

WATER CRISIS IN INDIA AND POSSIBLE SOLUTIONS

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"There will be constant competition over water, between farming families and urban dwellers, environmental conservationists and industrialists, minorities living off natural resources and entrepreneurs seeking to commodify the resources base for commercial gain" -UNICEF report on Indian water.[1]

1. Introduction

It is roughly estimated that more than two billion people worldwide live in regions facing water scarcity [2] and in India this is a particularly acute crisis. Millions of Indians currently lack access to clean drinking water and the situation is only getting worse. India's demand for water is growing at an alarming rate. India currently has the world's second largest population, which is expected to overtake China's by 2050 when it reaches a staggering 1.6 billion,[3] putting increased strain on water resources as the number of people grows. A rapidly growing economy and a large agricultural sector stretch India's supply of water even thinner. Meanwhile, India's supply of water is rapidly dwindling due primarily to mismanagement of water resources, although over-pumping and pollution are also significant contributors. Climate change is expected to exacerbate the problem by causing erratic and unpredictable weather, which could drastically diminish the supply of water coming from rainfall and glaciers. As demand for potable water starts to outstrip supply by increasing amounts in coming years, India will face a slew of subsequent problems, such as food shortages, intrastate and international conflict.

India's water crisis is predominantly a manmade problem. India's climate is not particularly dry, nor is it lacking in rivers and groundwater. Extremely poor management, unclear laws, government corruption and industrial and human waste have caused this water supply crunch and rendered what water is available practically useless due to the huge quantity of pollution. In managing water resources, the Indian government must balance competing demands between urban and rural, rich and poor, the economy and the environment. However, because people have triggered this crisis, by changing their actions they have the power to prevent water scarcity from devastating India's population, agriculture and economy. This paper is an overview of the issues surrounding India's water scarcity: demand and supply, management, pollution, impact of climate change and solutions the Indian government is considering.

2. Demand and Usage

In 2006 among the domestic, agricultural and industrial sectors, India used approximately 829 billion cubic meters of water every year. By 2050 demand is expected to double and consequently exceed the 1.4 trillion cubic meters of supply. [4]

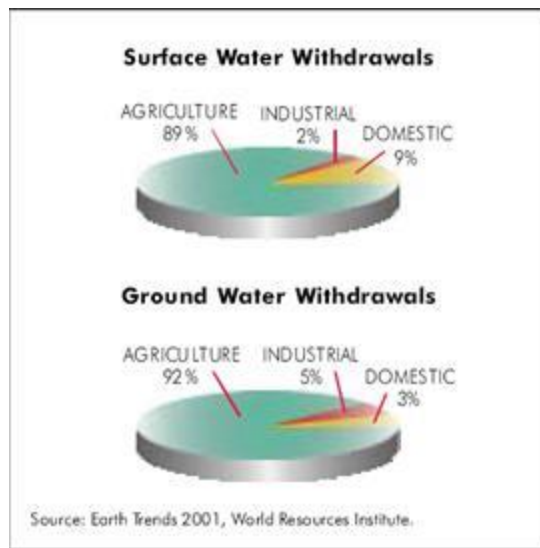


Figure 1: Water Demand by Sector
 (Source: Earth Trends 2001, World Resources Institute)

2.1 Domestic

India's more than 1.2 billion people need access to clean drinking water. The demand for drinking water is divided between the urban and rural populations and comprises about 4-6% of total water demand.[5] Due to the amenities of typical urban life, such as flush toilets and washing machines, people living in cities tend to lead more water intensive lives. The urban population has doubled over the past 30 years, now representing more than 30% of India's total population [6] and is expected to reach 50% of the total population by 2025.[7] Population growth is going to accelerate the water crisis in India, especially as more and more people move into the cities and become part of the middle class. Because the rivers are too polluted to drink and the government is unable to consistently deliver freshwater to the cities, many urban dwellers are turning to groundwater, which is greatly contributing to the depletion of underground aquifers. Rural citizens face a similar crisis. Currently 30% of the rural population lack access to drinking water and of all states in India, only about 7 have full availability of drinking water for rural inhabitants.[8] Most people who live in rural areas demand less water for day-to-day living than people living in cities and the majority of their water demand comes from agricultural needs.

2.2 Agricultural

Despite the recent rapid growth in the services and industrial production, agriculture is still an integral part of India's economy and society. Between 1947 and 1967 India underwent the Green Revolution, which concentrated on expanding farm yields by double-cropping existing farmland and using seeds with improved genetics.[9] The result was a huge increase in agricultural production, making India one of the world's biggest exporters of grain. The availability of canal water led farmers to adopt highly profitable, but extremely water intensive crops, such as sugar cane.[10] In addition, India achieved its goal of obtaining food security. The rural economy sustains two-thirds of India's 1.2 billion citizens.[11] Unfortunately, this huge surge in agriculture, required significant water resources for irrigation and accelerated the onset of present water shortages.

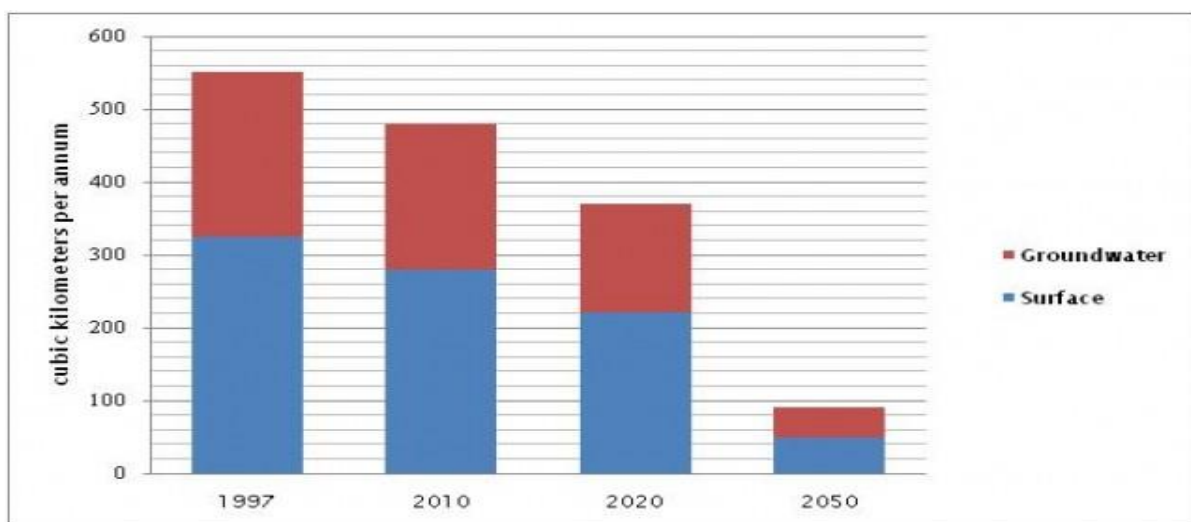
India's agricultural sector currently uses about 90% of total water resources.[12] Irrigated agriculture has been fundamental to economic development, but unfortunately caused groundwater depletion. Due to water pollution in rivers, India draws 80% of its irrigation water from groundwater.[13] As water scarcity becomes a bigger and bigger problem, rural and farming areas will most likely be hit the hardest. Thus far, food security has been one of the highest priorities for politicians and the large farming lobby has grown accustomed to cheap electricity, which allows extremely fast pumping of groundwater, which is something they are unwilling to give up for the sake of water conservation. If India wants to maintain its level of food security, farmers will have to switch to less water intensive crops. Otherwise India will end up being a net importer of food, which would have massive ramifications for the global price of grain.

2.3 Industrial

Water is both an important input for many different manufacturing and industrial sectors and used as a coolant for machines, such as textile machines. Cheap water that can be rapidly pumped from underground aquifers has been a major factor in the success of India's economic growth. For example, the garment industry in Tirupur, a city in the southern state of Tamil Nadu, was growing faster than anyone thought possible for several decades. By 1990's, however, the town was running out of water, which is a critical input for dyeing and bleaching.[14] Despite the many benefits from a thriving economy, industrial waste is largely responsible for the high levels of pollutants found in India's rivers and groundwater. Many corporations end up polluting the very water they later need as an input. 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.[15] This demand is expected to rise sharply in the next decade, given the enormous forecasts of 9% economic growth.

3. Supply

Surface water and groundwater are the sources of India's water supply. Other sources, such as desalination, are negligible because they are not cost effective.



*Figure 2: Surface Water, Groundwater over Time
(Source: World Bank Report on Water in India)*

3.1 Surface Water

The main river systems, the Ganges, Brahmaputra, Mahanadi, Godavari, Krishna, Kaveri, Indus, Narmada and Tapti, flow into the Bay of Bengal and Arabian Sea. They can be classified into four groups: Himalayan, coastal, peninsular and inland drainage basins. The Himalayan Rivers, such as the Ganges, are formed by melting snow and glaciers and therefore have a continuous flow throughout the year. The Himalayas contain the largest store of fresh water outside the polar ice caps and feed seven great Asian rivers.[17] This region receives heavy rainfall during monsoon, causing the rivers to swell and flood. The coastal rivers, especially on the west coast, are short in length with small catchment areas. The peninsular rivers, which include the Mahanadi, Godavari, Krishna and Kaveri, flow inland and also greatly increase in volume during the monsoon season. Finally, the rivers of the inland drainage basin, such as the Mahanadi and the Godavari, dry out as they drain towards the silt lakes such as the Sambhar or are lost in the sands. [18]

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.[19] Rainfall is confined to the monsoon season, June through September, when India gets, on average, 75% of its total annual precipitation. Once again, due to India's storage crunch the government is unable to store surplus water for the dry season.

3.2 Groundwater

Groundwater is the major source of drinking water in both 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 this 395 bcm, 82% goes to irrigation and agricultural purposes, while only 18% is divided between domestic and industrial.[20] Total static groundwater available is approximately 10,812 bcm.[21] Groundwater is increasingly being pumped from lower and lower levels and much faster than rainfall is able to replenish it. The average groundwater recharge rate of India's river basins is 260 m³/day.[22] Groundwater crisis is not the result of natural factors; it has been caused by human actions. During the past two decades, the water level in several parts of the country has been falling rapidly due to an increase in extraction. The number of wells drilled for irrigation of both food and cash crops have rapidly and indiscriminately increased.[24].

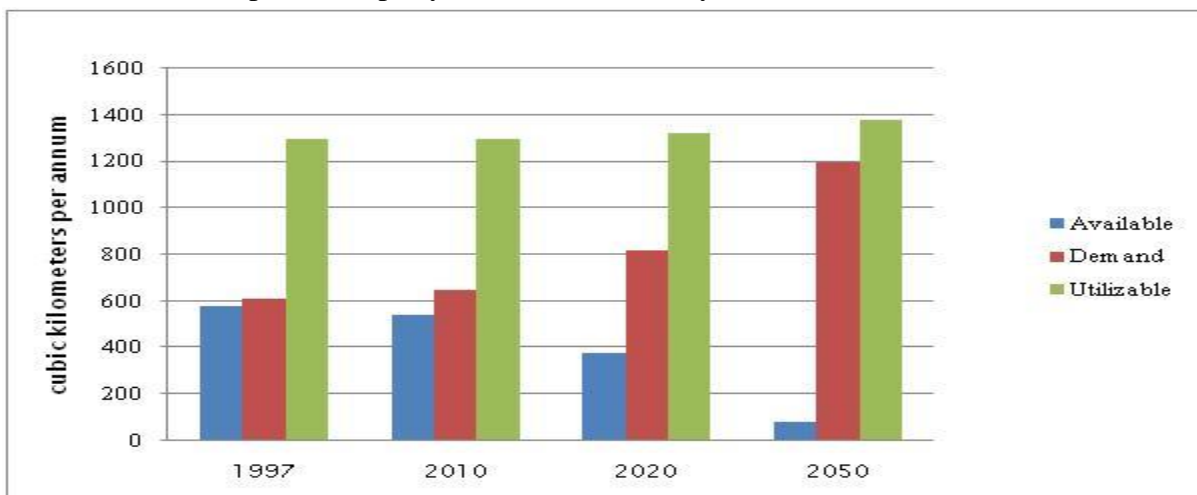


Figure 3: Utilizable water, demand and available water (Source: World Bank Report on Water in India)

4. Climate Change and Water

Climate change is exacerbating the depleting supply of water. As the climate warms, glaciers in the Himalayas and the Tibetan Plateau have been melting. According to the IPCC, global temperatures have gone up by 0.76 Celsius over the last 100 years.[25] The result is increased flooding initially, especially during the monsoon season when rainfall is already at its heaviest. However, in subsequent years, there will be less and less glacial melt water to continuously supply India's major rivers e.g. nearly 70% of water to the Ganges comes from snow-fed rivers, which means that if Himalayan glaciers dry up, the Ganges too would dry up.[26] It would have drastic consequences for a huge population. The glaciers, which regulate the water supply to the Ganges, Indus, Brahmaputra, Mekong, Thanlwin, Yangtze and Yellow Rivers, are believed to be retreating at a rate of about 33-49ft each year.[27]

Climate change also affects rainfall patterns. Scientists agree that climate change will ultimately make rainfall more erratic and cause unpredictable weather. It is argued that increased average water temperature in oceans, will increase the probability and intensity of monsoons during the summer.[28] As one of the world's largest emitters of greenhouse gases, India contributes significantly to global warming, but is not adequately answerable. This is yet another regrettable example of how India sacrifices its environment and its supply of resources for economic growth.

5. Water Management and Conservation

The tragedy of India's water scarcity is that the crisis could have been largely avoided with better water management practices and population control measures. There has been a distinct lack of attention in this regard. Historically water has been viewed as an unlimited resource that did not need to be managed as a scarce commodity. This attitude is changing in India and there is a growing desire for decentralized management.

Since independence India's primary goals have been economic growth and food security, completely disregarding water conservation. This has caused serious ramifications being felt today, as many citizens still operate under these principles. Unlike many other developing countries, especially those with acute water scarcity issues such as China, Indian law has virtually no legislation on groundwater. Anyone can extract water: homeowner, farmer or industry as long as the water lies underneath their plot of land.[30] The development and distribution of cheap electricity and electric pumps have triggered rapid pumping of groundwater and subsequent depletion of aquifers. There are about 20 million individual wells in India that are contributing to groundwater depletion.[31] Industry applies the same logic and rather than reusing the water used for cooling machines, they dump it back into rivers and canals, along with the pollution it has accumulated. Even Prime Minister Manmohan Singh has warned against over-pumping, but local officials won't take any action as that would upset the farm lobbies.[32]

The governments in India also lack the ability to store and deliver potable water to its citizens, while China is able to store 5-times more water per person as compared to India making it clear how poor India's water management is. The government claims that 9 out of 10 people have access to water. Even if this were true, it disregards the fact that almost of all of that water is too

contaminated to use and none of the Indian cities with a population of more than one million can claim to distribute water for more than a few hours per day.

6. Pollution

Given that India does not regulate water usage, it should come as no surprise that there is also little regulation on pollution and even less enforcement of what regulations do exist. A lot has been spent on pollution control, but no one knows where it went because no changes have been seen. A combination of sewage disposal, industrial effluents and chemicals from farm runoffs, arsenic and fluoride has rendered India's river waters unfit for drinking, irrigation and even industrial purposes. New Delhi alone produces 3.6 million cubic meters of sewage every day, but, due to poor management only half is effectively treated. The rest is dumped into the River Yamuna. New Delhi actually cannot get rid of the sewage it produces because 45% of the population is not connected to the public sewage system. Meanwhile, the quantity of sewage is constantly increasing due to population growth.

Every river in India is polluted to some degree. The water quality in underground wells violates the desired levels of dissolved oxygen and coli form, the presence of which is one measure of filth, in addition to having high concentrations of toxic metals, fluoride and nitrates. India's rivers also have high fluoride content (see *Figure 4*), beyond the permissible limit of 1.5ppm, which affects 66 million people. The polluted water then seeps into the groundwater and contaminates agricultural products when used for irrigation. Over 21% of transmissible diseases in India are related to unsafe water. Millions of the poorest are affected by preventable diseases caused by inadequate water supply and sanitation.

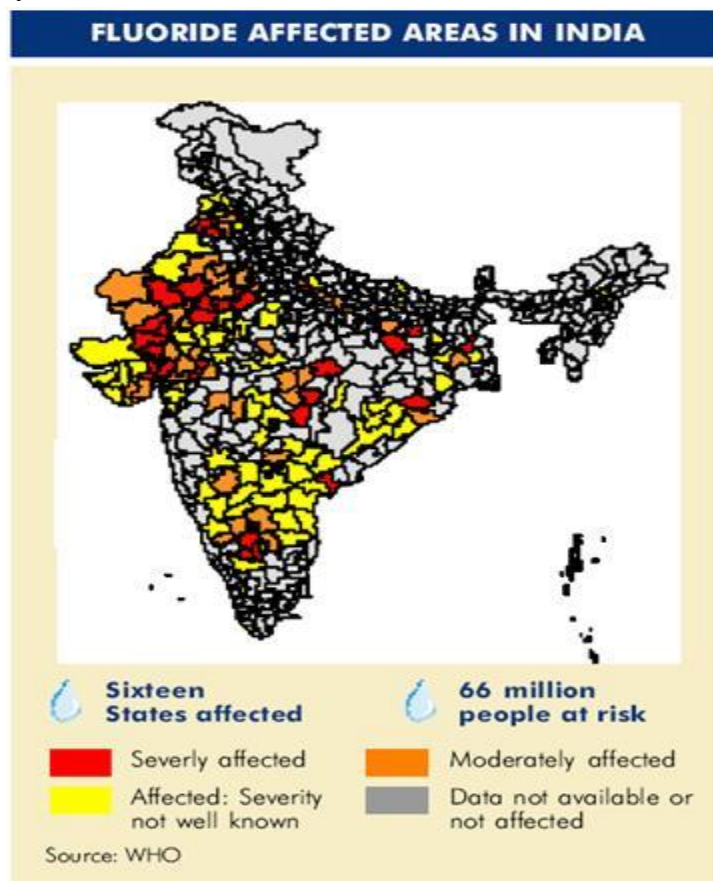


Figure 4: Fluoride Pollution (Source: WHO)

7. Possible Solutions

An immediate solution to India's water crisis is to *change water management practices by regulating usage with effective legislation*. Another proposed solution to the water crisis is the privatization of water. Proponents claim that a privatized water supply would prevent waste, improve efficiency and encourage innovation. The World Bank supports a policy of privatized water in India, claiming that water could be supplied to all of India's inhabitants, but at a higher cost. Many people vehemently oppose this plan arguing that it will not only exacerbate poverty, but also that water privatization does not have a good track record around the world.

India is also considering large-scale engineering projects, similar to those adopted in China, such as Water Diversion Project. However, as India is the world's largest democracy, such projects have been extremely difficult to pass because they are controversial and have stirred lots of debate and much resistance. The most talked about project is the \$112 billion Interlinking of Rivers (ILR) project. This was approved by the president in 2002 and was due for completion in 2016. However, many civil society organizations and traditional water managers dismissed the ILR as it might stir up conflicts. Further, ILR will face the same fate as India's dams: broken and inefficient due to lack of maintenance and reinvestment. The Indian government is already trying to get states to start rainwater harvesting in order to more efficiently tap into the huge quantity of monsoon rain. Collection of rainwater recharges water tables, allows easier accessibility to water resources and increases availability for irrigation throughout the year.

8. Conclusion

India is facing a looming water crisis that has implications not only for its people, but for the entire globe. India's demand for water is growing even as it stretches its supplies. Water infrastructure is crumbling, preventing the government from being able to supply drinking water to its citizens. Pollution is rampant due to unfettered economic growth, poor waste management laws and practices. Although many analysts believe that demand will outstrip supply by 2020, there is still hope for India. Water scarcity in India is predominantly a manmade problem; therefore if India manages its resources soon, it could ward off, or at least mollify, the impending crisis. India has had success with water infrastructure development, which allowed the country to take advantage of its water resources in the first place and achieve food security. These projects did enable the expansion of urban and industrial sectors and increased availability of safe drinking water, but then they were allowed to dilapidate. India needs to make water supply a national priority the way it has made food security and economic growth priorities in the past. India's need for a comprehensive management programme is urgent because of its rapidly depleting water supply, environmental problems and growing population. If the country continues with a business as usual mentality the consequences will be severe. India will see a sharp decrease in agricultural production, which will negate all of the previous efforts at food security. India will become a net importer of grain, which will have a huge effect on global food prices, as well as the global supply of food. A rise in food prices will aggravate the already widespread poverty when people have to spend larger portions of their income on food. In addition to devastating the agricultural sector of India's economy, the water crisis will have a big effect on India's industrial sector, possibly stagnating many industries. India has the power to avoid this dark future if people take action immediately: start conserving water,

begin to harvest rainwater, treat human, agricultural and industrial waste effectively and regulate how much water can be drawn out of the ground.

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