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NAMAMI GANGE

Handbook

On District Ganga Planning

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In consultation with

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RIVER DEVELOPMENT & GANGA REJUVENATION

FOREWORD

Rejuvenation of Ganga requires an integrated approach which considers multi-dimensional aspects on river cleaning and restoration at the basin, sub basin and local levels. The Authority Notification of 2016 for rejuvenation, protection, and management of river Ganga and its tributaries mandates the District Ganga Committees (DGCs) to prepare a holistic District Ganga Plan (DGP).

Holistic and integrated strategic approaches of river rejuvenation address entire river basins and go beyond pollution abatement to address non-biophysical and institutional aspects such as regulatory framework, coordination among various agencies and capacity development. It is important that DGPs build on, directly support, and complement existing programmes and plans to avoid duplication and are synergised to the respective basin plans. Gender, social inclusion and equity are highly relevant for the management of a river basin, where women play a key role in the provision, management and safeguarding of water for domestic and agricultural purposes.

Since April 2022, the District Ganga Committees (DGCs) have been conducting Monthly, Mandated, Monitored, Minuted (4 M) meetings regularly. Minutes of 1862 such meetings held since then, till now are uploaded on Ganga District Performance Monitoring System (www.gdpms.mowr.gov.in). DGCs deliberate on issues related to rejuvenation of Ganga & its tributaries, tapping of nallahs flowing into the Ganga river, afforestation, maintenance of assets (sewage treatment infrastructure) created under Namami Gange Scheme, prevention of solid waste flowing into the river, conservation of aquatic biodiversity etc.

On an experimental basis, to strengthen the district planning process, four districts within Ramganga Basin have prepared comprehensive DGPs adopting the River Basin Management (RBM) cycle approach. These plans are based upon a District Ganga Planning framework approved by NMCG. The DGP preparation in two districts, Udham Singh Nagar and Shahjahanpur has been supported by the Indo-German Cooperation Project-Support to Ganga Rejuvenation-II (SGR-II) being implemented by GIZ together with NMCG. DGPs forthe two other districts, Moradabad

Contd...

and Bareilly have been prepared with support of WWF India. Simultaneously, a District Planning Handbook has been developed which includes the elements of the DGP framework and also captures the experiences gained during preparation of the model DGPs. Gender-sensitive approaches are integrated throughout all steps of the District Ganga planning cycle in order to have an inclusive approach during the development of the DGPs.

This DGP handbook provides holistic but simple guidelines for river basin management at the district level that can be directly adopted by DGCs to prepare their respective DGPs. It explains the various elements and provides detailed directions on how to prepare a DGP translating their specific issues and needs at district level into strategic action plans. The handbook is not specific to a particular district and is intended as a guiding tool for preparing the plan for any district within Ganga Basin. The DGP handbook will form the basis for planning and implementing the activities to be undertaken by the District Ganga Committee for protection and rejuvenation of the river Ganga and its tributaries.

I sincerely acknowledge the support of Indo-German Cooperation project and the team involved of GIZ and WWF India for their contributions in the development of this handbook. I am sure this handbook will serve as an important tool to guide the District Ganga Committees in the preparation of their respective DGPs

Dated : 20th September 2023

(G Asok Kumar)

Introduction

This District Ganga Planning Handbook is the basis for the preparation of comprehensive District Ganga Plans (DGPs) for the protection and rejuvenation of River Ganga and its tributaries. It will support to strengthen the District Ganga Committee's (DGCs') capacities and coordination mechanisms to collaborate and effectively take actions on the prioritised issues and gaps in the respective districts.

Water is a shared resource and river basins cut across multiple jurisdictions and administrative boundaries with applications in agricultural, domestic, industrial, and environmental uses. This necessitates the need for diverse stakeholders to work together, develop and implement integrated collective action plans to protect, conserve and rejuvenate freshwater ecosystems and preserve the socio-cultural significance of healthy river scapes.

India's national institutions have recognised that a systemic strategy towards the protection and rejuvenation of rivers is essential. Application of holistic and integrated strategic approaches has already been initiated. The ongoing Ganga rejuvenation interventions have simultaneously started to address the entire river basin and consider issues like sewage, industrial effluents, irrigation water withdrawal, hydropower utilisation, solid waste management, environmental flows, biodiversity conservation and stakeholder stewardship etc. in a comprehensive manner.

A holistic River Basin Management (RBM) based upon the RBM Cycle approach has now been taken up in Indian river basins such as Tapi and Ramganga. Further, four DGCs within Ramganga Basin have prepared their respective model District Ganga Plans (DGPs) adopting a common framework. The Cyclic approach, built upon the implementation philosophy of EU Water Framework Directive, offers distinct advantages to prioritise the key issues to be addressed in a phased manner and simultaneously create new information on identified gaps.

These interventions towards RBM planning have been taken up in Indian river basins under the Indo-German Development Cooperation project "Support to Ganga Rejuvenation (SGR)" implemented by *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH on behalf of the German Federal Ministry of Economic Cooperation and Development (BMZ). Since 2015, Germany is committed to work together with the Ministry of Jal Shakti and the National Mission for Clean Ganga on Ganga rejuvenation. Since 2017, the project is jointly implemented with an EU co-financing to strengthen the India-EU Water Partnership (IEWP).

The project also supports allied aspects, which are needed to ensure a successful river rejuvenation programme and develop integrated solutions for practical planning, coordination and steering mechanisms. This includes topics such as institutional strengthening of National Mission for Clean Ganga (NMCG), environmental flows (E-Flows) initiative in the Ramganga Basin, faecal sludge and sewage management, promotion of Safe Reuse of treated water, public awareness, and capacity development among others.

World Wide Fund for Nature – India (WWF-India) since 2007 in its India's Rivers & Wetlands programme is collaborating with multiple stakeholders from diverse sectors to develop and implement a shared vision for rejuvenation of Ganga and one of its major tributaries—the Ramganga. WWF-India's work in the Ganga and Ramganga is driven by the principle that collaborative actions with diverse stakeholders is needed to protect, conserve, and rejuvenate freshwater ecosystems. The organisation has drawn its

experience from multi-faceted, multistakeholder programme at various levels—state, basin, districts, aquifers and watersheds implemented with financial support from HSBC and Reckitt—to contribute to this Handbook. This includes the work on river basin management including Ramganga; assessment and restoration of E-Flows in Ramganga with various partners; surface-groundwater interactions; river-wetland co-management with District Ganga Committees of Moradabad and Bareilly; citizen science based river health assessments; conservation of aquatic biodiversity and their habitats; and industrial and urban water stewardship; stakeholder engagement and participative basin governance in the form of mitras (friends of rivers) with IIT Consortia, SWARA, NMCG and SPMG Uttar Pradesh.

Since River Basin Management planning is complex and involves expertise from various agencies and institutions, NMCG, GIZ and WWF-India have come together to jointly work on the District Ganga Planning process by bringing in their respective experience and knowledge enriching the entire process. At outset a framework for the District Ganga planning was jointly developed and agreed with the stakeholders to be used for the development for District Ganga Plans. After that, GIZ has been facilitating the process in two districts- Udham Singh Nagar in Uttarakhand and Shahjahanpur in Uttar Pradesh - and WWF India in two other districts - Moradabad and Bareilly in Uttar Pradesh. The process to develop these model DGPs in four districts has been a participative and an iterative one, where all the concerned line departments and stakeholders at the district level along with District Administration (through DGC) were integral part of the team that developed the respective DGPs.

The DGPs include the measures to achieve defined targets for specific issues, which will be undertaken by the DGCs for protection, control, and abatement of environmental pollution in river Ganga and its tributaries, and their riverbed area abutting the specified district. Gender-sensitive approaches are integrated throughout all steps of the District Ganga Planning cycle to ensure an inclusive approach.

Along with these DGPs, a guiding Handbook on the District Ganga Planning process has simultaneously been developed, capturing the experiences gained during preparation of the model DGPs. This Handbook describes the approach in a systematic manner in simple steps, illustrated with examples from the Ramganga Basin and other catchments. It provides recommendations and illustrates how urgent challenges in basin water resource management are being addressed in practice. As a guiding tool, templates for different stages in the DGP preparation are provided. The Handbook gives an overview of a wide range of topics and possible solutions to be referred to by all DGCs across the Ganga Basin for the preparation of their DGPs.

This Handbook is an outcome of an intense engagement with our partners. We are thankful for the support and constant cooperation with NMCG, State Missions for Clean Ganga (SMCGs) and line departments in Uttar Pradesh and Uttarakhand. The four pilot DGCs' engagement in the whole process in the development of their DGPs has been very encouraging and essential in gathering of experiences for preparation of this Handbook. We hope this Handbook will be used by all other DGCs across the Ganga Basin to prepare their DGPs and accordingly take actions towards a successful rejuvenation of the river Ganga and its tributaries and contribute to Namami Gange's vision of Aviral and Nirmal Ganga.

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Abbrevations

BOD	Biological Oxygen Demand
CETP	Common Effluent Treatment Plants
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organization
DGC	District Ganga Committee
DGP	District Ganga Plan
DO	Dissolved Oxygen
EC	EU Commission
EF	Environmental Flow
ETP	Effluent Treatment Plants
FSSM	Faecal Sludge and Septage Management
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit
GLOF	Glacier Lake Outburst Floods
GPI	Grossly Polluting Industries
GRBMP	Ganga River Basin Management Plan
GVPs	Garbage Vulnerable Points
IEC Incl	Information, Education and Communication Incl including
MAR	Managed Aquifer Recharge
M&E	Monitoring and Evaluation
NGO	Non-Governmental Organisation
NRLM	National Rural Livelihoods Mission
QA/QC	Quality Assurance / Quality Control
SAFE	Suitability, Acceptability, Feasibility Evaluation
SRLM	State Rural Livelihoods Mission
SMCG	State Mission for Clean Ganga
SPCB	State Pollution Control Board
SPI	Seriously Polluting Industries
STP/ SPS	Sewage Treatment Plant / Sewage Pumping Station
UDD	Urban Development Directorate
ULB	Urban Local Bodies
WQ	Water Quality
WUA	Water Users Associations
WWF	World Wide Fund for Nature

Glossary

The following definitions are used for this document:

Specific targets

The use of the term 'specific targets' in this manual is consistent with the commonly used term 'performance indicators' and, in the context of district Ganga planning, refers to measuring the successful implementation of interventions

01 Section About The Handbook: Why A Practical Guide Is Needed And How To Use It

1.1 Objective, approach and scope of the handbook

Objective

As per the Ganga Authority Notification of 2016 regarding the rejuvenation, protection, and management of river Ganga and its tributaries, each district in the Ganga basin should prepare a periodically revised District Ganga Plan (DGP). The plans focus on the river Ganga, its tributaries, and associated riverine zone within the specific district. The plan shall include the activities to be undertaken by the District Ganga Committee (DGC) for ensuring a healthy Ganga and its tributaries protection, control, and abatement of environmental pollution in River Ganga and its tributaries, and their riverbed area abutting the specified district. In addition, the plans shall include detailed budgets and timelines for the mentioned interventions.

Water is related to almost everything and, vice versa, almost everything is related to water—population growth, rapid urbanisation and industrialisation, the expansion of agriculture and tourism, and climate change are putting increasing pressure on the water resources. Accordingly, river rejuvenation needs to address entire river basins and consider not only problem of the sewage generated by human settlements but also other pressure factors such as industry, irrigation water withdrawal, hydropower utilisation, solid waste discharge and bank degradation. These interdependencies require a holistic and stronger integrated river basin management approach of the respective Ganga sub-basin and dynamic cooperation between stakeholders, making District Ganga Planning increasingly complex.

To this end, this handbook provides holistic but simple guidelines for river basin management at the district level that can be directly adopted by DGCs to meet the requirements of the 2016 Authority Notice. For that, the handbook explains the various elements and provides detailed directions on how to prepare a District Ganga Plan translating their water resources issues and needs at district level into strategic action plans.

Scope

In particular, the handbook

- builds on principles based on the River Basin Planning and Management Cycle developed for the Ganga Basin and will use the experiences gained during the development of model District Ganga Plans.
- is not specific to a particular district.
- describes the approach in a systematic manner in simple steps, which will be illustrated with real-life examples from the Ramganga basin and other related catchments.
- provides suggestions rather than definitive answers and illustrates how urgent challenges in basin water resource management are being addressed in practice.
- targets the DGCs and all their partners involved in water resources management at district level.
- is tested and validated through the development of four model District Ganga Plans (for the districts Shahjahanpur, Udham Singh Nagar, Bareilly and Moradabad). The development of the handbook is based on the experiences and feedback received during preparation of the model District Ganga Plans.

What DGCs can expect from the handbook and how to use it

The handbook guides DGCs step by step through the preparation of a DGP, starting with an overview of the general design principles in Section 2. Applied, these principles ensure the development of practical, effective, concise as well as environmentally sound, socially inclusive, gender-sensitive and economically beneficial district plans.

Section 3 provides important information to understand the context in which DGPs are embedded. Here, the legal framework that requires the preparation of DGPs is explained, as well as past and ongoing work and its bearing onto the plans. In addition, an overview of the water-related situation of the Ganga Basin and the institutional set-up is given.

In line with the river basin planning and management cycle, Section 4 describes all relevant steps in preparing DGPs. The general structure of a DGP including its chapters and subchapters is presented in Section 1.2. To support the understanding of the methodology, helpful tips, practical templates and illustrative examples are given for each chapter. Model DGPs are available (e.g. for Shahjahanpur, Udham Singh Nagar) which can serve as further inspiration for the preparation of other DGPs.

Further readings on district planning and Ganga protection and rejuvenation are recommended to DGCs in Section 5, which provides an overview of the references used for the preparation of the handbook as well as helpful literature and data bases.

Helping the DGCs in identifying relevant water-related issues and associated interventions for their districts, Annex 1 and Annex 2 provide a list of the most common water-related issues in the Ganga basin and possible, associated interventions that can be applied in the implementation of a district basin plan, sorted by the issues they address, respectively.

What DGCs can expect from the handbook:

- Practical step-by-step guidance on preparing District Ganga Plans
- Simple instructions illustrated with examples from completed DGPs
- Inventory of most common water issues and associated potential interventions to combat these

1.2 Who can use this handbook

This handbook has been prepared with two distinct roles at district level in mind. A management role to initiate the preparation of the DGP, and an implementation role to produce the actual document.

The first role is the responsibility of the District Ganga Committee, which comprises the key administrative authorities and natural resources managers in the district. The DGC has been tasked with periodically producing a DGP as per the Authority Notification of 2016. This Handbook provides a clear definition of what is expected by SMCG and NMSG. It defines the scope and structure of the DGP, provides a template of the intended outputs, and clarifies the level of detail that is required. It also spells out the stakeholder consultation requirements. Thus, the Handbook is intended to assist the DGC in preparing the detailed Terms of Reference for the task force that has been assigned to prepare the actual DGP. In this regard, the Handbook supports the DGC to initiate the project, guide the task force, monitor progress, and evaluate if the final DGP meets the requirements of SMCG and NMCG.

The second role - the implementation role - is concerned with supporting a dedicated team that will produce the DGP. It will probably comprise a diverse group of technical officers at district level from different line departments. The Handbook serves as a manual on how to prepare the DGP. For each chapter, it describes how the required material can be produced in a stepwise and consultative manner. It standardizes and structures the end-product by presenting a detailed table of content, a standard list of figures and maps, and templates for all elements of the DGP. These elements include the vision, analysis of key issues, actions plan, map layouts, tables, data collection forms, etc. Hence, the Handbook can be used to guide all individuals and institutions involved in the preparation of the DGP, whether they prepare a full chapter or just a single map.

02 Section Principles For Preparing District Ganga Plans

Simple

In order to be practical, effective, and concise, the DGPs should preferably be implemented within the existing institutional setting and budget constraints, and with existing staff. Complex solutions typically require resources at vastly greater scale—in terms of budget, skilled staff, management and information systems, models, and budgets.

Generic yet specific

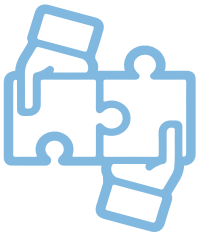
To ensure consistency among DGPs, achieve uniform quality, and streamline the development of the plans, some elements of the DGPs can be generic. It is recognized, however, that water issues will be district specific.

Synergistic

It is important that District Ganga Plans build on, directly support and complement existing programmes and plans to avoid duplication. These include: Sub-basin Management Plan and with the overall Ganga River Basin Management Plan (GRBMP), Urban River Management Plans and Arth Ganga.

Environmentally responsible

Prioritise measures that have a minimal impact to no damage to ecosystems and the environment. This can be promoted by choosing nature and ecosystem-based green measures rather than grey infrastructure.



Socially inclusive

Prioritise measures that provide equal access to benefits for all members of society. At its best, it promotes the conditions for individuals and groups to participate in society - improving the abilities, opportunities and dignity of those who are disadvantaged and vulnerable, including women on the basis of their identity.

Economically beneficial and sustainable

Prioritize measures that have a positive economic impact for the local population and builds livelihood focusing on circular economy. Propose measures that can be easily sustained with existing local resources and do not rely on (long-term) external funding - see Key Principle 1.

Gender sensitive

Prioritise measures that promote women's participation in decision-making at all levels. This ensures that the needs and interests of women, who have an important role in water management, are not overlooked.

Measurable

An integrated M&E plan allows for evaluation of the impact of actions, continuous updating and improvement of district plans, and ensures that mistakes are not repeated.

03 Context

Section

3.1 GRBMP & its vision for Ganga and tributaries rejuvenation - Regulatory & political framework (Chapter 1.1 of the DGP)

The Ganga River Basin Management Plan has the Vision of the "Restoration of "Wholesomeness" of rivers in the Ganga Basin. Its main missions related to Aviral and Nirmal Dhara, Ecological health and basin governance lay the framework for the activities for each of the Ganga tributaries when looking into the rejuvenation, protection and management of the rivers. Important activities, to contribute to the overall vision on the Basin level, are to be implemented at local scale in the districts. While the Vision for the District Ganga Plan would focus on river rejuvenation at the district level, goals, objectives and outcomes for each river may vary; though in totality contribute to the single vision.

As per the Authority Notification of 2016 each district in the Ganga basin is to prepare a District Ganga Plan. The plans are concerned with the reach of River Ganga, its tributaries, and associated riverine zone within the specific district. The plan shall include the activities to be undertaken by the District Ganga Committee (DGC) for protection, control, and abatement of environmental pollution in River Ganga and its tributaries, and their riverbed area abutting the specified District

3.2 Past work around similar exercises in the basin & its linkages with the District Ganga Plans (Chapter 1.2 of the DGP)

Efforts to Ganga rejuvenation date back several decades. In 2014, the Government of India launched the 'Namami Ganga Programme' as an integrated conservation mission to achieve the goal of effective pollution control, conservation and rejuvenation of the Ganga. The National Mission for Clean Ganga (NMCG) was established as the nodal agency for the implementation of this programme. Initially, the focus was on cleaning the main stem of the Ganga, but since many tributaries are also heavily polluted and carry waste to the river, the approach was expanded to the entire Ganga basin.

Under this flagship, several programmes have already been implemented and plans and guidelines developed. When developing DGPs, synergies with these programmes should be sought and used to avoid duplication and needless effort. Where there is overlap with existing action plans, reference should be made. A selection of the most important initiatives is presented below that should be considered when preparing DGPs.

The District Ganga Plan (timeframe 2022-2027) needs to align with the Sub-Basin Management Plan (e.g. Ramganga RBM plan, find more information in Box 1) and with the overall Ganga River Basin Management Plan (GRBMP), developed by NMCG through a consortium of seven IITs. While all the aspects of the GRBMP, may or may not have direct bearing on the District Ganga Planning exercise; however, the basin principles, of Aviral Dhara (uninterrupted flows) and Nirmal Dhara (unpolluted flows) must remain the central theme of the District Ganga Plan as well.

Box 1: Ramganga RBM Plan

Ramganga, as a tributary of Ganga flows through stretches of Uttarakhand and Uttar Pradesh. A river basin management (RBM) plan (here: sub-basin RBM) guides the responsible authorities and stakeholders to manage and use the water resources in the basin in a sustainable, integrated, and equitable manner, while taking into account the diverse environmental and socio-economic context. Thus, the plan sets limits on surface and groundwater use, provides environmental flow recommendations, and defines water quality thresholds. The plan also identifies key water resources issues at basin scale and proposes a suite of measures how to address them. For the Ganga basin, all RBM plans will address two primary objectives, which are condensed in

1. ensuring uninterrupted flow, and
2. supporting unpolluted flow. The proposed measures in the respective RBM plans, however, will be diverse and site specific as a function of local conditions.

Regarding the preparation of the DGP, the RBM Plan prepares the framework by defining the higher-level context and by setting basin-level objectives and priorities. For the Ganga River basin, only the RBM Plan for the Ramganga is currently in preparation.

At the district level, there are several other plans that contribute to the rejuvenation and protection of rivers in the district. These include the district environmental plan focusing on the protection of the environment and natural resources, including assessment, mitigation and monitoring of the negative impacts of various sources of pollution at the district level. Further, district irrigation plans aim efficient storage and allocation of available water resources and PCB action plans to reduce pollution in the district's rivers.

3.3 Ongoing financing schemes and programmes

Table 1 presents an overview of selected ongoing schemes and programmes at national, state and district level that provide financial support for the implementation of DGPs. The relevance of these programmes to the identified measures and their eligibility must be verified (see section 4.8.3 of this handbook for more information).

Table 1. Ongoing financing schemes and programmes

Department	Ongoing financing schemes and programmes	Thematic focus
Ministry of Jal Shakti	▪ Jal Jeevan Mission ▪ Jal Shakti Abhiyan ▪ Atal Bhujal Yojana ▪ Namami Gange Programme ▪ National Aquifer Mapping Programme ▪ Master Plan for Artificial recharge to Groundwater in India ▪ Swachh Bharat Mission (Gramin)	Safe drinking water, saving and conserving rainwater, community-led sustainable ground water management, abatement of river pollution, conservation and rejuvenation of National River Ganga, mapping and management of all the aquifer systems, Artificial recharge with Rainwater Harvesting, Check Dams, Sanitation Coverage
Rural Development (MNREGA)	▪ MGNREGS ▪ SRLM/NRLM	Planning and utilization of MNREGA resources for improving ecosystem services
Dept. of Water Resources, River Development & Ganga Rejuvenation	▪ Atal Bhujal Yojna	Ground water management Scheme
Ministry of Housing and Urban Affairs (MoHUA)	▪ Smart Cities Mission ▪ Swachh Bharat Mission (urban) ▪ Atal Mission for Rejuvenation and Urban Transformation (AMRUT)	promoting cities to provide core infrastructure, clean and sustainable environment, universal sanitation coverage and drinking water coverage
Ministry New and Renewable Energy	▪ PM-KUSUM	Installation of solar, agriculture pumps and use of renewable energy
MSME	▪ Solar Charkha Mission	Sustainable development, Rural economic development

Department	Ongoing financing schemes and programmes	Thematic focus
MoEF&CC	▪ Climate Resilience Building Among the Farmers Through Crop Residue Management ▪ National Action Plan on Climate Change	Pollution abatement, offset the adverse environmental impacts induced by the burning of stubble, enhance the ecological sustainability

3.4 Basin overview (Chapter 4.1 of the DGP)

The Ganga is India's longest river. It rises in the western Himalayas in the state of Uttarakhand. After leaving the mountains, the river flows east in the Gangetic plain of North India. Major left-bank tributaries include the Ramganga River, Gomti River, Ghaghara River, Gandaki River and Kosi River; major right-bank tributaries include the Yamuna River, Son River, Punpun and Damodar. Several left bank tributaries receive most of their water from Nepal. The Ganga enters Bangladesh some 18 km downstream of the Farakka barrage.

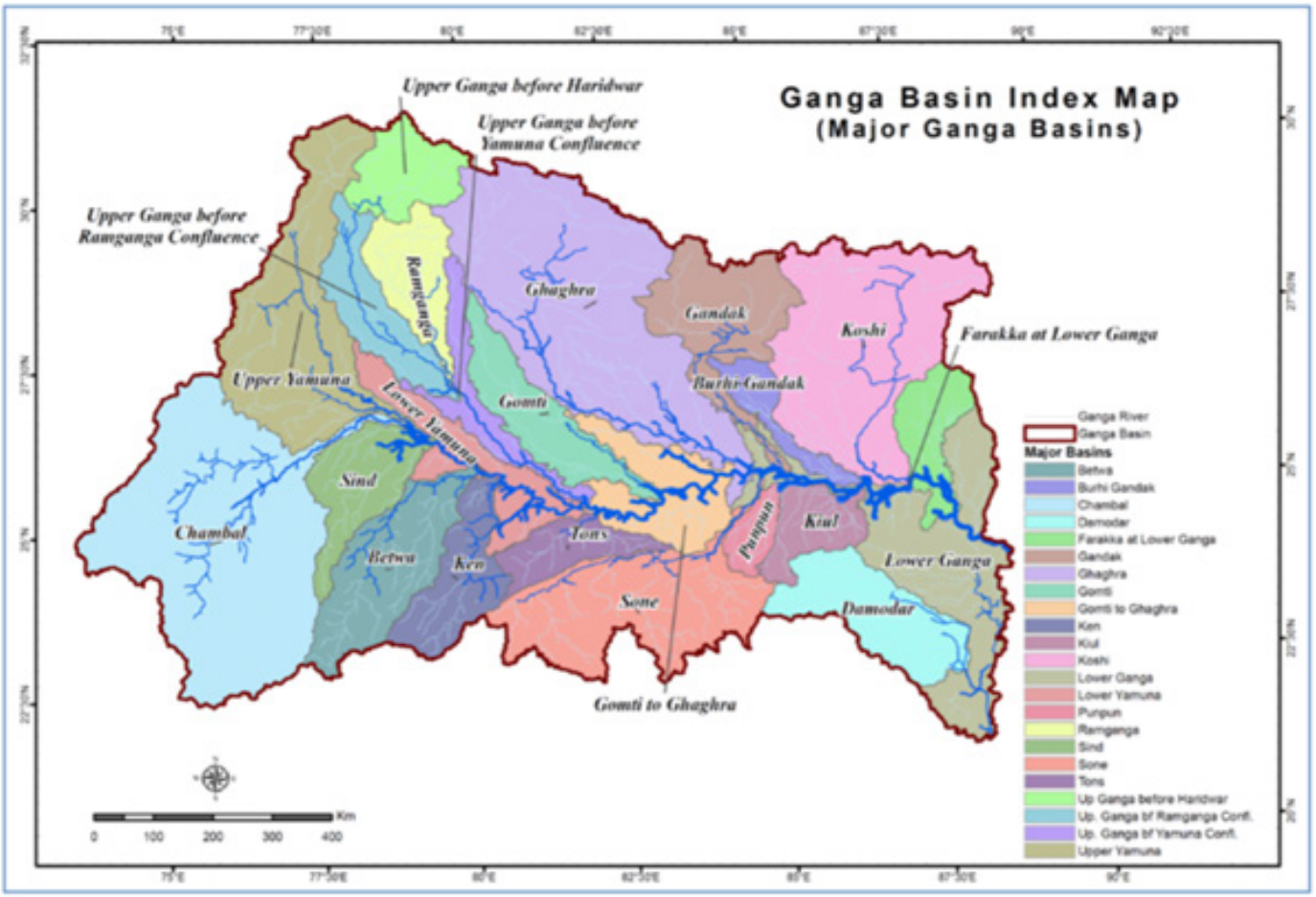
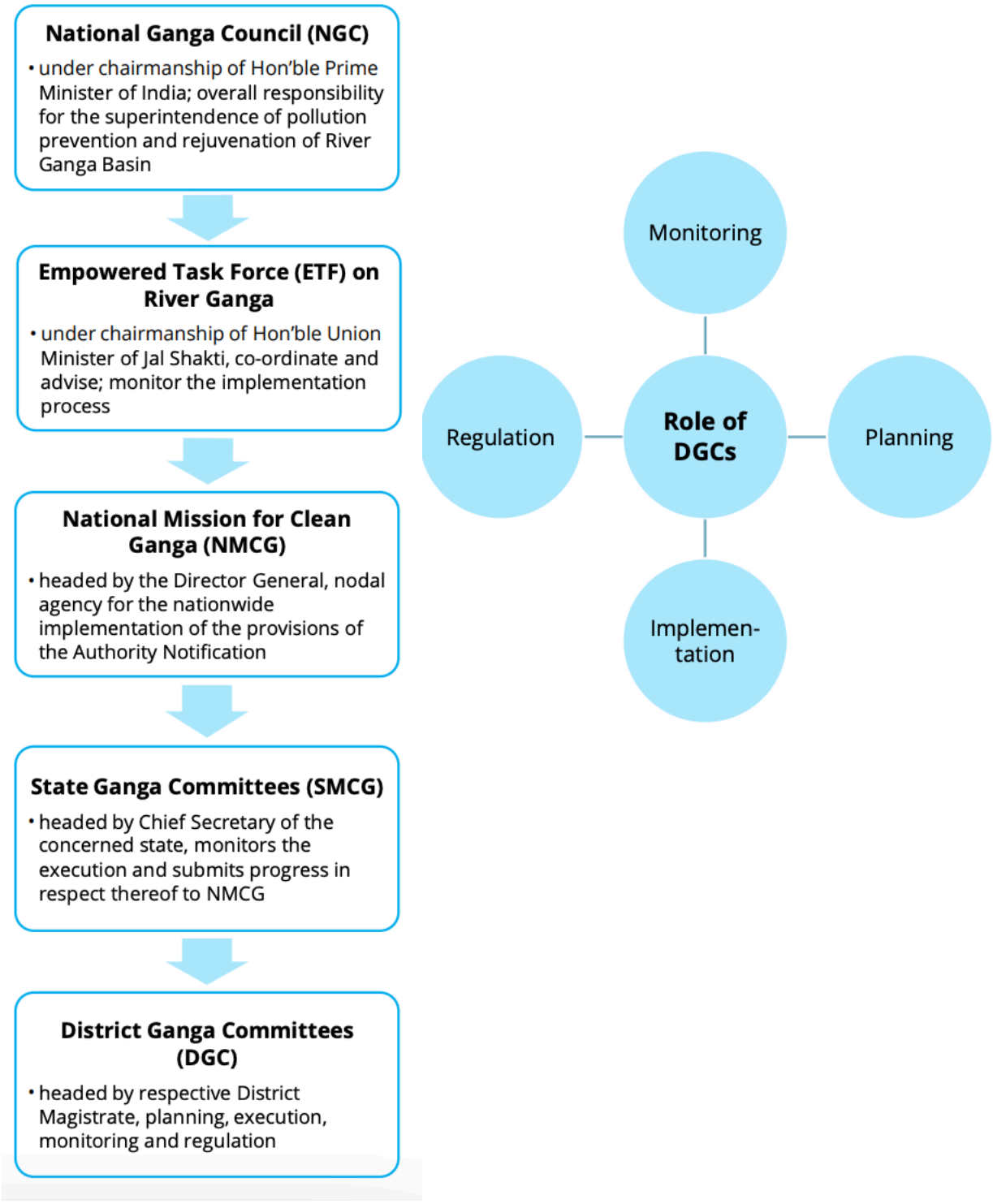


Figure 1. Ganga basin map

3.5 Roles and types of basin organisations

In order to implement measures cleaning and rejuvenation of the Ganga, the Ministry of Water Resources, River Development and Ganga Rehabilitation (now Ministry of Jal Shakti or MoJS) has set up a five-tier structure operating at the national, state and district level. This five-tier structure ensures the involvement of all relevant stakeholders, starting from the highest level of the Prime Minister down to the district level, where the actual implementation of activities takes place, and seeks to bring all stakeholders together on one platform to take a holistic approach.



04 Section Roadmap To Preparing District Ganga Plans

4.1 General considerations

4.1.1 Introduction

Chapter 4 will describe how each element of the District Ganga Plan (DGP) can be produced in a systematic, consultative, and stepwise manner.

Prior to presenting the detailed methodology (Par 4.2), this chapter starts with a concise discussion of several themes that have relevance to every aspect of preparing the DGP, and similarly impact on its implementation. These themes are the river basin planning and management cycle, stakeholder engagement, need for gender-inclusive approach, linkages with Arth Ganga, and data collection. The above themes need to be carefully considered in each step of the DGP preparation process to ensure its successful completion and subsequent implementation.

4.1.2 River Basin Planning and Management Cycle

The general structure of the DGPs is aligned to the River Basin Planning and Management Cycle, which has been adopted by NMCG and will be briefly presented below.

Ganga rejuvenation is a continuing responsibility. Developing the District Ganga Plans (DGPs), therefore, is understood as a spiral process, in which plans are made and implemented, new information is reviewed, feedback is received, priorities are modified and refined, and plans are adapted to changed circumstances. The cycle will be repeated after five to six years.

This process is referred to as 'adaptive management'. It is characterized by a systematic and institutionalized process to improve management practices based on constant feedback and continuous learning, with the aim to adapt to changing environmental and socio-economic conditions.

Figure 2 shows this River Basin Planning and Management Cycle at the national level, which builds on the implementation philosophy and requirements of the EU Water Framework Directive (2000/60/EC). This cycle will be adapted to the district level in paragraph 4.2.

Figure 2. River basin planning and management cycle

4.1.3 Stakeholder engagement

Effective policy action is based on views among a broad group of decision makers, key actors, and relevant stakeholders. Hence effective implementation of the District Ganga Plan will require some level of consensus on 1) which issues to address during the plan period, 2) what causes these issues, and 3) the best way to solve them I.e. programme of measures (PoM).

Stakeholder engagement, therefore, is critical at key stages of the development of the District Ganga Plans. These include:

- Identification, categorization, and ranking of water issues
- Selection of issues to address in this management cycle
- Development of a conceptual understanding of these water issues (to assure buy-in, but also
- to improve the quality of the analysis)
- Identification and selection of proposed measures
- Reaching agreement on implementation modalities

Still, a balance must be found between inclusiveness and effective implementation of the District Ganga Plans. After all, the assumption that managerial resources are scarce will also apply to the capacity of the District Ganga Committee engage with stakeholders.

Selection of stakeholders, therefore, needs to be strategic. Priority should be given to those with a broad network of influence or who represent communities or relevant trades. Stakeholders will also differ in the various stages of developing the District Ganga Plans. For instance, in the initial stages—which are focused on identifying and ranking water issues across the district—a wide perspective is required. At a later stage—with emphasis on addressing a select set of issues—a much narrower outlook will be more effective. Table 2 presents selection criteria for and key examples of stakeholders to be involved in the preparation of DGPs and their potential roles in the process. A more detailed stakeholder list with their general roles and responsibilities in District Ganga Planning are provided in the Annex 5.5.

It is recognized that women play a key role in water governance at household and smallholder level but are sometimes not well represented in participatory processes because of institutional factors. Hence concerted efforts will be made to adequately include the voice of women in the stakeholder consultation process (see paragraph on Need for a gender-inclusive approach below).

Table 2. Proposal for selection criteria for potential stakeholders to be involved in preparing DGPs and their roles in Ganga rejuvenation and protection

S. No.	Proposal for selection criteria for potential stakeholders to be involved in the development of DGPs	Examples of key stakeholders	Role in District Ganga Planning
1	Water policy and law makers involved in water governance, water allocation, developing of water policies, establishment of RBM organizations, development of IWRM projects and issuing of water-use permits such as government ministries/ departments and public authorities at district, tehsil, block and village levels	Irrigation & Water Resources Department	Monitor preparation and implementation of DGP with special focus on Water resources planning, allocation, management, irrigation, river management, floods management
		Forest department	Providing information, monitor preparation and implementation of DGP with focus on issues related to the forest including environment, wildlife, and species conservation
		Agriculture Department	Providing information, monitor preparation and implementation of DGP with focus on issues related to farming, farmers, crops, agricultural inputs and equipment
		Groundwater Department	Providing information, monitor preparation and implementation of DGP with focus on issues related to groundwater exploration, level monitoring, classification into different zones
		State Pollution Control Board	Providing information, monitor preparation and implementation of DGP with focus on issues related to liquid waste, pollution, industries
		City Nagar Nigam (City Municipal Corporations)	Providing information, monitor preparation and implementation of DGP with focus on issues related to solid waste, encroachment (in city), illegal dumping of waste

S. No.	Proposal for selection criteria for potential stakeholders to be involved in the development of DGPs	Examples of key stakeholders	Role in District Ganga Planning
2	Representatives of the main water users	Water utilities	Delivery of data, implementation of suggested interventions and specific targets
		Farmers	
		Industry	
		Vehicle washing centres/workshops	
		Business premises	
		Wildlife parks	
		Fisheries	
		Households	
		Navigation	
		Tourism	
3	Stakeholders having good network with main water polluters involving solid waste, liquid waste, industrial waste, medical waste etc.	Representatives from district level towns	Delivery of data on water pollution, implementation of suggested interventions and specific targets, contribution on capacity building and awareness programmes
		Small towns and villages, industry representatives	
		Agricultural organisations	
		Community leaders	
4	Experts on water quality and water pollutants	Research institutions	Delivery of data on water quality and pollution types and sources, suggestion of (innovative) interventions and specific targets
		Universities	
		Local water departments	

S. No.	Proposal for selection criteria for potential stakeholders to be involved in the development of DGPs	Examples of key stakeholders	Role in District Ganga Planning
5	Representatives from society	WWF India	Delivery of data, suggestion of interventions and specific targets, coordination related to capacity building and trainings on District Planning plus working on Moradabad district
		Earthwatch	
		WaterAid	
		Local / riparian community	
		Water user associations	
6	Stakeholders involved in educational activities and public information for water quality conservation such as promotion/ encouragement of rainwater harvesting, ground water recharge, managed aquifer recharge, soak pits construction for bathrooms, kitchens wastewater filtration as well as the organization of mass awareness programs; information, education and communication (IEC) campaigns; seminars; workshops, school curriculars etc.	Educational institutions and media	Capacity building and awareness on water and wastewater management

4.1.4 Need for a gender-inclusive approach

Gender equality refers to the equal rights, responsibilities and opportunities of women, men, and boys, girls and all vulnerable groups. Inclusion means acknowledging and addressing everyone's perspectives and needs regardless of their gender identity and ensuring that into the systems and processes.

Gender, social inclusion and equity are highly relevant to ensuring a safe and healthy society and economic prosperity. This is especially true for the management of a river basin, where women play a key role in the provision, management and safeguarding of water for domestic and agricultural purposes. At the same time, women are more vulnerable to abuse, attack and ill-health, affecting their ability to study, work and live in dignity without safely managed water, sanitation and hygiene (WASH) services. Societies that value all genders as equal are safer and healthier.

Although, gender equality constitutes a human right and sustainable development goal (SGD5), women and other vulnerable groups are to date often not adequately included in water governance forums, organisations, decision-making opportunities, and practices, despite global initiatives such as the Dublin Principles, which call for the central role that women play in water management to be recognised, utilised, and valued. Thus, water resources/river basin management calls for a gender-responsive approach enabling systemic changes and better economic and environmental benefits for communities (Global Water Partnership 2021)[1].

Promoting gender sensitive approaches in District Ganga Plans:

A gender-sensitive participatory approach acknowledges the numerous obstacles to women's participation and sets up mechanisms for lifting those obstacles. Particular attention is given to the differential experiences of women and men, and, thus, their different opinions, concerns, needs, and priorities. It encourages the participation of all genders including women, either together or separately. It is an excellent way of collecting sex disaggregated data and everybody's views.

Participatory tools, for example, social mapping, wealth ranking, the use of VENN diagrams, and transect walks, are most appropriate for poor, marginalised and illiterate people (mainly women), because these tools enable them to visualise and understand the issues, communicate with each other, analyse options, and make decisions.[2]

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[1] Global Water Partnership 2021: Advancing towards gender mainstreaming in water resources management (https://www.gwp.org/globalassets/global/activities/act-on-sdg6/advancing-towards-gender-maintreaming-in-wrm---report.pdf)

[2] Guidelines for participatory gender sensitive approaches. - Prepared by Min Bdr. Gurung and Brigitte Leduc Nov 2009 - ICIMOD

Meaningful participation is possible.

...when women have access to information

...when they are expressing their views

...when their views are listened to and discussed

...when they ask questions for clarification

...when they can influence decision making

...when decision making integrates their concerns

Before developing any programme/action plan or carrying out any consultation with the community especially with women, check the below obstacles first! There are several obstacles to women's (and other vulnerable groups) participation in development and natural resources management, despite their extensive knowledge and experience in managing water and their essential role in domestic use of water, sewage disposal, controlling water pollution, water and sanitation, farm production and food security.

Obstacles to women's participation in public meetings and decision making

- Ignorance and illiteracy, which is emphasised by both women and men.
- The mockery, criticism, and brutal attitudes that confront women who speak out.
- Distrust from development workers and other members of the community.
- Traditional roles and power divisions.
- The monopoly by men over information and resources
- Meetings are organised at places and at time which are not suitable for women
- Meetings are conducted in a non-local language
- Lack of access to or control over financial resources
- Lack of solidarity among women or conflict within the community
- Undue pressure on women to succeed
- Lack of self-confidence and low self-esteem
- Ignorance of their rights.

Methods for gender-sensitive design to be adopted in District Ganga Plans:

- Include in your District Ganga Plan gender-inclusive outcomes, outputs and targets where needed for different interventions
- Overcome gender-based constraints that hamper capabilities and productivity (see examples of obstacles for women's participation above)
- Conduct a thorough gender sensitive situational analysis including the collection of sex-disaggregated data including information on gender specific constraints, needs and priorities
- Ensure that all stakeholders are consulted in the design of the project, including women and other vulnerable groups
- Conduct a detailed gender and social analysis to identify key gender inequalities and constraints that the action plan will aim to address Ensure that your action plan promotes gender-balanced access to resources, services, and opportunities
- Promote inclusive participation and decision making at the community level
- Increase community ownership of the sustainability of projects
- Ensure that all the project stakeholders are gender sensitive and if they lack the knowledge in this area, their capacities need to be enhanced on gender inclusive approach before the project is designed and implemented or include capacity building measures into the district action plan
- Strengthen the institutions involved in developing and implementing district action plans to be more gender-sensitive and enhance gender awareness
- Avoid using general concepts and language, such as 'farmers', 'traders', 'water users', 'communities'. Instead, state precisely who is being talked about: 'women farmers', 'male traders', 'male herders', 'women water users association' and 'wealthy women and so on
- Try to highlight differences and similarities in opinions, viewpoints, experiences, and expectations of women and men
- Monitor and evaluate the project impact on the different gender groups before implementing the action plan
- Ensure gender-sensitive image selection when preparing outreach material
- Make sure that texts referring to or addressed to different genders make them equally visible. This applies to, amongst others, forms, documents, telephone directories, texts on the intranet and the internet, advertising for events, folders, posters etc.

Meaningful participation is possible.

The Kalyani river which is a tributary of the Ramganga has been the source of drinking water supply for the entire urban area of Udham Singh Nagar. The Kalyani river water cannot be utilised for consumption purpose as it is highly polluted, which is causing a great concern for the local communities and women in particular as they are responsible for water use at home. Currently all industrial waste, plastic and sewage disposal are disposed into the river.

During the consultation process, care was taken to ensure that women and men are equally involved. Although women farmers in Shahjahanpur (49% of the overall farmer group) seemed to have low awareness of gender sensitivity and inclusivity, they were eager to participate in the consultations and were articulate in the discussions. However, during the consultation process in Shahjahanpur, women showed less active in mixed consultation meetings involving men and women, whereas in the interactions with an all women farmers' group, they were very vocal and active. To encourage women in consultations to discuss women's issues, it is therefore recommended to hold a 'women only' group. Separate FGD could be conducted for discussing common issues. This women group should include members from all strata including those from vulnerable groups like single women headed family, differently abled women, etc. It is also helpful to ensure that CSOs/NGOs/Community groups involved in the consultations are gender-sensitive or are sensitized to gender inclusive approaches.

It was interesting to see that especially women expressed concerns about the future availability of water for the next generation during the consultations.

4.1.5 Linkages with Arth-Ganga

To further drive pollution reduction, protection and rejuvenation of the Ganga River, the government introduced the Arth-Ganga Model in 2019. The model envisages sustainable development focusing on economic activities related to cleaning and rejuvenating the Ganga River. This is to strengthen the link between people and the river and ensure economic sustainability of interventions. Thus, the Wherever possible linkages with Arth Ganga components needs to be taken into account while preparing the related action plan.

Under the Arth-Ganga model six main pillars are focussed on:

- Zero Budget Natural Farming involving chemical-free farming on 10 km on either side of the river, and the promotion of cow dung as fertiliser through the GOBARdhan scheme
- Culture Heritage & Tourism through boat tourism, adventure sports and by conducting yoga activities
- Monetisation of reuse of sludge and wastewater seeking to reuse treated water for irrigation, industries and revenue generation for Urban Local Bodies (ULBs)

- Livelihood generation opportunities for people residing in the region by setting up Haats where locals can sell medicinal plants and ayurvedic products and other local produce
- Public participation in the development and sustenance of the Ganga River through economic partnerships and reliance
- Institutional Building by empowering local administration for improved water governance

4.1.6 Data collection

Data collection is needed in three distinct stages of the DGP development process.

The first stage is concerned with preparing the general description of the water resources in the district (chapter 4). This chapter includes a set of maps that are based on public domain data sources from well-established institutions that cover the entire Ganga basin and are subject to standardized methods for data processing and analysis. A major source will be the India Water Resources Information System (https://indiawris.gov.in/wris/#/). Since these data products and layers are periodically updated, consistency in time is achieved. This will allow comparing data products for the same area for different years to investigate how hydrological parameters and water resources issues are changing in time. Detailed instructions for locating and downloading relevant GIS layers is provided in Annex 6.4.

The data collected in the second stage—the situation analysis (chapter 7)—will differ per district and per management cycle. The exact data needs can only be identified when the inventory of issues in each specific district is made. The data will originate from specific sources within the district and need to be collected as a function of the prioritized issues. The quality and resolution of these data may vary per district and per issue. Data collection templates for this stage are presented in Annex 6.2.

The final stage in data collection occurs when the Detailed Action Plan (chapter 8) is prepared. This data collection effort will be specifically geared towards designing and quantifying the selected set of measures. Data needs will be ad hoc and very specific, and this stage of the data acquisition process will only commence during the final design phase. No templates for data collection for this phase have been provided. Besides this, there are several website sources from central/state government departments and organizations, from where the information pertaining to following can be obtained for a district/block/location:

- State of water resources (SW & GW)
- Water resources infrastructure
- Water polution and sources
- Land-use and changes
- Rainfall, temperature
- Soil type
- Agriculture pattern
- STPs and ETPs

4.2 Introduction and Methodology

4.2.1 Table of Content of the DGP

The main structure of the DGP is provided by the Table of Content presented below.

SECTION A

Introduction

1 Introduction
- 1.1 GRBMP and its vision for Ganga and tributaries rejuvenation
- 1.2 Past work around similar exercises and its bearing onto the District Ganga Plans

2 Vision and Scope

3 General Approach and Methodology

SECTION B

Biophysical and non-biophysical context

4 The Water Resources of the District
- 4.1 Basin overview
- 4.2 District overview
- 4.3 Topography and Drainage Network
- 4.4 Climate
- 4.5 River basins
- 4.6 Water Quality
- 4.7 Land Cover and Land Use
- 4.8 Protected Areas and Environmental Resources
- 4.9 Socio-economic Features

5 The Institutional Arrangement in the District
- 5.1 NMCG, SMCG and DGC
- 5.2 Key Stakeholders
- 5.3 Existing Policies and Programs

SECTION C

Stock taking and analysis of key issues for this planning cycle

6 A Summary of the Achievements in the Previous Planning Period

7 Prioritized Issues/Gaps That Will Be Addressed in this Management Period
- 7.1 Situation Analysis, Key Issues, and Ongoing Actions
- 7.2 Selected Issues with gap analysis and specific targets

SECTION D

Action And Monitoring Plan And Implementation

8 Detailed Action Plan

- 8.1 Action Plan for selected measures and specific targets
- 8.2 Monitoring and Evaluation Mechanism
- 8.3 Gender Sensitive Outreach Plan

9 Capacity and partnerships for implementation

Chapters 1 to 3 provide the context for the preparation of the District Ganga Plan and are, to a greater or lesser extent, similar in each DGP. Chapters 4 and 5 are district-specific and present a general description of the water resources and institutional set-up in the district. Chapter 6 is used to review the activities of the previous planning and management cycle for the specific district. The main content of the DGP is presented in Chapters 7 and 8, including a comprehensive inventory of critical water resource management problems in the district, an associated gap analysis, and the development of action plans to address the identified key issues.

4.2.2 Stepwise Planning and Implementation Process

The Table of Contents for the DGP—as discussed above—has been merged with the general River Basin Planning and Management Cycle—as discussed in paragraph 4.1.2. This is depicted in Figure 3. The inner circle shows the stepwise planning and implementation process of the District Ganga Plan. The outer circle presents the respective chapters in the DGP that discuss and detail these individual planning steps.

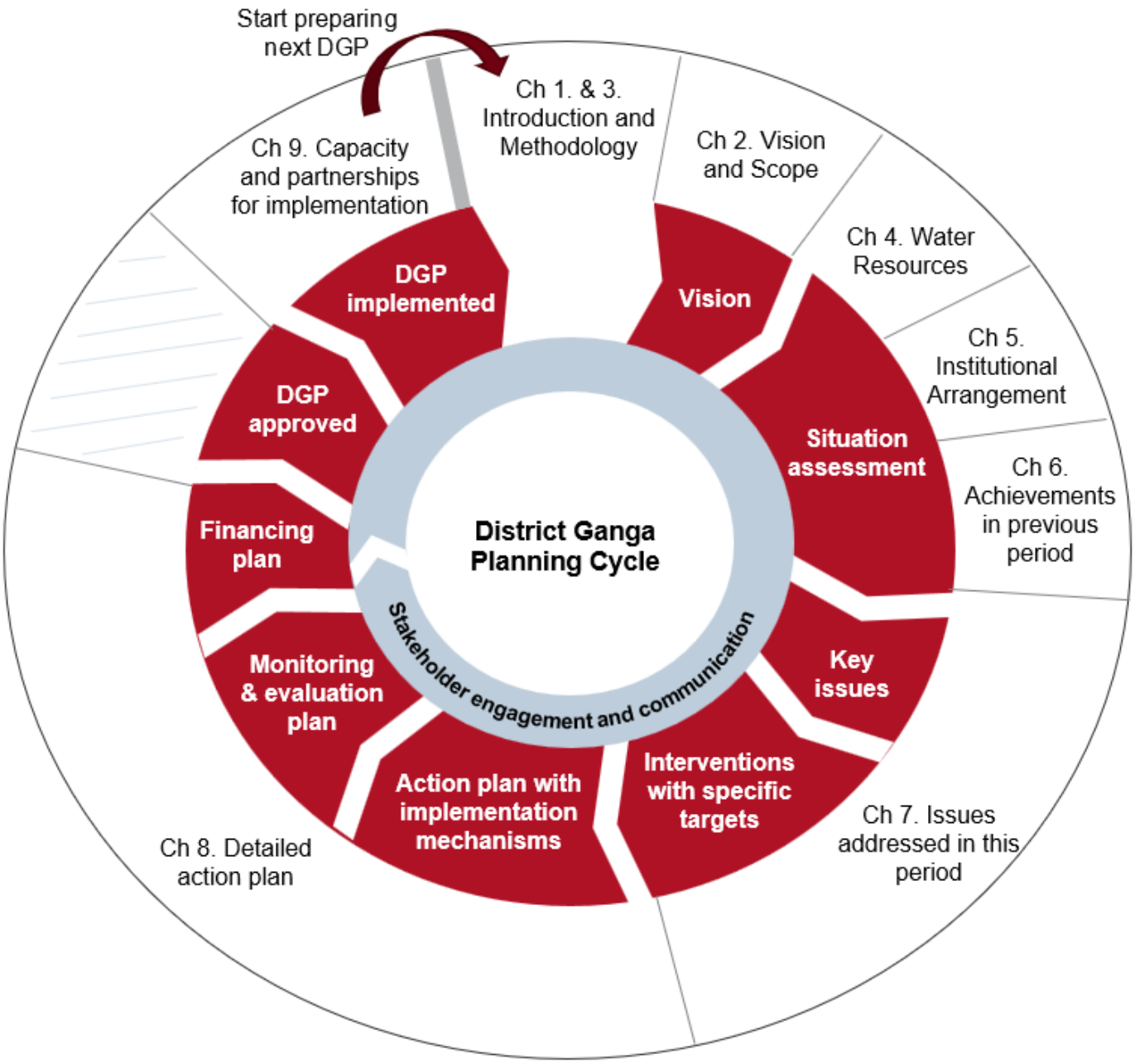

Figure 3. District Ganga Planning Cycle

The above methodology has been simplified in a stepwise process of 13 consecutive steps, as illustrated in the flow chart below.

Step 1 Develop a vision

Step 2 Prepare a baseline report and description of the water resources in the district

Step 3 Map the institutional arrangements and relevant stakeholders

Step 4 Implement a Stock Tacking exercise

Step 5 Identify the key issues (4-6) that will be addressed in this management cycle

Step 6 Conduct a pressure and risk analysis for each selected key issue, and define the specific targets

Step 7 For each specific target, prepare an action plan including timelines and budget estimations

Step 8 Develop a monitoring and evaluation plan

Step 9 Specify a funding source for each proposed intervention

Step 10 Finalise the draft District Ganga Plan

Step 11 Submit the draft District Ganga Plan for review from the relevant authorities and stakeholders; adapt DGP as needed

Step 12 Submit the District Ganga Plan for approval by the SMCG

Step 13 Implement DGP

A draft of the District Ganga Plan is compiled in Step 10. The draft document is then submitted for review by stakeholders and the relevant authorities. When this process is completed, the final version of the DGP will be submitted to SMCG for approval, after which it is implemented in Step 13.

Each step in the above process is discussed in the remainder of this chapter.

4.3 Vision

4.3.1 STEP 1: Develop a vision

The District Ganga Plan will define a vision for the management period under consideration. It will describe in general terms what the district aims to achieve in this time frame regarding Ganga rejuvenation. This vision statement must adhere to the overall vision of the Namami Gange Program:

> The Vision for Ganga Rejuvenation constitutes restoring the wholesomeness of the river defined in terms of ensuring "Aviral Dhara" (Continuous Flow"), "Nirmal Dhara" ("Unpolluted Flow"), Geologic and ecological integrity. (Vision for Ganga Rejuvenation of NMCG[3])

[3] https://nmcg.nic.in/vision_key.aspx

For the District Ganga Plans, the vision should be more concrete and have a medium-term perspective. It should be based on the district's specific environmental and institutional context and emphasize its priorities in this management period. An example is provided below.

Box 2: Example of a vision:

The Vision for the District constitutes making the Ganga (or tributary) cleaner each year, holding polluters accountable, making progress in restoring riverine ecosystems, while promoting the "Arth Ganga" concept which synchronizes river conservation with promoting livelihoods derived from the river.

Further examples for visions are available in the model DGPs.

4.4 The Water Resources of the District

Chapter 4 of the DGP

4.4.1 STEP 2: Prepare a baseline report and description of the water resources in the district

The situation assessment in the DGP comprises two components:

1. a general one, and
2. a very specific assessment of the selected key issues that will be addressed in this management period (see section 4.7).

The fourth and fifth chapter of the DGP are only concerned with the general situation assessment. It aims to describe the geographic, climatological, hydrological, and socio-economic features of the district, and specifically of the Ganga watershed in the district.

The general situation assessment should lead to a better understanding of the contextual environment in which the DGP needs to be prepared and implemented, and of the main drivers that impact on the state of the Ganga waters in the district. It needs to be concise and should not exceed 12 pages.

The assessment is subdivided into two main components:

1. The Water Resources of the District (the "biophysical context") (this, chapter 4 of the DGP)
2. The Institutional Arrangements in the District (the "non-biophysical context") (the next, chapter 5 of the DGP)

Box 3 lists the elements that aim to describe "The Water Resources of the District". These elements should be presented as maps with only very limited explanatory text. For this section, emphasis is placed on the visual presentation of information and data. Annex 6.4 presents detailed instructions on how to prepare these maps and also provides examples of each map.

Box 3: The Water Resources of the District

- Basin and Sub-Basin Overview (concise overview of the entire Basin and sub-basin (as applicable), its main characteristics and issues, and positioning of the district within the Basin).

The below topics only apply to the district

- Topography and Drainage Network
- Climate
  - → Rainfall
  - → Potential Evapotranspiration
- River-basins
  - → Surface Water (incl. hydrologic regime)
  - → Groundwater
  - → Water Quality (incl. main pollution sources, wastewater treatment, sanitation, etc.)
  - → District Transboundary Aspects (incl. import and export of pollutants etc.)
- Land Cover and Land Use
- Protected Areas and Environmental Resources
- Socio-economic Features
  - → Population
  - → Socio-economic Profile (including assessment of gender issues)
  - → Dominant Livelihood Systems
  - → Water Use Per Sector
  - → Main water users (municipal, industrial, agricultural, environmental, etc.)
  - → State of Water Users Associations (WUAs) in the district

Box 4a: Examples of GIS maps illustrating water resources characteristics of the district

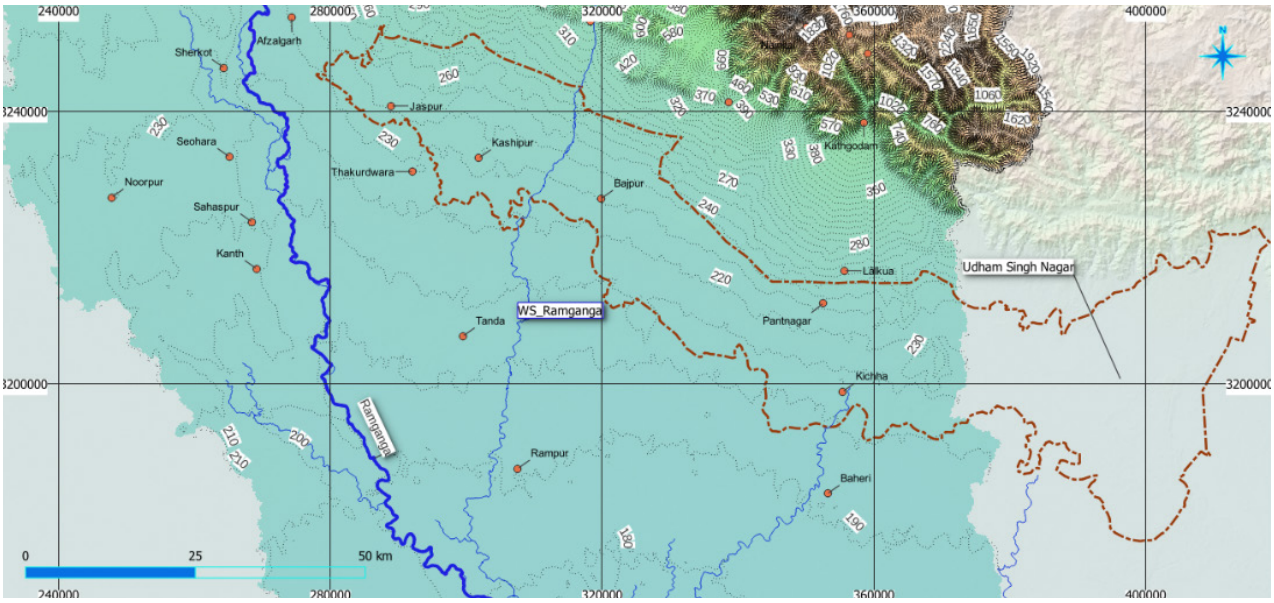

Figure 4. Topography of District Udham Singh Nagar

Box 4b: Examples of GIS maps illustrating water resources characteristics of the district

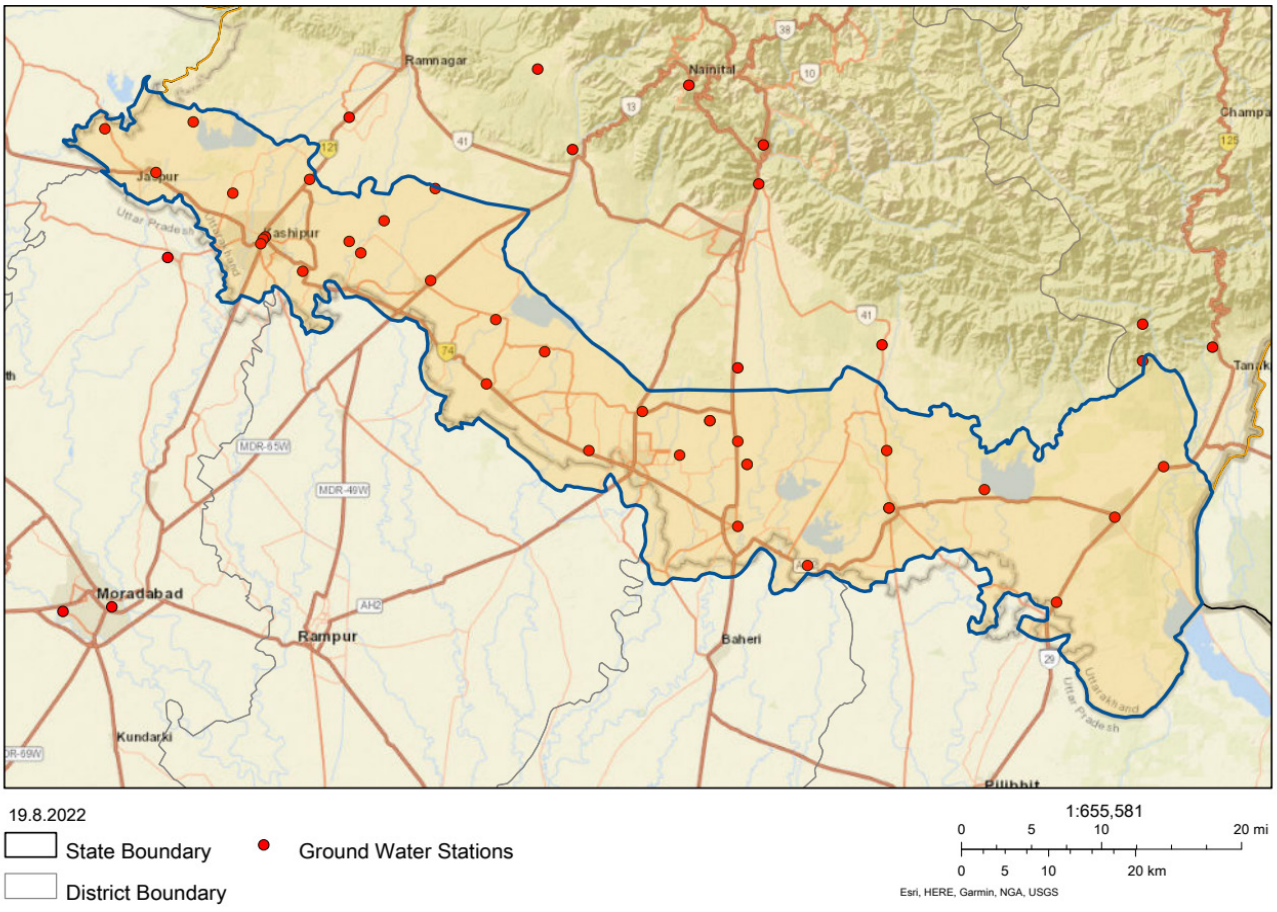

Figure 5. Groundwater monitoring stations in US Nagar (Source: Indiawris)

4.5 The Institutional Arrangement in the District

Chapter 5 of the DGP

4.5.1 STEP 3: Map the institutional arrangements and relevant stakeholders

In addition, the assessment should outline the institutional setup in the district, specifically those elements that impact on the implementation of the DGP.

Box 5: The Institutional Arrangement in the District

(With principal focus on protection and rejuvenation of Ganga river & its tributaries)

- Constitution and Status of DGC
- Relevant Government Agencies
- Key Stakeholders (including roles and responsibilities)
- Existing Policies and Programs (at National, State, and District Level)
- Specific Role of District authorities in the rejuvenation of the Ganga Basin and specifically in the prior assessed policies and programs (incl. role District Ganga
- Planning Committees (DGC))
- An Assessment of the Budgetary Resources at District Level

Box 5 shows the components that describe "The Institutional Arrangements in the District". It aims to present the non-biophysical factors that impact on Ganga rejuvenation such as institutional setup, laws and regulations, existing policies and programs, coordination requirements, managerial capacity, and budgetary constraints.

Text needs to be prepared for each bullet point in Box 5. A brief explanation is presented below.

Constitution and Status of DGC. The functional status of the DGC, its constitution and a brief description of the different components of Ganga rejuvenation activities being implemented by the executing agencies should be presented.

Relevant Government Agencies. Many government agencies will play a role in preparing and implementing the DGP to a greater or lesser extent. This section will map the relevant government agencies, describe their specific responsibilities regarding Ganga rejuvenation, and indicate the coordination requirements when developing and carrying out the DGP. The focus should be on the departments that are represented in the DGC.

Key Stakeholders. Effective and sustainable policy action is based on involvement of key stakeholders (line departments in the district, local communities and/or representatives). It will improve the DGPs and strengthen and maintain support for the proposed measures. This section will list and briefly describe the relevant stakeholders and partners that could contribute to developing and implementing the DGPs. Criteria for stakeholder selection are provided in section 4 of the handbook.

Existing Policies and Programs. It is important that the DGPs build on, directly support, and complement existing programs and plans. For instance, the DGPs will seek synergies with the Urban River Management Plans and the Arth Ganga initiative, to mention just a few. Duplication with existing programs must be avoided. This segment will present an inventory of existing water-related projects, programs, policies, and initiatives in the district, and will briefly discuss how these initiatives could support the DGPs.

For analysing existing policies and programs, the below table can be used.

Table 3. Template for analysing existing policies and programs with example

Policy or program	Level	Topic	Objectives concerning Ganga rejuvenation on district level	Budget allocation	Achievements
Example: Master Plan for Artificial recharge to groundwater in India	National	Ground-water recharge	Reducing groundwater overexploitation	The total cost for implementation of this revised master plan is Rs 1,33,529.69 Cr, with Rs 96,735.45 Cr (72%) for rural areas and Rs 36,794.23 Cr (28%) for urban areas	Under Master Plan, an area of 11. 23 km^2 has been identified for artificial recharge. The water required for artificial recharge has been worked out for each state. The surplus available for recharge after deducting the committed supply has been estimated for each State.

Specific Role of the District Authorities in Ganga Rejuvenation. Because water resources management covers a broad range, many issues related to Ganga rejuvenation will be outside the mandate of the District Authorities and must be addressed by technical agencies for agriculture, irrigation, forestry, hydropower, or others. At the same time, there will be a level of overlap in responsibilities between the districts and the technical agencies and some degree of flexibility in the mandate is therefore required. It is equally important to ensure that no issues are left unattended.

This section will clarify the scope of the DGPs and the role of the district authorities—i.e. what should and can be addressed at district level. In parallel, this segment should point out which critical Ganga rejuvenation issues should be addressed at State or river basin level.

An Assessment of Budgetary Resources at District Level. Sustainability is enhanced when proposed measures are comfortably implemented and maintained with the available local resources, and do not rely on (long-term) external funding. This section will present an outline of the available budgetary means and convergence of different ongoing schemes/programs by different departments which has linkages with interventions required for Ganga rejuvenation at district level.

4.6 A Summary of the Achievements in the Previous Planning Period

Chapter 6 of the DGP

4.6.1 STEP 4: Implement a Stock Taking exercise

The Stock Taking section will evaluate the effectiveness of the actions implemented in the previous management cycle and the extent to which they have achieved their intended specific targets. This is achieved by presenting a simple table that compares the current state with the specific targets set in the previous DGP. For targets that were not met, or only partially met, a concise analysis and explanation should be provided.

Table 4. Template for stock taking

Intervention 1	Target (as defined in the previous DGP)	Current state (as per predefined performance indicator)	Explanation and lessons learned (if target was not met)

The purpose of the stock-taking exercise is multifold:

- to improve the next DGP based on previous experience
- to better understand the challenges associated with Ganga rejuvenation
- to set more realistic targets in the future
- to have internal and external accountability

This section should not exceed 4 pages. The table will not be prepared for the first DGP.

4.7 Prioritized Issues/Gaps that will be Addressed in this Management Period

Chapter 7 of the DGP

4.7.1 STEP 5: Identify the key issues (4-6) that will be addressed in this management cycle

Because of the geographic extent and heterogeneity of the Ganga basin, water resources issues in the basin are diverse, location specific, and ranging in scale from small to very large. Many of these challenges impact on the state of the river Ganga to a greater or lesser extent. Despite the variety of the issues encountered, the rejuvenation of the Ganga effectively comprises two main components:

1. pollution abatement, and
2. increasing dry season river flows to sustain critical environmental value.

For practical reasons, only 4-6 key issues will be addressed in each management cycle. Identifying, ranking, and selecting these issues that will be included in the DGP in this management period involves a consultative and participatory process with key stakeholders and decision makers. Make sure that the prioritized issues are within the mandate of the District, as it is recognized that many water management issues in the Ganga basin such as low irrigation efficiencies or periodic flooding along the main river, to mention just a few should in principle be addressed by other agencies. For prioritising selected issues, the template below may be helpful (Table 5)

Table 5. Template for prioritising selected key issues

Key issues identified	Severity (very high – very low)	District mandate / capacities	Ongoing actions	Gaps / required actions	Prio (please select 4-6 isssues)

A broad range of water issues related to the rejuvenation of the Ganga are listed in Annex 5.1. Out of this list, a total of indicative 20 key issues have been discussed in detail in this chapter. These issues have been selected because they are widespread, occur across the basin, and are considered representative of the main threats to the health of the river that must be addressed. Evidently, districts may identify other priority issues not included in the list that have a major impact on the state of the river in their specific district. Box 6 provides an example for an imaginary district.

Box 6: Example of key Issues to be addressed in a management cycle. Annex 5.1 provides a detailed description of each key issue.

- Pollution from industrial effluent
- Pollution from liquid waste
- Pollution from solid waste
- Insufficient water storage
- Wetland encroachment
- Non-point sources pollution-Agricultural run-off etc.

It is suggested that only 4-6 key issues are addressed in a management cycle for practical reasons, depending on the resources and capacities available with the DGC.

4.7.2 STEP 6: Conduct a pressure and risk analysis for each selected key issue, and define the specific targets

Once the key issues have been selected, a targeted situation assessment will be conducted to better understand the problem/gaps that needs to be addressed. It concerns a very practical analysis that attempts to estimate the scale of the issue, determine its root cause, and assess if there are constraining factors that may impede the solution of the problem. The principal aim is to assess what type of intervention would be most effective in this specific context. In this regard, the situation assessment should also review previous programs and measures and evaluate why they have been effective, or not. If multiple interventions are required, the situation assessment should also provide clues about the timing and sequencing of these measures. Box 7 provides an example of a situation analysis. For some of the gaps identified or concern areas, these may be depicted through graphs, charts, maps.

Box 7: Example of a Situation Analysis and Specific Target

Key Issue: Wetland deterioration Situation Analysis (example): The wetland is located near the outskirts of a large urban area and covers some 55 ha of public land. It is formed by an internal depression in the landscape that collects runoff from the surrounding areas, including urban storm runoff from 6 drains. Some 20 ha of the wetland is permanently flooded while the remaining 35 ha is only inundated during part of the year and gradually dries out in the period between November and June in an average rainfall year. The wetland represents important environmental value and serves as a sanctuary for migratory birds, including several endangered species. Birders have counted over 120 bird species. Ecotourism—mostly from the nearby urban area— has grown exponentially in the last decade and the site has become a popular destination on Saturdays and Sundays. In addition, the wetland plays a critical role in recharging the local aquifer, which is being used for municipal water supply for new urban areas that are not yet connected to the city water supply system.

The wetland, however, has deteriorated in recent years. First, it is used for unauthorized dumping of solid waste. This illegal activity is gradually filling the wetland but also contributes to severe water pollution, which will in time affect groundwater quality. In addition, the urban storm runoff that is drained into the wetland contains sediment, debris, and diverse organic and chemical contaminants and pathogens. Finally, the seasonal part of the wetland area—which is dry during for about 6-8 months of the year—is being overgrazed since there are no effective limitations to the number of livestock that can use the area. Consequently, the variety of grass species has declined exponentially, and this part of the wetland area no longer serves as a habitat for grassland birds.

Potential interventions

Solid waste dumping

- Enforce existing laws to stop illegal dumping of solid waste in the wetland area
- Provide an alternative dumping ground if necessary
- Remove the solid waste from the wetland area
- Regular monitoring to ensure that solid waste dumping has permanently stopped

Drainage of polluted storm runoff

- Establish solid waste management, including sweeping programmeand solid waste collection in the urban area that drains directly into the wetland
- Establish diverse green infrastructure and micro-scale water retention basins in the urban area that drains into the wetland
- Establish a bio-filter that serve as a biological stormwater treatment facility at the outlet of each of the six drains

Overgrazing

- Identify a community organization
- Implement an awareness campaign on sustainable grazing
- Develop a sustainable grazing scheme—that reduces the number of livestock on the seasonal wetland—in close consultation with local stakeholders
- Provide a one-time compensation to herders that can no longer graze on the seasonal wetland
- Ensure compliance with the agreed upon grazing scheme

Specific target(s)

1. Provide five alternative landfill sites for inert and non-recyclable waste (responsible: ULB)
2. Remove solid waste on 1 ha of wetland (responsible: ULB and PCB)
3. Establish a sweeping programmeon a street network with total length of 3 km (responsible: ULB)
4. Establish solid waste collection for 250 households (responsible: ULB)
5. Establish 4 micro-retention basins with a surface area of 0.5 acre each (responsible: irrigation department)
6. Establish 6 bio-filters with a surface area of 1 acre each, at the outlet of each drain (responsible: forest/ agriculture/ horticulture department)
7. Reduce the number of grazing animals on the seasonal wetlands to 20 (responsible: identified CBO)

Annex 5.2 provides a template for the information that needs to be collected. It specifies the detailed data needs for a wide range of key issues. Evidently, data should only be collected for those key issues that are taken up in this management cycle (see Step 5).

For each key issue, annex 5.3 lists a series of potential interventions. This catalogue is not exhaustive, and the district can propose other measures as a function of local conditions, experience, or preference. What matters is that proposed interventions are realistic and achievable, and that they can be assigned to an implementing agency such as a government institution, NGO, group of farmers, contractor, etc. It is critical that interventions are implemented in the proper sequence. An example is presented in Box 7.

Based on the situation assessment and a realistic inventory of potential measures, the specific target can be defined with consideration of the required budget and time, and other practical implementation constraints. The specific target should be measurable, realistic, and achievable in this management cycle. An example is provided Box 7.

Given the scale of the Ganga rejuvenation tasks, it is probable that many measures and programs that improve the health of the river will be implemented in phases that can span multiple management cycles.

In addition, obvious synergies exist between the DGP and other initiatives in the basin, such as the District Environment Plan, the Urban River Management Plan, the District Irrigation Plan, and the District Arth Ganga Plan (see section 3.2 of the handbook). All these programs work in some way towards the same target of improving the state of the river. Hence the DGPs can include elements from other plans as appropriate. In fact, incorporating elements from other similar initiatives is encouraged. Arguably, the DGPs role is to provide an overarching vision and framework, coordinate the activities of other initiatives, and spearhead measures that are not covered by others.

Active and broad stakeholder involvement during this step should be sought to reach a level of consensus on 1) which are the key issues that need to be addressed, 2) what causes these issues, and 3) what is the best way to solve them.

It is recognized that women play a key role in water governance at household and smallholder level but are sometimes less well represented in participatory processes because of institutional factors. Hence concerted efforts must be made to adequately include the voice of women in the stakeholder consultation process (see section 4.1.2 of this handbook).

4.8 Detailed Action Plan

Chapter 8 of the DGP

4.8.1 STEP 7: For each specific target, prepare an action plan

The Action Plan outlines the concrete steps in which the specific targets will be achieved. It includes a list of actions, a timeline with clear targets and milestones, and an itemized budget. The action plan also specifies who will implement each action. An example is provided in the below table. Alternatively, the action plan can be presented in a Gantt Chart. A set of further potential interventions are listed in the Annex 5.3 sorted by issues they address.

Table 6. Template for an action plan with example

Specific Target 1: Provide five alternative landfill sites for inert and non-recyclable waste				
Action description	**By**	**Start date**	**End date**	**Milestones**
Identification of suitable landfill sites	ULB / City Municipal Corporation / PCB	1 Jan	31 Jan	Selection criteria are defined, GIS maps are prepared
Development and protection of land fill sites	ULB / City Municipal Corporation / PCB	1 Feb	30 Sep	Tenders are published, construction company is selected, site is developed, site is protected
Arrangement for bulk waste trucks for transport from collection point to landfill sites	ULB / City Municipal Corporation / PCB	1 Oct	31 Dec	Bulk waste trucks are available, Truck drivers and supporters are hired

	Required resources	Outcome	Comments / Linkages
	Budget (for defining selection criteria, data collection, GIS mapping)	Proper sites of landfill have been selected	
	Budget (for construction work, materials,supervision, fencing, etc.)	Deposition of nonrecyclable and inert waste in environment have improved, leachate from solid waste have not polluted the environment and ground water	Swachh Bharat Mission
	Budget (for bulk waste trucks, labours)	Solid waste pollution load in environment has decreased	Swachh Bharat Mission

4.8.2 STEP 8: Develop a monitoring and evaluation plan

Monitoring and Evaluation (M&E) is a vital element of the DGPs. It provides a mechanism to evaluate the progress of implementation within the district and the success of its objectives.

A measurable indicator will be specified for each specific target. It serves to monitor progress, strengthen accountability, and assess if the proposed intervention is working as intended. The indicator should be simple and accurately describe the specific target. It is important that the indicator is not data intensive and does not require a complicated data acquisition effort. Examples are provided in Table 7.

Table 7. Template for a Monitoring and Evalution Plan with example

S.No.	Specific Target	Indicator	Baseline	Target
1.	Provide five alternative landfill sites for inert and non-recyclable waste	Number of alternative landfill sites	31 Jan	5
2.	Remove solid waste on 1 ha	Area free of solid waste	0 ha	1 ha
3.	Establish a sweeping programmeon a street network with total length of 3 km	Length of street cleaned	0 km	3 km

4.8.3 STEP 9: Specify a funding source for each proposed intervention

When budgetary resources are necessary to implement the action plan, it is required to clearly indicate where these funds will come from. When these funds originate from existing budgets, indicate the relevant budget line. Action items that are not funded or are not funded in a timely manner could delay or inhibit the successful implementation of the DGP. It is recommended to only propose measures that can be comfortably maintained and implemented with the available local resources and do not rely on (long-term) external funding, or that can be implemented within the scope of ongoing programs and initiatives at district, state, or national level.

	Means of verification	Frequency (how often will it be measured?	Responsible (who will measure it)	Reporting (where will it be reported)
	Observers	Yearly	surveyor	Assessment map, planning documents
	Observers	Weekly	Local authorities like ULBs	Programme report
	Observers	Weekly	ULBs	Programme report

The below guiding question will help evaluate and identify suitable financing schemes and programs for the action plan:

- How quickly is funding needed? Is the action short- or long-term?
- How much funding is needed?
- Which of the existing financing schemes and programs at district, state and national level cover your planned action and are you eligible for? (find a list of financing schemes and programs in section 3.3.

4.9 Capacity and partnerships for implementation

Chapter 9 of the DGP

In general, it is recommended to prioritise interventions that are both urgent and feasible within the given capacities. Beyond that, the DGP enables the identification of capacity gaps through a capacity needs assessment for interventions with a high prioritisation and urgency. This chapter describes required measures to fill identified capacity gaps including capacity building and resource mobilisation for efficient implementation of planned activities. These may include trainings, mass awareness programs, information, education and communication (IEC) campaigns, seminars, workshops that are needed for strengthening the involved stakeholders and implementation partners to achieve the intended target.

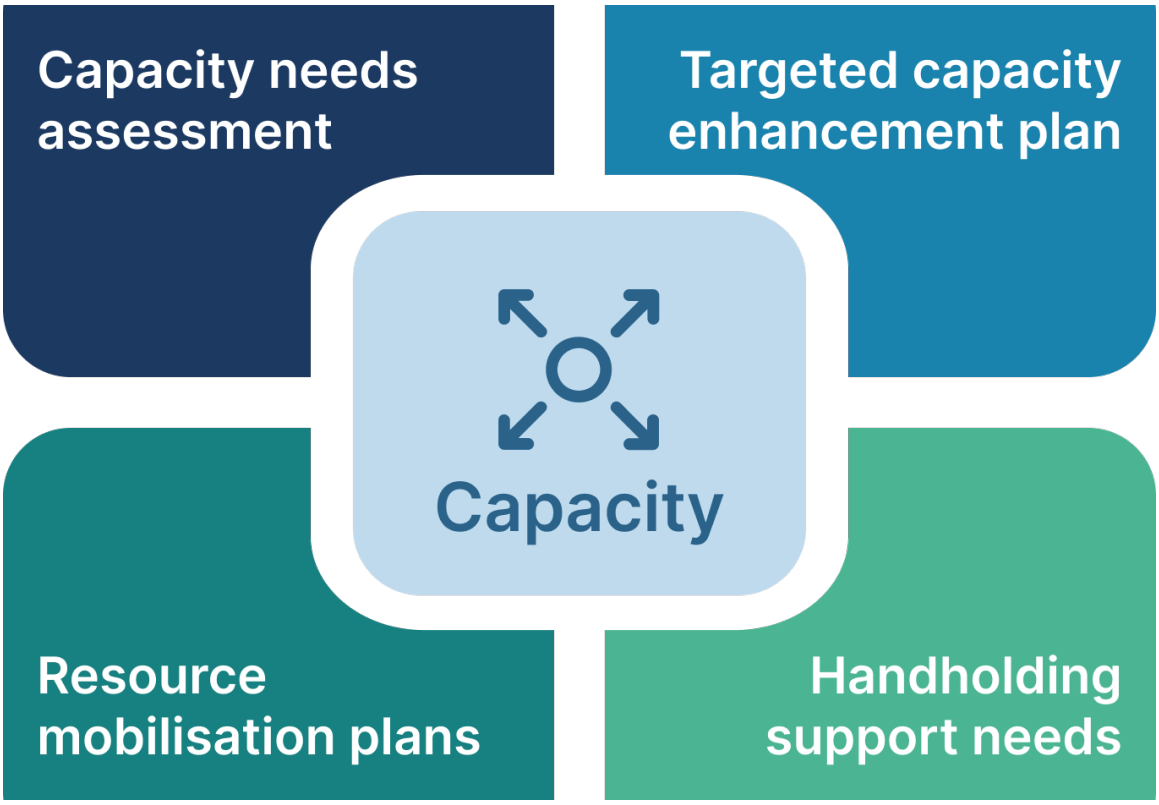

Figure 6. Components of capacity development

Table 8. Template for capacity needs assessment documentation with example

Planned actions in this period	Responsible organisation and stakeholder involved in the successful implementation	Gaps in capacity and awareness and resulting needs	Possible partnerships that could cover capacity needs	Suitable capacity building measures
Identification of suitable landfill sites	ULB / PCB	Development of GIS maps	External consultancies	GIS training

The capacity enhancement plan results from the identified needed capacity building measures. The plan can be structured in a similar way to the action plan (Table 6), whereby the below questions should be considered during its preparation:

- Which of the identified needed capacity building measures are already offered by recognized organizations (e.g. training organizations)?
- Who is the target audience of the measures?
- How soon are the measures needed and are they in line with ongoing offer of the identified organizations?
- What financial resources are needed?

4.10 Completing the District Ganga Plan

Refinement and approval

4.10.1 STEP 10: Compile the draft District Ganga Plan

Review the information and chapters gathered in steps 1 to 9 and compile the draft DGP. Check the material for consistency and comprehensibility and refine as needed. An introductory chapter (see ToC in paragraph 4.2.1) will be added to present the GRBMP and its vision for Ganga rejuvenation. This introduction will also provide an overview of past work including environmental plans, irrigation plans, and others, which the DGPs will refer to and built upon.

Sample texts for this introductory chapter of the DGP can be found in chapters 1-3 of this handbook. Note that some edits may be required to adapt to the specific district for which the DGP is being prepared.

4.10.2 STEP 11: Submit the draft District Ganga Plan for review from the relevant authorities and stakeholders; adapt DGP as needed

To foster the implementation process of the developed action plan and create ownership with the concerned executing agencies the draft DGP V0.1 should be shared with the identified stakeholders and especially with the authorities in charge of implementing the measures. This feedback loop will collect valuable inputs for fine tuning the analysis of the issues and the selection of the most suitable and appropriate measures. The DGC shall be cautious that the overall vision and the targets are not compromised on and that authorities do not hinder the required decisions on measures which might inflict additional workload on them. The final decision on incorporating the feedback or on informing on its rejection should stay with the DGC.

4.10.3 STEP 12: Submit the District Ganga Plan to SMCG for approval by NMCG

The final draft DGP V0.2 including the feedback from the district stakeholders and authorities needs to be subjected to the established review and approval process. While stakeholder review and buy-in is an essential step in this process as it is critical to effective policy action, the final approval will be given by NMCG. Thus, the DGC will submit the final version of the DGP to the SMCG. This institution will have the final responsible for the timely and complete implementation of the plan.

4.10.4 STEP 13: Implement DGP

With the finally reviewed and approved DGP the implementation phase can commence. The DGC instructs the concerned authorities and departments to follow the action plan and monitoring and evaluation programme as elaborated in steps 7 and 8. These make use of the assessment of available funding schemes identified in step 9 and possibly acquire additional capacities as required.

4.10.5 STEP 14: Communication of the DGPs and outreach

Communication is important to pool ideas, ensure buy-in from key stakeholders (internal and external), foster collaboration and commitment. Communication can be useful at all stages of district planning: from developing action plans to implementing measures and communicating successes. For each communication activity, it is crucial to adapt the objectives, communication methods and means to the target audience. For this, you might use the template provided in Table 7.

Table 9. Template for preparing an internal and external communication plan with example

Which issue(s) to communicate?	To whom?	What is the goal?	Through which means of communication?	When and how often?	Who is responsible?	Budget needed	Source of funding
Example: Test phase of the new facility for managed aquifer recharge using an innovative monitoring system successfully-completed	Water users	Communicating the benefits and reliability of the system (e.g. on innovative monitoring systems installed) and the stability of the water quality, increasing the acceptance of the produced water among users	Newsletters, Homepage of the DGC, etc.	After testing phase is completed and before system is started	Operating company	-	-

05 Annex

5.1 List of key issues in Ganga basin

Cluster 1

Water Quality

Pollution from industrial effluent:

surface water in (mostly) urban areas is contaminated by untreated industrial effluent (point-source pollution)

Pollution from liquid waste:

surface water in urban and peri-urban areas is contaminated by untreated domestic sewage (non-point source pollution)

Pollution from solid waste:

surface water in rural and urban areas is polluted by solid waste (non-point source pollution)

Pollution from storm-water runoff in urban areas:

urban stormwater runoff is a major source of pollution that encompasses sediment, debris, and diverse organic and chemical contaminants and pathogens that are washed off the urban landscape during intense rain events (non-point source pollution)

Pollution from agricultural runoff:

runoff of soil, pesticides, and fertilizer from agricultural fields pollutes water resources and damages valuable riverine and aquatic ecosystems (non-point source pollution)

Urban flooding:

drainage congestion in low-lying areas cause periodic inundations in the urban zone; these local flood events are associated with pollution and health risks, and cause damage to properties and critical infrastructure

Cluster 2

Water Quantity

Insufficient water storage:

there is inadequate storage capacity—at all scales—to store surface water resources in times of excess, for productive use at a later point in time; as a result, over-extraction of river water occurs in the lean season

Floods:

periodic floods cause damage to crops, properties, and critical infrastructure in the riverine zone while wasting scarce water resources

Declining groundwater table due to unknown groundwater potential:

the sustainable yield of the considerable groundwater resources is not known with adequate precision, increasing the risk of groundwater over-abstraction and receding baseflows to rivers

Declining groundwater table due to inadequate groundwater management:

groundwater levels are declining because of unregulated groundwater extraction and inadequate groundwater management; it can lead to lower baseflows in nearby rivers

Inadequate urban and peri-urban water supply:

insufficient water supply for municipal and industrial purposes in urban and peri-urban areas often lead to uncontrolled private groundwater abstraction increasing the risk of over-use of groundwater and locally declining groundwater tables, with adverse consequences for baseflows in nearby streams

Water insecurity in the irrigation scheme:

water security in irrigated agriculture is not guaranteed for the entire command areas causing a combination of occasional water deficits, low yields, and over-irrigation; this inefficient use of irrigation water results in over-abstraction and reduced baseflows; water insecurity in the command areas is caused by changes in cropping pattern and intensification, as well as by canal sedimentation and inadequate canal maintenance.

Water logging and soil salinization:

over-irrigation in combination with inadequate drainage facilities cause water logging and subsequent salinization in tail-end sectors of irrigation schemes; this water—which partly evaporates without productive use—would otherwise have increased baseflows in the downstream river reach

Cluster 3

Ecological Integrity

Wetland encroachment:

wetlands are encroached (due to habitation or agriculture) upon and/or destroyed with adverse implications for a broad set of wetland functions that sustain the health of the river and attenuate hydrological extremes

Floodplain encroachment:

encroachment of the floodplain aggravates pollution and has adverse impacts on critical floodplain functions and riverine ecosystems

Environmental flows not maintained:

environmental flows (flows that the required to maintain integrity of riverine ecosystem and to support the goods and services for the people and nature) are not prioritized and therefore frequently not met, causing damage to riverine ecosystems

Incised river channels:

incised channels concentrate floodwater, lower the groundwater table, and cause environmental degradation

Unauthorized sand mining:

large industrial-scale sand mining with heavy machinery results in a lowering of the groundwater table, changes the river morphology, or compromises the environmental integrity of the riverine ecosystems

High sediment content in rivers:

a combination of landslides, road construction in mountainous areas, deforestation, and inappropriate agricultural practices aggravate soil erosion and high sediment loads in rivers and irrigation canals

Cluster 4

Water Related Issues

Inadequate water management capacity:

sustainable and equitable management of water resources is impeded by prevailing silo-thinking and inadequate coordination mechanisms to resolve and preempt potential water resources conflicts

5.2 Template for data collection needed for the analysis of selected issues

When analysing issues, a lot of information is necessary. In order not to lose the overview, Table 10 presents a selection of relevant data needs for the most common issues identified for the Ganga basin and described in annex 5.1.

Table 10. Template for data collection needed for the analysis of selected issues

ID	Key issues identified	Data needs	Status	Source
1	**Cluster 1: Water Quality**			
1	Pollution from industrial effluent	Total number of polluting industries sector-wise highlighting grossly polluting industries		
		List of GPI and SPI Industries		
		Total industrial effluents generated		
		Total capacity of treatment facilities available and its utilization;		
		Number of ETPs/CETP installed and functioning condition in the district.		
		Status of connectivity of ETPs with CETP/ Untreated discharge in drains		
		Total show causes and closure direction given for noncompliance of industries in the district		
		Existing law enforcement instruments / policies		
		Water Quality (indicator parameter BOD, COD and DO and parameters of main concern) downstream of major industrial pollution stretches		

ID	Key issues identified	Data needs	Status	Source
1	**Cluster 1: Water Quality**			
2	Pollution from liquid waste	Total sewage generation (per local body, (main cities), population entire district.)		
		Treatment facilities (STP/SPS/ MPS) their location, capacity, utilization and quality of treated effluents / working status		
		Water Quality (indicator parameter BOD and DO and parameters of main concern) downstream of major domestic pollution stretches		
		Sanitation coverage including type, function status and usage of toilets;		
		Gender usage statistics of toilets (% of men and women having access to toilets, doing the maintenance)		
		Percentage Households dependent on onsite sanitation systems (complete septic tanks with soak pits/ only pits/direct discharge in drains)		
		Number of drains tapped in the STP/SPS/MPS		
		Number of untapped drains		
		Volume of untreated sewage in each of the drains		
		Number and location of drains directly discharging in the river incl. information on the volume of untreated sewage		
		Number of drains with bar screen		

ID	Key issues identified	Data needs	Status	Source
1	**Cluster 1: Water Quality**			
2	Pollution from liquid waste	Remedial measures taken for the treatment of untreated drains		
		Current status of Faecal sludge management and disposal of septage		
		Sewerage network system and number of connected households		
		% of treated sewage recycled / type of use		
		Encroachment sites in urban areas (no. and length)		
3	Pollution from liquid waste	Municipal Solid and biomedical waste generation trends and typology of waste		
		Disposal practices (% of unregulated disperse, informal sump sites, official collection sports, good and bad practices)		
		Treatment facilities, their capacities and functioning conditions		
		Total solid waste generated in main cities / entire district		
		Legacy waste sites (number and size)		
		Segregation at source / waste collection & transportation / processing capacity/ disposal and recycling facilities		
		Status of Garbage Vulnerable Points (GVPs)/Locations where riverbeds are used as dumping sites		

ID	Key issues identified	Data needs	Status	Source
1	**Cluster 1: Water Quality**			
4	Pollution from storm-water runoff in urban areas	Water Quality (indicator parameter BOD and DO and parameters of main concern such as pathogens, organic and chemical contaminants, sediments) downstream of major domestic pollution stretches		
		Status of solid waste management		
		Decentralised rainwater harvesting facilities		
		Status of green infrastructure / percentage of urban sealing		
		Number of drains with bar screen		
5	Pollution from agricultural runoff	Land under agriculture		
		Amount and types of fertilizers and pesticides used (in kg per ha)		
		Major crops and average yields (in ton per ha)		
		Farming practices/techniques		
		Parameters of main concern from agricultural runoff and their highest concentrations		
		Burning practices		
		Crops grown in river beds and river banks		
		% of land under organic farming		
		Level of sensitization of communities on reducing dependency on chemical fertilizers.		
		Involvement of women in farming and their roles		

ID	Key issues identified	Data needs	Status	Source
1	**Cluster 1: Water Quality**			
6	Urban flooding	Number of extreme rain events (in the past and expected for the future)		
		Drainage congestion		
		Capacity of urban drainage systems (especially of combined drainage systems)		
		Percentage urban sealing / green infrastructure		
		Decentralised rainwater harvesting systems		

ID	Key issues identified	Data needs	Status	Source
2	**Cluster 2: Water Quantity**			
7	Insufficient water storage	Surface Basin water budgets (incl precipitation, seasonal water levels and river flow trend during the year)		
		List and status of dams, barrages, anicuts, embankments, small pond areas etc. and their design storage capacities		
		Siltation status of surface water bodies		
		Current effective Surface water storage capacity per rainfall		
		Encroachment status of surface water bodies – Ganga, key rivers, ponds and wetlands		
		Surface water usages (incl floods)		

ID	Key issues identified	Data needs	Status	Source
2	**Cluster 2: Water Quantity**			
7	Insufficient water storage	Existing rainwater harvesting structures		
		Existing water conservation practices		
		Type, no and capacity of rejuvenated water bodies and further scope for rejuvenation (type, no and capacity)		
		Existing groundwater recharge systems		
8	Floods	Basin water budgets allocation		
		List and localization of major flood events		
		Mapping and status of floodplains (encroachment?)		
		Information on precipitation and its trends		
		Storage capacity available to manage floods		
		Usage of flood water – Look for any good practices by communities on usage of flood water. We might come across some traditional practices which could be revived.		
		Management practices of stormwater runoff (in urban areas)		
		Land cover and land use		
		Existing flood forecasts and warning systems		
		Mapping of floodplain wetlands in a 5km radius of River Ganga and its tributaries		

ID	Key issues identified	Data needs	Status	Source
2	**Cluster 2: Water Quantity**			
9	Declining groundwater table due to unknown groundwater potential	Zonal Groundwater budget (including groundwater abstraction rates, natural groundwater recharge etc.)		
		Areas with groundwater pollution and pollution type		
		Main aquifer and their storage capacity		
		Zones where surface-groundwater interaction is high		
		Existing Managed Aquifer Recharge (MAR) systems		
		scope for groundwater recharge / MAR systems (locations / area, capacity, water source and usage purpose)		
10	Declining groundwater table due to inadequate groundwater management	Local abstraction regulations		
		Aquifer mapping		
		GW budget (incl. GW abstraction rates and purposes)		
		Trend of water levels		
		Well register (permissions for extraction)		
		No and locations of illegal well fields		
11	Inadequate water supply	Per farmer and crop irrigation water availability		
		Irrigation water usage pattern (water use per ha and crop or yield)		
		Existing measures to predict water shortages		
		Existing measures to overcome water shortages in agriculture		

ID	Key issues identified	Data needs	Status	Source
2	**Cluster 2: Water Quantity**			
11	Inadequate water supply	Existing measures to control unauthorized use of irrigation water		
12	Water insecurity in the irrigation scheme	Cropping patterns, crop variety used and cropping cycle, crops discouraged and promoted		
		Irrigation practices and sources		
		Status of implementation of participatory irrigation management act		
		Status of water users' associations in irrigation systems		
		Information about progressive farmers in the district and practices adopted for sustainable agriculture and efficient water use		
		Identify and map rivulets, local rivers and their proximity to irrigation canals		
		Plans for revival of these rivulets/local rivers through saved water meant for irrigation		
		Existing reservoirs/ponds in the irrigation system (number and capacity)		
		Existing political incentives for efficient irrigation practices, incentives for inefficient practices such as canal irrigation, irrigation fee charged on crop bases rather on water use, etc.		

ID	Key issues identified	Data needs	Status	Source
2	**Cluster 2: Water Quantity**			
13	Water logging and soil salinization	Stratification of the subsurface and water level (existence of aquitards)		
		Irrigation practices and efficiency, cases of excessive irrigation		
		Status of the drainage infrastructure and associated maintenance schemes		
		Occurrence of heavy rain events		
		Siltation of drainage infrastructure		
		Feasibility of groundwater usage for different purposes (e.g. groundwater quality		
		Constructions of tube wells (especially state tube wells)		
		Use of fertilisers and / or pesticides		

ID	Key issues identified	Data needs	Status	Source
3	**Cluster 3: Ecological Integrity**			
14	Wetland encroachment	Mapping and status of wetlands in the river basin including Amrit Sarovars created		
		Status of wetland health (MoEFCC template-9 indicators)		
		Status of urban wetlands in all ULBs		
		Reasons for intact and unhealthy wetlands and their effects on the river water quality		

ID	Key issues identified	Data needs	Status	Source
3	**Cluster 3: Ecological Integrity**			
15	Floodplain encroachment	Total area of floodplain and riverine zones being encroached upon		
		Owners of encroached land		
		Crops grown in river beds and river banks		
		Agriculture practices		
		Extent of Pallage farming and agro-chemicals used		
16	Environmental flows not maintained	What (if any) systems are there to manage e-flows (are there water-allocation mechanisms?)		
		Identifying critical components of the flow regime that govern the environmental conditions (e.g. dry and wet season base flows, and different-sized high flows and floods)		
		Water levels of the river during the year (especially dry season)		
		River water quality during dry season		
		Impacts on freshwater biodiversity and habitats and their ecosystem services		
		Status of glaciers (where available)		
		What (if any) systems are there to manage e-flows (are there water-allocation mechanisms?)		
		Identifying critical components of the flow regime that govern the environmental conditions (e.g. dry and wet season base flows, and different-sized high flows and floods)		

ID	Key issues identified	Data needs	Status	Source
3	**Cluster 3: Ecological Integrity**			
17	Incised river channels	Channelization		
		Erosion		
		In-stream gravel mining		
		Sealing / land use changes of river banks (timber removal etc.)		
		Sediment delivery into the river		
		Velocity of the river stream		
18	Unauthorized sand mining	Assessment of sand-mining sites in the district		
		Commercial mining hotspots to be identified along with the info about quantum of sand mining –It is important to observe the impact of sand mining on the communities and do analyse whether child labour exists.		
		Status of channels (degradation and erosion)		
		Status and usage of groundwater resources below (level etc.)		
19	High sediment content in rivers	Places with high risks of soil erosion / type (natural or human), status and magnitude of causes (e.g. natural: geomorphology, seismic activities, heavy rain events due to climate change; human pressures: construction activities, overgrazing, land degradation, deforestation, inadequate agricultural practices (e.g. evidence of slash & burn practices), forest fires, sewage sludge discharged into the river)		

ID	Key issues identified	Data needs	Status	Source
4	**Cluster 4: Water Related Issues**			
20	Inadequate water management capacity	Basin water budgets		
		Regulations regarding water usage		
		Administrative situation and coordination between water users		
		Status of Ganga management board		
		Institutional mechanisms for resolving water conflicts		
		Status of water user organisations		
		Role distribution between men and women in irrigation practices		
		Women's capacity and participation in WUO		

5.3 Inventory of potential interventions sorted by issues addressed

This chapter describes the 20 identified water-related key issues in the Ganga basin in more detail and lists potential interventions to overcome these. The list of interventions should be seen as examples and does not claim to be complete.

5.3.1 Cluster 1: Water Quality

Key Issue 1 **Pollution from industrial effluent**

Discussion: With rapid economic growth and urbanization, industrial pollutants (point-source pollution) from diverse sources and industrial processes are anticipated to grow exponentially. In many places, untreated industrial wastewater is discharged in rivers and streams, contaminating surface and groundwater resources. Consequently, many rivers act as major drainage outlets where untreated industrial effluent collects. Regulations exist that aim for 'zero waste' from industries with a principal role for the SPCB. However, mechanisms to ensure prompt compliance seem ineffective in some cities.

This is attributed to several factors, which include

1. irregular sampling and inspection of industries to identify hotspots,
2. the absence of defensible water quality data that pinpoint pollution sources and will stand up in a court of law, and
3. inadequate capacity of the respective water management and regulatory agencies to ensure prompt and effective compliance with environmental regulations.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
1.1	Improving WQ monitoring network, with a specific focus on hotspots of water contamination	Number of WQ stations established (including sensors installed; equipped with sampling kits); number of WQ samples taken	Short-mid term	Grey
1.2	Build capacities on WQ monitoring	Number of qualified personnel trained in WQ monitoring	Short-term	Soft

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
1.3	Establish proper QA/ QC procedures for WQ data to ensure they meet the required standards and can stand up in a court of law	QA/QC procedures for WQ data established; Number of personnel trained in WQ monitoring ((taking samples, lab work, analysis of WQ data etc.)	Short-term	Soft
1.4		Number of qualified personnel for WQ monitoring	Short-term	Soft
1.5	Regular sampling and inspection of industrial wastewater to map all pollution sources and identify pollution hotspots	WQ monitoring programmeestablished; Number of measurement points that can be compared with each other and are included in the evaluation	Short term	Soft
1.6	Build capacities of water agencies to ensure prompt and effective compliance with environmental regulations	Percentage of personnel trained	Short term	Soft
1.7	Initiate the necessary action against industries that do not meet the standards (as per the District Environment Plan)	Number of pollution sources where pollution has abated and now meet WQ standards	Medium term	Soft
	Please identify other interventions …			

Cross Reference

- Urban River Management Plan
- District Environment Plan

Key Issue 2 Pollution from liquid waste

Discussion: Domestic wastewater contains high levels of organic matter, nutrients and coliforms which, if released untreated into the environment, contaminate water bodies and cause diseases such as cancer, reproductive problems, typhoid and stomach diseases. In the Ganges basin, the volume of domestic wastewater is increasing at a fast rate due to the rapidly growing urban population combined with general economic growth. While many treatment plants are already in place or under construction, the gap between installed treatment capacity and wastewater generation is expected to grow further. This mismatch between treatment and generation is further exacerbated by improperly working of the existing STPs failing to utilise their full capacity. In addition, many urban settlements are not yet connected to underground sewage systems and pollute ground and surface waters through open, untapped drains. The faecal sludge is often discharged into open drains, fields, vacant lots, etc. in the absence of designated sludge disposal sites, contributing to this environment pollution. According to CPCB (2013), 80% of the sewage in the Ganga basin is discharged untreated into the Ganga River in or near urban areas, routinely polluting groundwater and surface water.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
2.1	Develop additional STP capacity through a decentralized approach including a set of local/small facilities	Number of new STPs implemented	Long-term	Grey
2.2	Develop additional STP capacity through improving existing STPs	Treatment capacity added	Mid-term	Grey
2.3	Expand the underground sewerage network	km of underground sewerage network added and km of open drainage systems replaced	Long-term	Grey
2.3	Expand the underground sewerage network	km of underground sewerage network added and km of open drainage systems replaced	Long-term	Grey

ID	Intervention	Specific Targets	Time Frame	Type
2.4	Develop faecal sludge and Septage Management (FSSM) Plan including assessment of the existing situation across the sanitation service chain, citywide integrated sludge and septage management, reporting, monitoring and feedback systems, safe sludge disposal sites	FSSM plan developed; m^3 of faecal sludge properly treated and recycled; Number of safe sludge disposal sites	Mid-term to long-term	Grey
2.5	Ensure that stormwater does not mix with wastewater	Length of separate sewage system implemented	Mid-term	Grey
	Please identify other interventions …			

Cross Reference

- Environment Plan
- Urban River Management Plan (2020)
- Central Public Health and Environmental Engineering Organization (CPHEEO) Manual on Sewerage and Sewage Treatment S District ystems (2013)
- National Policy on Faecal Sludge and Septage Management (FSSM) (2017) published by the Ministry of Housing and Urban Affairs (MoHUA)
- Intervention 6.3

Comments

Note from the District Environment Plan: "The Action Plan for installing new/up-grading sewage treatment plants and laying of sewerage network is the mandate of local bodies. Being cost intensive action points, the district administration may draw action points in consultation with ULBs and Urban development department. Action Plan need not be prepared in Tabular form. ULBs, SPCBs/PCC and UDD may be part of action plan for collection and treatment of sewage. Action Plan may also dwell upon other relevant action points which are not mentioned in above template."

Key Issue 3 Pollution from solid waste

Discussion: Municipal solid waste is a principal contaminant of surface water bodies and streams (non-point source pollution), and mainly consists of food waste, plastics, glass, tins, paper, textiles, and others. It also includes electric and electronic waste. While solid waste pollution is recognized as a key issue in urban areas, it also constitutes a major challenge in rural areas. Solid waste management in rural areas, therefore, requires adequate attention.

A considerable part of solid waste is recyclable or biodegradable. Waste recycling, composting, or biogas production can provide an income stream for local entrepreneurs, and solid waste management is therefore closely associated with the Arth Ganga initiative.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Collection, transport, recycling, and disposal			
3.1	Establish segregation-at-source by households or other waste generators: instruct formal and informal waste collectors to only collect segregated waste; introduce financial incentives to encourage segregation-at-source	Number of solid waste generation points (households, blocks, or wards) that separate their waste; number of financial incentives implemented; number of waste collectors that only collect separated waste	Short/ medium term	Soft
3.2	Organize comprehensive house-to-house awareness and education campaign with the help of civil society (e.g. local NGOs and other community organisations)	Number of awareness and education events conducted, messages, news and articles published	Short term	Soft
3.3	Arrange for door-to-door waste collection; this will require (mini) trucks or trolleys with separate compartments	Number of households/ blocks/wards that participate in the door-to-door segregated waste collection program	Short/ medium term	Grey
3.4	Establish a sweeping program; either manual or mechanical	Area that have implemented sweeping program	Short term	Grey
3.5	For areas without door-to-door waste collection, establish waste deposit points (with separate compartments)	Number of waste deposit points established	Short term	Grey

ID	Intervention	Specific Targets	Time Frame	Type
	Collection, transport, recycling, and disposal			
3.6	Establish bio-waste collection and processing facilities at large markets; involve local entrepreneurs	Number of large markets with new bio-waste collection and processing facilities	Short/ medium term	Grey
3.7	Arrange for bulk waste trucks for transport from collection point to waste management centers (see below)	Number trucks used	Short/ medium term	Grey
3.8	Establish decentralized centers (at municipal level) for material recovery, micro-composting, bio-gas generation, and waste disposal including hazardous waste; involve local entrepreneurs	Number of decentralized waste processing and recycling centers established	Medium term	Grey
3.9	Establish sanitary landfills for disposal of inert and non-recyclable waste	Number of landfills established	Medium term	Grey
	Miscellaneous			
3.10	Organize river-bank clean-ups; involve NGOs and local community organizations	Number of river-bank clean-ups implemented	Short term	Grey
3.11	Organize pond and small-reservoir clean-ups; involve NGOs and local community organizations		Short term	Soft
3.12	Build 'plastic traps' in rivers to collect floating plastic from water bodies; involve NGOs and local community organizations	Number of cleaning events	Short term	Grey
3.13	Legacy landfills	Number plastic traps implemented		
3.14	Encourage (bio)mining to clean legacy waste from landfills	Number of (bio)mining sites established	Medium term	Grey

ID	Intervention	Specific Targets	Time Frame	Type
	Miscellaneous			
3.15	Bio-capping of legacy waste dump sites	Number legacy waste dumping sites capped	Medium term	Grey
	Please identify other interventions …			

Cross Reference

- District Environmental Plan
- District Urban River Management Plan
- District Arth Ganga Plan
- Intervention 4.1

Key Issue 4 Pollution from stormwater runoff in urban areas (non-point source pollution)

Discussion: Urban stormwater runoff is a major source of pollution that encompasses sediment, debris, and diverse organic and chemical contaminants and pathogens that are washed off the urban landscape during intense rain events.

Pollution from stormwater runoff collects in drainage channels and is routinely discharged into nearby streams and rivers.

Management of stormwater pollution is closely associated with solid waste management.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Solid water management			
4.1	Solid waste management, including sweeping programs and solid waste collection	m^3 of solid waste prevented from entering the environment	Short term	Grey
4.2	Implement municipal legislation to discourage intensive livestock rearing in urban and peri-urban areas	% of intensive livestock rearing in urban and peri-urban areas reduced	Short term	Soft
4.3	Organize comprehensive house-to-house awareness and education campaign with the help of civil society (e.g. local NGOs and other community organisations)	Number of awareness and education events conducted, messages, news and articles published	Short term	Soft
	Capture rainfall and slow-down surface runoff			
4.4	Encourage decentralized rainwater harvesting	Number of buildings equipped with rainwater harvesting facilities; m^3 of rainwater harvested	Short/ medium term	Grey/ Green

ID	Intervention	Specific Targets	Time Frame	Type
	Capture rainfall and slow-down surface runoff			
4.5	Establish or restore decentralized rainwater detention ponds and bio-swales at all scales that serve as biological stormwater treatment facilities; this is preferably implemented with community participation; develop a long-term preventive approach to avert degradation of these infrastructure elements; it includes an awareness programmethat will be developed and implemented with the help of civil society	m^2 equipped with green infrastructure; Number of micro ponds	Medium/ long term	Green/ Soft
4.6	Establish diverse green infrastructure in urban areas, including porous pavements for roads, parking lots, and sidewalks, and micro-scale water retention basins	m^2 equipped with green infrastructure; Number of micro ponds	Medium term	Green
4.7	Establish raingardens at all scales, from micro to large with deep rooted plants; implement outreach programs and involve local communities	m^2 of rain gardens established	Medium term	Green

Cross Reference

- District Urban River Management Plan
- Indicative Guidelines for Restoration of Waterbodies (polluted lakes, ponds, rivers) in 2019 (CPCB)
- Intervention 3.4
- Intervention 6.1
- Intervention 6.2
- Intervention 7.7
- Intervention

Key Issue 5 Pollution from agricultural runoff

Discussion: Runoff of soil, pesticides, and fertilizer from agricultural fields—commonly referred to as agricultural runoff—causes non-point source pollution of water resources that damages valuable riverine and aquatic ecosystems. For instance, excess nitrogen could lead to harmful algal blooms in water bodies while simultaneously pollute groundwater resources over time. Agriculture is currently among the major causes of river pollution. Contamination of water resources from agricultural runoff will probably worsen since the use of chemical fertilizer and pesticides is expected to increase.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Reduce application of agricultural chemicals			
5.1	Reduce fertilizer use by sensitization and providing training in the rate/timing/method of application;	Number of farmers sensitized and trained in sensible field application of fertilizers	Mid/long term	Soft
5.2	Implement a comprehensive awareness programmein close collaboration with respective Water Use Organizations (in the irrigation schemes)	Number of awareness and education events conducted, messages, news and articles published	Short term	Soft
5.3	Promote organic agriculture and reduce the cultivation of summer paddy	Area converted to organic farming	Mid/long term	Green
	Establish bio filters			
5.4	Establish a riparian zone—some 10 m in width—along rivers, creeks, and drainage channels that will provide a natural filtration zone for agricultural runoff	Length of riparian zones established	Mid term	Green
	Please identify other interventions …			

Cross Reference

- District Irrigation Plans
- District Environmental Plan

Key Issue 6 Urban flooding

Discussion: Drainage congestion during intense rain events cause periodic inundations in the urban zone, specifically in low-lying areas where excess drainage water collects. Urban flooding in areas near a river can be exacerbated by back-water effect, in which high water levels in the river obstruct the discharge of drainage water to the river. Urban flooding is associated with solid waste pollution, overflow of raw sewage in combined drainage systems, and increased health risks. It also causes damage to properties and critical infrastructure.

With more intense rainfall events because of climate change and the ongoing expansion of paved areas—which are impervious and lead to higher surface run-off—urban flooding is expected to become worse in many cities. Three main strategies exist to address urban flooding:

1. capture as much rainfall as possible and slow-down surface runoff,
2. expand drainage facilities with separate systems for stormwater and sewage, and
3. protect or raise critical and high-value areas.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Capture rainfall and slow-down surface runoff			
6.1	Encourage decentralized rainwater harvesting	m^3 of rainwater harvested	Short/ medium term	Grey/ Green
6.2	Protect and/or establish water bodies and green spaces in urban areas; establish diverse green infrastructure	number of water bodies and green spaces in urban areas established or protected; m^2 of green infrastructure established	Medium/ long term	Green
	Capture rainfall and slow-down surface runoff			
6.3	Establish separate drainage systems for stormwater and sewage, specifically in areas vulnerable to urban flooding	Length of separate drainage system implemented	Medium/ long term	Grey
6.4	Increase the capacity of stormwater drainage facilities in urban areas	Length of stormwater drainage system implemented	Medium/ long term	Grey

ID	Intervention	Specific Targets	Time Frame	Type
	Develop and enforce regulations for urban floodplains			
6.5	Strict regulations for dumping of solid waste, wastewater discharge etc. in the river zone	km of riverbanks free of solid waste dumping and wastewater discharges	Short term	Soft
6.6	Remove and relocate unauthorized settlements; prepare relocation strategies and alternative settlements	Number of households and settlements relocated from floodplains	Medium term	Soft / Grey
6.7	Strict monitoring mechanisms in place based on regular inspections and up-to-date high-resolution satellite imagery; identify hotspots and problem areas that require more frequent inspections	Length of river with floodplains adequately monitored	Short term	Soft
6.8	Strick enforcement in the floodplain; include economic instruments such as 'Polluter Pay Principle" and hefty penalties for non-conformers	Number of enforcement measures implemented	Short to medium term	Soft
6.9	Recognition and Awards for top performing industries and Resident Welfare Associations.	Number of awards given	Short term	Soft
	These could be in the form of "River Awards" or linked to existing "Green Certification"			
	Please identify other interventions …			

Cross Reference

- Urban River Management Plan
- Intervention 2.5
- Intervention 4.4
- Intervention 4.6
- Intervention 7.7
- Intervention 8.13
- Intervention 8.14
- Intervention 15.5
- Intervention 15.7
- Intervention 15.10
- Intervention 15.11

5.3.2 Cluster 2: Water Quantity

Key Issue 7 **Insufficient water storage**

Discussion: Because of the unimodal rainfall regime in the Ganga basin, most flow in the river and its tributaries is recorded in the Monsoon period. This pattern is even more pronounced for tributaries that are not glacier-fed. There is inadequate storage capacity to capture the flood wave, and a substantial percentage of the annual Ganga flow runs off without productive use. As a result, over-extraction for gravity irrigation and other purposes occurs in the lean season, which compromises environmental flows.

An obvious remedy to the occasional water shortages—at all levels—is to capture excess rainfall and runoff and store it in the landscape or in a distributed set of retention infrastructure of all sizes—at plot, farm, landscape, and catchment scale. It will attenuate the hydrological regime, increase water security, provide a level of protection from very wet and very dry periods, and make more water available for productive use in the dry season.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
7.1	Establish large or medium size water storage facilities on the main tributaries; this is admittedly a delicate undertaking that must be very carefully considered with full participation of all stakeholders	Number of small to large water storage facilities established and volume of water stored	Long term	Green/ Grey
7.2	Establish small reservoirs on smaller tributaries or provide funds for reservoir construction	Number of small reservoirs established and volume of water stored	Medium term	Green/ Grey
7.3	Repair, de-silt and protect local ponds/sarovars with community participation including re-connect ponds with neighbouring water bodies; provide funds (or loans)	Number, mcm water storage	Short/ medium term	Green/ Grey
7.4	Establish and/or renovate farm ponds, micro reservoirs, or valley tanks (at farm level)	Number of farm ponds established Number of local ponds rejuvenated	Short/ medium term	Green/ Grey
7.5	Reconstruct and/or protect wetlands	Number, area	Medium/ long term	Green

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
7.6	Encourage rainwater harvesting in agricultural areas through diverse means (swales, pits, contour bunds, etc.)	m^3 of rainwater harvested	Short/ medium term	Grey/ Green
7.7	Promote rainwater harvesting in urban areas	m^3 of rainwater harvested	Short/ medium term	Grey/ Green
	Please identify other interventions …			
7.8	Capacitate local communities and stakeholders on River Health Assessment	number of people conducting RHA number of locations on river/s where EHA is being conducted	Short/ medium term	

Cross Reference

- River basin management plan
- Key issue 4, particularly intervention 4.4
- Intervention 6.1,
- Intervention 8.13
- Intervention 12.1
- Intervention 12.2

Key Issue 8 Floods

Discussion: Flooding is a regular phenomenon in the low-lying areas in the Ganga basin. It causes damage to crops, properties, and critical infrastructure in the riverine zone while wasting scarce water resources. Floodwaters are typically contaminated with pollutants and debris and carry a very high sediment load.

Flooding is mainly caused by natural factors: intense rainfall during the monsoon, the many parallel north-south tributaries that originate in the (seasonally wet) Himalayas, and the low gradient of the Gangetic plain that leads to drainage congestion where tributaries meet. Flooding is further aggravated by landscape degradation—such as deforestation—in the upper and middle catchment regions, in combination with inadequate surface water storage capacity in the basin.

Stormwater runoff in urban areas contribute to local flooding and contamination of water sources. In the upper catchment areas, intensive rainfall and cloud burst events in combination with the mountainous terrain can cause flash floods and landslides.

It is probable that climate change will increase the intensity and frequency of flood events. Climate change will also increase the risk of Glacier Lake Outburst Floods (GLOF) in the upper catchment zone.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Zoning of land use in the floodplain			
8.1	Develop flood maps (ground-truth) with the help of local inhabitants	Area covered by flood maps developed	Short term	Soft
8.2	Flood zone demarcation and zoning of land use; ensure that floodplain functions are maintained; prohibit construction of permanent structures in the floodplain (assign as no-development zone)	m^2 of flood plains clearly designated and protected	Short term	Soft
8.3	Use floodplain for agricultural purposes but select crops that are tolerant to periodic inundation	% of floodplains used for agricultural purposes	Medium term	Green

ID	Intervention	Specific Targets	Time Frame	Type
	Zoning of land use in the floodplain			
8.4	Relocate critical infrastructure (that is vulnerable to floods or flash floods)	% of critical infrastructure protected from flooding	Medium/ Long term	Soft / Grey
8.5	Remove unauthorized encroachments of the floodplain	% of unauthorized encroachments removed	Short term	Green
8.6	Improve resilience of existing infrastructure (such as bridges & dams) to higher floods	Number of infrastructure elements whose resilience to flooding has increased	Medium/ long term	Grey/ Green
	Increase water storage capacit			
8.7	Enlarge the floodplain to increase the water banking capacity, following the 'room for the river' approach	Area of new floodplain created	Short term	Green
	Catchment restoration			
8.9	Restoration of (small) catchments to reduce direct runoff and increase groundwater recharge	m^3 of direct run-off reduced and recharged into the groundwater by (small) catchments restored	Medium term	Green
8.10	Stream and small river restoration through check-dams in combination with tree planting along the banks	Number of check dams established and trees along the river planted	Short/Medium-term	Grey/ Green
	Flood prevention and damage control in urban areas			
8.11	Build/heighten embankments to prevent flooding of high value areas	Number of embankments build and heighten	Medium term	Green

ID	Intervention	Specific Targets	Time Frame	Type
	Flood prevention and damage control in urban areas			
8.12	Protect water bodies and green spaces in urban areas; establish diverse green infrastructure	Number/area of water bodies and green infrastructure established and protected	Medium/ long term	Green
8.13	Decentralized rainwater harvesting and conservation	m^3 of rainwater harvested	Short/medium term	Grey/ Green
8.14	Develop storm water drainage facilities in urban areas	Length of stormwater drainage system implemented	Medium/ long term	Grey
	Please identify other interventions …			

Cross Reference

- National Green Tribunal Order as reference for appropriate width of the floodplain
- Urban River Management Plan
- Intervention 4.4
- Intervention 4.6,
- Intervention 6.1
- Intervention 6.2
- Intervention 6.4
- Intervention 7.7

Key Issue 9 Declining groundwater table due to unknown groundwater potential

Discussion: The sustainable yield of the considerable groundwater resources in part of the Ganga basin is not known with adequate precision. SAFE criteria for groundwater exploitation have been established but recent studies report that annual groundwater recharge—the volume that can be safely extracted—is some 20% lower in some areas than previously estimated, specifically in periodic drought years. Hence water tables in some areas are declining even though water withdrawals are less than the SAFE groundwater recharge rates.

Renewable groundwater is ideally suited to increase the productivity of erratic rainwater or irrigation water sourced from rivers (which is sometimes unreliable because of siltation in the canal system or variations in river flow). As water mining needs to be avoided, it is important to determine the average multi-year recharge rate, which will probably differ for each location as a function of geology, climate, and land use.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
9.1	Initiate study to determine the long-term sustainable groundwater yield, at all scales	Number of catchments for which the long-term sustainable groundwater yield has been updated/determined	Mid-term	Soft
9.2	Update the SAFE criteria for groundwater exploitation	Number of catchments for which the SAFE criteria has been updated	Mid-term	Soft
9.3	Establish or expand the groundwater monitoring system; measure groundwater levels to confirm the long-term sustainable yield; adjust the SAFE criteria as needed	Area/catchment for which groundwater monitoring system has been established	Short-term	Soft
	Please identify other interventions …			

Cross Reference

- Intervention 10.1

Key Issue 10 Declining groundwater table due to inadequate groundwater management

Discussion: The Gangetic plains—which are immediately adjacent to the Himalayan foothills—generally have deep alluvial soils with high groundwater recharge capacity. In addition, rainfall in this area is quite substantial and exceeds 800 mm per year in large parts of the basin. Hence the difference between pre- and post-monsoon groundwater levels in the basin is generally between 0.5 and 1 m (Ramganga Basin Plan, March 2020). It represents a large annual storage of water.

Nevertheless, groundwater levels are reportedly declining because of unregulated groundwater extraction and inadequate groundwater management. Specifically, over-exploitation of groundwater is experienced near urban areas as well as in tail-end areas of irrigation schemes. It can lead to receding baseflows in nearby rivers, drying out of wetlands, and other adverse consequences.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Promote sustainable groundwater use			
10.1	Determine the long-term sustainable groundwater yield, at all scales; adjust the SAFE criteria as needed	Number of catchments for which the long-term sustainable groundwater yield and SAFE criteria has been updated/ determined	Short/medium term	Soft
10.2	Based on the modified SAFE criteria, set up a permitting system for groundwater abstraction for industrial, agricultural, municipal, (peri) urban, and other users	Number of catchments/areas for which a permitting system for groundwater abstraction has been set up	Medium term	Soft
10.3	Organize a comprehensive awareness programme regarding the permitting system; involve NGOs and other community organizations in organizing and implementing the awareness and education campaign	Number of awareness and education events conducted messages, news and articles published	Short term	Soft

ID	Intervention	Specific Targets	Time Frame	Type
	Promote sustainable groundwater use			
10.4	Monitor illegal groundwater abstractions and ensure compliance to the permitting system	Number of private wells monitored	Short term	Soft
10.5	Monitor groundwater levels to confirm the long-term sustainable yield; adjust the abstraction permits as needed	Area/catchment for which groundwater monitoring system has been established	Short-term	Soft
	Promote groundwater recharge			
10.6	Promote groundwater recharge by establishing, maintaining and protecting recharge ponds, wetlands, and floodplains	Number of recharge ponds, wetlands and floodplains established, maintained, protected	Medium term	Green
10.7	Promote groundwater recharge by establishing recharge wells (with support from the National Income Generation Program)	Number of recharge wells established	Medium term	Grey
10.8	Desilt dry wells that are repurposed for groundwater recharge	Number of dry wells prepared for groundwater recharge	Medium term	Grey
10.9	Establish percolation pits, infiltration pits, and small recharge ponds at farm level	Number of percolation pits, infiltration pits, and small recharge ponds established	Medium term	Grey/ Green
10.10	Direct harvested rainwater or grey water directly to groundwater recharge pits, wells, and tanks	m^3 of rainwater and grey water used for groundwater recharge	Medium term	Grey/ Green

ID	Intervention	Specific Targets	Time Frame	Type
	Promote groundwater recharge			
10.11	Establish financial incentives for each m^3 recharged into the groundwater (for communities, industry etc.)	Areas for which financial incentives have been created for groundwater recharge	Short term	Soft
10.12	Ensuring that groundwater recharge is remunerated and safe through improved monitoring of recharge systems	Number of Recharge systems monitored	Short term	Soft
10.13	Improve planning of recharge systems by using suitability maps and mainstreaming groundwater recharge into general planning processes	Areas for which groundwater recharge suitability maps have been created and groundwater recharge has been mainstreamed into general planning processes	Short term	Soft
10.14	Ensuring that groundwater recharge is remunerated through agreements	number of recharge systems that are improved through agreements between stakeholders	Short term	Soft
	Please identify other interventions …			

Cross Reference

- Intervention 9.1
- Intervention 9.2
- Intervention 9.3

Key Issue 11 Inadequate urban and peri-urban water supply

Discussion: Municipal and industrial water supply in urban and peri-urban areas is often inadequate. Companies and individuals respond by establishing private tube-wells, which causes over-extraction of groundwater and locally declining groundwater tables. It reduces baseflow in local streams and causes landscape dehydration. Groundwater over-use is aggravated by a general absence of conscious water conservation. Hence inefficient water-use including in industrial processes is widespread.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
11.1	Expand municipal water supply to peri-urban areas	% of peri-urban areas equipped with / integrated into the public water supply	Medium/ long term	Grey
11.2	Promote rainwater harvesting for domestic water supply; make it compulsory in urban areas	m^3 of rainwater harvested	Short/ medium term	Grey/ Green
11.3	Encourage water conservation and water demand management through tariffs (specifically for industrial purposes)	Areas for which new water tariffs are established	Short/ medium term	Soft
11.4	Encourage water conservation through awareness and education campaign; involve community organizations and NGOs	Number of awareness and education events conducted, messages, news and articles published	Short term	Soft
11.5	Encourage wastewater (grey water) re-use and re-cycle	m^3 of wastewater recycle/reused	Short/ medium/ long term	Grey/ Green/ Soft
11.6	Encourage groundwater recharge	m^3 of water recharged into the groundwater	Short/ medium/ long term	Grey/ Green/ Soft
	Please identify other interventions …			

Cross Reference

- Intervention 4.4
- Intervention 6.1
- Intervention 7.7
- Intervention 8.13
- Key issue 10

Key Issue 12 Inadequate urban and peri-urban water supply

Discussion: Water security in irrigated agriculture is not guaranteed for the entire command area, causing a combination of occasional water deficits and, paradoxically, over-irrigation. The latter represents inefficient use of irrigation water that leads to over-abstraction from rivers. This is among the main reasons for receding baseflow and why environmental flows are not met. In addition, over-irrigation can lead to water logging and salinization in tail-end areas of the irrigation scheme.

Irrigation aims to provide secure water supply—which is a prerequisite for high yields. Nevertheless, periodic water shortages are experienced in parts of most irrigation schemes. The root cause is high sediment load of irrigation water in the flood season, which result in canal siltation. Water delivery becomes unreliable when irrigation infrastructure is not adequately maintained. This specifically occurs at the lower end of the command area. As a result, farmers typically over-irrigate whenever water is available, even when it is not their turn in the roster. These practices exacerbate water insecurity in the areas further downstream, with negative implications for yields.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
12.1	Promote farm ponds and micro reservoirs	Number of farm ponds and micro reservoirs established	Short/medium term	Green
12.2	Promote rainwater harvesting for agricultural purposes	m^3 of rainwater harvested	Short/medium term	Grey/ Green

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
12.3	Promote conjunctive use of surface water and bulk groundwater	RURAL: xx hectare of farms comes under the regime of conjunctive use of water URBAN: yy number of households comes under the regime of conjunctive use of water PERI-URBAN: both above or as the case may be	Long term (3 to 5 years)	Grey
12.4	Strengthen Water Users Associations	Number of WUAs strengthened	Long term (3 to 5 years)	Soft
12.5	Prevent unauthorized use of irrigation water (outside the roster)	xx number of unauthorised instances curbed	Mid term (1 to 2 years)	Soft
12.6	Promote sprinkler and drip irrigation	Area of fields irrigated with sprinkler and drip irrigation	Long term (3 to 5 years)	Grey
12.7	Promote less water-intensive crops	Area of fields planted with drought-resistant plants	Long term (3 to 5 years)	Green
12.8	Introduce an irrigation charge based on volume used	Area with new irrigation charge	Medium term (1 to 2 years)	Soft
	Please identify other interventions ...			

Cross Reference

- Intervention 13.3
- Intervention 7.4
- Intervention 7.6

Key Issue 13 Water logging and soil salinization

Discussion: Water logging occurs in about 10-20% of the canal command area, usually in the tail-end sections of the scheme. It is caused by inadequate drainage infrastructure in combination with over-irrigation. Water logging is often exacerbated during high rainfall events.

In addition, water logging leads to an increase in soil salinity, when salts are not washed due to a lack of water transportation. Soil salinization reduces crop yields. In addition, sub-surface water logging in these areas prevents cultivation of deep-rooted crops or trees. There are growing areas in most irrigation schemes in the Ganga basin with slight to moderate salinity because of water logging. In addition, dry climates and low precipitation rates further exacerbate soil salinization.

It is noted that seepage from canals or plots does not necessarily represent a water loss if it recharges the groundwater. However, the fraction that evaporates does represent a net loss.

Water loggings represents inefficient—even wasteful—water use. This water—which partly evaporates without productive use—would otherwise have remained in the river and would therefore have increased flow in the downstream river reach.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
	Water logging			
13.1	Improve surface drainage through e.g. ditches, open drains, grassed waterways, humps, hollows	m^3 of logged water drained	medium term	Grey / Green
13.2	Improve subsurface drainage through e.g. mole drains, gravel mole ploughs (before you start, identify the soil type)	m^3 of logged water drained	medium term	Grey / Green
13.3	Groundwater pumping in water-logged areas (improved vertical drainage in case high groundwater levels are the reason for water logging)	Storage capacity of unconfined aquifer increased	Medium term	Grey
13.4	Promote (sustainable) groundwater as the principal source for irrigation in sections in the canal command area vulnerable to water logging	Number of fields irrigated with groundwater in areas prone to water logging	Medium term	Soft

ID	Intervention	Specific Targets	Time Frame	Type
	Water logging			
13.5	Diverse measures to improve water efficiency in irrigated agriculture; this includes a sensitization effort to increase water productivity and training of farmers in determining field irrigation water demand	m^3 of irrigation water saved	Short to long term	Grey / Soft / Green
13.6	Establish raised bed cropping	M^2 of fields that have raised their beds	Long term	Green
13.7	Avoid over-irrigation through increasing water security – see Interventions proposed for Key Issue 12	See key issue 12	See key issue 12	See key issue 12
	Soil salinization			
13.8	Reclaim sodic lands; but only with groundwater (else they will quickly revert to sodic)			Grey / Green
13.9	Irrigate with less saline water (groundwater, rainwater, etc.)	m^2 of fields that are irrigated with less saline water	medium term	Green
13.10	Avoid over-irrigation through water-efficient irrigation methods	Number of sprinkler and drip irrigation systems implemented		
13.11	Cultivate salt-tolerant crops	m^2 of fields cultivating salt-tolerant crops		
13.12	Mulching	m^2 of fields using mulching		
	Please identify other interventions …			

Cross Reference

- Key issue 12, particularly intervention 12.6
- Intervention 13.5

5.3.3 Cluster 3: Ecological Integrity

Key Issue 14 Wetland encroachment

Discussion: Many wetlands are encroached upon and/or destroyed with adverse implications for a broad set of wetland functions. These include providing wildlife habitats and sustaining important environmental value, groundwater recharge, flood attenuation and flood protection of downstream areas, increasing baseflow, nutrient and sediment transformation, improving water quality, and others. While there are many causes of wetland degradation, encroachment is among the most common factors. Once this is addressed, many wetlands will regenerate over time through natural processes and without further interventions

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
14.1	Delineate and demarcate wetlands	Number of wetlands delineated and demarcated	Short term	Soft
14.2	Establish the level of encroachment of each wetland (prepare inventory)	Number of wetlands assessed	Short term	Soft
14.3	Involve NGOs and other community organizations in organizing and implementing an awareness campaign on the value of wetlands, and on their sustainable use	Number of awareness and education events conducted, messages, news and articles published	Medium term	Soft
14.4	Ensure compliance to environmental regulations through appropriate administrative and legal measures, and reverse wetland encroachment	Number of administrative and legal measures implemented	Mid term	Soft
14.5	Monitor wetlands for illegal activities	Number of wetlands monitored	Short term	Soft
	Please identify other interventions …			
14.6	Capacitate local communities on Wetland Health Assessment	Number of people capacitated WHA conducted for number of wetlands	Short to medium term	Soft

Cross Reference

- District Environmental Plan

Key Issue 15 Floodplain encroachment

Discussion: The floodplain is the strip of land adjacent to the river that will be inundated by periodic floods. It generally has high soil fertility and supports diverse and rich ecosystems. In addition, it is often a desired location for settlements and infrastructure such as roads. In urban areas, floodplains are sometimes occupied by slums with very high population density and poor infrastructure. Floodplain functions include groundwater recharge, flood-wave buffering and attenuation, erosion control, improving surface water quality because of sediment deposition, and providing habitats for diverse aquatic and terrestrial flora and fauna.

Encroachment of the floodplain—or use of the floodplain for unauthorized activities such as sand mining or waste disposal—aggravates pollution and has adverse impacts on critical floodplain functions and riverine ecosystems.

Addressing encroachment and floodplain regeneration has proven difficult, specifically in urban areas. It requires awareness raising and sensitization, effective law enforcement, and probably the provision of alternative options for livelihoods and housing or solid waste disposal.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
15.1	Clearly demarcate the floodplain boundaries	Length of the river for which floodplain boundaries are established	Short term	Soft
15.2	Protect floodplain boundaries through roads, embankments, tree lines, or other means	Length of the river for which floodplain boundaries are protected	Short to medium term	Grey / Green
15.3	Determine permissible and non-permissible activities in the floodplain—this can differ per river reach	Length of the river for which illegal activities have been removed from the floodplain	Medium to long term	Soft
15.4	Sensitize population living in the vicinity of the floodplain about the regulations regarding use of the floodplain; involve NGOs and other community organizations in organizing and implementing the awareness and education campaign	Number of awareness and education events conducted, messages, news and articles published	Short term	Soft

ID	Intervention	Specific Targets	Time Frame	Type
15.5	Remove and relocate unauthorized settlements; prepare relocation strategies and alternative settlements	Number of households and settlements relocated from floodplains	Medium to long term	Soft / Grey
15.6	Regenerate waterfronts in urban areas	km of waterfronts regenerated	Short to medium term	Green
15.7	Prevent dumping of solid waste on the riverbanks and in the floodplain	km of riverbanks free of solid waste dumping	Short term	Soft
15.8	Only allow organic farming in the floodplain	Length of river with organic farming in the floodplain	Medium term	Green
15.9	Floodplain regeneration through constructed wetlands, parks, infiltration ponds, green infrastructure, and other flood-resilient developments	Length of river with floodplain regenerated	Medium term	Green
15.10	Strict monitoring mechanisms in place based on regular inspections and up-to-date high-resolution satellite imagery; identify hotspots and problem areas that require more frequent inspections	Length of river with floodplains adequately monitored	Short term and contin-uous activity	Soft
15.11	Strick enforcement in the floodplain; include economic instruments such as 'Polluter Pay Principle" and hefty penalties for non-conformers	Number of enforcement measures implemented	Short to medium term	Soft
	Please identify other interventions …			

Cross Reference

- Urban River Management Plan
- Urban River Management Plan, Intervention 6.6
- Urban River Management Plan, Intervention 6.5
- Urban River Management Plan, Intervention 6.7
- Urban River Management Plan, Intervention 6.8

Key Issue 16 Environmental flows not maintained

Discussion: There is general recognition of the importance of retaining some component of the natural flow regime of a river to protect river health and aquatic life. This is referred to as Environmental Flow (EF). The EF should be regarded as a carefully considered compromise between water resources development on one hand, and river maintenance in a healthy condition on another.

Note that there are many different methods to evaluate EFs. It is unclear whether the current EF requirements—if any—have been based on a proper understanding of the ecological functions and limits.

In the Ganga basin, environmental flows are generally not prioritized and therefore often not met. For instance, it is unclear whether EFs are taken into consideration when determining water abstractions for irrigation or other purposes. Consequently, some tributaries are virtually dry in some parts of the year. It causes damage to riverine ecosystems. In addition, the very low flow volumes in the dry season exacerbate water quality concerns, specifically downstream of major urban areas.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
16.1	Classify water bodies and determine EF requirements as a function of aspired socio-economic development, associated water demand, and current environmental value	Number of water bodies assessed, and EF requirements identified	Medium to long term	Soft
16.2	Include EF requirements in the operation policies of existing reservoirs and barrages	Number of EF requirements integrated into operation policies	Medium to long term	Soft
16.3	Encourage diverse measures to increase base-flow in the river	Number of measures implemented	Long term	Grey / Green / Soft
16.4	Monitor illegal water abstractions and ensure compliance to environmental regulations	Length of river with monitoring of abstraction	Mid term	Soft

ID	Intervention	Specific Targets	Time Frame	Type
	Please identify other interventions …			
16.5	Wherever E-Flows recommendations are made, create local stakeholders (comprising line departments, local interested citizens) and conduct joint monitoring of Flows at the river site	Number of people in stakeholder groups Diversity in the stakeholder groups Number of locations on river/s where joint E-Flows monitoring is being done Frequency of joint E-Flows monitoring	Medium to long term	Grey / Soft or both, as the case may be

Cross Reference

- River basin management plans
- District irrigation plans

Key Issue 17 Incised river-channels

Discussion: Incised river-channels concentrate floodwater and increase peak flow, lower the groundwater table, progressively dehydrate the landscape, and cause environmental degradation. It normally starts when vegetation is removed, and rainfall no longer infiltrates in the soil. As a result, runoff occurs on the ground surface and small drainage gullies are created. Where there is adequate slope, these gullies will erode. Floodwaters concentrate in these channels and no longer inundate the adjacent lands. The processes described above take place at all scales. Once taken off, they typically accelerate.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
17.1	Diverse landscape restoration and reforestation techniques aimed to re-establish a dense vegetation cover; this includes measures to reduce grazing to sustainable levels	Length of the river with established dense vegetation	Medium to long term	Green
17.2	Diverse erosion control measures such as contour bunds, half-moons, conservation ploughing, conversation tillage, etc.	Number of erosion control measures implemented	Short to medium term	Green / Grey
17.3	Build a series of gully plugs and check dams in the incised channel	Number of gully plugs and check dams implemented	Short to medium term	Grey / Green
	Please identify other interventions …			

Key Issue 18 Unauthorized sand mining

Discussion: Large industrial-scale sand mining with heavy machinery damages the floodplain and riverbanks, lowers the groundwater table, and can change the river morphology. It therefore poses a threat to the environmental integrity of the riverine ecosystems. It is important to distinguish between large-scale industrial sand mining and artisanal mining at small scale. The latter has been practiced for a very long time and provides a livelihood to the local population. Further, it has only minor impacts on the environment. Hence small-scale artisanal sand mining is usually permitted. It is important to distinguish between large-scale industrial sand mining and artisanal mining at small scale. The latter has been practiced for a very long time and provides a livelihood to the local population. Further, it has only minor impacts on the environment. Hence small-scale artisanal sand mining is usually permitted.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
18.1	Monitor mining activities and establish the level of compliance to environmental regulations	Length of river with continuous monitoring of mining activities	Short term	Soft
18.2	Prepare an inventory of illegal sand mining or other mining activity in the district	Number of illegal sand mining activities detected	Short term	Soft
18.3	Ensure compliance by the mining industry to environmental regulations through appropriate administrative and legal measures	Number of administrative and legal measures established and implemented	Short term	Soft
	Please identify other interventions …			
18.4	Conduct joint surveys to assess the habitat of turtles or basking grounds for gharials in and around the sand mining location; if any of the site comes as a known/claimed/proven habitat for the same, then halt sand mining	Number of joint surveys conducted and reports submitted to district authorities Number of sites recovered from mining activities and freed up	Short to medium term	soft

Cross Reference

- District Environmental Plan

Key Issue 19 High sediment content in rivers

Discussion: A combination of road construction in mountainous areas, deforestation, and inappropriate agricultural practices exacerbate soil erosion and lead to high sediment loads in rivers and irrigation canals. More intense rainfall because of climate change in combination with ongoing land-use changes—as well as forest fires—may further increase sediment content in rivers. In addition, more extreme weather may also increase landslides that cause a sudden spike in the sediment load.

Potential Interventions with related specific targets (list not complete)

ID	Intervention	Specific Targets	Time Frame	Type
19.1	Diverse soil and water conservation measures (at all scales), specifically in hilly and mountainous areas	Number of soil and water conservation measures	Short to long term	Green / Grey
19.2	Improved land management that discourages deforestation and promotes afforestation	m^2 afforested	Medium to long term	Green
19.3	Promote the concept of green roads; minimize blasting operations during road construction	km of roads designed and constructed according to the green roads concept	Medium term	Grey
19.4	Immediately clear minor landslides and mass wasting, and restore slopes with grass and other vegetation	Landslides and mass wasting cleared and m^2 of slopes regenerated	Short to medium term	Green
	Please identify other interventions …			

5.3.4 Cluster 4: Water Related Issue

Key Issue 20 **Inadequate water management capacity**

Discussion: Water resources management covers a broad spectrum. It requires technical capacity at district level in terms of data, equipment, software, models, and staff. It also requires effective law enforcement to ensure compliance with agreed upon rules and regulations. In addition, it requires coordination mechanisms to resolve and pre-empt potential water conflicts and to address the prevailing silo approach in water resources management at district and state level.

The District Ganga Plans will probably not address inadequate technical capacity. They could, however, support the institutional development of adequate coordination mechanisms among the respective water users and stakeholders at various scales.

ID	Intervention	Specific Targets	Time Frame	Type
20.1	Support the establishment of effective Water Use Associations (WUAs) within the command area to strengthen participatory irrigation management, promote effective water use, discourage over-use of fertilizer, etc.	number of WUAs established documentation related to WUAs affairs and manuals for them to deliver Frequency of WUA meetings and timeliness	Mid to Long term	Soft
20.2	Enhancement of women's capability and participation in WUAs.		Mid to Long term	Soft
20.3	Please identify other interventions …			

5.4 How to use GIS maps for situation assessment

This chapter does not claim to train DGCs in working with Geographic Information Systems (GIS) - for this, the manual refers to the many comprehensive guidelines that are already available online free of charge. Rather, recommendations and minimum quality and design requirements are given with the aim of making the GIS maps of the district plans comparable with each other.

Geographic information systems

A geographic information system (GIS) is a computer system for capturing, storing, reviewing and displaying data related to positions on the earth's surface. GIS helps to better understand spatial patterns and relationships. For example, a map could show locations of pollution sources, such as factories, and locations that are vulnerable to pollution, such as wetlands and rivers. Such a map would help people identify where water supplies are most at risk.

GIS can use any information that includes location. At a minimum, precise geographic location information needs to be available for the data layers of either vector or raster formats for them to be used for further work. Simple low-resolution images (such as – jpg, png formats, etc.) of maps, often used on websites, do not by themselves constitute good GIS data, since they cannot directly be used in a GIS software without significant loss of information and quality. In an oversimplified form, the difference between an image of a vector file and the geographical vector file itself is roughly similar to the differences between a text document in the very restrictive PDF format and the actual text file, such as from Microsoft Word.

5.4.1 Quality requirements for GIS maps of the DGPs

An optimal GIS map …

- conveys spatial information in an optimal way
- is unambiguous in its message,
- restricts itself to the essentials of the available information and relieves the map image of superfluous and irrelevant information,
  - → Is the information I need available for my district and for the locations where I am planning interventions?
  - → Omit unimportant things, simplify, interpolate, summarise, select and structure the data needed in a detail that is appropriate to the purpose of your map
- guarantees the required accuracy of location,
- guarantees the required accuracy of thematic and logical consistency
- provides the needed temporal quality
  - → Do I have enough data over a sufficient period of time to be able to draw conclusions needed?

- is easy to read, aesthetically convincing, and uses symbolism that spontaneously evokes the right associations,
  - → Are labels and signatures readable? Assuming good contrast between the map characters and the background, the following sizes are recommended:
    - Lines > 0.08 mm line thickness,
    - Isolated points > 0.3 mm diameter
    - Crosses > 0.8 mm
    - Spaces > 0.15 mm
  - → Avoid overlays
  - → Summarise related data into classes
  - → Use colour codes wisely: blue for water, brown for contour lines and boundary of regions, green for vegetation, white/grey for missing or unknown values etc.
- provides the needed description:

Map element	Mandatory	Optional
Title / subtitle	x	
Map frame with latitude and longitude	x	
Legend	x	
Signature (area, line, points, charts)	x	
North arrow	x	
Copy right, data source	x	
Scale bar (depending on topic, scale and purpose)		x
Graticule		x
Projection		x
Author, date		x

Table 11. Map elements[4]

[4] Adapted from Cartographic concepts and representations, University Stuttgart, Institute of Landscape Planning and Ecology

- Legend (translating code)
  - → Arranged at a good position (normally to the right)
  - → Short and precise without abbreviations
  - → No repetition of the map title in the legend needed
  - → No need to write LEGEND as legend title
  - → Unit of value only once
  - → In thematic maps only topic-relevant signature is necessary
  - → In topographic maps all signatures are shown in the legend
  - → Main topic first

Recommended sources for GIS data to prepare DGPs

Capturing, converting and combining the desired data to create GIS maps can be difficult and time-consuming. To help, many web-based platforms offer web mapping. As in the example of India WRIS, regularly updated water-related layers and data are provided and combined here, from different sources. If the respective DGCs do not have the resources and capacity to work with Q/ArcGIS, it is possible and convenient to use ready-made GIS maps, with the disadvantage of being bound to the platform's degrees of freedom and not being able to freely design the maps. A list of recommended web maps can be found below.

GIS experts familiar working with appropriate GIS software can also find below a list of commonly used databases containing raw geospatial data needed to create GIS maps for DGPs.

Recommended sources for pre-designed GIS maps:

- **India Water Resources Information system**
  (https://indiawris.gov.in/wris/#/)

  Public water information platform set up by Ministry of Jal Shakti with the aim of disseminating the most important aspects of water management in India. The platform contains good quality information on the below aspects as well as a Geoviewer (see below):

  - → Groundwater and surface water (visualization, comparison, options to download information on monitoring sites by several central & state agencies)
  - → Climate information (visualization, comparison, options to download information on monitoring sites by different meteorological stations of state and central agencies
  - → River points (visualization, comparison, options to download information on monitoring sites by several central & state agencies)

→ Reservoir data (access on water level, storage and salient features of reservoirs, monitored by various central & state agencies)

→ Water resources projects (information and spatial inventory of irrigation projects & water resources structures; e.g. location of dams, barrages, weirs, reservoirs, canals, etc.)

- **Geoviewer of the India Water Resources Information system**
  (https://indiawris.gov.in/wris/#/Geoviewer)

  The India WRIS Geoviewer (see the landing page showing the extent of areawide data coverage in Figure 7) allows the geographical visualisation of different thematic layers, the visibility of which can be switched on and off for comparison and for a customised view. The view is supported by various features including: Legend, Layerlist, Basemap, Print, Surface profile, Share, Add Data, Zoom in/Zoom Out, Previous/Next Zoom, Locate, Global Search, Attribute table, Select, Swipe, Measurement, Bookmark etc.

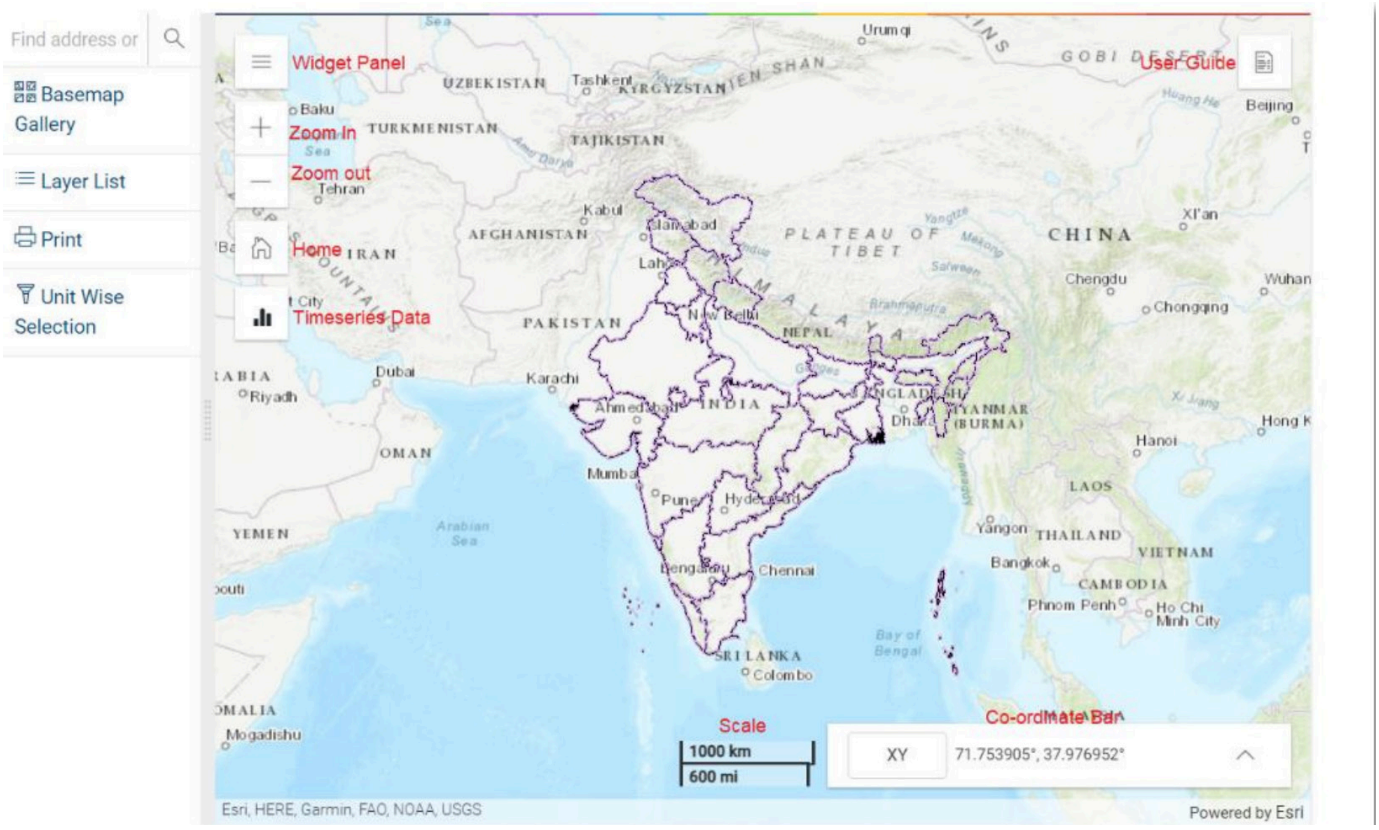

Figure 7: Screenshot of the India Water Resources Information system showing its areal data coverage

- **Indian Geo Platform of the Indian Space Research Organization (ISRO)**
  (http://bhuvan.nrsc.gov.in/gis/thematic/index.php)

  The platform provides pre-designed GIS maps and raw geospatial data for selected themes on basin and district level. Users can consume these Thematic Datasets and Integrate them into their systems as OGC Web Services.

- **Water Resources of India – Central Water Commission Web maps**
  (https://craigdsouza.in/water_resources_india/)

  A straightforward webmap that provides useful layers such as watersheds, river basins, aquifers, groundwater depth, soil productivity produced by the Water Resources Information System (WRIS) of the Central Water Commission. For more details: https://github.com/craigdsouza/water_resources_india

- **India Water Tool**
  (https://www.esri.in/en-in/industries/water/segments/water-resources)

  "India Water Tool Version 4 (IWT 4.0) is a comprehensive, high-resolution, userfriendly tool (web map) that helps companies and other users identify their waterrisks, prioritise their sites for further action and analyses and plan their water management interventions in India. IWT 4.0 combines 14 datasets and water stress models from key government authorities in India and other institutions." The data is displayed in a Web Map enabling the user to select and compare different thematic layers and to print them.

Commonly used sources containing raw geo-spatial GIS data:

- **NEXTGIS**
  https://data.nextgis.com/en/region/IN/base

  "At the service data.nextgis.com, regularly updated spatial datasets are made for any region in the world by utilising OpenStreetMap and a few other open and public domain sources. The datasets include land use data, water bodies data, settlements etc. and are made available in a variety of formats, including ESRI Shapefile, ESRI "At the service data.nextgis.com, regularly updated spatial datasets are made for any region in the world by utilising OpenStreetMap and a few other open and public domain sources. The datasets include land use data, water bodies data, settlements etc. and are made available in a variety of formats, including ESRI Shapefile, ESRI

- **Kaggle**
  (https://www.kaggle.com/datasets/nehaprabhavalkar/india-gis-data)

  This dataset contains various geospatial data of India on its water resources, etc., including shape files, project files, etc., useful for geospatial analysis.

- **EarthExplorer by USGS**
  (https://earthexplorer.usgs.gov/)

  "A range of various thematic data sets is provided by Earth Explorer (EE), it enables online search, browsing display, metadata export, and data download for U.S. Geological Survey earth science data repositories (USGS) worldwide. "

- **Climate Data Store - Copernicus**
  https://cds.climate.copernicus.eu/#!/home

  Climate data for download; "Copernicus is the European Union's Earth Observation Programme, looking at the planet Earth and its environment. It provides climate data world wide"

- **European Centre for Medium-Range Weather Forecasts**
  (https://www.ecmwf.int/en/forecasts/datasets)

  Weather forecast datasets; "The European Centre for Medium-Range Weather Forecasts (ECMWF) is responsible for the production and dissemination of weather forecast data. It provides climate data world wide".

- **OpenStreetMap**

  is a free, open geographic database updated and maintained by a community of volunteers via open collaboration. OpenStreetMap is freely licensed under the Open Database License and as a result commonly used to make electronic maps, inform turn-by-turn navigation, assist in humanitarian aid and data visualisation. OpenStreetMap uses its own topology to store geographical features which can then be exported into other GIS file formats. The OpenStreetMap website itself is an online map, geodata search engine and editor.

- **Datasets and maps by FAO**
  (https://www.fao.org/land-water/databases-and-software/en/)

  FAO's databases and software models (free for download) comprise:

  → AQUASTAT: FAO's global water information system

  → AQUACROP: The industry-leading crop–water productivity software model

  → AQUAMAPS: Global spatial database on water and agriculture

  → GAEZ: Global Agro-Ecological Zones

  → The Harmonized World Soil Database: 15 000 soil mapping units combining existing regional and national updates of soil information worldwide

- **Socioeconomic Data and Applications Center (SEDAC)**
  (https://earthdata.nasa.gov/eosdis/daacs/sedac)

  "NASA's Socioeconomic Data and Applications Center (SEDAC) is run by the Center for International Earth Science Information Network (CIESIN). [...] SEDAC synthesizes Earth science and socioeconomic data and information in ways useful to a wide range of decision-makers and other users. [...] SEDAC has extensive holdings related to population, sustainability, and geospatial data.

5.4.2 Thematic data needed for preparing GIS maps for DGPs and where to find them

At the time of writing the handbook, the data situation on the above-mentioned platforms was assessed for their usability in the creation of thematic spatial maps for DGPs that are usable for each district in the Ganga basin. Table 12 lists all relevant thematic data needed: on which platforms they can be found and in what form and detail.

Table 12. Data availability on the different platforms relevant for preparing DGPs

Thematic data	Data bases for GIS data on basin and district level	Data format
Topography and Drainage Network		
Topography and Drainage Network	Network https://indiawris.gov.in/wris/#/RiverMonitoring	Web map, ready to use maps downloadable
	IndiaWRIS Geoviewer	Web map, ready to use maps downloadable
Administrative Data		
District boundaries	IndiaWRIS Geoviewer	Web map, ready to use maps downloadable
	https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php	Web map, WMS
	https://gadm.org/download_country.html	Raster / vector data
Hydrological Boundary		
Basin boundary	IndiaWRIS Geoviewer	Web map, ready to use maps downloadable
Basin boundary	IndiaWRIS Geoviewer	Web map, ready to use maps downloadable
Climate data		
Rainfall	https://indiawris.gov.in/wris/#/rainfall	Web map
	https://datosclima.es/en/ghcn/Location.php	Web map, ready to use maps downloadable
Potential Evapotranspiration	https://indiawris.gov.in/wris/#/evapotranspiration	Web map, ready to use maps downloadable

Thematic data	Data bases for GIS data on basin and district level	Data format
Surface Water		
Storage Reservoir Sediment Studies	https://indiawris.gov.in/wris/#/sediment	Web map, ready to use maps downloadable
Storage Surface water bodies	https://indiawris.gov.in/wris/#/surfaceWater	Web map, ready to use maps downloadable
	https://bhuvan-wbis.nrsc.gov.in/	Web map, ready to use maps downloadable, WMS
	IndiaWRIS Geoviewer	Web map, ready to use maps downloadable
River	https://indiawris.gov.in/wris/#/RiverMonitoring	Web map, ready to use maps downloadable
	IndiaWRIS Geoviewer	Web map, ready to use maps downloadable
Surface Water quality	https://indiawris.gov.in/wris/#/SWQuality	Web map, ready to use maps downloadable
	https://bhuvan-wbis.nrsc.gov.in/	Web map, ready to use maps downloadable, WMS
Wetlands	https://indiawris.gov.in/wris/#/wetlands	Web map, ready to use maps downloadable
Groundwater		
GW Aquifer type	https://indiawris.gov.in/wris/#/Aquifer	Web map, ready to use maps downloadable
GW Exploration (well locations with lithological profile)	https://indiawris.gov.in/wris/#/Litholog	Web map, ready to use maps downloadable
Water Level Behaviour	https://indiawris.gov.in/wris/#/groundWater	Web map, ready to use maps downloadable
Ground Water resource estimation	https://indiawris.gov.in/wris/#/GWResources	Web map, ready to use maps downloadable
Groundwater prospects studies	https://indiawris.gov.in/wris/#/GWProspects	Web map, ready to use maps downloadable
Artificial recharge structures	https://indiawris.gov.in/wris/#/arsViewer	Web map, ready to use maps downloadable
Groundwater quality	https://indiawris.gov.in/wris/#/GWQuality	Web map, ready to use maps downloadable

Thematic data	Data bases for GIS data on basin and district level	Data format
Water Quality		
Main pollution sources, wastewater treatment, sanitation, etc	https://indiawris.gov.in/wris/#/Wasteland	Web map, ready to use maps downloadable
District Transboundary Aspects		
Import and export of pollutants	https://indiawris.gov.in/wris/#/SWQuality	Web map, ready to use maps downloadable
Land resources		
Landuse and landcover maps and tables	https://indiawris.gov.in/wris/#/lulc	Web map, ready to use maps downloadable
	https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php	Web map, ready to use maps downloadable, WMS
	arcgis.com	Web map, raster/vector data
Soil (soil depth, soil erosion soil productivity, soil slope)	https://indiawris.gov.in/wris/#/soil	Web map, ready to use maps downloadable
Water logging and salinity	https://indiawris.gov.in/wris/#/waterLoggingSoilSalinity	Web map, ready to use maps downloadable
	https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php	Web map, ready to use maps downloadable, WMS
Wasteland study	https://indiawris.gov.in/wris/#/Wasteland	Web map, ready to use maps downloadable
	https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php	Web map, ready to use maps downloadable, WMS
Socio economic data		
Socio-economic Census	https://indiawris.gov.in/wris/#/socioEconomic	Web map, ready to use maps downloadable
Socio-economic Profile	https://indiawris.gov.in/wris/#/socioEconomic	Web map, ready to use maps downloadable
Dominant Livelihood Systems / agro climatic regions	https://indiawris.gov.in/wris/#/Region	Web map, ready to use maps downloadable
Drought affected areas	https://indiawris.gov.in/wris/#/Drought	Web map, ready to use maps downloadable
District Transboundary Aspects (incl. import and export of pollutants etc.)	https://indiawris.gov.in/wris/#/interbasintransferLink	Web map, ready to use maps downloadable

5.5 List of key stakeholders for District Ganga Planning

5.5.1 National level

Stakeholder	Role and responsibility in District Ganga Planning
National Mission for Clean Ganga (NMCG)	Guidelines for district planning, mandate to DGCs in accordance with the Authority Notification. Approval of district plans and finances for implementation
Central Groundwater Board (CGWB)	Contributions in district planning for sustainable development and management of ground water resources of the country.
Central Water Commission (CWC)	Contributions in district planning for components related to water resource management and monitoring of river water quality
National Water Academy (NWA)	Contributions in district planning based upon international River basin management (RBM) cycle approach. NWA has been involved with NMCG and GIZ in implementation of RBM cycle trainings
Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR)	MOJS, DoWR, RS & GR will not be directly involved in the planning stage of district plans. However, MoJS is the nodal ministry at central level to support Ganga and sub basin water framework development by the states.
Ministry of Jal Shakti, Department of Drinking Water and Sanitation and (DWS)	MOJS, DWS will not be directly involved in the planning stage of district plans. However, MoJS is the nodal Ministry at central level to support Ganga and sub basin water framework development by the states.
Ministry of Housing and Urban Affairs (MoHUA)	Ministry of Housing and Urban affairs will not be directly involved in the planning stage of District Plans. However, the policies, strategies and guidelines are being provided by CPHEEO to the States & UTs Governments including Municipal Corporations / Committees.
Central Pollution Control Board (CPCB)	Contributions in data/information on pollution abatement and water quality monitoring in the Basin
Centre for Ganga River Basin Management and Studies (cGanga)	Coordination and synergies of District Ganga Plan with the Ganga Basin Plan
Wildlife Institute of India (WII)	Coordination on biodiversity aspects, local awareness activities
NIUA, MoHUA	Synergy with urban river management plan framework and urban river management plan for ULBs

Stakeholder	Role and responsibility in District Ganga Planning
National Institute of Hydrology, Roorkee, Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation, Govt. of India	Provide leadership in hydrology research through effective scientific solutions for achieving sustainable development and self-reliance of the water sector in India. Study scenarios of water resource availability under varying hydrological, climatic, sociocultural conditions through modelling techniques. Provide scientific advice to the various stakeholders on water related issues.

5.5.2 State level

Stakeholder	Role and responsibility in District Ganga Planning
State Mission for Clean Ganga	"Coordination with DGCs for District plan preparation. Financial and Technical Support to DGCs for execution and monitoring of District level activities related to Ganga rejuvenation."
Pey Jal Nigam (UKPJN)	"UKPJN will be primarily involved in water supply and liquid waste management planning component of the District Plans. It is also to be involved for designing and execution of projects related to faecal sludge and septage treatment facilities"
Jal Sansthan	
Pollution Control Board	
Urban Development Department	
Forest Department	
Irrigation Department	Information about hydropower projects, irrigation, water resources planning development and management
State Industrial Development Corporation	
Space Application Centre	

5.5.3 District level

Stakeholder	Role and responsibility in District Ganga Planning
District Ganga Committee	Mandated to prepare District Ganga Plan in line with Authority notification
Jal Sansthan	"to plan, promote and execute schemes and operate an efficient system of water supply. Where feasible, to plan, promote and execute schemes and operate, sewerage, sewage treatment and disposal and treatment of trade effluents."
Agriculture Department	The main work of Department is to encourage Food & Nutritional Security. The department provides various schemes, public friendly plans, soil testing, seeds & pesticides and information about machines for agriculture and soil conservation schemes.
Industrial associations in respective District	
District Panchayat Raj Department	The civic functions relating to sanitation, cleaning of public roads, minor irrigation, public toilets and lavatories, primary health care, vaccination, the supply of drinking water, constructing public wells, rural electrification, social health and primary and adult education, etc.
District Education Officer	Education laws, policies and regulations; Implementing approved education and sports development plans, strategies. and programs.
District eGovernence Department	National Informatics Centre (NIC) provides nationwide ICT infrastructure to support e-Governance services and various initiatives of Digital India to design, development and implementation of various eGovernance initiatives and Digital India programme.

5.5.4 Development agencies, NGO's and others

Stakeholder	Role and responsibility in District Ganga Planning
WWF India	Coordination related to capacity building and trainings on District Planning plus working on Moradabad district
World Bank	Delivery of data, suggestion of interventions and specific targets
Earthwatch	
WaterAid	
The Energy Research Institute (TERI)	
"National Environmental Engineering Research Institute (NEERI), Nagpur"	
United Nations Development Programme (UNDP)	
European Union (EU)	
International Water Management Institute (IWMI)	
Confederation of Indian Industry (CII) Triveni Water Institute	
"International Council for Local Environmental Initiatives (ICLEI)"	
Water and Land Management Institutes (WALMI)	
PTB	
GIZ-WASCA	
Indian Institute of Technology – Roorkee	
G. B. Pant University of Agriculture	