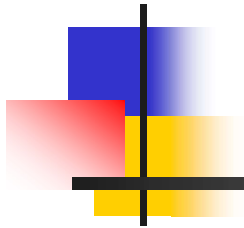


# Water resources management and challenges in India in the context of E-Flows: status quo and the way towards future implementation



Ashvani Kumar Gosain  
Emeritus Professor,  
Civil Engineering Department  
Indian Institute of Technology Delhi

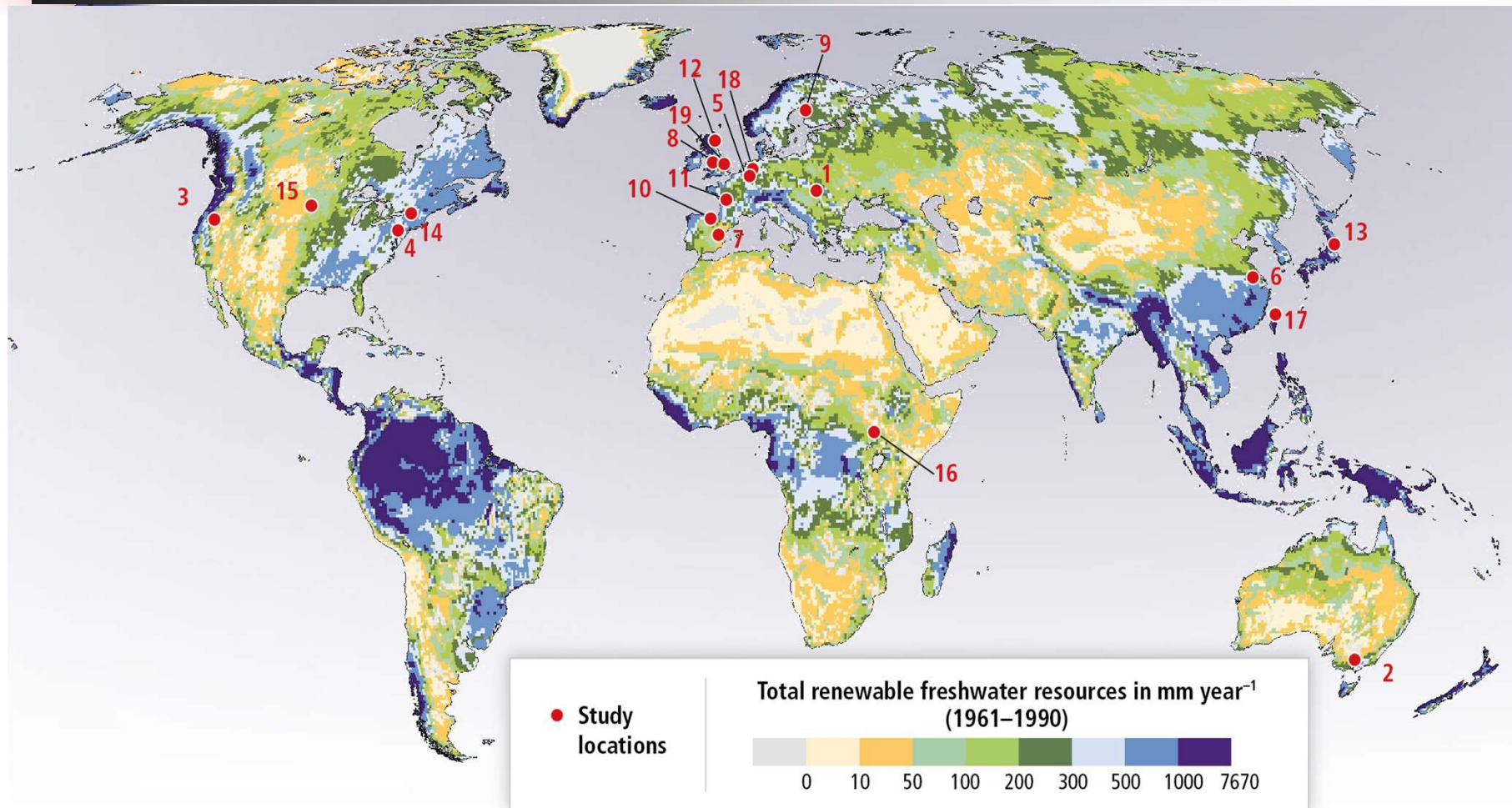


# Water Security – Every Country's Concern

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- A complex question and may mean differently
  - Water security for human consumption including domestic, agriculture, industrial, etc., requirement
    - Has always been a predominant factor
  - Water security for environmental requirement

# Total Renewable Fresh Water Resources in mm per Year



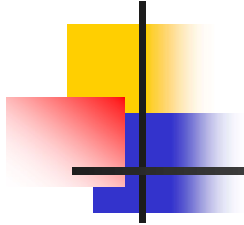
# Present Status of Water in India



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- Is very alarming
  - The demand imposed is more than availability
  - Reflected in the falling water tables
    - Implying that the deficit in availability is compensated through ground water abstraction

# Why we have reached such a situation



- Water resources development process is unplanned
- Demands are being imposed without analysing availability
- No check on overexploitation of groundwater
- But Environmental demands are ignored

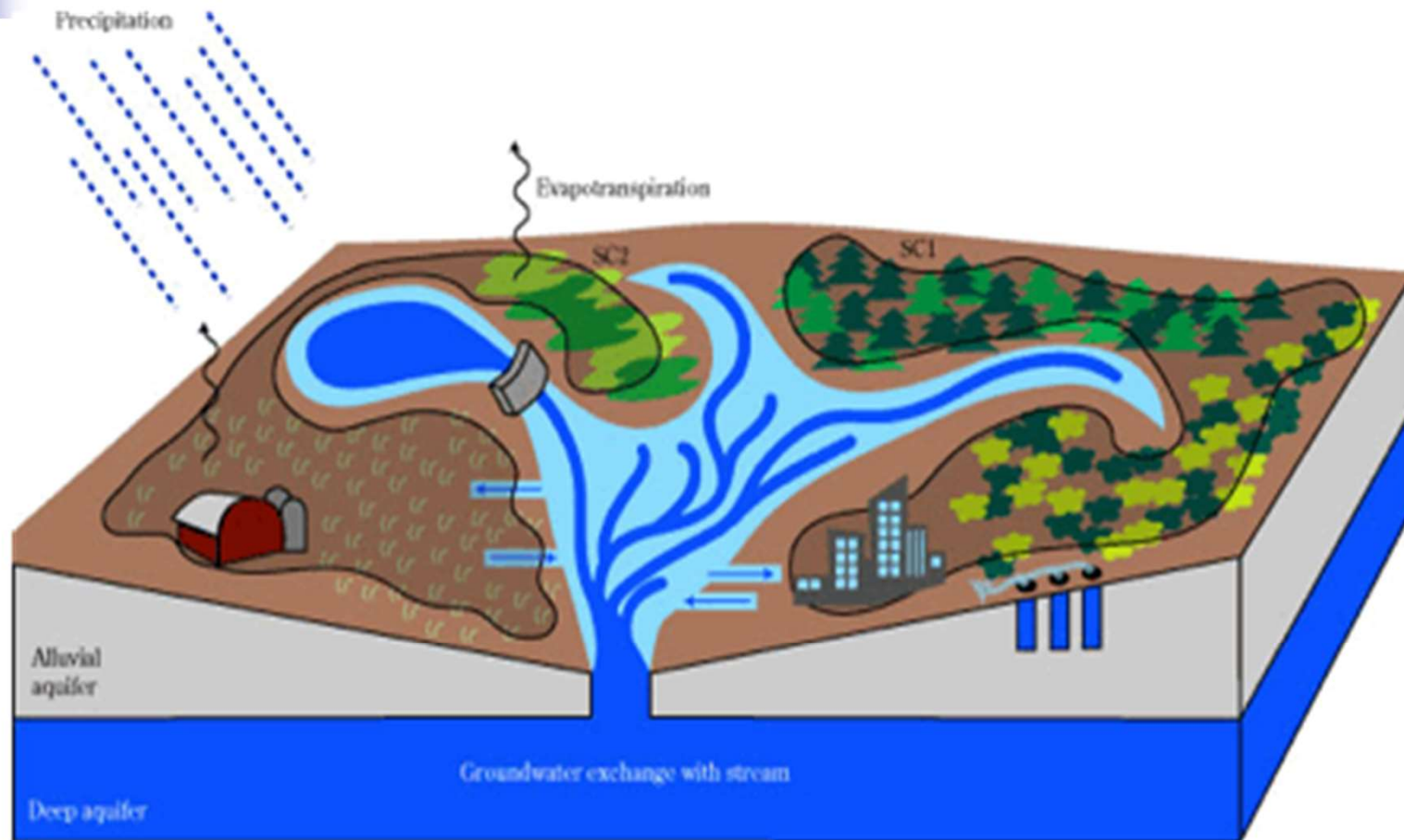


# Many Players in Development

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- MoWaterResources RD&GR (Jal Shakti)
  - Major & Medium Water Resource Projects
  - National Water Mission (under NAPCC)
- MoRural Development
  - MGNAREGA
- Equivalent State Departments
- Industry & Urban Development

# Interface between Natural Watershed and Managed Systems



**The interface between the natural watershed and managed systems.**



# Implications of Development

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- Water resource is finite (within natural variability)
- Any development big or small involves in moving the water around (more often upstream)
- Every development/intervention has some associated impact



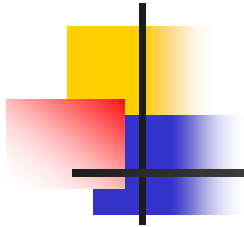


# Sustainability – Major Concern

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- This brings us to the question of sustainability
  - Which is about maintaining the hydrological and environmental health of the drainage system
- IWRM philosophy has been the scientific option available but seldom used
  - Watershed being the natural system where water balance can be resolved and thereby impacts of the manmade interferences quantified

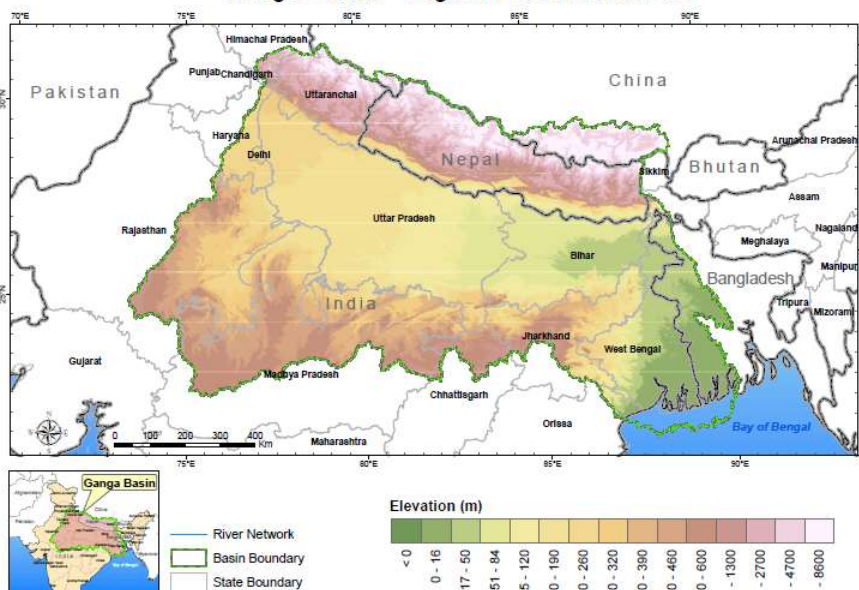
# How to Revive the Lost Environmental Flow?



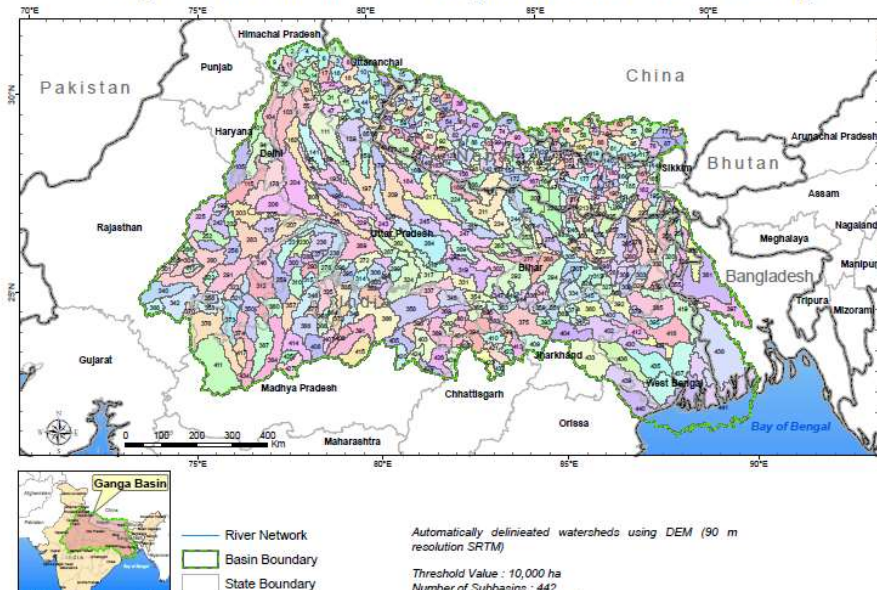
- Develop River Basin Management Plans
  - Assess Resource availability (temporal & spatial)
  - Assess Present & future demand
  - Evaluate Efficiencies of projects
  - Evaluate Environmental status
  - Developmental sustainable pathways (with & without Climate Change)
  - Generate Information and Share with all stakeholders

# Ganga Basin Hydrological Modelling – Base layers

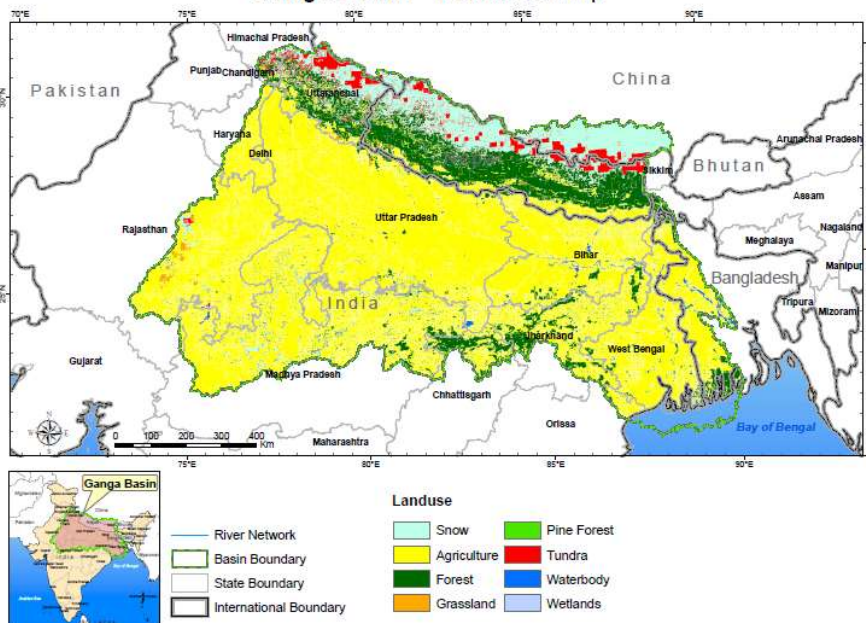
Ganga Basin - Digital Elevation Model



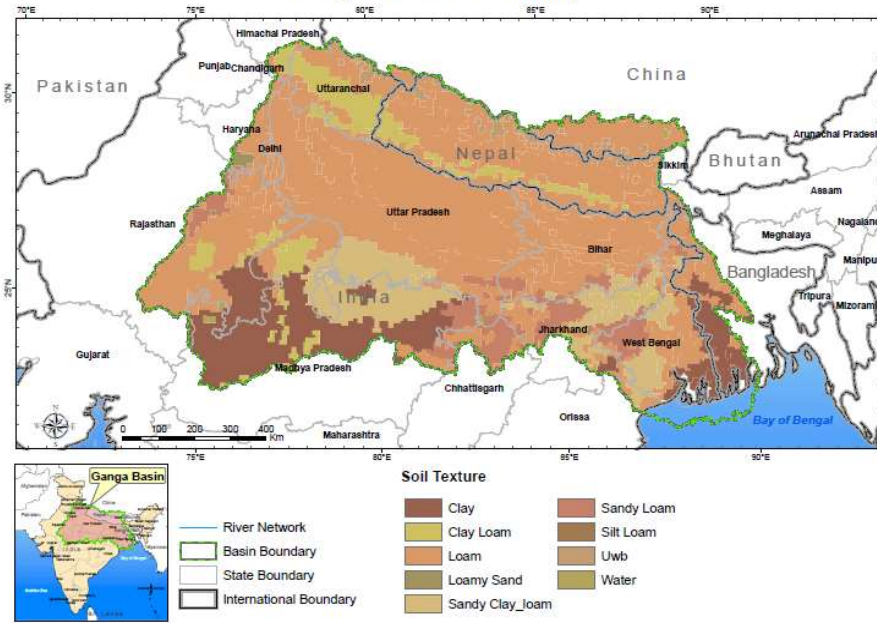
Ganga Basin - Subbasin Configuration used for Modelling



Ganga Basin - Landuse Map



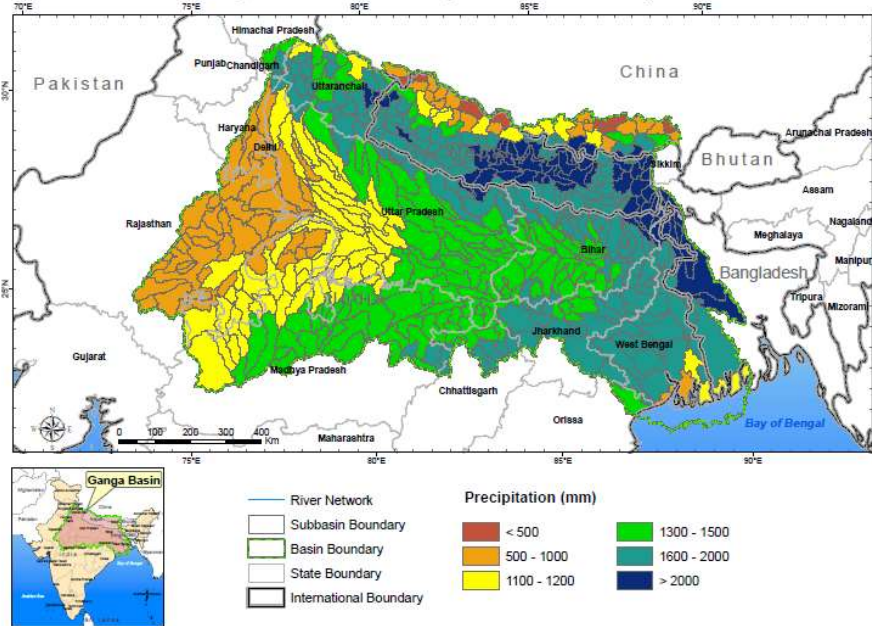
Ganga Basin - Soil Map



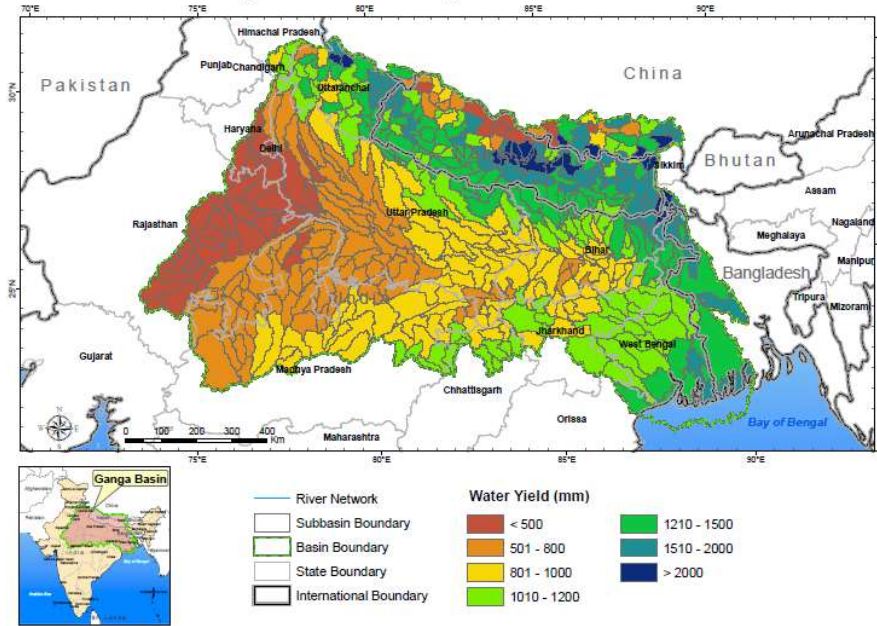


# Ganga Basin Hydrological Modelling – SWAT Outputs

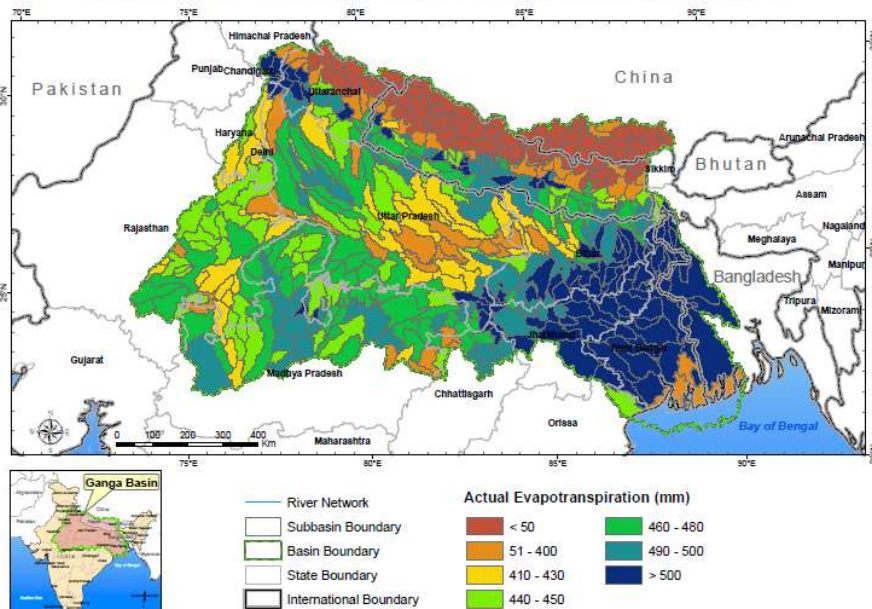
Ganga Basin - Average Annual Precipitation



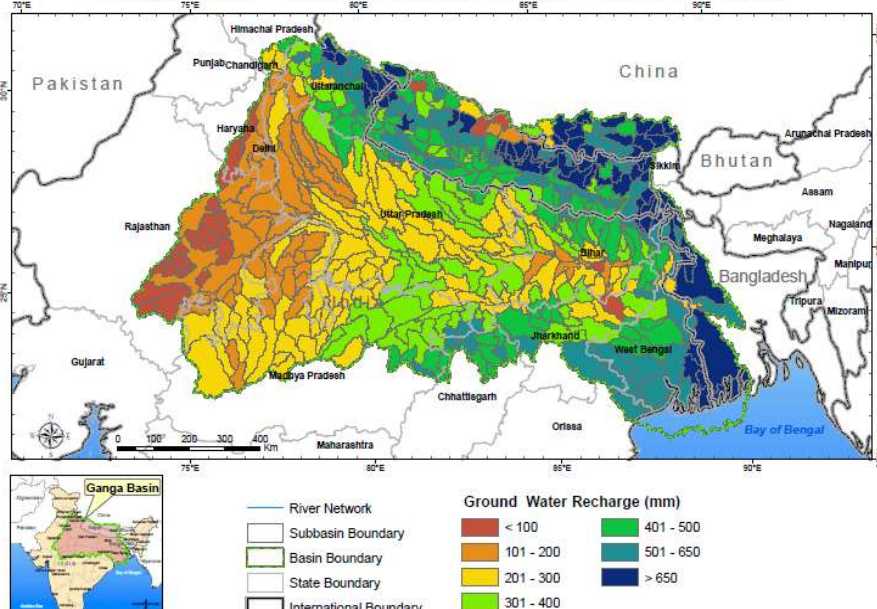
Ganga Basin - Average Annual Water Yield



Ganga Basin - Average Annual Actual Evapotranspiration

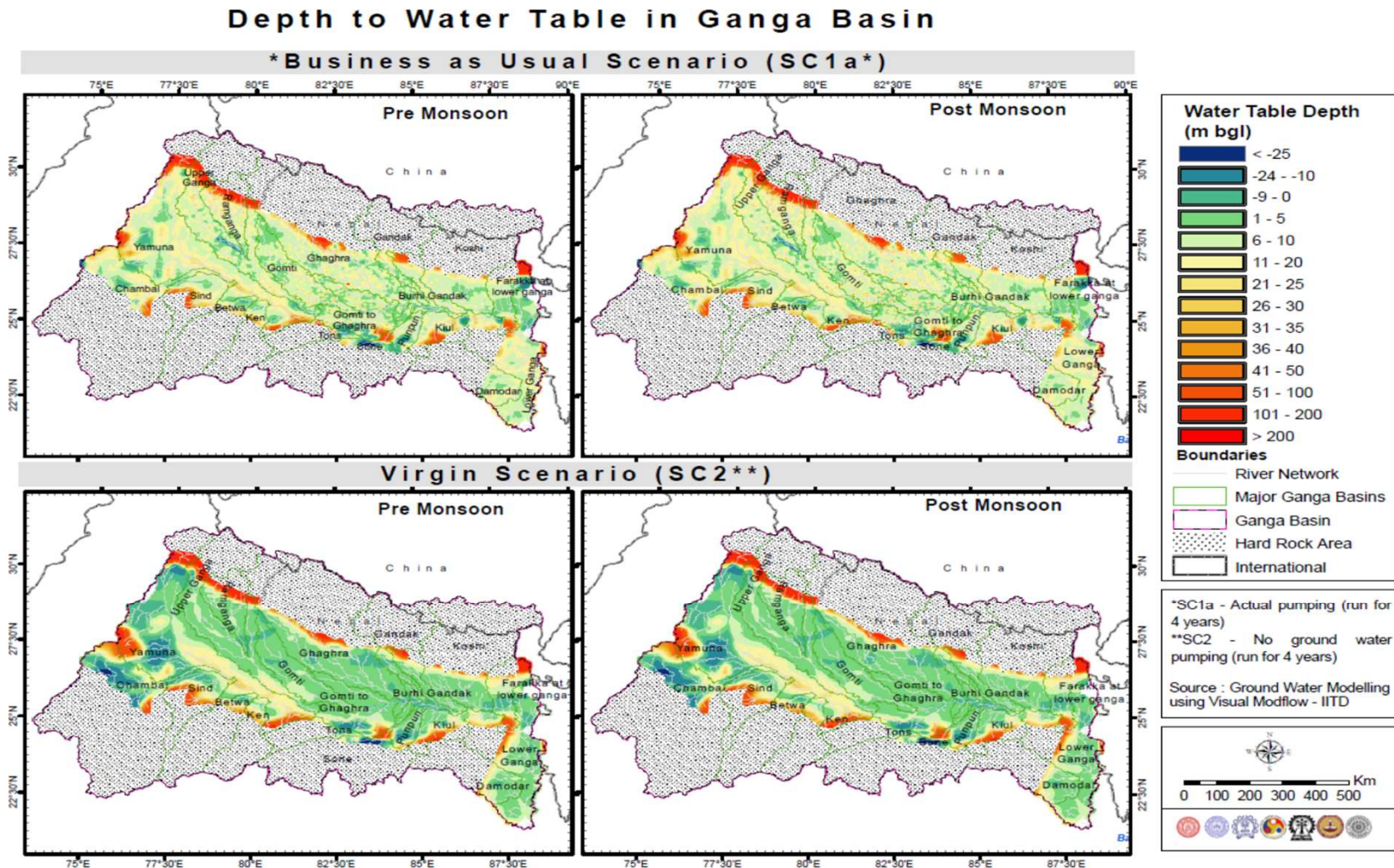


Ganga Basin - Annual Average Ground Water Recharge



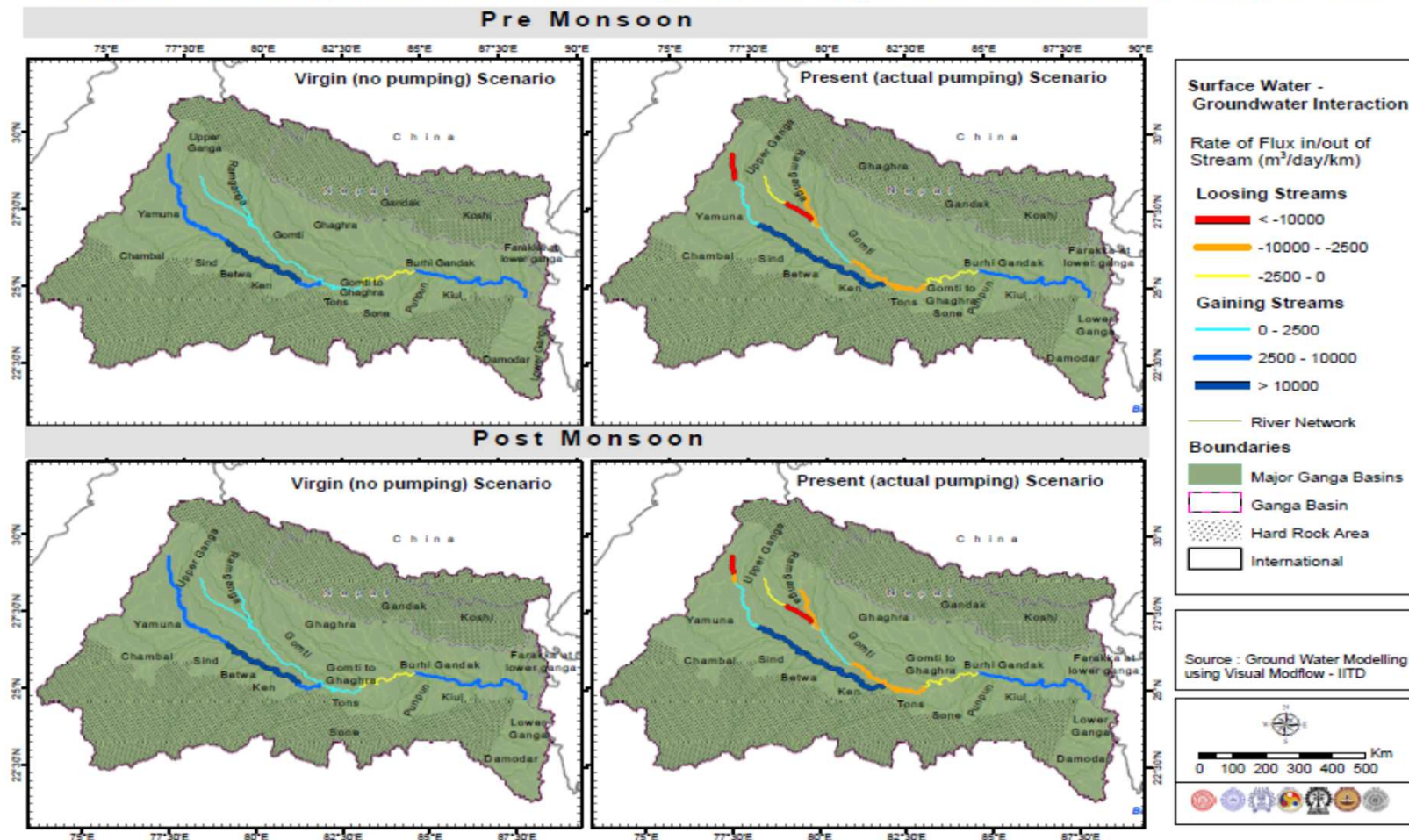


# Depth to Water Table for Present and Virgin Case



# Surface & Groundwater Interaction for Present and Virgin

Surface – Groundwater Interaction Map across major Stretches of the Ganga Basin





# What is Practicable?

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- Since all the action is at the District Level, translate the hydrological information to District and perform the following:
  - Establish water balance
  - Do the water audit of all sectors
  - Establish mechanism for demand management
  - Devise ways for groundwater revival
  - Validate through observational networks

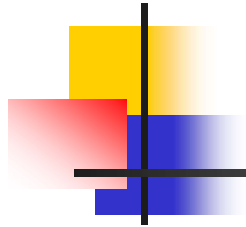


# Conclusions

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- Implement the Integrated Water Resources Management in reality
- Creation of sharable information is essential for sustainable use of water resources through engagement of stakeholders
- Capacity building of all the organizations engaged in the process





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Thank you