

India-UK Water Security Exchange Initiative



India's Water Science Priorities and Needs

Feb 18, 2016, Wallingford

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Alternate Hydro Energy Centre,

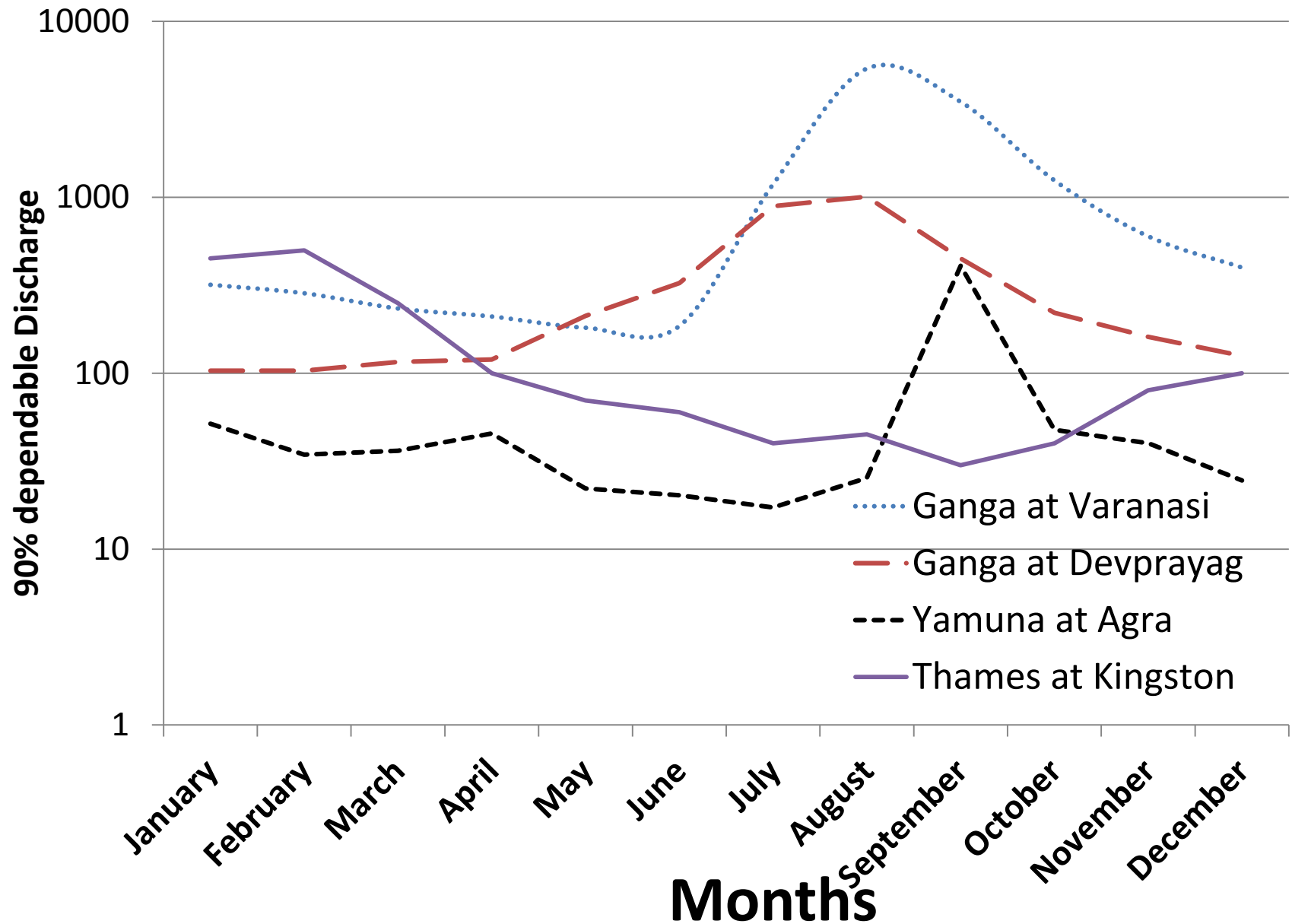
Indian Institute of

Technology Roorkee,

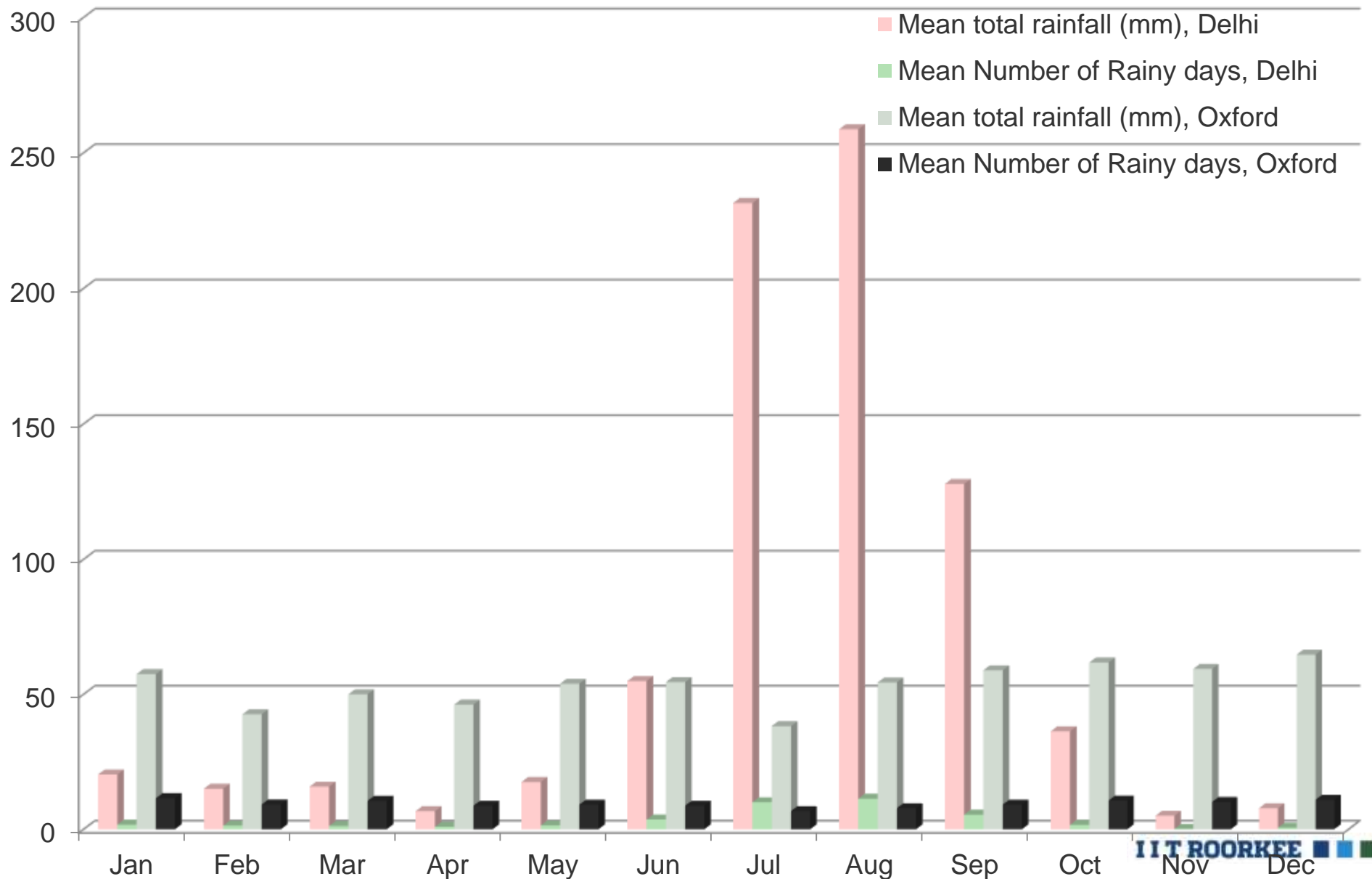
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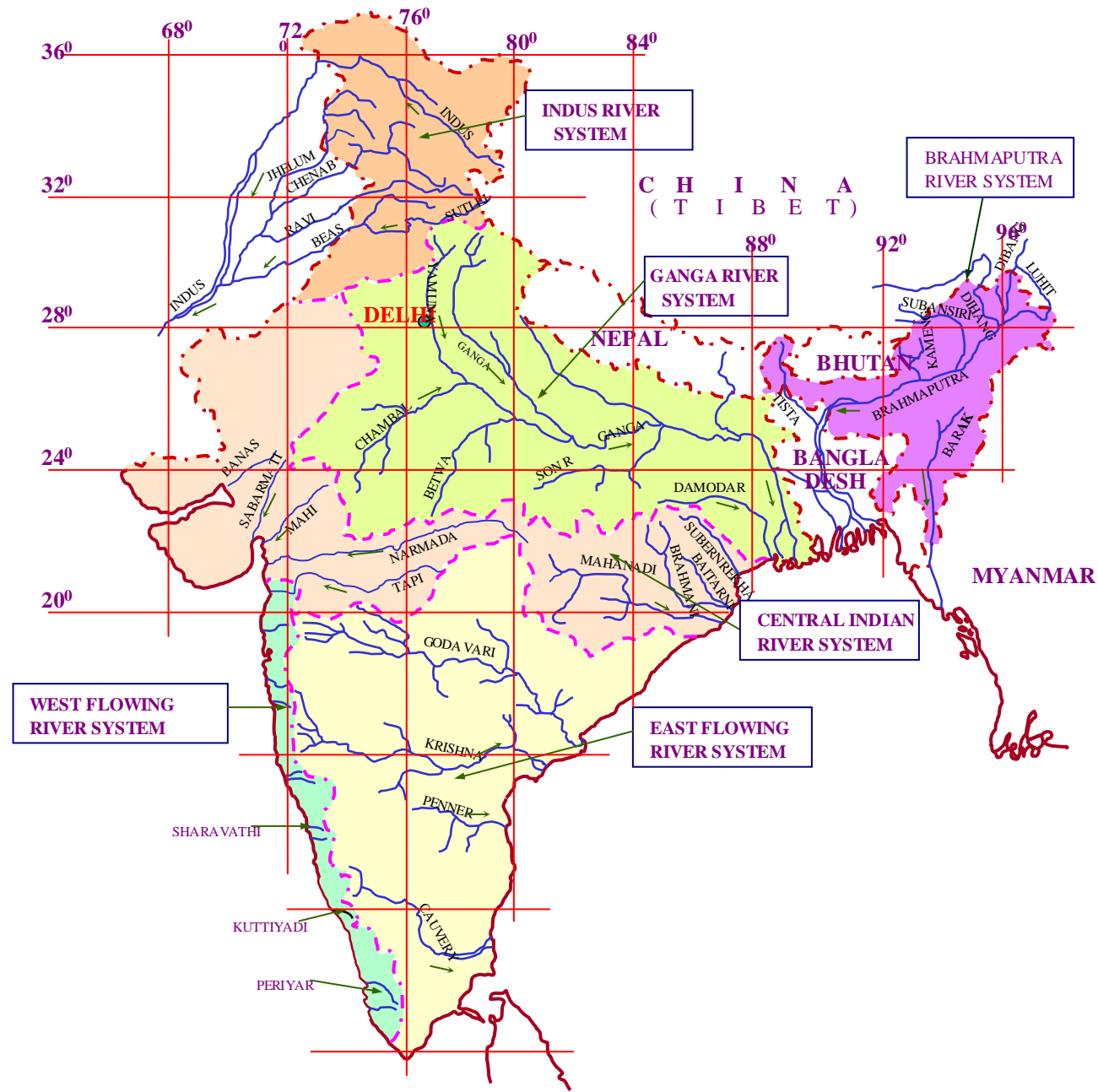
Discharge -Rivers Thames and Ganga as well as Yamuna

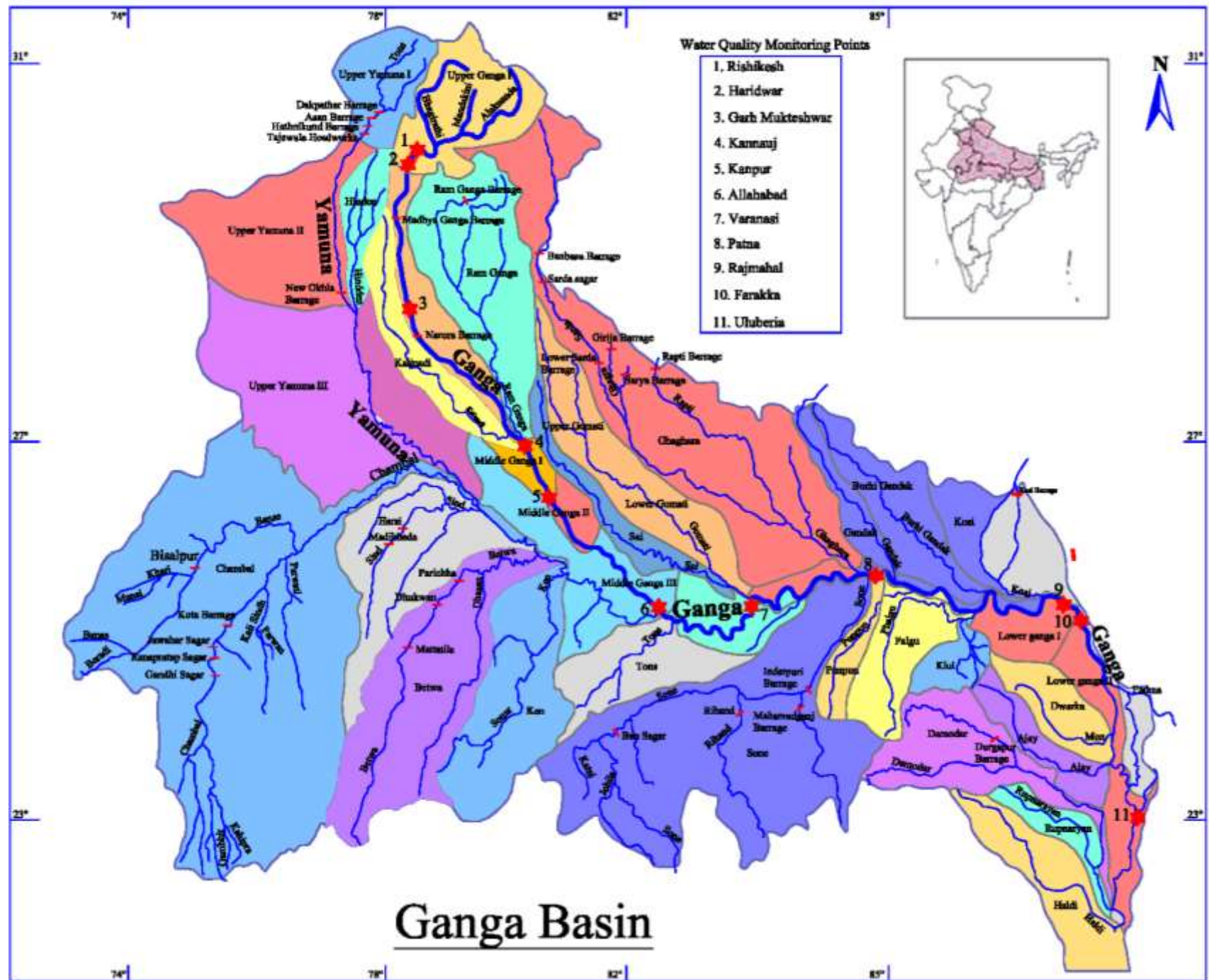


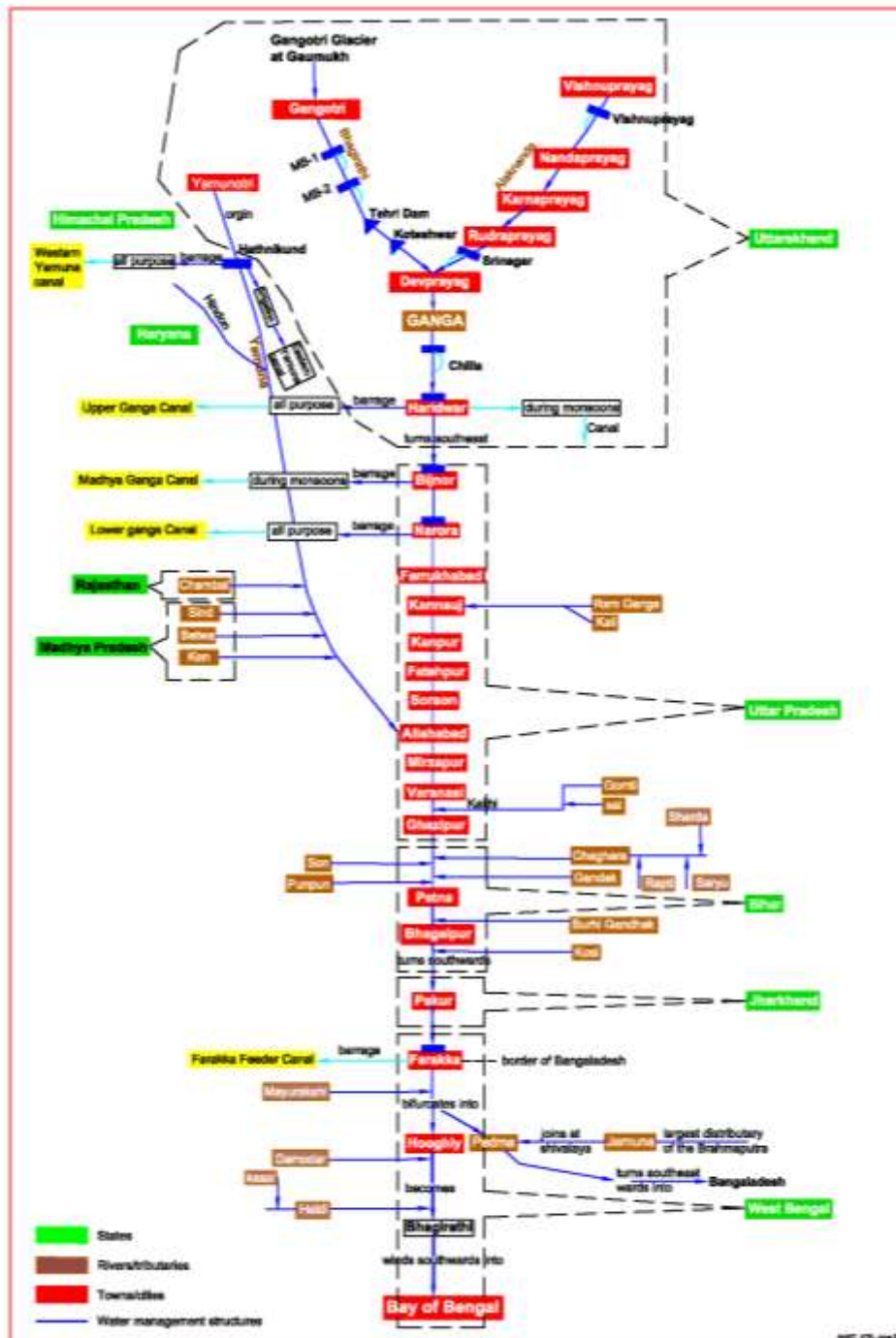
Rainfall Pattern in Delhi (Yamuna Basin) and Oxford (Thames Basin)



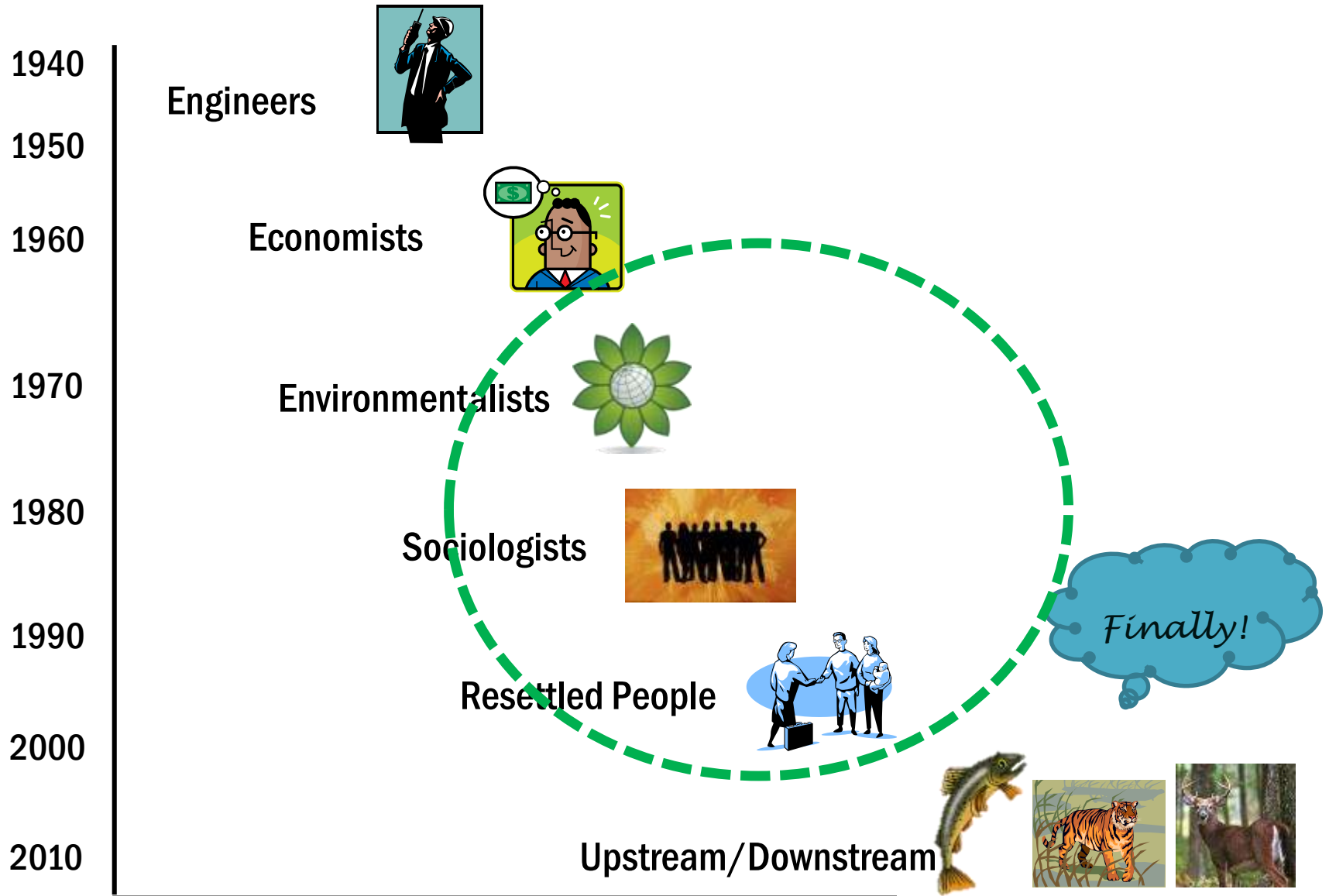
MAJOR RIVER SYSTEMS OF INDIA







Evolution of Thinking



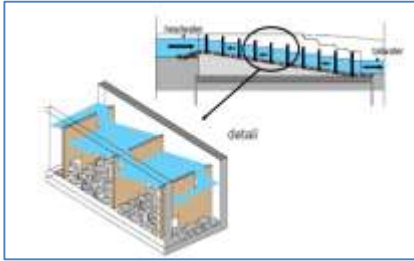
River Ganga: water use and Environment

- Water use and environment appears to be in conflict even though both are made for each other
- Water in the hills, in plains or in delta have different utility- Consumptive or non consumptive.
- River Ganga being the Holy river has been supporting the man kind for its needs.
- Water withdrawal for irrigation and drinking make the river dry on one hand and receiving untreated waste water on other hand are the major issues for discussions and suitable R&D.

TECHNICAL FISH PASSES

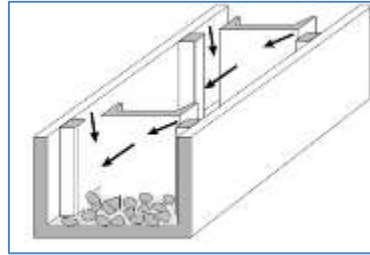


Pool Passes



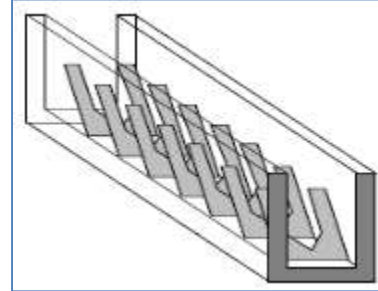
- Channel from headwater to the tailwater is divided into a number of successive pools by installing cross-walls.
- Orifices and notches in cross-walls are employed to pass the discharge

Vertical Slot Pass



- These kinds of fish passes are a variation of pool passes.
- The cross-walls in slot passes are notched over their entire height unlike pool passes.

Denil Pass



- Use backflows for energy dissipation to allow steeper slopes than other fish passes.
- Baffles placed at relatively short intervals bent against the flow direction.
- Installed generally by retrofitting of the existing hydraulic structures

Eel Ladders

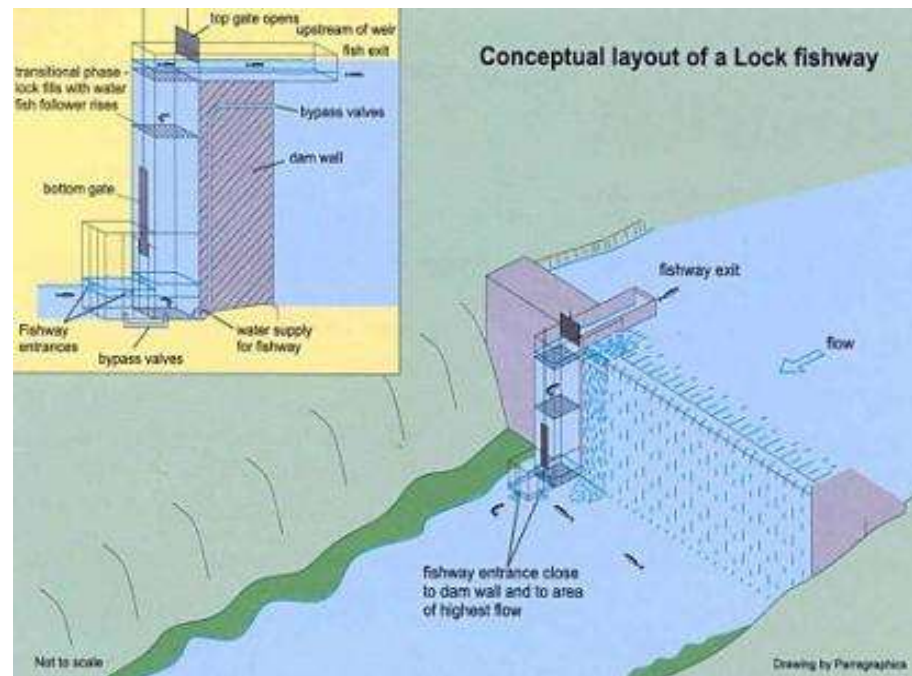


Main Components:
 Eel ascending ramp
 Supporting Structure
 Water feeding system
 Side gutter

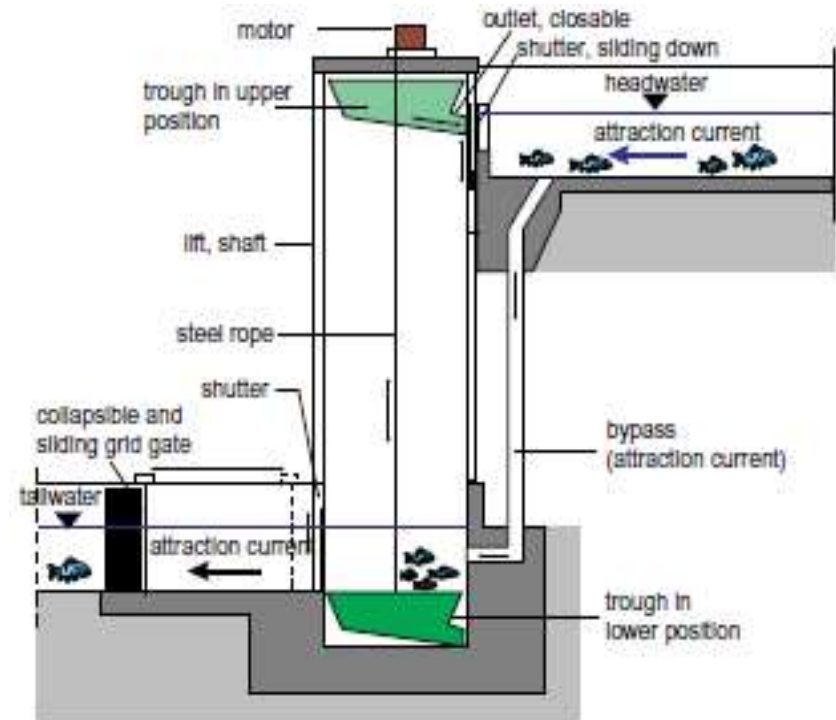
MECHANISED FISH PASSING STRUCTURES FOR HIGH HEAD ($H > 20\text{m}$)



FISH LOCKS



FISH LIFTS



Do we know:

How much water does a river need?

- No single answer
- Numerous methods
- Have we decided :
 - What sort of river do we want?
 - What are the pressures on the use of water?
 - What change Climate Change shall cause to water resources?
 - How to bring the states, owner of the water to understand and contribute for water to flow in the river?

R&D in Science for water management

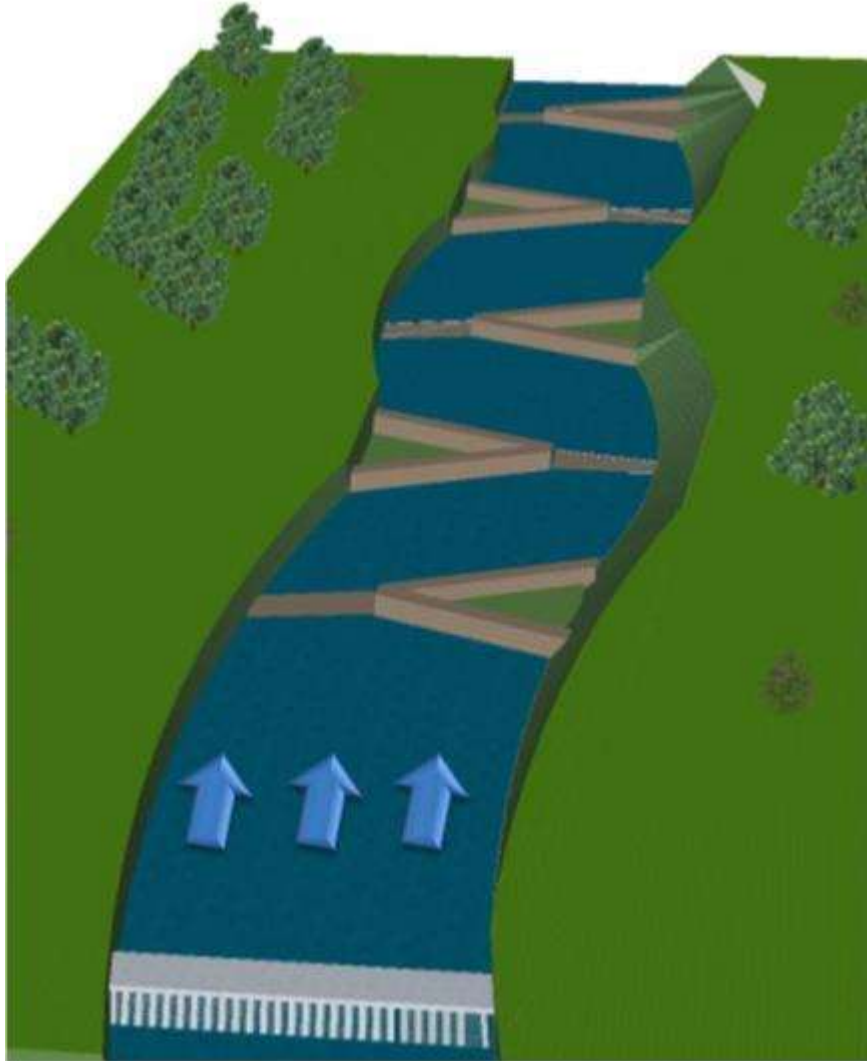
- Effective monitoring of Discharge, Sediment, Water quality, Aquatic life using reliable equipment and systems with IT based
- Effective governance and strict enforcement of provisions.
- Effective catchment development and management
- Effective involvement and benefit and damage sharing among the key stakeholders.
- Effective awareness among media, legal, leadership, entrepreneurs and engineers about today's need.

R&D needs in-ALTERNATIVE WASTE WATER TREATMENT

- Efficient Disinfection Systems to reduce F. Coli and T. Coli
- Different approaches for large cities and small towns
- Land Availability as a constraint, decentralized or centralized or multi storied
- Lower O & M
- Recycling and Reuse
- Treating the water of the quality required to the next use
- Segregation of black, gray and storm water
- Energy Alternatives in Remote Habitats where power supply is unreliable

Green Bridges

- The horizontal eco-filtration system
- A grafting of ecological system to treat the pollution flowing through the stream and rivers



Ahar River,
Udaipur

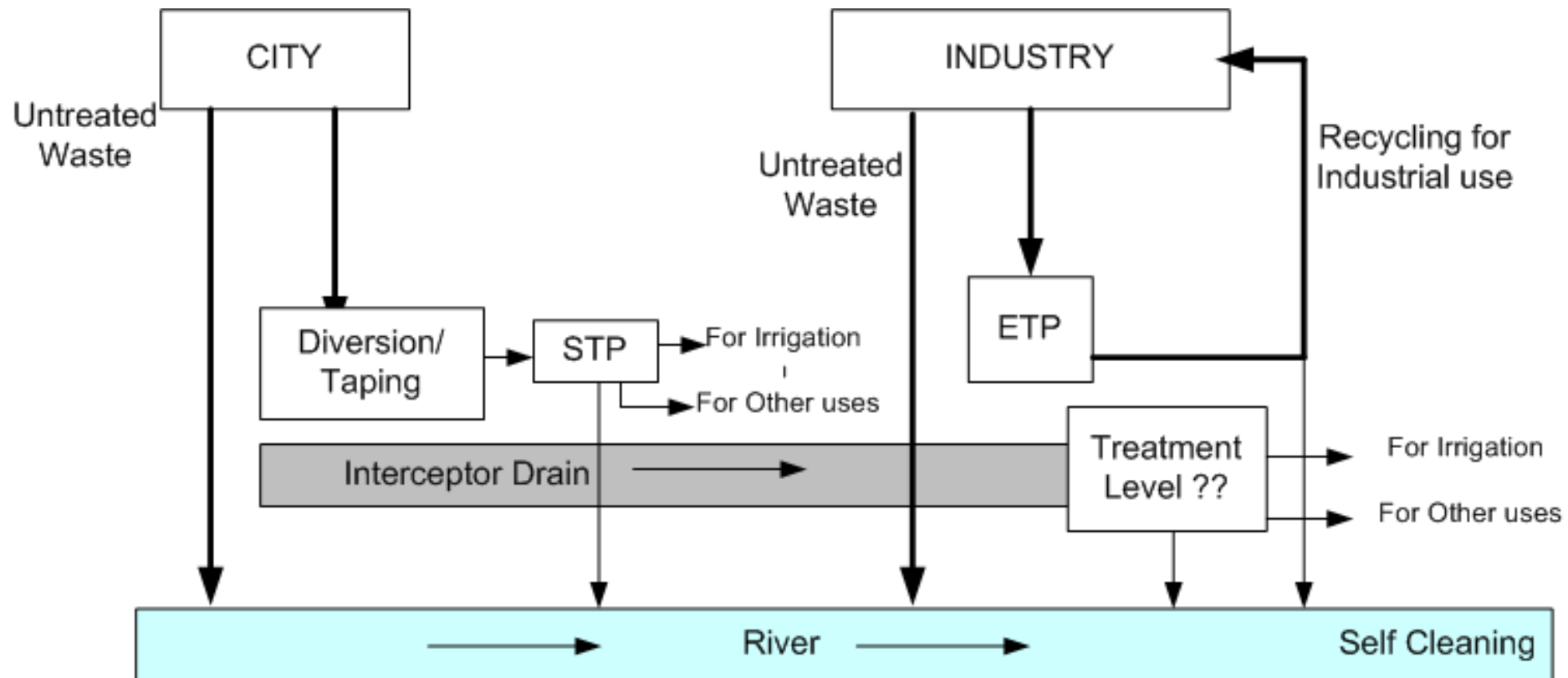


Pre-planted gravel bed for constructed wetland

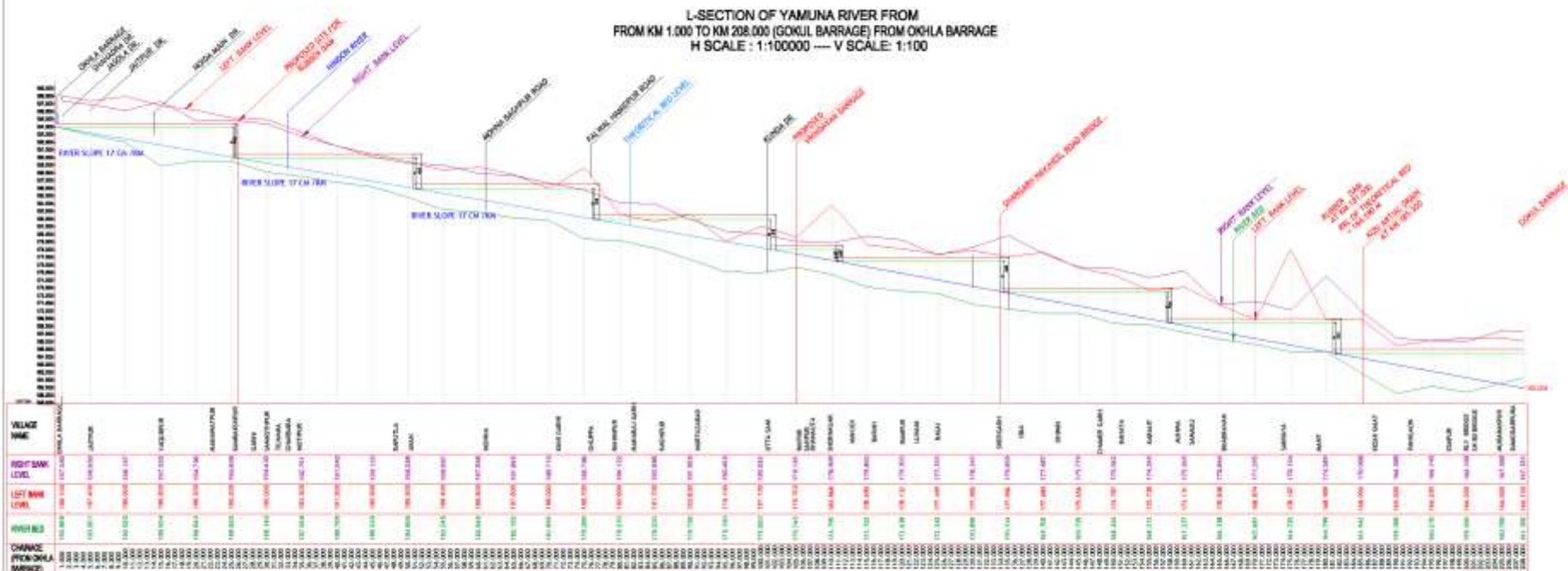


**Reed Bed at Kotitirth Kund, Mahakaleshwar
mandir, Ujjain**

Rejuvenation of River: Managing Waste Water



L-SECTION OF YAMUNA RIVER FROM
FROM KM 1.000 TO KM 208.000 (GOKUL BARRAGE) FROM OKHLA BARRAGE
H SCALE : 1:100000 — V SCALE : 1:100

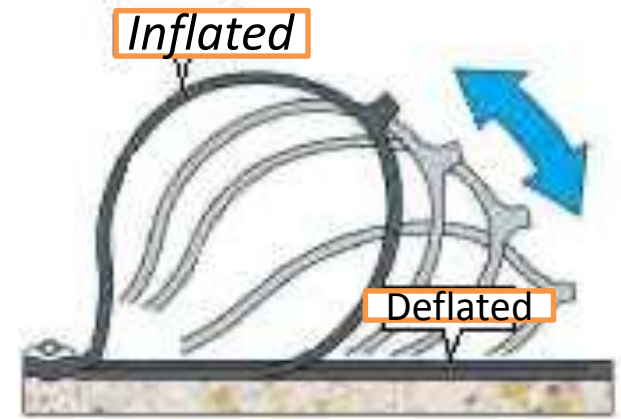
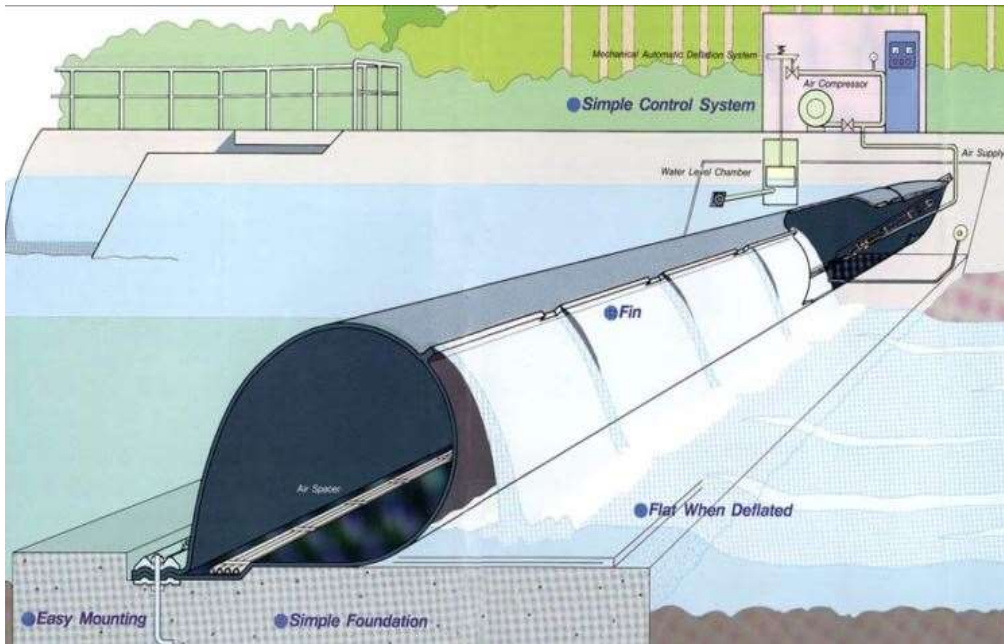


L SECTION OF YAMUNA RIVER FROM KM 1.0
D/S OF OKHLA BARRAGE TO 208.000 KM
(GOKUL BARRAGE)

GOVERNMENT OF UTTAR PRADESH
IRRIGATION AND WATER RESOURCE
DEPARTMENT

DRG. NO.
1

TYPICAL RUBBER DAM



Future Ganga: Science needs for water security: report of scientific workshop held at Delhi Dec 2-4, 2015 with Indian and UK scientists

- A unified modelling approach for the Ganga river basin needs to be developed.
- There is a need to understand how large-scale, human-induced changes in the Ganga basin (including land use, urbanisation and climate change) feedback to the whole hydrological system.
- Understanding of the dynamic interaction between surface and groundwater in the Ganga basin needs to be improved.
- There is an urgent need to define the sources, pathways and fate of environmental contaminants.
- The amount of water required to support the ecological functioning of the Ganga and its floodplain needs to be better understood.
- New techniques are needed to augment traditional environmental monitoring.
- The spatial and temporal patterns of hydrologically related hazards need to be determined and the potential impact of non-stationarity in management decisions explored.
- There is a need to define how science can support development of a future vision for the Ganga.

R&D needs requiring policy interventions and participation of all stake holders

- Improved irrigation techniques to improve water use efficiency and lower cost
- Identify best combination of crop type & rotation patterns to promote better growth
- Improved and cost effective techniques for in-situ treatment of sewage flowing through drains
- Cost effective decentralized sewage treatment techniques
- Improved cremation practices to reduce wood consumption
- Promotion of comprehensive urban wastewater management through PPP and other business models,
- Development of platform to foster capacity building
- Knowledge exchange to use innovative technologies



Identified Areas of research and priorities

Water availability:

1. Impact of urbanisation on groundwater regime due to reduction in recharge & excessive withdrawal of groundwater to meet the requirement of urban population and Remedial Measures thereof.
2. Impact of development and changes in land use on surface and groundwater regimes in rural watersheds and Remedial Measures thereof.
3. Identification of springs, wetlands, water bodies, which may have disappeared, undergone reduction and degradation; estimation of the extent of degradation and required legal, regulatory implementation and scientific/technical strategies as components of a framework for their revival and sustenance.
4. Assessment of contributions to the river flow from (i) glaciers, (ii) snow, (iii) rainfall, and (iv) sub-surface flow, particularly in segments of Ganga, which suffer from acute scarcity of discharge in the lean seasons.

RECOMMENDATIONS



Impact:

6. Impact Assessment of climate change on water security in the basin and mitigation and adaptation measures.
7. Investigations for assessment of impact of diversion / storage on in-stream (contribution due to irrigation return flow) water availability and also development as well as modelling/evaluation of the possible measures for augmenting flows during lean flow by creating flexible storage(rubber Dams)

Environmental Flows:

8. Estimation of environmental flow requirement for Ganga in its different stretches, in particular, the upper and middle segments and any other stretch identified for this purpose and formulation of policy, strategy and mechanism for ensuring availability of environmental flow.
9. Investigations of River-Aquifer interaction along the river and assessment of its impact on river flow.

Sediment:

10. Assessment of soil erosion, sediment characterisation and transport and management in various sub-basins of Ganga basin including scientific management of sand mining.



RECOMMENDATIONS- Water Quality:

- Assessment and management of point and non-point sources of pollution in Ganga Basin.
- Bio-monitoring of river including microbes on sustained basis
- Impact of current agricultural practices on river health and remedial measures thereof
- Evaluation of Cost-effective water and waste water treatment technologies including bio-remediation as well as in-situ technologies and also of decentralised systems.
- Development of water quality standards in the perspective of human health
- Reuse and recycling of treated municipal and industrial effluents and development of sustainable business models

RECOMMENDATIONS:

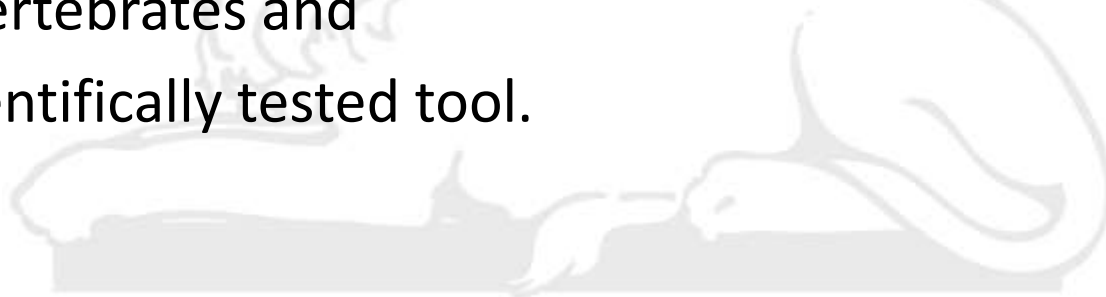


Implementation, regulatory and institutional Framework:

- Assessment and management of river ecosystem services.
- Development of low-cost, efficient, smart, real time data monitoring instrumentation along with management, storage, retrieval and dissemination of collected data.
- Studies on gender issues- empowering women in water sector with reference to Aviral dhara and Nirmal dhara of the Ganga.
- Impact of socio-economic and cultural activities on *Aviral* and *Nirmal Dhara*
- Impact of solid waste including domestic, biomedical, electronic, construction and other waste on river water quality.

Bio-monitoring of River Ganga

- Presently only Physico-chemical parameters of water are monitored,
- Biological communities if monitored can present an integrated view of all of the environmental stresses over a longer period of time and reflect the quality of their surroundings,
- Macroinvertebrates and algae make good biological indicators for a variety of reasons. Algae have shorter lifecycles than macroinvertebrates and
- It as a scientifically tested tool.



Water quality map of Kosi River, Uttarakhand



Water quality class based on Macroinvertebrates



Water Penny Beetle



Mayfly



Mussels



Snipe Fly



Stonefly



Alderflies



Riffle Beetles



Dobsonfly

HIGH WATER QUALITY

Water quality class based on Macroinvertebrates



Damselfly



Dragonfly



Crayfish



Amphipods



Blackfly



Caddisfly



Isopods



Crane fly

MODERATE QUALITY

Water quality class based on Macroinvertebrates



Midgefly
(blood-worm)



Worms



Leeches



Pouch Snail

POLLUTED QUALITY



Thank You

