



STUDY MATERIAL

ON

**Water Resources in India:
The Demand and Supply Scenario**

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NAAC Accredited – Grade A

Water availability in India and its; trend of change

India is rich in surface water resources. Average annual precipitation is nearly 4000 billion cubic meter (BCM) and the average flow in the river system is estimated to be 1869 cubic km. Because of concentration of rains in the three monsoon months, the utilizable quantum of surface water is about 690 BCM (GoI, 2016). India receives 70% of surface water in the form of rain (monsoon) during three to four months. Although India has sizeable water resources, the country faces huge challenges in the water sector as the distribution of water varies widely by season and region (Bhat, 2014).

Sl.No	Items	Quantity
1	2	3
1	Annual Precipitation (including snowfall)	4000 BCM
2	Average Annual Availability	1869 BCM
3	(i) Per Capita Water Availability (2001) in cubic metres	1816Cu.M
	(ii) Per Capita Water Availability (2011) in cubic metres	1545Cu.M
	(iii) Per Capita Water Availability (2015) in cubic metres*	1474Cu.M
4	Estimated Utilizable Water Resources	1123 BCM
	(i)Surface Water Resources	690 BCM
	(ii) Ground Water Resources	433 BCM

Source: Central Water Commission-2015
BCM : Billion Cubic Meter. Cu.M - Cubic Meter.

Table 1a: The per capita water availability of India, as per past record and future predictions. (Bhat, 2014)

Year	Population (Million)	Per capita water availability (m ³ /year)	% change from previous year
1951	361	5177	-
1955	395	4732	-8.59
1991	846	2209	-53.31
2001	1027	1816	-17.92
2011	1210	1545	-14.92
2025	1394	1341	-26.37
2050	1640	1140	-14.98

With the increasing population and luxury consumption the water resource is being overused and even abused. As a fall out of that, as it has been given in table 1a, the per capita annual water availability is decreasing rapidly, which may become a half in the year 2050, of that of 1991 (Table 1a).

The Demand scenario:

As you are already aware of the fact that, water resource is one of the most important and scarce resources on the Earth, not because of its' lack of overall availability but actually as nearly 97% of it remains unusable due to salinity. Moreover around four fifth of it is trapped as ice and only 0.62% of the total hydrospheric mass caters all the basic demands of the civilization. The fresh water resources either in form of surface water or ground water therefore are under tremendous pressure in sectors like, agriculture, industries and domestic utilities. However, the environmental or ecological demand of water, which is also known as Minimum Required Flow (MRF) in streams and rivers, is another important sector, although it has a steady demand scenario compared to other sectors.

On account of the rapid economic and demographic changes, the demand for crop yield is increasing with consequent increase in **demand for irrigation** / agriculture. The Agriculture is the most important and water demanding sector among all others. An estimate by the Ministry of Water Resources (MoWR) of India in the year 2000, showing the projected scenario indicates around 85% water demand in India is generated from irrigation sector for agricultural practices, followed by domestic sector. However, the demand is projected to be increased by 132% by 20125 and 155% by the year 2050 (Table 2).

The water demand in agriculture is followed by **the demand in domestic sectors**. With increasing household income and increasing contributions from the service and industrial sectors, the water demand in the domestic and industrial sectors could increase substantially. It is assumed that the average domestic water demand would increase from 85 liters per capita per day (lpcd) in 2000, to 125 and 170 lpcd by 2025 and 2050, respectively (Amarasinghe et al., 2007). The domestic water demand includes the livestock water demand as well, which is assumed to be 25 liters per head for the cattle and buffalo population. An estimated livestock water demand will increase from 2.3 Billion Cubic Meter in 2000 to 2.8 and 3.2 BCM by 2025 and 2050, respectively (Amarasinghe et al., 2007).

From the same projection of MoWR the total demand only for drinking water will increase 132% and 182% respectively in 2025 and 2050 compared to the 2010 baseline data (Table 2).

The industrial demand of water is going to enhance manifold during the these years. Because of rapid economic growth and technological demand from the civilization. The MoWR projects a doubling of industrial demand in between 2010 and 2025, while there will

be a five times increase in water demand in the year 2050 compared to 2010. The demand in energy sector is further rapid, with a projected 26 times increase from 2010 to 2050.

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
BCM: Billion Cubic Meters
MOWR: Ministry of Water Resources.

Ground water scenario:

The ground water depletion either in quantity or in quality is another threat to freshwater resources. In India, the amount of replenishable groundwater availability is around 10% of the total surface water resources. However, due to ever increasing demand particularly for the agricultural sectors, the ground water resource is depleting fast. As per the record of Central Ground Water Board (CGWB, 2013), the country is having a rate of 62% ground water development, i.e. 62% of the annual replenishable ground water is being drafted (Table 3).

Table 3: The Ground water availability and annual draft in India (CGWB, 2013)

1.	Total Annual Replenishable Ground Water Resources	447 bcm
2.	Net Annual Ground Water Availability	411 bcm
3.	Annual Ground Water Draft	253 bcm
4.	Stage of Ground Water Development	62%

However, a study by CGWB and PRS has reported that the number of overexploited wells are increasing steadily since 1995 (Suhag, 2016) recording a five times increase during 1995 to 2011 (Table 4). A sample survey by CGWB also reported that around 15.7% of all the ground water resources are overexploited with on 68.8% safe sources left (CGWB, 2013), which is to some extent threatening (Table 5). However, India suffers substantive problem of groundwater quality, because of contamination either in natural or anthropogenic ways. The major ground water quality problems include ground water Fluoride contamination (276 districts affected), Arsenic contamination (68 districts affected), Nitrate contamination (387

districts affected) , Iron in water (297 districts affected) and water salinity particularly in coastal zones or due to rapid ground water over abstraction in semi arid to arid zones (Suhag, 2016).

Level of ground water development	Explanation	% of districts in 1995	% of districts in 2004	% of districts in 2009	% of districts in 2011
0-70% (Safe)	Areas which have ground water potential for development	92	73	72	71
70-90% (Semi-critical)	Areas where cautious ground water development is recommended	4	9	10	10
90-100% (Critical)	Areas which need intensive monitoring and evaluation for ground water development	1	4	4	4
>100% (Over-exploited)	Areas where future ground water development is linked with water conservation measures	3	14	14	15

Sources: Central Ground Water Board; PRS.

Table 5: The present condition of ground water quality and development (Sample survey)

	Categorization of Assessment Units	No. of Unit	% Condition
	Total No. of Assessed Units	6584	
1.	Safe	4520	68.8%
2.	Semi Critical	681	10.3%
3.	Critical	253	3.8%
4.	Over-Exploited	1034	15.7%
5.	Saline	96	1.45%

Surface Water Hotspots:

The rapid increase in industrialization and efforts to enhance the irrigation efficiency or crop yield to meet the demand of the population, leads to intensification of industrial practices, urbanisation and other resource use including intensive landuse particularly in the season of water availability. Discharge of sewage in to the rivers and other surface water bodies, untreated or only partially treated, rampant use of fertilizers and pesticides, open defecation, lack of solid waste management practices contribute to surface water pollution, beyond permissible limit. The areas of surface water with regular waste deposition or permanently degraded surface water quality beyond permissible limits are known as ‘**surface water hotspots**’.

The Central Water Commission conducted a surface water monitoring activity at 371 check points in rivers throughout the India for 10 years. The physical and chemical quality of river water is important in deciding its suitability for drinking purposes. As such the suitability of

river water for potable uses with regard to its chemical quality has to be deciphered and defined on the basis of the some vital characteristics of the water. Considering the suitability of water for different uses as the basis of classification, the natural river water of India has been categorized as desirable, permissible and unfit for human consumption. River water quality is very important for aspect in India. The physic-chemical parameters like pH, electrical conductance (TDS), Chloride, Fluoride, Iron, Nitrate, Sulphate, Total hardness, Calcium and Magnesium are main constituents defining the quality of river water in surface water. Therefore, presence of these parameters in river water beyond the permissible limit in the absence of alternate source has been considered as river water quality hotspots. It was found that, different rivers of India are suffering from different types of pollution, i.e. region wise the polluting parameters differ (CWC, 2011).

However, the standard of different drinking water parameters are given below.

**Surface water quality criteria for different uses
(specified by CPCB, 1979 and the Bureau of Indian Standards, 1982)**

S. No	Water quality parameter	Characteristic of water body				
		A *	B *	C *	D *	E *
1	Dissolved Oxygen (DO) mg/l (minimum)	6	5	4	4	3
2	Biochemical Oxygen Demand (BOD), mg/l (max)	2	3	3	-	-
3	Total Coliform organisms ** MPN/100ml (max)	50 **	500	500	-	-
4	Total Dissolved Solids (TDS) mg/l (max)	500	-	1500	-	2100
5	Chlorides (as Cl ⁻) mg/l (max)	250	-	600	-	600
6	Colour, Hazen units (max)	-	10	300	300	-
7	Sodium Absorption Ratio (max)	-	-	-	-	20
8	Boron (as B), mg/l (max)	-	-	-	-	-
9	Sulphates (as SO ₄ ²⁻), mg/l (max)	400	-	400	-	1000
10	Nitrates (as NO ₃ ⁻) mg/l (max)	20	-	50	-	-
11	Free Ammonia (as NH ₃) mg/l (max)	-	-	-	1.2	-
12	Conductivity at 25°C micro mhos/cm (max)	-	-	-	1000	2500
13	pH value	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.0-8.5
14	Arsenic (as As), mg/l (max)	0.05	0.2	0.2	-	-
15	Iron (as Fe), mg/l (max)	0.3	-	-	0.5	-
16	Fluoride (as F), mg/l (max)	1.5	1.5	1.5	-	-
17	Lead (as Pb), mg/l (max)	0.1	-	0.1	-	-

Note: * Classes of water use:

- A Drinking water source without conventional treatment but after disinfection
- B Out door bathing (organised)
- C Drinking water source with conventional treatment followed by disinfection.
- D Propagation of wild life, fisheries.
- E Irrigation, industrial cooling, controlled waste disposal.

Roles of States in Water resource management:

As per the constitution of India, the water resource is a state matter and therefore, the responsibility of management directly falls on the state. However, the Central Government may and will contribute to the water resource management as and when required. Some of the specific roles of states as per the National water policy are as follows:

- The States are required to formulate their own water policies on the guidelines provided by the national policy and to prepare an operational action plan within a period stipulated by National policy.
- The management of water has to be done in a decentralised way in partnership between the state government and local communities having stake to the water resource.
- To give teeth to their actions the Central and State governments should enact suitable legislation and notify the permissible water depths to which ground water depletion will be permitted for each region/ block/ gram sabha/ watershed after identifying the special problems of each area. These should also have specific scopes to enable the changes to be implemented in practice.
- At the state level the nodal ministries/departments should be identified for water resources (MoWR), watershed development (MoRD), irrigation (Irrigation department) domestic water supply (Public Health Department), and pollution control (State Pollution control Board).

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