

An Analysis of Demand and Supply of Water in India

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Abstract

Water is one of the important renewable natural resource, no one can survive without it either humans or animals. India is rich in terms of different natural resources, water is one of them. Water comes from different sources such as precipitation, surface water and ground water. Which play an important role in India's supply of water. 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. Water Resources are the prime input to the growth and prosperity of the nation. The objective of this paper is to highlights the demand and supply of water in India, and the estimated water in major basins in India. **It has been found that the demand for water is increasing substantially** due to increasing population, growing urbanization, and rapid industrialization combined with the need for raising agricultural production. **The supply of water is inadequate compared to its growing demand in our country.** The per capita availability of water is also continuously decreasing. **Therefore** Sustainable development and efficient management of water is an increasingly complex challenge to India. It has been estimated that **More than 2.2 million people die each year from diseases related to contaminated drinking water and poor sanitation.**

Keywords: water supply and demand, ground water, surface water, basins

Introduction

Water is a chemical compound with the chemical formula H_2O . A water molecule contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is a liquid at standard ambient temperature and pressure, but it often co-exists on Earth with its solid state, ice, and gaseous state (water vapour or steam). Water also exists in a liquid crystal state near hydrophilic surfaces. Water covers 71% of the Earth's surface, and is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapour, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Only 2.5% of the Earth's water is fresh water, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products. Water appears in nature in all three common states of matter (solid, liquid, and gas) and may take many different forms on Earth, water vapour and clouds in the sky, seawater in the oceans, icebergs in the polar oceans, glaciers and rivers in the mountains, and the liquid in aquifers in the ground. Water on Earth moves continually through the hydrological cycle of evaporation and transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea. Evaporation and transpiration contribute to the precipitation over land.

Water is the important natural resource in our life; water is becoming scarce due to increase in population, industries and agricultural activities and due to poor rainfall. India home to 16 percent of the world's population has only 2.5 percent of the world's land area and 4 percent of the world's water resources at its disposal. Precipitation in the form of rain and snowfall provide over 4,000 trillion liters of fresh water to India. Most of this fresh water returns to the seas and ocean via many large rivers flowing across the subcontinent. A portion of this water is absorbed by the soil and is stored in underground aquifers. A much smaller percentage is stored in inland water bodies both natural (lakes and ponds) and man-made (tanks and reservoirs). Of the 1,869 trillion liters of water reserves, only an estimated 1,122 trillion liters can be exploited due to topographic constraints and distribution effects.

Among various continents, Asia has 36% of the available fresh water reserves, with over 60% of the world population where water is a scarce commodity. Compared to Asia, Africa is in a better situation, where 13% of the population has access to 11% of the fresh water reserves. Australia and Oceania have plenty of water with 1% population owning 5% of the fresh water reserves, followed by North and Central America, with 8% population and 15% water reserves and South America with 6% global population and 26% fresh water reserves.

More than 2.2 million people die each year from diseases related to contaminated drinking water and poor sanitation. By the year 2050, water scarcity will affect between two to seven billion people out of the projected total population of 9.3 billion.

The drivers of this resource challenge are fundamentally tied to economic growth and development. Agriculture accounts for approximately 3,100 billion m^3 or 71 percent of global water withdrawals today, and without efficiency gains will increase to 4,500 billion m^3 by 2030 (a slight decline to 65 percent of global water

withdrawals). The water challenge is therefore closely tied to food provision and trade. Centres of agricultural demand, also where some of the poorest subsistence farmers live, are primarily in India (projected withdrawals of 1,195 billion m³ in 2030), Sub-Saharan Africa (820 billion m³), and China (420 billion m³). Industrial withdrawals account for 16 percent of today's global demand, growing to a projected 22 percent in 2030. The growth will come primarily from China (where industrial water demand in 2030 is projected at 265 billion m³, driven mainly by power generation), which alone accounts for 40 percent of the additional industrial demand worldwide. Demand for water for domestic use will decrease as a percentage of total, from 14 percent today to 12 percent in 2030, although it will grow in specific basins, especially in emerging markets

Monsoon rain from June to September is the primary source of water in India. Rainfall pattern is the biggest challenge for water management. Eighty percent of annual rainfall is received in 5-6 days, which are spread over the rainy season. With increasing climate variability, Indian monsoons are becoming less predictable and reliable. The frequency of extreme weather events, such as floods and droughts, has increased over the past decade, causing supplies to diminish.

Due to various constraints of topography, uneven distribution of resources over space and time, it has been estimated that about 690 cu.km. of surface water resources potential can be put to beneficial use (NCIWRD, 1999). About 40 per cent of these utilisable surface water resources are presently in Ganga-Brahmaputra-Meghna system. In the majority of river basins, present utilisation is significantly high and is in the range of 50 per cent to 95 per cent of utilisable surface resources. The per capita surface water availability in India on the basis of census of 1991 and 2001 works out to be 2,300 and 1,900 m³ and these are projected to reduce to 1,400 and 1,190 m³ for the years 2025 and 2050 respectively; merely on the basis of population projections and with the assumption that the availability of water resources shall not change in future.

Objectives

To highlight the demand and supply of water in India

To find out the major sources (basins) of water in India

To find out the per capita water availability in India

Research Methodology

The researcher has adopted analytical, descriptive and comparative methodology for this report; Data has been collected from different sources such as books, journals, newspapers and online databases and on the views of writers in the discipline.

Supply of Water in India

India's land area can be divided into 19 major river basins. The per-capita water resource availability of these basins varies from a low of 240 m³ in the Sabarmati basin to a high of 17,000 m³ in the Brahmaputra basin, while water withdrawals vary from 243 m³ in the Meghna basin to 1,670 m³ in the Indus basin. Irrigation is by far the largest user of water in all the basins. The basins of the westerly flowing rivers of the Kutch and Saurashtra regions of Gujarat, and the Luni river—home to 6 percent physically water-scarce and food-dependent The second group of basins, the Indus and Pennar river basins—with 7 percent of India's population—are classified as physically water-scarce, but these basins have significant food surpluses. The grain surplus of the Indus basin alone is able to meet 85 percent of the grain demand from basins with grain production deficits. The water-scarcity problems of the third group of 11 river basins—home to 75 percent of the Indian population—are mixed, but almost all have significant deficits in crop production. The fourth and fifth groups of river basins are classified as “non-water-scarce and food-sufficient” and “non-water-scarce and food-surplus,” respectively. These last two groups of basins are home to 12 percent of India's population. The estimated water resource in India from various basins is shown in table 1.1 given below.

Table 1.1: Estimated Water Resource in India

Basin No.	Basin	Surface water availability	Surface water utilizable	Percent utilizable surface water	Replenish able ground water resource	Total utilizable resource
Billion Cubic Metre						
1	Indus	73.31	46.00	62.7	31.23	77.23
2	Ganga, Brahmaputra, Barak and other Basins	1110.62	274.00	24.7	209.85	483.85
3	Godavari	110.54	76.30	69.0	37.50	113.80
4	Krishna	78.12	58.00	74.2	26.65	84.65
5	Cauvery	21.36	19.00	89.0	10.15	29.15
6	Subernarekha	12.37	6.81	55.1	5.13	11.94
7	Brahmani & Baitarani	28.48	18.30	64.3	6.70	25.00
8	Mahanadi	66.88	49.99	72.6	17.72	67.71
9	Pennar	6.32	6.86	108.5	5.10	11.96
10	Mahi	11.02	3.10	28.1	3.12	6.22
11	Sabarmati	3.81	1.93	50.7	2.98	4.91
12	Narmada	45.64	34.50	75.6	12.90	47.40
13	Tapi	14.88	14.50	97.4	7.36	21.86
14	Ten composite Basins	286.02	81.03	28.3	57.30	138.33
Total		1869.37	690.32	36.92	433.69	1124.01

Source: CWC 2002

India receives an average of 4,000 billion cubic meters of rainfall every year. Unfortunately, only 48% of rainfall ends up in India's rivers. Due to lack of storage and crumbling infrastructure, only 18% can be utilized. Rainfall is confined to the monsoon season, June through September, when India gets, on average, 80% of its total annual precipitation. Due to India's storage crunch, the government is unable to store surplus water for the dry season. Such uneven seasonal distribution of rainfall has not stimulated the development of better capturing and storing infrastructure, making water scarcity a critical problem. India is blessed with good rainfall well distributed over 5-6 months in the year. The average annual rainfall in the country is 1170 mm with a wide range between 100 mm in desert areas of Rajasthan to 10000 mm in Cherapunji. The total available sweet water in the country is 4000 billion m³ per annum. Out of this, over 1047 billion m³ water is lost due to evaporation, transpiration and runoff, reducing the available water to 1953 billion m³ and the usable water to 1123 billion m³.

The brief description of water availability in India is shown in table 1.2.

Table 1.2: Area and Water Resources in India

A. GENERAL	
Geographical area	329 M. ha.
Area as % of world area	2.4 %
Forest cover	20.97 %
Population as on 1.3.2006	1114.2 million
Population as % of world population	17.2 %
Annual rainfall (2005)	1208 mm
Major river basins (catchment area > 20,000 sq. km)	12 253 M. ha.
Medium River Basins (Catchment area < 20,000 sq. km.)	46 24.6 M. ha.
B. Water Resources	
Average annual Precipitation	4000 BCM
Avg. precipitation during Monsoon (Jun-Sept)	3000 BCM
Natural Runoff	1986.5 BCM
Estimated utilizable surface water resources	690 BCM
Total utilizable ground water resources	433 BCM
Total annual utilizable water resources	1123 BCM
Per capita water availability	1720.29 cum

Groundwater is a major component of the total available water resources. Groundwater utilisation has been increasing over the past three decades and is likely to increase. This trend can potentially change the existing environmental services of surface and groundwater resources. Ground water is an annually replenishable resource but its availability is non-uniform in space and time. The ground water for the entire country is estimated to be 433 BCM with a stage of ground water development in the country of about 60%. CGWB has prepared hydro geological map of India depicting distribution of major rock types and the potential of different aquifer systems.

In India, most of the rainfall occurs in a relatively short period of three to four months during the monsoon period. The average rainfall in the four months from June to September during the southwest monsoon is about 903 mm. During the remaining eight months, an average of only about 294 mm of rainfall is received

Pollution of water resources is another major concern which is affecting the water supply as well as human health conditions. Although, 5% of the total water is used for domestic use, 27% of the villages and 4 to 6% urban population in India do not have access to drinking water. Apart from inadequate supply of water, there is a serious concern about the quality of water, which is severely affecting the health. It is reported that over 70% of the water consumed by rural population in India does not meet the WHO standards. It has been reported that 80% of rural illnesses, 21% of transmissible diseases and 20% of deaths among children in the age group of 5 years, are directly linked to consumption of unsafe water

India's supply of water is rapidly dwindling due to mismanagement of water resources, over-pumping and pollution. Climate change is expected to add to the problem by causing erratic and unpredictable weather, which could drastically diminish the supply of water coming from rainfall and glaciers

Demand for Water in India

India uses more water than any other country. Indians are the largest freshwater users in the world. Around 65% of India's total water demand is for groundwater, which plays an important role in shaping the nation's economic and social development. Agriculture, domestic and industrial use, respectively, comprises India's largest uses for water. Therefore with growing demand for water and depletion of the available water, assured supply of good quality water is becoming a growing concern.

The requirement of water for various sectors has been assessed by the National Commission on Integrated Water Resources Development (NCIWRD) in the year 2010. On the basis NCIWARD major component of demand in India is irrigation, Drinking water, Industry etc. is shown in table 2.1.

Table 2.1: Water requirements for various sources

Sector	Water Demand in Km ³ (or bcm)		
	2010	2025	2050
Irrigation	557	611	807
Drinking	43	62	111
Industry	37	67	81
Energy	19	33	70
Others	54	70	111
Total	710	843	1180

Demand in the country is projected to very soon overtake the availability of water. In some regions of the country, it has already happened. The rapid increase in population, urbanization and industrialization has led to a significant increase in water requirement. In the next decade the demand in water is expected to grow by 20 percent, fuelled primarily by the industrial requirements which are projected to double from 23.2 trillion liters at present to 47 trillion liters. Domestic demand is expected to grow by 40 percent from 41 to 55 trillion liters while irrigation will require only 14 percent more ten years hence, 592 trillion liters up from 517 trillion liters currently. As per the Ministry of Water Resources per capita water availability in 2025 and 2050 is estimated to come down by almost 36 percent and 60 percent respectively of the 2001 levels. According to the Ministry of Water Resources, industrial water use in India stands at about 50 billion cubic meters or nearly 6% of total freshwater abstraction. This demand is expected to increase dramatically in the next decade, given the forecasts of 9% growth.

Groundwater is the major source of drinking water in urban and rural India. It is also an important source of water for the agricultural and the industrial sectors. India possesses about 432 bcm of groundwater replenished yearly from rain and river drainage, but only 395 bcm are utilizable. Of that 395 bcm, 82% goes to irrigation and agricultural purposes, while only 18% is divided between domestic and industrial. Total static groundwater available is approximately 10,812 bcm. Groundwater increasingly is pumped from lower and lower levels, and much faster than rainfall is able to replenish it. The average groundwater recharge rates of India's river basins are 260 m³/day. The Delhi Jal Board, which is responsible for supplying potable water, estimates that water tables are dipping by an average of 0.4 meters a year.

Table 2.2: per capita water availability in India

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

Source: Government of India, 2009.

Groundwater and surface water are thus the two sources of water available for human consumption. Over the years due to swelling population, increasing industrialization and expanding agriculture, the demand for water has multiplied. It is evident from the table that the per capita availability of water reducing progressively from 1816 cubic meters 2001 to 1545 cubic meters as per the 2011 census. On the other hand it has been estimated that the per capita water use in India will increase from the current level of 99 litres per day to 167 litres per day in 2050, so the gap becomes widening day by day, by increasing population, urbanisation and industrialization. According to NCIWRD commission water demand in the domestic and industrial sectors could increase substantially.

It is assume 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.

The per capita industrial water demand could increase from 42 m³/person in 2000, to about 66 and 102 m³/person by 2025 and 2050, respectively or the total industrial water demand to increase to 92 and 161 BCM by 2025 and 2050, respectively.

As a result of increasing economic activities, the quality and quantity of water in some rivers are at a threateningly low level. However, with increasing campaigns by NGOs and civil societies, awareness of water-related environmental problems is increasing. As a result, the water demand for the environment could increase rapidly.

The demand for water is increasing day by day; on the other side supply of water either remains constant or decreasing due to global warming. The unadjustment of the demand and supply of water could cause water crisis which is already happening in some of countries in the world and the resultant cause would be:

- Inadequate access to safe drinking water.
- Inadequate access to water for sanitation and waste disposal.
- Groundwater over drafting (excessive use) leading to diminished agricultural yields.
- Overuse and pollution of water resources harming biodiversity.
- Regional conflicts over scarce water resources.
- Waterborne diseases.
- In addition of human population, Vegetation and wildlife will be the victims.

India is facing water stress. In addition due to contamination of water sources and poor water treatment facility it

is often difficult to get safe drinking. Therefore there is an urgent need to utilize this valuable resource in an efficient way and more and more water saving techniques waterless urinals, waterless car washes, rain water harvesting etc should be used in order to save water for future.

Conclusion

India is not a water deficit country, but due to severe neglect and lack of monitoring of water resources development projects, several regions in the country experience water stress from time to time. The annual rainfall received by India is unevenly distributed across its different parts, across different times of the year. As a result in spite of good annual rainfall, some river basins fall in the category of *water scarce* and *water stressed* regions, India faces a critical water shortage due to government mismanagement, pollution, ground water depletion, A major challenge for India is its rising water demand coupled with economic development. India's increasing population and economic growth has put tremendous pressure on India's water resources. Water demand is steadily increasing across all markets, and will continue to do so. Balancing water demand with available supply will be crucial for future economic growth and development For India to meet its growing water demands, it needs to clean its existing water supply and create new water supplies without increasing energy requirements.

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