WATER RESOURCES OF INDIA

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Introduction

Water is essential for human civilisation, living organisms, and natural habitat. It is used for drinking, cleaning, agriculture, transportation, industry, recreation, and animal husbandry, producing electricity for domestic, industrial and commercial use. Due to its multiple benefits and the problems created by its excesses, shortages and quality deterioration, water as a resource requires special attention. Table 1 gives land & water resources of India. On a global scale, total quantity of water available is about 1600 million cubic km. The hydrologic cycle moves enormous quantity of water around the globe. However, much of the world's water has little potential for human use because 97.5% of all water on earth is saline water. Out of the remaining 2.5% freshwater, most of which lies deep and frozen in Antarctica and Greenland, only about 0.26% fish in rivers, lakes and in the soils and shallow aquifiers which are readily usable for mankind.

TABLE – 1 : LAND AND WATER RESOURCES OF INDIA[1]

PARTICULARS	QUANTITY
Geographical Area	329 million ha.
Flood Prone Area	40 million ha.
Ultimate Irrigation Potential	140 million ha.
Total Cultivable Land Area	184 million ha.
Net Irrigated Area	50 million ha.
Natural Runoff (Surface Water and Ground Water)	1869 Cubic km.
Estimated Utilisable Surface Water Potential	690 Cubic km.
Groundwater Resource	432 Cubic km.
Available Groundwater resource for Irrigation	361 Cubic km.
Net Utilisable Groundwater esource for irrigation	325 Cubic km.

[1] *Water Resource India, National Institute of Hydrology. Website : www.nih.ernet.in;*

Source: National Institute of Hydrology

Water Resources[1]

Surface Water

India's average annual surface run-off generated by rainfall and snowmelt is estimated to be about 1869 billion cubic meter (BCM). However, it is estimated that only about 690 BCM or 37 per cent of the surface water resources can actually be mobilised. This is because (i) over 90 per cent of the annual flow of the Himalayas rivers occur over a four month period and (ii) potential to capture such resources is complicated by limited suitable storage reservoir sites.

Rainfall

The average annual rainfall in India is about 1170 mm. This is considerable variation in rain both temporarily and spatially. Most rain falls in the monsoon season (June-September), necessitating the creation of large storages for maximum utilisation of the surface run-off. Within any given year, it is possible to have both situations of drought and of floods in the same region. Regional varieties are also extreme, ranging from a low value of 100 mm in Western Rajasthan to over 11,000 mm in Meghalaya in North-Eastern India. Possible changes in rainfall patterns in the coming decade, global warming and climate change and other predicted or observed long-term trends on water availability could affect India's water resources.

Ground Water

India's rechargeable annual groundwater potential has been assessed at around 431 BCM in aggregate terms. On an all India basis it is estimated that about 30 per cent of the groundwater potential has been tapped for irrigation and domestic use. The regional situation is very much different and large parts of India have already exploited almost all of their dynamic recharge. Haryana and Punjab have exploited about 94 per cent of their groundwater resources. Areas with depleting groundwater tables are found in Rajasthan, Gujarat, most of western Uttar Pradesh and in all of the Deccan states.

Occurrence of water availability at about 1000 cubic meters per capita per annum is a commonly threshold for water indicating scarcity (UNDP). Investment to capture additional surface run-off will become increasingly more difficult and expensive in the future. Over time, both for surface and groundwater resources, a situation where resources were substantially under utilised and where considerable development potential existed, has transformed in little more than a generation to a situation of water scarcity and limited development options.

India faces an increasingly urgent situation : its finite and fragile water resources are stressed and depleting while various sectoral demands are growing rapidly. Historically relatively plentiful water resources have been primarily for irrigated agriculture, but with the growth of Indian economy and industrial activities water demands share of water is changing rapidly. In addition increase in population and rapid urbanisation also put an additional demand on water resources. Summing up the various sectoral projection reveals a total annual demand for water increasing from 552 billion cubic meter (BCM) in 1997 to 1050 BCM by 2025 (Fig 1).

Figure 1 : Sectoral Water Demand Trends

Under current sectoral trends, precious little water will remain for environmental and other needs. This is untenable

At Independence population was less than 400 million and per capita water availability over 5000 cubic meter per year (m^3/yr). With the population crossed 1 billion mark, water availability has fallen to about 2000m^3/yr per capita. By the year 2025 per capita availability is projected at only 1500 m^3/yr or 30% of availability levels at Independence.

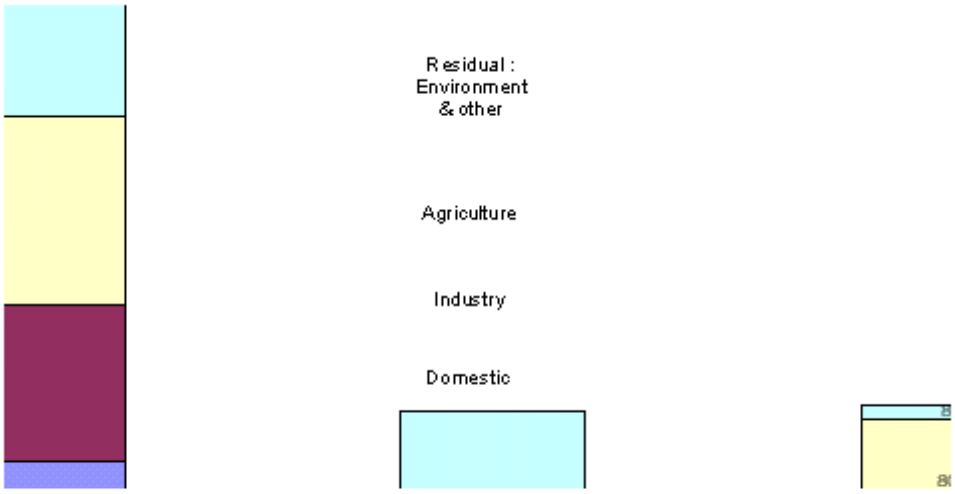

Figure 2 : Population and Water Availability Trends in India

Note : Government projections; Increasing sectoral demands planned to be met through new construction.
Source : GOI (1997d).

The water availability index includes surface water only, yet groundwater is an important component of water availability that factors significantly in the Indian economy. Ground water is an important source of drinking water and food security for India, supplying about 80 per cent of water for domestic use in rural areas and about 50 per cent of water for urban and industrial uses. Ground water provides a very significant percentage of water supply for irrigation, and contributed significantly to India's agricultural and overall economic development. With more than 17 million energised wells nationwide, groundwater now supplies more than 50 per cent of irrigated area.

[1] *Initiating and Sustaining Water Sector Reforms : A Synthesis World Bank in collaboration with the Government of India, Ministry of Water Resource.*

Populations Food Grain Requirement

In India the food grain availability is at present **around 525 gms per capita per day whereas the corresponding figures** in China & USA are 980 gms and 2850 gms respectively. If small raise is made in per capita consumption to 650 gms the food grain requirement will be about 390 MT of food grain. Taking the projections of about 1800 million by 2050 AD as reasonable, it would require about 430 MT of food grain annually at the present level of consumption. This will mean a much greater use of available inputs. First input is water, the second input would be fertilizers and third input would be much larger emphasis of research. This would also need increasing area under irrigation from present 28% to roughly 40% by the year 2050 and adopting drip and sprinkler irrigation in India.

The total geographical area of land in India is 329 mha which is 2.45% of the global land area. The total arable land is 165.3 mha which is about 50.2% of total georgraphical area against the corresponding global figure of 10.2%. India possesses 4% of the total average run off in the rivers of the world. The per capita water availability of natural run off is at least 1100 cu.m per year.

Water availability of both surface and groundwater is further reduced due to water pollution and in appropriate waste disposal practices. There are now few states or river basins in India where water quality issues are not present. Environmental problems include water quality degradation from agro-chemicals, industrial and domestic pollution, groundwater depletion, water-logging, soil salinization, siltation, degradation of wetlands, ecosystem impacts and various health related problems. Though India is facing various serious water constraints to-day, India is not on the whole a water scarce country. The present per capita availability of water in India of approximately 2200 m^3 per annum, actually compares quite favourably with a number of other countries.

Figure 3 : Water Availability and Agricultural Value Added - Selected Countries

Note : Israel Ag. Value Added not available.
Sources : World Resources Institute (1997) and World Bank (1998).

Current water resource constraints in India, in terms of both quality and quantity, can be expected to manifest themselves even more rapidly in the coming years. In the past, with lower population and development levels, there was still substantial room for each sector to satisfy its water needs and concerns independently. Now as the gap between the availability of water resources and the demands on such resources narrows, the past approach to water management pursued in India is no longer tenable. Competition for water between urban and agricultural sectors will be a major challenge in the forthcoming century. Provision for environmental and ecological concerns will have to be made.

Water should be treated as both a Social and Economic Ground

Water management in India in future must shift its emphasis from social good as at present to economic good, and use of market mechanisms with the participation of the business sector. Such a change will achieve a more efficient and effective allocation, use and management of water, and their roles of both public and private sectors in managing water resources must be defined.

Decentralisation of operation will be critical

Achieving sustainable use and management of water in India will further require a shift from the traditional top down centralised approach towards a more decentralised approach. While government has an important role to play, it is only one among many stakeholders involved. These stakeholders include Government of India, State Government, every household in India as a consumer of water, business sector, industries, larger community aggregates such as water uses association, villages.

Policy, Legislative and Regulatory Framework

The Central Government plays an important role in framing policy guidelines, legislative and regulatory framework. The most comprehensive Government of India (GoI) statement on water is the National Water Policy (NWP) adopted by the National Water Resources Council in 1987, which calls for a holistic, and integrated basin-oriented approach

to water development, promoting combined use of both the surface and groundwater, water conserving crop patterns as well as irrigation and production technologies. The National Water Policy in its present form appears to be a statement of intentions as it is not supported by any legislation and does not have an action. The NWP is undergoing revision.

Water Sharing Issues

The existing Constitutional provisions and legislation in India do not provide an appropriate framework to deal with water sharing issues between states, sectors and individuals. In the present set up (i) primary powers are vested at state levels which do not correspond to river basin boundaries; (ii) surface water rights are not clearly defined and such rights cannot be commercially transferred; (iii) ground water rights are purely private, and; (iv) environmental laws have not been comprehensively operationalised and regularly standards are either not enforced or do not exist.

The legal and absolute right to groundwater rests with the owner of the overlying land, irrespective of the social and environmental consequences.

Institutional Arrangements and Mechanisms

The present institutional arrangements in India, including central, state and local institutions, and both formal and informal structures, do not enable comprehensive water allocation, planning and management. The main problems that exist are : (i) inadequacies in necessary institutions for comprehensive water allocation, planning and management, particularly at state and basin levels where they are frequently absent; (ii) lack of co-ordination between institutions, duplication of responsibility and accountability gaps; (iii) inadequate fostering of grass-roots institution; and (iv) lack of involvement of civil society - local communities, NGOs, the business sector and academia.

Mechanism for **conflict resolutions** in matters of sharing of water resources and utilisation is weak and needs to be looked into and strengthened at various levels.

In the matters of water resources management the civil society has a very crucial role to play but unfortunately their contribution, and the contribution of the business sector has been greatly neglected. A substantial reason for their limited involvement to date is the limited efforts of government to inform the public on issues pertaining to water resources. In particular, outreach to women has been neglected, yet women are the most interested and involved in rural water supply, domestic urban water consumption, health and sanitation issues and are at least equally concerned as men in agricultural production.

Water Sector Investment

Being a vital resource for the lives and livelihoods of all Indian citizens, and having contributed significantly to India's economic growth since independence, water sector investments have rightly been accorded high priority in India's development plans.

With a massive resource commitment for irrigation since independence of Rs. 576 billion the gross irrigated area increased four-fold from 23 million hectares in 1951 to about 90 million ha in 1997, substantially increasing and stabilising the incomes of millions of farmers throughout the country. Significant achievements in drinking water coverage have also been realised. About 85 per cent of India's urban population have access to public water supplies and over 75 per cent of the rural population are now provided with public water supply. It may be mentioned here that more than 1000 million of people in India, about 70% live in the rural areas.

In all the sectors however there is a considerable scope for conserving water resources. Such conservation can be a reality if the subsidies in water pricing is gradually removed, particularly in the agricultural sector.

Reforms in the Water Sector

Various reforms in the management of water resources are necessary but by its nature water is multidimensional - it involves users from different sectors with widely different needs. India's task is made all the more difficult by its enormous population and its federal administrative structure.

The role of government needs to be more of a facilitation from a provider and financier of services, and an enabling environment to be put in place for the different stakeholders to play their role, with necessary incentive framework.

As the reform programme is implemented a long-term vision needs to be conceived through a public debate and participatory process.

References

1. *Website: www.nih.ernet.in; National Institute of Hydrology*
2. *Initiating and Sustaining Water Sector Reform: A Synthesis; World Bank in Collaboration with the Govt. of India, Ministry of Water Resources. Allied Publishers, 1999.*