Water Governance:

State Water Budgeting

For Water Security, Safety & Sustainability

Dr.M.Ariz Ahammed IAS
Mission Director
National Water Mission
Ministry of Water Resources, River Development & Ganga Rejuvenation

NWM -Mandate

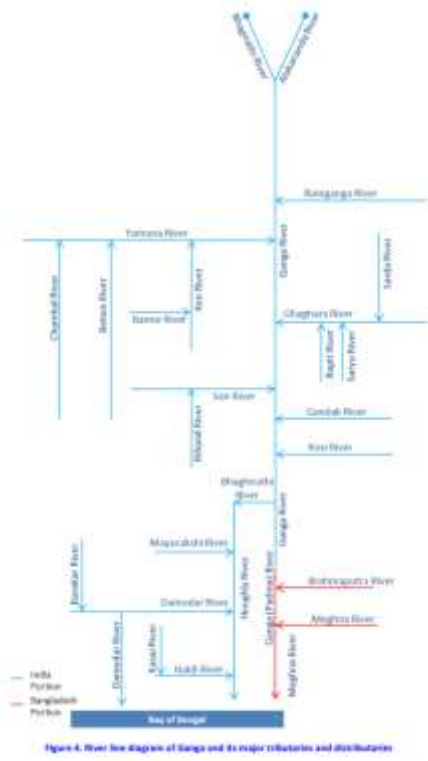
Constituted as a strategy to adapt to and to mitigate the effects of Climate Change under -National Action Plan on Climate Change.

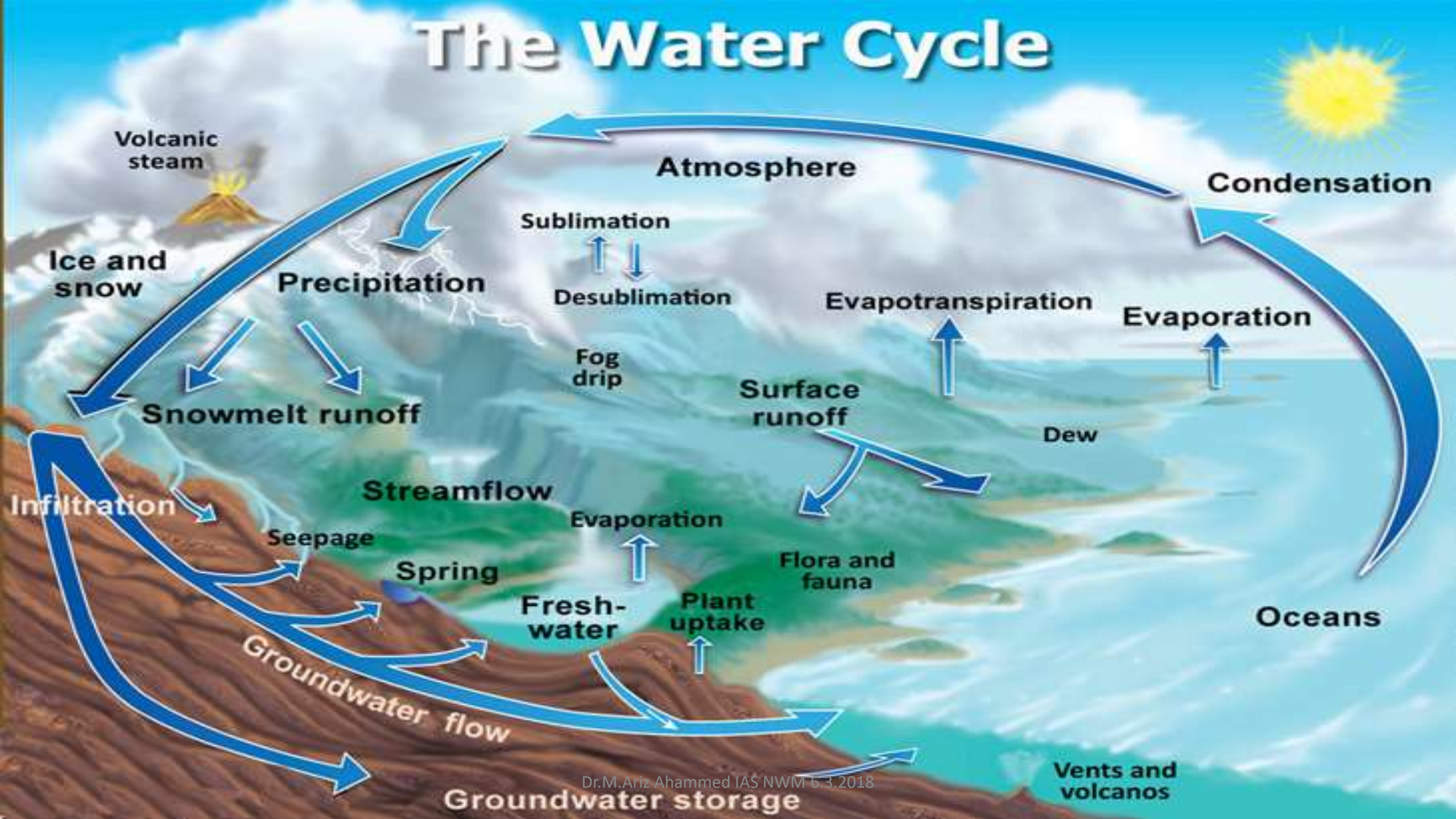
Some of possible implications of climate change on water resources

- Decline in the glaciers & snowfields in the Himalayas and rise of sea levels;
- Increased drought like situations due to overall decrease in the number of rainy days;
- Increased flood events due to overall increase in the rainy day intensity;
- Effect on groundwater quality in alluvial aquifers due to increased flood and drought events;
- Influence on groundwater recharge due to changes in precipitation and evapo-transpiration; and
- Increased saline intrusion of coastal & island aquifers due to rising sea levels

Personal Journey of ignorance: Water # Irrigation

- 2012 State Specific Action Plan on Water
- 2015 Fund flow
- 2017 June National Workshop
- 2017 October National Consultation



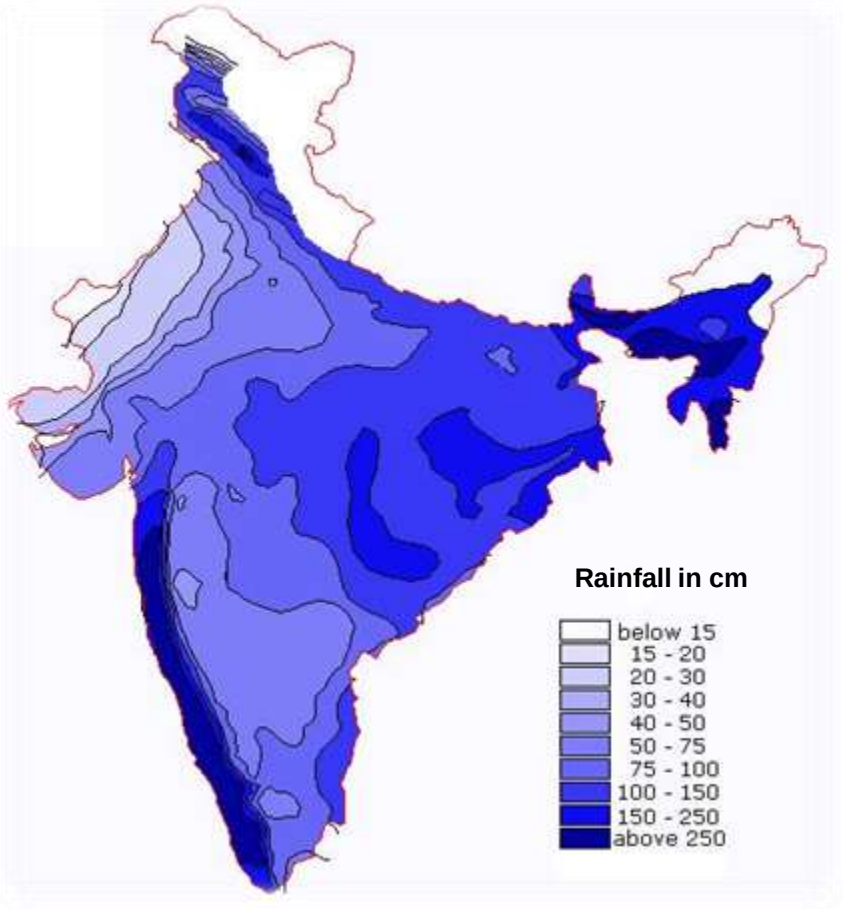


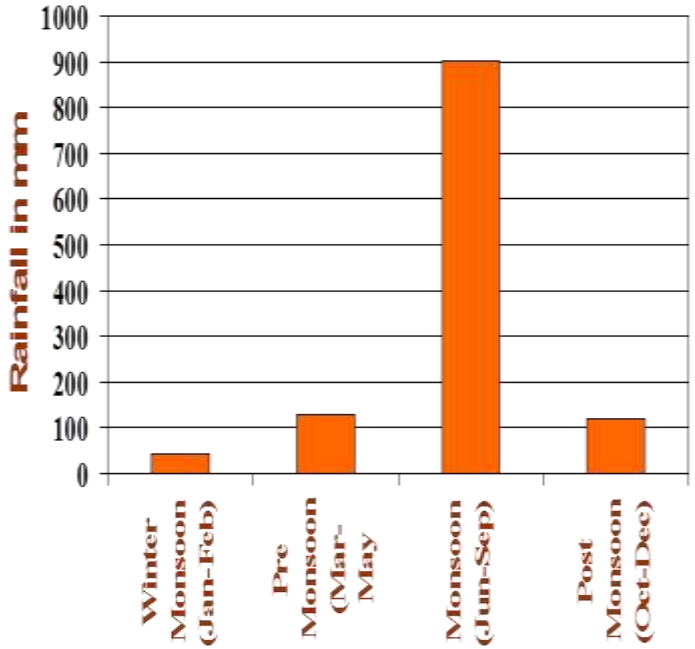
Dr.M.Ariz Ahammed IAS NWM 6.3.2018

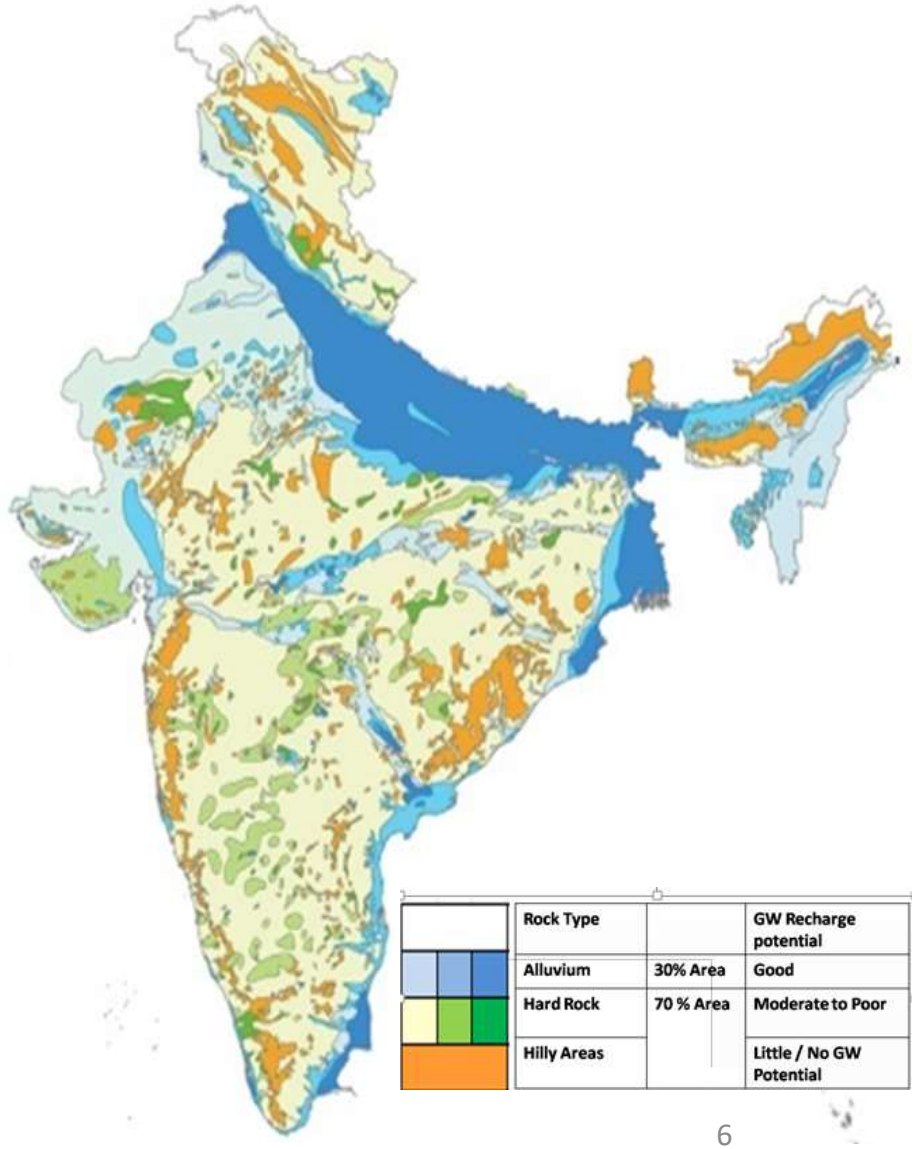
Water Dimensions

Supply/Source side	Demand/ Consumption side
1. Climate- Precipitation	1. Forestry & Wildlife
2. Glaciers	2. Farm Sector
3. Springs	a. Agri-Horticulture-Irrigated and Rainfed
4. River Basins	b. Livestock, Birds and others
5. Projects-Storage/ Irrigation/ Multi-purpose	c. Fisheries and others
6. Wetlands	3. Industry and Infrastructure
7. Tanks	a. Thermal Power Plants/
8. Coastal zone	b. Textiles and Jute
9. Ground Water Resources	c. Paper and Pulp
10. Waste Water	d. Iron and Steel
	e. Others
	4. Establishments & Institutions- Education, Health etc.
	5. Drinking Water and Domestic use -Rural & Urban

Annual Rainfall (Spatial & Temporal variability), Geomorphology & GW Recharge Potential







Water Governance-National Perspective

State List- entry 17 of List-II subject to the provision of Entry 56 of List-I i.e. Union List.

Entry 17 of List II (State List): "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to provisions of entry 56 of List I."

Entry 56 of List I (Union List):**"Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest."**

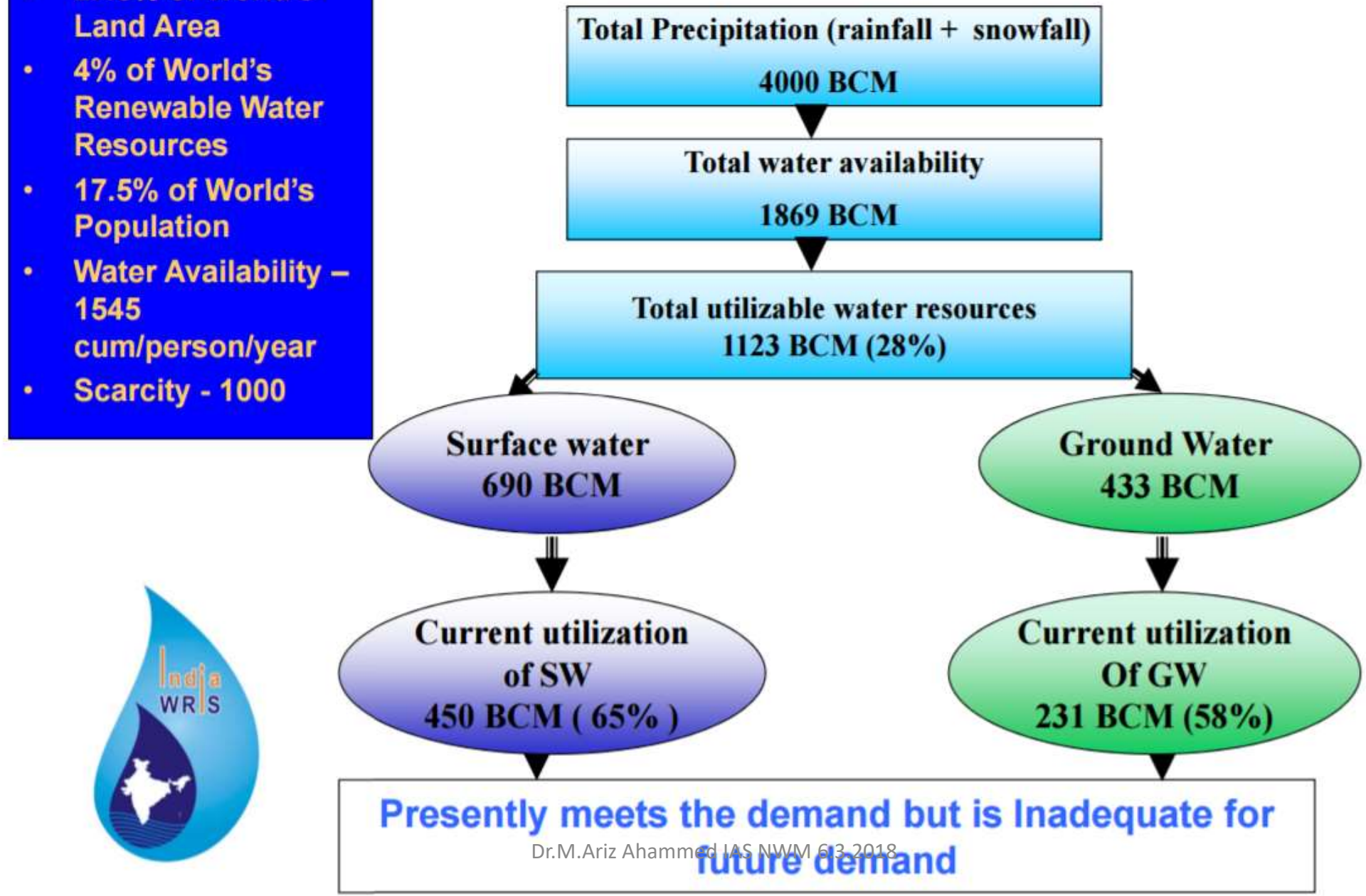
River Boards Act, 1956 (Under Art.246, List 1, Entry 56)

Art.262. Adjudication of disputes relating to waters of inter-State rivers or river valleys

Inter State Water Disputes Act, 1956 –provides for setting up of Tribunals

Water Resources Scenario - INDIA

- 2.45% of World's Land Area
- 4% of World's Renewable Water Resources
- 17.5% of World's Population
- Water Availability – 1545 cum/person/year
- Scarcity - 1000



Future Water Demand Scenario

Projected Water Demand in India (By Different Use)									
Sector	Water Demand in BCM(Billion Cubic Meter)								
	Standing Sub-Committee of MOWR			NCIWRD					
	2010	2025	2050	2010		2025		2050	
				Low	High	Low	High	Low	High
Irrigation	688	910	1072	543	557	561	611	628	807
Drinking Water	56	73	102	42	43	55	62	90	111
Industry	12	23	63	37	37	67	67	81	81
Energy	5	15	130	18	19	31	33	63	70
Other	52	72	80	54	54	70	70	111	111
Total	**813**	**1093**	**1447**	**694**	**710**	**784**	**843**	**973**	**1180**

Source: Basin Planning Directorate, CWC, XI Plan Document.
Report of the Standing Sub-Committee on "Assessment of Availability & requirement of Water for Diverse uses-2000"

Note: NCIWRD: National Commission on Integrated Water Resources Development *Report of the NCIWRDP (1999)*
BCM: Billion Cubic Meters
MOWR: Ministry of Water Resourses.

Source: National Commission for Integrated Water Resources Development (NCIWRD-1999)

- If current trends continue, in 20 years about 60% of India's aquifers will be in a critical condition (World Bank, 2012)

  (http://www.worldbank.org/en/news/feature/2012/03/06/india-groundwater-critical-diminishing)
- The International Water Management Institute (IWMI) Water Scarcity Study reveals that, by 2025 one-third of the populations of India (280 million people) live in regions that will face absolute water scarcity.
- 2030 Water Resource Group estimated that by 2030, demand in **India** will grow to almost 1.5 trillion m^3 against current water supply of approximately 740 billion m^3 with likely severe deficit unless concerted action is taken (2009)

  (https://www.2030wrg.org/team/charting-our-water-future/)

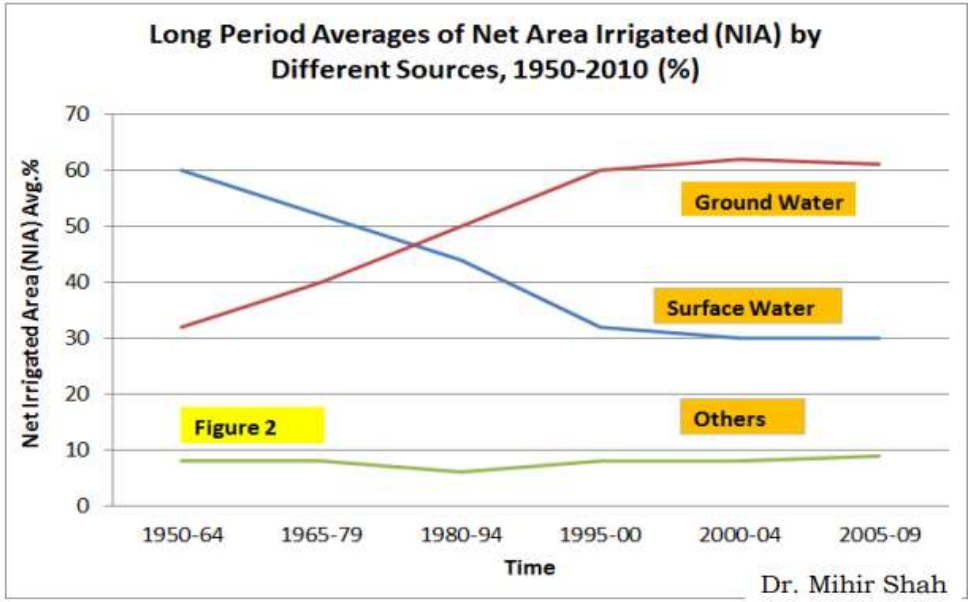
Importance of Ground & Surface water

Ground water accounts for

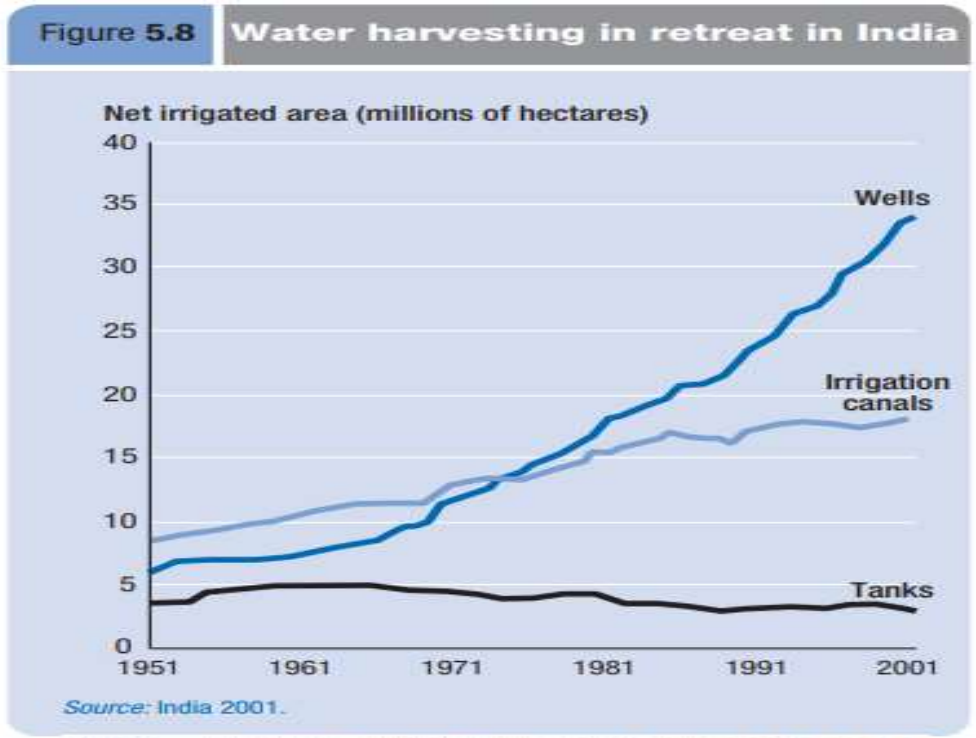
- **60 % of irrigation needs**
- **85% of rural drinking water needs**
- **50% of urban water needs**
- **Last 40 years – GW contributed more than 80 % in increasing Net Irrigated area**
- **Contributes about 9 % to GDP**
- **Since 1975 , Indian Agriculture has emerged as worlds largest user of ground water to grow food and fiber.**

Sustainability is major Challenge

Can we sustain this level of Utilization of G



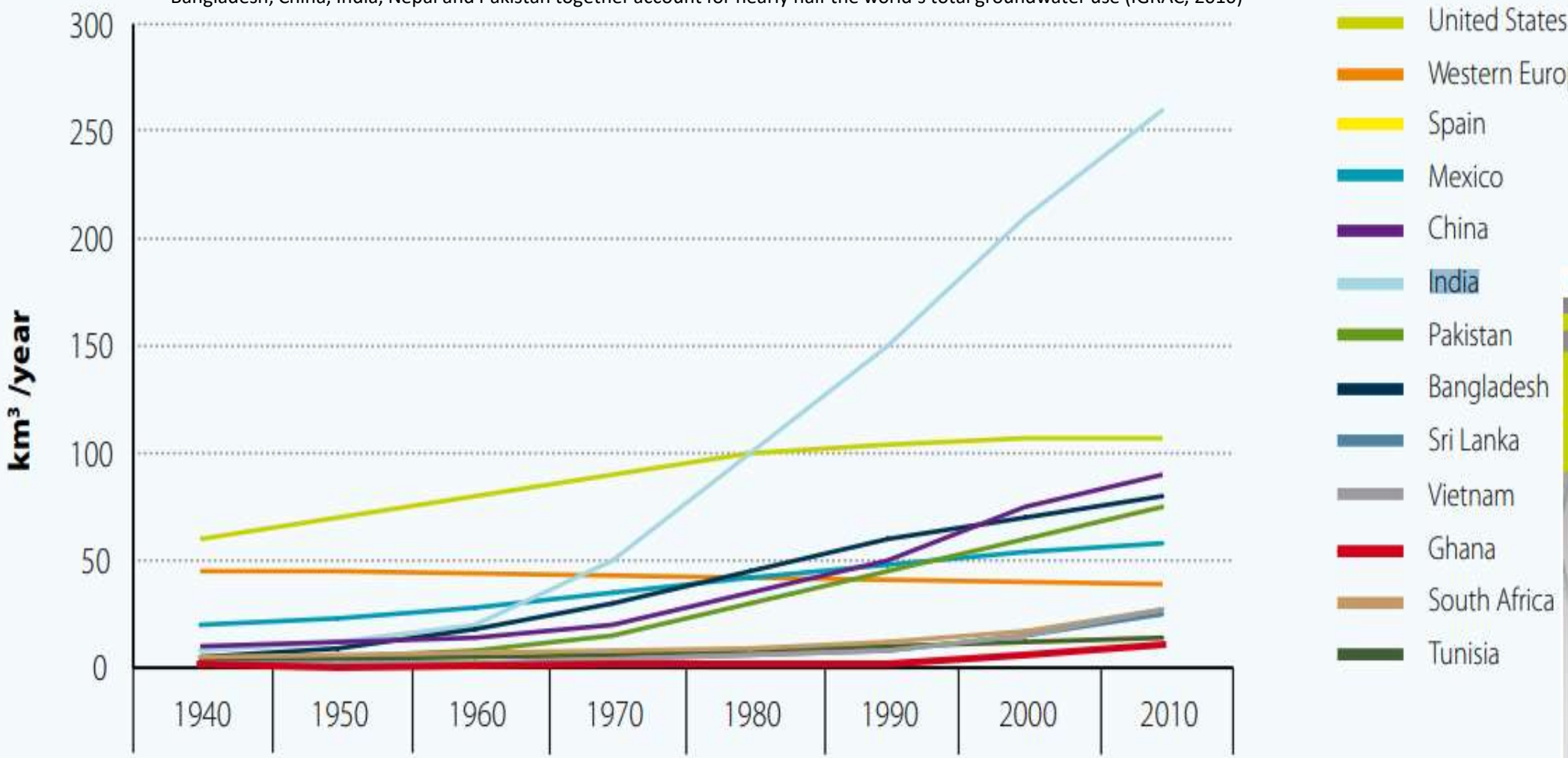
Dr. Mihir Shah
26th July 2016



Dr.M.Arz Mahmed IAS AWM 8.3.2018

Growth in agricultural groundwater use in selected countries, 1940–2010

Bangladesh, China, India, Nepal and Pakistan together account for nearly half the world's total groundwater use (IGRAC, 2010)



Source: Shah (2005). Reproduced from Figure 1 "Growth in groundwater use in selected countries: 1940-2010". Groundwater and Human Development: Challenges and Opportunities in Livelihoods and Environment. Water, Science & Technology 51 (8): 27-37 with permission from the copyright holders, IWA Publishing.

http://www.unwater.org/publications/world-water-development-report-2015/

55% of Surveyed Industries are using groundwater.

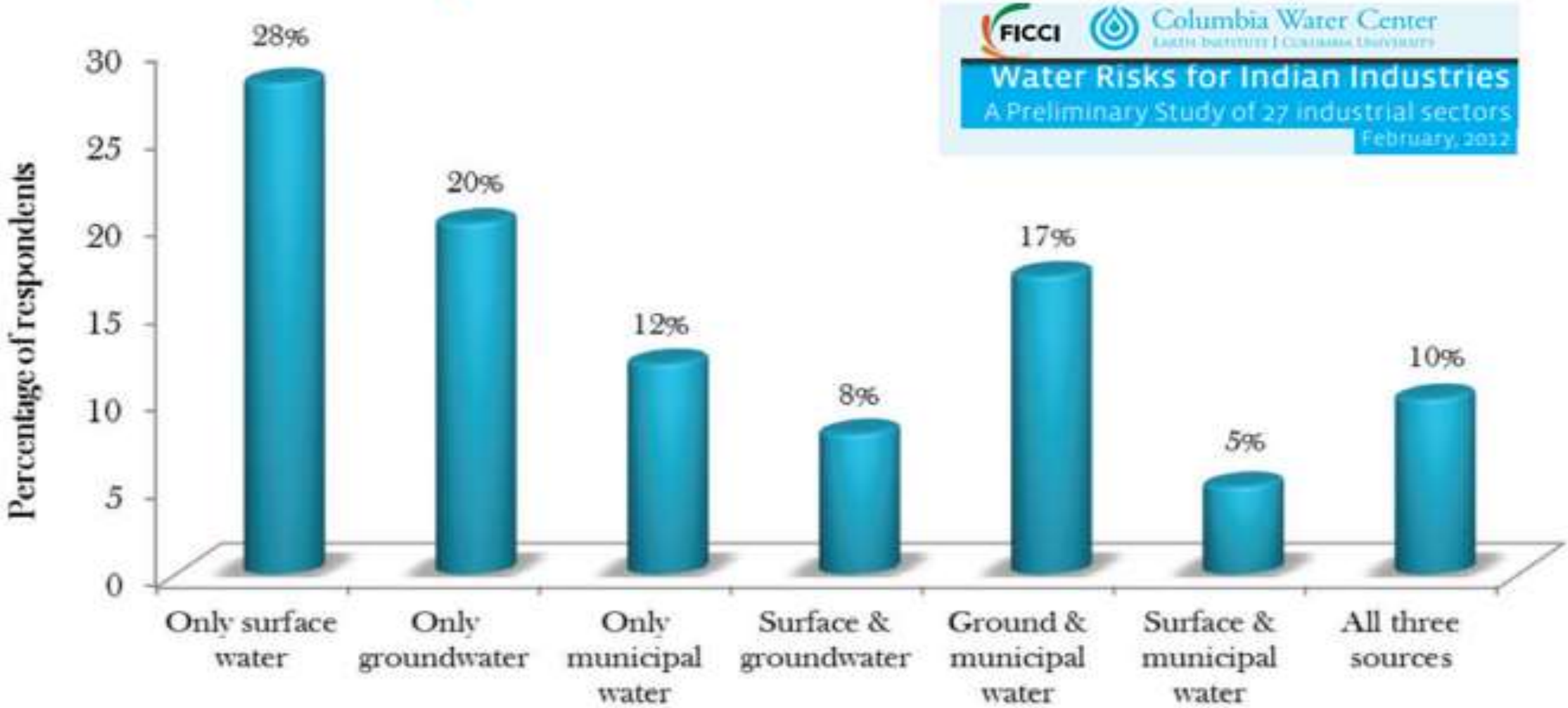


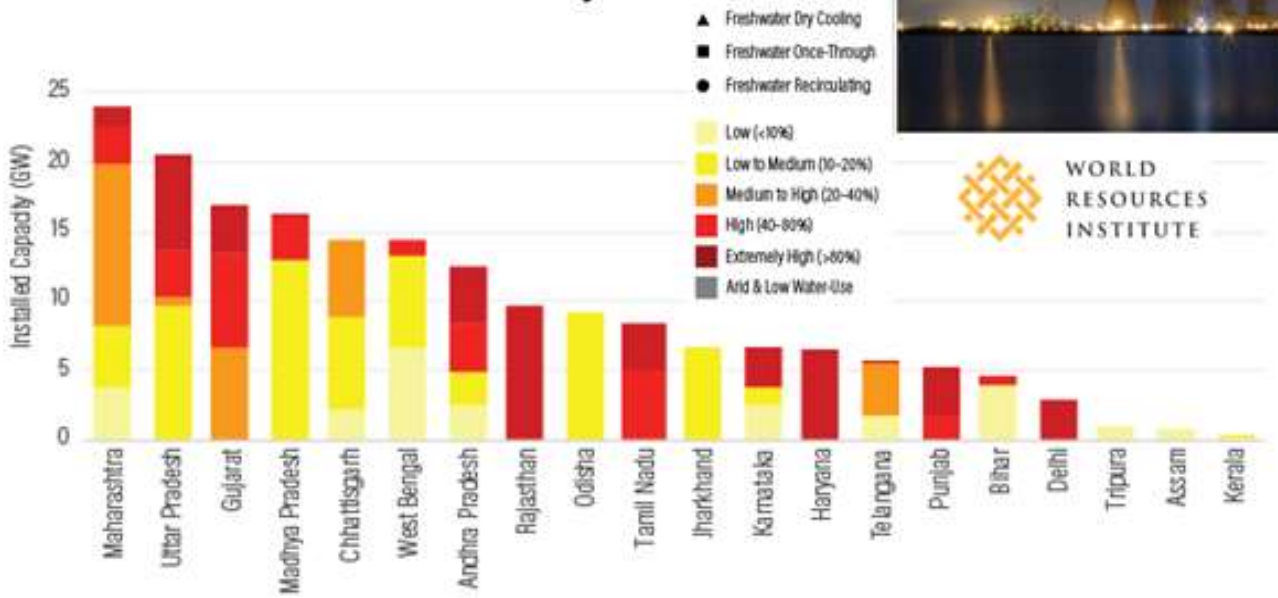
Figure 2: Source of water for industrial uses

http://water.columbia.edu/files/2012/06/FICCI_CWC_IndiaWaterCrisisPaper.pdf

40% of India's Thermal Power Plants Are in Water-Scarce Areas, Threatening Shutdowns

by  Tianyi Luo - January 16, 2018

Water Stress and Power Plants by State



WORLD RESOURCES INSTITUTE

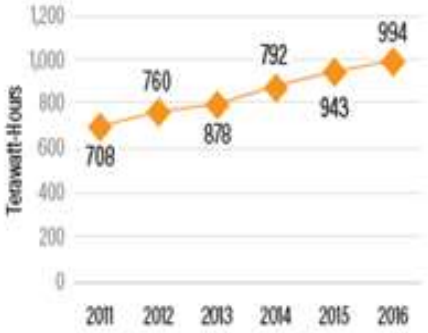
Thermal power—power that relies on fuels like coal, natural gas and nuclear energy—provides India with 83 percent of its total electricity.

14 of India's 20 largest thermal utilities experienced at least one shutdown due to water shortages between 2013-2016, costing the companies $1.4 billion.

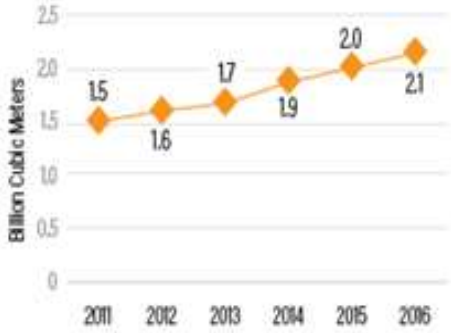
Almost 90 percent of India's thermal power generation depends on freshwater for cooling.

India's Annual Thermal Utility Generation and Freshwater Consumption between 2011 and 2016

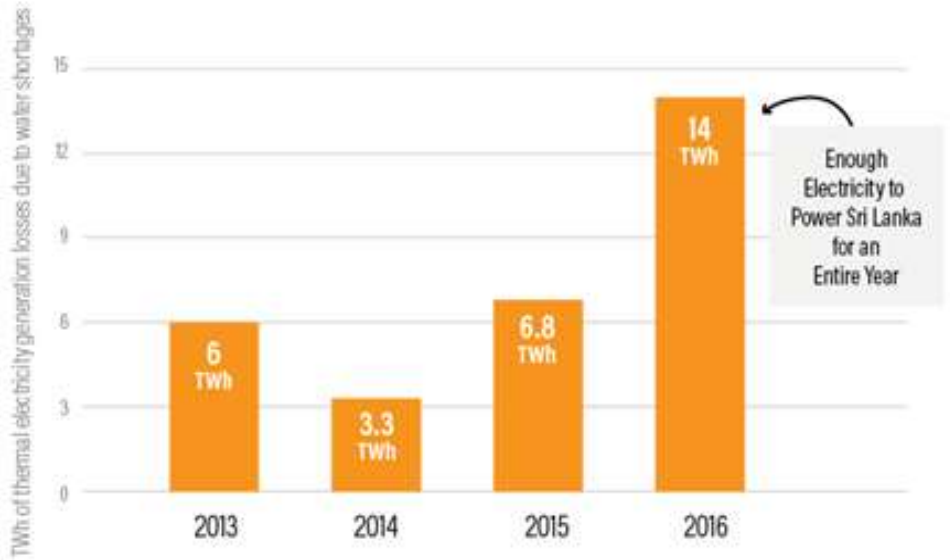
Thermal utility generation grew by 40% between 2011 and 2016



Freshwater consumption increased by 43% between 2011 and 2016



Over the last 4 years, water shortages cost India's thermal power plants 30 TWh in potential electricity generation



http://www.wri.org/blog/2018/01/40-indias-thermal-power-plants-are-water-scarce-areas-threatening-shutdowns

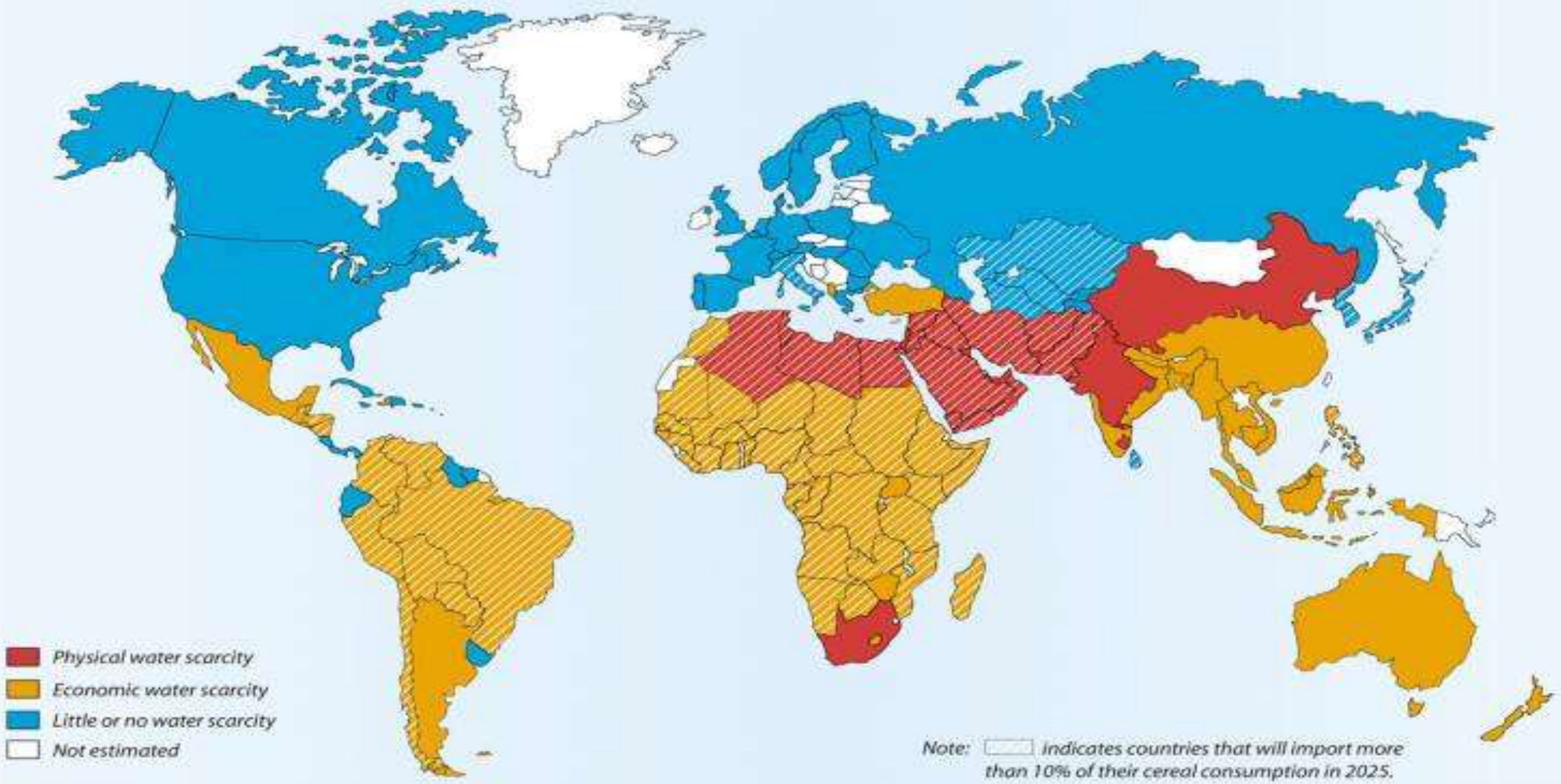
Sources: WRI analysis; CEA 2017; Ceylon Electricity Board 2015; Platts 2017 WORLD RESOURCES INSTITUTE

The 15 nations with the largest estimated annual groundwater extractions (2010)[7] are:

Country	Population 2010 (in thousands)	Groundwater extraction			
		Estimated groundwater extraction 2010 (km^3/yr)	Breakdown by sector		
			Groundwater extraction for irrigation (%)	Groundwater extraction for domestic use (%)	Groundwater extraction for industry (%)
India	1224614	251.00	89	9	2
China	1341335	111.95	54	20	26
United States	310384	111.70	71	23	6
Pakistan	173593	64.82	94	6	0
Iran	73974	63.40	87	11	2
Bangladesh	148692	30.21	86	13	1
Mexico	113423	29.45	72	22	6
Saudi Arabia	27448	24.24	92	5	3
Indonesia	239871	14.93	2	93	5
Turkey	72752	13.22	60	32	8
Russia	142985	11.62	3	79	18
Syria	20411	11.29	90	5	5
Japan	126536	10.94	23	29	48
Thailand	69122	10.74	14	60	26
Italy	60551	10.40	67	23	10

Source: NGWA: http://www.ngwa.org/Fundamentals/Documents/global-groundwater-use-fact-sheet.pdf

Projected Water Scarcity in 2025

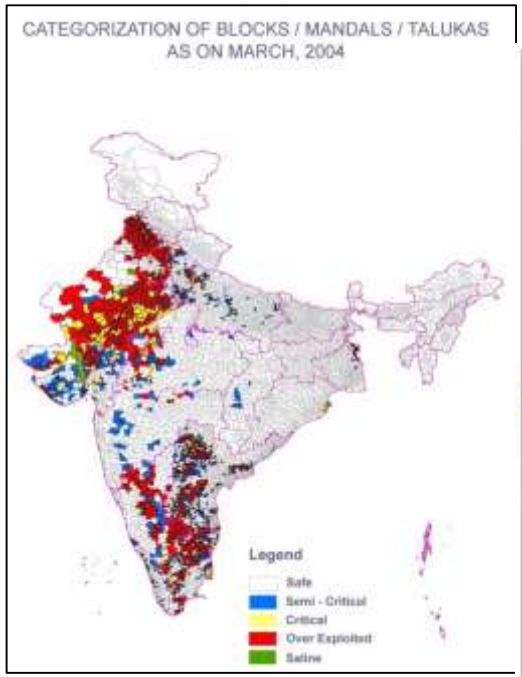


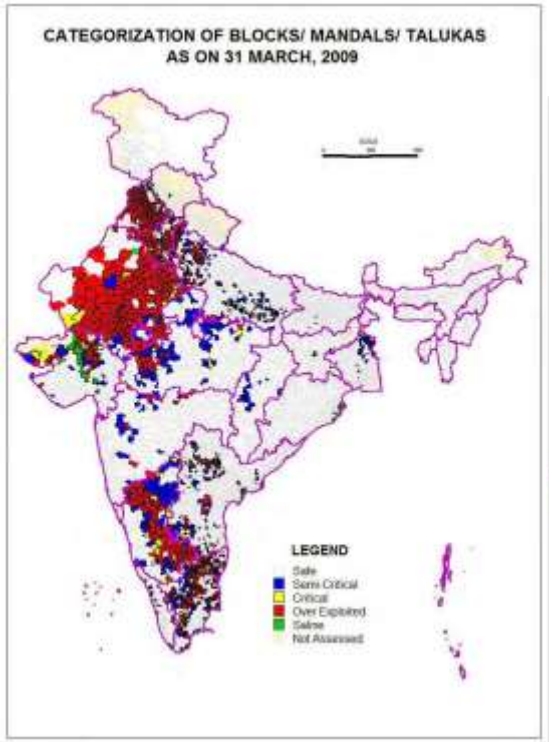
IWMI
INTERNATIONAL WATER MANAGEMENT INSTITUTE

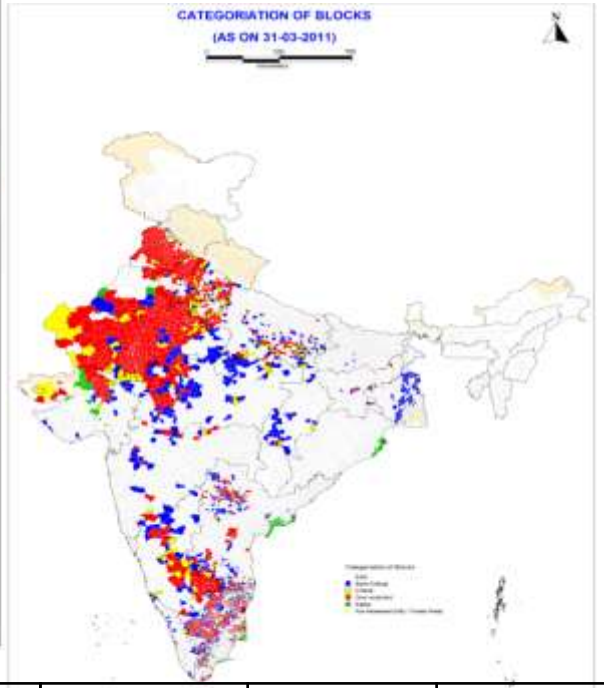
Prepared by IWMI as input for the World Water Vision, The Hague, March, 2000.

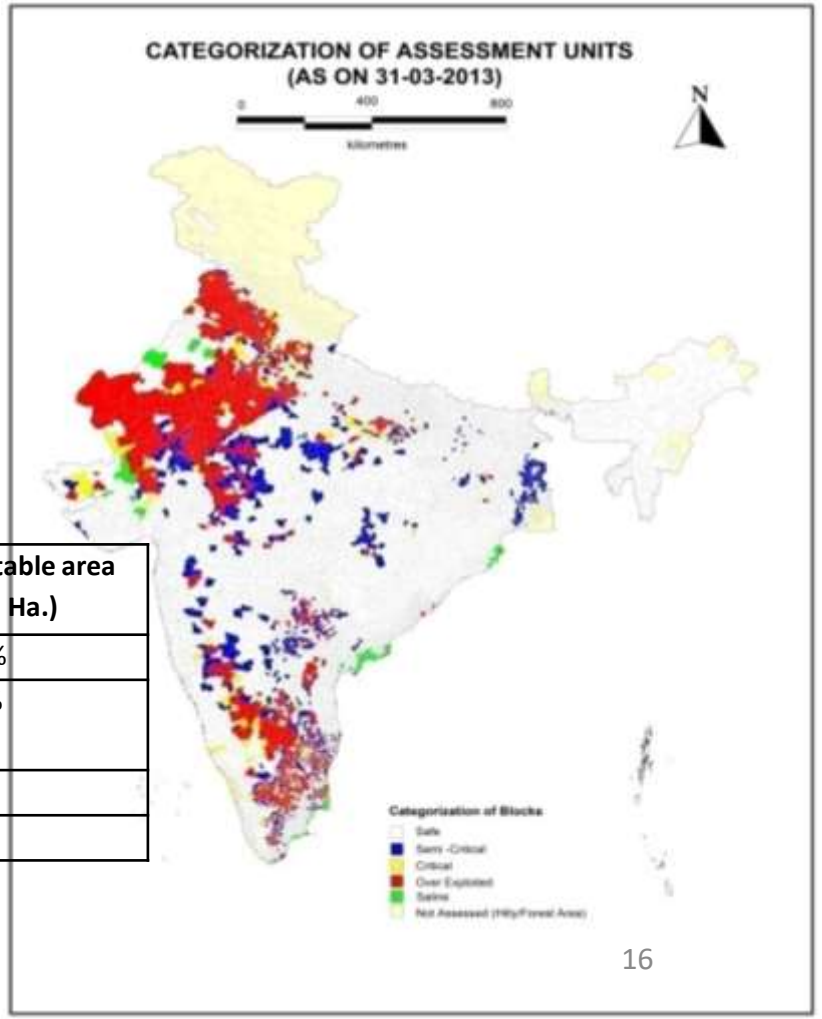
http://iwmi.org

Ground Water: Over Exploitation: 2004-2013









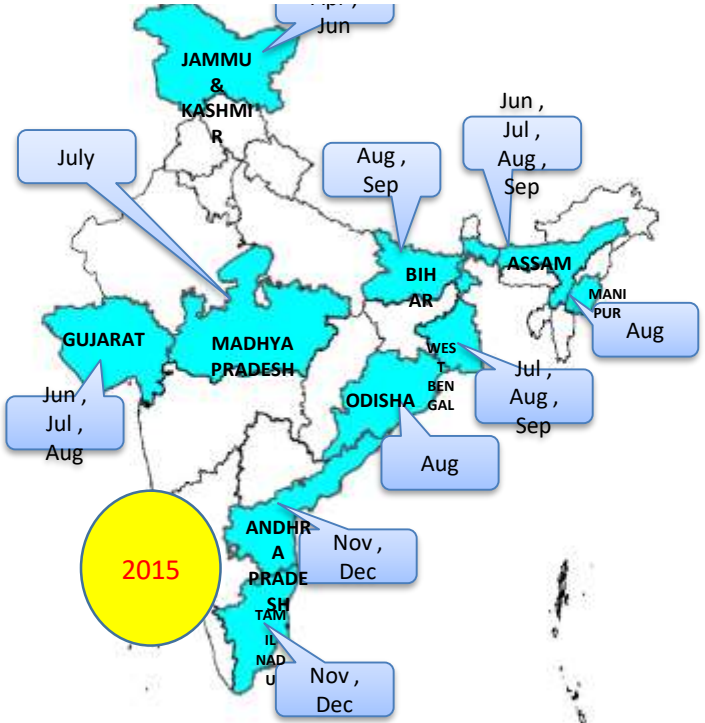
Water Status	Year wise total number of Blocks / Units in the country			
	2004	2009	2011	2013
Over exploited	839	802	1071	1034
Critical	226	169	217	253
Semi-Critical	550	523	697	681
Saline	30	71	92	96

	Lakh Sq.Km	% GW exploitable area (23 Lakh Ha.)
Over Exploited	410605.5	17 %
Critical	85149.72	14%
Semi-critical	243737.45	
Saline	21114.84	
	760607.51	

NREGS Expenditure in Water related works in Crores (Source: Dept.of RD)

2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
533	3047	5158	6360	10640	13453	13345	13156	15749	23635	21165

STATEWISE FLOOD INUNDATED AREA STATISTICS FOR 2017
Source: NRSC



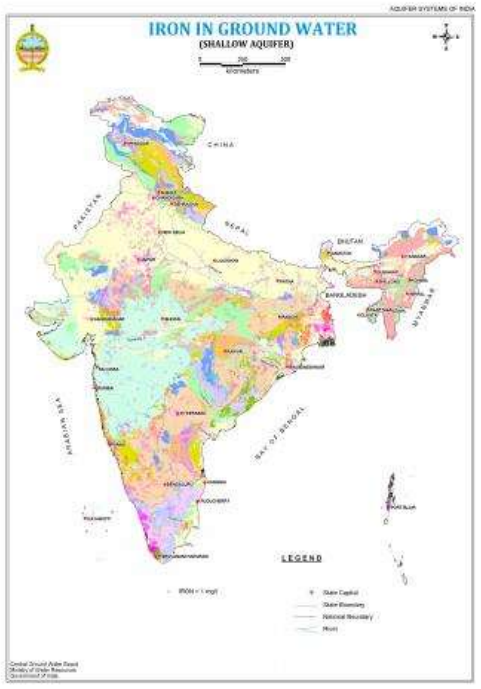
State	2010	2015	2017
Andhra Pradesh	200372	238357	
Arunachal Pradesh			3841
Assam	336597	720450	1164200
Bihar	319357	149552	866643
Chattisgarh	8800		
Delhi	3192		
Gujarat		80151	96686
Jammu & Kashmir		17726.7	
Madhya Pradesh		7708.45	
Manipur	5183	20321.3	82545
Odisha		53431.5	38320
Punjab & Haryana	266201		
State	2010	2015	2017
Tamilnadu		181732	
Tripura	1261		
Uttar Pradesh	574635		285084
Uttarakhand	1708		
West Bengal	3074	286247	445010
	1724400	1759706.95	2984346

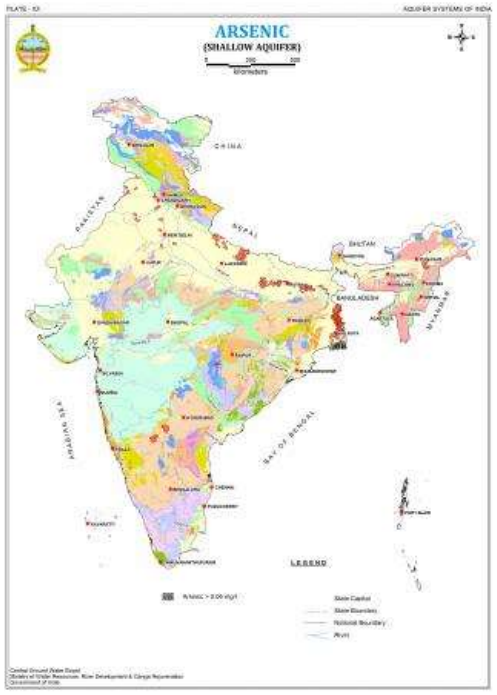
Flood Damage Data Period(India): 1953-2016 Source: CWC (2018)					
Area Affected (mha)		Affected Population (million)		Total Damages (in Crores)	
Average	Maximum	Average	Maximum	Average	Maximum
7.2	17.5 (in 1978)	31.88	70.45 (in 1978)	5432	57394 (in 2015)

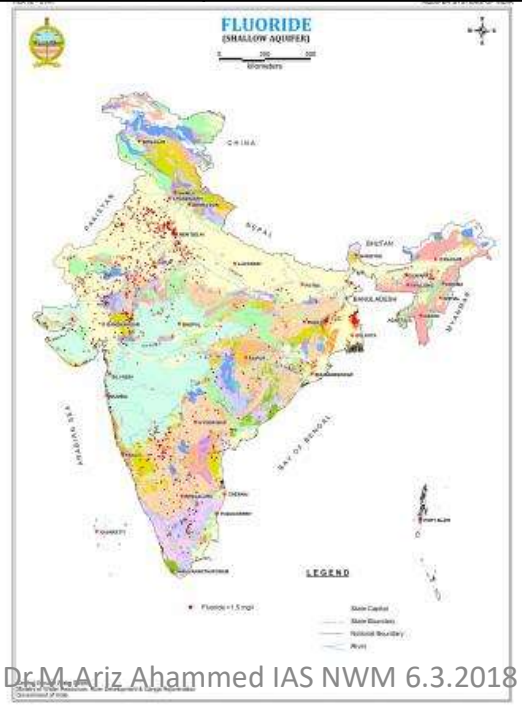
Water Quality challenges (Chemical)

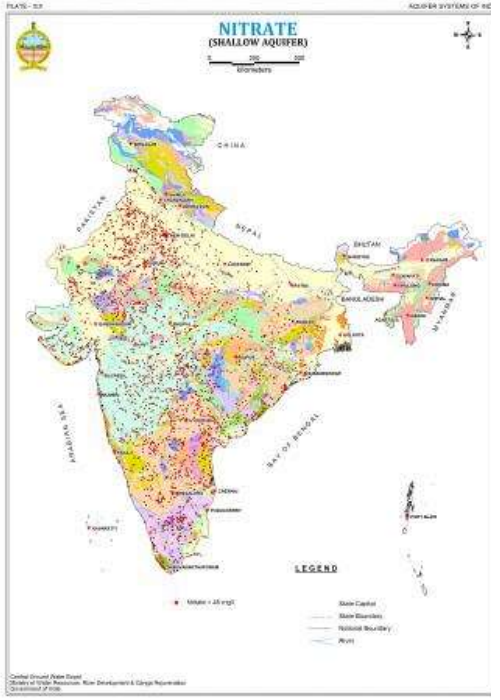
Source: HDR, 2006 + CGWB

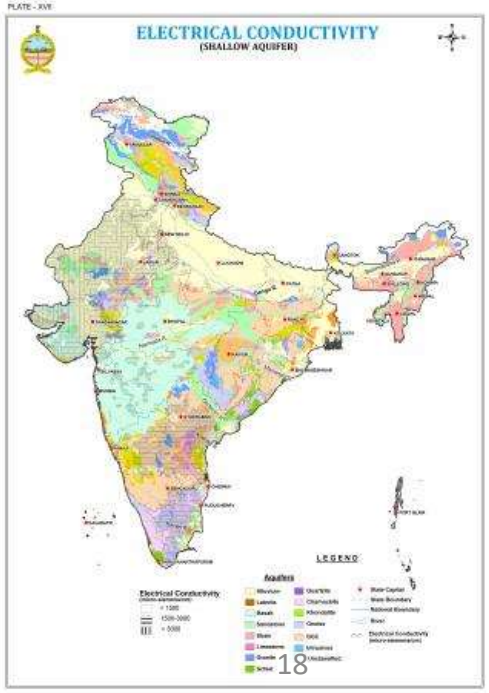
	Number of Districts affected			
	2000	2005	2010	2015
Fe	Not monitored annually			303
Arsenic	Not monitored annually			153
Fluoride	151	145	169	193
Nitrate	267	259	262	339





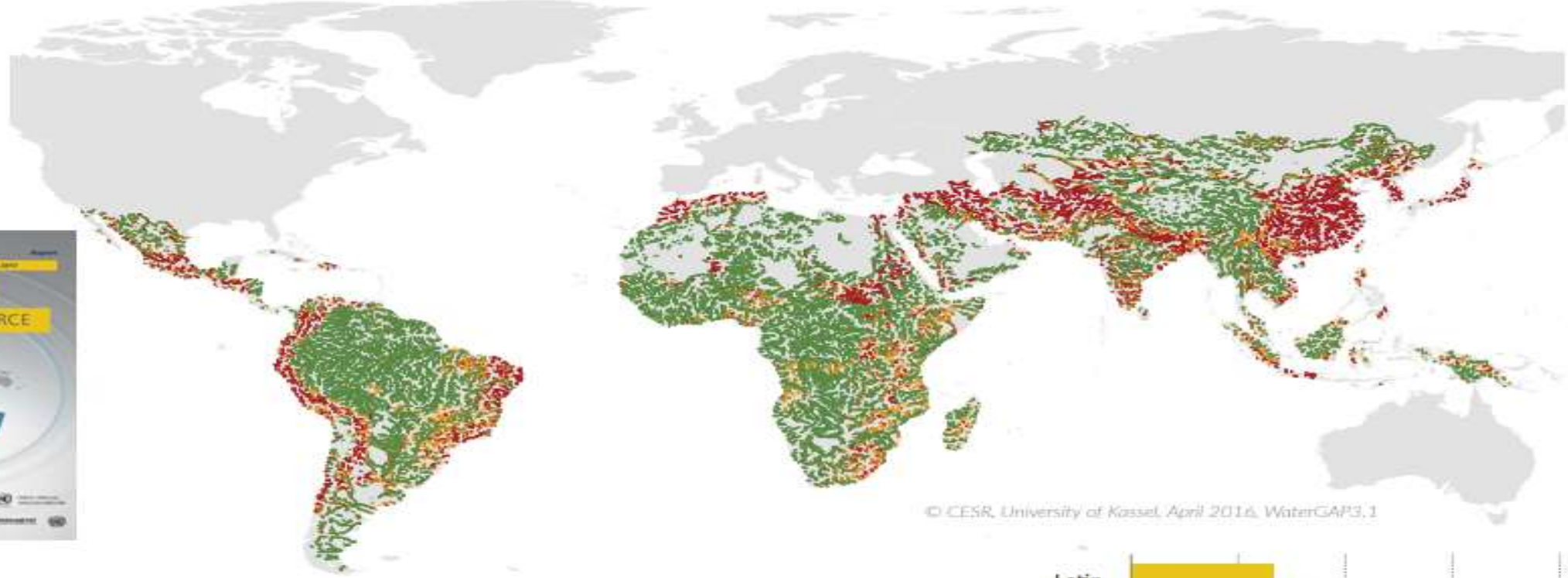






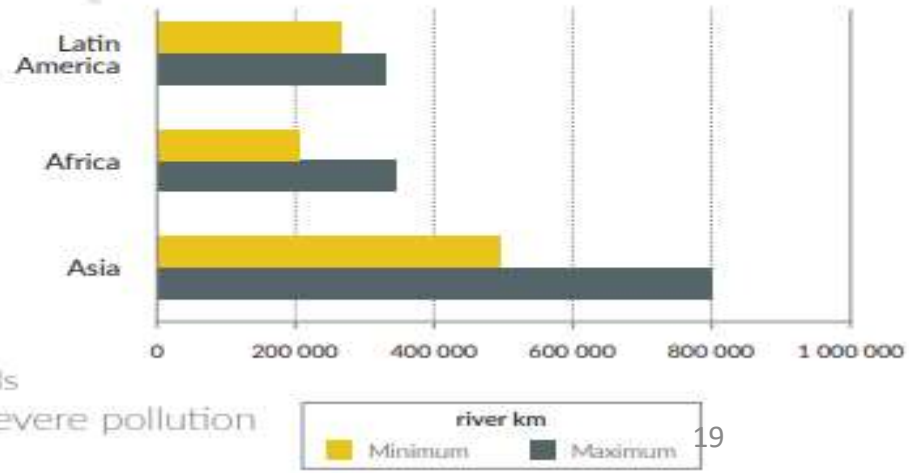
2017 UN World Water Development Report: Wastewater,

Figure 4 Estimated in-stream concentrations of faecal coliform bacteria (FC) for Africa, Asia and Latin America (February 2008–2010)* *Source: UNEP (2016, Fig. 3.3, p. 20).*



February 2008–2010
FC [cfu/100ml]

- Not computed
- Low pollution (=200)
- Moderate pollution (200<x=1000)
- Severe pollution (>1000)



Notes: *Low*: Suitable for primary contact; *Moderate*: Suitable for irrigation; *Severe*: Exceeds thresholds

* Bar charts show minimum and maximum monthly estimates of river stretches in the severe pollution class per continent in the period from 2008 to 2010.

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Figure 6 Trend in BOD concentrations in rivers between 1990–1992 and 2008–2010*

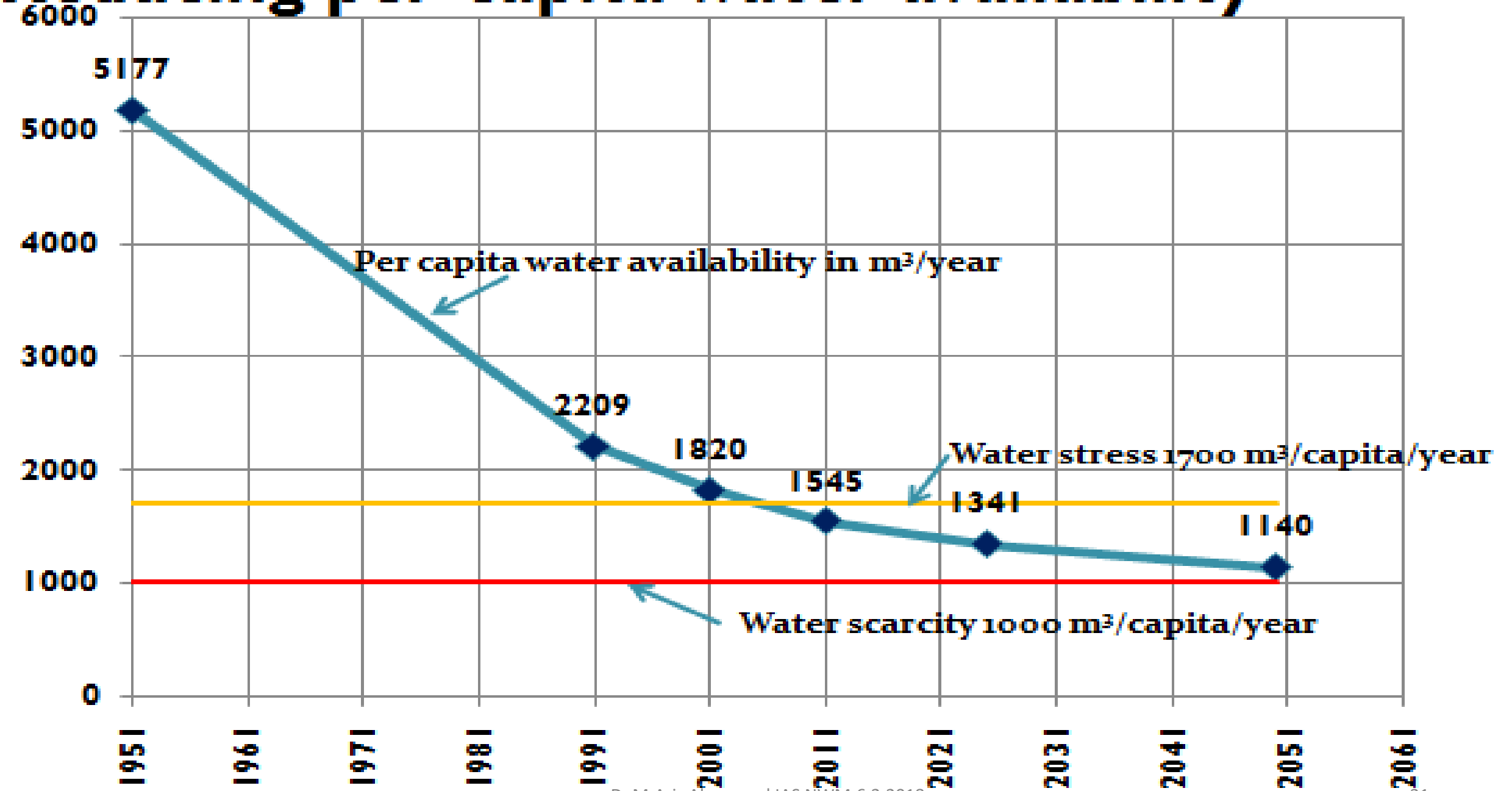
Source: UNEP (2016, Fig. 3.15, p. 34,

* River stretches marked with orange or red have increasing concentrations between these two periods. River stretches marked with red have an "increasing trend of particular concern" meaning that in these stretches, the pollution level increased into the severe pollution category in 2008–2010, or that they were already in the severe pollution category in 1990–1992 and further increased in concentration by 2008–2010.

Trend of BOD in-stream concentration

Not computed
Not increasing
Increasing trend
Increasing trend of particular concern

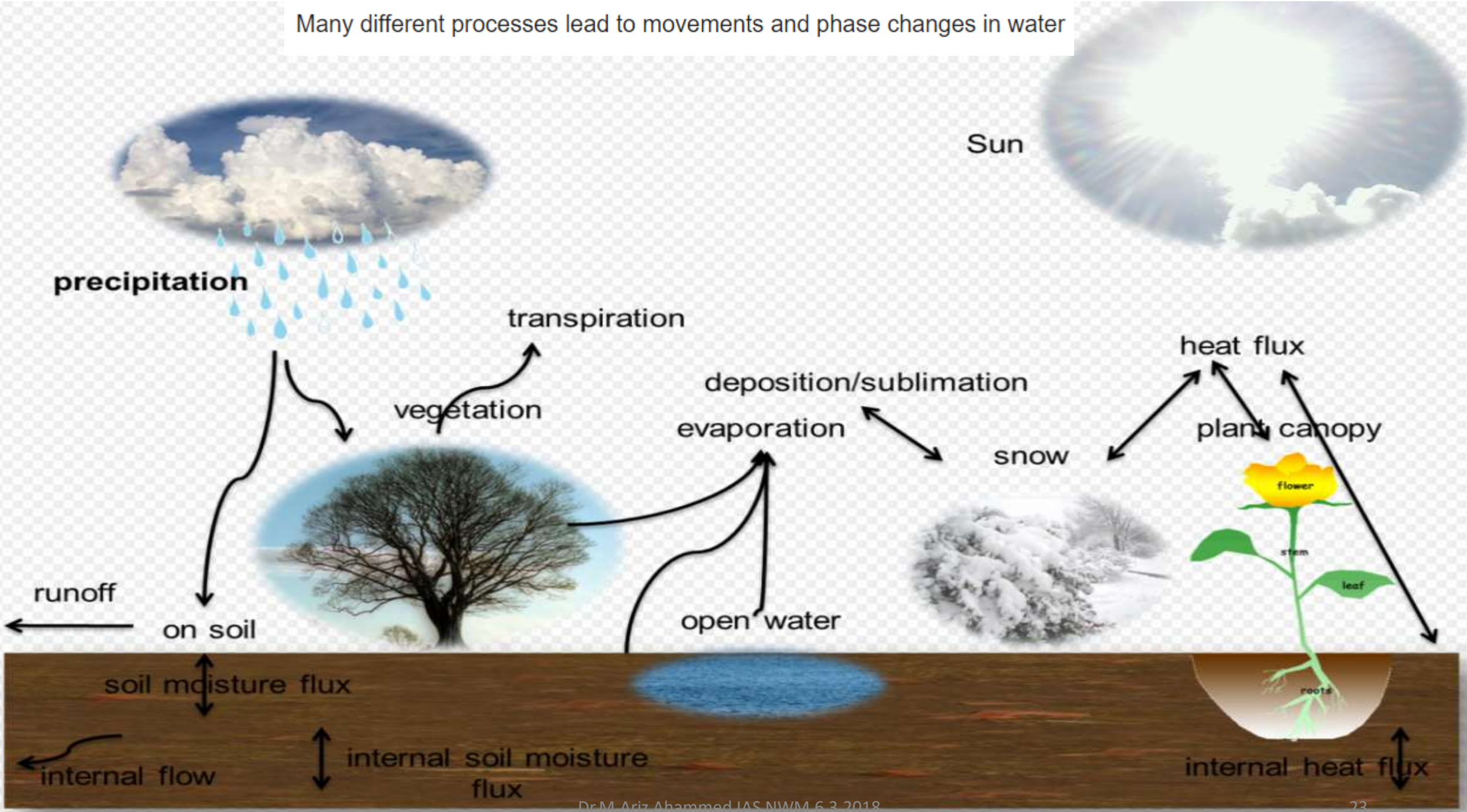
Reducing per capita water availability



* As per Falkenmark Water Stress Indicator

Water Governance-Salient features

Many different processes lead to movements and phase changes in water



(Chen et. al., 1996, 1997; Chen and Dudhia, 2001; Ek et. al., 2003; Koren et. al., 1999)

Water Dimensions

Supply side

Demand Side

Water governance- Distributed

No single coordination Agency

Supply/Source side	Demand/ Consumption side
1. Climate- Precipitation	1. Forestry & Wildlife
2. Glaciers	2. Farm Sector
3. Springs	a. Agri-Horticulture-Irrigated and Rainfed
4. River Basins	b. Livestock, Birds and others
5. Projects-Storage/ Irrigation/ Multi-purpose	c. Fisheries and others
6. Wetlands	3. Industry and Infrastructure
7. Tanks	a. Thermal Power Plants/
8. Coastal zone	b. Textiles and Jute
9. Ground Water Resources	c. Paper and Pulp
10. Waste Water	d. Iron and Steel
	e. Others
	4. Establishments & Institutions- Education, Health etc.
	5. Drinking Water and Domestic use -Rural & Urban

Water related Central Ministries/ Departments

Supply / Source side	Demand / Consumption side
1. Earth Sciences/ IMD- Precipitation 2. Defence-DRDO/SASE (Snow) 3. Science and Technology a. DST (Glaciers & Springs/ Research) b. Climate Change c. CSIR-Technology 4. Water Resources, River Development and Ganga Rejuvenation a. Rivers knowledge and financing i. Rivers Mgt and Hydrology ii. Irrigation Projects/ Reservoirs iii. Command Area Dev. iv. Dam safety b. Flood forecasting & Mgt.financing c. Ground Water and Quality Assessment-Knowledge sharing d. River Disputes e. Ganga Cleaning f. R&D, Capacity building, g. NWM: Climate Change 5. DoNER- WR development 6. Panchayat a. Tanks & Wetlands & b. Community participation 7. Rural Development a. Water conservation & b. Community participation 8. Housing and Urban Affairs a. Tanks & Wetlands b. Community participation 9. Environment, Forests and Climate Change a. Waste Water & b. Water Quality c. Climate Change	Forestry and Wildlife 10. Environment, Forests and Climate Change (Forestry/ Plantations & Wild life) Farm Sector: 11. Agriculture and Farmers Welfare-DACFW & DAHD Industry 12. Power- Thermal 13. Steel 14. Textiles 15. MHIPE-Heavy Industries and Public Enterprises 16. Chemicals & Fertilizers, 17. MSME 18. Food Processing 19. Mines 20. Coal 21. Commerce & Industry 22. Electronics and IT Infrastructure 23. Road Transport and Highways 24. Shipping 25. Railways 26. Civil Aviation 27. Tourism 28. Housing and Urban Affairs Establishments & Institutions 29. Human Resources Development-DSEL & DHE 30. Health and Family Welfare 31. Housing and Urban Affairs Drinking Water 32. Drinking Water and Sanitation 33. Housing and Urban Affairs

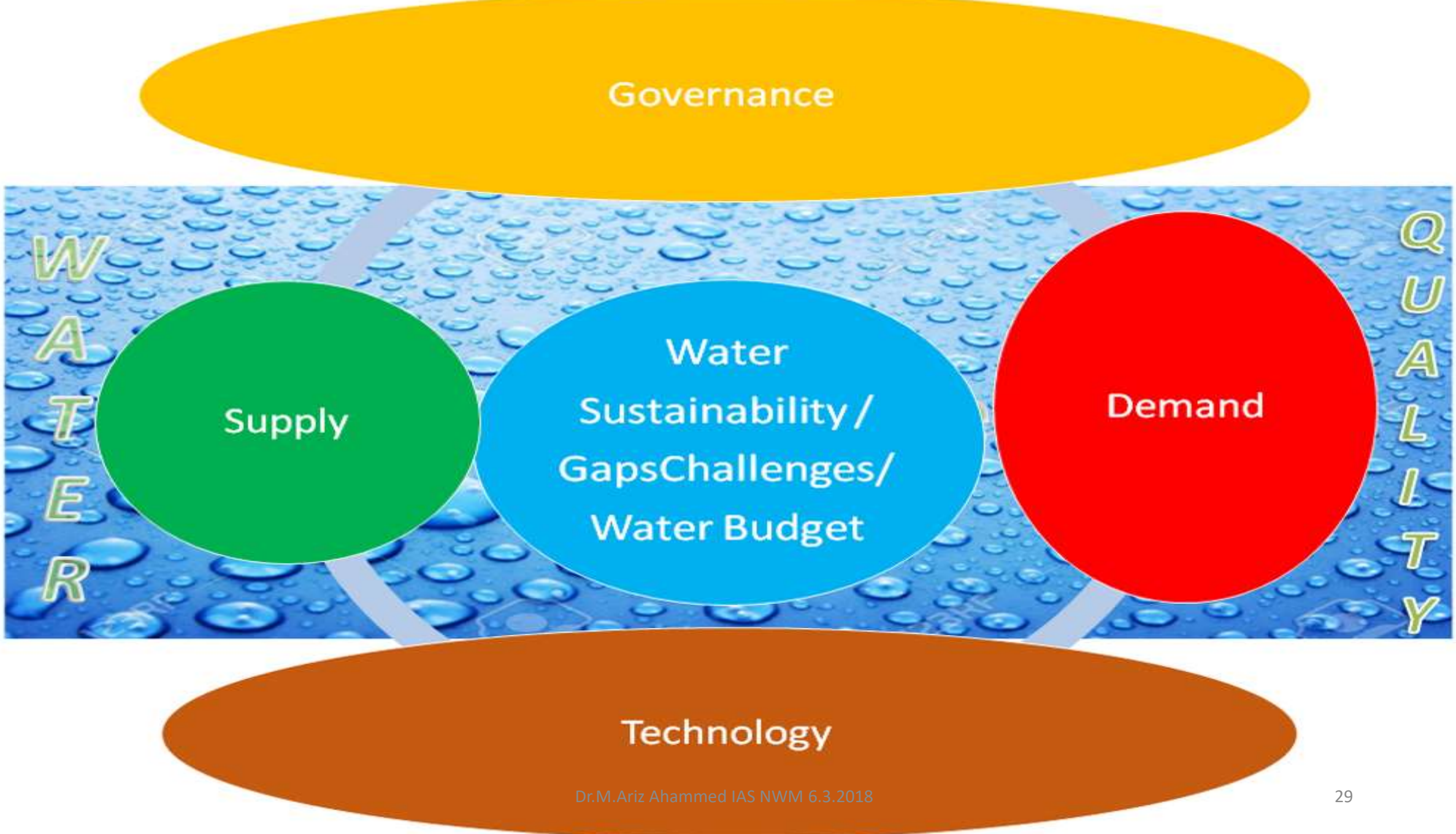
+ Ministry of Finance

Evolution of Ministry of Water Resources, River Development & Ganga Rejuvenation

August 1952	November 1974	June 1980	January 1985	September 1985	July 2014
• Ministry of Irrigation and Power	• Separate Department of Irrigation (Ministry of Agriculture and Irrigation)	• Full fledged Ministry of Irrigation	• Ministry of Irrigation and Power	• Ministry of Water Resources created by upgrading Department of Irrigation	• Ganga Rejuve-nation and River Develop-ment added

Evolution timeline

Governance: A comparison- Money-Power-Water


Governance
WATER
Supply
Water Sustainability / GapsChallenges/ Water Budget
Demand
QUALITY
Technology

STATE / UT WATER BUDGET-ANNUAL EXERCISE

Challenge: Hydrological Unit vs Administrative Unit

State/ UT Water Budget

Income		Expenditure		Gap
Utilisable Water Resources		Allocation of Water Resources		
Source wise		Sector wise		
Surface Water		Rain fed Agriculture		
Irrigation Projects		Irrigated Agriculture		
Water Bodies Lakes		Industry		
Ponds / Tanks		Thermal		
Ground Water		Steel		
Other sources		Textiles		
		Others		
		Drinking Water		
Waste water		Other uses		

Pareto principle: 80/20 rule

- For many events, roughly 80% of the effects come from 20% of the causes.
- Pareto noticed that 80% of Italy's land was owned by 20% of the population

Distribution of world GDP, 1989[8]

Quintile of population	Income
Richest 20%	82.70%
Second 20%	11.75%
Third 20%	2.30%
Fourth 20%	1.85%
Poorest 20%	1.40%

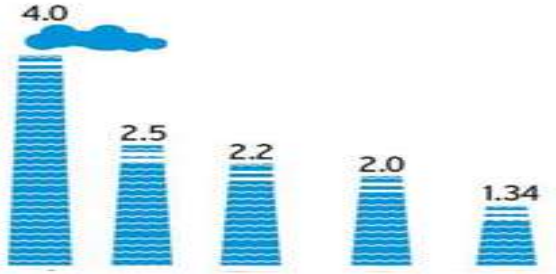
Water Sector: Pareto 80/20

What constitutes 80% of each of the Sector/ component ?

Ex: Agriculture- Irrigated 87 M.ha

Rice, Wheat, Sugarcane, Cotton: 60 M.Ha

Performance Mgt: Productivity



Water Productivity/ WUE Specific Water Consumption (Water required to produce a unit of product) Illustrative			District.1	District.2	District.3
	Paddy 1 Tonne		2.5 million lit	5 ML	10 ML
			Plant.1	Plant.2	Plant.3
	Processed Milk 1 litre		1.5	2	3
			Farm.1	Farm.2	Farm.3
	Poultry 100 Eggs				
	Thermal Power 1 MWh		Plant.1	Plant.2	Plant.3
	Steel 1 T of Crude Steel		Plant.1	Plant.2	Plant.3
	% of total water consumption being met from treated Waste Water				
			Zone.1	Zone.2	Zone.3
	Railways Per passenger				

Standard template of **Each Chapter – Sub Headings**

(of Supply/Demand / Quality Chapters/Sub-chapters)

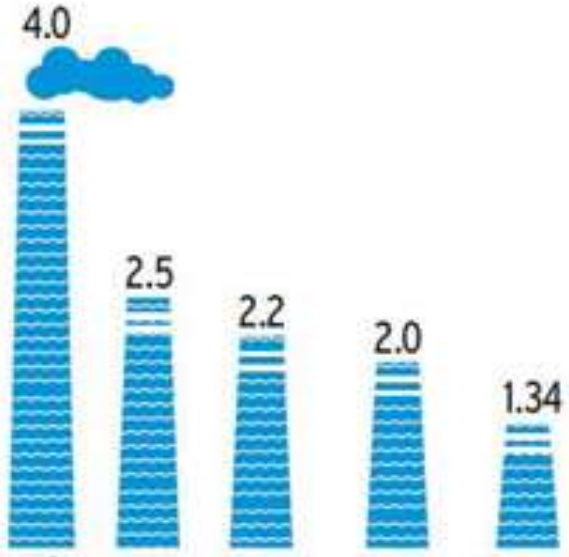
1. Subject Matter (May include sub heading, data, graphs etc.)
2. Water Budgeting

Availability	Utilizable	Demand	Supply	Consumption

3. Issues and Challenges
4. Problem Tree / Root cause Analysis: Cause, Effect and Interventions
5. Governance / Management:
   a. Statute / Law / Policy/ Regulations if any
   b. Institutions governing / managing / monitoring
   c. Areas of Peoples/Private Participation if any
6. Water Financing and Economics
7. Measurement, Monitoring and Data Constraints/ Management
8. Performance Indicators:
   a. Bench Marks/ Norms/ Standards and deviation
   b. Status of various Performance Indicators – **for comparison across Districts/ Plants/ Units/ Products etc.**

Category of Indicators (Illustrative)	Indicator	Bench Mark	District.1/ Industry.1	District.2/ Industry.2	District.3/ Industry.3
Water Measurement					
Water Conservation					
Water Demand Management					
Water Productivity					
Water Quality					
Participatory Water Management					
Water Economics					
Others					

9. Reforms undertaken / being undertaken / proposed if any
10. Road map of activities / tasks proposed for



Way forward:
Water Security, Safety & Sustainability

Challenges

- Identification of Stakeholders
- Convergence- Common understanding
- Single Identified Agency for management
- Measurement
- Harmonising –Science (Hydrology/Geology) and Administrative units
- Re-engineering of Governance

Way forward-Institutionalisation

- State Water Budgeting

What merits State Water Budgeting -SWB !!??

Merits

- **Holistic hydrological cycle approach**.
- Create organised conflict vs. Laisse faire approach.
  - **Check deficits by balancing consumption with availability**:
- **Paradigm shift in focus from Supply to Demand**
- **Culture of** measurement and accountability
- **Introduction of the concept of** value for resource:
- Democratisation and transparency

Challenges

- Convergence
- Measurement
- Capacity building
- Expertise

State / UT Specific Action Plan on Water

1. State Water Budgeting
2. Preparation of interim report on:
    1. Impact of Climate change on State.
    2. Alternative Interventions required to address each of the issues/concerns identified in Status Report and Interim Report.
3. SSAP- Water 2050

Only by together
we can make a difference