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Water scarcity: Not Enough to Drink

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ABSTRACT: Issues related to water in India were examined in this study. The aim of the study was to provide status of water availability in India from different sources and the factors which are responsible for the water scarcity in India. Therefore, issues like water shortage in different cities of India, water pollution which is declining the fresh water quantity and quality in nearby sources. Different studies and research which were conducted before are used to obtain data on different factors and issues related to water shortage. Thereafter, tables and percentages were used to process and present the data. It was revealed from the study that the India is at a stage of occasional water shortage and in future it will be water scarce country if water source will not be managed properly. Many cities in India including metro cities are suffering from water shortage. This study is conducted to understand the status of water in India and future issues and problems related to it.

Keywords: water supply, scarcity, stress

I. INTRODUCTION

The land-to-water ratio on Earth is about 29 percent land to 71 percent water, according to the U.S. Geological Survey. Most of the Earth's water, about 96.5 percent, is saline water contained in the oceans. A very less portion of water is available in potable water form which is also on form of glaciers melted and flow through rivers to us. India receives good amount of rainfall in monsoon season with an average annual rainfall of 4000 billion cubic meter. Out of which 1869cubic km flows in rivers of India and out of 1869 Cubic km only 690BCM is utilizable. 431 BCM is utilizable in ground water form which makes 1121 BCM in total available water for use. (central water commission, 2013) In India, population is growing at very fast rate as from 2001 population was 1.028 billion and it increase to 1.221 billion in 2011 (census of India,2011), a new life is coming every second in India. Water available per capita annually was 1816 Cubic meter in 2001 and it decrease to 1544 Cubic meter in 2011. (central water commission, 2013) Water available per capita is decreasing and it will decrease more as precipitation amount is limited but the population is increasing day by day. This increase in population causing pressure on water source, and creating water scarce zone to the future generation. The problem is that the sporadic, spatial and temporal distribution of precipitation rarely coincides with demand. Areas like Thar desert receives rainfall less than 200mm annually whereas 11,400 mm of rainfall is recorded in Cherrapunji in Northeast. 22 out of 32 big cities of India facing water crisis, in these worst is Jamshedpur where the gap between demand and supply is 70%. Crisis is acute in Kanpur, Asansol, Dhanbad, Meerut, Faridabad, Vishkhapatnam, Madurai and Hyderabad-supply here fails to meet 30% of the demand. Also, cities like greater Mumbai and Delhi has highest demand among all cities and the gap between demand and supply is comparatively less. Shortage accounted for Delhi is 24% and for Mumbai its 17%. (The Hindu) Potable water scarcity is swallowing the whole country, no idea what new generations will see in future mainly related to water. Settlements used to locate near water bodies to access it but now whether they are close or far level of water is decreasing. This is the time when metro cities are also facing water shortage problems as increase in population and migration to urban areas is increasing rapidly, before it's too late we have to wake up or our future generations will not get this entity. Increasing population causing pressure on available infrastructure in urban areas and pressure on available water sources. Extraction of water without giving back to nature creates imbalance in hydrological cycle, it need to be balanced which requires proper water management of water sources. Water will become a conflict point between countries, states and cities in future when they not get it easily which may lead to global instability. Burning issue of this century is the water resources management so that future needs can be fulfilled with increasing population.

The study deals with the factors responsible for the decrease in per capita water availability and problem and remedies for the same.

II. STATUS OF INDIA

Water is the requirement of each individual and in various sector whether it is urban area or rural area, in rural area water's 90% consumption is for irrigation purposes but in urban area it is divided in many different uses. Water available to settlements is in form of surface water and ground water and extraction from these sources satisfy the need of people.

Dynamic and static are two facets in which water resources can be deal. Dynamic resources measured as flow is more relevant for most of developmental needs. Static nature involves quantity and area of water bodies.

Water bodies. These are classified as rivers, canals, reservoirs, tanks, lakes, ponds etc. total area which provide inland water source are distributed all over the country in 7.4 Mha of land which are mainly concentrated to 12 states of the country.

Ground water. Precipitation stores in two forms: surface and ground water form.

Table 1: Inland water sources of India.

Inland water resources						
		Area lakh ha				
Name of state	Length in km	Reservoirs	Tanks and ponds	Floodplains lakes	Brackish water	Total
Orissa	4500	2.56	1.14	1.8	4.3	9.8
Andhra Pradesh	11514	2.34	5.17	-	0.6	8.11
Karnataka	9000	4.4	2.9	-	0.1	7.4
Tamil Nadu	7420	5.7	0.56	0.07	0.6	6.93
West Bengal	2526	0.17	2.76	0.42	2.1	5.45
Kerala	3092	0.3	0.3	2.43	2.4	5.43
Uttar Pradesh	28500	1.38	1.61	1.33		4.32
Gujarat	3865	2.43	0.71	0.12	1	4.26
Maharashtra	16000	2.79	0.59	-	0.1	3.48
Arunachal Pradesh	2000	-	2.76	0.42	-	3.18
Rajasthan	5290	1.2	1.8	-	-	3
Madhya Pradesh	17088	2.27	0.6	-	-	2.87
other include UT,s	84415	3.53	3.24	1.39	1.2	9.36
Total	195210	29.07	24.14	7.98	12.4	73.59

Source: Water and related statistics, 2013

Table 2: Annual replenish able ground water sources.

Annual replenish able ground water sources		
State	BCM/Yr	%
Orissa	17.78	4.1
Andhra Pradesh	33.83	7.8
Karnataka	16.81	3.9
Tamil Nadu	22.94	5.3
West Bengal	30.5	7.1
Punjab	22.56	5.2
Uttar Pradesh	75.25	17.5
Gujarat	18.43	4.3
Maharashtra	35.73	8.3
Bihar	28.63	6.6
Rajasthan	11.86	2.8
Madhya Pradesh	33.95	7.9
Assam	30.35	7
Chhattisgarh	12.22	2.8
others	40.19	9.3
Total	431.02	100

India has large underground reservoirs which get recharged with precipitation. Total annual ground water potential of India is estimated by central Ground Water Board, Ministry of Water Resources as 431 BCM. 14 states of country has 91% of ground water potential. Which means half of the country has only 9% ground water source to share which shows pressure on the ground water as it is founded in Rajasthan where ground water level is continuously decreasing due to limited water sources. All big and small cities depends on these two sources of water surface and groundwater. Due to lack of proper management and increasing demands these source are even not sufficient for fulfilling needs of country's population.

III. WATER SCARCITY

Situation in which fresh water is not available of appropriate amount which can satisfy the daily needs of people cause water scarcity. Areas which lack in fresh water sources are water scarce areas as water is not readily available to people for their daily consumption. Availability of water but not of feasible quantity or quality consumption of which cause problems to people cause water scarce situation as potable water is not available to use. But in developing world, finding a reliable source of water is time consuming and expensive known as economic scarcity. Water can be found but it requires more resources to do it. This simply isn't enough. That is known as physical scarcity. Water available from different sources in India, is maximum used for the irrigation purposes and then for potable uses. With the time, these demands are going to increase which will put further pressure on the ground water and surface water source of India. 85% of water demand is from agriculture sector and only 7% from the drinking purposes.

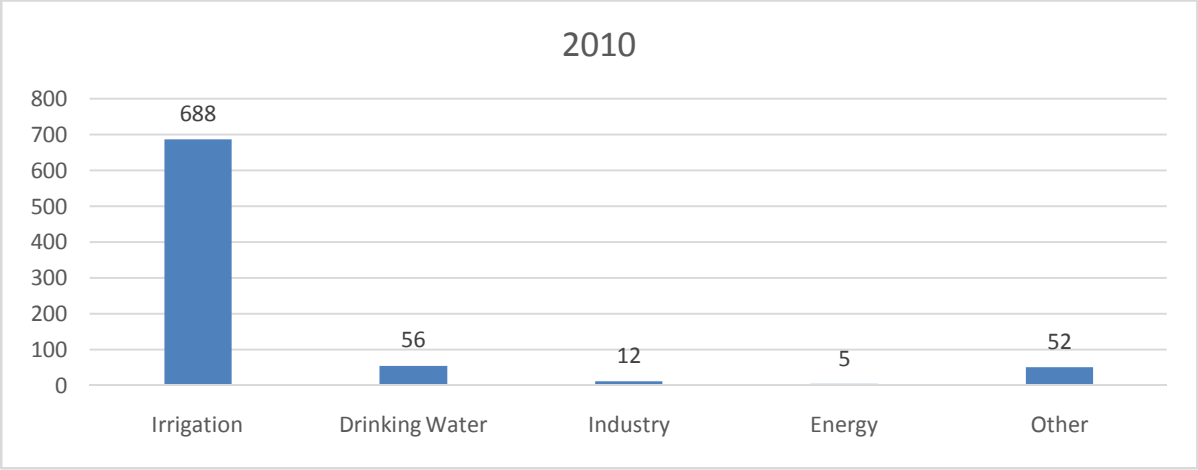

Fig. 1. Consumption pattern of water in India (Source: Ministry of Water Resource).

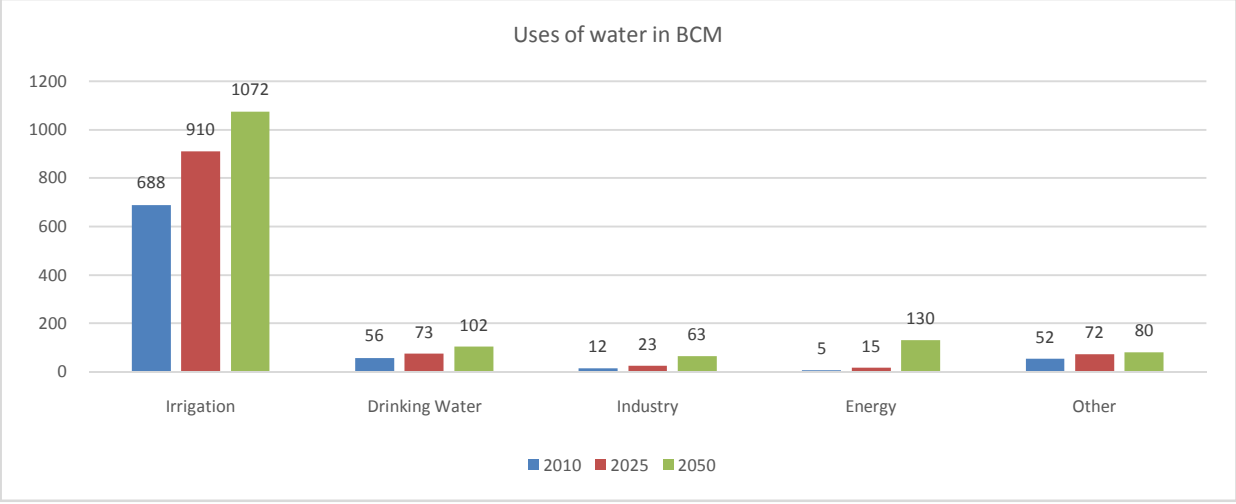

Fig 2: Projected demand of different uses as per different uses of water. (Source: Ministry of Water Resource).

But water available per capita is decreasing continuously as water available is fixed per year 1869BCM, in 2001 per capita water available was 1816 Cubic meter and in 2011 it was 1544 Cubic meter. Projected water demands and population shows a further decrease in water availability per capita.

Table 3: Projected population of India and per capita water availability.

Year	Population (million)	Per capita average annual water (m^3/yr)
2001	1029	1816
2011	1210	1545
2025	1394 (projected)	1340
2050	1640 (projected)	1140

Source: GOI, Ministry of Water Resource

Availability of water per capita less than 1700 m^3/yr is occasional water stressed condition but when per capita quantity available is less than 1000 m^3/yr situation is water scarce condition. (RK Sivanapan, 2006). As per the above stats, India is in condition of water stress and approaching slowly to the water scarce condition where water is not readily available for consumption. This is the situation when water is considered to be spread all over the country at same Intensity but the true picture is much different than this. As settlements are available near to the water bodies and also away from the water sources, those which are near to sources are now in water stress or may getting water all time annually but areas away from water bodies require infrastructure to carry water to these areas which may be possible and sometimes not so these areas like Jaisalmer (Rajasthan) faces water scarce situations.

Groundwater. With the increasing population and demand on ground water, many areas in country shows critical to over exploited status for water level and these areas need ground water recharge so that water level can be increased to meet the future demands. Rural settlement mainly depends on the groundwater as no water supply infrastructure is available in all settlements and mainly water is used for the agriculture purpose. Rajasthan is showing areas with over-exploited status as there is no natural river in it, people left with ground water only as a source of water. State is also suffering with poor rainfall.

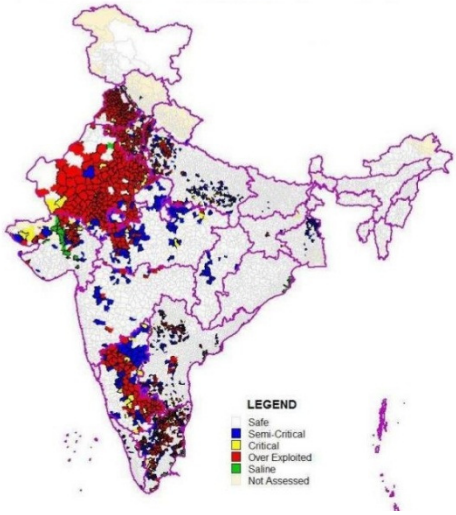

Fig. 3. Ground Water Scenario of India, (Source: Central Ground Water Board).

Surface water. Out of 20 river basin, 13 are showing water scarcity for the population. Increasing demand of water lead India in a water scarce situation if water is not used wisely without proper management or pressure should be decrease by using different sources or with limited use.

Table 4: Surface water available in India.

Sl. No.	River Basin	Average Annual water Resources potential (BCM)	estimated population			per capita avaialbility M^3		
			2010	2025	2050	2010	2025	2050
1	Indus	73.3	57.69	69.2	81.41	1270.58	1059.25	900.38
2	ganga	525	494.47	593.04	697.69	1061.74	885.27	752.48
3	brahamputra	537.2	40.07	48.06	56.64	13406.54	11177.69	9501.48
4	barak and others	48.4	8.54	10.24	12.05	5667.54	4726.56	4016.59
5	godavari	110.5	74.36	89.18	104.92	1486.01	1239.07	1053.18
6	krishna	78.1	83.72	100.41	118.13	932.87	777.81	661.14
7	cauvery	21.4	40.34	48.39	56.93	530.49	442.24	375.9
8	subernaekwha	12.4	12.94	15.52	18.26	958.27	79.97	679.08
9	Brahamani	28.5	13.49	16.18	19.04	2112.68	1761.43	1496.85
10	mahanadui	66.9	36.63	43.93	51.68	1826.37	1522.88	1294.51
11	Pennar	6.3	13.36	16.02	18.85	471.56	393.26	334.22
12	Mahi	11	14.46	17.34	20.4	760.72	634.37	539.22
13	sabarmati	3.8	14.46	17.34	20.4	262.79	219.15	186.27
14	narmada	45.6	20.24	24.28	28.56	2252.96	1878.09	1596.64
15	tapi	14.9	20.38	24.44	28.75	731.11	609.66	518.26
16	tapi to tadri	87.4	35.53	42.61	50.13	2459.89	2051.16	1743.47
17	tapi to kanyakumari	113.5	44.89	53.84	63.34	2528.4	2108.09	1791.92
18	mahanadi to pennar	22.5	32.5	38.97	45.85	692.31	577.37	490.73
19	pennar to kanyakumari	16.5	61.96	74.32	87.43	266.3	222.01	188.72
20	kutvh and saurashtra	15.1	30.43	36.5	42.94	496.22	413.22	351.65
21	Rajasthan		9.78	11.73	13.79			
22	minor rivers	31	2.07	2.48	2.91	1497.85	12500	10652.92

Source: Central water commission

Status of Urban Water supply. Water supply is collected form the different research papers and reports on water supply of respective cities regarding the supply and demand of water in cities. On the basis of the study on different cities of India, it can be seen that in the present Indian cities are facing water shortage and this will increase in future years. Due to the increasing population and pollution of fresh water sources is increasing demand and decline in quantity if fresh water available. Due to the expansion of urban areas these are running over the natural routes of water bodies and hinders the water bodies flow.

Many cities have adequate water supply now but in the future, they may also face water scarcity due to increasing demand of water and inadequate supply and source of water. Water shortage are more in the areas where natural water bodies are not available or where the ground water quality is not good. (central ground water board) the only solution to this problem is recharge of ground water recharge so that water can be available to the people. Areas lying in the heavy rainfall areas also facing water shortages so there is need to explore the ground water source as a source of water supply. Most of the cities have already exploited their natural water resources to such an extent that there is urgent need to resort for other type of water sources (Ashish, Manu 2000). If still cities government bodies are unable to manage and unsuccessful in searching of new water sources for supply than these cities will see situation of major water stress and scarcity.

Table 5: Water supply data of different Indian cities.

WATER SUPPLY STATUS OF DIFFERENT INDIAN CITIES						
NAME	POPULATION	PRESENT REQUIRE (MLD)	WATER SUPPLY (MLD)	%GAP	FUTURE DEMAND (MLD)	%GAP (2021)
	2011				2021	
HYDERABAD	6731790	1242	613	50.6	1514	59.5
PATNA	1684222	216	186	13.9	335	44.5
JAIPUR	3046163	419	340	19	776	58.4
AHMEDABAD	5577940	1060	836	21.1	1428	41.5
MUMBAI	12442373	2619	2559	2.3	3053	16.2
BHOPAL	1798218	377.6	242	35.9	465	48.0
SURAT	4467797	1087	980	9.8	1548	36.7
SHIMLA	169578	62	40	35.5	67	40.3
CHANDIGARH	1055450	350	318	9.1	425	25.2
BANGLORE	8520435	1400	1350	3.6	1615	16.4
PUNE	3124458	1250	921	26.3	1543	40.3
CHENNAI	4646732	1630	1535	5.8	2245	31.6
DELHI	16349831	5182	3591	38.7	6273	48.5
KOLKATA	14035959	1894	1332	29.7	2802	52.5

Source: water supply departments of Cities, City Development Plan and research papers

Per capita domestic demand is increasing in urban areas for 135lpcd to 225 lpcd (central water commission) which will increase pressure on water supply infrastructure and demand for more expenditure on current system to meet demands. It will be more aggravated as water sources are getting polluted and demand is increasing. Harvesting of rain water or decrease in consumption by changing their usage patterns can help to control the demand and decrease the gap in water supply and demand.

IV. WATER ISSUES AND MANAGEMENT

Due to poor management and gap in demand and supply lead to water crisis. Extraction of water form water bodies without giving or recharging back to them cause depletion of water bodies. Also, due to increase in pollution, improper waste management pollutes the surface and ground water sources. Increase in industrial activities and disposal of waste in water streams ruined the fresh water source as waste contains harmful substance and chemicals like arsenic, fluoride, salts made Indian rivers unfit for drinking, irrigation and for aquatic life too. (Mukesh Kumar,) Areas where surface water is not available ground water is used for irrigation which cause depletion in water table along with pesticides seepage through soil spoil the water in ground and contaminate it. Due to global warming, whole world is suffering with erratic and unpredictable rainfall which affects recharge of water bodies and mainly agriculture sector.

In developing countries like India, about 80% of diseases with which people suffer are water borne diseases. Women of India specially of rural settlement have to walk several kilometers to fetch water due to non-availability of water surface nearby. Due to decline in quality of water available for irrigation affects the production of crops which lead to lesser crop production. India became net importer of grain from the exporter which increase the prices of food articles and increase poverty as no people have to spend more for their meals. This is the only time when country is facing water stress situation to manage the water sources and people take immediate action to control the use and wastage of water effectively/ planning for the water sources is required so that exploitation can be checked and sustainable approach can be attained for water. Till 2011, 31.16% of India population resides in urban areas which are putting pressure on current water infrastructure and sources which will further increase as by 2030, 40.76% of India's population will be in cities. So, management for water must be of prime importance to the government, policy makers, stakeholders and for general public.

V. MANAGEMENT RECOMMENDATION

(i) Need to fetch water from other source like Rainwater Harvesting, which requires maximum implementation of this at household, community and city level. Than only it can support water demand in low rainfall areas also.

(ii) Maximum wastage of water is noticed while carrying water from source to tap through pipe leakage like in Mumbai almost 20% of water waste due to poor pipelines and linkage. Same in Delhi. (P. Saravana, 2013)
(iii) Recovery of rivers, lakes, reservoirs to make them available for fresh water like in old days. For example, Ganga water is not sufficient for even bathing but once it was effective to cure skin problems. It happened because of water pollution.
(iv) Century in which modern technology is prevailing, there is need for innovative idea and technology which can check pollution of water bodies to improve water quality.
(v) Awareness among people regarding status of water in country and how common people can help to cater this problem of water crisis.
(vi) Demand of water is increasing as population is increasing, control of this factor will push the water scarcity situation away.

VI. CONCLUSION

Decrease in per capita use of water and less wastage of water will help a lot but along with it alternate source of water is also required to support the current water sources. Due to unpredictable amount of precipitation, it is necessary to harvest each drop. And store it to use in stress period. Check on the pollution source which are destroying the quality of water. Due to lack of planning and management of water sources problem is dominating which happens due to lack of resources, privatization, industrial and human waste disposal and corrupt people.

Water supply and demand will become worse in year 2050 as that will be the period when maximum cities will water scarce form water stress situation due to increase in population and lack of alternate solutions of water. Wars may occur globally due to the lack of fresh water between countries, states, cities, political, economic, social crisis will develop and India will also suffer from the same, this is the crucial time in which with proper planning and management situation can be controlled or it will become worse and deadly.

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