, with groundwater taken both for irrigation purposes and also to supplement or replace domestic water supply systems [9].

Figure 7 Map of Ramganga Basin

The river's hydrological regime is significantly impacted by the monsoon season, wherein approximately 80% of the total surface water flow occurs between 15 June and 15 October (Figure 8). Concurrently, more than 70% of the annual sediment load is transported during the monsoon months [8].

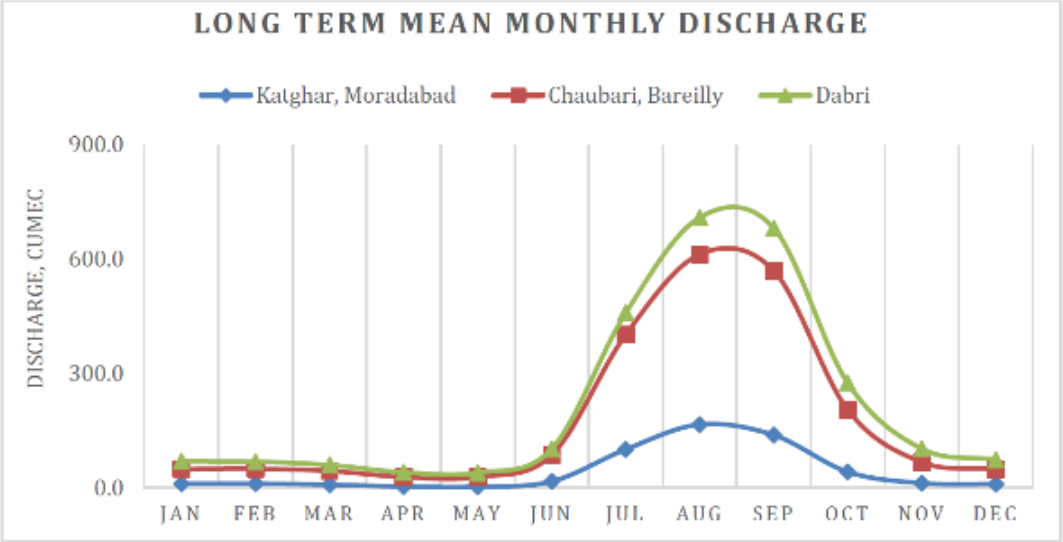


Figure 8 Average river flows at selected sites in the Ramganga River [11]

Table 1 Key features of the Ramganga Basin. Source: Ramganga E-Flows report of WWF India.

Characteristic	Details
Length	<650 km
Catchment area	24,459 km^2
Average annual renewable water resources	Total: 18 BCM Groundwater: 6.2 BCM Surface water: 11.8 BCM
Utilisable water resources	Total: 10.95 BCM Groundwater: 5.65 BCM Surface water: 5.30 BCM
Total average water abstractions (surface and groundwater)	Total: 10.43 BCM Consisting of: • 0.44 BCM abstracted within the Rāmgangā • 8.44 BCM abstracted from groundwater within the basin • 1.38 BCM diverted to Lower Ganga Canal annually • 0.17 BCM diverted for drinking water supplies to Delhi
Total instream water storage	2.9 BCM
Contribution to the flow of the Ganga	Approx. 2%
Major tributaries	Binao, Gagas, Nair, Badangad, Mandal, Sona, Khoh, Gaagan, Dhara, Baneilli, Pili, Phika, Dehla, Kosi, West Baigul, Aril,and East Baigul
Spatial distribution	Uttarakhand (12 % of the area), Uttar Pradesh (88 %)
Population	Approx. 18.36 million
GDP (within the basin)	>105,498 Rs. Cr.
Climate	Predominately sub-tropical monsoon

Average rainfall	800 - 2,200mm
Major land use categories (% of the basin)	Agriculture: 71.17% Forests: 17 % Pasture: 10.49% Water bodies: 1.02% Built-up land and settlements: 0.24%
Major industries	Metals, chemicals, fertilizers, paper, pulp, textiles, leather
Agriculture	The area under Agriculture land: 16,465 km^2 Major Kharif Crops: rice, jowar, maize, bajra and moong Major Rabi Crop: wheat, barley, pea Perennial Crop: sugarcane

4.2 Overview of the Moradabad District

Moradabad, situated in the Indian state of Uttar Pradesh, is a prominent district. Its establishment dates back to 1625 A.D. when it was founded by Rustam Khan. The city derives its name from Prince Murad Baksh, who was the son of the renowned Mughal Emperor Shah Jahan [12]. District Moradabad, situated in the western region of Uttar Pradesh, India, is renowned for its expertise in brass handicraft manufacturing [13]. The total land area of the district spans 3718 square kilometres, with 3570 square kilometres designated as rural and 148 square kilometres designated as urban. The population density in the district is recorded at 1284 individuals per square kilometre. The district is home to significant social and cultural landmarks, including the Kali Devi Temple, Jama Masjid, and Gurudwara Shri Guru Tek Bahadur Sahab Ji Maharaj, all situated along the riverbank. During the Navratri Mela at the Kali Devi Temple, several thousands of visitors gather to pay homage and visit the river.

According to the census conducted in 2011, the aggregate population of Moradabad District amounts to 4,772,006 individuals. Among them, 1,573,623 individuals (32.98%) reside in urban areas, while 3,198,383 individuals (67.02%) reside in rural areas. Based on projections, the estimated current population of the district in 2023 is 5,990,000 individuals [14].

Moradabad District consists of four Tehsils: Thakurdwara, Kanth, Moradabad, and Bilari (Table 2). Among these, Thakurdwara Tehsil comprises two blocks, namely Thakurdwara and Dilari, and encompasses a total of 313 villages. Kanth Tehsil, on the other hand, has only one block named Chajjlet, encompassing 201 villages. Moradabad Tehsil comprises three blocks, namely

Moradabad, Mundapandey, and Bhagatpur Tanda, with a total of 355 villages. Lastly, Bilari Tehsil consists of two blocks, Bilari and Kundarki, and includes 341 villages (Figure 9).

Table 2 Blocks in Moradabad district

Tehsil	Blocks	No. of Villages
1. Thakurdwara	1. Thakurdwara	313
	2. Dilari	
2. Kanth	3. Chajjlet	201
3. Moradabad	4. Moradabad	355
	5. Mundapandey	
	6. Bhagatpur Tanda	
4. Bilari	7. Bilari	341
	8. Kundarki	

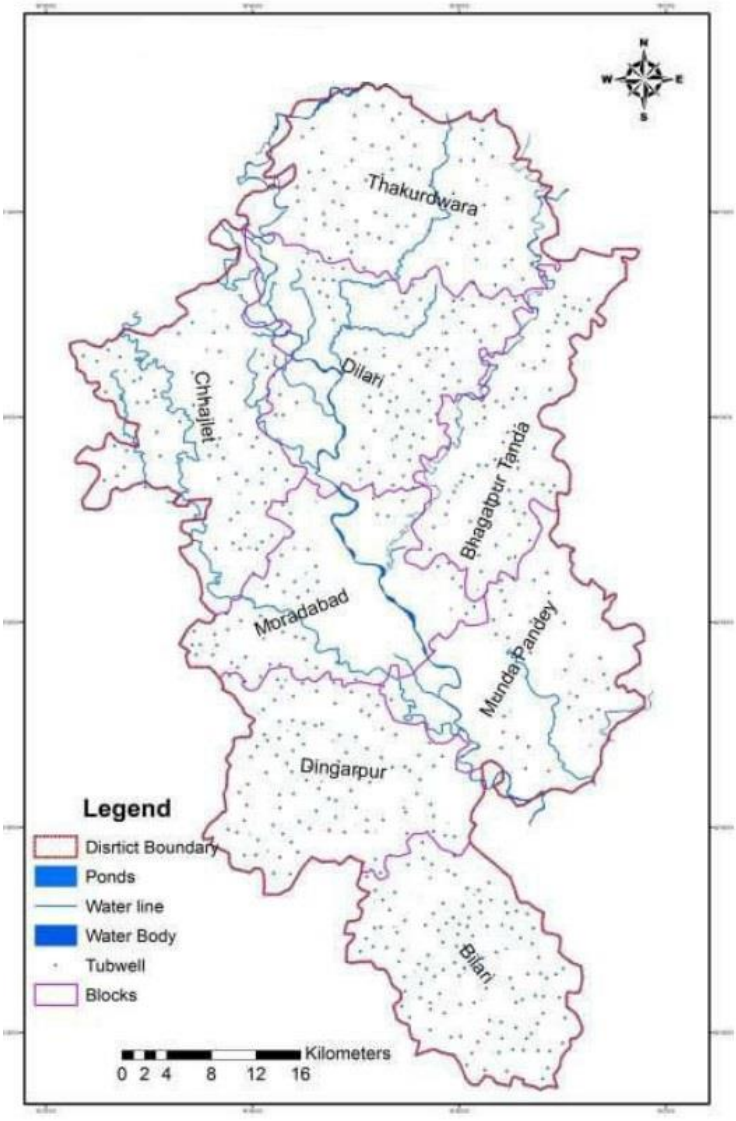


Figure 9 Blocks in Moradabad district [15]

The cartographic representation of Moradabad city (Figure 10) illustrates a notable expansion of the urban centre in the western region, adjacent to the railway line, with a particular focus on the Gaagan River direction. This development is observed due to the already high population density in the central area of the city. In conjunction with the growth of residential zones, a multitude of emerging industries have also been established. However, it is crucial to consider that these industries have the potential to generate untreated effluents that may pose a risk of polluting the Gaagan River, subsequently impacting the Ramganga River.

The urban area encompasses a comprehensive network of 70 administrative wards, with ward number 8 exhibiting the lowest population count and ward number 7 demonstrating the highest population count (Figure 10).

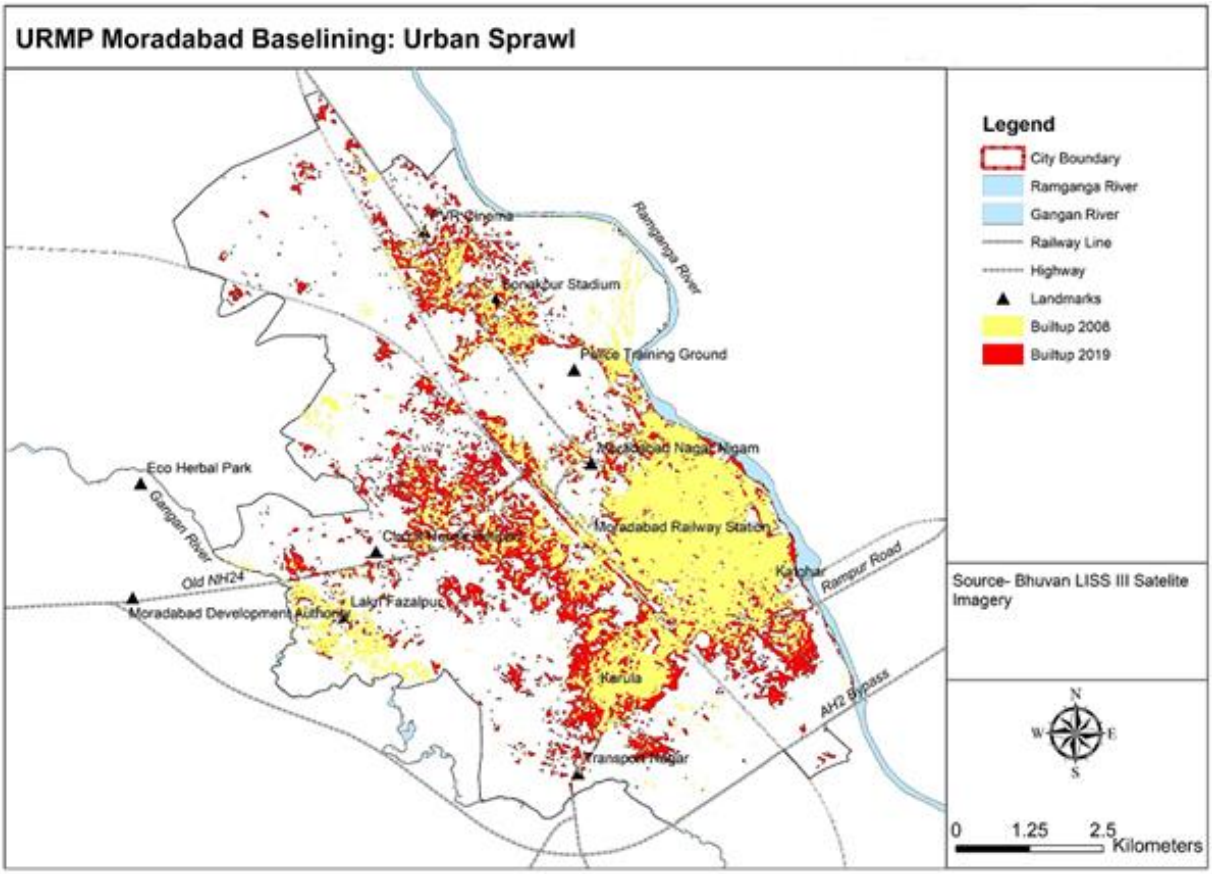


Figure 10 Map of Moradabad city indicating a rapid growth

The accompanying graphic representation (Figure 11) provides an overview of the population distribution across each ward within the Nagar Nigam Moradabad (NNM) region. This map serves to visually depict the varying levels of population density in the respective wards.

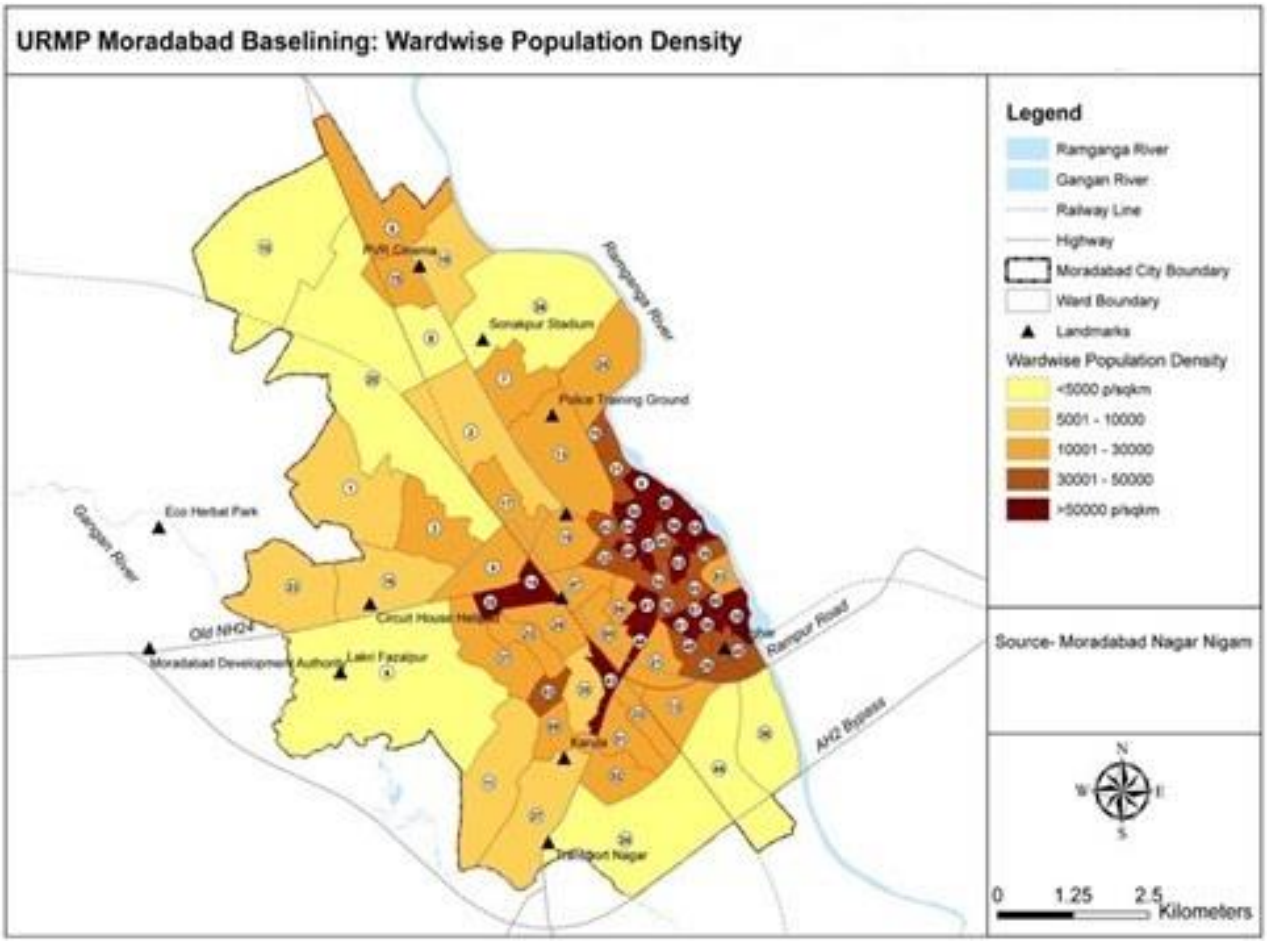


Figure 11 Map of Moradabad city showing ward-wise population density

4.3 Topography and drainage system

The Moradabad district is traversed by the Ramganga River, which serves as the primary watercourse, accommodating the convergence of several small tributaries within the district and in downstream areas. The district's hydrological system comprises five distinct river catchments, namely Ramganga, Gaagan, Dhela, Kosi, and Aril. The eastern region of the district is predominantly influenced by the Ramganga River and its affiliated tributaries, including Lapakna, Rajhera, Kosi, and Dhela, among others. Within the district's boundaries, the rivers Dhela and Gaagan join the Ramganga River, while the Aril River originates within the district's jurisdiction and subsequently flows downstream [15]. The hydrological system of the district is primarily influenced by the river Ramganga and its tributaries. The Ramganga River is subject to the influx of sewage originating from the Moradabad city, primarily conveyed through a network of 24 significant drainage channels.

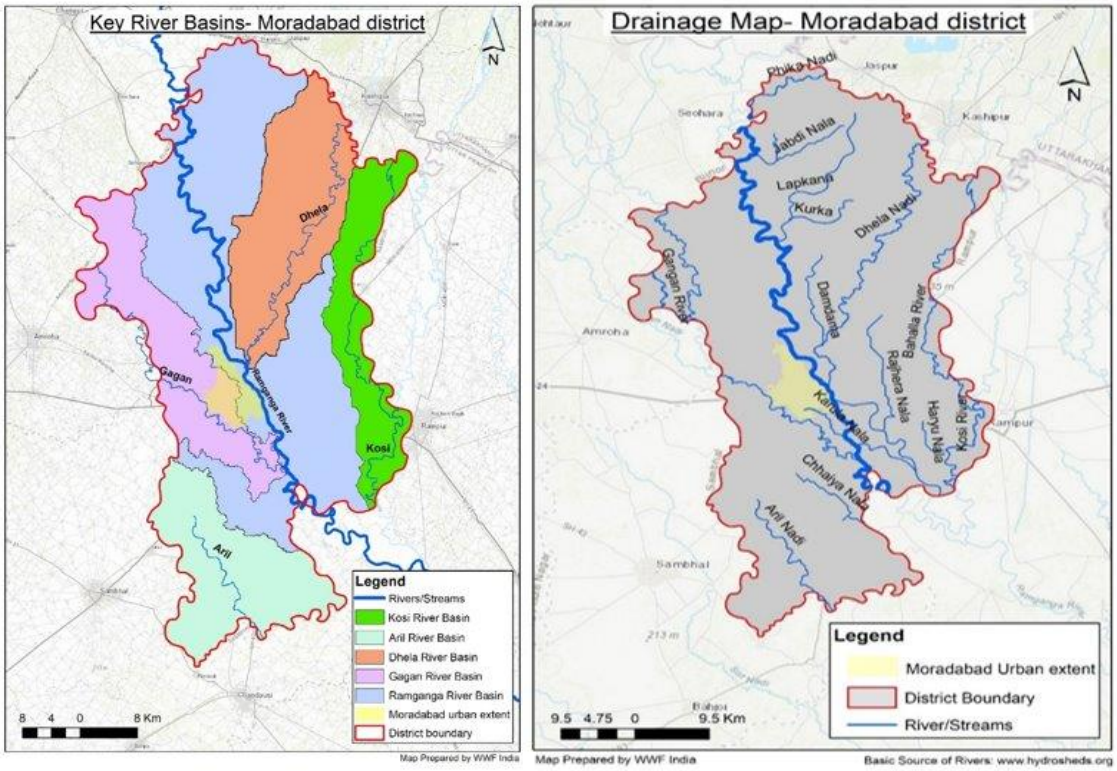


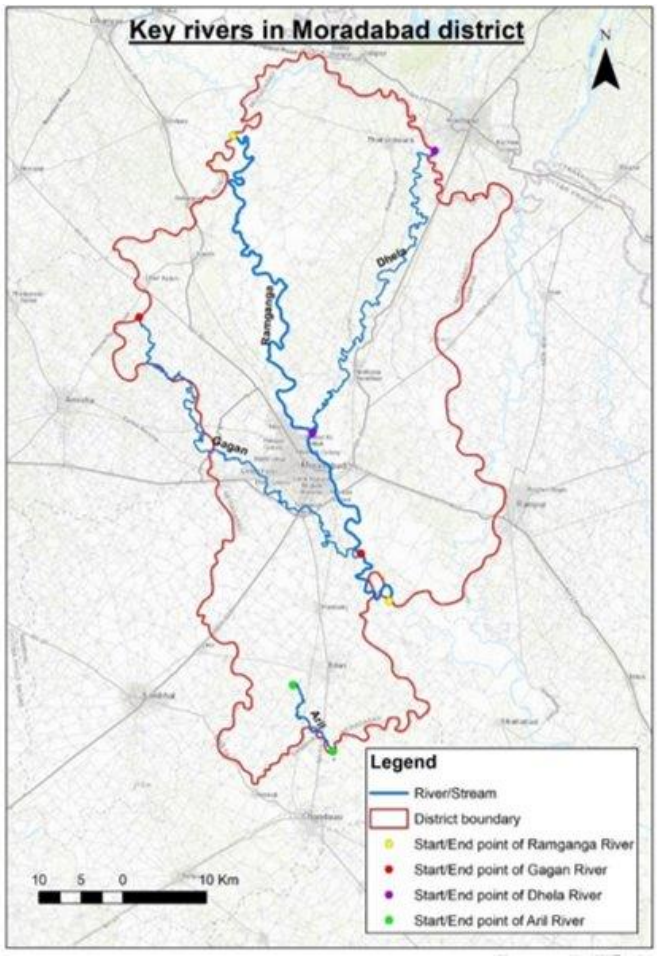
Figure 12 Moradabad district - Key River Basins (left) and Drainage Map (right). Source: WWF India (left) and Basic source of rivers - hydrosheds.org (right)

The western part of the district is drained by the Gaagan, Karula[1], and Aril rivers. Conversely, the eastern part of the district is drained by the Ramganga River and its key tributaries, namely Lapakhna, Rajhera, Kosi, and Dhela Rivers [15].

Table 3 River and its tributaries in the Moradabad district

First-order river (main river)	Second-order river (Tributary)	Third-order river (Sub tributary)
Ramganga river (97.5 Km)	Dhela (70.5 Km)	Dhandi
		Damdama (19 km)
	Gaagan (60.3 Km)	
	Aril (20.2 Km)	
	Karula (20.7 Km) Approx	
	Chhaiya	
	Lapakhna (32 km)	Kurka (10.5 km)
	Phika (10 km)	
	Kosi (18 km)	Bahalla (34 km)
	Rajhera (18 km)	

[1] The Karula River or drain mentioned here is a different from the one in upstream Bijnor district; where Agriculture Water Management work is going on. The Karula River of Bijnor district is a tributary of Gaagan River, whereas the Karula River or drain, mentioned in this document is a direct tributary to Ramganga River.



Name	Latitude	Longitude
Ramganga entry	29.1954	78.6703
Ramganga exit	28.6956	78.8721
Dhela entry	28.9967	78.5589
Dhela confluence	28.746	78.833
Gaagan entry	29.1826	78.9179
Gaagan confluence	28.8758	78.7738
Aril origin	28.603	78.756
Aril exit	28.5324	78.8065

Figure 13 Key rivers of the district Moradabad with Coordinates

Based on the recent study conducted in 2022, the basin area of the Dhela River was segmented into three zones, with zone 3 the administrative boundaries of the Moradabad district. Zone 3 encompasses the catchment area starting from Kachanalgaji in Udham Singh Nagar and extending to the Bhojpur village in the Moradabad district, where the Dhela River eventually merges with the Ramganga River near the place known as Chakkar Ki Milak. The river course within Moradabad District spans approximately 70.5 km. Within the catchment area of the Dhela River in Moradabad district, the major settlements include Pipalsana and Bhojpur, situated under the Thakurdwara Tehsil. The Dhela River enters Moradabad District near the village of Farid Nagar.

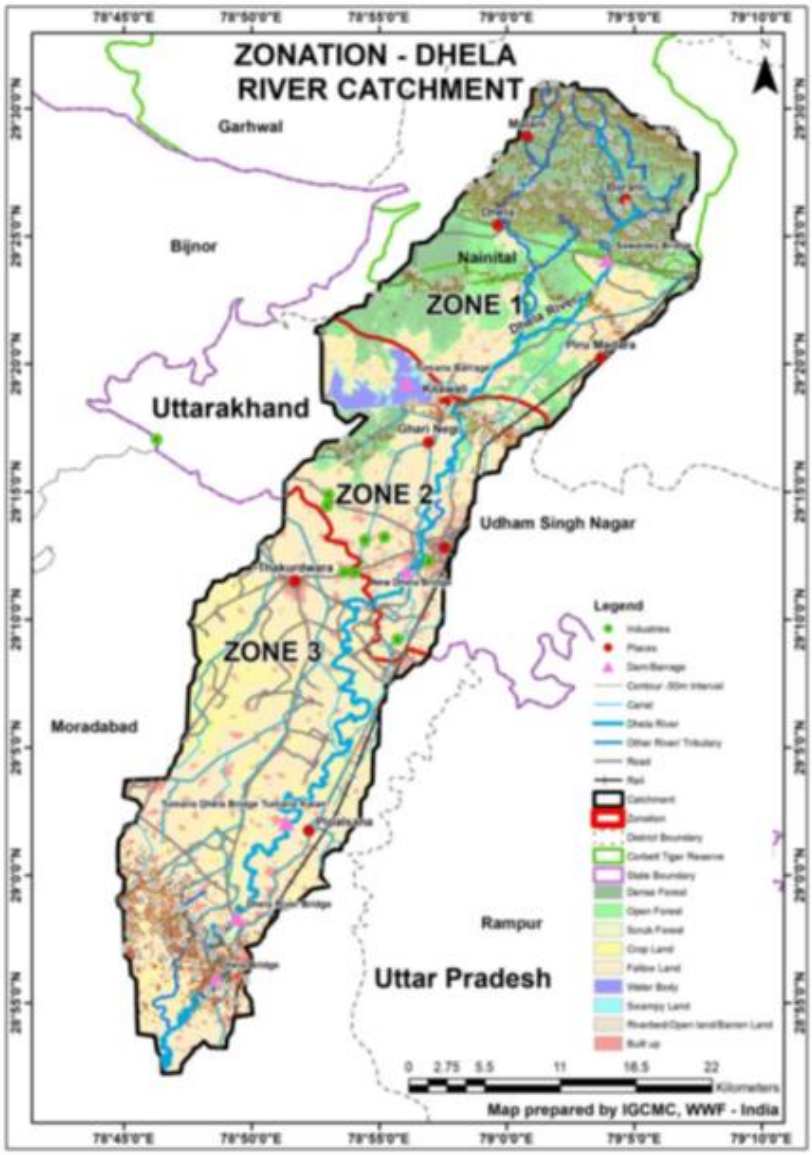


Figure 14 Zonation of Dhela River Catchment

The downstream catchment area of Dhela Basin within zone 3 of Moradabad district exhibits a varying elevation range of 188 to 250 meters. This geographical region encompasses diverse land uses, including water bodies, cultivated land for crops, and developed areas. In terms of climatic conditions, the temperatures recorded in these areas range from 27 to 28.6°C, while the annual rainfall falls within the range of 953 to 1200 mm. The prevailing soil type in this zone is primarily alluvial-derived soil, which is characteristic of the region. Additionally, a population density map is utilized to depict the distribution of population across the area, with green indicating areas of lower population density and red representing areas with higher population density.

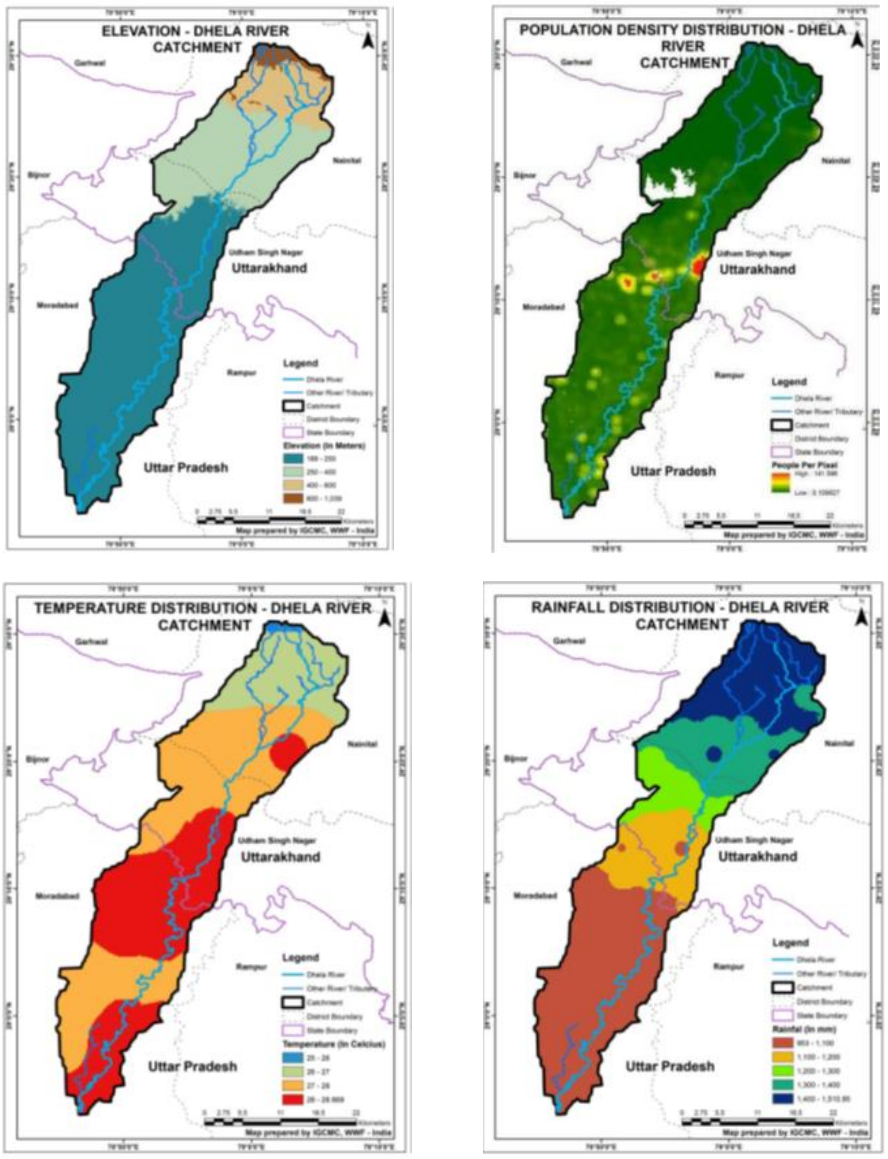


Figure 15 Graphical representations showing (a) elevation, (b) population density, (c) temperature and (d) rainfall distribution in the Dhela Basin

4.4 Rainfall and Climate

The advancement of hydrometeorology as a scientific field is intricately connected to the increased utilization of meteorology in addressing issues related to hydrology, agriculture, and groundwater studies. Rainfall data plays a pivotal role in groundwater recharge assessments, as well as in the design and construction of water resource projects. Long-term rainfall data is crucial in estimating the water flows within streams. All forms of precipitation are quantified in terms of the vertical depth of water that would accumulate on a level surface if the entire precipitation were to remain in place. For the district under consideration, the normal monsoon rainfall (1951-2000) amounts to 855.2 mm, while the normal non-monsoon rainfall stands at 137.2 mm. The average annual rainfall for the district is recorded as 992.9 mm [15]. It is worth noting that a declining trend in rainfall has been observed in the Moradabad district between 2011 and 2020, with precipitation decreasing from 1000 mm to 550 mm [16].

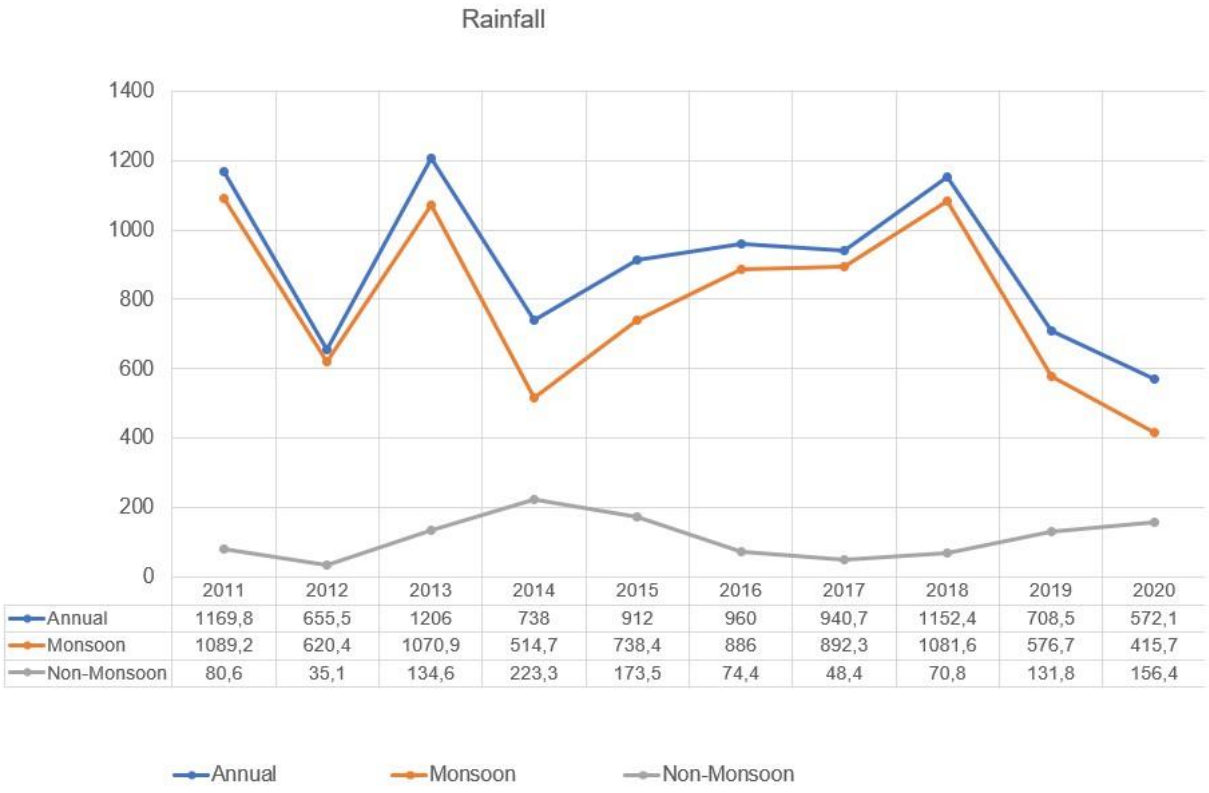


Figure 16 Recorded rainfall in Moradabad district from 2011 to 2020 during monsoon and non-monsoon times [16]

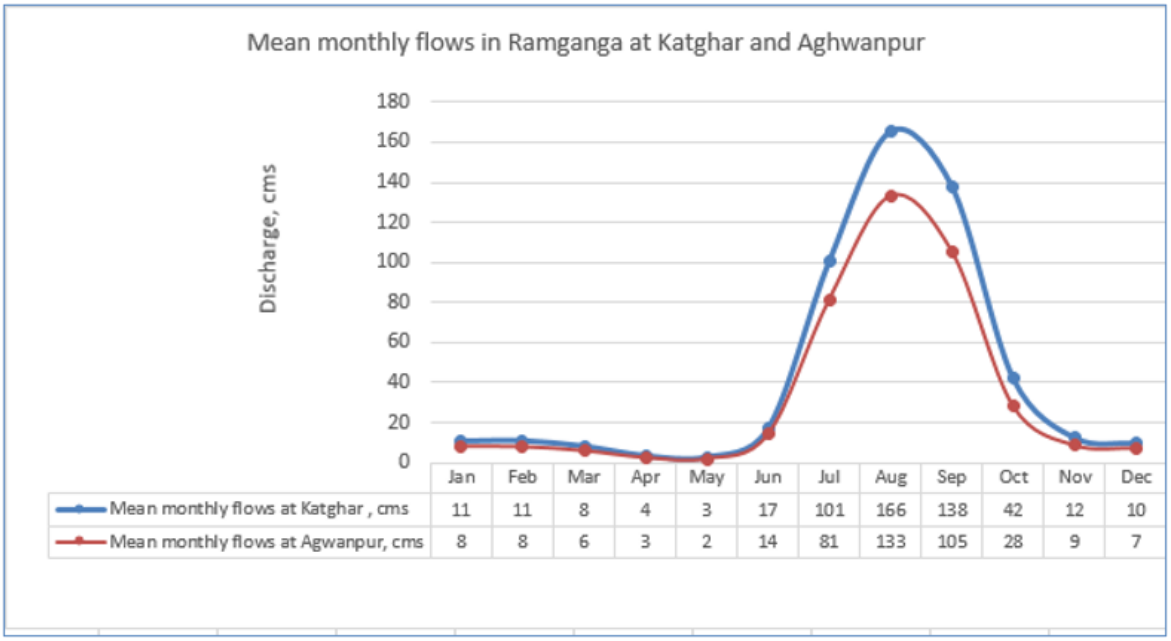
In terms of temperature, the district experiences an average minimum of 13.8°C in January and a maximum of 31.5°C in June, based on data spanning from 1991 to 2021 [16]. Significant temperature fluctuations are observed during the winter and summer months in the region. In May and June, the average daily maximum temperature reaches approximately 40°C, while

the average daily minimum temperature hovers around 25°C. Conversely, during the winter season, the average daily maximum temperature decreases to around 21°C, with the average daily minimum temperature dropping to approximately 8°C. Furthermore, when the district experiences the influence of cold waves caused by frigid winds originating from the Northern Himalayas, the temperature drops considerably, leading to even lower temperatures than the aforementioned averages [15].

4.5 Available water resources

4.5.1 Surface water (Rivers)

The Central Water Commission (CWC) has set up a gauge station at Katghar in Moradabad to monitor the water discharge of the Ramganga River. Regular measurements of the river's flow are taken from this site and Figure 17 depicts an average monthly flows regime in Ramganga River at Katghar location in Moradabad. At upstream of this location, there is another CWC gauge station near Seohara in Bijnor district. Additionally, one more gauge station has been established by WWF India and UPID (Uttar Pradesh Irrigation Department) upstream of the Ramganga River at Hareoli Barrage in the Bijnor district in 2022 (functional in lean season only). This gauge station monitors the recommended Environmental Flows (during lean season) that are being released from Hareoli Barrage.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly flows at Katghar , cms	11	11	8	4	3	17	101	166	138	42	12	10
Mean monthly flows at Agwanpur, cms	8	8	6	3	2	14	81	133	105	28	9	7

Figure 17 Mean monthly flows in Ramganga River at Katghar and Aghwanpur

The mean annual volume of water in the Ramganga River at Agwanpur, before the point of confluence with the Dhela River, has been recorded as 1000 million cubic meters (MCM) based on long-term average data spanning the last 30 years. On the other hand, after the confluence with the Dhela River, the mean annual volume of water in the Ramganga River at Katghar is recorded as 1400 MCM, considering the same long-term average data over the past three decades. It is necessary to establish an additional monitoring station at a feasible location on the tributaries of Ramganga River, which have their majority of lengths within the district. This information would be beneficial for gaining insights into the overall volume of water being discharged from the district. This will also help in monitoring and documenting baseline flows scenario of smaller tributaries which will also assist in planning river rejuvenation activities.

4.5.2 Surface water (Wetlands)

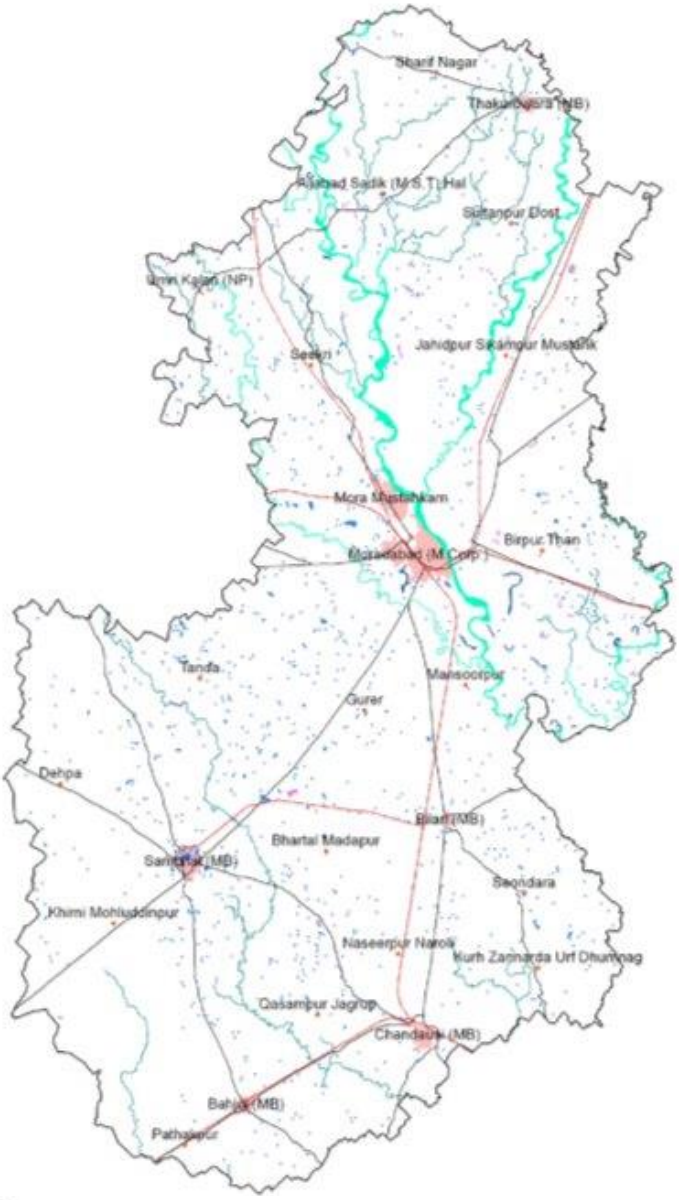
As Per the National Wetland Atlas, the overall wetland area within the district measures 7174 hectares. The predominant wetland type in the district is categorized as River/Stream, encompassing 67 percent of the total wetland area in the district. Other significant wetland types include oxbow lakes, tanks/ponds, and waterlogged areas. The waterlogged category attributed to human activities, particularly associated with canals, covers an area of 185 hectares. A total of 1083 small wetlands, each measuring less than 2.25 hectares, have been identified and marked off. During the post-monsoon season, the area occupied by aquatic vegetation is 386 hectares, while in the pre-monsoon season, it is 68 hectares. The water spread area during the post-monsoon season amounts to 3013 hectares, whereas, in the pre-monsoon season, it measures 2203 hectares. Moderate turbidity is predominantly observed across numerous wetlands in the district [17].

Area in ha

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Open Water	
						Post-monsoon Area	Pre-monsoon Area
	1100	**Inland Wetlands - Natural**					
1	1101	Lakes/Ponds	28	224	3.12	83	63
2	1102	Ox-bow lakes/ Cut-off meanders	24	268	3.74	189	116
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	4	22	0.31	22	13
5	1105	Waterlogged	27	242	3.37	168	184
6	1106	River/Stream	52	4874	67.94	3013	2203
	1200	**Inland Wetlands -Man-made**					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	61	276	3.85	193	116
9	1203	Waterlogged	21	185	2.58	147	72
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	**217**	**6091**	**84.90**	**3815**	**2767**
		Wetlands (<2.25 ha), mainly Tanks	1083	1083	15.10	-	-
		Total	**1300**	**7174**	**100.00**	**3815**	**2767**

Figure 18 Area estimates of wetlands in Moradabad [17]

Symbol	Typecode	Level I	Level II	Level III
		Inland Wetlands		
			Natural	
	1101			Lakes/Ponds
	1102			Ox-bow lakes/ Cut-off meanders
	1103			High altitude wetlands
	1104			Reverine wetlands
	1105			Waterlogged
	1106			River/Stream
			Man-made	
	1201			Reservoirs/Barrages
	1202			Tanks/Ponds
	1203			Waterlogged
	1204			Salt pans
		Coastal Wetlands		
			Natural	
	2101			Lagoons
	2102			Creeks
	2103			Sand/Beach
	2104			Intertidal mud flats
	2105			Salt marsh
	2106			Mangroves
	2107			Coral reefs
			Man-made	
	2201			Salt pans
	2202			Aquaculture ponds



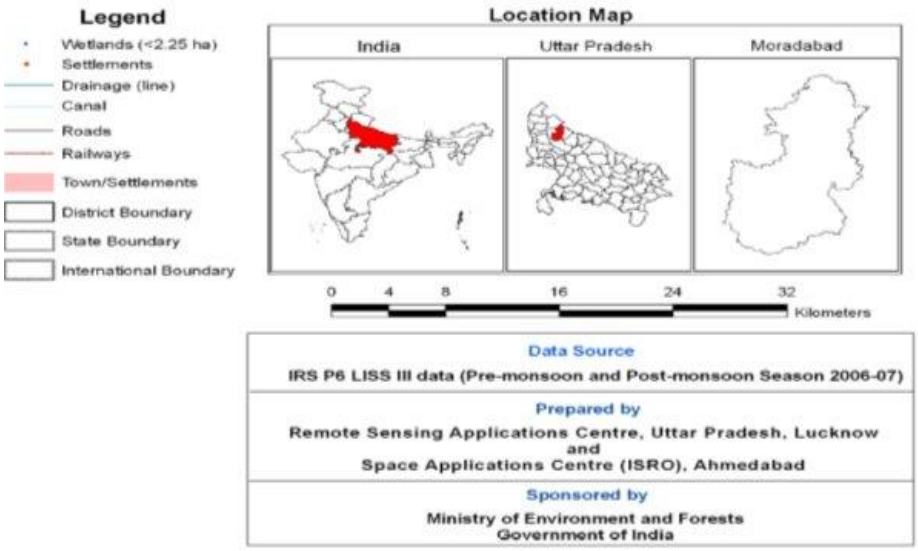


Figure 19 Locations of wetlands in Moradabad district

A joint initiative between WWF India and IIT (Indian Institute of Technology) Kanpur was undertaken to conduct a comprehensive study (during 2020-21) aimed at assessing the current state of wetlands within the Ramganga basin. The study specifically focused on examining the connectivity of these wetlands with the rivers (river wetlands relationship). The analysis resulted in the identification of four distinct categories of wetlands based on their characteristics and behaviour during the study period.

A total of 122 wetlands were successfully identified in Moradabad district and categorized according to the following classifications (Figure 20):

- Persistent: Wetlands falling under this category were mapped using pixels exhibiting a Wet% value ranging from 90% to 100%. This indicates that these pixels remained consistently wet for at least 90% of the duration of the study. Persistent wetlands, also known as permanent wetlands, refer to the areas of land that remain saturated or inundated with water for extended periods, typically throughout the year or for a significant period of it. These wetlands are characterized by a high water table, resulting in the presence of standing water or saturated soil conditions that support unique ecosystems. Persistent wetlands play crucial ecological roles by providing habitat for specialized plant and animal species, contributing to water storage and filtration, and supporting overall biodiversity
- Intermittent: These wetlands displayed intermittent patterns of being alternately wet and dry throughout the study period. Intermittent wetlands, also known as seasonal wetlands, are areas of land that experience fluctuations in water availability throughout the year. Unlike persistent wetlands, which remain wet or saturated for extended periods, intermittent wetlands may undergo periods of complete drying or significantly reduced water levels during certain seasons or climatic conditions. These wetlands are typically dependent on seasonal rainfall to fill up with water. During wet periods, they support diverse aquatic ecosystems, including unique plant and animal species adapted to these dynamic conditions. However, during dry periods, the wetland may appear as dry land or contain only isolated pockets of water. Intermittent wetlands play essential roles in water storage, nutrient cycling, and providing critical habitats for various species, particularly those adapted to both aquatic and terrestrial environments.

- Intensifying: Wetlands falling within this category demonstrated a higher frequency of being wet in recent times compared to their historical state between 1990 and 1994. These are the wetlands that experience an expansion in the water-spread area over time and are often referred to as expanding wetlands or growing wetlands. These wetlands demonstrate an increase in the extent of their water-covered areas, which can result from various factors such as changing hydrological patterns, increased rainfall, reduced evaporation, or altered land use practices in their surrounding areas.
- Diminishing: Wetlands categorized as diminishing displayed a reduced frequency of being wet in recent times compared to their historical state. Diminishing wetlands refer to wetland areas that are experiencing a reduction in their extent or ecological quality over time. These wetlands are undergoing a process of decline, often due to various factors such as habitat loss, drainage for agriculture or urban development, pollution, invasive species, altered hydrological regimes, or climate change impacts. The reduction in wetland areas can result in the loss of critical habitats for numerous plant and animal species, leading to declines in biodiversity. Diminishing wetlands also have implications for water storage, flood control, water quality, and other ecosystem services that wetlands provide. Conservation efforts are essential to protect and restore diminishing wetlands to ensure their ecological functions and the benefits they provide to both wildlife and human communities.

Additionally, two further classifications were assigned:

- New: This category comprises wetlands that have formed only within the past five years, indicating recent development.
- Lost: Wetlands falling into this category have been lost or disappeared within the past five years.

Furthermore, these wetlands were further categorized based on their size and proximity, specifically within a 5-kilometre radius of the river.

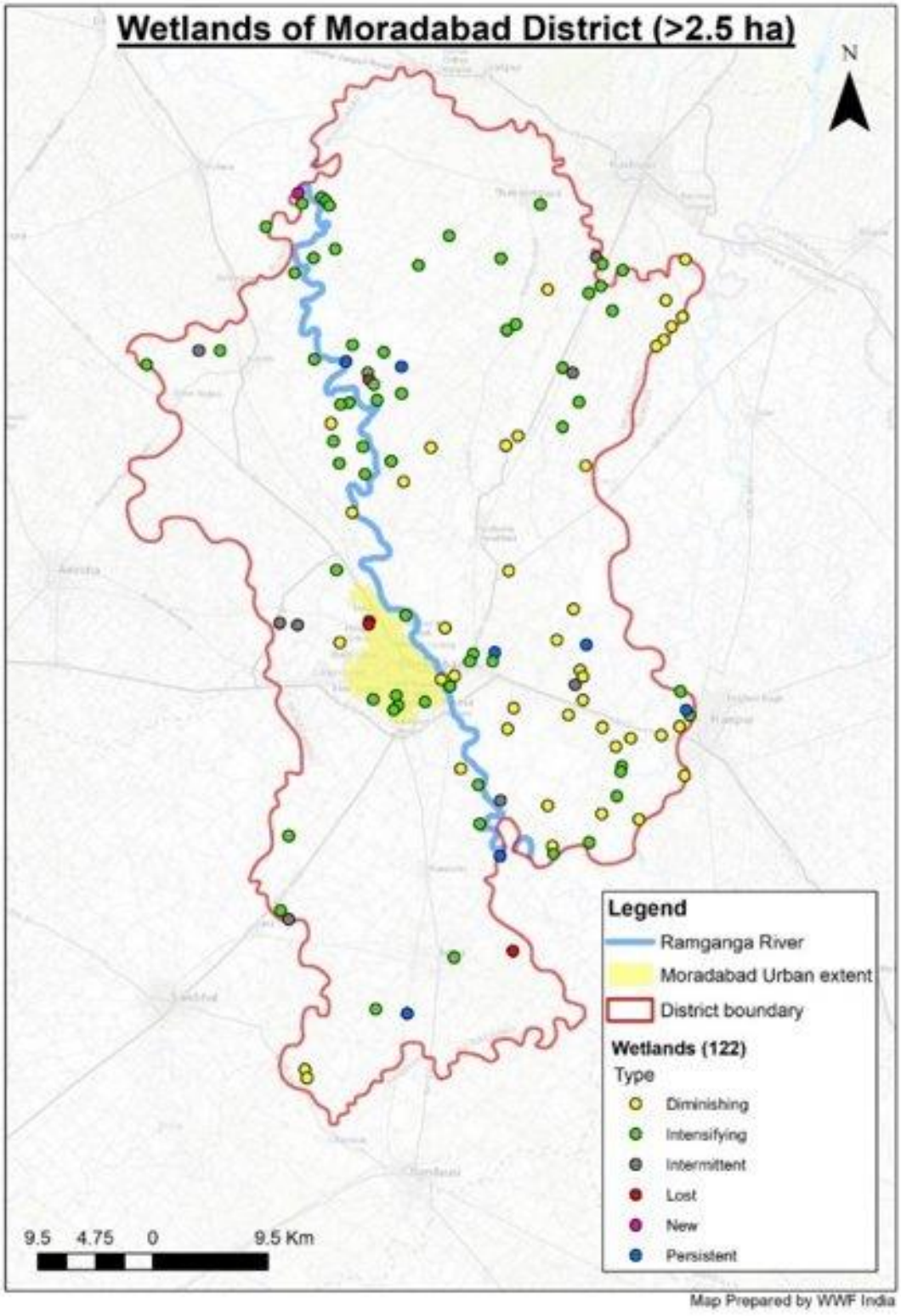


Figure 20 Types of wetlands in Moradabad District

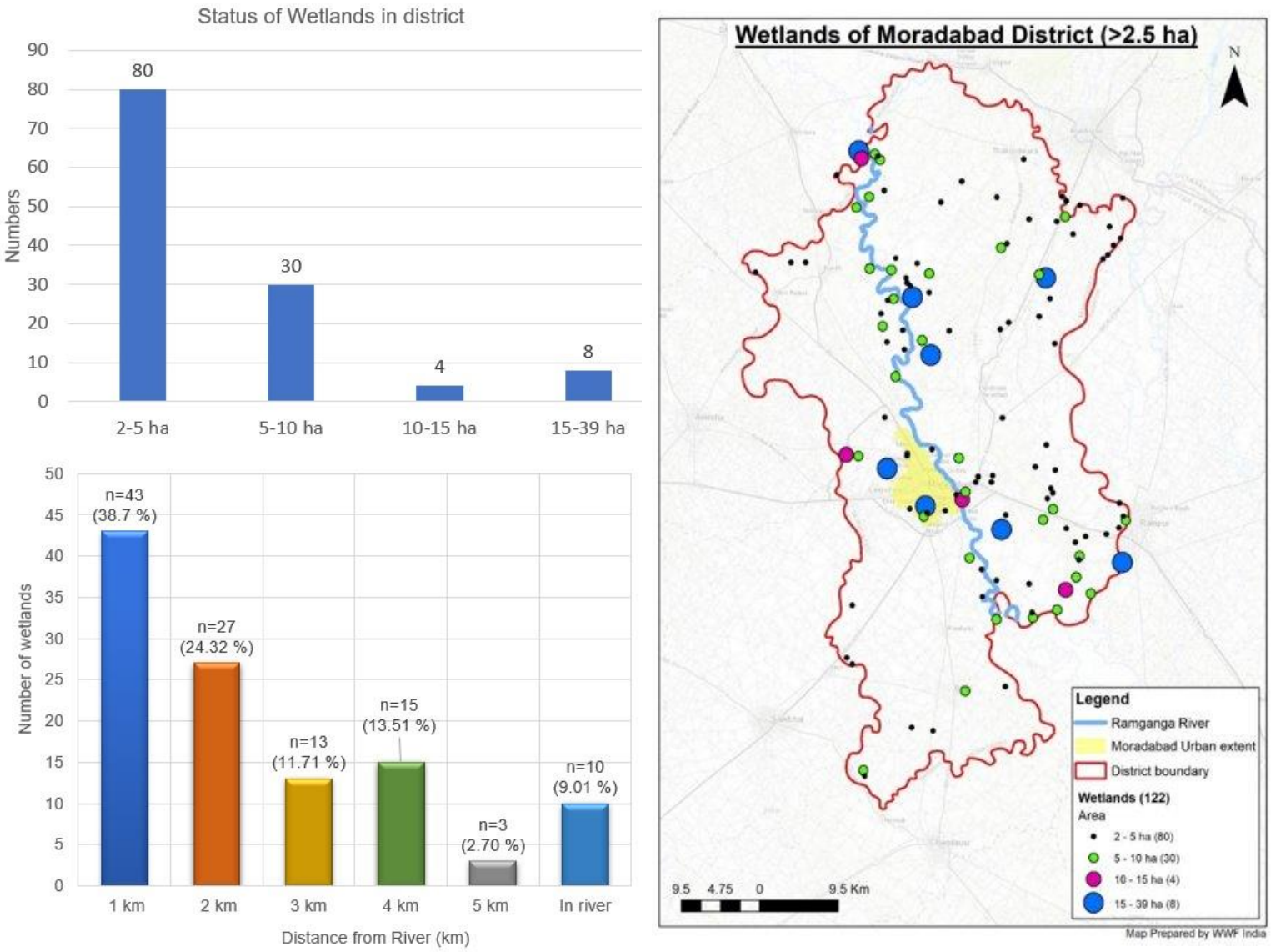


Figure 21 Status of wetlands in Moradabad district

A comprehensive assessment of floodplain wetlands mapping was conducted in the Thakurdwara and Dilari Blocks. This was a collaborative effort between the District Administration Moradabad and WWF India resulting in a joint survey of the wetlands in Thakurdwara. The survey, conducted from January to February 2019, identified a total of 111 floodplain wetlands. Of these, water was observed in 46 wetlands, while 55 were found to be dry. These wetlands were distributed across 26 villages within the surveyed area. Based on the survey findings, a total of 16 wetlands were recommended for restoration under the MNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme to revive their ecological functioning. This successful endeavour suggests the potential for conducting

similar wetlands mapping projects in other Tehsils like Moradabad, Kanth, and Mundapandey etc. within the Moradabad region.

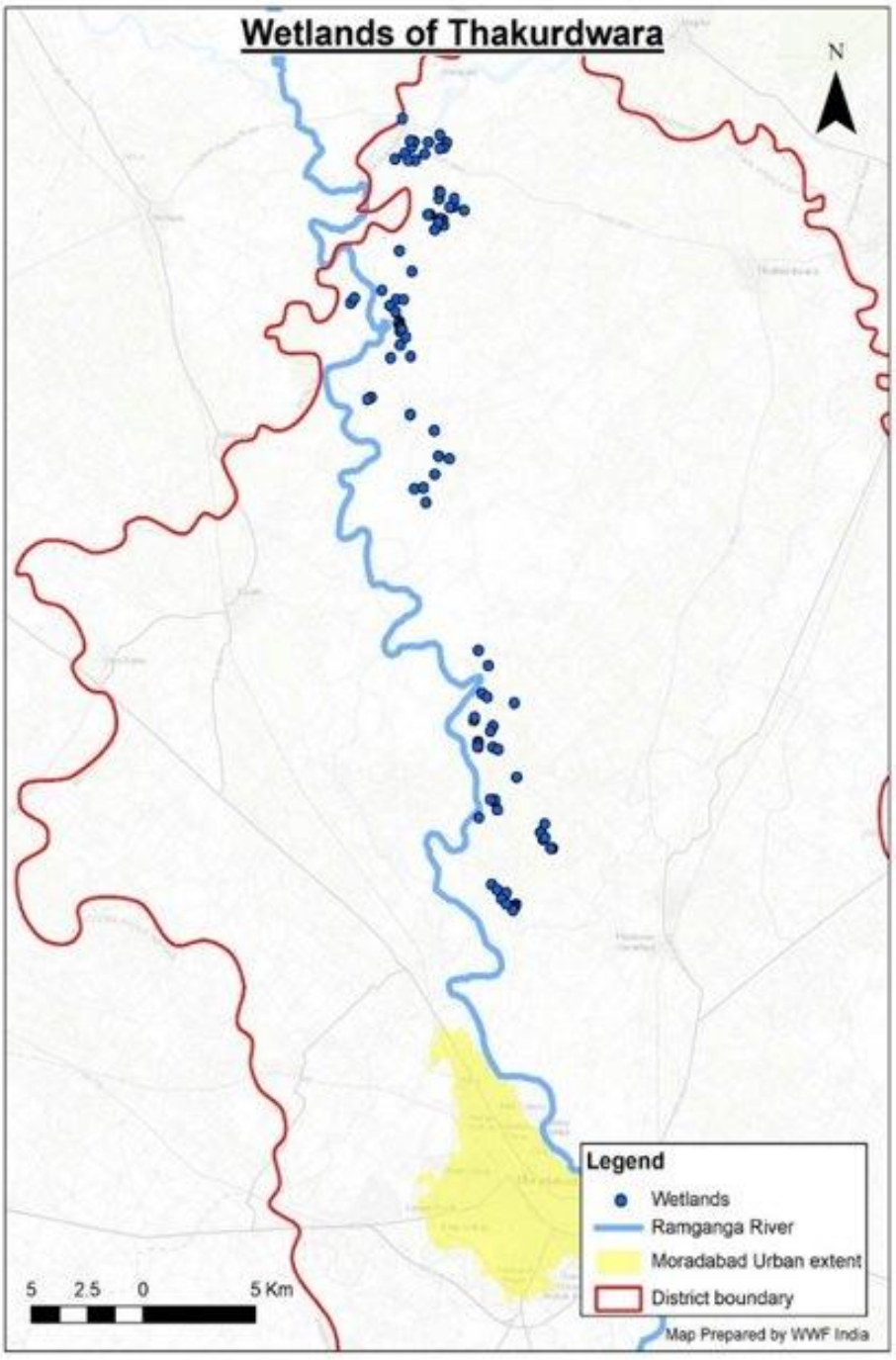


Figure 22 Wetlands of Thakurdwara

A complete assessment was conducted on each wetland to evaluate various threats, encompassing domestic activities such as bathing, the release of domestic sewage, fishing, pollution from solid waste, encroachment, and agricultural practices. The results (Figure 23) revealed that encroachment emerged as the most significant threat, affecting 69.4% of the

surveyed wetlands. This was followed by solid waste pollution, impacting 34.2% of the wetlands, while pollution resulting from sewage disposal was observed in 31.5% of the wetlands.

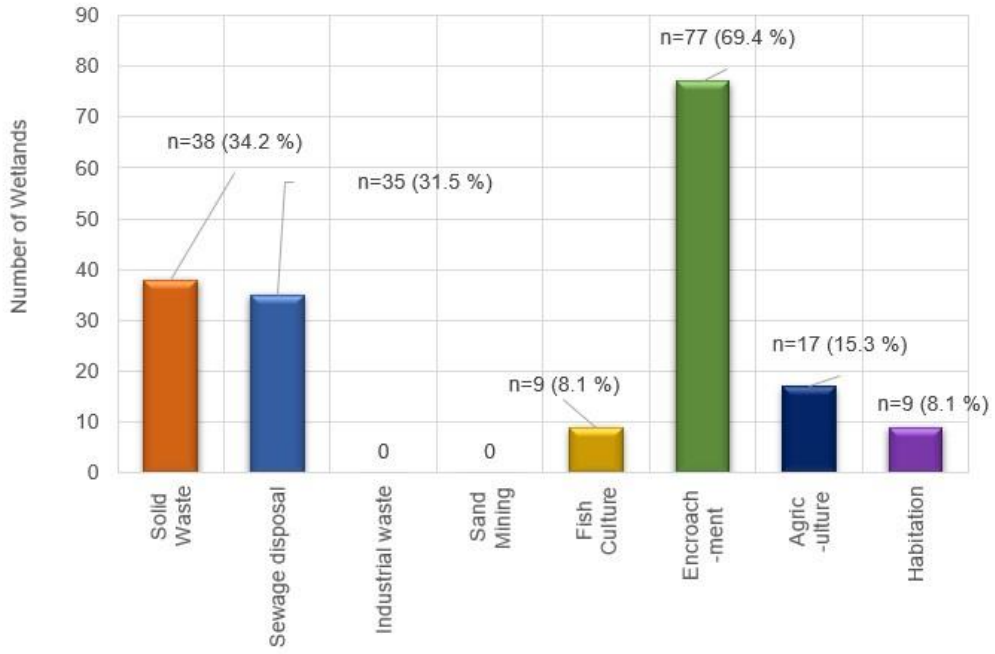


Figure 23 Threats to wetlands in Thakurdwara and Dilari Blocks

Apart from this study, a mapping endeavour was also undertaken to assess floodplain wetlands located along the Ramganga River. The survey focused specifically on 11 prioritized floodplain wetlands within the district (Figure 24), as identified in the WWF India-IIT Kanpur report. Ground truthing activities were conducted to validate and gather data on specific parameters related to these wetlands.

In addition to the Floodplain wetlands, urban wetlands were also mapped in Moradabad city. The Moradabad city underwent a comprehensive Census of Urban Wetlands in 2014, led by the *Ramganga Mitras*[2]. Based on the 2013 Nagar Nigam data, a total of 87 wetlands were reported, with 6 of them having multiple (2 or more) *gata* numbers. Consequently, the city had 80 wetlands as per the list. Findings from the "*Hamare Talaab, Hamari Dharohar*" campaign revealed that out of the 80 wetlands, 47 were still in existence, while 33 had

[2] Group of active citizens in the Ramganga basin, who join the Ramganga conservation efforts on voluntary basis. In this multi-stakeholder group, people come from different walks of life, for instance – government departments, district administration, social workers, civil society, teachers, youth, businessmen etc.

completely vanished. This implies that the city has experienced a rapid loss of 41% of its wetlands, equivalent to a loss of 3.9 hectares of wetland area.

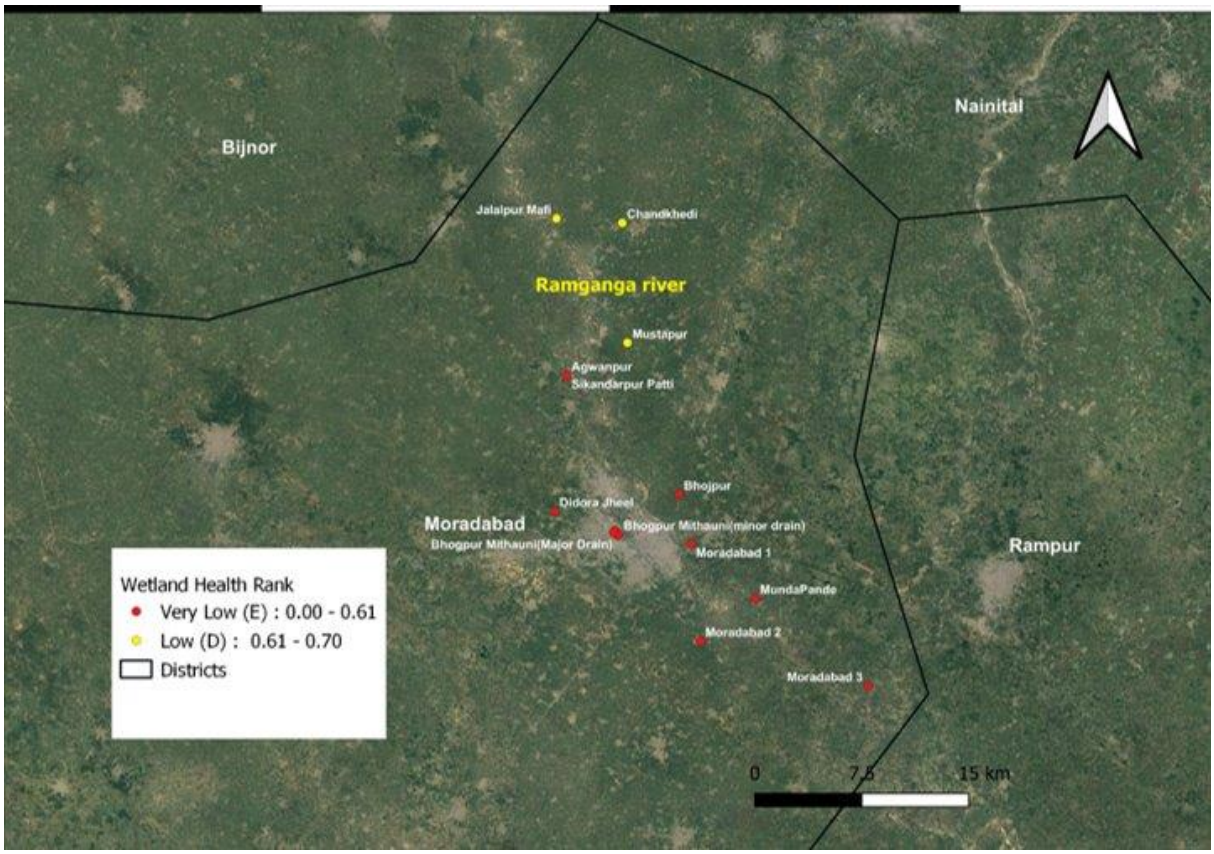


Figure 24 Ten Prioritized floodplain wetlands along the Ramganga River

During the campaign, an additional 10 new wetlands were identified, resulting in a total count of 57 wetlands in the city (47 existing and 10 new). These 57 wetlands are distributed across 14 wards, meaning that 46 wards in the city do not have any wetlands. Consequently, now after 10 years of last such survey, there is a need to conduct a similar survey in the city to ascertain the current status of wetlands and identify any changes that may have occurred.

4.5.3 Groundwater

Groundwater is present within the pore spaces of the unconsolidated alluvial sediments in the saturation zone. The near-surface sediments, reaching depths of up to 30 meters, consist of fine to medium-grained sand with occasional thin clay layers. Groundwater in this zone typically exists under unconfined conditions, where dug wells and common hand pumps are commonly constructed. Above this zone, between two to six meters in depth, the sediments primarily exhibit an argillaceous nature, composed of silt and clay. Beneath this cover lies the sand formation, which forms the upper aquifer. This aquifer is largely unconfined and

accommodates numerous cavity wells, dug wells, domestic hand pumps, and shallow private tube wells. These water sources are utilized for domestic purposes, gardening, and irrigation purposes by marginal farmers. Groundwater in the second and third aquifers occurs under semi-confined to confined conditions [18].

Moradabad district is characterized by the presence of Quaternary alluvium, which has been deposited by the Ganga and Ramganga river systems. From a lithological perspective, the alluvial sediments consist of varying proportions of sand, silt, clay, and *kankars*. The Moradabad district consists mainly of alluvial soil, with a specific yield estimated at 16% and rainfall infiltration at 22% for all its blocks [15].

Table 4 The summary of the estimation of dynamic groundwater resources in Moradabad district [15].

1	Total Annual ground water recharge by all sources	= 76059.02 ham
2	Net ground water available in the district.	= 69092.04 ham
3	Existing gross ground water draft for all uses	= 66773.43 ham
4	Provision for domestic, industrial requirement up to 2025	= 79691.26 ham
5	Net ground water available for future irrigation development	= 5800.72 ham
6	Stage of ground water development average of district	= 96.64 %.
7	Over exploited Moradabad city	
8	Critical Block is Bilari	= 1
9	Semi Critical blocks are Dingarpur, Mundapandey, Chhajlet, Dilari, Moradabad and Bhagatpur Tanda	= 6
10	Safe blocks (Thakurdwara)	= 1

The rivers in the district, including Ramganga, rely on groundwater as their primary source of water. Analysis of data from the past decade reveals a consistent decrease in both rainfall and the groundwater table. Specifically, the rainfall has declined from 1000 mm to 550 mm (Figure 25). Additionally, the groundwater levels have experienced a decline of approximately 4-5 meters at the district level. Currently, there is a lack of significant large-scale rainwater harvesting systems implemented within the district.

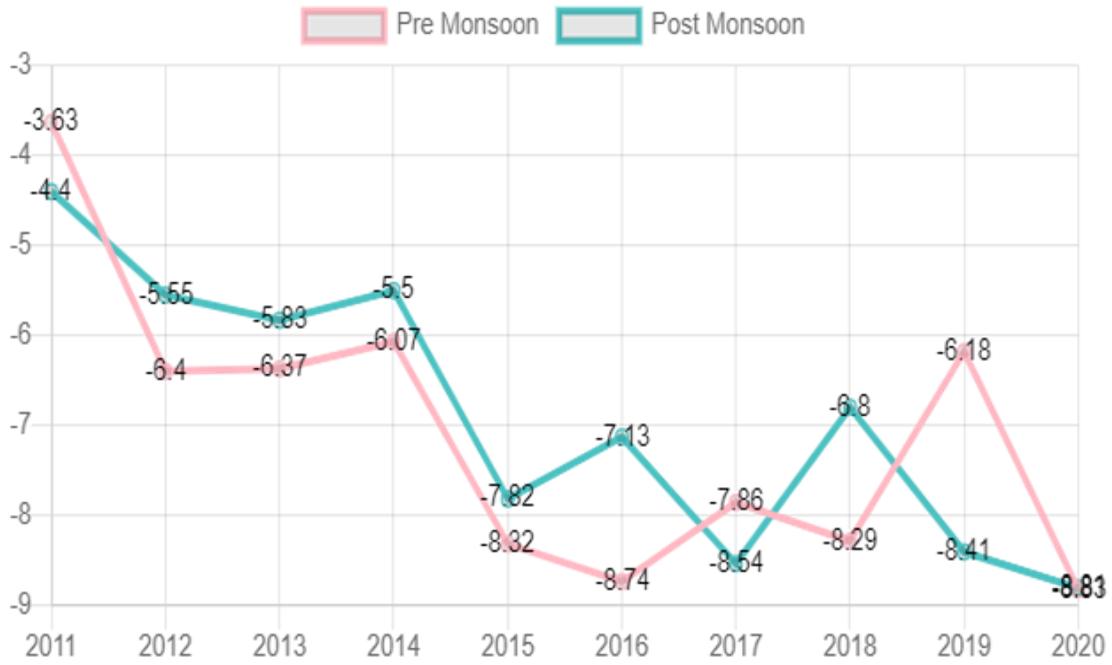


Figure 25 Decline in Groundwater table levels over the past ten years in the district [16]

Table 5 Recharge & Discharge Estimates of Moradabad district [15]

S.No.	Assessment Unit- Blocks	Recharge from Rainfall during Monsoon Season	Recharge from Other Sources during Monsoon Season	Recharge from Rainfall during Non-Monsoon Season	Recharge from Other Sources during Non-Monsoon Season	Total Annual Ground Water Recharge
1	BHAGATPUR TANDA	5911.55	674.98	660.11	898.13	8144.77
2	BILARI	4454.17	743.67	720.66	976.80	6895.30
3	CHHAJLET	7719.87	1826.38	811.54	2420.53	12778.32
4	DEENGARPUR	7391.88	851.68	825.41	1150.27	10219.24
5	DILARI	3787.57	3121.46	629.39	3310.23	10848.65
6	MUNDA PANDEY	7392.40	819.00	825.47	1343.76	10380.63
7	MORADABAD	3009.73	534.53	504.12	917.41	4965.78
8	THAKURDWARA	3745.09	3320.29	622.34	4138.61	11826.33
	TOTAL	43412.26	11891.99	5599.04	15155.74	76059.02

Table 6 Dynamic Ground Water Resource of Moradabad district [15]

S.No.	Blocks	Net Annual Ground Water A vailability	Existing Gross Ground Water Draft for All Use (4+5)	Provision for Domestic and Industrial Requirement Supply for next 25 years	Net Ground Water Availability for future Irrigation development (3-4-7)	Stage of Ground Water Development (6/3)* 100 (%)	Category
1	2	3	6	7	8	9	10
1	BHAGATPUR TANDA	7330.30	7300.42	946.14	0.00	99.59	CRITICAL
2	BILARI	6205.77	8058.38	714.72	0.00	129.85	OE
3	CHHAJLET	12139.40	11352.31	906.17	474.83	93.52	CRITICAL
4	DEENGARPUR	9197.31	7816.62	1312.49	895.16	84.99	SAFE
5	DILARI	9763.78	13364.05	1154.55	0.00	136.87	OE
6	MUNDA PANDEY	9342.57	7078.79	988.85	1895.27	75.77	SAFE
7	MORADABAD	4469.20	3590.44	1153.51	373.26	80.34	SAFE
8	THAKURDWARA	10643.69	8212.42	792.83	2162.18	77.16	SAFE
	TOTAL	**69092.04**	**66773.43**	**7969.26**	**5800.72**	**96.64**	

The block-level groundwater data of Moradabad district reveals a decline in water levels specifically in Bhagatpur Tanda, Bilari, Chajlet, and Dingerpur, while the remaining blocks have remained relatively stable. Notably, blocks such as Dilari and Mundapandey, which are located adjacent to the Ramganga River, have either maintained stability or shown improvements in groundwater levels (Figure 26). On the other hand, blocks like Billari, which are situated away from the river, have experienced the maximum decline.

Within Moradabad District, six blocks fall under the semi-critical category in terms of groundwater availability. However, Moradabad city is classified as being in an over-exploited zone. This can be attributed to the high population density in the city, leading to significant water extraction for domestic, industrial, and agricultural purposes [16]. Bilari is in critical and Thakurdwara is in a safe zone.

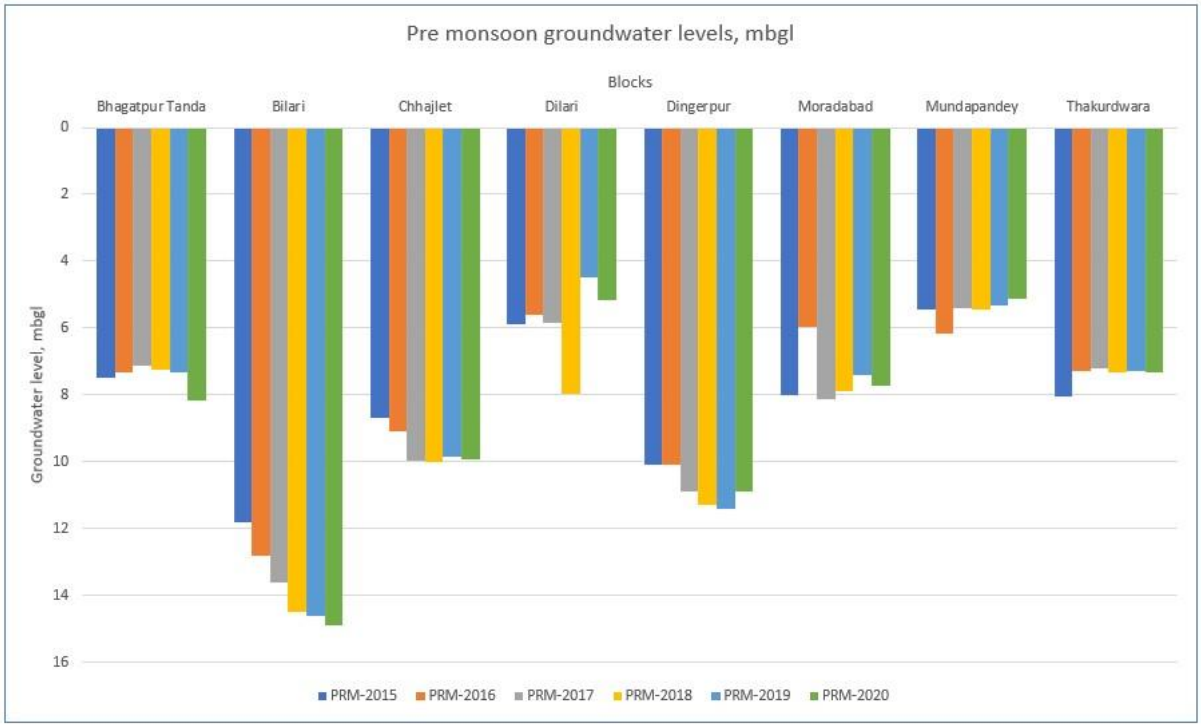
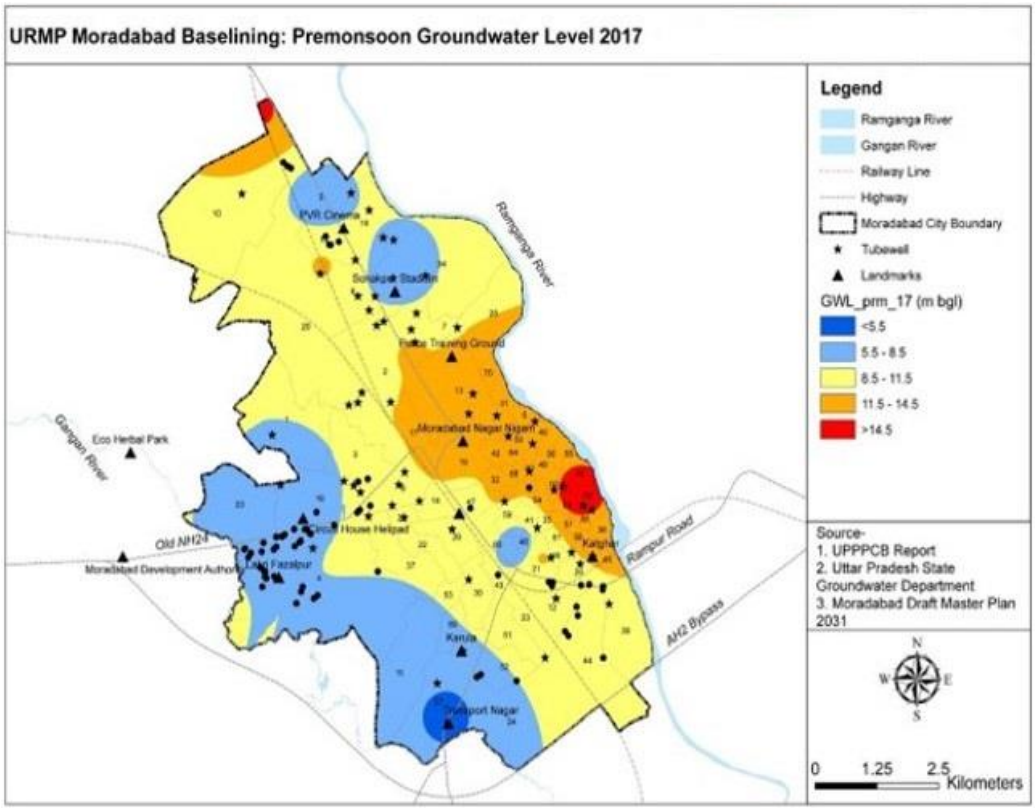


Figure 26 Block-wise Average Depth of Water level of Moradabad District [16]

The groundwater situation in Moradabad City is currently a matter of concern. The city relies solely on groundwater as its primary water source, with an extraction rate of approximately 190 million litres per day (MLD) to meet domestic water demand. Alarming findings from the monitoring conducted by the state groundwater department indicate a significant decline in groundwater levels, with a reduction of 90 cm per year. These findings raise concerns about the sustainability of the current extraction rates. According to the NAQUIM (National Aquifer Mapping and Management Program), report specifically addressing Moradabad district, the stage of groundwater extraction in this area is estimated to be at 80.34%, classifying it as a semi-critical situation. As a result, the city is in urgent need of innovative strategies to reduce its reliance on groundwater and ensure its judicious and sustainable use [15].

Analysis of groundwater data from the years 2017 and 2021 indicates a consistent and concerning downward trend in the water table, particularly in the western region of the city, which coincides with the concentration of industrial activities. This decline in groundwater levels is anticipated to intensify in the future due to increased water consumption rates.



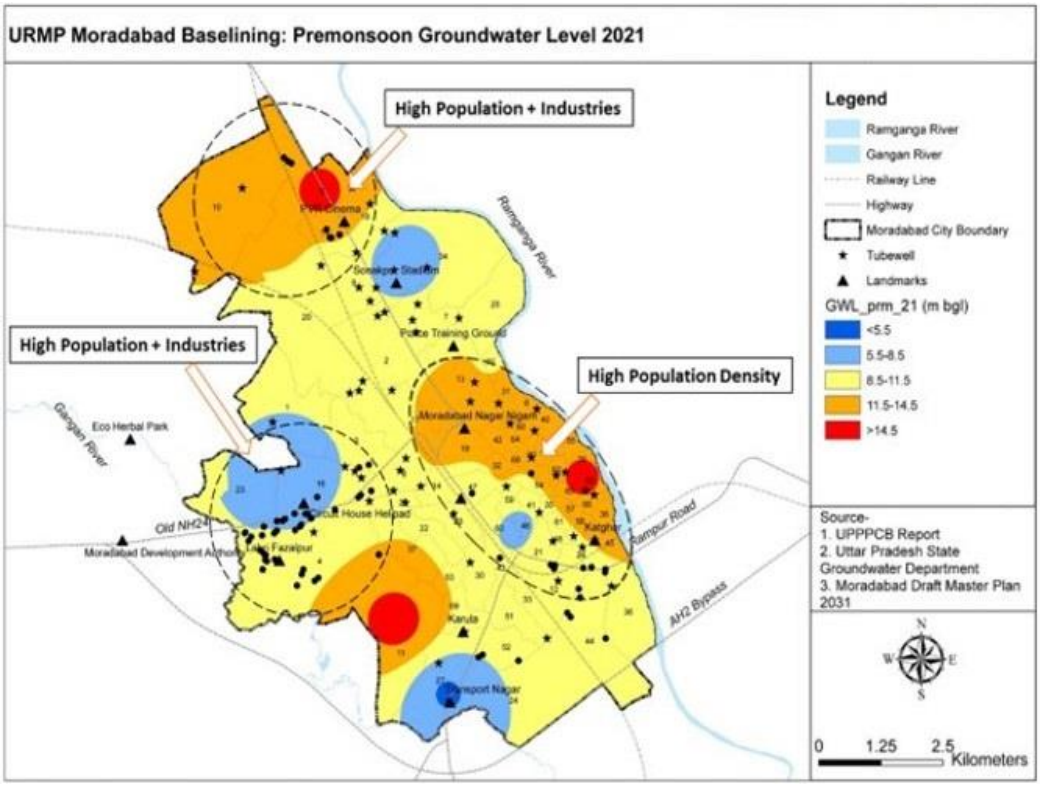
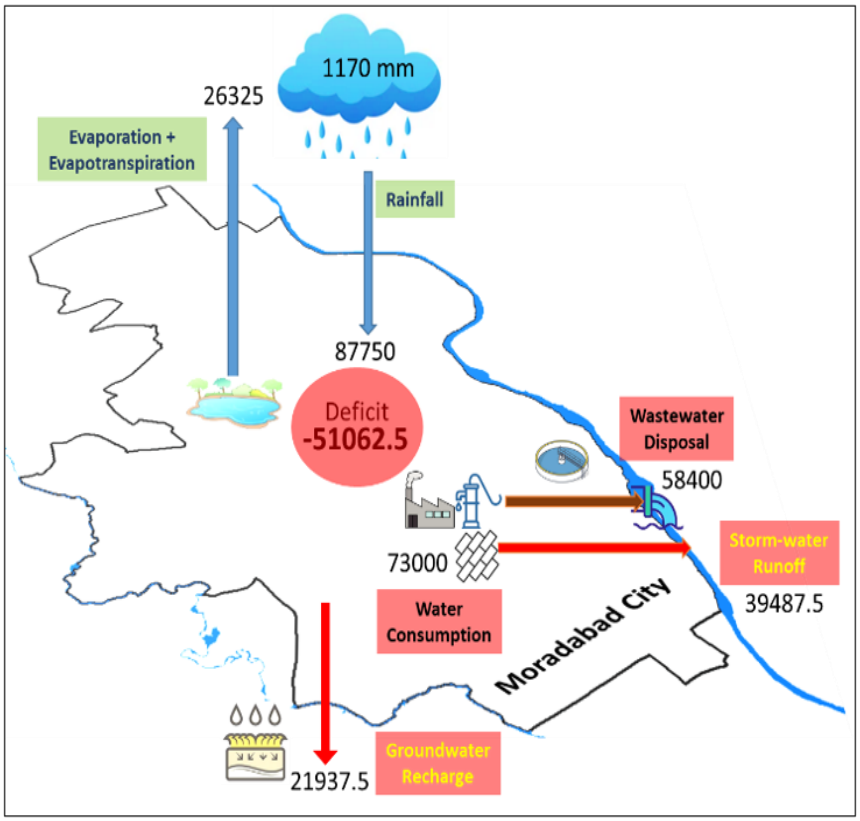


Figure 27 Comparison of Groundwater scenario in Moradabad city from 2017 and 2021

The water budget of Moradabad City has been evaluated by considering various factors such as the city's area of 75 square kilometres, an average annual rainfall of approximately 1100 mm, and accounting for normal recharge conditions, runoff, and natural water losses. Based on these considerations, an estimated water budget has been formulated. However, the analysis reveals a negative net water balance for the city, indicating that the withdrawal of water exceeds the annual demand met through rainfall input. This suggests a deficit in the available water resources to meet the city's water requirements.



Scenario 1 – Business-as-Usual		
Rainfall availability for 75 sq.km.@ 1170 mm/year	87,750	ML
Natural recharge – 25%	21,937.5	ML
Runoff (Stormwater flow) – 45%	39,487.5	ML
Evapotranspiration – 30%	2,6325	ML
Water Balance		
Water Demand(Consumption) @200 MLD	73,000	ML
Net water balance	-51,062.5	ML
Negative Water Balance (over extraction of groundwater)		

Figure 28 Water budget of the Moradabad city. Source: Urban River Management Plan (under submission)

The Tumaria reservoir, Dhela feeder, and Dehla Barrage are situated along Dehla River in Uttarakhand. In recent years, these water bodies have experienced a significant decline in water levels, accompanied by a reduction in groundwater recharge during the monsoon season. This decline can be attributed to changes in rainfall patterns and the escalating demands of the growing population for industrial and agricultural purposes.

The groundwater quality in specific locations is a cause for concern. Farid Nagar village (Tehsil Thakurdwara) exhibits heavily polluted water with depths ranging from 80 to 100 feet. Basai experiences heavily polluted water at a depth of 180 feet. Bhojpur encounters water pollution

with depths of 50 to 60 feet. Chandpur suffers from water pollution with depths of 90 to 100 feet. Lalpur Baxaura faces slightly polluted water at depths ranging from 100 to 150 feet.

4.6 Water quality

4.6.1 Surface water

Moradabad is renowned as "Peetal Nagri" due to its brassware industries. The impact of urban and industrial activities on the water quality of the Ramganga River in Moradabad has been significant [19]. Table 7 presents an analysis of several key parameters, namely pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total coliform, and faecal coliform. The analysis covers the period from January to August 2022 and focuses on two specific locations: upstream of the Ramganga River at Agwanpur and at Katghar, situated beneath a road bridge. This assessment was achieved by summarizing the multiple water test results into a single indicator known as the Water Quality Index (WQI). The WQI serves as a concise measure for water quality management and decision-making purposes [19].

Table 7 Surface water characteristics in Rivers of Moradabad [20]. The green colour represents a value less than the permissible limit, whereas red represents a value exceeding the permissible limit.

Location	u/s Ramganga river, Agwanpur						Katghar under road bridge					
Year 2022	**pH**	**DO (mg/l)**	**BOD (mg/l)**	**COD (mg/l)**	**Total Coliform (MPN/ 100 ml)**	**Feacal Coliform (MPN/ 100ml)**	**pH**	**DO (mg/l)**	**BOD (mg/l)**	**COD (mg/l)**	**Total Coliform (MPN/ 100 ml)**	**Feacal Coliform (MPN/ 100ml)**
January	NA	8.40	2.00	16.00	700		NA	4.30	7.00	24.00	13000	
February	NA	7.80	2.20	16.00	700		NA	3.80	8.00	32.00	15000	
March	7.5	8.50	2.20	20.00	700		7.3	3.10	7.60	24.00	11000	
April	7.2	8.20	4.60	16.00	900		7.7	3.60	7.20	28.00	17000	
May	7.2	8.50	2.00	16.00	700		7.5	4.10	7.60	32.00	13000	
June	7.6	7.80	2.00	16.00	900		7.3	4.00	7.80	28.00	17000	
July	7.6	7.90	2.00	16.00	700		7.6	4.30	7.20	32.00	19000	
August	7.6	7.80	2.00	16.00	900	500	7.6	4.00	8.00	32.00	23000	9000

CPCB Class B (Outdoor Bathing)Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more; Biochemical Oxygen Demand 5 days 20C 3mg/l or less

CPCB Class D (Propagation of wildlife and fisheries)- pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more; Free Ammonia (as N) 1.2 mg/l or less

During the lean season, which spans from January to June, analysis of the Ramganga River's dissolved oxygen (DO) levels at the Katghar, Moradabad site (Figure 30) for the period of January 2022 to January 2023, revealed that 60% of the observations indicated DO concentrations precisely at the permissible limit of 4 mg/l. Conversely, 40% of the observations depicted DO levels falling below this permissible limit. In contrast, during the subsequent monsoon and post-monsoon season, covering the period from June to December, it was observed that 90% of the observations demonstrated DO concentrations above the permissible limit of 4 mg/l. The data recorded at the immediate upstream of Moradabad city (Agwanpur site) indicates that the DO remained way above permissible limits (6-8 mg/l) showing good river health in terms of water quality (Figure 30).

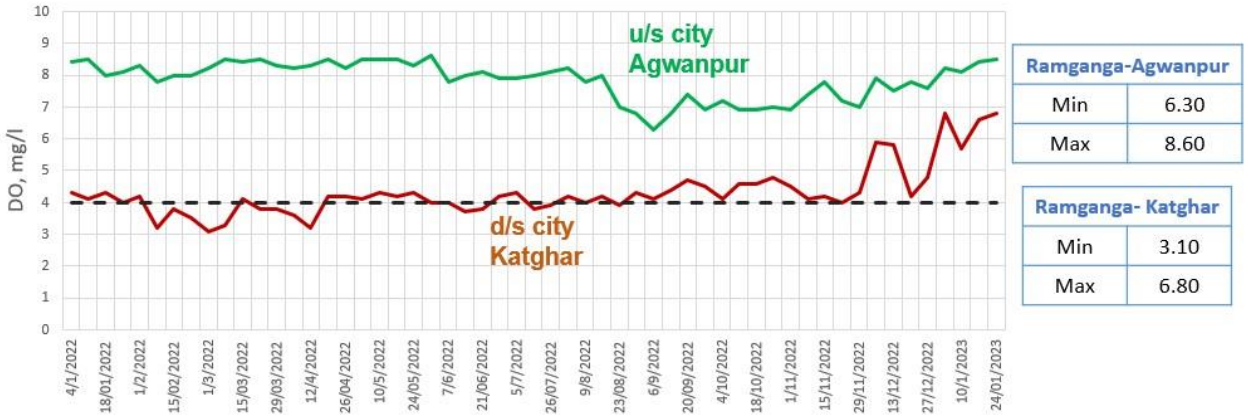


Figure 29 Variation in Biological Oxygen Demand- Ramganga (Jan 2022-Jan 2023) [20]. >3 mg/l is the MAX limit CPCB Class D- Propagation of Wildlife and fisheries

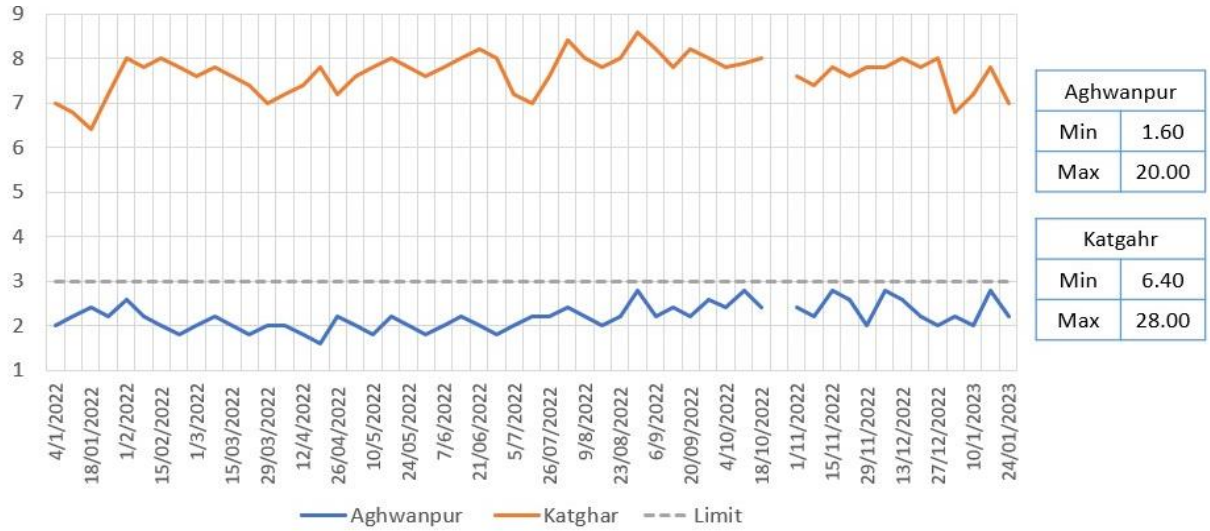


Figure 30 Variation in Dissolved Oxygen- Ramganga (Jan 2022-Jan 2023) [20].

The data collected from January 2022 to January 2023 demonstrates that the dissolved oxygen (DO) levels in Dhela (Figure 31) consistently remained below the permissible limits, measuring less than 4 mg/l. On the other hand, in Gaagan, the DO levels consistently remained above the permissible limits, measuring greater than 4 mg/l.

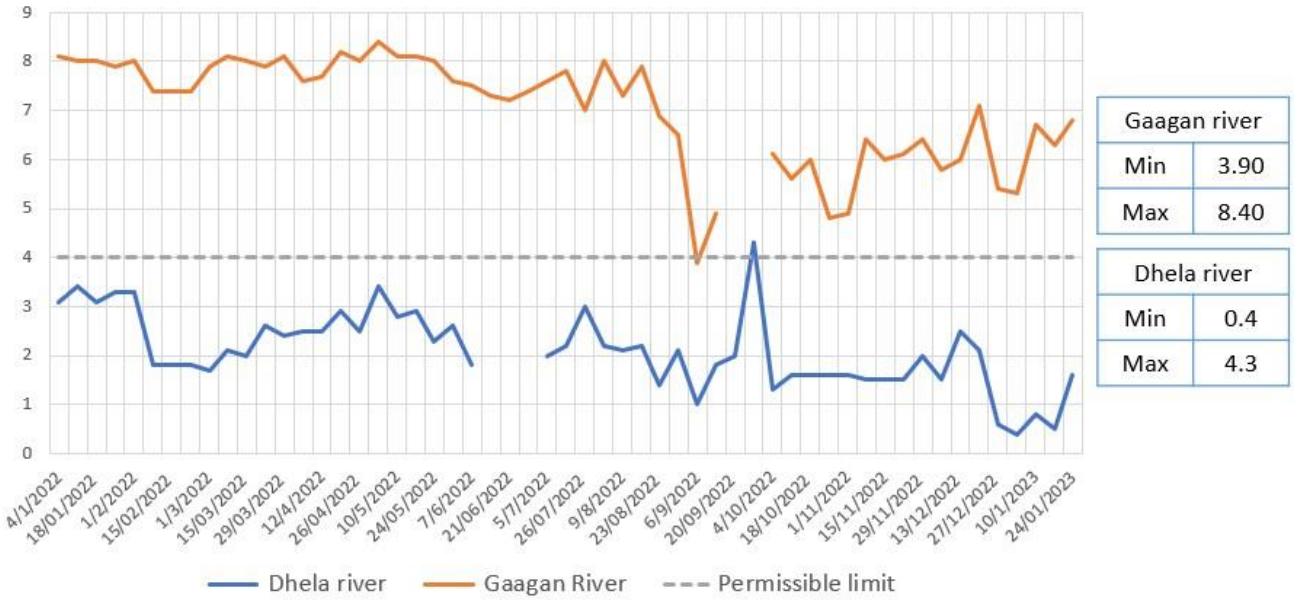


Figure 31 Variation in Dissolved Oxygen; mg/l- Dhela and Gaagan rivers (Jan 2022-Jan 2023)

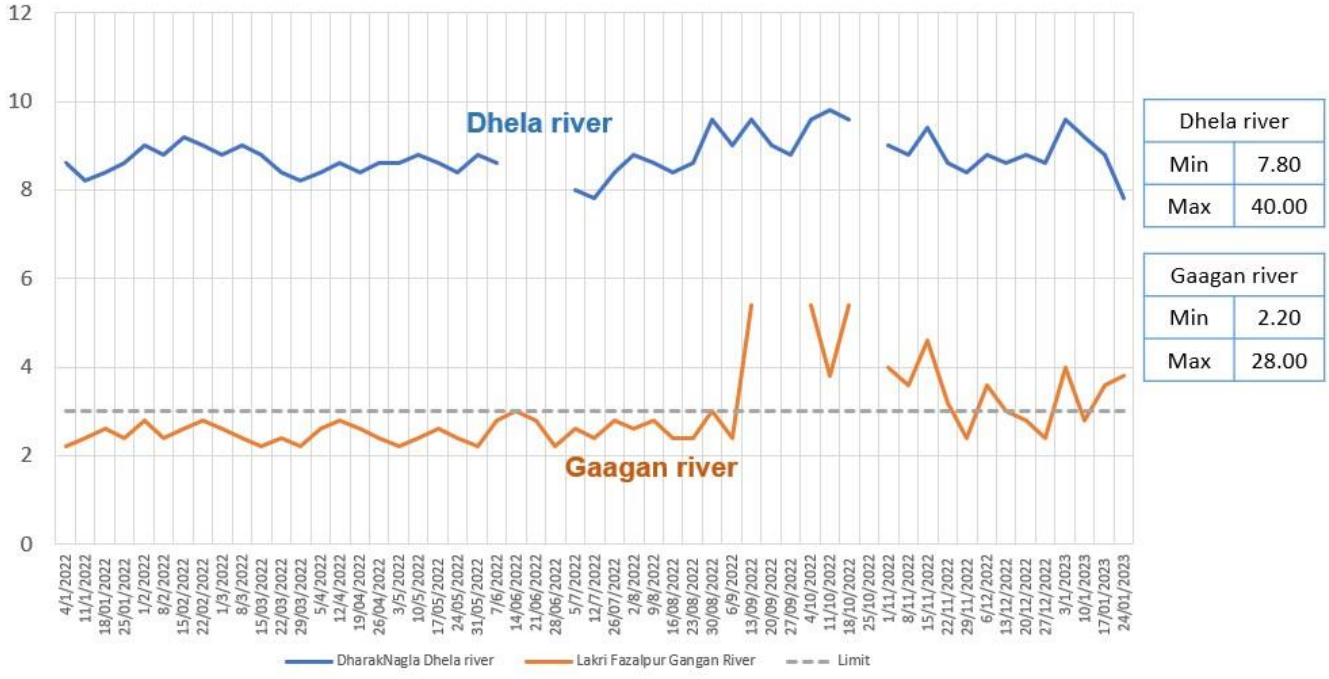


Figure 32 Variation in Biological Oxygen Demand- Dhela and Gaagan river (Jan 2022-Jan 2023). >3 mg/l is the MAX limit CPCB Class D- Propagation of Wildlife and fisheries

In July 2022, WWF India conducted water quality monitoring in the Moradabad district to assess the water quality of rivers and drains. The findings are presented in Figure 33. Within the core city area, the drains exhibited alarmingly low levels of Dissolved Oxygen (DO), almost approaching zero. Furthermore, elevated values of Biochemical Oxygen Demand (BOD) were recorded in six drains located within the core city.

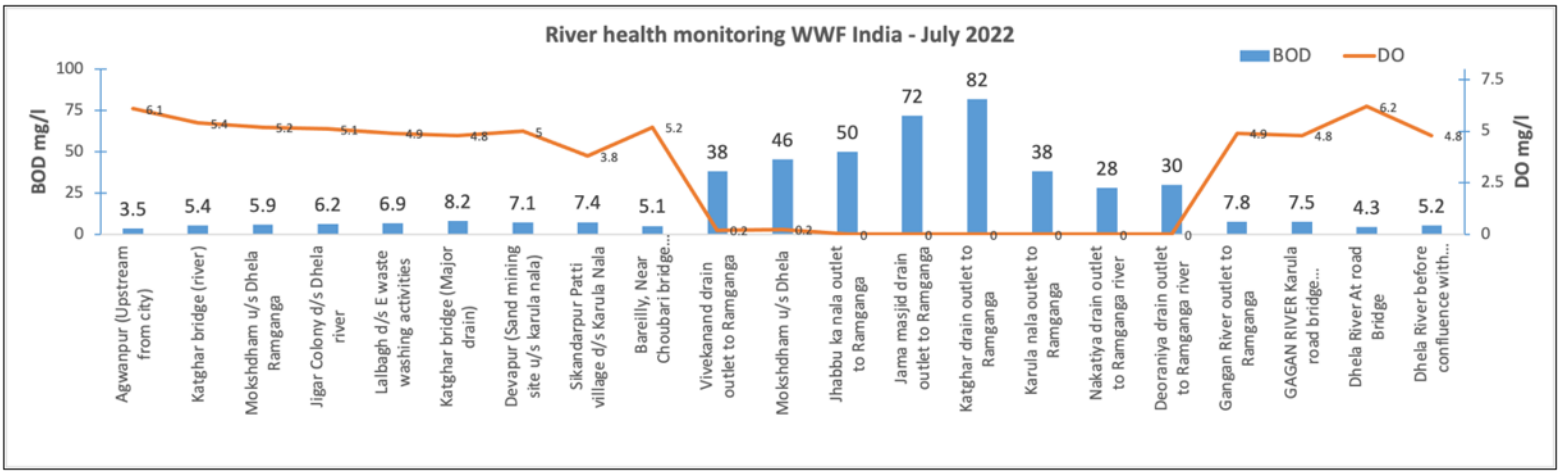


Figure 33 River health monitoring done by WWF

Table 8 Water quality of Dhela impacting River Ramganga. Source: Report on Dhela river- 2022-23 WWF India. Red represents a value exceeding the permissible limit.

	L-1		L-2		L-3		L-4		L-5	
	(Dehla vill.)		Dehla Barrage		Manpur		Burhanpur		Bhagatpur	
	PRM	PTM	PRM	PTM	PRM	PTM	PRM	PTM	PRM	PTM
Air Temp. (0C)	42	38		35		35	35	36		31
Water Temp. (0C)	35	29		30		24	34	31		26
Water appearance	clear	clear		muddy		clear	Black	Black		Black
Turbidity (NTU)	>10	>10		>50		>10	100	<100		100
pH	7	7.5		7		7	6	7		7
Dissolved oxygen (mg/lit)	7.5	7		4		6	ND	ND		ND
Ammonia (mg/lit)	ND	ND		1		1	2	3		1
Phosphorus (mg/lit)	ND	ND		ND		ND	0.4	0.3		0.1
Chloride (mg./l)	35.45	35.45		35.45		35.45	248.15	70.9		212.7
Nitrate (mg/lit.)	ND	ND		ND		ND	5	10		5
Total hardness (mg./lit.)	120	160		200		240	400	520		400
Coliform (Present/Absent)	A	A		A		A	P	P		P

4.6.2 Groundwater

In 2020, a comprehensive assessment of groundwater quality status was conducted by analyzing 39 water samples extracted from IM II Handpumps situated throughout the district (

Table 10). The results revealed that 5% of the samples exceeded the standard limit for pH, indicating an imbalance in the acidity or alkalinity of the groundwater. While fluoride contamination is a significant concern in certain areas, none of the samples collected from the district exhibited fluoride concentrations surpassing the permissible limit, ensuring compliance with safety guidelines. Moreover, 10% of the samples exhibited nitrate levels exceeding 45 mg/L. This elevation in nitrate concentration is likely attributed to anthropogenic activities such as agricultural practices, domestic sewage, and industrial operations. Additionally, the analysis showed that 15% of the groundwater samples in the district demonstrated elevated concentrations of total hardness. This indicates an increased presence of minerals in the water, which can impact its suitability for various applications.

Table 9 Groundwater quality status - Moradabad district

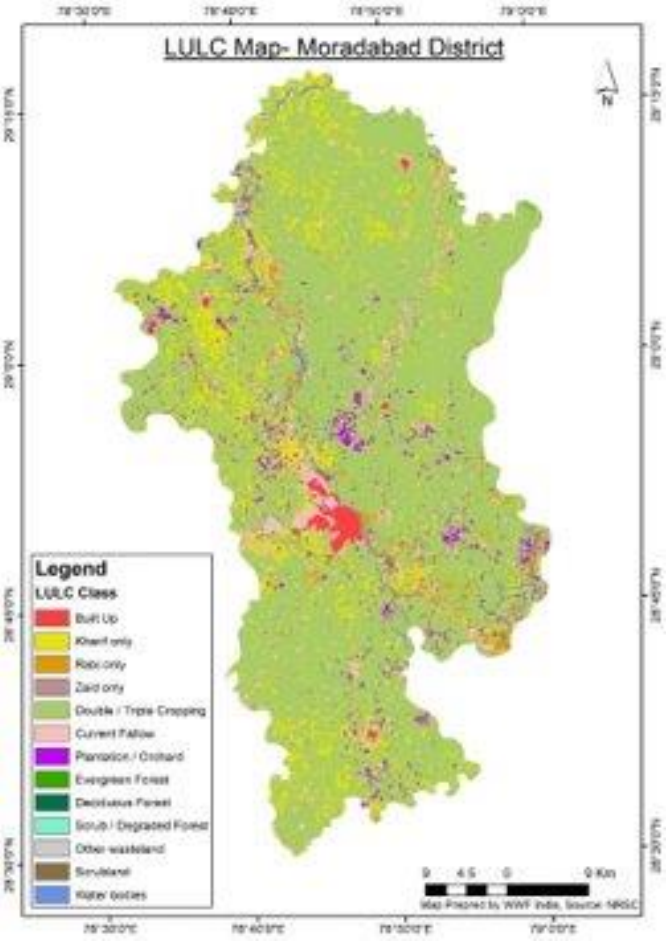
Water quality	**Limit**	**Unit**	**Percentage of sample beyond the limit**
pH	6.5-8.5	mg/L	5
Fluoride	1.5	mg/L	0
Nitrate	45	mg/L	10
Total Hardness	250	mg/L	15
Phosphate	0.2	mg/L	0

Table 10 Result of 39 water samples extracted from IM II Handpumps situated throughout the Moradabad district. Red represents a value exceeding the permissible limit.

S.N		pH	EC	CO3	HCO3	Cl	F	NO3	SO4	TH	Ca	Mg	Na	K	SiO2	PO4
1	GWS 1	8.39	440	24	183	14	0.24	0.4	3.2	160	52	7	25	2	26	0.11
2	GWS 2	8.46	376	12	195	7	0.19	4.6	6.5	170	40	17	15	2	14	nd
3	GWS 3	8.35	398	6	207	21	0.22	nd	5.7	125	16	21	42	2	9	nd
4	GWS 4	7.82	1160	nil	171	184	nd	112	83	370	96	32	82	11	10	nd
5	GWS 5	7.54	795	nil	372	35	0.32	1.3	78	355	100	26	29	15	31	nd
6	GWS 6	7.65	900	nil	366	78	0.27	0.41	51	320	96	19	63	7	31	nd
7	GWS 7	8.11	510	nil	183	57	0.24	0.2	15	190	40	22	26	6	27	nd
8	GWS 8	7.82	382	nil	232	14	0.54	0.17	4	160	48	10	20	4	29	nd
9	GWS 9	7.85	510	nil	293	14	0.24	0.25	17	220	60	17	22	5	27	nd
10	GWS 10	7.93	410	nil	256	7	0.28	0.15	10	190	56	12	19	4	28	nd
11	GWS 11	7.83	380	nil	238	7	0.29	0.02	4.9	160	48	10	17	4	28	nd
12	GWS 12	7.56	945	nil	427	78	0.26	0.73	54	380	88	39	61	10	33	nd
13	GWS 13	8.17	400	nil	207	14	0.01	0.2	6	140	20	22	21	6	33	nd
14	GWS 14	8.2	305	nil	171	14	0.06	nd	8.4	110	24	12	24	4	11	nd
15	GWS 15	8.43	348	6	165	18	0.21	2	16	135	20	21	23	4	14	nd
16	GWS 16	8.54	368	6	195	18	0.12	0.49	8	160	48	10	17	3	11	0.15
17	GWS 17	8.19	377	nil	134	7	0.05	13	70	145	24	21	26	5	21	nd
18	GWS 18	8.08	375	nil	232	7	0.28	0.07	3.3	170	40	17	15	2	8	nd
19	GWS 19	8.23	470	nil	244	14	0.35	0.2	4	120	24	15	51	2	22	nd
20	GWS 20	7.88	475	nil	268	21	0.28	0.31	11	200	40	24	27	3	12	nd
21	GWS 21	8.73	395	12	214	7	0.22	nd	6.1	95	14	15	56	2	12	nd
22	GWS 22	7.83	828	nil	195	92	0.16	101	70	305	60	38	66	7	24	nd
23	GWS 23	8.07	540	nil	183	50	0.16	0.2	39	190	48	17	30	10	23	nd
24	GWS 24	8.19	420	nil	214	28	0.18	4.3	10	165	24	26	26	8	17	nd
25	GWS 25	8.07	515	nil	250	25	0.32	19	24	200	40	24	36	5	17	nd
26	GWS 26	7.98	550	nil	177	78	0.08	20	25	230	40	32	30	5	19	nd
27	GWS 27	8.42	348	6	146	35	0.01	4.3	8.5	110	28	10	35	3	8	nd
28	GWS 28	8.35	365	6	110	35	0.04	nd	48	135	24	18	28	4	16	nd
29	GWS 29	7.91	860	nil	122	78	0.13	166	79	280	76	22	67	4	27	nd
30	GWS 30	8.2	818	nil	183	71	0.24	124	99	220	28	36	98	3	13	nd
31	GWS 31	8.38	440	12	92	67	nd	15	23	160	24	24	30	7	16	nd
32	GWS 32	7.85	416	nil	195	28	0.25	0.7	25	155	44	11	23	18	7	nd
33	GWS 33	8.2	485	nil	262	14	0.76	nd	30	130	48	2	61	4	11	nd
34	GWS 34	8.37	530	24	220	21	0.15	0.2	13	180	52	12	36	3	23	0.11
35	GWS 35	8.19	668	nil	262	71	0.23	16	35	250	64	22	43	6	11	nd
36	GWS 36	8.18	525	nil	329	7	0.71	nd	5	145	24	21	66	1	10	nd
37	GWS 37	8.17	398	nil	244	7	0.36	nd	3.9	115	20	16	46	3	14	nd
38	GWS 38	8.1	435	nil	268	7	0.38	nd	6.5	135	30	15	48	2	10	nd
39	GWS 39	8.35	610	12	305	7	0.5	0.44	15	110	12	19	90	1	21	nd

4.7 Land use and land cover

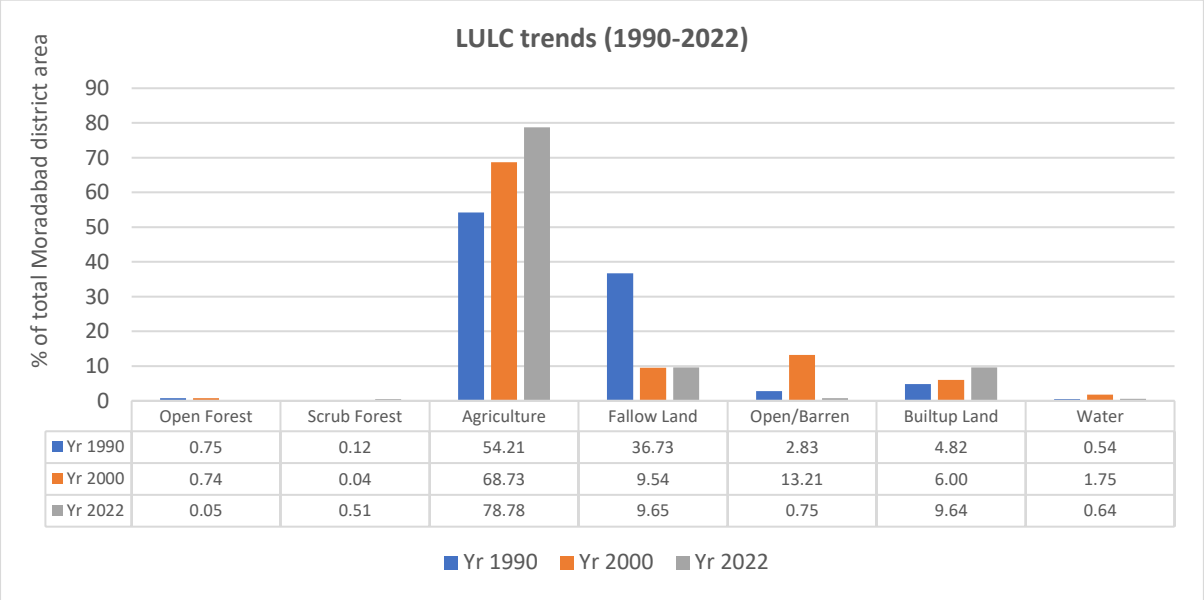
In the Moradabad district, the majority of the land area, amounting to 90%, is dedicated to agricultural activities. The prevalent crops in this region, such as sugarcane and paddy, require significant amounts of water for their growth, leading to substantial extraction of groundwater resources within the district. Surface water-based irrigation, reliant on canals, is susceptible to the impacts of droughts. Canal irrigation systems are present in select blocks of the district, namely Chajjlet, Dilari, and Thakurdwara. It is worth noting that approximately 16,488 hectares of land in the district are irrigated using canals and other surface water sources, while the remaining 266,753 hectares heavily rely on groundwater sources for irrigation purposes. The district of Moradabad exhibits a high reliance on groundwater for irrigation, accounting for 94% of the irrigated area, while the remaining portion is serviced by canal-based irrigation systems. The available resources for irrigation in the district include 511 canals, 471 government-owned tube wells, 107,191 pump sets, and 524 groundwater pump sets.



CLASS NAME	Area ha	Area %
Built-Up	2174.19	0.93
Kharif only	22092.49	9.47
Rabi only	5289.18	2.27
Zaid only	1451.65	0.62
Double / Triple Cropping	178653.50	76.58
Current Fallow	13080.88	5.61
Plantation / Orchard	5821.36	2.50
Evergreen Forest	31.36	0.01
Deciduous Forest	14.11	0.01
Scrub / Degraded Forest	27.28	0.01
Other wasteland	344.33	0.15
Scrubland	1911.71	0.82
Water bodies	2399.35	1.03

Figure 35 Lanuse and landcover of Moradabad district. Source: WWF-India

The analysis of land use and land cover trends in the Moradabad district from 1990 to 2022 reveals significant changes. The area dedicated to agriculture has experienced a substantial increase, witnessing a growth of 25% over the observed period. Conversely, the extent of fallow land has decreased by 24%, indicating a decline in unused or uncultivated areas. Another notable trend is the expansion of built-up land, primarily associated with urbanization. The built-up land area witnessed a rise of 5% during the same period, indicating the transformation of rural or natural areas into developed urban regions.



	Open Forest	Scrub Forest	Agriculture	Fallow Land	Open/Barren	Builtup Land	Water
Yr 1990	0.75	0.12	54.21	36.73	2.83	4.82	0.54
Yr 2000	0.74	0.04	68.73	9.54	13.21	6.00	1.75
Yr 2022	0.05	0.51	78.78	9.65	0.75	9.64	0.64

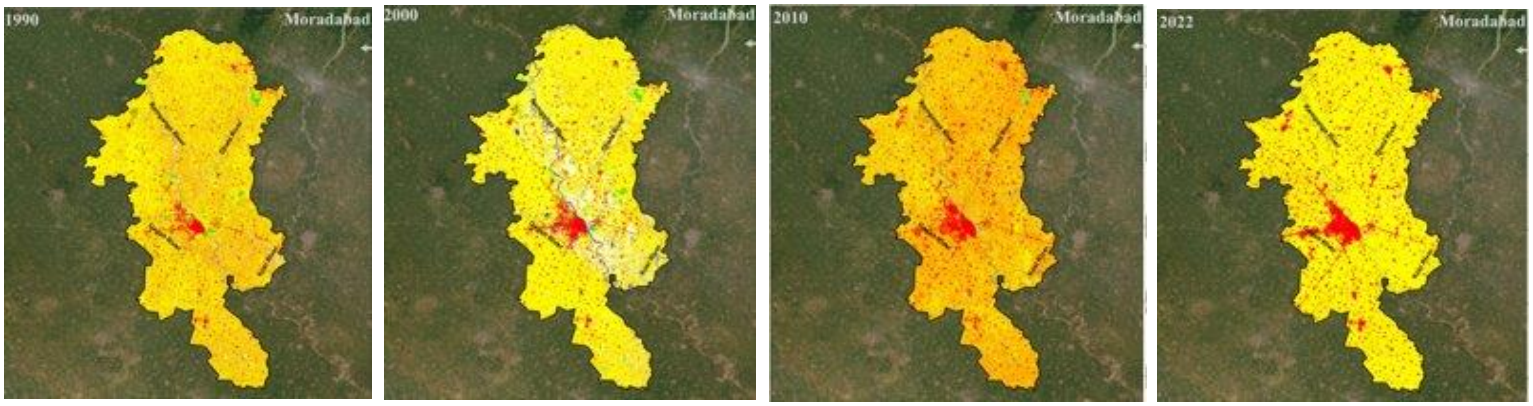


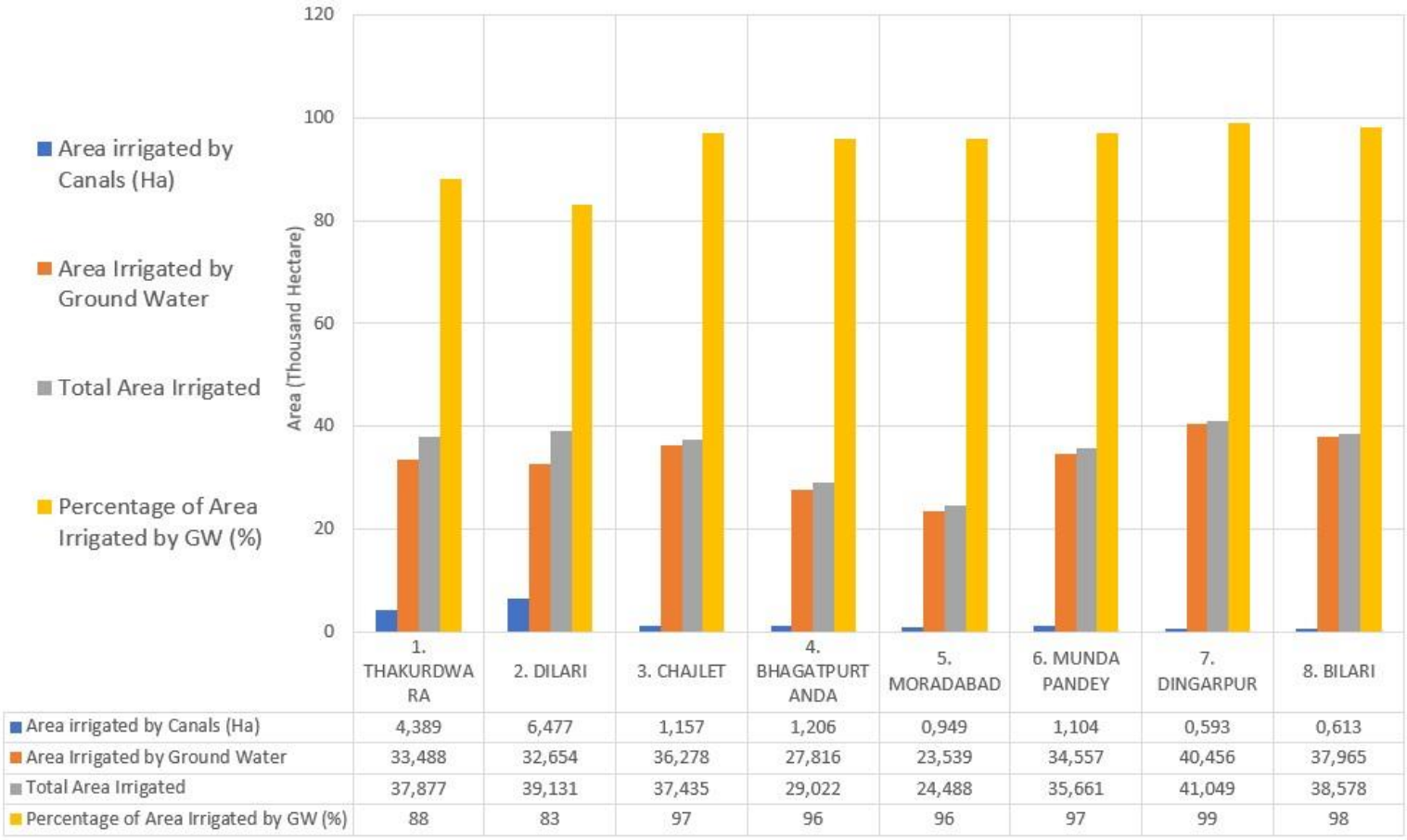
Figure 36 Land use and land change trends (1990-2022). Source: WWF-India

4.8 Agriculture and irrigation

Irrigation within the Moradabad district is facilitated by various minor irrigation structures, including tube wells, ponds, and water derived from Sewage Treatment Plants (STP) or Effluent Treatment Plants (ETP). Canal irrigation, on the other hand, is limited to specific blocks within the district, namely Thakurdwara, Bhagatpur, Dilari, and Chhajlet. Out of the total area of 17,941 hectares, approximately 16,488 hectares are irrigated by canals and other surface water sources, while the remaining 158,453 hectares are irrigated by groundwater sources in the district (Table 11) (Figure 37) [15].

Table 11 Irrigated Area (Ha) by Surface and Ground Water in Moradabad district [15]

BLOCKS	Canal (Ha)	Tubewell		Well	Pond	Total
		Public	Private			
THAKURDWARA	4389	900	15774	16814	0	37877
DILARI	6477	606	15340	16708	0	39131
CHAJLET	1157	2526	17219	16533	0	37435
BHAGATPURTANDA	1206	404	11971	15441	0	29022
MORADABAD	949	684	9975	12880	0	24488
MUNDA PANDEY	1104	707	15979	17871	0	35661
DINGARPUR	593	3043	10198	27215	0	41049
BILARI	613	3607	8934	25424	0	38578
Total Rural	16488	12477	105390	148886	0	283241
Total Urban	0	875	7169	9567	0	17611
Total District (Ha)	**16488**	**13352**	**112559**	**158453**	**0**	**300852**



	1. THAKURDWARA	2. DILARI	3. CHAJLET	4. BHAGATPURTANDA	5. MORADABAD	6. MUNDA PANDEY	7. DINGARPUR	8. BILARI
Area irrigated by Canals (Ha)	4,389	6,477	1,157	1,206	0,949	1,104	0,593	0,613
Area Irrigated by Ground Water	33,488	32,654	36,278	27,816	23,539	34,557	40,456	37,965
Total Area Irrigated	37,877	39,131	37,435	29,022	24,488	35,661	41,049	38,578
Percentage of Area Irrigated by GW (%)	88	83	97	96	96	97	99	98

Figure 37 Irrigated Area (Ha) by Surface and Ground Water in Moradabad district [15]

A significant proportion, specifically 94%, of the district's land area is supported by groundwater irrigation. The overall length of the canal network within the district amounts to 511 kilometres (Table 12).

Table 12 Percentage of Area (Ha) Irrigated by Groundwater in Moradabad district [15]

Block	Area irrigated by canals (Ha)	Area irrigated by Groundwater	Total irrigated area	Percentage of the area covered by Groundwater (%)
THAKURDWARA	4389	33488	37877	88
DILARI	6477	32654	39131	83
CHAJLET	1157	36278	37435	97
BHAGATPURTANDA	1206	27816	29022	96
MORADABAD	949	23539	24488	96
MUNDA PANDEY	1104	34557	35661	97
DINGARPUR	593	40456	41049	99
BILARI	613	37965	38578	98
Total District	**16488**	**266753**	**283241**	**94**

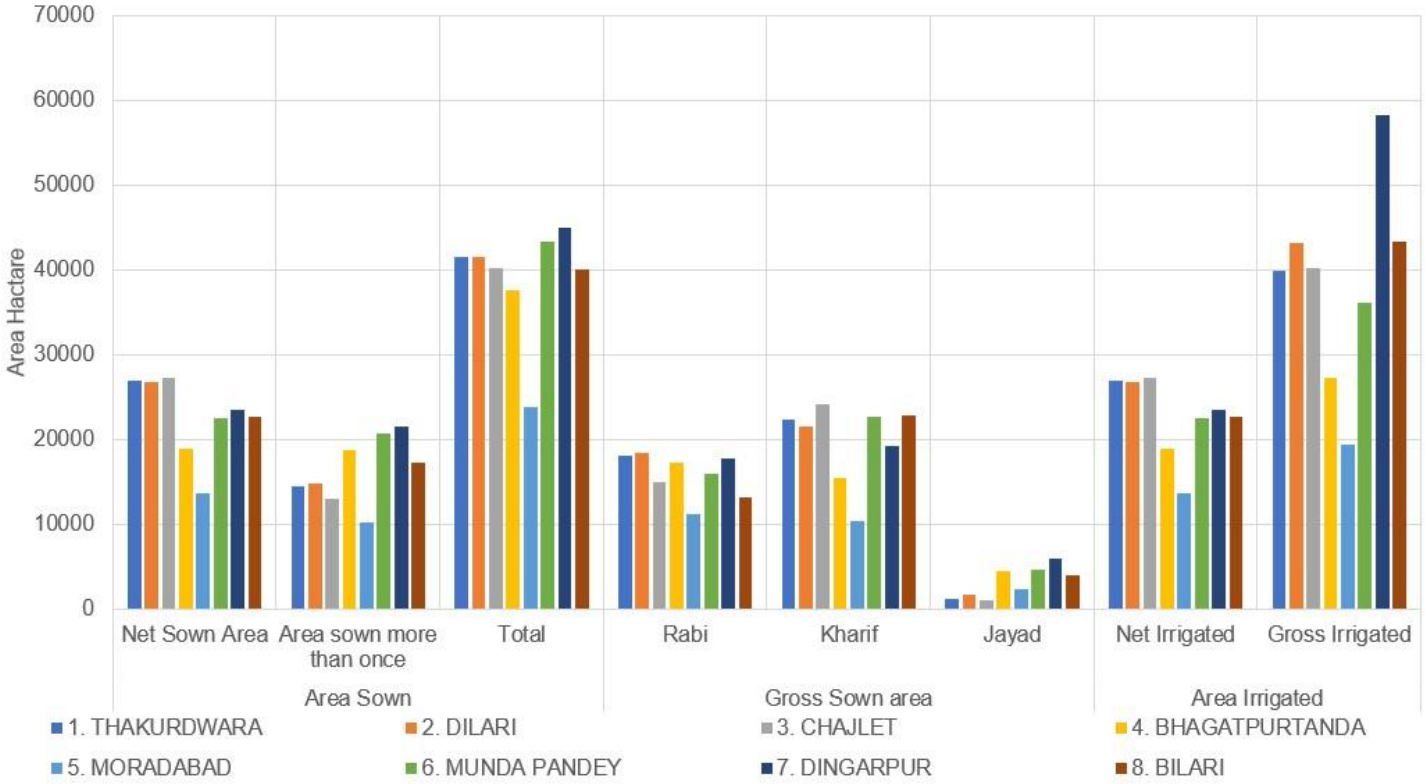


Figure 38 Area under main crops in Moradabad district [15]

Table 13 Major crops sown in Moradabad district [15]

	Total rice		Wheat		Total pulses (Chiefly Urad, Masur, Gram, Pea etc.)		Total Oilseeds (Chiefly Lahi/ Sarson & Til)		Sugarcane	
Block	**Total**	**Irrig.**	**Total**	**Irrig.**	**Total**	**Irrig.**	**Total**	**Irrig.**	**Total**	**Irrig.**
1. Thakurdwara	17082	17082	16801	16801	512	37	63	58	7986	7986
2. Dilari	18779	18779	16693	16693	307	41	55	55	4680	4680
3. Chajlet	6494	6494	13312	13312	131	65	225	225	17849	17849
4. Bhagatpurtanda	15418	15418	14516	14516	266	36	203	203	2636	2636
5. Moradabad	8948	8948	9388	9388	146	21	99	99	2633	2633
6. Munda pandey	17767	17767	18097	18097	356	64	209	197	1244	1244
7. Dingarpur	364	364	15926	15926	615	88	667	667	3785	3785
8. Bilari	8779	8779	14272	14272	1439	157	810	803	3402	3402
Total Rural	***93631***	***93631***	***119005***	***11900***	***3772***	***509***	***2331***	***2307***	***44215***	***44215***
Total Urban	***2674***	***2674***	***2871***	***2871***	***907***	***14***	***80***	***73***	***504***	***504***
Total District	***96305***	***96305***	***121876***	***12187***	***4679***	***523***	***2411***	***2380***	***44719***	***44719***

In the Moradabad district, certain blocks like Chajjlet, Thakurdwara, Dilari, and Bhagatpur Tanda have an abundant water supply. However, there has been a significant decline in irrigated land and crop production over the past decade. Several blocks in irrigated areas, namely Dingerpur, Bilari, Bhagatpur Tanda, and Moradabad, are facing critical conditions due to the overexploitation of water resources. The primary irrigation facilities in these critical blocks include tube wells, pump sets, and ponds. Unfortunately, the groundwater levels in these areas have been depleting rapidly, and there is an absence of canals. The only source of groundwater recharge is rainfall during the southwest monsoon period. Moreover, the excessive use of irrigation for crop cultivation has led to a reduction in the availability of water from the Ramganga Canal [21].

Moradabad district is characterized by the cultivation of major crops such as Sugarcane, Wheat, and Paddy (Figure 38) (Table 13). Additionally, the practice of pallage farming is prevalent, focusing primarily on cucurbits, with melons, cucumbers, and gourds being the most commonly grown varieties. Sugarcane cultivation takes place from September to October, with harvesting occurring between February and March. The preferred seed varieties for Sugarcane are 038 and 064. For optimal growth, Nitrogen is administered in the form of urea at a rate of 40-50 kg per bigha, along with compost. Diammonium phosphate (DAP) is applied to provide the necessary phosphorous, as well as a portion of the nitrogen. A recommended dosage for phosphorous is 40-60 kg P2O5 per hectare.

Wheat is sown from October to December and harvested from April to May. The recommended seed varieties for Wheat are 2967 and 54502. To manage weeds effectively, herbicides such as Piroxofop Propanyl and Clodinafop Ropargyl at a concentration of 15% WP are used. Additionally, Metribuzin at a concentration of 20% WP, Urea at 0.5%, Diammonium phosphate (DAP) at 7-10 kg per *bigha*, and Zinc (3-4 kg per *bigha*) are applied before sowing.

Paddy cultivation begins in June, with harvest occurring from mid-October to November. The recommended seed varieties for Paddy include 2626 Basmati, Noori, and Sharbati. Herbicides such as Clodinafop Propargyl, Combitec, and Endosulfan (reported in some villages) are utilized. In terms of fertilization, a combination of Zinc and NPK at a ratio of 12:32:16 is applied, along with 10 kg of Urea and organic fertilizer (*gobar khad*) per *bigha*. In *pallage* farming, the recommended practices involve the application of Urea, NPK, and Piroxofop Propanyl at a concentration of 15% (0.5L per *bigha*).

4.9 Floodplain and wetlands encroachment

The National Green Tribunal (NGT) has issued a directive to designate a no-construction zone extending 100 meters from the edge of the Ganga River, spanning from Haridwar to Unnao. Due to limited available land, there has been encroachment upon the floodplain in various areas of Moradabad, particularly along the rivers passing through the city, namely Ramganga, Gaagan, and Karula. The urbanized regions within the floodplains of the Ramganga River have been established for approximately 40-50 years, whereas the development on the floodplains of the Gaagan River is relatively recent, with a timeframe of 15-20 years (according to available Google imagery). Floodplains are of critical importance as they are susceptible to periodic inundation during flood seasons. The high density of the population has led to the expansion of built-up areas reaching towards the rivers. Significant encroachment hotspots, including both built-up and agricultural areas, have been identified along the Ramganga, Gaagan, Karula, and Aril rivers.

According to an analysis conducted using Google imagery, several notable hotspots of built-up areas in stretch (28.882634°N, 78.749574°E to 28.815130°N, 78.803056°E) have been identified in the vicinity of the Ramganga River (Figure 39). These locations include TDI City, Chakkar Ki milak, Jigar Colony, Daulat Bagh, Kisrol, Faiz Ganj, Lalbagh, Gadi Khana, Jama Masjid, Barwalan, and Dayanand Colony. These areas exhibit a significant presence of constructed structures as observed from the visual data available through Google imagery.

Figure 39 Built up area in stretch: Ramganga river

Through the utilization of Google imagery, a prominent hotspot of built-up area has been identified along the stretch encompassing the Gaagan River (Figure 40), specifically ranging from coordinates 28.842300°N, 78.687022°E to 28.816563°N, 78.718983°E. The identified locations within this stretch include Lakri Fazalpur and Sector 15, New Moradabad.

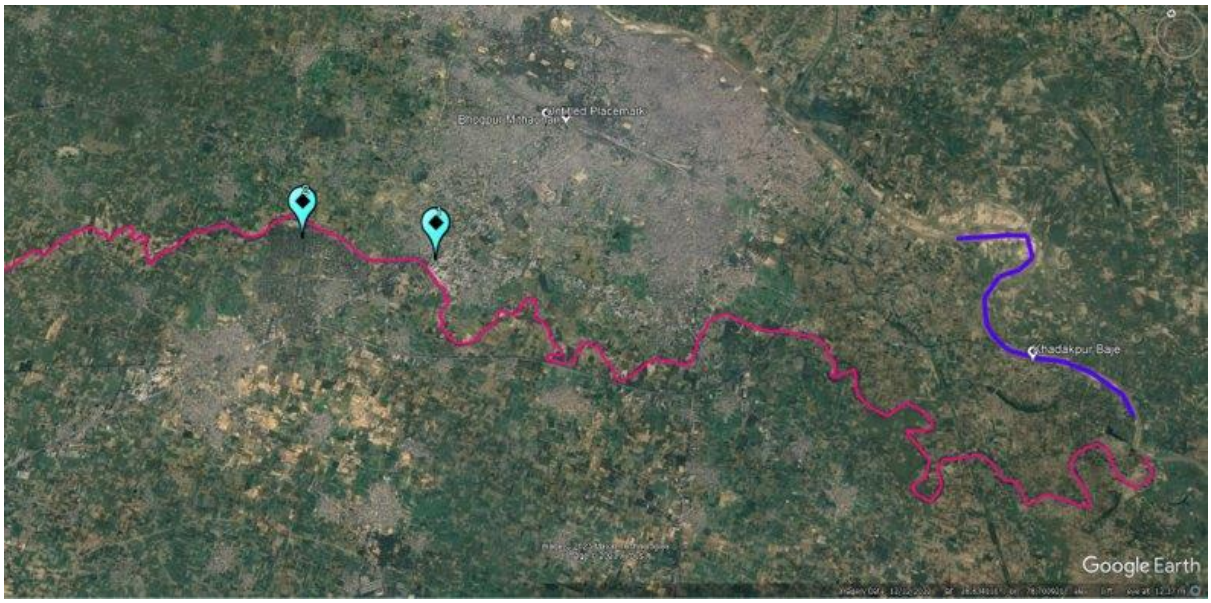


Figure 40 Built-up area in stretch: Gaagan River

Similarly, Utilizing Google imagery, a comprehensive analysis has identified specific locations where encroachments have taken place along the Karula River. These areas demonstrate the presence of unauthorized structures or activities encroaching upon the designated space, as observed through the comprehensive examination of Google imagery data. The identified encroachment sites span from coordinates 28.852405°N, 78.734978°E to 28.807251°N, 78.781347°E. The locations exhibiting encroachment along this stretch include Gautam Budh Colony, Bank Colony, Kashiram Nagar, Hydel Colony, Chidiya Tola, Line Par, Prem Nagar, Karula, Zahid Nagar, and Rahmat Nagar.

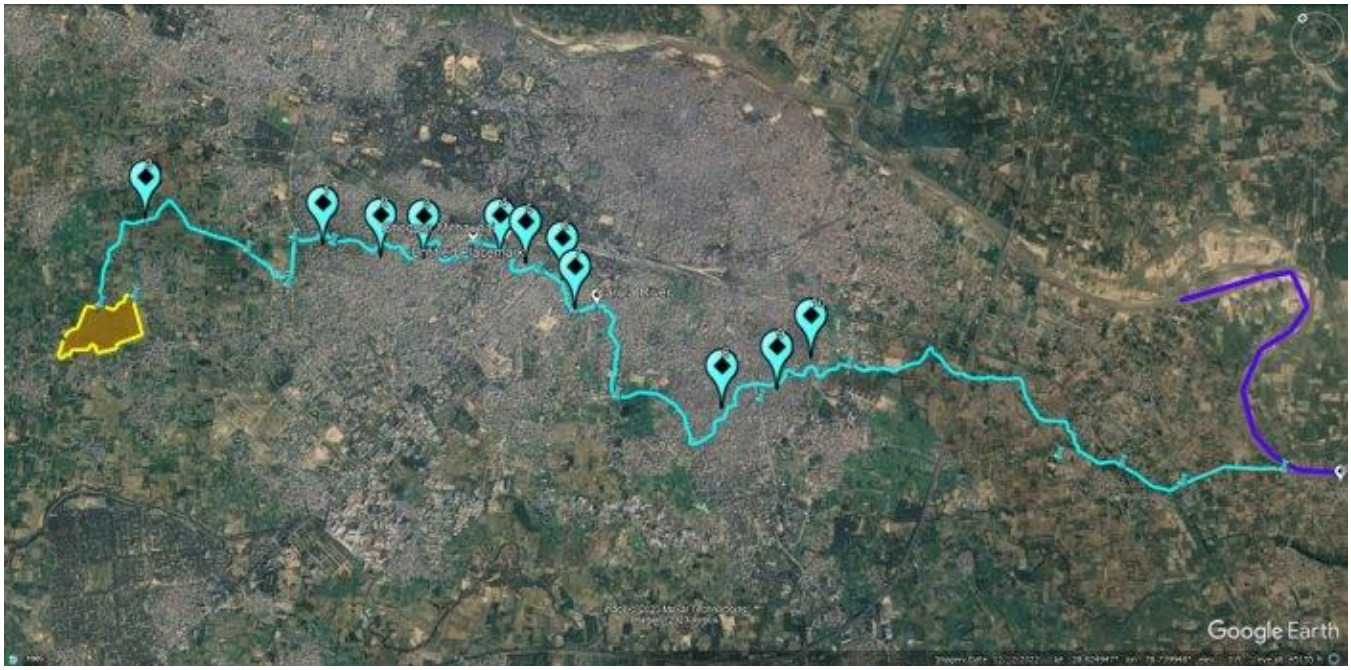


Figure 41 Built-up area in stretch: Karula River

The following cartographic representations (Figure 39, Figure 40, and Figure 41) delineate the precise alignment of embankments along the Ramganga and Gaagan rivers, alongside the demarcation of a 100-meter no-development zone, as stipulated by the directives set forth by the esteemed National Green Tribunal (NGT). These maps effectively elucidate the pervasive encroachments observed in proximity to the riverbanks within the urban core, thereby emphasizing the urgent requirement for a comprehensive resettlement initiative.

The preservation of the rivers and wetlands from the detrimental effects of urban development presents a formidable challenge to the municipal administration. Nevertheless, the city's master plan encompasses judicious provisions, including the demarcation of floodplains and the implementation of Development Control Regulations (DCRs), intended to proactively forestall any future encroachments within the remaining areas.

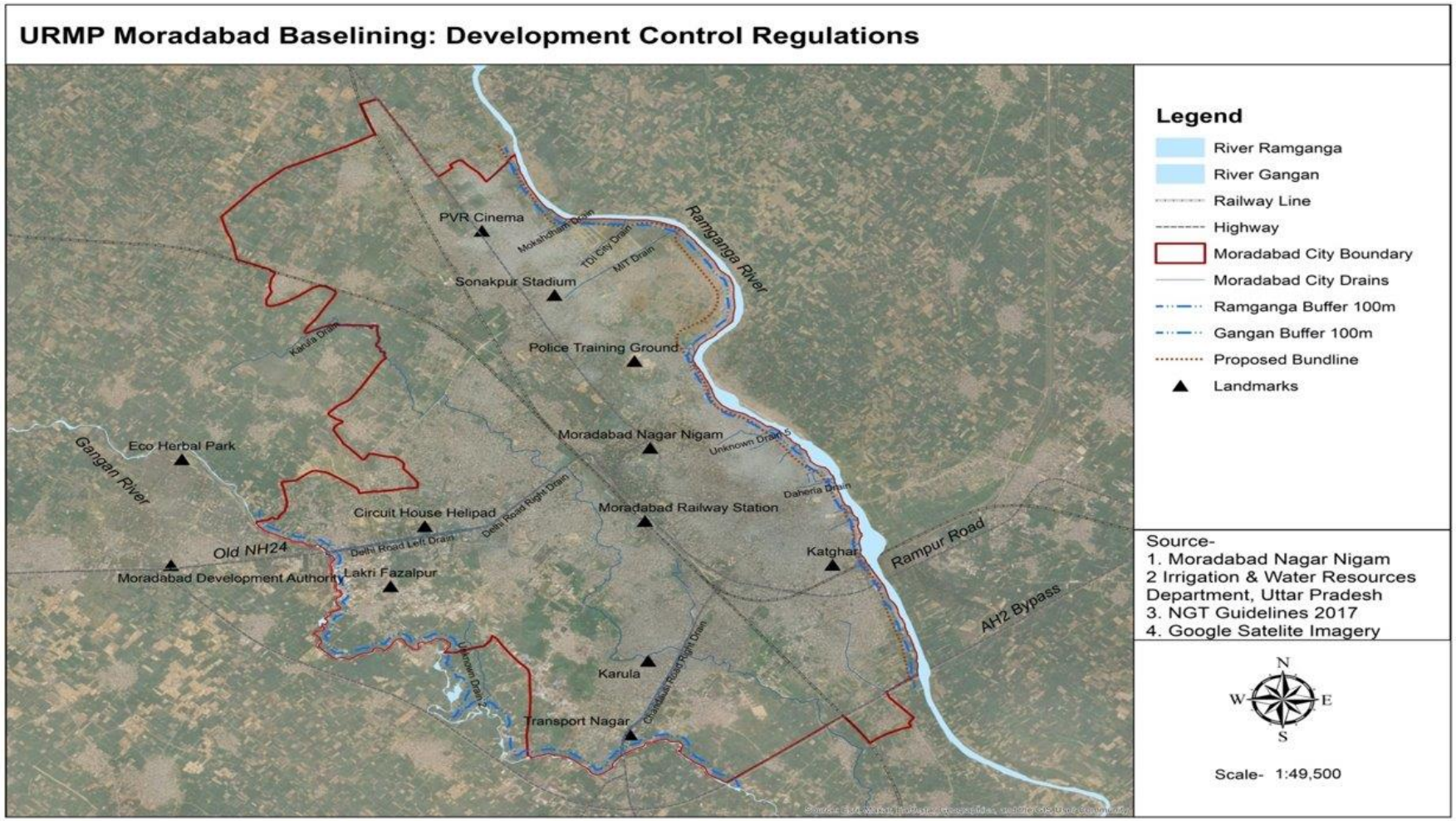


Figure 42 Urban River Management Plan (URMP) Moradabad Baselining

4.10 Industry

The prominent industries in the district encompass a range of sectors including Sugar, Milk processing, Paper, Distillery, Dyeing, textile synthetic fiber, and brass manufacturing. Of particular concern is the pollution of rivers resulting from the discharge of industrial effluents. The pollution burden in surface water streams, rivers, and drains, particularly in Karula Nala and Dhela Rivers, poses a significant issue. According to the Uttar Pradesh Pollution Control Board – Moradabad (UPPCB), the overall quantity of industrial waste generated in the district is measured at 5.92 MLD. Within the city, a total of 78 Effluent Treatment Plants (ETPs) have been established specifically for brass industries. These ETPs collectively discharge 0.530 MLD of treated effluent into five city drains, which ultimately flow into the Ramganga River through the Karula *Nala* and Gaagan Rivers. Karula *Nala* serves as the primary conduit for industrial waste originating from a significant portion of the city, ultimately discharging into the Ramganga River near Sikandarpur Patti village. Regrettably, the district currently lacks a Common Effluent Treatment Plant (CETP), exacerbating the challenges associated with managing industrial wastewater [20].

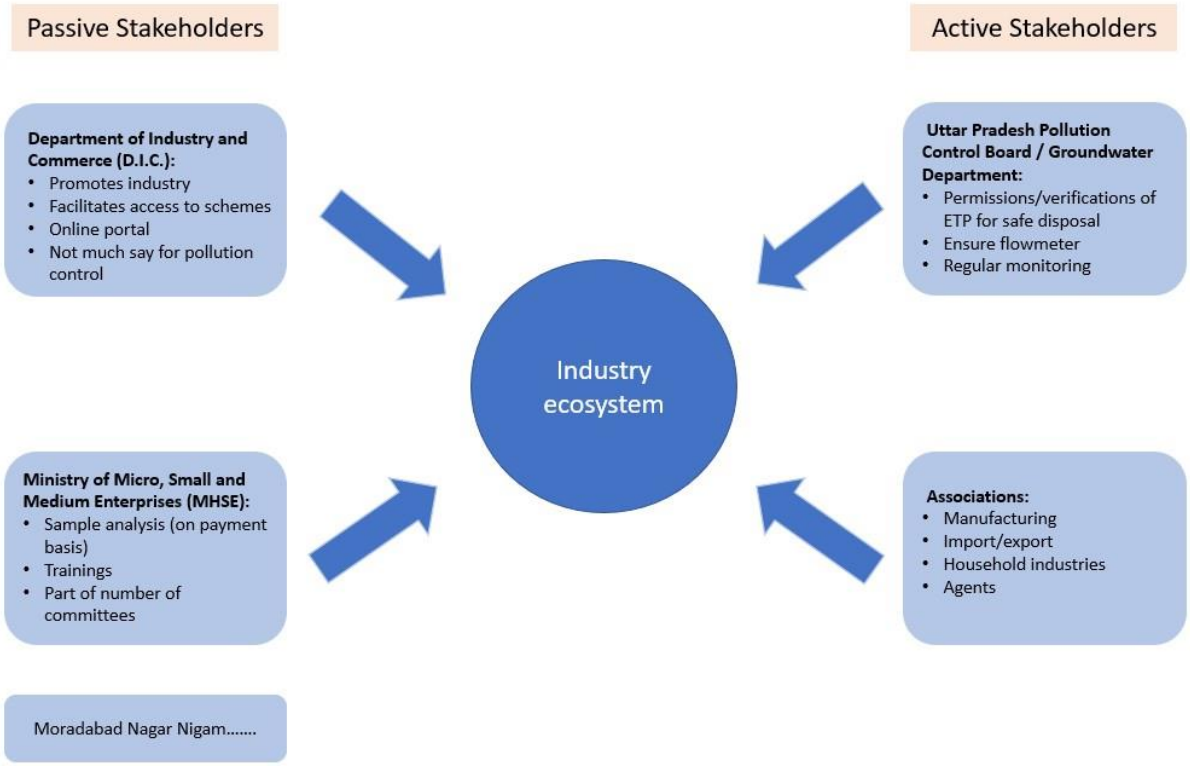


Figure 43 Industry ecosystem in Moradabad District

Moradabad city has gained renown for its thriving metalware industry. According to official records, approximately 9,330 small-scale industries are operating within the city [22]. However, it is crucial to acknowledge that the metalware handicraft industry and e-waste processing sectors are also significant contributors to the pollution of rivers. Moradabad boasts an estimated 4,000-5,000 manufacturing units, out of which 600 units are primarily engaged in export activities. Among these units, approximately 1,200 rely on water consumption for electroplating processes. Unfortunately, only 20% of these units have taken the initiative to install Effluent Treatment Plants (ETPs), and even among those, 80% are currently non-functional.

Table 14 List of Grossly Polluting Industries (GPI) Industries in district

1	Ajudhya Sugar Mills, Raja ka sahaspur, Bilari	Sugar
2	Deewan Sugar Ltd., Agwanpur, Kanth Road	Sugar
3	Genus Paper & Boards Ltd., Agwanpur	Paper
4	Milk Food Ltd., Agwanpur	Dairy
5	National Industrial Corporation Ltd. Raja ka sahaspur, Bilari	Distillery
6	Pashupati Acrylon Ltd., Kashipur Road, Thakurdwara	Dyeing and Textile synthetic fibre
7	Ramchandra Straw Products Ltd., Vill-Vijaipur, Tehsil Bilari, Dist	Paper
8	Rana Sugar Ltd. (Unit 3), Belwara, Manpur	Sugar
9	Shakumbhri Straw Products Ltd. (Unit-1), Vill- Deori, Chandausi Road. Tehsil Bilari	Paper
10	Shakumbhri Straw Products Ltd. (Unit-II), Vill- Deori, Chandausi Road. Tehsil Bilari	Paper
11	Shakumbhri Straw Products Ltd. (Unit-III), Vill- Deori, Chandausi Road. Tehsil Bilari	Paper
12	Triveni Engineering & Ind. Ltd. (Sugar Unit), Rani Nagal, Tehsil- Thakurdwara	Sugar

Within the catchment area of Dhela River, there are 14 Grossly Polluting Industries (GPIs) in operation. The combined water consumption of these GPIs amounts to 56,514 KLD (Kilo Liters per Day), while approximately 29,490 KLD of wastewater is discharged either directly or indirectly into the Dhela River through drainage systems [23].

Table 15 Status of Industrial pollution in Dhela River [23]

	Water use (KLD)	Effluent generate
Katyayini Paper Mills Pvt. Ltd. Near Sodhi Farm, vill. KuddiyawalaJaspur	2665	2250
Katyayini Paper Mills Pvt. Ltd. Near Sodhi Farm, vill. KuddiyawalaJaspur	5430	4920
Naini Tissues Ltd., Moradabad Road, Kashipur	7675	5020
Prolific Papers Pvt. Ltd.Vill. Girdhai, Kashipur	1858	1000
Sidarth Papers Pvt. Ltd (Unit 2), Moradabad Road, Kashipur	5625	2200
Siddheshwari Paper Udyog Pvt. Ltd., Moradabad Road, Kashipur	4660	2000
Bahl Paper Mills Limited., Aliganj Road, Kashipur	5000	3450
Sidharth Papers Pvt. Ltd., Moradabad Road, Kashipur	4680	2200
Sahota Papers Limited., Narayanpur, Jaspur	5010	2250
Dev Rishi Papers Pvt. Ltd., Jagatpurpatti, Jaspur, Kashipur	2325	1650
Fibremarx Papers Pvt Limited., Haldua Sahu, Shivrajpur, Kashipur	3500	2600
Vishwanath Paper & Boards Ltd, Haldua Sahu, Shivrajpur, Kashipur	1965	1750
B.R. Papers Pvt. Ltd., Vill. Lalpur, Tehsil Jaspur, Kashipur	1296	270
The Kisan Sahakari Chini Mill, Nadehi, US Nagar	4825	180

The Uttar Pradesh Pollution Control Board (UPPCB) has four monitoring stations in the Moradabad district, two of them on the Ramganga River, one on the Dhala River, and one on the Gaagan River. One monitoring station is upstream of the Ramganga River at Agwanpur village, while the other is on the downstream side at Katghar, Road bridge. On the Dhela River, the monitoring station is located in Dharak Nagla (Bhojpur), while on the Gaagan River, the monitoring station is located at Lakri Fazalpur, Delhi Road bridge. In addition to the aforementioned four locations along the rivers, the UPPCB is also actively monitoring a total of 24 drains in the city.

4.11 Aquatic Biodiversity (Fishes)

According to a study published in the Indian Journal of Animal Sciences, a comprehensive assessment of fish species in the Ramganga River was conducted at eight distinct locations. Notably, two of these locations, Agwanpur and Katghar, were situated within the boundaries of the Moradabad district. Their survey revealed a total of 92 fish species present in the Ramganga River, with 36 species recorded in Agwanpur and 43 species recorded in Katghar. These species predominantly belong to the families Cyprinidae, Siluridae, Belonidae, Ambassidae, and Bagridae. Furthermore, fish surveys were conducted during E-Flows monitoring of the Ramganga River at additional locations, including Hareoli (Bijnor), Agwanpur, and Katghar (Moradabad). The outcomes of these surveys have been visually represented through graphical presentations [24].

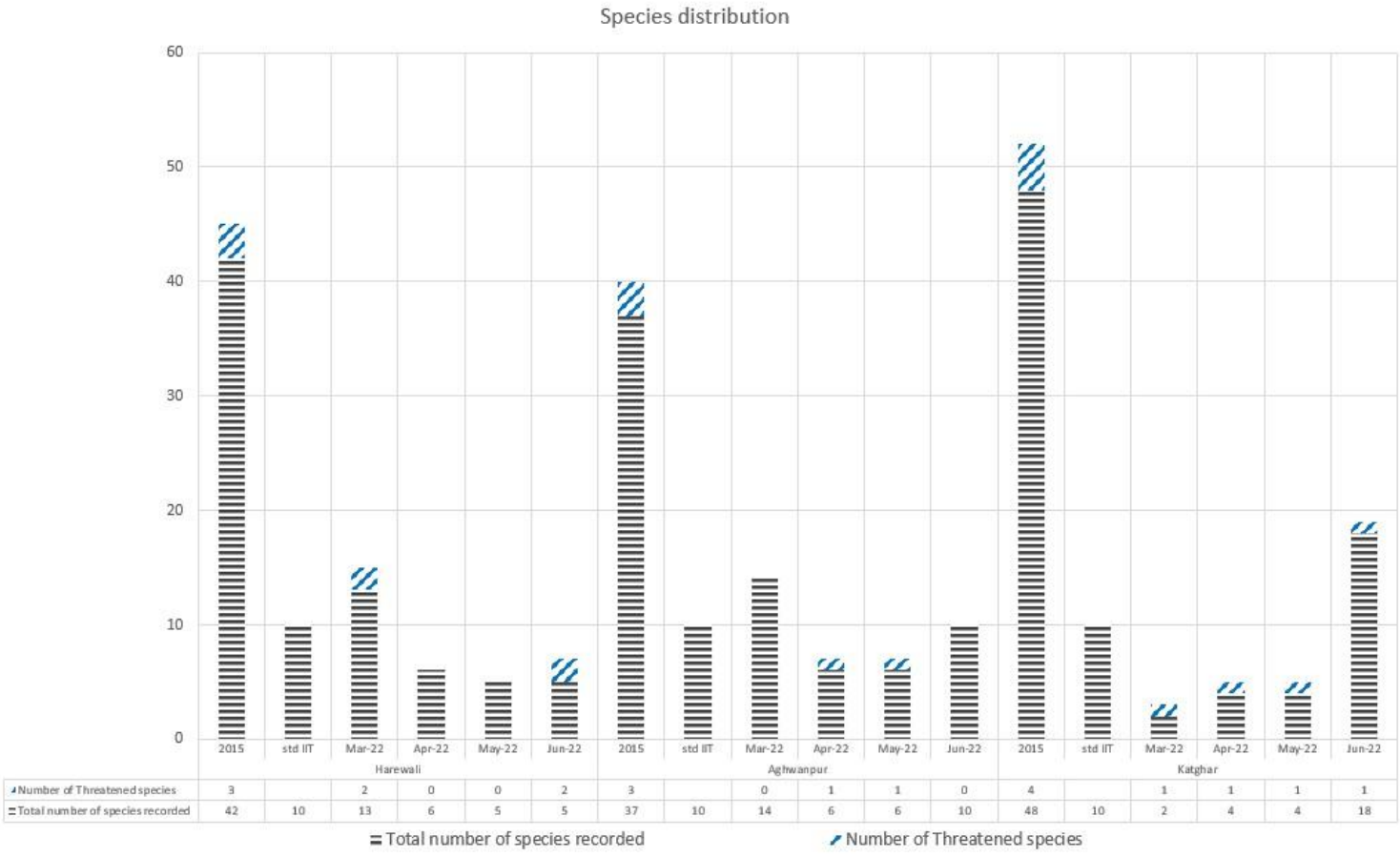


Figure 44 Fishes of Ramganga river

A total of 52 species, distributed among 16 families, were documented during the E-Flows monitoring conducted from March to June 2022 by the WWF (Figure 45). Among these, Katghar accounted for 18 species, while Agwanpur contributed 14 species. Out of the entire recorded species, four are classified as threatened according to the IUCN List. *Cyprinus carpio* is an exotic species and falls under the vulnerable category as designated by the IUCN list. *Chela laubuca*, which was observed in both Agwanpur and Katghar, is categorized as near threatened.

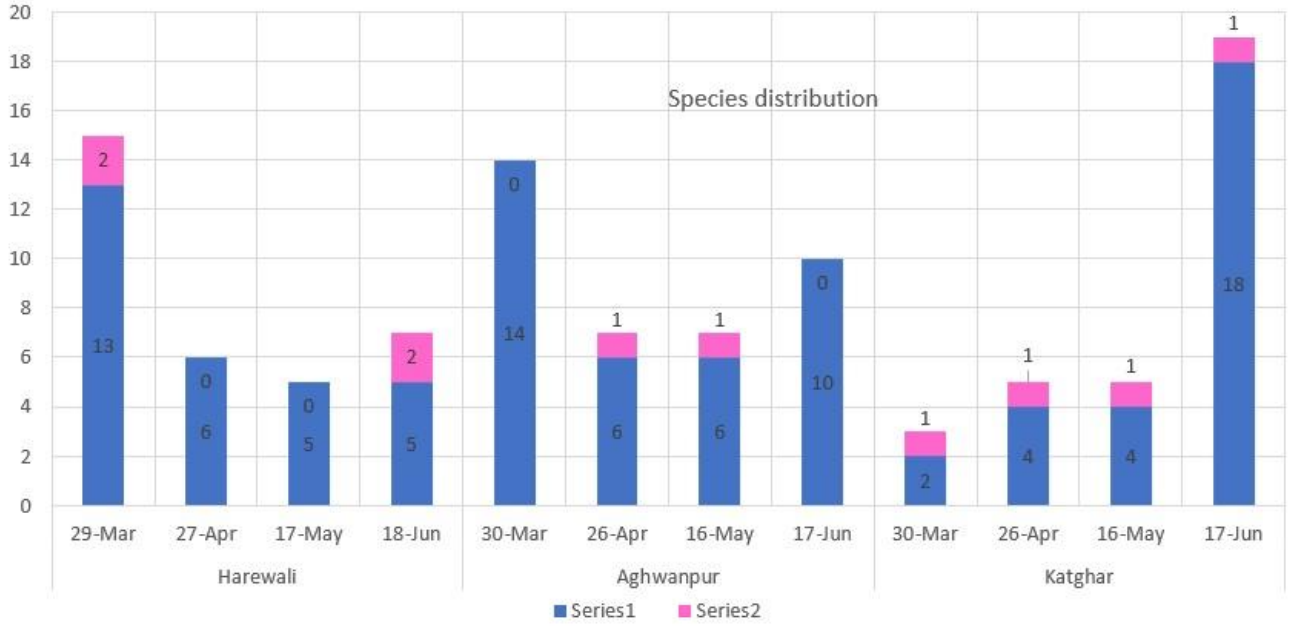


Figure 45 Species distribution in the Ramganga River. Series 1 represent number of threatened species and Series 2 represent total number of species

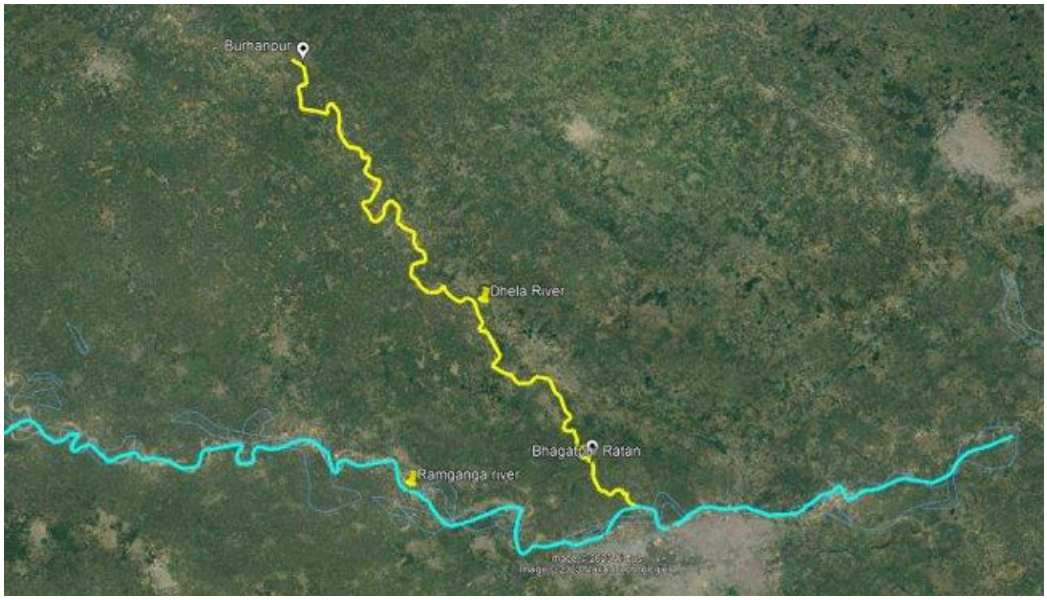


Figure 46 Dhela River confluence with Ramganga River

A comprehensive investigation into the ichthyofauna and water quality of the Dhela River was conducted in June 2022, focusing on five designated locations: Bhagwatipur, Masanpur, Burhanpur, Dhela Village, and Swaldha, along with Dhela Barrage. Among these locations, the three sites situated in the Moradabad district were determined to be completely devoid of water, exhibiting no signs of aquatic presence (Figure 47). During the study, a total of 9 fish species (Table 16), belonging to 2 orders and 4 families, were identified and documented at two specific sampling stations, namely Burhanpur and Dhela Village in Uttarakhand. Out of the 9 recorded species, 8 were categorized as least concern, indicating a relatively stable conservation status, while one species, *Tor putitora* (*Mahseer*), was classified as endangered, highlighting the need for conservation measures to protect its population.

Figure 47 River Dhela at Bhagwatipur in Moradabad District in May 2022

Table 16 Key species recorded in Dhela River in the District boundary

Channa punctata* (Bloch 1793)- *Sol
Channa striata (Bloch, 1793)- *Soli*
Colisa fasciatus (Bloch & Sch. 1801)-
Rasbora rasbora (Hamilton 1822)-
Heteropneustes fossilis (Bloch 1794)- Singhi

4.12 Waste and Sewage

The overall volume of sewage generated within the district amounts to 163 million litres per day (MLD), which is subsequently discharged into River Ramganga, Gaagan, and Karula nala/river through a network of 24 primary drainage channels. Among these 24 drains, 17 channels exclusively transport domestic waste, while the remaining 7 drains carry mixed types of waste. None of the drains solely carry industrial waste. Due to the absence of separate sewer line networks in cities, stormwater often becomes intermingled with the sewage flow. Within the city, a sewage treatment plant (STP) with a capacity of 58 MLD is operational, aiming to treat and manage the sewage effectively. Out of the total 24 drains, 21 channels direct approximately 108 MLD of waste to the Ramganga River, while the remaining 3 drains convey 35 MLD of waste to Gaagan. The cumulative municipal sewerage generation stands at 163 MLD, whereas industrial waste contributes 0.530 MLD, which is transported through 5 specific drainage channels [20].

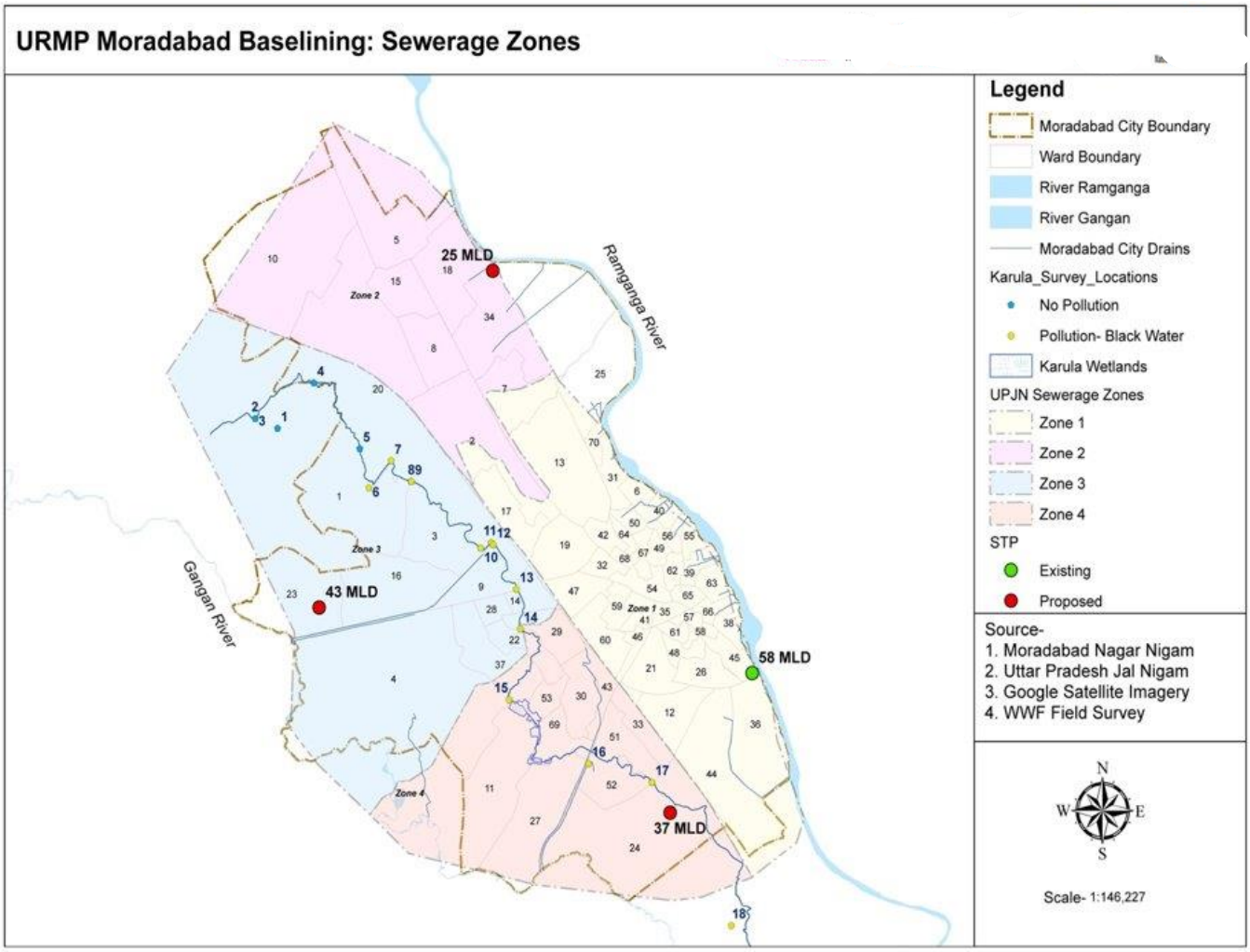


Figure 48 Zone wise location of STP in Moradabad district

Table 17 Summary of STP- Existing and Under Planning in Moradabad District [22]

S.No.	Zone	No. of drains	Status of Drain			Sewage discharge (MLD)			Total discharge in the rivers
			Tapped	Un-tapped	Partially tapped	Treated	Un-Treated	Total	
1	I	14	14	0	0	24	34	58	58
2	II	5	0	5	0	0	25	25	25
3	III	2	0	2	0	0	43	43	43
4	IV	3	0	3	0	0	37	37	37
Total		**24**	**14**	**10**	**0**	**24**	**139**	**163**	**163**

Zone (a)	Households (2015-16) (b)	Households connected with toilet (c)	% (d)	STP (MLD) (e)	Remark
I	79,500	78,247	98.42%	58	Existing, operational at 41 % capacity (24 MLD)
II	23,128	19,476	84.21%	25	Proposed under NMCG grant, DPR prepared (2017-18)
III	27,265	21,908	80.35%	43	Proposed, DPR prepared (2020-21)
IV	26,073	19,668	75.43%	37	Proposed, DPR prepared (2020-21)
	1,55,966	1,39,299	84.60%	163	

The Nagar Nigam of Moradabad has successfully implemented a total of 32 bio-remediation units along the 24 drainage channels responsible for carrying sewage to both the Ramganga River and Gaagan Rivers. Within the municipal corporation limits, a fully operational 10 thousand litres per day (KLD) decentralized sewage treatment plant has been established, ensuring efficient treatment of sewage within the designated area [22].

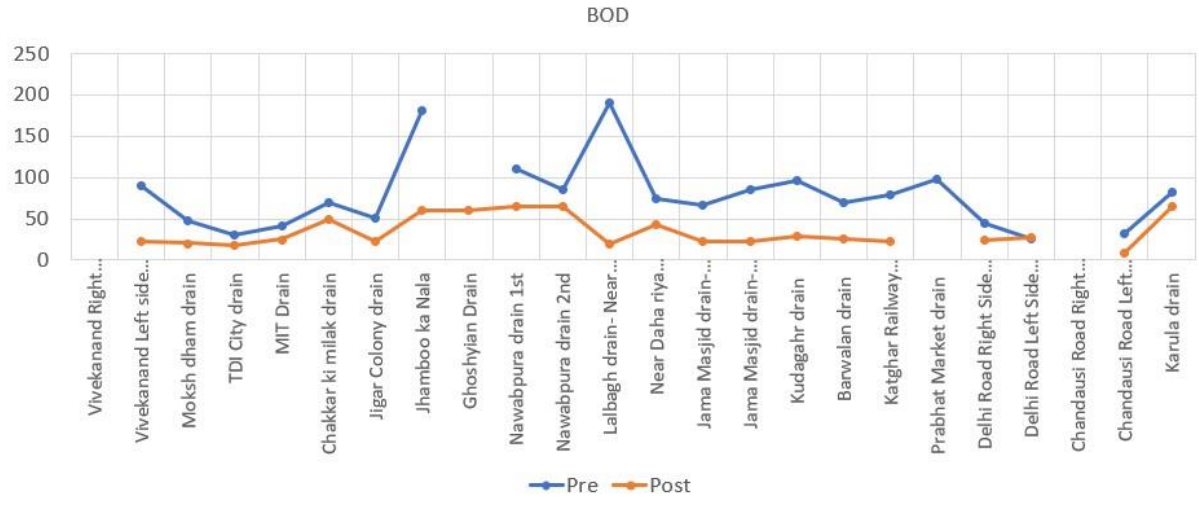


Figure 49 Graph representing pre and post-effect on BOD after the installation of 32 Bio-remediation units on the 24 drains carrying sewage to the Ramganga river and Gaagan Rivers.

Table 18 Status of Sewage drains in Moradabad District. Drains with GREEN colour have been tapped.

S.No.	Name Of Drain	Discharge (MLD)	Tapped Discharge	Discharge as per contract	Average flow recorded
1	Vivekanand (Left) Drain	1.08		1.08	
2	Vivekanand (Right) Drain	2.61		2.61	2.90
3	Mokshdham Drain	7.22		7.22	18.43
4	TDI City Drain	4.86		4.86	0.50
5	MIT Drain	7.50		7.50	35.33
6	Chakkar ki Milak Drain	2.00	2.00	0.00	2.99
7	Jigar Colony Drain	1.00	1.00	0.00	1.41
8	Jhabbu Ka Nala	10.00	4.00	6.00	9.66
9	Ghosiyan Drain	2.00	1.50	0.50	
10	Nawabpura Drain(1)	1.00	1.00	0.00	1.53
11	Nawabpura Drain(2)	2.00	2.00	0.00	2.15
12	Lalbagh Kali Mandir Drain	1.00	1.00	0.00	1.68
13	Near Dahariya Behind Hathi Mandir	2.50	2.00	0.50	3.27
14	Jama Maszid (Left)	1.00	1.00	0.00	1.84
15	Jama Maszid (Right)	0.90	0.80	0.10	2.06
16	Kudaghar Darin	5.00	0.50	4.50	4.47
17	Barvalan Drain	5.00	4.00	4.50	0.39
18	Katghar Rly St.Drain near Bridge	6.50	1.50	2.50	2.28
19	Prabhat Market Drain	1.75	1.75	0.00	
20	Delhi Road (Right) Drain	4.86		4.86	2.69
21	Delhi Road (Left) Drain	2.09		2.09	2.50
22	Chandausi Road (Left) Drain				
23	Chandausi Road (Right) Drain	2.98		2.98	0.38
24	Karula Drain	26.11		26.11	44.08
		100.96	**22.3**	**77.91**	**141**

A substantial percentage, approximately 74%, of households within Moradabad city is connected to on-site sanitation systems, including septic tanks and soak pits (Figure 50). As a result, effective management of faecal sludge and septage (FSSM) becomes imperative for the city's sanitation infrastructure. Despite having a Faecal Sludge Treatment Plant (FSTP) with a capacity of 32 kiloliters (KL), the current utilization of the facility is limited due to inadequate planning and a lack of awareness among the city's residents. The existing provisions for septage management are severely inadequate, posing a significant risk to the health and hygiene of rivers, water bodies, and drainage systems. Approximately 65% of the city is covered by a sewerage network, providing a more comprehensive sanitation solution. To cater

to the needs of the floating population, the construction of 88 community toilets at 11 locations and 226 public toilets at 29 locations has been undertaken throughout the city. Furthermore, 36 smart toilets have been strategically installed at 18 locations within the city, leveraging technological advancements for improved sanitation facilities.

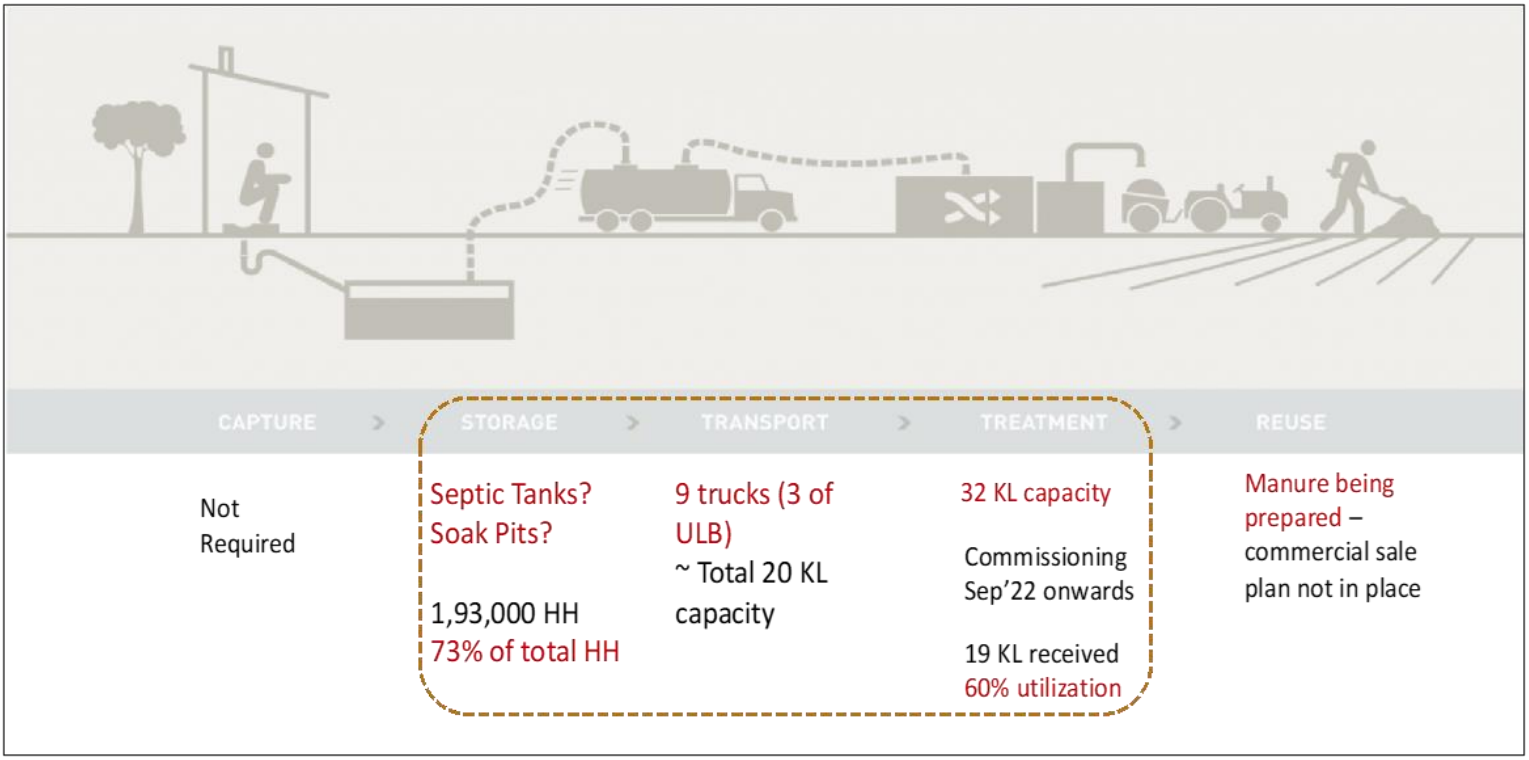


Figure 50 Current status of FSM value chain in Moradabad city. Source: URMP (under submission)

An 18 Million Liters per Day (MLD) capacity Sewage Treatment Plant (STP) is currently under construction, while a proposal for a 14 MLD STP has been submitted to the National Mission for Clean Ganga (NMCG) for financial assistance on the Dhela River. The rivers Dhela is directly polluted by industrial effluent transported through the Dhandi and Pachhna drains, as well as the Choti Dhela and Lapakna Nala. In addition, six municipal drains carry sewage and municipal drainage from Kashipur town, which ultimately flows into the Dhela River. The sewage generated by Kashipur town amounts to approximately 28 MLD.

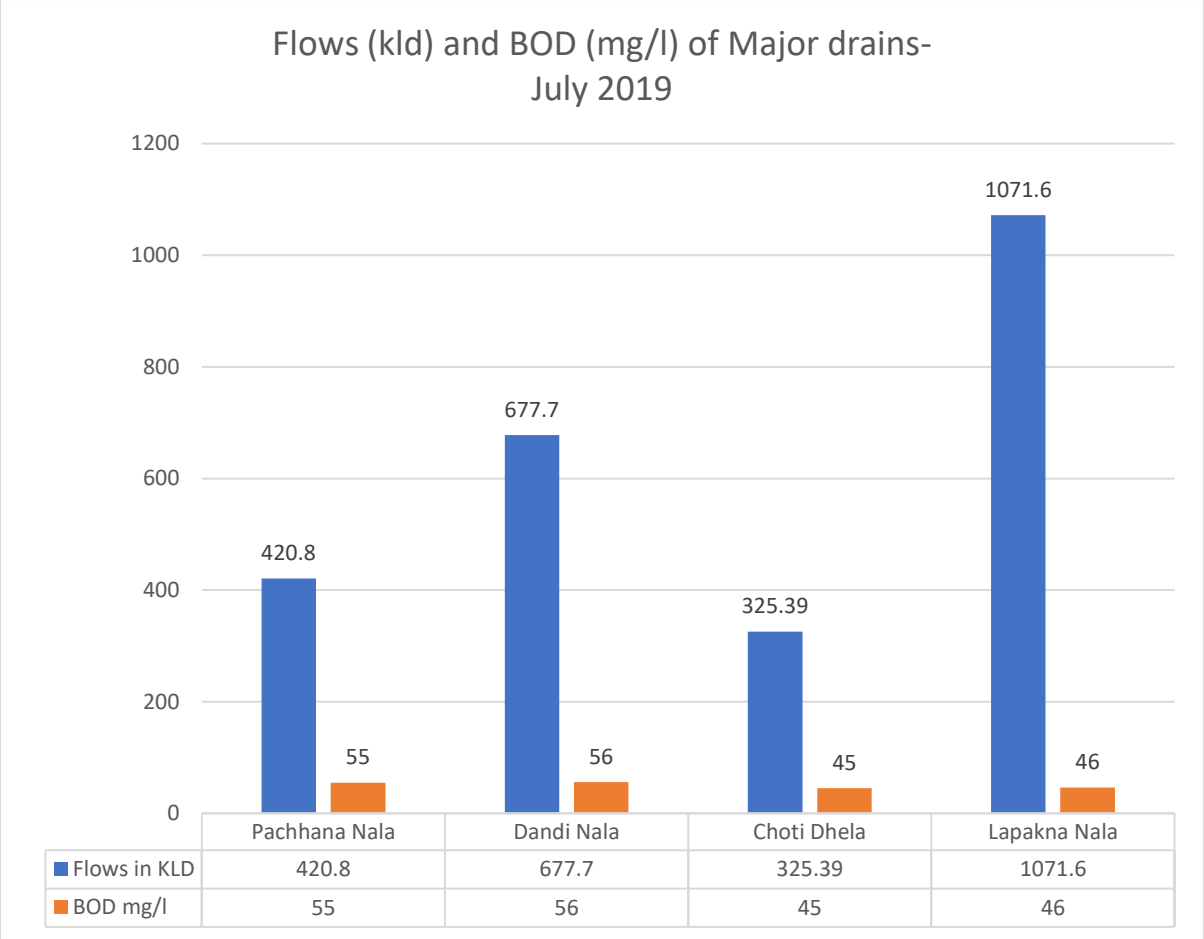


Figure 51 Status of Domestic sewage in Dhela River [25]

4.12.1 Solid waste

The total quantity of solid waste generated in the city of Moradabad is estimated to be 372 Tons per Day (TPD). Currently, 31% of the waste is being separated at the source of generation. The waste collection system covers all 70 wards, ensuring that 100% of the waste is collected and transported to the designated landfill site. This process involves the use of 280 waste collection vehicles equipped with separate compartments for dry and wet waste. To further enhance waste segregation at the source, an NGO called Samvedna Society is collaborating with the Municipal Corporation (MC) to educate residents at the ward level. The trenching ground located at Rampur Road is tasked with handling 580,000 metric tonnes of legacy waste. M/s NACOF has been selected to manage the processing and safe disposal of this waste. The agency commenced waste processing activities on January 18th, 2022, and has processed approximately 285,000 metric tonnes of legacy waste so far. M/s NACOF has installed a Pozollana machine plant with a capacity of 2,200 TPD. The project is expected to

be completed by June 30th, 2023. The city does not have any identified Garbage Vulnerable Points (GVPs) within its jurisdiction.

The Municipal Corporation has established a fully operational "Waste to compost plant" with a capacity of 400 Tons per Day (TPD). Currently, all freshly generated waste is being disposed of at the designated processing site. The diverse culture, changing food habits, and lifestyles in the area contribute to the generation of various types of waste, posing a challenge for the Municipal Corporation in terms of waste collection, treatment, and management. In the current circumstances, the Moradabad Municipal Corporation is undertaking actions to address the management of Municipal Solid Waste (MSW) through the implementation of potential solutions at both centralized and decentralized levels. This involves utilizing scientific treatment processes such as fresh waste treatment, legacy waste treatment, and water treatment. Legacy solid waste has been deposited in the floodplain and along the riverbank, while the MSW processing unit is also situated in the floodplain area. There is currently no leachate treatment facility available at the dumping yard. Religious waste, specifically at the Kali Temple, has been observed to be dumped along the riverbanks [26].

4.12.2 E-waste

Addressing the issue of E-waste is of paramount importance in mitigating river pollution in Moradabad city. E-waste processing is visibly concentrated in two specific locations. The first site is situated in the river bed, adjacent to the Kali Mata Temple. The second site is located at the Bandhe Wali Mazar, opposite the Jama Masjid (Figure 53). These sites serve as hubs where primitive industries engage in processing e-waste. The e-waste is directly discharged into the river or wetland, to extract metals and ash. Informal household metalware industries utilize this recovered ash, which is employed in lining furnaces, while the extracted metals are utilized in the production of handicraft items.

According to information provided by a local non-governmental organization (NGO), approximately 500 young workers are engaged in this informal and highly polluting activity. At any given time, around 100 workers operate at the aforementioned sites. The e-waste is sourced from markets in the Delhi National Capital Region (NCR). Workers purchase the waste and subsequently burn it to recover valuable metals, primarily copper, gold, and aluminium. The following (Figure 52) represents the supply chain involved in the informal e-waste processing activities within the city.

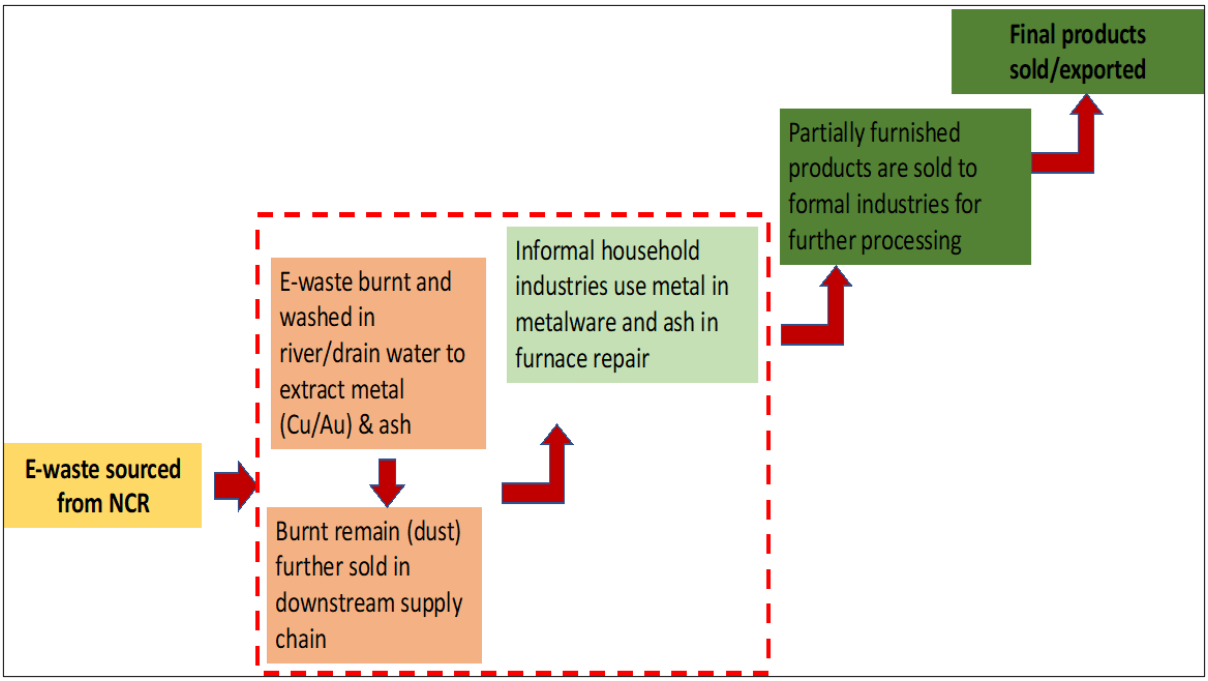


Figure 52 Informal E-Waste Processing in Moradabad City

Figure 53 Key Hot Spots of E-Waste processing along Ramganga River

5. Institutional arrangement of the District

Comprehensive and integrated strategies for the rejuvenation of rivers encompass entire river basins, taking into account not only the issue of sewage generated by human settlements but also other contributing factors such as industrial activities, irrigation water extraction, hydropower utilization, discharge of solid waste, and degradation of riverbanks. Therefore, it is imperative to establish planning, financing, monitoring, and coordinating authorities to strengthen the collective efforts of the Central Government, State Governments, and stakeholders in alignment with the NMCG Authority Notification Order of 2016. This will ensure the effective mitigation of pollution and the restoration, protection, and management of the Ganga River.

5.1 NMCG, SMCG, and DGC

National Mission for Clean Ganga (NMCG): The NMCG is responsible for developing guidelines for district planning and mandates the District Ganga Committees (DGCs) under the Authority Notification. It approves district plans and facilitates financial arrangements for their implementation.

State Mission for Clean Ganga Uttar Pradesh (SMCG UP): The SMCG UP is an extended arm of the National Mission for Clean Ganga (NMCG) specifically designated for the state of Uttar Pradesh. It implements the Namami Gange program and other related initiatives through various executing agencies.

District Ganga Committee (DGC – Moradabad): The DGC in Moradabad is mandated to formulate the District Ganga Plan following the Authority Notification.

5.2 Key Stakeholders

5.2.1 National level

- **Central Groundwater Board (CGWB):** Contributes to district planning by providing inputs for the sustainable development and management of groundwater resources across the country.
- **Central Water Commission (CWC):** Contributes to district planning by focusing on components related to water resource management and monitoring the quality of river water.

- **National Water Academy (NWA):** Contributes to district planning based on the internationally recognized River Basin Management (RBM) cycle approach. NWA collaborates with NMCG and GIZ to implement RBM cycle training.
- **Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR):** While not directly involved in the planning stage of district plans, MoJS, DoWR, RD & GR serve as the nodal ministry at the central level to support the development of Ganga and sub-basin water frameworks by the states.
- **Ministry of Jal Shakti, Department of Drinking Water and Sanitation (DWS):** Similar to the previous ministry, MoJS, DWS is not directly involved in the planning stage of district plans but provides central-level support for the development of Ganga and sub-basin water frameworks by the states.
- **Ministry of Housing and Urban Affairs (MoHUA):** Although not directly involved in the planning stage of district plans, MoHUA provides policies, strategies, and guidelines through CPHEEO to the state and union territory governments, including municipal corporations/committees.
- **Central Pollution Control Board (CPCB):** Contributes by providing data and information on pollution abatement and monitoring the water quality within the basin.
- **Centre for Ganga River Basin Management and Studies (cGanga):** Coordinates and ensures synergy between the District Ganga Plan and the Ganga Basin Plan.
- **Wildlife Institute of India (WII):** Coordinates biodiversity aspects and local awareness activities within the district plans.
- **National Institute of Urban Affairs (NIUA), MoHUA:** Ensures synergy with the urban river management plan framework and urban river management plans for urban local bodies (ULBs).
- **National Institute of Hydrology, Roorkee,** Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation, Govt. of India**:** Provides leadership in hydrology research, offering scientific solutions for sustainable development and self-reliance in the water sector. Conducts studies on water resource availability under varying hydrological, climatic, and sociocultural conditions using

modelling techniques. Offers scientific advice to various stakeholders on water-related issues.

5.2.2 State level

- **Uttar Pradesh Jal Nigam:** Uttar Pradesh Jal Nigam will primarily play a key role in the water supply and liquid waste management planning component of the District Plans. It will also be involved in the design and execution of projects related to faecal sludge and septage treatment facilities.
- **Uttar Pradesh Pollution Control Board:** The Uttar Pradesh Pollution Control Board is responsible for providing recommendations and implementing measures related to the prevention and control of water and air pollution. They collect, compile, and analyze data on water and air pollution, as well as organize Information, Education, and Communication (IEC) activities on pollution prevention, control, and waste management.
- **Urban Development Department, Govt. of Uttar Pradesh:** The Urban Development Department of the Government of Uttar Pradesh works towards implementing major schemes through the Urban Development Directorate.
- **Department of Rural Development, Govt. of Uttar Pradesh:** The Department of Rural Development, under the Government of Uttar Pradesh, implements various programs aimed at promoting self-employment, rural housing, rural connectivity, village development, and other initiatives for the development of rural economy and infrastructure.
- **Board of Revenue, Uttar Pradesh:** The Board of Revenue in Uttar Pradesh serves a role in revenue administration and management within the state.
- **Uttar Pradesh Forest Department:** The Uttar Pradesh Forest Department is responsible for implementing the National Forest Policy, focusing on ecological stability and the sustainable management of natural resources.
- **Uttar Pradesh Irrigation and Water Resources Department:** The Irrigation and Water Resources Department, under the Government of Uttar Pradesh, is mandated for construction, operation and maintenance of water resources infrastructures (primarily irrigation and flood protection) in the state. They also maintains information on

irrigation, rivers, water resources infrastructure, hydropower, water resources and management.

- **Remote Sensing and Application Centre, Uttar Pradesh:** The Remote Sensing and Application Centre (RSAC-UP) is involved in geophysical surveys and employs techniques for soil and water testing. Its main objectives are the assessment, monitoring, utilization, and management of various natural resources in the state. RSAC-UP provides support for crop area estimation, production estimation of different crops, space-based information for decentralized planning, wetland inventory assessment, integrated watershed monitoring, vulnerability assessment, desertification and land degradation monitoring, plantation assessment, water sector restructuring, unauthorized colony mapping, asset mapping, groundwater targeting, rural and urban planning (including smart city planning), and infrastructure planning.
- **State Water Resources Data Analysis Centre (SWaRDAC):** SWaRDAC serves as the technical arm of the Uttar Pradesh Water Management and Regulatory Commission (UPWaMReC). It provides technical advice to the commission and supplies water-related data to the State Water Resources Agency (SWaRA) and other central/state water plans for all river basins in the state.

5.2.3 District level

- **District administration authorities:** The district administration authorities are responsible for law and order, as well as planning, development, and management activities within the district.
- **Urban local bodies (ULBs) falling in the district:** Urban local bodies, including Nagar Nigam, are involved in planning, development, upkeep, and management activities within their respective urban areas.
- **Jal Nigam:** Jal Nigam is responsible for the planning, survey, design, and execution of water supply and sewage schemes in both urban and rural areas of Uttar Pradesh. It is also authorized as a construction agency.
- **UP Irrigation & Water Resources Department:** The Irrigation Department is responsible for the construction operation and management of canals, state-tube wells, flood protection works, reservoirs for water conservation and anti-erosion works. The Flood Divisions of this department, in some of the flood-prone districts of

the state, deals extensively with the floods and river management. One such division exists in Moradabad as well, called Floods Division – Moradabad. Officials from this division office are part of Moradabad DGC as well.

- **Public Works Department:** The Public Works Department is involved in the construction, maintenance, and planning of roads, bridges, and government buildings.
- **Division/District Office of Environment, Forest, and Climate Change Department:** The forest officers in the Division/District Office of the Environment, Forest, and Climate Change Department are responsible for issues related to forests, the environment, and wildlife within their jurisdiction.
- **Agriculture Department:** The Agriculture Department focuses on promoting food and nutritional security. They provide various schemes, soil testing services, seeds and pesticides, and information about agricultural machinery and soil conservation programs.
- **Industrial associations:** Industrial associations play a role in the district's development and may contribute to relevant initiatives or programs.
- **District Panchayat Raj Department:** The District Panchayat Raj Department is responsible for civic functions related to sanitation, cleaning public roads, minor irrigation, public toilets and lavatories, primary healthcare, vaccination, drinking water supply, construction of public wells, rural electrification, and social health and primary and adult education.
- **District Education Department:** The District Education Department oversees education laws, policies, and regulations. They implement approved education and sports development plans, strategies, and programs.
- **District e-Governance Department:** The District e-Governance Department, in collaboration with the National Informatics Centre (NIC), supports nationwide ICT infrastructure to facilitate e-Governance services and various initiatives of the Digital India program.
- **Individual community representatives or organizations:** The involvement of individual community representatives or organizations such as community-based organizations (CBOs), non-governmental organizations (NGOs), or water user groups is

crucial to address local concerns and ensure community participation in decision-making processes.

- **Revenue Department: T**he Revenue Department is responsible for various administrative and financial functions related to revenue collection, land management, and related matters. The department plays a crucial role in managing the state's resources, ensuring proper utilization of land, and generating revenue for the government.

5.2.3 Other organizations work

WWF India, under the guidance of the district administration, has been organizing training programs for Ramganga *Mitras* in the Moradabad district. *Mitras*, known as Friends of Rivers and Wetlands, is a group of dedicated volunteers representing various stakeholder groups. Their primary objective is to safeguard rivers and wetlands through active participation in conservation efforts and the sustainable management of these natural resources.

These training programs are aimed to enhance their awareness of responsibilities towards river conservation and their roles within the District Ganga Committee (DGC). The training sessions focused on building their capacities in River Health Assessment, Wetlands Health Assessment, and Sustainable Agriculture.

- **River Health Assessment:** The *Mitras* received training on conducting water quality tests using portable water testing kits and meters. They gained knowledge about testing parameters such as dissolved oxygen, phosphate, nitrate, etc. Additionally, they learned about assessing the health of rivers in terms of floodplain health, river channel health, biota health, and community perception.
- **Wetlands Health Assessment:** The training covered the mapping and conservation of wetlands. Experts provided detailed presentations on different types of wetlands, their functions, and the major threats they face. The participants understood the significance of wetlands for humans, animals, and the environment. Water quality testing kits were also provided to the heads of five villages from each block in the district.
- **Sustainable Agriculture:** The *Mitras* gained knowledge about best agriculture practices that promote water and chemical savings. They were exposed to live

demonstrations on the preparation of bio-fertilizers and bio-pesticides using locally available ingredients.

5.3 Existing policies and procedures

5.3.1 National Water Policy (2012)

The National Water Policy (2012) emphasizes the integration of a participatory approach into various aspects of water resources planning, design, development, and management. The ultimate goal is to facilitate the transfer of management responsibilities for constructed facilities to user groups or local bodies. The NWP 2012 mandates the central government, state governments, and local bodies to guarantee that all citizens have access to a minimum quantity of safe drinking water for essential health and hygiene purposes, conveniently available within their households' proximity. Furthermore, the policy recognizes women's specific concerns regarding water within the context of the household, which is the officially acknowledged social unit in all NWP documents. The primary objectives of this policy are:

- Ensure the preservation and optimal utilization of available water resources.
- Facilitate qualitative enhancements in water resource management.
- Sustain the quality of surface and underground water.
- Maintain ecological and environmental equilibrium during the development of water resources.

5.3.2 National Water Mission

The primary objective of the National Water Mission (NWM) is to promote the conservation of water, minimize wastage, and ensure a more equitable distribution of water resources both within and across states through integrated development and management of water resources. The NWM encompasses five specific goals:

- Establishing a comprehensive water database accessible to the public and assessing the impact of climate change on water resources.
- Encouraging citizens and states to take action in water conservation, augmentation, and preservation.
- Providing focused attention to particularly vulnerable areas, including those that are over-exploited.
- Achieving a 20% increase in water use efficiency.

- Promoting integrated water resources management at the basin level.

A budget allocation of Rs 50 crore has been assigned for the research, development, and implementation of the NWM during the period of 2023-24 [27].

5.3.3 National Hydrology Project

The primary objective of the National Hydrology Project (NHP) is to enhance the scope, quality, and accessibility of water resource information while strengthening the capacity of targeted water resources management institutions. This undertaking involves the modernization of monitoring networks, the transformation of knowledge access, the enhancement of analytical tools, and the modernization of relevant institutions. Significant accomplishments of the project include:

- Establishment of a nationwide centralized platform, referred to as the National Water Informatics Centre (NWIC), which serves as a singular point for all states to collaborate and exchange data on water resources.
- Substantial advancements have been made in the domains of Water Resources Management Systems (WRMS), Water Resources Information Systems (WRIS), Water Resources Operation and Planning Systems (WROPS), and Water Resources Institutional Capacity Enhancement (WRICE).
- A nationwide repository of water resources data has been successfully established. Emphasis is being placed on establishing a Real-Time Data Acquisition System (RTDAS) on a pan-India scale.
- Integrated water resources management is being implemented through the utilization of cutting-edge technology.

For the period of 2023-24, the National Hydrology Project has a total budget allocation of Rs. 500.0 crores. Additionally, an allocation of Rs. 3.95 crore has been dedicated to the establishment of the National Water Informatics Centre (NWIC) [27].

5.3.4 Master Plan for Artificial Recharge to Groundwater in India

Regarding the Master Plan for the Artificial Recharge of Groundwater in India, a revised plan has been formulated at the district/block level to encompass the entire country. This plan macroscopically examines the feasibility of various structures suitable for the diverse terrain

conditions of the country and estimates their respective costs. Key achievements of the Master Plan include:

- Identification of an area of 11.23 km² for artificial recharge.
- Determination of water requirements for recharge in each state, taking into account the surplus available after deducting the committed supply.

The budget allocation for implementing this revised master plan amounts to Rs. 1,33,529.69 crore, with Rs. 96,735.45 crore (72%) allocated for rural areas and Rs. 36,794.23 crore (28%) allocated for urban areas [27].

5.3.5 State Specific Action Plan (SSAPs) for Water Sector under NWM

National Water Mission (NWM) facilitates the formulation of state-specific action plans for the water sector, supporting states and Union Territories (UTs) in this endeavour. The State Specific Action Plan (SSAP) encompasses a comprehensive policy that promotes integrated water resource management at the basin level. This policy is a multidisciplinary undertaking that requires active involvement from all government departments involved in water supply, demand, governance, technology, and environmental and climate change aspects. It also involves the participation of non-governmental agencies and citizens. Hence, the formulation of plans necessitates convergence and synergy among all governmental and non-governmental stakeholders.

In terms of budget, the Uttar Pradesh State Government has allocated 51 Lakhs for the implementation of this plan.

5.3.6 Jal Shakti Abhiyan

Jal Shakti Abhiyan focuses on the conservation and preservation of rainwater. It involves the participation of states and all stakeholders to establish rainwater harvesting structures suitable for specific climatic conditions and sub-strata. The objective is to accelerate water harvesting, conservation, and bore well recharge activities in 256 water-stressed districts. The initiative promotes water conservation and water resource management through the implementation of five targeted interventions: water conservation and rainwater harvesting, renovation of traditional and other water bodies, reuse of water and recharging structures, watershed development, and intensive afforestation. Additionally, special interventions include the development of Block Water Conservation Plans, District Water Conservation

Plans, Krishi Vigyan Kendra Melas, Urban Wastewater Reuse, and 3D contour mapping of all villages.

Notable achievements of the Jal Shakti Abhiyan include:

- The implementation of over 3.5 lakh water measures in 256 districts. This includes 1.54 lakh measures related to water conservation and rainwater harvesting, 20,000 measures for the rejuvenation of traditional water bodies, over 65,000 structures for reuse and recharge, and 1.23 lakh projects for watershed development.
- Approximately 2.64 crore people have actively participated in the Abhiyan, making it a mass movement (Jan Andolan).

5.3.7 National Policy for Women 2016

The National Policy for Women 2016 serves as a comprehensive policy framework that guides various sectors to develop more detailed policy documents specific to their domains. The policy envisions a society where women achieve their full potential and participate as equal partners in all spheres of life, influencing the process of social change. Its mission is to establish an effective framework for developing policies, programs, and practices that ensure equal rights and opportunities for women in family, community, workplace, and governance. Key features of the National Policy for Women's Empowerment include:

- The creation of a society where women work as equal partners in all spheres of life.
- Development of a framework for ensuring equal rights and opportunities.
- Provision of skill development and equal employment opportunities.
- Addressing all forms of violence against women.

In terms of budget allocation, the funding dedicated to women-only schemes across various government ministries experienced growth from ₹ 11,388.41 crores in 2015-16 to ₹ 17,412.01 crores in 2016-17. Specifically, the allocation for Women's Training Programmes aimed at women police officers increased from ₹ 12 lakh in 2015-16 to ₹ 16 crore in 2016-17. The overall budget for women is typically computed by combining Part A, where 100% of the provision is designated for women, and Part B, where allocations for women constitute a minimum of 30% of the provision. In 2016-17, the total budget for women amounts to ₹ 90,624.76 crore, as compared to ₹ 81,249.12 crore in 2015-16 [28].

5.3.8 Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA)

The Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) aims to provide up to 100 days of unskilled manual work per financial year to every rural household based on demand, resulting in the creation of productive assets. Its objectives include the construction of quality and durable productive assets such as roads, canals, ponds, and wells, enhancing the livelihood resource base of the poor, promoting social inclusion, and strengthening Panchayati Raj Institutions (PRIs). The scheme prioritizes labour-intensive activities related to water harvesting infrastructure, drought relief, and flood control.

In terms of budget allocation, the financial provision for MNREGA has increased from Rs. 61,500 crore at the Budget Estimate stage to Rs. 1,11,500 crore at the Revised Estimate stage in the financial year 2020-21. Similarly, for the financial year 2021-22, the allocation was raised from Rs. 73,000 crore at the Budget Estimate stage to Rs. 98,000 crore at the Revised Estimate stage [29].

5.3.9 Mission Amrit Sarovar

Mission Amrit Sarovar has a primary objective of conserving and harvesting water for future generations. It also serves additional purposes such as expediting infrastructural projects using soil and silt from ponds, generating employment opportunities, irrigation, promoting tourism, and fostering fisheries. Key features of the mission include:

- Construction or rejuvenation of a minimum of 75 Amrit Sarovars in each district, with each Sarovar having a pondage area of at least 1 acre and a water holding capacity of around 10,000 cubic meters.
- The Sarovars will be surrounded by tree plantations, including Neem, Peepal, and Banyan, and will be utilized for various activities such as irrigation, fisheries, water tourism, duck farming, water chestnut cultivation, and other livelihood generation initiatives [30].

5.3.10 Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) focuses on the development of basic urban infrastructure in the water supply sector within designated mission cities. Its main objective is to achieve universal access to portable water for every

household in these cities. The AMRUT 2.0 scheme was launched for a period of five years, from FY 2021-22 to 2025-26. The goals of AMRUT include ensuring access to tap water and sewerage connections for every household and enhancing the aesthetic value of cities through the development of well-maintained green spaces, such as parks. Regarding achievements:

- The scheme has successfully provided 79 lakh household tap water connections and 45 lakh sewer connections.
- Additionally, it has promoted energy efficiency by replacing 76 lakh streetlights with energy-efficient LED streetlights.

In terms of budget allocation, the total outlay for AMRUT 2.0 is Rs. 2,99,000 crore, including a central outlay of Rs. 76,760 crore for the five years. This outlay incorporates funding of Rs. 22,000 crore (with Rs. 10,000 crore as central assistance) for ongoing AMRUT projects until March 2023. Among the various components of the plan, Rs. 39,011 crore (50%) is allocated to water supply, Rs. 32,456 crore (42%) to sewerage and septage management, and Rs. 2,969 crore (4%) to stormwater drainage projects. The Government of India has allocated Rs. 39,011 crore for drinking water supply projects and Rs. 32,546 crore for sewerage and septage projects under this scheme.

5.3.11 Programs under the Tourism Department, Government of Uttar Pradesh

Under the Programs of the Tourism Department of Uttar Pradesh, a budget of Rs. 2.10 crore has been allocated for the beautification of Ghats near Hanumat Dham, situated near the Khannaut River.

5.3.12 Projects under Jal Nigam

Projects undertaken by the Uttar Pradesh Government under Nagar Vikas Nigam/Jal Nigam include:

- Out of 24 drains, 14 are fully or partially tapped, and the tapping process is underway for 5 drains. In Zone 2, the remaining 5 drains are scheduled to be tapped by 2025, as the Detailed Project Report (DPR) for the same has been submitted to NMCG in New Delhi.
- One 58 MLD Sewage Treatment Plant (STP) is installed and operational, while a 25 MLD STP is currently under construction.

- Two STPs, with capacities of 35 MLD and 45 MLD, are proposed, with a target completion date set for 2025.
- A 32 KLD Faecal Sludge Treatment Plant (FSTP) is currently operational, processing 10 KLD.
- The installation of 125 km of sewer lines in Zone-2 is in progress and is expected to be completed by January 2024. The commissioning of the sewer line will take place after the completion of the 25 MLD STP.
- The Detailed Project Report (DPR) for Inflow and Infiltration (I&D) work and a 3.70 MLD STP in Kanth Nagar Panchyat, Moradabad, under Swachh Bharat Mission-Urban-2.0, has been submitted to headquarters.
- Additionally, the DPR for I&D work and a 3.90 MLD STP proposed in Bilari Nagar Palika Parishad, Moradabad, under Swachh Bharat Mission-Urban-2.0, has also been submitted at headquarters.

5.3.13 Swachh Bharat Mission

The Swachh Bharat Mission (SBM) was initiated with two components: SBM (Gramin) and SBM (Urban), to construct household and community-owned toilets and promote their usage, as well as implement effective Solid and Liquid Waste Management (SLWM) to achieve an Open Defecation Free (ODF) India. The rural component is overseen by the Department of Drinking Water and Sanitation, while the urban component falls under the Ministry of Housing and Urban Affairs. To incentivize the construction and usage of toilets, the government provided a financial incentive of Rs. 12,000 per toilet.

In October 2021, the Urban Swachh Bharat Mission 2.0 was launched to make all cities in India "Garbage Free." SBM-Urban 2.0 focuses on several key areas, including sludge management, wastewater treatment, source segregation of garbage, reduction in single-use plastics, and controlling air pollution caused by construction, demolition, and bio-remediation of dumpsites. Some notable achievements of the Swachh Bharat Mission include:

- Construction of 10.28 crore toilets in 36 states and union territories under SBM (Gramin), resulting in 603,175 villages being declared open defecation free.
- Additionally, over 30 crore people participated in behaviour change campaigns, and the establishment of the Rashtriya Swachhata Kendra (RSK) in New Delhi provided an

audio-video experience centre to showcase the continuous promotion and success of the Swachh Bharat Mission.

- Under SBM-Urban, the goal is to eliminate open defecation in urban areas and achieve 100% scientific management of municipal solid waste in over 4,000 towns across the country. By October 2, 2019, 66 lakh individual household toilets (IHHLs) were constructed under SBM Urban, and this target was later revised to 59 lakh IHHLs by 2019, which was successfully achieved by 2020.
- The Swachh Bharat Mission has led to a significant change in behaviour, with 55 crore people adopting toilet usage and contributing to a notable reduction in water and sanitation-related diseases. Moreover, it has resulted in an annual profit of over Rs. 50,000 per household in rural India.

The budget allocation for the Swachh Bharat Mission in the year 2023-24 is Rs. 7192.0 crores for SBM (Rural) and Rs. 5000.0 crores for SBM (Urban) [31].

5.3.14 Namami Gange Mission

The Namami Gange Programme is a comprehensive conservation initiative aimed at achieving two main objectives: effectively reducing pollution and conserving and rejuvenating the National River Ganga. It operates under the Department of Water Resources, River Development, and Ganga Rejuvenation, which falls under the Ministry of Jal Shakti. The program is implemented by the National Mission for Clean Ganga (NMCG) and its state counterpart organizations known as State Programme Management Groups (SPMGs). Recognizing the significance and scope of the program, the Government of India has approved Namami Gange Mission-II. Key accomplishments of the Namami Gange Programme include:

- The undertaking of 374 projects focused on cleaning the main stem of the River Ganga and its primary tributaries, encompassing the main stem towns and 15 tributaries. Out of these 374 projects, 210 have been completed, while the remaining projects are at various stages of completion.
- Furthermore, 49 sewage management projects are currently being implemented, and 98 sewage projects have been completed across nine states. Additionally, 28 sewage projects are in the tendering phase, and one new sewage project has been launched

in these states. Work is underway to create a sewerage capacity of 5175.87 million litres per day (MLD).

- The program has initiated the construction and modernization of 70 Ghats/Crematoria and the renovation of 267 Ghats/Crematoria and Kunds/Ponds.
- Moreover, projects are being undertaken to develop science-based plans for the restoration of aquatic species in the Ganga River, while also focusing on the conservation and restoration of aquatic biodiversity.
- Numerous public outreach and community participation activities have been organized, including events, workshops, seminars, conferences, and various Information, Education, and Communication (IEC) initiatives. Various awareness activities such as rallies, campaigns, exhibitions, cleanliness drives, competitions, plantation drives, and the development and distribution of resource materials have been conducted. To ensure wider publicity, mass media channels such as TV, radio, print media advertisements, advertorials, and featured articles have been utilized.
- The program emphasizes the regulation and enforcement of environmental norms through regular and surprise inspections of Grossly Polluting Industries (GPIs) to verify compliance. Action has been taken against 110 non-compliant GPIs, and closure directions have been issued. Additionally, Online Continuous Effluent Monitoring Stations (OCEMS) connectivity has been established to the Central Pollution Control Board (CPCB) server in 885 out of 1072 GPIs.
- In terms of sanitation, 1674 Gram Panchayats in the five Ganga Basin States have been identified for toilet construction. Out of the targeted 15,27,105 units, the Ministry of Drinking Water and Sanitation (MoDWS) has completed the construction of 8,53,397 toilets. Efforts are also underway to develop the Ganga River Basin Plan and establish 65 model villages.

The budget allocation for Namami Gange Mission-II is Rs. 22,500 crore, while the National Ganga Plan under NGM-II has been allocated a budget of Rs. 4000 crore for the fiscal year 2023-24 [27][32].

Section C: Situation Analysis of key issues for the planning cycle

This part describes the stock taking and key issues for the planning cycle. This also includes collection of existing information and generation of baseline information.

6. District Ganga Plan: Sample scenarios for synergy

A comprehensive analysis is required for all rivers within the district, including those that contribute hydrologically and ecologically to the main stem of the Ganga or its tributaries, down to the sub-tributary level. It should be noted that detailed information may not be readily accessible for all rivers within the district, particularly considering the varying stream orders. Therefore, the proposed district plan should encompass an action plan and resource allocation specifically dedicated to data collection and planning for such rivers.

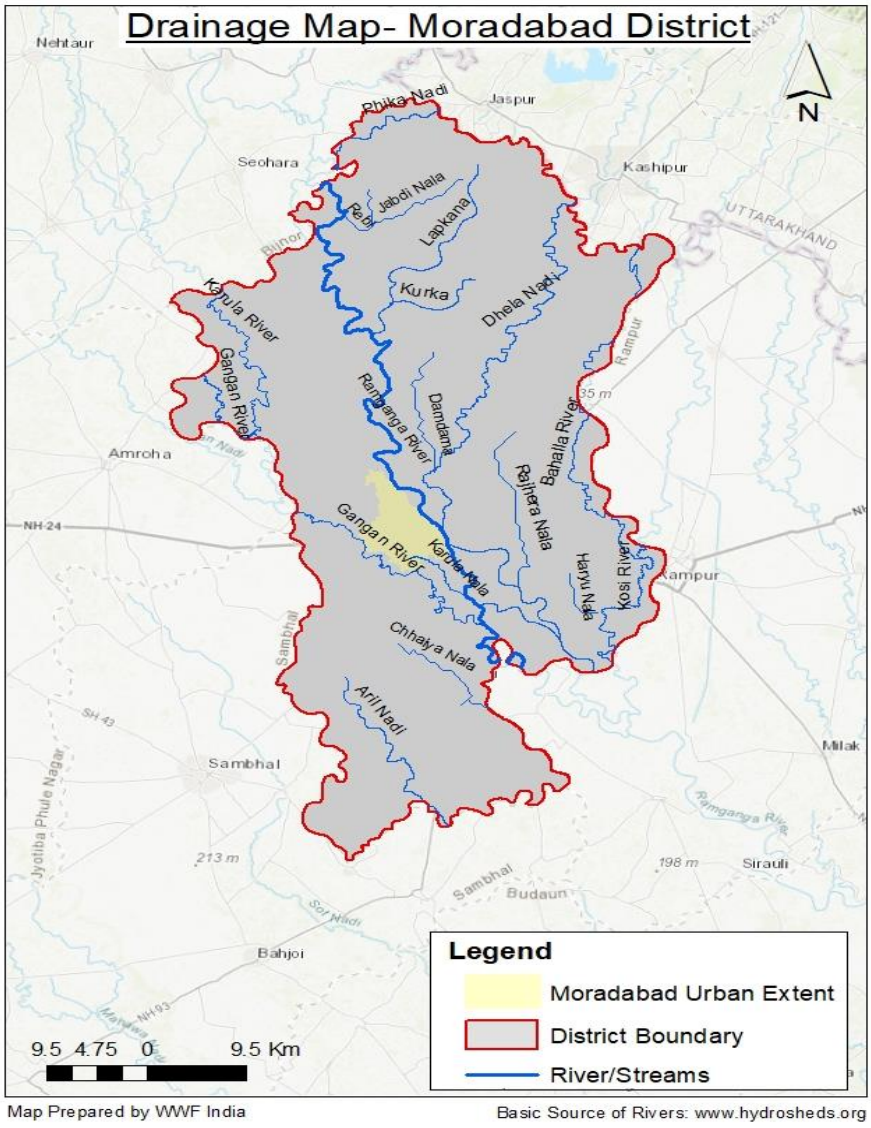


Figure 54 Drainage map of Moradabad District

- **Scenario 1:** In this scenario, the focus is on rivers that fall entirely within the district boundaries. The planning and management efforts should be directed towards these rivers to ensure their sustainable development and conservation.
- **Scenario 2:** This scenario recognizes the transboundary nature of certain rivers, requiring collaborative planning and coordination with neighbouring districts. Synergistic approaches should be employed to address the shared challenges and opportunities presented by these rivers.
- **Scenario 3:** In this scenario, the district, being located in the most downstream stretch of the river, will establish synergies with all the upstream districts. The planning efforts should encompass the entire river basin, aiming to effectively manage the resources and address the cumulative impacts on the downstream region (Figure 55).

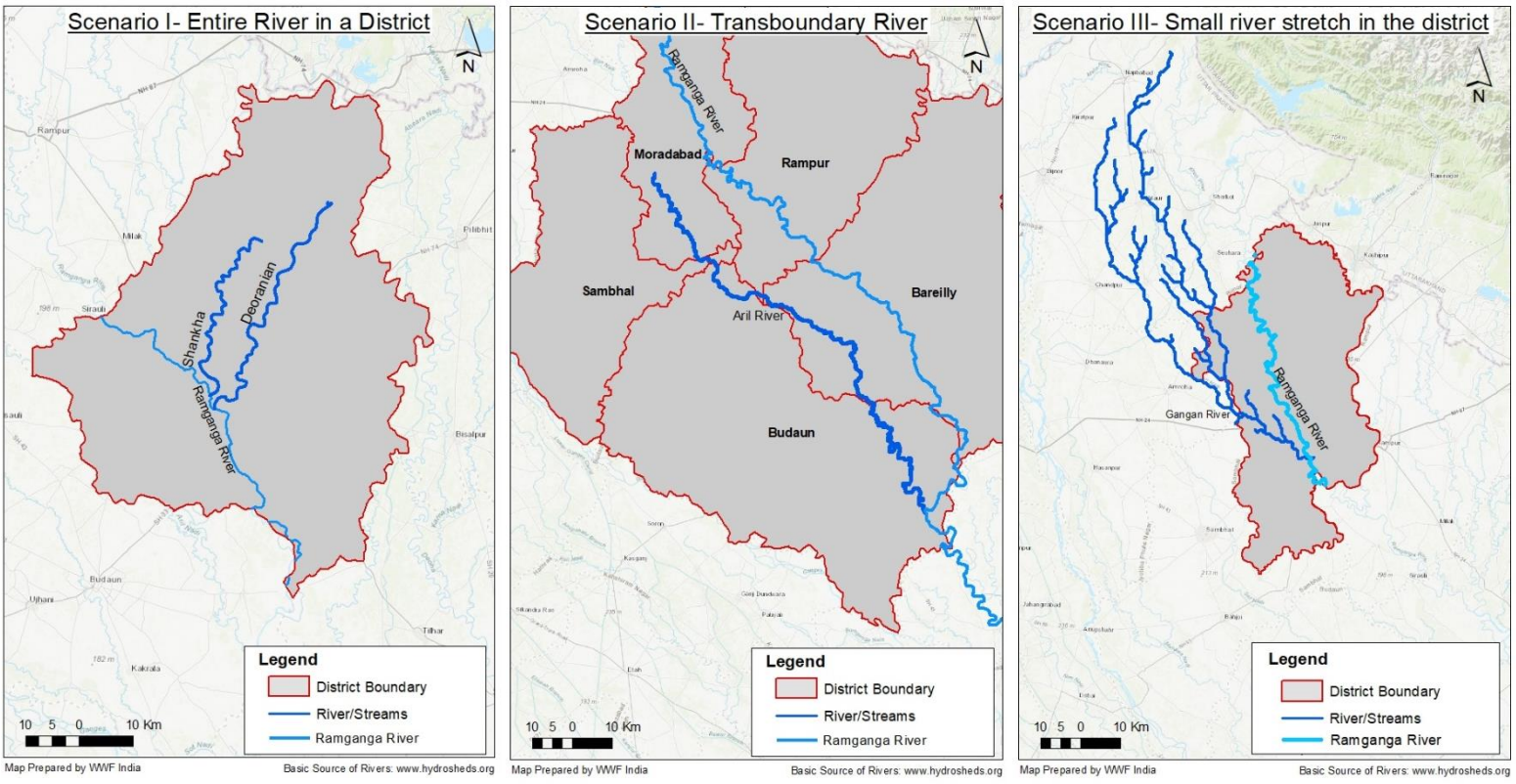


Figure 55 District Ganga Plan: Sample Scenarios for Synergy Analysis

While drafting the Key Priority Issues, the above dimension is taken into account and the suggestions are made accordingly.

7. Selected key issues of Moradabad district to be addressed

A total of nine key priority issues have been identified in the Moradabad District that need to be addressed:

- **Effective management of domestic sewage:** The focus will be on developing comprehensive strategies for the management and treatment of domestic sewage in the district, ensuring proper sanitation practices and reducing pollution. Emphasis will be placed on managing water demand and implementing sewage treatment measures in urban and peri-urban areas to address the challenges posed by increasing population and urbanization.
- **Pollution mitigation in Dhela River:** Measures will be taken to address the pollution issues originating from the Dhela River, which has been causing adverse impacts on the water quality and ecological health of the Ramganga River.
- **Agriculture water management:** The adoption of appropriate practices and policies (Irrigation Water Use Efficiency) will be promoted to enhance water and food security in the agricultural sector, while also improving climate resilience.
- **Floodplain protection and wetlands restoration:** Efforts will be made to safeguard the floodplains and restore wetland ecosystems, with particular attention given to addressing river floodplain protection in the Ramganga, Gaagan, Aril, and Karula rivers within the district.
- **Industrial water and waste management:** Measures will be implemented to ensure the effective management of water resources in industrial activities, along with the proper treatment and disposal of industrial waste.
- **Capacity building and human resources development:** The development of skills and knowledge will be prioritized, particularly at the District Ganga Committees (DGCs), including the Arth Ganga initiative, to strengthen their capacity in managing Ganga-related programs and projects.
- **Solid waste and E-Waste management:** Strategies will be devised to manage solid waste and electronic waste effectively, both in urban and rural areas, aiming for sustainable waste management practices.

- **Conservation and understanding of key tributaries:** Efforts will be made to gather knowledge and information regarding the current status and conservation of significant tributaries within the Moradabad district.
- **Regional focus on Environmental Flows:** Measures will be taken to maintain and enhance the Environmental Flows in the Ramganga River and its tributaries, ensuring the ecological health and sustainability of the entire river system.

7.1 Key Issue- 1: Domestic sewage management; Water demand management and sewage treatment in urban/peri-urban areas

7.1.1 Potential intervention

1. Enhancement of Faecal Sludge and Septage Management (FSSM) in the city:

- Establish a comprehensive digital database of on-site sanitation systems (households, public/community toilets) to effectively monitor and manage the faecal sludge and septage in the city.
- Arrange for adequate number of dedicated vehicles (30 to 40 depending upon the need) to carry out the scheduled emptying of septic tanks and cesspools, ensuring timely and efficient waste removal.
- Geo-tag the existing desludging vehicles to track their location and optimize their deployment for improved service delivery.
- Optimize the utilization of existing Faecal Sludge Treatment Plants (FSTP) with a capacity of 32 kiloliters per day, exploring strategies to maximize their operational efficiency.
- Explore the possibility of co-treatment of faecal sludge in the existing Sewage Treatment Plants (STP) with a capacity of 58 million litres per day, thereby leveraging the existing infrastructure to handle additional waste streams.

2. Development of an effective municipal and e-waste management plan:

- Notification of designated clusters for e-waste washing, ensuring compliance with appropriate regulations and guidelines.
- Explore the potential for reusing treated wastewater in handcart units involved in e-waste washing, subject to water quality testing to ensure suitability and safety.

- Establish a joint monitoring group involving community stakeholders to actively monitor the Sewage Treatment Plant (STP) outlets and assess their compliance with relevant standards and regulations.

3. Promoting sustainable practices in high-rise buildings, residential colonies, educational institutions, and multiplexes:

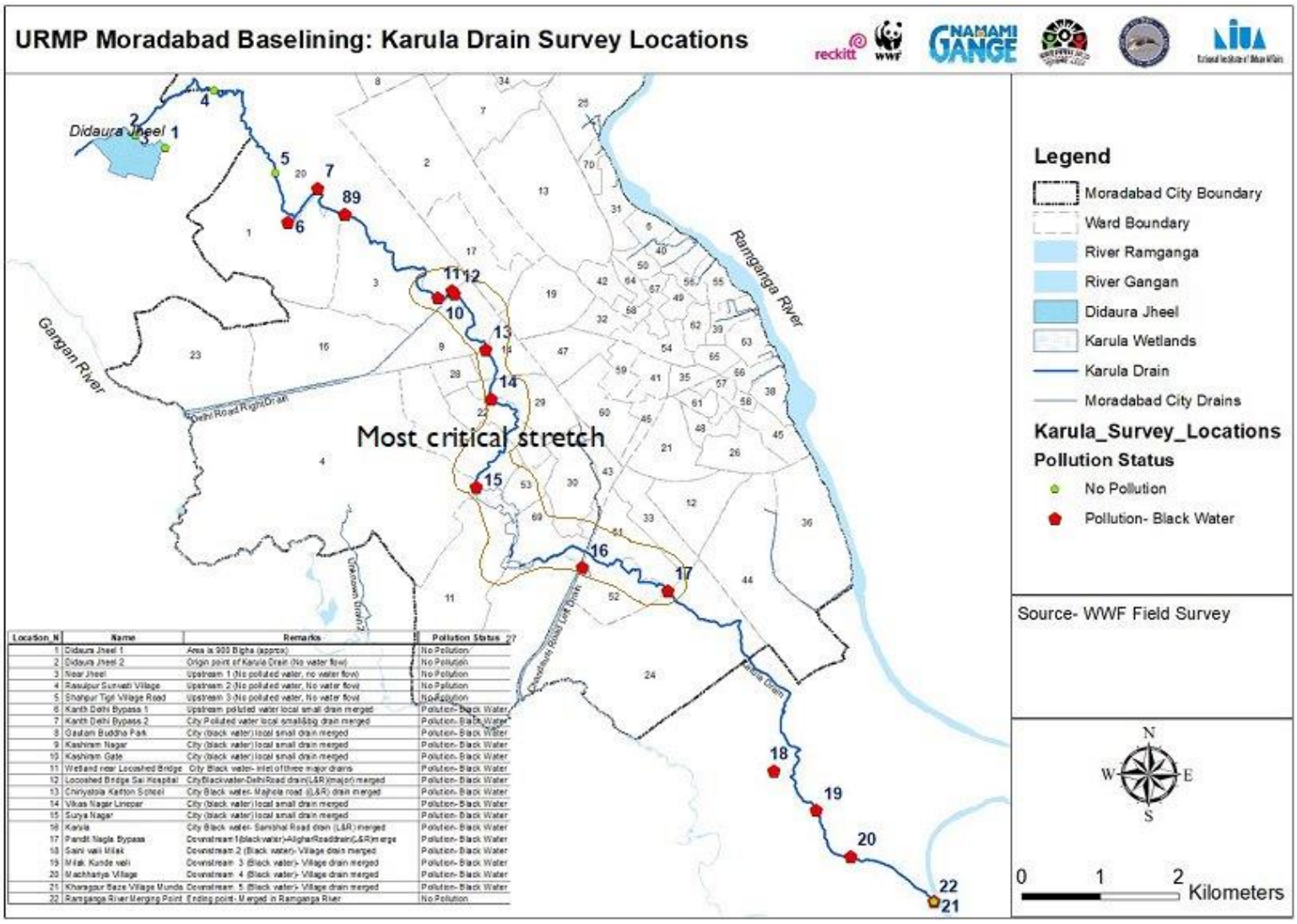
- Encourage the reuse of treated water from STPs for non-potable purposes such as flushing and gardening, thereby promoting water conservation practices.
- Ensure compliance with water-saving measures in these establishments, aiming to minimize water wastage and optimize resource utilization.

7.1.2 Potential intervention

The Karula drain, which spans approximately 25 kilometres from its origin in the Dindaura Jeel outside the Municipal Corporation's limits to its final discharge point in the Ramganga River, is the longest in the area. Fifteen smaller drains converge into the Karula drain, further contributing to its pollution load.

1. Implementation of decentralized wastewater treatment in the Karula drain and Pollution control in the Karula Drain using Nature-based Solutions (NbS).

2. A proposed Sewage Treatment Plant (STP) with a capacity of 38 million litres per day (MLD) is planned for the downstream section of the Karula drain.



Location_N	Name	Remarks	Pollution Status
1	Didaura Jheel 1	Area is 900 Bigha (approx)	No Pollution
2	Didaura Jheel 2	Origin point of Karula Drain (No water flow)	No Pollution
3	Near Jheel	Upstream 1 (No polluted water, no water flow)	No Pollution
4	Rasulpur Sunvati Village	Upstream 2 (No polluted water, No water flow)	No Pollution
5	Shahpur Tigri Village Road	Upstream 3 (No polluted water, No water flow)	No Pollution
6	Kanth Delhi Bypass 1	Upstream polluted water local small drain merged	Pollution- Black Water
7	Kanth Delhi Bypass 2	City Polluted water local small&big drain merged	Pollution- Black Water
8	Gautam Buddha Park	City (black water) local small drain merged	Pollution- Black Water
9	Kashiram Nagar	City (black water) local small drain merged	Pollution- Black Water
10	Kashiram Gate	City (black water) local small drain merged	Pollution- Black Water
11	Wetland near Lacoshed Bridge	City Black water- inlet of three major drains	Pollution- Black Water
12	Lacoshed Bridge Sai Hospital	CityBlackwater-DelhiRoad drain(L&R)major) merged	Pollution- Black Water
13	Chiriyatola Kattion School	City Black water- Majhola road (L&R) drain merged	Pollution- Black Water
14	Vikas Nagar Linepar	City (black water) local small drain merged	Pollution- Black Water
15	Surya Nagar	City (black water) local small drain merged	Pollution- Black Water
16	Karula	City Black water- Sambhal Road drain (L&R) merged	Pollution- Black Water
17	Pandit Nagla Bypass	Downstream1(blackwater)+HighwRoaddrain(L&R)merge	Pollution- Black Water
18	Saini vali Milak	Downstream 2 (Black water)- Village drain merged	Pollution- Black Water
19	Milak Kunde vali	Downstream 3 (Black water)- Village drain merged	Pollution- Black Water
20	Machhariya Village	Downstream 4 (Black water)- Village drain merged	Pollution- Black Water
21	Kharagpur Baze Village Munda	Downstream 5 (Black water)- Village drain merged	Pollution- Black Water
22	Ramganga River Merging Point	Ending point- Merged in Ramganga River	No Pollution

Figure 56 Locations of Survey at the Karula Drain done by WWF

The comprehensive revival plan consists of three main stages (Table 19), encompassing site preparation and pollution mitigation measures in both the drain and the core wetland area.

Table 19 Revival plan for the Karula Drain

Stage 1	Site preparation	The delineation of a 30-meter buffer zone around the wetland is proposed to establish a designated area known as the "people-water connect belt." Within this belt, a total of 18 smaller segments have been identified, which can be developed as riparian buffer strips measuring 5-10 meters along the periphery of the wetland. The implementation of these buffer strips aims to effectively mitigate pollution and prevent encroachment in the vicinity of the wetland.
Stage 2	Pollution abatement in the drain	Creation of treatment lagoons at the confluence point of Karula drain and Karula wetland.
Stage 3	Pollution abatement in wetland	Floating wetlands for the waterbody revival in various zones of wetlands are proposed in these 3-stage plan.

7.1.3 Potential intervention

Case Study-1

Water Footprint Campaign

The Water Footprint Campaign in Moradabad is a collaborative initiative undertaken by Nagar Nigam and WWF-India. This initiative is predicated on a strategic vision aimed at exemplifying a demand-side management paradigm within the context of 10,000 households.

The primary objectives of this campaign encompass educating and motivating individuals and households concerning the Water Footprint concept. Furthermore, it entails equipping individuals with the requisite skills to quantify water consumption and identify wastage patterns at the household level. The campaign seeks to bolster positive behavioural patterns by advocating water-efficient practices as a component of demand-side management strategies implemented within the city.

An integral facet of this undertaking is the identification and recognition of individuals or entities who have demonstrated noteworthy reductions in their water footprint. These exemplary water users are envisioned to serve as catalysts, inspiring others and assuming the mantle of water champions within the city. Integral to the campaign's success is the measurement of the water footprint and the subsequent cultivation of efficient water utilization practices among households. This transformation encompasses both behavioural adjustments and the implementation of pertinent technical interventions.

The campaign has received participation from 4,595 households, covering 25 schools and 5 wards. It emphasizes the importance of measuring the water footprint and encourages households to adopt efficient water use practices through behavioural changes and technical interventions.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Improving Faecal Sludge and Septage Management (FSSM) in the city	▪ Establishing a comprehensive digital database of on-site sanitation systems (households, public/community toilets) for the efficient monitoring and management of faecal sludge and septage in the city. ▪ Ensuring the availability of an adequate fleet of dedicated vehicles (30 to 40, depending on demand) to carry out scheduled emptying of septic tanks and cesspools, ensuring timely and efficient waste removal. ▪ Geographically tagging the existing desludging vehicles to track their locations and optimize their deployment to enhance service delivery.	▪ Maximizing the utilization of existing Faecal Sludge Treatment Plants (FSTP) with a daily capacity of 32 kiloliters, exploring strategies to improve their operational efficiency. ▪ Investigating the potential for co-treatment of faecal sludge in existing Sewage Treatment Plants (STP) with a capacity of 58 million litres per day, thereby leveraging the existing infrastructure to manage additional waste streams.		▪ Nagar Nigam in collaboration with local community members ▪ Jal Nigam ▪ Revenue department ▪ District Administration ▪ Uttar Pradesh Pollution Control Board ▪ Local organizations ▪ WWF India	▪ Swachh Bharat Mission (Urban) 2.0 ▪ Gandhivadi E-waste Yojna of MoEF ▪ Jalshakti Abhiyan ▪ Waste to Energy
2. Developing an efficient municipal and e-waste management strategy	▪ Designating specific clusters for e-waste processing, ensuring adherence to				

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	relevant regulations and guidelines. ▪ Evaluating the possibility of reusing treated wastewater in handcart units involved in e-waste processing, contingent upon water quality testing to ensure suitability and safety. ▪ Establishing a collaborative monitoring group involving community stakeholders to actively oversee the Sewage Treatment Plant (STP) outlets and assess their compliance with applicable standards and regulations.				
3. Encouraging sustainable practices in high-rise buildings, residential colonies, educational institutions, and multiplexes	▪ Explore the possibility of promoting the utilization of treated wastewater from STPs for non-potable purposes like toilet flushing and gardening, thereby endorsing water conservation practices. ▪ Pilot test in atleast 5 high rise building and large complexes/colonies	▪ Enforcing water-saving measures in these establishments to minimize water wastage and optimize resource utilization.			

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
4. Karula Drain	▪ Identify the suitable sites for the implementation of Nature based solutions along the course of Karula drain. ▪ Design and plan nature-based solutions tailored to each site, which could include vegetated swales or biofiltration systems. ▪ Secure necessary permits and approvals for the construction and operation of these solutions. ▪ Collaborate with local community members and WWF India to engage volunteers and local expertise in the implementation process. ▪ Install and establish site specific NbS at key locations ▪ Regularly monitor the effectiveness of the nature-based solutions in treating domestic wastewater and reducing pollution.	▪ Scale up NbS to remaining sites ▪ Continue regular monitor of the effectiveness of the nature-based solutions in treating domestic wastewater and reducing pollution. ▪ Implementing decentralized wastewater treatment in the Karula drain for pollution control. ▪ Planning to construct a proposed Sewage Treatment Plant (STP) with a daily capacity of 38 million litres in the downstream section of the Karula drain.			

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	▪ Conduct public awareness campaigns to inform residents about the importance of these solutions and encourage responsible wastewater disposal.				
5. Upscaling of Water Footprint Campaign	▪ Develop educational materials and outreach programs to raise awareness about the Water Footprint concept among households and individuals. ▪ Collaborate closely with WWF-India to develop a comprehensive plan for expanding the Water Footprint Campaign. ▪ Identify key target areas within the city and peri-urban regions for the campaign's expansion.	▪ Organize workshops, seminars, and community events to engage residents and motivate them to adopt water-saving practices.	▪ Monitor and evaluate the campaign's impact through surveys, data collection, and feedback from participants.		

7.2 Key Issue- 2: Agriculture water management; mainstreaming package of practices/policies to enhance food/water security and enhance climate resilience

7.2.1 Potential intervention

Agricultural water management should adopt a three-pronged approach:

- **Supply-Side Interventions:** Optimize water availability for irrigation through the maintenance and rehabilitation of canals and the conjunctive utilization of groundwater for irrigation purposes. Linking of tail-ends of canals with nearby drains/streams/rivulets/rivers or ponds/wetlands is also a critical activity under this approach.
- **Demand-Side Interventions:** Promote judicious use of irrigation water by implementing practices such as line sowing, maintaining optimum water depth in farms, adopting trench-based sugarcane cultivation, and using bio-fertilizers and bio-pesticides, application of micro-nutrients etc. These practices aim to maximize irrigation water use efficiency and maintain humus in the soil.
- **Institutional Strengthening (Water User Associations-WUAs):** Establish and strengthen Water User Associations and similar groups to provide a joint platform for farmers to collaborate and work towards sustainable agricultural practices.

While adopting these three approaches agriculture can aid efficient water management leading to saving of freshwater for environmental and other ecosystem purposes (like enhancing the water levels in the river, improving the water availability in the ponds and wetlands for more number of days/months in a year for the people and nature).

Case Study- 2

Sustainable agriculture water management

WWF-India along with several stakeholders (District administration, UPI&WRD, Agriculture department, Water Users Association, communities), is working on agriculture water management through training and demonstration of a Package of Practices in crops like Sugarcane, Wheat, and Maize in canal command areas of Bijnor, Moradabad and Amroha. This endeavour, which has been in progress since 2017, has engaged more than one hundred thousand farmers. The cumulative outcome of these interventions has resulted in the conservation of a substantial volume of water, exceeding one hundred million litres, from irrigation activities. Significant water savings ranging from 17% to 34%, have been realized at the farm level through the diligent execution of these initiatives.

Figure 57 Agriculture water management work in Canal command

Parallel similar sustainable agriculture activities were carried out in the zone of influence of wetlands in Bareilly district during the year 2021-22 (Aril river basin). Along with wetland restoration activities in wetlands one of the objectives was also to train farmers on better management practices in agriculture to reduce water abstractions and use of chemical inputs. Training and demonstration of PoPs including generation and use of organic bio-fertilizers and pesticides were conducted with 500 plus farmers (in crops like Wheat, Mentha, and vegetables). This increased yield of crop produce (10-15%), water savings of 25%, reduction of chemical usage by 10-20% and enhanced soil health.

Figure 58 WWF-India initiatives in sustainable agriculture water management in wetlands catchment

The strategic expansion of this undertaking across the expanse of the Bareilly district holds the potential to furnish notable advantages to the region's indigenous freshwater resources, encompassing rivers, ponds, and groundwater reservoirs.

Figure 59 Village kesopur meeting krti sharda devi main cannel (left) and Making of Amrit Khad and Amrir Paani (right)

7.2.2 Potential intervention

This potential has been implemented since 2017 across the canal command area of irrigation schemes managed by the UP Irrigation & Water Resources Department, benefiting over one lakh forty thousand farmers in the Bijnor-Moradabad-Amroha; Kasganj districts. As a result, more than 250 million litres of saved water from irrigation canal command area have contributed to enhanced flows in the Karula and Gaagan rivers.

Figure 60 Use of Trencher tool in raising Sugarcane crop in a farm in Bijnor district

Significant water savings ranging from 17% to 34% have been observed at the farm level through these initiatives. By scaling up this work throughout the Moradabad district, local freshwater resources, including rivers, ponds, and groundwater, can further benefit from these measures.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Transform 10% of Agriculture Area in the district.	▪ Collaborate with farmers, KVKs, Agriculture department, to raise awareness and provide training on sustainable farming practices, including efficient irrigation methods, crop selection, and organic farming. ▪ Initiate the transformation of 2-3% of the agriculture area in each block within the first year through training, capacity building and adoption of better management practices in agriculture (including adoption and application of biofertilizers Amrit Paani and Amrit Khaad)	▪ Continue scale up of demonstration and training in agriculture area keeping 10% area target (implementation plan can be can be developed at block level) ▪ Monitor impacts at farm level on aspects like productivity, soil health, input costs, economic benefits, adoption of organic farming techniques etc. ▪ Provide incentives and support to encourage farmers to transition to sustainable practices.	▪ Sustain the practice and aim for continuous improvement, ensuring that the agriculture area remains under sustainable practices, with a focus on long-term environmental and economic benefits.	▪ Agriculture Department ▪ Horticulture ▪ Krishi Vigyan Kendra's ▪ Uttar Pradesh Irrigation Department ▪ WWF India ▪ Farmers	▪ Rashtriya Krishi Vikas Yojana (RKVY) ▪ Mission for Integrated Development of Horticulture. ▪ Pradhan Mantri Krishi Sichayee Yojana (PMKSY) ▪ Micro Irrigation Fund (MIF): ▪ National Mission on Sustainable Agriculture (NMSA) ▪ MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) ▪ Paramparagat Krishi Vikas Yojana (PKVY)
2. Constitution of WUA's as per UP-PIM act 2009 across all	▪ Identify canal systems with functional WUA's in the district and the ones where WUA's are not	▪ Expand the formation of WUA's to cover 30% of	▪ Constitute Water Users' Associations in atleast 70% of feasible canal systems across the		

functional irrigation canals in the district.	formed/process initiated and develop a list of feasible canal command areas for WUA formation. ▪ Raise awareness among farmers in canal command area on significance and functions of WUA's in atleast 5 canal system ▪ Organize exposure visits of irrigation department field functionaries and farmers in active and progressive WUA. ▪ Training and capacity building of farmers and Irrigation department field functionaries on UPPIM act 2009 and WUA formation process ▪ Under preparatory phase of WUA formation in 5 canal system, identify villages in commands, make voter list, hold elections. ▪ Establish Water Users' Associations (WUA's) in 5 irrigation canals irrigation canals in Bareilly district.	the total feasible canal command areas	district, ensuring effective, community-led water resource management, and sustained support for sustainable water use practices Monitoring and evaluation of the impact		

3. Linking tail ends of canals with nearby rivers/ponds	▪ Identify and assess the feasibility of linking tail ends of canals with nearby rivers/ponds to initiate pilot projects (for all the canals in the district). ▪ Conduct field validation surveys in tail ends with farmers and concerned line departments ▪ Develop detailed implementation plan (techno-financial) and connect atleast 30% of feasible canal systems tail ends to nearby river/pond ▪ Install gauges at tail ends and monitor the flows going into river/ponds.	▪ Link 40% more canal tail with nearby rivers or ponds to enhance local water security and rejuvenate smaller rivers/ponds, especially during the summer season. ▪ Monitor flows at tail ends at regular intervals and maintain a temporal database.	▪ Among the feasible canal system, connect rest of the 30% of canal system tail ends to rivers/ponds. ▪ Calculate the total amount of water saved and evaluate the impact.		
4. Promotion of Agricultural Systems and Organic Farming	▪ Conduct awareness programmes to engage with farmers to discuss and demonstrate the benefits of organic farming practices. ▪ Train and build capacity of farmers in 10% of villages in district (200 villages) generation and use of bio-fertilizer and bio-pesticide	▪ Scale up the training, capacity building and demonstration of use of organic ways of cultivation in additional 20% of villages (400 villages) ▪ Monitor and document impacts. ▪ Award and recognize progressive farmers/villages/officials	▪ By end of 5 years atleast 50%of the villages should be adopting organic ways of cultivation ▪ Scale up the training, capacity building and demonstration of use of organic ways of cultivation in additional		

	(Amrit paani and Amrit khaad) ▪ Monitor and document impact on crop health, Water savings, soil health, productivity, reduction in chemical use, costs etc ▪ Award and recognize progressive farmers/villages/officials on adoption of organic farming techniques	on adoption of organic farming techniques	20% of villages (400 villages). ▪ Monitor and document impacts ▪ Award and recognize progressive farmers/villages/officials on adoption of organic farming techniques		

7.3 Key Issue- 3: Untreated/Partially treated liquid and solid waste from industries

7.3.1 Potential intervention

- Regular monitoring and sampling of industrial wastewater are essential to accurately identify and map all pollution sources within the district and pinpoint areas of significant contamination. To enhance the monitoring network and focus on areas with high water contamination, improvements need to be made.
- Strict actions should be initiated against industries that fail to meet the standards outlined in the District Environment Plan or those set by regulatory agencies such as the Pollution Control Board (PCB) or the Bureau of Indian Standards (BIS).
- Regular and surprise inspections should be conducted on Gross Polluting Industries (GPIs), Brass industries, and industries falling under the Red category. The purpose of these inspections is to ensure compliance with effluent discharge standards set by relevant regulatory agencies.
- Given that all the listed industries rely on groundwater as a water resource, it is crucial to implement extensive water recycling measures, particularly in units that generate substantial volumes of effluents like paper mills, sugar mills, and distilleries.
- It is imperative to install the Counter Current Mechanism (CCM – developed jointly by WWF India and IIT Kanpur) in brass industries equipped with electroplating plants. Additionally, efforts should be made to identify unregistered plants operating in densely populated remote areas of the city and raise awareness about the benefits of CCM. Encouraging and promoting the installation of CCM in these unregistered plants is essential.

7.3.2 Potential intervention

- Out of the total 78 industries with Effluent Treatment Plants (ETPs) installed, they must modify or upgrade their systems with the latest technology for effluent treatment. These industries should adopt appropriate technologies that enable Zero Liquid Discharge (ZLD) to effectively manage their wastewater.

7.3.3 Potential intervention

- Establish a collaborative monitoring mechanism involving irrigation authorities, UPPCB (Uttar Pradesh Pollution Control Board), scientific experts from institutions such as TMU

(Teerthanker Mahaveer University), Hindu College, and representatives from local organizations. Random inspections of industries should be conducted once per season, and a comprehensive report should be submitted to the District Ganga Committee (DGC).

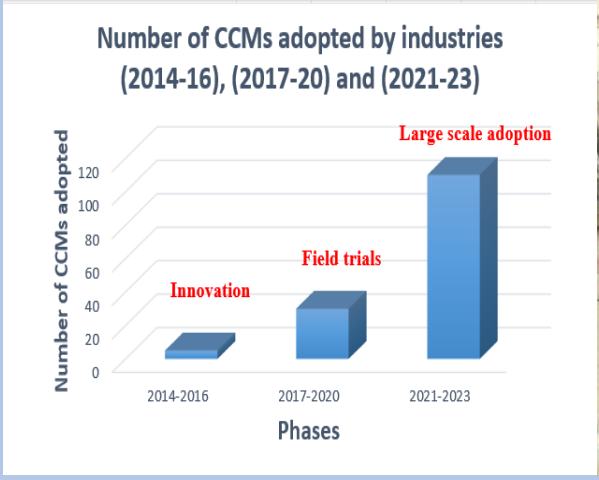
- Ensure the installation of water treatment facilities in all industries, achieving 100% compliance.
- Ensure the proper operation of existing Effluent Treatment Plants (ETPs) and install ETPs in industries where they are currently absent.
- Strengthen the capacity of personnel in water quality (WQ) monitoring and quality assurance/quality control (QA/QC) procedures for WQ data.
- Regularly test the sewage and industrial wastewater for specific parameters such as Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen
- Demand (COD), Ammonia, Chlorides, Fluoride, Nitrate, Phosphate, as well as heavy metals including Zinc (Zn), Copper (Cu), Lead (Pb), Chromium (Cr), using RHA/Merck kits at specified intervals. (Responsible Departments: UPPCB, Nagar Nigam, and Local Organizations).

Case study- 3

Counter Current Mechanism- A clean technology solution to reduce freshwater consumption in metalware industry

Rinsing is a daily operation in electroplating plans of brass industries, often carried out using traditional methods that excessively consume rinse water, leading to a notable depletion of fresh water resources. WWF India has introduced a device known as the Counter Current Mechanism, developed collaboratively by WWF India and IIT Kanpur specifically for brass industries equipped with electroplating plants in Moradabad. This mechanism proves effective in reducing fresh water consumption in these industries.

The automated Counter Current Mechanism (CCM) comprises a composite Polypropylene tank with three partitions, allowing water to flow between partitions. Moreover, the CCM incorporates an automatic Total Dissolved Solids (TDS) controller mechanism, ceasing the flow of fresh water when the TDS falls below a specified threshold. In contrast to the conventional system, which involves 2 to 3 simultaneous fresh water taps and leads to overconsumption, the CCM employs only one tap. This tap activates when the TDS surpasses a predetermined threshold and automatically stops when the TDS drops below the specified value.



Presently, 148 units of the Counter Current Mechanism (CCM) have been installed in 31 metalware industries. The initial implementation involved the installation of 2 units at the MHSC institute in 2017-18 as a pilot for testing purposes.

Following several upgrades, including the addition of a TDS controller, sensor, and solenoid valve, these units have been installed in various household units as well as small, medium, and large-scale industries. The Polypropylene (PP) tank, crucial for this industry, is priced at approximately INR 18-25 thousand. Data analysis indicates significant water savings ranging from 30-40% in different scenarios when utilizing these tanks.

Notable Achievements:

- 32 prominent export units have successfully embraced 140 Counter Current Mechanisms (CCMs).
- A majority of leading exporters have taken the initiative to adopt CCMs, utilizing their own funds and benefiting from technical guidance provided by WWF-India.
- There is a growing interest among industries to transition their electroplating units entirely to CCM-based rinsing methods.
- The adoption of CCMs has contributed to industries attaining a higher sustainability index.
- A significant reduction of 14 million liters in fresh water consumption has been achieved as of February 2023.
- A Buyer-Supplier platform has been established to integrate CCM practices into the core of business operations.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Establish New Water Quality Monitoring Stations	▪ Set up additional water quality monitoring stations in key rivers such as Aril, Gaagan, and Karula nala/river, with a specific focus on locations like upstream of Khadakpur Baje village (28.776947°N; 78.806178°E). ▪ Increase the number of monitoring stations in existing rivers like Ramganga, both at the entry point (29.1954 N; 78.6703 E) and exit point (28.6956 N; 78.8721 E) within the district boundary. ▪ Consider establishing monitoring stations at critical points like Sikandarpur Patti village (downstream of Karula nala/river), Dhela River before its confluence with	Continue monitoring the water quality parameters and publish the data		▪ Uttar Pradesh Pollution Control Board ▪ Nagar Nigam ▪ District Administration ▪ Expert from TMU or Hindu Colleges ▪ Central Pollution Control Board ▪ NMCG & SMCG – UP & Uttarakhand	▪ Jal Shakti Abhiyan ▪ National Plan for Conservation of Aquatic Eco-systems (NPCA) ▪ Mission Amrit Sarovar

	Ramganga River, and Gaagan River at locations where major drains discharge into the river.				
2. Enforce Stringent Measures on Major Polluting Units	▪ Implement rigorous enforcement measures on major polluting industrial units, compelling them to upgrade and modify their manufacturing processes and Effluent Treatment Plants (ETPs) to strictly comply with the required discharge parameters.				
3. Ensure 100% Effluent Treatment through ETPs	▪ Mandate that all industries release effluent only after it has undergone proper treatment through Effluent Treatment Plants (ETPs) before being discharged into any stretch of river or stream.	▪ To enhance adherence, a coalition comprising stakeholders and external experts, potentially affiliated with universities or colleges, can be established. ▪ This team will conduct routine inspections of these industries in collaboration with the UPPCB team and provide regular reports to the DGC			

7.4 Key Issue- 4: Pollution from solid and E-Waste in urban and rural areas

7.4.1 Potential intervention

- Promote and establish the practice of waste segregation-at-source among households and waste generators, and instruct both formal and informal waste collectors to only collect segregated waste. Consider introducing financial incentives to encourage segregation-at-source.
- Implement a 50% reduction in waste collection charges for individuals or households that engage in waste segregation.
- Organize a comprehensive door-to-door awareness and education campaign in collaboration with civil society entities such as local non-governmental organizations (NGOs) and community organizations. Expand these efforts to Urban Local Bodies (ULBs).
- Encourage large housing complexes, buildings, multiplexes, and similar establishments to setup composting and waste separation facilities.
- Establish dedicated bio-waste collection and processing facilities at major markets, such as the Vegetable and Fruit Mandi at Prem Nagar Line Par area and the fish market at Rampur Doraha. Involve local entrepreneurs in the implementation of these facilities. Additionally, establish sanitary landfills for the disposal of inert and non-recyclable waste.
- For areas where door-to-door waste collection is not available, establish waste deposit points equipped with separate compartments for different types of waste.

7.4.2 Potential intervention

- Set up decentralized centres at the municipal level dedicated to material recovery, micro-composting, bio-gas generation, and waste disposal, including hazardous waste. Local entrepreneurs should be actively involved in these initiatives.
- Establish sanitary landfills specifically designed for the safe and appropriate disposal of inert and non-recyclable waste materials.
- Coordinate river-bank clean-up activities, engaging community organizations in the process.

- Construct and deploy "plastic traps" in rivers to effectively capture and collect floating plastic debris from water bodies. Community organizations should be actively engaged in these efforts.
- Commission a comprehensive study focusing on sustainable e-waste management practices, aiming to identify effective strategies and guidelines for the appropriate handling and disposal of electronic waste.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Integration of Waste and Rag Pickers	▪ Formalize the inclusion of waste and rag pickers into the formal workforce, providing them with permanent public employment opportunities. ▪ Emphasize the inclusion of women pickers in these initiatives.			▪ Nagar Nigam ▪ Urban Local Bodies ▪ Local NGOs ▪ Uttar Pradesh Pollution Control Board	▪ Swachh Bharat Mission-Urban (SBM-U) ▪ zero garbage generation scheme ▪ Total Sanitation campaign
2. Achievement of 100% Source Segregation	▪ Develop a comprehensive plan outlining the strategy for achieving 100% source segregation in all ULBs (Urban Local Bodies). ▪ Provide financial incentives (if possible) to households and entities that effectively practice waste segregation at the source. ▪ Implement source segregation in 20% of target area	▪ Implement source segregation in 40% of target areas ▪ Explore and implement financial incentives, such as reduced waste collection fees, for individuals and entities actively engaged in waste segregation practices.	▪ Implement source segregation in 100% of target areas		

3. Regular Awareness and Education Events	▪ Organize a minimum of two awareness and education events per month in collaboration with local community organizations, schools, and experts (aligning with initiatives like Swachh Bharat Abhiyan and other initiatives by state Govt.) ▪ These events should include workshops, seminars, street plays, and community meetings to educate residents about the importance of waste segregation and responsible waste disposal. ▪ Publish messages, news articles, and educational materials in local newspapers, on social media, and through other communication channels to reach a broader audience.	▪ Continue to organise these events include workshops, seminars, street plays, and community meetings to educate residents about the importance of waste segregation and responsible waste disposal.			
4. School-Based Awareness Programs	▪ Collaborate with local NGOs and experts to design and implement	▪ Continue the process of spreading awareness in the schools to achieve set targets of these years	▪ Continue the process of spreading awareness in the schools to achieve set targets of this years		

	awareness programs in schools. ▪ Phase the programs to target 25% of the schools in the district every year, ensuring that all schools are covered over time. ▪ Develop age-appropriate educational materials and curriculum for students to learn about waste segregation and environmental stewardship. ▪ Organize interactive sessions, competitions, and field visits to waste management facilities to engage students actively.				

7.5 Key Issue- 5: Floodplain encroachment and degradation of wetlands leading to destruction of habitats and loss of lateral connectivity in Ramganga/ Gaagan/ Aril/ Karula rivers in the district

7.5.1 Potential intervention

In the district, a total of 122 wetlands have been identified and classified into different categories, including Persistent, Intermittent, Intensifying, Diminishing, New, and Lost. It is necessary to adopt distinct management strategies for each category of wetland. Priority should be given to the conservation of Diminishing wetlands as they are at a high risk of disappearing, while a more lenient approach can be taken for Persistent wetlands. To ensure accurate data, joint surveys of prioritized floodplain wetlands will be conducted involving the Revenue Department, community members, the Rural development department, the Irrigation department, the UP-Pollution control department, the District Administration and WWF-India. Using baseline data collected, wetlands can be prioritized based on a prioritization matrix and restoration activities can be initiated.

The Ministry of Environment, Forest and Climate Change has developed a comprehensive four-pronged approach for wetland conservation, which includes:

- Inventorization of Wetlands and Preparation of 'Brief Documents' reporting its current status including threats, ecosystem services, values, ownerships etc.
- Preparation of Wetland Health Cards
- Enrolment of Wetland *Mitras* (Friends)
- Preparation of an Integrated Management Plan covering aspects such as Catchment and Hydrology, Water Quality, Biodiversity, and Governance.

7.5.2 Potential intervention

As per the rules and regulations governing wetlands, specific activities have been categorized as prohibited, permitted, and regulated. These classifications aim to ensure the effective management and conservation of wetland ecosystems.

Table 20 According to wetlands rules following activities are prohibited, permitted and regulated

Activity	Prohibited	Regulated	Permitted
Reclamation/ filling up			
Solid waste disposal	Within Wetland	Surrounding the Wetland	
Sewage disposal	Within Wetland	Surrounding the Wetland	
Selective desilting			
Promotion of fisheries			
Use of agro-chemical		Zone of Influence	

7.5.3 Potential intervention

- Identify prominent structures with substantial roof areas within the district for rainwater harvesting (RWH) purposes.
- Conduct routine monitoring of groundwater quality in collaboration with multiple stakeholders and domain experts.
- Investigate potential opportunities for recharge utilizing alternative sources such as canal networks, seepage from tanks, and water bodies.

7.5.4 Potential intervention

- In anticipation of the pending floodplain zonation exercise, delineate some strip of land along both sides of the rivers. This task will involve collaboration among the Revenue Department (RD), Uttar Pradesh Irrigation & Water Resources Department (UPI&WRD), and the District Administration.
- Safeguard the boundaries of the floodplain by implementing nature-based solutions, such as establishing tree lines or employing other suitable measures. Strict restrictions should be imposed on permitting any new construction activities within the river catchment area.

7.5.5 Potential intervention

- Floodplain delineation in alignment with NGTs directives for Ganga, while considering the "Room for the River" approach will be done.
- Specific Development Control Regulations (DCR) will be formulated to guide development activities within the designated floodplain areas.

- A public green space will be established on the cleared area adjacent to the floodplain, providing a recreational and environmentally friendly area for the community.
- Strict monitoring mechanisms will be put in place, utilizing regular inspections and up-to-date high-resolution satellite imagery. This will enable the identification of hotspots and problem areas, allowing for frequent inspections of sites such as Mokshdham, Lalbagh and Katghar.
- Measures will be implemented to prevent the unauthorized dumping of solid waste on the riverbanks and in the floodplain. This will include targeting specific locations such as Mokshdham, Lalbagh and Katghar.

Case Study-4

River rejuvenation through Wetland restoration in Aril basin (Bareilly district)

The Aril floodplain wetland restoration case study entailed a collaborative effort of several stakeholders including District administration, Line departments, community members and WWF-India, in conjunction with partner institutions IIT-Kanpur and Geovale. Earlier, WWF-India carried out an extensive study of mapping of wetlands Ramganga basin covering several districts. This comprehensive study was aimed at evaluating the wetland locations and connectivity with catchments and rivers within the Ramganga basin. The study was instrumental in identifying suitable wetlands within the Aril basin for potential restoration initiatives. Three specific wetland areas were specifically chosen for restoration activities: Khangwa Shyam (10.6 hectares), Lilaur Lake (42 hectares), and Bahoda Kheda (7.42 hectares), all situated within the Bareilly district.

Throughout the restoration process, a spectrum of pivotal variables encompassing critical threats, ecosystem service delivery, water quality, hydrological connectivity, and water availability underwent meticulous assessment. Elaborate baseline surveys were conducted, focusing on parameters such as water quality, hydrological connectivity, and the prevalence of aquatic vegetation. The discerned threats and pressures encompassed aspects such as the excessive proliferation of weeds, congestion in channels which are water inflow and outflow pathways, sewage contamination, excess usage of water and chemicals in agriculture and the fragmentation of habitats. A comprehensive evaluation was executed encompassing the identification of threats, topographical surveys and cross-sectional analysis of water quality testing enabling a holistic appraisal of the wetland health. Following this assessment, a robust wetland restoration strategy was devised. This strategy was subsequently realized through a collaborative, multi-stakeholder approach, involving the active participation of the District Administration, line departments, local village communities, and WWF-India.

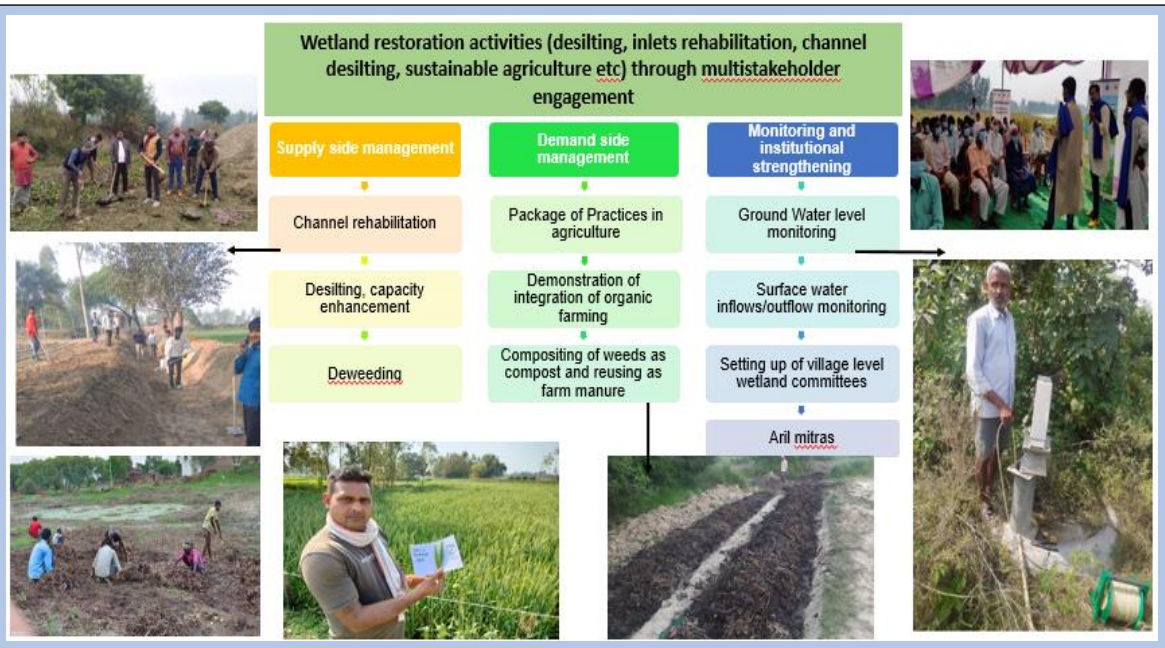


Figure 61 Wetland restoration activities

The implementation was augmented by harnessing resources from various departments and schemes; like – MNREGA, Irrigation, and Forest. WWF-India contributed technical expertise alongside financial support.

Noteworthy achievements emanated from these endeavours. Notably, during the period of August 2022, approximately 60 million litres of water were channelled into the Aril River via the Khangwa Shyam wetland outlet. Collectively in three target wetlands in Bareilly

Figure 62 Rejuvenated Khangwa Shyam Wetland

Figure 63 Rejuvenated Lilaur Lake

Figure 64 Rejuvenated Bahoda Kheda Wetland

Agricultural practices were positively impacted, manifesting in improved yields and crop health attributed to the adoption of sustainable agricultural techniques such as "Amrit Paani," "Amrit Khaad," "Jeevamrat," and the "Wheat Package of Practice" (PoP). The adoption of PoPs resulted in a 10-20 % reduction in chemical usage, a 25% reduction in water application/abstraction and a 10-20% improvement in yields.

Figure 65 Adoption of better agriculture practices leading to better crop health

Moreover, discernible enhancements in groundwater levels underscored successful aquifer recharge (GW levels enhanced by 4-5 feet), signifying the effective role of the restored wetland in facilitating groundwater replenishment within the region's ecosystem.

Apart from this about 2,500 quintals of water hyacinth weed were removed from the wetland and converted into 700 quintals of organic compost which was distributed among farmers to support organic farming.

Figure 66 Pre and post-scenario of the revival of Aril's floodplain wetland through de-weeding

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Comprehensive Study on Streams	▪ Collaborate with Groundwater department, UPI&WRD and other technical experts to conduct a comprehensive study to develop understanding of surface and groundwater inter-linkages to identify losing and gaining streams/stretches. ▪ Field validation of identified stretches to develop water management plan	▪ Use the study's findings to prioritize areas for interventions in river rejuvenation and groundwater recharge and reduce water demand during the first cycle of the District Ganga Plan (DGP).	▪ Monitor and evaluate the impact of interventions	▪ District Administration ▪ Revenue department ▪ Uttar Pradesh Irrigation Department ▪ Forest Department ▪ State Wetlands Authority (SWA) ▪ WWF India ▪ Local NGO's	▪ National Plan for Conservation of Aquatic Ecosystems (NPCA) ▪ Amrit Darohar and Amrit Sarovar Scheme ▪ Ministry of Environment, Forest and Climate Change (MOEFCC) ▪ Jal Shakti Abhiyan ▪ Atal Bhujal Yojana ▪ National Water Mission ▪ MNREGA
2. Restoration of 50 % of degraded Wetlands in next 5 years	▪ Collect baseline data of all 122 degraded wetlands (>2.5 ha area) (format of data collection to be shared by WWF-India). ▪ Considering threats, degradation, groundwater critical zones, ecological	▪ Continue working on restoration activities for wetlands taken up under year 1. Scale up the wetland restoration work in additional 5 wetlands in each of 8 blocks (covering 40 wetlands) ▪ Monitor impacts through pre and post	▪ Scale up the wetland restoration work in additional 5 wetlands in each of 8 blocks (covering 40 wetlands). Target should be to carry out atleast one or more restoration activity in		

	significance and ownership, develop on ground restoration plan with detailed activities for atleast 5 prioritized wetlands in each block, which are of ecological and hydrological significance. The activities should be implemented in a phased manner, addressing short-term threats first and progressing toward long-term restoration measures. Focus should on restoration of 122 odd degraded category wetlands. ▪ Prioritize the restoration activities and make plan for implementation in 1st year ▪ Implement critical selected activities in 1st year of restoration and monitor the impacts ▪ Align the wetland conservation work with initiatives of Central and State government (like	implementation observations on parameters like inflows, groundwater levels, water quality, weeds, inlet conditions, biodiversity etc. ▪ Reward and recognize water champions	each of the identified wetlands. ▪ Monitor impacts through pre and post implementation observations on parameters like inflows, groundwater levels, water quality, weeds, inlet conditions, biodiversity etc. ▪ Evaluate the impact of interventions on these wetlands and see the improvement of water quality and ground water levels		

	Save Wetland campaigns, Amrit Sarovar etc) ▪ Monitor impacts through pre and post implementation observations on parameters like inflows, groundwater levels, water quality, weeds, inlet conditions, biodiversity etc.				
3. Management of Aquatic Weeds (e.g., Hyacinth)	▪ Identify wetlands that are plagued by aquatic weeds like hyacinth. ▪ Implement strategies to remove and manage these weeds, including the conversion of the removed biomass into bio compost. ▪ Training and capacity building of various stakeholders, block wise, (farmers, line departments, panchayat raj officials etc) on removal and conversion into biocompost. ▪ Carry out deweeding and subsequent conversion into biocompost in 10%	▪ Scale up and periodic the deweeding , and subsequent conversion into biocompost in additional 30% of wetlands which are infested with weed. ▪ Monitor impacts on wetland health ▪ Promote the use of the bio compost in local agriculture to improve soil health and support organic farming practices. ▪ Reduce pollution loads in wetlands/rivers to	▪ Scaleup the process of weed removal in other identified wetlands. ▪ Establish a robust compost distribution system through KVK,s and gram panchayat level (compost generated from water hyacinth)		

	of wetlands which are infested. ▪ Develop a distribution mechanism of water hyacinth compost among farmers in wetlands zone of influence ▪ Application of organic compost generated from weed into agriculture farms and monitor the impacts.	minimize spread of water hyacinth wed			
4. Restoration of Floodplain Wetlands	▪ Select floodplain wetlands strategically, focusing on those that can help increase base flows along the Ramganga and other selected tributaries. Priority should be given to those wetlands, outlets of which can be connected to nearby rivulets to enhance surface water flows. ▪ Develop and implement restoration plans with multistakeholder approach for 2-3 wetland in each block to enhance hydrological connectivity,	▪ Scale up developing of restoration plans and implementation of prioritized activities in selected floodplain wetlands and continue working on wetlands taken up under 1st year. ▪ Monitor impacts (inflows, storage capacity, water quality, groundwater levels etc) through wetland health assessment ▪ Develop educational programs and engage the community to raise awareness about the importance of floodplain	▪ Monitor and evaluate the impact of restoration of floodplain wetlands on the rivers, biodiversity habitats, local water security, and groundwater of the area. ▪ Scaleup the models to the other tributaries in the district. ▪ Legal Protections: Advocate for and implement legal protections and regulations that ensure the long-term conservation and		

	Invasive weed management, water quality improvement. ▪ Carry out restoration of floodplain wetlands ▪ Monitor impacts (pre and post implementation of activities)	wetlands and their restoration.	preservation of the floodplain wetland.		
5. Collaboration and Technical Support	▪ Stakeholder Identification: Identify and engage key stakeholders, including government agencies, environmental organizations, local communities, landowners, and experts in relevant fields, to form the basis of collaboration ▪ Establish a multi-departmental and inter-agency collaboration involving the District administration, Revenue Department, UPI&WRD, Flood Control Department, Rural Development Department, Groundwater department, Gram	▪ Collaborative Research: Foster partnerships with academic institutions and research organizations to conduct scientific research relevant to the floodplain wetland restoration. Encourage innovation and knowledge sharing. ▪ Organise multiple training sessions for stakeholders, on the biodiversity conservation, River Health assessment and Wetland health assessment	▪ Long-Term Funding Sustainability: Establish mechanisms for long-term funding sustainability to support ongoing monitoring, maintenance, and adaptive management of the restored wetland. ▪ Monitoring and Evaluation: Maintain a robust monitoring and evaluation framework to assess the progress of restoration efforts, adapt strategies as needed, and measure the long-term impact of the project.		

	pradhans, WWF-India, DGC's can act as a multi-departmental and inter-agency collaboration platform headed by District Magistrate. ▪ Support in developing Standard Operating Procedure (SoPs) and training of key resources for wetland restoration of different typologies (schemes that can be leveraged, budgets, expenditures, roles and responsibilities etc) ▪ Leverage schemes like Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) to engage local communities in wetland restoration efforts, providing employment opportunities. ▪ Needs Assessment: Conduct an initial assessment of technical, financial, and logistical				

	support required for the restoration project. ▪ Resource Mobilization: Begin seeking funding and resources to initiate the restoration project and secure commitments from potential collaborators. ▪ Agreement Framework: Establish agreements or Memoranda of Understanding (MOUs) outlining the roles, responsibilities, and expectations of all involved parties.				

7.6 Key Issue- 6: Gaps in capacity, skills (Social, technical and institutional) and human resources in DGC for implementation of Ganga authority order

There is significant potential for augmenting capacities and human resources at the District Ganga Committee (DGC) to address the necessary actions for initiating, preparing, implementing, operating, and maintaining projects and activities associated with the rejuvenation of rivers and wetlands, encompassing improvements in both water quality and quantity. Multiple funding sources are accessible for the implementation of Ganga rejuvenation initiatives and can be effectively utilized by the DGC.

Case Study-5

Nodal officers Trainings

Under the guidance of the district administration Moradabad, WWF India has organized training programs for the Nodal Officers (Gram Pradhans) representing 54 floodplain villages located along the bank of river Ramganga. These programs aimed to enhance their awareness of their responsibilities towards river conservation and their roles within the District Ganga Committee (DGC). The training sessions focused on building their capacities in River Health Assessment, Wetlands Health Assessment, Sustainable Agriculture and community led turtle conservation.

As Nodal Officers in the District Ganga Committee, their roles and responsibilities encompass various areas:

- **River Health Assessment:** The Nodal Officers received training on conducting water quality tests using portable water testing kits and meters. They gained knowledge about testing parameters such as dissolved oxygen, phosphate, nitrate, etc. Additionally, they learned about assessing the health of rivers in terms of floodplain health, river channel health, biota health, and community perception.

- **Wetlands Health Assessment**: The training covered the mapping and conservation of wetlands. Experts provided detailed presentations on different types of wetlands, their functions, and the major threats they face. The participants understood the significance of wetlands for humans, animals, and the environment. Water quality testing kits were also provided to the heads of five villages from each block in the district.

- **Sustainable Agriculture:** The Nodal Officers gained knowledge about best agriculture practices that promote water and chemical savings. They were exposed to live demonstrations on the preparation of bio-fertilizers and bio-pesticides using locally available ingredients.

Case study- 6

Community led turtle conservation

The Gangetic River system in Uttar Pradesh, India, hosts 14 turtle species. Unfortunately, extensive riverbed farming along the Ganga River in Uttar Pradesh has encroached upon these turtles' natural habitat, leading to the destruction of their nesting and basking grounds. In response to this threat to endangered turtles in the Upper Ganga region, a collaborative in-situ turtle conservation program was initiated in 2012 by the UP Forest Department and WWF-India, with a focus on involving local communities.

Between 2012 and 2021, 828 turtle nests were rescued from riverbed farming with the help of 520 riverbed farmers in the Upper Ganga and Ramganga rivers. These newly hatched turtles from the rescued egss, were nurtured in a specially designed nursery pond during the flood season and then released into their respective rivers during the winter when their reduced food requirements eased their transition to their natural habitat.

The community-led turtle conservation approach in the Upper Ganga River and river Ramganga comprises three main elements: raising awareness and providing training to local riparian communities, rescuing turtle nests from riverbed farming, and protecting vulnerable turtle nests on-site. The program includes organizing awareness campaigns in riparian villages to engage local residents in freshwater turtle conservation. These efforts also build the capacity of community members to protect turtle nests near their agricultural fields.

The conservation process involves selecting suitable sites for turtle hatcheries, establishing the hatcheries, collecting eggs from riverbed farming, transporting them, placing them in the hatchery, incubating and caring for the hatchlings in the nursery, and finally, releasing them.

Riverbed farmers are encouraged to monitor and conserve turtle nests in their fields, fostering a sense of ownership and stewardship toward biodiversity conservation.

The collaboration between WWF-India and the Uttar Pradesh State Forest Department ensures that farmers offer turtle eggs found in their farms for safekeeping in riverside hatcheries. Farmers are also encouraged to safeguard turtle nesting habitats along the River Ganga in the Hastinapur Wildlife Sanctuary.

Before this initiative, farmers used to discard turtle nests found in their fields. However, the program has encouraged farmers to care for these nests and inform the Uttar Pradesh Forest Department and WWF-India about vulnerable turtle nests. Farmers also assist field teams in relocating these nests to riverside hatcheries. This program fosters a sense of ownership among riparian communities and raises awareness about the importance of turtles in the river's ecosystem.

This initiative showcases a model of community-based conservation in which communities voluntarily allocate a portion of their land, previously used for riverbed farming, for the nesting and basking of freshwater turtles in the River Ganga. This act benefits the turtles and also safeguards crops from submersion due to fluctuating water levels, along a 40-meter-wide, 5-kilometer-long strip of riverbed.

7.6.1 Potential intervention

- Utilize the available resources from ongoing programs and projects such as the Ramganga Mitras initiative under the Arth Ganga Concept by the National Mission for Clean Ganga (NMCG) for capacity building and human resource development in the field of river rejuvenation.
- Establish an additional dedicated capacity within the District Ganga Committee (DGC) in the form of a supporting cell, consisting of designated professionals. This cell will provide essential support and expertise in carrying out the committee's objectives.
- Make use of the existing network of Ramganga Mitras for community mobilization, awareness campaigns, and sensitization activities related to River Health Assessment and Wetland Health Assessment.
- Promote, establish and strengthen the capacities of Water Users Associations (WUAs) to enhance their ability to participate in and contribute to sustainable water management practices.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Promotion of Cultural Heritage and Tourism	▪ Identify the places that are heritage and have culturally importance in the district. ▪ Collaborate with the Tourism Department and local stakeholders to promote cultural heritage and tourism along the Ramganga and its surroundings.	▪ Organize activities to attract tourists and raise awareness about the region's natural and cultural significance. ▪ Develop promotional materials, to highlight the unique cultural and natural attractions of the area.		▪ Tourism Department ▪ District Administration ▪ District Ganga Committee ▪ WWF India ▪ Local institutions ▪ Forest Department ▪ Nagar Nigam	▪ National Water Awards and Water Heroes ▪ Har Khet Ko Pani ▪ Information, Education & Communication (IEC) scheme of DoWR, RD & GR ▪ Jalanidhi, Swajaladhara ▪ NYKS Awareness Generation Campaign
2. Establishment of Biodiversity Park	▪ Collaborate with the Forest Department, Revenue department and local communities to identify suitable locations for these parks and this may be in urban or peri urban areas.	▪ Expedite the process of establishing biodiversity parks in both urban and peri-urban regions. ▪ Develop and implement awareness programs to engage the public in biodiversity conservation and create a sense of ownership			
3. Dedicated Supporting Cell for DGC	▪ Establish a dedicated supporting cell or secretariat within the District Ganga Committee	▪ Build the capacity of these resources on various aspects when required.			

	(DGC) to oversee the implementation, monitoring, and revision of the District Ganga Plan (DGP). ▪ Appoint two trained resource persons who will be responsible for coordinating and facilitating the DGP's activities.				
4. Training for Executing Agencies	▪ Identify 4-5 executing agencies (e.g., Jal Nigam, Irrigation Department, Nagar Nigam, and UPPCB) involved in river rejuvenation and groundwater management. ▪ Provide training to these agencies on river rejuvenation techniques, the River Basin Management (RBM) cycle, and the operation, maintenance, and joint monitoring of Sewage Treatment Plants (STPs), Common Effluent Treatment Plants (CETPs), and Faecal Sludge	▪ Provide support to build capacities and assist in implementation through collaborative efforts			

	Management (FSM) systems. ▪ Include a focus on gender-sensitive training and ensure women's participation in the capacity-building programs.				
5. Awareness-Raising at "Jalshakti Kendra"	▪ Conduct awareness-raising activities and programs at "Jalshakti Kendra" to engage local citizens and involve different line departments in efforts to elevate the profile of river rejuvenation. ▪ Collaborate with the District Ganga Committee (DGC) and WWF India for effective implementation.				

7.7 Key Issue- 7: Gaps in knowledge on status, issues and actions needed for the conservation of key tributaries in Moradabad district

7.7.1 Potential intervention

- Addressing the knowledge gap regarding water resources, water quality, encroachment, and other pertinent information related to the critical tributaries of the Ramganga River, namely Aril, Karula, and Gaagan.
- Undertaking a comprehensive mapping and assessment exercise to evaluate the condition and health of 3rd-order and 4th-order streams that contribute to the Ramganga River.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Seasonal Surveys of Tributaries and data collection	▪ Survey protocols: Develop a comprehensive survey plan with protocols that outlines the scope, objectives, and methodologies for conducting seasonal surveys of the Ramganga River tributaries, including Dhela, Gaagan, Aril, Karula naala and others. ▪ Stakeholder Engagement: Identify and engage relevant stakeholders, such as government agencies, local communities, and environmental organizations, to participate in or support the survey efforts. ▪ Baseline data collection: Carry out seasonal (pre monsoon, post monsoon and monsoon season surveys) recording	▪ Data Continuity: Maintain consistent seasonal surveys over multiple years to detect patterns and variations in tributary conditions, allowing for more robust trend analysis. ▪ Water Quality Improvement: Initiate or advocate for water quality improvement efforts, such as the reduction of pollutants or the restoration of riparian habitats based on the data findings ▪ Data Analysis: Begin analyzing the temporal collected data to identify immediate issues and trends affecting the tributaries, which can inform early mitigation efforts.	▪ Ecosystem Health Improvement: Implement long-term restoration and conservation measures based on the data collected to improve the overall health of the tributaries and the larger water bodies they feed. ▪ Water Resource Planning: Integrate the long-term survey data into regional water resource planning, ensuring that the needs of both the environment and the community are considered in future water management decisions.	▪ Revenue Department ▪ Uttar Pradesh Pollution Control Board ▪ Uttar Pradesh Irrigation Department and Flood Division ▪ Uttar Pradesh Forest Department ▪ Groundwater Department ▪ Uttar Pradesh Jal Nigam ▪ Nagar Nigam ▪ Urban Local Bodies ▪ Experts from Universities and Colleges ▪ WWF India	▪ Public Interaction Programs ▪ Water Nirmal Abhiyan

	observation on hydrology (river flows) groundwater levels, water quality (chemical and physical characteristics), and biodiversity (including fish populations). ▪ Install river flow monitoring gauges on tributaries to assess the baseline flows ▪ Public Awareness: Raise awareness about the importance of tributary surveys and their potential impact on the health of larger water bodies within the community.				
2. Reporting and Data Utilization		▪ Compile the data obtained from seasonal surveys into comprehensive reports, including baseline information on the tributaries' current state. ▪ Share the findings and reports with relevant stakeholders, including government agencies,			

		local communities, and environmental organizations. ▪ Use the generated data to identify key issues and challenges in the tributaries, and develop plans for their remediation and restoration. ▪ Use the Data to build awareness among community and other stakeholders ▪ Publish the survey findings as reports and photo albums/brochures			
3. Implementation of Restoration Plan		▪ Collaborate with relevant stakeholders (government departments, CSO's, technical experts etc) and use the long-term trend data and reports to develop integrated river basin plans (with focus on tributaries) for sustainable water management ▪ Prioritize actions to restore and rehabilitate the tributaries based on	▪ Implement remedial measures, such as habitat restoration, water quality improvement, and sustainable fisheries management, as needed. ▪ Develop policies around protection of floodplains, inlet channels, wetlands etc.		

		the severity of issues and available resources.			

7.8 Key Issue- 8: Regional issues- maintaining and enhancing Environmental Flows in Ramganga River and its tributaries

7.8.1 Potential intervention

Ensuring the maintenance of Environmental Flow (E-Flow) in the Ramganga River is of paramount importance in safeguarding the river's ecological well-being and fostering thriving biodiversity across the entire river basin.

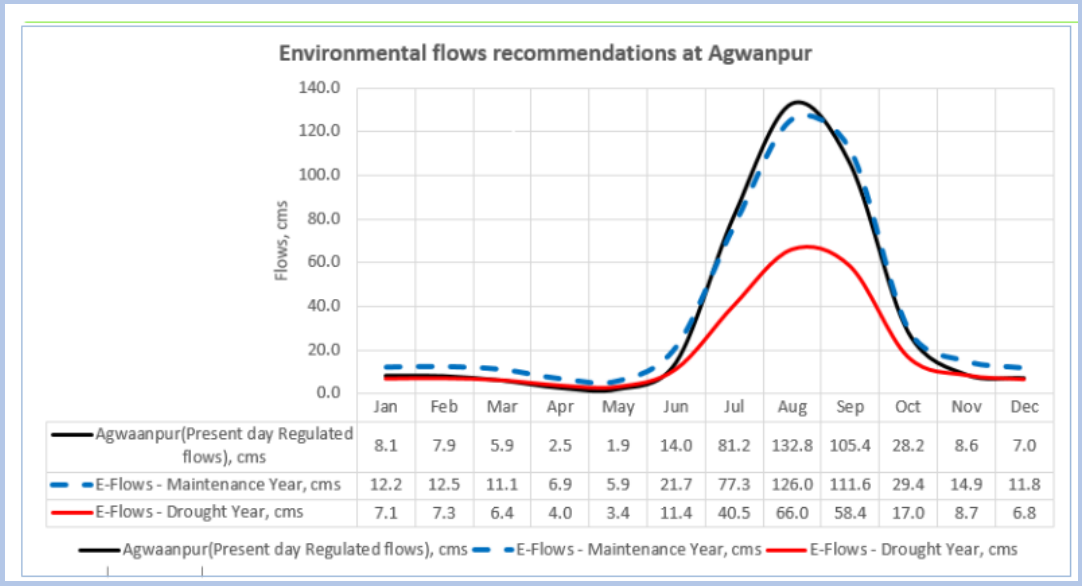
-Regional issues-

Case study- 7

Maintaining Environmental Flows in Ramganga River at Agwanpur and Katghar site in Moradabad district

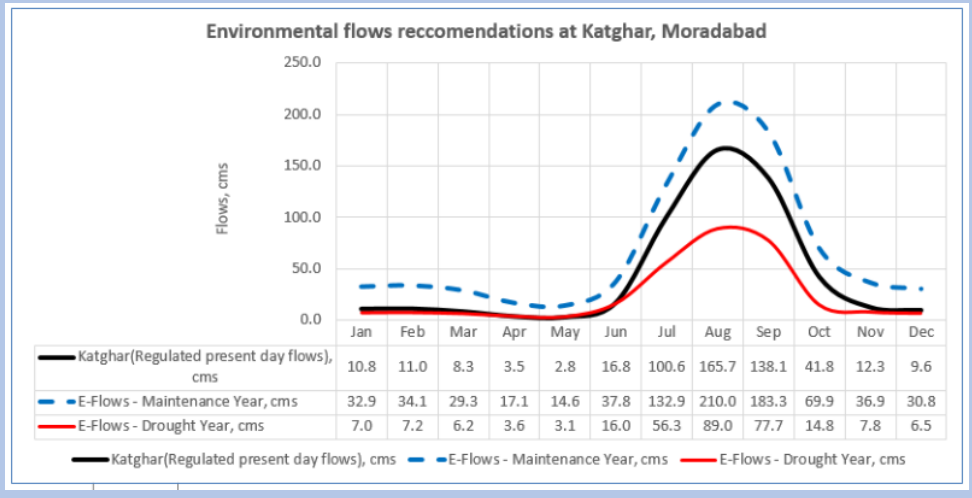
WWF India, in collaboration with various partner organizations, took up a scientific assessment of the E-Flows at eight designated locations within the Ramganga River basin.

In the Moradabad district, the E-Flow study was conducted at two specific sites: Agwanpur, situated upstream of the city, and Katghar site, located near the railway bridge downstream of the city (**Error! Reference source not found.**)(Figure 68). Before 2018, the river experienced inadequate water flow throughout the year. However, through the dedicated efforts of WWF-India and constructive engagement with key stakeholders, particularly the Uttar Pradesh Irrigation Department (UPID), a sustainable year-round water flow has now been achieved. The assessment of the Ramganga River's Environmental Flows was carried out between 2013 and 2015.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agwaanpur(Present day Regulated flows), cms	8.1	7.9	5.9	2.5	1.9	14.0	81.2	132.8	105.4	28.2	8.6	7.0
E-Flows - Maintenance Year, cms	12.2	12.5	11.1	6.9	5.9	21.7	77.3	126.0	111.6	29.4	14.9	11.8
E-Flows - Drought Year, cms	7.1	7.3	6.4	4.0	3.4	11.4	40.5	66.0	58.4	17.0	8.7	6.8

Figure 67 E-flows recommendations at Agwanpur, Moradabad



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Katghar(Regulated present day flows), cms	10.8	11.0	8.3	3.5	2.8	16.8	100.6	165.7	138.1	41.8	12.3	9.6
E-Flows - Maintenance Year, cms	32.9	34.1	29.3	17.1	14.6	37.8	132.9	210.0	183.3	69.9	36.9	30.8
E-Flows - Drought Year, cms	7.0	7.2	6.2	3.6	3.1	16.0	56.3	89.0	77.7	14.8	7.8	6.5

Figure 68 E-flows recommendations at Katghar, Moradabad

Under the Uttar Pradesh Irrigation Department (UPID) directive issued in February 2021, a discharge of 144 cusecs of Environmental Flows (E-Flows) is being released from the Hareoli barrage into the Ramganga River during the lean season, spanning from December to mid-June, every year.

A collaborative effort was undertaken to monitor the release of E-Flows during the year 2022, and it is recommended that this monitoring exercise be continued in the subsequent years as well. The outcomes of the monitoring conducted in 2022 are depicted in the below figures (Figure 69)(Figure 70).

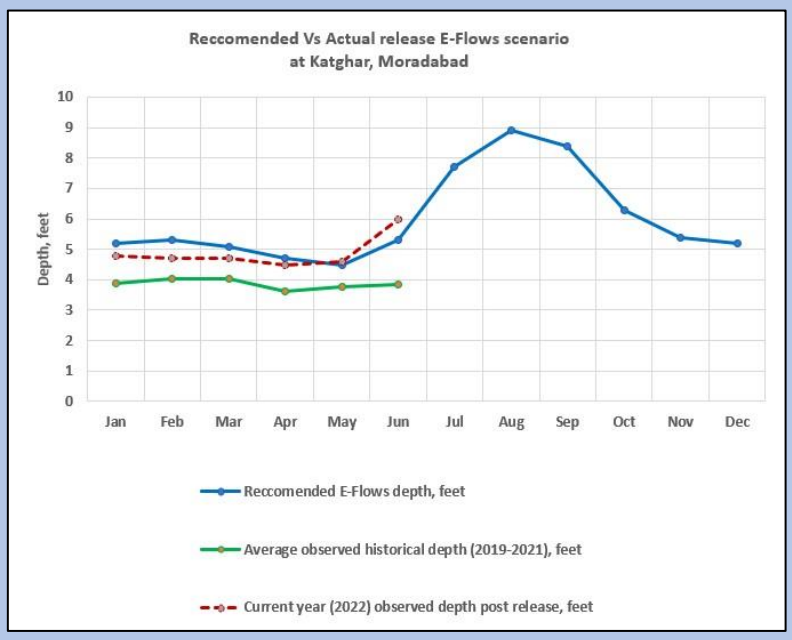


Figure 69 Recommended vs actual released e-flows at Katghar, Moradabad

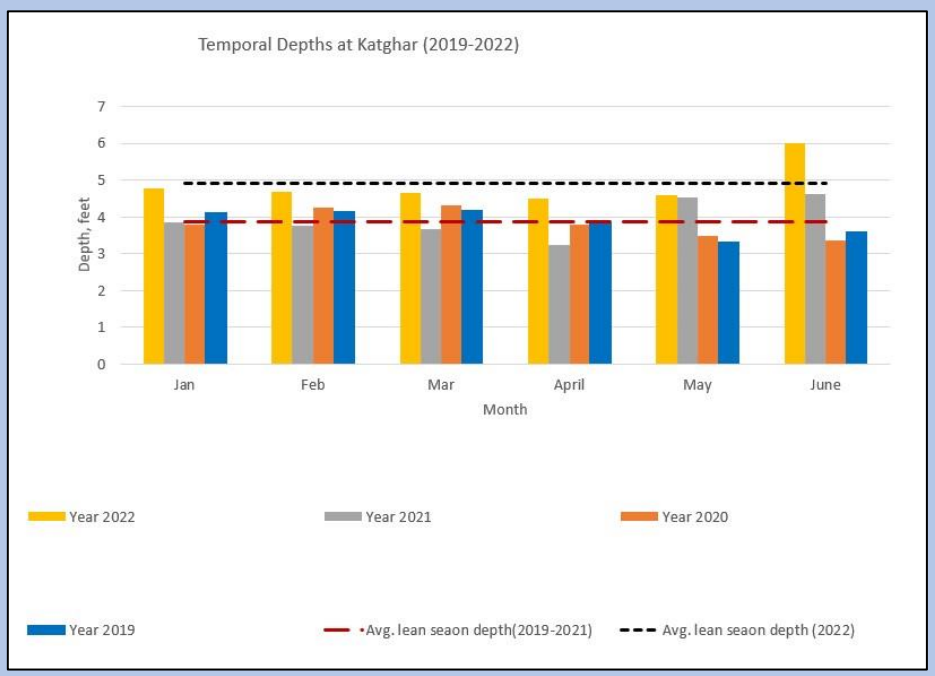


Figure 70 Temporal depths at Katghar, Moradabad

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Regular Monitoring of the impact of enhanced flows in Ramganga river At selected location	▪ Assess baseline information of diversity, occurrence and population of aquatic species (fish, turtles etc) in Ramganga river. ▪ Jointly monitor the impact of E-Flows maintenance/enhanced flows on fish populations, aquatic biodiversity, and the assimilating capacity of the Ramganga and Dhela River	▪ Periodic data collection on fish populations, aquatic biodiversity, and water quality in the Ramganga river. ▪ Share the findings with relevant stakeholders and the public to raise awareness	▪ Use the monitoring results to adapt and refine the E-Flows maintenance strategy as needed to maximize ecological benefits.		▪ AMRUT 2.0 Scheme ▪ Mission Amrit Sarovar ▪ Namami Gange Programme
2. Long-term E-Flows Maintenance Target in Ramganga river and Tributaries	▪ Collaborate with UPI&WRD and other stakeholders, thematic experts to E-Flows assess E-Flows in Dhela River. ▪ Map and prioritize floodplain wetlands which can provide hydrological benefits to river. ▪ Restore wetlands in loosing nature stretches of	▪ Carry out E-Flows assessment of critical tributaries which has majority of portion within Moradabad district (like Dhela, Gaagan and Aril rivers) ▪ Improve hydrological connectivity of tributaries of Dhela like Dhandi river.	▪ Carry out tributary rejuvenation activities which will not only improve health of tributaries but also Ramganga river. ▪ Regularly assess and adjust flow releases as needed to meet E-Flows targets. ▪ Seek funding and support from relevant stakeholders	▪ District Administration ▪ KVK's ▪ Uttar Pradesh Irrigation Department (UPID) ▪ Ground water department ▪ Agriculture Department	

	river (where river loses water to groundwater) ▪ Build capacity of riparian village farmers (in losing stretch) to adopt sustainable water management in agriculture starting by adoption of usage of "Amrit paani/Jeevamrat" (biofertilizers) which improves soil water holding capacity and reduce water demand and groundwater abstractions	▪ Restoration of floodplain wetlands in river basin ▪ Monitor riverine flows in Dhela before confluence with Ramganga river. ▪ Increase coverage of sustainable agriculture practices with aim to reduce water application, by 10% in each block (especially in riparian villages along Dhela, Gaagan and Ramganga river) ▪ Focus on rejuvenation of tributaries (like Dhandi, Karula and Gaagan) to support E-Flows maintenance in Ramganga river	to implement and sustain the E-Flows initiative.	▪ Local universities/ Research institution ▪ WWF India	

7.9 Key Issue- 9: Regional issues- : Pollution from the Dhela River, Reduced flows and heavy pollution loads negatively impacting the Ramganga River

7.9.1 Potential intervention

Conduct an environmental flows assessment of the Dhela River to determine the desired water quantity and quality that should be maintained before its confluence with the Ramganga River. This work is currently underway by WWF India, with the support from UP Irrigation Department.

The specific targets are:

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
1. Conduct Comprehensive E Flows Assessment	▪ Develop a detailed plan for an E Flows assessment of the Dhela River to accurately understand the current flow patterns and identify specific areas of water stress. ▪ Collaborate with relevant environmental agencies, hydrologists, and experts to ensure a comprehensive evaluation of the river's ecological flow requirements.	▪ Analyze the findings of the E Flows assessment to determine the recommended flows necessary for sustaining the ecological balance of the Dhela River. ▪ Develop a strategy for the operational management of the Dhela Barrage to align with the recommended flow rates identified in the E Flows assessment.		▪ District Administration ▪ KVK's ▪ Uttar Pradesh Irrigation Department (UPID) ▪ Ground water department ▪ Agriculture Department ▪ Revenue Department ▪ WWF India	▪ Water Nirmal Abhiyan ▪ National Water Supply Scheme ▪ National Rural Drinking Water Program ▪ Mission Amrit Sarovar
2. Conduct Comprehensive Hydraulic Connectivity Assessment of Dhela river	▪ Design a comprehensive plan for the restoration of floodplain wetlands, incorporating scientific principles and best practices. ▪ Map and prioritize floodplain wetlands which can provide hydrological benefits to river.	▪ Implement an adaptive management approach, regularly reviewing data and making adjustments to the restoration plan based on monitoring results and changing environmental conditions.			

	▪ Restore wetlands in loosing nature stretches of river (where river loses water to groundwater) ▪ Specify restoration techniques, such as re-establishing natural water flow channels, removing invasive species, and promoting native vegetation. ▪ Engage local communities, environmental groups, and relevant stakeholders in the restoration efforts.				
3. Tributary Restoration Plan	▪ Initiate a comprehensive restoration plan for key tributaries, starting with Dhandi, to enhance the inflow of freshwater into the Dhela River ▪ Conduct a detailed assessment of the Dhandi tributary's current ecological health, focusing on water quality, flow rates, and overall ecosystem condition. ▪ Implement restoration measures for Dhandi, emphasizing the	▪ Introduce interventions to optimize water flow in the Dhandi tributary, addressing obstacles, sedimentation, and channel morphology to enhance freshwater contribution to the Dhela River. ▪ Engage local communities and stakeholders in the restoration process, fostering awareness and collaboration for sustained tributary health.	▪ Implement strategies to improve water quality in the Dhandi tributary, addressing pollution sources and promoting sustainable land use practices in the catchment area.		

	restoration of natural habitats, reforestation, and the creation of buffer zones to support biodiversity.				
4. Establishment of Meso-Level Setup	▪ Formulate and establish a meso-level institution, committee, or working group dedicated to basin-scale activities for the Dhela River. ▪ Ensure representation and participation from both districts, Moradabad and Udham Singh Nagar, to address the diverse priorities and interests of each district. ▪ Task the meso-level entity with the responsibility of planning and coordinating activities aimed at enhancing the health of the Dhela River. ▪ Develop a strategic plan that considers input from both districts and aligns with the overall objectives of river health improvement.	▪ Facilitate collaboration among stakeholders and streamline the execution process. ▪ Encourage active participation and engagement from relevant stakeholders, including local communities, government bodies, and environmental organizations, within the meso-level setup. ▪ Facilitate regular meetings and deliberations within the meso-level setup to review progress, address emerging challenges, and adapt strategies based on evolving conditions.	▪ Allocate resources effectively within the meso-level setup to support the planning, coordination, and execution of activities for Dhela River improvement. ▪ Identify funding sources and ensure equitable distribution of resources between the two districts.		

	▪ Empower the meso-level setup to oversee the execution of planned activities, ensuring effective implementation of strategies for Dhela River improvement.				

Section D: Stakeholder Engagement

This part describes the overall process for the implementation and continuous monitoring of the District Ganga Plan (DGP)

7 Detailed Action Plan

The District Ganga plan framework was collaboratively developed with SMGC and subsequently presented in the meeting of the District Ganga Committee in Moradabad held in April 2022. During this meeting, the District Magistrate was requested to constitute a committee and designate a nodal officer to initiate the development of the District Ganga Plan (DGP) in Moradabad district.

In July 2022, upon the proposal of the Divisional Forest Officer Moradabad, the District Magistrate, Shri Shailendra Kumar Singh, approved the formation of a DGP working group, under the Chair of CDO (Chief Development Officer). This group included key members from various line departments. To conduct a situational analysis, WWF India began collecting data on the major rivers within the district boundaries, such as Ramganga, Dhela, Aril, Gaagan, and Karula rivers. The findings of this analysis were presented during the inception meeting of the District Ganga Plan working group in October 2022, chaired by Chief Development Officer Shri Sumit Yadav. The members discussed the presented data and identified gaps that required further data collection from related line departments.

Following consultation with the line departments, data collection commenced, and the drafting of the DGP began. The draft plan was shared with the DGP working group in May 2023, where it received feedback and comments from the members, which were subsequently incorporated into the plan. The final draft was then presented to the District Ganga Committee in July 2023, where comments from the members were taken and integrated to create this final version of the plan (Figure 5).

Figure 71 DGP Working group meeting held on 21 Oct 2022

Figure 72 DGP Working group meeting held on 24 May 2023

Formation of a working committee (or group) under the nodal officer appointed by DM:

- The formation of a working committee is proposed, with representation from key line departments and stakeholder groups. The committee would be convened and steered by the Nodal officer appointed by the DM/DGC.
- Each department/stakeholder group to subsequently nominate a member who will work closely with the nodal officer. The nominated member would be the concerned authority for implementation, data management and monitoring of progress as per action assigned to their relevant department.

Role of the DGP working committee (or group):

- Driving force for the planning process.
- The members of the committee will represent their respective departments and stakeholder groups, and be the key point of contact for coordination and implementation.
- This committee will support situation analysis, consolidation of data and baseline information, and overall knowledge management, led by representatives from respective line departments and stakeholder groups.
- The group shall be responsible for both planning and defining the vision and goal for the district and key rivers identified as well as the monitoring of progress against targets, budgets and timelines.
- The committee will support and work closely with the Nodal officer.

Review, discussion and Capacity Building on DGC Planning Framework:

- The DGP working committee (or group) will review and discuss the framework to gain an understanding through a capacity-building exercise of how the framework is organized and how it supports the planning process.

Inception meeting to discuss outcomes of Situation Analysis:

- An inception workshop would be conducted with members of the working committee, nominated members from all concerned line departments and any other relevant stakeholders to initiate the process of District Ganga Plan development.

- This meeting is useful in discussing the way forward for the stakeholders concerned. This would be a participatory process.

Situational analysis of Key rivers/Tributaries:

- Subsequently, data collection for situation analysis to be initiated, this would help in understanding the current scenario of the ecological health (keys threats and issues) of the key rivers within the district boundaries (i.e. 4 in Moradabad – Ramganga, Dhela, Gaagan and Aril).
- In certain cases, some data may not be readily available, in that case, field surveys, and primary, and secondary data collection may be undertaken to supplement available data on the current status of the rivers at specific points.

Gap analysis, identification of Stakeholders and Potential synergies:

- This process allows for an assessment of gaps in implementation, resource allocations, limitations and the need for additional support. Subsequently, issues and areas of work may be prioritized. This would also allow the opportunity to identify potential synergies among different stakeholder groups and departments.

Prioritization of Issues:

- Here the results of the situational analysis may be presented, basis which this will contribute to later stages of gap analysis, prioritization of issues and subsequently allocation of work to concerned departments and stakeholders.

Visioning exercise with the working committee, (Vision/Goals/Outcomes), Setting targets:

- This exercise will focus on envisioning a future for key rivers in a district and the goals and objectives that would contribute to it.
- With baselines available and gaps identified, through this exercise the working committee would arrive at an informed decision on what District plans should aim to achieve. Further, this exercise helps arrive at how this vision for the rivers and the district can be realised.

Monthly meetings, monitoring and course correction:

- Regular monthly meetings of the working committee are to be organized for review and monitor progress, as well as course corrections if required.
- Data from all the related line departments are to be collected on the various aspects indicated in the framework, for developing the district plan.

Draft District Ganga Plan developed with a detailed work plan:

- Drafting of District Ganga Plan to be initiated basis the available data, consultation, visioning exercises and brainstorming.
- This draft may be further discussed with the working group and the concerned stakeholders towards finalisation and be presented to the DGP working committee and District Ganga Committee to get insight from the members and incorporate their suggestions and comments.

Finalisation of District Ganga Plan:

- Following the incorporation of inputs and feedback from stakeholders and working committee members, the plan is to be finalised.

Monitoring and evaluation against plan activities and reporting:

- Once the implementation of the plan is initiated it would be vital to monitor and evaluate progress against set targets, budgets and timelines. If required, the plan may be adapted and revised. This process will be supplemented by monthly meetings.

8 Stakeholder engagement (Ramganga Mitras in action)

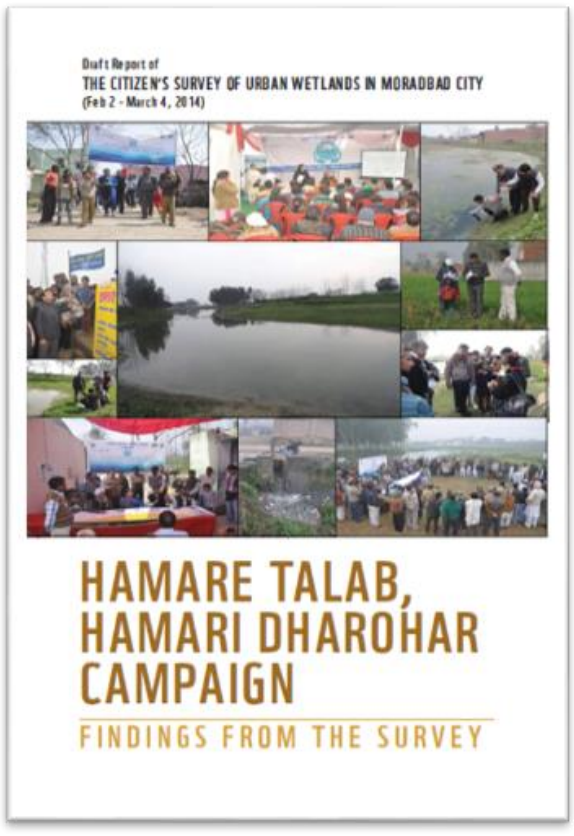
Mitra's, known as Friends of Rivers and Wetlands, is a group of dedicated volunteers representing various stakeholder groups. Their primary objective is to safeguard rivers and wetlands through active participation in conservation efforts and the sustainable management of these natural resources.

Mitra's come together with a common purpose, collaborating and fostering a collective vision for the preservation of freshwater resources. They possess valuable indigenous and local knowledge of the wetlands and catchment areas, enabling them to contribute effectively to conservation initiatives.

These passionate individuals are driven to protect rivers, wetlands, and aquatic biodiversity. They demonstrate self-motivation and a willingness to invest their time and efforts in these endeavours. Mitra's act as influencers within their communities, offering support and understanding regarding wetland issues and recognizing the intrinsic value of these ecosystems.

Figure 73 Ramganga Mitras in action.

Figure 74 Mitras in action to know the cause of fish mortality in Ramganga river in April 2016 in Moradabad.



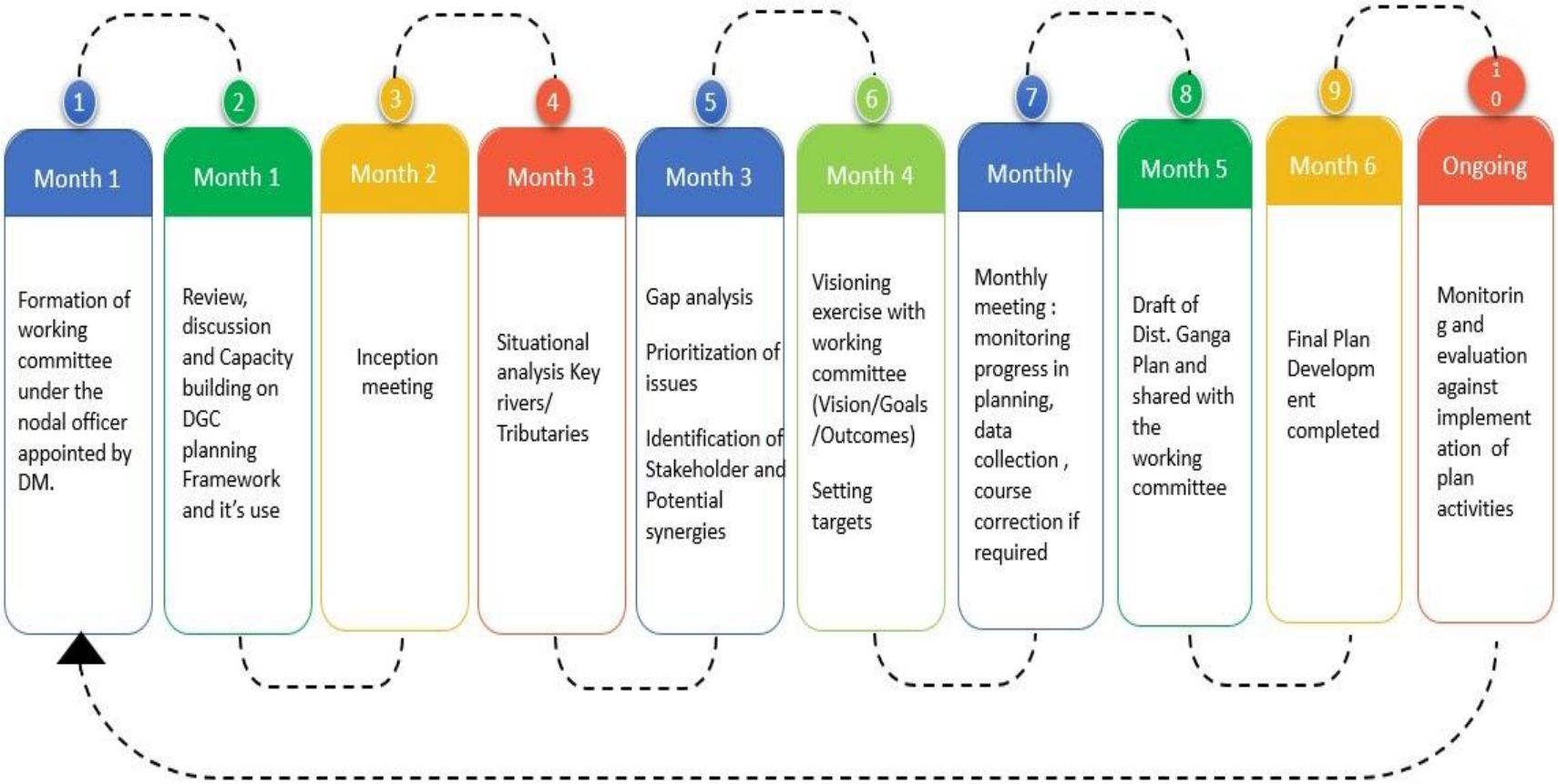


Figure 75 Stakeholder engagement Process for District Ganga Detailed Action Plan

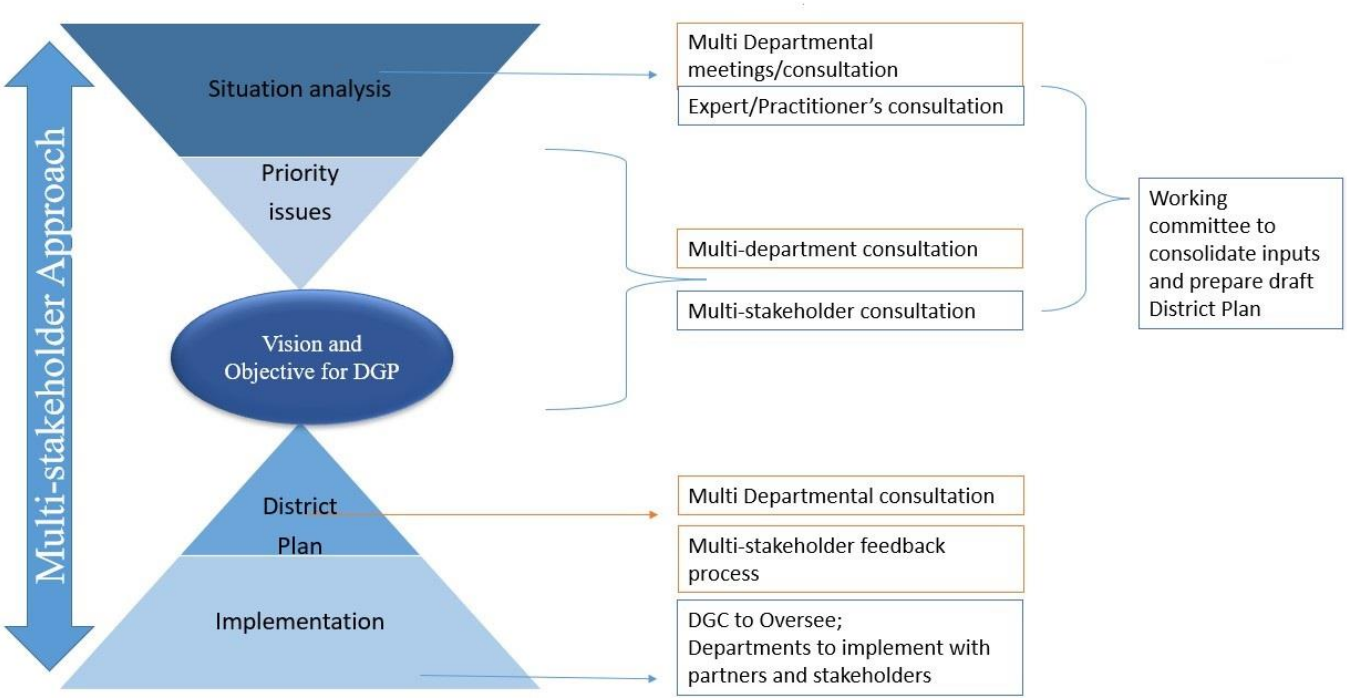


Figure 76 Detailed stakeholder process

Table 21 All relevant state policies (Environment, water, forest, agriculture, pollution) having bearing on river floodplain and larger basin scale will be considered as part of this process.

List of stakeholders	Situation analysis	Priority issues and principle	Vision and Objective	District Plan	Implementation
Municipal corporation	√	√	√	√	√
Irrigation department, Flood division	√	√	√	√	√
UPPCB	√	√	√	√	√
Divisional Forest Department	√	√	√	√	√
Jal Nigam	√	√	√	√	√
Ground water department	√	√	√	√	√
Panchayat Raj department	√	√	√	√	√
Revenue department	√	√	X	X	X
Health department	√	X	X	X	X
Fisheries department	√	√	√	√	√
Development authority	√	√	√	√	√
District Industries centre	√	√	√	√	√
Agriculture department	√	√	X	√	√
Sugarcane department	√	√	X	√	√
CSO- Mitras, Civil defence, Farmers, etc.	√	√	√	√	√
Ganga grams and other gram panchayats	√	√	√	√	√
Academia/ Sector experts	√	√	√	√	X
NGO's	√	X	√	√	√
Industry and Industry associates	√	√	X	√	√
Rural Development (CDO, DDO DC MANREGA)	√	√	√	√	√
NMCG	√	X	X	√	X
SMCG	√	√	√	√	X

8.1 Stakeholder Engagement Plan

A stakeholder engagement plan (Figure 78) is a strategic document that outlines how an organization will engage and communicate with its stakeholders. Stakeholders are individuals, groups, or organizations that have an interest or can be affected by the activities and decisions of the organization. Developing a stakeholder engagement plan is essential to ensure that stakeholders are effectively involved, their needs and concerns are addressed, and their perspectives are considered in decision-making processes. Stakeholder engagement should be an ongoing process, and it is crucial to maintain open and transparent communication with stakeholders throughout the life cycle of a project or organization. [33].

- Facilitates increased community ownership.
- Promote greater community engagement in rejuvenation and conservation initiatives.
- Strengthen collaboration among stakeholders.
- Promote a comprehensive understanding of the imperative for a holistic approach to River Ecology and River Rejuvenation.

Figure 78 Stakeholder Engagement Plan

9 Monitoring and Evaluation

The process of Monitoring and Evaluation (M&E) is an essential component of the District Ganga Plan (DGP), aimed at assessing the implementation progress within the district and the achievement of its objectives. M&E entails establishing measurable indicators for each specific target, which enable the monitoring of progress, enhancing accountability, and evaluating the effectiveness of the intended intervention. These indicators should be concise and accurately describe the specific target, avoiding excessive data requirements or complex data acquisition efforts.

During this stage, the implementation of the plan takes place, involving the deployment of various components such as media products, messages, partnerships, and capacity-building initiatives. It is crucial to monitor the intervention to ensure that it is yielding the desired outcomes and to facilitate adjustments as needed during the course of implementation. Gender considerations are of particular importance at this stage, ensuring that gender norms and roles do not hinder the participation of any group in the activities being rolled out.

Following Table 22 lists the monitoring and evaluation tasks for all the key identified issues.

Table 22: M&E approach for key identified issues

Objective	Monitoring	Evaluation
Identified Key Issue-1 Domestic sewage management; Water demand management and sewage treatment in urban/peri-urban areas		
Bolstering Faecal Sludge and Septage Management (FSSM)	Track improvements in FSSM infrastructure, service coverage, and efficiency.	Assess reduction in open defecation, increase in safe waste disposal, and FSSM facility utilization.
Systematic Emptying with Geotagged De-sluggers	Record frequency and efficiency of emptying using geotagged de-sluggers.	Measure reduction in untreated waste, improved scheduling, and optimized resource allocation.
Collaborative STP Monitoring with Local Communities	Engage local communities and experts from TMU and Hindu College etc. in STP monitoring and record participation levels.	Evaluate community awareness, involvement, and the impact on STP operation and maintenance.
Decentralized Wastewater Treatment for Karula Drain	Monitor the implementation and performance of decentralized treatment for Karula drain.	Assess water quality improvement, reduction in pollution, and drain ecosystem restoration.

Upscaling Water Footprint Campaign	Track the spread of the water footprint campaign in the city and peri-urban areas.	Measure increased public awareness, behaviour change towards water conservation, and reduced water wastage.
Identified Key Issue-2 Agriculture water management- overuse of water and chemicals leading to depletion of ground water table, pollution due to agriculture runoff and leaching.		
Objective:	**Monitoring:**	**Evaluation:**
Conversion of Farmland to Sustainable agriculture and water management practices	Track the percentage of farmland transformed annually	Assess crop yield improvements, water usage reductions, and adoption rates of sustainable practices.
Establishment of Water Users' Associations (WUAs) across all irrigation canals	Record the number of WUAs established and their coverage. Capacity building initiatives for WUAs	Evaluate the effectiveness of WUAs in promoting sustainable farming practices and community engagement.
Linking tail-ends of irrigation Canals to Nearby Water Bodies (rivers/streams/rivulets/village-ponds/wetlands)	Number of canals-to-water body linkages annually in the district	Measure increased water availability, ecological enhancements, and local water security.
Promotion of irrigation Water Use Efficiency (WUE) and Organic or semi-organic farming practices (Package of Practices – PoPs)	Adoption rates of PoPs around irrigation WUE and organic or semi-organic farming practices.	Assess improvements in soil health and moisture, water retention, and crop productivity through farmer consultations. Assess improvements in irrigation WUE and routing the same to local water-bodies (rivers/streams / rivulets/village-ponds/wetlands)
Identified Key Issue-3 Disposal of untreated/ Partially treated liquid and solid waste from industries into water bodes		
Objective:	**Monitoring:**	**Evaluation:**
Implementation of Counter Current Mechanism (CCM) in Electroplating Brass Industries	Track the number of adoptions of CCM in electroplating brass industries.	Assess the reduction in pollution levels, improved water use efficiency, and regulatory compliance due to CCM implementation. Also, measure the reduction of freshwater consumption.
Identification of Unregistered Plants	Identify unregistered electroplating plants in the city and record their compliance status.	Measure the increase in registered and compliant plants due to awareness campaigns and incentives.
New Water Quality Monitoring Stations	Install monitoring stations at designated spots as specified like upstream of Khadakpur	Regularly analyze water quality data to detect changes, pollution

	Baje village (28.776947°N; 78.806178°E), Sikandarpur patti village downstream of Karula nala/river, at Dhela river pre-Ramganga confluence, Dhandi river, and Gaagan river meeting major drains	sources, and trends in pollution levels. Reporting of results and analysis in the DGCs for further action.
Identified Key Issue-4 Pollution from solid and E-Waste in urban and rural areas		
Objective:	**Monitoring:**	**Evaluation:**
Incentives for Source Segregation	Track the adoption rate of source segregation and the reduction in collection charges for participants	Assess the increase in source segregation, reduction in mixed waste, and effectiveness of the incentive scheme.
Extensive Awareness Drives and Expansion	Measure the reach of awareness campaigns, including civil society involvement and expansion to urban local bodies (ULBs).	Evaluate increased public awareness, participation, and improved waste sorting practices.
Sustainable E-Waste Management Study	Track the progress and completion of the e-waste management study. Involve local academic institutions like – Hindu College, TMU etc.	Evaluate the study's findings and recommendations, including feasible strategies for sustainable e-waste management. Implementation of study findings in a phased manner.
Bio-Waste Processing Units in Markets	Track the establishment and operation of bio-waste processing units in markets.	Measure the reduction in organic waste sent to landfills, involvement of local entrepreneurs, and the impact on local waste management.
Identified Key Issue-5 Floodplain encroachment leading to degradation of habitats (for aquatic life-forms) and loss of lateral connectivity in Ramganga/ Gaagan/ Aril/ Karula rivers in district		
Objective:	**Monitoring:**	**Evaluation:**
Joint scientific surveys through remote sensing and GIS applications and priority area identification (river floodplains and critical village ponds and wetlands along/near the river floodplains)	Number of joint surveys involving Revenue, local organizations, and district Administration to assess degree of floodplain and wetland degradation.	Evaluate the survey findings to determine critical river stretches and floodplain wetland sites for conservation and restoration based on ecological significance and potential impact. Identification of priority areas for action and initiation of action.
Strict Monitoring Mechanisms and Hotspot Identification	Implement regular inspections and utilize remote sensing and GIS applications for continuous monitoring.	Assess the effectiveness of monitoring through identified hotspots, problem areas, and early intervention measures at critical sites, such as Mokshdham, Lalbagh Katghar
Buffer Zone Establishment and Nature-Based Techniques	Establish and monitor the 500-meter buffer zone on	Evaluate the buffer zone's impact on floodplain protection, water

	both riverbanks using nature-based techniques like vegetation and tree barriers.	quality, and ecosystem health, and assess the success of nature-based techniques.
Floodplain Wetland Restoration	Select floodplain wetlands for restoration and implement restoration measures.	Monitor the restoration progress.
Identified Key Issue-6 Gaps in capacity, skills (Social, technical and institutional) and human resources in DGC for implementation of Ganga authority order		
Objective:	**Monitoring:**	**Evaluation:**
Dedicated Supporting Cell for DGP	Track the establishment of the supporting cell and its functioning.	Evaluate the effectiveness of the cell in coordinating DGP activities, resource allocation, and overall project management.
Training of Executing Agencies	Monitor the training of executing agencies (Jal Nigam, Irrigation department, Nagar Nigam, UPPCB) on river rejuvenation, RBM cycle, STP/CETP operation, and FSM.	Assess the improvement in agencies' understanding on river management concepts and their ability to effectively execute related tasks.
Training Programmes for Line Departments	Track the organizing of training programs involving representatives from various line departments, including women's participation.	Evaluate participants' knowledge enhancement, adoption of sustainable practices, and increased inter-departmental collaboration.
Activities at "Moradabad Jalshakti Kendra"	Monitor the activities, trainings and programs conducted at "Jalshakti Kendra" to raise awareness and involve various line departments.	Assess the level of public awareness, community participation, and integration of multiple departments for holistic water management.
Cultural Heritage and eco-tourism Promotion	Monitor the promotion of cultural heritage and tourism activities (boat rides, bird watching) around Ramganga and its surroundings.	Assess the increase in tourist footfall, local community engagement, and overall impact on cultural preservation and tourism development.
Identified Key Issue-7 Gaps in knowledge on status, issues and actions needed for conservation of key tributaires in Moradabad district.		
Objective:	**Monitoring:**	**Evaluation:**
Expert Team Formation (inter-disciplinary) and Seasonal Surveys	Form a team of inter-disciplinary experts and conduct seasonal surveys of tributaries (2nd, 3rd, and 4th orders) to gather baseline data on hydrology, water quality, overall floodplains and	Assess the completeness and accuracy of collected data, track survey frequency, and coverage of tributaries. Presentation of survey findings at DGC Meetings and actions initiated.

	wetlands health and aquatic biodiversity (e.g., fish).	
Bridging Knowledge Gap on Water Resources	Monitor the dissemination of information on water resources, water quality, flood-plains and wetlands health etc., of critical tributaries (Aril, Karula, Gaagan).	Evaluate the reach of information, community engagement, and the extent to which the knowledge gap is being addressed.
Identified Key Issue-8 Régional issues- a) Maintaining and enhancing Environmental Flows in Ramganga river and its tributaries		
Objective:	**Monitoring:**	**Evaluation:**
Joint Environmental Flows Monitoring	Regularly monitor flows in Ramganga River at Agwanpur and Katghar and its comparison of E-Flows recommendations.	Assess the quantity and quality of water flows to ensure the health and aquatic biodiversity of the river.
Sustaining Environmental Flows (E-Flow)	Continuously monitor and assess the maintenance of Environmental Flows in Ramganga River.	Evaluate the river's health, biodiversity, and the effectiveness of E-Flows management measures.
Identified Key Issue-9 Régional issues- b) Pollution from Dhela river, Reduced flows and heavy pollution loads negatively impacting the Ramganga river		
Objective:	**Monitoring:**	**Evaluation:**
Long-Term E-Flows Maintenance	Continuously monitor and assess the maintenance of long-term and year-round environmental flows (E-flows) in Ramganga with support from UPI&WRD (Uttar Pradesh Irrigation & Water Resources Department).	Evaluate the success in achieving consistent and sustainable E-Flows levels.
Impact on river health, including – Fishes and aquatic Biodiversity:	Jointly monitor the impact of E-Flows maintenance on fish populations, aquatic biodiversity, and the river's assimilating capacity.	Assess changes in fish diversity, abundance, and overall river ecosystem health.

9.1 Gender-sensitive outreach Plan

Gender-sensitive outreach refers to the deliberate inclusion and active participation of women (as well as other vulnerable groups) in the planning process through the adoption of inclusive processes and mechanisms that address barriers they may face. Communication for Development (C4D) has been utilized for several decades as a powerful tool for enhancing the

well-being of children, women, and families. It is employed to promote various human rights issues such as health, nutrition, water, sanitation, education, and more.

A wealth of evidence demonstrates that communication strategies, implemented through a diverse range of approaches, and channels, and targeting different participants and stakeholders, can effectively inform, influence, motivate, engage, and empower individuals and communities. Communication plays a pivotal role in advancing gender equality by challenging and transforming attitudes and stereotypes that perpetuate gender-based discrimination. Moreover, it is closely intertwined with empowerment as it contributes to building the confidence and skills necessary to negotiate choices and demand equal access to and control of resources.

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