7 Water

Introduction

Over last few decades, there has been a paradigm shift in water management as the perception that freshwater is a free and abundant resource has changed to that of water being an economic good in scarce supply, threatened by pollution and warranting efficient use. The challenge of sustainable water use is particularly daunting for developing countries grappling with burgeoning populations and the need to enhance standards of living and economic growth.

Agenda 21 recognizes that a key component of sustainable development is the efficient management of fresh water. This chapter discusses India's initiatives in the water sector and evaluates these in the light of Agenda 21's objectives set out for the sector[a].

The chapter begins with a brief overview highlighting the institutional arrangements within the sector, resource endowment and demand pressures. The chapter goes on to discuss the relevance of Agenda 21 concerns for the freshwater resources sector. Major policy and other developments in the sector are reviewed in order to analyze the extent to which Agenda 21 objectives have been achieved and the concerns that remain. Finally, directions and strategies are proposed that will go towards ensuring adequate clean water equitably and efficiently.

Overview of the sector

Institutional set-up and legal framework

As per the Constitution of India, water and sanitation are state subjects, empowering the states to enact laws, frame policies or fix prices of related services. Planning and implementation of water development projects is currently handled both at the centre and state levels. Annexure 7.1 illustrates the institutional framework for water management in the country and the responsibilities handled by different institutions.

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[a] This chapter deals with fresh water resources; marine and coastal environment is dealt with in Chapter 11

Resource availability

India is considered rich in terms of annual rainfall and total water resources available at the national level, however the uneven distribution of the resource causes regional and temporal shortages. India's average annual rainfall equivalent of about 4000 billion cubic metres (BCM) is unevenly distributed both spatially as well as temporally. The annual per capita utilizable resource availability varies from 18,417 cubic metres in the Brahmaputra valley to as low as 180 cum in the Sabarmati basin (Chitale, 1992). Even in the Ganga basin, the annual per capita availability of water varies from 740 cubic metres (cu m) in the Yamuna to 3,379 cu m in the Gandak. Levels of precipitation vary from 100 mm annually in western Rajasthan to over 9 000 mm in the northeastern state of Meghalaya (Engleman and Roy, 1993). With 75% of the rainfall occurring over the four monsoon months and the other 1000 BCM spread over the remaining eight months, our rivers carry 90% of the water between June and November. Thus, only 10% of the river flow is available during the other six months.

Resource demand

The rapid increase in the country's population, from about 343 million at the time of Independence to over 1 000 million in 2000, accompanied by growth of agriculture, rapid urbanization, economic growth and improved access to basic services has resulted in an increase in the demand for water. A requirement of 629 BCM against the availability of 1122 BCM indicates surplus at the national level; however spatial and temporal variations give rise to shortages in some regions. The Western plains, the Kachchh region, and some pockets in the Northern plains face acute water shortages. The country's total water requirement is projected to grow to 1180 BCM by the year 2050 as against 629 BCM in 1997-98. The widening gap between demand and supply has led to a substantial increase in the share of groundwater consumption by the urban, agricultural and domestic sectors. The quality of water sources is threatened because of inadequate provisions for the treatment of wastewater.

Water and Agenda 21

Agenda 21 recognizes that the objective of water management is to maintain adequate supplies of water of a good quality for the entire population, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases.

The Agenda has identified the following key action areas for the freshwater sector. Each of these objectives requires the active involvement of local communities, authorities and the private sector in water management, creation of awareness amongst the people and promotion of international scientific research cooperation.

Drinking water supply and sanitation for urban and rural development

Access to safe water supplies and sanitation is vital for improving health, alleviating poverty, protecting the environment and ensuring sustainable growth. This would include:

- Expansion of infrastructure for urban and rural water supplies and sanitation.
- Efficient and equitable allocation of water resources, which includes reconciliation of development planning with the availability and sustainability of water resources, and introducing water tariffs, to the extent possible, to reflect the economic and opportunity cost of water especially for productive uses.
- Protection of water resources from depletion, pollution and degradation by promoting low-cost upgradable technologies for sanitary waste; recycling and reuse of industrial and domestic waste water and solid waste; protection of existing watersheds.
- Control of water-associated diseases[a].

Water for sustainable food production[b]

Sustainability of food production depends on sound and efficient water use and conservation practices, which include irrigation development and management, including water management in rain-fed areas, livestock water supply, inland fisheries and agro-forestry. In addition to improving the water supply for irrigation, this would require:

- Enhancing agricultural water use efficiency and productivity through better soil management and improved agricultural practices to prevent waterlogging.
- Water quality management in agriculture through the optimal use of on-farm inputs, minimization of soil run-off and sedimentation.

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[a] This is dealt with in Chapter 16 on Poverty eradication and human resource development

[b] Some of these issues are dealt with in Chapter 14 on Agriculture

- Developing efficient and environmentally sound aquaculture technologies.
- Capacity-building of local water users groups for better agricultural water use in conditions of scarcity with competing demands for water.
- Water resource development programmes to develop both small and large scale multipurpose irrigation projects, while minimizing the negative environmental impacts of large projects.

Protection of water resources, water quality and aquatic ecosystems

Recognizing the pollution of water by - untreated or partially treated domestic sewage and industrial wastewater, ill-considered siting of industrial units, poor agricultural practices, deforestation etc., Agenda 21 highlights the need to integrate water quality into water resource management to ensure the integrity of the ecosystem and protection of public health. Protection of water resources would include:

- Progammes for the protection, conservation and rational use of all sources of water on a sustainable basis. This would include identification of potential sources of water supply, preparation of water quality profiles, development of approaches that check degradation of water sources and replication of best practices.
- Programme for effective prevention and control of water pollution based on an appropriate blend of pollution reduction-at-source, environmental impact assessments and enforcement of standards for major point source discharges and high-risk non point sources. This would include establishing biological, physical and chemical quality criteria for all water bodies commensurate with their socio-economic development.
- Establishment of networks for continuous surveillance of water bodies and participation, as far as appropriate, in international water-quality monitoring and management programmes such as the Global Water Quality Monitoring Programme (GEMS/WATER) etc.
- Adopting an integrated approach to environmentally sustainable management of water resources and related coastal ecosystems, including consideration of fisheries, aquaculture, animal grazing, agricultural activities and biodiversity.

Water resource assessment including evaluation of impacts of climate change on water resources

The objective of water resource assessment, is to determine the sources, extent, dependability and quality of water resources, along with the demand for water so as to build a scientific data basis for rational water resource management. This would involve strengthening systems for collection, collation, analysis and dissemination of data relating to water availability and its quality, including flood and drought forecasting, impact of climate change on freshwater and relevant data on resources such as land and forests. An efficient data system would in turn require availability of assessment technologies, financial resources, an appropriate institutional framework and capacity-building.

Agenda 21 emphasizes the need to invest resources and enhance co-operation to understand and quantify the threat of climate change on freshwater resources, in areas prone to floods and droughts, and to facilitate the implementation of effective national counter measures.

Integrated water resources development and management

Integrated water management is based on a multisectoral approach to water management which seeks to optimize the use of all sources of water for the following uses; supply and sanitation, agriculture, industry, urban development, hydropower generation, inland fisheries, transportation, recreation, etc. It advocates the integration of water management efforts with that of other natural resources such as land and forests within the framework of the national economic and social policy. Integrated water management should be carried out at the catchment or sub-basin level and would involve optimal water allocation for competing uses; promotion of efficiency in use; integration of environmental and resource quality considerations; and flood and drought management. These would be effected through pricing mechanisms, regulatory measures, development of databases, forecasting models, environmental impact assessment methods, public awareness, involvement of local communities and authorities in water management and promotion of international scientific research cooperation.

Having discussed Agenda 21's main concerns for the freshwater sector, the following sections seek to evaluate policy and other developments relating to the water sector in India in the light of key Agenda 21 objectives. The analysis begins with a snapshot of major developments in the water sector since Independence.

Review and analysis of legislation, policies and other initiatives in water sector

Highlights of legislation, policies, programmes and other initiatives

Several activities have been undertaken in India, in line with the objectives of Agenda 21. Table 7.1 below gives the highlights of policies, acts and programmes in India, relevant to freshwater resources.

Table 7.1 Highlights of legislation, policies, acts and programmes

Year	Policy/Act/Programme	Salient features
1956	River Boards Act	▪ Empowering the Central Government to establish, on request from the state governments, a River Board for advising the governments on matters concerning the regulation or development of an inter-state river or river valley. ▪ Central Government has not constituted any River Board under this Act so far.
1956	Inter-State Water Disputes Act	▪ Enabling the creation of a Water Disputes Tribunal for the adjudication of water disputes that cannot be settled by negotiations with powers as are vested in a civil court under the Code of Civil Procedure, 1908. ▪ The Tribunal has the powers to carry out, or permit to be carried out, necessary surveys and investigation. ▪ Any matter referred for arbitration under the River Boards Act, however, does not qualify to be referred to the Interstate Water Disputes Tribunal. Similarly, neither the Supreme Court nor any other court shall have or exercise jurisdiction in respect of any water dispute which may be referred to a Tribunal under this Act.
1901,1972	Irrigation Commissions *(First Irrigation Commission1901,; Second Irrigation Commission, 1972)*	▪ To review and examine: ▪ Irrigation facilities available in the country and adequacy of water supply in major irrigation projects ▪ The administrative and organizational set up for planning, execution and operation of irrigation works ▪ Criteria for sanctioning irrigation projects and develop matters related

Year	Policy/Act/Programme	Salient features
		to irrigation development in the country ▪ Recommended: ▪ River basin and sub-river basin approach for water resource planning and management ▪ High priority to irrigation works in drought-prone areas and efforts at resource conservation
1972-73	Accelerated Rural Water Supply Programme (ARWSP)	Introduced by the Government of India to assist the states and union territories to accelerate the pace of coverage of drinking water supply in rural areas. The entire programme was given a *mission approach* with the launch of the technology mission called the Rajiv Gandhi National Drinking Water Mission aimed at covering the rural inhabitations of Not Covered (NC), Partially Covered (PC) and quality affected categories.
1973	Drought Prone Areas Programme (DPAP)	Aims to minimize the adverse effects of drought on the production of crops and livestock and productivity of land, water and human resources in areas that are constantly affected by severe drought conditions. Since 1995-96, the programme's approach has been redesigned and based on river watershed development.
1974	The Water (Prevention and Control of Pollution) Act	▪ Established the Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCBs). ▪ Empowers the SPCBs to lay down and maintain location and source specific standards for discharge of wastewater. ▪ The actual provisions for enforcement such as penalties, imprisonment etc. are confined to source-specific standards for individual polluters.
1974-75	Command Area Development Programme (CADP)	This centrally-sponsored command area development programme aims at increased utilization of the available irrigation potential by provisions such as better micro systems for water distribution; provision of inputs like seeds, fertilizers, pesticides and other infrastructural facilities and; dissemination of advanced technology amongst farmers.

Year	Policy/Act/Programme	Salient features
1977	The Water Cess Act	▪ Empowers the SPCBs to levy a cess on local authorities supplying water to consumers and on consumption of water for certain specified activities. ▪ Acts as a supplementary market-based instrument for pollution abatement ▪ Provides for a rebate on the cess payable if the local authority or industry concerned installs a plant to treat sewage or trade effluent.
1983	National Water Resources Council	Headed by the Prime Minister, the Council's scope includes preparing and reviewing the National Water Policy; reviewing water development plans and giving directions for related studies; advising practices and procedures for fair distribution and utilization of water resources in different regions and by different beneficiaries.
1986	Centrally Sponsored Rural Sanitation Programme (CSRSP)	The programme supplements the state's efforts by providing financial and technical assistance to include sanitation issues and other issues like personal hygiene, home sanitation, garbage and excreta disposal.
1986	Environment Protection Act	▪ An umbrella Act providing for the protection and improvement of environment and for matters connected therewith. ▪ Authorises the central government to intervene directly in order to protect the environment and also allows public interest litigation for the same purpose. ▪ The nature of penalties under this Act is similar to those authorized under the Water Act.
1993	National Lake Conservation Plan (NLCP)	Focuses on urban lakes subjected to anthropogenic pressures and aims at prevention of pollution from point and non-point sources, treatment of the catchment area etc. 21 urban lakes have been identified for conservation of which 11 have been recognized for study during the first phase of the programme.
1995	National River Conservation Directorate (NRCD)	The Central Ganga Authority established in 1985 under the chairmanship of the Prime Minister was redesignated the National River Conservation Directorate in July 1995. It coordinates the implementation of schemes under the Ganga and other river action plans. These include works to intercept,

Year	Policy/Act/Programme	Salient features
		divert and treat wastewater from all sources a) *Ganga Action Plan Phase-I* aiming at restoring the river water quality to the 'Bathing Class' standard. b) The *National River Conservation Plan* launched in 1995 covers 18 major rivers in 10 states of the country. Under this action plan pollution abatement works are being taken up in 46 towns in the states of Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajasthan and Tamil Nadu. c) *Ganga Action Plan Phase-II* includes: ▪ *Yamuna Action Plan* under which pollution abatement work is ongoing in 6 towns of Haryana, 8 towns of UP and in Delhi. ▪ Under the *Gomti River Action Plan* pollution abatement works are being taken up in Lucknow, Sultanpur and Jaunpur in Uttar Pradesh. ▪ *Damodar Action Plan* under which pollution abatement works are being taken up in 12 towns including 8 in Bihar and 4 in West Bengal. Under the Ganga Action Plan (Main stem and Supreme Court Cases) pollution abatement works are being taken up in 59 towns in Uttar Pradesh, Bihar and West Bengal
1996	Accelerated Irrigation Benefits Programme (AIBP)	Launched by the Government of India, the programme aims to accelerate the implementation of the on-going irrigation/multipurpose projects on which substantial progress has already been made but targets have spilled from plan to plan due to the financial constraints faced by the state governments.
1992, 1993	73rd and 74th Amendments to the Constitution	The 73rd and 74th Constitutional Amendments entrusted local bodies with functions relating to water supply. The amendments also seek to ensure a better relationship between the state governments and urban local bodies.
2002	National Water Policy,	▪ Accords top priority to drinking water supply in the allocation of water resources for various beneficial uses. ▪ Also addresses issues like need for well-developed information system for better resource planning, maximizing water

Year	Policy/Act/Programme	Salient features
		availability, planning of water resource development projects, financial and physical sustainability of projects, participatory approach, private sector participation, water quality, water zoning, water conservation, flood and drought management, performance improvement. The Policy also calls for intensifying research in areas like assessment of water resources, hydrometeorology, water quality, water harvesting, water losses etc

Achievements

Drinking water supply and sanitation for urban and rural development

High investments have been made over successive Five-Year Plans with a view to achieving 100% domestic water supply coverage in consonance with the National Water Policy (NWP), which assigns the highest priority to drinking water supply needs. Provisions for drinking water supply have been made in all water resource development projects as per the guidelines in the NWP and the drinking water requirements of most cities is being met by multipurpose irrigation schemes located nearby or by long distance transfer. Guidelines on the conjunctive usage of surface water and groundwater are being implemented for different end uses. Water resource consolidation projects are being implemented and planned in different states aiming to bring sustainability in water resource management.

Table 7.2 highlights the estimated figures of population covered with drinking water and sanitation facilities. The progress made by the country, compared to 1985 levels, reflects the achievements made under different programmes such as the Rajiv Gandhi National Drinking Water Mission and Centrally Sponsored Rural Sanitation Programme. Various sub missions launched in rural areas with the objective of providing safe drinking water by controlling brackishness, eradicating guineaworm, and controlling iron, arsenic and fluorosis have also been successful.

Sanitary facilities for individual households below the poverty line, setting of sanitary marts and adopting locally suitable and acceptable models of latrines have led to improvements in the quality of life in rural areas and urban slums.

Table 7.2 Estimated figures on percent population coverage with drinking water and sanitation facilities

	1985	1990	1999*
Drinking water supply			
Rural	56.3	73.9	98.0
Urban	72.9	83.8	90.2 @
Sanitation			
Rural	0.7	2.4	9.0
Urban	28.4	45.9	49.3 @

* Provisional As on 31.3.1997

Source. MoF (2001)

Water for sustainable food production[a]

The initial phase of water resource development, post independence, encouraged the state governments to expeditiously formulate and develop projects for specific purposes such as irrigation, flood control, hydropower generation, drinking water supply and industrial and other miscellaneous purposes. Because of the storage works created the country today has a designed live storage capacity of 177 thousand million cubic metres at full reservoir levels. An irrigation potential of 94 million hectares has been created as against the created irrigation potential of 22.6 million hectares in 1951. The Central Government also provides active financial support under the Accelerated Irrigation Benefits Programme for multipurpose and irrigation projects that have spilled over because of the financial constraints being faced by the state governments. Considerable achievements have also been recorded in programmes such as Command Area Development Programme (CADP) to ensure efficient utilization of the created irrigation potential and increasing agricultural productivity with 234 projects covering 22.76 million hectares spread over 28 states and 2 union territories. Initiatives such as the Participatory Irrigation Management (PIM) to promote efficient allocation of water through the water users association are also being taken. This water resource development drive together with the Green Revolution in the agricultural sector has enabled the country's transition from an economy deficit in food grains to one that is marginally surplus.

[a] Aquaculture and inland fisheries will be covered in the chapter on Agriculture since these subjects are dealt with the Ministry of Agriculture.

Water resource assessment including evaluation of impacts of climate change on water resources

The Ministry of Water resources (MoWR) constituted the National Commission for Water Resources Development in 1996 to prepare an integrated plan for development of water resources based on resource availability and demand patterns and to suggest modalities for transfer of surplus water to water deficit basins. Assessment of groundwater resources and irrigation potential of the country is carried out on a regular basis for different basins. A network of 157 flood forecasting stations covering most of the interstate river systems under the Central Water Commission forecasts the occurrence of floods and inflows. Of the identified 40 million hectares of area susceptible to floods, flood management measures undertaken so far have provided a reasonable degree of protection to about 16.4 million hectares (upto the end of Ninth Five-Year Plan) through measures such as flood embankments and drainage channels. Similarly extensive measures have been taken for the identified drought-prone area comprising 1/6th of the country's geographical area. A thrust has been given to watershed development, dry farming and the construction of simple, low-cost structures under the Drought Prone Area Programme. Flood and drought management, and environmental and social impact assessments are an integral part of project formulation and implementation for all water resource planning processes.

Recently, the Government of India has launched a research programme in partnership with the UK Department of the Environment, Transport and the Regions, on the impacts of climate change in India. The study seeks to build on India's expertise to assess the sectoral impacts of climate change, reduce uncertainties in the current climate change prediction models and make a valuable contribution to international climate science. The impact on water resources will be studied by the Indian Institute of Tropical Meteorology, Pune.

Protection of water resources, water quality and aquatic ecosystems

The Central Pollution Control Board (CPCB) has been monitoring water quality of national aquatic resources in collaboration with the concerned state pollution control boards (SPCBs) since 1977. The monitoring programme started with merely 17 stations on the river Yamuna and has extended steadily over the years to 507 locations currently. The Central Water Commission also has a network to measure flow and monitor water quality at about 369 field stations. The Central Ground Water Board (CGWB) monitors groundwater quality at 15355 locations. In an effort to assess the health of a water body, the CPCB has

also initiated a bio-monitoring project under the Indo-Dutch Collaboration Programme on Environment and selected 215 locations for the introduction of bio-monitoring based on the interpretation of physico-chemical data at different locations. Limited water quality monitoring of wells is also being undertaken in different states to estimate violations of pH, dissolved oxygen, BOD and total coliform over desired levels. Source-specific standards for discharge of wastewater have been laid down by the CPCB under the Water Act. The Act also empowers the SPCBs to lay down and maintain standards more stringent than those specified by CPCB depending on local conditions. The actual provisions for enforcement such as penalties, imprisonment etc. are confined to source-specific standards for individual polluters.

Under the National River Action Plan (NRAP), a holistic and integrated approach is adopted by addressing not only river pollution but related factors like internal sewage, solid waste disposal, and low cost toilets. Sewage collection and treatment works are being constructed to reduce the pollution load in rivers. These include schemes for better sewage interception and diversion, construction of sewage treatment plants, provision for low cost sanitation and other schemes. In the first phase, under the GAP (Ganga Action Plan), 29 towns were selected along the river and 261 schemes of pollution abatement sanctioned. At present 156 towns are being considered under the NRAP, out of which about 74 towns are located on the river Ganga, 21 on the river Yamuna, 12 on the Damodar, 6 on the Godavari, 9 on the Cauvery, 4 each on the Tungbhadra and Satlej, 3 each on the Subarnrekha, Betwa, Wainganga, Brahmini, Chambal, Gomti, 2 on the Krishna and one each on the Sabarmati, Khan, Kshipra, Narmada, and Mahanadi. The National Lake Conservation Plan is also being given the same priority as the rivers. The Bhoj Lake of Madhya Pradesh is already getting assistance under funds provided by OECF, Japan for betterment of its water quality. Coastal towns are being given special attention due to the high possibility of sewage, solid waste, bio-medical waste and the like being dumped into the sea.

A ‘Water Quality Assessment Authority’ has also been established recently under the Environment Protection Act, 1986. The Central Ground Water Board constituted the Central Ground Water Authority for regulating the development and management of groundwater resources. To this end it has notified and banned fresh bores in areas affected by groundwater depletion. The Authority is also promoting rainwater harvesting and artificial recharge and has circulated guidelines for implementing artificial recharge projects.

Under the 1994 EIA notification, an Environmental Impact Assessment has already been made mandatory for 30 categories of development activities involving investments of Rs 500 million and above. Environmental clearance for activities is given by the Ministry of Environment and Forests. Construction of common effluent treatment plants (CETP) for treatment of effluents from a cluster of industries particularly of small scale is also getting encouraging support. Under the World Bank-aided Industrial Pollution Control project there is a provision of loan and grant assistance for construction of CETPs in an industrial estate or a cluster of SSIs. The CWC also undertakes the environmental evaluation of completed water projects. The Environmental Monitoring Committee of the CWC is monitoring 85 projects at present according to the guidelines of the Environmental Management Plans for water resources projects.

Integrated water resources development and management

Water resource management and development efforts in the country recognize the interrelationships between water and land use. Various schemes are being implemented on an integrated watershed basis with agencies such as the Damodar Valley Corporation, Krishna Godavari Commission, Sone River Commission, Ganga Flood Control Board and Ganga Flood Control Commission, Brahmaputra Board, Narmada Control Authority, Bhakra-Beas Management Board, Upper Yamuna River Board. The mandate of these agencies includes development and allocation of water resources at river basin and local levels for all identified end uses. Preliminary studies have been carried out to explore the possibilities of inter-basin transfer to making more water available in water-stressed basins. The National Water Development Authority (NWDA) under the National Perspective Plan has carried out water balance and feasibility studies for interlinking of rivers under specific programmes- Himalayan Rivers Development and Peninsular River Development.

The National Water Policy identified multi-stakeholder involvement as an integral part of all water resource development programmes. Stakeholders including women are encouraged to play an active role in water distribution and conservation, collection of water charges etc. through participatory irrigation management systems such as water users associations. Human resource development is being implemented through water and land management institutes and other organizations and agencies. Various research institutes and organizations undertake R&D and capacity-building programmes

on different subjects ranging from resource assessment and conservation to better operational technology.

Concerns

Despite the above achievements, there are issues of concern that require immediate action. These concern the significant sections of population still without access to safe water and sanitation, low per capita consumption of water in the country compared to minimum requirements, inequitable access within the country and the high levels of water pollution.

Inequitable access to basic services

Huge disparities exist in the provision of basic services.

- Only 77 of the 299 Class-I cities have 100% piped water supply coverage
- 203 of the 345 Class-II towns have low per capita supply of less than 100 lpcd
- Per capita water supply ranges from as low as 9 lpcd in Tuticorin to as high as 584 lpcd in Triuvannamalai
- Access available to slums in urban areas is poor
- 100% access to water supply services in the rural areas has been achieved only in Uttar Pradesh, Delhi, Pondicherry and Chandigarh. Percentage habitations fully covered in Assam, Punjab and Kerala are only 57.4%, 33.3% and 22.2%, respectively.

Besides the inequitable distribution of water in a given city, the supplies are erratic and levels of access to adequate sanitation services vary considerably.

Ground water depletion

Shortages in water supply for domestic and industrial consumption, is resulting in over-exploitation of groundwater beyond its recharge capacity. The share of groundwater in net irrigated areas has also increased considerably from a third in 1965/66 to over half at present to either supplement surface deliveries of water or to provide irrigation water when limited or no surface supplies are available. Groundwater overdraft beyond recharge capacity is posing serious threats, in the form of a long term decline in water levels, with associated adverse consequences such as land subsidence, deterioration of water quality in aquifers, and ingress of saline water in coastal aquifers.

Resource quality

Water quality of Indian rivers has degraded considerably, not only because domestic wastewater is collected inadequately and treated inefficiently in Class-I cities but also because highly complex waste from industries is discharged into water bodies. Indicators of this deterioration include depletion of oxygen, excessive presence of pathogens, settling of suspended material when the flow is lean, and bad odour. Some of the polluted river stretches and their critical parameters and possible sources of pollution are given in Annexure 7.2. Groundwater sources too, are undergoing severe degradation due to chemical contamination, mainly from fertilizers, industrial waste, municipal solid waste as well as biological contamination, particularly in the form of human waste in dug wells.

The following sections briefly discuss the causes underlying these concerns.

Inefficiency in resource use / management

Water has conventionally been considered a free commodity and government policies have provided little incentive to encourage its efficient use. The following highlight poor resource-usage practices.

- High percentage of evapotranspiration losses
- Excessive distribution losses of treated water in municipal water supply systems
- High seepage losses in irrigation and water losses in agriculture due to water overapplication
- Industrial output per unit of water withdrawal in India at about $5 per cubic metre as compared to an output of $25 and $32 for equal quantity of water in developed countries as Japan and Sweden respectively

Besides, other inefficiencies also persist at the supply end –in the form of overstaffing, high administrative costs, and time and cost overruns in the execution of projects.

Pricing policies

Water is a state subject, and the price for its use in different sectors is fixed by the state government and varies from state to state. Typically, water rates for agriculture and domestic consumption, do not cover even the working expenses of providing the service, let alone capital costs. In the irrigation and urban sectors, the percentage recovery of working expenses through gross receipts in recent years is only about 10% and 30%, respectively. The subsidy regime has on the one hand encouraged inefficient use of the resource and on the other, led

to poor financial health of the sector, resulting in poor services and user dissatisfaction.

Institutional set-up and legal framework

Planning and implementation of water development projects is currently cumbersome with a number of organizations involved both at the centre and state resulting in duplication and ambiguity of functions. Few states have defined water policies and organizations for planning and allocating water. While there is an extensive legislative framework to address water pollution, there are no regulations on water abstraction. Groundwater authorities attempt to regulate groundwater withdrawals through licensing but do not define any limits for withdrawals, thereby not addressing inequitable and unsustainable groundwater withdrawals. Implementation of environmental laws in general remains weak, mainly on account of inadequate financial resources and capacity of the pollution control boards.

Clearly, steps need to be taken to improve resource management and solve disputes between states, sectors and communities. The following section concludes with proposed strategies for sustainable water management.

Strategies for sustainable water management

The country has come a long way since Independence in improving access to basic services especially to the poor and those in far-flung remote areas, and becoming self-sufficient in food grain requirements. At the same time, as discussed in the previous section, there still remain issues of concern. Recent initiatives clearly indicate that the government is cognisant of the policy, institutional and legal changes that are required to achieve the national goal of universal and equitable access to water and sanitation.

On the policy front, it is recognized that long-overdue price reforms be undertaken such that the price of water and related inputs (such as fertilizers and power in the case of agriculture) reflect the cost of providing these services and to the extent possible the environmental externalities, while satisfying the national social obligations. Price reforms will encourage resource conservation on one hand and provide additional financial support for the fund-starved municipal service providers on the other. It needs to be added that any attempts at rationalizing water tariffs must go hand in hand with improvements in supply efficiency and service quality. It is also necessary to introduce market-based instruments to arrest water misuse and quality degradation. Economic instruments should be supported by environmental management tools such as

performance benchmarking, ISO 14000 standards and environmental rating to improve not only environmental performance but also the international image and competitiveness of Indian industry.

Institutional reform can be implemented if the service sector be it irrigation projects or municipal services is allowed adequate autonomy. This would involve devolution of administrative and financial responsibilities and involving the community and the private sector as much as possible in the provision of these services. This would not only improve efficiency but also facilitate the use of cost-effective domain-specific technological options including the use of traditional knowledge. The need to involve the community in the management and maintenance of water projects has been re-emphasized in the Approach Paper to the Tenth Plan (Planning Commission, 2001). Necessary legislation also needs to be enacted for preservation of existing water bodies by preventing encroachment.

The move towards a river-basin approach to water management must be strengthened since issues related to an adequate and sustainable supply of quality water usually transcend local boundaries and need to be addressed in consonance with other resources such as land. Appropriate legislation will be required to set up planning units such as river-basin authorities, which will act as autonomous institutions with policy formulation, planning, financial, and regulatory powers.

With the supplies of utilizable surface water at about 35% of the total available run-off, it is necessary to augment the available resources to the maximum possible extent. The need is to develop surface-irrigation sources, harvest rainwater, and prevent run-off. The run-off can be tapped by building appropriate water-harvesting structures in the lower reaches especially during June–November when the rivers generally carry water in excess of 90%. The concept of watershed development which effectively contributes to the revival of local traditional water control works has also to be adopted more rigorously. The possibilities of inter-basin transfers of water also need to be explored to make optimal use of the country's water resources. The National Water Development Agency envisages the utilization of 200–250 billion cubic metres of water by such transfers. Preliminary studies also highlight the possibility of using about 160 billion cubic metres through artificial recharge (MoWR, 1999). Detailed feasibility studies need to be carried out to study the potential for increasing utilizable water resources.

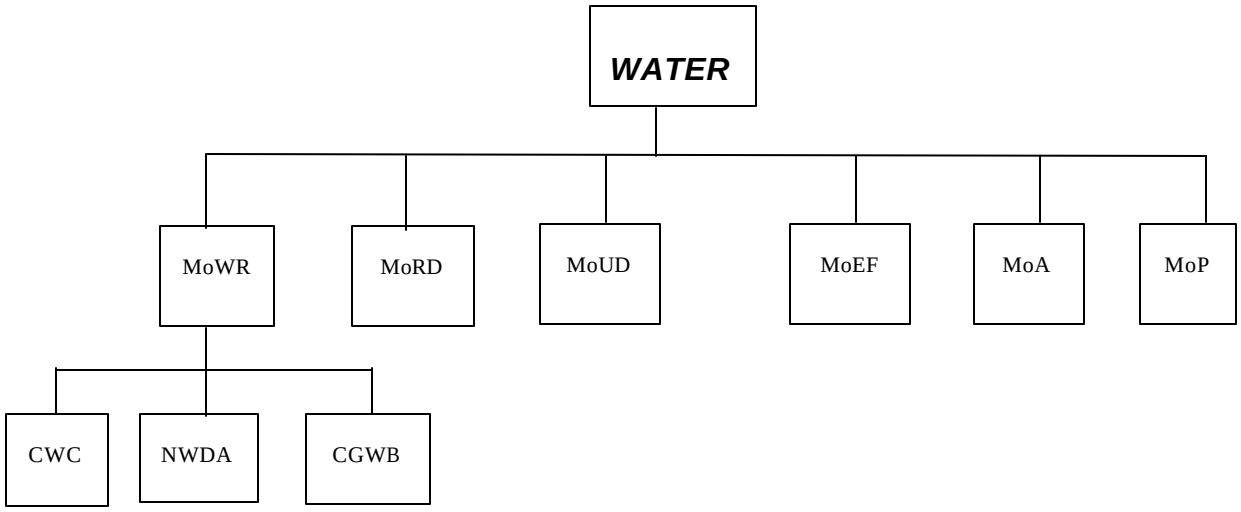
Demand management has to form an integral part of water management. It is necessary that water conservation practices in the day-to-day use of water be

encouraged through appropriate policies; promotion of low-cost and water-efficient technological options, R&D efforts and awareness-building. Reuse options for domestic wastewater also need to be explored.

Since Independence, developmental planning in the water sector has sought to address the central issues raised in Agenda 21—improving access and addressing resource degradation. Overtime as the pressures on the resource have grown, other issues—enhancing efficiency in provision and use of services through the promotion of appropriate practices and technologies, involving local communities and the private sector and following an integrated water management approach— have become increasingly important considerations. These efforts would need to be redoubled in partnership with the international community to realize the global vision of efficient resources management and universal access envisaged at the Earth Summit.

Annexure 7.1

The institutional set-up for water management in India



MoWR - Ministry of Water Resources

MoRD– Ministry of Rural Development

MoUD– Ministry of Urban Development

MoEF – Ministry of Environment & Forests

MoA- Ministry of Agriculture

MoP – Ministry of Power

CWC – Central Water Commission

NWDA - National Water Development Agency

CGWB – Central Ground Water Board

Table 7.3 Institutional responsibilities for collecting water related data

Organisation	Water quantity	Surface water quality monitoring	Ground water quality monitoring	Drinking water quality monitoring	Sanitation	Drinking water supply
CPCB		X	X			
CWC	X	X				
SPCB		X	X			
CGWB	X		X			
MoUD					X	X
MoRA&E				X	X	X
MoEF		X			X	
MA				X	X	X

Source. World Bank. (1998)

Note: CPCB – Central Pollution Control Board; CWC – Central Water Commission; SPCB – State Pollution Control Boards; CGWB – Central Ground Water Board; MoUD – Ministry of Urban Development; MoRD – Ministry of Rural Development; MoEF – Ministry of Environment and Forests; MA – Municipal Authorities

Annexure 7.2

List of polluted river stretches [a]

River	Polluted stretch	Desired class	Existing class	Critical parameters	Possible source of pollution
Sabarmati	Immediate upstream of Ahmedabad upto Sabarmati Ashram	B	E	DO, BOD, Coliform	Domestic and industrial waste from Ahmedabad
	Sabarmati Ashram to Vautha	D	E	DO, BOD, Coliform	Domestic and industrial waste from Ahmedabad
Subarnarekha	Hatia dam to Bharagora	C	D/E	-do-	Domestic and industrial waste from Ranchi and Jamshedpur
Godavari	Downstream of Nasik and Nanded	C	D/E	BOD	Wastes from sugar industries, distilleries and food processing industries
Krishna	Karad to Sangli	C	D/E	BOD	Wastes from sugar industries and distilleries
Sutlej	Downstream of Ludhiana to Haike	C	D/E	DO, BOD	Industrial wastes from hosieries, tanneries, electro-plating and engineering industries and domestic waste from Ludhiana and Jalandhar
	Downstream of Nangal	C	D/E	Ammonia	Wastes from fertilizer and chloralkali mills from Nangal
Yamuna	Delhi to confluence with Chambal	C	D/E	DO, BOD, Coliform	Domestic and industrial wastes from Delhi, Mathura and Agra
	In the city limits of Delhi, Mathura	B	D/E	DO, BOD, Coliform	Domestic and industrial wastes from

River	Polluted stretch	Desired class	Existing class	Critical parameters	Possible source of pollution
	and Agra				Delhi, Mathura and Agra
Hindon	Saharanpur to confluence with Yamuna	C	D	DO, BOD, Toxicity	Industrial and domestic wastes from Saharanpur and Ghaziabad
Chambal	Downstream of Nagda and downstream of Kota	C	D/E	BOD, DO	Domestic and industrial waste from Nagda and Kota
Damodar	Downstream of Dhanbad	C	D/E	BOD, Toxicity	Industrial wastes from Dhanbad, Durgapur, Asansol, Haldia and Burnpur
Gomti	Lucknow to confluence with Ganges	C	D/E	DO, BOD, Coliform	Industrial wastes from distilleries and domestic wastes from Lucknow
Kali	Downstream of Modinagar to confluence with Ganges	C	D/E	BOD, Coliform	Industrial and domestic wastes from Modinagar

Source. CPCB (1999)

[a] Water quality and the desired water quality is expressed in classes A, B, C, D, and E, which reflect the best use of that water. Class A indicates that water is fit for drinking without conventional treatment but after disinfection; Class B that it is suitable for outdoor bathing; and Class C, that it is suitable for drinking after conventional treatment. Class D water is suitable for propagation of wildlife and fisheries and Class E water can be used for irrigation, industrial cooling, and controlled waste disposal.

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