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Draft District Ganga Plan for Bareilly

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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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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
GRBMP	Ganga River Basin Management Plan
IUCN	International Union for Conservation of Nature
MCM	Million Cubic Meters
BDA	Bareilly 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

Executive summary

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

The "District Ganga Plan for Bareilly 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 and the detailed action plan highlight the collaborative efforts needed for successful implementation. This document serves as a valuable resource for policymakers, stakeholders, local departments/agencies and organizations involved in the management and conservation of the Ganga River Basin in the Bareilly District.

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 the establishment of working groups to identify and prioritize pertinent issues (from the perspective of water resources management) that the district is grappling with. The vision and scope of the document is 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 Bareilly aims to address core challenges related to the protection, regulation, and reduction of river and catchment degradation impacting river health and freshwater resources in the Ramganga River and its tributaries. The plan prioritizes water management issues specific to the district and identifies existing programs, initiatives, and best practices aimed at resolving these challenges. The fundamental objective is to ensure robust ecological health and vitality for all rivers within the district, ensuring long-term water security for the city and its 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 between different components of the river system, which directly affect its overall well-being and efficiency. The following approach was followed to develop the District Ganga Plan for Bareilly District.



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 Bareilly 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 resources and their implications for the Ganga River Basin.

The entire hydrological network in the region is regulated by the dominant presence of the Ramganga River and its associated tributaries, including the Siddha, Dojora, Baigul (west), Kicha, Sankha, Deoraniya, Nakatia, Baigul (east), Deoha, and Aril rivers. It is noteworthy that all of these rivers, except for the Aril River, converge with the Ramganga River on its left bank.

The primary contributor to precipitation in the region is the monsoon season, typically occurring from mid-June to mid of October. Among these months, July and August experience the highest rainfall. Throughout the year, the district's average temperature ranges from a minimum of 14.1 °C in January to a maximum of 31.6 °C in May. Over the period from 2011 to 2020, a noticeable downward trend in average annual rainfall has been observed in Bareilly district. Specifically, there has been a decline from 1196 mm to 750 mm in rainfall amounts.

Water-intensive agricultural practices, particularly the cultivation of crops such as paddy exert a substantial demand for freshwater resources in the region, leading to significant groundwater extraction in the Bareilly District. The land use and land cover analysis of District Bareilly reveals that the majority of the area (87%) is dominated by agricultural activities. The predominant crops grown in the region is wheat followed by rice and then sugarcane. Among these, sugarcane and paddy require significant amounts of water, resulting in extensive extraction of groundwater in the district.

Within the district, 11 blocks are categorized as being in the safe category (out of 15 blocks) in terms of groundwater availability. However, the city of Bareilly is classified as over-exploited, while Alampur Zafarabad, Majhgawan, Ram Nagar, and Fatehganj fall into the semi-critical category.

The Aril River basin experiences large-scale over-extraction of groundwater due to its prominence as the primary water source for various purposes. Consequently, this excessive exploitation has resulted in a rapid decline in groundwater levels in recent years. This decline can be attributed to reduced areas available for recharge, particularly close to the Aril River.

Mapping carried out by WWF-India and IIT Kanpur indicates that there are 275 wetlands/ponds (>2.5 ha) in Bareilly district, which provides valuable ecosystem services including local water security to communities, groundwater recharge, base-flows to rivers, habitats for aquatic and avian species etc. Due to several threats and pressures, about 70% of them have become degraded over a period, which needs to be protected and conserved to support the ecological health of the basin and district.

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

This section outlines various strategies for effective water management in the Bareilly district. It includes developing comprehensive plans for addressing Water Over-Abstraction, promoting sustainable Agricultural and Waste Water Management, devising strategies for Solid Waste Management, safeguarding Floodplain Integrity and Wetlands Conservation, enhancing Capacity, Skills, and Human Resource Gaps at District Ganga Committees, and addressing Knowledge Deficits in Tributary Conservation for effective conservation efforts. Efforts will also focus on understanding and conserving key tributaries and ensuring Environmental-Flows (E-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. WWF India operates the Ganga/Ramganga Mitra Programme, involving several dedicated volunteers ("Ramganga Mitras"). The program aims to conserve the Ganga and Ramganga rivers by designing initiatives 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.

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* (continuous flow) and *Nirmal Dhara* (clean flow) [1]. 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 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 (NMCG) through the State Mission for Clean Ganga (SMCG) 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 riverbed areas.
- An estimation of the associated expenditure for implementing the proposed activities.

- Clear timelines delineating the planned activities and their corresponding milestones.

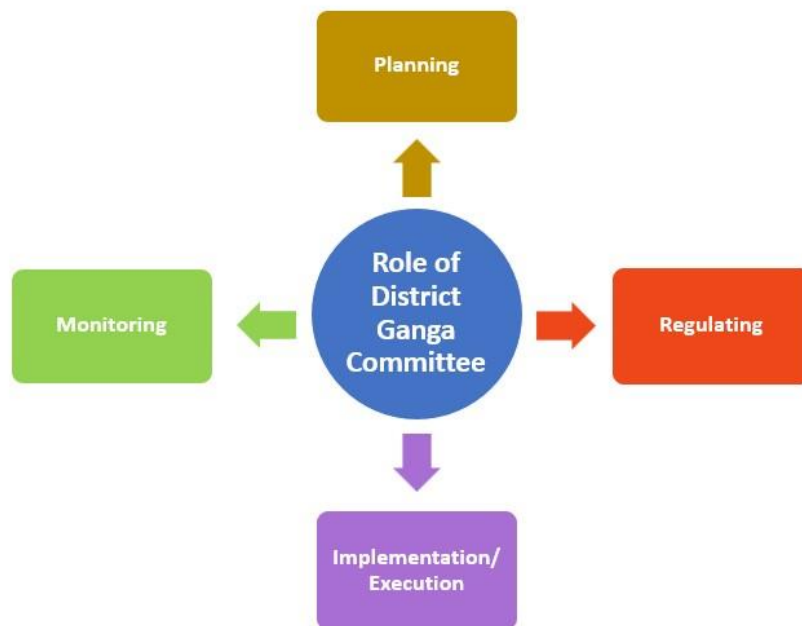


Figure 1 Role of District Ganga Committee (DGC)

Each district-level plan will centre its efforts on safeguarding and reviving pivotal rivers situated 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 an 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) and *Nirmal Dhara* (unpolluted flows) 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 select 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 World Wide Fund for Nature India (WWF India) along

with UP SWaRA has developed E-flow recommendations for all the major rivers of Uttar Pradesh.

The World Wide 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 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, WWF India also operates the Ganga/Ramganga Mitra Programme, which aims to conserve the Ganga River and its primary tributary, the Ramganga. The "Ramganga Mitras" is a dedicated volunteer group comprising several individuals. This platform fosters discussions and debates to design initiatives for mitigating ongoing threats to the rivers. The initiatives encompass various aspects such as promoting the use of organic fertilizers, reducing reliance on harmful agrochemicals, advocating for organic farming, and implementing best management practices for sustainable agriculture. These measures contribute to the reduction of pollution load in the rivers.

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 encompasses 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) focuses 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 and Plantation. 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

The Bareilly district administration along with WWF India is developing the Bareilly District Ganga Plan (DGP) with support from all line departments and agencies. This work is under the aegis of NMCG, Ministry of Jal Shakti, Government of India. There are four DGPs, which are under formulation. These plans are for the districts of Moradabad and Bareilly (developed jointly by respective district administrations and WWF India along with line departments) and Udham Singh Nagar and Shahjehanpur (developed jointly by respective district administrations and GIZ along with line departments).

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 6,000 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 Plan by WWF India

WWF India has formulated the Ramganga River Basin Management (RBM) plan, which aligns with the Ganga RBMP of 2015, outlining a strategic framework for the development, management, and conservation of the Ramganga River basin over the next 20 years. The Ramganga RBM plan is grounded on two fundamental concepts, namely *Aviral Dhara* (uninterrupted flow) and *Nirmal Dhara* (unpolluted flow), 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 Bareilly 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 deficiencies 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 basin document, prepared by WWF India in collaboration with the Uttar Pradesh State Water Resources Agency.

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

By leveraging the methodology employed in the Ganga River Basin Management Plan (GRBMP), the vision is grounded in two indigenous Indian principles, namely *Aviral Dhara* (continuous flow) and *Nirmal Dhara* (unpolluted flow). 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 within the district's boundaries 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. 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:** All relevant stakeholders while securing necessary investments for its execution formally endorse a comprehensive five-year basin management plan, accompanied by a well-defined implementation roadmap. The District Ganga Conservation 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, 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."

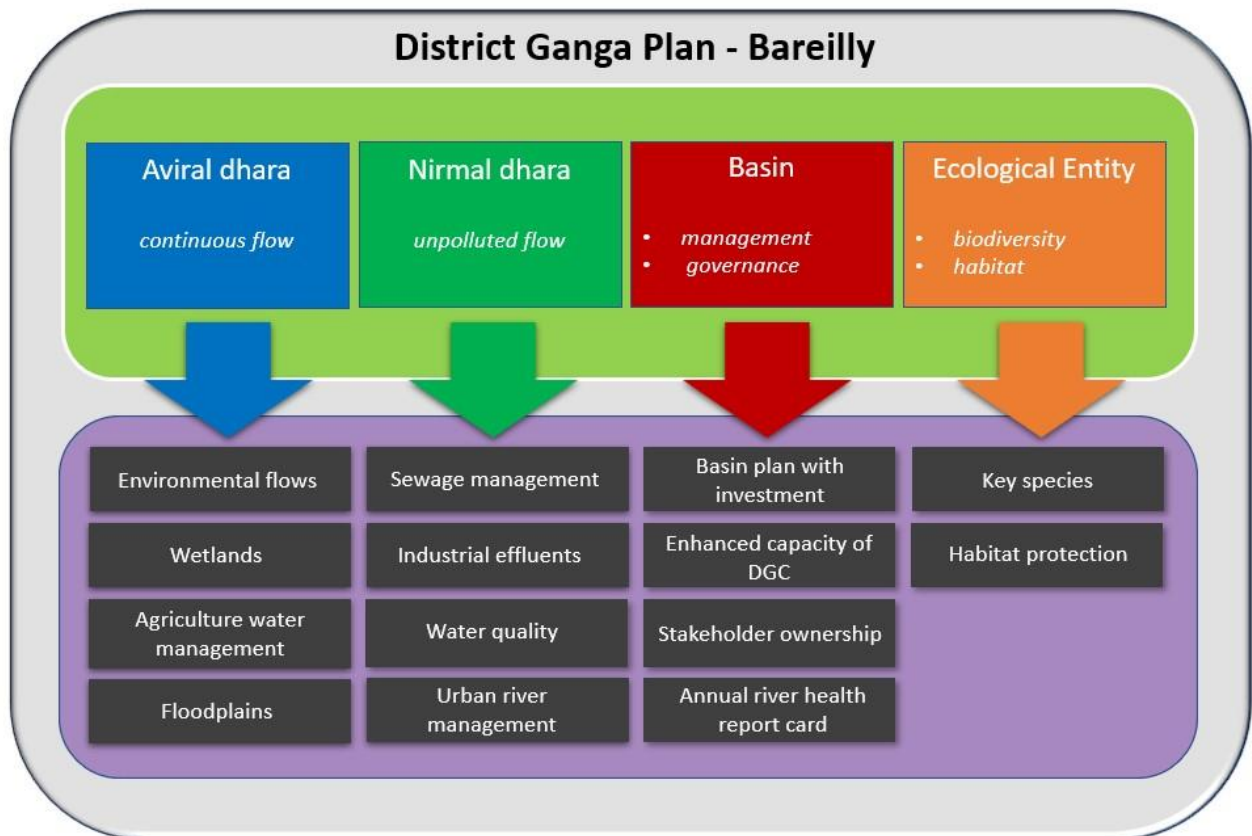


Figure 2 Vision and scope for the District Ganga Plan - Bareilly

3. Framework for District Plan: General approach and methodology

The State Mission for Clean Ganga and WWF India have collaboratively devised a comprehensive framework that is employed by the District Ganga Committees (DGCs) to jointly formulate District Ganga Plans. Initially, this framework will undergo 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 revitalization of crucial rivers 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.

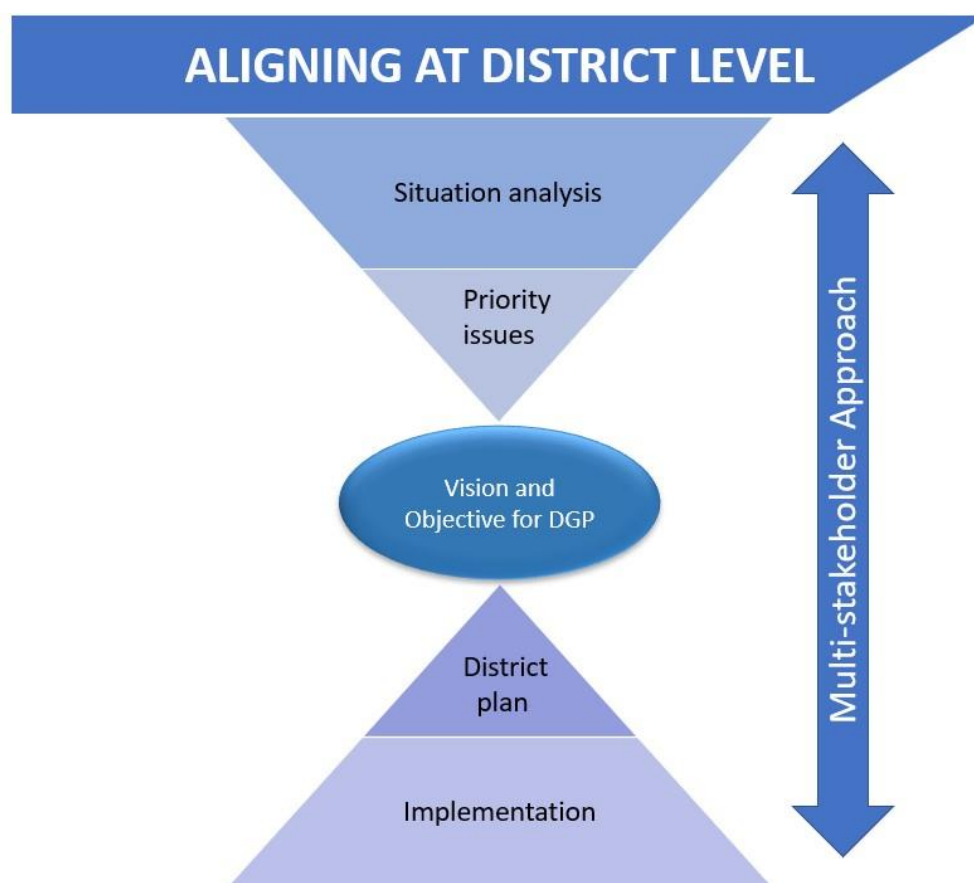


Figure 3 Approach for designing District Ganga Plan (DGP)

The key methodological principles and general principles for developing a District Ganga Plan entail ensuring alignment with the Ganga River Basin Management Plan (GRBMP), 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.

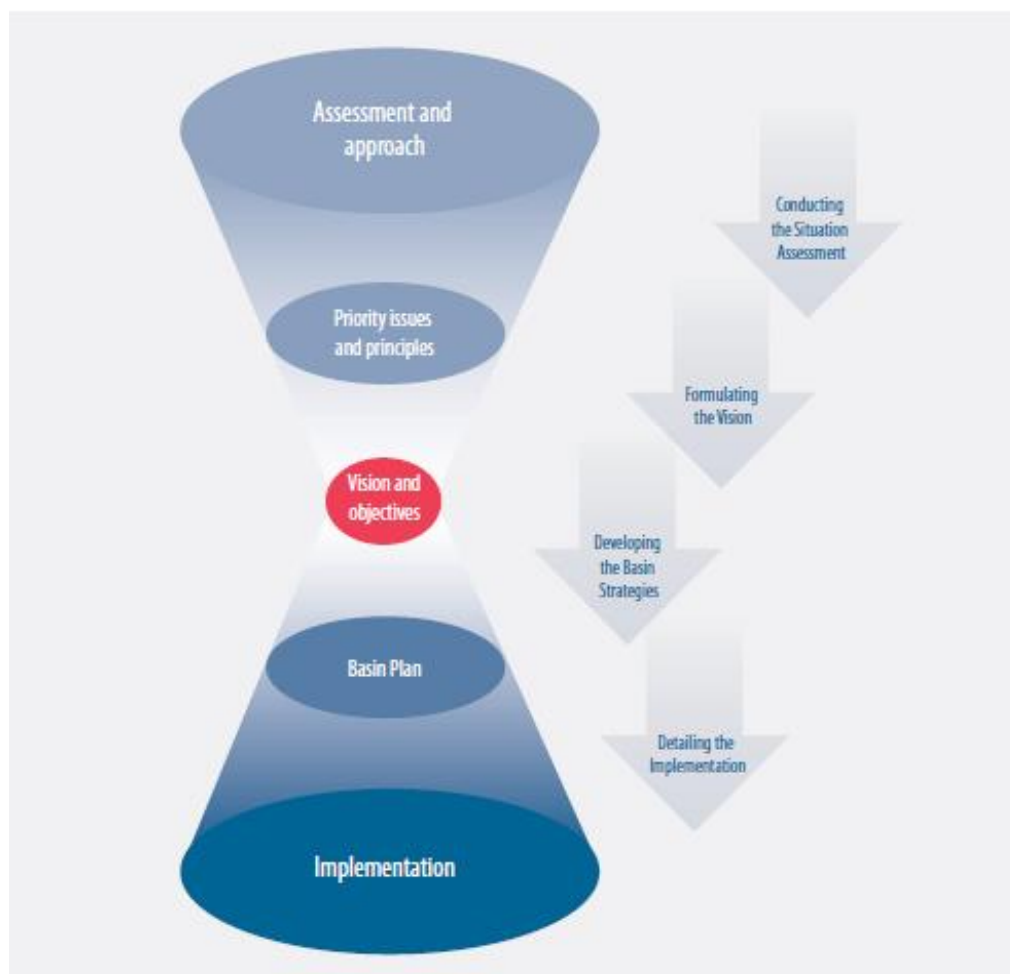


Figure 4 Key principles for designing a district plan comprehensively [7]

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.

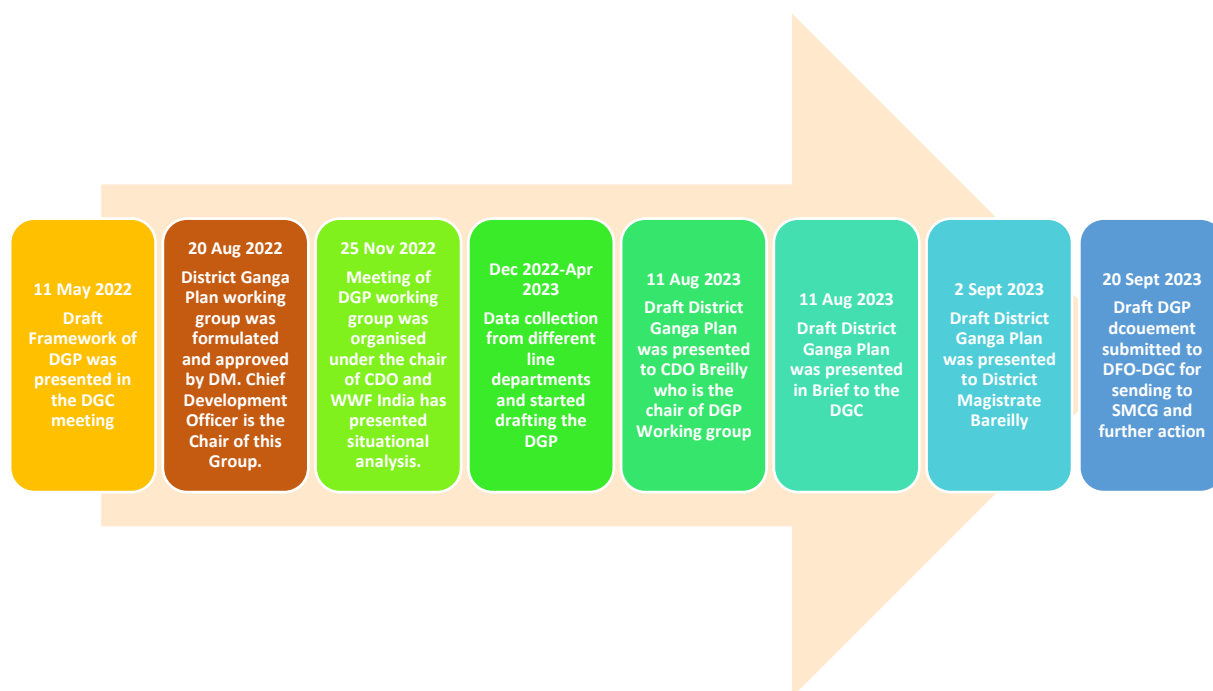


Figure 5 WWF-India's Approach to develop the DGP with timelines

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 issues:** The prioritization of 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, 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.

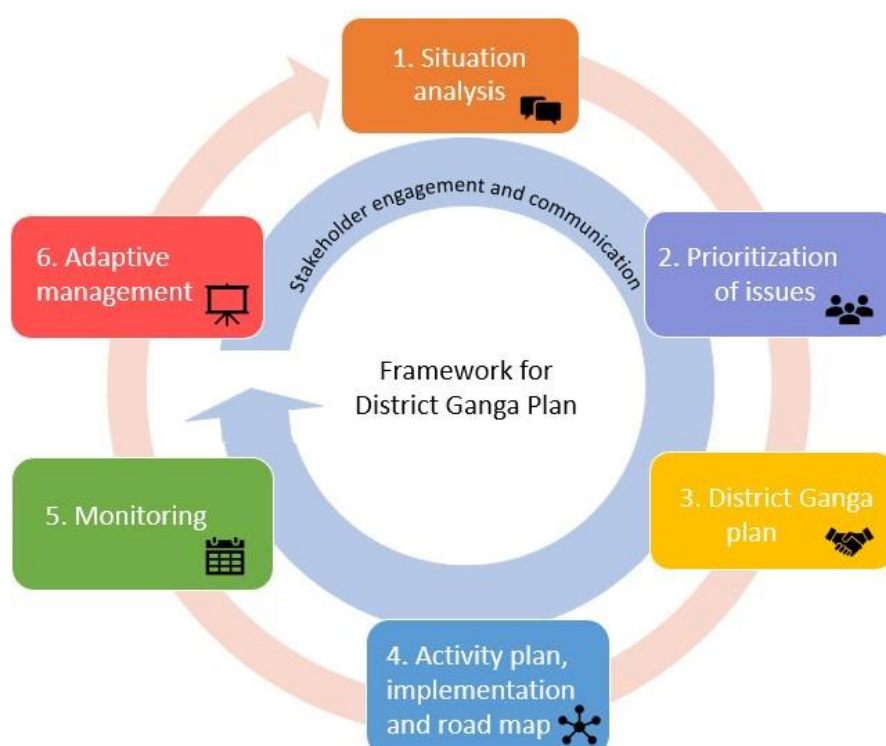


Figure 6 Framework for District Ganga Plan

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 address 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 originates in Uttarakhand and there are two rivers known with the name Ramganga. The Western Ramganga and Eastern Ramganga, both of them flow independently. 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 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, Moradabad, Rampur, Bareilly, Badaun, and Shahjahanpur, before eventually joining the Ganga in Hardoi district (tehra-ghat) [8].

The Western Ramganga River is a spring-fed river and the first major tributary to join the Ganga River. The source of the river is located at an elevation of 3,110 meters above sea level (Latitude 30°5'N, longitude 79°16'E) and from its origins there, in the Central Lower Himalayas within the state of Uttarakhand, 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 in the Hardoi district of Uttar Pradesh. The basin is approximately 24,459 km². 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].

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).



Figure 7 Map of Ramganga Basin

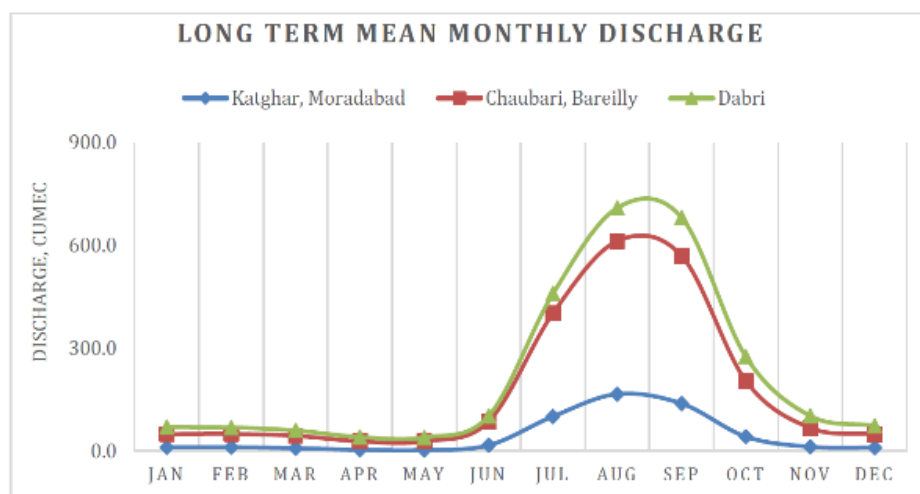


Figure 8 Average river flows at selected sites in the Ramganga River [11]

Table 1 Key features of the Ramganga Basin. Source: National Institute of Hydrology, 1998-99; Central Water Commission 2012, WWF-India (2014-19).

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: <ul style="list-style-type: none"> • 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	Approximately 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 agricultural 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 Bareilly District

Bareilly is a municipality situated in the northern region of Uttar Pradesh, India, close to the Ramganga River. It is designated as a Commissionery district and falls within the geographical region of Rohilkhand. The city is located 252 kilometres (157 miles) to the north of the state capital, Lucknow, and 250 kilometres (155 miles) east of the national capital, Delhi. It ranks as the seventh-largest metropolis in Uttar Pradesh and the 50th-largest city in India. Bareilly is also selected as one of the ambitious projects under the "100 Smart City" initiative in India. Bareilly serves as a prominent centre for furniture manufacturing and trade, specializing in cane furniture production. It is also involved in the commerce of cotton, cereals, and sugar. The city gained significance through its inclusion in the "Counter Magnets" list of the National Capital Region (NCR), contributing to its status and development. Additionally, it is known as Bans-Bareilly; however, the name is not derived from the bans (cane) market, as it was named after two princes, Bansaldev and Baraldev, who were the sons of Jagat Singh Katehriya, the founder of the city in 1537 [\[12\]](#) [\[13\]](#).

The total area of Bareilly district is recorded as 4120 square kilometres. As per the population data from 2011, the district has a population of 4,448,359 individuals. The literacy rate in Bareilly stands at 58.49 percent. Bareilly is comprised of one corporation, with a total of 20 municipalities, 15 blocks, and 2,070 villages (Table 2) (Figure 9) [\[12\]](#).

Table 2 Physical features of Bareilly District

Tehsil	06
Blocks	15
Geographical area	4120 sq. km.
Gram panchayat	1193
Villages	2072
Total population	4448359

Tehsil	Blocks
1. Bareilly	Bhojipura
	Kyara
	Bithri Chainpur
2. Aonla	Alampur Zafarabad
	Ramnagar
	Majhgawa
3. Bahedi	Bahedi
	Richha
	Shergarh
4. Fareedpur	Fareedpur
	Bhuta
5. Meerganj	Meerganj
	Fatehganj West
6. Nawabganj	Nawabganj
	Bhadpura

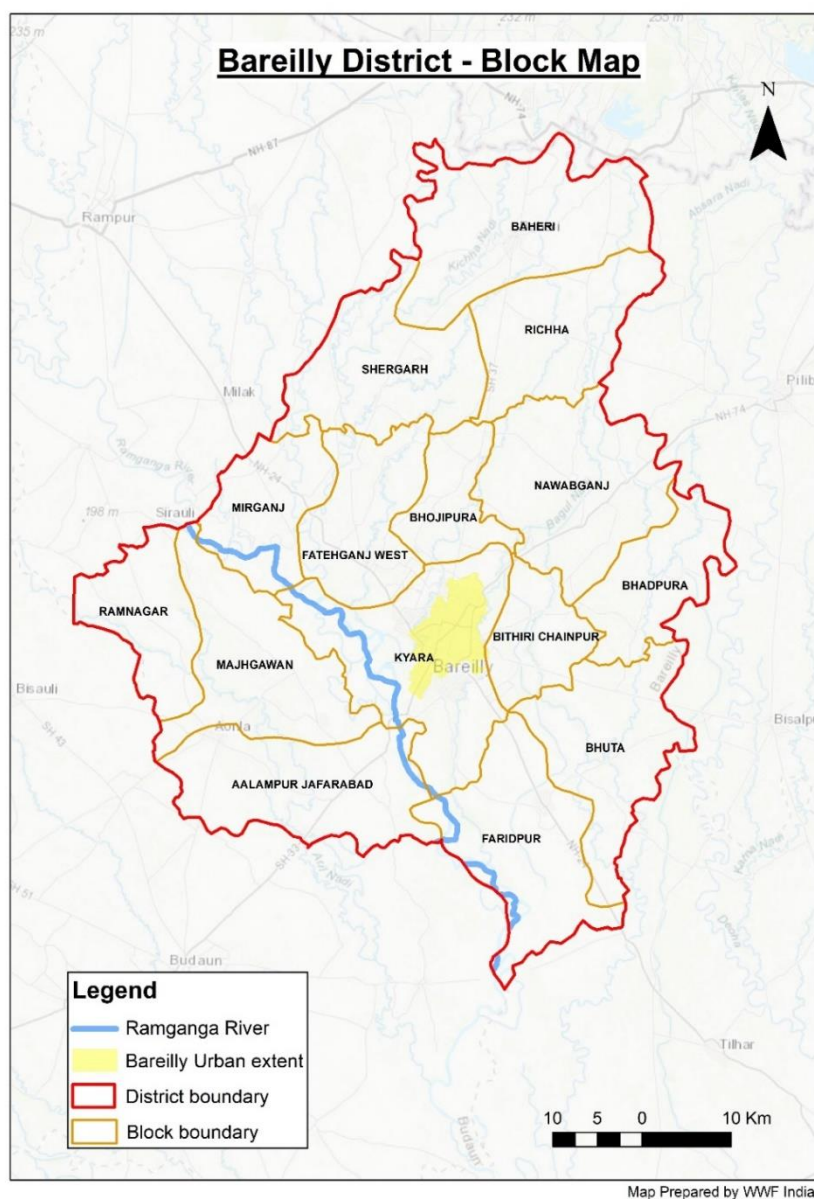


Figure 9 Administrative map of Bareilly District

4.2.1 Bareilly City

The city of Bareilly, with a jurisdiction of 10605 Ha (106.05 sq. km) of area, is a Municipal Corporation administered by Bareilly Nagar Nigam. The prominent rivers in the vicinity of Bareilly include Ramganga, Devraniya, Nakatiya, and Shankha. Furthermore, Bareilly serves as a key railway junction within the Central Zone, and it is intersected by important roadways such as SH-33, SH-37, and NH 24.

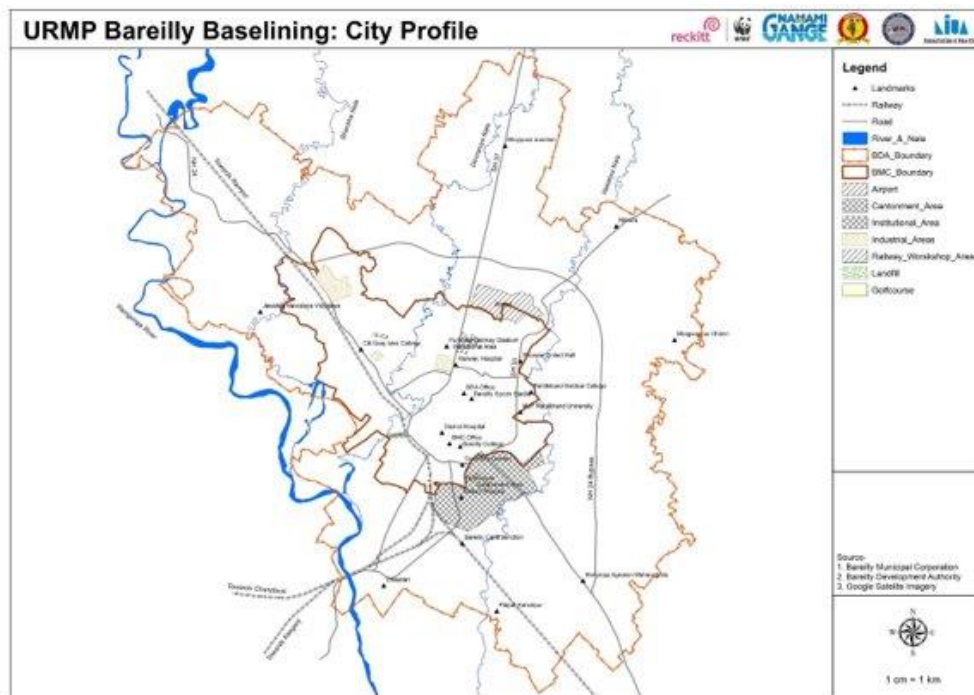


Figure 10 Bareilly City profile

Ward-wise population density is given in the below map (Figure 11). It is noted that the old settlement has a high-density population in the city.

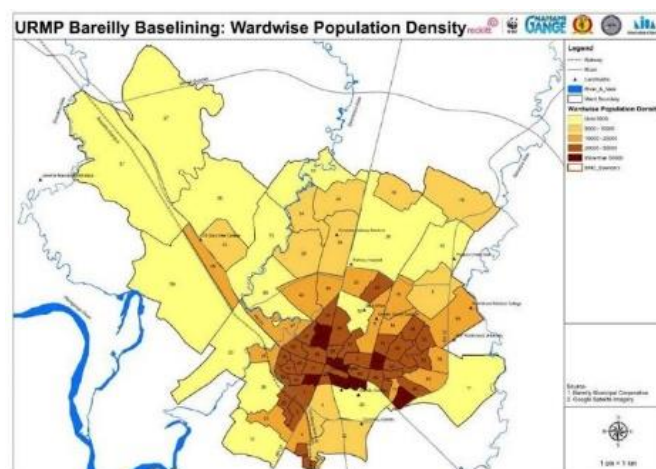
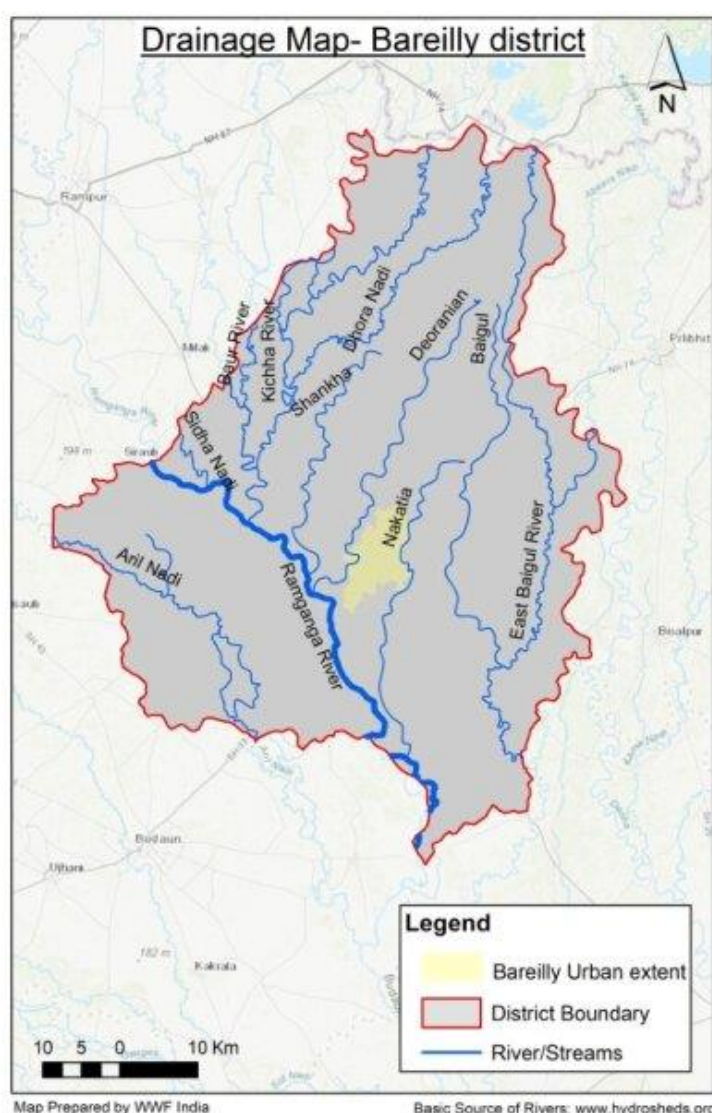


Figure 11 Ward-wise Population Density Distribution of Bareilly City

4.3 Topography and drainage system

The Ramganga River, a significant freshwater source, courses through the Bareilly district, accommodating various minor tributaries both within the district itself and in downstream districts.

Though Aril River drains a catchment of Ramganga from the right bank of Ramganga of the western region of the district the eastern portion of the district is drained by the Ramganga River and its associated tributaries, namely Sidha, Baur, Kichha, Dhora, Shankha, Deoraniya, Nakatiya, and Baigul rivers.



River/ Stream	Length (km)	Starting Point	End point
Ramganga	74.72	79.129E, 28.487N	79.484E, 28.04N
Aril	49.0	79.00E, 28.398N	79.27E, 28.164N
Nakatia	50.8	79.54E, 28.494N	79.471E, 28.145N
Deoraniya	58.38	79.554E, 28.683N	79.346E, 28.337N
Shankha	45.73	79.433E, 28.617N	79.34E, 28.361N
Dhora	106.9	79.566E, 28.84N	79.258E, 28.418N
Kichha	70.28	79.494E, 28.865N	79.311E, 28.575N
Nabaur	24.3	79.227E, 28.585N	79.269E, 28.481N
Sidha	12.85	79.165E, 28.52N	79.204E, 28.46N
East Baigul	128.15	79.629E, 28.862N	79.622E, 28.15N

Figure 12 Drainage map of Bareilly District with locational attributes of drainage network in Bareilly district

The entire hydrological network in the region is regulated by the dominant presence of the Ramganga River and its associated tributaries, including the Siddha, Dojora, Bahgaul (west), Kicha, Sankha, Deoraniya, Nakatia, Bahagaul (east), Deoha, and Aril rivers. It is noteworthy that all of these rivers, except for the Aril River, converge with the Ramganga River on its left bank.

The Ramganga River, a significant tributary of the Ganga River, originates in the Garhwal mountain range. Serving as a crucial right-bank tributary of the Ramganga River, the Aril River holds substantial importance within the hydrological framework [14].

Table 3 Details of rivers in district Bareilly [15]

	River name	Discharge (cusec)	Total length (km)	Length in dist. (km)	Tehsil	Origin point	Confluence
1	Ramganga river	400000	360	75	Meerganj, Sadar	Kalagarh Dam	Ganga Kannauj
2	Pilakhar	80484	51	20	Meerganj	Kemri Dam rampur	Bhakra
3	Kulli	21180	65	15	Meerganj	Rampur	West Baigul
4	Kichhha	163000	120	30	Bahedi	Nainital	West Baigul
5	Dhora	28240	50	21	Meerganj	Dhaura Dam	West Baigul
6	West Baigul	90620	95	46	Meerganj	Haripura	Dojora
7	Bhakra	84014	107	37	Meerganj	Nainital	Dojora
8	Dojora	141200	12	12	Meerganj	Bhakra+Wbaigul	Ramganga
9	Devraniya	8825	112	55	Sadar	d/s Baigul dam	Ramganga
10	Pangheli	24710	67	19	Nawabganj	Baigul Dam	Kailash River
11	Apsara	24710	62	21	Nawabganj	Baigul Dam	Kailash River
12	Kailash	56480	115	49	Fareedpur	Pandheli+Apsara	East Baigul
13	East Baigul	20156	48	18	Nawabganj	Daigul Dam	Kailash River
14	Devha	127009	245	30	Nawabganj	Nanak Sagar Dam	Ganga Kannauj

The cluster of natural drainage pathways plays a significant role in understanding the hydrological and river basin dynamics of Bareilly.

The topography and the contours of the city direct the flow and deviation of the storm water and un-tapped wastewater ultimately to the Ramganga river through various channels and Nakatiya and Deoraniya rivers.

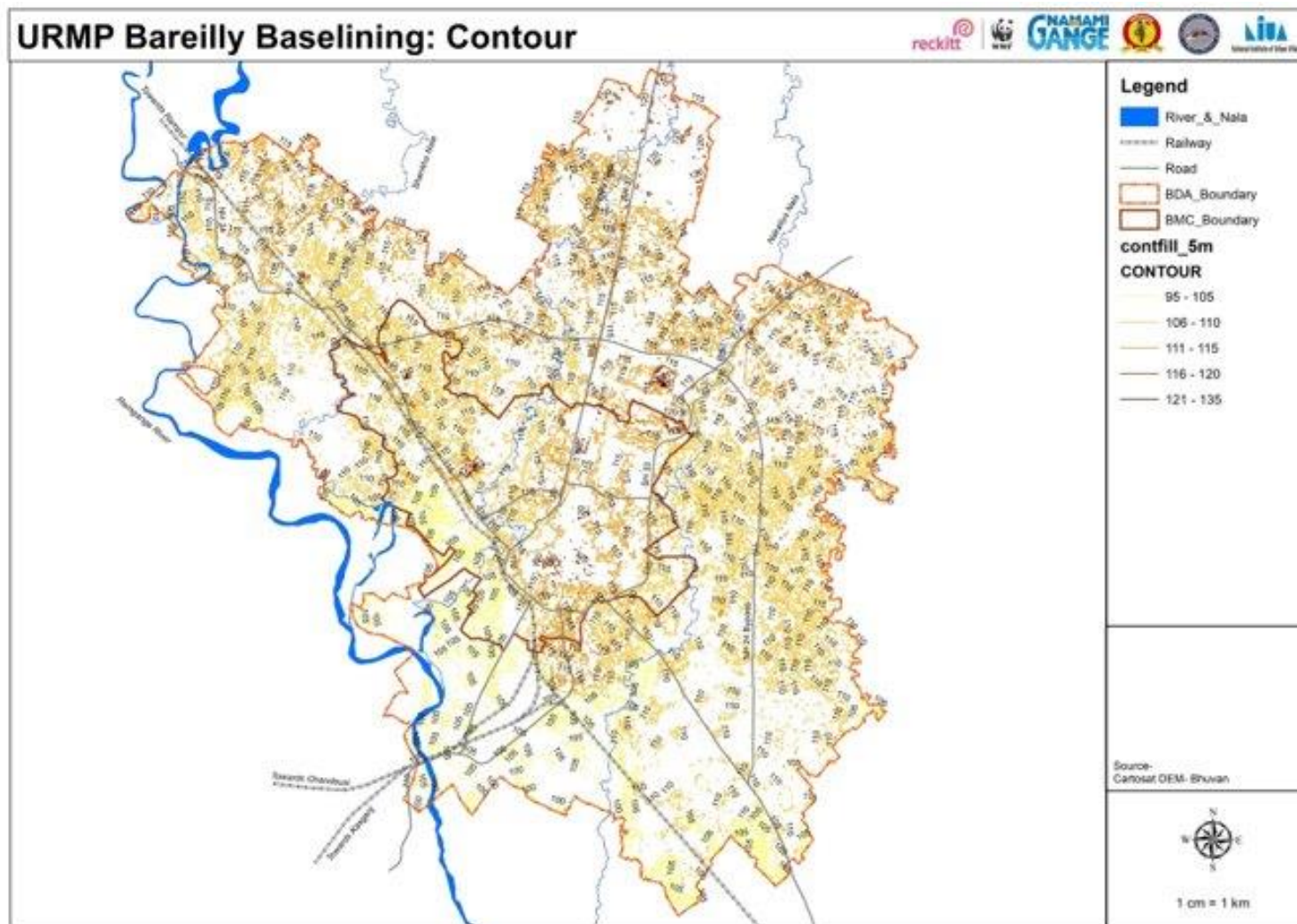


Figure 13 Contour lining of Bareilly

Bareilly district is drained by several rivers, the surface water resources data and information are available only for Ramganga and Aril River as of now. In the initial 5-year (First phase) plan of the District Ganga Plan, the focus has been placed on four key rivers within Bareilly District: specifically, the Ramganga River, Aril River, Deoraniya River, and Nakatiya River. It is noteworthy that the latter two rivers have undergone a transformation into drainage systems, and their status with regard to pollution is being examined in various sections of the report.

WWF-India is working in both Ramganga and Aril from past several years and have collected critical information related to various thematic including flows, landuse, groundwater and pollution, which is being presented here. For other rivers/streams it is strongly recommended that a monitoring mechanism to be set in place through concerned line department to collect flow data in different rivers which are critical for Bareilly district.

The Aril River Basin

Apart from Ramganga basin in Bareilly district, WWF India as part of its initiative has done research on Aril River, a tributary of Ramganga River and a critical river passing through the district. The following subsection discusses the status of Aril River basin and its health. The Aril River at Bareilly traverses through three distinct administrative divisions, namely Ramnagar Block, Majhgawan Block, and Alampur Jafarabad Block. The comprehensive village mapping in the Bareilly district reveals a total of 62 villages distributed across these blocks:

- Ramnagar Block: Comprises 23 villages
- Majhgawan Block: Comprises 17 villages
- Alampur Jafarabad Block: Comprises 22 villages

The population residing in this area amounts to approximately 1.89 million individuals, as per the 2011 Census data. Among this population, around 11% can be classified as urban residents.

Aril is a 170 Km long tributary of Ramganga having a catchment area of 2,240 square kilometres, which accounts for approximately 10.97% of the entire Ramganga basin. The Aril River originates from Gumsani village in the Sambhal district where its catchment and traverses drain water from 17 blocks across six districts, namely Moradabad, J.P. Nagar, Sambhal, Rampur, Bareilly, and Budaun. It eventually merges with the Ramganga River at Navada-Madhukar village in the Dataganj block of Budaun (Figure 14).

To strengthen its initiatives towards wetland conservation to maintain the hydrological, geomorphological and ecological balance of the Ganga basin and its tributaries, WWF-India is working in the Aril River basin on river and wetland rejuvenation. The river is predominantly fed by groundwater and used to be a perennial river a few decades back however due to degradation in its catchment due to over-abstractions of groundwater, encroachment, land use change, increase in water demand, degradation of wetlands etc. These pressures have led to a state where the river does not even hold seasonal flow for even a couple of months now and has turned into a seasonal flashy river.

Regarding rainfall, the Aril River experiences an average annual precipitation of 854.64 mm, based on data from 1961 to 2015. The majority of this rainfall is attributed to the monsoon season, accounting for 86.36% of the total rainfall.

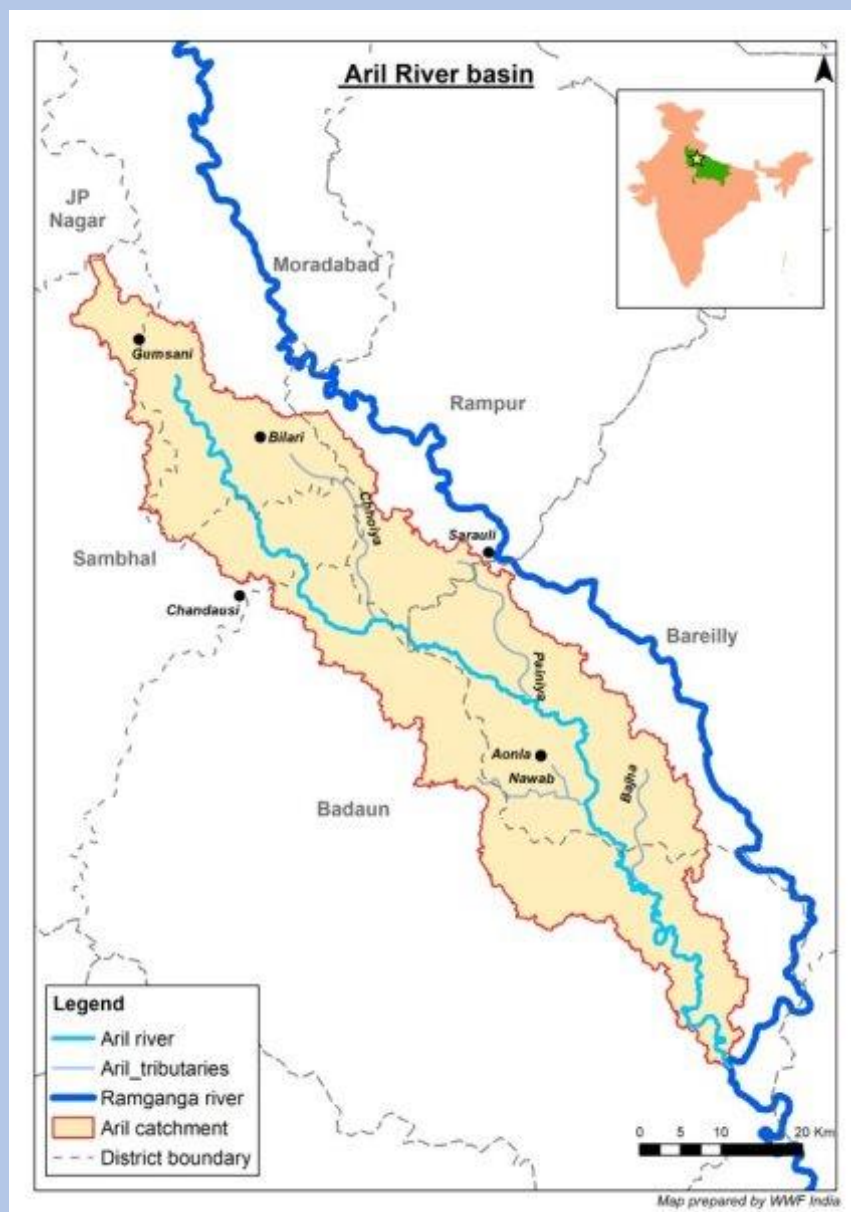


Figure 14 Districts in the Aril Basin

Within the monsoon season, the months of July and August receive the highest amount of rainfall, constituting 69.44% of the monsoon rainfall and 59.97% of the overall precipitation.

The Aril Basin experiences a sub-tropical, monsoonal climate characterized by distinct seasonal variations. During the winter months, spanning from October to February, the climate is cool and dry, often accompanied by fogs and light showers. Summers, from March to early June, are hot and dry. The monsoon season, occurring from mid-June to September is characterized by warm and humid conditions, with frequent episodes of heavy rainfall.

In terms of temperature, the Aril plain exhibits a range of 5°C to 25°C during winter and 20°C to over 40°C during summer. The highest monthly mean maximum temperature is recorded in June, reaching 35.62°C, while the lowest monthly mean minimum temperature is observed in January, measuring 17.87.

The Aril River which used to be a perennial river a few decades ago is now being turned into a seasonal flashy river where flows remain in the river for only a few months/days when it rains. The baseflows are almost negligible in the river. There is one monitoring station on Aril near Dataganj (maintained by the flood control department). The surface water resources amount to 486.05 Million Cubic Meters (MCM), while the groundwater resources contribute an additional 528.37 MCM. Combined, these sources yield a total water availability of 1014.42 MCM. But the water demand exceeds the supply which is leading to reduced flows in the river.

There is no major water resource infrastructure on the rivers passing through Bareilly except the newly constructed Budaun Irrigation Project on Ramganga, which was built to provide canal water to the Budaun district. The designed discharge at barrage head-works is 56 cumec for a period of 120 days in a year.

4.4 Rainfall and Climate

The primary contributor to precipitation in the region is the summer monsoon, typically occurring from mid-June to Mid-October. Among these months, July and August experience the highest levels of rainfall. Throughout the year, the district's temperature ranges from a minimum of 14.1 °C in January to a maximum of 31.6 °C in May, based on data collected between 1991 and 2021 [14][16].

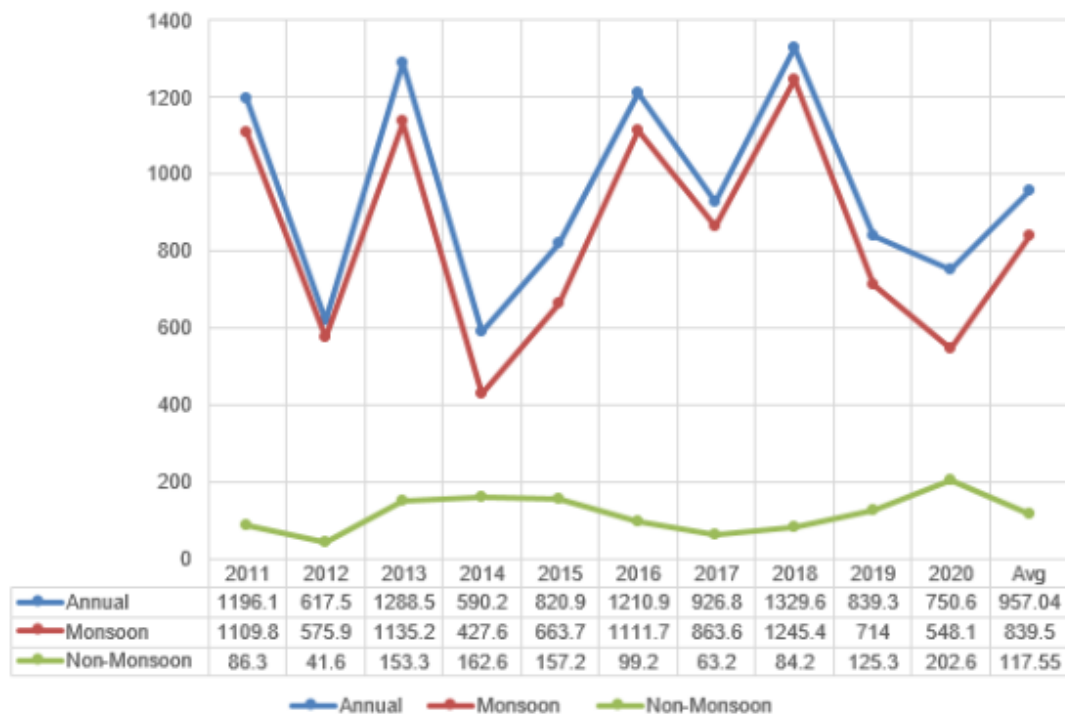


Figure 15 Average Annual Rainfall in Bareilly District from 2011 to 2020 [16].

Over the period from 2011 to 2020, a noticeable downward trend in average annual rainfall has been observed in Bareilly district. Specifically, there has been a decline from 1196 mm to 750 mm in rainfall amounts [16].

4.5 Available water resources

4.5.1 Surface water (Rivers)

The Bareilly district is drained through several rivers and its tributaries carrying significant amounts of freshwater. The volumetric amount passing through this particular location at Chaubari on the Ramganga River, on an annual basis is estimated to be approximately 5600 Million Cubic Meters (MCM). The majority of this flow is during monsoon season while the river lacks adequate Environmental Flows. It is essential to emphasize that this figure represents the long-term average data derived from observations spanning the past three

decades, thus providing a comprehensive and reliable assessment of the district's water availability over an extended period.

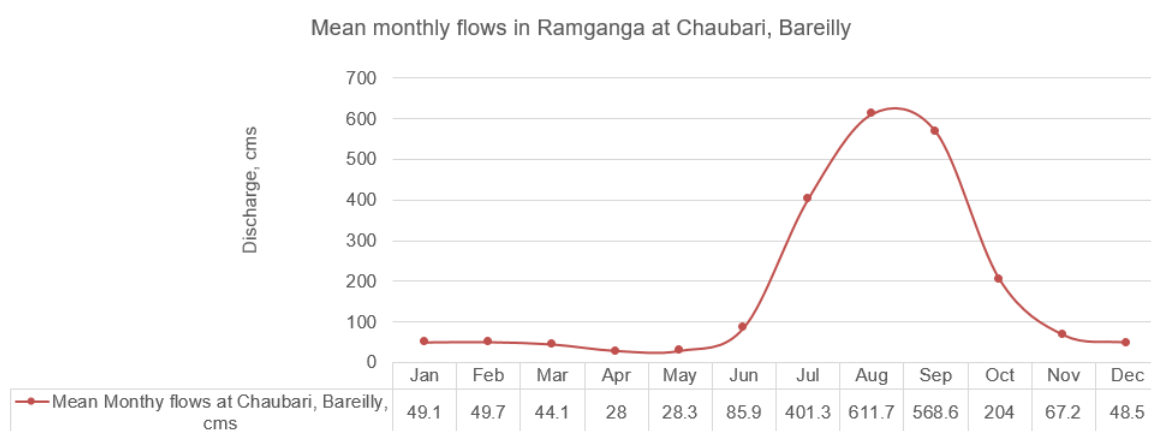


Figure 16 Surface water resources in Bareilly District

Apart from Ramganga and Aril, there are several key tributaries like Kichha and East Baigul (along with other smaller streams) for which data around surface water resources is not well monitored or if it is done, the data is not available in the public domain. The data if available with any department can be collected and appended here in this valuable document. In addition to surface water in rivers, Bareilly district is home to a complex network of canals that receive water from minor barrages on left-bank rivers such as Kichha and Baigul. These canals provide water for irrigation on the right bank of Ramganga (Bareilly district). The left bank (Aril catchment) does not have any operational canal command.

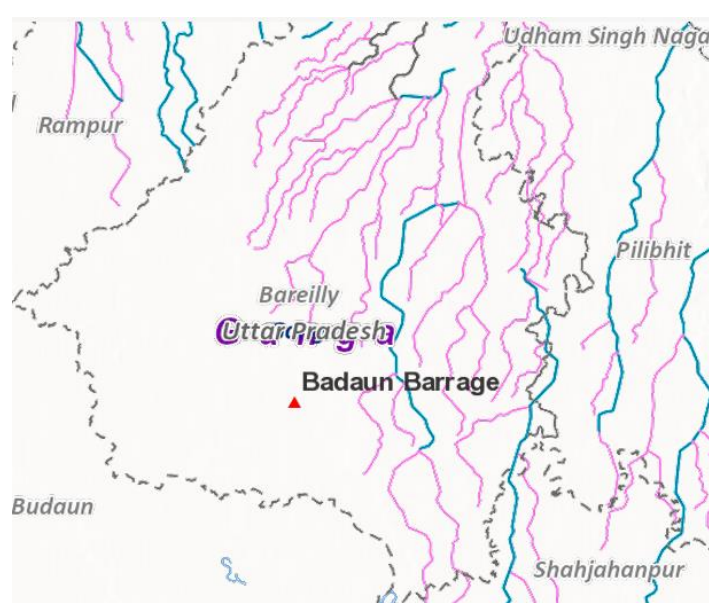


Figure 17 Canal network map of Bareilly district (IndiaWRIS)

4.5.2 Surface water (Wetlands)

Wetlands play a crucial role in river rejuvenation by maintaining aquifers' health and providing baseflows to rivers. A healthy wetland also helps improve local water security, supporting key biodiversity, acting as a carbon sink, and flood cushion, and helping improve resilience. Healthy flowing rivers provide a myriad of ecosystem services. The rivers and wetland catchments are subjected to loss of connectivity, due to over-abstraction of groundwater, diversion of surface water, unsustainable agriculture practices, pollution, land use change, encroachment of inlets etc. Based on the comprehensive study carried out by WWF India and IIT Kanpur during the period of 2020-21, a total of 275 wetlands (>2.5 ha) have been mapped within the Bareilly district along with their degradation status that has happened over some time. These wetlands have been categorized based on their characteristics and dynamics (Figure 18).

- **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.
- **Intermittent:** These wetlands displayed intermittent patterns of being alternately wet and dry throughout the study period.
- **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.
- **Diminishing:** Wetlands categorized as diminishing displayed a reduced frequency of being wet in recent times compared to their historical state.

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.

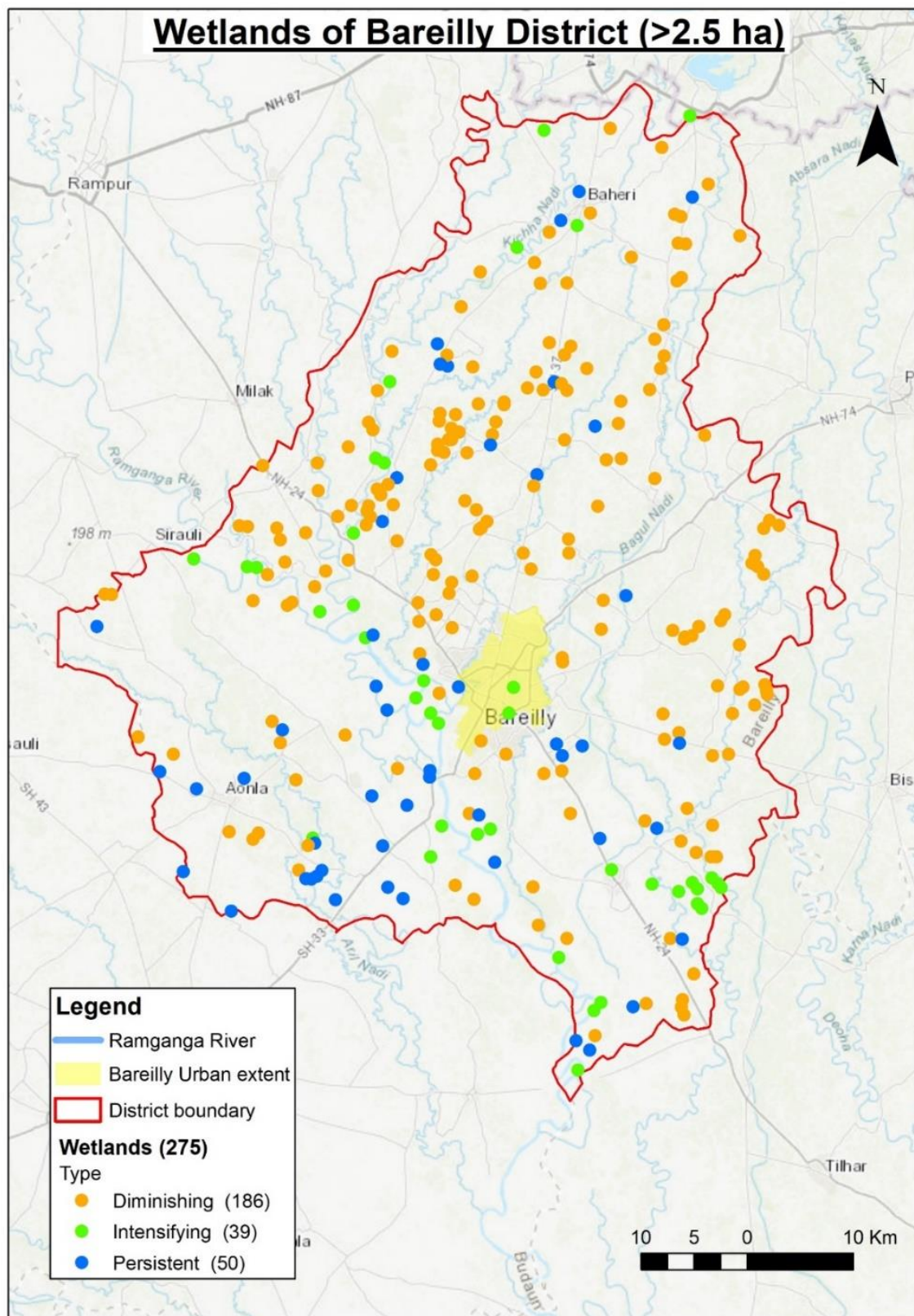


Figure 18 Wetlands in Bareilly District

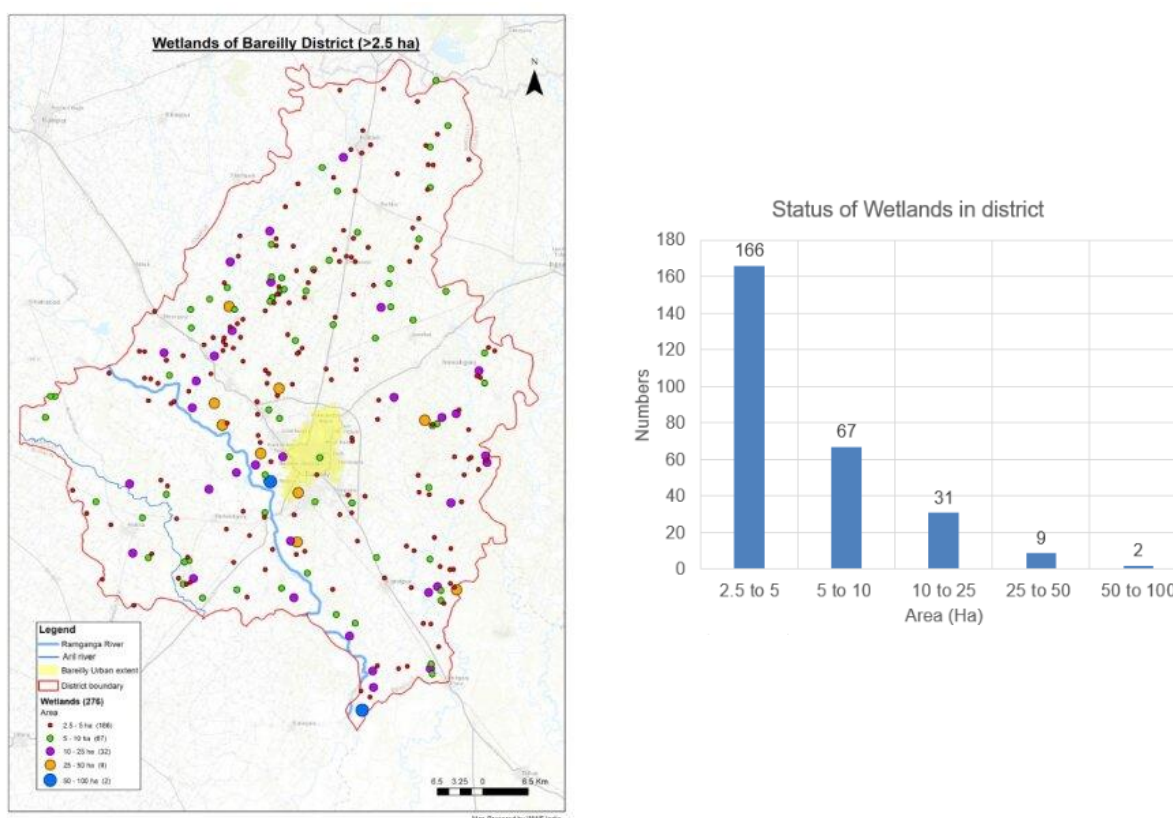


Figure 19 Categorization of wetlands based on area (Bareilly District)

The data (Figure 19) suggests that the majority of wetlands in Bareilly district (>2.5 ha) are diminishing or degraded in nature whereas the rest 30 % is either of stable health or getting intensified (largely due to continuous load of pollution). Area of about 60% of the wetlands are between 2.5-5 ha, 25% between 5-10 ha whereas large wetlands (>25 ha) are about 4%. According to National wetland Atlas (2010), Bareilly district has 353 wetlands in the district (Table 4).

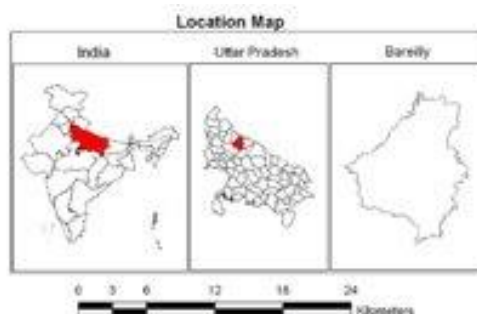
Table 4 Area estimates of wetlands in Bareilly. Source: National Wetland Atlas: Uttar Pradesh, Space Applications Centre, SAC/RESA/AFEG/NWIA/ATLAS/12/2010, ISRO, Ahmedabad, India, 372p

Sr. No.	Wettcode	Wetland Category	Number of Wetlands	Total Wetland Area	% of wetland area	Area in ha	
						Open Water Post-monsoon Area	Pre-monsoon Area
	1100	Inland Wetlands - Natural					
1	1101	Lakes/Ponds	43	473	4.34	144	139
2	1102	Ox-bow lakes/ Cut-off meanders	37	574	5.27	362	195
3	1103	High altitude wetlands	-	-	-	-	-
4	1104	Riverine wetlands	42	1370	12.57	1116	294
5	1105	Waterlogged	54	391	3.59	274	138
6	1106	River/Stream	95	6269	57.53	5030	3630
	1200	Inland Wetlands -Man-made					
7	1201	Reservoirs/Barrages	-	-	-	-	-
8	1202	Tanks/Ponds	13	59	0.54	56	32
9	1203	Waterlogged	69	612	5.62	399	212
10	1204	Salt pans	-	-	-	-	-
		Sub-Total	353	9748	89.46	7381	4640
		Wetlands (<2.25 ha), mainly Tanks	1148	1148	10.54	-	-
		Total	1501	10896	100.00	7381	4640

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/Sarrages
	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

Legend

- Wetlands (>2.25 ha)
- Settlements
- Drainage (line)
- Canal
- Roads
- Railways
- Town/Settlements
- District Boundary
- State Boundary
- International Boundary



Data Source
IRS P6 LISS III data (Pre-monsoon and Post-monsoon Season 2006-07)
Prepared by
Remote Sensing Applications Centre, Uttar Pradesh, Lucknow and Space Applications Centre (ISRO), Ahmedabad
Sponsored by
Ministry of Environment and Forests Government of India

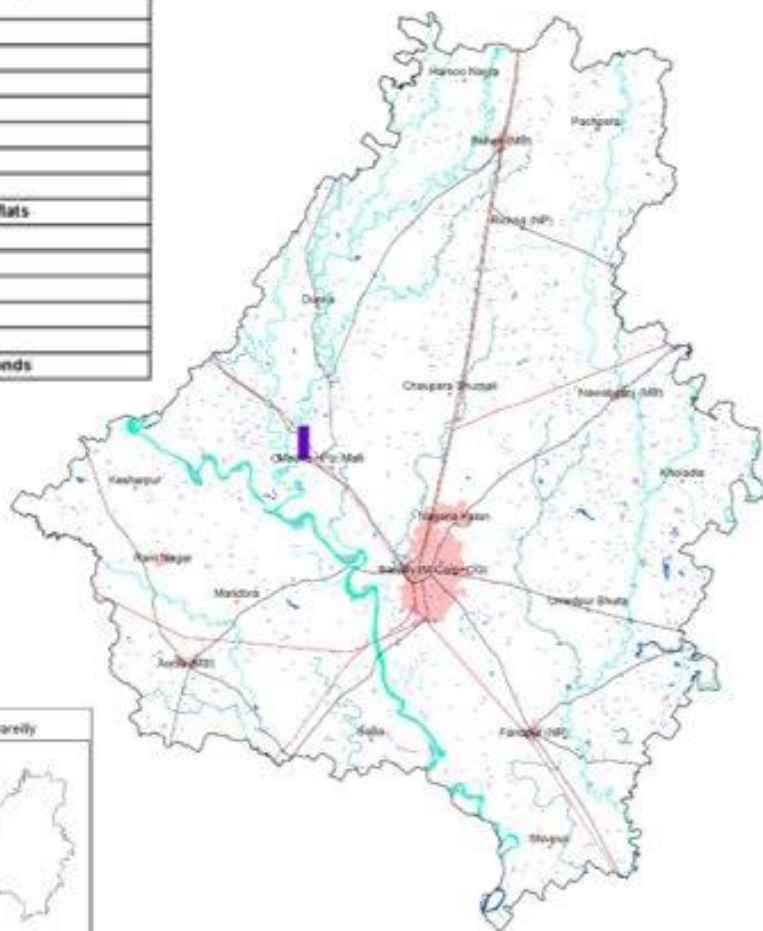


Figure 20 Map of Wetlands in Bareilly district (Source: National Wetland Atlas)

Wetlands of Aril Basin

A comprehensive assessment conducted in the Aril Basin has identified 34 wetlands in Aril basin within the Bareilly district with the inherent capability to augment base flows and provide crucial support to the Aril River. The identification of these specific wetlands and their associated significance in maintaining base flows accentuates their pivotal role in preserving the hydrological integrity and resilience of the Aril basin. This systematic identification and understanding of these wetland resources serve as essential guidelines for the development of targeted conservation and management strategies, facilitating the preservation and sustainable utilization of these invaluable water resources for the benefit of the Aril River and its surrounding ecosystem.

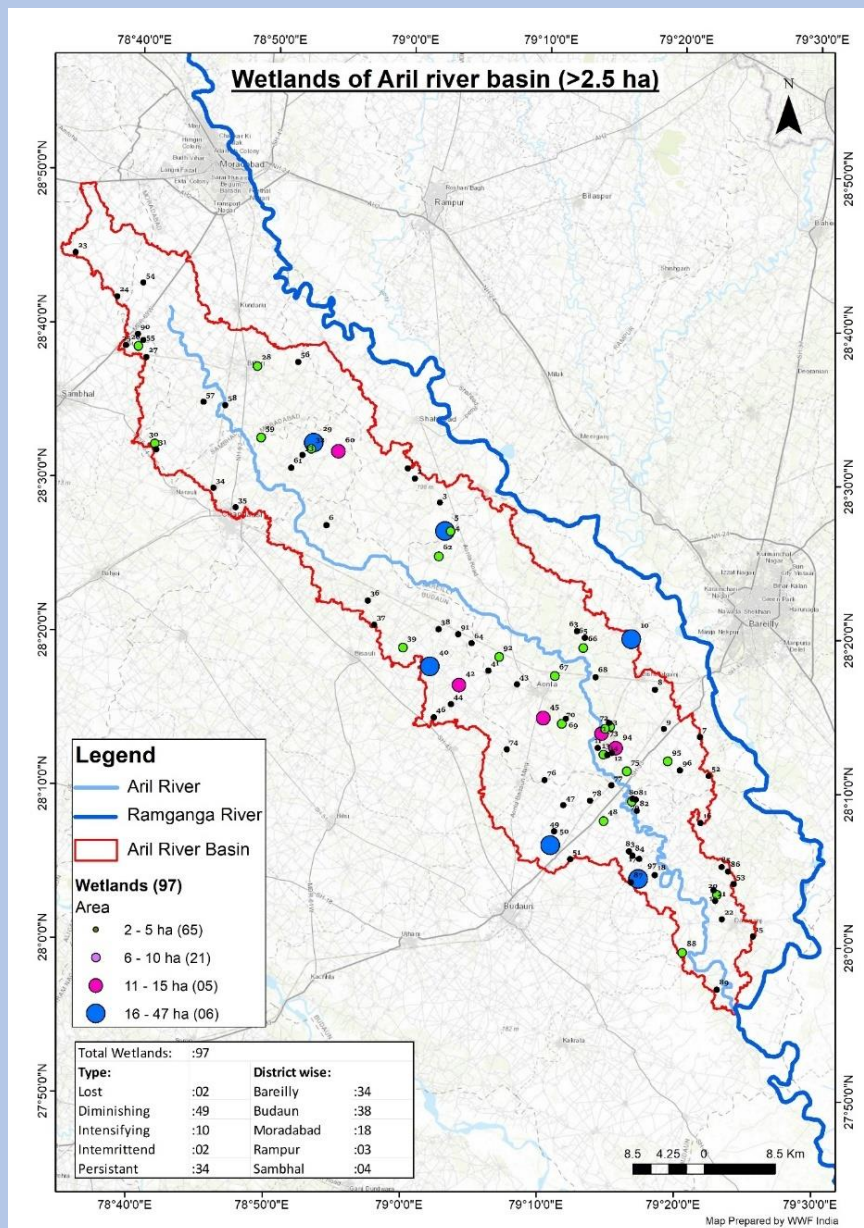


Figure 21 Wetlands of Aril Basin

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 erected. 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 [17].

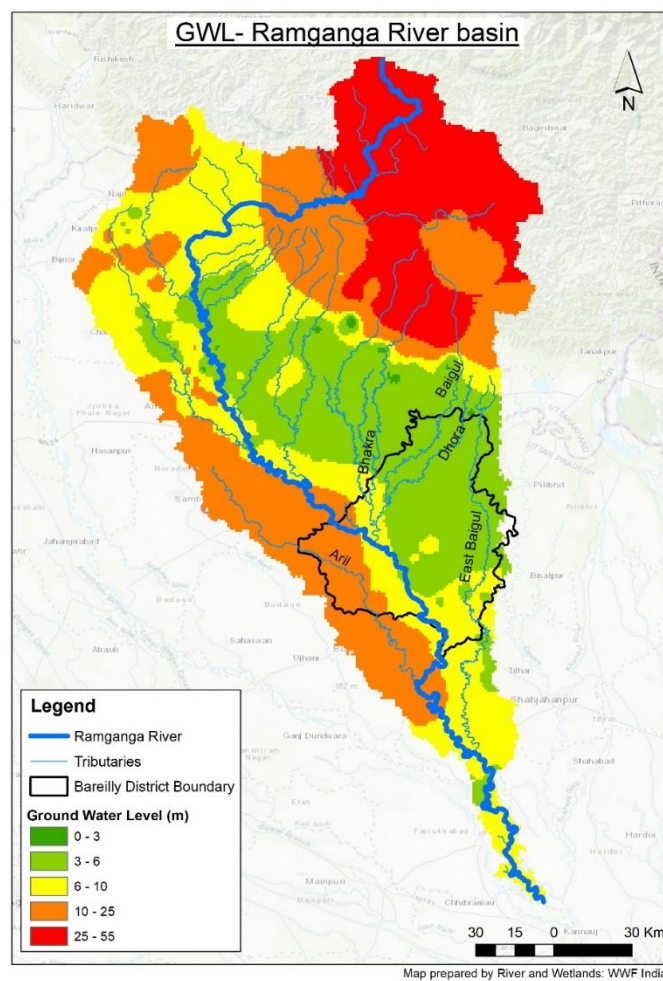


Figure 22 Depth to groundwater levels (below ground level) in Ramganga basin and Bareilly district (lower aquifer)

Bareilly district is heavily reliant on its groundwater reserves to fulfil requirements for domestic, commercial, and industrial water consumption. According to the Central Ground Water Board (CGWB), the subsurface water level in Bareilly is undergoing rapid depletion.

An examination of the dynamics of groundwater resources in 2020 reveals crucial indicators. The existing gross groundwater draft for all uses is estimated to be 85,236 Hectare-meters (Ham), whereas the net annual groundwater availability stands at 125,453 Ham. The stage of groundwater development, which indicates the proportion of groundwater extracted compared to its availability, currently stands at 67.94%. The groundwater study carried out by WWF-India for the entire Ramganga basin indicates that water levels in Bareilly district ranged from 0-6 m (bgl) on the left bank of Ramganga while its ranges from 6-25 m (bgl) on the right bank of Ramganga (Aril catchment).

Water-intensive agricultural practices, particularly the cultivation of crops such as paddy and sugarcane, exert a substantial demand for water resources in the region, leading to significant groundwater extraction in the Bareilly District. Within the district, 11 blocks are categorized as being in the safe category in terms of groundwater availability. However, the city of Bareilly is classified as over-exploited, while Alampur Zafarabad, Majhgawan, Ram Nagar, and Fatehganj fall into the semi-critical category [17].

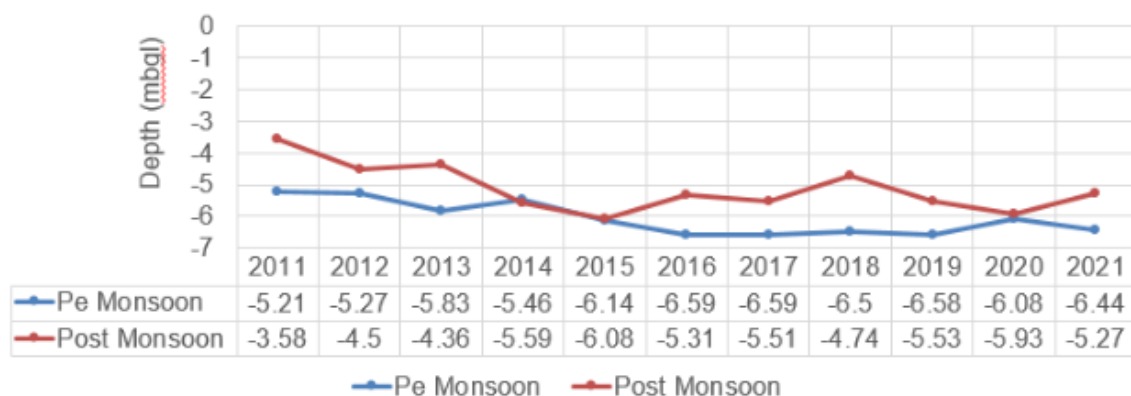


Figure 23 Groundwater scenario in Bareilly District

The average groundwater level data of the past decade indicates water levels in both pre and post-monsoon seasons have declined by 1.5 m (5 feet). However, there is spatial variation in the groundwater scenario over the district. Based on block-level data analysis (Figure 23), a

noticeable decrease in water levels has been observed in Ramnagar, Alampur Zafrabad, Faridpur, and Majhgawan. The data makes it evident that blocks such as Ramnagar and Alampur Zafrabad are situated within the basin of the Aril River, which experiences dry conditions for a significant portion of the year. Consequently, reliance on groundwater becomes essential for fulfilling various water-related needs.

In these blocks, there is substantial groundwater extraction, encompassing both domestic and agricultural purposes [16]. The Alampur Jafarabad block is currently undergoing a situation of pronounced over-exploitation, manifesting at a substantial rate of 109.11% (Table 5). In contrast, the Meerganj block is positioned within the under-critical range, exhibiting a value of 99.04%.

Table 5 Ground water scenario in the Bareilly District [16]

DYNAMIC GROUND WATER RESOURCES OF BAREILLY, U.P.
(As on 31.03.2004)

Sl. No.	Assessment units blocks	Annual ground water recharge (in ham)	Net annual ground water availability (in ham)	Existing gross ground water draft for all uses (in ham)	Net ground water availability for future irrigation development (in ham)	Stage of ground water development (in %)	Category of block
1.	Alampur Zafrabad	5752.79	5177.51	5649.36	-681.08	109.11	Over exploited
2.	Baheri	13231.33	11908.19	6940.81	4710.32	58.29	Safe
3.	Bhadpura	6257.25	5944.39	5885.44	-159.03	99.01	Semi critical
4.	Bhojipura	5918.18	5622.27	4973.36	528.02	88.46	Safe
5.	Bhutah	9600.08	9120.08	8903.09	-112.75	97.62	Semi critical
6.	Bithrichainpur	6290.65	5661.58	4330.94	1170.24	76.50	Safe
7.	Faridpur	10008.33	9507.91	8338.05	971.33	87.70	Safe
8.	Fatehganj (W)	6492.72	6168.08	6002.41	22.76	97.31	Semi critical
9.	Kiyara	3736.05	3362.44	3277.85	-40.51	97.48	Semi critical
10.	Majhgawn	6237.22	5613.50	5043.81	449.60	89.85	Safe
11.	Meerganj	6955.48	6259.93	6199.96	-169.66	99.04	Critical
12.	Nawabganj	9092.08	8182.87	8174.65	-188.91	99.90	Semi critical
13.	Ram Nagar	5751.07	5175.97	4804.73	193.29	92.83	Semi critical
14.	Richha	9115.23	8203.70	4590.08	3443.62	55.95	Safe
15.	Shergarh	8249.86	7424.87	7064.61	98.61	95.15	Semi critical
	Total	112688.31	103333.31	90179.15	10235.83	87.27	

This situation is a cause for significant concern, especially given the absence of a formulated strategy by the Jal Nigam for integrating surface water sources into the existing water supply infrastructure.

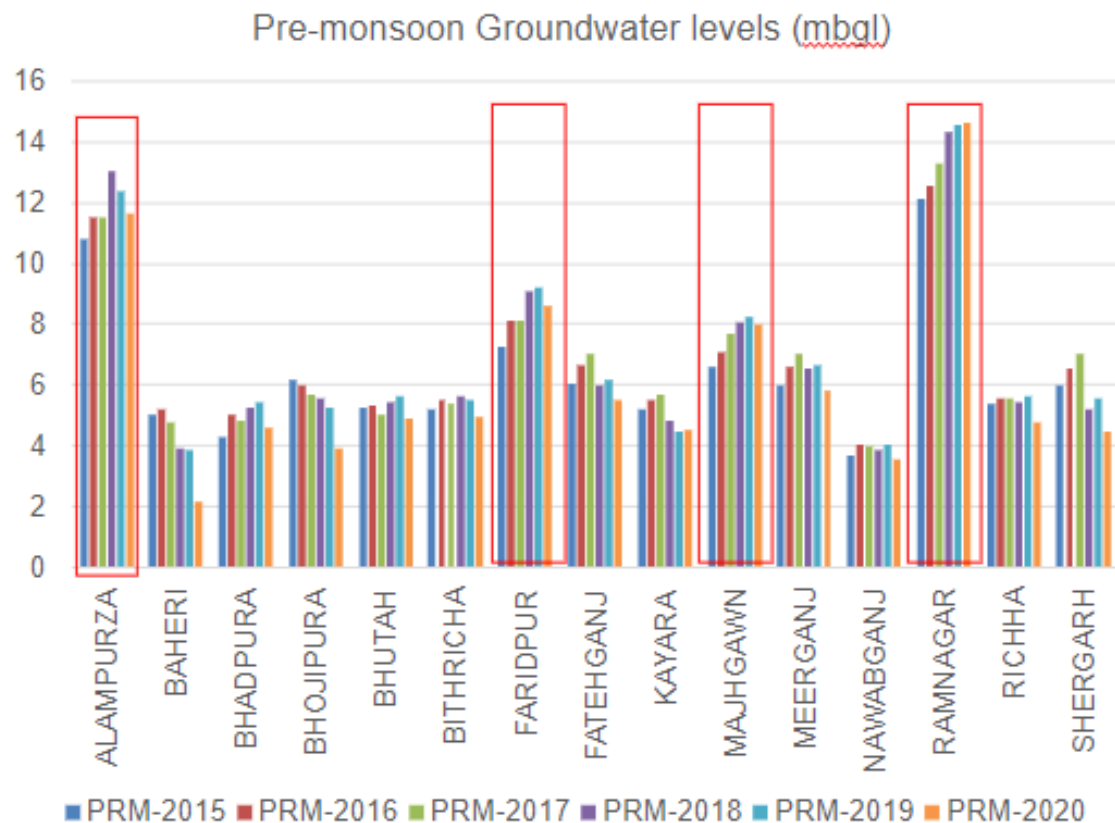


Figure 24 Block-wise Average Depth of Water level of Bareilly [16]

The Ramganga River, along with other rivers in the district, constitutes a network of river systems primarily sustained by groundwater sources. Analysis of data spanning the past decade reveals a discernible decrease in both rainfall patterns and groundwater levels (Figure 23)(Figure 24). Specifically, the recorded rainfall has exhibited a decline from 1196 mm to 750 mm. Currently, no extensive rainwater harvesting systems have been observed within the district [16].

The Aril River basin experiences large-scale over-extraction of groundwater due to its prominence as the primary water source for various purposes. Consequently, this excessive exploitation has resulted in a rapid decline in groundwater levels in recent years. This decline can be attributed degradation of wetlands, over-abstraction of groundwater for agriculture and changes in climate. The level of groundwater development in the region currently stands at 92.97%. The water table has significantly declined beyond the depths of 10-20 meters

below ground level (mbgl) in approximately 59% of the basin area, while it has reached depths of 5-10 mbgl in 40% of the area.

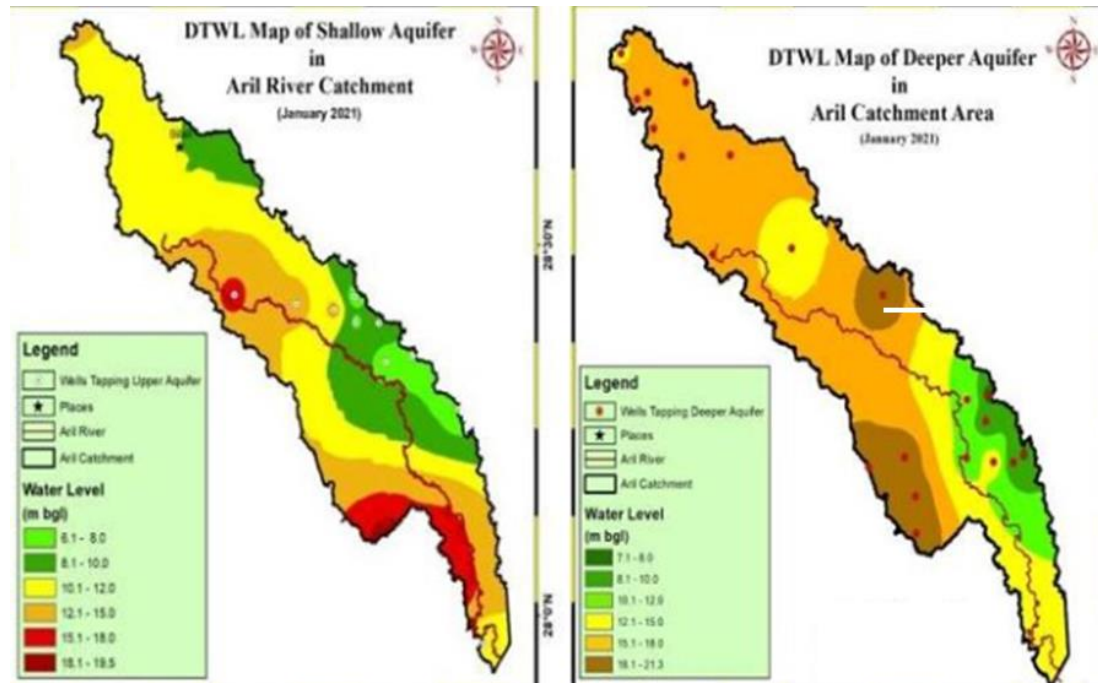
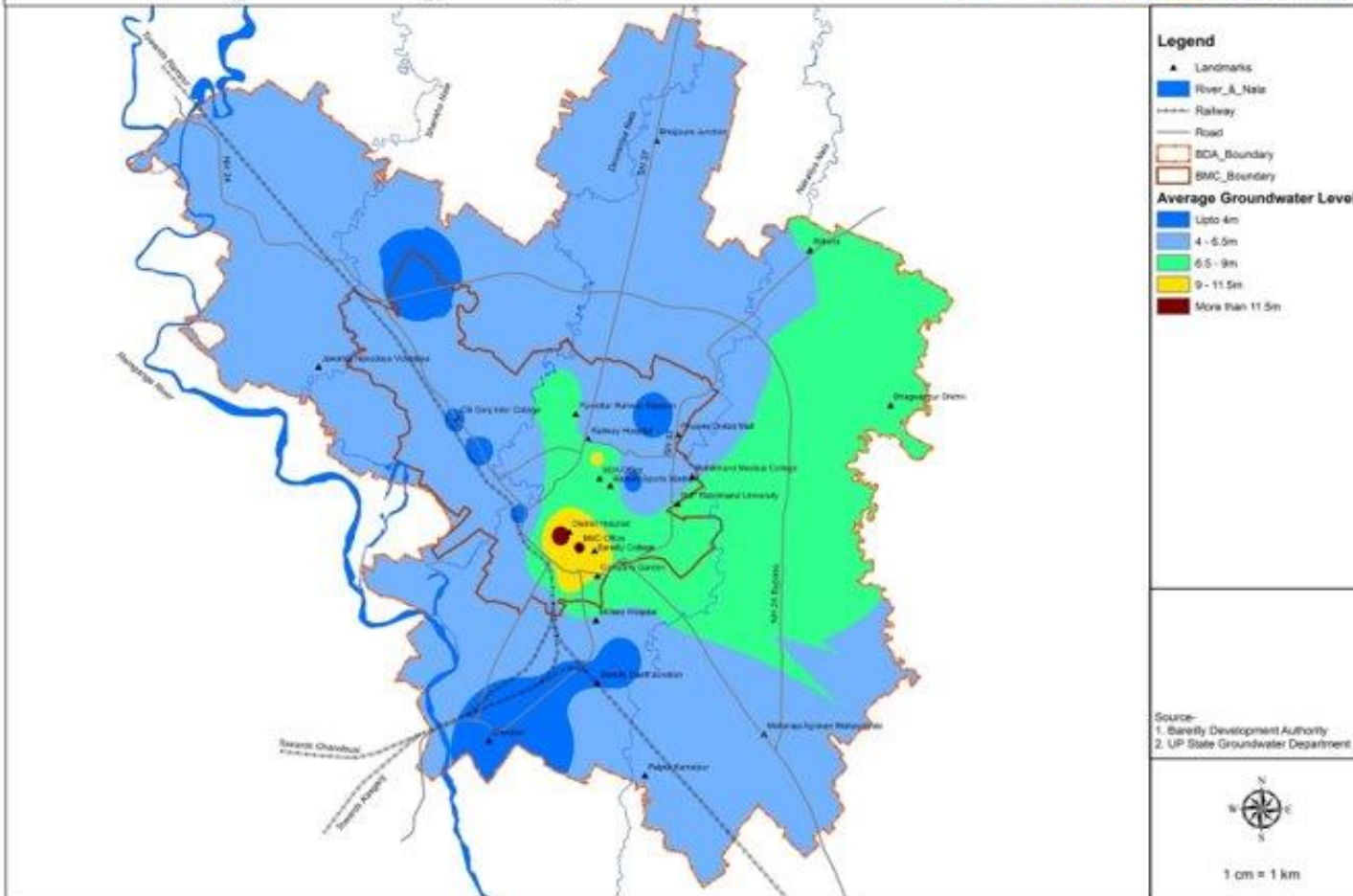


Figure 25 Groundwater scenario in the Aril basin

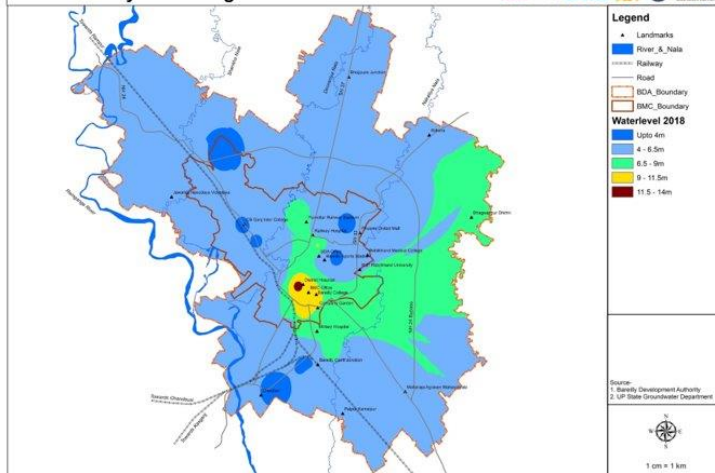
The cumulative effect of water-intensive agriculture and over-extraction of groundwater highlights the pressing need for sustainable management practices and conservation efforts to mitigate the adverse impacts on groundwater resources, particularly in the Aril River basin.

Bareilly city and its water demand within the administrative boundary (BDA/BMC) is heavily dependent on its groundwater reserves. It is mainly to fulfil requirements for domestic, commercial, and industrial water consumption. According to the Central Ground Water Board (CGWB), the subsurface water level in Bareilly is undergoing rapid depletion. This situation is a cause for significant concern, especially given the absence of a formulated strategy by the Jal Nigam for integrating surface water sources into the existing water supply infrastructure.

URMP Bareilly Baseline: Average Groundwater Level



URMP Bareilly Baseline: Groundwater Level 2018



URMP Bareilly Baseline: Groundwater Level 2022

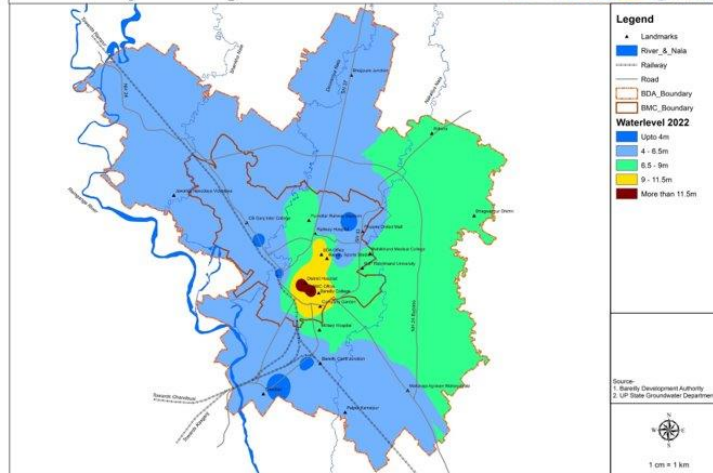


Figure 26 Bareilly Groundwater levels. (a) Average Groundwater level, and (b) Difference between Bareilly Ground level in 2018 and 2022.

4.6 Water quality

4.6.1 Surface water

There are several sources of water pollution within Bareilly district that flow through a few streams and rivulets into bigger rivers like Ramganga. In accordance with the Central Pollution Control Board (CPCB) guidelines, the permissible limits for water quality parameters in Class B (Outdoor Bathing) are as follows:

- Total Coliforms Organism MPN/100ml: The count should be 500 or less.
- pH: The pH level should fall within the range of 6.5 to 8.5.
- Dissolved Oxygen: The minimum concentration of dissolved oxygen should be 5mg/l or more.
- Biochemical Oxygen Demand (BOD): The BOD level, determined over a period of 5 days at 20°C, should be 3mg/l or less.

On the other hand, for Class D (Propagation of Wildlife and Fisheries), the CPCB guidelines prescribe the following limits:

- pH: The pH value should range from 6.5 to 8.5.
- Dissolved Oxygen: The minimum concentration of dissolved oxygen should be 4 mg/l or more.
- Free Ammonia (as N): The level of free ammonia should be 1.2 mg/l or less.

Water quality samples of Ramganga river at Kapurpur, Mirganj, Bareilly were analysed for parameters (Table 6 Surface water characteristics- Ramganga River Bareilly [19]). Table 6 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 one specific location: upstream of the Ramganga River. 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 [18].

Table 6 Surface water characteristics- Ramganga River Bareilly [19].

Note: 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

Location	u/s Ramganga river, Kapurpur, Mirganj, Bareilly					
Year 2022	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/ 100 ml)	Fecal Coliform (MPN/ 100ml)
January		8.0	3.2	24	14000	
February		8.5	3.1	20	13000	
March	7.6	8.2	3.1	24	13000	
April	7.5	8.3	3.2	24	14000	
May	7.6	7.7	3.2	28	14000	
June	7.4	6.2	3.0	24	14000	9300
July	7.4	6.5	3.2	24	14000	9300
August	7.0	5.8	3.2	28	17000	11000

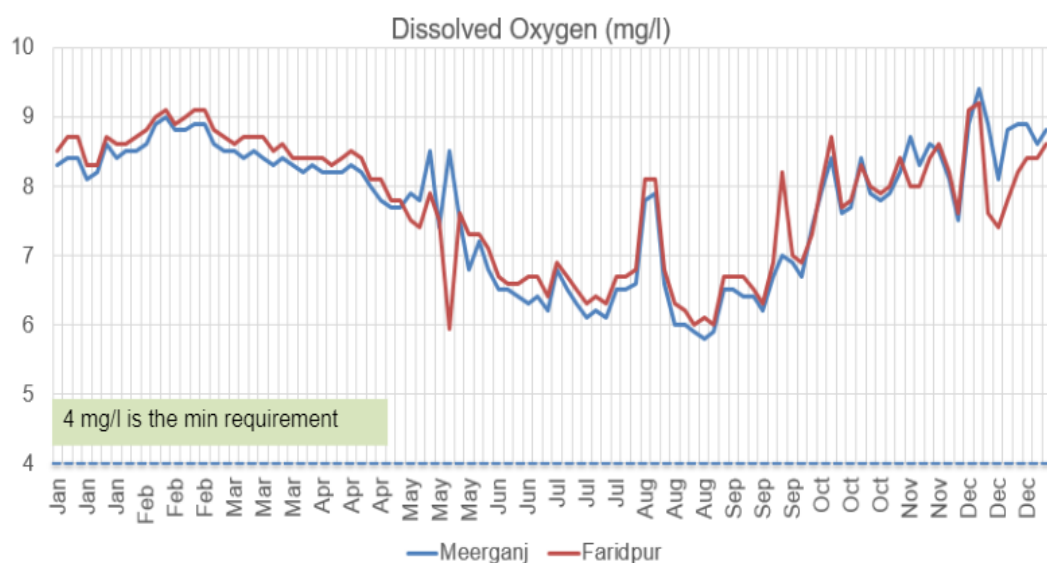


Figure 27 Dissolved Oxygen of Ramganga River (2022)

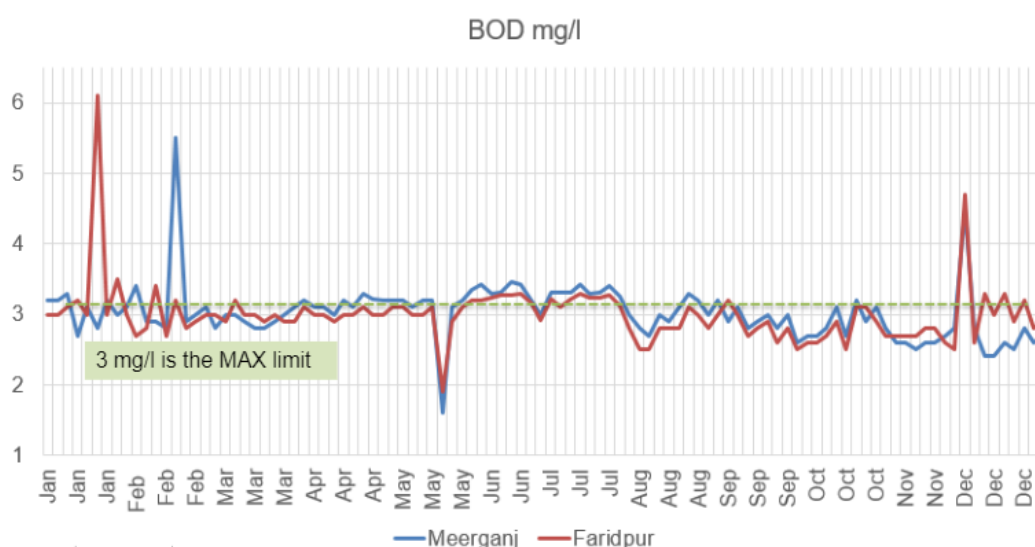


Figure 28 BOD of Ramganga River (2022)

Surface water characteristics of the Nakatiya, Deoraniya rivers, and Choubari drains were subjected to weekly monitoring of water quality by the Uttar Pradesh Pollution Control Board (UPPCB). The Nakatiya drain, spanning a length of 100 kilometres, the Deoraniya river with a length of 5.5 kilometres, and the Choubari drain extending for 17 kilometres were the areas under observation. The annual average data for the year 2022 has been provided in Table 7. It is worth noting that the levels of dissolved oxygen in all three water bodies are significantly below the minimum requirement of 4 mg/l, which is essential for the survival of most aquatic organisms. Moreover, the levels of BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), and Total Coliforms in these water bodies exceed the standard limits prescribed for water quality assessment.

Table 7 Annual average data for the year 2022 for the Nakatiya, Deoraniya rivers and Choubari drain [19].

Annual average-2022	pH	Dissolved Oxygen (mg/L)	BOD (mg/L)	COD (mg/L)	Total Coliform (MPN/100 mL)
Nakatiya	7.17	0.37	38.77	277.36	11936363.64
Deoraniya	7.15	0.34	35.80	238.93	8627272.73
Choubari	7.19	0.14	31.03	230.17	1308571.43



Figure 29 Nakatia River getting waste through 15 drains.

4.6.2 Groundwater

All groundwater samples exhibited elevated levels of total alkalinity, ranging from 247.5 mg/l to 574 mg/l, surpassing the maximum permissible limit of 200 mg/l (). With the exception of Dhanaura and Beevni villages, total coliforms were detected in all the samples. Out of the 11 samples collected, 6 samples demonstrated elevated levels of total hardness, exceeding the standard value of 200 mg/l. Analysis revealed that 8 samples contained high levels of phosphate, while in 3 samples, the phosphate content remained within the acceptable limit of 0.2 mg/l.

Table 8 Block wise ground water quality. Red represents a value exceeding the permissible limit.

Locations of Ground water sample.2016		Dhanora in Alampur Jafrabad block	Chandaura in Alampur Jafrabad block	Ghillora in Alampur Jafrabad block	Firojpur in Alampur Jafrabad Block	Badrai in Alampur Jafrabad Block	Chura Narvadia in Machgawan Block	Beevni in Machgawan Block	Dhaka in Machgawan Block	Langura Alampur Jafrabad Block	Akha in Machgawan Block	Gainj in Machgawan Block
Parameters		Bareilly	Bareilly	Bareilly	Bareilly	Bareilly	Bareilly	Bareilly	Bareilly	Bareilly Ctrl	Bareilly Ctrl	Bareilly Ctrl
Water temperature	25	26	26	28	27	27	28	28	26.8	28	27.5	27
pH	6.5-8.5	7.1	7.08	7.02	7.55	7.14	7.16	7.62	7.46	6.98	7.5	7.24
Turbidity	10	12.8	37.5	1.7	0	29.4	0	10.5	0	43.3	0	0.8
Total dissolved solids	500	596	1042	452	402	756	402	442	542	518	412	428
Electrical conductivity		858	1494	648	581	1088	579	629	780	735	595	612
Total suspended solids	100*	28	34	8	6	16	8	16	8	32	4	11
Total Hardness	200	380	560	280	190	380	120	190	230	270	180	150
Total Alkalinity	200	376.2	574	346.5	267.3	356.4	267.3	415.8	356.4	297	316.8	247.5
Ammonia	0.5 max	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrates	45	BDL	1.6	2	1.8	1.1	1.3	BDL	1.6	1.4	2.2	2.1
Total Phosphates	<0.2	BDL	0.7	0.57	0.24	0.18	0.38	BDL	0.4	0.2	0.38	0.2
Chlorides	250	25	135	15	15	70	20	50	10	35	10	20
Fluoride	1.5 max	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium		94.5	160	46	90.5	81.5	145	72	120	58.5	97	140
Potassium		3.5	21	9.6	5.1	19.8	3.2	103	6.2	35	6.3	6.1
Total coliform	Absent	Absent	3	7	5	10	5	Absent	7	5	8	11
Fecal Coliform	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

4.7 Land use and land cover

The land use and land cover analysis of District Bareilly reveals that the majority of the area (87%) is under agriculture use. The predominant crops grown in the region are Wheat, followed by Rice and Sugarcane (NICRA). Crops like sugarcane and paddy, require significant amounts of water, resulting in extensive extraction of groundwater in the district. Surface water irrigation for agriculture is susceptible to drought conditions, and there are canals available in certain blocks of the district (Right bank of Ramganga), although specific data regarding their operations and distribution is currently unavailable. It is worth mentioning that an area of 13,135 hectares is irrigated by canals, while 131 hectares rely on ponds for irrigation. The remaining 295,638 hectares in the district rely on groundwater sources for irrigation. Approximately 96% of the total area in District Bareilly is irrigated using groundwater, while the remaining portion is served by canals and ponds.

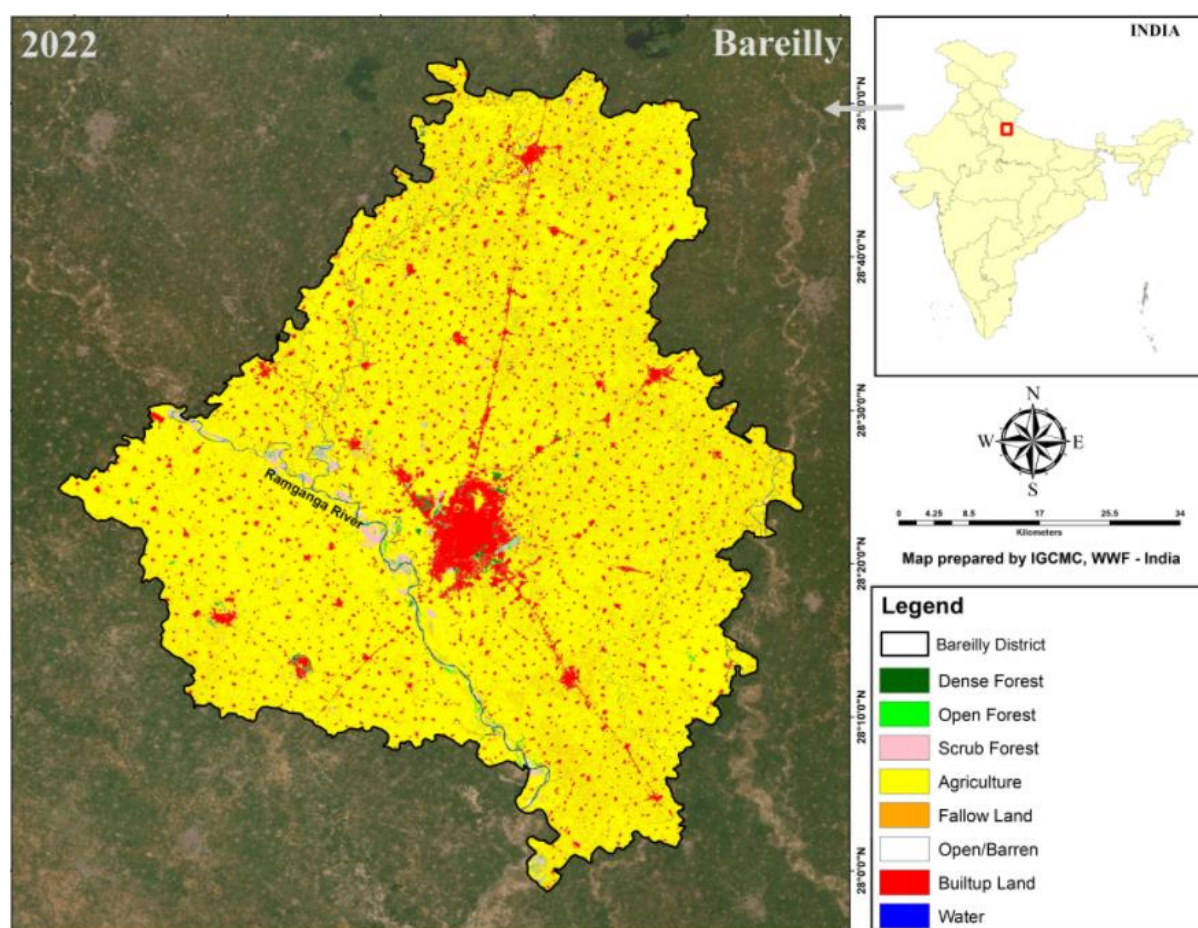


Figure 30 Landuse/Landcover map of Bareilly district, 2022 (WWF-India)

The existing irrigation infrastructure in the district comprises 3,265 kilometres of canals, 2,685 government-owned tube wells, and a significant number of privately-owned tube wells and pumps, estimated to be 421,723 in total.

Table 9 Land use and land cover trend of District Bareilly (1990-2022)

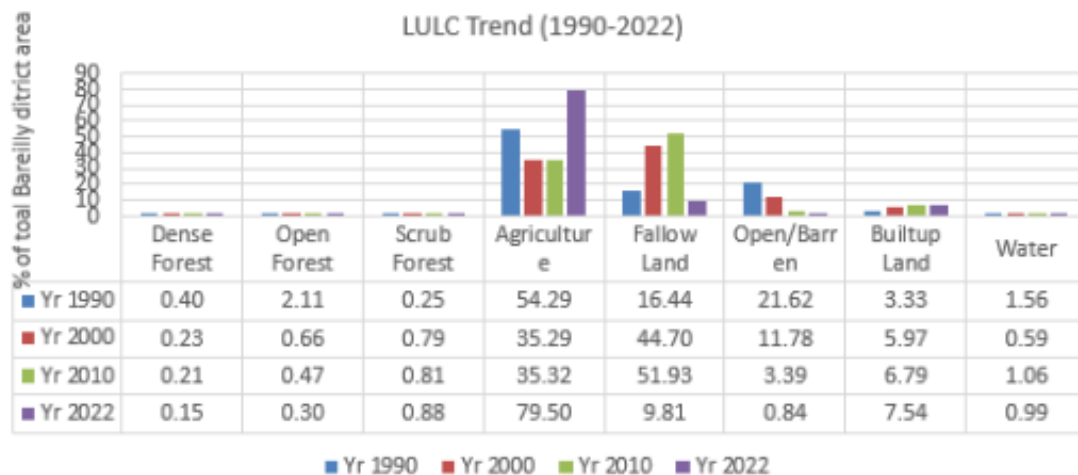
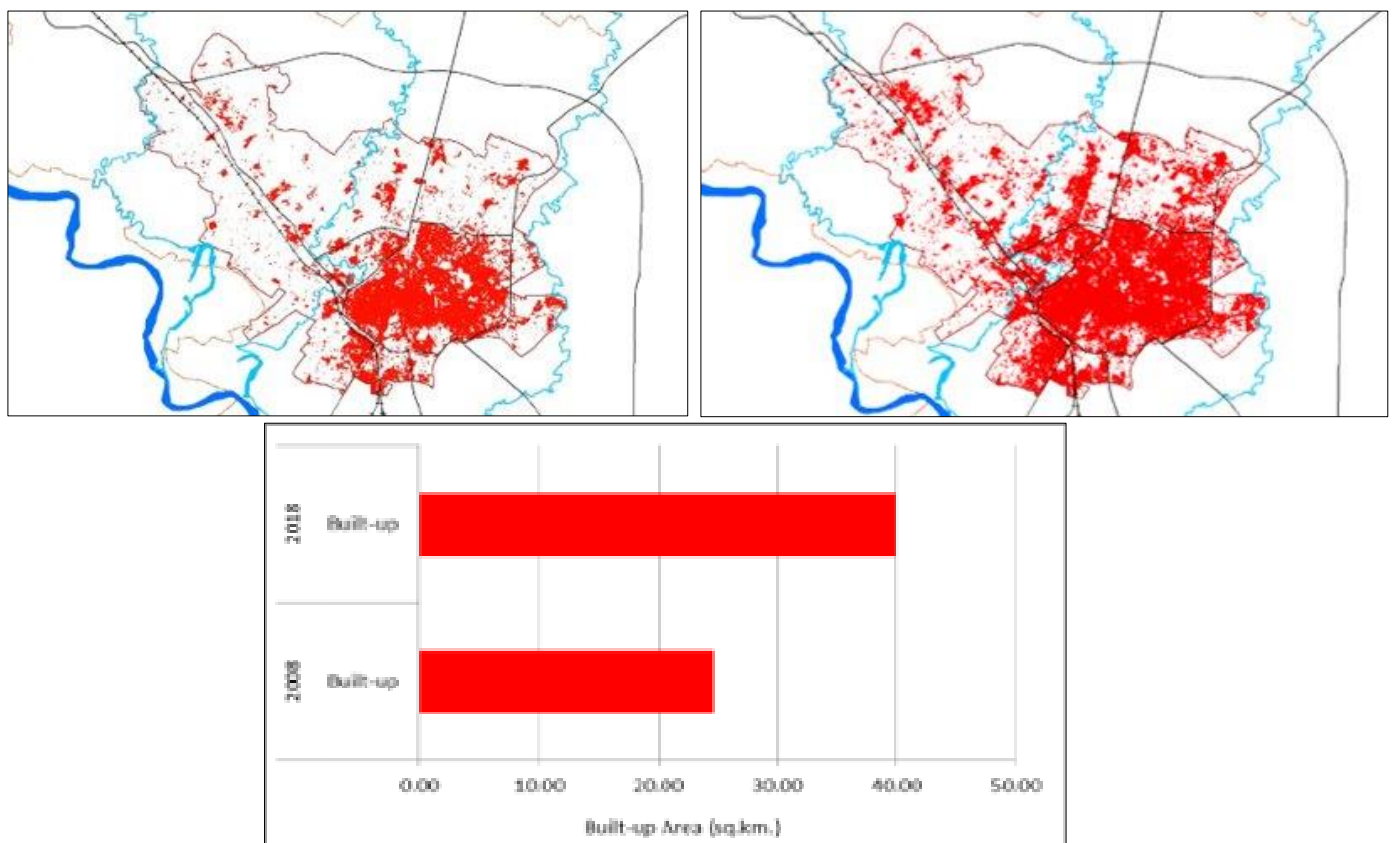


Figure 31 Landuse and Landcover of Bareilly City in 2008 (left) and 2018 (right)

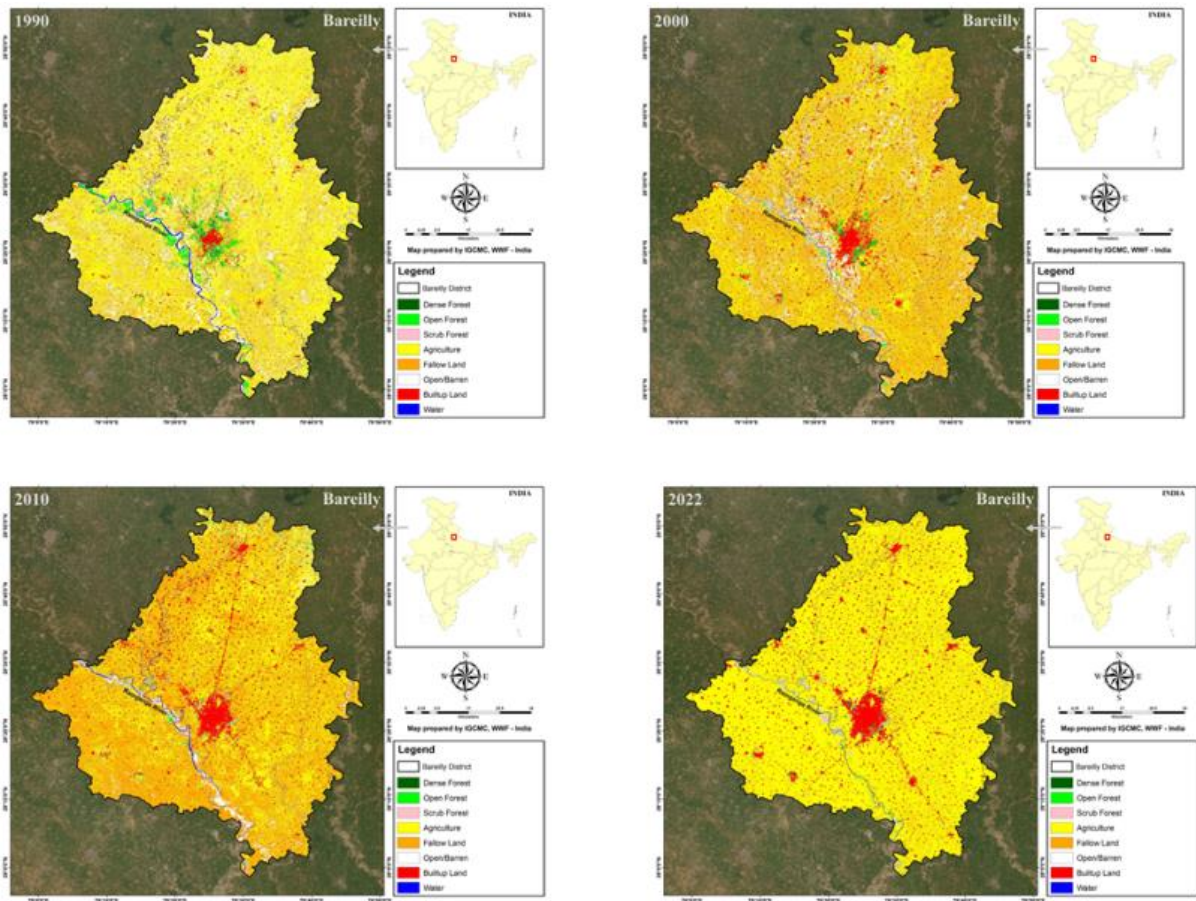


Figure 32 Land use and land cover trend of District Bareilly (1990-2022)

Since 1990, there has been a notable transformation in land use patterns in this region (Table 9)(Figure 31). The area dedicated to agriculture has expanded by approximately 18-20%, equivalent to 750 square kilometres. Conversely, the extent of open and barren land has decreased by 20%, while the built-up areas, encompassing both urban and rural regions, have seen a growth of 4%, accounting for an additional 160 square kilometres. Furthermore, the area covered by water bodies has experienced a marginal decline of 0.5%, shrinking by 20 square kilometres (Figure 32). In summary, a significant portion of open land has been converted into agricultural and urban zones, while water bodies have been encroached upon by agricultural land use. The increase in area under agriculture and built-up land indicates an increase in water demand (irrigation and domestic) and also pollution load which is putting pressure on water resources.

4.8 Agriculture and irrigation

In the district, irrigation is primarily facilitated through minor irrigation structures, which include tube wells, dug wells, and ponds. Canal irrigation, however, is limited to specific blocks within the district (right bank of Ramganga). The exact details regarding the blocks where canal irrigation is practised are currently unavailable and await further data. It is important to note that a total area of 13,266 hectares in the district is irrigated through canals and other surface water sources. The remaining area of 158,453 hectares relies on groundwater sources for irrigation purposes (Figure 33). Approximately 96% of the area in the district is irrigated by Groundwater.

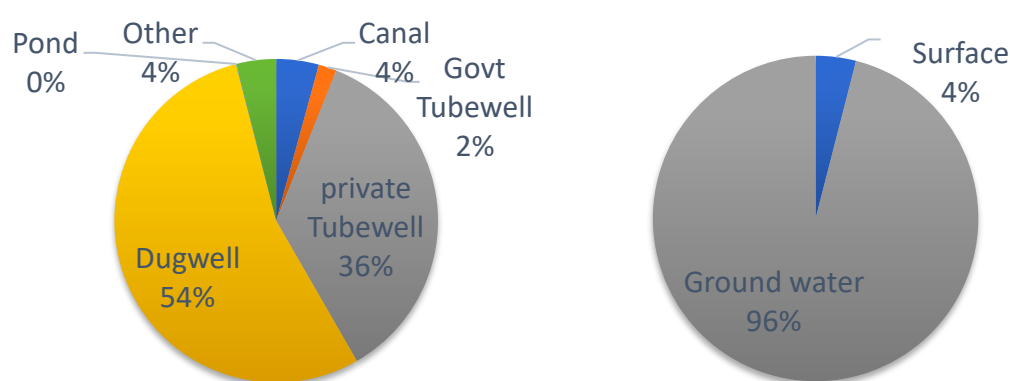


Figure 33 Irrigation sources for the Bareilly District

Table 10 Agriculture statistics in Bareilly district- 2018-19 (Area in Ha)

Total Reporting Area	406915
Net area under cultivation	326527
Area sown more than once	210272
Gross area sown, <i>Rabi</i> , <i>Kharif</i> and <i>Zayed</i>	534758
Area sown under <i>Rabi</i> crops	237879
Area sown under <i>Kharif</i> crops	276559
Area sown under <i>Zayed</i> crops	20320

Table 11 Irrigated Area (Ha) by Surface and Ground Water -Bareilly district [20].

S.No.	Block Name	Blockwise Irrigated area in hectare						
		Canal	Tubewell		Dugwell	Pond	Other	Total
			State	Private				
1	Baheri	2770	270	15495	11185	8	904	30632
2	Shergarh	1414	309	7268	9471	12	1030	19504
3	Richha	2066	216	6262	10882	14	815	20255
4	Meerganj	24	215	5693	8987	6	877	15802
5	Fatehganj	118	416	6023	4042	8	863	11470
6	Bhojipura	709	307	7914	5031	6	865	14832
7	Kiyara	0	289	2883	6673	18	740	10603
8	Ram Nagar	0	781	6835	9888	5	900	18409
9	Majhgawan	0	314	8724	16082	2	760	25882
10	Alampur Zafarabad	0	263	6116	15859	4	599	22841
11	Bithri Chanpur	967	254	8657	10271	3	559	20711
12	Nawabganj	2089	544	9507	13451	33	1005	26629
13	Bhadpura	982	143	6717	11098	2	674	19616
14	Bhutah	1494	585	5657	15685	4	986	24411
15	Faridpur	502	633	5704	14297	6	588	21730
	Village Total	13135	5539	109455	162902	131	12165	303327
	Urban Total	0	40	608	4865	0	64	5577
	District Total	13135	5579	110063	167767	131	12229	308904

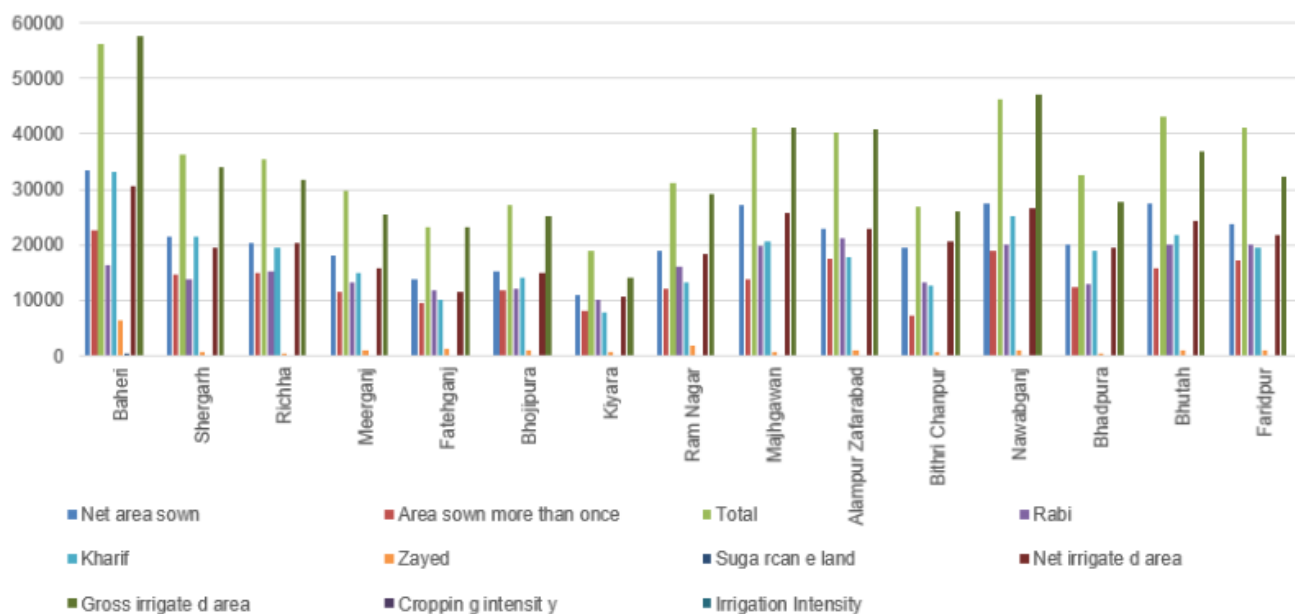


Figure 34 Block wise area under main crops in Bareilly district [20].

The agricultural statistics in Bareilly District for 2018-19 (Table 10) reveal various important metrics related to land utilization in the region. The total reporting area, which represents the land utilized for agricultural activities, is documented as 406,915 hectares. Within this reporting area, the net area under cultivation amounts to 326,527 hectares. A significant portion of the cultivated area, namely 210,272 hectares, is allocated for multiple crop rotations. Furthermore, the gross area sown, which includes Rabi, Kharif, and Jayed crops, encompasses an extensive land extent of 534,758 hectares. Among the sown areas, 237,879 hectares are specifically allocated for Rabi crops, while a designated portion of 276,559 hectares is utilized for sowing Kharif crops. Lastly, a distinct area measuring 20,320 hectares is dedicated solely to the cultivation of Jayed crops. These statistics provide valuable insights into the distribution and utilization of land resources for agricultural purposes in the region.

In the Aril Basin, the predominant crops cultivated are wheat and mentha (commonly known as mint). Paddy cultivation, on the other hand, is primarily undertaken for self-consumption and is not pursued for commercial purposes. Mentha cultivation, known for its high water requirements, is widespread throughout the region, occupying approximately 30-40% of the agricultural land area. In addition to the main crops, poplar and eucalyptus trees are grown to serve as an additional source of income for farmers.

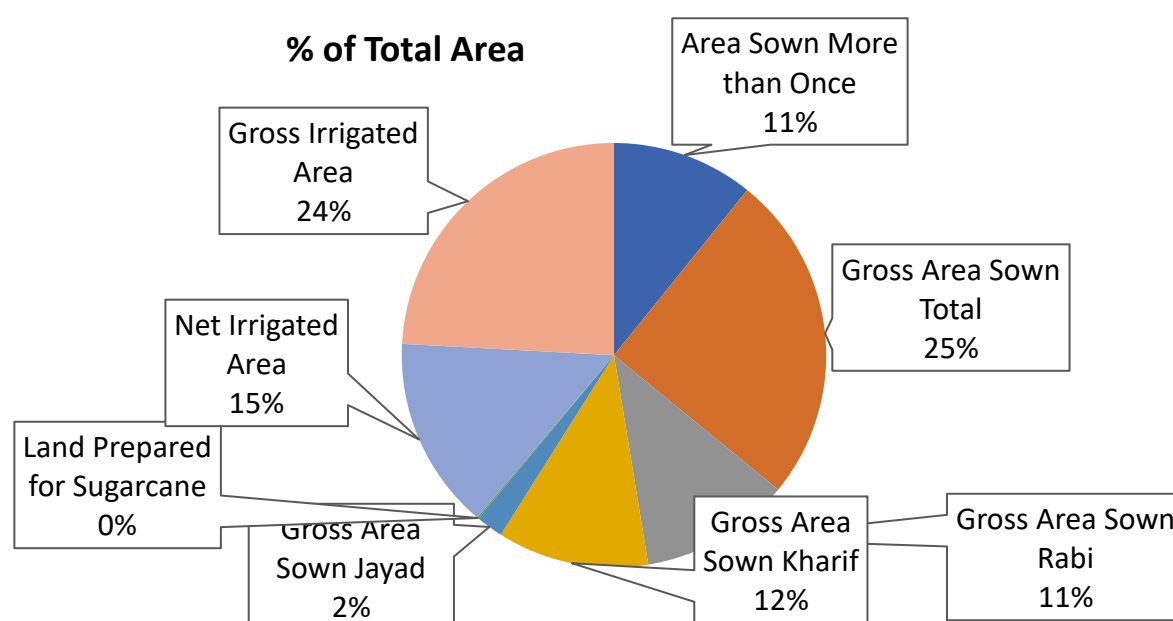


Figure 35 Cropping pattern in Aril basin

Notably, extensive eucalyptus plantations have been observed in this area, contributing to the agricultural landscape and providing economic benefits to the local community.

4.9 Floodplain and wetlands encroachment

The floodplains of rivers, inlets and wetland areas are subjected to encroachment and land use change. This leads to choked inlets, a decline in freshwater inflows, a reduction in the flood cushioning capacity of rivers, a decrease in groundwater recharge etc.



Figure 36 Extensive Eucalyptus plantation has been observed in the Aril Basin area.

The Landuse/Landcover changes suggest that the region has been subjected to a huge change in land use/landcover. About 20% of open land (which includes river floodplains, inlet channels, wetland zones of influence and other areas) has been converted to agriculture land and settlements built-up area. There has been an encroachment on the floodplain in various rivers and wetlands. One of the main reasons for degradation in 50% of wetlands is the loss of connectivity due to encroachment and choking of inlets. Floodplain demarcation measures are not consistently implemented, resulting in the construction of houses and long-term habitation in these areas for durations spanning 10 to 20 years.

As these areas are floodplains, they are prone to periodic inundations, and the provision of basic facilities is inadequate or non-existent. The encroachment has extended towards the river due to the high population density in the region. Notably, significant encroachment hotspots have been identified along the Nakatiya and Deoraniya rivers. Furthermore, in Bakar Ganj along the Deoraniya River, a municipal solid waste dump has been established close to the river bank, at a distance of 430 meters.



Figure 37 Encroached stretch: Deoraniya or Qila river (28.358205° N; 79.385808° E to 28.387137° N to 79.389495° E)

Several locations have been identified as sites of encroachment in the vicinity of the Deoraniya River. These locations include Anand Vihar Colony, Swaleh Nagar, Gangwar Colony, Kela Bagh, Katghar, Bakar Ganj, and Prem Nagar. These areas have experienced unauthorized occupation and construction, encroaching upon the land near the Deoraniya River. The identification of these specific locations is crucial for understanding the extent and distribution of encroachment activities in the region.



Figure 38 Encroached stretch sections: Deoraniya or Qila river. (1 and 2) Bakar Ganj and (3) Nainital Bypass



Figure 39 Encroached stretch: Nakatiya river (Left side - From 28.397381°N; 79.467480°E to 28.356993°N; 79.471186°E, Total 7.45 km Stretch) and (right side - From 28.340578°N; 28.340578°E to 28.330510°N; 79.453911°E, Total 2.8 km Stretch)

Several locations have been identified as areas of encroachment around the Nakatiya River. These locations include Dhaurera Mafi, Umang Phase 2, Ujjwal Phase 1, Rain Phase 1 and 4, Mahanagar Colony, Suresh Sharma Nagar, Greater Green Park Colony, Umariya, and Chetna Colony. These areas have experienced unauthorized occupation and construction, encroaching upon the land adjacent to the Nakatiya River. Identifying these specific locations is important for assessing the extent and distribution of encroachment activities in the region surrounding the Nakatiya River.



Figure 40 Encroached stretch sections: Nakatiya river

Various locations have been observed in the Aril River stretch (within Bareilly district) where floodplain encroachment has taken place. This encroachment primarily occurs for agricultural purposes, as the river experiences low flow throughout most of the year. The encroachment involves the occupation of land adjacent to the Aril River for agricultural activities. By identifying these specific locations, we gain insight into the extent and nature of encroachment along the course of the Aril River.



Figure 41 Encroached stretch sections: Aril River

Encroachment is also observed in inlets of wetlands, which brings freshwater inflows from the catchment. For instance, one such wetland is Khangwa Shyam (Aonla), where WWF-India worked with the district administration Bareilly to rehabilitate the inlet channels, which are choked, and encroached (Figure 42).



Figure 42 Encroachment and choking of wetland inlet (before and after rehabilitation)

4.10 Industry

The industrial landscape in Bareilly encompasses a range of sectors, including Sugar, Food and Beverages, fertilizers, Distillery, Slaughterhouse and Meat Processing, Chemical, Milk Processing, and Paper. A significant concern arises from the pollution of rivers due to the discharge of industrial effluents. It is worth noting that the board through a closure order has closed the slaughterhouse, and all industries have implemented Effluent Treatment Plants (ETP) to manage their wastewater. Approximately 12,732 kilolitres per day (KLD) of industrial wastewater is generated by 14 industries in the region. This wastewater is discharged into nearby water bodies, ultimately reaching the Ramganga River. The wastewater follows a route through Shankha, Bhakra, West Baigul, Kichha, Deoraniya, Nakatiya, and East Baigul. The pollution load in surface water streams, rivers, and drains, particularly in Nakatiya Nala and Deoraniya, raises significant concerns in stretches passing through Suresh Sharma Nagar and Mahanagar Colony. In the densely populated areas of the city, municipal and industrial drains are the sole sources of water flow in the rivers, namely Nakatiya and Deoraniya. During monsoon seasons, the flows increase, and locals report a depth increase from 4-5 feet to 7-8 feet at Bakar Ganj. Notably, the district lacks a Common Effluent Treatment Plant (CEPT) to address the wastewater management needs effectively.

Table 12 List of Grossly Polluting Industries (GPI) Industries in the Bareilly 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

Table 13 Discharge and Route of Industrial effluent.

S.No.	Name & Address of Unit	Route to reach the river	Discharge (KLD)
1	Brindavan Beverages Pvt. Ltd.	Indsustrial → Shankha River→ Ramganga	1200.0
2	D.S.M. Sugar	Pilakhar Drain → Bhakra River→ West→ Behgul→Ramganga	1000.0
3	Dwarikesh Sugar Industries Ltd.	ZLD	ZLD
4	Dwarikesh Sugar Industries Ltd.	Drain→ East Begul →Ramganga	750.0
5	IFFCO Ltd., Aonla,	Aril River → Ganga	5712.0
6	Kesar Enterprises Ltd. (Distillery Unit)	Kicha River → Bhakra River → West Behgul → Ranganga	ZLD (450)
7	Kesar Enterprises Ltd. (Sugar Unit)	Kicha River → Bhakra River → West Behgul → Ranganga	1250.0
8	Kisan Sahkari Chini Mills Ltd.	Drain → Deoraniya Drain → Ramganga	1000.0
9	Rehbar Food Industries Pvt. Ltd.	Drain→ Nakatiya Drain→ Ramganga	1000.0
10	Nagar Nigam Slaughter Houe,	Drain→ Nakatiya Drain→ Ramganga	120.0
11	Oswal Overseas Ltd. (Sugar Unit	Local Drain → East Behgul → Ramganga	250.0
12	Premier Agri Foods Pvt. Ltd.	Local Drain → Nakatiya Drain→ Ramganga	350.0
13	Rama Shyama Paper Ltd.,	Sathrapur Drain→ Nakatiya Drain → Ramganga	1100.0
14	Superior Industries Ltd. (Distillery)	Local Drain → Deoraniya Drain → Ramganga	ZLD (360)

Table 14 Monitoring stations of UPPCB in Bareilly district

Exiting Monitoring stations	Name of the Rivers/Drains	Monitoring station locations	Latitude	Longitude
1	Nakatiya drain		28.250412	79.43643047
2	Deorania drain			
3	Choubari drain		28.29485692	79.39262486
4	u/s Ramganga	Meerganj, Rampur road bridge	28.455113	79.197405
5	d/s Ramganga	Faridpur, Shahjahanpur rd bridge	28.131778	79.486891
6	West Baigul		28.49756093	79.27236313
7	Bhakhra		28.520499	79.250902
8	East Baigul		28.071719	79.637491
9	Aril River		28.229238	79.235029

Within the Aril Basin (within Bareilly district), the industrial sector is represented by the presence of the Fertilizer Industry, specifically IFFCO (Indian Farmers Fertiliser Cooperative Limited) which generates approximately 5,712 kiloliters per day (KLD) of effluent part of which (treated/partially treated) is discharged into Aril river. It is noteworthy that an operational Effluent Treatment Plant (ETP) has been installed to manage and treat the effluent produced by the fertilizer industry within the basin.



Figure 43 Water Effluent Discharge in Aril from IFFCO Plant

4.11 Aquatic Biodiversity (Fishes)

According to the research findings published in the esteemed journal "[Indian Journal of Ecology \(2022\) 49\(5\): 1786-1793, 2022](#)," a comprehensive study identified a total of 18 fish species inhabiting the Choubari section of the Ramganga river. These fish species are classified into several families, namely Bagridae, Ambassidae, Belontiidae, Channidae, Cobitidae, Heteropneustidae, and Mastacembelidae. This study provides valuable insights into the diverse fish fauna present in the specific region of the Ramganga river, contributing to the understanding of aquatic biodiversity and ecological dynamics in the area.

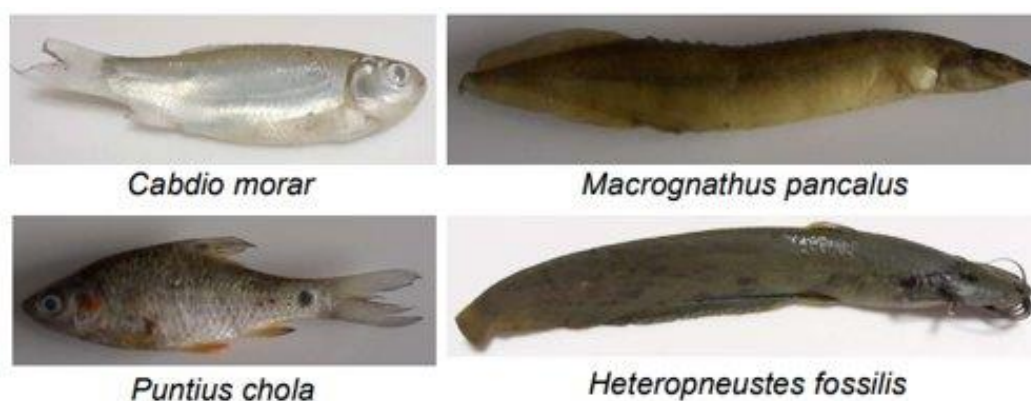


Figure 44 Fishes of Ramganga river

Evaluating biodiversity is crucial for assessing the state of biological diversity across various ecological levels and for tracking changes in both time and space. This gathered information serves as a guiding principle for making decisions about the management of biological diversity, encompassing aspects of production and conservation. Unfortunately, we currently lack data regarding the hydraulic habitat requirements of the major vertebrate and invertebrate fauna in the River Ramganga.

The River Ramganga, a significant tributary of the River Ganga, was chosen as the site for an E-Flows Assessment and pilot demonstration conducted by WWF India from 2014 to 2015. This assessment involved the participation of local and national experts. The study focused on eight specific locations along the Ramganga River, with comprehensive year-round field investigations encompassing aquatic biodiversity, fluvial geomorphology, river health, socio-cultural aspects, and livelihoods considerations. One of the identified locations was Choubari comes in the Bareilly district. To gather information on the fish fauna, the research team conducted experimental fishing using cast nets at each site for a duration of one hour. During each catch, they recorded data on species diversity, abundance, size, and weight. Additionally, they preserved a sample of each species in a 10% Formaldehyde Solution. Fish species were identified according to established identification guides, and all species names adhered to the Fish Base database.

The study documented a total of 32 fish species in Ramganga river at Choubari, which are listed in Table 15. *Cyprinus carpio*, an exotic fish was recorded from this location along with other threatened species like *Wallago attu* (NT); *Bagarius bagarius* (NT) and *Ailia colia* (NT).

Table 15 Fish species recorded at Choubari in River Ramganga during the study period (May 2014 - January 2015)

S.no	Name of the fish species	Common name	Conservation status
	Order-Cypriniformes		
	Family-Cyprinidae		
1	<i>Cyprinus carpio</i> (Linnaeus, 1758)	Common carp	Exotic
2	<i>Labeo boga</i> (Hamilton, 1822)	Boga	Least Concern (LC)
3	<i>Devario devario</i>	Sind Danio	Least Concern (LC)
4	<i>Laubuca laubuca</i> (Hamilton, 1822)	Indian Glass Barb	Least Concern (LC)
5	<i>Pethia conchonius</i> (Hamilton, 1822)	Rosy Barb	Least Concern (LC)
6	<i>Pethia ticto</i> (Hamilton, 1822)	Ticto Barb	Least Concern (LC)
7	<i>Osteobrama cotio</i> (Hamilton, 1822)	Minnows	Least Concern (LC)
8	<i>Cabdio morar</i> (Hamilton, 1822)	Morari	Least Concern (LC)
	Family-Cobitidae		

9	<i>Acanthocobitis botia</i> (Hamilton, 1822)	Mottled Loach	Least Concern (LC)
10	<i>Aborichthys elongates</i> Hora, 1921		Least Concern (LC)
11	<i>Setipinna phasa</i> (Hamilton, 1822)	Gangetic Hair-fin Anchovy	Least Concern (LC)
Order-Osteoglossiformes			
Family-Notopteridae			
12	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Padin	Near Threatened (NT)
13	<i>Sisor raddophorus</i> (Hamilton, 1822)	Sisor Catfish	Least Concern (LC)
Family-Bagridae			
14	<i>Sperata seenghala</i> (Sykes, 1839)	Giant River-Catfish	Least Concern (LC)
15	<i>Sperata aor</i> (Hamilton, 1822)	Long-whiskered Catfish	Least Concern (LC)
16	<i>Mystus vittatus</i> (Bloch, 1794)	Striped dwarf catfish	Least Concern(LC)
17	<i>Mystus cavasius</i> (Hamilton, 1822)	Gangetic Mystus	Least Concern (LC)
18	<i>Mystus bleekeri</i> (Day, 1877)	Day's Mystus	Least Concern (LC)
Order-Beloniformes			
Family- Belonidae			
19	<i>Xenentodon cancila</i> (Hamilton, 1822)	Freshwater Garfish	Least Concern (LC)
Order- Siluriformes			
Family- Sisoridae			
20	<i>Glyptothorax telchitta</i> (Hamilton, 1822)	Sisorid Catfishes	Least Concern (LC)
21	<i>Glyptothorax pectinopterus</i> (McClelland, 1842)	River Cat	Least Concern (LC)
22	<i>Gagata cenia</i> (Hamilton, 1822)	Gagata	Least Concern (LC)
23	<i>Bagarius bagarius</i> (Hamilton, 1822)	Goonch	Near Threatened (NT)
Family- Schilbeidae			
24	<i>Ailia colia</i> (Hamilton, 1822)	Gangetic Ailia	Near Threatened (NT)
Order- Perciformes			
Family-Ambassidae			
25	<i>Chanda nama</i> (Hamilton, 1822)	Elongate Glass-perchlet	Least Concern (LC)
26	<i>Parambassis ranga</i> (Hamilton, 1822)	Indian Glassy Fish	Least Concern (LC)
Family-Osphronemidae			
27	<i>Trichogaster fasciata</i> (Bloch & Schneider, 1801)	Banded Gourami	Least Concern (LC)
Family-Channidae			
28	<i>Channa punctata</i> (Bloch, 1793)	Spotted Snakehead	Least Concern (LC)
Family-Gobiidae			
29	<i>Glossogobius giuris</i> (Hamilton, 1822)	Tank Goby	Least Concern (LC)
Order-Synbranchiformes			
Family-Mastacembelidae			
30	<i>Macrognathus pancalus</i> (Hamilton, 1822)	Barred Spiny Eel	Least Concern (LC)
Family-Claridae			
Family-Schilbeidae			
31	<i>Eutropiichthys murius</i> (Hamilton, 1822)	Schilbid Catfishes	Least Concern (LC)
Order- Mugiliformes			
Family-Mugilidae			
32	<i>Sicamugil cascasia</i> (Hamilton, 1822)	Yellow-tail Mullet	Least Concern (LC)

4.12 Waste and Sewage

Currently, there is no operational treatment plant in the district. However, a treatment plant with a capacity of 35 million litres per day (MLD) has been completed and is currently undergoing trial runs. As a temporary solution, the installation of bioremediation systems utilizing Mesars Green way technology from New Delhi has been implemented in all the drains. Water quality testing is conducted on a fortnightly basis to monitor the effectiveness of these measures. The total volume of wastewater generated in the district amounts to 129.68 MLD, and unfortunately, all the sewage is discharged into the rivers without undergoing any treatment through 15 drains, including Nakatiya and Deoraniya.

The Uttar Pradesh Jal Nigam (rural) is actively involved in the construction of four Sewage Treatment Plants (STPs) to address this issue. These projects include the completion and testing of the 35 MLD Saraye Talfi (Amrut) STP, scheduled to be conducted next month, the 1 MLD Trishuul airbase (*Nammai Gange*) STP planned for 2023, the 42 MLD Harun Nagla (*Nammai Gange*) STP also expected to be operational in 2023, and the 20 MLD Choubari (*Nammai Gange*) STP, which is also planned for completion in 2023. In most cities, there is a lack of separate sewer line networks, resulting in the mixing of stormwater with sewage. The sewerage connectivity in the region accounts for approximately 32%, while 68% of toilets are connected to septic tanks and soak pits, as reported by the NNM Bly (National Nutrition Mission Bly) initiative [16].

The overall length of the sewerage network pipes within the city spans approximately 206.2 kilometres. However, it is important to note that the age of these sewerage network pipes is relatively young, estimated to be around 35 years. The area covered by the sewerage network is limited to approximately 25 square kilometres.

In accordance with the requirements set by the Urban Local Body (ULB), all households have been equipped with toilets and Individual Household Latrines (IHHL). The construction targets have been successfully achieved. Additionally, Community Toilets (CT) and Public Toilets (PT) have been constructed to accommodate the needs of the floating population.

A significant proportion of households rely on septic tanks for sewage disposal. Unfortunately, many of these septic tanks lack soak pits. Consequently, the black water discharged from these

septic tanks flows into open sewerage drains, leading to surface water pollution and biodiversity degradation in the surrounding river stretches.

Table 16 Status of wastewater in Bareilly

Total number of current households in ULB	292075
Total number of HH with sewage connection	65265
Total number of HH with Onsite sanitation (OSS) Septic tank	104287
Total number of HH with Onsite sanitation (OSS) Twin pit	33780

Table 17 Major drains carrying waste to Nakatiya

S.No.	Drain	Discharge
1	Dhaurera mafi Barrier Nala	Total discharge of the first 13 drains is 42 MLD
2	Dhaurera mafi Village Nala	
3	100 foota road Nala	
4	Jagatpur Police Choki to Nakatiya river	
5	Supercity Nala	
6	Sunrise colony Nala	
7	Asheesh Royal Park Nala	
8	Rohillkhand College Nala	
9	Mahanagar Nala	
10	Harunagla Nala-1	
11	Harunagla Nala-2	
12	Green Park Nala	
13	Satellite Bus stand Nala	
14	Airforce drain	1 MLD
15	Choubari drain	20 MLD

The Municipal Corporation (Nagar Nigam) has implemented a total of 15 bioremediation points along the 14 drains that transport sewage to the Ramganga river. These bioremediation points have been strategically installed to address and mitigate the environmental impact of the sewage discharged into the river.

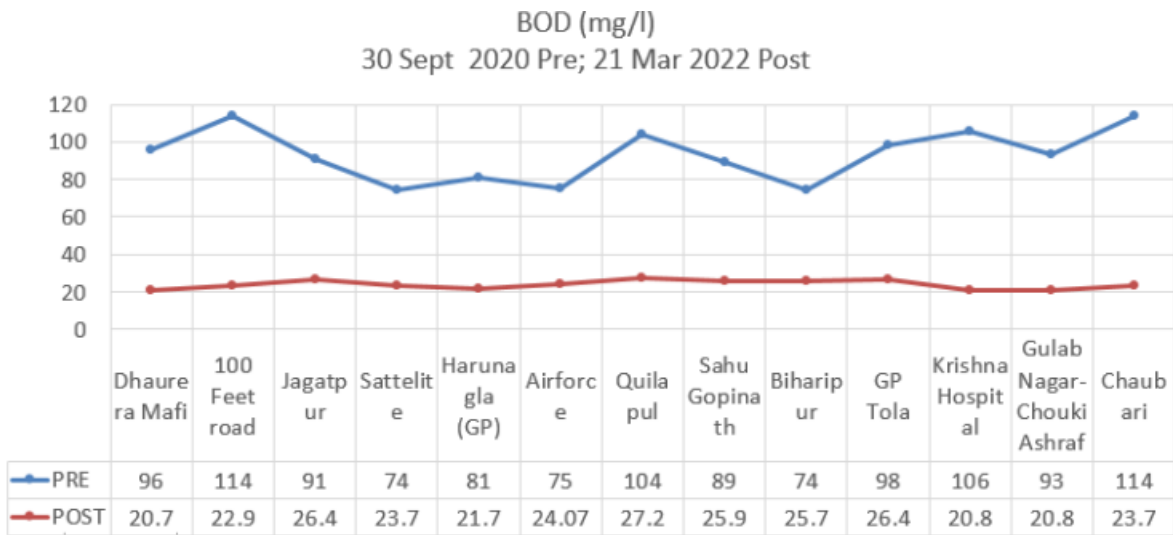


Figure 45 Phytoremediation technique in Bareilly District

Bioremediation in Bareilly refers to the implementation of biological processes to mitigate environmental pollution and restore contaminated sites in the region. This methodology involves the utilization of living organisms, such as bacteria, plants, or fungi, to break down, absorb, or neutralize pollutants present in soil, water, or air. The objective of bioremediation is to promote the natural degradation of pollutants, thereby reducing their adverse impact on the local ecosystem and human health [25].

In the context of Bareilly, where groundwater depletion and environmental contamination have been identified as pressing concerns, bioremediation strategies could potentially address these issues. For instance, bioremediation techniques might involve introducing specific bacteria or plants that can break down pollutants in the soil or groundwater. By harnessing the natural capabilities of these organisms, the contamination levels could gradually be reduced, allowing for the rehabilitation of affected areas.

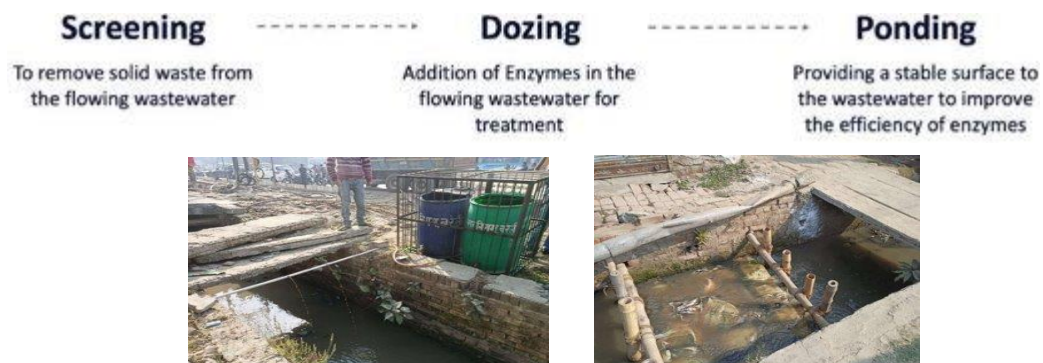


Figure 46 Dozing of Enzymes at Satellite Drain Bareilly (left) and Process of Ponding at Satellite Drain Bareilly (right)

The Municipal Corporation of Bareilly has successfully commissioned a decentralized wastewater treatment facility, situated at Akshar Vihar Park, with a processing capacity of 25,000 litres per day (KLD). This facility operates as a reception point for wastewater originating from the adjacent residential sectors. Subsequently, the wastewater undergoes comprehensive treatment processes, culminating in the release of treated effluent into a designated pond. Furthermore, the reconstituted wastewater resulting from the plant's treatment operations is efficiently harnessed to address various horticultural demands in locations including Gandhi Park, proximate parks, and roadside plantations. Additionally, the treated wastewater is judiciously employed for road cleansing activities.



Figure 47 Wastewater Treatment Plant at Akshar Vihar, Bareilly (left) and Pond at Akshar Vihar Park (right)

4.12.1 Solid waste

The total quantity of solid waste generated within the ULBs (Urban Local Bodies) of Bareilly is estimated to be approximately 432 tons per day (TPD). As part of waste management initiatives, 32 Community Composters have been installed in a ward-wise manner, and Pit Composting is also being practised in the city. Currently, 40% of door-to-door waste segregation has been implemented in all ULBs, falling short of the targeted 100%.

None of the ULBs have facilities for managing waste generated by Bulk Waste Generators. Thirteen ULBs have GPS-enabled vehicles for waste collection, namely Bahari, Anola, Fareedpur, Bisaratganj, Meerganj, Sahi, Shergadh, Deoraniya, Thiriya Nizamat Kha, Rithaura, Sirauli, Richa, and Sheeshgadh. There are no Solid Waste Processing Facilities specifically for dry waste (RDF) within the ULBs. Thirty-four compost pits are available across the ULBs for waste management. Sixteen ULBs have constructed Material Recovery Facility (MRF) centres,

with one under construction and one MRF centre (NPP Nawabganj) in the process of being established. These MRF centres collectively have a functional capacity of approximately 190 TPD for the management of dry waste.

There are two waste sites identified in the area:

- Bakar Ganj
- Swale Nagar (under construction for the establishment of a new waste site)

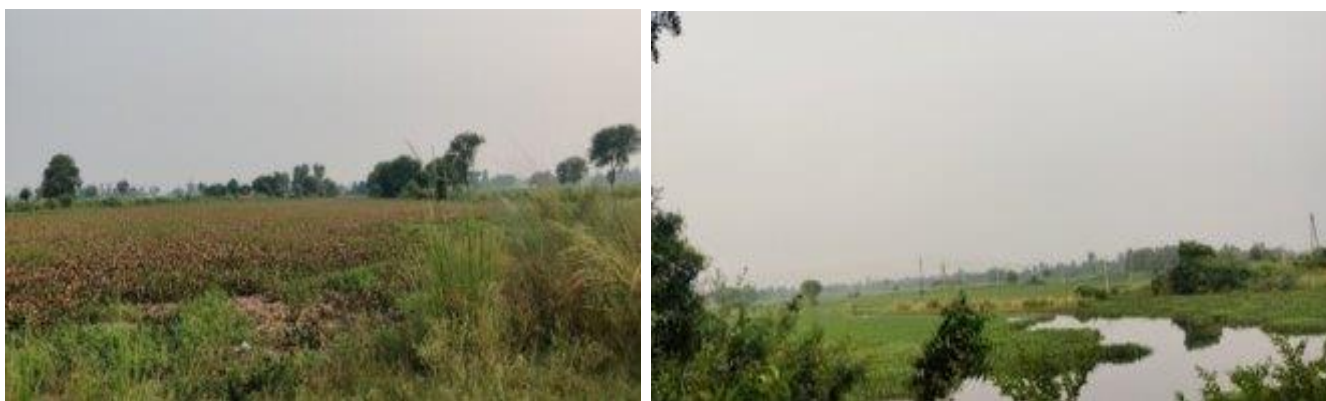


Figure 48 Drain which moves to Paiga village and connected to Aril River

Currently, 25% of waste segregation is being practised in all wards of the city. Solid waste is being disposed of at the Bakar Ganj site, which covers an area of 5.17 hectares. The mixing of waste poses challenges to recycling and material recovery efforts since segregated waste transportation becomes inconsistent. The groundwater quality in the Bakar Ganj area is reported to be very poor, and locals do not rely on it for drinking purposes.

The management of solid and liquid waste within the Aril basin poses a significant challenge, particularly in the villages. The accumulation of both biodegradable and non-biodegradable waste is observed throughout the villages and even in the river bed, contributing to environmental pollution. The presence of open drains in all villages exacerbates the situation by facilitating the flow of liquid waste, which poses a health hazard to the local population. Additionally, it is worth noting that domestic sewage originating from Aonla City finds its way to the Aril River through the Nawab (Pilia) River, further contributing to the pollution load. These observations are sourced from a report conducted by WWF India during the Aril survey.

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 Bareilly (DGC – Bareilly): The DGC in Bareilly 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. MGNREGA under MoRD aims to enhance livelihood security in rural areas where one of the aims is to create durable assets such as roads, canals, ponds and wells.
- **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.
- **Irrigation and Water Resources Department, Govt. of Uttar Pradesh:** The Irrigation and Water Resources Department, under the Government of Uttar Pradesh, maintains information on hydropower projects, irrigation, water resources planning,

development and management. The department is also known as Uttar Pradesh Irrigation Department (UPID), Uttar Pradesh Irrigation & Water Resources Department (UPI&WRD).

- **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.
- **Uttar Pradesh Irrigation & Water Resources Department (UPI&WRD):** The UPI&WRD is responsible for the construction of canals, tube wells, flood protection works,

reservoirs for water conservation and electricity generation, maintaining drainage network, and anti-erosion works.

- **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.

5.2.4 Other organizations work

WWF India, under the guidance of the district administration, has been organizing training programs for Ramganga Mitras in the Bareilly 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.

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 [\[21\]](#).

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) [\[21\]](#).

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 [\[21\]](#).

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 crore in 2015-16 to ₹ 17,412.01 crore 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 amounted to ₹ 90,624.76 crore, as compared to ₹ 81,249.12 crore in 2015-16 [\[22\]](#).

5.3.8 Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)

The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) 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 MGNREGS 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 [\[23\]](#).

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 [24].

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 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 crore for SBM (Rural) and Rs. 5000.0 crore for SBM (Urban) [26].

5.3.13 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 [\[21\]](#)[\[27\]](#).

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. Selected key issues of Bareilly district to be addressed

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

- **Over-Abstraction of water and Agricultural Water Management:** This challenge pertains to the excessive groundwater withdrawal of water, predominantly in both urban and rural regions encompassing domestic and agricultural domains within the Ramganga and Aril basins.
- An intricate issue involves the imprudent utilization of water resources (excess withdrawal amplified by low water use efficiencies) and chemicals in agricultural practices, leading to the undesirable diminishing of groundwater levels and water quality. Furthermore, the ramifications encompass pollution due to agricultural runoff and leaching.
- **Waste-water Management:** Necessitating meticulous attention, this matter spans both domestic (specifically in Deoraniya and Nakatiya) and industrial sectors, warranting efficacious management protocols.
- **Solid Waste Management:** This facet demands a comprehensive approach in both urban and rural environments, necessitating effective strategies to mitigate the challenges posed by solid waste.
- **Floodplain Integrity and Wetlands Conservation:** To ensure regional water security and augment climate resilience, safeguarding and rehabilitating floodplains, particularly addressing issues related to mining and palaze activities, is of paramount significance. This initiative also extends to the safeguarding of wetlands. These measures are pivotal for riverbank preservation, wetland health and river-wetland co-management.
- **Capacity, Skills, and Human Resource Gaps:** Challenges arise from inadequacies in capacities, and skills encompassing social, technical, and institutional domains, and

the availability of human resources within the District Ganga Committee (DGC) to effectively execute mandates stipulated by the Ganga authority order.

- **Knowledge Deficits in Tributary Conservation:** A knowledge deficit prevails regarding the current status, issues, and requisite actions for the conservation of vital tributaries within the Bareilly district. Addressing these gaps is integral to informed and effective conservation efforts.

6.1 Key Issue- 1 (a): Over abstraction of water in Urban areas (b) Over abstraction of water in Agriculture; non-point source of pollution

6.1.1 Potential intervention

Over-abstraction of water, whether in urban or rural areas for domestic or agricultural use, can lead to serious water resource depletion and environmental issues. Implementing effective interventions is crucial to address this problem sustainably. With an increase in population and area under agriculture (WWF-India LULC trend analysis, 2023) the water demand and abstractions are increasing. Within the degradation of freshwater resources, it is imperative to minimize the over-abstraction for a sustainable future.

- **Setting up of monitoring mechanism:** To manage the resources better, it has to be well monitored at a finer level. This will not only help understand the demand-supply gap but also make appropriate policies around the management and use of water resources. It is recommended here that Bareilly district being rich in rivers, wetlands and groundwater, monitoring sites be established on key rivers; increase the number of groundwater monitoring stations; and collect baseline info on wetlands.
- **Education and Awareness:**
 - Raise awareness about the importance of water conservation and the consequences of over-abstraction through campaigns like water footprint campaigns (WWF-India, Bareilly Nagar Nigam etc.).
 - Conduct educational campaigns to inform the public about responsible water use practices
- **Rainwater Harvesting:**
 - Encourage the collection and storage of rainwater for domestic and agricultural purposes.

- Provide incentives or subsidies for the installation of rainwater harvesting systems

Case Study-1

Water Footprint Campaign

The Water Footprint Campaign in Bareilly 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

- **Sustainable Agriculture Practices:** About 80-90% of freshwater resources are abstracted for irrigation purposes. To minimize water abstraction rates and quantum, it is recommended to train/build the capacity of farmers and other stakeholders on sustainable farming practices that use improved irrigation practices to enhance water use efficiency, adopt water-efficient crop varieties and usage of organic fertilizers/pesticides (*Amrit Paani* and *Amrit Khaad*) to save water in agriculture.
- **Integrated Water management Plans:**
 - Develop comprehensive integrated tributary catchment level water management plans which provide accurate info on demand, supply and gap

analysis along with specific recommendations on water management that take into account the needs of all water users, including environmental needs.

A comprehensive approach to agricultural water management should incorporate a three-fold strategy:

- **Supply-Side Interventions:** This encompasses strategic measures aimed at optimizing the accessibility of water for irrigation purposes. Such measures encompass the maintenance and rehabilitation of both canal systems and groundwater-based irrigation mechanisms. There are several canal systems and wetlands, which also provide water for irrigation, canals (through surface water) and wetlands spread over Bareilly district (through ground water recharge function) should be identified and rehabilitated/rejuvenated through a multi-stakeholder led collective action approach.
- **Demand-Side Interventions:** This facet entails the prudent utilization of irrigation water through a range of techniques. These techniques encompass precision practices such as line sowing, meticulous management of water depths within agricultural plots, the implementation of trench-based sugarcane cultivation methodologies (improving water use efficiencies), and the application of bio-fertilizers and bio-pesticides (improving soil health, water retention capacities). The objective is to ensure the utmost efficiency in the use of irrigation water while concurrently maximizing agricultural output.
- **Institutional Strengthening (Water Users' Associations – WUAs):** This entails the establishment and empowerment of Water Users' Associations (WUAs) and water users' groups. These entities provide a collaborative platform for farmers to collectively adopt and pursue sustainable agricultural practices. Furthermore, this approach seeks to foster a sense of unity among farmers and facilitate the adoption of practices that ensure long-term agricultural sustainability.

Additionally, a strategy involving the linkage of the terminus of canal systems with nearby local rivers or ponds is recommended. This linkage is envisioned to bolster the water availability within these localized freshwater resources, thereby contributing to enhanced overall water resource availability.

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 49: 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 50 WWF-India initiatives in sustainable agriculture water management in wetlands catchment I in Bareilly district

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 51 Making of Amrit Khad and Amrir Paani

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
Every year, Transform 10% of Agriculture Area toward Sustainable Practices	<ul style="list-style-type: none"> 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 within the first year, focusing on pilot projects to assess feasibility and gather data 	<ul style="list-style-type: none"> Continue scale up of demonstration and training in agriculture area keeping 10% area target (implementation plan 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. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Agriculture Department Horticulture Krishi Vigyan Kendra's Uttar Pradesh Irrigation Department WWF India Farmers 	<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Constitution of Water Users' Associations (WUA's) 	<ul style="list-style-type: none"> Identify canal systems with functional WUA's in the district and the ones 	<ul style="list-style-type: none"> Expand the formation of WUA's to cover 30% 	<ul style="list-style-type: none"> Constitute Water Users' Associations in atleast 70% of feasible canal systems 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<p>where WUA's are not formed/process initiated and develop a list of feasible canal command areas for WUA formation.</p> <ul style="list-style-type: none"> ▪ 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 	of the total feasible canal command areas	across the district, ensuring effective, community-led water resource management, and sustained support for sustainable water use practices Monitoring and evaluation of the impact		<p>Employment Guarantee Act)</p> <ul style="list-style-type: none"> ▪ Paramparagat Krishi Vikas Yojana (PKVY)

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	in commands, make voter list, hold elections <ul style="list-style-type: none"> Establish Water Users' Associations (WUA's) in 5 irrigation canals in Bareilly district. 				
<ul style="list-style-type: none"> Linking Tail Ends of Canals with Nearby Rivers/Ponds 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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. 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	flows going into river/ponds.				
<ul style="list-style-type: none"> Promote Organic Farming to be integrated with conventional practices 	<ul style="list-style-type: none"> 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 (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 	<ul style="list-style-type: none"> 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 on adoption of organic farming techniques 	<ul style="list-style-type: none"> 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 20% of villages (400 villages). Monitor and document impacts Award and recognize progressive farmers/villages/officials on adoption of organic farming techniques 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
<ul style="list-style-type: none"> Upscaling of Water Footprint Campaign 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Develop educational materials and outreach programs to raise awareness about the Water Footprint concept among households and individuals. Organize workshops, seminars, and community events to engage residents and motivate them to adopt water-saving practices. 	<ul style="list-style-type: none"> Monitor and evaluate the campaign's impact through surveys, data collection, and feedback from participants. 		

6.2 Key Issue- 2: Waste water management (Domestic-Deoraniya and Nakatiya and industrial)

- Conduct an assessment of the operational effectiveness of Sewage Treatment Plants (STPs) (Once they have started in the district) regarding the discharge of treated effluent. This evaluation should transpire precisely at the juncture of the effluent's release into the adjacent river or stream.
- Formulate a comprehensive plan for the management of faecal sludge and septage (FSSM) to ensure judicious handling and disposal practices.
- Compile pertinent data about sanitation arrangements at the household level. The municipal authorities (Nagar Nigam) can oversee this monitoring initiative on a ward-wise basis, considering that the city is segmented into a total of 70 administrative wards. Active community engagement is imperative for the success of this endeavour.
- Recognizing that high-rise buildings, residential complexes, educational institutions, and multiplexes collectively represent significant sources of both sewage generation and municipal solid waste, stringent measures should be enforced to ensure the establishment of metered water supply in these infrastructures. The absence of an effective Sewage Treatment Plant (STP) leads to the discharge of untreated wastewater into the Nakatiya, Deoraniya, and Ramganga rivers, instigating considerable pollution and thereby posing substantial risks to public health.

Available data validates the influx of pollutants into the Ramganga River originating from the Nakatiya and Deoraniya Rivers. These pollutants encompass a combination of domestic and industrial effluents, accompanied by elevated Biological Oxygen Demand (BOD) levels. These levels markedly exceed the recommended thresholds set by the Central Pollution Control Board (CPCB), surpassing the stipulated limit of 3 mg/l.

Situated within a hydrologically sensitive geographical context, Bareilly City interfaces with multiple watercourses. This scenario is further exacerbated by encroachments and pollution sources, which are notably accentuated by the lack of adequate sewage treatment infrastructure. In response to this imperative, the proposition of establishing four nature-based wastewater treatment facilities is put forth as a viable course of action (Figure 52).¹

¹ Nature-Based Solutions (NBS): Nature-based solutions are strategies and approaches that use or mimic natural processes to address environmental and societal challenges. These solutions harness the power of nature to provide sustainable and

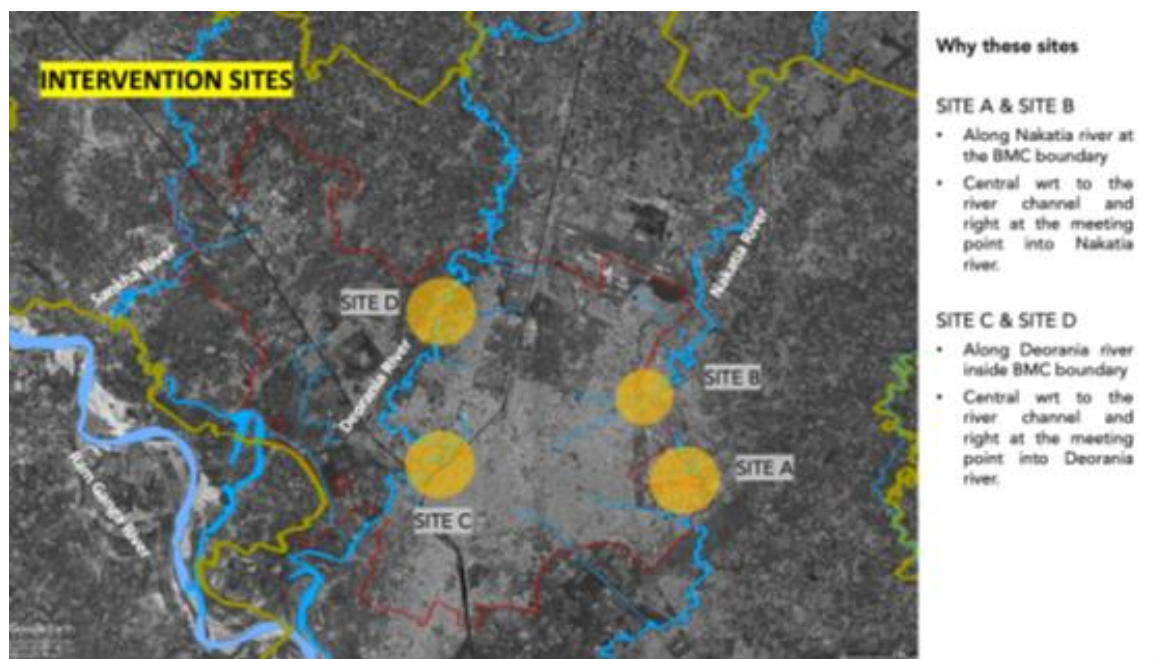


Figure 52 Potential identified intervention sites [20]



effective ways to mitigate and adapt to various issues, such as climate change, biodiversity loss, and sustainable development. Nature-based solutions often involve the restoration, protection, and sustainable management of ecosystems and biodiversity to enhance their capacity to provide benefits to both people and the environment.





The proposed treatment systems for these sites include:

Floating Wetlands (FTWs): FTWs are small artificial platforms that facilitate the growth of aquatic emergent plants (*i.e. Typha, Phragmitis, Scirpus etc*) in deeper water. These plants absorb nutrients and contaminants, while their extensive root systems and floating island material create a biofilm that promotes nutrient uptake and degradation. FTWs also provide shelter, reducing turbulence and aiding sediment settling, thus transforming pollutants into harmless by products.

Treatment Lagoons: Wastewater treatment lagoons are manmade ponds designed to receive, hold, and naturally treat wastewater. Beneficial bacteria and other organisms break down organic components over time. Lagoons are constructed and lined to prevent groundwater leakage and can be used individually or as part of a larger treatment system.

Phumdis: Phumdis are unique floating islands found exclusively in Manipur's Loktak Lake in north-eastern India. These islands consist of a mix of vegetation, soil, and organic matter in various stages of decomposition, covering a significant portion of the lake's surface.

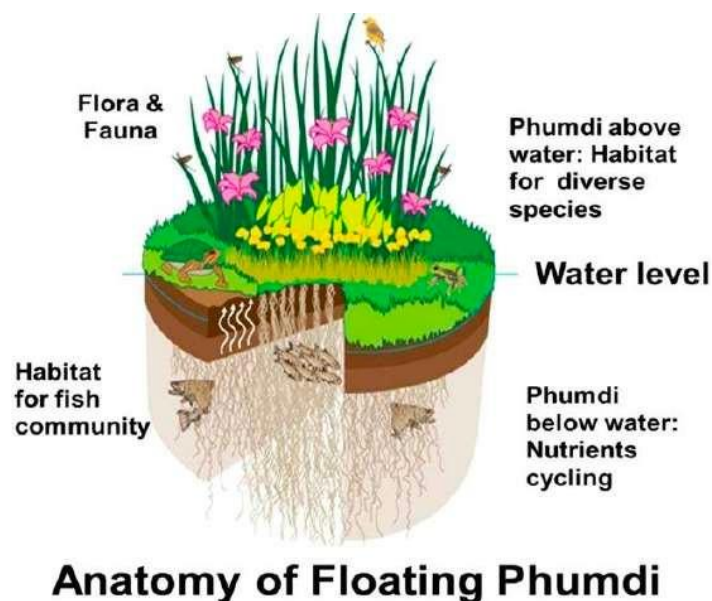


Figure 53 Phumdis during different seasons

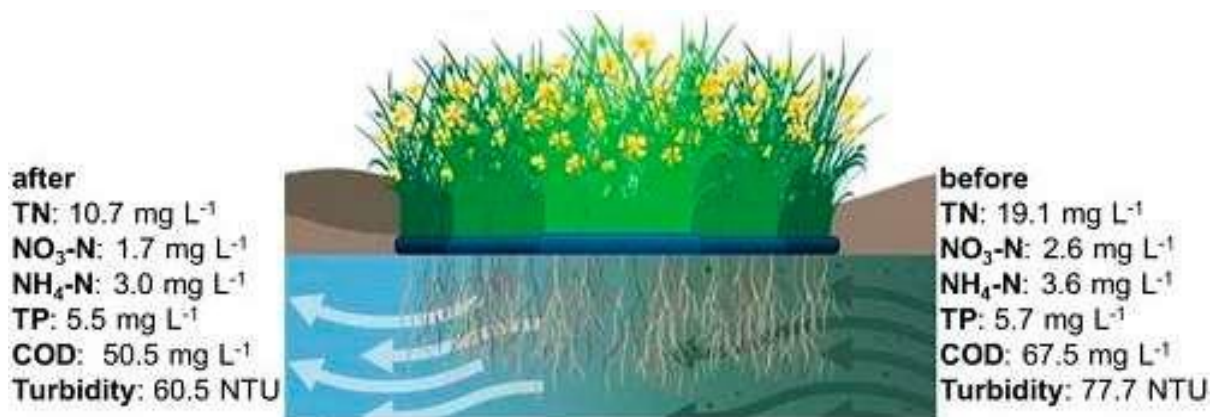
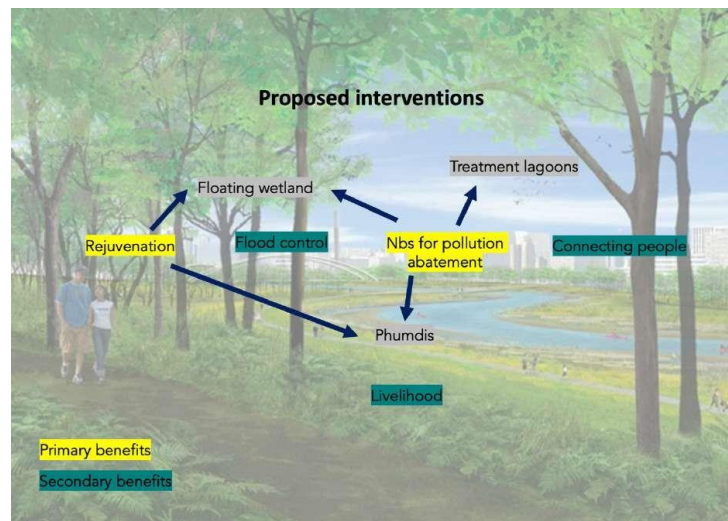
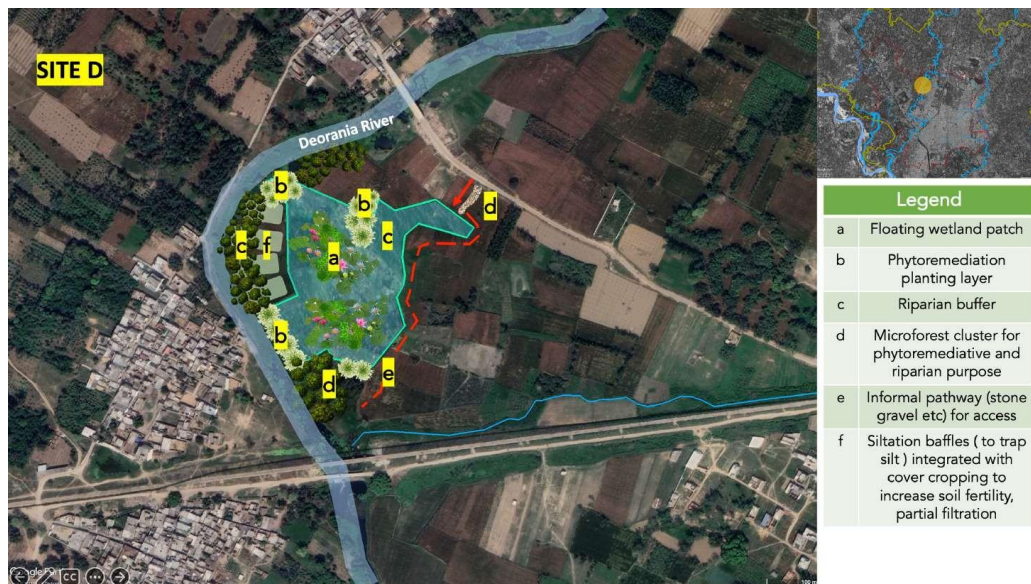
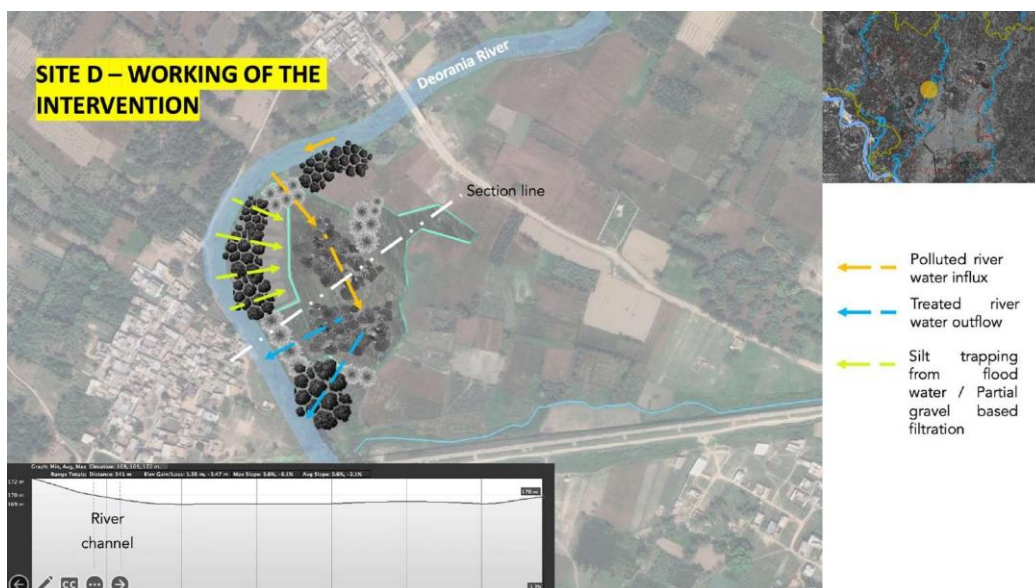


Figure 54 Treatment of Wastewater through Floating Wetland

These nature-based solutions offer a multifaceted approach to address pollution in the river channels, enhance flood control measures, and foster a stronger connection between people and the river.

A conceptual plan for Site D illustrates the strategic placement of these diverse nature-based technologies and their contribution to wastewater treatment.

These systems will significantly alleviate the burden on Sewerage Treatment Plants (STPs), reducing their workload by X%. Additionally, they open up opportunities for alternative economic activities beyond pollution control, including tourism, recreational fishing, and fish farming.



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. Joint Monitoring of Drains	<ul style="list-style-type: none"> Establish a collaborative team involving representatives from Nagar Nigam, local community members, and local organizations. Develop a monitoring plan that outlines the responsibilities of each stakeholder, frequency of monitoring, and data collection methods. Testing of Water quality and effluent volume in selected drains (monthly /seasonal) 	<ul style="list-style-type: none"> Implement regular inspections and monitoring of drains to identify blockages, damage, or other issues. Create a reporting mechanism for stakeholders to share findings and coordinate actions for drain maintenance and repairs. 		<ul style="list-style-type: none"> Nagar Nigam Local community members Uttar Pradesh Pollution Control Board District Administration WWF India 	<ul style="list-style-type: none"> Swachh Bharat Mission (Urban) 2.0 Gandhivadi E-waste Yojna of MoEF Jalshakti Abhiyan Waste to Energy
2. Implementing Nature-Based Solutions for Wastewater Treatment	<ul style="list-style-type: none"> Conduct a detailed site assessment for the four identified locations along the Nakatiya and Deoraniya rivers and identify best suited NBS method to improve water quality 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Scale up different working models in regions with similar pollution issues (river stretches and wetlands) Develop policy around NBS methods for ecological restoration highlighting their 		

	<ul style="list-style-type: none"> ▪ Develop techno-financial implementation plan to improve water quality using nature-based solutions in target rivers and wetlands ▪ Pilot test the NBS method at one site each on Nakatiya and Deoraiya rivers and wetlands if needed. 	<p>expertise in the implementation process.</p> <ul style="list-style-type: none"> ▪ Through monitoring mechanism assess the impacts of NBS solutions ▪ Scale up and replicate the successful NBS methods in more sites along the target rivers ▪ Conduct public awareness campaigns to inform residents about the importance of these solutions and encourage responsible wastewater disposal. ▪ Document various successfully implemented NBS methods along with their efficacy and replicability in rivers and wetlands. 	<p>efficacy, cost effectiveness, working typologies/water quality thresholds etc.</p>		
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6.3 Key Issue- 3: Solid waste management in urban and rural areas

- Facilitate and promote waste segregation at its source, to be carried out by households or entities generating waste. Provide explicit instructions to formal and informal waste collectors, mandating them to exclusively gather waste that has been segregated at the point of origin. Explore the introduction of financial incentives aimed at stimulating adherence to the practice of waste segregation at the source.
- Consider the option of reducing waste collection fees by half for individuals and entities actively engaged in waste segregation practices.
- Coordinate an all-encompassing campaign targeted at increasing awareness and education regarding waste management. This initiative can be collaboratively undertaken with civil society entities, including local non-governmental organizations (NGOs) and other community-based organizations. This awareness drive should subsequently extend to urban local bodies (ULBs).
- Promote the establishment of composting and waste separation facilities within substantial residential complexes, high-rise buildings, and multiplexes. This is intended to enhance the capacity for on-site waste management.
- Undertake the establishment of facilities designed to collect and process organic waste, particularly within prominent marketplaces like Vegetable and Fruit Mandis and fish markets. This engagement can involve the participation of local entrepreneurs. Furthermore, the creation of sanitary landfills tailored for the disposal of inert and non-recyclable waste is proposed.
- For areas that are not equipped with door-to-door waste collection systems, implement designated waste deposit points outfitted with separate compartments for distinctive waste streams.
- Institute decentralized facilities at the municipal level dedicated to material recovery, micro-composting, bio-gas generation, and comprehensive waste management, encompassing the handling of hazardous waste. Facilitate the active participation of local entrepreneurs in these endeavours.
- Initiate the establishment of sanitary landfills specifically intended for disposing of inert and non-recyclable waste, effectively addressing the management of waste streams that are not amenable to conventional recycling processes.

- Coordinate concerted efforts to conduct clean-up operations along riverbanks. In the pursuit of this objective, seek the involvement of community organizations to ensure broad-based participation.
- Engineer and implement structures known as 'plastic traps' within water bodies to capture floating plastic debris from rivers. To achieve this, engage the active participation of community organizations to foster a collective commitment to the endeavour.
- Commence the commissioning of a study focused on sustainable management strategies for electronic waste (e-waste), a critical facet of contemporary waste 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. 100% Achievement on Source Segregation:	<ul style="list-style-type: none"> 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 10% of target area 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Implement source segregation in 100% of target areas 	<ul style="list-style-type: none"> Urban Local Bodies Uttar Pradesh Pollution Control Board Nagar Nigam Central Pollution Control Board NMCG & SMCG – UP & Uttarakhand Local NGOs 	<ul style="list-style-type: none"> Jal Shakti Abhiyan National Plan for Conservation of Aquatic Eco-systems (NPCA) Mission Amrit Sarovar
2. Awareness and Education Events	<ul style="list-style-type: none"> 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.) 	<ul style="list-style-type: none"> 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. 			

	<ul style="list-style-type: none"> ▪ 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. 				
3. Awareness Programs at School Levels	<ul style="list-style-type: none"> ▪ Collaborate with local NGOs and experts to design and implement 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 	<ul style="list-style-type: none"> ▪ Continue the process of spreading awareness in the schools 	<ul style="list-style-type: none"> ▪ Continue the process of spreading awareness in the schools 		

	<p>segregation and environmental stewardship.</p> <ul style="list-style-type: none">▪ Organize interactive sessions, competitions, and field visits to waste management facilities to engage students actively.				
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6.4 Key Issue- 4: Floodplain (mining and palaze) and wetlands protection and restoration to ensure local water security and enhance climate resilience, which includes measures to address riverbank encroachment- Ramganga/Aril River/Deoraniya/Nakatiya

The district has identified a total of 275 wetlands, which have been categorized based on their characteristics into Persistent, Intermittent, Intensifying, Diminishing, New, and Lost. These distinct categories necessitate the formulation of distinct management strategies tailored to each. Diminishing wetlands warrant immediate attention due to the imminent risk of their disappearance, whereas Persistent wetlands can be approached with a more restrained intervention strategy and should be protected through policy and monitoring that can prevent them from any degradation.

Concerted collaborative efforts involving the Revenue Department, WWF, Village community, Rural development department, Minor irrigation/flood department and the district administration should conduct joint field surveys of all 275 wetlands, aimed at validating their characteristics on the ground. This will help authorities to create a repository of wetlands and their status. This data will help identify the threats, and pressures and develop individual wetland restoration plans. A brief simplified format of baseline data collection is available with WWF-India, which is being used to collect baseline data. In January 2023, about 30 plus stakeholders from selected blocks falling within the Aril basin of Bareilly district were trained by WWF-India on wetland conservation and baseline data collection using the mentioned format. The participants included technical assistants, gram pradhans, panchayat secretaries etc.

The Ministry of Environment, Forest and Climate Change has developed a comprehensive four-pronged approach to wetland conservation, encompassing the following phases:

- Inventory Creation of Wetlands and Formulation of Concise Documentation
- Compilation of Wetland Health Cards
- Facilitation of Wetland Mitra Enrollments
- Formulation of Integrated Management Plans encompassing Catchment and Hydrology, Water Quality, Biodiversity, and Governance aspects.

According to Wetlands Rules of Government of India, the 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	

- Regular Groundwater quality and water level monitoring with the support of multi-stakeholders and experts. The density of monitoring stations within each block should be increased. Community-level groundwater level monitoring should be encouraged and training should be provided to the key people. This will help in planning and implementing appropriate water conservation measures to tackle water security issues at a local scale.
- Explore the possibilities of recharge from other sources like canal networks, and seepage from tanks and water bodies.
- Identify the key building with a large roof area in the district for RWH (Rain Water Harvesting).

In anticipation of the forthcoming floodplain zonation process, delineate a tract of land spanning 500 meters on both banks of the rivers. This undertaking involves collaborative efforts amongst the Revenue Department (RD), Uttar Pradesh Irrigation Department (UPID), and the District Administration.

- Ensure the preservation of floodplain demarcations through the adoption of nature-based interventions, such as the establishment of vegetative tree lines or comparable methodologies. Stringent regulations must be enforced, disallowing any approvals for new construction activities within the river catchment area.
- The revenue department and district administration should map all the rivulets and their actual width as per cadastral records and effort should be made in consultation with community members to free up river space so that freshwater flows can contribute to better health of rivers and wetlands.

- Implement the creation of a publicly accessible green area within the space that has been recently cleared in proximity to the floodplain.
- Enforce a rigorous system of monitoring characterized by frequent inspections and the utilization of current high-resolution satellite imagery. This monitoring mechanism is designed to identify focal points of concern and areas presenting issues, thus facilitating the necessary intervention measures.
- Mitigate the improper disposal of solid waste along riverbanks and within the floodplain, particularly at unauthorized sites situated in the vicinity of the Nakatiya and Deoraniya rivers.

Case Study-3

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.

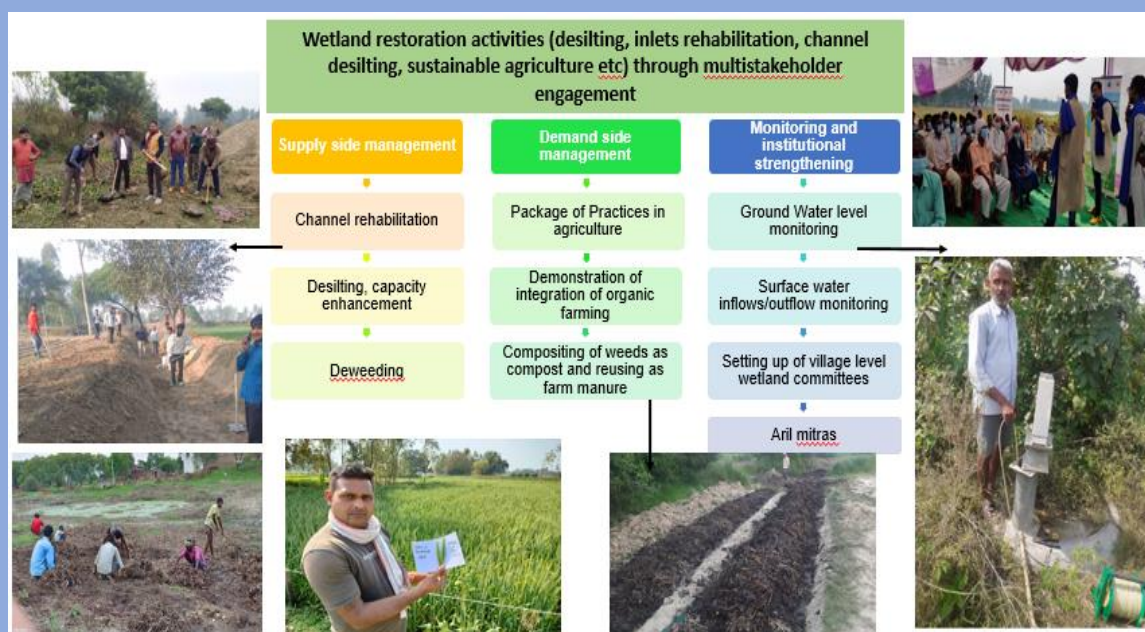


Figure 55 Wetland restoration activities

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 district, about 300 million litres of additional water flowed into these wetlands (30 Million litres in Khangawa Shyam, 20 ML in Bahoda kheda and 250 ML in Lilaur Lake).



Figure 56 Rejuvenated Khangwa Shyam Wetland



Figure 57 Rejuvenated Lilaur Lake



Figure 58 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 59 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 60 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. Identifying Losing and Gaining Streams and Groundwater Mapping	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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). 	<ul style="list-style-type: none"> Monitor and evaluate the impact of interventions 	<ul style="list-style-type: none"> District Administration Revenue department Forest department Uttar Pradesh Irrigation Department WWF India Local NGO's MNREGA 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Collect baseline data of all 270 plus degraded wetlands (>2.5 ha area) (format of data collection to be shared by WWF-India). Considering threats, degradation, groundwater critical zones, ecological 	<ul style="list-style-type: none"> 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 14 blocks (covering 70 wetlands) Monitor impacts through pre and post implementation 	<ul style="list-style-type: none"> Scale up the wetland restoration work in additional 5 wetlands in each of 14 blocks (covering 70 wetlands). Target should be to carry out atleast one or more restoration activity in each of the identified wetlands. Monitor impacts through pre and post 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<p>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 180 odd degraded category wetlands.</p> <ul style="list-style-type: none"> ▪ 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 	<p>observations on parameters like inflows, groundwater levels, water quality, weeds, inlet conditions, biodiversity etc.</p> <ul style="list-style-type: none"> ▪ Reward and recognize water champions 	<p>implementation observations on parameters like inflows, groundwater levels, water quality, weeds, inlet conditions, biodiversity etc.</p> <ul style="list-style-type: none"> ▪ Evaluate the impact of interventions on these wetlands and see the improvement of water quality and ground water levels 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<p>initiatives of Central and State government (like Save Wetland campaigns, Amrit Sarovar etc)</p> <ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Scaleup the process of weed removal in other identified wetlands. Establish a robust compost distribution system through KVKs and gram panchayat level (compost generated from water hyacinth) 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<p>removal and conversion into biocompost.</p> <ul style="list-style-type: none"> Carry out deweeding and subsequent conversion into biocompost in 10% 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. 	<ul style="list-style-type: none"> Reduce pollution loads in wetlands/rivers to minimize spread of water hyacinth weed 			
4. Restoration of Floodplain Wetlands	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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. 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	rivulets to enhance surface water flows. <ul style="list-style-type: none"> Develop and implement restoration plans with multistakeholder approach for 2-3 wetland in each block to enhance hydrological connectivity, Invasive weed management, water quality improvement. Carry out restoration of Monitor impacts (pre and post implementation of activities) 	etc) through wetland health assessment <ul style="list-style-type: none"> Develop educational programs and engage the community to raise awareness about the importance of floodplain wetlands and their restoration. 	<ul style="list-style-type: none"> Legal Protections: Advocate for and implement legal protections and regulations that ensure the long-term conservation and preservation of the floodplain wetland. 		
5. Collaboration and Technical Support	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<ul style="list-style-type: none"> 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 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) 	<ul style="list-style-type: none"> Organise multiple training sessions for stakeholders, on the biodiversity conservation, River Health assessment and Wetland health assessment 	progress of restoration efforts, adapt strategies as needed, and measure the long-term impact of the project.		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<ul style="list-style-type: none"> ▪ 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, 				

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	responsibilities, and expectations of all involved parties.				

6.5 Key Issue- 5: Gaps in capacity, skills (Social, technical and institutional) and human resources in DGC for implementation of Ganga authority order

Presently, there exists substantial potential for augmenting the capabilities and human resources within the District Ganga Committee (DGC). This augmentation is imperative to facilitate the comprehensive examination, formulation, execution, operation, and sustenance of projects and activities pertinent to the restoration of rivers and wetlands. These endeavours encompass both the enhancement of water quality and the augmentation of water quantity. Multiple funding avenues are accessible to facilitate the implementation of Ganga rejuvenation initiatives, which can be effectively harnessed by the District Ganga Committee (DGC).

- Utilize the available resources derived from ongoing programs and projects focused on capacity enhancement and human resource development, such as the Ramganga Mitras initiative operating within the framework of river rejuvenation under the Arth Ganga Concept supported by the National Mission for Clean Ganga (NMCG).
- Augment the existing infrastructure of the District Ganga Committee (DGC) by establishing an additional specialized capacity in the form of a dedicated support cell comprising skilled professionals. The group should also be trained in conflict resolution.
- Leverage the existing cadre of Ramganga Mitras to facilitate a range of community mobilization, awareness propagation, and sensitization undertakings. These initiatives encompass campaigns related to River Health Assessment and Wetland Health Assessment.
- Promote the establishment and fortification of Water user organisations, fostering their operational capabilities in the context of sustainable water resource management.

Case Study-4

Nodal officers Trainings

WWF India, in collaboration with the district administration, has successfully executed the first phase of training aimed at Nodal Officers (Gram Pradhans) hailing from 49 floodplain villages. The primary objective of this training was to cultivate an awareness regarding the pivotal roles these officers play in the preservation of rivers and the functioning of the District Ganga Committee. This training initiative encompasses the augmentation of their competencies in sustainable agriculture practices, as well as the deepening of their understanding of the responsibilities entrusted to the District Ganga Committee. The training regimen encompassed comprehensive instruction on sustainable agricultural methodologies, including hands-on demonstrations of bio-fertilizers and bio-pesticides. This instructional program was further extended to encompass the subject of Community-led Turtle Conservation, thereby enriching the participants' knowledge base.

The forthcoming phase of training is poised to engage Nodal Officers in hands-on activities employing portable analytical kits to assess crucial water quality parameters. This segment of training will be dedicated to fostering an in-depth comprehension of river health dynamics and the significance of wetland ecosystems. The officers will be equipped with the skills necessary for evaluating the health of rivers and wetlands.





The gaps in capacity, skills (Social, technical and institutional) and human resources in DGC can be categorised into the following sections:

- **Social**
 - Awareness, Mitras, public participation
- **Technical**
 - Capacity building on hydrological scenarios, monitoring, connectivity etc.
 - Training and capacity building on biodiversity conservation in Ganga and its tributaries.
- **Institutional**
 - Training programs on Ganga conservation, environmental science, and relevant technical skills.
 - Collaboration with academic institutions and NGOs to provide technical expertise.
 - Regular review and evaluation of DGC activities to identify ongoing capacity needs.

Case study-5

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 eggs, 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.

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. Promoting Cultural Heritage and Tourism	<ul style="list-style-type: none"> Identify the places that are heritage and have cultural importance in the district. Collaborate with the Tourism Department and local stakeholders to promote cultural heritage and tourism along the Ramganga and its surroundings. 	<ul style="list-style-type: none"> Organize activities such as boat tours, bird watching tours, and yoga sessions to attract tourists and raise awareness about the region's natural and cultural significance. Develop and distribute promotional materials, including brochures and online content, to highlight the unique cultural and natural attractions of the area. 		<ul style="list-style-type: none"> Tourism Department District Administration District Ganga Committee WWF India Local institutions Forest Department Nagar Nigam 	<ul style="list-style-type: none"> National Water Awards and Water Heroes Har Khet Ko Pani Information, Education & Communication (IEC) scheme of DoWR, RD & GR
2. Establishment of Biodiversity Parks	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 			<ul style="list-style-type: none"> Jalanidhi, Swajaladhara NYKS Awareness Generation Campaign

3. Dedicated Supporting Cell/Secretariat for DGC	<ul style="list-style-type: none"> Establish a dedicated supporting cell or secretariat within the District Ganga Committee (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. 	<ul style="list-style-type: none"> Built the capacity of these resources when required. 			
4. Capacity Building for Executing Agencies	<ul style="list-style-type: none"> Identify 4-5 executing agencies (e.g., Jal Nigam, Irrigation Department, Nagar Nigam, and UPPCB) involved in river rejuvenation and groundwater management. 	<ul style="list-style-type: none"> 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 Management (FSM) systems. Include a focus on gender-sensitive training and ensure women's 			

		participation in the capacity-building programs.			
5. Organizing Training Programs	<ul style="list-style-type: none"> Coordinate training programs with representatives from different line departments involved in water management and river rejuvenation. 	<ul style="list-style-type: none"> Ensure that the training programs are comprehensive and cover key aspects of sustainable water management. Continue ongoing training for the District Ganga Committee (DGC) to enhance their knowledge and skills. 			

6.6 Key Issue- 6: Gaps in knowledge on status, issues and actions needed for the conservation of key tributaries in Bareilly district

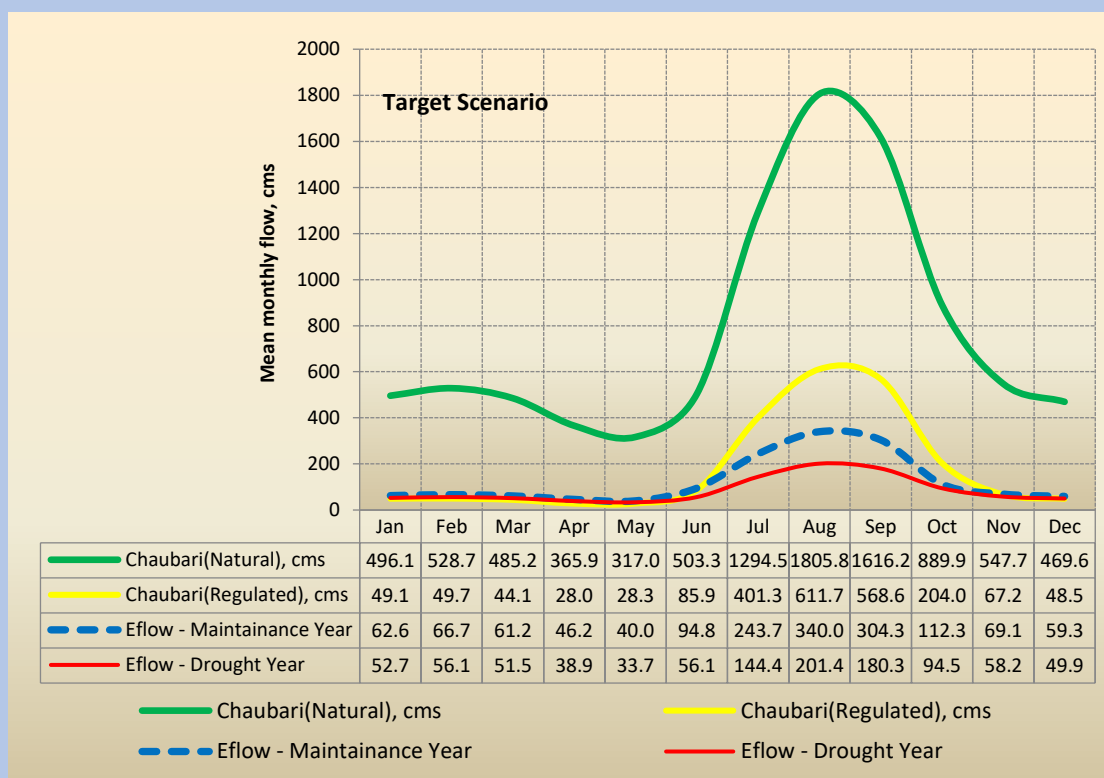
- Bridging the knowledge gap on information around water resources, water quality, encroachment etc. of some critical tributaries of the Ramganga River. (Aril, Nakatiya and Deoraniya).
- Setting up of river flow monitoring sites and water quality monitoring sites on tributaries (like Kichha, East Baigul, Deoraniya, Shanka) whose majority of stretch falls in Bareilly district or joins Ramganga or any other major tributaries. This can be a unique initiative by the district administration to strengthen the monitoring mechanism of smaller tributaries, which can set up baselines and help formulate strategies to restore.
- Develop a smaller river restoration plan considering a holistic Integrated River basin management approach. This will align with the Government of India's and NMCG's initiative of rejuvenating a target of 75 rivulets in Uttar Pradesh. By rejuvenating smaller rivers hydrological and ecological health of Ganga can be improved.
- Identification and mapping of Key hotspots (cultural and heritage) along the river Ramganga and its tributaries.

– Regional issue –

Case Study - 6

Maintaining Environmental Flows in Ramganga River at Chaubari site in Bareilly district

WWF India along with partners (IIT Kanpur, IIT Delhi, IIT BHU Varanasi, HNB Garhwal University, People's Science Institute, local experts) conducted E-Flows assessment for Ramganga River (2013-15). As part of that exercise, E-Flows recommendations are made for Chaubari site in Bareilly district, the present-day flows and desired E-Flows are illustrated in following graph. The recommended E-Flows regime is required to be maintained at Chaubari location and for that, the district authorities need to interact with upstream districts (Moradabad & Bijnor).



It is envisaged that, since in this district, there is strong surface-water and ground-water interaction and hence the regulation and check on ground-water extraction will improve the base-flows in the Ramganga River and thus eventually aid E-Flows maintenance in Ramganga River at Chaubari site. Besides this, healthy floodplain wetlands will significantly contribute to the base-flows and local water security. This will help in maintaining the ground-water levels and will therefore aid E-Flows maintenance in Ramganga River in the district.

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. Long-term E-Flows Maintenance Target in Aril and Ramganga river	<ul style="list-style-type: none"> Collaborate with UPI&WRD and other stakeholders, thematic experts to E-Flows assess E-Flows in Aril River. Map and prioritize floodplain wetlands which can provide hydrological benefits to river. Restore wetlands in loosing nature stretches of 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 	<ul style="list-style-type: none"> Carry out E-Flows assessment of critical tributaries which has majority of portion within Bareilly district (like Kichha, East Baigul) Rehabilitate river channels in Upper reaches of Aril to enhance hydrological connectivity and increase catchment contribution of surface run off Improve hydrological connectivity of tributaries of Aril by removing encroachments in floodplains. Restoration of floodplain wetlands in river basin Monitor Aril riverine flows at exit of Moradabad district, and in Bareilly district 	<ul style="list-style-type: none"> 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 to implement and sustain the E-Flows initiative. 	<ul style="list-style-type: none"> District Administration KVK's Uttar Pradesh Irrigation Department (UPID) Ground water department Agriculture Department Local universities/ Research institution WWF India 	<ul style="list-style-type: none"> AMRUT 2.0 Scheme Mission Amrit Sarovar Namami Gange Programme Public Interaction Programs Water Nirmal Abhiyan

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
		<ul style="list-style-type: none"> ▪ Increase coverage of sustainable agriculture practices with aim to reduce water application, by 10% in each block (especially in riparian villages along Aril and Ramganga river) ▪ Focus on rejuvenation of tributaries (like Kichha, Baigul etc) to support E-Flows maintenance in Ramganga river 			
2. Monitoring Impact on Fishes and Aquatic Biodiversity Target	<ul style="list-style-type: none"> ▪ Assess baseline information of diversity, occurrence and population of aquatic species (fish, turtles etc) in Ramganga, its tributaries and floodplain wetlands ▪ Jointly monitor the impact of E-Flows maintenance/enhanced flows on fish populations, aquatic biodiversity, and the assimilating capacity of the Ramganga and Aril River 	<ul style="list-style-type: none"> ▪ 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 	<ul style="list-style-type: none"> ▪ Use the monitoring results to adapt and refine the E-Flows maintenance strategy as needed to maximize ecological benefits. 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<ul style="list-style-type: none"> ▪ 				
3. Seasonal Surveys of Tributaries and data collection	<ul style="list-style-type: none"> ▪ 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 Kichha, East Baigul, Deoraniya, Shanka, 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 	<ul style="list-style-type: none"> ▪ ▪ 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. 	<ul style="list-style-type: none"> ▪ 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. 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
	<p>observation on hydrology (river flows) groundwater levels, water quality (chemical and physical characteristics), and biodiversity (including fish populations).</p> <ul style="list-style-type: none"> ▪ 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. 				
4. Reporting and Data Utilization		<ul style="list-style-type: none"> ▪ Compile the data obtained from seasonal surveys into comprehensive reports, including baseline information on the tributaries' current state. 			

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
		<ul style="list-style-type: none"> ▪ 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 ▪ 			
5. Implementation of Restoration Plan		<ul style="list-style-type: none"> ▪ Collaborate with relevant stakeholders (government departments, CSO's . technical experts etc) and use the long term trend 	<ul style="list-style-type: none"> ▪ Implement remedial measures, such as habitat restoration, water quality improvement, and 		

Actions	Short term (upto 1 year)	Medium term (2-3 Years)	Long term (4-5 Years)	Responsible department/ agencies/ stakeholder	Remark / Scheme
		<p>data and reports to develop integrated river basin plans (with focus on tributaries) for sustainable water management</p> <ul style="list-style-type: none"> ▪ Prioritize actions to restore and rehabilitate the tributaries based on the severity of issues and available resources. 	<p>sustainable fisheries management, as needed.</p> <ul style="list-style-type: none"> ▪ Develop policies around protection of floodplains, inlet channels, wetlands etc. 		

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 framework for the District Ganga Plan (DGP) was collaboratively developed with the State Mission for Clean Ganga (SMGC). It was later presented at the District Ganga Committee meeting in Bareilly held on May 13, 2022. During this presentation, the roles of various line departments and other stakeholders in the development of the DGP in the district were explained. Following this, the District Magistrate was asked to establish a working group (committee) for the DGP and appoint a nodal officer to kickstart the planning process in Bareilly district.

On August 20, 2022, at the recommendation of the Divisional Forest Officer Bareilly, the District Magistrate approved the formation of the DGP working group (Committee). This group included key members from different line departments and other stakeholders. This multi-stakeholder group is responsible for coordinating meetings, conducting a comprehensive situational analysis, and formulating the DGP, with technical support from WWF-India.

To conduct a situational analysis, WWF India initiated data collection on major rivers within the district boundaries, such as the Ramganga, Nakatiya, Deoraniya and Aril rivers. The results of this analysis were presented during the inception meeting of the DGP working group on November 24, 2022, chaired by Chief Development Officer. During this meeting, members discussed the presented data and identified gaps that required further data collection from relevant line departments.

Following consultations with these line departments, data collection began to fill the gaps, and the drafting of the DGP commenced. The draft plan was shared and presented to Chief Development Officer, who also chairs the DGP working group. His feedback and comments were incorporated into the plan. Subsequently, the District Ganga Plan was presented to the District Ganga Committee meeting held on August 11, 2023; later on, the same was presented in detail to the District Magistrate, Bareilly on September 2, 2023.



Figure 61 WWF-India presented the DGP Framework to the DGC in the meeting held on 13 May 2022

(2)

कार्यालय जिलाधिकारी बरेली।

पत्रांक 821 / 29-5 बरेली दिनांक 20 अगस्त 2022

आदेश

भारत सरकार के जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय द्वारा जारी राजपत्र संख्या 2458 दिनांक 07 अक्टूबर 2016 के अन्तर्गत दिये गये निर्देशों के क्रम में गंगा नदी के पुनरुद्धार हेतु जिला स्तर पर जिला गंगा संरक्षण समिति (जिला गंगा समिति) का गठन इस कार्यालय के पत्रांक 1123/29-5 दिनांक 19-09-2017 द्वारा पूर्ण किया जा चुका है। भारत सरकार के उक्त राजपत्र के खण्ड-57 के अनुसार प्रत्येक जिला गंगा समिति गंगा नदी और उसकी सहायक नदियों और उनके नदी तटों से सटे विनिर्दिष्ट जिलों के संरक्षण हेतु अपनी योजना तैयार करेगा और उक्त को राष्ट्रीय स्वच्छ गंगा मिशन को अनुमोदन के लिये प्रस्तुत करेगा। इस सम्बन्ध में राज्य स्वच्छ गंगा मिशन और डब्ल्यू.डब्ल्यू.एफ. इण्डिया ने संयुक्त रूप से जिला गंगा योजना के लिये एक रूप रेखा विकसित की है।

अतः जनपद बरेली की जिला गंगा योजना तैयार किये जाने हेतु निम्न प्रकार से बहु-हितधारक कार्यकारी समूह का गठन निम्न प्रकार से किया जाता है:-

"बहु हितधारक-कार्यकारी समूह जनपद-बरेली"

क्रमांक	अधिकारी का पदनाम	कार्यकारी समूह में भूमिका
1	2	3
1	मुख्य विकास अधिकारी बरेली	अध्यक्ष
2	उपाध्यक्ष बरेली विकास प्राधिकरण बरेली अथवा नामित प्रतिनिधि	सदस्य
3	नगर आयुक्त नगर निगम बरेली अथवा नामित प्रतिनिधि	सदस्य
4	मुख्य चिकित्सा अधिकारी बरेली अथवा नामित प्रतिनिधि	सदस्य
5	अधिराज्य अभियंता बाढ़ खण्ड/सिंचाई खण्ड/रूहेलखण्ड नहर	सदस्य
6	अधिराज्य अभियंता/सहायक अभियंता, भू-गर्भ जल विभाग, बरेली	सदस्य
7	उप जिलाधिकारी बरेली, मीरगंज, आवला व फरीदपुर।	सदस्य
8	जिला विकास अधिकारी बरेली।	सदस्य
9	अधिराज्य अभियंता उ०प्र० जल निगम, बरेली	सदस्य
10	जिला अर्थ एवं संस्थाधिकारी बरेली।	सदस्य
11	उपायुक्त उद्योग, जिला उद्योग केन्द्र बरेली।	सदस्य
12	क्षेत्रीय अधिकारी उ०प्र० प्रदूषण नियंत्रण बोर्ड बरेली।	सदस्य
13	जिला पंचायत राज अधिकारी बरेली।	सदस्य
14	उप निदेशक, कृषि बरेली।	सदस्य
15	जिला गन्ना अधिकारी बरेली।	सदस्य
16	सहायक निदेशक मत्स्य बरेली।	सदस्य
17	उपायुक्त श्रम एवं रोजगार बरेली।	सदस्य
18	जिला नियंत्रक सिलिव डिफेंस बरेली	सदस्य
19	डा० आलोक खरे, एसोसिएट प्रोफेसर बोटनी विभाग, बरेली कॉलेज बरेली	सदस्य
20	निदेशक रिवर बेसिन, वैटलैण्ड एण्ड वॉटर पॉलिसी डब्ल्यू.डब्ल्यू.एफ. इण्डिया।	सदस्य
21	उप प्रभागीय वनाधिकारी वन एवं वन्य जीव प्रभाग, बरेली	सदस्य

क्रमशः.....2 पर

उक्त गठित कार्यकारी समूह जिला गंगा समिति के अन्तर्गत रहते हुये जिला गंगा प्लान तैयार किये जाने हेतु विभिन्न विभागों से जो भी सूचनाएं/आकड़ों की आवश्यकता होगी, उन्हें कार्यकारी समूह को उपलब्ध कराया जायेगा जिससे कि ससमय गंगा एक्शन प्लान तैयार कर उच्च स्तर को प्रेषित किया जा सके। कार्यकारी समूह के कार्यों का विवरण निम्न प्रकार है:-

- 1- हितधारकों के सहयोग से जिला गंगा योजना की तैयारी, समीक्षा और अंतिम रूप देने के लिये मार्ग दर्शन देना।
- 2- जिला गंगा योजना को विकसित करने की प्रक्रिया में हितधारकों का सहयोग करना, बैठकें आयोजित करना, दृष्टि और लक्ष्यों को परिभाषित करना, प्रमुख नदियों की पहचान करना जिला गंगा योजना के लिये कार्ययोजनाएं और बजट तैयार करना।
- 3- जिला गंगा योजना को बनाने में विभिन्न विभागों से इनपुट प्राप्त करना, उनकी समीक्षा करना तथा जिला गंगा योजना का प्रारूप तैयार करना।
- 4- संस्थागत स्तर पर सहायता हेतु सभी सम्बन्धित विभागों के साथ समन्वय बनाते हुये जिले में नदियों की वास्तु स्थिति का आकलन करना और जानकारी एकत्रित करना।

(शिवाकान्त द्विवेदी)
जिलाधिकारी
बरेली

पत्रांक 821 / 29-5 दिनांकित।

प्रतिलिपि-मुख्य विकास अधिकारी बरेली/नोडल अधिकारी जिला गंगा समिति को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

प्रतिलिपि-प्रभागीय वनाधिकारी वन एवं वन्य जीव प्रभाग, बरेली को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

प्रतिलिपि-उपरीक्त नामित समस्त सदस्यों को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

प्रतिलिपि-निदेशक रिवर बेसिन, वैटलैण्ड एण्ड वॉटर पॉलिसी डब्ल्यू.डब्ल्यू.एफ. इण्डिया मुद्रादादा को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

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बरेली

Figure 62 Bareilly District Magistrate formulated the DGP working group on 20 August 2022

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

- The formation of a working committee was proposed, with representation from key line departments and stakeholder groups. The committee was convened and steered by the Nodal officer appointed by the DM/DGC.
- Each department/stakeholder group subsequently nominated a member who has worked closely with the Nodal Officer. The nominated member was 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 represented their respective departments and stakeholder groups, and they were the key point of contact for coordination and implementation.
- This committee supported situation analysis, consolidation of data, baseline information, and overall knowledge management. From each line department, the representing officer provided required information.
- The group was 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 supported and worked closely with the Nodal Officer.

Review, discussion and Capacity Building on DGC Planning Framework:

- The DGP working committee (or group) reviewed and discussed the framework to gain an understanding through a capacity-building exercise on how the framework was organized and how it would support the planning process.

Inception meeting to discuss outcomes of Situation Analysis:

- An inception workshop was 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 was useful in discussing the way forward for the stakeholders concerned. This was a participatory process.

Situational analysis of Key rivers/Tributaries:

- Subsequently, data collection for situation analysis begun, this helped in understanding the current scenario of the ecological health (key threats and issues) of the key rivers within the district boundaries.
- In certain cases, some data was not be readily available, in such cases, field surveys, and primary, and secondary data collection was 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 allowed for an assessment of gaps in implementation, resource allocations, limitations and the need for additional support. Subsequently, issues and areas of work were jointly prioritized. This allowed the opportunity to identify potential synergies among different stakeholder groups and departments.

Prioritization of Issues:

- The results of the situational analysis was presented. On this basis, 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 focussed 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 arrived at an informed decision on what, District Plan should aim to achieve. Further, this exercise helped in 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 were organized for review and monitor progress, as well as course corrections if required.

- Data from all the related line departments were collected on the various aspects indicated in the framework, for developing the district plan.

Draft District Ganga Plan developed with a detailed work plan:

- The drafting of District Ganga Plan initiated on the basis of available data, consultation, visioning exercises and brainstorming.
- This draft was further discussed with the members of the working committee and the concerned stakeholders. Afterwards, the same was presented to the DGP working committee. The comments and suggestions from the working committee members were addressed and later on, the DGP was presented to the District Ganga Committee to get the 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 and DGC members, the plan was 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 actions)

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.



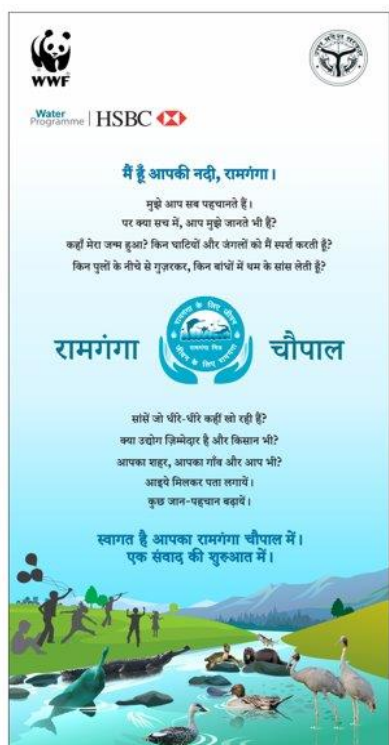
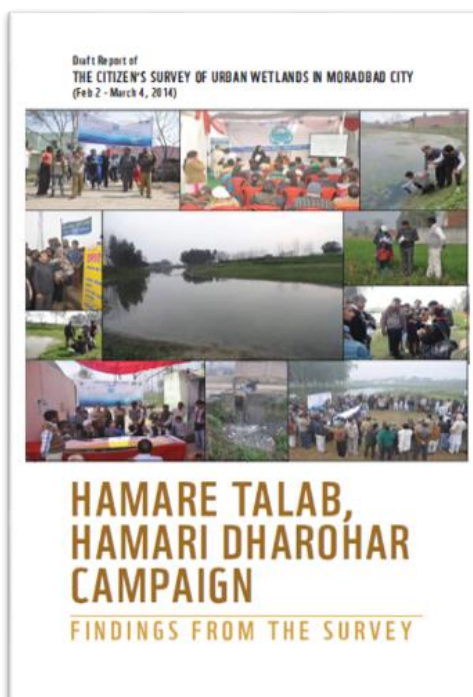
Figure 63 Ramganga Mitras in action.

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 64 Mitras contributing to different restoration and monitoring activities in rivers and wetlands in Bareilly district



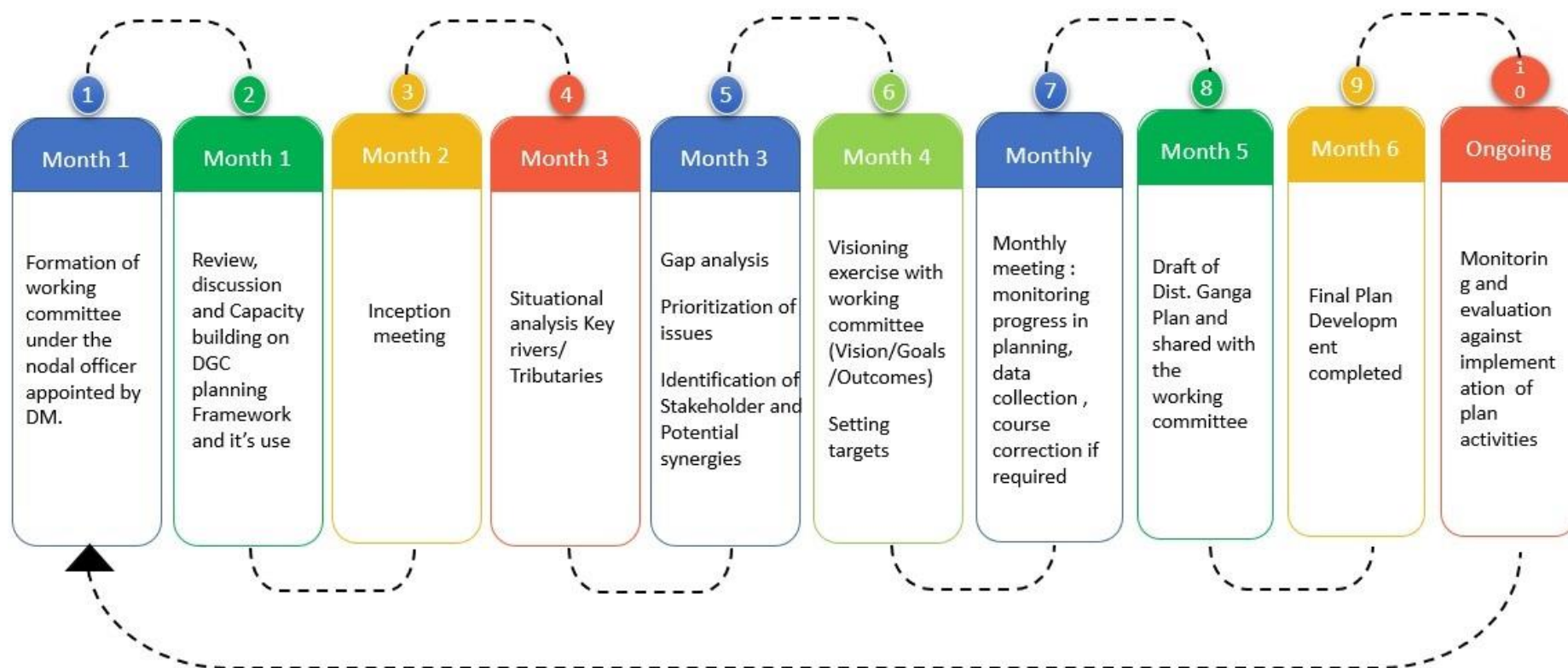


Figure 65 Process for development of District Ganga Plan

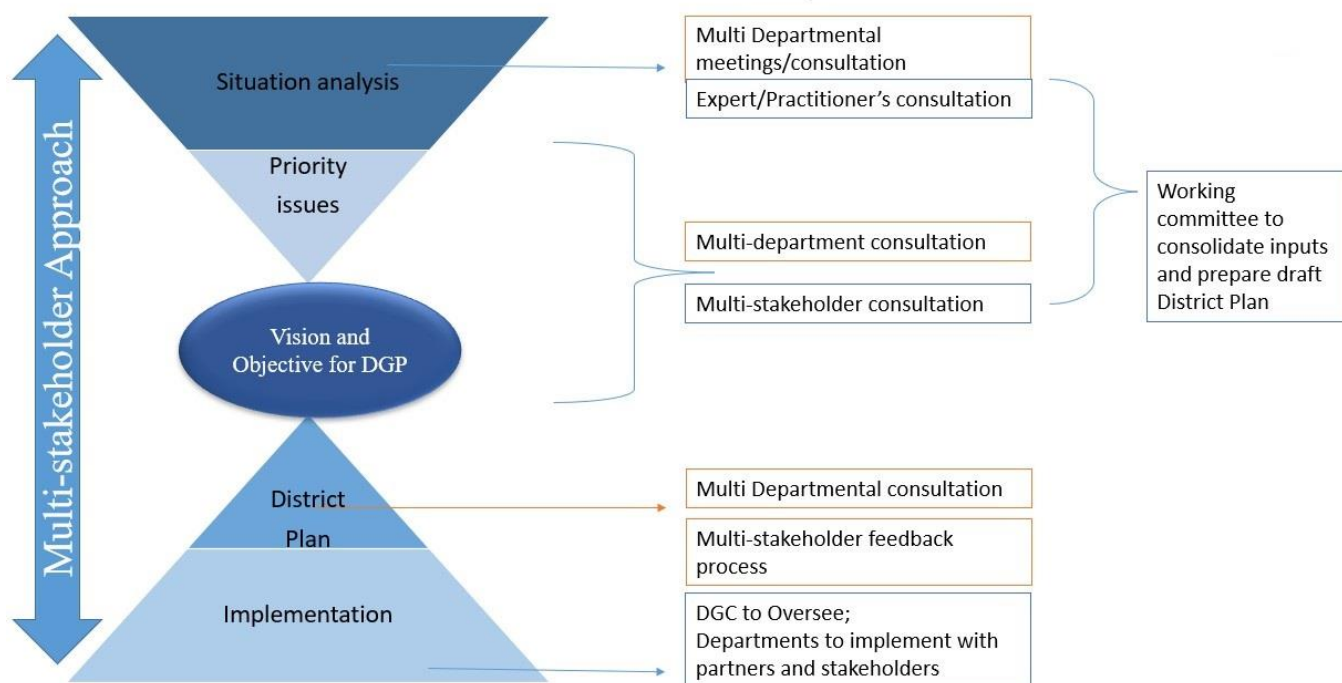


Figure 66 Detailed stakeholder process

Table 18 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 68) 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 68 Stakeholder Engagement Plan

9. Monitoring and Evaluation

The process of Monitoring and Evaluation (M&E) is an essential component of the District Governance Program (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.

Table 19 Monitoring and Evaluation of Bareilly DGP - key identified issues

Objective	Monitoring	Evaluation
Identified Key Issue-1		
Over use of water in irrigation, leading to depletion of the groundwater table and depletion of base flow in Ramganga and Aril rivers.		
Monitoring Water Usage in Irrigation	Continuously monitor water usage for irrigation activities, particularly groundwater extraction.	Assess trends in water consumption and groundwater levels over time.
Groundwater Table Depletion	Regularly measure groundwater levels and assess changes in the groundwater table.	Evaluate the rate of groundwater depletion and its impact on the aquifer.
Base Flow Depletion in Rivers	Monitor base-flows and corresponding water levels in the river, particularly in the Ramganga and Aril rivers.	Assess the impact of excessive water use on river base flow and aquatic ecosystems.
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:
Water Usage in Agriculture	Continuously monitor water consumption in agriculture, focusing on groundwater extraction. Track trends in water usage to identify excessive use	Evaluate the adherence of farmers to water and chemical usage regulations. Assess the effectiveness of enforcement measures

Chemical Usage	Regularly monitor the use of chemicals, pesticides, and fertilizers in agriculture. Record quantities used and types of chemicals applied	Assess the adoption of water-efficient irrigation methods and sustainable farming practices. Evaluate the reduction in water use and chemical inputs
Groundwater Table Depletion	Monitor groundwater levels at regular intervals in affected areas. Evaluate changes in the groundwater table to assess depletion	Evaluate the extent of groundwater depletion caused by agricultural practices. Assess the impact on the aquifer and water availability
Pollution Levels	Monitor water quality in areas affected by agriculture runoff and leaching. Assess pollution levels, including the presence of chemicals and contaminants	Evaluate the degree of pollution in water bodies due to agricultural runoff and leaching. Assess the impact on aquatic ecosystems and water quality
Identified Key Issue-3		
Waste water management (Domestic-Deoraniya river and Nakatiya river and industrial)		
Objective:	Monitoring:	Evaluation:
Wastewater Generation	Continuously monitor the volume of domestic and industrial wastewater generated. Track sources and quantities of wastewater.	Evaluate the impact of domestic and industrial wastewater on Deoraniya and Nakatiya rivers. Assess changes in water quality, aquatic life, and ecosystem health.
Wastewater Treatment	Regularly monitor the performance of wastewater treatment plants (WWTPs) when operated. Assess the efficiency of treatment processes.	Assess the effectiveness of wastewater treatment plants in reducing pollution. Evaluate their contribution to improved water quality.
Water Quality	Monitor the quality of discharged wastewater into Deoraniya and Nakatiya rivers. Measure parameters like biochemical oxygen demand (BOD) and chemical oxygen demand (COD).	Evaluate the reduction in pollution load in the rivers due to wastewater management efforts. Assess improvements in water quality indicators.
Compliance with Standards	Monitor compliance with wastewater discharge standards and regulations. Track violations and non-compliance incidents.	Evaluate the involvement of industries and communities in wastewater management initiatives. Assess the impact of awareness programs.
Identified Key Issue-4		
Solid waste management in urban and rural areas		
Objective:	Monitoring:	Evaluation:
Waste Generation and Collection	Continuously monitor the quantity and types of solid waste generated in urban and rural areas. Track the efficiency of waste collection processes.	Evaluate the effectiveness of waste reduction and recycling initiatives. Assess the reduction in waste sent to landfills and increased recycling rates
Waste Transportation	Regularly monitor the transportation of collected waste to disposal sites. Assess	Assess the efficiency of waste collection, transportation, and disposal. Evaluate the cost-

	the effectiveness and frequency of waste transportation.	effectiveness of solid waste management programs.
Waste Segregation and Recycling:	Monitor the implementation of waste segregation at source and recycling programs. Track the quantities of recyclable materials collected.	Assess the impact of solid waste management on the local environment. Evaluate the reduction in pollution, landfill gas emissions, and soil contamination
Landfill Management:	Monitor landfill operations, including waste disposal and compaction. Assess landfill capacity and environmental impact.	Evaluate the level of community involvement in waste management practices. Assess the impact of awareness campaigns and community participation.
Identified Key Issue-5 Floodplain (mining and palaze) and wetlands protection and restoration to ensure local water security and enhance climate resilience. which includes measures to address riverbank encroachment- Ramganga/Aril river/Deoraniya/Nakatiya rivers		
Objective:	Monitoring:	Evaluation:
Floodplain and Wetlands Condition	Continuously monitor the condition of floodplains and wetlands in the target areas. Track changes in their extent, quality, and ecosystem health	Evaluate the effect of floodplain and wetland protection and restoration on local water security. Assess changes in water availability for communities and agriculture
Riverbank Encroachment	Regularly monitor riverbanks along the Ramganga, Aril, Deoraniya, and Nakatiya rivers. Assess encroachment levels and encroachment trends	Evaluate the success of riverbank encroachment control measures. Assess the reduction in encroachment and the protection of riverbanks.
Restoration Activities	Monitor the implementation of floodplain and wetland restoration measures. Track the progress of restoration projects and their effectiveness	Assess changes in biodiversity and ecosystem health in floodplains and wetlands. Evaluate the restoration's impact on local flora and fauna
Water Security Measures	Monitor the implementation of water security measures in floodplains and wetlands. Assess the impact on local water availability and climate resilience	Assess the enhancement of climate resilience achieved through floodplain and wetland restoration. Evaluate the mitigation of flood risks and improved water storage
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:
Capacity Assessment	Continuously monitor the capacity and skills of the District Ganga Committee (DGC) members. Track their existing skills, training needs, and institutional support requirements	Evaluate the effectiveness of training programs in enhancing the technical, and institutional skills of DGC members. Assess the level of skills improvement and knowledge transfer

Training Programs	Monitor the implementation of training programs aimed at enhancing technical, and institutional skills. Track participation rates and training outcomes	Assess the impact of capacity building on DGC's ability to make informed decisions. Evaluate the quality and effectiveness of decision-making processes
Resource Allocation	Monitor the allocation of human and financial resources to the DGC. Assess whether resources are being allocated effectively to address capacity gaps	Evaluate the efficient utilization of human and financial resources by the DGC. Assess whether resources are allocated to address capacity gaps effectively
Compliance with Ganga Authority Orders	Regularly monitor DGC's compliance with orders and directives from the Ganga Authority. Track the implementation of required actions	Evaluate DGC's compliance with Ganga Authority orders and directives. Assess the degree of implementation and adherence to prescribed actions
Identified Key Issue-7 Gaps in knowledge on status, issues and actions needed for conservation of key tributaries in Bareilly district.		
Objective:	Monitoring:	Evaluation:
Baseline Knowledge Assessment	Conduct an initial assessment of the existing knowledge regarding the status, issues, and conservation actions needed for key tributaries in Bareilly district	Assess the quality and availability of data and information related to key tributaries. Evaluate whether data collection efforts have been successful
Research and Data Collection	Monitor ongoing research, data collection, and studies related to tributary conservation. Track the progress of data gathering activities.	Evaluate the extent to which knowledge gaps have been reduced through research, data collection, and awareness programs. Assess the improvement in understanding tributary status and conservation needs
Awareness and Training Programs	Monitor the implementation of awareness and training programs aimed at increasing knowledge on tributary conservation. Track the participation and engagement of stakeholders in these programs	Evaluate the effectiveness of awareness and training programs in increasing awareness and knowledge among stakeholders. Assess changes in attitudes and behaviour's related to tributary conservation.

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.

References

- [1] National Mission for Clean Ganga Ministry of Jal Shakti (Department of Water Resources, River Development & Ganga Rejuvenation) Government of India (2023): [Ganga River Basin Management Plan](#)
- [2] KD Alley (2016): [Rejuvenating Ganga: Challenges in Institutions, Technologies and Governance](#)
- [3] Mishra et al., (2021): [DISTRICT GANGA COMMITTEES: A DECENTRALIZED APPROACH TO REJUVENATE GANGA](#)
- [4] Foster and Choudhary (2009): [Lucknow City – India: Groundwater Resource Use & Strategic Planning Need](#)
- [5] NATIONAL MISSION FOR CLEAN GANGA, Ministry of Water Resources, River Development and Ganga Rejuvenation, GOVERNMENT OF INDIA (2017): [VISION GANGA](#)
- [6] [Uttar Pradesh State Disaster Management Institute, Government of Uttar Pradesh \(2022\)](#)
- [7] [General Institute of Water Resources and Hydropower Planning and Design \(GIWP\), Ministry of Water Resources \(MWR\) of China \(2020\)](#)
- [8] Khan et al., (2015): [Assessment of surface water quality and its spatial variation. A case study of Ramganga River, Ganga Basin, India](#)
- [9] Ray (1998): [Ecological imbalance of the Ganga river system: its impact on aquaculture](#)
- [10] Khan et al., (2017): [Spatial and temporal variations of physicochemical and heavy metal pollution in Ramganga River—a tributary of River Ganges, India](#)
- [11] INRM (2014): [Hydrological Modelling of the Ramganga River Basin](#)
- [12] Government Of Uttar Pradesh: [Bareilly \(2023\)](#)
- [13] Singh et al., (2009): [SPATIAL-TEMPORAL MONITORING OF GROUNDWATER USING MULTIVARIATE STATISTICAL TECHNIQUES IN THE BAREILLY DISTRICT OF UTTAR PRADESH, INDIA](#)
- [14] Tripathi and Issac (2016): [Rainfall Pattern and Groundwater Fluctuation in Ramganga River Basin at Bareilly District, Uttar Pradesh, India](#)
- [15] [Irrigation & Water Resources Department \(2023\): State Government of Uttar Pradesh, India](#)
- [16] [Jal Jeevan Mission - Uttar Pradesh \(JJM - UP \), Namami Gange & Rural Water Supply Department \(2021\)](#)
- [17] FW Schwartz, H Zhang (2002): [Fundamentals of ground water](#)
- [18] Srivastava et al., (2011): [Water Quality Assessment of Ramganga River at Moradabad by Physico-Chemical Parameters Analysis](#)
- [19] [Uttar Pradesh Pollution Control Board – Bareilly](#)
- [20] Central Ground Water Board, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Government of India (2020): [AQUIFER MAPPING AND](#)

[21] MINISTRY OF FINANCE BUDGET DIVISION (2023): [EXPENDITURE BUDGET 2023-2024](#)

[22] Ashwaq Masoodi (2016): [Budget 2016 | Mixed bag for women](#)

[23] Ministry of Rural Development (2022): [Allocation of Funds under MGNREGS](#)

[24] [Mission Amrit Sarovar \(2023\)](#)

[25] VM Kensa (2011): [BIOREMEDIATION - AN OVERVIEW](#)

[26] Government of India (2021): [Swachh Bharat Mission - Grameen - Ministry of Jal Shakti](#)

[27] Ministry of Jal Shakti (2021): [Details of Funds Spent on Namami Gange Programme](#)

[28] Bruce and Shelley (2010): [Assessing Stakeholder Engagement](#)

Other documents referred:

1. Kaushal N. Babu S., Mishra A, O'Keeffe J. Environmental Flows for a healthy Ramganga (2018). World Wide Fund for Nature India (WWF India)
<https://www.wwfindia.org/?19842/Environmental-Flows-for-a-Healthy-Ramganga>
2. Kaushal, N.; Babu, S.; Mishra, A.; Bajpai, R.; Sinha, P.K.; Arya, R.K.; Tickner, D.; Linstead, C. Securing Flows in the River Systems through Irrigation Water Use Efficiency—A Case Study from Karula River in the Ganga River System. *Water* **2022**, *14*, 2894.
<https://doi.org/10.3390/w14182894>
3. Angela H. Arthington, David Tickner, Michael E. McClain, Mike C. Acreman, Elizabeth P. Anderson, Suresh Babu, Chris W.S. Dickens, Avril C. Horne, Nitin Kaushal, Wendy A. Monk, Gordon C. O'Brien, Julian D. Olden, Jeffrey J. Opperman, Afua G. Owusu, N. LeRoy Poff, Brian D. Richter, Sergio A. Salinas-Rodríguez, Beauty Shamboko-Mbale, Rebecca E. Tharme, Sarah M. Yarnell. Accelerating environmental flows implementation to bend the curve of global freshwater biodiversity loss (2023). Environmental Reviews. Canadian Science Publishing.
https://www.researchgate.net/publication/372178971_Accelerating_environmental_flows_implementation_to_bend_the_curve_of_global_freshwater_biodiversity_loss