Drinking water quality in rural India: Issues and approaches

Background Paper

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Drinking water quality in rural India: Issues and approaches

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Executive Summary

The rural population of India comprises more than 700 million people residing in about 1.42 million habitations spread over 15 diverse ecological regions. It is true that providing drinking water to such a large population is an enormous challenge. Our country is also characterised by non-uniformity in level of awareness, socio-economic development, education, poverty, practices and rituals which add to the complexity of providing water.

The health burden of poor water quality is enormous. It is estimated that around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year. The problems of chemical contamination is also prevalent in India with 1,95,813 habitations in the country are affected by poor water quality. The major chemical parameters of concern are fluoride and arsenic. Iron is also emerging as a major problem with many habitations showing excess iron in the water samples.

The provision of clean drinking water has been given priority in the Constitution of India, with Article 47 conferring the duty of providing clean drinking water and improving public health standards to the State. The government has undertaken various programmes since independence to provide safe drinking water to the rural masses. Till the 10th plan, an estimated total of Rs.1,105 billion spent on providing safe drinking water. One would argue that the expenditure is huge but it is also true that despite such expenditure lack of safe and secure drinking water continues to be a major hurdle and a national economic burden.

On one hand the pressures of development is changing the distribution of water in the country, access to adequate water has been cited as the primary factor responsible for limiting development. The average availability of water is reducing steadily with the growing population and it is estimated that by 2020 India will become a water stressed nation. Groundwater is the major source of water in our country with 85% of the population dependent on it.

The 2001 Census reported that 68.2 per cent of households in India have access to safe drinking water. According to latest estimates, 94 per cent of the rural population and 91 per cent of the people living in urban areas have access to safe drinking water. Data available with the Department of Drinking Water Supply shows that of the 1.42 million rural habitations in the country, 1.27 million are fully covered (FC), 0.13 million are partially covered (PC) and 15,917 are not covered (NC).However, coverage refers to installed capacity, and not average actual supply over a sustained period or the quality of water being supplied which is the most essential part.

While accessing drinking water continues to be a problem, assuring that it is safe is a challenge by itself. Water quality problems are caused by pollution and over-exploitation. The rapid pace of industrialisation and greater emphasis on agricultural growth combined with financial and technological constraints and non-enforcement of laws have led to generation of large quantities

of waste and pollution. The problem is sometimes aggravated due to the non-uniform distribution of rainfall. Individual practises also play an important role in determining the quality of water.

Water quality is affected by both point and non-point sources of pollution. These include sewage discharge, discharge from industries, run-off from agricultural fields and urban run-off. Water quality is also affected by floods and droughts and can also arise from lack of awareness and education among users. The need for user involvement in maintaining water quality and looking at other aspects like hygiene, environment sanitation, storage and disposal are critical elements to maintain the quality of water resources.

The government policies and programmes has also undergone a series of transition ever since independence. To begin with, the emphasis was on setting up physical infrastructure in form of handpumps. Thereafter one has seen a transition from technology measures to a socio-technological approach seeking close participation of people. A national water policy was drafted in 1987 which was subsequently revised in 2002. For ensuring sustainability of the systems, steps were initiated in 1999 to institutionalise community participation in the implementation of rural drinking water supply schemes through the sector reforms project. *Sector Reform* ushers in a paradigm shift from “Government oriented supply driven approach” to “People oriented demand responsive approach”.

Water quality monitoring is now being considered an important part of the government programme. Since 2000, water quality monitoring has been accorded a high priority and institutional mechanisms have been developed at national, state, district, block and panchayat levels. The government has also outlined requisite mechanisms to monitor the quality of drinking water and devise effective Information, Education and Communication (IEC) interventions to disseminate information and educate people on health and hygiene.

The Government of India launched the National Rural Drinking Water Quality Monitoring and Surveillance Programme in February 2006. This envisages institutionalisation of community participation for monitoring and surveillance of drinking water sources at the grassroots level by gram panchayats and Village Water and Sanitation Committees, followed by checking the positively tested samples at the district and state level laboratories. One major problem when it comes to addressing the problems related to water is that the provisions for water are distributed across various ministries and institutions. With several institutions involved in water supply, inter-sectoral coordination becomes critical for the success of any programme.

When it comes to dealing with maintaining water quality, the users and in large the communities have to play a key role in maintaining hygiene near water sources. One has to improve the ways in which we collect and store water so as to avoid contamination while collection, storage and use. With the decentralisation of programmes for water supply it is essential that communities and institutions like panchayats are actively involved in the planning, implementation and execution of programmes for water supply. These institutions will also have to undertake the monitoring of water sources and be made aware so simple remedial measures. It is true that this will require training and capacity building at a large scale.

There can be little doubt that water is a basic necessity for the survival of humans. There is interplay of various factors that govern access and utilisation of water resources and in light of the increasing demand for water it becomes important to look for holistic and people-centred approaches for water management.

Drinking water quality

Introduction

Rural India has more than 700 million people residing in about 1.42 million habitations spread over 15 diverse ecological regions. Meeting the drinking water needs of such a large population can be a daunting task. The non-uniformity in level of awareness, socio-economic development, education, poverty, practices and rituals and water availability add to the complexity of the task. Despite an estimated total of Rs. 1,105 billion spent on providing safe drinking water since the First Five Year Plan was launched in 1951, lack of safe and secure drinking water continues to be a major hurdle and a national economic burden.

Around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year.[1].

While 'traditional diseases' such as diarrhoea continue to take a heavy toll, 66 million Indians are at risk due to excess fluoride[2] and 10 million due to excess arsenic in groundwater. In all, 1,95,813 habitations in the country are affected by poor water quality.[3] It is clear that the large investments have not yielded comparable improvements in health and other socio-economic indicators.

Water Resources and Utilisation

- India has 16 per cent of the world's population and four per cent of its fresh water resources.
- Estimates indicate that surface and ground water availability is around 1,869 billion cubic metres (BCM). Of this, 40 per cent is not available for use due to geological and topographical reasons. [4]
- Around 4,000 BCM of fresh water is available due to precipitation in the form of rain and snow, most of which returns to the seas via rivers. [4]
- Ninety two per cent groundwater extracted is used in the agricultural sector, five and three per cent respectively for industrial and domestic sector.
- Eight nine per cent of surface water use is for agricultural sector and two per cent and nine per cent respectively are used by the industrial and domestic sector.

While on the one hand the pressures of development are changing the distribution of water in the country, access to adequate water has been cited as the primary factor responsible for limiting development. The average availability of water remains more or less fixed according to the natural hydrological cycle but the per capita availability reduces steadily due to an increasing population.

- In 1955, the per capita availability was 5,300 cubic metres (cu.m) per person per year, which came down to 2,200 cu. m in 1996.[5]

- It is expected that by around 2020, India will be a *'water stressed'* state with per capita availability declining to 1600 cu m/person/year.[4] A country is said to be water stressed when the per capita availability of water drops below 1700 cu. m/person/year.[6]

Rural Water Supply

The provision of clean drinking water has been given priority in the Constitution of India, with Article 47 conferring the duty of providing clean drinking water and improving public health standards to the State. Rural water supply (RWS) programmes in India can be divided into several distinct phases

***Early Independence* (1947-1969)**

1949: The Environment Hygiene Committee (1949) recommends the provision of safe water supply to cover 90 per cent of India's population in a timeframe of 40 years.

1950: The Constitution of India confers ownership of all water resources to the government, specifying it as a state subject, giving citizens the right to potable water.

1969: National Rural Drinking Water Supply programme launched with technical support from UNICEF and Rs.254.90 crore is spent during this phase, with 1.2 million bore wells being dug and 17,000 piped water supply schemes being provided.

Transition from technology to policy (1969-1989)

1972-73: Introduction of the Accelerated Rural Water Supply Programme (ARWSP) by the Government of India to assist states and union territories to accelerate the pace of coverage of drinking water supply.

1981: India as a party to the International Drinking Water Supply and Sanitation Decade (1981-1990) declaration sets up a national level Apex Committee to define policies to achieve the goal of providing safe water to all villages.

1986: The National Drinking Water Mission (NDWM) is formed.

1987: Drafting of the first National Water Policy by the Ministry of Water Resources.

Restructuring phase (1989-1999)

1991: NDWM is renamed the Rajiv Gandhi National Drinking Water Mission (RGNDWM).

1994: The 73rd Constitutional Amendment assigns panchayati raj institutions (PRIs) the responsibility of providing drinking water.

1999: For ensuring sustainability of the systems, steps are initiated to institutionalise community participation in the implementation of rural drinking water supply schemes through sector reform. Sector reform ushers in a paradigm shift from the 'Government-oriented supply-driven approach' to the 'People-oriented demand-responsive approach'. The role of the government is envisaged to change from that of service provider to facilitator. Under reform, 90 per cent of the infrastructure is funded by the government, with the community contributing 10 per cent of the remaining

infrastructure cost and 100 per cent of operation and maintenance costs. Sector reforms projects were introduced in 67 districts across the country on pilot basis.

1999: Total Sanitation Campaign (TSC) as a part of reform principles initiated in 1999 to ensure sanitation facilities in rural areas with broader goal to eradicate the practice of open defecation. As part of the programme, a nominal subsidy in the form of incentive is given to rural poor households for construction of toilets. TSC gives strong emphasis on Information, Education and Communication, Capacity Building and Hygiene Education for effective behaviour change with involvement of PRIs, CBOs, and NGOs

Consolidation phase (2000 onwards)

2002: Nationwide scaling up of sector reform in the form of Swajaldhara.

2002: The National Water Policy is revised, according priority to serving villages that did not have adequate sources of safe water and to improve the level of service for villages classified as only partially covered.

2002: India commits to the Millennium Development Goals to halve by 2015, from 1990 levels, the proportion of people without sustainable access to safe drinking water and basic sanitation.

2004: All drinking water programmes are brought under the umbrella of the RGNDWM.

2005: The Government of India launches the Bharat Nirman Programme for overall development of rural areas by strengthening housing, roads, electricity, telephone, irrigation and drinking water infrastructure. The target is to provide drinking water to 55,069 uncovered habitations; those affected by poor water quality and slipped back habitations based on 2003 survey, within five years.

2007: Pattern of funding under the Swajaldhara Scheme changes from the previous 90:10 central-community share to 50:50 centre-state share. Community contribution is now optional.

The approach paper for the 11th Five Year Plan calls for a comprehensive approach which encompasses individual health care, public health, sanitation, clean drinking water, access to food and knowledge about hygiene and feeding practice. It also states the need to upscale more schemes related to community management of water reducing the maintenance burden and responsibility of the state. It is envisaged to provide clean drinking water for all by 2009 and ensure that there are no slip-backs by the end of the 11th Plan.

Coverage and investment

The 2001 Census reported that 68.2 per cent of households in India have access to safe drinking water.[7] According to latest estimates, 94 per cent of the rural population and 91 per cent of the people living in urban areas have access to safe drinking water.[8] Drinking Water and Sanitation Status in India, WaterAid India, 2005. Data available with the Department of Drinking Water Supply shows that of the 1.42 million rural habitations in the country, 1.27 million are fully covered (FC), 0.13 million are partially covered (PC) and 15,917 are not covered (NC).[9]

However, coverage refers to installed capacity, and not average actual supply over a sustained period or the quality of water being supplied.

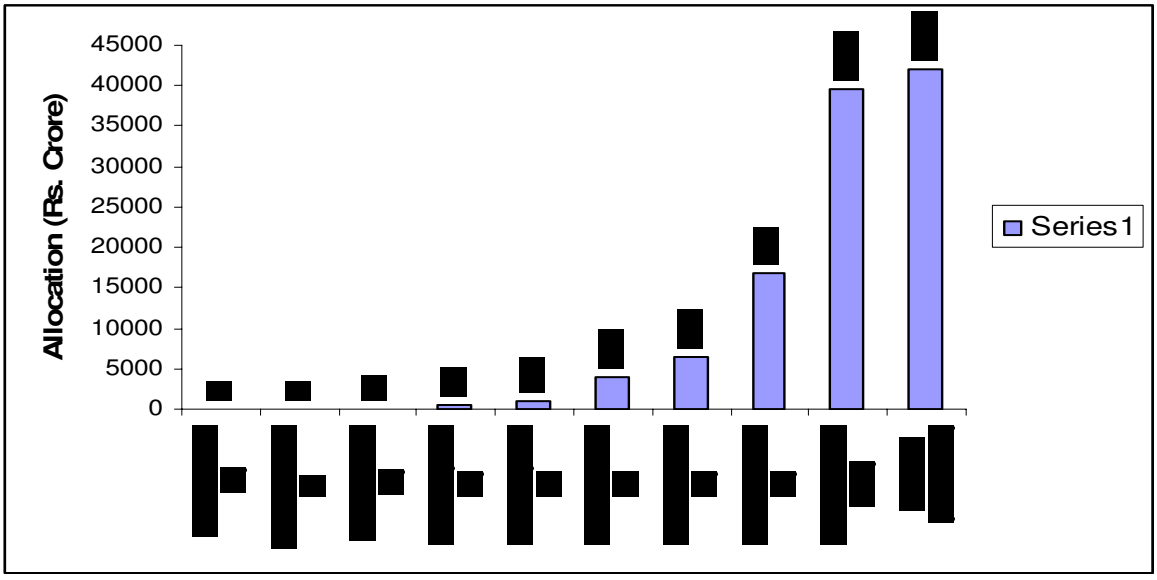

Figure 1: Budget outlay for water and sanitation

Data Source: http://planningcommission.nic.in/data/dataf.htm

From the 1990s, there has been a considerable increase in rural water supply in the five year plans, with Rs.16,711 crore being the budget outlay in the Eighth plan; Rs.39,538 crore in the Ninth and Rs.42,000 crore projected for the 10th Five Year Plan, as indicated in Figure 1. The percent outlay planned investment in watsan sector is shown in Figure 2.

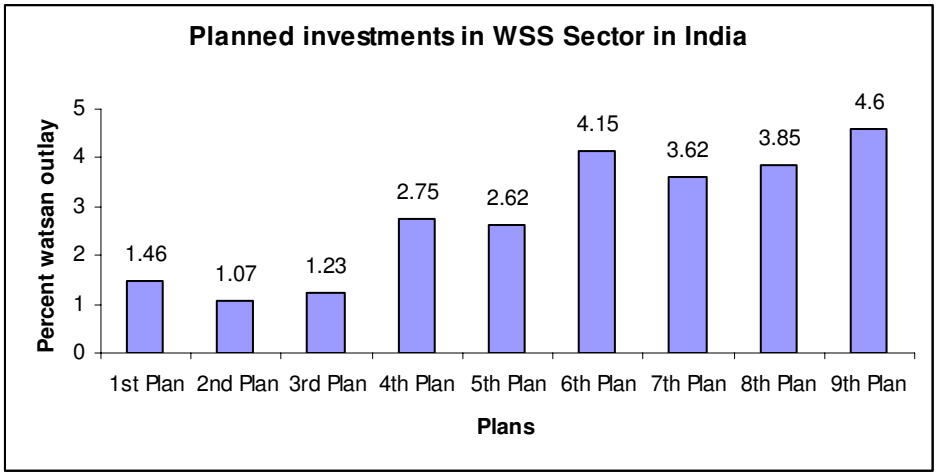

Figure 2: Planned investment in watsan sector

Data Source: http://planningcommission.nic.in/data/dataf.htm

Despite the enormous allocation made to the various ministries the expenditure has been very low. The Ministry of Water Resources incurred only 22% expenditure out of the plan outlay of Rs.3, 600 crores in the first 2 plan periods. The approved outlay for water supply (rural and urban) was Rs.44, 206.55 crore and expenditure was to the tune of 27% of the approved outlay. The Department of Drinking Water Supply (DDWS) was allocated Rs.14,200 crore for rural WATSAN &

expenditure was 36% of allocated funds. The investment in the watsan sector does not commensurate with health benefits. Figure 3(a) and 3(b) depicts the morbidity on selected water borne diseases.

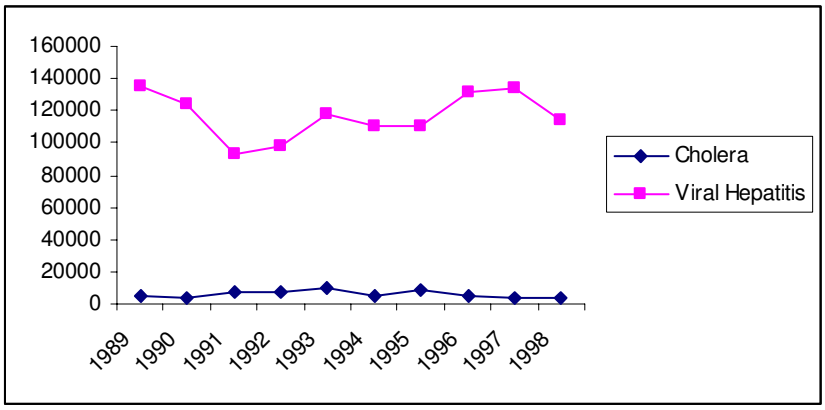

Figure 3(a): Morbidity due to cholera and viral hepatitis
Data Source: Central Bureau of Health Investigation

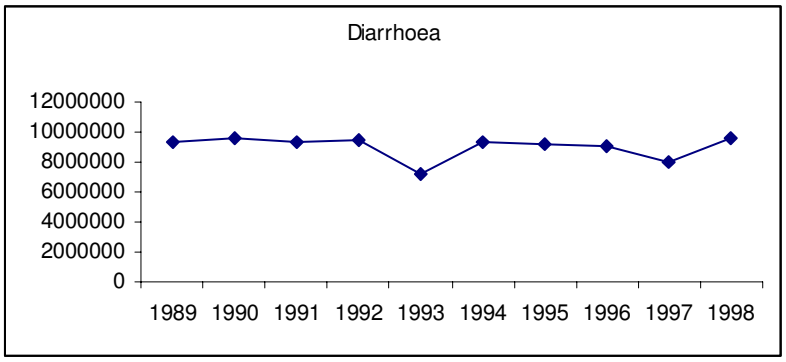

Figure 3(b): Morbidity due to diarrhoea
Data Source: Central Bureau of Health Investigation

There is a growing need to address the twin problem of sustainability of water resource and water quality. DDWS has estimated a large gap in resources of about Rs.6,800 crores to tackle problems of rural water sustainability & water quality.

While accessing drinking water continues to be a problem, assuring that it is safe is a challenge by itself. Water quality problems are caused by pollution and over-exploitation. The rapid pace of industrialisation and greater emphasis on agricultural growth combined with financial and technological constraints and non-enforcement of laws have led to generation of large quantities of waste and pollution. The problem is sometimes aggravated due to the non-uniform distribution of rainfall. Individual practises also play an important role in determining the quality of water.

Water quality is affected by both point and non-point sources of pollution. These include sewage discharge, discharge from industries, run-off from agricultural fields and urban run-off. Water quality is also affected by floods and droughts and can also arise from lack of awareness and education among users. The need for user involvement in maintaining water quality and looking at other aspects like hygiene, environment sanitation, storage and disposal are critical elements to maintain the quality of water resources.

Bacterial contamination

Bacterial contamination of water continues to be a widespread problem across the country and is a major cause of illness and deaths with 37.7 million affected by waterborne diseases annually. The major pathogenic organisms responsible for water borne diseases in India are bacteria (*E Coli, Shigella, V cholera*), viruses (*Hepatitis A, Polio Virus, Rota Virus*) and parasites (*E histolytica, Giardia, Hook worm*).

The Central Pollution Control Board monitoring results obtained during 2005 indicate that organic pollution continues to be predominant in aquatic resources. Organic pollution measured in terms of bio-chemical oxygen demand (BOD) and *coliform* count gives an indication of the extent of water quality degradation in different parts of the country. It was observed that nearly 66 per cent of the samples had BOD values less than acceptable limits while 44 per cent of the samples indicated the presence of *coliform* while according to the BIS there should be no *coliform* in drinking water samples.[10]

Contamination due to over-exploitation

In the 1980s and 1990s, groundwater tables buckled under increased extraction as water tables started to decline and bore wells ran dry. What was more disturbing was that by then, 80 per cent of drinking water sources were groundwater-dependent. As a result, habitations and villages that were 'covered' with a safe water supply by the government started 'slipping back'.

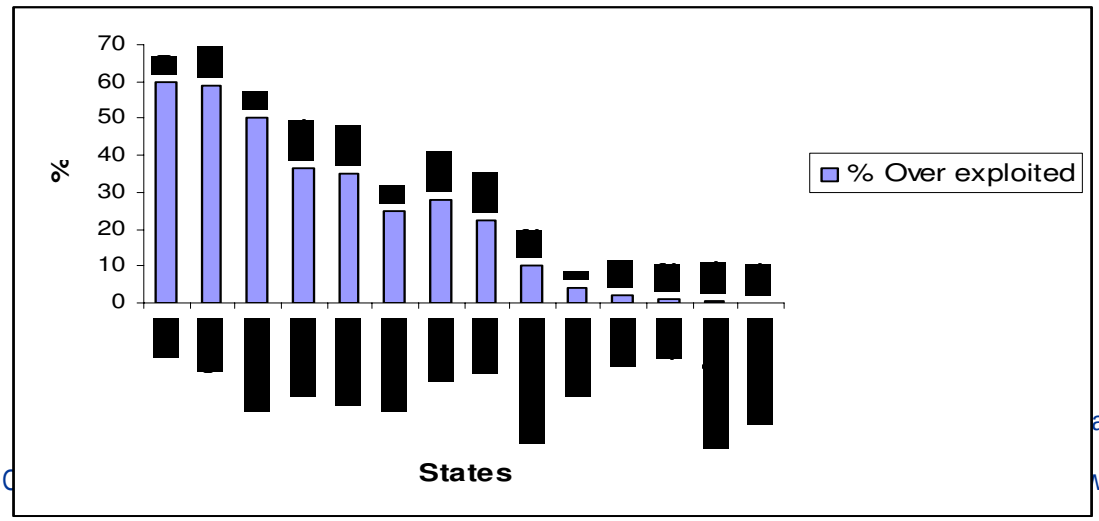

Figure 4: Percentage of overexploited blocks/taluks/ watersheds with regard to groundwater extraction

Source: Annual

ation.

Report, CGWB, 2002-2003

Water quality also started becoming a problem. This time, the culprit was not microbial contamination. Drinking water problems began to emerge in places where this was previously unheard of, such as in West Bengal. The problems were chemical in nature, best pointed out in the case of West Bengal. Endowed with 1,650 mm of rainfall and several rivers, West Bengal was earlier using surface water and shallow ponds as drinking water sources. As the state shifted to groundwater sources, reports of arsenic contamination began coming in from the right bank of the Ganga. Similarly, over-extraction of groundwater has also resulted in increase in fluoride concentration in the states of Andhra Pradesh, Assam, Gujarat, Karnataka, Madhya Pradesh and Rajasthan.

Other contaminants include excess iron, nitrates and brackishness, the latter especially in coastal areas. Increase in brackishness in coastal areas has been the result of groundwater extraction through deep tube-wells for drinking and irrigation purposes, leading to salinity ingress where seawater seeps in. The occurrence of inland salinity is due to over-extraction of groundwater and less recharge of aquifers.

Thus, the problems that emerged from groundwater use were not limited to depleting sources, but also contaminants that did not need to be dealt with before. As of now, the scenario is fearful and alarming. There are a variety of problems that relate to quantity as well as quality. Eighty per cent of our drinking water needs are met by groundwater, which is depleting at an alarming rate, compounded with large scale contamination.

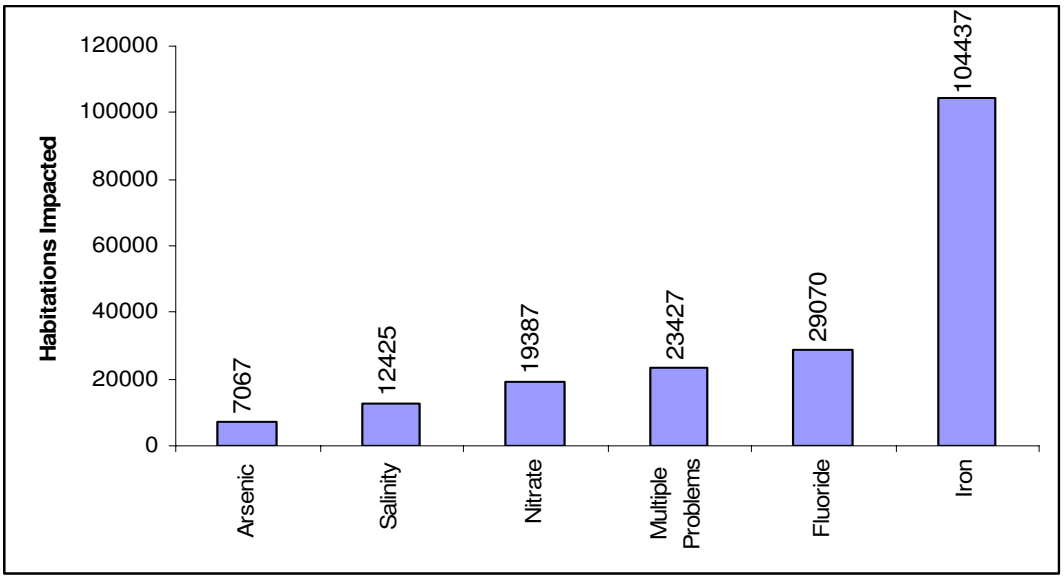

Figure 5: Number of Habitations affected by water quality problems

Data Source: DDWS, MoRD

It is estimated that about 66 million people in 20 states are at risk due to excess fluoride[11] and around 10 million people are at risk due to excess arsenic in ground water.

Effluents and industrial waste

Another major cause for concern is the pollution of ground and surface water from increased fertiliser and pesticide use in agriculture and from industrial sources. The consumption of fertilisers shot up from 7.7 million tonnes in 1984-85 to 13.9 million tonnes in 1994-95 and that of pesticides from 24,305 tonnes in 1974 to 85,030 tonnes in 1994-95.

The rise in the usage of such compounds has degraded the quality of surface water resources by causing nitrate contamination. The World Bank has estimated that the total cost of environmental damage in India amounts to US$9.7 billion annually, or 4.5 per cent of the gross domestic product. Of this, 59 per cent results from the health impacts of water pollution.[12]

A 1995, a survey undertaken by the Central Pollution Control Board identified 22 sites in 16 states as critical for groundwater pollution due to industrial effluents. There have been instances of heavy metals like lead, cadmium, zinc and mercury being reported in groundwater in Gujarat, Andhra Pradesh, Kerala, Delhi and Haryana.[13]

An emerging threat to water quality is due to the use of persistent organic pollutants (POPs). These are chemicals that degrade very slowly and remain in the environment for years. POPs bio-accumulate in the fat tissue of organisms once exposed which meant that they are not excreted from the body. The POPs used widely in India are DDT, with an annual consumption of 10,000 Metric Tonnes; polychlorinated biphenyls used widely in capacitors and transformers and dioxins and furans used in the cement and pipe industry. Ground water in some locations in Jharkhand, West Bengal, Himachal Pradesh and Delhi have reported levels of DDT, aldrin, dieldrin and heptachlor that are in excess of prescribed standards.[14]

Table: States affected by various water quality problems

Parameter	Maximum permissible limit	Health impact	Affected states
Fluoride	1.5 mg/ l	• Immediate symptoms include digestive disorders, skin diseases, dental fluorosis • Fluoride in larger quantities (20-80 mg/day) taken over a period of 10-20 years results in crippling and skeletal fluorosis which is severe bone damage	Andhra Pradesh, Assam, Bihar, Chattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal
Arsenic	0.05 mg/l	• Immediate symptoms of acute poisoning typically include vomiting,	Assam, Bihar, Chattisgarh, Jharkhand, Tripura, West Bengal, Uttar Pradesh

		oesophageal and abdominal pain, and bloody 'rice water' diarrhoea. • Long-term exposure to arsenic causes cancer of the skin, lungs, urinary bladder, and kidney. There can also be skin changes such as lesions, pigmentation changes and thickening (hyperkeratosis)	
Iron	1 mg/ l	• A dose of 1500 mg/l has a poisoning effect on a child as it can damage blood tissues • Digestive disorders, skin diseases and dental problems	Arunachal Pradesh, Assam, Bihar, Chattisgarh, Jharkhand, Jammu and Kashmir, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tripura, Tamil Nadu, Uttar Pradesh, West Bengal, A&N Islands, Pondicherry
Nitrate	100mg/ l	• Causes Methamoglobinemia (Blue Baby disease) where the skin of infants becomes blue due to decreased efficiency of haemoglobin to combine with oxygen. It may also increase risk of cancer.	Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh
Salinity	2000 mg/l	• Objectionable taste to water. • May affect osmotic	Andhra Pradesh, Chattisgarh, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra,

		flow and movement of fluids	Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Pondicherry
Heavy Metals	Cadmium – 0.01 mg/ l Zinc – 15 mg/ l Mercury – 0.001 mg/ l	Damage to nervous system, kidney, and other metabolic disruptions	Gujarat, Andhra Pradesh, Delhi, Haryana, Kerala
Persistent Organic Pollutants	None	High blood pressure, hormonal dysfunction, and growth retardation.	Delhi, Himachal Pradesh, Jharkhand, West Bengal,
Pesticides	Absent	Weakened immunity, abnormal multiplication of cells leading to tumour formation They contain chlorides that cause reproductive and endocrinal damage.	

- Compiled from: BIS Standards: IS 10500: 1991,
- http://www.ddws.nic.in/popups/submissionfunds-200607-195.pdf
- www.cseindia.org/programme/health/pdf/conf2006/a69industrydelhi.pdf

Behavioural practices: Interventions for providing safe drinking water can become ineffective in the absence of improved sanitation. In order to provide access to sufficient quantities of safe water, the provision of facilities for a sanitary disposal of excreta, and introducing sound hygiene behaviour are of utmost importance. The ways and means by which water is collected also has an impact on its quality. It is essential to have a clean surrounding around the source to prevent contamination. Open drains and disposal of solid waste near sources of water may lead to presence of ammonia and coliform bacteria in the drinking water source. Thus prevention of ***water contamination at source*** is necessary to ensure the potability of supplied water.

Cultural practices: There are various religious practices that revolve around sources of water. Immersion of idols in surface water bodies is a prime cause of deteriorating water quality. Water bodies have been used as dumping grounds for various offerings that have degraded the potability

of surface water. Defecation on boundaries of water bodies results in bacteriological contamination.

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Pollution Load - Domestic and Industrial Wastes

- 90% of the sewage generated by municipal councils and over 50% of sewage discharged by municipal corporations goes untreated.
- The industrial sector contributes 30729.2 million cubic metres of effluent being discharged into our water bodies.

Source: http://www.cseindia.org/dte-supplement/industry20040215/industry.pdf

- In India, an estimated 200,000 tonnes of faecal load is generated every day due to open defecation

Source: http://ddws.nic.in/SSHE_in_**India**_Paper_2004.pdf.

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Water Quality Monitoring

In India, the financial and technical support for rural and urban water supplies are provided by the central government while the planning, designing, construction, operation and maintenance is undertaken by state government agencies. While larger cities have their own laboratories for testing water, institutional framework for water quality monitoring and data processing is inadequate in rural areas.

Priority and programmes

- Since 2000, water quality monitoring has been accorded a high priority and institutional mechanisms have been developed at national, state, district, block and panchayat levels. The government has also outlined requisite mechanisms to monitor the quality of drinking water and devise effective Information, Education and Communication (IEC) interventions to disseminate information and educate people on health and hygiene.

- The Government of India launched the National Rural Drinking Water Quality Monitoring and Surveillance Programme in February 2006. This envisages institutionalisation of community participation for monitoring and surveillance of drinking water sources at the grassroots level by gram panchayats and Village Water and Sanitation Committees, followed by checking the positively tested samples at the district and state level laboratories.

- From 2006-07 onwards, the states have been directed to earmark up to 20 per cent of Accelerated Rural Water Supply Programme (ARWSP) funds for tackling water quality problems.[15]

- With the aim of setting up laboratories, the Government of India has sanctioned 430 district level laboratories out of which 252 have been established till 2005. Various state governments and other organisations have also established 158 laboratories.[16]

- The Government of India has made an allocation of Rs.1,040 crore for the current financial year (2007-08), to states and Union Territories for tackling water quality problems due to excessive fluoride, nitrate, arsenic, iron and salinity.

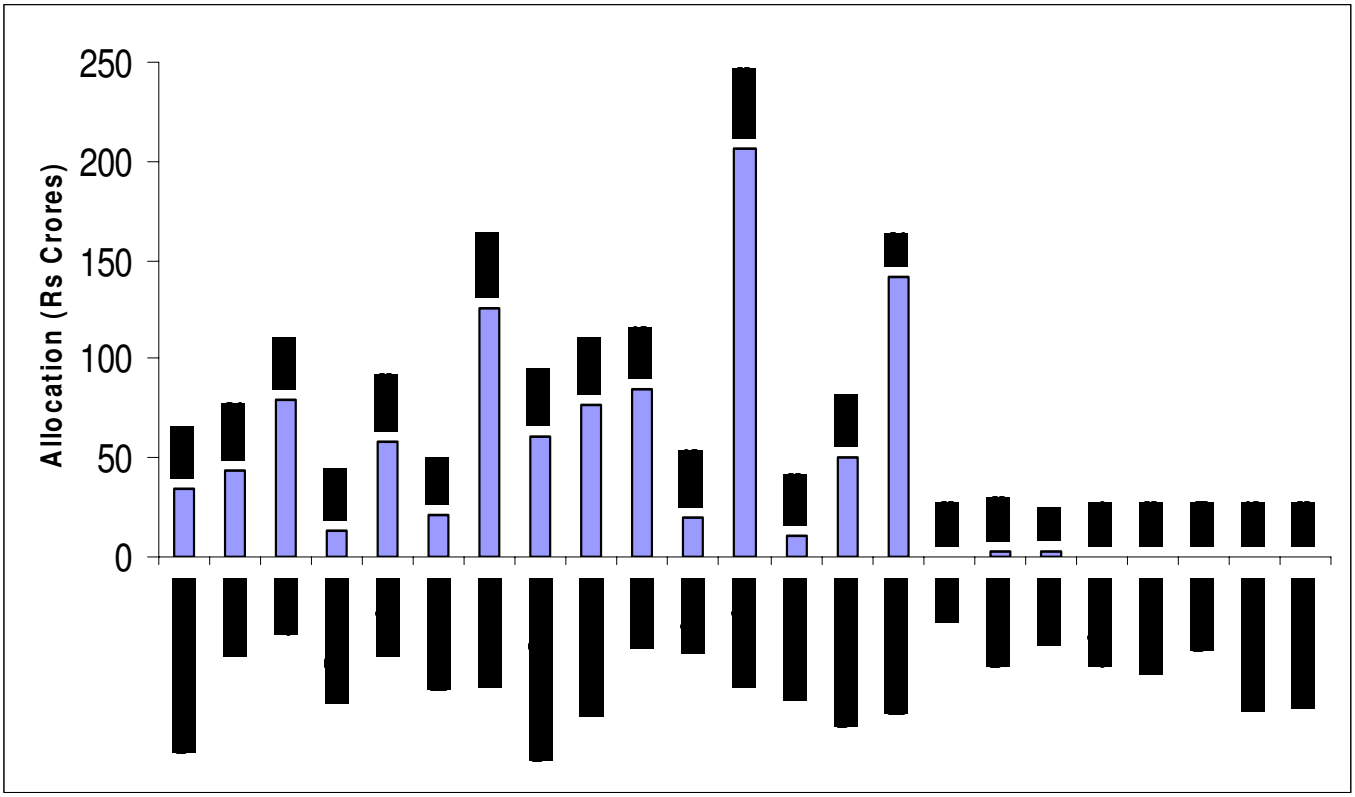

Figure 6: Allocation made to various states for tackling water quality problems
Data Source: DDWS, Ministry of Rural Development

Service Providers

In India, the primary responsibility for providing drinking water and sanitation facilities lies with the state governments. With the 73rd and 74th Constitutional Amendments, the states have the authority to give the responsibility of local supply of water to Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs).

The role of the Centre is to allocate funds and guide investments, encourage research, develop human resources through training and other capacity-building efforts, promote water quality monitoring, provide guidelines for various programmes and ensure the implementation of the water supply programmes.

Institutional structure

Figure 7 depicts the institutional structure for water and sanitation supply in India. Though not directly involved in the supply chain, the judiciary has also played a role in resolving conflicts and taking up issues of public interest. With several institutions involved in water supply, inter-sectoral coordination becomes critical for the success of any programme.

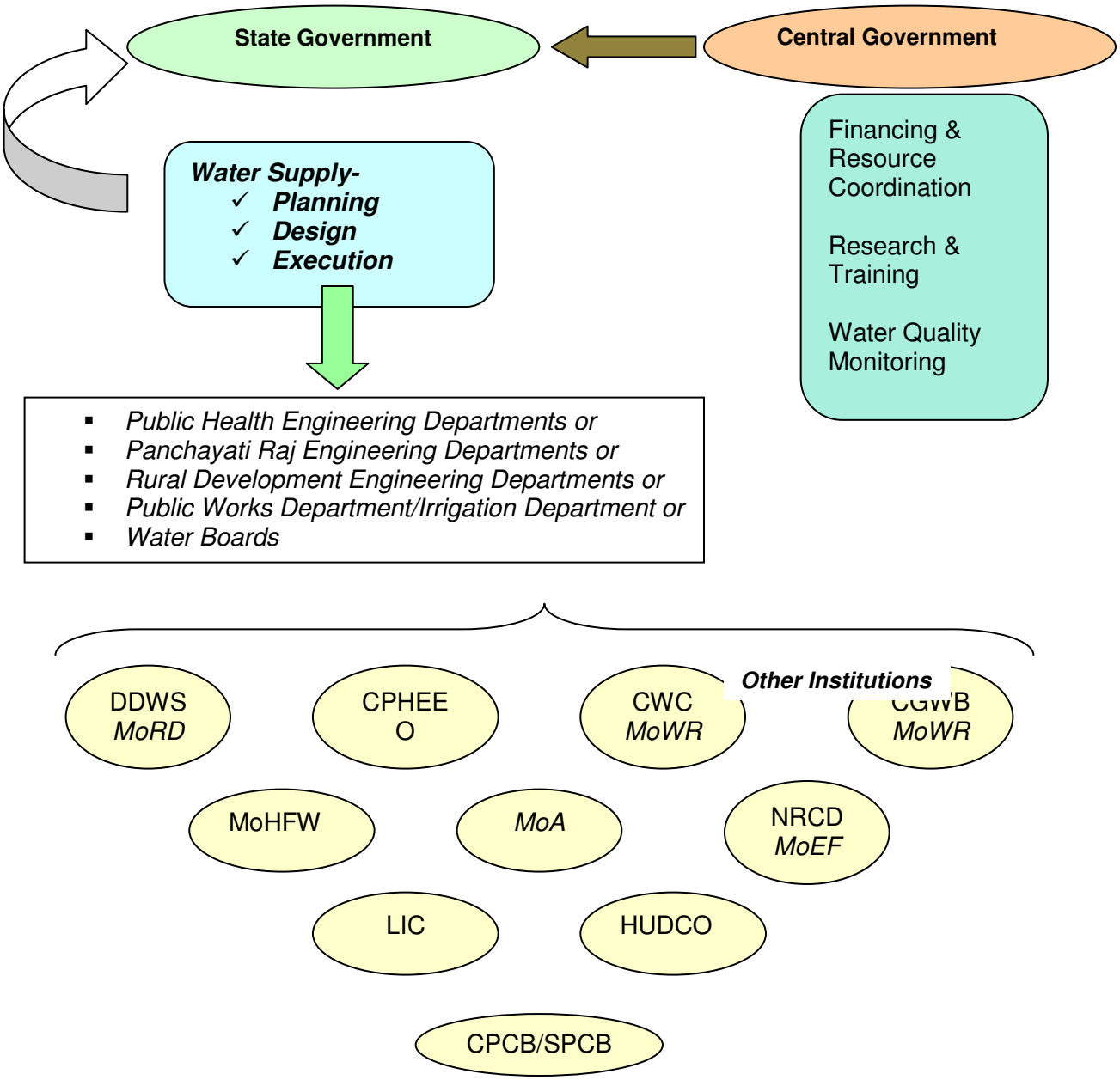

Figure 7: Institutional Structure for Water and Sanitation Supply in India

Responsibility of various agencies

The role of the **Central government** is to guide investments in this sector, encourage the need for training and research, and also to promote water quality monitoring and human resources development programmes.

The **states** plan, design and execute water supply schemes and operate through departments like Public Health Engineering Departments, Panchayati Raj Engineering Departments or Rural Development Engineering Departments and Water Boards.

The Central Water Commission (CWC) in the Ministry of Water Resources (MoWR) is responsible for regulating the use of surface water for irrigation, industry and drinking water purposes. It also mediates in inter-state water allocation disputes.

Central Groundwater Board (CGWB) under the MoWR has an overseeing responsibility for the monitoring of groundwater levels and rates of depletion and the production of water resource inventories and maps.

National Rivers Conservation Directorate (NRCD) under the Ministry of Environment and Forests (MoEF) oversees the implementation of Action Plans to improve the quality of the rivers in India

Central Pollution Control Board (CPCB) under the **Ministry** of Environment and Forests (MoEF) promotes basin-wide pollution control strategies. It liaises with State Water Pollution Control Boards for laying down standards for treatment of sewage and effluents. The Board is also responsible for action in the case of non-compliance by agencies.

Rajiv Gandhi National Drinking Water Mission (RGNDWM) under the Department of Drinking Water Supply, Ministry of Rural Development (MoRD) formulates policies, sets standards, and provides funds and technical assistance to the states for rural water supply and sanitation activities.

Ministry of Agriculture (MoA) is involved in planning, formulation; monitoring and reviewing of various watershed based developmental project activities.

Ministry of Urban Development (MoUD) is the nodal ministry for policy formulation and guidance for the urban water supply and sanitation sector. The Ministry's responsibilities include broad policy formulation, institutional and legal frameworks, setting standards and norms, monitoring, promotion of new strategies, coordination and support to state programmes through institutional expertise and finance.

Life Insurance Corporation (LIC) which is owned by the Government of India as part of its statutory requirements has to invest 25 per cent of net accretion from its controlled funds in socially oriented schemes such as housing, education, water supply and road transportation. It has been advancing loans to local bodies and state level water supply and sewerage boards.

Central Bureau of Health Intelligence (CBHI) under the Ministry of Health and Family Welfare deals with the collection, compilation, analysis and dissemination of the information on health conditions in the country.

Housing and Urban Development Corporation (HUDCO) is active in supporting activities in this sector. Realizing the importance of water supply needs HUDCO has accorded topmost priority to financing water supply schemes, especially in small and medium towns. For instance, as much as 37 per cent of the cumulative loan sanction for urban infrastructure schemes by HUDCO has gone to the water sector – for augmentation, rehabilitation extension as well as new schemes with development of sources for un-served areas in Orissa.

BIS is responsible for drafting of standards pertaining to drinking water quality.

Health and Economic Burden

Poor water quality spreads disease, causes death and hampers socio-economic progress. Around five million people die due to waterborne diseases. In addition, these diseases affect education and result in loss of work days, estimated at 180 million person days annually. The annual economic loss is estimated at Rs.112 crores.[17]

Water-related diseases put an economic burden on both the household and the nation's economy. At household levels, the economic loss includes cost of treatment and wage loss during sickness. Loss of working days affects national productivity. On the other hand, the government spends a lot of money and time on treatment of the sick and providing other supportive services.

Expenditure on health

According to Government of India estimates, expenditure on health adds up to Rs.6,700 crore annually (approximately Rs.60 per head per year). The WHO recommends that 5 per cent of a nation's GDP be earmarked for investments in the health sector. However, public health expenditure in India has declined from 1.3 per cent of its GDP in 1990 to 0.9 per cent of its GDP in 1999. The National Rural Health Mission of the Government of India has set the target of rising public spending on health from 0.9 per cent of its GDP to 2-3 per cent of its GDP.[18] In India, 60-80 per cent of the resources in the health system is spent on hospital care, leaving a much lower proportion for basic services. In addition, the focus is on urban-curative services, leaving rural areas more vulnerable.[19]

As per estimates, the average expenditure of rural households on health services amounts to 5.28 per cent of their average annual income[17] this percentage can vary with population in different income groups but the important message that can be derived from these facts is that our rural households are forced to spend a significant amount of their earnings on health.

Water quality and the poor

According to Down to Earth, rural people in India spend at least Rs.100 each year for the treatment of water/sanitation-related diseases. According to the Government of India, this adds up to Rs.6,700 crore annually, which is just Rs.52 crore less than the annual budget of the Union Health Ministry and more than the allocation for education.[20]

There are other poverty-related factors behind inequalities in child mortality, including poor nutrition and access to affordable healthcare. But increased exposure to the risk of waterborne infections is a major causal link. Children who are malnourished are more likely to suffer from diarrhoea and sickness episodes last longer. Repeated incidences of diarrhoea result in weight loss, stunted growth and vitamin deficiency, with greater chances of dropping out from school, leading to reduced earning power and poverty.

However supplying clean water alone would not solve health-related problems. Only an integrated approach of water quality improvement with improvement in water availability combined with sanitation and hygiene education will help address this issue.

Towards cleaner water

Providing safe drinking water to all in rural India is a challenging task. Given the diversity of the country and its people, solutions have to be diverse. One has to look at an approach that seeks the participation of users through interventions engaging the communities with various government schemes and policies. Citizens should be made aware of the demand for clean drinking water as a right. Such an integrated approach would incorporate collaborative efforts of various sectors involving the government, civil society and needless to say the people.

Role of Government

1. ***Supporting awareness drives:*** One of the major challenges is to make people aware on the need to consume safe water. There are examples where despite being provided potable water by the government, people drink water from contaminates surface sources. The government needs to support civil society and organisations involved in increasing awareness. An integrated campaign can result in wide spread information dissemination amongst the masses on the ways and means of preventing contamination of water sources.

2. ***Testing and remedial action:*** There is an urgent need to enhance the monitoring network by establishing monitoring stations across all regions and seasonal assessments of all water sources. In case of contamination being detected, an action plan for dealing with sources should be provided. The challenge lies in establishing well equipped laboratories with well-trained staff. This also calls for training of people and infrastructure development. Although there has been wide usage of field testing kits, they often give false or semi-quantitative results. One can rely on field testing kits for a broader picture, but laboratory tests are necessary for accurate results. The generated data should be made available in the public domain. The data in respected of water quality affected habitations is available in the website of DDWS but many of the state water and sanitation departments do not have such data. Generating data, its interpretation and communication is essential for effective management of water and the use of Geographical Information System (GIS) can assist in mapping, modelling and decision-making.

3. ***Capacity building of communities:*** The roles of panchayats are becoming more important and stress is being laid on community-based approaches in dealing with water-related problems. A prerequisite for increasing community participation is training of people form the communities so that they are able to make well-informed decisions. The objectives of decentralisation can come about only if there is an attitudinal change among government functionaries as well as

the people, with respect to decentralisation, transferring authority and responsibility to the people at the community level. The role of the government in implementing capacity building programmes is essential.

Gram Mitra for monitoring water quality

To strengthen the village level water quality monitoring, teams by the name of Gram Mitra are being involved in the villages across Gujarat. Training is organized at the block level in coordination with the Government of Gujarat, block level functionaries with the support of NGOs. As hands on exercise, the Gram Mitras are asked to get one sample from a drinking water source in the village along with the sanitary survey of that source. During the training the testing of these samples link between the sanitary situation around the source and the quality of water is established. These Gram Mitras undertake monitoring of water sources in villages across the state and also spear awareness on ways and means to keep surroundings of water sources clean.

4. ***Inter-agency coordination:*** One major bottleneck in an effective policy formulation and implementation has been the current institutional set-up involving various government agencies. There is a fragmented approach at the state and central level with the involvement of numerous agencies in the supply and management of water. Better co-ordination amongst ministries and departments would ensure effective implementation. The option of a single nodal ministry with the overall supervision and administration pertaining to water resources may be looked into as is the case with countries like Australia.

5. **Making the service provider accountable:** Article 21 of the Constitution of India, relates to the Protection of Life and Personal Liberty and the right to pollution-free water is guaranteed under this provision. The user has the right to know whether water being provided at source is free from any contamination as claimed by authorities. Financial expenditure on water supply schemes and testing water quality should be known to the public. The example of Tamil Nadu water supply and drainage board should be emulated by other states where financial expenditure is in the public domain through their website.

Constitution of India- Provision for Right to Water

Under fundamental rights provided by the Constitution of India, Article 21 entitles 'protection of life and personal liberty'. It states that *'no person shall be deprived of his life or personal liberty except according to procedure established by law'*. Article 21 has been interpreted by Supreme Court to include all facets of life. The court order has resulted in expanding the right to life to include several other vital aspects of human life like pollution-free water and air, health, environment, and housing.

Article 15(2) of the Constitution states that no citizen shall ‘on grounds only of religion, race, caste, sex, place of birth or any of them’ be subject to any disability, liability, restriction or condition with regard to ‘the use of wells, tanks, bathing ghats.’

The directive principles of state policy, which the Constitution in Article 37 recognizes the principle of equal access to the material resources of the community.

Article 39 (b) mandates that ‘the State shall, in particular, direct its policy towards securing that the ownership and control of the material resources of the community are so distributed as best to subserve the common good.’

Article 51-A(g) casts a fundamental duty on every citizen of India 'to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures.'

The centre recognised the need for a decentralized structure of governance at the panchayat level. This was implemented through the 73rd and 74th Constitutional Amendments; whereby the States have the authority to give responsibility and powers to the Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs) for the supply of water. The provisions introduced by this amendment provide for administrative and legislative powers.

As per provisions of Article 243G, the state legislature can make laws to empower the panchayat to prepare plans for economic development and social justice apart from other matters specified in the Eleventh Schedule to the Constitution. The topics in the Eleventh Schedule include minor irrigation, water management and watershed development (Entry 3), fisheries (Entry 5) drinking water (Entry 11), waterways (Entry 13), health and sanitation (Entry 23), public distribution system (Entry 28) and maintenance of community assets (Entry 29).

Civil society and the judiciary have played a key role in not only highlighting concerns but establishing linkages between people and their entitlement for water. Sh. Balwant Singh Mehta one of the signatories of the constitution demanded his right to clean water by filling a case demanding cleaning of lakes in Udaipur. The court has recognized that water is a community source which is to be held by the State in public trust in recognition of its duty to respect the principle of inter-generational equity.

Enlisted below are some of the important judgments defining people's right to water –

- ***Bandhua Mukti Morcha V Government of India (1984)*** – "Right to healthy environment as part of right to life"
- ***Subhash Kumar V State of Bihar (1991)*** – "Right to life includes right to enjoyment of pollution free environment"
- ***State of Karnataka V State of Andhra Pradesh (2000)*** – "Right to water is right to life and thus a fundamental right"
- ***Narmada Bachao Andolan V Union of India (2000)*** – ""Water is a basic need for survival of human beings and is part of right to life and thus a fundamental right"

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6. ***Water quality standards and provision of water under the Food Law Bill:*** The quality of drinking water supplies in India by public agencies is presently governed by Bureau of Indian Standards (BIS) specifications IS: 10500-1991. In case of drinking water monitoring, standards such as IS: 2488, for sampling methods and IS: 3025 for testing procedures should also be adhered to. Prior to drafting of standards it is important to establish the precise dose-response mechanism through appropriate epidemiological studies both in rural and urban areas. However, the World Health Organisation (WHO) has its own standards and in some cases, there is a difference in the permissible limits between the two. The best example is of arsenic, for which the WHO's prescribed limit is 10 ppb (parts per billion) and that of BIS is 50 ppb. There have been discussions at the national level to re-look at the current standards and modify them.

The Government of India is considering the issue of regulation of drinking water by making suitable provision in the integrated Food Law Bill. Various formulations on the issue of either putting water in the definition of food, or alternatively, having a separate provision for schemes related to water and their implementation or their inclusion in the Integrated Food Law is under consideration.

7. ***School Water Supply Programme:*** India has one of the largest numbers of school going children, especially in rural areas with about 6.3 lakh rural schools. As per National Family Health Survey 75 percent of the children in the age group of 6-14 years are attending schools in rural areas. A matter of concern is that out of these 6.3 lakh rural schools only 44 per cent have water supply facilities. The survey also points out that half of all Indian children are undernourished and half of all adult women suffer from anaemia. At the time of the survey, 30 per cent of all children under the age of three had fever, another 20 per cent had diarrhoea, and another 20 per cent had symptoms of acute respiratory infection[13]. These figures portray a grim picture with almost half of our country's children suffering some form of ailment. The Government of India has launched school water supply, sanitation and hygiene education programme (SSHE) through the Ministry of Rural Development under the Accelerated Rural Water Supply and Swajaldhara Programmes and the Sarva Shiksha Abhiyaan of the Ministry of Human Resource Development which has provisions for setting up schools with facilities for effective water supply and sanitation. By focussing on children today and providing them with knowledge with regard to maintaining water quality and effective sanitation practices we will be securing the upcoming generation from the threats of water and sanitation related diseases. This will not only provide a hygienic environment in schools, the children will also convey the message back home.

8. ***Role of environment sanitation and hygiene:*** A direct relationship exists between water, sanitation, health, nutrition and human well being. Consumption of contaminated drinking water, improper disposal of human excreta, lack of personal and food hygiene and improper disposal of solid and liquid waste have been the major causes of diseases in our country. There has been a key focus in various government programmes like the Total Sanitation Campaign to spread the message of maintaining personal hygiene for reducing water pollution. Better linkages between ministries of health and rural development for developing programmes to solve problems of drinking water and health will be useful.

Role of Civil Society and Communities

9. ***Awareness:*** The user should be made aware of the importance of preventing contamination of water and also of the importance of clean and healthy surroundings near water sources. Effective IEC campaigns by civil society will play an important role in spreading awareness. One has to keep in mind that such campaigns should be based on the local needs and problems and use tools that are easily understandable by the people.

10. ***Accountability:*** Users should also realise their individual responsibility in maintaining the quality of water supplied to them. Cultural and behavioural practices like open defecation, bathing of cattle results in contamination of water sources. The responsibility of maintaining the safety of water provided also rests with the users. Factors like contamination at source and storage in clean vessels lies with the users.

11. ***Community Based Water Quality Monitoring:*** Many water quality problems are caused due to communities being unaware of the different aspects of managing and maintaining the quality

of water resources. Raising their awareness of appropriate practices will help them realise the grim realities of depleting water sources and at the same time help in engaging them in monitoring and maintenance. There have been initiatives for community driven water monitoring programmes, such as the Community-managed Water Quality Surveillance Programme in Alappuzha district of Kerala by the Socio-Economic Unit Foundation, where the responsibility of management and operation of the water quality surveillance system has been entrusted to women's groups, called Water Quality Surveillance Groups (WQSG), as a self-employment programme.

Capacity-building in Community Based Organisations on Water Quality Assessment

WaterAid India in partnership with Peoples Science Institute (PSI) undertook a programme to train 50 NGOs on water quality monitoring in Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand, Orissa, Andhra Pradesh, Karnataka and Tamil Nadu. The objective was to build the skills of NGOs in water quality assessment. The procedure involved –

- Initial training of NGOs on water quality monitoring using field testing kits,
- Generation of data and
- Further analysis and validation of data

Once the data was generated, training was imparted on treatment options that can be carried out at the local level. The data generated by NGOs were further validated by PSI and in most cases were found to be accurate, which authenticated the claim that once trained, community based organisations (CBO's) can monitor water quality.

This whole exercise of collection and analysis of data from across 300 villages spanning eight states is an example of large scale capacity building of CBO's to engage in the field on water quality surveillance.

Community Based Maintenance of Water Sources

Ramakrishna Mission Lokasiksha Parishad (RKMLP) is one of the biggest units of the Ramakrishna Mission Ashram, Narendrapur. It has done remarkable work in the field of maintaining water sources and has successfully demonstrated community based maintenance of 800 handpumps in Medinipur.

To carry out this process, a seven-member 'water committee' with four female and three male members from the beneficiary families were formed for each hand pump. These members were trained in operation and maintenance by the RKMLP. A maintenance chest fund was developed for individual pumps, with each family contributing one rupee per month.

The money is collected once or twice a year depending on the paying capacity of the family. An innovative strategy developed is to collect the money during religious ceremonies after the harvest season as people have money during this time of the year. In this way, the water committee was able to collect Rs. 300-500 from the beneficiary families. The members of the committee also organised awareness generation activities relating to safe collection, storage and handling of drinking water simultaneously promoting sanitation and personal hygiene practices.

The involvement of women is being seen as a step towards women empowerment. The women also feel that they have earned respect in the society and recognition for work in the villages. Young girls are now getting involved into the management of hand pumps with their mothers. This is a great step in the direction of ensuring sustainability of the system

Seeing the success of this venture, the Medinipur Zilla Parishad introduced this strategy and mechanism in about 22,000 hand pumps installed by the Zilla Parishad from 1996.**

Water quality monitoring is being done in laboratories by people selected from the communities. Training is imparted to selected persons. At present, 54 water monitoring labs are being run by RKMLSP and 135,000 tests have been performed for the entire state. These test monitor water quality at the block level, with each lab catering to three to four blocks. Field motivators, selected from the villages, are responsible for collection of samples from the sources and bringing them to the laboratories. The samples are tested for chemical and bacterial contamination. The monitoring is done twice a year for all the water samples but there are plans to increase the frequency to three times a year.

Similar to the management of water sources by water committees, a federation for water quality monitoring has been set up in five gram panchayats in east and west Medinipur districts.

The results of the monitoring are submitted to the panchayat and remedial actions are sought by the residents.

**Source: http://ddws.nic.in/nandigram_report_final.pdf*

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12. ***Maintenance:*** The lack of maintenance of rural water supplies and infrastructure is an area of concern. This may be due to lack of funding capacity, apathy or unwillingness on the part of the communities to handle operation and maintenance. This calls for a change in the shift among the users that the onus of maintaining a water source rests with the people and the communities as they are the owners of the system and are most likely to be impacted in case of the degradation of the water supply system. This calls for joint implementation by panchayats and communities.

Sustaining safe sources

13. Looking for alternate water sources: Water Harvesting

Rain Water Harvesting and subsequent recharge of groundwater can help lower the concentration of minerals in aquifers. Setting up community-based water harvesting units will involve creating social mobilisation, awareness and confidence among all sections of the community.

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Water Harvesting in Balisana Village, Gujarat

The village of Balisana in Patan district of Gujarat was under the acute grip of fluoride pollution. Six years back, the villagers started a community drive to solve the crisis, with help from a Ahmedabad-based non governmental organisation, UTTHAN. The villagers started to de-silt a 3.05

metre long canal through which they diverted rainwater to a 300-year-old tank. About 82,000 cubic metre of silt was extracted from the tank at a cost of Rs.52 lakh.

Sixty per cent of the cost came from the government, 40 per cent was community shramdaan. A 12 kilo meter long bund was reconstructed to hold the diverted rainwater. Adjacent to the tank, was a 45 m deep recharge well that was fitted with an ultra-poly vinyl chloride (high density pipe). The horizontal pipe carries water from the tank to the recharge well. Water from the well is pumped into a storage tank near the well. A 12 year old dead well nearby has got water now that is also free from fluoride. This water is increasingly used by villagers for drinking purposes.

The villagers have evolved laws to protect the resource like, no new tube wells will be dug and water from the well will be first used for drinking purposes and then can be used for irrigation.

Source: http://www.rainwaterharvesting.org/Rural/Balisana1.htm

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14. Dual water supply and waste water treatment

To reduce the burden on fresh water sources, the option of dual water system is being worked out in several parts of the country. The success of this system lies in the fact that filtered purified water is used only for drinking purposes while other source of water may be used for purposes other than drinking. This is also is cost saving measure as resources spent on providing clean water is saved by using alternate sources. Waste water treatment can also be another effective means of reducing the burden on freshwater sources. The treated waste water can be used for purposes other than drinking. One example of effective wastewater treatment is in Mehsana district of Gujarat where wastewater from homes in villages is used for agriculture. The wastewater coming out of homes is collected in a pond which is then auctioned to farmers for use in agriculture. The subsequent boxes depict the use of dual water supply in Gujarat and Madhya Pradesh.

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The power of two

Magod Dungri village in Valsad district in Gujarat has a population of 4,264. An old well served as a water source, but the water was saline and not potable. In 2006, this village was brought under the Bigri Malwan group water supply scheme of the GWSSB and it started receiving safe drinking water. But in-village distribution of water continued to pose a problem.

Under the Swajaldhara programme, the village community decided to develop a system of household connections. The entire community made a 10 per cent contribution towards capital costs and the responsibility of collecting the contribution was taken up by one individual in each habitation. In the process, a 5,000 litre water tank in the village school, electricity connections, a 2,208 metre distribution pipeline, a 318 metre gravity pipeline and 15 stand posts were made. Out of a total expenditure of Rs.5, 20,000, the community contributed Rs.80,000.

The foremost priority of the village was to get regular and safe water to meet their drinking water requirements. As far as water for other purposes was concerned, this need could easily be met from the village well. For drinking water, the villagers make use of the treated water supplied through the regional water supply scheme. This is accessed from the 15 stand posts constructed in the 15 habitations in the village. Drinking water is received for about 30-45 minutes every day.

Thus by making use of dual sources of water, the community has ensured that treated water is not wasted and is used only for drinking purposes.

The villagers regularly pay water tariff fixed by the Pani Samiti. The Pani Samiti regularly pays Rs 14 per person as water tariff to the water supply department and if need be the villagers are ready to contribute more. The villagers also contribute Rs.16 per person towards electricity and maintenance charges.

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Group water supply in Jhabua district M.P

In 34 villages of Jhabua distt. of M.P. where the contamination of fluoride in groundwater is more than 1.5 ppm, a scheme of group water supply has been developed. The PHED department is involved in the construction of tanks, laying of pipes to provide freshwater to the villages. The approach devised in these villages involves the mixing of groundwater rich in fluoride with the freshwater sources. This results in lowering the concentration of fluoride in the groundwater and also helps in saving the pipe water. Local NGO, Vasudha have been responsible for raising awareness amongst the residents of the area by stressing on judicious use of water, dietary measures for reducing the ill-effects of fluoride and operation and maintenance of piped water schemes.

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15. Exploring simple, low-cost treatment technologies

Once contamination is detected in a water source, there is need for treatment. In case of rural areas, modern water purification technologies might not be viable. In villages, it is important that simple technologies that are easy to use and can be operated without much technical know-how be promoted. The price factor is also important as technologies with high operational and recurring costs might not be useful. In India, one cannot neglect the use of traditional methods of water purification. The use of traditional methods, however, should not be publicised unless its effectiveness have been proved through appropriate research.

Water purification can be carried out at the household level and at the community level. When one is talking about community based water purification systems, issues of ownership and equitable distribution becomes important. Social factors can play a role in determining access to water. In case of community based water purification systems, there should be a mechanism of contribution by the community and they can be made responsible for maintenance to ensure sustainability.

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Traditional Methods of Water Purification

- *Strychancs potatroum* (Kataka seeds) are natural coagulants used for the purification of muddy water.
- *Morenga olifers* (drumstick) seeds are used as a coagulant. They also inhibit the growth of bacteria and fungi.
- *Vetiveria zizanoides* (khas) are laid in a clay jar which has a few tiny holes in its bottom. Water filtered through this layer of roots is not only clear but also has a pleasant smell.

- Dusting of water with plant ashes, earth from termite hills, paddy husks or crushed seed coats from elaichi (*Elettaria cardamum*) improves clarity of water.
- *Osimum sanctum (*Tulsi) is a water purifier with antibacterial an insecticidal properties.
- Water stored in Copper or brass pots do not breed bacteria

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The selection of an appropriate technology is governed by acceptance by users. Use of modern technologies such as reverse osmosis and ozonation are effective in the treatment of water but their feasibility in a rural setting needs to be worked out in terms of capital expenditure and manpower in operating and maintaining such systems. There is also a need for proper field testing before any product is launched with proper certification and validation by prescribed authorities.

Table – Treatment Methods

Parameter	Treatment Methods
Turbidity	✓ Cloth Filtration ✓ Slow Sand Filtration ✓ Coagulation ✓ Candle Filtration
Odour	✓ Aeration ✓ Carbon Filtering using charcoal ✓ Boiling
Colour	✓ Carbon Filtering using charcoal ✓ Slow Sand Filtration
Bacterial Impurities	✓ Boiling ✓ Chlorination ✓ Ultra Violet Radiation - SODIS ✓ Slow Sand Filtration
Fluoride	✓ Activated Alumina Technology ✓ Nalgonda Technique
Ammonia	✓ Chlorination ✓ Boiling
Iron	✓ Oxidation and settling
Hardness	✓ Boiling and Settling/ Filtration ✓ Reverse Osmosis

Chloride	✓ Reverse Osmosis
Arsenic	✓ Ion-exchange ✓ Alum-Iron Coagulation

16. Revival of traditional water conservation structures

Traditional water conservation structures like tanks, lakes, ponds have been in use in India since ages. These served as sources of water for people by capturing rainfall and surface runoff. However in the past few decades one has seen many of these structures becoming dysfunctional. The usefulness of these structures still holds good and there has been initiatives across the country for revival of such systems. These structures are a good source of water and have proved useful in dry arid regions of the country.

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Reviving Ooranis in Tamil Nadu

Villagers in Ramanathapuram district of Tamil Nadu have worked on reviving traditional ponds or "ooranis" to deliver water to villages. These ponds collect surface runoff and sub-surface freshwater at places. To rejuvenate "ooranis", Vivekananda Kendra, an NGO in Kanyakumari began close interaction with local communities. The villagers participated in desiltation exercise and the storage capacities were increased by widening the riverbeds. Recharge tubewells were provided to augment the water supply. People were trained on maintaining the ponds and this successful initiative have resulted in providing water to the people of the area.

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17. Community enterprise for water

Communities, civil society, technology provider can form enterprise for delivery of water services. Each of the stakeholders plays an important role in the operation and maintenance of water purification system and delivery. The example of Reverse Osmosis water enterprise system in Gujarat is an initiative where WASMO in collaboration with a technology provider has set up community managed reverse osmosis system in 71 villages across the state to address the problem of salinity. The communities contributed 10% of the capital cost and the rest was provided by the government. The technology provider assists in training of village youth ffor running the plant RO plant. People are getting water at a price of 5 paisa per lit per person. This example is now being replicated in other parts of the state. This type of an initiative not only solves the problem of providing safe drinking water but is also a source of employment for the village youth.

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Water enterprise for providing safe water

Byrraju Foundation has set up community based water purification system in villages across Andhra Pradesh. The model is a community-based plant supported jointly by Gram Panchayat, Community (Gram Vikas Samithi) and Byrraju Foundation and the technology provider, and is an example of Panchayat-Public-Private Partnership (4P) model.

The role of the panchayat was to provide land, get permission for raw water and get an electric connection. The gram vikas samiti contributed in form of labour towards construction, supported partially for the water purifying equipment and participation in operation of plant and distribution

of water. The technology is provided by TATA and involves membrane filtration and UV radiation while Byrraju foundation contributed to the cost of the equipment and is involved in quality testing and control.

The people are reaping benefits of this plant. They pay Rs.1.5/- per day for 12 litres of water which is made available in containers provided by the foundation. Members from the local village are employed in the plants for operation and maintaining the plant. There is a system of card for each family where record of water cans taken and money deposited is maintained. Regular monitoring of the water for bacterial contamination and TDS is done by the staff of the plant. The money collected from the sale of water is deposited in the bank and is used for maintaining the plant. There has been significant improvement in water related disorders in the villages with the setting up of these plants. Health records have shown a drop of 30% in incidences of diarrhoea after the setting up of the plant.

Conclusions

In India, investments in community water supply and sanitation projects have increased steadily from the 1st plan to the 10th plan. However, the health benefits in terms of reduction in water-borne disease have not been commensurate with the investments made.

Though health sector is bearing the burden of water and sanitation related infectious diseases, presently it does not have adequate institution or expertise for monitoring and surveillance of community water supply programmes in the country.

India has witnessed significant improvement in rural water supply with increasing coverage of areas and a large volume of financial resources made available. A series of schemes are aimed at improving the supply of drinking water for rural habitations and now for monitoring and ensuring quality. The past few years have seen greater emphasis on water quality monitoring and surveillance with specific allocation being made under Central grants. There has been great focus on setting up and upgrading laboratories at the state and district levels, and on water monitoring through field testing kits.

However, awareness, surveillance, monitoring and testing, mitigation measures, availability of alternate water sources and adoption of hygienic practises continues to remain roadblocks. There is a need to promote sanitary inspection along with the community based water quality monitoring and surveillance at the grass root level as a mechanism to identify problems and to take corrective measures.

One of the greatest challenges has been the convergence of various departments associated with water: water and sanitation programmes have operated largely in isolation from programmes in health and education. A wider approach is needed where water and sanitation issues are looked at with the aim of reducing disease, improving hygiene, improving educational levels and reducing poverty.

There can be little doubt that water is a basic necessity for the survival of humans. There is interplay of various factors that govern access and utilisation of water resources and in light of the increasing demand for water it becomes important to look for holistic and people-centred approaches for water management.

Clearly, drinking water is too fundamental and serious an issue to be left to one institution alone. It needs the combined initiative and action of all, if at all we are serious in socioeconomic development. Safe drinking water can be assured, provided we set our mind to address it.

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