Water Governance:

State Water Budgeting

For Water Security, Safety & Sustainability

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Mission Director
National Water Mission
Ministry of Water Resources, River Development & Ganga Rejuvenation

NWM -Mandate

सत्यमेव जयते

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

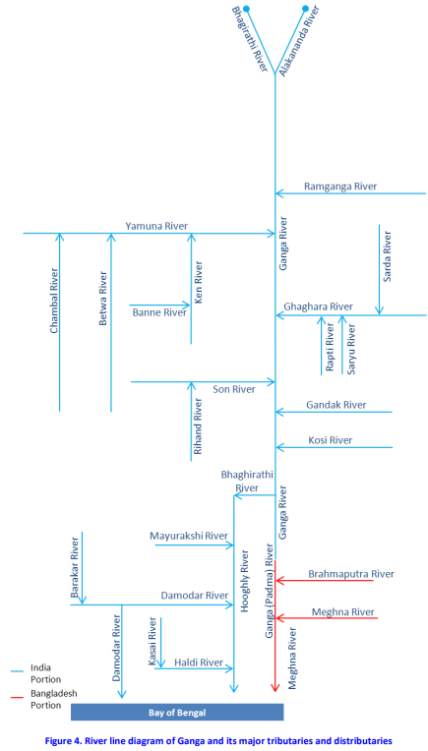
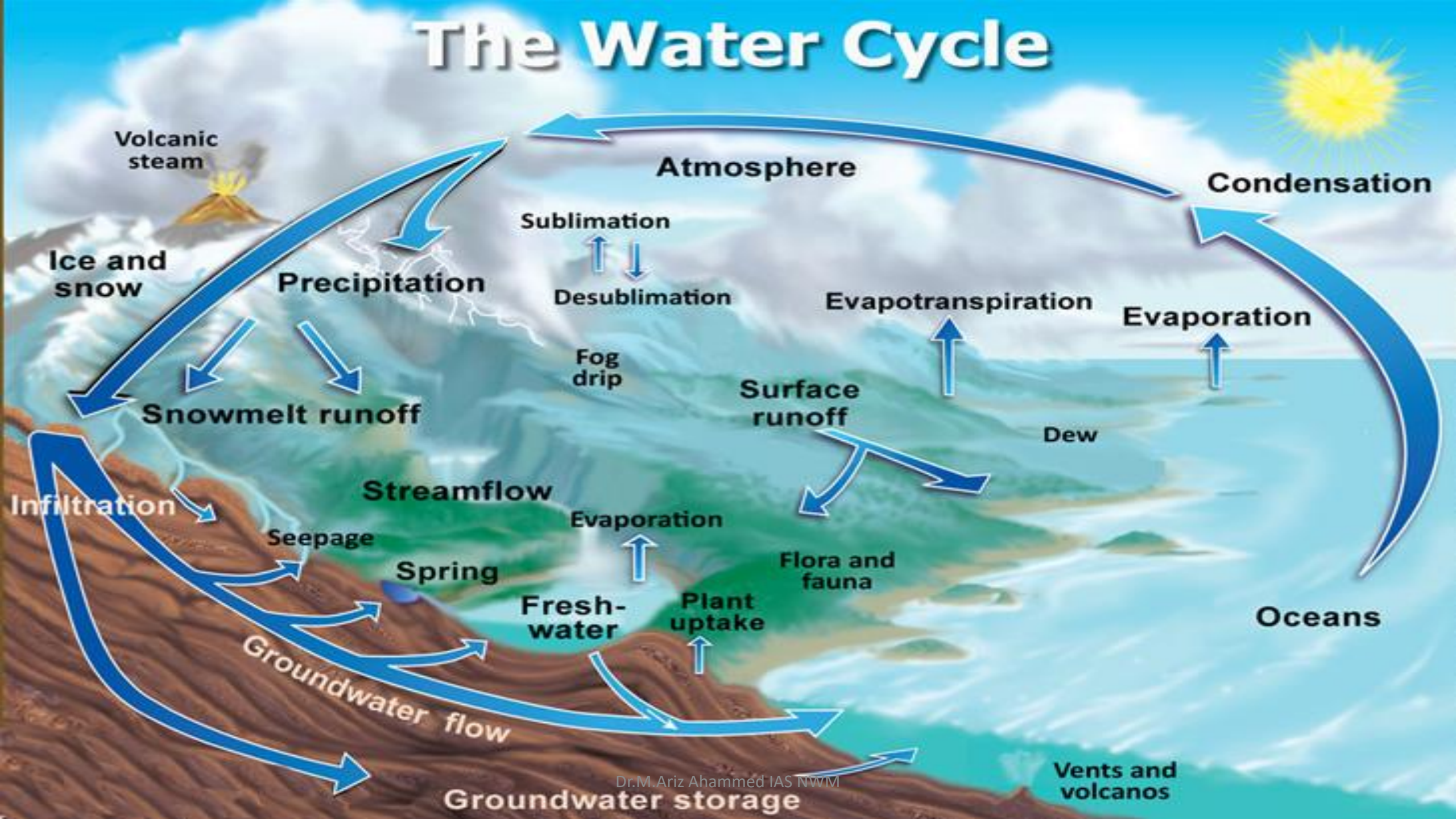


Figure 4. River line diagram of Ganga and its major tributaries and distributaries



Water Dimensions

Supply / Source Side	Demand / Consumption side
1. Precipitation (Rainfall/ Snow)	1. Forestry and Wild Life
2. Glaciers	2. Farm sector
3. Springs	a. Agri- Horticulture- Rain fed & Irrigated
4. River Basins	b. Livestock, Birds and others
5. Projects- Reservoirs/Multi-purpose	c. Fisheries & Others
6. Tanks	3. Industry & Infrastructure
7. Wetlands	a. Thermal Power Plants
8. Coastal Region	b. Iron and Steel
9. Ground Water Resources	c. Textiles and Jute
10. Waste Water	d. Paper and Pulp
	e. Other Industry
	f. Airports/Rail / Road Transport/etc
	4. Establishments / Institutions- Educational & Health Institutions
	5. Drinking water and Domestic use- Rural & Urban

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

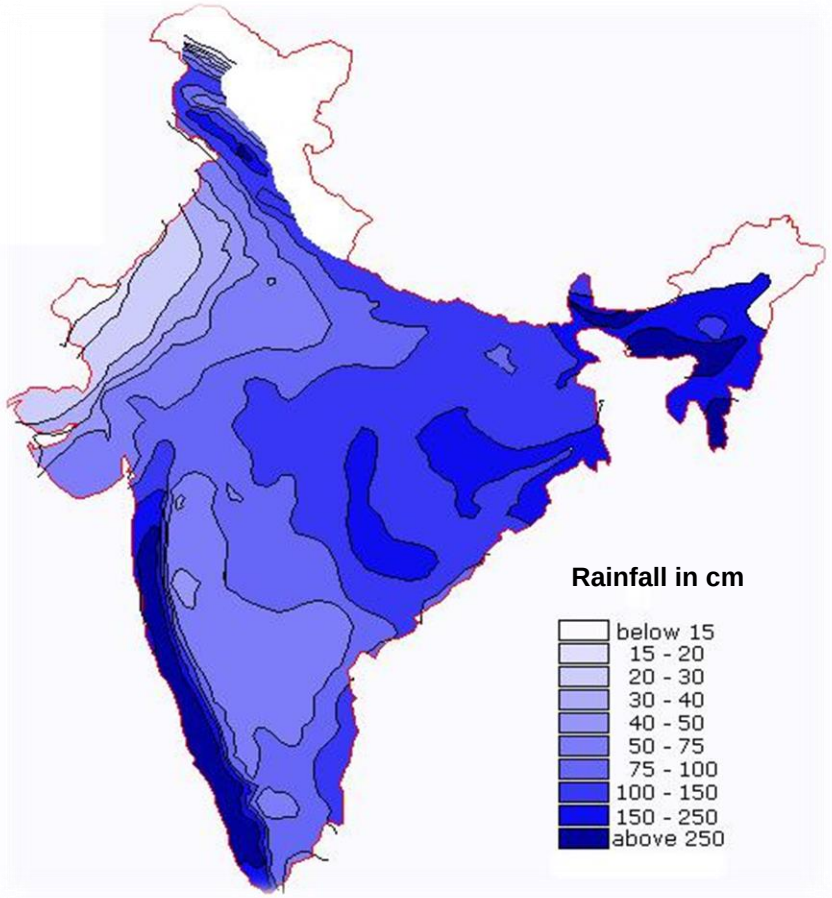
August 1952	November 1974	June 1980	January 1985	September 1985	July 2014
• Ministry of Irrigation and Power	• Separate Department of Irrigation (Ministry of Agriculture and Irrigation)	• Full fledged Ministry of Irrigation	• Ministry of Irrigation and Power	• Ministry of Water Resources created by upgrading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

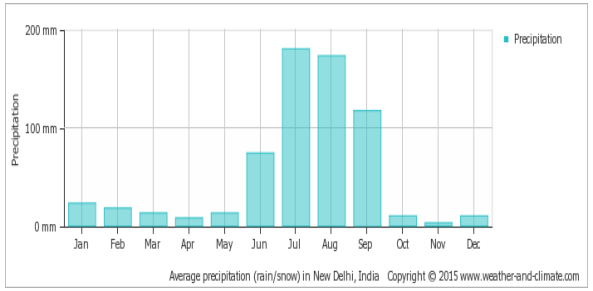
Evolution timeline

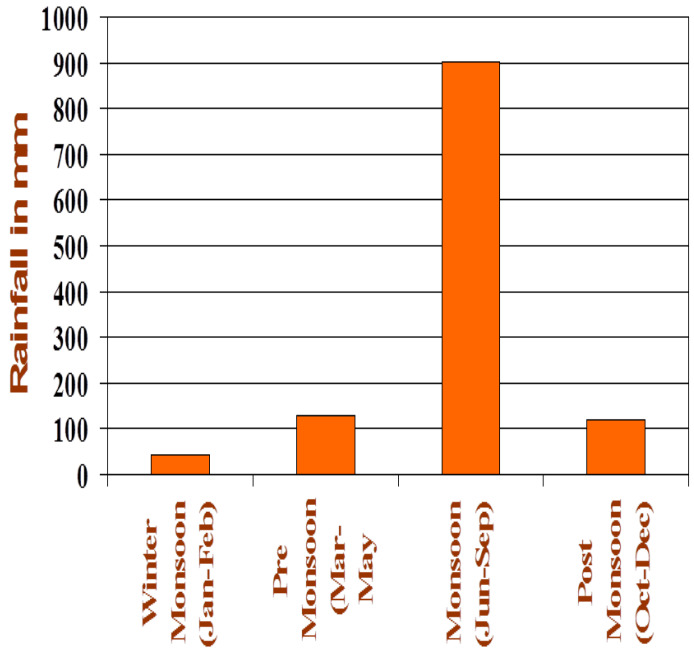
Water Resources

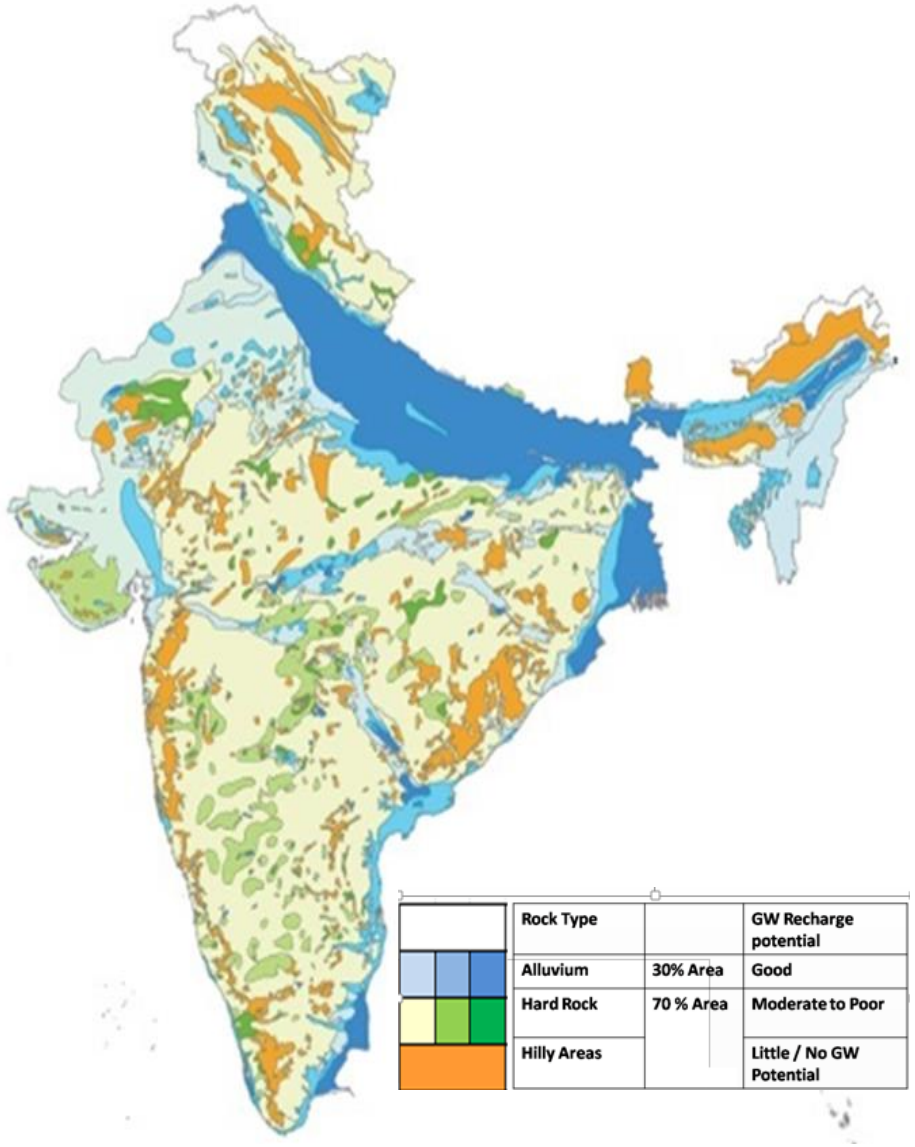
1. Source and Variability
2. Availability, Utilisable & Demand
3. Crisis - Illustrative
    a) Per capita
    b) GW exploitation- Agriculture, Industry, Withdrawals
    c) Peninsular river- Shrinking / Low base flow
    d) Floods /Droughts /Reservoir storage/ Agrarian crisis
    e) Quality-Chemical & Biological; Contamination
    f) Investments-Results: Paradox
    g) Climate Change
    h) Nations' water problem Statement
4. Water Governance
    1. Constitutional framework
    2. Challenges: Measurement & Single Agency Coordination
    3. Challenges: Hydrological unit and States
    4. Structural Limitations
    5. Water Financing and Economics
    6. State Water Budgeting
    7. Power of Technology
    8. SSAP-Water
    9. Reflection

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









The Water Cycle

Natures' Water Budget
Total rainful input =   **Surface Water flows (Run off) +**   **(Evaporation + Transpiration)+**   **Groundwater recharge**

precipitation

condensation

run-off

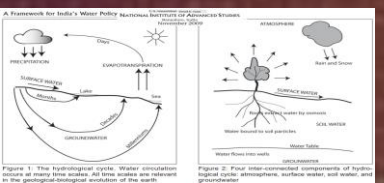
run-off

transpiration

run-off

evaporation

infiltration



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

Total Precipitation (rainfall + snowfall)
4000 BCM

Total water availability
1869 BCM

Total utilizable water resources
1123 BCM (28%)

Surface water
690 BCM

Ground Water
433 BCM

Current utilization of SW
450 BCM (65%)

Current utilization Of GW
231 BCM (58%)

Presently meets the demand but is Inadequate for future demand

Natures' Water Budget
Total rainfall input = Evapotranspiration+ Surface water flows (Run off) + Groundwater recharge

India: Reservoir Capacity (CWC 2017)

	State /UT	BCM
1.	Maharashtra	37.358
1.	Madhya pradesh	33.075
1.	Karnataka	31.903
1.	Andhra pradesh	28.716
1.	Orissa	24.032
1.	Gujarat	22.553
1.	Uttar pradesh	14.263
1.	Himachal pradesh	13.792
1.	Kerala	9.768
1.	Rajasthan	9.708
1.	Tamil nadu	7.859
1.	Chhatisgarh	6.736
1.	Uttarakhand	5.670
1.	Bihar	2.613
1.	Jharkhand	2.436
1.	Punjab	2.402
1.	West Bengal	2.027
1.	Nagaland	1.220
1.	Meghalaya	0.479
1.	Manipur	0.532
1.	Tripura	0.312
1.	Goa	0.290
1.	Jammu & Kashmir	0.029
1.	Andaman & Nicobar	0.019
1.	Assam	0.012
1.	Sikkim	0.007
1.	Arunachal pradesh	0.00006
1.	Mizoram	0.000
	TOTAL	**257.812**

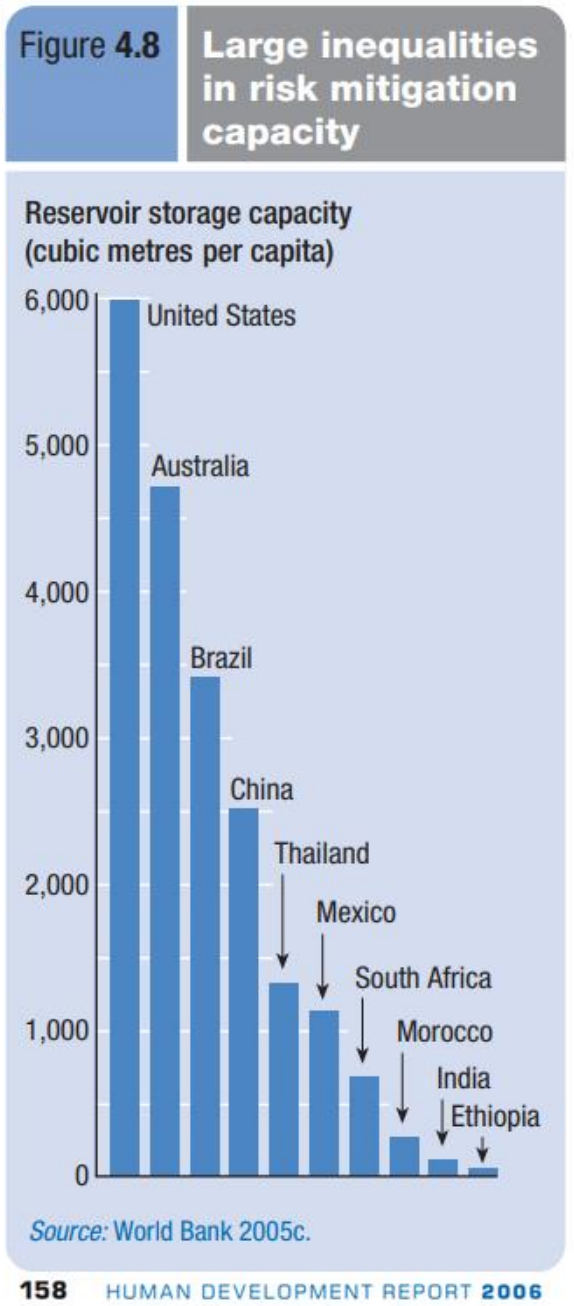
Utilisable Surface Water: 690 BCM

Ideally required Live Storage Capacity:450 BCM

The status of creation of live storage capacity in the country as in 2010 in BCM

1	Total Live Storage capacity of the completed projects	257.812
2	Total live storage capacity of projects under construction by various State Governments	50.959
3	Total live storage capacity of projects under consideration for construction by various state governments.	104.000
	Total	408.347
4	Likely loss of reservoir capacity by 2050 due to silting of reservoirs (Estimated by working group on major and medium irrigation for XI plan	53.000
5	Balance live storage capacity that would be available.	355.000

Challenges in **expansion: Ecology; Land acquisition Relief and Rehab**

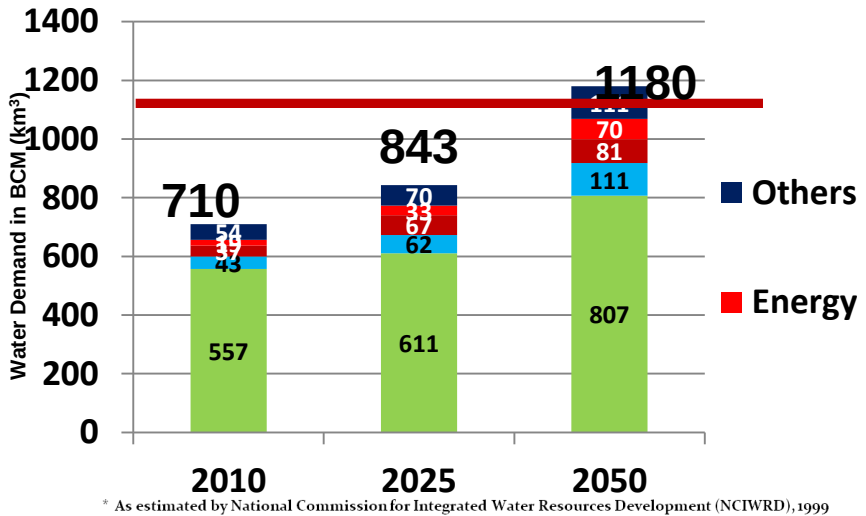


http://hdr.undp.org/sites/default/files/reports/267/hdr06-complete.pdf

Future Water Demand Scenario

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

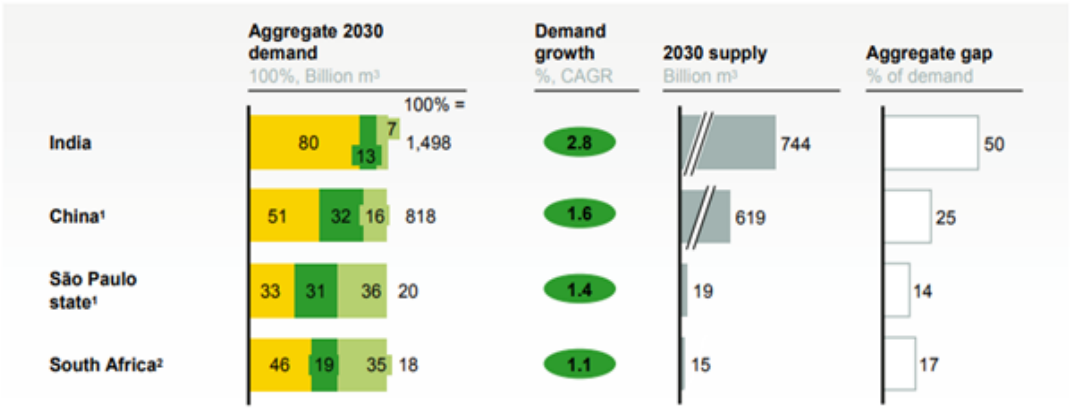
Particulars	Water Demand in Km³ or BCM		
Year	2010	2025	2050
Water Demand from all Sectors	710	843	1180
Irrigation	557	611	807
Drinking Water	43	62	111
Industry	37	67	81
Energy	19	33	70
Others	54	70	111
Availability of Utilisable Water	1123	1123	1123
Excess/Short fall	413	280	-57



* As estimated by National Commission for Integrated Water Resources Development (NCIWRD), 1999

Exhibit IV

Base-case demand, supply, corresponding and gaps for the regional case studies



1 Gap greater than demand-supply difference due to mismatch between supply and demand at basin level
2 South Africa agricultural demand includes a 3% contribution from afforestation
SOURCE: 2030 Water Resources Group

Charting Our Water Future

- 2030 Water Resource Group estimated that by 2030, demand in **India** will grow to almost 1.5 trillion m³ against current water supply of approximately 740 billion m³ with likely severe deficit unless concerted action is taken (2009)

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

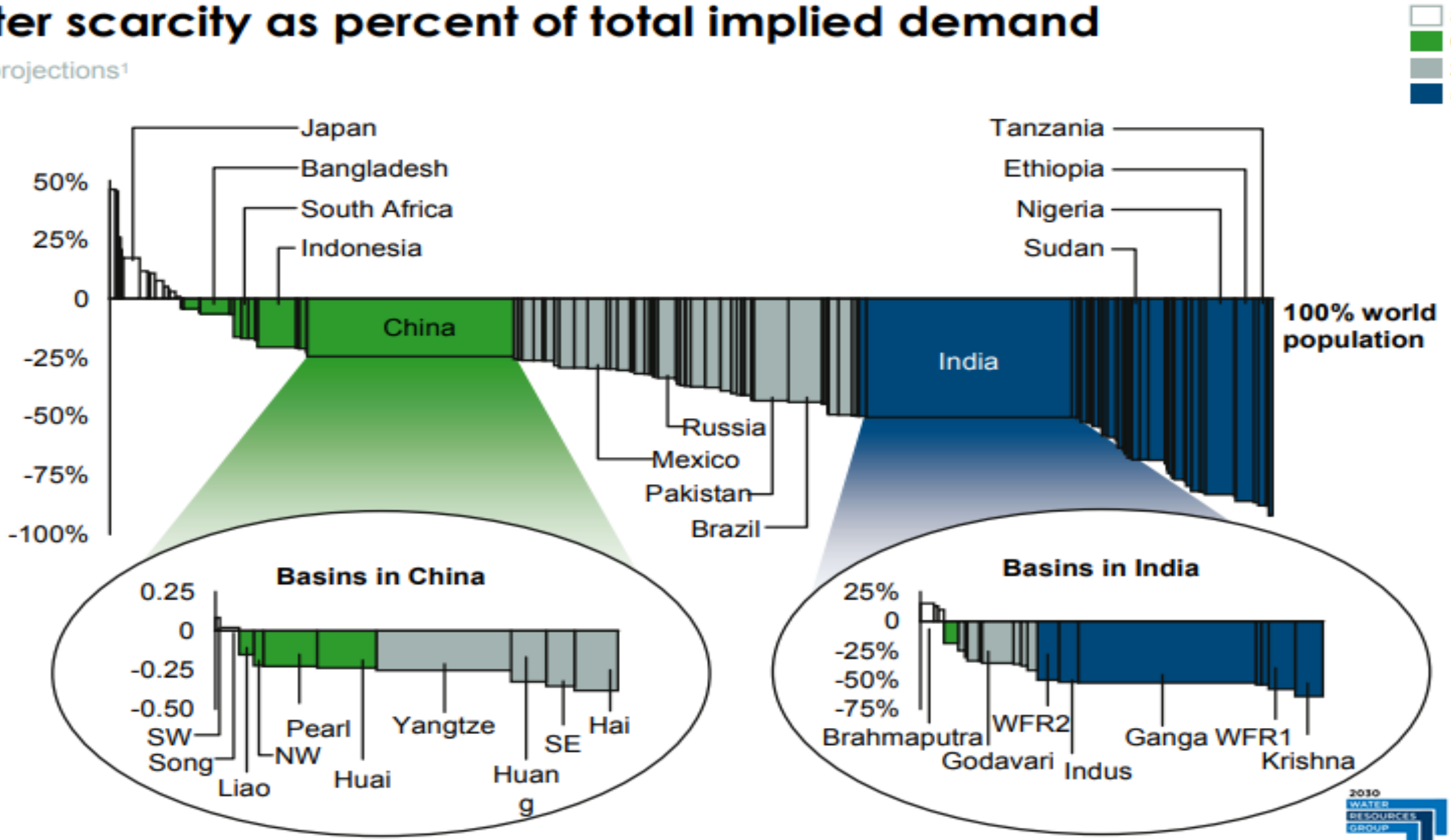
- If current trends continue, in 20 years about 60% of India's aquifers will be in a critical condition (World Bank, 2012) (http://www.worldbank.org/en/news/feature/2012/03/06/india-groundwater-critical-diminishing)

- 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.

Exhibit 9

Water scarcity as percent of total implied demand

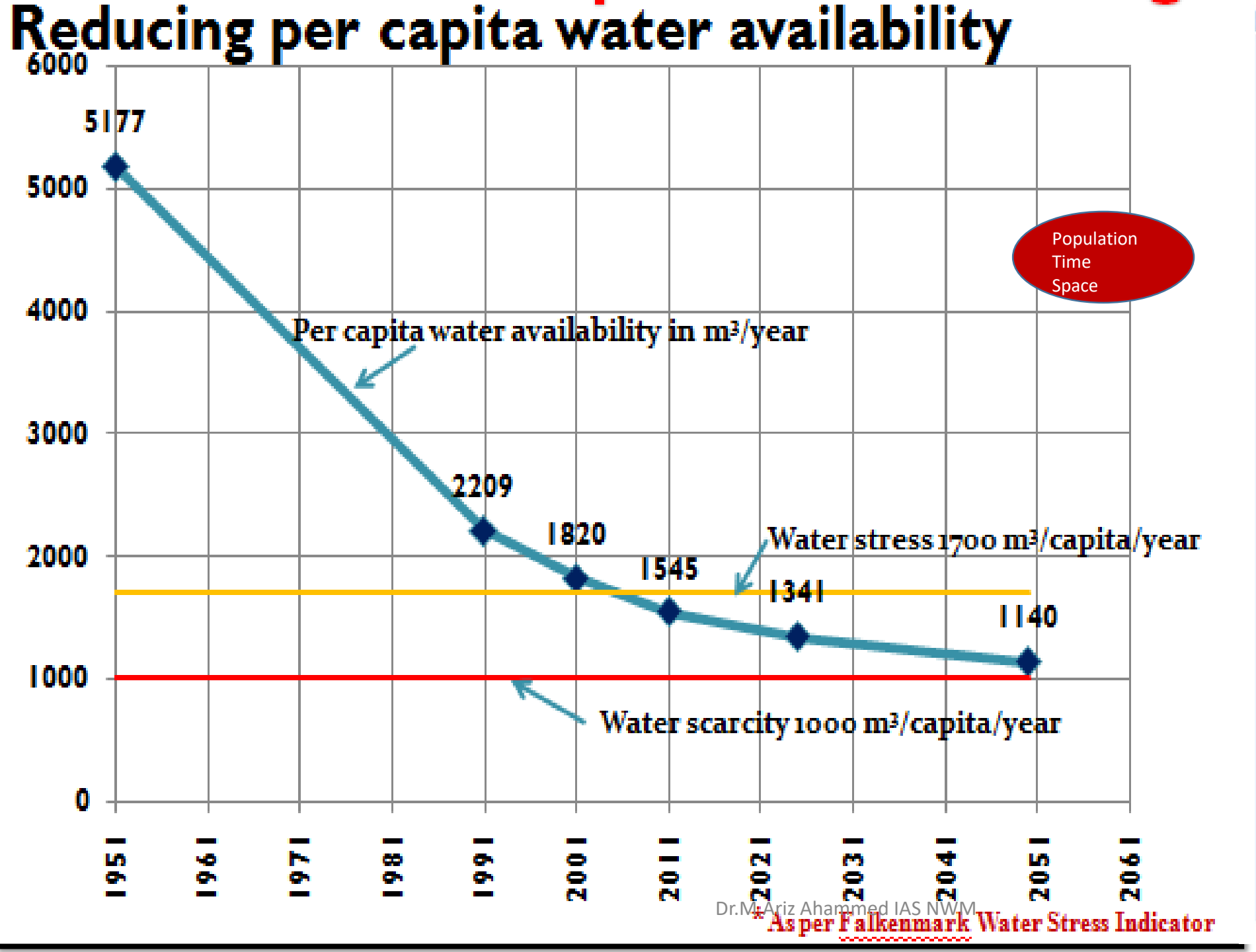
2030 projections[1]



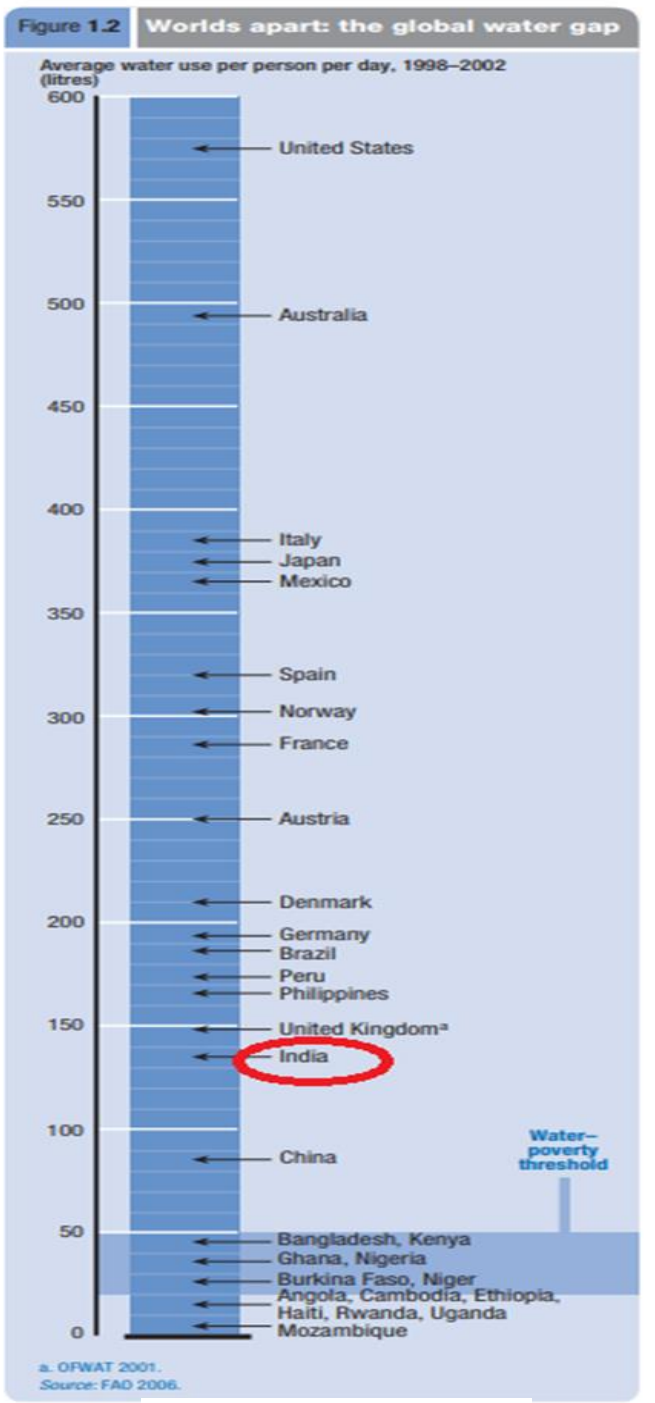
1 2030 projections, assuming technological innovation and infrastructure improvement investments are frozen at 2010 levels
SOURCE: 2030 Water Resources Global Supply and Demand model; based on IFPRI data

Charting Our Water Future

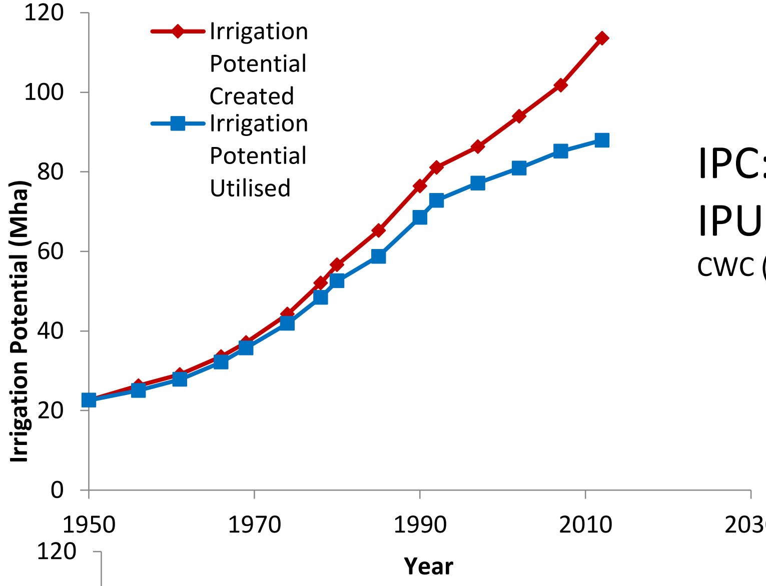
Reducing per capita water availability



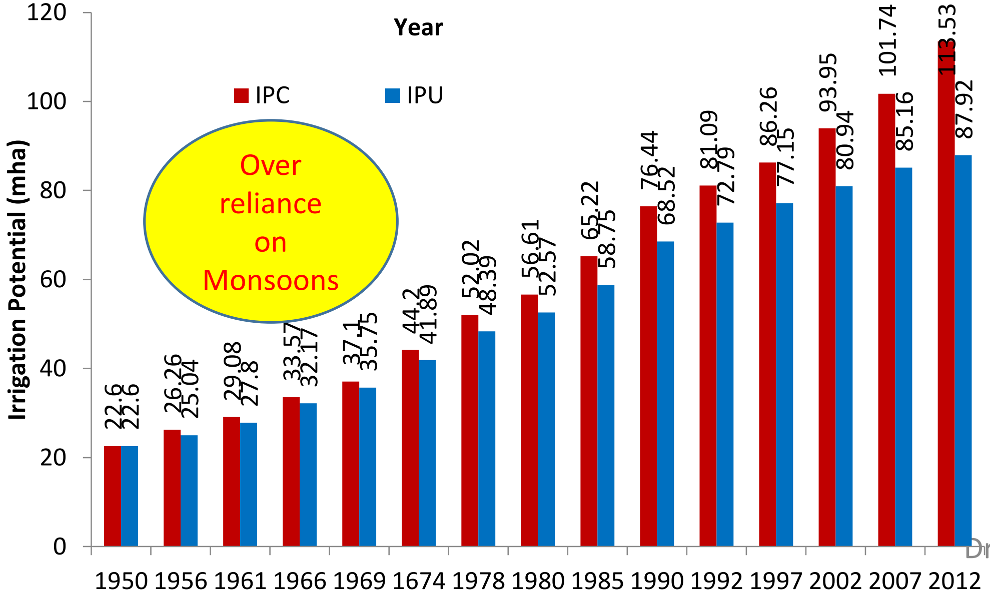
* As per Falkenmark Water Stress Indicator



SW: Irrigation Potential Created & Utilised: Widening gap



IPC: 113.53 Mha
IPU:87.92 Mha
CWC (2018)



Invested Rs. 400,000 crore in major and medium irrigation projects since Independence. Mihir Shah (2016)

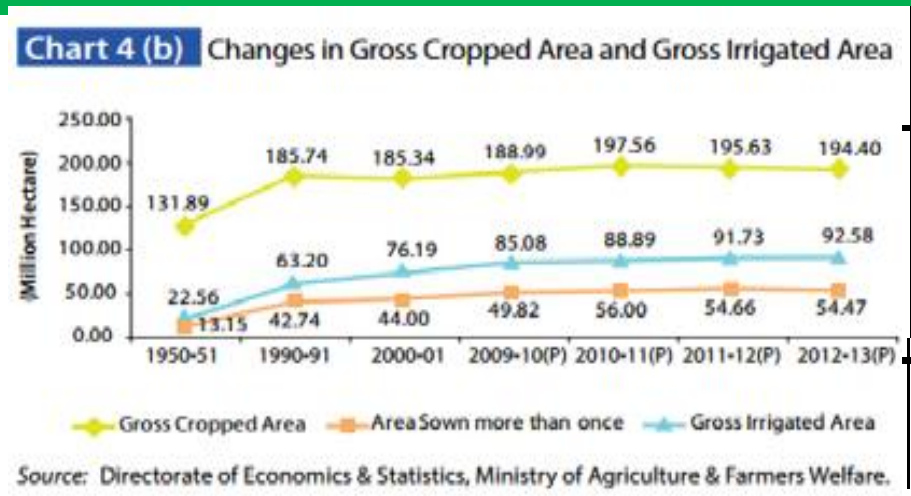
Dr.M.Ariz Aha

ANNEXURE 5.7
Water Use Efficiency of Completed Major/Medium Irrigation Projects Based on Field Measurements of Losses

Sl. No.	Name of Project	Culturable Command Area (Hectares)	Conveyance Efficiency (per cent)	On Farm Application Efficiency (per cent)	Overall Project Water Use Efficiency (per cent)
(1)	(2)	(3)	(4)	(5)	(6)
1.	Bhairavanithippa Project	4,856	86	67	58
2.	Gajuladinne (Sanjeevaiah Sagar Project)	10,300	57	45	26
3.	Gandipalem Project	6,478	73	38	28
4.	Godavari Delta System (Sir Arthur Cotton Barrage)	4,10,108	83	54	45
5.	Kurnool – Cuddapah Canal System	65,465	62	45	28
6.	Kaddam Project	27,519	51	36	18
7.	KoilSagar Project	11,700	83	75	62
8.	Krishna Delta System (Prakasam Barrage)	5,29,000	87	46	40
9.	Nagarjuna Sagar Project	8,89,000	56	39	22
10.	Narayanapuram Project	15,855	47	32	15
11.	Nizamsagar Project	93,659	87	45	39
12.	Srisailam Project	59,900	50	34	17
13.	Rajolibanda Diversion Scheme	35,410	82	51	42
14.	Somasila Project	54,650	56	32	18
15.	Sri Ram Sagar Project	3,71,054	78	57	45
16.	Tungabhadra High Level Canal	45,800	81	58	47
17.	Tungabhadra Low Level Canal	61,163	72	45	32
18.	Vamsadhara Project	82,087	91	58	53
19.	Yeleru Project	27,240	50	28	14
20.	Augmentation Canal Project	85,443	79	72	57
21.	Dholabaha Dam Project	2,600	74	71	53
22.	Ranjit Sagar Dam Project	3,00,000	51	65	33
23.	Ahraura Dam Irrigation Project	14,964	70	70	49
24.	Matatila [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25.	Naugarh Dam Irrigation Project	64,221	71	70	50

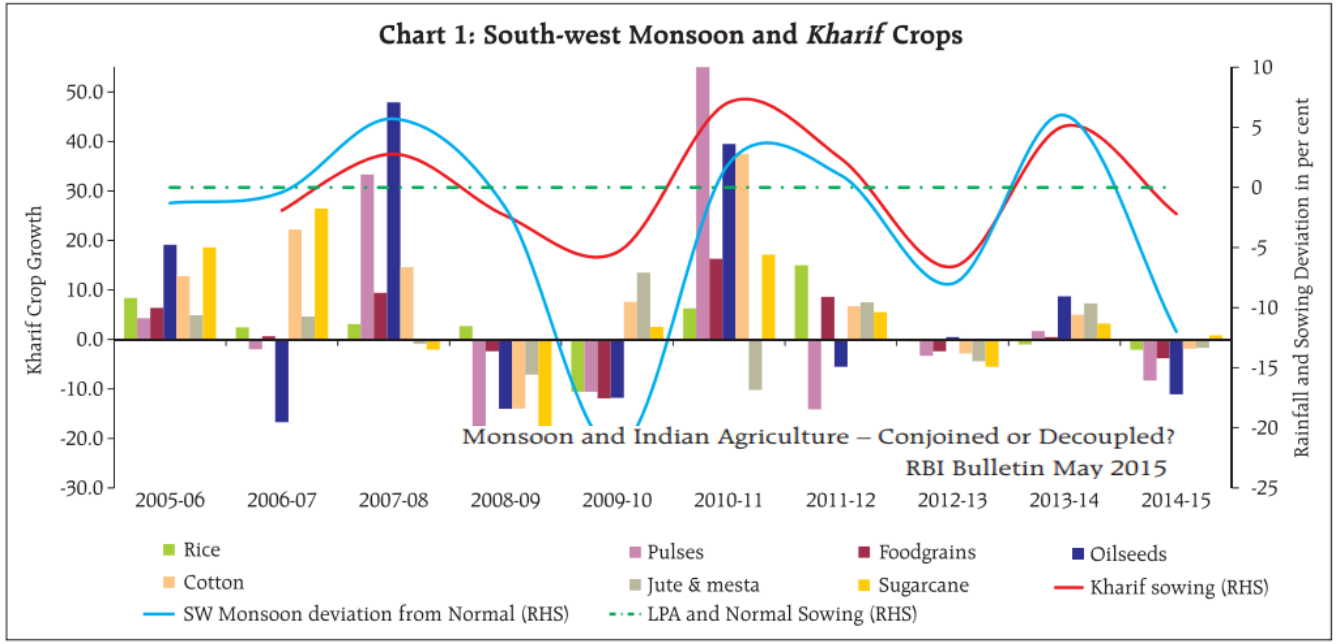
http://planningcommission.nic.in/plans/planrel/fiveyr/12th/pdf/12fyp_vol1.pdf

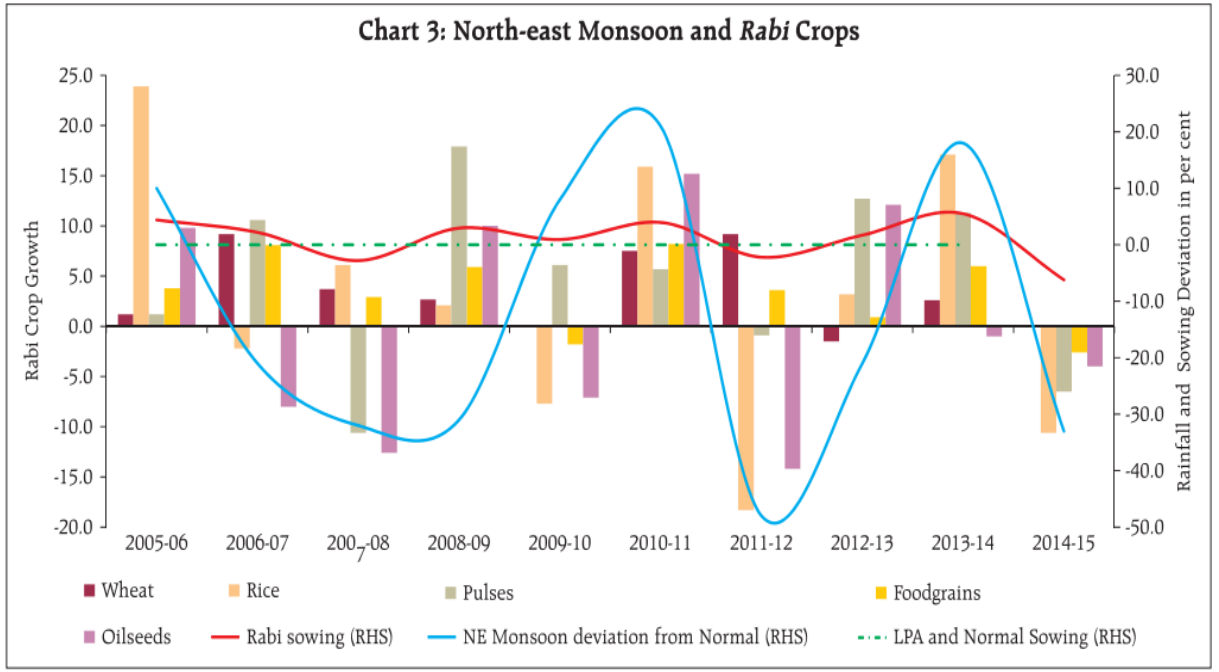
Indian Agriculture-
Continues to rely mostly on/ gamble with Monsoon



ALL INDIA 2014-15 (thousand hectares)

Agricultural Land	Net area Sown	Net Irrigated Area
181886	140130	68383



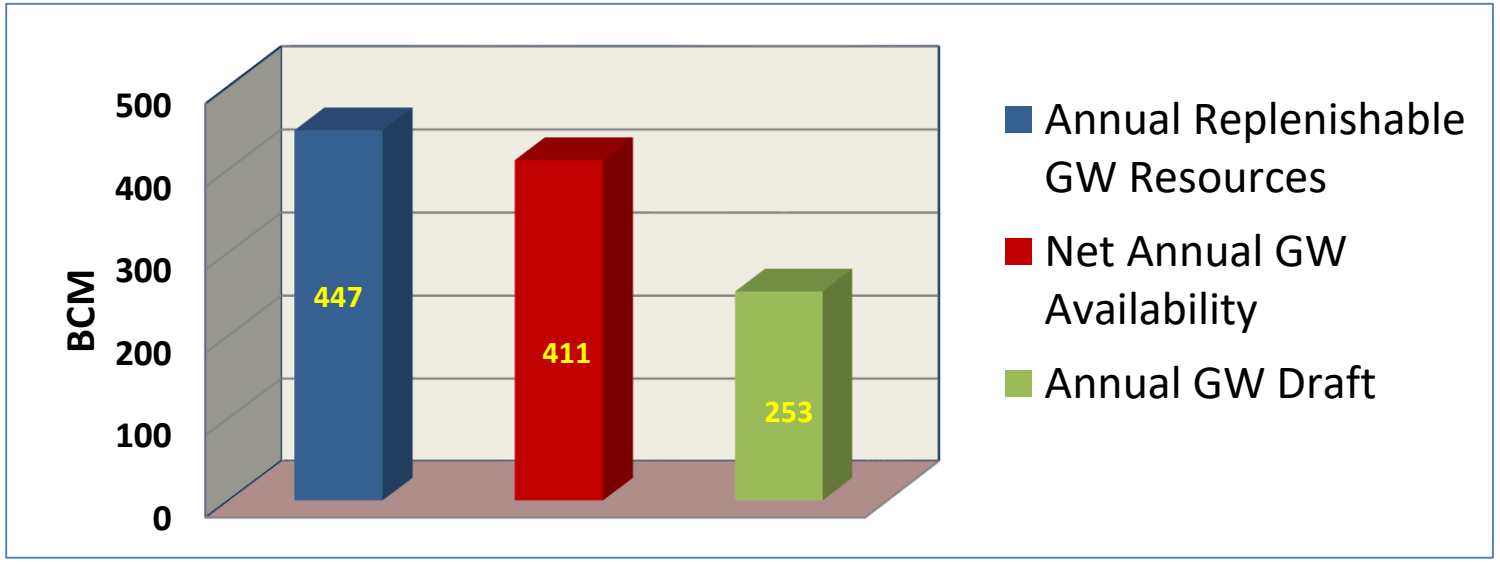


https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/03ARE19041941BD1459CA876A339F836C520.PDF

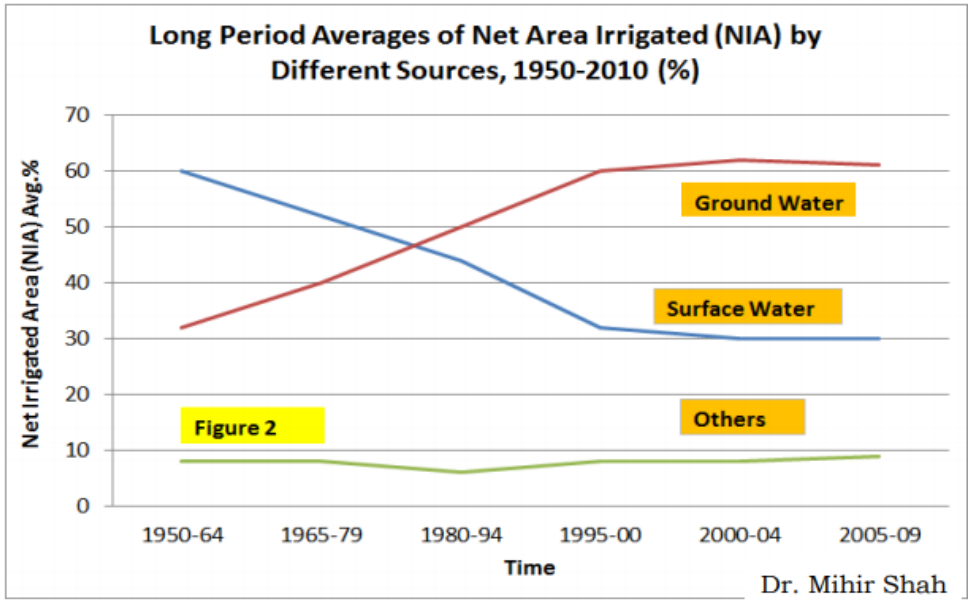
Importance of Ground & Surface water- Sustainability?

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.

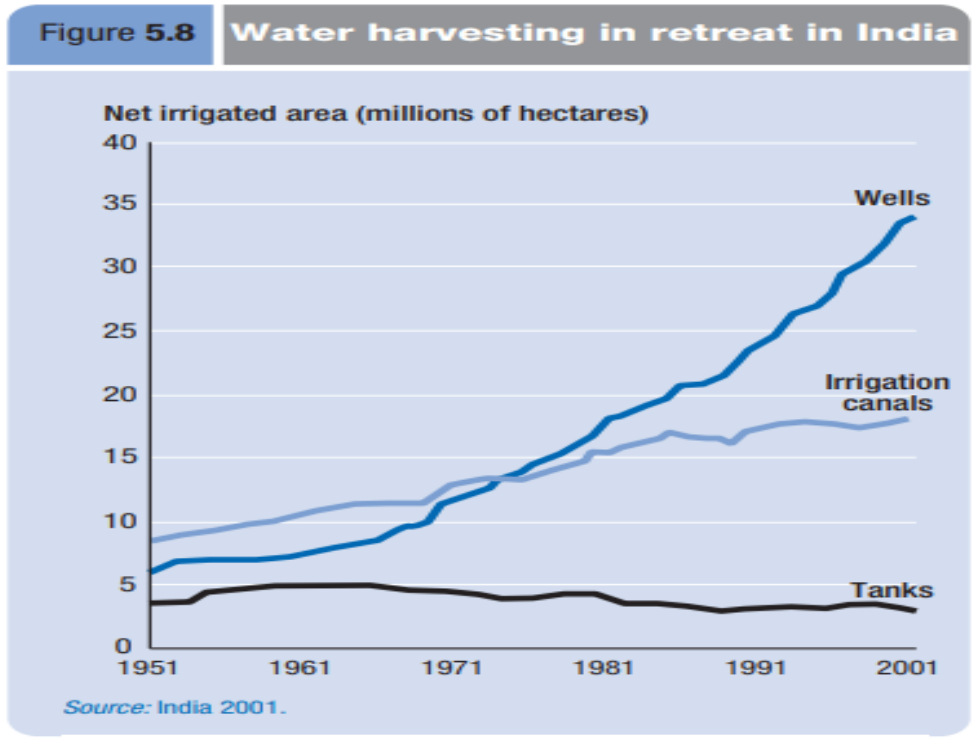


Can we sustain this level of Utilization of GW Resource…???



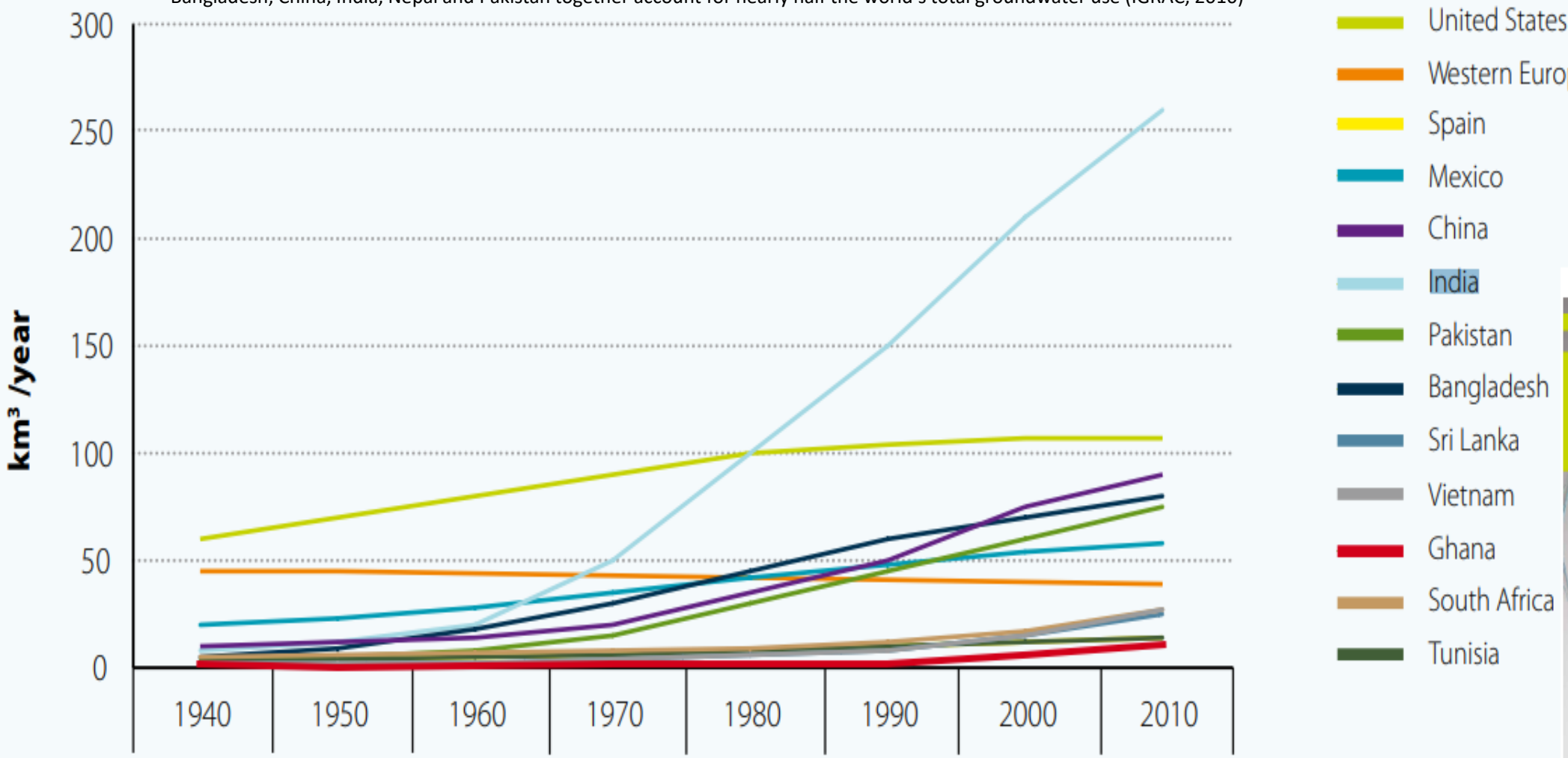
Dr. Mihir Shah

26th July 2016



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/

GW Regulation:
CGWA / State Authorities

CGWA Regulation-NOCAP	CGWA-NOCAP-Not Covered	
State	State /UT	State's own Authority
1. ARUNACHAL PRADESH	1. ANDHRA PRADESH	WALTA Act Commissioner
2. ASSAM	2. GOA	Act & CE (WR)
3. BIHAR	3. HIMACHAL PRADESH	Act & Authority
4. CHHATTISGARH	4. JAMMU AND KASHMIR	Act & Authority
5. GUJARAT	5. KARNATAKA	Act & Authority
6. HARYANA	6. KERALA	Act & Authority
7. JHARKHAND	7. TAMIL NADU	CE (GSW) GOs
8. MADHYA PRADESH	8. TELANGANA	WALTA Act Commissioner
9. MAHARASHTRA	9. WEST BENGAL	Act & Water Investigation Dir
10. MANIPUR		
11. MEGHALAYA	Union Territory	
12. MIZORAM	10. CHANDIGARH	Municipal Corpn.
13. NAGALAND	11. DELHI	DC under EP Act
14. ODISHA	12. LAKSHADWEEP	Regulation, Administrator
15. PUNJAB	13. PUDUCHERRY	Act & Authority
16. RAJASTHAN		
17. SIKKIM		
18. TRIPURA		
19. UTTAR PRADESH		
20. UTTARAKHAND		
Union Territory		
21. ANDAMAN AND NICOBAR ISLANDS		
22. DADRA AND NAGAR HAVELI		
23. DAMAN AND DIU		

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

compiled by NGWA

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	
Saudi Arabia	27448	24.24	92	5	
Indonesia	239871	14.93	2	93	
Turkey	72752	13.22	60	32	
Russia	142985	11.62	3	79	
Syria	20411	11.29	90	5	
Japan	126536	10.94	23	29	
Thailand	69122	10.74	14	60	
Italy	60551	10.40	67	23	

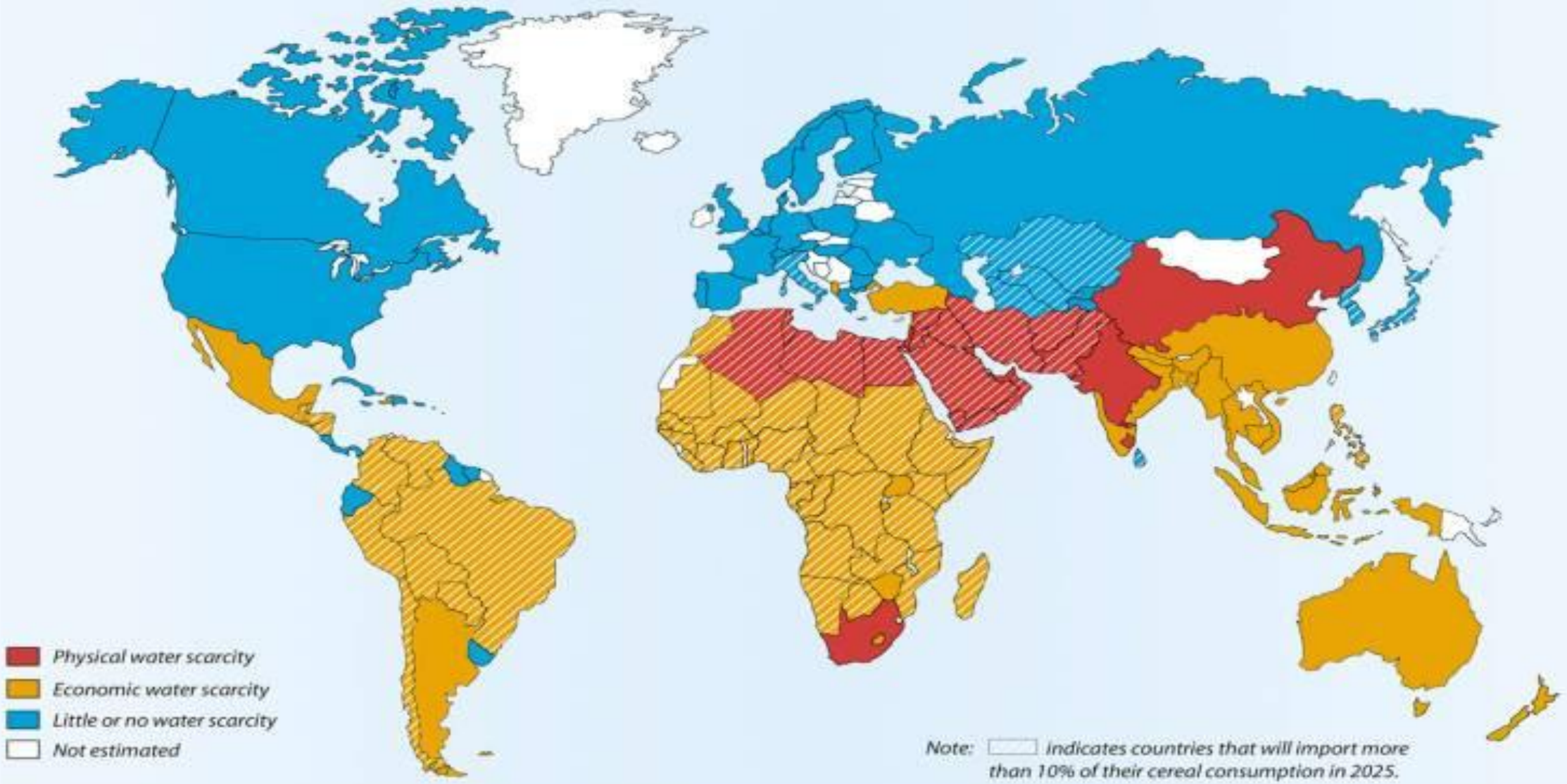
TABLE 5.1
Top 10 Groundwater-Abstracting Countries as of 2010

Rank	Country	Abstraction (km^3/year)
1	India	251
2	China	112
3	United States of America	112
4	Pakistan	64
5	Iran	60
6	Bangladesh	35
7	Mexico	29
8	Saudi Arabia	23
9	Indonesia	14
10	Italy	14

Source: 'Managing Water Under Risk and Uncertainty', The United Nations World Water Development Report 4, Volume 1 (2012).
Note: About 72 per cent of the global groundwater abstraction takes place in these 10 countries.

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

Projected Water Scarcity in 2025

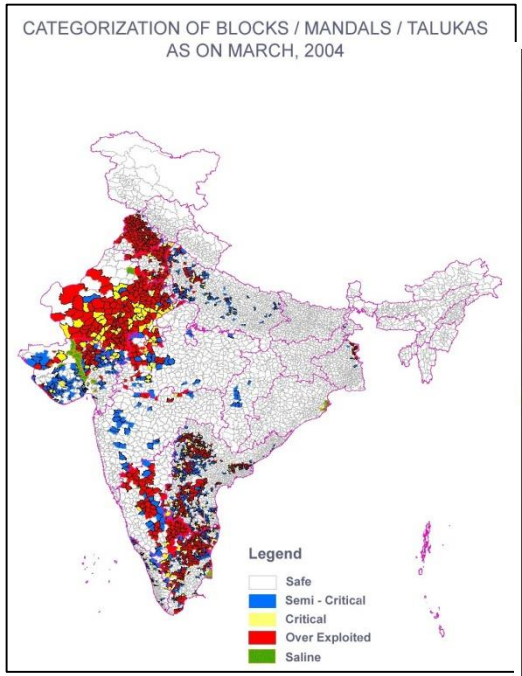


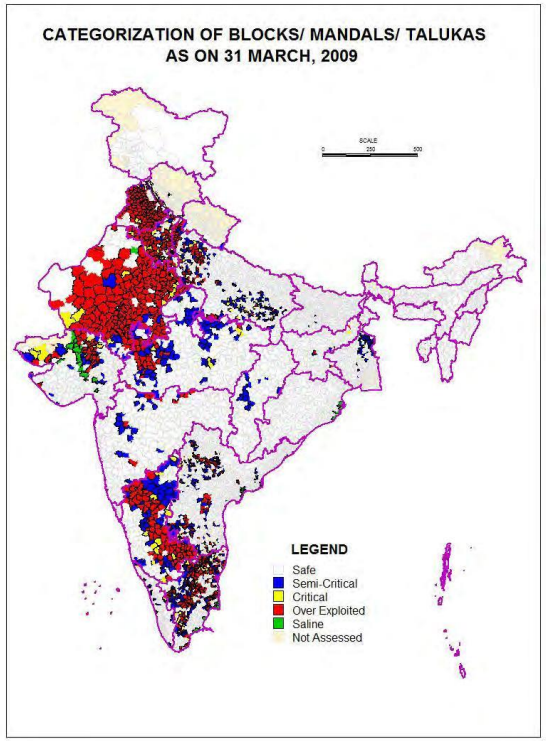
IWMI
INTERNATIONAL WATER MANAGEMENT INSTITUTE

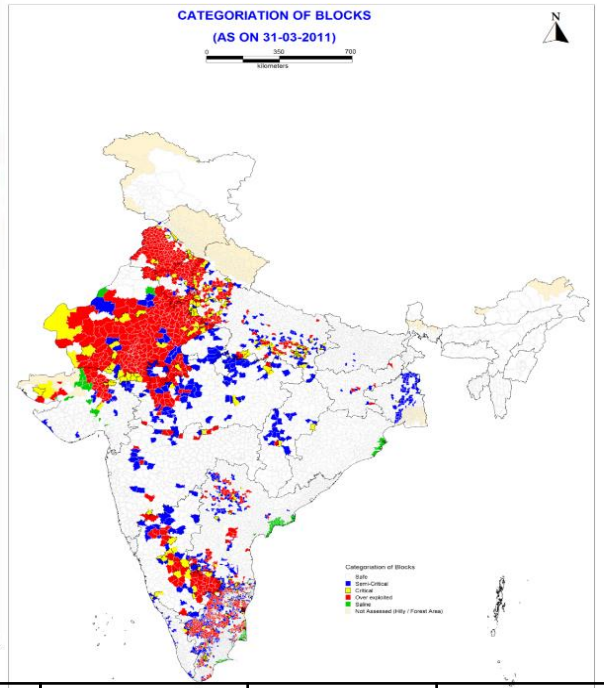
Prepared by IWMI as input for the World Water Vision, The Hague, March, 2000.

http://iwmi.org

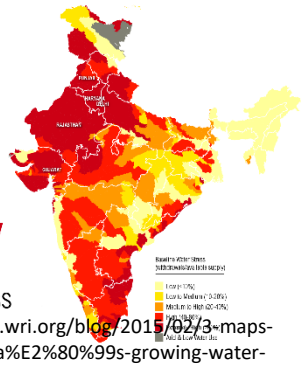
Ground Water: Over Exploitation: 2004-2013 (CGWB)







54% of India Faces **High** to **Extremely High** Water Stress



http://www.wri.org/blog/2015/02/3-maps-explain-india%E2%80%99s-growing-water-risks

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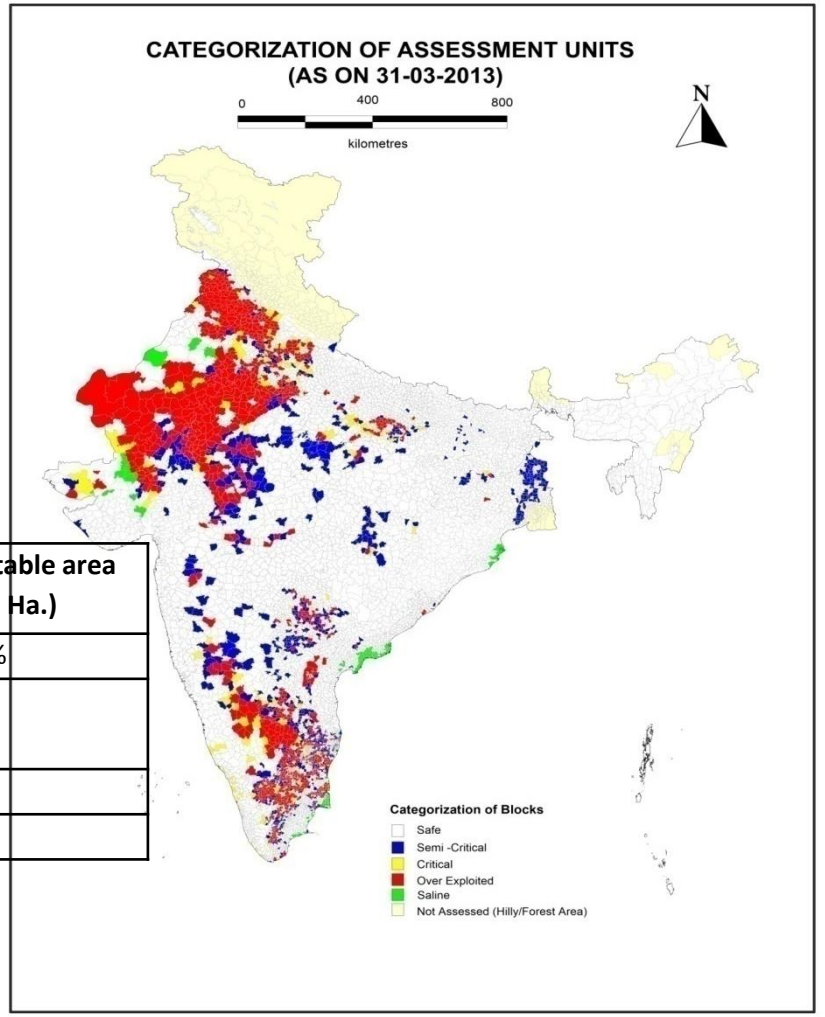


Water Status	Year wise total number of Blocks / Units in the country			
	2004	2009	2011	2013
Over exploited	839	802	1071	1034
Critical	226	169	217	253
Semi-Critical	550	523	697	681
Saline	30	71	92	96

	Lakh Sq.Km	% GW exploitable area (23 Lakh Ha.)
Over Exploited	410605.5	17 %
Critical	85149.72	
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

NREGS-Expenditure in Water Related works (In Cr.) 2007-2018 (DORD)

#	State	FY 2017-18	FY 2016-17	FY 2015-16	FY 2014-15	FY 2013-14	FY 2012-13	FY 2011-12	FY 2010-11	FY 2009-10	FY 2008-09	FY 2007-08	Total
1	ANDAMAN AND NICOBAR	0.21	0.11	0.55	1.12	2.71	0.00	0.00	0.00	0.00	0.00	0.00	4.69
2	ANDHRA PRADESH	2579.30	2384.46	2186.09	1116.75	1283.04	1235.41	756.43	0.00	0.00	0.00	0.00	11541.48
3	ARUNACHAL PRADESH	41.80	25.03	9.25	4.81	15.44	10.41	0.23	0.00	0.59	0.16	0.00	107.71
4	ASSAM	181.29	245.26	79.74	58.29	76.94	79.09	104.17	113.24	74.48	38.43	3.20	1054.13
5	BIHAR	505.11	415.01	264.24	118.08	253.62	280.70	131.42	174.91	45.03	18.44	0.91	2207.46
6	DADRA & NAGAR HAVELI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	DAMAN & DIU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	GOA	1.84	2.56	1.77	2.42	1.13	0.29	1.55	1.61	0.86	0.00	0.00	14.02
9	GUJARAT	220.54	273.66	177.86	110.25	130.08	190.09	199.86	278.41	321.36	20.22	0.11	1922.43
10	HARYANA	138.94	145.15	68.25	75.27	95.52	96.55	69.41	60.41	40.50	24.05	1.33	815.39
11	HIMACHAL PRADESH	192.45	187.29	138.47	183.43	305.99	275.89	217.30	183.93	142.91	60.20	1.86	1889.72
12	JAMMU AND KASHMIR	238.48	195.65	184.54	136.68	240.95	273.09	140.49	18.58	6.49	1.51	0.02	1436.49
13	KARNATAKA	1142.57	1358.37	617.70	510.04	816.38	561.69	524.11	517.82	797.66	113.58	10.23	6970.14
14	KERALA	779.16	1153.52	713.55	866.98	689.42	591.58	428.47	0.00	0.00	0.00	0.00	5222.67
15	MADHYA PRADESH	1263.31	1399.40	650.35	1050.90	881.90	1442.62	1583.64	878.61	458.31	366.80	198.58	10174.42
16	MAHARASHTRA	803.15	990.33	881.82	510.50	414.10	891.89	685.92	162.42	87.95	65.22	24.93	5518.25
17	LAKSHADWEEP	0.05	0.00	0.06	0.17	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.69
18	MANIPUR	29.07	133.22	54.70	65.49	57.17	106.51	39.76	2.54	5.15	8.01	0.00	501.62
19	MEGHALAYA	139.03	117.24	25.89	37.89	38.23	23.68	40.21	45.49	13.85	5.42	0.20	487.14
20	MIZORAM	39.17	30.57	42.27	15.00	6.09	11.16	13.49	6.23	4.82	0.61	0.05	169.46
21	NAGALAND	123.23	81.99	15.74	5.94	14.96	19.23	43.78	32.75	9.92	10.10	0.00	357.65
22	ODISHA	365.06	507.06	295.41	200.60	320.99	451.93	261.07	55.80	261.94	138.94	141.00	2999.79
23	PUDUCHERRY	10.39	9.08	8.05	5.27	10.35	11.24	9.67	1.43	0.00	0.00	0.00	65.48
24	PUNJAB	186.17	159.84	92.50	81.02	81.53	49.61	45.32	64.09	47.33	4.19	0.12	811.73
25	RAJASTHAN	1772.61	2172.16	1516.49	1320.42	1137.50	1385.20	1103.32	222.16	520.69	1113.49	2.82	12266.86
26	SIKKIM	20.44	37.43	22.86	15.79	28.29	15.66	7.11	3.48	1.20	0.43	0.00	152.68
27	TAMIL NADU	4121.59	3595.89	3636.92	2492.79	2948.15	2944.83	3.62	0.01	0.00	0.00	0.00	19743.82
28	TRIPURA	148.31	300.06	240.74	236.68	234.40	172.51	208.67	89.85	158.54	92.70	0.16	1882.61
29	UTTAR PRADESH	1259.68	1828.98	73.84	684.03	661.30	700.93	1301.89	1339.01	1054.26	477.47	4.30	9385.68
30	WEST BENGAL	2176.26	2425.29	1523.10	1606.94	1294.42	0.00	1097.83	891.87	370.41	79.06	12.07	11477.25
31	CHHATTISGARH	1054.79	1240.90	565.29	584.58	619.94	701.51	726.90	445.29	244.57	169.03	60.25	6413.05
32	JHARKHAND	626.21	1244.98	761.10	560.46	512.83	775.06	769.51	681.02	456.43	228.67	69.31	6685.57
33	UTTARAKHAND	234.45	277.16	197.90	134.83	172.11	155.22	125.33	89.93	33.04	11.05	2.19	1433.21
34	TELANGANA	771.29	698.09	702.53	363.40	0.00	0.01	0.00	0.00	0.00	0.00	0.00	2535.32
	Total	21165.96	23635.71	15749.55	13156.83	13345.89	13453.60	10640.48	6360.91	5158.27	3047.78	533.63	126248.61

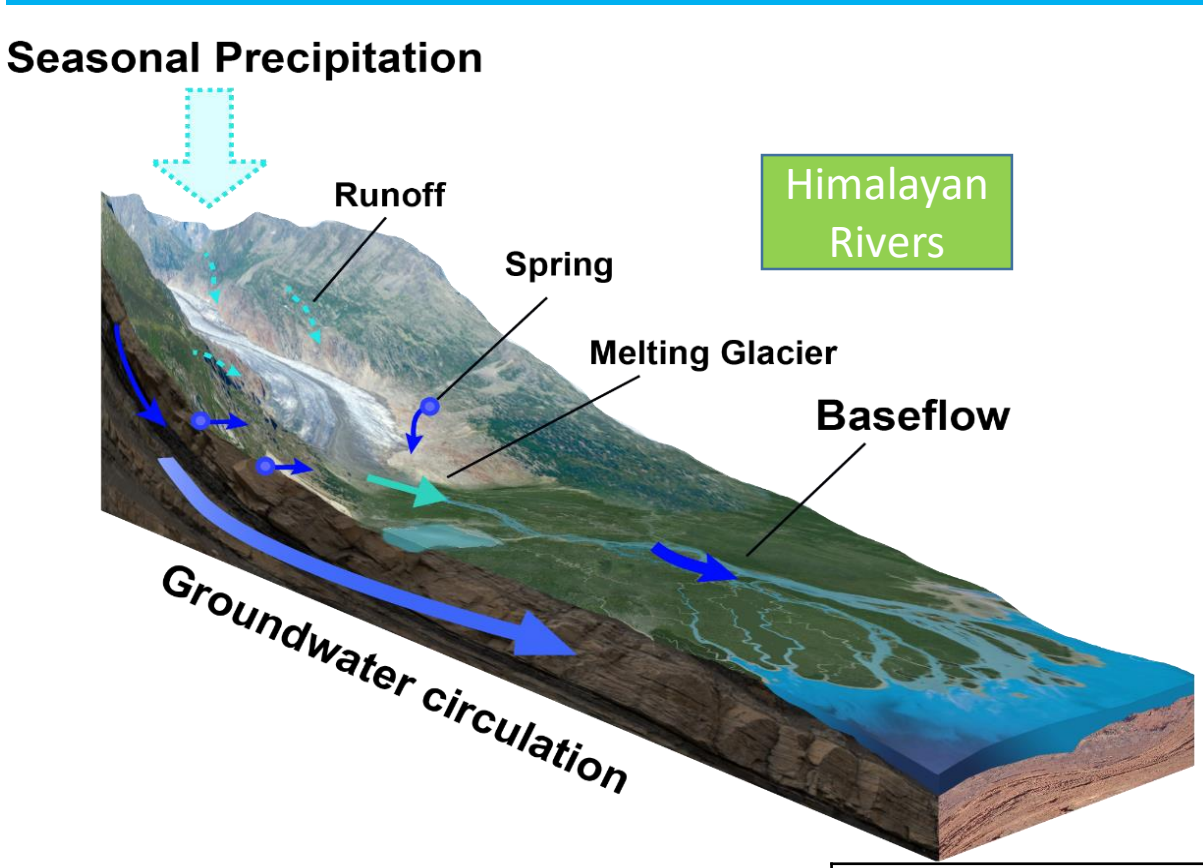
Ground Water Availability, Net Draft and Level of Development for 2004, 2009, 2011, 2013 (CGWB)

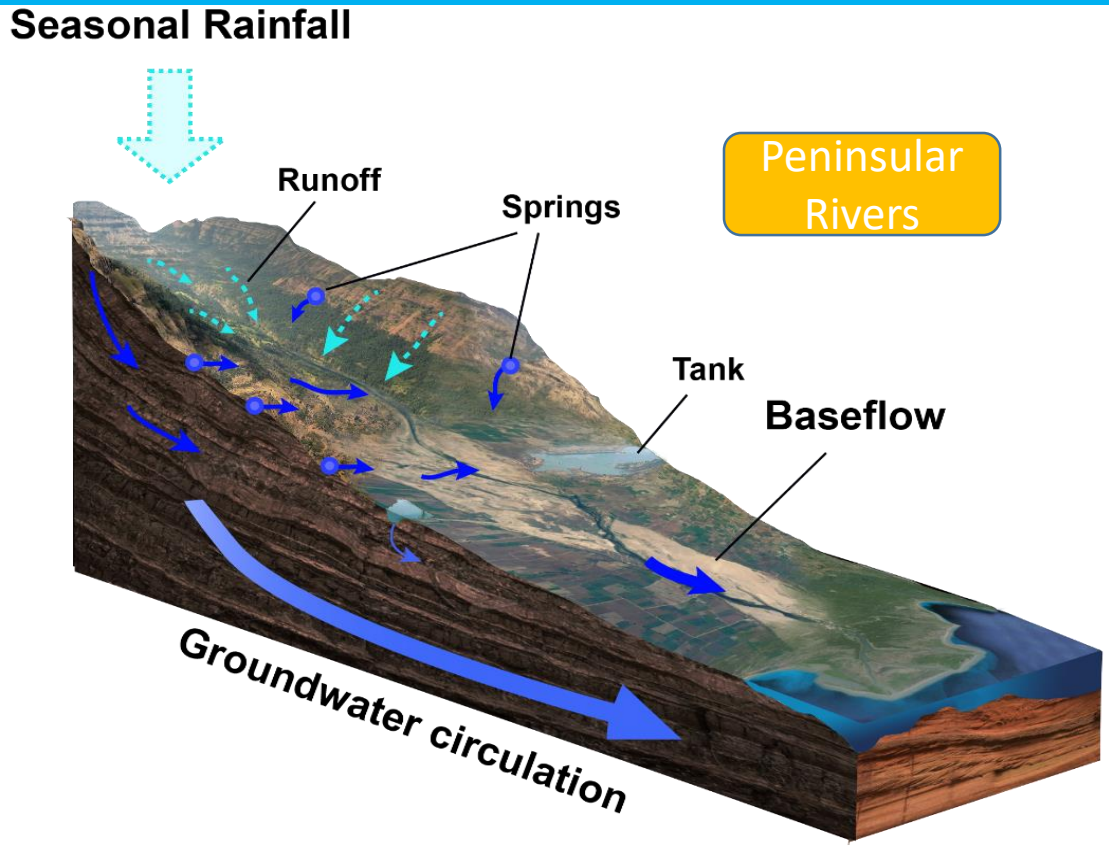
Sl. No.	States / Union Territories	Total Annual Replenishable Ground Water Resource (bcm)				Net Annual Ground Water Availability (bcm)				Total Annual Ground Water Draft (bcm)				Impact on GW Stocks			Stage of Ground Water Development (%)			
		2004	2009	2011	2013	2004	2009	2011	2013	2004	2009	2011	2013	2004-2009	2011-2013	2011-2013	2004	2009	2011	2013
	States																			
1	**Andhra Pradesh**	**36.5**	33.83	20.79	20.39	32.95	30.76	32.57	18.48	14.90	14.15	7.01	8.10	-2.19	1.81	-0.40	45	46	37	44
2	**Arunachal Pradesh**	**2.56**	4.45	4.51	4.433	2.300	4.01	4.06	3.990	0.0008	0.00	0.00	0.01	1.71	0.05	-0.07	0.04	0.07	0.08	0.23
3	**Assam**	**27.23**	30.35	28.52	32.11	24.89	27.81	25.79	28.90	5.44	6.03	3.49	4.74	2.92	-2.02	3.11	22	22	14	16
4	**Bihar**	**29.19**	28.63	29.34	31.31	27.42	26.21	26.86	28.49	10.77	11.36	11.95	12.73	-1.21	0.65	1.63	39	43	44	45
5	**Chhattisgarh**	**14.93**	12.22	12.42	12.80	13.68	11.58	11.63	11.90	2.80	3.60	4.05	4.40	-2.10	0.05	0.27	20	31	35	37
6	**Delhi**	**0.3**	0.31	0.31	0.34	0.28	0.29	0.29	0.31	0.48	0.40	0.39	0.39	0.01	0.00	0.02	170	138	137	127
7	**Goa**	**0.28**	0.22	0.242	0.24	0.27	0.13	0.145	0.15	0.07	0.04	0.041	0.05	-0.14	0.01	0.00	27	33	28	37
8	**Gujarat**	**15.81**	18.43	18.57	20.85	15.02	17.35	17.59	19.79	11.49	12.99	11.86	13.44	2.33	0.24	2.20	76	75	67	68
9	**Haryana**	**9.31**	10.48	10.78	11.36	8.63	9.80	9.79	10.30	9.45	12.43	13.06	13.92	1.17	-0.01	0.51	109	127	133	135
10	**Himachal Pradesh**	**0.43**	0.59	0.56	0.56	0.39	0.53	0.53	0.53	0.12	0.31	0.38	0.27	0.14	0.00	0.00	30	58	71	51
11	**Jammu & Kashmir**	**2.7**	3.70	4.25	5.25	2.43	3.33	3.83	4.82	0.33	0.73	0.81	1.18	0.90	0.50	0.99	14	22	21	24
12	**Jharkhand**	**5.58**	5.96	6.31	6.56	5.25	5.41	5.76	5.99	1.09	1.61	1.86	1.35	0.16	0.35	0.23	21	30	32	23
13	**Karnataka**	**15.93**	16.81	17.03	17.00	15.30	14.81	14.81	14.83	10.71	10.01	9.41	9.76	-0.49	0.00	0.02	70	68	64	66
14	**Kerala**	**6.84**	6.62	6.69	6.27	6.23	6.03	6.07	5.66	2.92	2.81	2.84	2.63	-0.20	0.04	-0.41	47	47	47	47
15	**Madhya Pradesh**	**37.19**	33.95	35.04	35.98	35.33	32.25	33.29	34.16	17.12	17.99	18.83	19.36	-3.08	1.04	0.87	48	56	57	57
16	**Maharashtra**	**32.96**	35.73	33.95	33.19	31.21	33.81	32.15	31.48	15.09	16.95	17.18	17.07	2.60	-1.65	-0.67	48	50	53	54
17	**Manipur**	**0.38**	0.44	0.440	0.474	0.340	0.40	0.396	0.426	0.002	0.00	0.004	0.004	0.06	0.00	0.03	0.65	1	1	1.01
18	**Meghalaya**	**1.15**	1.23	1.7805	3.31	1.04	1.11	1.6024	2.98	0.002	0.00	0.0017	0.0120	0.07	0.49	1.37	0.18	0.15	0.08	0.4
19	**Mizoram**	**0.04**	0.04	0.030	0.03942	0.04	0.04	0.027	0.03548	0.0004	0.00	0.001	0.00104	0.00	-0.01	0.01	0.90	1	4	2.9
20	**Nagaland**	**0.36**	0.42	0.61591	1.94	0.32	0.38	0.55432	1.75	0.01	0.01	0.03399	0.03	0.06	0.17	1.19	3	2.14	6.13	2.0
21	**Orissa**	**23.09**	17.78	17.78	17.78	21.01	16.69	16.69	16.69	3.85	4.36	4.73	5.02	-4.32	0.00	0.00	18	26	28	30
22	**Punjab**	**23.78**	22.56	22.53	25.91	21.44	20.35	20.32	23.39	31.16	34.66	34.88	34.81	-1.09	-0.03	3.07	145	170	172	149
23	**Rajasthan**	**11.56**	11.86	11.94	12.51	10.38	10.79	10.83	11.26	12.99	14.52	14.84	15.71	0.41	0.04	0.43	125	135	137	140
24	**Sikkim***	**0.08**	-	-	-	0.08	0.05	0.04	-	0.01	0.01	0.01	-	-0.03	0.00	-	16	21	26	-
25	**Tamil Nadu**	**23.07**	22.94	21.53	20.65	20.76	20.65	19.38	18.59	17.65	16.56	14.93	14.36	-0.11	-1.27	-0.79	85	80	77	77
26	**Telangana**	-	-	15.098	14.74	-	-	-	13.39	-	-	7.50	7.77	-	-	-0.29	-	-	55	58
27	**Tripura**	**2.19**	2.97	2.58664	2.471	1.97	2.74	2.358	2.269	0.17	0.16	0.16259	0.165	0.77	-0.38	-0.09	9	6	7	7.3
28	**Uttar Pradesh**	**76.35**	75.25	77.19	76.34	70.18	68.57	71.66	71.58	48.78	49.48	52.78	52.76	-1.61	3.09	-0.08	70	72	74	74
29	**Uttarakhand**	**2.27**	2.17	2.04	2.00	2.10	2.07	2.00	1.97	1.39	1.05	1.13	0.99	-0.03	-0.07	-0.03	66	51	57	50
30	**West Bengal**	**30.36**	30.50	29.25	29.33	27.46	27.58	26.58	26.56	11.65	10.91	10.69	11.84	0.12	-1.00	-0.02	42	40	40	45
	Total States	**432.42**	**430.45**	**432.11**	**446.14**	**398.70**	**395.52**	**397.60**	**410.65**	**230.44**	**243.14**	**244.85**	**252.87**	**-3.18**	**2.08**	**13.05**	**58**	**61**	**62**	**62**
	Union Territories																			
1	**Andaman & Nicobar**	**0.33**	0.31	0.308	0.420	0.320	0.30	0.286	0.378	0.010	0.01	0.013	0.0037	-0.02	-0.01	0.09	4	4	4	1
2	**Chandigarh**	**0.023**	0.02	0.022	0.022	0.020	0.02	0.019	0.0194	0.0000	0.00	0.000	0	0.00	0.00	0.00	0	0	0	0
3	**Dadara & Nagar Haveli**	**0.063**	0.06	0.062	0.070	0.060	0.06	0.059	0.063	0.009	0.01	0.013	0.020	0.00	0.00	0.00	14	15	22	32
4	**Daman & Diu**	**0.009**	0.01	0.018	0.015	0.008	0.01	0.017	0.014	0.009	0.01	0.016	0.010	0.00	0.01	0.00	107	99	97	70
5	**Lakshdweep**	**0.012**	0.01	0.0105	0.01055	0.00400	0.00	0.0035	0.00350	0.00200	0.00	0.0023	0.00237	0.00	0.00	0.00	63	74	67	68
6	**Puducherry**	**0.16**	0.17	0.189	0.193	0.144	0.15	0.170	0.174	0.151	0.15	0.153	0.153	0.01	0.02	0.00	105	98	90	88
	Total Uts	**0.597**	**0.59**	**0.61**	**0.73**	**0.56**	**0.54**	**0.56**	**0.65**	**0.18**	**0.18**	**0.20**	**0.189**	**-0.01**	**0.02**	**0.09**	**33**	**34**	**36**	**29**
	Grand Total	**433.02**	**431.03**	**432.72**	**446.87**	**399.25**	**396.06**	**398.16**	**411.30**	**230.62**	**243.32**	**245.06**	**253.06**	**-3.19**	**2.10**	**13.14**	**58**	**61**	**62**	**62**

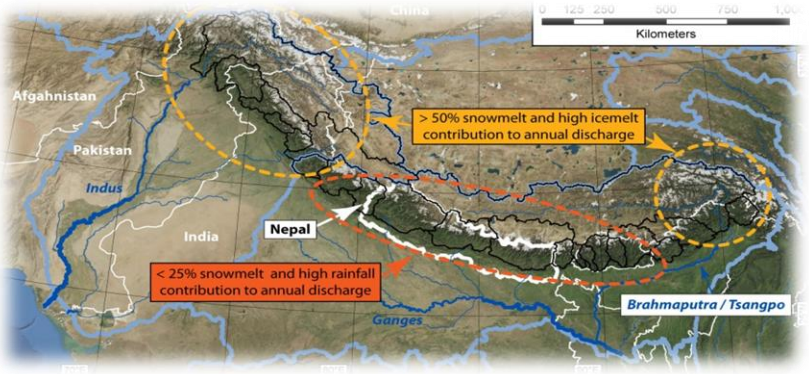
Comparison - Categorization of Blocks/ Mandals/ Taluks/Firka In India from 2004 to 2013 (CGWB)

Sl.No	States / Union Territories	Total No. of Assessed Units				Safe				Semi-critical				Critical				Over-exploited				Saline			
		2004	2009	2011	2013	2004	2009	2011	2013	2004	2009	2011	2013	2004	2009	2011	2013	2004	2009	2011	2013	2004	2009	2011	2013
	States																								
1	Andhra Pradesh	1231	1108	662	670	760	867	534	497	175	93	42	54	77	26	7	17	219	84	41	61	0	38	38	41
2	Arunachal Pradesh	13	16	11	11	13	16	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Assam	23	23	27	27	23	23	27	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Bihar	515	533	533	534	515	529	522	520	0	4	11	14	0	0	0	0	0	0	0	0	0	0	0	0
5	Chhattisgarh	146	146	146	146	138	132	125	125	8	14	18	18	0	0	2	2	0	0	1	1	0	0	0	0
6	Delhi	9	27	27	27	2	2	2	5	0	5	5	7	0	0	2	0	7	20	18	15	0	0	0	0
7	Goa	11	11	20	12	11	11	20	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Gujarat	223	223	223	223	97	156	171	175	69	20	13	9	12	6	5	6	31	27	24	23	14	14	10	10
9	Haryana	113	116	116	119	42	18	23	30	5	9	7	11	11	21	15	14	55	68	71	64	0	0	0	0
10	Himachal Pradesh	5	8	8	8	5	6	5	6	0	0	0	0	0	1	2	1	0	1	1	1	0	0	0	0
11	Jammu & Kashmir	8	14	14	22	8	14	14	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Jharkhand	208	208	210	260	208	200	199	244	0	2	5	10	0	2	0	2	0	4	6	4	0	0	0	0
13	Karnataka	175	270	270	176	93	154	152	98	14	34	34	21	3	11	21	14	65	71	63	43	0	0	0	0
14	Kerala	151	152	152	152	101	126	126	131	30	22	23	18	15	3	2	2	5	1	1	1	0	0	0	0
15	Madhya Pradesh	312	313	313	313	264	224	218	228	19	61	67	58	5	4	4	2	24	24	24	25	0	0	0	0
16	Maharashtra	318	353	353	353	287	324	325	324	23	19	16	19	1	1	2	1	7	9	10	9	0	0	0	0
17	Manipur	7	8	8	9	7	8	8	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Meghalaya	7	7	7	11	7	7	7	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Mizoram	22	22	22	22	22	22	22	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Nagaland	7	8	8	11	7	8	8	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Odisha	314	314	314	314	308	308	308	308	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6
22	Punjab	137	138	138	138	25	23	22	26	4	2	2	3	5	3	4	4	103	110	110	105	0	0	0	0
23	Rajasthan	237	239	243	248	32	31	25	44	14	16	20	28	50	25	24	9	140	166	172	164	1	1	2	3
24	Sikkim	1	4	4	-	1	4	1		0	0	0		0	0	0		0	0			0	0		
25	Tamil Nadu	385	386	1129	1139	145	136	437	429	57	67	235	212	33	33	48	105	142	139	374	358	8	11	35	35
26	Telangana			448	443			343	311			55	74			8	12	0		42	46	0		0	0
27	Tripura	38	39	39	39	38	39	39	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Uttar Pradesh	803	820	820	820	665	605	559	603	88	107	82	45	13	32	68	59	37	76	111	113	0	0	0	0
29	Uttarakhand	17	17	18	18	12	11	11	16	3	5	5	1	0	1	2	1	2	0	0	0	0	0	0	0
30	West Bengal	269	269	271	268	231	231	217	191	37	38	53	76	1	0	1	1.00	0	0	0	0	0	0	0	0
	Total States	**5705**	**5792**	**6554**	**6533**	**4067**	**4235**	**4481**	**4475**	**546**	**518**	**693**	**678**	**226**	**169**	**217**	**252**	**837**	**800**	**1069**	**1033**	**29**	**70**	**91**	**95**
	Union Territories																								
1	Andaman & Nicobar	1	33	36	34	1	33	36	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Chandigarh	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Dadra & Nagar Haveli	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Daman & Diu	2	2	2	2	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0
5	Lakshdweep	9	9	9	9	6	5	6	6	3	4	3	3	0	0	0	0	0	0	0	0	0	0	0	0
6	Puducherry	4	4	4	4	2	2	2	3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Total Uts	**18**	**50**	**53**	**51**	11	**42**	**46**	**45**	**4**	**5**	**4**	**3**	**0**	**0**	**0**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**
	Grand Total	**5723**	**5842**	**6607**	**6584**	**4078**	**4277**	**4527**	**4520**	**550**	**523**	**697**	**681**	**226**	**169**	**217**	**253**	**839**	**802**	**1071**	**1034**	**30**	**71**	**92**	**96**

Shrinking of Peninsular rivers







	RIVER DISCHARGE CONTRIBUTION			
	HIMALAYAN RIVERS		NON-HIMALAYAN RIVERS	
	Monsoon Season	Dry Season	Monsoon Season	Dry Season
Glacier	5%	**60%**	0%	**0%**
Precipitation	90%	5%	95%	5%
Groundwater (Base flow)	5%	**35%**	5%	**95%**

Groundwater is the major source of water for different industrial sectors across India. 55% of those surveyed used groundwater with or without some other source of water

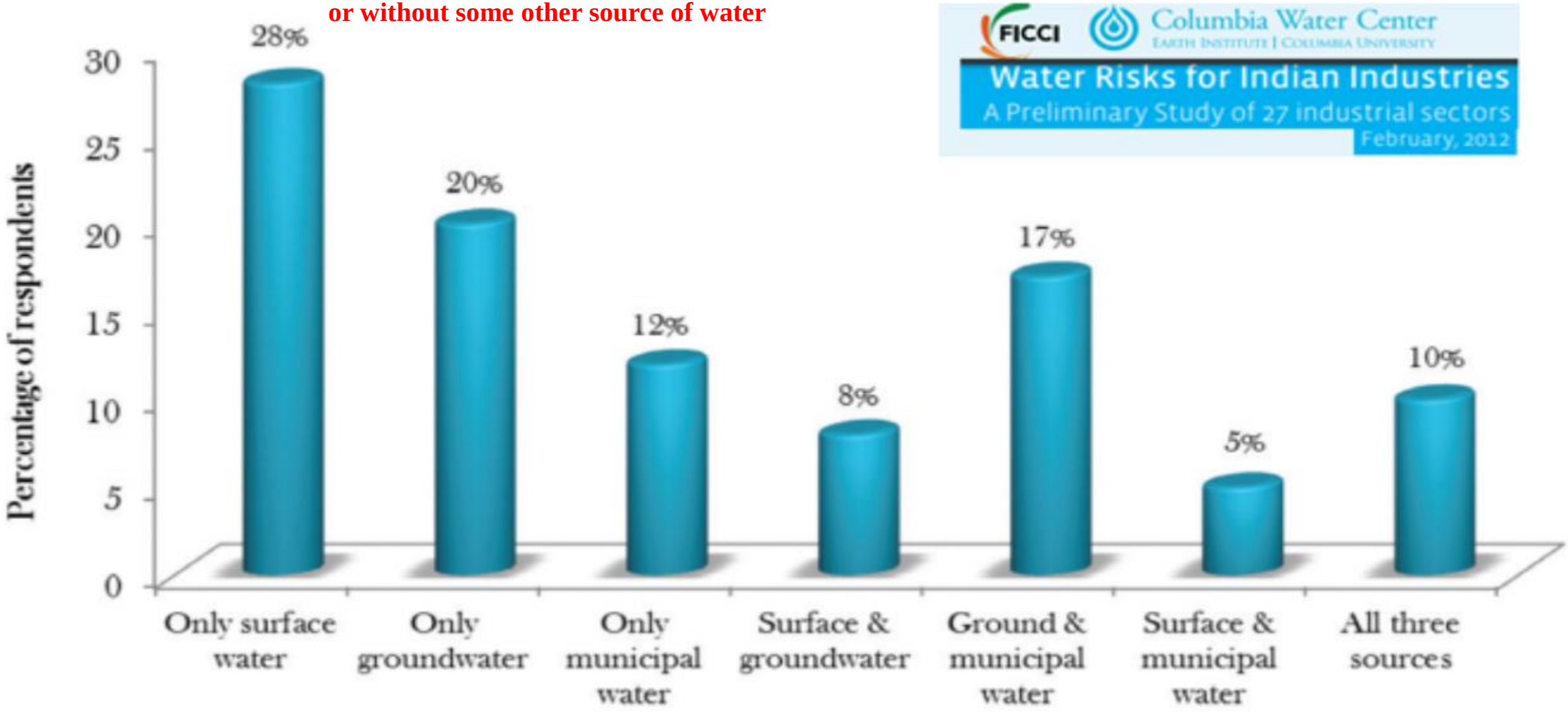
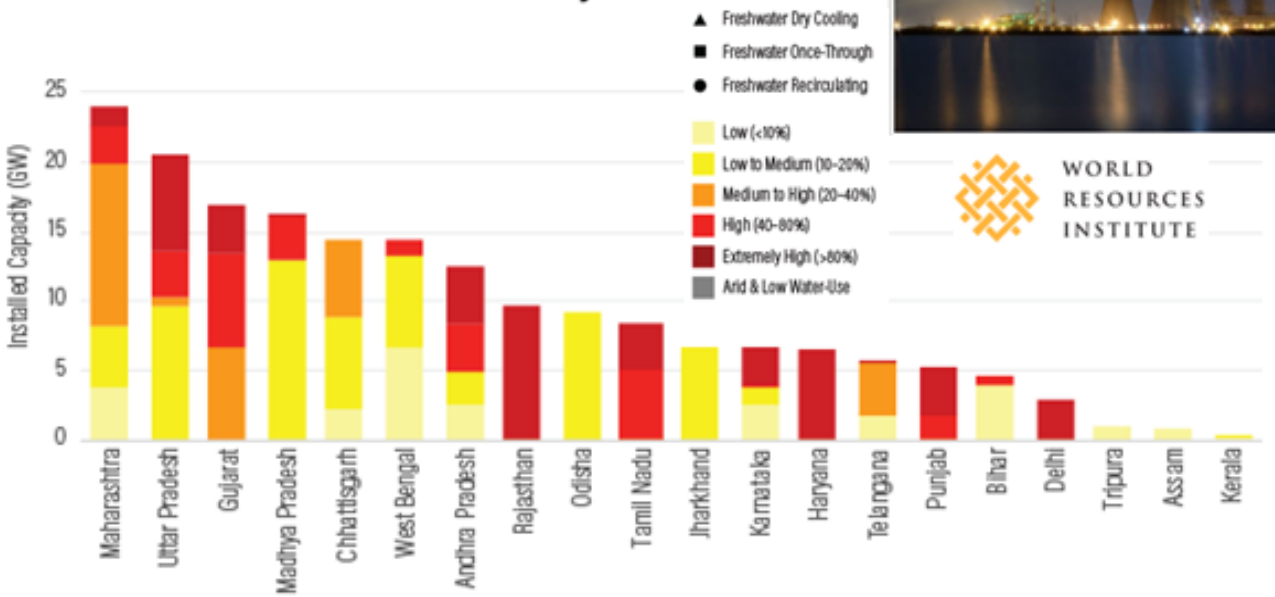


Figure 2: Source of water for industrial uses

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

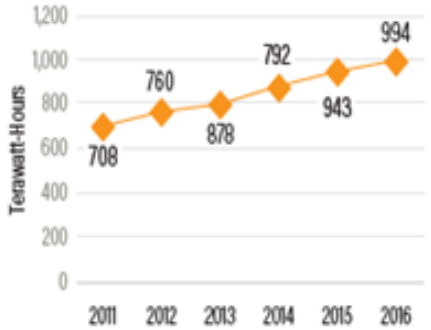
Thermal power—power that relies on fuels like coal, natural gas and nuclear energy—provides India with 83 percent of its total electricity.

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.

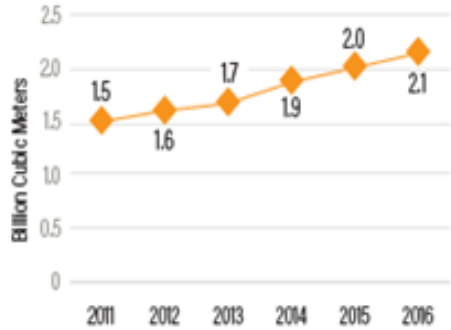
Almost 90 percent of India's thermal power generation depends on freshwater for cooling.

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

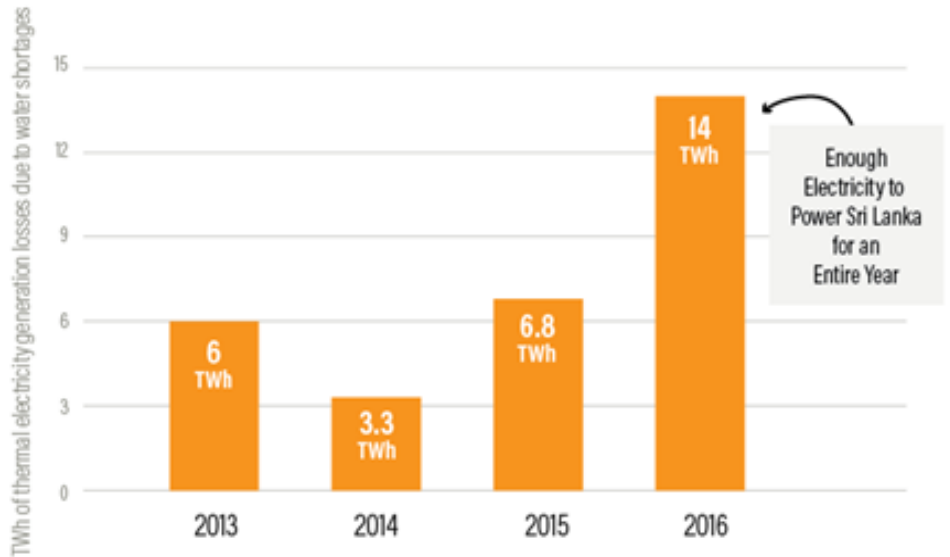
Thermal utility generation grew by 40% between 2011 and 2016



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



Dr.M.Ariz Ahammed IAS NWM

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

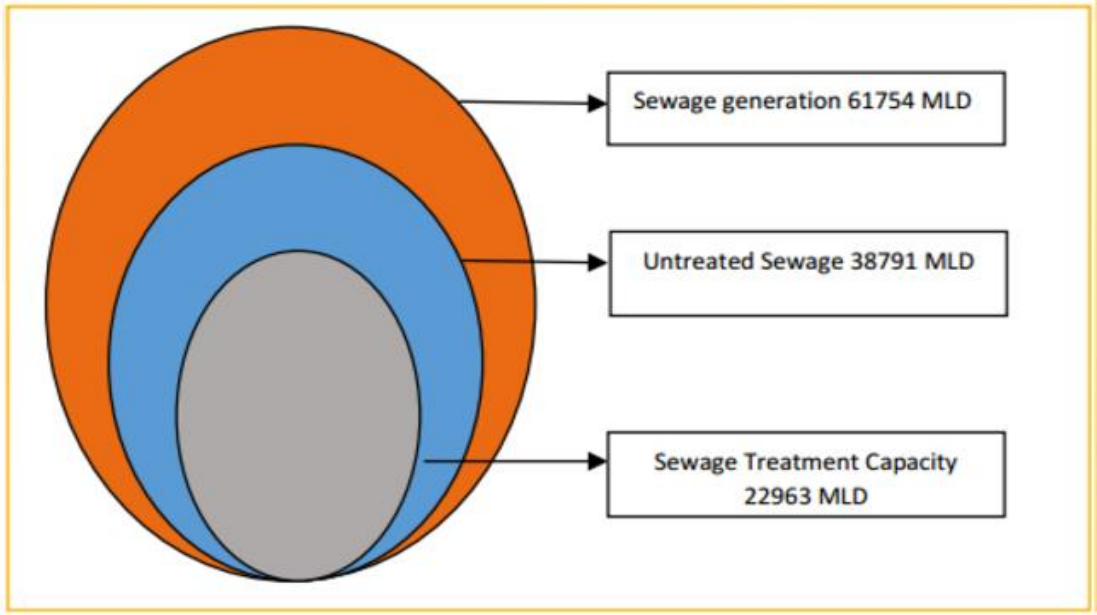
Sources: WRI analysis; CEA 2017; Ceylon Electricity Board 2015; Platts 2017 WORLD RESOURCES INSTITUTE

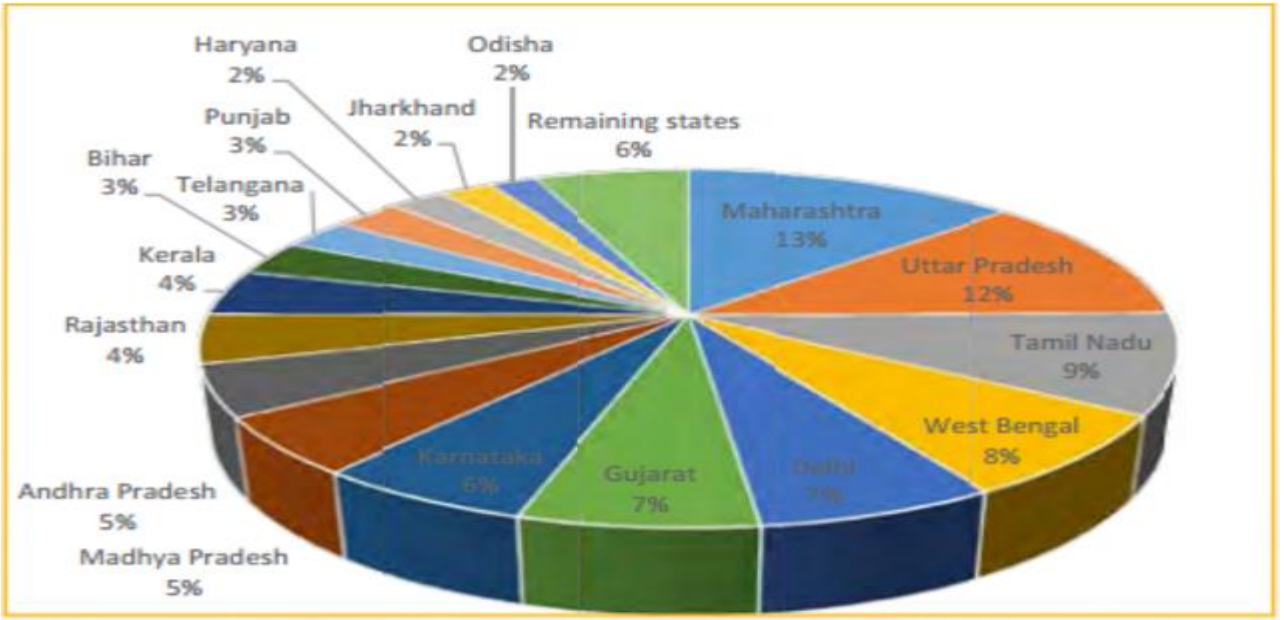
National status of waste water generation & treatment

During 2015,the estimated sewage generation in the country was 61754 MLD as against the developed sewage treatment capacity of 22963 MLD. 62% of the total sewage I

http://www.sulabhenvis.nic.in/Database/STST_wastewater_2090.aspxs discharged directly into nearby water bodies

- 5 states viz Maharashtra, Tamil Nadu, Uttar Pradesh, Delhi & Gujarat account for approximately 50% of the total sewage generated.
- Maharashtra, Gujarat, Delhi , Uttar Pradesh & Gujarat account for 67% of the total sewage treatment capacity installed
- No sewage treatment plant has been established in seven states/UTs viz. Arunachal Pradesh, Chhattisgarh, Daman Diu, Nagaland , Assam & Tripura.
- The capacity of STPs installed in the two states viz. HP & Sikkim is adequate to treat the total quality of sewage generated in these states.





DILAPIDATED TANKS

Damaged Weir

Breached Bund

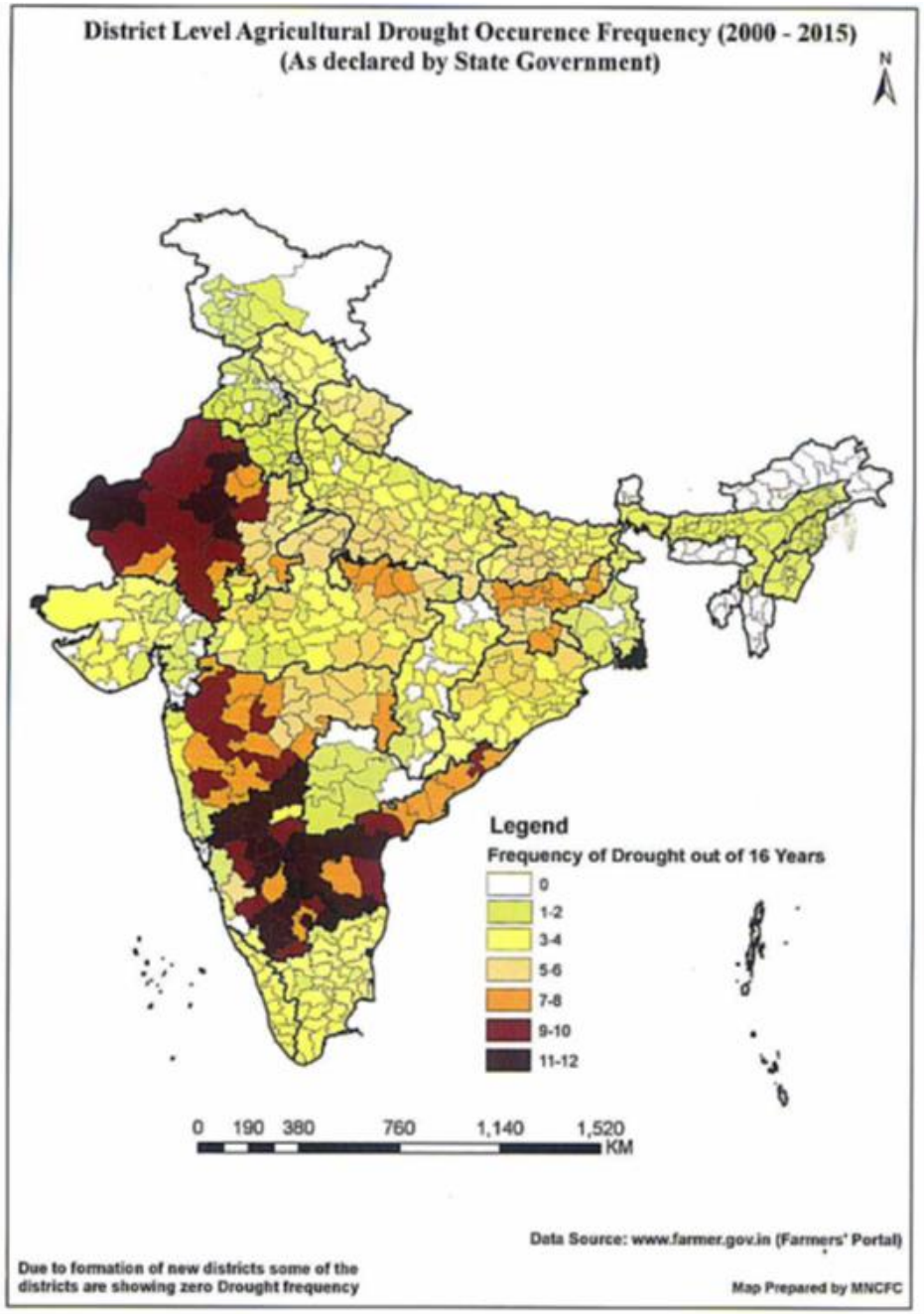
Damaged Sluice

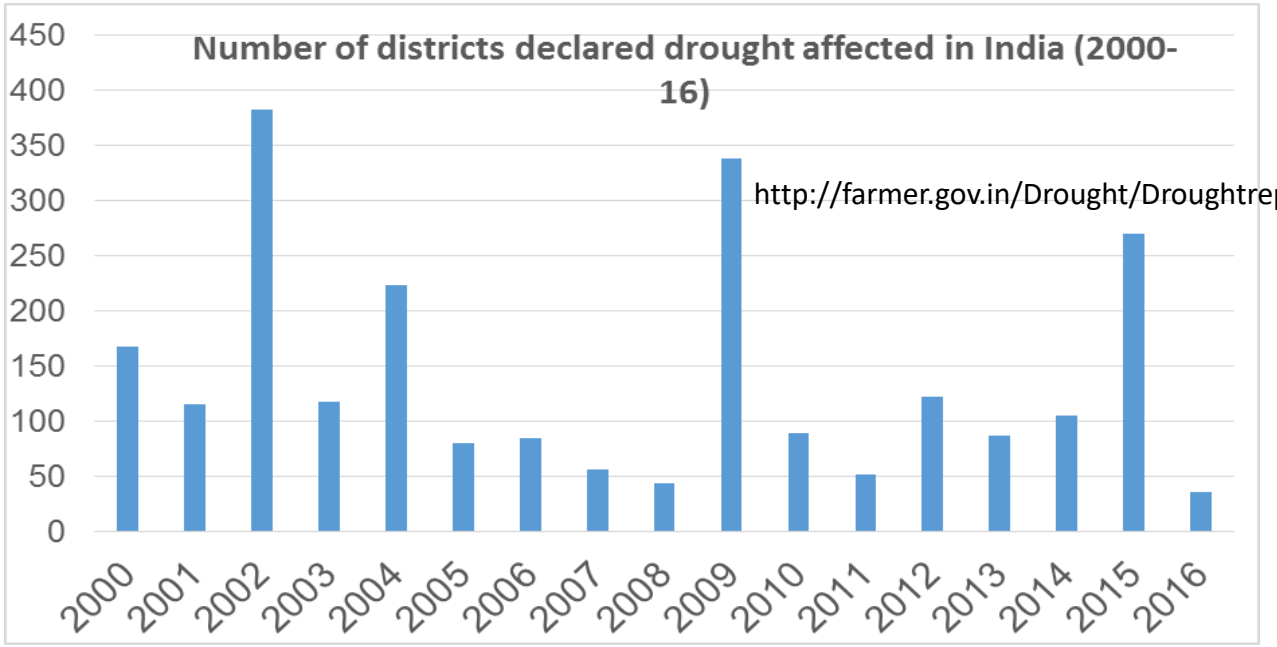
Damaged Bund

Damaged Bund

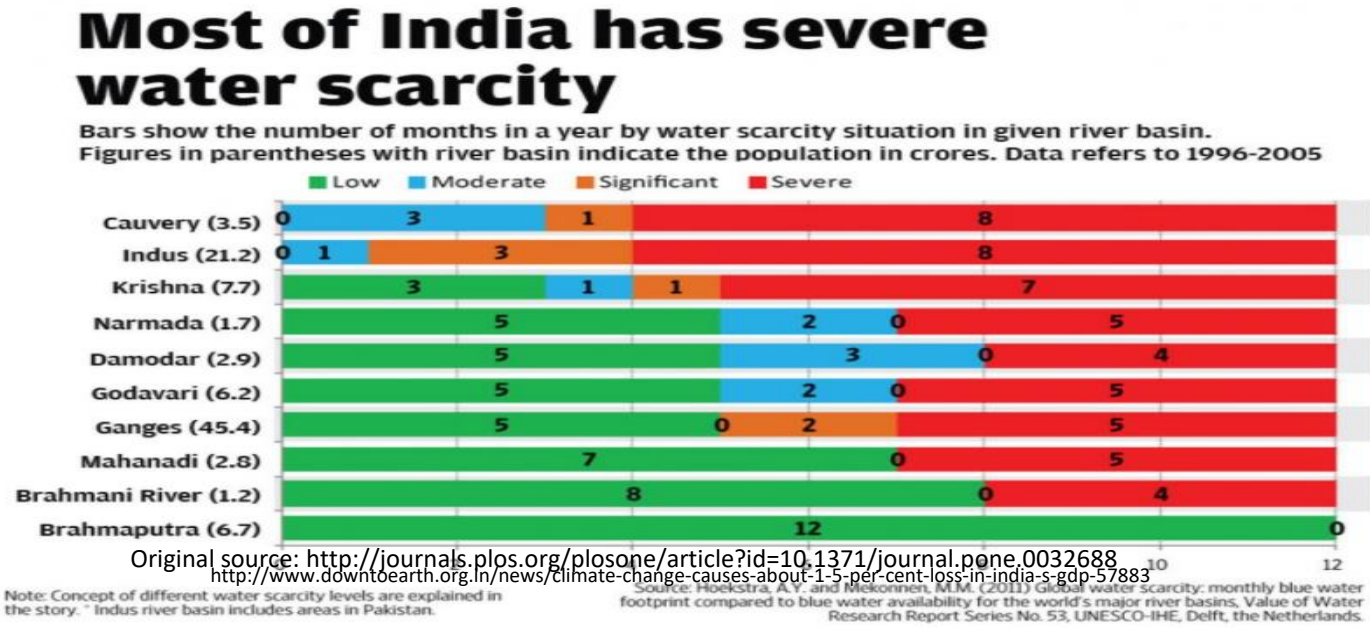
Dried tank full of silt

Risks: Droughts- Regular feature?





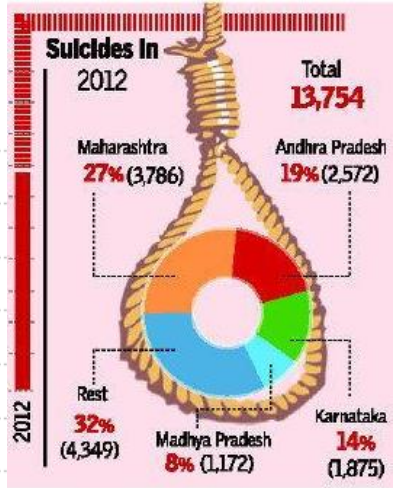
http://farmer.gov.in/Drought/Droughtreport.aspx



Original source: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0032688
http://www.downtoearth.org.in/news/climate-change-causes-about-1-5-per-cent-loss-in-india-s-gdp-57883

Farmer suicides from 1995 to 2015

Total No of Farmer suicides reported in India per year as NCRBC, India[2][8][9][10]



Suicides Reported as per NCRB

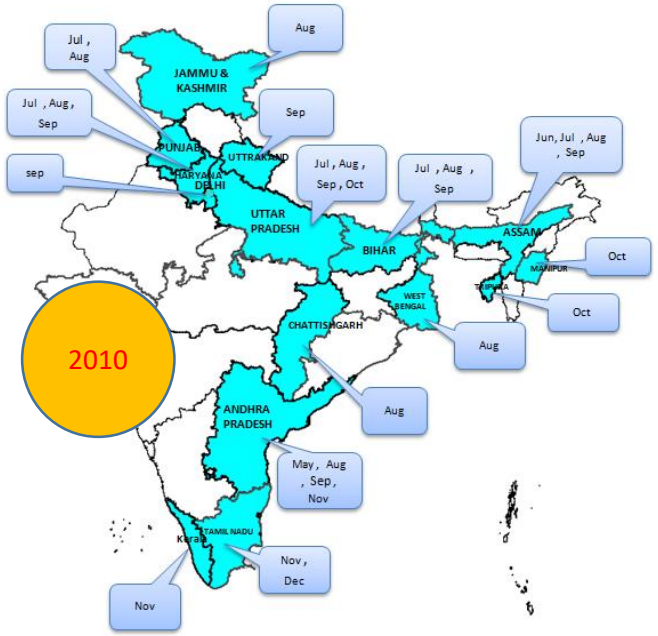
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0

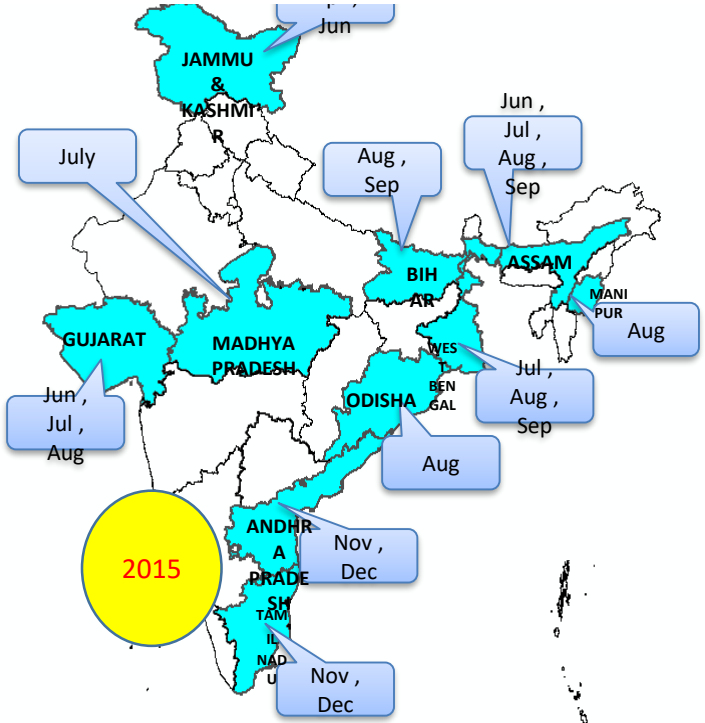
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

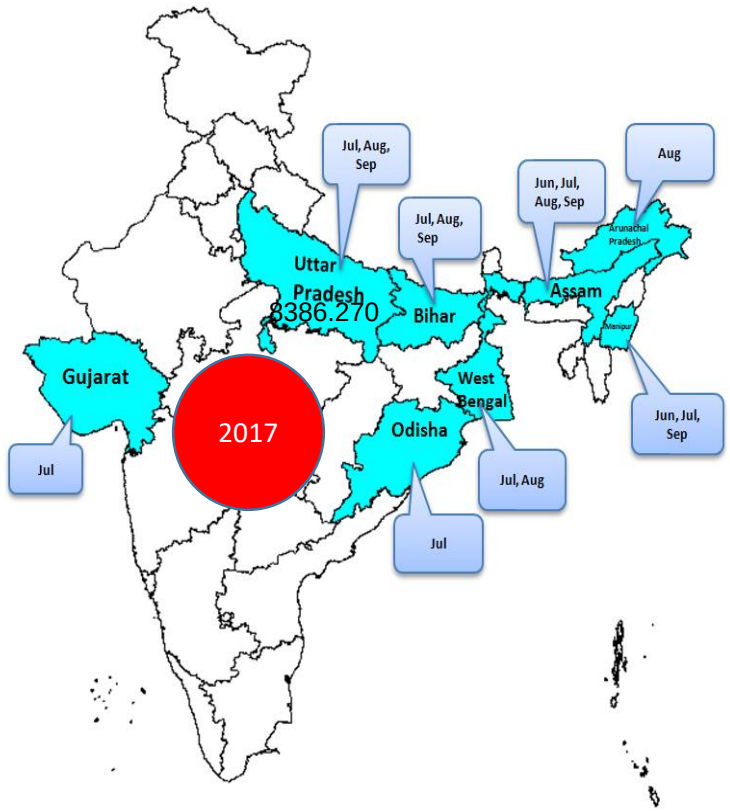
Year

https://en.wikipedia.org/wiki/Farmers%27_suicides_in_India#/media/File:Farmer_suicide.png

STATEWISE FLOOD INUNDATED AREA STATISTICS FOR 2017
Source: NRSC







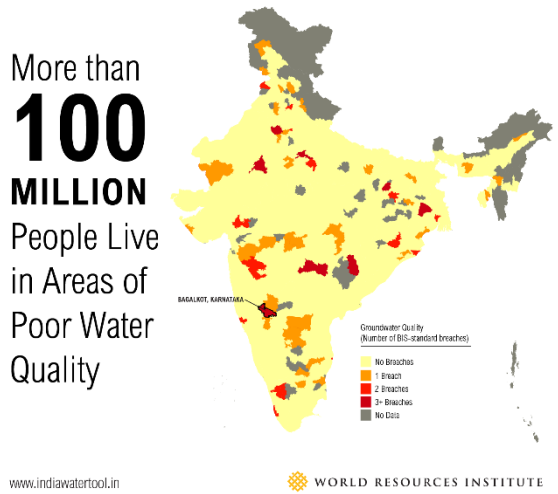
State	2010	2015	2017
Andhra Pradesh	200372	238357	
Arunachal Pradesh			3841
Assam	336597	720450	1164200
Bihar	319357	149552	866643
Chattisgarh	8800		
Delhi	3192		
Gujarat		80151	96686
Jammu & Kashmir		17726.7	
Madhya Pradesh		7708.45	
Manipur	5183	20321.3	82545
Odisha		53431.5	38320
Punjab & Haryana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

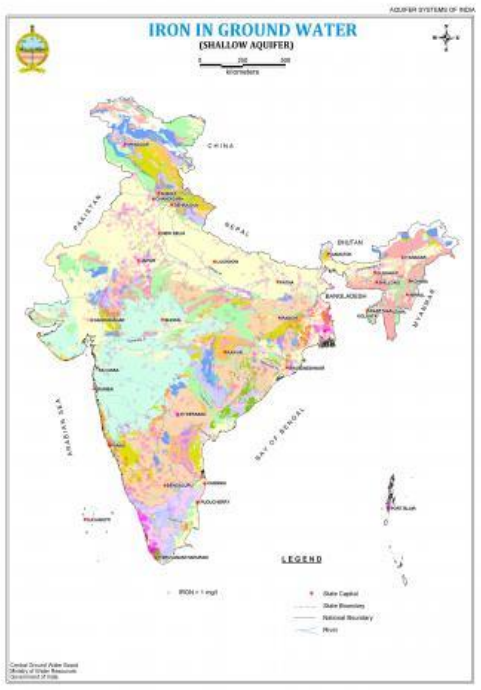
Flood Damage Data Period(India): 1953-2016 Source: CWC (2018)					
Area Affected (mha)		Affected Population (million)		Total Damages (in Crores)	
Average	Maximum	Average	Maximum	Average	Maximum
7.2	17.5 (in 1978)	31.88	70.45 (in 1978)	5432	57394 (in 2015)

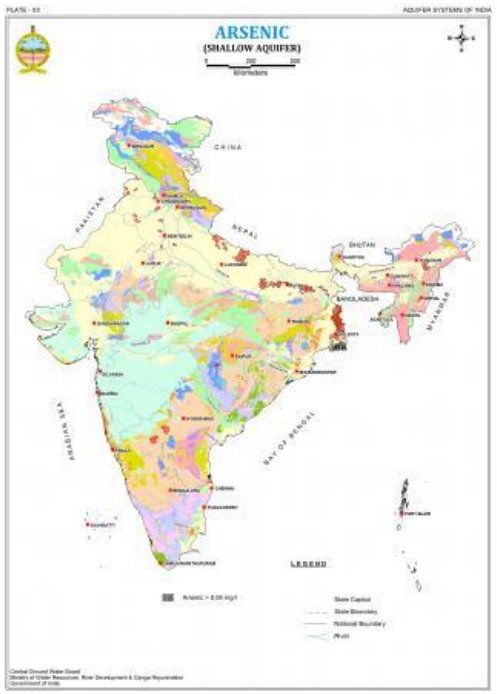
Water Quality challenges (Chemical)

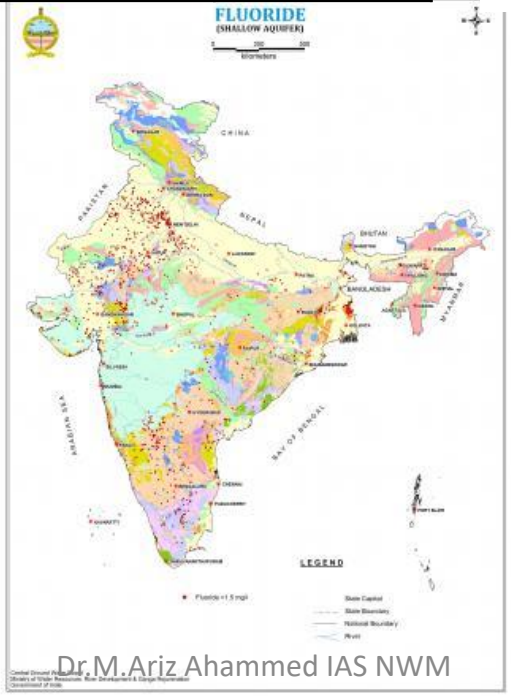
Source: HDR, 2006 + CGWB

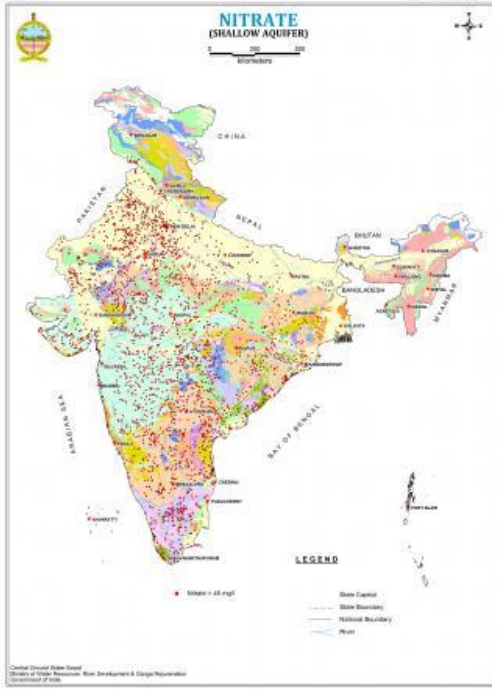
	Number of Districts affected (CGWB)			
	2000	2005	2010	2015
Fe	Not monitored annually			301
Arsenic*	Not monitored annually			153
Fluoride	151	144	184	171
Nitrate	267	265	282	286
EC	167	144	162	154

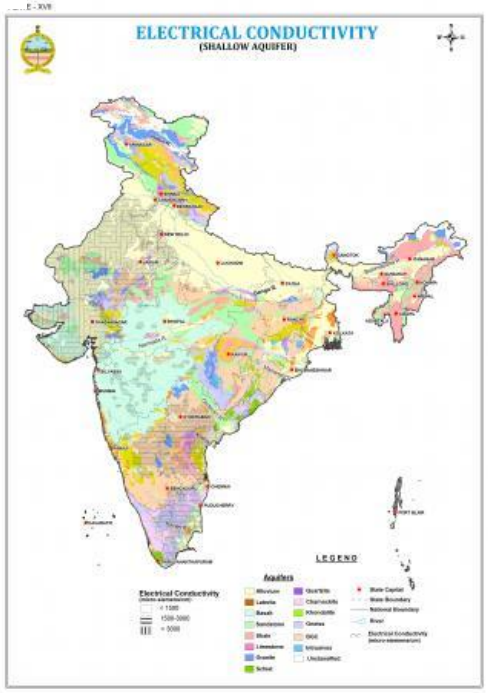


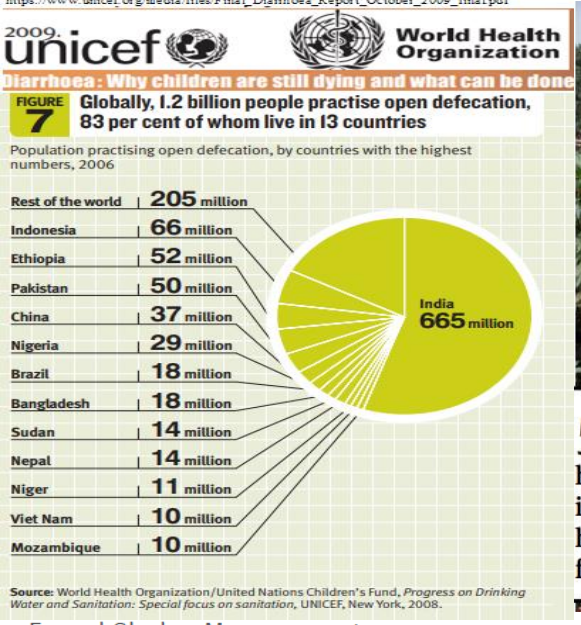




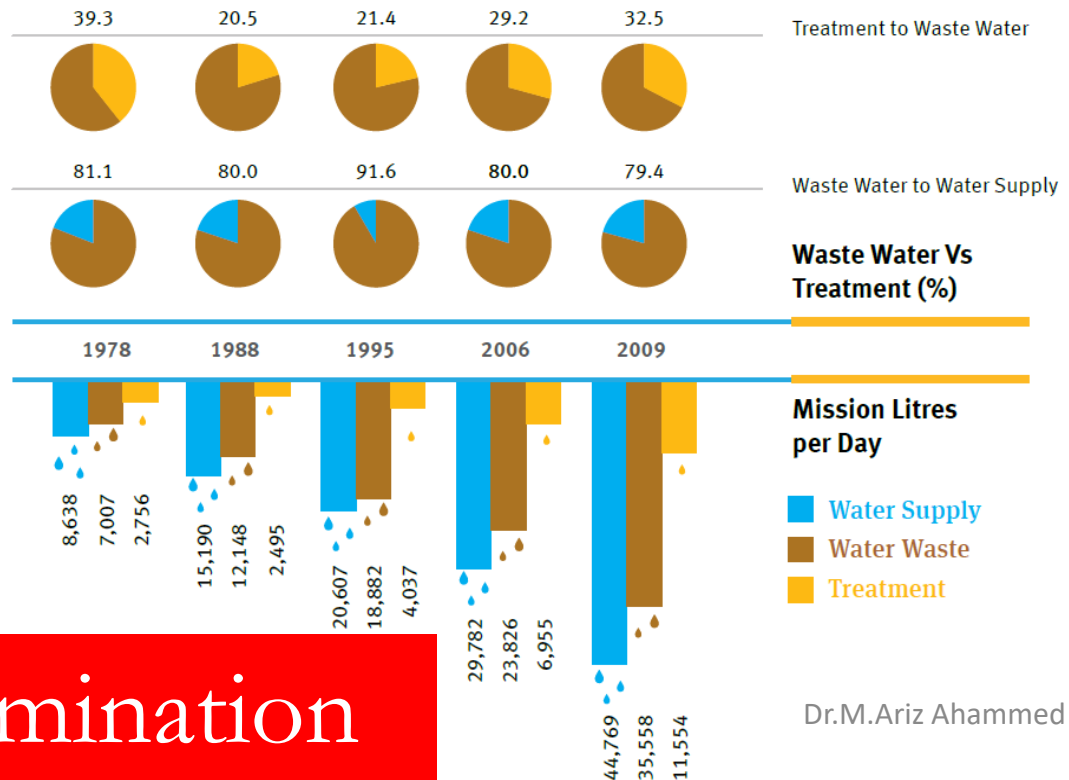








Faecal Sludge Management



	Installed Capacity (MLD)	Actual Utilised capacity (MLD)	% Utilisation	No. of STPs
Delhi	20	20	100	2
Uttar Pradesh	168.4	123.7	73	9
Madhya Pradesh	284	124.2	44	6
Gujarat	232	226	97	2
Maharashtra	798.94	394	49	18
Tamil Nadu	779.6	585.8	75	24
	4716.33	3126.42	66	152

Table 5 - State-wise treatment capacity and capacity utilisation

Source - Performance evaluation of Sewage Treatment Plants by CPCB, 2013, p 15

Contamination

Lok Sabha Unstarred Question No. 3203 5th January, 2018 on 'Pollution in Rivers'

THE TIMES OF INDIA

Polluted rivers

Ashish Chauhan| TNN | Jan 29, 2018, 06:34 IST

STATE RANKINGS

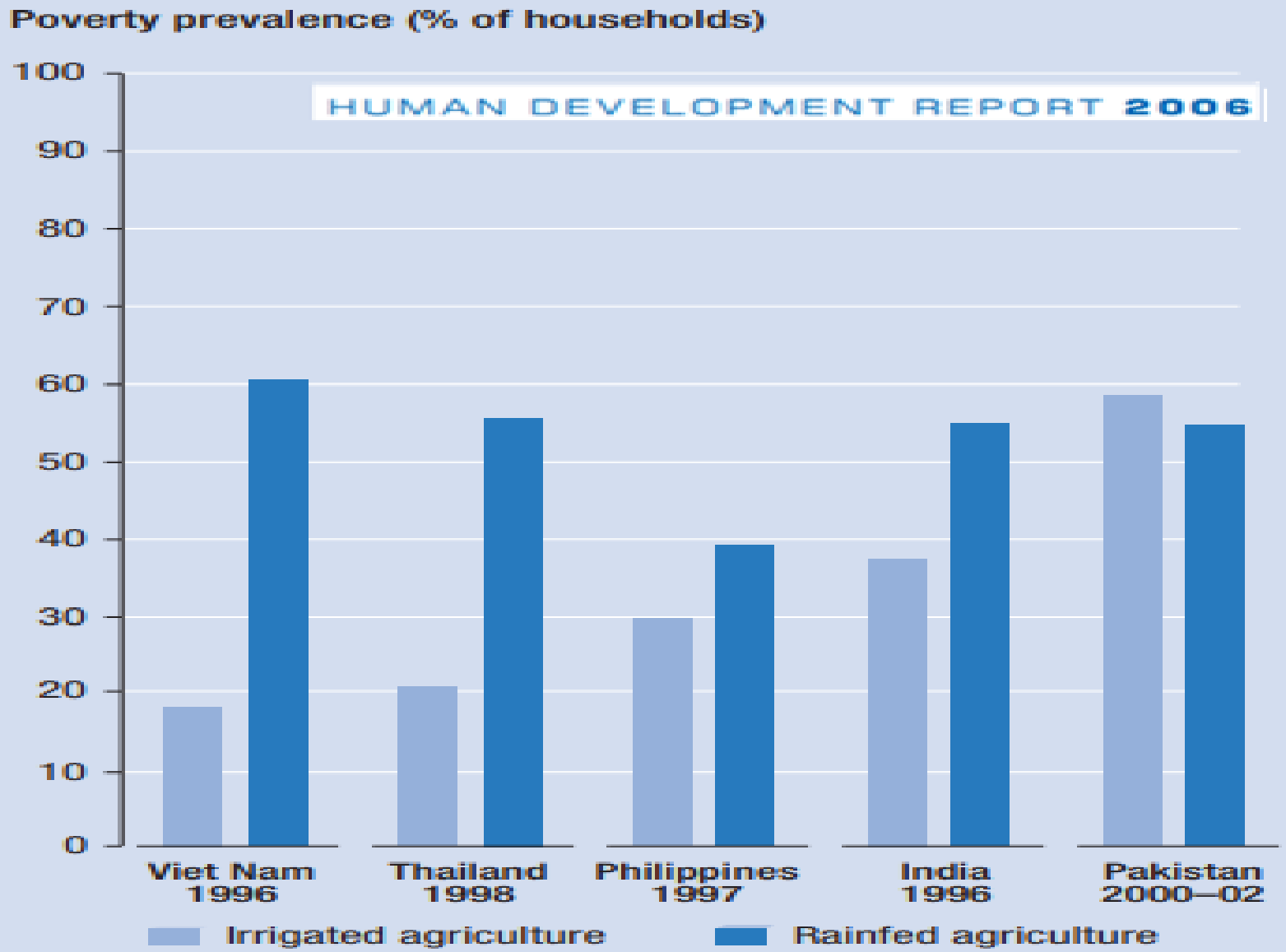
States with most polluted rivers

State	Number of Polluted Rivers
Maharashtra	49
Assam	28
MP	21
Gujarat	20
West Bengal	17
Karnataka	15
Kerala	13

As per figures of the Union Ministry of Environment, Forest and Climate Change (MoEF) submitted in Lok Sabha on January 5 2018

https://timesofindia.indiatimes.com/city/ahmedabad/polluted-rivers-guj-ranks-4th/articleshow/62685910.cms

Figure 5.4 **Irrigation is linked to lower poverty in many developing countries**

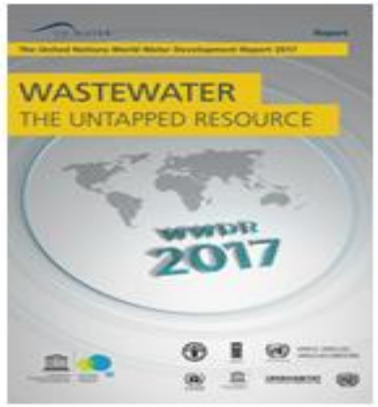


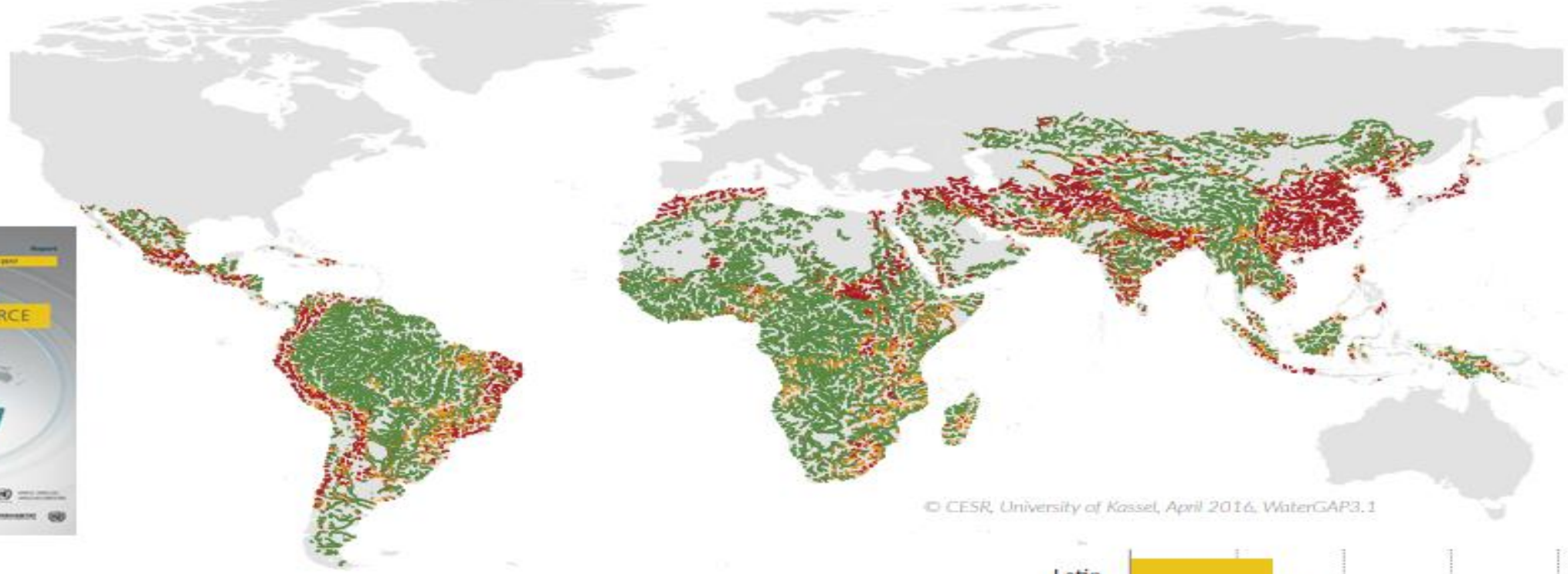
Note: Data refer to selected sites in each country.

Source: Hussain and Hanjra 2003.

2017 UN World Water Development Report: Wastewater,

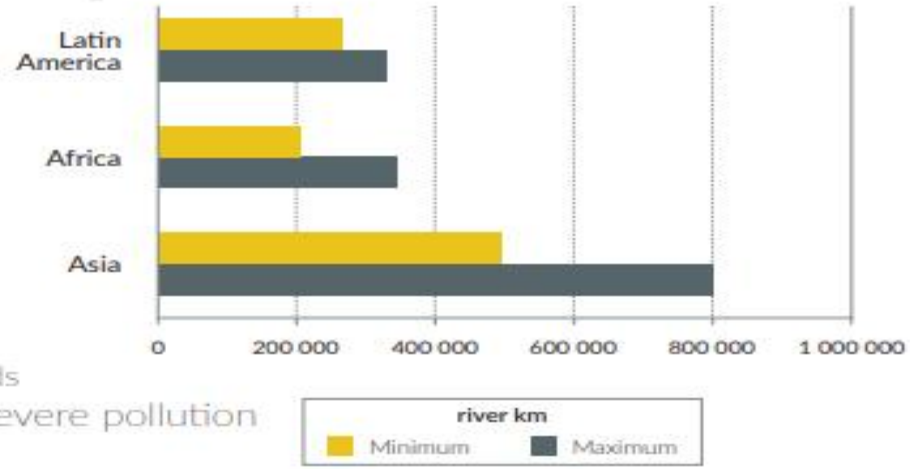
Figure 4 Estimated in-stream concentrations of faecal coliform bacteria (FC) for Africa, Asia and Latin America (February 2008–2010)* *Source: UNEP (2016, Fig. 3.3, p. 20).*





February 2008–2010
FC [cfu/100ml]

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



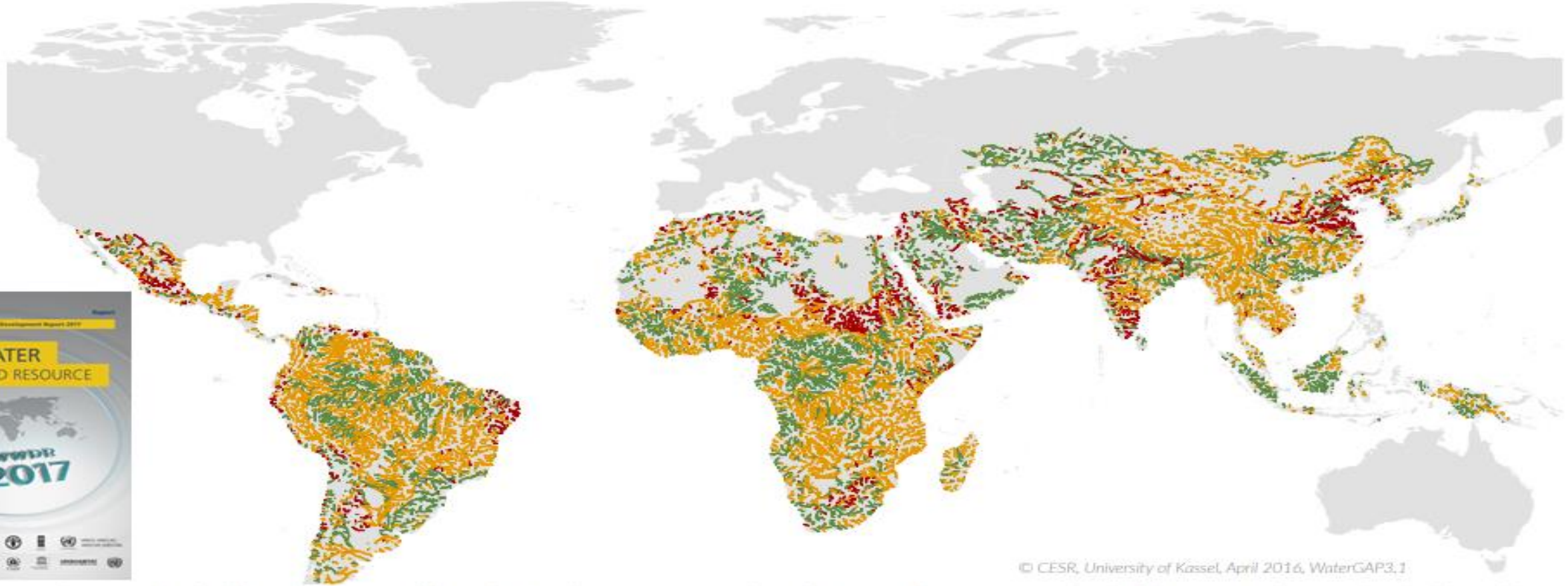
Notes: *Low*: Suitable for primary contact; *Moderate*: Suitable for irrigation; *Severe*: Exceeds thresholds

* 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.

2017 UN World Water Development Report: Wastewater,

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

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



© CESR, University of Kassel, April 2016, WaterGAP3.1

* 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

Water : Health (Biological)

Lack of access to clean drinking water and sanitation

unicef
for every child

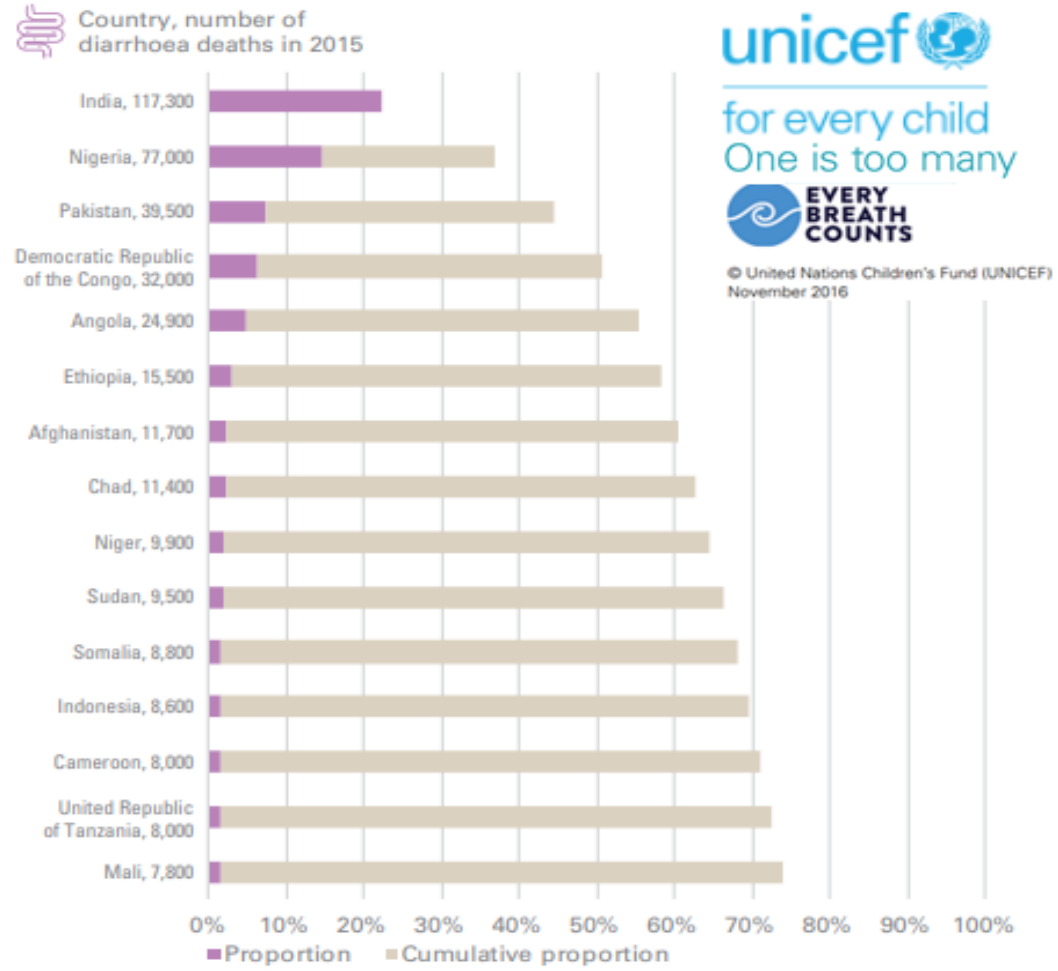


Figure 4b: Top 15 countries with highest number of diarrhoea deaths in children under 5 in 2015

Number of people with blinding trachoma by country or region, 2004

Region	Number of people with blinding trachoma
China	1,174,000
India	865,000
Other Asia and islands	1,362,000
Sub-Saharan Africa	1,380,000
Middle East	927,000
Latin America	158,000
Total	**5,866,000**

Source: Sight Savers International 2006.

India's Water Problems' Statement

		Scenario / Impact	Cause
Supply/ Source side	Ground Water	Water Scarcity in North-western States	Indiscriminate extraction /decline in water tables with distorted power policy; Inland salinity
		Water scarcity: Western states	Arid: Low recharge with low rainfall.
		Water Stress/ scarcity in Central India States (Bundelkhand region).	Geo-morphology / Hard rock formation with meagre discharge/ High runoff.
		Water Stress/ Scarcity : Southern States	Hard rock formation/ Limited yields / Poor storage
		Shallow Water tables in Eastern States	Underutilisation, Poor crop intensification; Poor farmers; Small & fragmented landholdings; Poor (/no) power supply
	Surface Water	Decline in base flow in non-monsoon in Peninsular rivers.	Over Extraction of GW; Inadequate afforestation & Water conservation
		Flow of large runoff into sea	Inadequate reservoir storage
	Coastal zone	Mixing of saline water; Sea water intrusion	Tidal fluctuations; Cyclone/ Storm Surge induced forced recharging
	Tanks & Wetlands	Encroachment / ruin; Degradation of Watershed	Human factors / Socio-economic issues
	Springs	Drying ; obstructions	No inventory, Human factors and Climate change
	Wastewater	Underutilisation of Waste Water	lack of water treatment plants; underutilisation of capacity; Poor maintenance & poor enforcement
	Precipitation	Droughts	Low rainfall, intense evaporation; Inadequate Storage
		Floods & Erosion	Uneven distribution of rainfall in time & space frame, inadequate capacity of drainage system, unregulated development of flood plains, Inadequate flood storages
Demand side	Drinking Water	Less-availability of safe DW	Stress / Scarcity at source; Poor Measurement, capital intensive infrastructure for water treatment plant; Leakages, In efficient technology.
	Farm Sector	Irrigated: Largest consumer; Poor WUE	Inadequate storage; Seasonal shortages Rice, Wheat, Sugarcane, Cotton are in 60 M.Ha against total irrigated area of 87 MHa.
		Rainfed: Droughts	Extremes of Water availability
	Industry	Poor WUE; Inadequacy in supply; Closure of Industries	Poor technology; Poor recycling Location in water scarce areas;

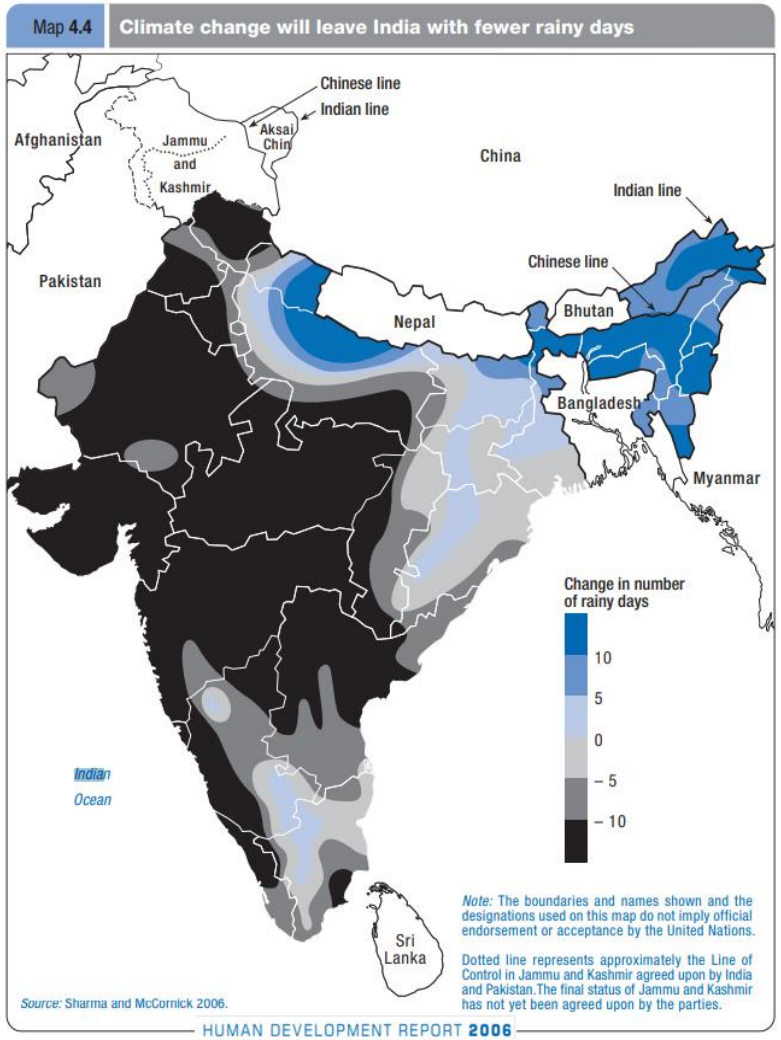
India's Water Problems' Statement -2

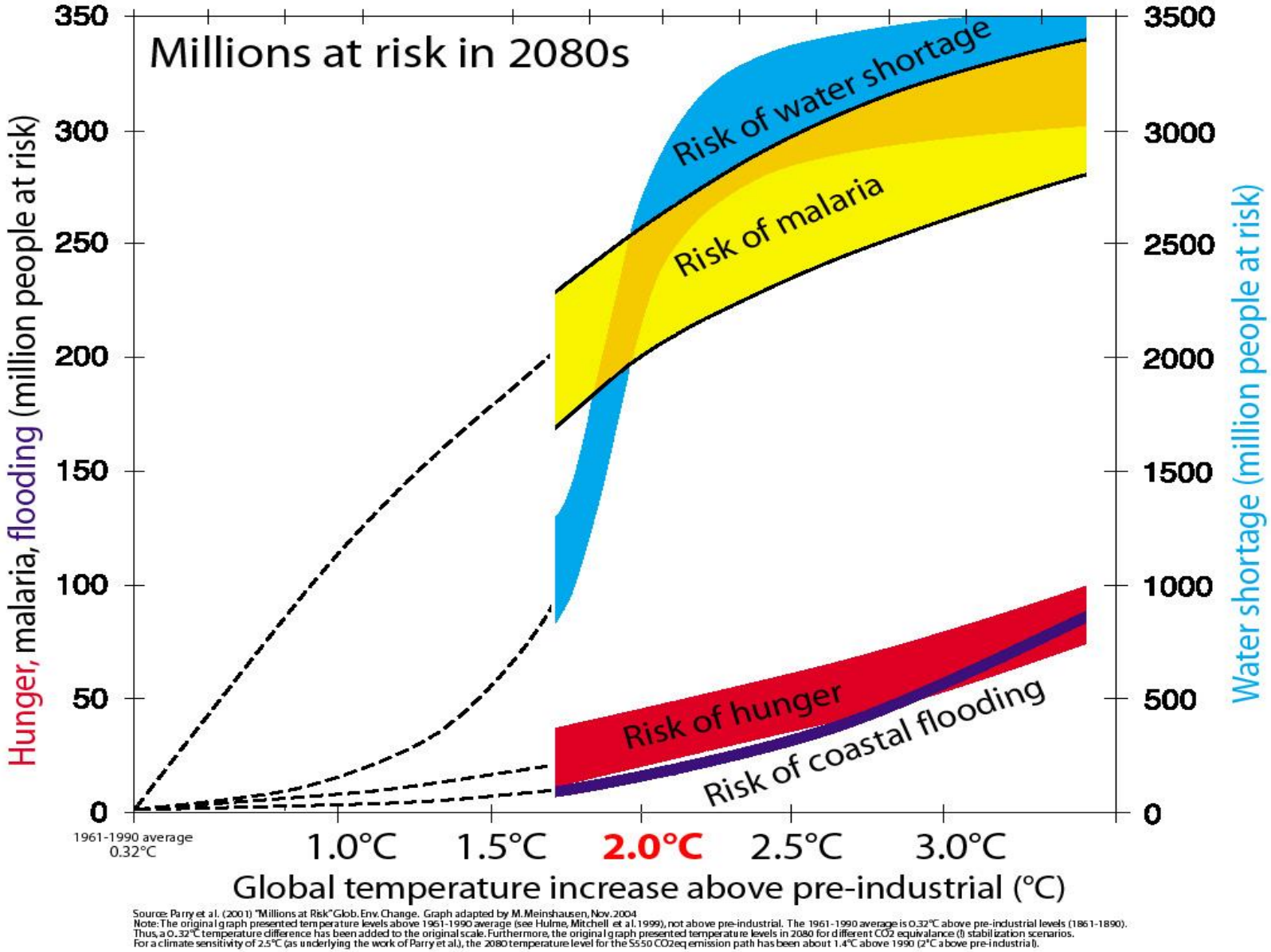
Quality	GW and SW	Pollution / Contamination: Geo-genic & anthropogenic
	Drinking Water	Deteriorating Water Quality- Physical, Chemical and Biological
		Contamination: Sewage; Inadequate and ineffective treatment facility
	Farm Sector	Deteriorating Water Quality; Irrational application of Fertilizers, Pesticides etc; Salinity
	Industry	Contamination of Industrial effluents SW and GW
Climate Change	Source	Glaciers, Springs- Melting/ Drying.
		Salinisation of Coastal Areas
		Precipitation-Variability- Spatial and Temporal
Institutional	**Water Governance**	No control on consumption exceeding availability; State Subject; GOI: only advisory role; No Single Agency for coordination
	GW	Absence of ground water cell in most states and UTs.; Hydrogeologists etc. are missing.
	Measurement/ Assessment	Poor monitoring of resource availability (supply) and consumption (demand); Measurement is almost nil Except Reservoir, Rivers & Ground Water resources
	Regulation	Water Regulatory Authority- Ineffective / Do not exist
Infrastructure	Dams & Reservoirs	Dams and CAD - Many are old and incomplete; Safety; Inadequate reservoir storage capacity Poor maintenance
	Canal network	In efficient conveyance
	Wells and Tube wells	Inefficient pumps
	Drinking water	Universal Piped water supply- still far away, leakages, technology, STP etc.

India's Water Problems' Statement -3

Technology • Planning • Conservation • Augmentation • Use Efficiency	Farm Sector	Poor distribution / canal conveyance; Mostly not piped, High ET losses
		Precision irrigation area is very less ; Mostly flood irrigation.
		Mismatch of Cropping pattern for water availability
		High Chemicals usage; Laissez faire approach
	Industry	Less WUE /Water saving / efficient; Weak Measurement; Water in-efficient technology No Water Audits
	Drinking Water	Leakages; Less WUE /Water productivity; Water saving technology / containing leaks
Economics	Value for resource	Not valued; Wastage
Financing	Investments	Inadequate investments; No private investment; Non-completion of projects in time leading to cost and time overrun; Non pricing of water; Innovative financial solutions are need of the hour.
Transparency	Data; Resources Funds	Poor measurement systems; No data transparency in Supply, Demand and Quality
Democracy	Public empowerment	No ownership; WUA –not much successful; Lack of awareness
Conflicts		Absence of evidence based allocations; Between sectors; Between: urban and rural areas; Between States; Undermining wider social benefit
Benefits / Services		Wide gap in IPC & IPU: (112.53-89.26 MHa) Leakages in distribution/ conveyancing, Seepage, Method (Flood) of irrigation; Poor Management system / Scheduling; Low Investment
		Sub-optimal Water Use Efficiency- Wastage; Inefficient (unlined/ unpiped) water distribution system
		In-equitable across the sectors; Laissez faire approach

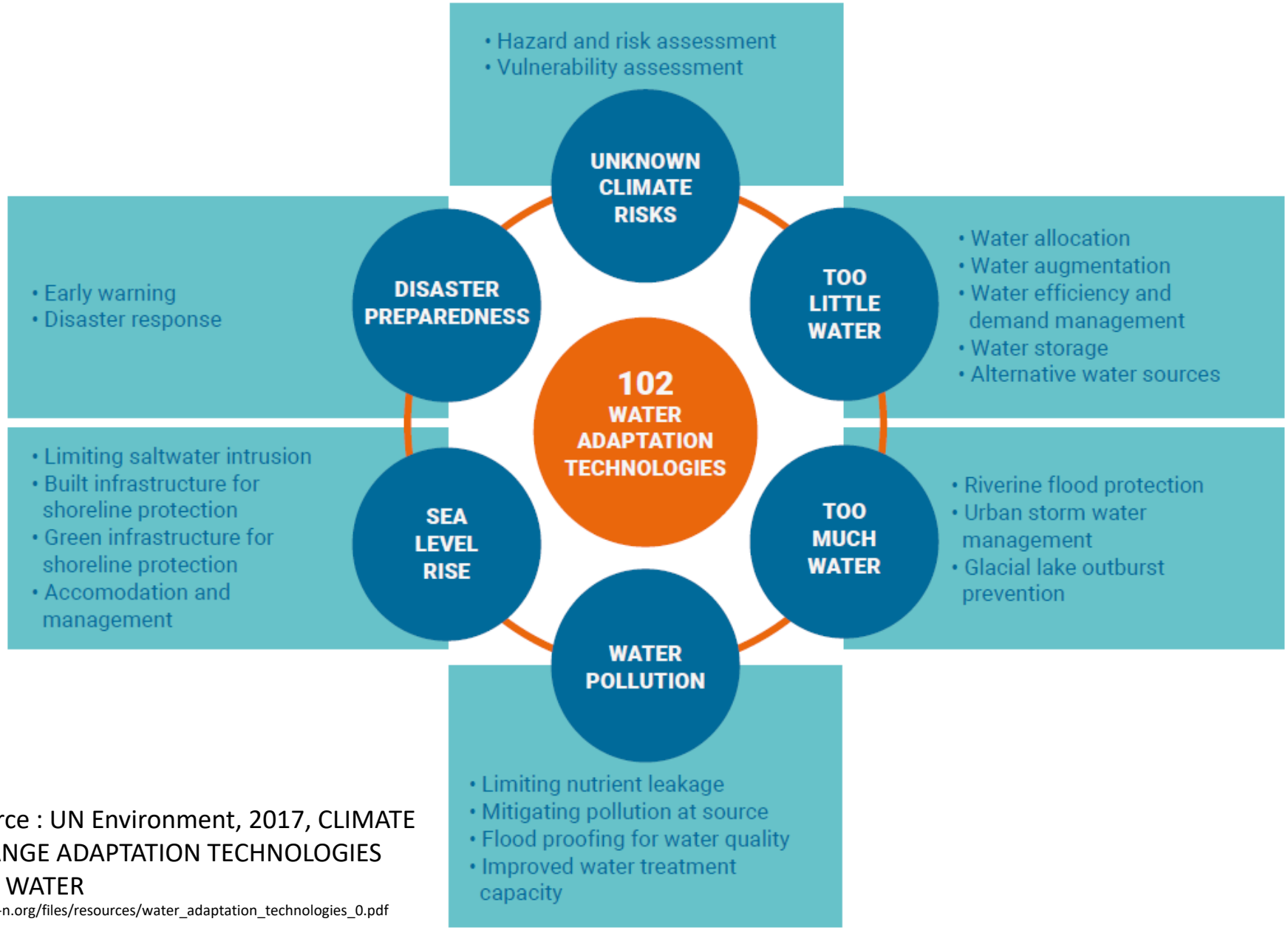
Climate change: Millions at Risk





https://digital.library.unt.edu/ark:/67531/metadc12057/m1/71/?q=%20date%3A2000-2099

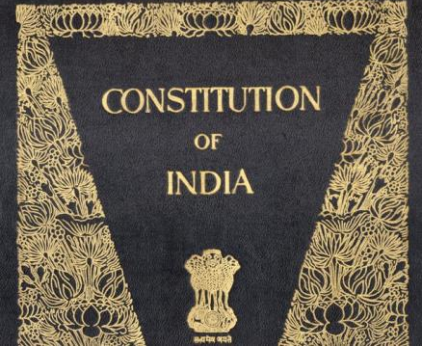
Climate change adaptation and water – overview of challenges and responses



Source : UN Environment, 2017, CLIMATE CHANGE ADAPTATION TECHNOLOGIES FOR WATER

https://www.ctc-n.org/sites/www.ctc-n.org/files/resources/water_adaptation_technologies_0.pdf

Water Governance -Salient features



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."

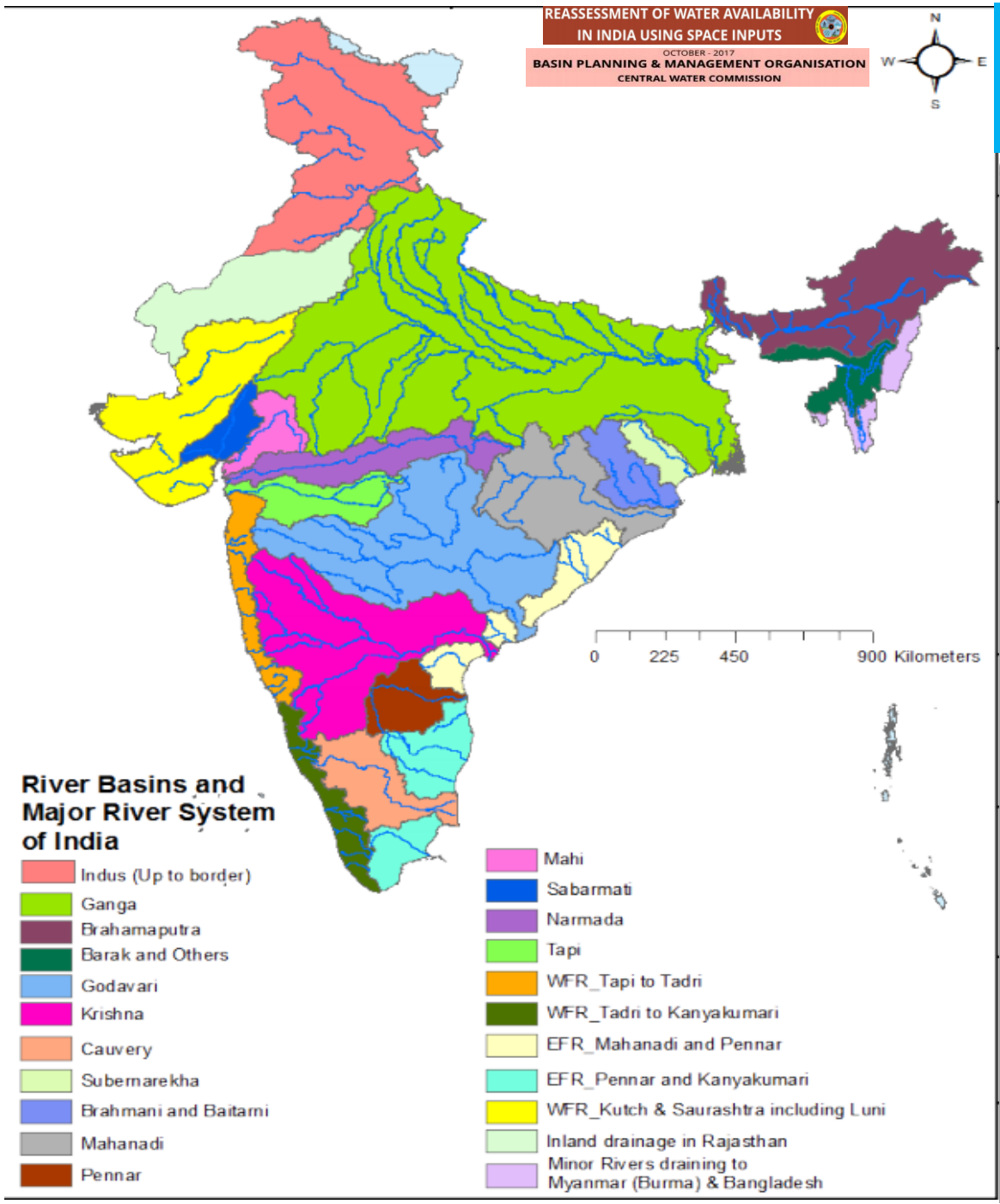
Entry 56 of List I (Union List):**"Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest."**

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

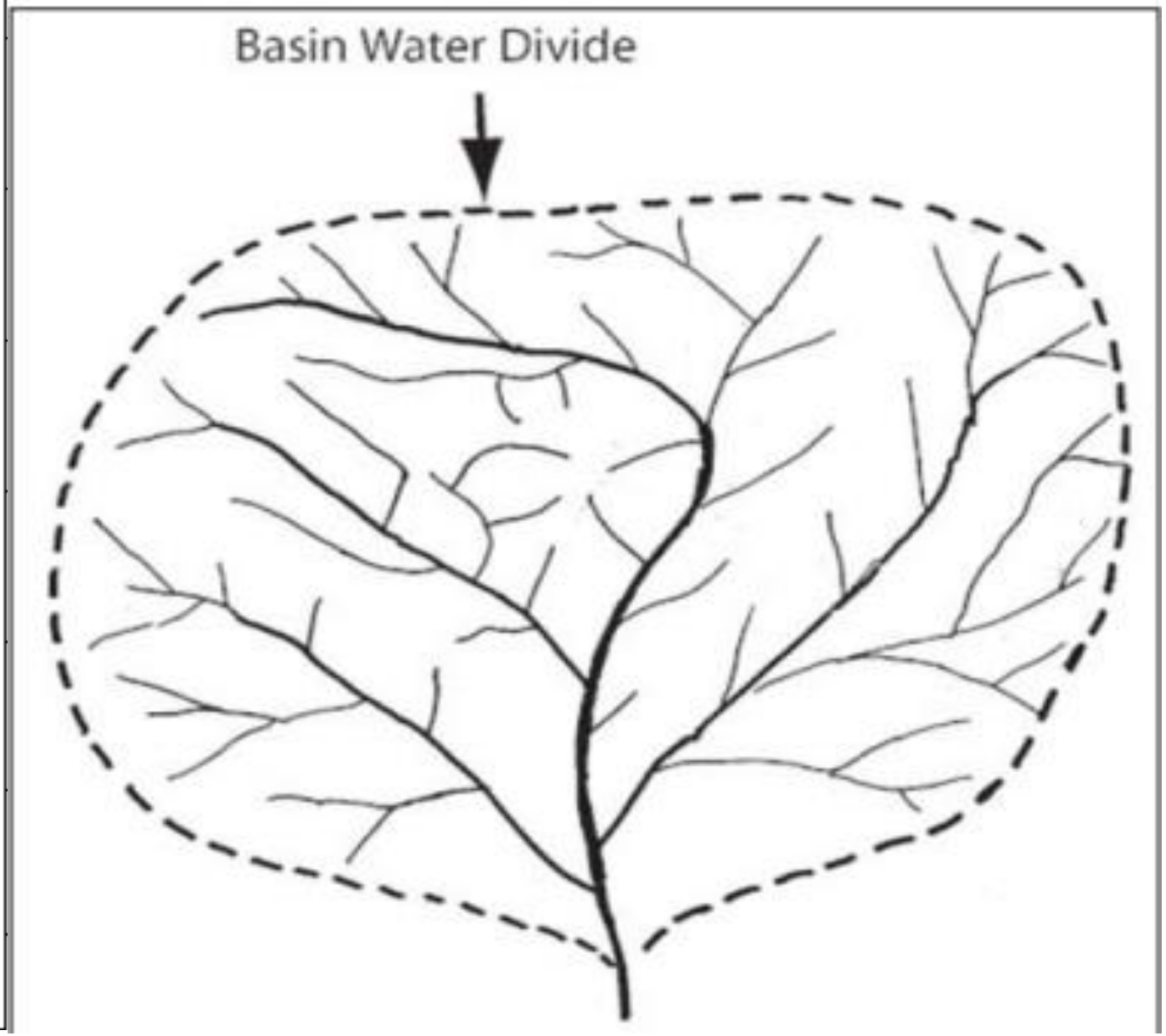
Art.262. Adjudication of disputes relating to waters of inter-State rivers or river valleys

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

National Water Framework Law (NWFL)



Hydrological Units # Political Units (States/ UTs) Districts# Sub-Basin/Watershed



Water Dimensions

- Supply side
- Demand Side

Water governance- Distributed

No single coordination Agency

Supply / Source Side	Demand / Consumption side
1. Precipitation (Rainfall/ Snow)	1. Forestry and Wild Life
2. Glaciers	2. Farm sector
3. Springs	a. Agri- Horticulture- Rain fed & Irrigated
4. River Basins	b. Livestock, Birds and others
5. Projects- Reservoirs/Multi-purpose	c. Fisheries & Others
6. Tanks	3. Industry & Infrastructure
7. Wetlands	a. Thermal Power Plants
8. Coastal Region	b. Iron and Steel
9. Ground Water Resources	c. Textiles and Jute
10. Waste Water	d. Paper and Pulp
	e. Other Industry
	f. Airports/Rail / Road Transport/etc
	4. Establishments / Institutions- Educational & Health Institutions
	5. Drinking water and Domestic use- Rural & Urban

Water related Central Ministries/ Departments

Supply / Source side

1. Earth Sciences/ IMD- Precipitation
2. Defence-DRDO/SASE (Snow)
3. Science and Technology
    1. DST (Glaciers & Springs/ Research)
    2. Climate Change research
    3. CSIR-Technology
4. Water Resources, River Development and Ganga Rejuvenation
    1. Knowledge Management and Financing
        i. Rivers
            1. Hydrology, Planning & Management
            2. Irrigation Projects/ Reservoirs
            3. Command Area Dev.
            4. Dam Design & safety
            5. Flood forecasting & Mgt
            6. Cleaning: Ganga
        ii. Ground Water and Quality Assessment- Knowledge sharing
        iii. R&D, Capacity building,
        iv. NWM: Climate Change
    2. Inter-state River Disputes
5. DoNER- WR development
6. Home Affairs / Disaster Mgt- Floods
7. Panchayat
    1. Tanks & Wetlands &
    2. Community participation
8. Rural Development
    1. Water conservation &
    2. Community participation
9. Housing and Urban Affairs
    1. Tanks & Wetlands
    2. Community participation
10. Environment, Forests and Climate Change
    1. Waste Water &
    2. Water Quality
    3. Climate Change

Demand / Consumption side

Forestry and Wildlife

11. Environment, Forests and Climate Change (Forestry/ Plantations & Wild life)

Farm Sector:

12. Agriculture and Farmers Welfare-DACFW & DAHD

Industry

13. Power- Thermal
14. Steel
15. Textiles
16. Paper & Pulp
17. MHIPE-Heavy Industries and Public Enterprises
18. Chemicals & Fertilizers,
19. MSME
20. Food Processing
21. Mines
22. Coal
23. Commerce & Industry
24. Electronics and IT

Infrastructure

25. Road Transport and Highways
26. Railways
27. Shipping
28. Civil Aviation
29. Tourism
30. Housing and Urban Affairs

Establishments & Institutions

31. Human Resources Development-DSEL & DHE
32. Health and Family Welfare
33. Housing and Urban Affairs

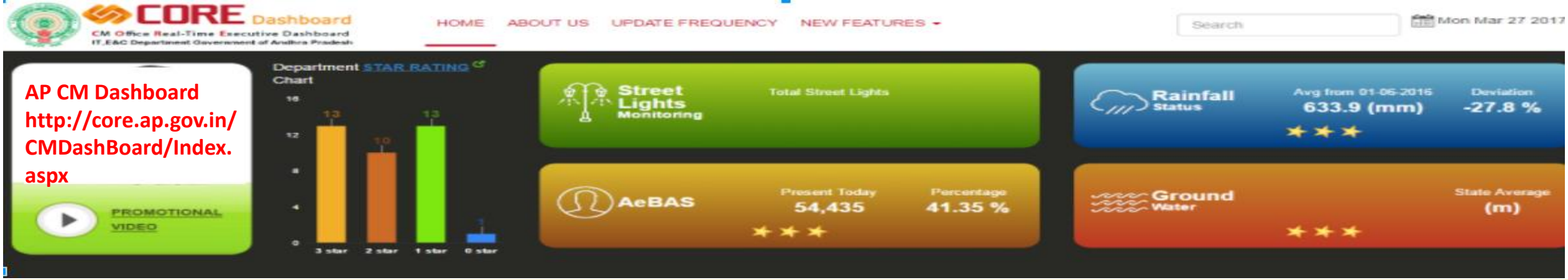
Drinking Water & Domestic usage

34. Drinking Water and Sanitation- Rural
35. Housing and Urban Affairs-Urban

+ Ministry of Finance + Ministry of Information and Broadcasting

WR: Measurement: Supply side: Inadequate ; Demand side: Almost missing

Supply / Source Side	Measurement	Demand / Consumption side	Measurement
1. Precipitation (Rainfall/ Snow)	√	1. Forestry and Wild Life	
2. Glaciers		2. Farm sector	
3. Springs		a. Agri- Horticulture- Rain fed & Irrigated	
4. River Basins	878 HOS + 720	b. Livestock, Birds and others	
5. Projects- Reservoirs/Multi-purpose	√	c. Fisheries & Others	
6. Tanks		3. Industry & Infrastructure	
7. Wetlands		a. Thermal Power Plants	
8. Coastal Region		b. Iron and Steel	
9. Ground Water Resources	23000 NHS/ D/T/B -Wells	c. Textiles and Jute	
10. Waste Water	?	d. Paper and Pulp	
		e. Other Industry	
		f. Airports/Rail / Road Transport/etc	
		4. Establishments / Institutions- Educational & Health Institutions	
		5. Drinking water and Domestic use- Rural & Urban	?



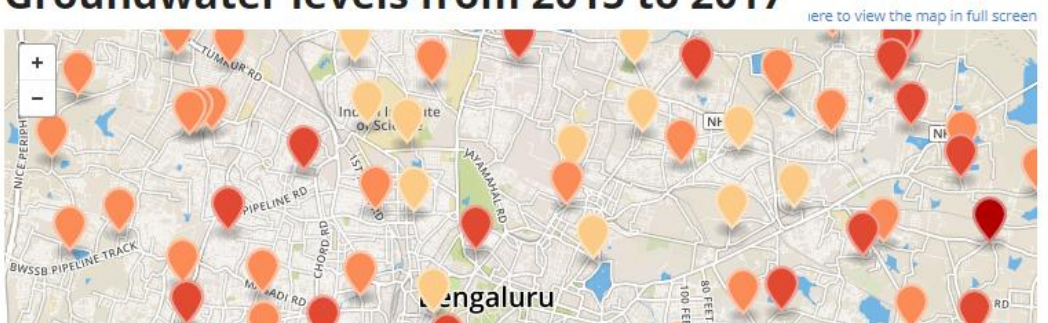
District Wise and Month Wise Average Groundwater Levels (Meters below ground level)

S.No.	District	Mar-16	May-16	Nov-16	Feb-17		Rise (+) / Fall (-) from current water level				Rainfall (in mm) 01/06/2016 to tillnow		
								May-16	Nov-16	Feb-17	Actual	Normal	Deviation in %
1	SRIKAKULAM	7.82	7.36	5.14	6.95	7.64	0.18	-0.28	-2.5	-0.69	757.1	1023.9	-26.1
2	VIZIANAGARAM	6.79	6.51	4.36	6.41	6.87	-0.08	-0.36	-2.51	-0.46	928.3	981.5	-5.4
3	VISAKHAPATNAM	7.85	7.89	5.88	7.5	8	-0.15	-0.11	-2.12	-0.5	972.3	1048.5	-7.3
4	EAST GODAVARI	9.16	9.24	7.09	8.02	9.26	-0.1	-0.02	-2.17	-1.24	871	1105.2	-21.2
5	WEST GODAVARI	19.13	19.08	16.67	18.88	18.98	0.15	0.1	-2.31	-0.1	847	1062.1	-20.3
6	KRISHNA	10.43	10.84	8.34	10.03	10.4							
7	GUNTUR	12.15	12.05	6.7	8.97	9.33							
8	PRAKASAM	17.77	18.86	18.72	21.49	21.99							
9	NELLORE	4.46	5.21	8.3	8.25	8.81							
10	COASTAL ANDHRA REGION	10.62	10.78	9.02	17.31	11.25							
11	CHITTOOR	12	11.54	15.33	17.31	20.12							
12	KADAPA	13.53	15.7	17.52	20.39	22.34							
13	ANANTHAPUR	18.92	19.23	21.35	23.9	25.67							

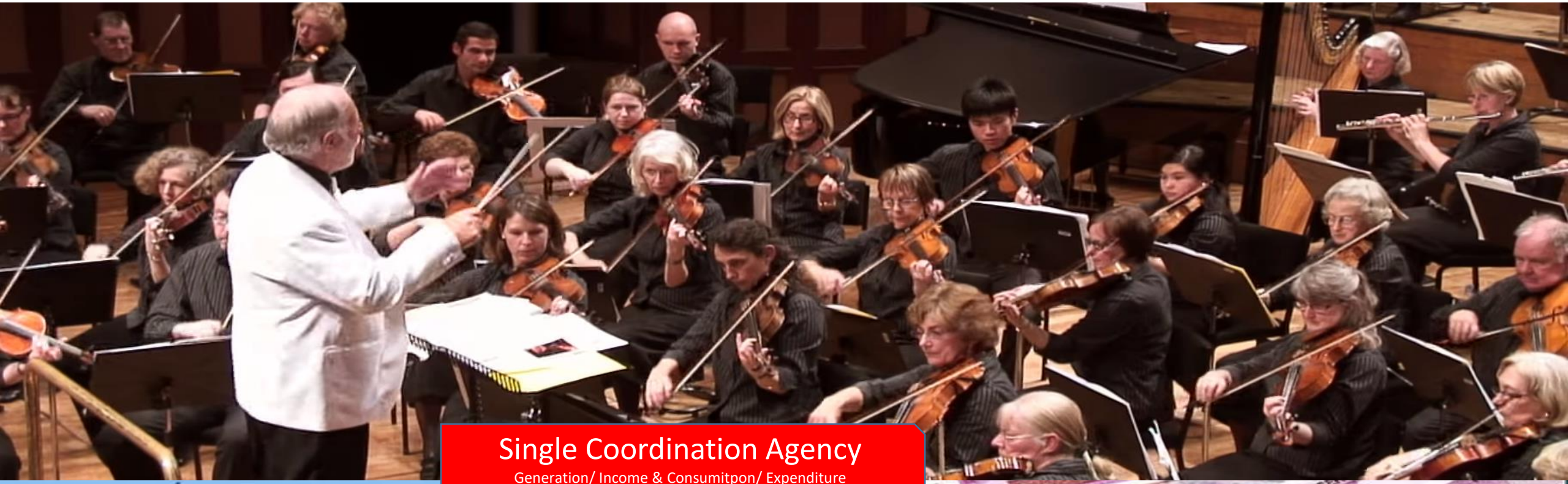
Measurement Best Practices

Bangalore Urban Metabolism Project (BUMP)

Groundwater levels from 2015 to 2017

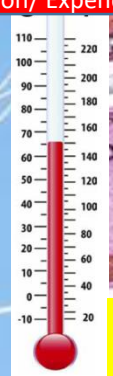


Governance: A comparison-Money-Power-Water



Single Coordination Agency

Generation/ Income & Consumitpon/ Expenditure



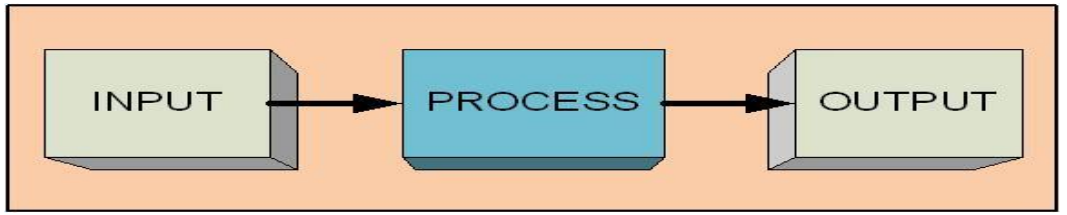
Measurement

Governance: Structural Limitations

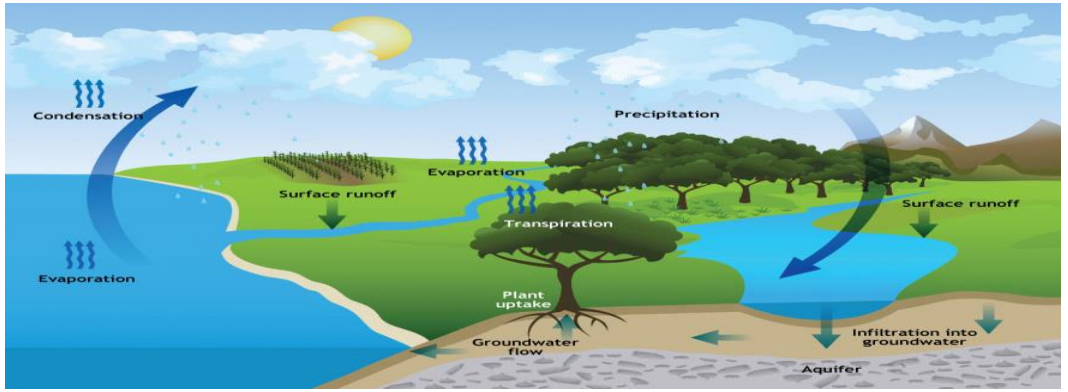
Passing the **baton:**
Short Shelf life of WR Top Executive

Expertise in Policy Making & Implementation

Simple/ Linear Models: Well built



Complex/Circular Models: Expertise to be built



Islands of success to Universalisation

Community participation: HIWARE BAZAR, Ahmednagar District , Maharashtra

Successful implementation by community participation / Gram Panchayat through

Demand side intervention –

•Water Budgeting leading to Change in cropping pattern

• Use of Drip / Sprinkler Irrigation

Supply side interventions –

- Construction of rain water harvesting eg. Earthen bunds, percolation tanks, stone bunds, check dams, trenches
- Aforestation and protection of recharge Zones
- Revival of water bodies

Benefits

- Improvement in water level and Increase in Soil moisture
- Enhanced **average income of the villagers due to assured crop yield**
- **Assured Drinking water** supply.








Source: CGWB 8/2/2018

Power of Technology

SlNo.	Major Area	Sub/Micro-area
1	Water Planning	Irrigation distribution system (viz. Drone), Industry, Drinking Water etc.
2	Water conservation	Domestic/Municipal/Industrial establishments
3	Water augmentation / availability	Flood water recharge Control of evaporation Desalination Waste water treatment and Water recycling Hydrological budget
4	Water use management	Irrigation Increase water use efficiency River flow/discharge Drought and flood

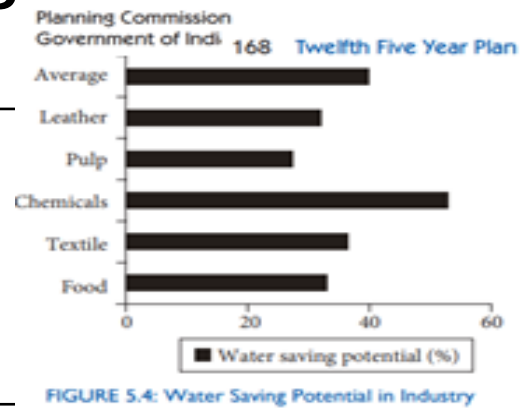
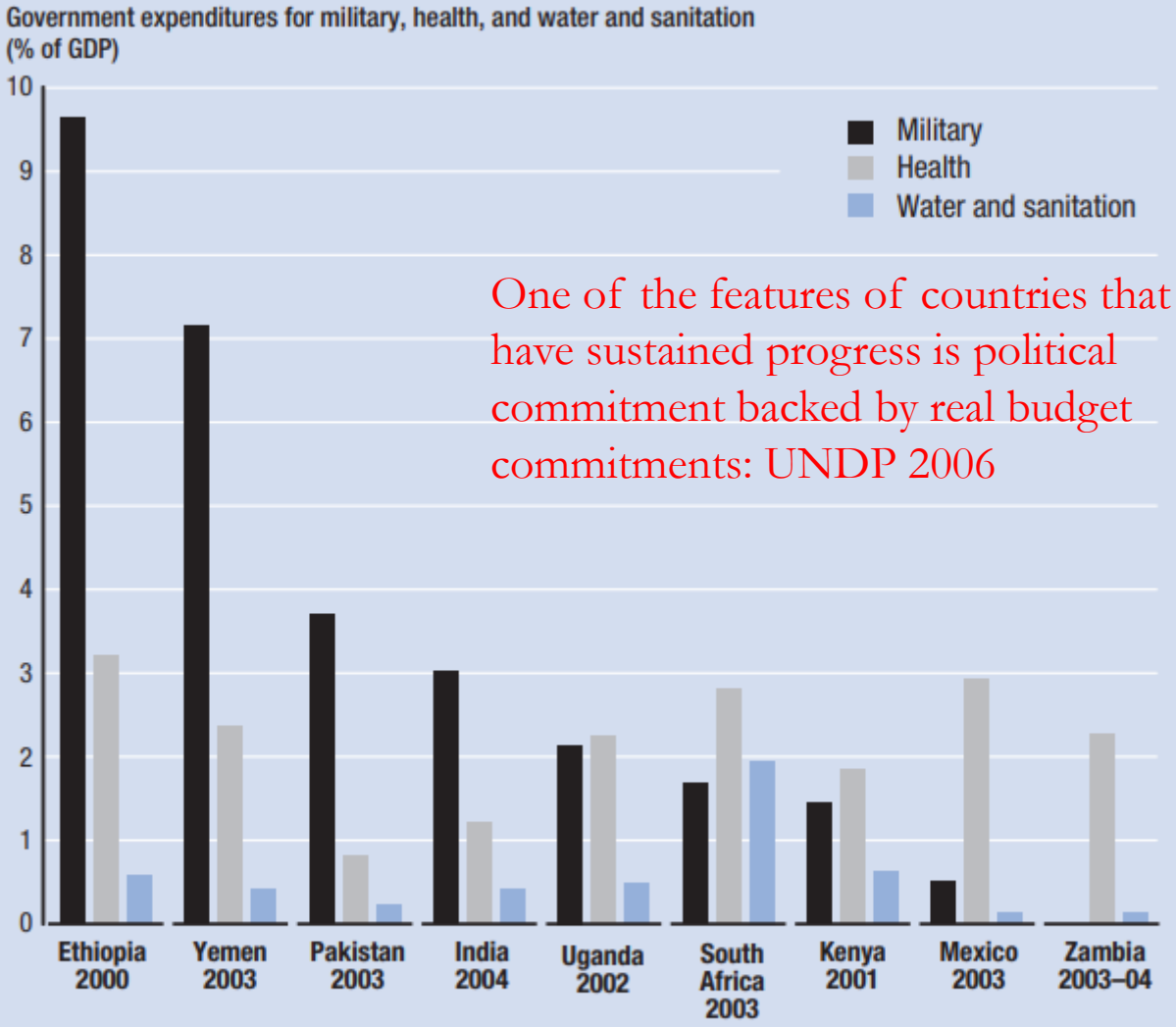


FIGURE 5.4: Water Saving Potential in Industry

Water Financing and Economics

Figure 1.22 **Water: a low priority in many budgets**



Source: Ethiopia, Kenya and South Africa, WSP 2003; Yemen, Yemen 2002; Pakistan, Pakistan 2004; India, Nayyar and Singh 2006; Uganda, Slaymaker and Newborne 2004; Mexico, INEGI 2006a; Zambia, Zambia 2004b.

One of the features of countries that have sustained progress is political commitment backed by real budget commitments: UNDP 2006

2.15 Although plan expenditure on irrigation has increased from Rs 441.8 crore in the First Plan to Rs 95743.42 crore (outlay) in the Tenth Plan, the share in total plan expenditure has decreased from 23% in the First Plan to 6.3% in the Tenth Plan. The trends in change of per cent of total plan expenditure on irrigation sector are shown in Figure 2.1.

Planning Commission
Government of India 11th FY Plan (2007-2012) Vol.III p.46

FIGURE 2.1: Expenditure on Irrigation

Invested Rs. 400,000 crore in Major and medium irrigation projects since Independence. Mihir Shah (2016)

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%

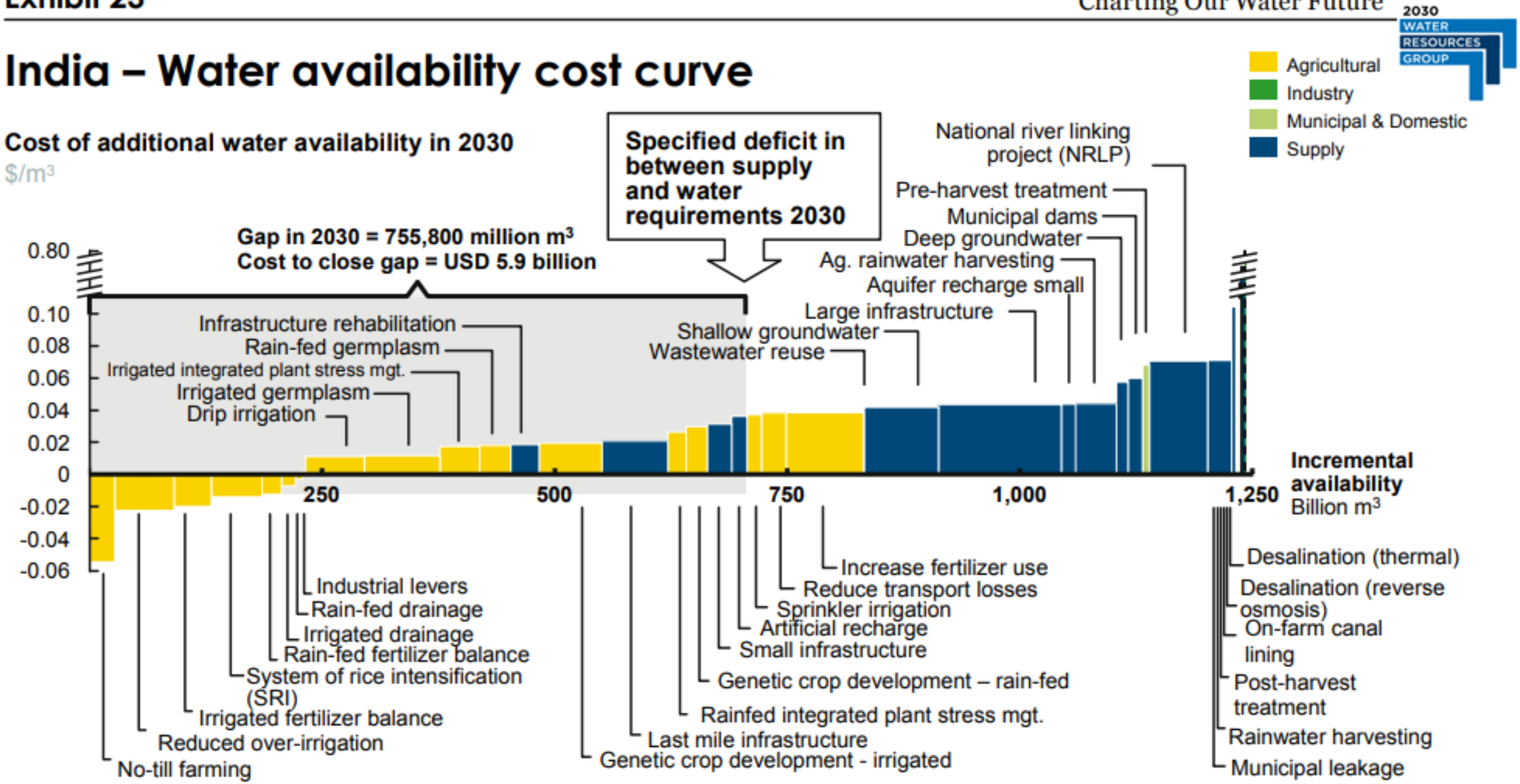
Water Sector: Pareto 80/20

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

Ex: Agriculture- Irrigated 87 M.ha

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

India – Water availability cost curve



SOURCE: 2030 Water Resources Group

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		

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

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

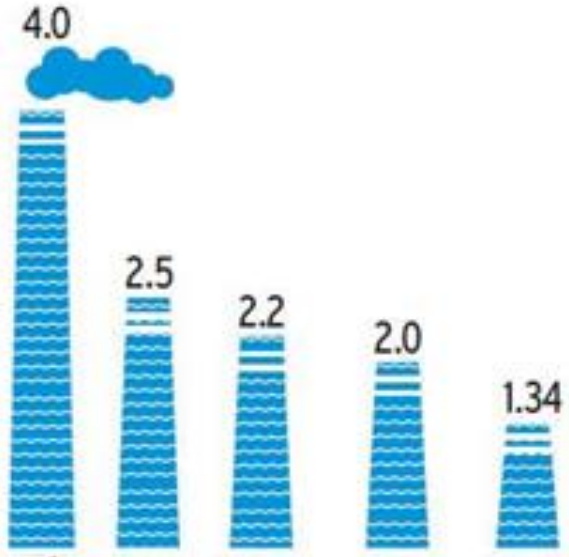
1. Subject Matter (May include sub heading, data, graphs etc.)
2. Water Budgeting

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



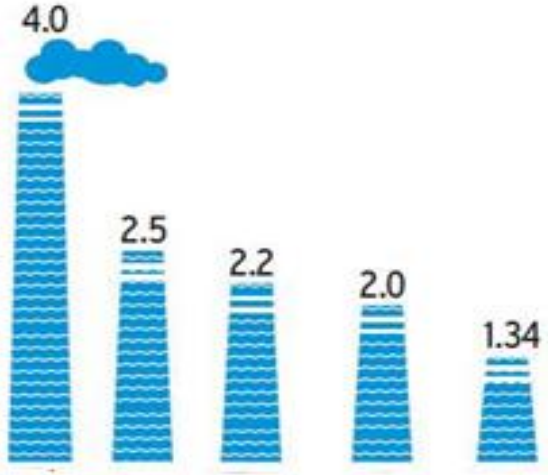
Performance Mgt: Productivity

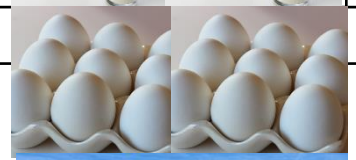
Demand side:
Water Productivity/
WUE
Specific Water Consumption
(Water required to produce a unit of product)

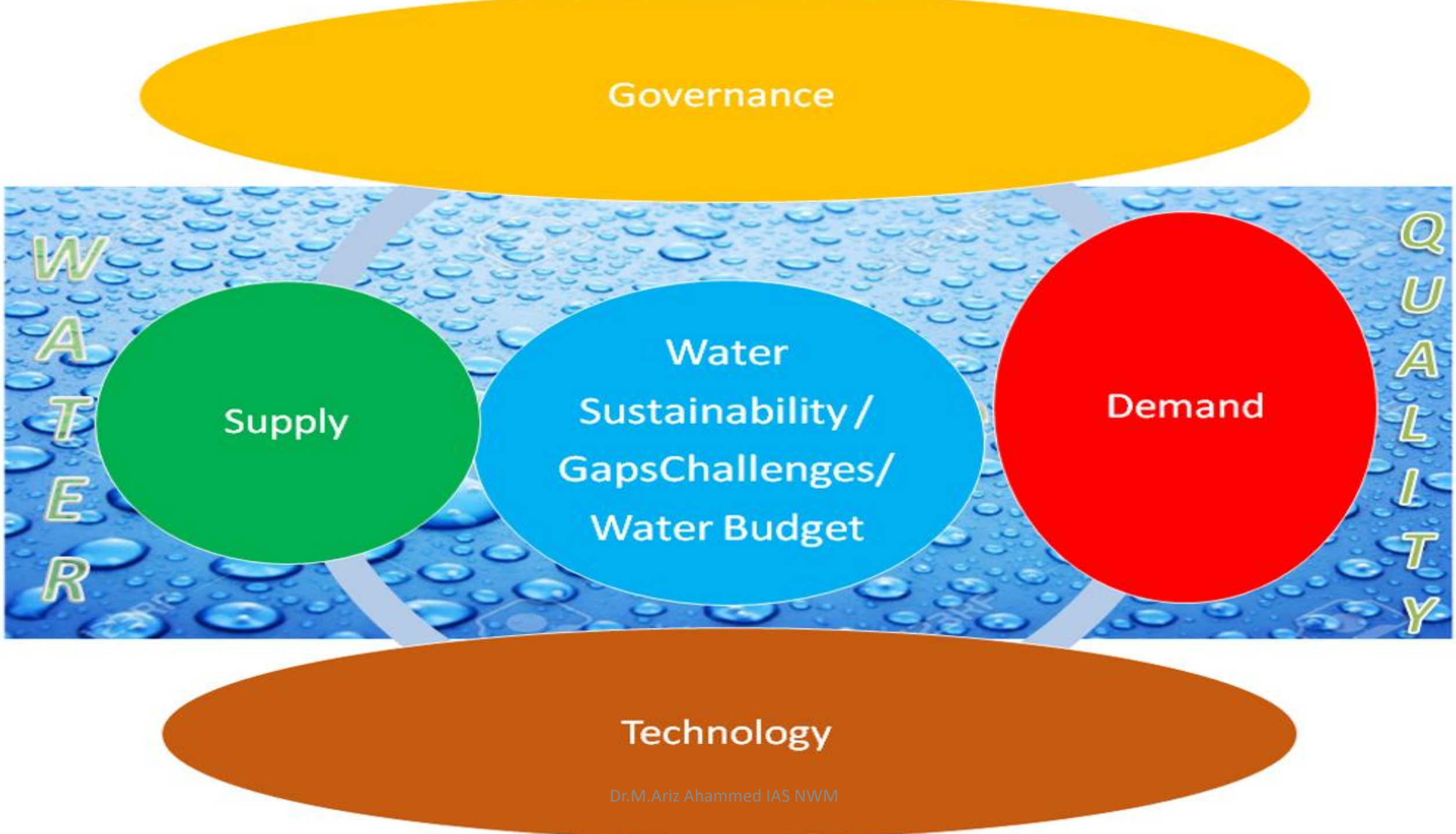
And

Supply side Performance

Illustrative



		Bench Marking	District.1	District.2	District.3
Paddy 1 Tonne Irrigated		200 TL	250 TL	500 TL	1000 TL (Thousand Litres)
			Plant.1	Plant.2	Plant.3
Processed Milk 1 litre		1.5 m^3	1.5 m^3	2 m^3	3 m^3
			Farm.1	Farm.2	Farm.3
Poultry 100 Eggs					
Thermal Power 1 MWh			Plant.1	Plant.2	Plant.3
		0-2.5 m^3	2.5 m^3	5 m^3	10 m^3
Steel 1 T of Crude Steel			Plant.1	Plant.2	Plant.3
		5-20 m^3	5	20	30
		TCS			
% of total water consumption being met from treated Waste Water					
			Zone.1	Zone.2	Zone.3
Reservoirs Performance					


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

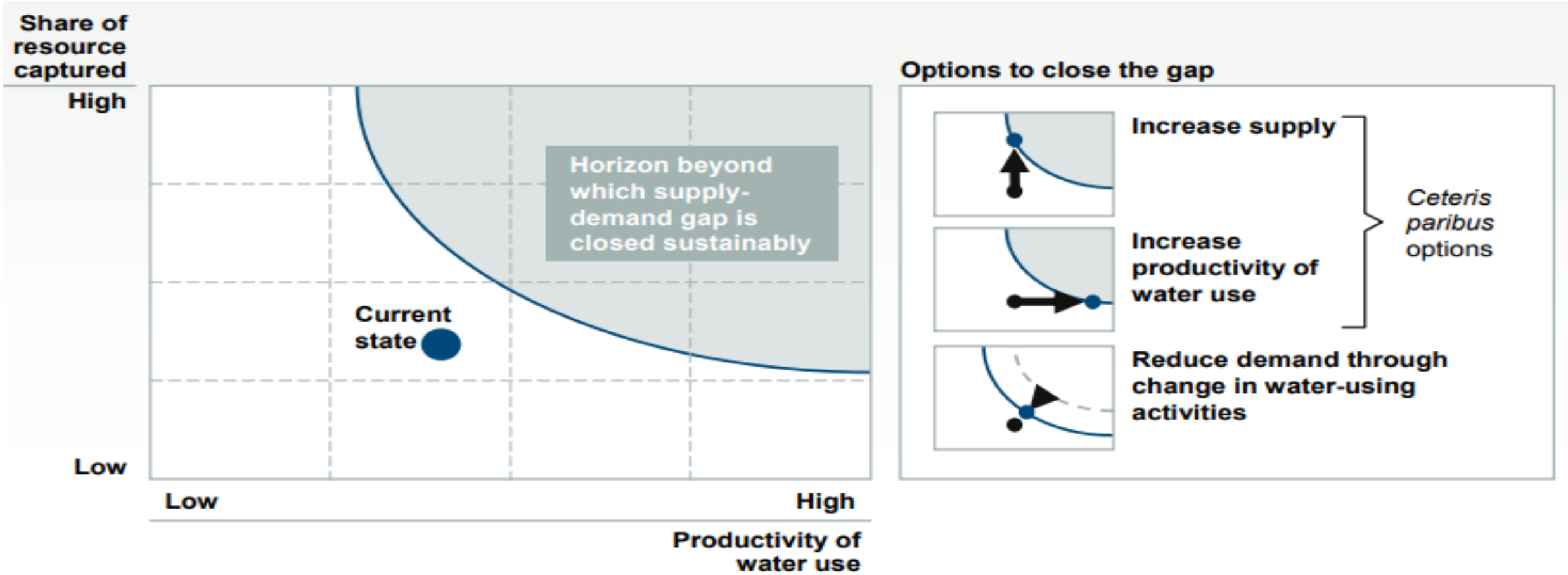
Approaches to close the supply-demand gap

A country's starting point on the path to water resource availability is determined by the current water productivity of different segments of the economy and the amount of water it is able to capture and deliver reliably.

Exhibit 20 Charting Our Water Future

2030 WATER RESOURCES GROUP

Three options for closing the supply-demand gap



SOURCE: 2030 Water Resources Group

SWB: Envisioned Paradigm Shift

	As Usual Approach	SWB Approach
Governance	Compartmental	Hydrological cycle-Multi-disciplinary
Department	Multitude of Depts; No coordination	Single Coordination Agency –Water Resources Department with enlarged mandate
Unit of Governance	Varied	Basin/ Sub-basin / Hydrologic unit
Focus	Supply Oriented	Equal emphasis on 1. Supply 2. Demand 3. Quality 4. Technology across-S,D & Q
Measurement	Limited to 1. Rainfall 2. River Monitoring 3. GW Resource Assessment 4. DW Supply	All Components of Supply, Demand, Quality
Transparency	Opaque	Transparent
Performance Mgt.	No exercise	Performance Mgt. of every component
Community participation	Islands of success; No true empowerment	True empowerment
Ground water	Invisible	Visible
Financing	Supply & Crisis oriented	Comprehensive
Economics	Not developed	Will develop
Consumption Vs. Availability	Laissez faire approach	Create organised conflict / Programmed Approach
Water Budget	At local level in isolated areas by NGOs	State level as an Annual exercise like that of Financial Budget
Empowerment & Accountability of Stakeholders	Only at local level; Responsiveness?	At all levels: Political executive/Bureaucracy, Farmers/Business/Industry/ Citizens

Strategy	Challenges
State Water Budgeting- Annually like Financial Budgets	1. Govt.Will 2. Convergence 3. Measurement 4. Capacity building

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
  - ✓ As an Annual exercise

Water Security-Safety and Sustainability

1. Food Security
2. Nutritional Security
3. Health Security
4. Energy Security
5. Livelihoods
6. Economy

Quality of Life

Constitutional Mandate- Right to life and Liberty

Reflection- Why State Water Budgeting:

Widely discussed bigger solutions to Nations' Water Challenge

- Water- to make Union Subject or Concurrent Subject
- Water Pricing
- Common property / heritage / trust
- River Basin Organisation (RBO)
- Merger of CWC and CGWB

- 70 Years + Experience

- New NWM Offer

- **State Water Budgeting**

✓ **As an annual exercise**

Features

- Evolving initiative
- Existing framework
- Support to States and Uts
- Empowerment and Engagement of Stakeholders
- Formulated involving
  - State Governments
  - 30 Central Ministries
  - 60 National / Expert Institutions
  - Industry Associations
  - Civil Society
- Use of SWB: Intense communication for empowerment and engagement

Work in Progress

Possible Action Points emerging out of the suggestions made by officers

2. Water as a subject is dealt by several Ministries and there is no coordination. Steep decline in percapita availability of water in the country. A single agency to coordinate supply and demand of water may be examined (NITI Aayog) Set Two:

CABINET SECRETARIAT
RASHTRAPATI BHAWAN
*****

Reference this Secretariat's earlier correspondences vide which possible action points emerging out of suggestions made by officers (AS/JS and DS/Directors) in their interaction with the Prime Minister was sent to various Ministries/Departments for further necessary action (copy enclosed).

2. In this regard action so taken may kindly sent to this Secretariat at the earliest.

(Meera Mohanty)
Deputy Secretary

JS(CA)

To,
All Secretaries to the Government of India
Cabinet Secretariat ID No. 501/1/7/2017-CA.V dated 09.03.2018

Role of Resource Persons / Participants

- To help NWM in State / UT level Workshops.
  - To sensitize political executive and civil servants on State Water Budgeting- at all possible levels, based on facts.
  - To network and extend mentoring/ expertise.
  - To network with all Stakeholders in Water Sector.

- Communication- The exercise of undertaking State Water Budgeting- annually like that of Financial Budget at State / UT level.
  - Articles / Workshops / Seminars etc.
  - To make water -everybody's responsibility
  - To build a national narrative

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