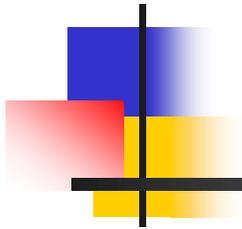
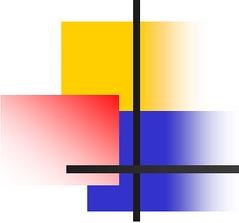


Water resources management and challenges in India in the context of E-Flows: status quo and the way towards future implementation



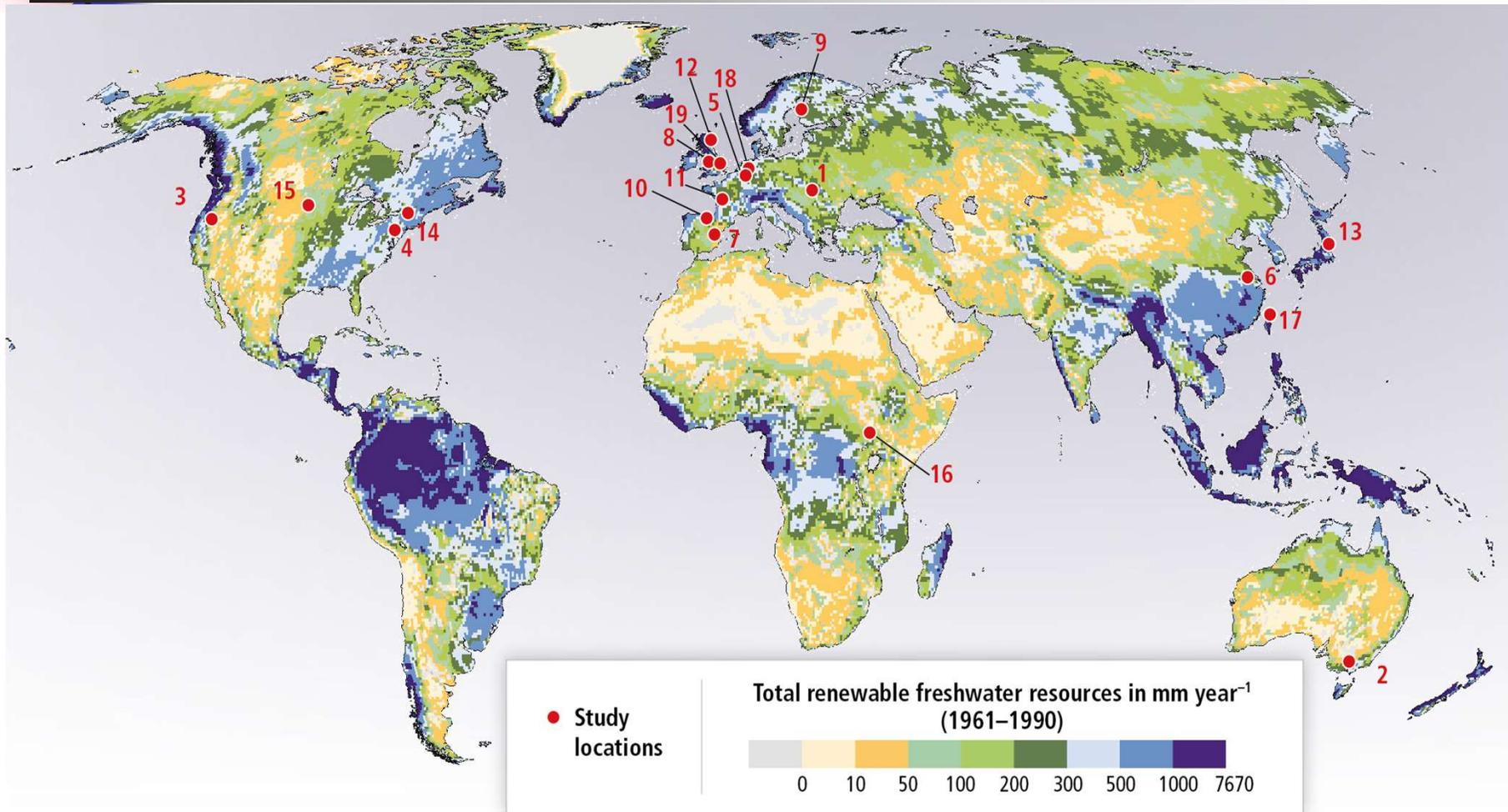
Ashvani Kumar Gosain
Emeritus Professor,
Civil Engineering Department
Indian Institute of Technology Delhi



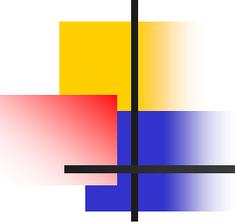
Water Security – Every Country's Concern

- 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

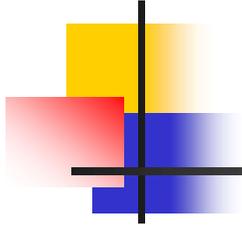


Present Status of Water in India

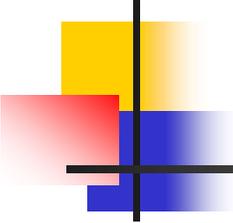


- Is very alarming
 - The demand imposed is more than availability
 - Reflected in the falling water tables
 - Implying that the deficit in availability is compensated through ground water abstraction

Why we have reached such a situation



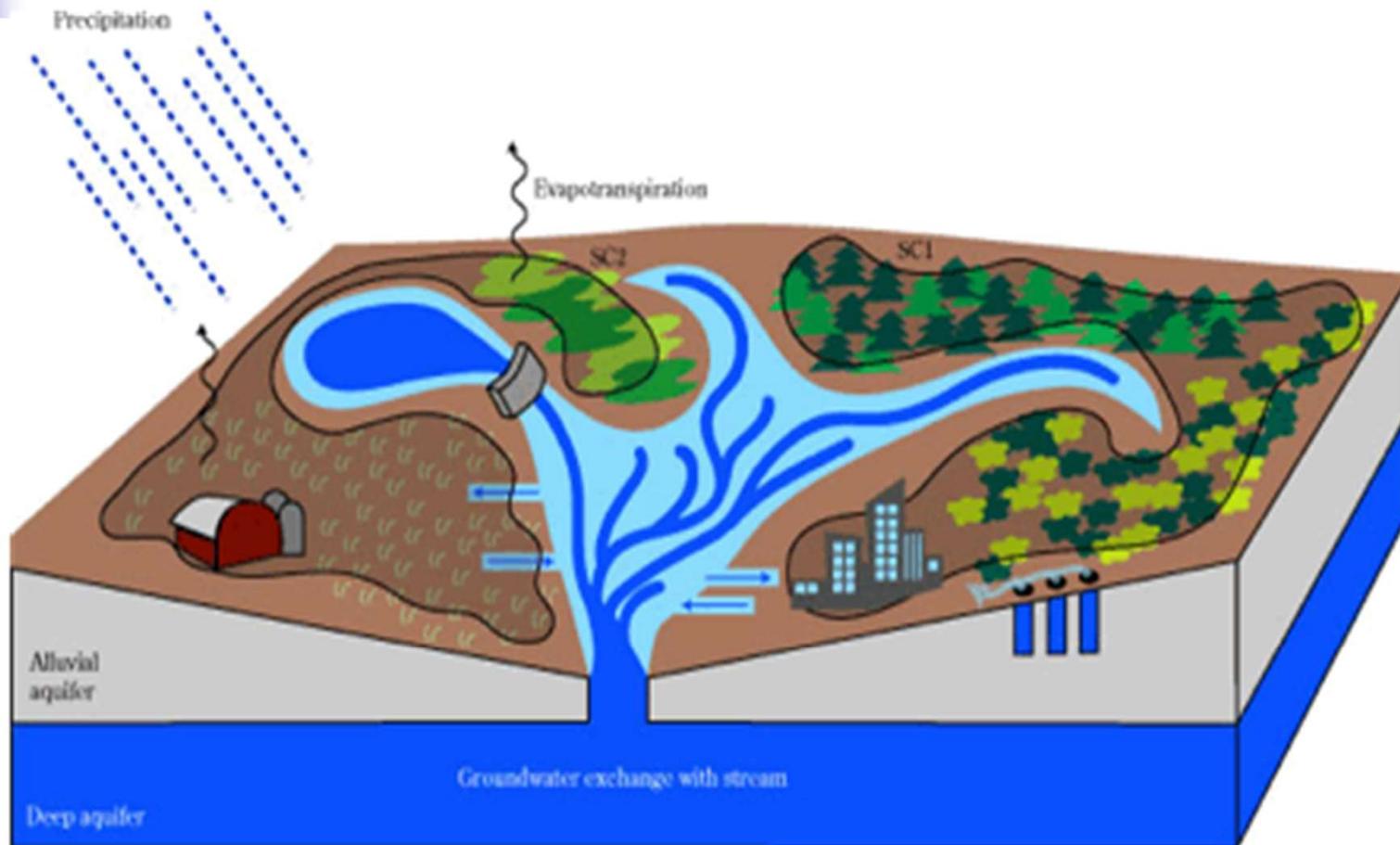
- Water resources development process is unplanned
- Demands are being imposed without analysing availability
- No check on overexploitation of groundwater
- But Environmental demands are ignored



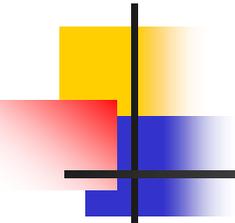
Many Players in Development

- 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

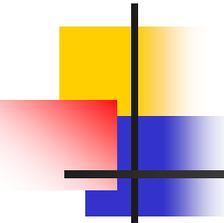


The interface between the natural watershed and managed systems.



Implications of Development

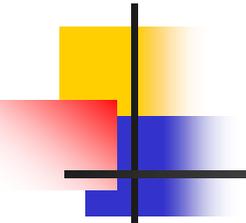
- Water resource is finite (within natural variability)
- Any development big or small involves in moving the water around (more often upstream)
- Every development/intervention has some associated impact



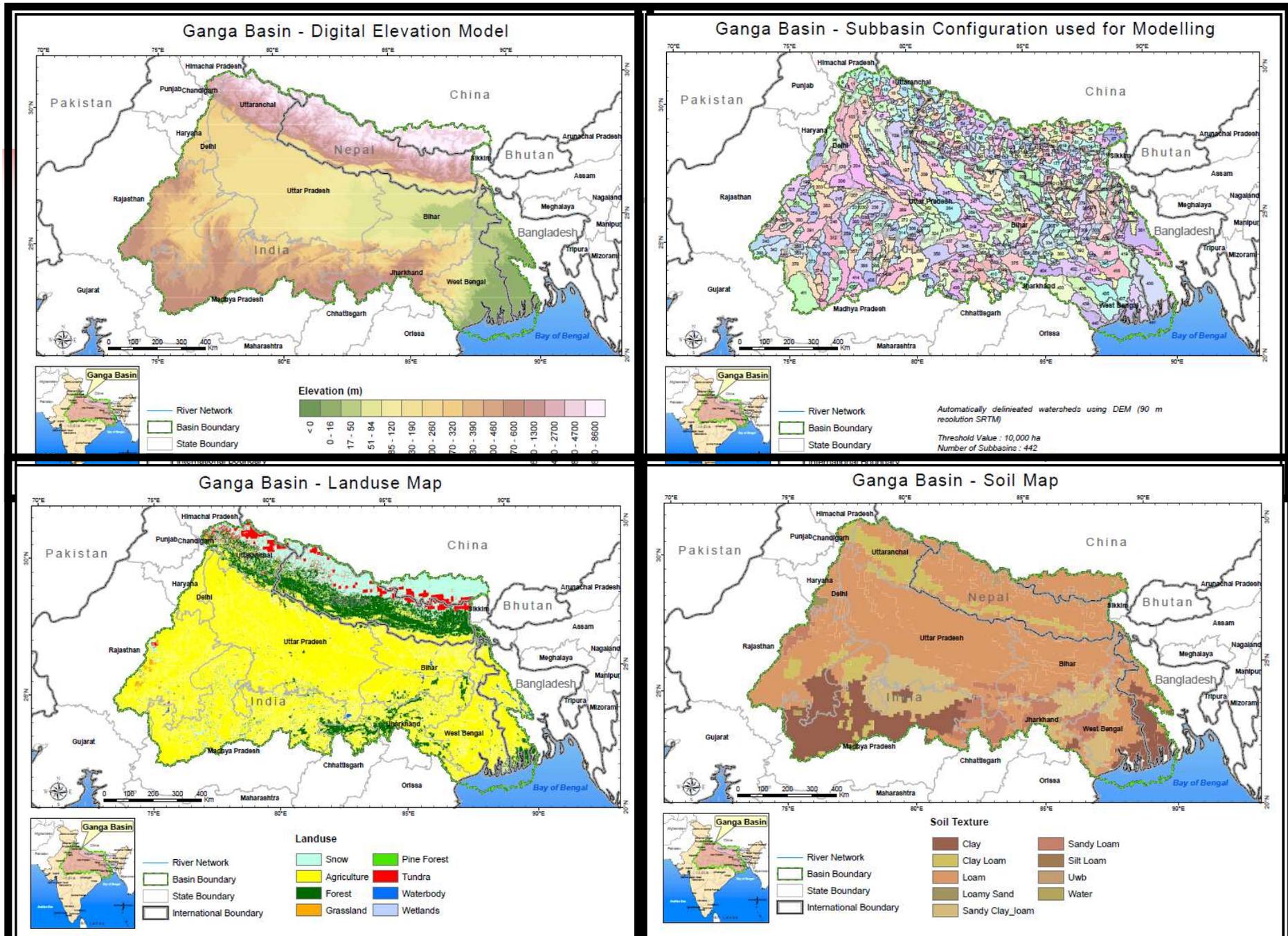
Sustainability – Major Concern

- 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

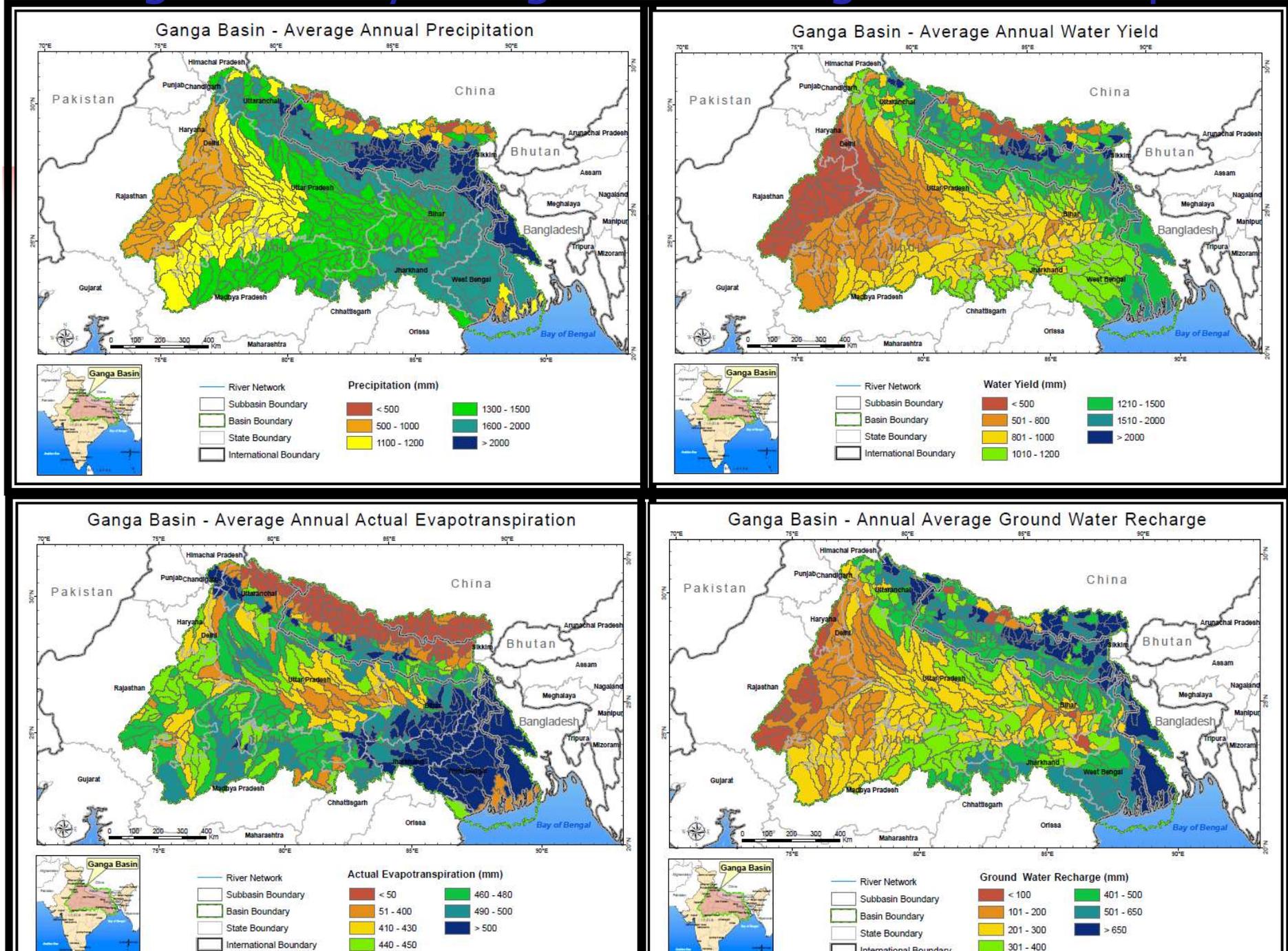
How to Revive the Lost Environmental Flow?

- 
- 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



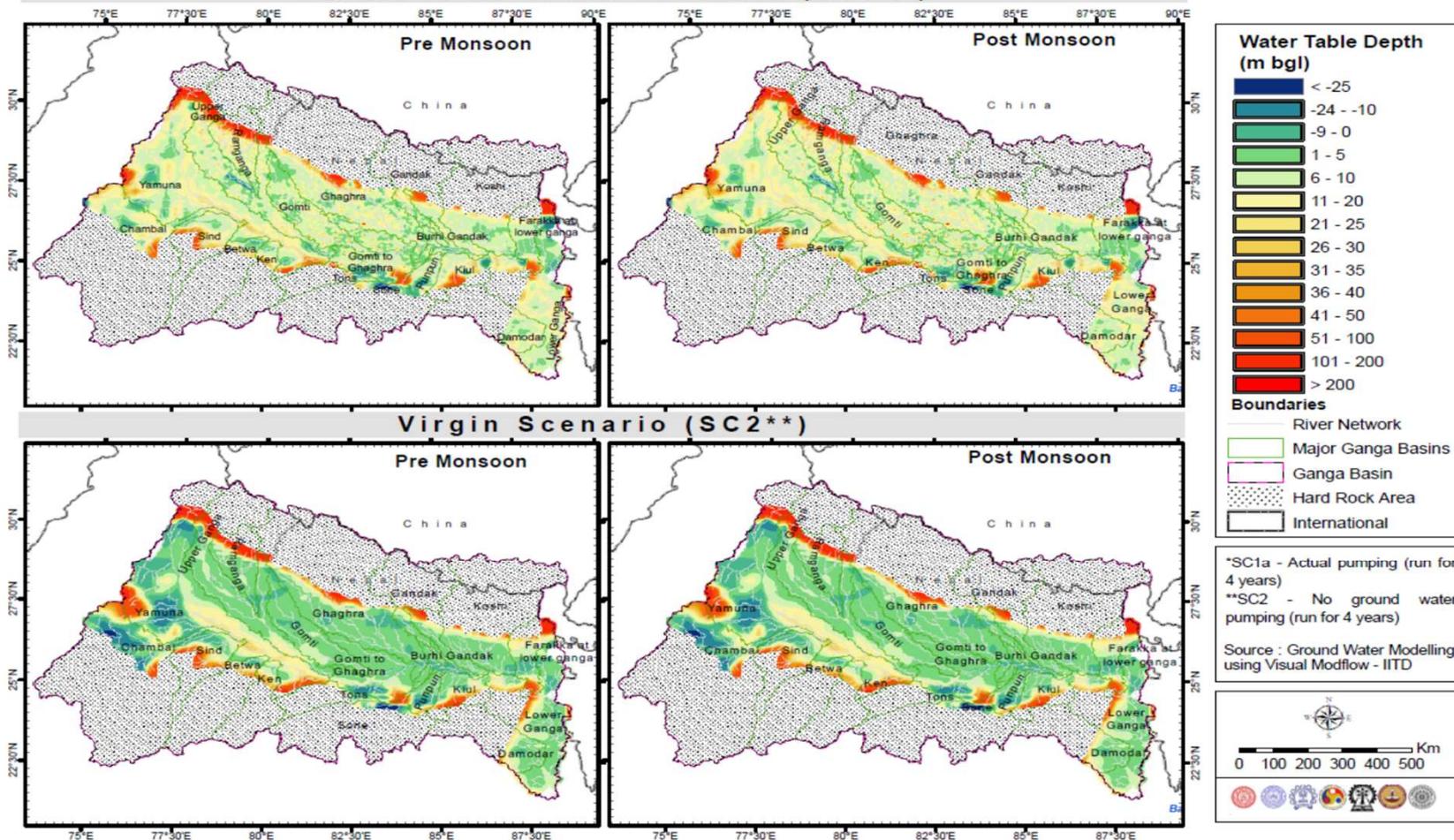
Ganga Basin Hydrological Modelling – SWAT Outputs



Depth to Water Table for Present and Virgin Case

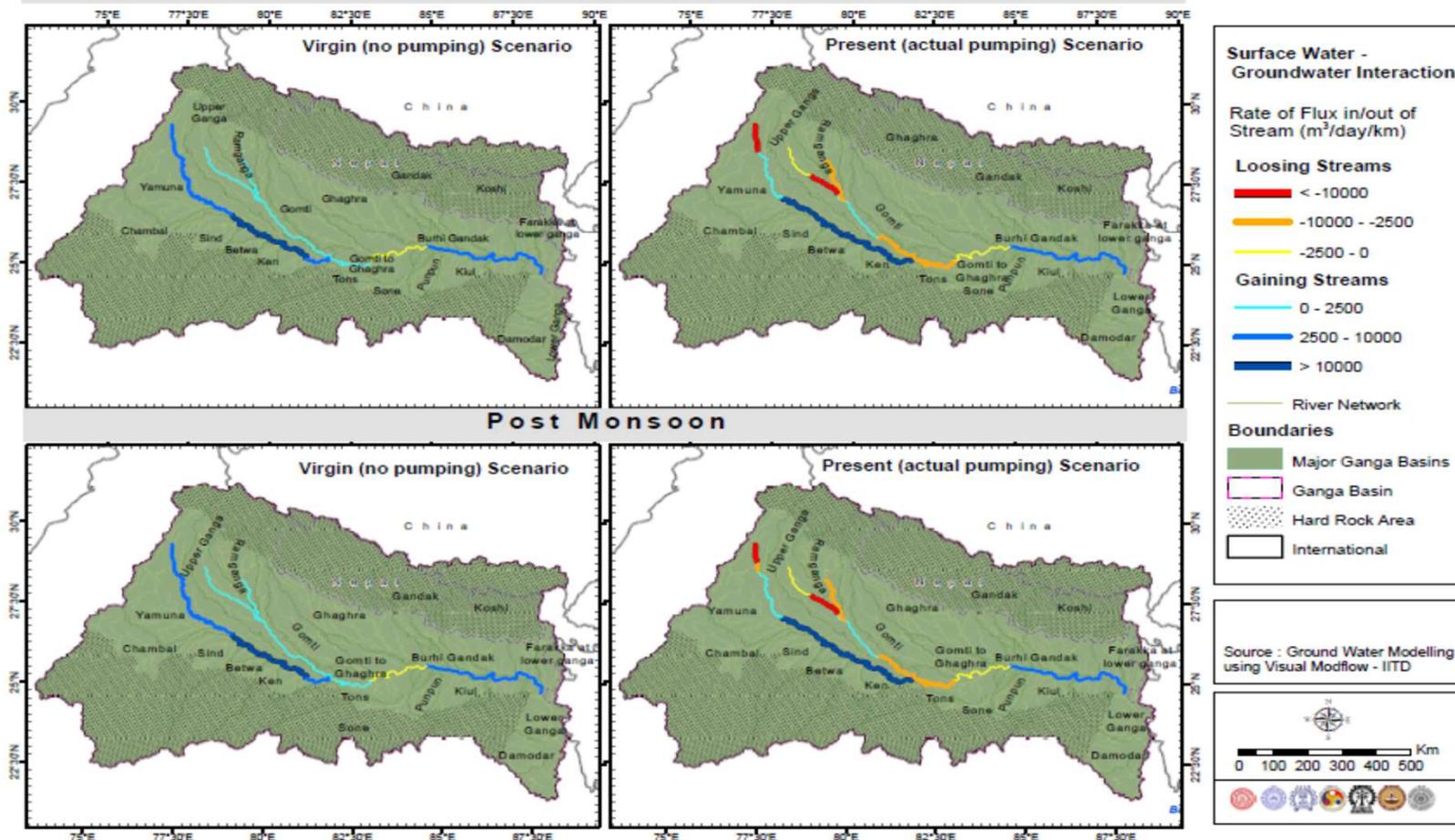
Depth to Water Table in Ganga Basin

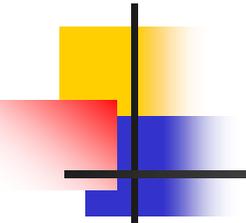
Business as Usual Scenario (SC1a)



Surface & Groundwater Interaction for Present and Virgin

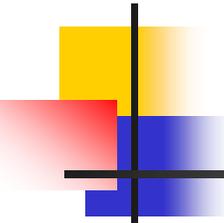
Surface – Groundwater Interaction Map across major Stretches of the Ganga Basin
Pre Monsoon





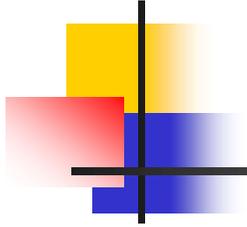
What is Practicable?

- 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

- 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



Thank you