Tracing the extension of newly discovered paleo-channel near Prayagraj and 3D mapping of aquifer system in the middle Ganga plain in collaboration with CGWB and NGRI
Ground and surface water linkages

- Surface water and ground water are linked as component in hydrological-ecological system
- Abstraction from and contamination of either one will affect each other.
- During lean season flow in streams is augmented by Ground water.
River Ganga (Rejuvenation, Protection, Management) Authorities Order, 2016

Principles to be followed specifies:

• The integral relationship between the surface flow and sub-surface water (ground water) shall be restored and maintained.

• The bank of River Ganga and its flood plain shall be construction free Zone to reduce pollution sources, pressures and to maintain its natural ground water recharge functions
Recently (December, 2018), the CSIR-NGRI, under the aegis of MoWR-RD-GR, conducted helicopter borne geophysical survey covering Prayagraj and Kaushambi region led significant findings as:

- 3D structural settings of aquifer system
- Discovery of a buried paleo channel (ancient river, now underground) that joins Yamuna river at Durgapur village, roughly 26 km south of the current Ganga-Yamuna Sangam at Prayagraj.
- Aquifer merging at places due to tectonic activities.
- River Ganga has good hydrogeological connectivity with surrounding aquifers

BACKGROUND

ALLHABAD Sangam
Flight Line
Tie Line
Elevation (amsl m)

<table>
<thead>
<tr>
<th>Distance scale (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 10 20</td>
</tr>
</tbody>
</table>

Block-A:
NGRI acquired additional data using own funding
Block-A +: CGWB approved

Prayagraj
Kaushambi
Ganga River
Yamuna River
Sisuna Khaderi R.
Sangam
ALLHABAD

Tie Line
Flight Line

Elevation (amsl m)

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500
Discovered ancient buried river

Dimension:
- Around 4 km wide,
- 45 km long and
- ~15 m thick layer
- buried under 10-15 m thick soil

Volume of Paleochannel

\[ 2.7 \times 10^9 \text{ m}^3 \]

40-50% can be used for GWR storage through managed aquifer recharge

Confirmed by drilling
In any case this mega feature of buried paleo channel can be converted as groundwater reserves by diverting surface run off of the rainfall through managed aquifer recharge structure.
Proposed to **extend** the survey further west ward from **Kaushambi to Kanpur** (Bock B) to conclude the finding of paleo channel which will work as potential feature for **managed aquifer recharge**.

Knowledge on subsurface **connectivity** between Ganga and Yamuna rivers will play very crucial role in planning of **Ganga cleaning** as well as protecting the **safe groundwater resources**.

**Area:** ~ 8500 sq.km  
**Location:** Ganga-Yamuna doab between Kaushambi and Kanpur, U.P.
Objectives
• Tracking the inferred paleo channel further northwestward
• 3D Mapping of Principal Aquifers system
• Establishing linkages between aquifer system including paleo channel with river system

Methodology/approach
• Integrated HydroGeophysical investigations including heliborne, ground and borhole geophysics.
• 3D Geophysical model of hydrogeological settings
• Validation and correlation through drilling and logging
• Translating geophysical model into hydrogeological settings
• 4-6 recoverable bore log to get sediment samples from the region along and adjacent to the paleo channel for reconstruction.

Deliverables
• 3D resistivity map with geometrical settings of principal aquifers
• Paleo channel map and its 3D catchment of sediments
• Linkages between aquifer system including paleo channel and river system
How this is useful?

RIVER DISCHARGE CONTRIBUTION FOR HIMALAYAN RIVERS

<table>
<thead>
<tr>
<th></th>
<th>Monsoon Season</th>
<th>Dry Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glacier</td>
<td>5%</td>
<td>60%</td>
</tr>
<tr>
<td>Precipitation</td>
<td>90%</td>
<td>5%</td>
</tr>
<tr>
<td>Groundwater (baseflow)</td>
<td>5%</td>
<td>35%</td>
</tr>
</tbody>
</table>

NGRI (2009)

1) Strong need of Managed aquifer recharge (MAR)

2) Subsurface linkages for groundwater contaminant migration?

Groundwater over-exploitation

- declining of water level
- Reduction of Baseflow
- Reduction in river water flow

where?
How this is useful?

SUBSURFACE INTER-LINKAGES

The river Ganga, Yamuna and discovered ancient river are connected at places through first principal aquifer
Thank you

Cleaning contamination & Ganga Groundwater recharge and crucial for aquifer

LINKAGES

SUBSURFACE INTER

How this is useful?
Addressing the urban drivers of river health in the Ganga River Basin

27 Sep 2019
Project Concept

Pollution
- Solid waste
- Liquid waste

Indiscriminate Abstraction & Restriction of Natural Flow

Encroachments

Flooding

Other Activities
Project Concept

- Treatment Plants
- Sewer Networks
- Cleanliness Drives
- Ghat development
- Water body conservation
- Research and Innovations
Project Concept

Need to integrate river health management into the long-term planning for a city
Project Objectives

OBJECTIVE 1: Develop Strategic Guidelines to mainstream urban river management into a city’s Master Plan
OBJECTIVE 2: Supporting the city of Kanpur in the development of an Urban River Management Plan
National Mission for Clean Ganga
Department of Water Resources, River Development and Ganga Rejuvenation
Ministry of Jal Shakti
Government of India
27th September, 2019
Ganga River Basin – Fact Sheet

Total length of river is 2525 km with longest stretch of 1000 km in Uttar Pradesh

Catchment area of the basin is 8,61,404 km².

11 states in the Ganga Basin with 5 on Ganga main stem
Ganga Basin covers 26% of India’s total landmass

India’s 43% population resides in Ganga Basin

Contributes 28% of India's water resources

Habitat for rich Biodiversity

Information Source: National Mission for Clean Ganga; Ganga River Basin Management Plan; Agropedia (IIT Kanpur)
Pollution in River Ganga

Central Pollution Control Board Standard for Bathing (Class ‘B’)
- Dissolved Oxygen (DO) \( \geq 5 \text{mg/l} \)
- Biochemical Oxygen Demand (BOD) \( \leq 3 \text{mg/l} \)
- Faecal Coliform \( \leq 500 \text{mpn/100ml} \)

Critically Polluted Stretch in terms of B.O.D and Faecal Coliform

Issues related to Faecal Coliform

Issues related to Faecal Coliform
Municipal Waste Water
Industrial Pollution
Solid Waste
Non Point sources
Efforts Towards Ganga Conservation

A Shift Towards Basin Based Approach

**GAP I**
- Launched in 1985
- Focus on Main stem of River Ganga
- 25 Towns Covered
- 260 schemes

**GAP II**
- Extended from GAP I in 1993
- Merged with NRCP in 1996
- Included – Yamuna, Gomti, Damodar & Mahananda

**NRCP**
- Launched in 1995
- 41 major Rivers of the country
- 8 Ganga basin rivers viz Ganga, Yamuna, Gomti, Damodar Mahananda, Betwa, Mandakini, Ramganga

**NGRBA**
- Separate Authority for Ganga in 2009
- Chaired by Prime Minister of India
- NMCG implementing body at center and SPMGs at states

**Namami Gange**
- Launched in 2015
- Integrated conservation mission
- Basin approach
- All tributaries included

- **GAP**: Ganga Action Plan
- **NRCP**: National River Conservation Plan
- **NGRBA**: National Ganga River Basin Authority
- **NMCG**: National Mission for Clean Ganga
- **SPMGs**: State Program Management Groups
### Salient Features of Namami Gange

<table>
<thead>
<tr>
<th>PREVIOUS EFFORTS</th>
<th>NAMAMI GANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>River Wise program: (GAP I, GAP II, YAP I, Gomti Action Plan etc.)</td>
<td>Comprehensive integrated programme</td>
</tr>
<tr>
<td>Centrally sponsored</td>
<td>Central Sector</td>
</tr>
<tr>
<td></td>
<td>(100% Govt. of India funding for new projects)</td>
</tr>
<tr>
<td>O&amp;M main bottleneck with state funds</td>
<td>Long term O&amp;M (15 years) included in project cost</td>
</tr>
<tr>
<td>Lack of Finances/ Uncertainty on availability of funds</td>
<td>5 years dedicated budget allocation</td>
</tr>
<tr>
<td>No Performance based PPP Approach</td>
<td>Hybrid Annuity Mode – Performance linked payments</td>
</tr>
<tr>
<td>Focus on Urban Sector only</td>
<td>Comprehensive program including Rural sanitation, Aviral dhara, Afforestation, Biodiversity, Communication and Public outreach etc.</td>
</tr>
</tbody>
</table>
Namami Gange Programme

Components:

i. Pollution Abatement
   ❖ Sewerage Infrastructure
   ❖ Solid waste management
   ❖ Industrial Pollution Abatement
   ❖ Rural Sanitation
   ❖ Water Quality Monitoring

ii. River Front, Ghats and Crematoria

iii. Urban River Management plan

iv. Aviral Dhara

v. Research and Knowledge management

vi. Afforestation and Biodiversity conservation

vii. Public participation
Development of Institutional Framework

The River Ganga Authorities Order, 7th October 2016

Salient Features

• Empowers NMCG to discharge its functions including regulatory ones with powers of Section 5 of Environment Protection Act 1986.
• Strengthening of management structure
• Prior permission for raising any structure in River Ganga or its Tributaries or active Flood Plain area.
• Enhanced financial sanctioning powers
• 23 Executive Committee meetings conducted since March 2017. Sanctioned 150 sewerage projects worth Rs. 23,130.95 Crore (Total – 298 projects with sanctioned cost Rs. 28,534.62 Crore.)
5 Tier structure of Governance

- National Council for River Ganga (Rejuvenation, Protection and Management)
- Empowered Task Force
- National Mission for Clean Ganga
- District Ganga Committees
- State Ganga Committees
## Summary of Namami Gange projects

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Type of Project</th>
<th>Name of State</th>
<th>No of works Taken up</th>
<th>Total Cost of Project (Rs in Cr )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sewerage Projects</td>
<td>Uttarakhand</td>
<td>34</td>
<td>1,144.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uttar Pradesh</td>
<td>50</td>
<td>10,263.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bihar</td>
<td>28</td>
<td>5,186.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jharkhand</td>
<td>2</td>
<td>156.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>West Bengal</td>
<td>22</td>
<td>3,789.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Haryana</td>
<td>2</td>
<td>217.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delhi</td>
<td>11</td>
<td>2,361.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Himachal Pradesh</td>
<td>1</td>
<td>11.57</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
<td></td>
<td><strong>23,130.95</strong></td>
</tr>
<tr>
<td>2</td>
<td>Industrial Pollution Abatement</td>
<td></td>
<td>12</td>
<td>964.58</td>
</tr>
<tr>
<td>3</td>
<td>River front, Ghats and Crematoria</td>
<td></td>
<td>76</td>
<td>1441.01</td>
</tr>
<tr>
<td>4</td>
<td>Afforestation and Biodiversity conservation</td>
<td></td>
<td>24</td>
<td>387.1</td>
</tr>
<tr>
<td>5</td>
<td>Rural Sanitation</td>
<td></td>
<td>1</td>
<td>1421.26</td>
</tr>
<tr>
<td>6</td>
<td>Other Projects</td>
<td></td>
<td>35</td>
<td>1189.72</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>298</strong></td>
<td></td>
<td><strong>28,534.62</strong></td>
</tr>
</tbody>
</table>
Sewerage Sector Projects: Strategy and Approach

- Mapping of 97 towns and villages along Ganga
- Condition assessment of existing infrastructure
- Sustainability through O&M of Existing STPs
- Projects planned for 2035 Demand
- Hybrid Annuity Model PPP - Performance based contract
- ‘One City One Operator’ - Improving Governance
- Reuse & Recycle of waste
- Bioremediation/ Modular STPs
- Similar approach towards tributaries
Sewerage Infrastructure Projects

Sewage generation vs. Treatment capacity in 97 Ganga towns

Number of Sewerage projects before and after 2014
<table>
<thead>
<tr>
<th>Sewerage Infrastructure Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ganga Main stem</strong></td>
</tr>
<tr>
<td><strong>Ganga Tributaries</strong></td>
</tr>
</tbody>
</table>

**HIMACHAL PRADESH**
1 Sewerage Projects: ₹ 11.57 Cr.
- 1.72 MLD

**HARYANA**
2 Sewerage Projects: ₹ 217.87 Cr.
- 145 MLD
- 40.94 Km.

**DELHI**
11 Sewerage Projects: ₹ 2,361.08 Cr.
- 1,384.5 MLD
- 125.58 Km.

**JHARKHAND**
2 Sewerage Projects: ₹ 156.12 Cr.
- 15.5 MLD
- 89.21 Km.

**UTTARAKHAND**
34 Sewerage Projects: ₹ 1,144.77 Cr.
- 165.28 MLD
- 186.19 Km.

**UTTAR PRADESH**
50 Sewerage Projects: ₹ 10,263.28 Cr.
- 1,648.14 MLD
- 1,783.86 Km.

**BIHAR**
28 Sewerage Projects: ₹ 5,186.55 Cr.
- 619.5 MLD
- 1,754.01 Km.

**WEST BENGAL**
22 Sewerage Projects: ₹ 3,189.71 Cr.
- 864.67 MLD
- 1,063.05 Km.
Hybrid Annuity Based PPP: Improving Long Term Performance

• Learning from past – Hybrid Annuity Model (HAM) introduced for long term satisfactory performance

• Construction linked payments – 40% of capital cost

• Performance linked payments – 15 Years (60% quarterly Capex Annuity with Interest with additional O&M payments)
One City One Operator: Improving Governance

- Paradigm shift in the sector – one stop solution for sewage treatment in the entire city
- Integration of new and existing sewage treatment infrastructure under HAM

**“One City One Operator”** - STPs in towns/city clusters (Kanpur – Unnao - Shuklaganj, Prayagraj, Mathura, Farrukhabad, Mirzapur – Ghazipur, Patna, Bhagalpur, Kolkata, Howrah-Bally-Kamarhati-Baranagar, and Maheshtala – Hugli Chinsura, Bareilly, Agra, Mathura, Muzzaffarnagar - Budhana, Meerut etc.) are being integrated & tendered with Hybrid Annuity based projects.

<table>
<thead>
<tr>
<th>City</th>
<th>Total STP capacity (MLD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prayagraj</td>
<td>343.5</td>
</tr>
<tr>
<td>Kanpur</td>
<td>475</td>
</tr>
<tr>
<td>Kolkata</td>
<td>183</td>
</tr>
<tr>
<td>Howrah</td>
<td>187</td>
</tr>
<tr>
<td>Patna</td>
<td>150</td>
</tr>
</tbody>
</table>

ONE CITY – ONE OPERATOR UNDER HYBRID ANNUITY BASED PPP MODE(HAM).

17
Status of Existing Sewage Infrastructure & Interventions

97 towns on Ganga Main Stem
Sewage Generation: 2953 MLD (Yr. 2016), 3603 MLD (Yr 2035)
Available Treatment Capacity (31/03/2019) 92 STPs - 1794 MLD in 50 Towns

- 29% Defunct (236 MLD) - 27 STPs
- 15% Operational and non-compliant & under utilized (581 MLD) - 14 STPs
- 56% Recently commissioned, working fine along with long O&M (977 MLD) - 51 STPs
River Front Development Projects

RFD PATNA

• Cost: Rs. 336.73 Crore

➢ No. of Ghats: 20
➢ Promenade: 6.6 km
➢ Crematoria: 1
Ghat and Crematoria projects

- Total projects: 204
  - Ghats: 161
    - Completed: 121
    - Under progress: 40
  - Crematoria: 43
    - Completed: 33
    - Under progress: 10

- Project cost: Rs. 725.6 Crores

Atal Ghat, Uttar Pradesh

Before

Chandi Ghat, Haridwar

After
Solid Waste Management – Status of Towns Along Ganga

- Responsibility of managing SWM primarily with ULBs. ULBs to ensure that:
  1. No solid waste is disposed into the drains or river banks
  2. Cleaning of solid waste dumps near the drains and river
  3. Regular cleaning of banks and Ghats
  4. Screens/filters installed on the drains to trap solid waste
  5. Ban on the use of polythene

- States directed for achieving 100% scientific Solid Waste Management
- Door to Door collection (DTDC) and segregation at source crucial. In its absence, garbage may end up in River Ganga directly or through drains.
- Decentralised/Centralised Composting (Windrow, Vermi, pit etc), Biomethanation, Waste to Energy etc common waste processing technologies.
## Ghat Cleaning projects

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Name of Project</th>
<th>Sanction Cost (Rs in Cr)</th>
<th>Date of Sanction</th>
<th>Duration of project</th>
<th>Total expenditure incurred (Rs in Cr)</th>
<th>Brief Status on Physical Progress</th>
<th>Tentative year of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cleaning of the 84 Ghats at Varanasi</td>
<td>15.00</td>
<td>17.10.16</td>
<td>3yrs</td>
<td>12.18</td>
<td>Ongoing</td>
<td>2019-20</td>
</tr>
<tr>
<td>2</td>
<td>Ghat cleaning Project at 4 towns of Bithoor (19), Kanpur (20), Allahabad (21), Mathura-Vrindavan (27)</td>
<td>12.97</td>
<td>20.07.18</td>
<td>3yrs</td>
<td>0.00</td>
<td>Ongoing</td>
<td>2020-21</td>
</tr>
<tr>
<td>3</td>
<td>Cleaning of the 72 Ghats at Haridwar</td>
<td>15.90</td>
<td>17.07.18</td>
<td>3yrs</td>
<td>0.00</td>
<td>Ongoing</td>
<td>2020-21</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>43.87</strong></td>
<td></td>
<td></td>
<td><strong>12.18</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Before**  
Kshameshwar Ghat  
**After**
Haridwar Ghat Cleaning Project Photographs

- Maharshi Kashyap Ghat - Haridwar
River Surface Cleaning projects

- Floating waste collected manually where water depth is less and Equipment/Machine is not maneuverable. At least 10 dedicated workers deployed with skimmers.
- Collected waste transported to the identified disposal points at the shores
- Further transported at designated site on regular basis by the respective ULBs.
- Certification/Verification of services - recorded and monitored on regular basis

<table>
<thead>
<tr>
<th>Location of Trash Skimmers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uttarakhand</strong></td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Haridwar</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Regulation of Polluting Industries

- Inventorization of all Grossly Polluting Industries (GPIs) done
- 100% annual inspection of GPIs being conducted through 12 independent institutions of repute
- Action on inspection reports by concerned SPCBs within 30 days of receipt of reports.
- Improvement in compliances observed.
  - 538 out of 1109 industries non-complying during 2016-18
  - 122 out of 961 industries non-complying during 2018-19
  - Action against non-complying units by issuing direction to close. (215 industries temporarily closed, 19 permanently closed)

GPI – Industry with BOD $\geq 100$ kg/day and /or using Hazardous Chemicals
Industrial Sector Development

**Tannery**
CETP approved at Jajmau (Kanpur) at the cost of Rs. 554 Crore with adoption of cleaner process and reduced water consumption.

**Paper and Pulp**
Zero black liquor discharge achieved. Estimated reduction in the fresh water consumption and effluent generation are about 45-50% as compared to 2012.

**Distillery**
Zero liquid discharge achieved in molasses based distillery.

**Sugar**
Effluent generation reduced from 400 to 200 litres per tonne of cane crushed

**Textile**
Most of the units are in process of upgrading existing ETPs/ installation of new ETPs/CETPs. Upgradation of CETP, Mathura sanctioned at the cost of Rs 13.87 Cr
• Manual Water Quality monitoring being conducted at 94 locations through respective SPCBs and data compiled at CPCB.

• 44 Real Time Water Quality Monitoring Stations (RTWQMS) installed on river Ganga.

• Additional 40 RTWQMS stations being set up.

• Further, the river water quality assessment carried out in 2018 indicates improvement in water quality trends as compared to 2017.

• Out of 79 locations the Dissolved Oxygen (DO) levels have improved at 36 locations, Biological Oxygen Demand (BOD) levels improved at 42 locations and out of 65 locations, 46 show improvement in terms of Faecal Coliform Count.
Rural Sanitation

- NMCG supplementing efforts of Department of Drinking Water & Sanitation in ensuring sanitation in Ganga villages.
- All 4465 Ganga bank villages declared ODF. Rs 829 cr released for 11 lakh Independent Household Latrines (IHHL).
- Need based Liquid Waste Management in Ganga villages - Rs. 124 cr. Released
Urban River Management Plan

Mainstreaming Urban River Management in Planning Process

• An analysis of Master plans of prominent Indian cities brings out the inadequate attention that a River receives in their long term planning process.
• A river, which sustains the city with water, ecology, livelihood, economic benefits, weaving through the very character of the city, does not find prominence or mention in its planning.
• A project to mainstream river planning into the Master planning process has been initiated by NMCG with the development of India’s first Urban River Management Plan (URMP).
• The URMP is a river centric development plan which feeds into the Masterplan of a city by combining environmentally sustainable, socially inclusive and economically viable programmes, projects and proposals based on improving the health of the river in the long run.
• Along with the URMP, the project includes capacity building programmes for Urban Local bodies, sensitizing them towards river health and guiding them to create their own URMPs.
## Analysis of City Masterplans for River Planning

### Assessment of Gaps

**Essential components of river management in a Master Plan**

<table>
<thead>
<tr>
<th>Master Plan</th>
<th>Water Management Components</th>
<th>Extent of coverage in the Master Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patna Master Plan, 2031</td>
<td>MP Vision/ Objectives vis-à-vis river, River Background, River Zone Delineation</td>
<td>No mention, Generic, Basic details</td>
</tr>
<tr>
<td>Kanpur Master Plan, 2021</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>Allahabad Master Plan, 2021</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>Dehradun Master Plan, 2025</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>Master Plan for Delhi, 2021</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>Agra Master Plan, 2021</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>Compr. Dev. Plan Ahmedabad, 2021</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>MP for Chennai Metro. Area, 2026</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>New Orleans Master Plan, 2030</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
<tr>
<td>Ulaanbaatar Master Plan, 2030</td>
<td>no mention, Generic, Basic details</td>
<td></td>
</tr>
</tbody>
</table>

### Current Status – Ganga Towns

- **Ganga Towns**
  - MP Vision/ Objectives vis-à-vis river, River Background, River Zone Delineation

### Best Practices – River Towns

- **River Towns**
  - MP Vision/ Objectives vis-à-vis river, River Background, River Zone Delineation

### Best Practices – International

- **International**
  - MP Vision/ Objectives vis-à-vis river, River Background, River Zone Delineation

#### Relative Scoring (of 11 components)

- **New Orleans Master Plan, 2030**
  - 9
- **Ulaanbaatar Master Plan, 2030**
  - 5.5
- **Compr. Dev. Plan Ahmedabad, 2021**
  - 2
- **MP for Chennai Metro. Area, 2026**
  - 9
- **Patna Master Plan, 2031**
  - 4
- **Kanpur Master Plan, 2021**
  - 1
- **Allahabad Master Plan, 2021**
  - 4.5
- **Dehradun Master Plan, 2025**
  - 1
- **Master Plan for Delhi, 2021**
  - 4
- **Agra Master Plan, 2021**
  - 4

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**Analysis of City Masterplans for River Planning**

<table>
<thead>
<tr>
<th>Extent of coverage in the Master Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>No mention</td>
</tr>
<tr>
<td>Generic</td>
</tr>
<tr>
<td>Basic details</td>
</tr>
</tbody>
</table>
## Framework for URMP

<table>
<thead>
<tr>
<th>ELEMENTS</th>
<th>ENVIRONMENTAL RESPONSIBILITY</th>
<th>SOCIALLY INCLUSIVE</th>
<th>ECONOMICALLY VIABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISION</td>
<td>River Health</td>
<td>Social Cohesion</td>
<td>Economic Value</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>1. Rivers Supports Aquatic Life</td>
<td>Citizens are connected to River</td>
<td>River supports economic development</td>
</tr>
<tr>
<td></td>
<td>2. Maintain environmental/ecological flow in the river</td>
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<tr>
<td></td>
<td>3. Rejuvenation of waterbodies (ponds, lakes)</td>
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<td></td>
<td>4. Adopt rainwater harvesting</td>
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<td></td>
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<tr>
<td></td>
<td>5. Control erosion along river banks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTERVENTIONS</td>
<td>1. Increase awareness of citizens on river, waterbodies</td>
<td></td>
<td>1. Develop eco-friendly riverfronts</td>
</tr>
<tr>
<td>OUTPUTS</td>
<td>2. Engage citizens in river, waterbody management</td>
<td></td>
<td>2. Promote River Tourism</td>
</tr>
<tr>
<td>INDICATORS</td>
<td>3. Develop eco-friendly riverfronts</td>
<td></td>
<td>3. Develop Waterways</td>
</tr>
<tr>
<td></td>
<td>4. Promote River Tourism</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Develop Waterways</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SHORT-MEDIUM-LONG TERM PROJECTS**

- MONITORING & EVALUATION, ACCOUNTABILITY
Aviral Dhara

- Determination of Ecological flow- Notification for Uttarakhand and from Haridwar – Unnao stretch
- Adopting scientific practices for water conservation and improving water use efficiency
- Reuse and Recycle of water
- Monitoring and regulation of ground water
- Rain water harvesting
- Conservation of water bodies and wetland
Wetland Conservation

Wetland conservation is an integral component of ‘Namami Gange’. As part of Jal Shakti Abhiyan, a special drive has been taken through NMCG-Wildlife Institute of India team with key focus on -

• Cleaning and de-siltation of inlet and outlet of the wetland for restoration of flushing mechanism
• Removal of invasive species in and around the wetlands.
• Removal of solid waste in and around the wetlands.
• Plantation in the banks, catchment area to restrict nutrient inflows.
• Habitat enhancement for key aquatic species.
• Community involvement in wetland and water conservation.
Kakrakhera pond, Hardoi

Restoration of Kashipur wetland

Sensitization activities for villagers
Kakrakhera pond, Hardoi

Restoration of Bilona wetland

Restoration of Kashipur wetland
Wetland Conservation

Recent projects include -

• Development of detailed briefs and an integrated management plan for 101 wetlands situated in 27 Ganga districts in U.P. up to 5 Kms. on either side of river.

• 51 wetlands identified in Uttarakhand for inventorization and development of management plan. A similar exercise would also be taken up in other States.

• As a part of Jal Shakti Abhiyan all District Ganga Committees have been requested to take up inventorization and rejuvenation of traditional water bodies. A specific project has also been sanctioned for rejuvenation of 10 kunds in Varanasi.

• With the help of School of Planning & Architecture, New Delhi a model toolkit is under development for integrated management and rejuvenation of urban wetlands with the case study of Bhagalpur. This is also being coordinated with the Urban Development Departments of States.
Urban wetland management guidelines – Toolkit for local stakeholders

- Surface water bodies play an important role in the lives of common people by way of various uses.
- They also maintain quality and quantity of base flow to the river especially when settlement is on the banks of the river.
Afforestation and Biodiversity
Forestry Interventions for Ganga

- Scientific DPR by Forest Research Institute (FRI), Dehradun at a cost of Rs. 2300 cr. for plantation over 1.34 lakh ha.
- 1 crore saplings planted over 8500 ha. by Forest Departments.
- Ganga Vriksharopan Abhiyan for intensive plantation in tandem with State campaigns like: Ganga Haritma Abhiyan (Uttar Pradesh), Harela (Uttarakhand), Har Parisar Hara Parisar (Bihar), Van Mahotsav (Jharkhand & West Bengal).
- Ganga Task Force: 529 member Territorial Army Unit- Ganga Task Force, for four years supporting in patrolling of ghats & river, public outreach, afforestation, water quality testing, etc.
Biodiversity Conservation - important component being natural indicator for pristine Ganga.

Collaboration for Biodiversity conservation with premier institutes.
- Wildlife Institute of India (WII), Dehradun
- ICAR-Central Inland Fisheries Research Institute (CIFRI), Kolkata
- Centre for Environment Education (CEE)

Biodiversity conservation projects for Aqualife, fishery research and promoting community participation for Conservation.
Sustainable Agriculture
Organic Farming in Ganga Basin

• MoU with Ministry of Agriculture & Farmer Welfare to promote organic farming and to create awareness about balanced use of chemicals, fertilizers and pesticides, promote micro irrigation for water conservation in Ganga Basin.

• The organic farming practices is based on cluster approach of Paramparagat Krishi Vikas Yojana (PKVY) guidelines.
Marketing of organic produce
Medicinal plants in Ganga catchment area

- MoU with Ministry of AYUSH with an objective of growing / conservation of medicinal plants in Ganga catchment area.

- **Forest Nursery in Alaknanda**

- **Demonstration of Juice & Seed Pickle of Sea Buckthorn Fruit**
Ganga Knowledge centre: Research projects

River Ganga – LiDAR Mapping

- LIDAR (Light Detection and Ranging)
- Project with Survey of India
- Mapping for high resolution DEM
- 45000 sq km area covered along Ganga main stem panning 5 states
GIS-based Mapping of Microbial Diversity across the Ganges for Ecosystem Services

1. Bioinformatic analysis of generated sequence data to identify taxonomy and functional genes, viz, multi-drug resistant markers as well as genes of xenobiotic degradation pathways
2. Estimating projected health risks
3. Understanding ecosystem services of microbial community
4. Developing bioinformatics pipelines to differentiate E.coli from human and animal origin

River Ganga – The Cultural Mapping

- Project Proponent - INTACH
- Time duration – 25 months

<table>
<thead>
<tr>
<th>What’s being mapped?</th>
<th>Architectural</th>
<th>Intangible</th>
<th>Built</th>
<th>Natural</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Where it is being mapped?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Uttarkashi 8 Jyotibaphule Nagar 15 Unnao 22 Allahabad 29 Chapra 36 Khagaria</td>
</tr>
<tr>
<td>2  TehriGarhwal 9 Bulandshahr 16 Kanpur Dehat 23 Mirzapur 30 Vaishali 37 Bhagalpur</td>
</tr>
<tr>
<td>3  Rudraprayag 10 Badaun 17 Kanpur Nagar 24 Varanasi 31 Bhojpur 38 Katihar</td>
</tr>
<tr>
<td>4  Haridwar 11 Etah 18 Fatehpur 25 Chandauchi 32 Patna 39 Sahibganj</td>
</tr>
<tr>
<td>5  Bijnor 12 Farukhabad 19 Rae Bareli 26 Ghazipur 33 Begusarai 40 Malda</td>
</tr>
<tr>
<td>6  Muzzafarnagar 13 Hardoi 20 Pratapgarh 27 Balia 34 Munger 41 Murshidabad</td>
</tr>
<tr>
<td>7  Meerut 14 Kannauj 21 Kaushambi 28 Buxar 35 Kaushambi 42 To Ganga Sagar</td>
</tr>
</tbody>
</table>

What’s being mapped? Architectural Intangible Built Natural

Where it is being mapped?

- Project Proponent - INTACH
- Time duration – 25 months
Synergy With Other Ministries

- **Ministry of Agriculture** – Steps for Sustainable agriculture, promotion of Organic farming in Ganga Catchment.

- **Ministry of AYUSH** - Conservation of medicinal plants in Ganga catchment

- **Ministry of Power** – Utilize treated waste water from STPs in power plants located within 50 kms distance.

- **Ministry of Petroleum & Natural Gas** - Use of treated water at different establishments of the Ministry operationalized at Mathura.

- **Department of Youth Affairs** - Promoting and encouraging youth in Ganga cleaning.

- **Ministry of Human Resources Development** - spreading awareness and environmental literacy in villages along Ganga.

- **Ministry of Rural Development** - Revival of water bodies in Ganga Districts under MGNREGA Scheme.
Financial Progress of NMCG (Rs.in cr.)

Note: The figure for 2019-20 is projected expenditure based on current liabilities of sanctioned projects.
Clean Ganga Fund set up in 2015 to receive donations from individuals, NRIs, Corporate Entities for funding Ganga rejuvenation projects.

Contributions to Clean Ganga Fund are 100% exempt from Income Tax and qualify for Corporate Social Responsibility projects.

**CSR Projects**

- Development of Ghats in Badrinath and Gangotri.
- Treatment of drains in Allahabad.
- Plantation of Rudraksh in Uttarakhand and afforestation in Gautam Budh Nagar.
- Provision of amenities at Katwa Ghat West Bengal.
- Provision of amenities at Triveni Ghat and Astha Path in Rishikesh.
Communication and Public Outreach

Launch of ‘Clean Ganga’ Messages in Bank ATMs & Branches

Bal Ganga Mela

Ganga Swachhta Pakhwada

Mission Gange River Rafting Expedition

The Great Ganga Run, Varanasi - Mar’19

The Great Ganga Run, Delhi - Sept’19
Communication and Public Outreach

Kumbh Mela- 2019
Ganga Pavilion

Travelogue series ‘Rag Rag Mein Ganga’ and ‘Ganga Quiz’

Ganga Quest 2019

Theatre Promos and Outdoor Publicity

His majesty King Carl XVI Gustaf and Her Royal Highness Crown Princess Victoria and Duchess of Vastergotland who took keen interest in various activities displayed in the exhibition and spent quality time in the pavilion.
Way Forward

• **Nirmal Ganga:**
  – Completion of all Sewerage projects including those on Tributaries & Monitoring of their operation
  – Improving Regulation and enforcement at ULB and Industry level for all aspects; Urban River Management Plans
  – Non-point source pollution, Organic farming

• **Aviral Ganga:**
  – Implementation of e-flow Notification for Ganga for Uttarakhand and for Haridwar-Unnao Stretch
  – Similar approach for important tributaries such as Yamuna
  – Afforestation
  – Conservation of Wetlands and Water Bodies
  – Spring Rejuvenation
  – Rain Water Harvesting
  – Demand side management-Water use efficiency, Micro-irrigation, sustainable agriculture, Reuse policies
Thank You
Bringing EU and Indian approaches together for E-Flow assessments within the India EU Water Partnership

Jyoti Nale

India Water Week-2019

Special Session: REJUVENATION OF THE RIVER GANGA – FROM PLANNING TO ACTION

27 September 2019, 10:00 – 13:00, Vigyan Bhavan, New Delhi
Objectives of the Joint Initiative

- Development of the **Data Framework for E-flows Assessments**

  - European experiences and lessons learnt
  - Case-studies and success stories from EU and international indicatives
  - Comparative evaluation of E-flows assessment methodologies
  - Standardise the methodology(ies) for assessment for 3 different hydro-climatic regions

The guidance document will be finalised after the assessments in three pilots; including the lessons
Objectives of the Joint Initiative

• Evolve a mechanism for assessing the socio-economic benefits/impacts of E-flows and river ecoservices.

• Recommendation of a **Strategy for implementing** E-flows including pilot implementation and monitoring of e-flows.
Diverse hydro-climatic regions of India

- Ramganga River Basin: Sub-Himalayan system
- Mahanadi Delta: Estuarine eco-sensitive hotspot
- Bharathapuzha River Basin: Westward flowing River

The Basis of Selection - **heterogeneity** in terms of hydro-meteorological and ecological domain
Joint efforts undertaken so far

- Joint Workshop during 21-22 May 2018 followed by field visits to deliberate on most appropriate methodologies.
Ramganga Field Visit

Locations visited

- Important Towns
- Abstraction/diversion structures
- Eco-sensitive zones
• **Ramganga Basin**: Field visit during 23-25 May 2018 to identify the critical reaches.
1. Below Kalagarh Dam- (on Ramganga River)

2. Below the confluence of Ramganga and Kho- (Seohara on Ramganga River)

3. Moradabad (on Ramganga River)

4. Below Ramnagar Barrage (on Kosi River)
Data Collection
Ramganga Data Collection

Cross section surveys during October 2018
Ramganga Ecological Data

Fishermen/locals Consulted

Species noted- Soli, Lachi, Chaal, Singhara, Muraki, Kalabans and Golden Mahseer
Flow Depth Requirement

Adult Golden Mahseer:

Flow Depth- 0.5 to 2 m

Juvenile Golden Mahseer

Flow Depth- 0.3 to 0.6 m
E-flow Assessment
E-flow Assessment methods

Flow

Ecological Benefits

Hydrological Methods

Hydraulic Rating Methods

Habitat Analysis Methods

Jowett, 1997
Hydrological Analysis

Approaches-
- Percentages of flows (e.g. 10% of flow)
- Hydrological Alteration limits-

Understanding hydrological regime
- Baseline/reference scenarios
- Present Scenario
- Vision/objectives of E-flows
Hydraulic Analysis

- A Cross section in a Pool at Kalagarh Site
Habitat Analysis-PHABSIM

• PHABSIM: Physical habitat Simulation Model

• Estimates changes in physical habitat as a function of flow.

• Results are in the form of ‘Weighted Usable Habitat Area (m²/km) against Discharge’.

• PHABSIM Inputs:
  • Cross sections
  • Discharge data
  • Habitat Suitability Criteria curves
Habitat Analysis

Golden Mahseer Habitat Requirements -

- **Flow Depth (cm)**
  - Adult
  - Juvenile

- **Flow Velocity (m/s)**
  - Suitability

---

**Indian Water Partnership**
**European Union**
**German Cooperation**
Habitat Analysis Results

Kalagarh Site

Flow (cumecs)

Habitat Area (sq m / km)

Thousands

- Adult-Habitat
- Juvenile-Habitat
Other Two Pilots
Mahanadi Delta Field Visit

- **Mahanadi Delta**: Field visit during 28 January-01 February 2019.
- Developed insights on hydrological and ecological scenarios of the delta.
Mahanadi Delta – Data Collection

15 April-17 April 2019.
Training Workshop on Environmental Flow Assessment-Approaches
(Focus: Ecological Approaches and Assessments – experiences from the EU)

CWC MERO Office, Bhuvneshwar - On 18 April 2019
Bharathapuzha Field Visit

Bharathapuzha Basin: Field visit during 07-11 January 2019 to identify the critical sites
Bhrathapuzha- E-flow Sites

- Barrage/weir
- CWC Site
Indo-German Technical Co-operation Project-
Support to Ganga Rejuvenation - GIZ India
will organize-

International Workshop on

Environmental Flow Assessments and Implementation-

An International Perspective

On 21–22 October 2019 in New Delhi

in cooperation with the

India-EU Water Partnership, National Mission for Clean Ganga & Central Water Commission
Thank you for your attention!

Dr. Jyoti Nale
Project Advisor, IEWP