Status of water availability in India
AND
Efforts made by international and national agencies to mitigate water scarcity

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Why study this!

- Water is one of the most important renewable natural resources for sustaining all life forms
- It is impossible to substitute for most of its uses, *difficult to de-pollute*, *expensive to transport*, and it is truly a **unique gift** to mankind from nature
- The surface water and groundwater resources play a major role in agriculture, hydropower generation, livestock production, industrial activities, forestry, fisheries, navigation, recreational activities, etc

Water Availability in India

- On an average, India receives **annual precipitation** (including snowfall) of about **4000 km3**
- However, there exist **considerable spatial and temporal variations** in the distribution of rainfall and hence in availability of water in time and space across the country
- Water Availability < 1700 m^3 per capita

  => Water Stressed

  Water Availability < 1000 m^3 per capita

  => Water Scarcity

Water Availability Facts at a Glance

Area of the country as % of World Area	2.4%
Population as % of World Population	17.1%
Water as % of World Water	4%
Rank in per capita availability	132
Rank in water quality	122
Average annual rainfall	1160 mm (world average 1110 mm)
Range of distribution	150-11690 mm
Per capita water availability (2010)	1588 m^3

(Source: http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=India%27s_Water_Wealth)

Remark:

- In India, the availability of surface water in the years **1991 and 2001 were 2309m^3 and 1902 m^3**. However, it has been **projected** that per capita surface water availability is likely to be reduced to **1401 m^3 and 1191 m^3 by the years 2025 and 2050, respectively**
- The Per capita water availability in the year 2010 was 1588 m^3 against 5200 m^3 of the year 1951 in the country

(Source: http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=India%27s_Water_Wealth)

Water Resources of India

Water Resources Of India

- They can be broadly categorized in two categories
  - Surface Water Resources
  - Ground Water Resources
- Surface Water Resources
  - The National Commission for Integrated Water Resources Development estimated the basin-wise average annual flow in Indian river systems as 1953 km^3
  - Utilizable water resource is the quantum of extractable water from its place of natural occurrence
  - The utilizable annual surface water of the country is 690 km^3

Table 1. Basinwise average flow and utilizable water[9] (in km³/year)

Sl. no	River basin	Average annual flow	Utilizable flow
1	Indus	73.31	46
2	Ganga–Brahmaputra–Meghna Basin		
	2a Ganga	525.02	250
	2b Brahmaputra sub-basin	629.05	24
	2c Meghna (Barak) sub-basin	48.36	
3	Subarnarekha	12.37	6.81
4	Brahmni–Baitarani	28.48	18.3
5	Mahanadi	66.88	49.99
6	Godavari	110.54	76.3
7	Krishna	69.81	58
8	Pennar	6.32	6.86
9	Cauvery	21.36	19
10	Tapi	14.88	14.5
11	Narmada	45.64	34.5
12	Mahi	11.02	3.1
13	Sabarmati	3.81	1.93
14	West-flowing rivers of Kachchh and Saurashtra including Luni	15.1	14.98
15	West flowing rivers south of Tapi	200.94	36.21
16	East-flowing rivers between Mahanadi and Godavari	17.08	
17	East-flowing rivers between Godavari and Krishna	1.81	13.11
18	East-flowing rivers between Krishna and Pennar	3.63	
19	East-flowing rivers between Pennar and Cauvery	9.98	16.73
20	East-flowing rivers south of Cauvery	6.48	
21	Area of North Ladakh not draining into Indus	0	NA
22	Rivers draining into Bangladesh	8.57	NA
23	Rivers draining into Myanmar	22.43	NA
24	Drainage areas of Andman, Nicobar and Lakshadweep Islands	0	NA
	Total (rounded)	1953	690

(Source: Theme paper on 'Inter Basin Transfers of Water for National Development – Problems and Prospects', Indian Water Resources Society, Roorkee, 1996)

- Groundwater Resources
  - The annual potential natural groundwater recharge from rainfall in India is about 342.43 km^3 , which is 8.56% of total annual rainfall of the country.
  - The annual potential groundwater recharge augmentation from canal irrigation system is about 89.46 km^3 .
  - Thus, total replenish-able groundwater resource of the country is assessed as 431.89km^3 .

Table 2. Groundwater resources of India (in km^3/year)

1	Total replenishable groundwater resource	432
2	Provision for domestic, industrial and other uses	71
3	Available groundwater resource for irrigation	361
4	Utilizable groundwater resource for irrigation (90% of the sl. no. 3)	325
5	Total utilizable groundwater resource (Sum of sl. nos 2 and 4)	396

(Source: Central Groundwater Board (CGWB))

Water Resources at a glance

Sl.No.	Water Resource at a Glance	Quantity (km^3)	Percentage
1	**Annual precipitation (Including snowfall)**	4000	100
2	**Precipitation during monsoon**	3000	75
3	**Evaporation + Soil water**	2131	53.3
4	**Average annual potential flow in rivers**	1869	46.7
5	**Estimated utilizable water resources**	1123	28.1
	Surface water	690	17.3
	Replenishable groundwater	433	10.8
	Storage created of utilizable water	253.381	22.52
	Storage (under construction) of utilizable water	50.737	4.5
6	**Estimated water need in 2050**	1450	129
7	**Estimated deficit**	327	29
	Interlinking can give us	200	17.8

(Source: Water Resources at a Glance 2011 Report, CWC, New Delhi, (http://www.cwc.nic.in))

Water Resources Management

Challenges in the country

- Natural situation (Tropical Monsoon climate)
  - Causes large scale spatial and temporal variation in water availability
  - Recurring droughts and frequent floods
- Human, Managerial and Developmental challenges
  - Increasing water demand
  - Falling per capita availability
  - Water use and energy efficiency
  - Deterioration of water quality

- Over exploitation and depletion of ground water resources
- Water-logging and soil salinity in irrigated lands

- Climate change impact
  - Increase in up-tides due to melting of polar ice caps
  - Decrease in fresh water

Image of water distribution in Delhi

World's top 20 water-stressed cities

A study, carried out by non-profit **The Nature Conservancy**, says that India's capital city is world's second most water-stressed city, just behind Tokyo. The study was carried out after surveying the water infrastructure of world's 500 cities with population of more than 750,000 (called large cities in the study). Its results have been published in journal Global Environmental Change.

Tokyo	Istanbul
Delhi	Shenzhen
Mexico City	Chongqing
Shanghai	Lima
Beijing	London
Kolkata	Wuhan
Karachi	Tianjin
Los Angeles	Chennai
Rio de Janeiro	Bangalore
Moscow	Hyderabad

Management of Water Crisis

Management of Water Crisis

- There is currently no global institution in place for the management and management of trans-boundary water sources
- International co-operation has happened through ad hoc collaborations between agencies, like the Mekong Committee which was formed due to an alliance between UNICEF and the US Bureau of Reclamation.

Intra-national Policies

- Federal Water Pollution Control Act (1948)
  - primary federal law in the United States governing water pollution. Its objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands
- Canada Water Act

Few Water Organizations

- Charity-water
  - Non profit organization which provides clean water technologies that range from wells to water filtration
- Miya
  - Miya's approach takes into consideration the needs, budget and goals of a particular city to design the most appropriate Non-Revenue Water reduction strategy
- Columbia Water Center
  - The Columbia Water Center scientists and researchers work in the fields of hydrology, engineering, public policy, agriculture and finance to address sustainable water use and allocation, tailoring their solutions to fit the needs of each region.

- WATERisLIFE
  - It has developed a water filtration product called The Straw which provides clean drinking water when immersed into a water source
- PureMadi
  - First project was a ceramic water filter that used local materials to effectively purify water
  - The next creative and life saving endeavor on the docket is the MadiDrop, a simple ceramic water purification tablet that can disinfect water for up to six months by being placed in a container through which water is poured

(Source: http://www.goodnet.org/articles/1000)

Interesting facts!

- ‘**World Water Day**’ is held annually on **22 March** as a means of focusing attention on the importance of freshwater and advocating for the sustainable management of freshwater resources.
- California’s ‘Water Year’ 2014 Ends as Third Driest on Record
- Water scarcity is fast becoming **urban India's number one woe**, with government's own data revealing that residents in **22 out of 32 major cities have to deal with daily shortages.** (Source: TOI)

- India’s urban population is projected to increase to 600 million and urban share of GDP to 75 per cent by 2031. It is not clear how the resulting increase in urban water demand will be met. (Source: The Indian Express)

- Kaveri Water Dispute

Efforts in India

Efforts In India

- Government has taken steps towards commissioning '**desalination plants**' to meet the needs of people with no access to safe water
  - For example:
    - Minjur Desalination Plant, Tamil Nadu, India
    - Nemmeli Seawater Desalination Plant, Chennai, India

- **Rainwater Harvesting**
  - The Government has been promoting the adoption of 'Rainwater harvesting' as a mass movement. 'Rainwater Harvesting' is also an important component for achieving the goals of 'Water Security'. 'Shelter Security' and 'Ecological Security'

LEGISLATIONS ON RAINWATER HARVESTING

Ahmedabad:

In 2002, the Ahmedabad Urban Development Authority (AUDA) had made rainwater harvesting mandatory for all buildings covering an area of over 1,500 square metres. According to the rule, for a cover area of over 1,500 square metres, one percolation well is mandatory to ensure ground water recharge. For every additional 4,000 square metres cover area, another well needs to be built.

Bangalore:

In order to conserve water and ensure ground water recharge, the Karnataka government in February 2009 announced that buildings, constructed in the city will have to compulsorily adopt rain water harvesting facility. Residential sites, which exceed an area of 2400 sq ft (40 x 60 ft), shall create rain harvesting facility according to the new law.

Port Blair:

In 2007, Port Blair Municipal Council (PBMC) directed all the persons related to construction work to provide a proper spout or tank for the collection of rain water to be utilized for various domestic purposes other than drinking. As per the existing building by-laws 1999 the slab or roof of the building would have to be provided with a proper spout or gutter for collection of rain water, which would be beneficial for the residents of the municipal area during water crisis.

Chennai:

Rainwater harvesting has been made mandatory in three storied buildings (irrespective of the size of the rooftop area). All new water and sewer connections are provided only after the installation of rainwater harvesting systems.

(Available:http://www.legalindia.com/rainwater-harvesting-as-governments-public-policy-decision/)

Humara Jal, Humara Jeevan

- The Government of India has adopted various other initiatives to deal with the problem of water scarcity. Few of them are:

  - **The National Water Policy, 1987**

  - **Bharat Nirman, 2005** - The main aim of the initiative was to provide safe drinking water to all the under developed areas.

  - **National Mission for clean Ganga, 2009**

  - **National Water Mission, 2011-** The objective of the initiative is conservation of water and minimizing wastage of water.

Efforts By UN-Water

- Members have identified specific activities to be implemented. They currently include:
  - Country-level coordination
  - Regional-level coordination
  - Water security
  - Water resources management
  - Capacity development of water operators
  - Wastewater management
- Multi-agency Initiative
  - Safe Use of Wastewater in Agriculture Initiative
  - GEMI - Integrated Monitoring of Water and Sanitation Related SDG Targets

Wedge Approach to Water Stress

- In a paper published in *Nature Geoscience*, the researchers outline strategies in **six key areas** that they believe can be combined in different ways in order to effectively reduce water stress
- The six strategies are separated under Hard-path measures and Soft-path measures
- "**Hard path**" measures involve building more reservoirs and increasing desalination efforts of sea water
- "**Soft path**" measures focus on reducing water demand rather than increasing water supply through community-scale efforts and decision-making, combining efficient technology and environmental protection

(Available: http://www.nature.com/ngeo/journal/v7/n9/full/ngeo2241.html)

Thank you!!!