Making every drop count

The Energy and Resources Institute

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India's water resources are under stress with regard to both the availability and quality of water. This stress threatens not only agricultural and industrial development but also the basic quality of human life. There are many manifestations of India's water crisis. These include a decline in per capita water availability, falling water tables, poor access to safe drinking water and sanitation, and deterioration of water quality. These problems have resulted on the one hand from the growing demand for water from all the consuming sectors – agriculture, industry and households – and on the other hand from a policy and regulatory framework that does not promote equity, efficiency, and sustainability in water management.

Issues in water management

This book (1) reviews the problems and issues confronting the management of India's water resources; (2) examines the trends in the availability of water, the implications of a diminishing water supply for the quality of life, and the policy and institutional failures that are responsible for the current state of affairs; and (3) also looks at some positive signs and initiatives before concluding with a discussion of what further interventions are needed.

Falling per capita water availability

A growing population in the face of a limited water supply means that much less is available for the sustenance needs of each individual. The water resources that are available to meet the requirements of a given population are limited; as population grows, it means that progressively much less is available to meet the per capita requirements of a population.

Indicators of water stress and scarcity are used to reflect the overall water availability in a country or region. When the annual per capita water availability of renewable fresh water in a country or region falls below 1700 cubic metres, it is considered to be a situation of water stress; below 1000 cubic metres, it is known to be a situation of water scarcity; below 500 cubic metres, it is said to be a situation of absolute scarcity (Engelman and Roy 1993). This concept has been propounded by a noted Swedish hydrologist, Malin Falkenmark, on the premise that 100 litres a day (36.5 cubic metres a year) is roughly the minimum per capita requirement to maintain good health; roughly 5 to 20 times that amount is needed to satisfy the requirements of agriculture, industry, and energy.

In 1947, the per capita water availability in India was 6008 cubic metres; in 1997, it was down to 2266 cubic metres (TERI 1998a). It fell further to 1250 cubic metres in 2003 and it is projected to be lower than 750 cubic meters by 2050 (Figure 1). As we would be left with progressively less to meet the needs of our population, we must increasingly make a judicious use of our water resources.

The per capita water availability figures presented above are at a national level. They hide important regional disparities. Per capita water availability differs widely in the country. India receives an annual rainfall of about 4000

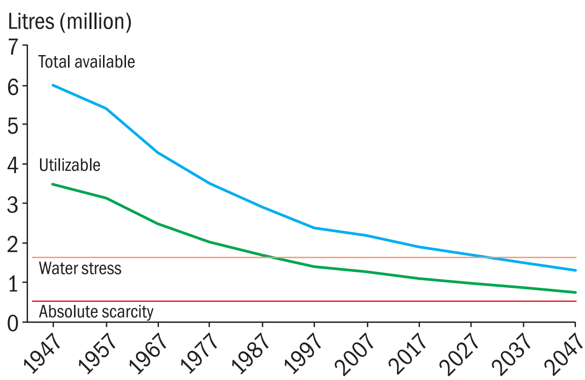

Figure 1 Renewable quantities (per capita) of fresh water in India: 1947 to 2047 (annual availability in millions of litres)

cubic kilometres distributed unevenly across space and time. Most of the rainfall is confined to the monsoon season, from June to September, and levels of precipitation vary from 9000 mm a year in the north-eastern state of Meghalaya to about 100 mm in the state of Rajasthan.

As our population grows, this resource will come increasingly under stress, as there will be an increase in the demands for water from all sectors. At present, agriculture is the single largest user of water, accounting for about 85% of the total water withdrawals in the country (Figure 2).

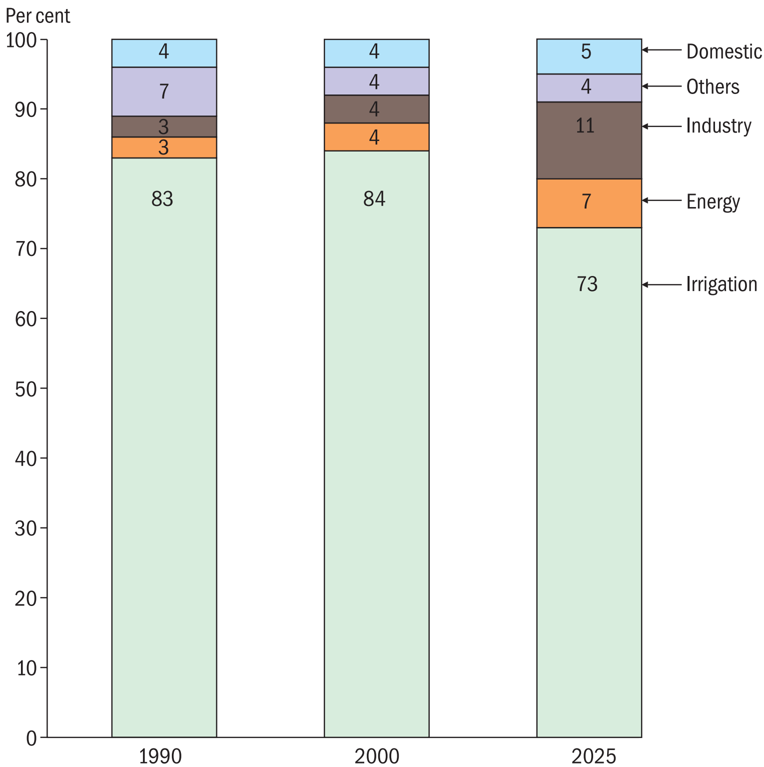

Figure 2 Share (%) of different sectors in total water demand

Groundwater depletion

We will now look at a very important challenge with regard to water resource management in the country, namely groundwater depletion. Groundwater is the water that is stored underneath the earth's surface. A groundwater aquifer, essentially, is a water-bearing rock. Groundwater is an important resource for India. It supplies 80% of the domestic water supply in rural areas and meets 50% of the urban and industrial demand. In drought years, groundwater also serves as the primary, major, and reliable source of irrigation. It is estimated that as much as 70%–80% of the value of production from irrigated lands in India depends upon groundwater as a source of irrigation. Since agriculture contributes roughly 29% of India's GDP (gross domestic product), and production from irrigated lands is far more than that from rain-fed agriculture, a large proportion of India's GDP could actually be seen as tied closely to the availability of groundwater (World Bank 1998a). On account of the share of groundwater in raising agricultural productivity, its role as a catalyst of rural development as well as in poverty alleviation cannot be denied either (World Bank 1998a).

Groundwater irrigation has played an important role in the spread of the green revolution technology. This is because the green revolution technology requires timely application of water to crops; this cannot always be provided through surface or canal water, which is usually supplied through government machinery, often according to set schedules of operation. On the other hand, farmers who have their own sources of water from tube-wells are more likely to be able to provide water when their crops need it and are better placed to grow crops such as rice that require more water.

The indiscriminate pumping of groundwater, however, has led to a steep fall in the water table, or the level at which

groundwater is found beneath the earth's surface, in many places. At an aggregate level, groundwater overexploitation in India is not a major concern. In fact, India uses only about 32% of the annual utilizable potential (World Bank 1998a). However, overexploitation is a serious concern in a few states. In Punjab, for instance, the level of exploitation is already 94%. Haryana follows suit, at 84%. The situation is also precarious in Rajasthan (51%) and Tamil Nadu (60%).

The situation acquires a more serious dimension at the district level. For instance, six districts in Punjab and three in Haryana show a utilization rate of over 140% and Kapurthala district, at 260%, tops the chart (Saleth 1996). In Coimbatore in Tamil Nadu and Mehsana in Gujarat, the aquifers have become permanently depleted in the absence of sufficient recharge (Chitale 1992). This is a serious concern because agriculture in these districts depends heavily on groundwater. The groundwater table in about 87% of the total area of Rajasthan went down alarmingly between 1998 and 2001, according to a study of the long-term trends of groundwater level conducted by the state government (*The Hindu*, 3 September 2002). With the problem compounded by the failure of monsoons, the public health engineering department in the state faces an enormous challenge in ensuring adequate supply of drinking water across the state. At present, out of the 237 blocks in the state, only 49 can be considered to be safe: In 1998, the number was 137.

About 18 600 villages in the state face the problem of fluoride whereas about 16 300 face the problem of brackish water. The position of drinking water is reported to be alarming in Ajmer, Barmer, Fatehsagar, Jaitaran, Mandal, Pali, Parbatsar, Rajasamand, and Siwana districts in Rajasthan, where water is being supplied once in 48 hours or once in 24 hours. Following the acute water scarcity, 1500 villages and 7 towns are being supplied water through tankers.

A US-based think-tank, the Worldwatch Institute, noted that the water table continues to fall by half a metre each year in Punjab, India's breadbasket (*The Statesman*, 23 June 2002). The problem of groundwater depletion has been aggravated by the practice of giving free or subsidized electricity and free water to some segments of the population. The water stress is being caused by the practice of growing such water-consumptive crops as the rice/wheat combination. Correcting this situation requires a change in incentives that affect crop choice among farmers.

Groundwater depletion is a concern not only in rural areas but also in urban centres like Delhi. Delhi's population has gone up by 20% in the last four years (*The Asian Age*, 18 May 2002). The city has been facing a shortage of 680 million litres per day of water due to high demand and water loss (*The Asian Age*, 12 January 2002). The city needs about 3635 million litres of water a day but the supply is restricted to 2955 million litres a day. Besides, Delhi loses 20% water due to leakage and 4%–5% due to pilferage.

Part of the demand and supply gap has to be met by drawing upon groundwater reserves, which has adverse implications for the water table. According to reports available with the Central Groundwater Authority, a prominent decline in groundwater levels has been occurring in most parts of the city (*The Times of India*, 11 December 2002). While the consumption rates are very high, sufficient recharge has failed to take place. Surfaced roads, pavements, and similar built-up structures also prevent rainwater from percolating down to the ground. If pumping continues at the current pace, it is feared that the city's supply of fresh water will mix with saline water and Delhi's groundwater reserves could turn saline.

The precarious situation with regard to groundwater could be traced to an adverse policy, institutional, and regulatory framework that has failed to limit groundwater withdrawals. On the one hand, giving free or subsidized electricity generates perverse incentives by encouraging farmers to pump water liberally; at the same time, we do not have a policy and regulatory framework that succeeds in limiting groundwater extractions. Though some efforts have been made in this direction in the past, they have been very limited in their impact. Not only have they failed to limit water withdrawals but they have also encouraged preemption of the resource by the rural elite. Thus, the policy framework for groundwater management has been regressive and inequitable.

Efforts have been made to regulate groundwater withdrawals through licensing, credit, or electricity restrictions or through spacing norms for the creation of tube-wells. However, these measures have sought only to regulate the establishment of groundwater structures rather than the quantum of water withdrawn. Further, rich and influential farmers have tended to misuse licenses issued for electricity connections by the state groundwater departments (Shah

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