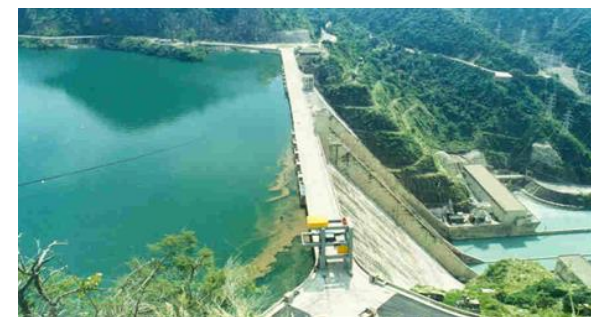


River Basin Management Planning & Investment Planning

Anju Gaur
Sr. Water Resources Management Specialist
New Delhi



WORLD BANK GROUP
Water



India's Water Resources

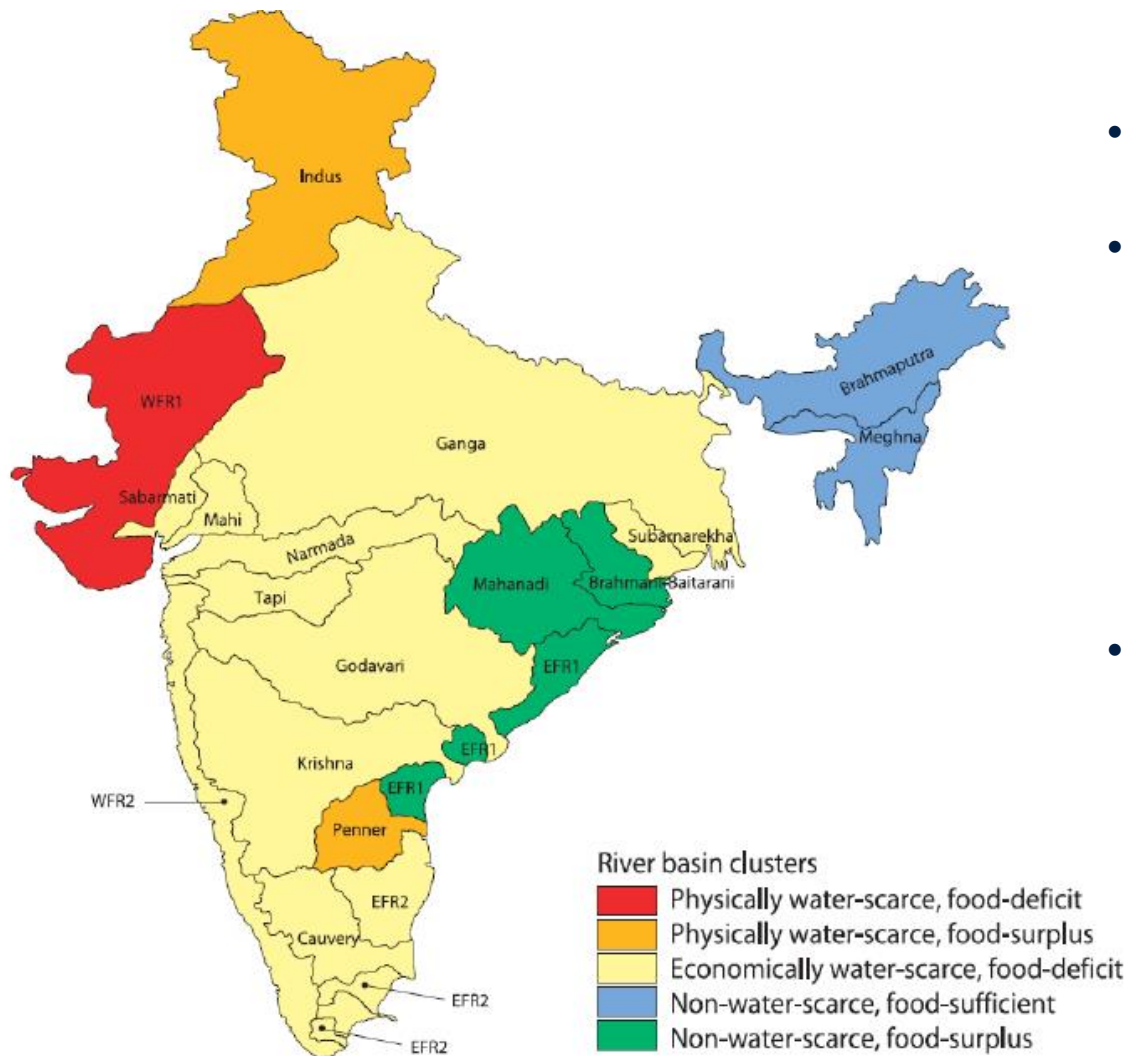
- Increasing relative water scarcity
 - 4% of the world's renewable water resource
 - 2% of the global land mass
 - but 17% of the global population
 - per capita water availability of global average Ranked 50th in the world
- High Climate Variability – seasonal and inter-annual
 - 80% precipitation June– September
- High spatial variability
 - Influence of Himalaya on the monsoon

Rainfall is highly spatio-temporal

Increasing relative scarcity

Year	Population (Million)	Per capita water availability M ³ /year
1951	361	5177
1955	395	4732
1991	846	2209
2001	1027	1820
2025	1394	1341
2050	1640	1140

Water Scarcity in India



- More than 50% of the basins are water scarce
- 90% of water is used for irrigation (~55 Mha under irrigation of total~140 Mha in agriculture). However, Agriculture accounts only 16% of GDP
- Rest 10% is used by other users (Industry, domestics, hydro-power etc.)

Water Demand Projections (from IWMI)

Sector	2000		2025		2050	
	Total	% from groundwater	Total	% from groundwater	Total	% from groundwater
	BCM	%	BCM	%	BCM	%
Irrigation	605	45	675	45	637	51
Domestic ^a	34	50	66	45	101	50
Total	680	44	833	43	900	47

Increased inter-sectoral water allocation conflicts

- Total increase by 2050: 220 BCM, 32%
- Contributions to increase
 - Irrigation 32 BCM, 15%
 - Domestic 65 BCM, 30%
 - Industrial 119 BCM, 55%

Water Supply and Sanitation

- Huge unmet needs in WSS; MDG sanitation target will not be met
 - 99 million without access to improved drinking water
 - 931 million without piped water on premises
 - 807 million without improved sanitation
 - 620 million practice open defecation
- Major Challenge: improving WSS with efficient and sustainable services



Flood prone Area in India



Flood prone area= 40 M ha (12%)
Land area= 18.5 M ha
Cropped area = 3.7 M ha
No. of people affected = 30 M

As per 12th Five year plan, annual flood damage to private infrastructure and property to be US\$1 Billion (INR 6000 crore) and 30 Million people



Major Water Resources Issues and Implications in India

Issues:

- Uncertainty in water availability (spatial & temporal).
- Frequent hydrological extremes (flood & drought) impose high economic and social costs.
- Increasingly stressed water resource base – rivers & GW severely polluted and over-abstraction in lean season common.
- Very low levels of water storage by world standards.
- Trans-boundary management a particular challenge.
- Very low efficiency of the existing irrigation system
- Low technical and managerial capacity of the existing water agencies.
- Sectoral and adhoc approaches to water management

Implications:

If Water Resources Management challenges are unmet, water will increasingly be limiting factor in economic growth in many sectors (urbanization, industry etc.) and poverty reduction and will become a source of conflict in the near future.

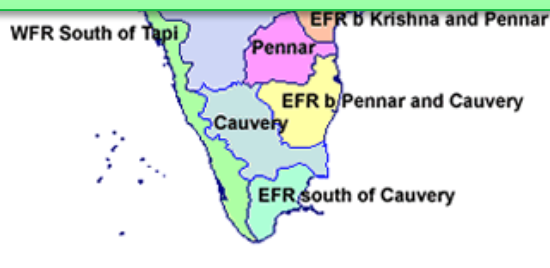
For a sound developmental/ investment planning, understanding water availability (quality & quantity) is pre-requisite.

Water Availability by Basin



Basin	SW Resource (BCM) CWC, 1993
Indus	73
Ganga	525
Brahmaputra/Barak	585
Godavari	110
Krishna	78
Maharashtra	67
Others	336
TOTAL	1869

Uncertainty in Water resources assessment due to insufficient monitoring system



River Basin
Brahmaputra
Krishna

CWC 1993
537 BCM
78 BCM

NCIWRDP 1999
629 BCM
69 BCM

**1 BCM is enough to
serve Delhi for 1.5
year.**

Management decisions at different phases of development

Construct

Legislate

Enforce

Manage demand

Empower

Water resource development

Threats and opportunities:

- Reducing opportunities for development
- Increased risk (from droughts)
- Climate change
- Management options constrained
- Involvement of stakeholders
- Need for dialogue
- Need for information dissemination

Areas for action:

- Institutional reform in the water sector
- Engagement with stakeholders
- Re-education of water professionals
- Re-education of politicians and planners
- Knowledge management and dissemination
- Improved efficiency and productivity of water
- Demand management, reduction in water use
- Identification of opportunities and mechanisms for changing use
- Water trading

Time

Management Initiatives

- ❑ Government of India has been implementing several water resources development and management projects to address various issues.
- ❑ Government has further planned to invest **USD 46 (INR 2,800) billion** for Agriculture and Water Resources Development under 12th Five Year Plan.
- ❑ National Irrigation Scheme: **PMKSY (INR 50,000 Crore)**

World Bank's Initiatives

Priority areas for Bank's support in WRM in India are:

1. Increasing efficiency of existing irrigation system.
2. Support India in meeting MDG water supply & sanitation target.
3. Development of reliable water database and data standardization.
4. Standardization of tools/ methodologies for water assessment.
5. Holistic River Basin Approach to water management.
6. Mitigating water related disasters including Dam Safety
7. Capacity Building of water agencies.

Ongoing WBG Water Resources Lending Portfolio (US\$3B)

Project	Duration	Age	Amount
Orissa Community Tank Management	8	6.3	\$67M
AP Community Tank Management	9	7.7	\$174M
Dam Rehabilitation	8	4.5	\$279M
WB Accelerated Development of Minor Irrigation	6	3.2	\$250M
MP Water Sector Restructuring	11	10.3	\$387M
UP Water Sector Restructuring	7	2.3	\$360M
AP Water Sector Improvement	6	4.6	\$450M
National Ganga River Basin Project	8	3.6	\$1,000M
AVERAGE/TOTAL	7.9	5.2	~\$3,000M
National Hydrology Project	In prep		\$175M
National GW Management & Improvement Projects	In Prep		\$500M

India Water Resources Projects

National Projects

- Hydrology Project
- Watershed Project

State Projects

- ▼ DRIP Project (Dams): 4
- ▲ Tank /Irrigation: 4
- Water Sector Restructuring Project: 3
- ⦿ Watershed/Agriculture: 3



National Ganga River Basin Project

- Objectives
 - build capacity of NGRBA's nascent operational-level institutions at both the central and the state levels, so they can manage the long-term Ganga clean-up and conservation program
 - implement diverse investments for reducing **point-source pollution** in a sustainable manner
- Institutional Development (\$200 Million)
 - Support to NMCG & SPMGs
 - Ganga Knowledge Center
 - Upgrading WQM systems
 - Capacity building of ULBs, PCBs
 - Communications & outreach
- Infrastructure Investments (\$1,356 Million)
 - Framework approach
 - Four sectors: Wastewater Industrial pollution Solid waste management; River front development



NGRBA – Lessons Learnt

- A prioritization plan is urgently needed
 - Limited resources have been allocated across five States but not evidence based decision making, and no exclusive focus on “hot spots”
- The central government cannot subsidize *ad infinitum*
 - Clean-up is expensive. Traditional wastewater conveyance systems and treatment are expensive. Adding in re-use and re-cycling is expensive. Transaction costs high
 - Private sector participation and local state and urban revenue generation are essential; their mobilization however, requires policy reforms
- Clean-up cannot be de-coupled from policy making
 - PPPs are contingent on revenue streams. Hard to secure private sector investment in absence of better regulation and realistic pricing of water in cities and industries
- Urban governance reforms are major missing piece
 - GOI can only go so far, and undue reliance on states but limited involvement of ULBs Long-term sustainability at risk despite 10-year DBOs
 - Cannot rely on diverting funds from cities or PPPs. Must establish parallel urban reform agenda, including the devolution of functions, finances and functionaries to cities. Dovetail with Smart Cities program?

Dam Rehabilitation and Improvement Project

- Objective
 - improve the safety and operational performance of 261 dams in Tamil Nadu (105), Kerala (53), Karnataka (27), Madhya Pradesh (50) and Odisha (26)
- Key components
 - Rehabilitation of dams and associated infrastructure
 - Dam instrumentation and monitoring; asset management plans and emergency preparedness plans
 - Institutional strengthening, focusing on regulatory and technical frameworks for dam safety assurance



Andhra Pradesh Water Sector Improvement Project

- Objectives
 - To improve irrigation service delivery on a sustainable basis so as to increase productivity of irrigated agriculture in Nagarjuna Sagar Scheme
 - To strengthen institutional capacity for multi-sectoral planning, development and management of water resources
- Components
 - A: Improving irrigation service delivery and management (US\$752M)
 - B: Irrigated Agriculture Intensification and Diversification (US\$21M)
 - C: Institutional Restructuring and Capacity Building (US\$23M)
 - D: Project management (US\$14M)



AP WSIP – Interventions

- Typical dilapidated canal system and poor water management and unsustainable agriculture production system
 - Participatory rehabilitation & modernization of canals
 - Improved water management practices
 - Agriculture diversification
- Strengthening of institutional capacity
 - Establishing and operationalizing State Water Resources Regulatory Authority
 - Restructuring of I&CADD
 - Strengthening of WALAMTRI
 - Water Users Organizations
 - Computerized Information System

**Primary & Secondary
System Losses =5%**

**Watercourses
Losses = 20%**

**Outlet Losses =
15%**

**Field application
Losses = 25%**

**Overall Irrigation
efficiency = 35%**



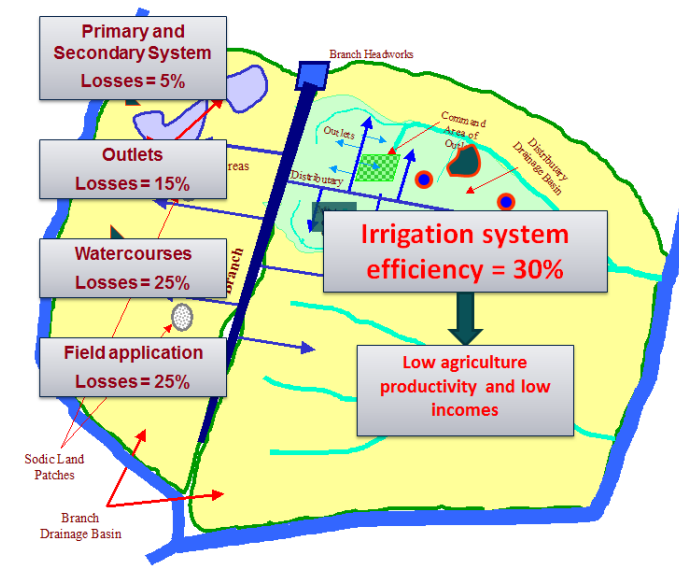
Uttar Pradesh Water Sector Restructuring Project II

- Objectives
 - Assist the GoUP in strengthening its institutional and policy framework for integrated water resources management for the entire State; and
 - Enable farmers in targeted irrigated areas to increase their agricultural productivity and water use efficiency
- Components
 - A: Strengthening of water institutions and inter-sector coordination (\$15M)
 - B: Modernization & rehabilitation of irrigation and drainage systems (\$326M)
 - C: Consolidation and enhancement of irrigation department reforms (\$42M)
 - D: Enhancing agriculture productivity (\$32M):
 - E: Feasibility studies and activities for Phase III (\$5M):
 - F: Project coordination and monitoring (\$15M)



UP WSRP – Interventions

- Typical low productivity agricultural system
 - Modernization and rehabilitation of irrigation and drainage systems
 - Participatory rehabilitation & modernization of canals
 - Improved water management practices
 - Agriculture diversification
- Strengthening of water institutions – IWRM knowledge base and analytical capacity
 - Integrated water resources information system by State Water Resources Agency
 - Strategic river basin assessments and basin planning
 - Study on climate change impacts on water resources
 - Flood management information system



South Asia Water Initiative

- Strategic Basin Planning in India
 - Three sub-components
 - Participatory river basin modelling for scenario-based planning
 - Surface-groundwater interactions
 - Environmental flow assessments
 - Link to and support preparation and implementation of relevant Bank projects in the Ganga (river clean-up, IWRM, irrigation management, water monitoring and modelling, navigation, flood management)
 - Integrate data and knowledge from across projects into single analytical framework
- National and basin level dialogue processes to cross-connect
- Supported by regional capacity program and regional dialogue

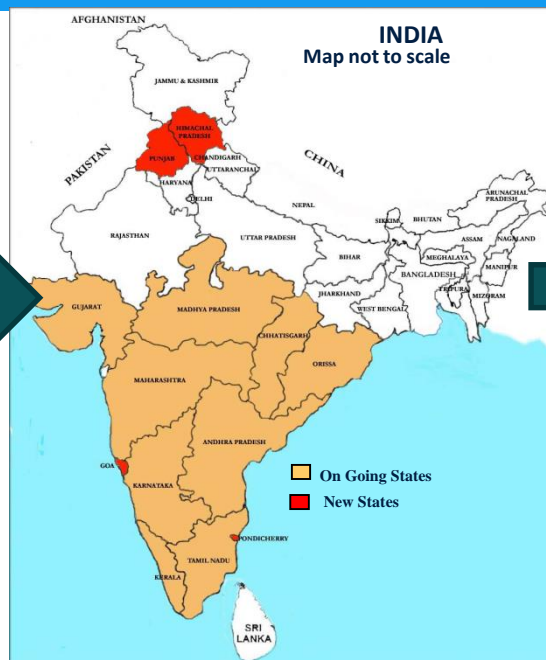
NHP - Journey

HP-I (1995-2003)



- 9 States; 6 Central Agencies
- Manual Data Collection
- Desktop data management
- Data collection & management

HP-II (2006-2014)



- 13 States; 8 Central Agencies
- Real Time Data Acquisition
- Web-based data management
- Data Collection, management & analysis (pilot basis)

National Hydrology Project



- Pan-India; 10 Central Agencies
- Standardization of RTDAS at national level
- Web-based National Database – IndiaWRIS
- Institutionalization of data collection, management and analysis/ modelling at Pan-India scale

HP-II (2006-2014)

- Development of RTDAS in 3 states
- Development of web-based databased management system
- Real Time Flood Forecasting and Decision Support System.
 - Piloted in 2 basins (Krishna - Bhima & Bhakra-Beas Basins)
 - Flood modelling coupled with climate forecast
 - Use of MIKE11
- Decision Support System for water resources planning
 - Piloted in 9 states/ basins
 - Use of MIKE BASIN/ MIKE HYDRO



National Hydrology Project

Institutionalization of Water Resources Modelling in India

- Development of RTDAS on Pan-India scale
- Development of National Water Informatics Centre (NWIC) and IndiaWRIS
- Standardization of modeling tools (National level Committee constituted under MoWR to take action in this regard)
- Development of data sharing protocol for different agencies and inter-state basins
- Real Time Flood Forecasting and Decision Support System for all major river basins in India including development of Integrated Flood Control Centre
- Water Resources Assessment and Planning for all 20 River basins of India.
- Exploring the use of open/ non-licensed software including HEC, WEAP etc
- International collaboration (NCAR, RIMES, BOM etc) for climate forecast
- Development of Centre of excellence for modelling and WRM.



Better Basin Planning and Operational Decisions in Water Management

D. Institutional Capacity Enhancement



Centre of Excellence

Collaboration with National/ International Institutes

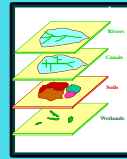


Capacity Building

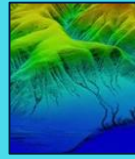


Outreach and Awareness

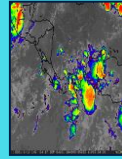
B: Water Resources Information System



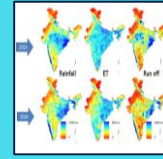
GIS Layers



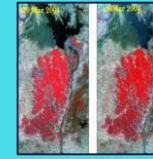
High Resolution DEM



Weather Forecast



Generic Hydrological Products



Remote Sense Imageries



A: Water Resources Data Acquisition System



Meteorological Monitoring



River/Reservoir Monitoring



Groundwater Monitoring



Water Quality Monitoring



SCADA for canal/ reservoir

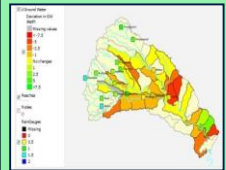


Community monitoring/ crowd sourcing

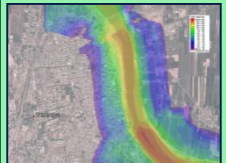


State Data Centers

C: Water Resources Operation and Planning System



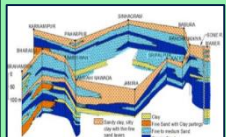
River Basin Planning



Flood



Reservoir



Groundwater Assessment



Irrigation management

Flood prone Area in India



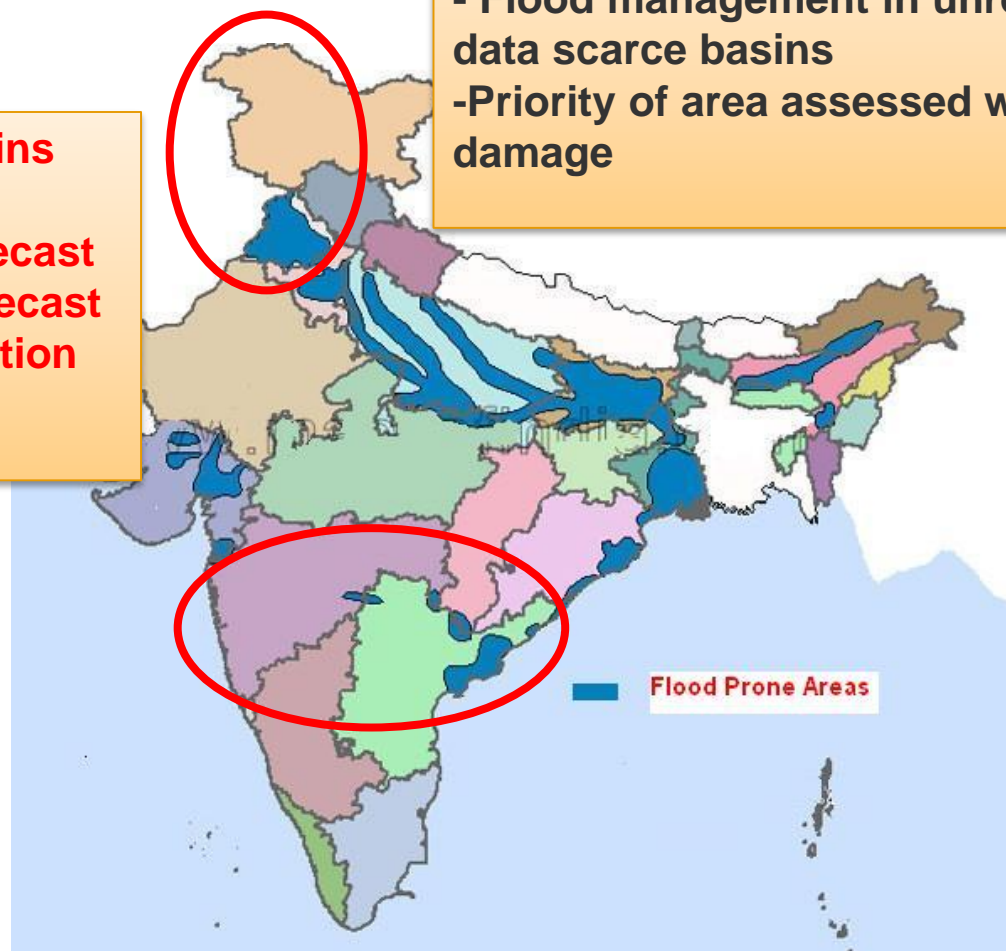
WORLD BANK GROUP

Ganga-Brahmaputra

- Flood management in unregulated and data scarce basins
- Priority of area assessed with flood damage

Bhakra and Krishna Basins

- Regulated basin
- First time streamflow forecast linked with the weather forecast and real time data acquisition systems



Existing forecast system in Central water commission is based on upstream water level in the streams

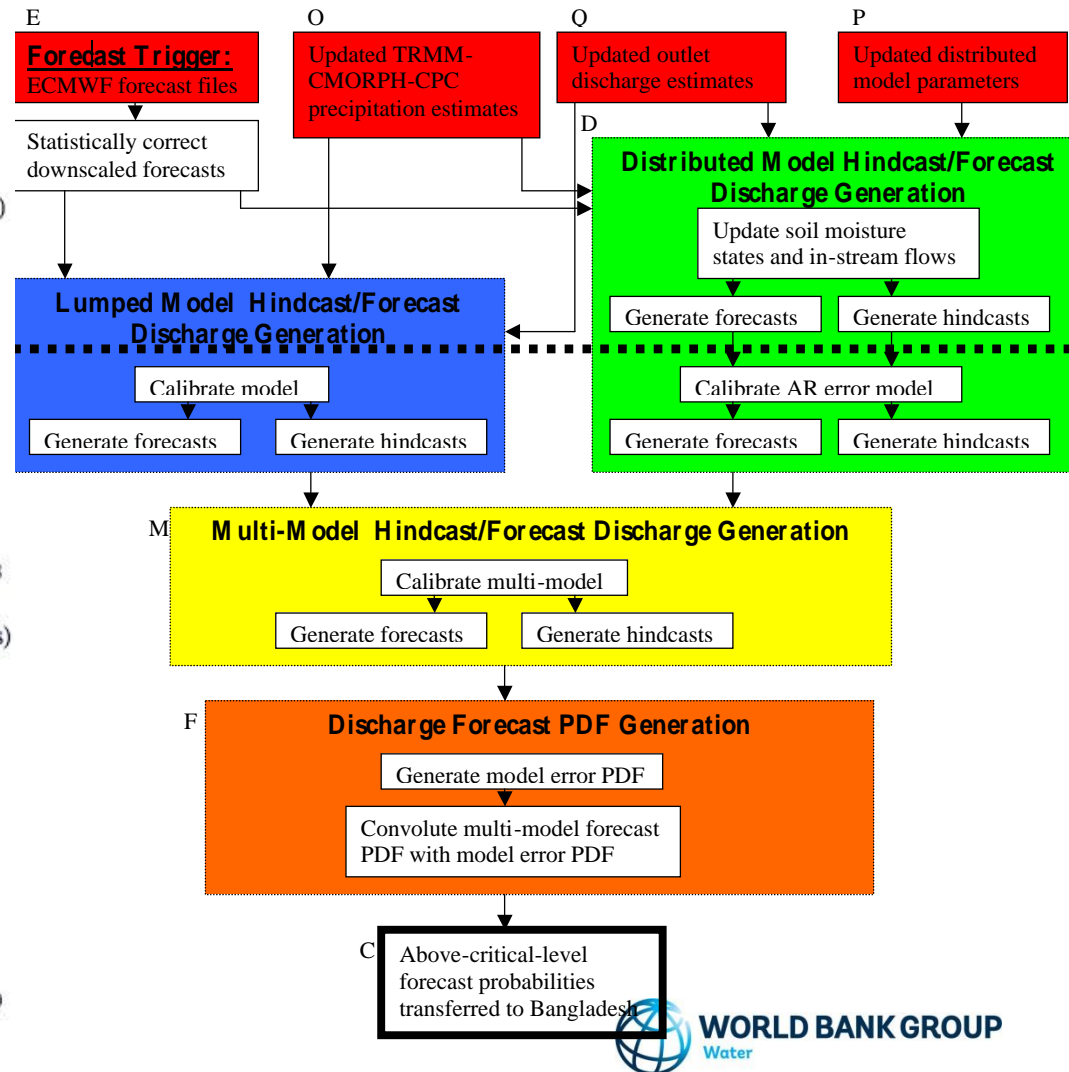
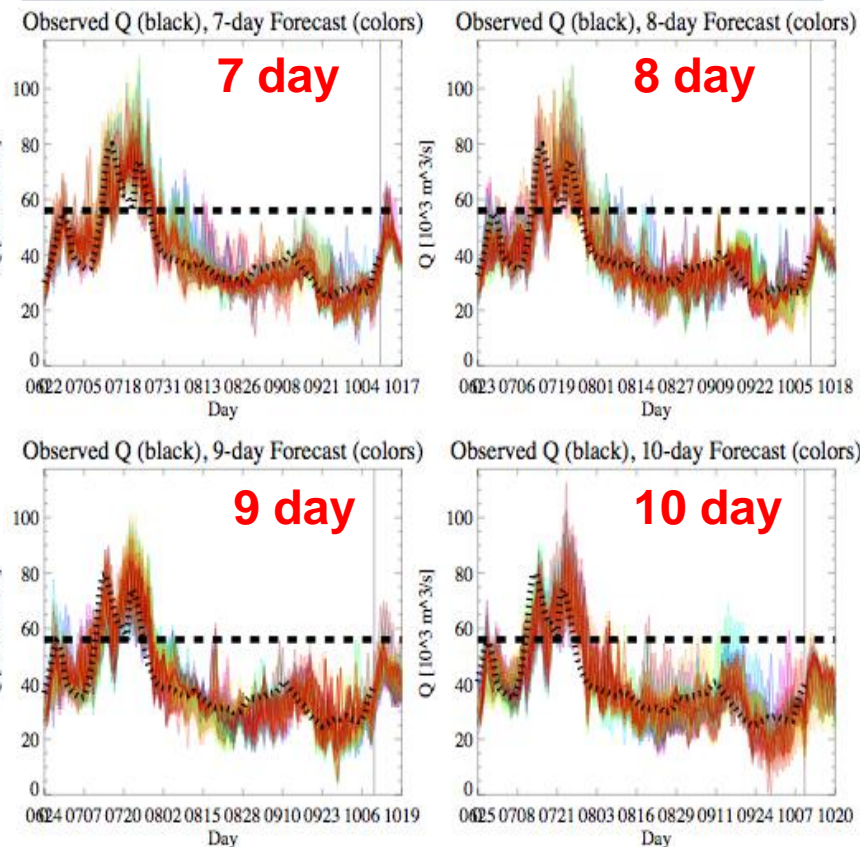
World Bank Initiatives



WORLD BANK GROUP

Ensemble forecast in Brahmaputra in collaboration with NCAR

Brahmaputra Discharge Forecast Ensembles



WORLD BANK GROUP

Ongoing vision

- **Build the information base to support evidence-based planning and management at Basin scale.**
- **Progress legislative reforms to enable empowered RBOs and appropriate water entitlement system**
- **Incentivize water use efficiency in all sectors**
- **Focus government efforts on ensuring social and environment benefits are protected**
- **Continue the shift in focus from new infrastructure to improved management**
- **Shift the flood management focus from protection to improved forecasting and warnings, and floodplain zoning**
- **More effort required to understand regional scale climate change risks to water resources and build system resilience**

Thank You



WORLD BANK GROUP
Water

www.worldbank.org/water | www.blogs.worldbank.org/water |  @WorldBankWater