Water in India: Situation and Prospects

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This report was carried out by UN agencies working in India and involved on water issues. This included active participation from WHO, UN-Habitat, UNESCO and UNRC office. The work was funded by FAO and UNICEF and was managed by Aidan Cronin (UNICEF Water, Sanitation and Hygiene Section, India Country Office) and Satya Priya (FAO, National Programme Coordinator - Land and Water).

This publication was carried out in partnership with the South Asia Consortium for Interdisciplinary Water Resources Studies, SaciWATERs, a policy research institute that works on transforming water resources knowledge systems from an interdisciplinary approach. It looks at water resources from a pro-poor, gendered and human development perspective, with emphasis on exchange, interaction and collaboration at the South Asia level.

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FOREWORD

UNITED NATIONS **UNITED NATIONS**

United Nations Resident Coordinator
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The aim of this report is to present information on the water sector in an integrated, holistic manner. The report compiles data on the full range of water issues from water hydrogeology to resource use, water quality, health impact, agricultural productivity, livelihoods, governance and gender. In producing this report, the UN in India hopes to contribute to efforts by the Government of India and partners to manage water resources more effectively during implementation of the Twelfth Five Year Plan.

Improved management of water resources will have a major impact on India's social and productive progress. Nowhere is this more important than in the area of child health. Studies show that forty-five percent of India's children are stunted and 600,000 children under five die each year, largely because of inadequate water supply and poor sanitation. Improving water supply, for example by reducing, and eventually eradication open defecation, would contribute majorly to reducing child morbidity and mortality and improving nutrition.

Better management of water resources will also help to ensure sustainable food security. The UN's Food and Agriculture Organization estimates that total water demand will equal water availability by 2025. With industries and cities needing more and more water, steps need to be taken now to boost productivity of both irrigated and rein-fed agriculture.

This publication, which was prepared by FAO, UNICEF and SaciWATERs, is timed to contribute to the implementation of the Government of India's Twelfth Five Year Plan. By highlighting critical challenges and priorities and offering recommendations for policy makers and planners, the UN hopes to contribute to a sustainable water sector for all.

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The crisis of access to adequate and safe water for drinking, agriculture and livelihood activity for the poor has gained currency in recent years. This is more so after the debate around MDGs that tracks development of countries on various developmental index including access to water. Sanitation too has long been seen as key gap in the Sector in India. This report worked towards building a comprehensive and consolidated interdisciplinary understanding on the status of different aspects of water in India with the latest available information. The report aims at achieving a holistic and dynamic understanding of the current situation in India and looks at the strategic steps required for the appropriate actions. It aspires at creating an environment where water is available for all in a sustainable manner: safe drinking water for basic needs, sufficient water for agriculture, water for industry etc. Thus it encompasses both a picture of the state of water resources, potential problems and progress towards identified goals, and workable solutions.

This report was commissioned by the United Nations (UN) agencies working in India and involved in water issues. This included United Nations Children's Fund (UNICEF), Food and Agriculture Organisation (FAO), World Health Organization (WHO), UN-Habitat, United Nations Educational, Scientific and Cultural Organization (UNESCO) and United Nations Resident Coordinator (UNRC) office. The work was funded by FAO and UNICEF.

Five consultations were held in 2011 with representations from Northern, Eastern, Western, Southern and North-Eastern states of India. The participants of these consultations included government representatives, experts, civil society members and grass roots NGOs. We sincerely thank the participants of the consultation workshops for their active engagement and suggestions to improve the content of the report. The process of consultations included partnership with local institutions where the workshops were held. We would like to thank Indian Institute of Technology, Guwahati (IITG), Centre for Environmental Planning (CEPT), Ahmedabad, Xaviour Institute of Management, Bhubaneswar (XIMB), which hosted the consultation workshops. In particular, Dr. Anamika Barua, IITG, Dr. Shrawan Kumar Acharya, CEPT and Dr. S Peppin, XIMB deserves special mention. Each of these workshops had two keynote addresses to represent government and non-government\academic\activists perspective. We would like to thank Mr. Vinay Kumar, IFS, State Commissioner, Irrigation and Command Area Development Programme, Govt. of Andhra Pradesh, Dr. Jasveen Jairath, Save Our Urban Lakes (SOUL) Hyderabad, Mr. H. K Borah, Secretary Public Health and Engineering Department (PHED), Guwahati, Professor Chandan Mahanta, Associate Professor, Department of Civil Engineering, IITG, Mr. Sujoy Majumdar, Director (Water) Ministry of Drinking Water and Sanitation (MDWS), Dr. Sara Ahmed, Senior Programme Specialist, International Development Research Centre (IDRC), Mr. Surendra Nath Tripathi, Principle Secretary, Department of Rural Development, Orissa, Dr. Smita Mishra Panda, Human Development Foundation, Bhubaneswar, Orissa, Mr. H. K Dash, Principle Secretary, Department of Water Supply, Govt. of Gujarat and Prof. Amita Shah, Director, Gujarat Institute of Development Research for giving key note addresses and setting the stage for the consultation workshops.

The final draft report went through several presentations, consultations and reviews. The first draft of this report was reviewed by Prof. Chandan Mahanta of IITG and Dr. Jasveen Jairath, SOUL, Hyderabad. The members of UN Water Cluster who periodically reviewed the draft reports, deserve special mention. In particular, Ms. Sunetra Lala and Mr. Nitya Jacob (Solutions Exchange Water Community), Dr. Kulwant Singh (UN-Habitat), Dr. Srinivasan Iyer (UNDP), Dr. Bhanu R Neupane (UNESCO), Mr. Himanshu Pradhan, Dr. A Gunasekar (WHO) and members of the UNICEF India WASH team who have given their comments on different drafts of this report.

The final draft was reviewed by eminent Indian scholars working on water issues. Our sincere gratitude to Prof. Amita Shah of Gujarat Institute of Development Research (GIDR), Ahmedabad, Ms. Seema Kulkarni of Society for Promotion of Participative Ecosystem Management (SOPPECOM), Pune, Dr. Himanshu Kulkarni of Advance Centre for Water Resources Development and Management (ACWADAM), Pune, Mr. Vijay Shankar of Samaj Pragati Sahyog, Dewas, Madhya Pradesh and Dr. Ravi Narayan, Advisor Arghyam, Bangalore for minutely scanning the document and providing comments that have improved the draft considerably. Sunaina Rachel Dalaya painstakingly copy-edited this report. Comments received from Ministry of Drinking Water and Sanitation and Central Water Commission are graciously acknowledged.

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This report was commissioned to South Asia Consortium for Interdisciplinary Water Resources Studies, SaciWATERs, a policy research Institute working on the issues of integrated water resources management in South Asia. We would like to very sincerely thank Dr. Anjal Prakash and the SaciWATERs team for taking up this important assignment and working tirelessly on many drafts. Dr. Chanda Gurung Goodrich, Dr. Jayati Chourey, and Ms. Medhavi Sharma who worked with SaciWATERs during the time of commissioning this report need special mention for writing specific chapters and coordinating part of the workshops, writing initial drafts and case studies. A chapter of this report on Urban Water and Sanitation was written by experts associated with Health of the Urban Poor program funded by USAID. Anand Rudra, USAID, India, Sainath Banerjee, Shipra Saxena, Biraja Kabi Satapathy, Johnson R Jeyaseelan of HUB -PFI, Meeta Jaruhar, Merajuddin Ahmad, Anil Kumar Gupta of HUP – Plan and Himani Tiwari of HUP-IIHMR's contribution is profoundly acknowledged.

This is certainly not a perfect product; it has also been a difficult process to narrow down and not include other important issues pertaining to the Sector. We thank you for your understanding in this respect and we sincerely hope that this report will generate fresh debate and discussion to strengthen the water discourse in India.

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ABBREVIATIONS

ABD	Asian Development Bank
APWRDC	Andhra Pradesh Water Resources Development Corporation
ARWSP	Accelerated Rural Water Supply Programme
BCM	Billion Cubic Meters
BIS	Bureau of Indian Standards
BOD	Biochemical oxygen demand
CIFRI	Central Inland Fisheries Research Institute
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
CRED	Centre for Research on the Epidemiology of Disasters
CSE	Centre for Science and Environment
CWC	Central Water Commission
DDP	Desert Development Programme
DDWS/MDWS	Ministry of Drinking Water and Sanitation
DPAP	Drought Prone Area Programme
ELRS	Environmental Law Research Society
FAO	Food and Agriculture Organisation
GOI	Government of India
GRACE	Gravity Recovery and Climate Experiment
Ha	Hectare
ICID	International Commission on Irrigation and Drainage
INCCA	Indian Network for Climate Change Assessment
INCID	Indian National Committee of Irrigation and Drainage
IRAs	Independent Regulatory Authorities
IRAP	Institute of Resource Analysis and Policy
ISWP	Integrated State Water Plan
IWDP	Integrated Wasteland Development Programme
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
MGI	McKinsey Global India
Mha	Million Hectares
MoAC	Ministry of Agriculture and Cooperation
MoEF	Ministry of Environment and Forests
MoWR	Ministry of Water Resources
MoUD	Ministry of Urban Development
MTA	Mid Term Appraisal
MUS	Multiple Water Use
MWRRA	Maharashtra Water Resources Regulatory Authority
NAPCC	National Action Plan on Climate Change
NATCOM	India's National Communication to UNFCCC

NCIWRD	National Commission on Integrated Water Resources Development
NDMD	National Disaster Management Division
NFHS	National Family Health Survey
NRAA	National Rainfed Area Authority
NRDWP	National Rural Drinking Water Programme
NSS	National Sample Survey
NUEPA	National University of Educational Planning and Administration
NUSP	National Urban Sanitation Policy
NWDA	National Water Development Agency
NWM	National Water Mission
NWP	National Water Policy
NWRWS	Narmada, Water Resources ,Water Supply and Kalpsar Department
PIM	Participatory Irrigation Management
PIB	Public Information Bureau
PFI	Population Foundation of India
PHED	Public Health Engineering Department
PIM	Participatory Irrigation Management
PPM	Parts Per Million
PPP	Public Private Partnership
PRI	Panchayati Raj Institutions
RWLI	Rural Water Livelihood Index
SGRY	Sampoorna Grameen Rozgar Yojana
SoE	State of Environment
TSC	Total Sanitation Campaign
ULBs	Urban Local Bodies
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children Fund
UNWWDR	United Nations World Water Development Report
UTs	Union Territories
UPWMRC	Uttar Pradesh Water Management and Regulatory Commission
WASH	Water, Sanitation and Hygiene
WATSAN	Water and Sanitation
WB	World Bank
WES	Water Entitlement System
WHO	World Health Organisation
WRI	World Resources Institute
WSP	Water and Sanitation Programme
WUAs	Water Users Associations
WWP	Women Water Professionals

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EXECUTIVE SUMMARY

Introduction

Since independence, India has made significant progress in developing its water resources and supporting infrastructure. Post-independence years have witnessed large-scale investments in water storage structures which have contributed considerably in making India a self-sustaining economy. Today, India has the capacity to store about 200 BCM of water, an irrigated area of about 90 Mha, and an installed hydropower capacity of about 30,000 MW (World Bank, 2005). However, due to rapid development, increasing population and iniquitous distribution of water, the demand for this natural resource far outweighs its supply. In addition and for a while now, the water sector in India has faced significant and problematic issues related to management. In spite of a sizeable water resource base and vast land resource, India continues to struggle to meet its water sector infrastructure requirements, including operation and maintenance costs. India has about 16 per cent of the world's population as compared to only 4 per cent of its water resources. With the present population of more than 1,000 million, the per capita water availability is around 1,170 cu m/person/year (NIH, 2010).

Some of the crucial issues faced by the water sector in India include (a) erratic distribution of rainfall, often leading to floods and droughts in various areas; (b) water use inefficiency; (c) unregulated groundwater extraction; (d) water pollution; and (e) decreasing water quality due to poor waste management laws, inter-state river disputes, growing financial crunch for development of resources and scarce safe drinking water. Inadequate institutional reforms and ineffective implementation of existing provisions also affect the performance level for water service delivery. Severe water shortages have led to a growing number of conflicts between users in the agricultural and industrial sectors, as also the domestic sector. The situation is exacerbated due to the effects of climate change. Future predictions include worsening of the situation due to a disturbed hydrological cycle and regional climatic variability. The lack of water availability and poor management practices have also manifested in poor sanitation facilities, one among the biggest environmental and social challenges India faces today. A recent study conducted by the Water and Sanitation Programme (WSP), a global partnership administered by the World Bank, estimates that inadequate sanitation causes India 'considerable economic losses', equivalent to 6.4 per cent of India's gross domestic product (GDP) in 2006 (US$53.8 billion) (WSP, 2010).

Large-scale dams are now being used to transform hydropower and irrigation, and yet water storage infrastructure in India remains one of the lowest in the world. The governance structure around water has also undergone considerable change with a view to be more participative rather than techno-centric, the latter approach being more of a hindrance to the development of the Indian water sector. Apart from the dismal record of managing water, newer challenges such as climate change are going to transform the water management scenario rapidly. A case of the Lower Bhavani Project (LBP) in the southern state of Tamil Nadu, India, with a command area of 84,000 ha, is a clear example, where the most significant uncertainty factor is rainfall variability. This has led to water scarcity and a highly unpredictable situation for the farmers to endure and adapt to seasonal fluctuations in water availability without canal supply (UNWWDR4), 2012. It is estimated that the impact of climate change is significantly larger for the water sector and therefore newer strategies have to be evolved to achieve a sustainable trajectory of growth and development with respect to water management in the country. The management of water resources, accompanied by upgrading the existing water infrastructure, is therefore among the key challenges. Given the multiple issues that the water resource sector faces, it is necessary to re-think the approach to planning and implementation of the water projects. Since water is used for multiple purposes, involving potential users from the start of a project should be made essential. This would not only help resolve the conflicting demands, but also help maintain transparency. It is therefore necessary to have a comprehensive assessment of India's water sector, from an inter-disciplinary perspective.

The Millennium Development Goals (MDGs), through its eight international development goals, greatly emphasise the need for sustainable access to safe drinking water and sanitation. Issues of poverty, education, health and disease are all directly or indirectly related to water and therefore response options need to be formulated so that these goals are achieved effectively. Cases of better demand management, ensuring balance among competing water demands, addressing water rights issues, fair and effective water governance, water-based partnerships, promoting sustainable use, water harvesting and management, all of these need to be addressed and incorporated in the form of recommendations towards better water management.

In recent decades, much interest has been generated in India's water management and policy matters. The country's comprehensive National Water Policy (NWP), was formulated in 1987, and was revised in 2002. In 2012, a draft NWP has been put up for debate. Critiques point out that the most striking feature of 2012 NWP is the absence of a commitment towards Right to Water. Instead, the overall direction of the policy is to reduce the involvement of the State and leave out space for market to operate. Further, it does not recognize growing inequity in available water as the main driving force of the current water crisis, not the absolute water scarcity per se.[1]

Water is an immensely political issue due to the nature of the resource. This resource interacts with a highly inequitable society marked with class, caste and gender differentiation. Techno-managerial reforms in the water sector have been unable to tackle the fundamental issues of inequity in water supply.[2] In this light, the right to water issue becomes important. India is now a signatory to the 2010 United Nations (UN) declaration of water as a right. Rights promote the idea of equal opportunities for all. Rights could also be a useful strategic instrument, especially in negotiations with governments and donors (Sangameswaran, 2010). Therefore, a rights-based approach to water means that communities have the opportunity to participate in decision making on water-related projects and plans, and have access to information concerning water, such as safe hygiene practices and water quality data. Ensuring right to water means that the obligation to guarantee that everyone has access to safe clean water rests with governments. While lack of both financial and technical resources is in some cases an important barrier to a government's ability to ensure access to water for the entire population, it is crucial to understand that in most instances other factors also come into play. Lack of access to safe drinking water and sanitation can be related to economic, political and social power imbalances; discrimination against certain groups or communities; a government's failure to prioritise water for the poor; lack of political will; the exclusion of communities in water and sanitation decision making; and inadequate legal and policy frameworks relating to water access and use (FAN, 2010).

The Present Report

This report attempts to provide a comprehensive analysis of the state of water resource development and management in India, based on secondary information. It maps the current challenges and suggests feasible alternatives amidst increasing water scarcity and disenfranchisement of resource bases for the poor and the marginalised. The issues consolidated using secondary data are backed by consultations with major stakeholders. Thus, this report aims at achieving a holistic and dynamic understanding of the level of development around water and looks at the strategic steps required for action. In addition, major discourses on the subject are also presented. The focus is to evolve an environment where water is available for all in a sustainable manner—safe drinking water for basic needs, adequate water for agriculture, water for industry and for the ecosystem. Thus, it encompasses both a depiction of the state of freshwater resources and potential problems and progress towards identified goals, including workable solutions.

Methodology and Structure of the Report

This report is developed at three levels. Level one focuses on the status of water resources, including water availability, demand, water quality, and issues such as access to water and sanitation collected through secondary sources followed by the analysis. Secondary data was collected through available information, government records and census reports (Chapters 1 to 6). The second level includes documentation of successful water management cases which point towards sustainable management and efficient utilisation of the resource (Chapter 7). The third level is based on consultations at the regional level on issues arising out of the secondary data analysis (Chapters 8 and 9). In total, five consultation workshops were organised in the north, south, east, west, and north-east. The consultation workshops were attended by experts, government representatives, civil society members, and grass-roots non-governmental organisations (NGOs) who discussed and deliberated various solutions and alternatives.

The report is in three sections. Section A maps the status of water resources in the country in terms of

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[1] Excerpts of consultations at UN Solution Exchange Network - Water Community of practice - Query and feedback on Draft National Water Policy 2012.

[2] Prakash and Sama (2006) document one such experience from Gujarat where water access is intertwined with caste and gender relationships. The authors observed 'that power structure and social and economic hierarchy go hand in hand and unless the issue of resource inequity is tackled through policy and advocacy means, the real issue will not be solved'.

quality and quantity of available water and evaluates the major trends and shifts. It also looks into the issue of climate variability and its impact, present and future, on the limited water resources at our disposal. Section B analyses the water needs and demands and attempts an understanding of the changes required. Further, it looks into the multipurpose nature of water with a focus on problem areas and suggests means to incorporate the issues into the policy debates. In addition, it explores the pressures and drivers of change. Section C focuses on stakeholders' responses to the question: What can be done to reach the goal of water for all? It subsequently provides a framework for workable solutions and provides a way forward with specific recommendations for ensuring water for all.

Key Messages from this Report

1. New indices are needed to measure available water resources: The calculations of per capita water availability do not include disparity in water allocation and access. This disparity is identified as a major determining factor for water access and use. The per capita water availability does not take into account the temporal and spatial variability in a vast country like India that has varied socio-ecology.[3] These data are the starting points of policy initiatives in the country and therefore any ambiguity in identifying the magnitude of the problem will only hamper workable solutions to it. The validity of the per capita water availability index needs to be rethought in the light of social and economic disparities in water usage that exist in India. On the same grounds, putting forward the argument that increase in population leads to water scarcity needs rigorous debate. A farmer's need of water for basic livelihood support often gets mingled with wasteful water uses of high-end consumers. Therefore, as a point of departure from this orthodox concept, some new indices should be developed and used which are able to capture the underlying differences in water access.

2. Water demand is far exceeding supply and leading to inter-sectoral conflicts: Myopic approaches in attaining food security are risking agricultural sustainability by encouraging increased use of water. The water demand from agriculture is set to increase tremendously and will have to be met to ensure food security in a high consumption scenario. The concept of inter-state virtual water transfer also needs emphasis. The states with lower availability of water resources end up being the net exporters of virtual water to the water surplus states. With the current rate of industrial expansion in the country, the water demand from this sector will also escalate in future. Present experiences also suggest increasing inter-sectoral conflicts in the country. It is imperative to initiate efforts for designing an appropriate industrial water use policy which could provide a framework for sustainable water use by this sector. Multiple uses of water and the traditional water allocation priorities and quantities also need to be revisited. The concept of scarcity and surpluses of water must look beyond State Boundaries, as with a more disaggregated assessment, these comparisons will surely change.

3. The time bomb of increasing water pollution is ticking: Water quality issues in India have reached an alarming proportion. Augmenting water supply to achieve the MDG targets will not suffice until its quality is ensured. There is no model in India that shows best ways to tackle the waste water generated through the industrial and domestic sectors. The economic implications of poor sanitation in urban India and its impact on water quality are profound. The agencies responsible for checking industrial pollution have failed. Pollution has reached an alarming level and contributes to water scarcity by polluting freshwater resources. This situation needs to be addressed soon.

4. To achieve any headway in gender-sensitive policies, data disaggregation is urgently required: An analysis of the water sector is incomplete without an understanding of the inter-relations between gender and water. In India, gender intersects with class and caste and produces layered social hierarchies that impinge on one's access to, and control over, a precious resource, water. Gender and water issues remain at the level of rhetoric for the want of a broad based and shared understanding, without any support from the ground data on changing gender and social relations. The issue of gender disaggregated data needs to be taken up as priority by the state for any progress to be made in mainstreaming gender in water resources management. Apart from the mainstreaming gender in water-related projects, another major issue is about how to tackle gender mainstreaming at the organisational level. The bureaucratic set-up that manages water also suffers from serious inadequacies with respect to gender mainstreaming. Without addressing these issues, well-meaning gender inclusion efforts will not lead to logical and intended outcomes. These will have to be addressed at the earliest.

5. Reorientation and capacity building required for technocrats for a new vision for water

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[3] This report doesn't suggest a particular index but encourages academicions and policy makers to think beyond current indices used. For example, an index developed by Lawrence et al (2002) called the International Water Poverty Index, This index is created in an interdisciplinary measure which links household welfare with water availability and indicates the degree to which water scarcity impacts on human populations. Such an index makes it possible to rank countries and communities within countries taking into account both physical and socio-economic factors associated with water scarcity.

management: Educating technocrats working in various water - and environment-related departments with integration skills is the need of the hour. Present day engineers with their backgrounds in engineering education are incapable of resolving certain issues, for example, of everyday water supply. Once hired, these engineers have limited access to resources to refresh their existing knowledge and/or to acquire new knowledge for water management. In addition to the issue of the changing paradigm for water education in India, there appears to be lack of coordinated and concerted effort in training in-service engineers on the new vision of water management. Most of the engineers have received training from government-funded institutes that lack participatory methodology in imparting key messages and encouraging participants to understand the need for training and capacity building. India's water sector, dominated by engineers, has to see this change. Senior officials have often enunciated the need for more 'community involvement' but this has not translated into action on the ground for various reasons. A new set of capacity-building programmes and envisioning is required for technocrats to deal with present day water problems. An evaluation of current training program can inform the key gaps in training and education and provide the lead for further action.

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CHAPTER ONE

WATER AVAILABILITY AND SCARCITY

This chapter examines water availability and scarcity in India through the latest available statistics. While firmly focusing on issues of both surface and groundwater, the chapter highlights how extreme events like floods and droughts alter situations of both water availability and water scarcity. In addition, it addresses the worsening scenario in the present context of climate change. Last but not least, it discusses a key issue: decision making in the context of a changing climate.

1.1 Water Availability

India is the second most populated country in the world with over 1.2 billion people (Census of India, 2011). Water in India is intricately intertwined with the cultural fabric of the country, and has both economic and social connotations. Several attempts have been made to estimate the country's available water resources and the total estimated water budget varies considerably. Official estimates of the Ministry of Water Resources (MoWR) have put total utilisable water at 1,123 billion cubic metres (BCM)[4] as against the current use of 634 BCM, reflecting a surplus scenario (Planning Commission, 2010). Narsimhan (2008) calculated the water budget using an evapotranspiration rate of 65 per cent as against the 40 per cent[5] used in official estimates. The utilisable water for human use thus comes out to be 654 BCM, which is very close to the current actual water use estimate of 634 BCM reflecting an alarming situation (ibid.). Table 1.1 gives the comparative picture of the water budget as per the two estimates. It is pertinent to note that there exists a considerable temporal and spatial variation within the country with respect to water availability. For instance, the Ganga-Meghna-Brahmaputra basin covers a land area of 33 per cent and accounts for 60 per cent of India's water resources, while the catchment of rivers flowing west is 3 per cent and they account for 11 per cent of the country's water resources. Therefore, 71 per cent of India's water resources are available to only 36 per cent of the area while the remaining 64 per cent has 29 per cent available (Verma and Phansalkar, 2007). Various estimates point to a widening gap between water demand and supply in the future. For example, in the base case scenario developed

Table 1.1: India's Water Budget

	Analysis based on MoWR	Analysis based on MoWR Estimates based on worldwide comparison
	(Values in BCM)	
Annual rainfall	3,840	3,840
Evapotranspiration	3,840-(1,869+432)=1539 (40%)	3,8402,500 (65%) World-wide comparison
Surface runoff	1,869 (48.7%)	Not used in estimate
Groundwater recharge	432(11.3%)	Not used in estimate
Available water	2,301 (60%)	1,340 (35%)
Utilisable water	1,123 (48.8% of 2,301)	654 (48.8% of 1,340)
Current water use	634	634
Remarks	Current use (634) well below 1,123	Current use (634) well below 654

Source: Narsimhan (2008), cited in Planning Commission (2010: 427)

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[4] This is based on the Central Water Commission's (CWC) estimation of India's water resource potential as 1,869 BCM.

[5] This rate is in agreement with worldwide figures of 60 to 90 per cent.

by 2030 by the Water Resources Group, India faces a large gap between current supply and projected demand, amounting to 50 per cent of demand or 754 BCM (Addams et al., 2009). Critiques argue that the way in which India's water budget has been calculated, is highly aggregated and gross which does not lead to much of decision making. Garg and Hassan (2007) reveals that the assessment of utilisable water resources of India are overestimated to the range of 66 to 88%. The authors estimate the utilisable water resources as 668 BMC, much less than the estimates of CWC, NCIWRD and National Water Policy of India.

The report of the working group on water database development and management for the 12th five year plan (2012-2017) by the planning commission documents the historical account of this. "In the 1950's, A.N. Khosla, who headed the then newly constituted Central Water and Power Commission (CWC), used an empirical equation relating surface run-off to rainfall and evaporation (postulated as a function of temperature) to estimate average annual water resources potential in six regions. Subsequently, the CWC sought to assess the water resources potential in major basins. Studies based on statistical analysis of flow data wherever available and rainfall–run-off relations were done for 23 basins and sub-basins between 1952 and 1966, and for some major peninsular rivers and the Ganges and Brahmaputra basins during the 70s. At that time the needed data on rainfall, terminal discharge observations, and validated rainfall–surface flow relationships were limited. In the early 90s, the conceptual framework for assessing water resources availability for several basins was refined on the basis of observed outflows at the terminal site for upstream extraction of surface water, reservoir evaporation and return flows, and taking explicit account of the contribution of groundwater recharge and interactions between surface and groundwater. For some large basins, estimates adopted by tribunals ((Narmada, Godavari, Mahanadi and Cauvery) and those based on special studies (Ganges and Brahmaputra) were used. Subsequent reviews by the National Commission for Integrated Water Resources Development (NCIWRD) and an internal group of the CWC followed the same procedures and more or less endorsed the 1993 estimates of the country's water potential.

In any event, the estimates of overall water resources potential for the country made at different times have remained more or less the same. The CWC is currently engaged in a joint project with National Remote Sensing Centre (NRSC) to develop and test a water balance approach using remote sensing data for assessing overall water potential in two basins. It is also important to undertake rigorous analysis of rainfall–run-off relations in different regions using up-to-date data, ensuring that estimates of upstream extractions are based on reliable measurements, conducting systematic surveys to determine the magnitude of groundwater actually pumped, consumption for various non-agricultural uses, and other components of the balance equation. Estimates of overall water resources potential cover both surface flows and groundwater. Though these two sources are interrelated, estimates of their individual contributions, both overall and to utilizable volumes, are made independently by the CWC (for surface water) and the CGWB (for groundwater). Since interactions between these sources are significant, the sum of these two estimates cannot be taken as a measure of the total volume of available and utilizable water resources. It is essential that this exercise be done jointly by these two bodies." (Planning Commission, 2011: ii-iii)

1.2 Water Resources

According to the National Environment Policy (NEP) 2006:

"India's freshwater resources comprise the single most important class of natural endowments enabling its economy and its human settlement patterns. The freshwater resources comprise the river systems, groundwater, and wetlands. Each of these has a unique role and characteristic linkages to other environmental entities. (MoEF, 2006: 28)"

The following section provides a brief overview of the available water resources and related issues. We begin with an overview of rainwater, and then move onto surface and groundwater resources.

1.2.1 Rainwater

The long-term average rainfall for the country is 1,160 mm, which is the highest in the world for a country of comparable size.[6] Owing to physiographic factors, rainfall in India is highly variable. For example, in 2008, rainfall measured from about 500 mm in east and west Rajasthan to 3,798 mm in coastal Karnataka (CWC, 2010). India ranks first among rain-fed agricultural countries in terms of both extent (86 Mha) and value of produce (Amarsinghe and Sharma, 2009). More than 80 per cent of the annual run-off of the rivers occurs in the monsoon months of June to September, often causing floods. However, acute water shortage is faced in many parts of India during the rest of the year. Even in areas such as Cherrapunjee in Meghalaya, where there is surplus rainfall, the soil may not be able to retain the water for long thereby

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[6] Lal (2001) cited in Kumar et al. (2005)

causing water scarcity (Bandyopadhyay et al., 1998). In India, rain-fed agro-ecologies contribute 56.7 per cent of the net sown area, 40 per cent of the foodgrain production, and 66 per cent of the livestock. About 85 per cent of coarse cereals, 83 per cent pulses, 42 per cent rice, 70 per cent oilseeds and 65 per cent cotton are cultivated as rain-fed (CRIDA, 2011: 31). In addition, they are substantial means of providing livelihood, income, employment and environmental security. During 1985-95, the growth rate in un-irrigated areas was higher than that of irrigated areas. A study by Bhatia (2005)[7] showed that the crop yield per hectare from irrigated land was consistently much higher than the yield from rain-fed agriculture.

1.2.2 Surface Water Resources

Surface water resources comprise of rivers and inland water resources like lakes, tanks, canals, ponds, reservoirs, etc. They are crucial for ecosystem services as well as for providing livelihood support to a large section of the population.

1.2.2.1 Rivers

Of the many rivers in India, 12 are classified as major rivers whose total catchment area is 252.8 Mha. Among the major rivers, the Ganga-Brahmaputra-Meghna system is the biggest with a catchment area of about 110 Mha (CWC, 2010). The other major rivers with catchment areas of over 10 Mha are the Indus (32.1 Mha), Godavari (31.3 Mha), Krishna (25.9 Mha) and Mahanadi (14.2 Mha) (ibid.). The catchment area of medium rivers is about 25 Mha. Since independence, India has made significant progress in increasing the storage potential of the available water by building dams on various rivers. A total storage capacity of 212.78 BCM has been created in the country through major and medium projects. The projects under construction will contribute to an additional 76.26 BCM, while the contribution expected from projects under consideration is 107.54 BCM (ADB, 2009).

The entire country was divided into twenty river basins/group of river basins comprising twelve major basins: 1.Indus; 2.Ganga-Brahmaputra-Meghna, 3.Godavari, 4. Krishna, 5.Cauvery, 6.Mahanadi, 7.Pennar, 8.Brahmani-Baitarani, 9.Sabarmati, 10.Mahi, 11.Narmada and 12.Tapi each of these basins combining suitably together all the other remaining medium and small river basins are: 1.Subernarekha - combining Subernarekha and other small rivers between Subernarekha and Baitarni, 2. East flowing rivers between Mahanadi and Pennar, 3. East flowing rivers between Pennar and Kanyakumari, 4.Area of inland Drainage in Rajasthan Desert, 5.West flowing rivers of Kutch and Saurastra including Luni, 6.West flowing rivers from Tapi to Tadri, 7.West flowing rivers from Tadri to Kanyakumari and 8.Minor rivers draining into Myanmar(Burma) and Bangladesh.

After accounting for the natural process of evaporation etc., the average annual water resources potential in the country was assessed as 1869 BCM and given in the report entitled 'Reassessment of Water Resources Potential of India' (1993). It is estimated that owing to topographic, hydrological and other constraints, the utilizable water is 1123 BCM which comprises of 690 BCM of surface water and 433 BCM of replenishable ground water resources. A table showing the average annual water resources potential river basin-wise is given below.

The per capita average annual water availability in the country is reducing progressively due to increase in population. The average annual per capita availability of water in the country taking into consideration the population of the country as per the 2001 census, 2011 census and the population projections for the year 2025 and 2050 is as under:-

Table 1.2: Water Resources Potential of River Basins of India

River basin	Catchment area (Sq.Km)	Average Water Resources Potential (BCM)*
Indus	321289	73.3
Ganga-Brahmaputra-Meghna		
a. Ganga	861452	525
b. Brahmaputra	194413	537.2
c. Barak & others	41723	48.4

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[7] Cited in World Bank (2005: 15)

Godavari	312812	110.5
Krishna	258948	78.1
Cauvery	81155	21.4
Subernarekha	29196	12.4
Brahmani-Baitarni	51822	28.5
Mahanadi	141589	66.9
Pennar	55213	6.3
Mahi	34842	11
Sabarmati	21674	3.8
Narmada	98796	45.6
Tapi	65145	14.9
West Flowing Rivers from Tapi to Tadri	55940	87.4
West Flowing Rivers form Tadri to Kanyakumari	56177	113.5
East Flowing Rivers between Mahanadi and Pennar	86643	22.5
East Flowing Rivers between Pennar & Kanyakumari	100139	16.5
West Flowing Rivers of Kutch and Saurashtra including Luni	321851	15.1
Area of Inland Drainage in Rajasthan	—	Negl.
Minor Rivers draining into Myanmar (Burma) and Bangladesh	36302	31
Total		1,869.4

Source: CWC, 1993

Table 1.3: Average annual per capita

Year	Population (Million)	Per capita Average Annual Availability (m3/year)
2001	1029 (2001 census)	1816
2011	1210 (2011 census)	1545
2025	1394 (Projected)	1340
2050	1640 (Projected)	1140

A per capita availability of less than 1700 cubic metres (m^3) is termed as a water-stressed condition while per capita availability below 1000m^3 is termed as a water scarcity condition.

The per capita water availability figures given above are the national average figures while the position is quite different in the individual river basins. As mentioned above, distribution of water resources in space and time is highly uneven. Majority of the runoff is generated during the 3-4 months of the monsoon season. Brahmaputra, Barak and Ganga accounts for as much as 60% of the total flow causing recurring floods. At the same time large areas in Rajasthan, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu get scanty rainfall and face drought like condition. While per capita water availability in Brahmaputra and Barak basin is very high, it is low in the river basins such as Sabarmati, west flowing rivers in Kutch and Saurashtra including Luni, Cauvery, Pennar, etc.

To address the spatial inconsistencies in overall available water resources, the concept of developing a national grid by linking the river systems was proposed in the early 1970s. The National Water Development Agency (NWDA) set up in 1982 by the Government of India (GoI) worked out the possibilities of storage, links and transfer but the ambitious project reached an impasse as the concept of river interlinking is vehemently debated and awaits consensus. The per capita water availability of many river basins is declining over the years due to sustained pressures of population, agriculture and industrial expansion (also see box 1.1 on water scarcity in north-eastern states). Pennar, Sabarmati and east flowing rivers are believed to face acute water scarcity with per capita availability of water less than or around 500 cu m during 2010 (CWC, 2010). Water quality has also been affected because many stretches of rivers pass through industrial towns

Box 1.1: The North–east Water Paradox

The country's north-east, comprising eight states – Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim is known for its unique cultural and biological diversity. In the north-east consultation workshop held during the preparatory phase of this report at the Indian Institute of Technology (IIT) in Guwahati, the participants were unanimous in their views against projecting the north-east as a water surplus region, based on statistical data, since acute water shortages are emerging at the local level. There was a consensus among the participants that the physical surplus of water in the north-eastern region has for long given the rest of the country misconstrued notions about the water availability scenario in the region. Citing examples of cities like Shillong and Kohima they noted that unplanned urbanisation had led to some cities facing water scarcity and any upcoming policy planning in the region should recognise this at the outset. The participants expressed their concern over lack of coordination among the north-east states on water resource planning, an issue which will need to be addressed in order to make any headway in designing an integrated water resource management framework for the region. Another concern common across all the seven states was the large-scale damming of the region. The participants proposed the Enactment of National Water Security Act from three perspectives:

- The human rights, including health, perspective, thereby insuring there be a provision for clean water required for drinking and domestic uses.
- The livelihood perspective, thereby ensuring water for the livelihood of all.
- The ecological perspective, thereby ensuring protection of rivers, wetlands, lakes, water bodies, etc., and declaring some of the rivers/tributaries in each state as a 'NO GO ZONE' where no dams, barrages, or hydropower will be allowed.

Source: Culled out from responses of participants at multi-stakeholder's workshop at IIT Guwahati, August 5, 2010

1.2.2.2 Other Water Bodies

Inland water resources of the country are classified as rivers and canals, reservoirs, tanks, lakes and ponds, derelict water, and brackish water. These water sources are crucial support systems for a large percentage of the population especially that of rural areas where they are recognised as common property resources. They are sources from which a large number of poor and deprived communities derive economic and non -economic benefits. Other than rivers and canals, total water bodies cover an area of about 7.4 Mha. Of the rivers and canals, Uttar Pradesh occupies the first place with 31.2 thousand km stretches, which is about 17 per cent of the total length of rivers and canals in the country, followed by Jammu and Kashmir and Madhya Pradesh. Among the remaining inland water resources, reservoirs have maximum area (2.9 Mha) followed by tanks, lakes and ponds (2.4 Mha) (CWC, 2010). Most of the area under tanks, lakes and ponds lies in states of Andhra Pradesh, Karnataka, Arunachal Pradesh and West Bengal. These states account for 56 per cent of the total area under tanks and ponds in the country (ibid.). As far as and cities and are thus being severely polluted (for example, the Ganges in Kanpur and the Yamuna in Delhi). According to estimates, uncontrolled discharge of untreated domestic/municipal wastewater has resulted in contamination of 75 per cent of all surface water across India (MoUD, 2009).

In the backdrop of unsustainable development and increasing population pressure, many inter-state conflicts over river water have emerged, with the states involved claiming a greater share in the water or the benefits associated with it. The details of some of the major inter-state water issues are given in Table 1.4. With the growing situation of contending water uses, these conflicts can only be expected to escalate in future.

1.2.3 Groundwater

India is the largest consumer of groundwater in the world with an estimated usage of 230 km3 per year (World Bank, 2010a). Approximately 60 per cent of the demand from agriculture and irrigation, and about 80 per cent of the domestic water demand, is met through groundwater (ibid.). As per the Department of Drinking Water and Sanitation (DDWS)[8] nearly 90 per cent of the rural water supply is from groundwater sources. The last estimation of groundwater resources in the country was carried out in 2004 by the Central Ground Water Board (CGWB). According to it, the total annual replenishable groundwater resource of the country was 433 BCM at the time. The groundwater resources available for irrigation was 369.6 BCM, while for industrial, domestic and other purposes it

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[8] Cited in Shankar (2009: 37)

Table 1.4: Major Inter-state River Conflicts in India[9]

Rivers	States concerned	Date of reference to the tribunal	Decision of the tribunal
Krishna	Maharashtra, Andhra Pradesh, Karnataka	April 1969	May 1976
Godavari	Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Orissa	April 1969	July 1980
Narmada	Rajasthan, Madhya Pradesh, Gujarat, Maharashtra	October 1969	December 1979
Ravi and Beas	Punjab, Haryana and Rajasthan	April 1986	–
Cauvery	Kerala, Karnataka, Tamil Nadu and Puducherry	June 1990	–
Krishna	Karnataka, Andhra Pradesh and Maharashtra	June 1990April 2004	–
Madel/Mandovi/ Mahadayi	Goa, Karnataka and Maharashtra	November 2010	–
Vamasadhara	Andhra Pradesh and Orissa	February 2010	–
Periyar[10]	Tamil Nadu and Kerala	–	–
Godavari (Bhabli Barrage)	Maharashtra and Andhra Pradesh	–	–

Source: ADB (2009), updated with information available on Periyar River and Bhabli Barrage, 2011

was 71 BCM (CWC, 2009). These figures however do not project the actual situation of groundwater due to its highly skewed distribution across the country. The notion of groundwater as a private resource, the rights of which are associated with land rights, has led to an exploitative extraction regime. Since the 1970s, groundwater irrigation has been expanding at a very rapid pace in India. According to Shah (2009: 4): “Until [the] 1960s, Indian farmers owned just a few tens of thousands of mechanical pumps using diesel or electricity to pump water; today India has over 20 million modern water extraction structures. Every fourth cultivator household has a tube well; and two out of the remaining three purchased irrigation services are supplied by tube well owners.”

The National Sample Survey's (NSS) remote sensing data suggest that as much as 75 to 80 per cent of the country's irrigated area is served by groundwater wells (Shah,2009). This unsustainable level of exploitation has put the groundwater resources at great peril, lowering the groundwater table in many areas and causing saline water intrusion in various parts of the country. A growing demand for water coupled with unreliable public supply schemes has led to a growing dependence on the groundwater sources in the country whereby it is being extracted not only through the municipal water utilities but also by private owners through borewells and pumps. The share of groundwater in the net irrigated area has changed drastically during last couple of decades (see figure 1.1) using data imagery from NASA's Gravity Recovery and Climate Experiment satellites (GRACE), Rodell et al. (2009)[11] showed that during 2002-2008, three states (Punjab, Haryana and Rajasthan) together lost about 109 km3 of water leading to a decline in the water table to the extent of 0.33 m per annum. According to Shankar et al. (2011), in a span of nine years (from 1995 to 2004) the rate of groundwater withdrawal

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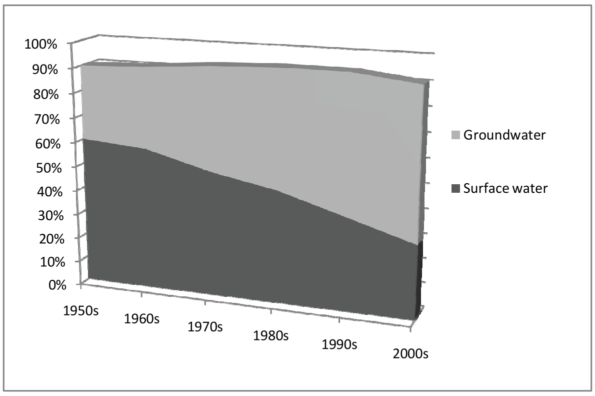
[9] The blank columns indicate the tribunals that have either not been formed or are awaiting a decision.

[10] For both, the Mullaperiyar dam issue over Periyar and Bhabli Barrage over Godavari, Supreme Court hearing has already commenced and is in different stages.

[11] Cited in Kulkarni et al. (2011: 38).

reached an 'unsafe'[12] level in 31 per cent of the districts, which is about 33 per cent of the land area and 35 per cent of the population. Even the so-called 'safe' districts battle some issue or other with water quality thus threatening water security.

Figure 1.1: Decade-wise trend of shares of groundwater and surface water to Net Irrigated Area - an aggregated National Picture



Source: Indian Agricultural Statistics, 2008 (Figure courtesy: Himanshu Kulkarni, ACWADAM)

While there are a lot of discussions on the overexploitation of groundwater resources, there is no update on the status of groundwater in India after 2004. The central agency, Central Groundwater Board (CGWB) uses the old 2004 data in its Groundwater Year Handbook 2011 (CGWB, 2011). So lack of data in public domain is a serious concern as in absence of data, any recent trends are not captured. Regarding the sustainable groundwater management, Shankar et al (2011) has discussed about carefully constructing a disaggregated picture by mapping aquifers and delineating aquifer typologies incorporating variations in hydrogeological and socio-economic contexts. They suggest that the aquifer mapping should take place at the scale of watersheds of the order of 1,000 to 2,000 hectares.

These maps can be then aggregated at a more regional scale rather than move down from an aggregated picture. Along with mapping, one also needs to build a comprehensive database on the groundwater flow systems and groundwater availability in each hydro-geological setting. The concern has also been reflected in the approach paper to the 12th Five Year Plan by the Planning Commission of India and the working group's report on sustainable groundwater management. Building on the premise of 'faster, sustainable and more inclusive growth', the approach paper to the 12th Five Year Plan emphasises the urgency to manage groundwater sustainably in four pronged approach. First, there is a need for comprehensive aquifer mapping at the watershed level. Second, the observation wells need to achieve a ratio of 1:100 between observation wells and groundwater use structures from the current ratio of 1:500 to estimate actual groundwater use more accurately. Third, developing sustainable groundwater management plans for each aquifer, based on partnerships between the stakeholders, hydro-geologists and social mobilisers is also the need of the hour. Fourth, separation of agricultural feeders to improve the power situation and revive the groundwater levels is needed (Planning Commission, 2011). The working group's report on sustainable groundwater management (Planning Commission, 2011) also focused on building strong partnerships and collaborations among a broad spectrum of institutions. It envisions improved co-ordination between various institutions dealing with groundwater resources such as CGWB, state agencies, technical research institutions, civil society organizations, PRIs.

It visualizes an institutional restructuring with specific roles being played by each of these. A crucial interface with the Ministry of Drinking Water and Sanitation (MoDWS) will also be established through the programme. Further, the group recommends that The National Programme on Groundwater Management will centrally address the challenge of groundwater legislation. Since groundwater is a fugitive resource that does not respect administrative boundaries and distinctions, it is important that the groundwater legislation provides for a separation of rights over land from rights over water. The focus of groundwater legislation should be on protection and sustainable use of groundwater. The group also recommends that groundwater management and use cannot be discussed in isolation from the patterns of energy consumption and pricing policies. Hence, a key aspect of the programme is the co-management of groundwater and energy use, with indirect instruments like pricing of electricity, subsidies etc., playing a crucial role. Creating consensus on the order of priority for different uses of groundwater: drinking water, water for livestock and domestic purposes, irrigation (small-holder, large scale), industrial uses, urban non-domestic; creating a system of regulation and water pricing to encourage allocation of water resource based on such priorities. (Ibid: 12)

1.3 Disasters and Extreme Events

Water availability and scarcity is governed by both seasonal and temporal factors. Seasonal extremes, coupled with the socio-economic dynamics of various regions, affect the water scenario in the country to a great extent. Due to its unique physiographical features, India is

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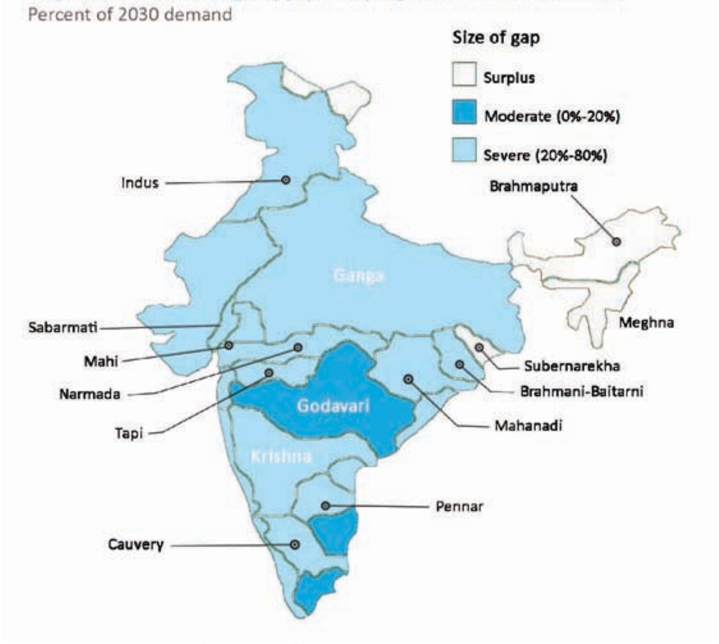
[12] The districts with the status of groundwater development greater than 70 per cent are termed 'unsafe'.

Figure 1.2: India's Water Supply and Demand Gap



Source: Addams et al. (2009 : 55)

vulnerable to various geophysical hazards. About 60 per cent of India's landmass is prone to earthquakes of various intensities; over 12 per cent is prone to floods; about 8 per cent to cyclones; and 68 per cent to drought (NDMD, 2004). The economic and humanitarian impact of such disasters is escalating due to the lack of appropriate organisational systems, inappropriate land management, pressure of increasing population, and settlements in high-risk areas, particularly by poor people (see Figure 1.2 and Table 1.5). Infact, India is in danger of being ill-prepared for natural disasters and climate change, while unsustainable water-use patterns are evident in Pakistan and Uzbekistan (UNWWDR4: 194). Unmitigated natural or anthropogenic disasters can be a serious impediment to the economy as they set back the development clock by many years (see Table 1.6). In the year 2009 alone, India incurred a loss of about Rs 121.14 billion owing to hydrological and meteorological disasters, with this figure being fourth highest in the world (Vos et al. 2009). In the state of Maharashtra, a single drought (2003) and flood (2005) absorbed more of the budget (Rs 175 billion) than the entire planned expenditure (Rs 152 billion) on irrigation, agriculture and rural development during 2002-7 (World Bank, 2008). This report is aware of the problem problem with such demand/supply gap projections as they assume that demand for water will grow at a rate consistent with its historical growth trend. Such an approach ignores that the binding constraint on water resource management is always on the demand side. Unless the end-uses to which water is applied are regulated, supply augmentation is never going to be a solution. Hence, the projection of demand/supply gap, in the absence of strategies for management of demand, has to be looked at from multiple angles. In absence of such calculations, the present figure (1.2) gives an aggregate situation which may just be the first step to understanding the complexity of situation.

Table 1.6: Economic Loss Potential (1967-2006)

Annual exceedance probability (in %)	Economic Loss (USD million)	Percentage to GDP
0.5	10,987	1.2
5	4,913	0.5
20	2,035	0.2

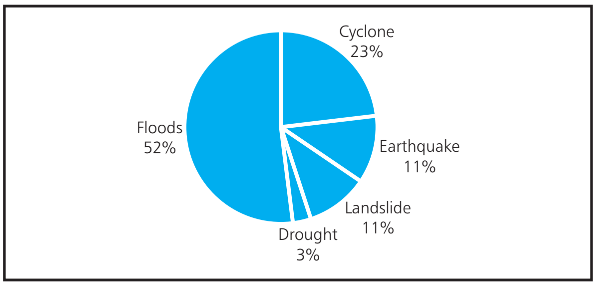
Source: UNISDR (2010)

Table 1.5: Disaster Risk Statistics for India (1967-2006)

Disaster type	Number of disasters/yr	Causalities/yr	Physical exposure (no./yr) million	Relative vulnerability (killed/million exposed)
Earthquake	0.88	2,672	0	14,836
Flood	4.05	1,308	18	72
Drought	0.20	8	24	0
Landslide	0.88	104	0	1,079
Cyclone	1.83	1,219	2	595

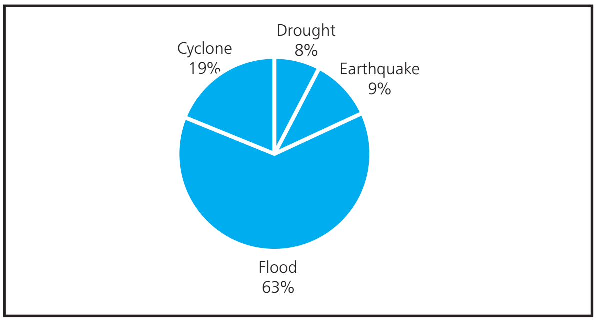
Source: UNISDR (2010)

Figure 1.3: Percentage Distribution of Reported Disaster in India (1967-2006)



Source: UNISDR (2010)

Figure 1.4.: Average Annual Economic Loss (USD million) of India



Note: Loss data for landslide insufficient.
Source: UNISDR (2010)

The above data provides information about extreme events till 2006. In 2008, the massive Kosi River floods caused unprecedented loss to lives, livelihoods, infrastructure and property in north-eastern Bihar. Although floods have been a recurring feature in parts of the state, the 2008 floods were not usual. The Kosi burst its embankments and changed course, inundating areas of Bihar that had not experienced such flooding for half a century. About 1,000 villages in five districts were affected, involving three million people, of whom about one million were evacuated. An assessment by the United Nations Development Programme (UNDP) shows that the valuation of houses damaged stands at around Rs 880 crores (US$195 million). Enormous amounts of goods were lost, including foodgrains and domestic items estimated to be worth Rs 400 crores (nearly US$88 million) and Rs 155 crores (US$34 million) respectively (UNDP, 2009).

The overall approach currently being followed in India is one of disaster management as opposed to risk management for more than 20 years. The socio-economic set-up of the country leaves a large chunk of the population without adequate capacity to cope with the after-effects of such events. Taking note of the lacunae in the overall approach, the GoI has formulated a number of schemes. Some of these include the Integrated Wasteland Development Programme (IWDP), Drought Prone Area Programme (DPAP), Desert Development Programme (DDP), flood control programmes, National Afforestation and Eco-development Programme, Accelerated Rural Water Supply Programme (ARWSP), crop insurance, Sampoorna Grameen Rozgar Yojana (SGRY), Food for Work, etc. But a changing climate will put these conventional approaches to test and newer methods will have to be devised to deal with both the increase in, and intensity of, natural hazards.

1.3.1 Floods

The magnitude of flooding has increased in recent decades. This can be deduced from the fact that flood affected areas have increased to 40 Mha (about 12 per cent of India's geographic area) from approximately 19 Mha in 1953 (NDMD, 2004). Floods have occurred almost every year since 1980 and were substantial in 2003 due to widespread rains, which affected even some of the most drought-prone areas. In recent years, the increase in population in vulnerable areas, inadequate drainage, and deforestation have all contributed to the rise in flood damage (World Bank, 2008). In 2008, flooding in the Kosi River in Bihar affected about 1.4 million people in 13 districts (WHO, 2008). In December 2010, floods wreaked havoc in the southern region of the country, killing about 180 people and forcing thousands of others to seek refuge in the government relief camps. The flash floods and mudslides of 2010 in Leh in north India claimed about 180 lives and injured about 400 people besides causing widespread damage to public and private properties (Table 1.7). In addition, epidemics in the aftermath of flood events are also responsible for considerable loss of human lives. For instance, the floods of July-August 2007 led to an outbreak of cholera in four districts of Orissa, killing more than 100 people (SDMC, 2008.

1.3.2 Droughts

About 73 per cent of India's annual rainfall is accounted for by the south-west monsoon, the failure of which generally results in drought and drought-like conditions (MoA, 2009). Droughts have always been a recurring event in the Indian subcontinent. There are debates around the occurrence of drought as meteorological or human factors. Critiques argue that droughts are variously experienced, politically inspired, socially constituted and arise essentially from the monopoly of available water (Jairath and Ballabh,2009). Almost 20 per cent of India's total land area is drought prone (World Bank, 2008). As per the Ministry of Agriculture (MoA), 14 states declared drought-like situation in 338 districts with Himachal Pradesh, Assam, Jharkhand, Manipur and Nagaland declaring all their districts as drought prone in the year 2009. The government of Kerala

Table 1.7: Flood Damages in India

	2008	Maximum Damage	Year of maximum damage
Affected area(Mha)	3.55	17.50	1978
Population affected (millions)	41.46	70.45	1978
Damage to crops (Rs crores)	1,336.32	4,246.62	2000
Damage to houses (Rs crores)	1,011.97	1,307.89	1995
Damages to public utilities (Rs crores)	1,591.62	5,604.46	2001
Cattle lost ('000)	71	618	1979
Human life lost (No.)	2,439	11,316	1977
Total damages to crops houses and public utilities (Rs crores)	3,939.90	8,864.54	2000

Source: CWC (2010)

also declared drought in 14 districts in 2010 due to acute water shortage and drying up of water sources. Since droughts are a deviation from the normal rainfall, they can occur in any rainfall region. Over the years, many cases in India have provided ample evidence that droughts are not exclusively caused by water scarcity or absence of rainfall; increasingly, it is mismanagement of water resources to blame, whereby such droughts are termed 'man-made' droughts. Droughts have huge social repercussions and cause large-scale and long-term distress to society

1.4. Water Scarcity

With an estimated per capita availability of 1,588 cu m/capita/year (CWC, 2010), India does not fall under the category of a water scarce country per se, rather it can be termed as a country under 'water stress'.[13] But it is widely believed that an aggregate estimation does not reveal the actual scenario. As mentioned earlier, in the 2030 base case scenario, India faces a large gap between current supply and projected demand, amounting to 50 per cent of demand or 754 BCM (Addams, 2009). This is depicted in Figure 1.1. A projected 40 per cent of the population will be living in the urban areas by 2030 with higher purchasing power. This will increase calorie intake putting greater pressure on existing water resources. For the projected 685 million metric tons of food production in 2030, 175 million tons are expected to come from rain-fed agriculture, which will leave some 510 million to irrigated production (ibid.). Many towns in India are currently in the midst of acute water stress, and even where water may be available, quality is a major concern. Several factors are responsible for this water scarcity.

The projected foodgrain and feed demand (in million tonnes) as estimated by National Commission on Integrated Water Resources Development (NCIWRD-1999) constituted by Ministry of Water Resources is as given below:

1.4.1 Population Growth

One of the major constraints often cited for India in achieving developmental goals is the pressure of an ever-increasing population. According to the provisional census data of 2011, the population of India is 1.21 billion. The per capita water availability during this period has decreased from 2,309 cu m in 1991 (Sharma and Bharat, 2009) to 1,588 cu m in 2001 (CWC, 2010). Considering the projected population growth in 2025, the per capita water availability can further decrease to 1,000 cu m, which would then be termed a 'water scarcity' situation. Despite the National Water Policy (NWP) assigning the highest priority to drinking water, providing adequate and safe drinking water to every household in the country remains an onerous task.

According to WHO-UNICEF data, as of 2008, about 96 per cent of the urban population and 84 per cent of the rural population has access to improved water sources (WHO-UNICEF, 2010). However, this access does not ensure adequacy and equitable distribution, and the per capita availability is not as per norms in many areas. Average access to drinking water is highest in Class I towns (73 per cent), followed by Class II towns (63 per cent), Class III towns (61 per cent), and other towns (58 per cent) (Planning Commission, 2008). The rural water supply coverage has also increased steadily in recent

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[13] According to the UN, an area experiences water stress when annual water supplies drop below 1,700 cu m per person. When annual water supplies drop below 1,000 cu m per person, the population faces water scarcity, and below 500 cu m 'absolute scarcity'.

years; however, water quality continues to be a major concern.

It must be noted that an indicator like 'per capita water availability' may not present the true picture as a large population does not have physical access to water even when it may appear so in official records. Similarly, rising population is cited as a reason for water scarcity although there exists a huge disparity between the water consumption patterns of the rich and the poor.[14] This approach considers the quantity of water but not its access and control by different agents. Access to water resources is governed by power relations in the society with the poor often being differentially excluded from this process. The efforts to augment water supplyand 'manage the scarcity' often concentrate on the technical and managerial aspects thereby reinforcing existing inequalities. It is imperative to consider the relational aspect of water scarcity and the differential consumption patterns as the scarcity experienced by a poor person with reference to basic livelihood needs should not be clubbed with the luxury needs of the urban rich. A detailed discussion of this issue is beyond the scope of this chapter.

1.4.2 Urban Development

One of the characteristics of population increase in India is the marked rise in urban population. In 2010, about 30 per cent of the population (377 million people) lived in urban areas (Census of India, 2011. This figure is set to increase to 40 per cent by 2030 (ibid.). Due to various socio-economic factors, like population pressure and poverty, the urban regions have witnessed a large influx of people from the rural areas. The consequence is

Table 1.8 : Food Grain and Feed Demand Projection

Demand	Years		
	2010	2025	2050
High Demand	224	291	449
Low Demand	222	280	382
With addition of seed, feed, wastage, etc			
High Demand	247	320	494
Low Demand	245	308	420

Total water requirement of the country for different uses as assessed by NCIWRD-1999, is given below:

Table 1.9 : Total Water Requirement for Different Uses

Uses	Year 1997-98	Year 2010		Year 2025		Year 2050	
		Low	High	Low	High	Low	High
Irrigation	524	543	557	561	611	628	807
Domestic	30	42	43	55	62	90	111
Industries	30	37	37	67	67	81	81
Power	9	18	19	31	33	63	70
Inland Navigation	0	7	7	10	10	15	15
Flood Control	0	0	0	0	0	0	0
Environment(1) Afforestation	0	0	0	0	0	0	0
Env.(2) Ecology	0	5	5	10	10	20	20
Evaporation Losses	36	42	42	50	50	76	76
Total	36	42	42	50	50	76	76

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[14] A study by Water Aid in Delhi reveals that in one particular locality, '92 per cent of water supplied goes to 20 per cent of population and the remaining 80 percent of population gets 8 per cent of the total piped water supply'. See Water Aid (2006: 58).

unprecedented pressure on urban infrastructure and resources. Increasing urbanisation coupled with rise in the consumption pattern would mean a new challenge for water resources. At present, access to water in urban India is severely constrained. While many major cities in developing countries maintain a nearly 24-hour water supply (see Box 1.2), Figure 1.5 shows that most Indian cities have water supply for only a few hours of the day (World Bank, 2006). The increasing population means that the urban settlements not only face the challenge of meeting the water requirement but also of adequate sanitation facilities (as will be discussed later; in 2008, 54 per cent of the urban population used improved sanitation[15] facilities). According to estimates, the loss due to diseases caused by poor sanitation for children less than 14 years in urban areas alone amounts to Rs 5,000 million at 2001 prices (MoUD, 2009); this is further elaborated in Chapter 4, Section 4.3. Although the access to water supply in the urban areas is considerable there exists a huge disparity in terms of accessibility with those living in the slums being worse off.

A detailed discussion of the urban water scenario is entailed in Chapter 3.

Box 1.2: 24X7 Water Supply

Although there has been a thrust in the water sector over the years about the 24x7 water supply schemes, the issue remains a contested one. Proponents of such scheme base their arguments on increasing water supply efficiency, the gains of which can be accrued to the poor who bear the maximum burden of erratic and irregular water supply. While on one hand such schemes are seen to result in higher efficiency in the water supply side, on the other they are also been seen as a means to allow private control of water supply. Some opine that the plan for 24x7 supply cannot be implemented given the present status of water infrastructure in the country. While many pilots in limited areas of a city have demonstrated the successful implementation of 24x7 water supply, it is not clear if these have served poorer locations or are confined to middle-class localities. Critiques believe that 24X7 water supply argument is a back door entry route to privatisation of water services in the name of the poor. The actual gains across all sections of society and equity concerns for stakeholders are some of the key concerns.

Source: Discussions between Dr David Foster and Dr Anjal Prakash at UNDP Solution Exchange. Document available at http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Strategy_for_Improving_Urban_Drinking_Water_Supply_Water_Supply_is_too_Expensive.pdf [accessed on 29 December 2011]

1.4.3 Localised Scarcity

The constraints posed by the terrain in India means that water is not uniformly distributed across the country. Apart from variation in the precipitation pattern, unplanned expansion of cities has exacerbated the pressure on water resources, especially groundwater. The recent NSS 65th round report, July 2008-June 2009, reveals that 14 per cent of rural households and 9 per cent of urban households did not have access to sufficient drinking water during that year (NSSO, 2010).

In India, the groundwater contamination rate is alarmingly high (MoEF, 2009). Seasonal water scarcity is also a matter of grave concern. What is alarming is that some of the most productive regions (industrial and agricultural) are faced with water shortages, due primarily to exploitative and unsustainable water use practice. According to 2004 data of the CGWB, with respect to groundwater, 48.67 per cent of blocks in Haryana are 'over-exploited' while about 9.7 per cent blocks fall under the 'critical category. These figures are 75.18 per cent and 3.64 per cent for Punjab respectively (CGWB, 2004). Many metros in the country have resorted to the practice of water rationing to make up for the erratic water supply. To add to existing woes, a scenario has developed where many metropolitans that have run out of water supply options are turning to water sources of the surrounding peri-urban areas or even nearby cities, as is the case with the national capital New Delhi. This may result in increases in conflict situations.

1.5 Managing Our Way to Scarcity

The water scenario presented above brings forth some grave challenges which will need to be addressed at the earliest. The first step would be to recognise the magnitude of the problem. Clearly, a considerable discrepancy exists in the estimation of total available water resources in the country. Any analysis pertaining to water resource management would be futile without incorporating the spatial and temporal variations in the distribution of the resource. The ambitious river

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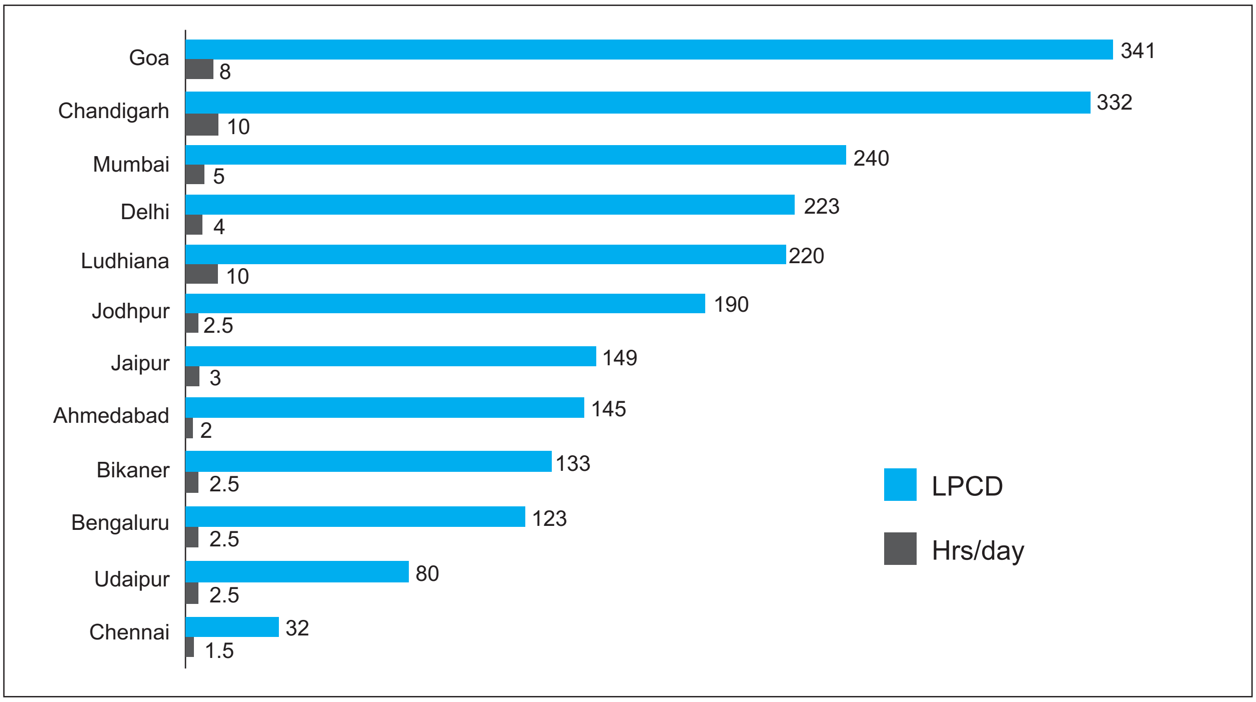
[15] According to WHO-UNICEF Joint Monitoring Programme for monitoring of MDGs, 'an improved sanitation facility is defined as one that hygienically separates human excreta from human contact' while 'an improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with faecal matter'. See WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation, available at http://www.wssinfo.org/definitions-methods/introduction/) [accessed on 25 March 2011].

Figure 1.5: Average Hours per day of Water Service in Select Indian Cities (2006)



Source: MoUD and WSP's benchmark study, ADB utilities book, cited in World Bank (2006: 14)

interlinking project aims to address this issue but has proved to be contentious between the government and civil society groups. While theoretically it might be feasible to divert water resources from surplus to deficit regions, the ecological sustainability and affordability of such an exercise puts constraints on its implementation. Even in the areas where water is made available it is important to revisit the sustainability of such supply by looking into service indicators and customer feedback rather than mere technical supply indicators. India will need to invest heavily on water storing structures while trying to find newer methods to enhance its irrigation efficiency. Much research will also be needed to back the policy initiatives strongly. For example, with an aim to support decision making, the study 'Charting Our Water Future' by 2030 Water Resources Group developed a 'water-marginal cost curve, which provides a microeconomic analysis of the cost and potential of a range of existing technical measures to close the projected gap between demand and supply in a basin' (p. 12).[16]

It is also imperative to take into account that people cope with declining water availability in a variety of ways. A recent study of the costs of coping with inadequate water supply in Delhi found that the true total costs of water supply are already 'privatized'; on average, the private coping costs are Rs 262 per month (when capital costs are included) versus a monthly water bill of only Rs 141 per month.[17] A UN-HABITAT supported study conducted in four major cities of Madhya Pradesh in 2006, revealed that the levels of system losses through 'unaccounted-for water' or 'non-revenue water' ranged between 31 per cent and 66 per cent, maximum being in Gwalior (UN-HABITAT, 2006). Similarly, the reforms will need to be more in line with current emerging situations. For the provision of availing a consistent 24x7 supply to water at higher cost might not appeal to the elite group which already has ensured supplies by means of borewells, water storage tanks or pumps. Managing this water scarcity situation is an immense challenge due to the socio-economic set-up of the country. This and workable solutions are discussed in Chapter 8, Section C.

1.6 Climate Change

Climate change has passed the phase of scientific curiosity and debate and has now become one of the developmental challenges for nations across

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[16] The 2030 Water Resources Group was formed in 2008 to contribute new insights to the increasingly critical issue of water resource scarcity. The group aimed to create an integrated fact base on the potential technical levers and costs for reducing water scarcity, with the ultimate goal of advancing solutions-driven dialogue among stakeholders. The report Charting Our Water Future was developed to take a first step in providing greater clarity on the scale, costs and trade-offs of solutions to water scarcity. For more details please visit http://www.2030waterresourcesgroup.com/water_full/Charting_Our_Water_Future_Final.pdf.

[17] Misra 2005 cited in World Bank (2006: 13).

the world. Scientific studies have established a changing climate, its impact on the natural resources and concomitantly on the lives and livelihoods of people. It is often quoted that such kinds of impacts will be more on people in the developing countries due to their heavy dependence on the natural resource base and lower resilience to environmental shocks. Climate change has an altogether different connotation for a country like India due to its varied topography, consisting of diverse bio-geographical features including forests, coasts, mountains, mangroves, islands, etc. Further, the dependence of people, especially the poor, on the natural resource base also makes them more vulnerable to such changes. In India, a great deal of research[18] has been undertaken to assess and bring forth the evidences of climate change and its impacts on human lives These studies have clearly indicated that a changing climate is manifesting itself in the form of unprecedented changes in almost all major ecosystems. From the receding glaciers to changing cropping patterns, studies have shown how the changing climate pattern is affecting the ecosystem and its services. A thorough analysis of climate change is beyond the scope of this report but the following is a summarised account of climate change vis-à-vis water resources in the Indian context.

1.6.1 Implications for Water Sector

According to India's Initial National Communication (NATCOM) to United Nations Framework Convention on Climate Change (UNFCC), climate change is likely to adversely affect the water balance in different parts of India due to changes in precipitation and evapotranspiration and rising sea levels, leading to increased saline intrusion into coastal and island aquifers. The National Water Mission (NWM), a part of the National Action Plan on Climate Change (NAPCC), identifies the threat to water resources in India due to climate change in terms of the expected decline in the glaciers and snow-fields in the Himalayas; increased drought-like situations due to the overall decrease in the number of rainy days over a major part of the country; increased flood events due to the overall increase in the rainy day intensity; effect on groundwater quality in alluvial aquifers due to increased flood and drought events; impact on groundwater recharge due to changes in precipitation and evapotranspiration; and increased saline intrusion of coastal and island aquifers due to rising sea levels (NWM, 2009).

1.6.1.1 Melting Ice and the Changing State

The Himalayas comprise about 16.2 per cent of the total geographical area of the country. India's three main rivers – Indus, Brahmaputra and Ganga – which support a very large percentage of the Indian population, originate from here. The average water yield per unit area of the Himalayan rivers is almost double that of the peninsular systems, indicating the importance of snow and glacial melt water contribution from the high mountains (Kumar and Sharma, 2005). Moreover the water from the glacial melts is also crucial for sustaining the lives and livelihoods of the people living in the Himalayan region. The Himalayan snowline and the glacier boundaries are sensitive to a changing climate. According to the Indian Network for Climate Change Assessment (INCCA) report (MoEF, 2010), the annual temperature in this region is expected to increase from 0.9±0.6oC to 2.6±0.7oC in the 2030s. The water yield in the Himalayan region, mainly covered by the river Indus, is likely to increase by 5 per cent to 20 per cent in most of the areas, with some areas of Jammu and Kashmir and Uttarakhand showing an increase of up to 50 per cent with respect to the base year of the 1970s (ibid.). Increased glacial melt due to warming is predicted to affect river flows. Increased warming might result in increased flows initially with reduced flows later as the glacier disappears. The impact of climate change on river basins can be understood with the example of the Indus River Basin. The total annual run-off from the upper basin is likely to increase by 11 per cent to 16 per cent. It is estimated that although increased run-off could be advantageous for water supply and hydropower production it could aggravate problems of flooding, water logging and salinity in the upper basin. Also, even with an overall water surplus, shortages might occur in local areas of the highly productive Punjab rice-wheat zone and in the unglaciated valleys of the upper basin (UNSDR, forthcoming).

1.6.1.2 Climate Variability

The south-west monsoon system in India is the most important climatic phenomenon. Shifts from the normal regime can have catastrophic effects in the form of floods, droughts or famines. Though it has been established that there will be an impact on the rainfall pattern of the country, it is not yet certain as to what that will exactly be, with some models predicting increase while others showing a decreased rainfall pattern. INCCA, in its recent report, has given a comprehensive region-wise analysis of the predicted changes in the precipitation pattern in the country. It indicates clearly that climate variability in the future will present newer challenges. The experiences from around the country over the past few years reiterate these predictions. Sectors which are climate

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[18] See, for example, Mohan and Sinha (2009) and Hallegatte (2010).

sensitive, such as agriculture, are likely to be worst affected by these changes. In a recent study on climate change and its impact on flood and drought-affected areas of India, the World Bank notes that farm incomes and yields are likely to be adversely impacted due to changes in temperature and precipitation (World Bank, 2008). Although the linkages between the two have yet to be categorically established, it is believed that in the absence of any countermeasures, climate change is expected to influence future disaster risks through likely increase in weather and climatic hazards. It may also increase the vulnerability of communities to natural hazards due to ecosystem degradation, reductions in water resources and food availability, and changes in livelihoods, and push more people to higher levels of hazard exposure (Asia Pacific Disaster Report, 2010). What is perhaps significant is to realise that year-to-year climate variability (as opposed to secular climate change) in itself is a source of risk to life and livelihoods in many parts of India. This manifests as floods, droughts and other forms of disasters and one of the key challenges in the water sector is to build resilience to such climate variability.

In India, an “Adaptive Strategies project was initiated in an attempt to reconcile differences in perceptions of and responses to extreme weather events in the context of climatic and social change. The project was designed to document and flesh out concepts and opportunities for more effective approaches to water management and flood and drought mitigation through an integrated study of four field locations: two drought affected areas in the arid regions of Rajasthan and Gujarat (India) and two flood affected areas along the Rohini and Bagmati River basins across the India-Nepal border” (UNWWDR4).

1.6.1.3 Saltwater Intrusion and Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC 2001: 383), 'salt water intrusion is the displacement of fresh surface water or groundwater by the advance of saltwater due to its greater density, usually in coastal and estuarine areas'. This usually occurs in coastal and estuarine areas due to reducing land-based influence (for example, either from reduced run-off and associated groundwater recharge, or from excessive water withdrawals from aquifers) or increasing marine influence (for example, relative rise in sea level). High population pressure, intense human activities, inappropriate resource use and absence of a proper management system are some such reasons. In India, the coastal aquifers are faced with degrading water quality due to various anthropogenic activities. Salinity ingress is already a major problem in the coastal regions of Tamil Nadu and Saurashtra, while inland salinity is a major problem in regions of Rajasthan, Haryana, Punjab and Gujarat. With its possible impact on the hydrological cycle, climate change can further exacerbate the problem of saline water intrusion in the coastal and island aquifers.

1.6.2 Decision Making in a Changing Climate: Progress and Challenges

Although India has no legally binding commitments to cut down its carbon dioxide emissions, it has been at the forefront of taking action for climate change. Developing NAPCC in 2008 has reflected a strong commitment in this direction. With its eight missions, NAPCC aims to adapt the country to the changing climate and make it more resilient to its future impact. As one of its missions, NWM aims to bring about 'conservation of water, minimizing wastage and ensuring more equitable distribution both across and within States through integrated water resources development and management' (NWM, 2009: iii). The goals envisaged by NWM are:

- Making public a comprehensive water database and the assessment of the impact of climate change on water resources.
- Promotion of citizen and state actions for water conservation, augmentation and preservation.
- Focused attention on over-exploited areas.
- Increasing water use efficiency by 20 per cent.
- Promotion of basin level integrated water resources management.

A revision of the NWP 2002 (the revision is one of the goals of the NWM) was undertaken in July 2010 recognising climate change as a serious challenge. India released a comprehensive document in November 2010, assessing the sector-wise climate change situation in the country. The report has been prepared by INCCA, a network- based programme that brings together over 120 institutions and over 220 scientists from across the country to undertake scientific assessments of different aspects of climate change. Water being a major sector, the report also provides information about current status and future predictions in water availability due to climate change. India's Ministry of Environment and Forests (MoEF) is preparing its second national communication on climate change (NATCOM) as a commitment to the UNFCCC. Climate change has also been recognised in the National Policy for Farmers, 2007, as well as in the NEP 2006.

Since its inception, the NAPCC has had its share of criticism. Critics maintain that the primary attention of the NAPCC has been towards the energy sector with the water sector still not receiving its due. It has also been condemned for not setting hard targets on the issues of water management. Achieving the goals set in the NWM will require a paradigm shift in the institutional mechanism and it is to be seen how this will be achieved. It is apparent that a sound response system to climate change should entail strengthening both the technological as well as the institutional set-up at the national, sub-national and local levels. Owing to India's geography and socio-economic profile, decision-making processes around climate change will have to be proactive. Additionally, to contend with climate change surprises, decision making must also be designed to be responsive and flexible to adjust to changes and new information. At the same time, decisions must be robust given the uncertainty surrounding climate risks if they are to enable communities and ecosystems to prepare for a variety of possible scenarios of impact. And, lastly, given the long-lasting nature and magnitude of the impact of climate change on water, as a result of the temporal and spatial scales of climate impact, decision-making processes must be durable.

1.7 Summing Up

There is evidence to suggest that water budget estimates may be seriously overestimating the availability of water in the country. The business-as-usual approach followed in the water sector has given rise to unsustainable management and extractive water use regimes particularly with respect to groundwater. The rivers and water bodies are already under tremendous pressure to meet the demands from various sectors while maintaining their ecological integrity. Climate variability, now a characteristic feature of the country, is more pronounced than ever, challenging people's resilience and increasing pressure on water bodies.

The national per capita water resource availability has declined considerably over the years and of particular concern is the disparity in water footprints of the rich and the poor. The government and local communities have responded well to many imminent challenges but a paradigm shift in the way water is perceived as a resource will be required to build a robust future course of action. The scenario of available water resources in India can be better gauged by comparing it vis-à-vis the sectoral demand scenario which is dealt with in the next chapter.

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CHAPTER TWO

WATER DEMAND

This chapter provides a brief review of the sectoral water demands in India, such as domestic household and sanitation, agricultural and industrial. Building on available data, the attempt is to evaluate the status of the present water demand, that is to identify the demands that these sectors currently exert on the available water resources of the country. In addition, the likely scenario in the future is presented. The chapter also encapsulates the vital concepts of water for livelihoods and water for ecosystem needs, both of which need to be integrated into water policy planning. In the light of varied water uses, a brief section on the concept of multiple use water systems in India has also been included.

Inadequate access to water is often referred to as one of the biggest factors limiting development in India. It is an indispensible factor of production in almost all enterprises, and access to water is inextricably linked to achieving the Millennium Development Goals (MDGs). Water is also a determinant of good health and productivity. The Human Development Report (UNDP, 2011: 46) notes, 'ensuring access–including modern cooking fuel, safe water and basic sanitation–also creates the potential to expand higher order capabilities, thereby enlarging people's choices and furthering human development'. The main users of water are the agricultural, domestic and industrial sectors. While agriculture continues to dominate in terms of water demand and use, industrial and domestic water demands are also rising steadily in the country. Table 2.1 gives the water demand estimate of diverse sectors by two different agencies—the Standing Sub-committee of the Ministry of Water Resources (MoWR) and the National Commission on Integrated Water Resources Development (NCIWRD). While assessing the population rise vis-à-vis demand, an estimate of the averages leads us to believe that we are nearing a 'water stressed' situation at the local level; many river basins are already faced with an acute water shortage. Nine out of 20 river basins with populations of 200 million are currently facing water scarcity (Planning Commission, 2008). The government has constructed many massive storage structures to store surface water and retrieve it for controlled use. But even after constructing 4,525 large and small dams, the per capita storage in the country is 213 cu m as against 6,103 cu m in Russia, 4,733 cu m in Australia, 1,964 cu m in the United States, and 1,111 cu m in China. Per capita storage may touch 400 cu m only after the completion of all the on-going and proposed dams (ibid.).

Table 2.1: Projected Water Demand (in BCM) for Various Sectors

Sector	Standing Sub-committee Report of MoWR			NCIWRD		
Year	2010	2025	2050	2010	2025	2050
Irrigation	688	910	1072	557	611	807
Drinking water	56	73	102	43	62	111
Industry	12	23	63	37	67	81
Energy	5	15	130	19	33	70
Others	52	72	80	54	70	111
Total	813	1093	1447	710	843	1180

Source: GoI (2006) cited in ADB (2009: 3)

2.1 Household/Human Consumption

As shown in Figure 2.1, the domestic water demand in India has remained low and accounted for 7 per cent of the annual freshwater withdrawal in 2010. It is pertinent to note that as much as 80 per cent of the domestic water requirement is met by groundwater (World Bank, 2005). The water crunch is felt the most during the critical summer months when many areas suffer from severe water shortages. The Government of India (GoI) has an ambitious scheme of providing piped drinking water to all uncovered habitations by 2012 under the Bharat Nirman Yojana. The programme was launched in 2005. Phase I of the programme was implemented in the period 2005-06 to 2008-09.Phase II is being implemented from 2009-10 to 2011-12. Rural drinking water is one of the six components of Bharat Nirman. During the Bharat Nirman Phase – I period, as per the official monitoring figures 55,067 un-covered and about 3.31 lakh slipped-back habitations were to be covered with provisions of drinking water facilities and 2.17 lakh quality-affected habitations were to be addressed for water quality problem. According to the Eleventh Plan document of the Planning Commission (2008), though more than 95 per cent coverage was achieved prior to Bharat Nirman, out of the 1.422 million habitations covered in the country, about 0.16 million have slipped back to a position where people do not have adequate water to drink and have to walk more than 2 km to fetch potable water. Similarly, about 0.18 million habitations are dependent on contaminated water supply, thereby exposing themselves to water induced diseases (ibid.). Improved water coverage for urban and rural areas till the year 2008 is given in Figure 2.1. It is notable that while the total coverage figures are satisfactory, the coverage with respect to household connections is a matter of concern. Further, a comparative analysis of the improved drinking water coverage over eight years (2000-08) reveals that in urban areas the coverage in terms of household connections has actually declined (see Figure 2.3). The same holds true for rural areas in 2005-08.

Water access is determined by the government more from the physical availability and access point of view. Understanding that there are social differences within communities, water is also a social factor and its access is socially constructed. Therefore overall water coverage data does not give an understanding of who is accessing and who does not. Further disaggregation of data at household and caste\community level will be a better indicator of individual's water access. The data presented in Figure 2.2 shows that even through the overall access to water has increased from 76 per cent to 84 percent in rural areas from 2000 to 2008, the overall household connections have almost been stagnant. In urban areas, where household connections have actually declined, there could be two issues which explains this; an increase in population leading to household connections not been able to keep pace with the rising population every year, and there could be slip-back due to groundwater depletion and water quality issues.

Figure 2.1: Estimated Improved Drinking Water Coverage in Urban and Rural Areas (2008)
Source: WHO-UNICEF (2010)

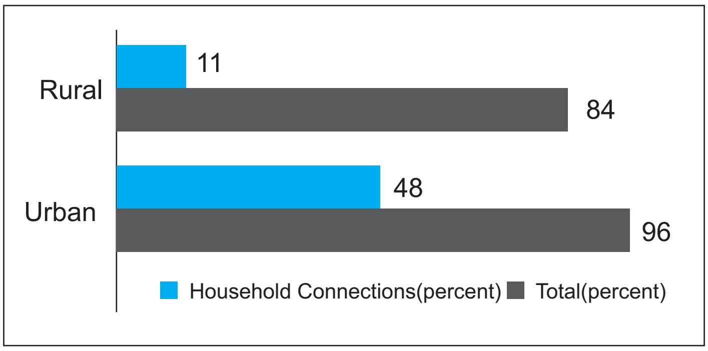
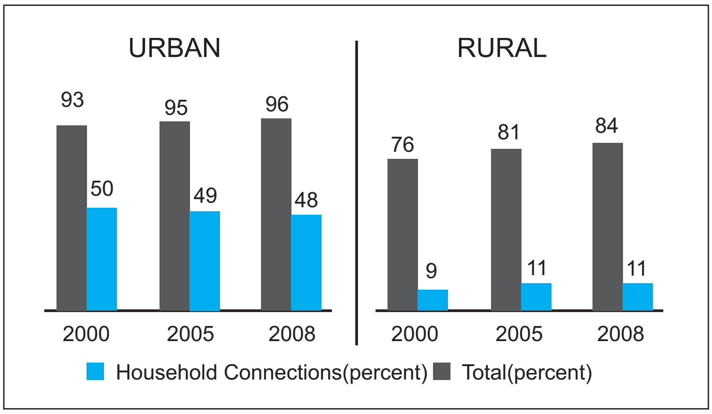


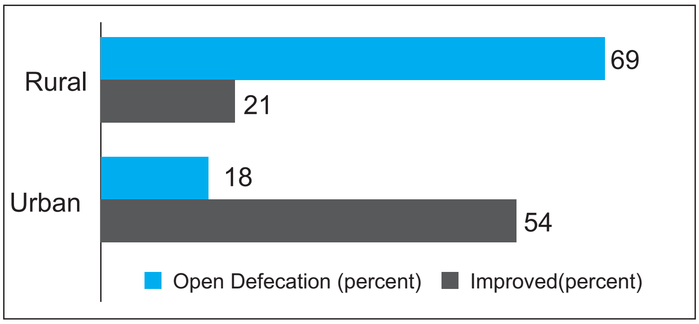
Figure 2.2: Comparative Analysis of Access to an Improved Drinking Water Source (2000-8)
Source: WHO-UNICEF (2010)



In terms of sanitation services, Figure 2.3 shows that in urban India an estimated 18 per cent of the population still do not have access to any kind of toilet facility (WHO-UNICEF, 2010). In rural areas, the scale of the problem is particularly daunting, as 69 per cent of the rural population still defecates in the open (ibid.). While building the physical infrastructure is accorded priority for increasing sanitation coverage, it will have to be accompanied by increasing water availability for achieving the real targets, including safe waste disposal. 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 diseases each year (Khurana and Sen, 2007). A recent study conducted by the Water and

Sanitation Programme (WSP) (WSP, 2010), a global partnership administered by the World Bank, estimates that inadequate sanitation causes India 'considerable economic losses' each year, equivalent to 6.4 per cent of its Gross Domestic Product (GDP) in 2006 (US$53.8 billion). The health and economic burden of inadequate sanitation is elaborated in Chapter 3. Tables 2.3 and 2.4 give the top five lowest and highest covered states with respect to physical coverage of drinking water supply as per the Ministry of Drinking Water and Sanitation data. Box 2.1 presents the case of improper sanitation facilities in the government schools in rural India. The data presented is based on the Annual Status of Education Report 2011. It is notable that in India, as in many South Asian countries, lack of toilets is cited as one of the major reasons for the high drop-out ratio of children, especially girls from schools (Boruah 2011). The decline in the household coverage is attributed to multiple factors like increase in population and lack of source sustainability. It is pertinent to note here that for a country like India where access to water is governed by many social and cultural factors (discussed later in the report), household connections can be argued to be better means of ensuring equitable water access.

Figure 2.3: Estimated Sanitation Coverage in Urban and Rural Areas (2008)



Source: WHO-UNICEF (2010)

Urban Water Demand Management

A water balance study of municipal water supply conducted in the four cities of Madhya Pradesh (UN-HABITAT 2006) suggests that the available water supplies theoretically translate into per capita availabilities ranging between 150-70 litres per capita per day (lpcd). But at the consumption end, the availability remains low, due to substantial non-revenue water which is estimated to range among cities between 28-45 per cent (Table 2.2) . The study reveals that the present water supply problems can be attributed to lack of governance and inadequate monitoring infrastructure rather than to scarcity of water resources. The financial and institutional assessments suggest that the reporting on revenue is inappropriate with poor estimates of collection efficiency, revenue and expenditure and over reliance on the government for financial support. Overall accountability and transparency is also very low. Current practices appear to match the disaster management approach rather than an organised style of functioning based on meticulous scientific planning.

Based on the outcome of the above studies, water demand management strategies reflect a three-pronged approach: (i) engineering solutions for controlling leakages including metering, water audits and balancing, setting up of district metered areas, etc.; (ii) accounting reforms and tariff rationalisation; and, (iii) institutional, legal and organisational changes, etc.

According to the National Sample Survey (NSS) 65th round report, in rural areas, tap as a major source of drinking water was the lowest among Scheduled Tribe (ST) households (19 per cent) and was the highest among Other Backward Class (OBC) households (33 per cent) followed by households in the residual social group (31 per cent). In rural areas, the highest proportion of Scheduled Caste (SC) households had no latrine facility (76 per cent), followed by ST households (75 per cent) and the lowest proportion of 'others' households (43 per cent). Likewise, in urban areas, the proportion of households who depended on 'tap' was lowest among ST households (69 per cent) and the same was highest among 'others' (78 per cent). In urban areas, the highest proportion of SC households had no latrine facility (23 per cent), closely followed by ST households (21 per cent) and 'others' households (4 per cent).

The data of physical coverage has to be taken with a pinch of salt. Data collected from the Department

Table 2.2: Water Balance in the Major Cities of Madhya Pradesh

Particulars	Bhopal	Gwalior	Jabalpur	Indore
Water Losses(%)	22.8	43.2	33.8	30.5
Non-revenue water (%)	28.2	43.9	36.9	38.5
Authorised consumption (%)	71.8	56.1	63.1	61.5

Table 2.3: Physical Coverage of Drinking Water Supply: Five Lowest Covered States

State	Percentage habitation level coverage as on 1 April 2011
Tripura	28.59
Karnataka	34.33
Jammu and Kashmir	43.12
Chhattisgarh	46.06
Manipur	48.29

Source: Department of Drinking Water and Sanitation (DDWS) (2011)

Table 2.4: Physical Coverage of Drinking Water Supply: Five Highest Covered States

State	Percentage habitation level coverage as on 1 April 2011
Jharkhand	98.04
Gujarat	95.46
Tamil Nadu	90.86
West Bengal	90.11
Goa	87.88

Source: (DDWS) (2011)

of Drinking Water Supply and Sanitation on the physical coverage of drinking water supply shows that Jharkhand tops the list of percentage of habitation level covered against the total habitation. The state has 98.04 percentage of habitation covered with drinking water supply sources. Any person with slightest understanding of the State Jharkhand may refute this. There could be two issues – one that the data may be wrong. If not, then the definition of coverage needs be changed to represent the reality in better fashion.

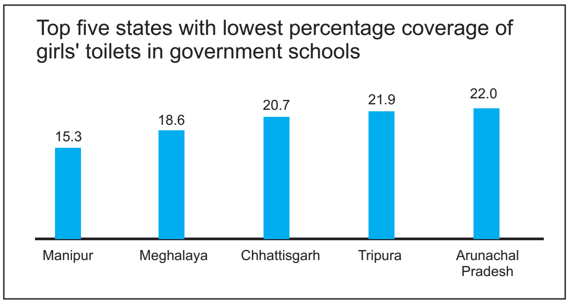
Box 2.1: State of Sanitation Facilities in Government Schools: ASER Report 2011

The 2011 Annual State of Education Report (ASER) reveals that only 43.8 per cent of the rural government schools in India have functional and usable toilets for girls. This is little less than a total 49.1 per cent schools with functional toilets. Only 73.5 per cent rural government schools have drinking water facility. The Right to Education Act guarantees the provision of free and compulsory education to children aged six to fourteen. To fulfil this right, the Act requires all schools to comply with the norm of having separate toilets for girls and boys. The schools are expected to meet these norms within three years of the implementation of the Act in 2009. The ASER survey is carried out each year between September and November where in, a total of 28,523 government schools were visited in 2010 and 2011. Following is the list of top five states with the lowest percentage of the coverage of girls' toilets in India. Incidentally, these are north-eastern and tribal states. The top five states with highest coverage of functioning girls' toilets are: Kerala (68.6%), Haryana (68%), Gujarat (67.7%), Rajasthan (66.3%) and Himachal Pradesh (64.9%).

Source : ASER (2011)

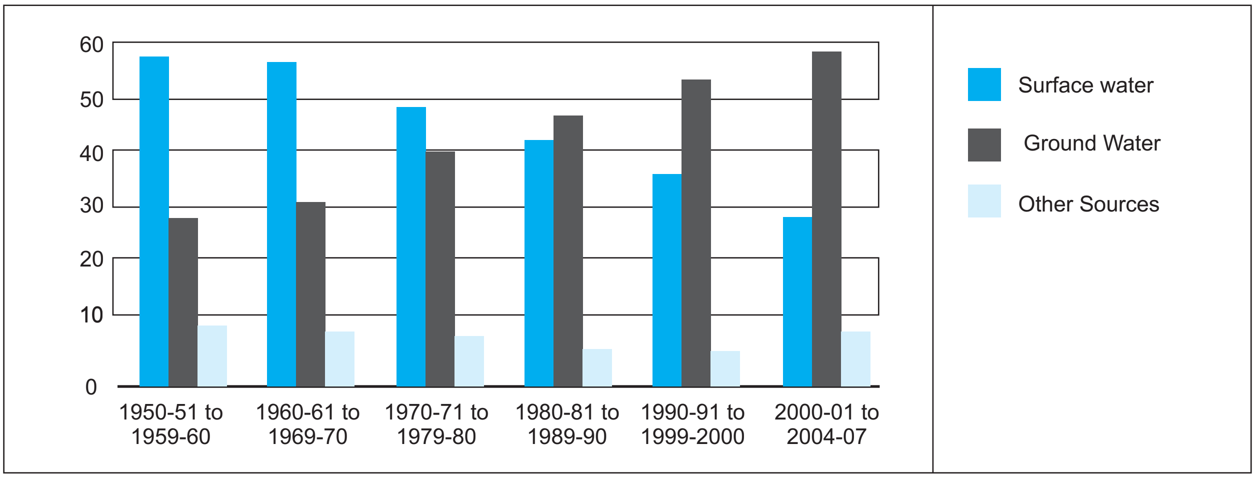
2.2 Agriculture

According to the Planning Commission (2008), although the share of agriculture in the GDP declined from over half at the time of independence to less than one-fifth in 2010, it remains the predominant sector in terms of employment and livelihood with more than half of India's workforce engaged in it as the principal occupation. It contributes significantly to export earnings and is an important source of raw materials for many industries. Therefore, it also receives the greatest share of the annual water allocation and the GoI has assigned the highest priority to development of the agricultural sector in the Eleventh Five Year Plan period (2007-12), with a targeted growth of 4 per cent (ibid.). Present extraction for the sector (along with livestock) accounts for 91 per cent of the total freshwater withdrawals in 2010 (FAO, 2010). One of the determining factors for the success of the green revolution was timely availability of water through utilisation of groundwater, contrary to the highly regulated and corrupt system of canal irrigation (World Bank, 2005).



It is widely agreed now that irrigation development in the country traversed an unsustainable trajectory with increased dependence on groundwater. Free or cheap power as an economic subsidy initially, and political sop later, has also been detrimental to sustainable groundwater extraction. The groundwater irrigation structures which stood at about 18.5 million in 2001 have been estimated to reach about 27 million, with every fourth rural household owning one such structure.[19] These

Figure 2.4: Decade-wise Share of Surface Water and Groundwater in Net Irrigated Area (%)



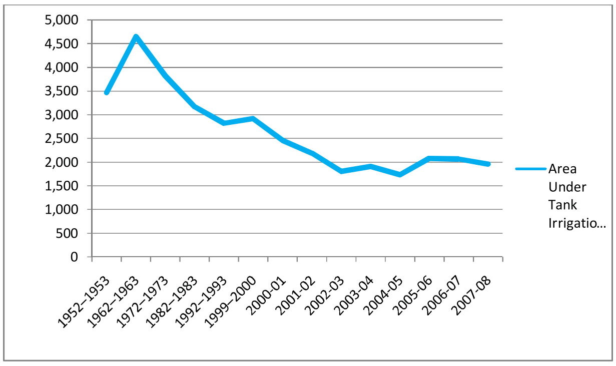
Source: Indian Agricultural Statistics (2008) cited in Kulkarni et al. (2011: 38)

figures reiterate that agriculture continues to put immense pressure on groundwater resources (see Figure 2.3). The 2030 case scenario projects increasing population and rise in demand for food/feed crops leading to agriculture accounting for 1,200 BCM or 80 per cent of total water demand which is almost double the demand in 2005 (Addams et al., 2009). The deteriorating state of traditional water management systems, which serve the multiple needs of livelihood security and irrigation source of many small-scale farmers, has been another disturbing trend. Figure 2.5, for example, shows the declining trend of tank irrigation in the country. To ensure the food security of the burgeoning population, as well as address the escalating levels of consumption by the urbanising population, enhancing agricultural productivity will be imperative while addressing the issue of sustainability at the earliest.

2.3 Water for Ecology

Much like the sectoral demand for water, there also exists an ecological demand. Although difficult to quantify it numerically, it is seen in some ways as a minimum right of ecosystems. The issue involved here is whether or not there is a need to ensure that minimum flows remain unbound and 'unused' so that ecosystem services may be regenerated. Though there is an increasing acceptance of this concept, there are different views on it. Those with environmental leanings tend to treat preservation of ecosystem integrity to be of higher importance than simple regeneration of ecosystem services, and tend to see minimum environmental flows as a prior charge on water services. The issue remains unresolved and probably some compromise will have to be made around the subject, but it is becoming increasingly clear that we can no longer treat unbound flows as 'wasted' because it 'flows out to the sea' and must reach consensus on the level of flows that may be treated as necessary for environmental needs (Joy and Paranjape, 2008). More recently, Ramaswamy Iyer, while proposing an alternate water policy for the country, has fervently put forth the argument for recognising environmental needs while designing any national water policy. He argues that rivers are more than mere water channels that can be regulated and altered at our will (Iyer, 2011). The ambitious project of interlinking rivers has reached an impasse due to vehement opposition by ecologists and hydrologists alike. Although empirical research[20] has persistently questioned the net benefits arising from such projects, considering the huge social and environmental costs involved, the enchantment of policy makers with big dams doesn't seem to fade. As per the National Register of Large Dams (CWC, 2009), there are 4,711 completed, large dams in India and another 390 dams under construction, although no comprehensive assessment has been done to evaluate the performance of the existing dams (Thakkar, 2005).

Figure 2.5: Net Irrigated Area under Tanks in India since Independence



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[19] Shah (2009) cited in Kulkarni et al. (2011: 37)

[20] See, for example, Thakkar (2005)

2.3.1 Wetlands

Wetlands cover an estimated area of 58.2 MHa (Prasad et al., 2002) of the country. Natural wetlands in India consists of the high-altitude Himalayan lakes; wetlands situated in the flood plains of the major river systems; saline and temporary wetlands of the arid and semi-arid regions; coastal wetlands such as lagoons, backwaters and estuaries; mangrove swamps; coral reefs; and marine wetlands. It is estimated that freshwater wetlands alone support 20 per cent of the known range of biodiversity in India.[21] They perform crucial ecosystem services, including retaining water during the dry periods, keeping the water table high. In Chilika Lagoon in eastern India, 200,000 people are dependent on wetland fishery and agricultural production; the sale of fishery-related products generated an estimated US$18.23 in 2004-5 (Wetlands International, 2010). The East Kolkata Wetland is an example of wetlands where usage of city sewage for traditional practice of fisheries and agriculture is practised (ibid.). The wetlands are seriously threatened by reclamation through drainage and landfill, pollution (discharge of domestic and industrial effluents, disposal of solid wastes), hydrological alterations (water withdrawal and inflow changes) and over-exploitation of their natural resources resulting in loss of biodiversity and disruption of ecosystem services. The Millennium Ecosystem Assessment (2005) highlighted that the primary direct drivers of wetland degradation were 'infrastructure development, land conversion, water withdrawal, eutrophication and pollution, over-harvesting and overexploitation, and the introduction of invasive alien species' (p. 15). India has lost 38 per cent of its wetlands in the last decade with the loss rate being as high as 88 per cent in some districts.[22] Currently, 25 wetlands in the country are designated as Ramsar Wetlands of International Importance,[23] and 68 wetlands have been identified for protection under the National Wetland Conservation Programme (ibid.). At least nine of India's 25 Ramsar sites are severely affected through hydrological alterations and large-scale water abstraction (ibid.). In 2009, the Ministry of Environment and Forests (MoEF) issued Guidelines for Conservation and Management of Wetlands and identified 122 wetlands for protection. In December 2010, it notified the Wetlands (Conservation and Management) Rules, under the Environment Protection Act of 1986 (MoEF, 2009). Though this has been a welcome step since India had no legislation to protect inland or freshwater resources the law has been criticised for its lack of citizen involvement among other things.

2.4 Industry

Industries are a large promoter of economic growth and as India strives to maintain and accelerate its impressive GDP growth, the demand for water in the industrial sector is also bound to increase. India is the tenth most industrialised country in the world with about 88 industrial clusters scattered across the country (CPCB, 2009). Water is an integral component in industrial infrastructure and hence its importance in sustaining the GDP cannot be undermined. As mentioned before, the industrial sector accounts for only 2 per cent withdrawal of the total freshwater resources of the country. According to the projected water demand for 2030, the demand from industry will quadruple to 196 BCM (13 per cent), pushing overall demand growth close to 3 per cent per annum (Addams et al., 2009). The Centre for Science and Environment (CSE) in 2004 published an analysis about water use in industry, making a case for the underestimation of water use by the industries in India (CSE, 2004). It argued that water use efficiency in Indian industries continues to be much lower when compared to some other developing countries in the world (Table 2.5). Water is not only needed as an input in the industrial process, but also for discharging the effluents generated. Industries like the pulp and paper industry, thermal power plants, textiles, and the iron and steel industry are highly water intensive. Industries in India have also been criticised for taking inadequate steps to comply with existing environmental standards (discussed later in Chapter 3). As mentioned earlier, stretches of some major rivers passing through industrial clusters are severely polluted. Extraction of water by industries has often come in conflict with the livelihood interests of the people, as is seen in the case of Plachimada, Kerala.[24] A boom in the real estate sector has raised the demand of sand for construction, leading to mining of sand in some riverine areas of the countries beyond sustainable levels. This has had a negative impact on both the ecosystem as well as the people dependent on it (Anappara 2005). The bottled water industry is one of the fastest growing industrial sectors and India ranks tenth in the list of largest bottled water consumers in the world (Bhushan 2006). Unchecked expansion of this industry also has adverse repercussions for water security in many areas where groundwater is the only water source.

Although industries make a significant contribution

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[21] Deepa and Ramachandra (1999) cited in Prasad et al. (2002)

[22] Vijayan (2004) cited in Dandekar and Thakkar (2010)

[23] For more details see: http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__

[24] See, for example, 'Water: Private, Limited – Issues in Privatisation, Corporatisation and Commercialisation of Water Sector in India' at: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Privatisation,%20Corporatisation%20and%20Commercialisation%20of%20the%20water%20sector_India_Manthan%20Adhyayan%20Kendra_2002.pdf (accessed on 25 November 2011).

to economic growth, their non-compliance to pollution control measures has led to a continuously growing water pollution burden. It is implicit that an unchecked rise in industrial demand will eventually prove to be harmful for India's water resources.

2.5 Water for Livelihoods

The dynamic nature of water makes it an indispensible input in almost all livelihood ventures. Even after 63 years of independence, most of the poor and the marginalised communities continue to depend on the natural resource base for sustenance. Water security is absolutely essential to ensure livelihood security especially in the context of both rural and urban poor, for in addition to basic uses like drinking, sanitation and irrigation, water is also used for livestock rearing, home gardens and other small-scale commercial activities. Contemporary development literature on water management cites many examples of using water as a means to address rural poverty by ensuring appropriate quality and quantity of water at the right time. A recent development in this regard has been the genesis of the Rural Water Livelihood Index (RWLI), which is essentially a composite index of four key aspects of rural livelihoods: (a) access to basic water services; (b) crop and livestock water security; (c) clean and healthy water environment; and (d) secure and equitable water entitlement (Sullivan et al., 2008). Water is an essential pre-requisite for development, not only because it is inextricably linked to agriculture and other production functions but also because it can be a focal point around which other interventions can be designed (World Water Assessment Programme, 2009). The examples collected from the field for the United Nations World Water Development Report (ibid.) exemplify the latter whereby water and sanitation interventions in the villages proved to be a starting point for Non-governmental Organisations (NGOs) and government agencies to address other concerns like gender imbalance and secure livelihoods. One such economic enterprise which generates income for the people is inland fisheries, a crucial livelihood support system to rural and urban poor. In the wake of changing patterns of growth, escalating inter-sectoral water competition and rising population have emerged as some of the serious concerns (see Box 2.2).

Box 2.2: Water for Livelihoods: Case of Inland Fisheries

- In a study conducted in the Tungabhadra sub-basin, Karnataka, 47 per cent of the fishermen surveyed cited pollution and fish kills as having a negative impact on health and income. According to the findings, 'Instances of fish kill have abounded at different stretches of the river, for instance, in Hale Ayodhya, in 2004; fish kill was very intense, where the fishing communities were unable to fish for the whole year. There are documentations on the composition of fish species that have been reduced or have become extinct over the years'.

(Source: Manasi, et al., 2009)

- Increased urbanisation and other anthropogenic activities are also hampering traditional livelihood practices of the people. For example, the Dal Lake, which is a source of income for the 1,200 houseboat owners and fishermen, has shrunk to less than half its original size in just 30 years . The Lakes and Waterways Development Authority blames the people living on the lake for this sorry state, even as the raw sewage from Srinagar's million plus inhabitants continue being dumped into it.

(Source: Byerly, 2010)

- A study (1999-2000) of the leather industries in Vellore district of Tamil Nadu by Sekar (2003), reveals that pollution of the common property resources (river Palar in the study) due to

Table 2.5: Comparative Water Use by Industry

Country	Industrial water use (billion cubic metres)	Industrial productivity (million US$)	Industrial water productivity (US$/cubic metres)
Argentina	2.6	77,171.0	30.0
Brazil	9.9	231,442.0	23.4
India	15.0	113,041.0	7.5
Republic of Korea	2.6	249,268.0	95.6
Norway	1.4	47,599.0	35.0
Sweden	0.8	74,703.0	92.2
Thailand	1.3	62,800.0	48.9
United Kingdom	0.7	330,097.0	443.7

Source: World Bank (2001) cited in CSE (2004) industrial effluents had altered the cropping pattern, employment potential, income distribution in the area, leading to social instability.

(Source: Sekar, 2003)

2.6 Water: Multiple Use of the Resource

Water has multiple functions social, economic and environmental. Historically, water from the same source has been used for different purposes simultaneously. In rural India, the water received or procured by a household is not only used for drinking and personal hygiene, but also for livestock, fishing, kitchen gardening, brick making, and other varied small enterprises. It is primarily the rural poor and people living in the peri-urban areas who depend on water for diversified livelihoods (van Koppen et al., 2006). An assured water supply in terms of quantity, quality and reliability with improved access can benefit these communities in two ways: by enabling resource base for these water dependent livelihoods and/or by helping them save precious time spent earlier in collecting water; time that can be used for livelihoods. Moriarty et al. (2004) use the concept of 'productive use' of water to refer to water used for small-scale, often informal, activities whose primary purpose is improved nutrition and/or income generation. According to them, “[H]ousehold water supplies are most often thought of as coming under the remit of the domestic water supply and sanitation (WATSAN) sub-sector, with its exclusive focus on water supplies for drinking, washing, cooking, and sanitation (so-called basic needs). Water for agricultural production is assumed to be provided by the irrigation sector, but this in turn seldom focuses on smaller scale or domestic uses at the household scale. (ibid.: 21).“

Thus, these multiple water use services have a lot to contribute in terms of livelihood security and the overall well-being of these people who otherwise face a serious resource crunch. While a community designed system will take into consideration the entire multiple uses to different extents, it is the top-down approach of water management by the various government departments which fails to acknowledge the same due to their highly segregated sectoral approach. In many areas, big irrigation schemes that supply large quantities of water would come up, even though the demand for basic survival needs of the population is not fulfilled. While in quantitative terms, it might be easy to manage the water needs of households from reservoir supplies, there are two common constraints in allocating water from such systems. First, the water available through irrigation schemes may not meet potability standards. Second, the irrigation sources, which primarily supply water to farms located far away from village settlements, may not be easily accessible for the rural households.

2.6.1 Multiple Use Water Services (MUS): The Indian Experience

Water allocation by state agencies in India is not based on environmental, social, economic, or fundamental rights considerations. For instance, the rural water supply agencies in most Indian states are concerned with supplying only 40 lpcd of water for basic human needs, without considering the water needs for cattle rearing, and watering homesteads, which are basic necessities of the rural households. National Rural Drinking Water Programme (NRDWP) guidelines stipulate that 40 lpcd water supply for drinking, cooking and bathing should maintain quality as per BIS standards and additional 30 lpcd for Desert Development Programme (DDP) areas to cover livestock. However, for other household and animal needs, other water sources of acceptable standard should be used. Thus, it leaves much to be desired from the point of view of equity and social justice. Water administration, works by compartmentalizing the broad functions of water supply into departments such as irrigation, drinking water, industrial water supply, etc., with about ten different ministries dealing with various aspects of water (CSE, 2004).[25] The statutory laws which govern the functioning of such bodies may not be relevant to the situation on the ground, where water allocation might be governed by customary laws, religious or cultural norms, and local administration and politics.[26] In India, as elsewhere, an ongoing scheme of water supply in an area is used by the people to serve other water needs as well. Reiterating this fact were the findings of Mikhail and Yoder (2008) in Maharashtra from their study of MUS implementation in Nepal and India. In this study on the implementation of multiple use water service in India, it was found that while government departments would make a distinction between various water uses, the people had been using four successive water schemes over the past 20 years to meet a variety of their water needs. However, because these uses are unplanned and rarely acknowledged, they often lead to health risks for water users, water shortages at the tail end of supply systems, damage to infrastructure, and conflicts between users.

In the Gangetic flood plain of West Bengal, wetlands are used as multiple use systems and have a significant impact on the livelihoods of rural people who derive major economic benefits from wetland cultivation, direct irrigation, jute retting,

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[25] For example, MoWR, MoI, MoP, MoEF, MoRD, MoUD and agencies like the Central Ground Water Board Authority, central and state pollution control boards.

[26] See, for example, Cullet (2007: 5-6)

and fisheries. The most important benefit is from fisheries, followed by wetland cultivation and jute retting.[27] However, these benefits also depend on the agro ecology, socio-economic conditions and the cultural context. In Sambalpur district of western Orissa, the village tanks serve functions as varied as a source of water supply for paddy and vegetable cultivation, for domestic use, for livestock, reservoir for fish cultivation and for recreation, with highest economic benefits accruing from irrigation. More importantly, the economic value realised from the use of water for irrigation was high during years of drought as compared to normal rainfall years (Kumar et al., 2011). Field-based research by the Indian Council of Agricultural Research (ICAR) in Bihar and Orissa show that well-designed multiple user systems can enhance the productivity of soil and water in eastern India remarkably (Sikka, 2009). This involved integrating fisheries, prawn farming and duck-keeping with paddy irrigation using local secondary reservoirs for the water. Research in south India shows how the revenue maximisation can be possible by using irrigation tanks for multiple uses such as social forestry, brick making, fisheries, silt collection and groundwater recharge (Palanisami et al., 2010). James (2004), in his study in Banaskantha in Gujarat and Anantapur in Andhra Pradesh noted that rural women allow the time saved by improved water supply to other productive work. In this way, each woman could earn between US$16 and US$115 per year. Similarly, from her work on gender roles and multiple uses of water in north Gujarat, Upadhyay (2005) concludes that women have a central role to play in many socio-economic production functions dependent on water such as dairy farming and crop cultivation, in addition to collecting water for domestic needs, and, therefore, MUS would prove to be beneficial for them.

Taking a cue from the successful implementation of MUS by International Development Enterprises (IDE) in the hills of Nepal, Sharma et al. (2010) have discussed how MUS can be used for poverty alleviation in India's north-eastern hilly region. Malik 2010,[28] while analysing the level of water security provided through infrastructure built as part of the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNERGS), found that although the structures allowed multiple uses of water, the water made available for each use may not be sufficient to meet thel requirements. About 43 per cent of the sampled farmers used the water available from these structures for single use only, as against 26 per cent who use it for at least four purposes, viz., irrigation, livestock, drinking and sanitation.

Other pilot projects of MUS are also being tried in different parts of India. For instance, in one of the three pilot experiments being carried out by the United Nations Children Fund (UNICEF), Groundwater Survey and Development Agency, Maharashtra , and Institute of Resource Analysis and Policy (IRAP) in Satara district of western Maharashtra involves converting a natural spring-based rural water supply scheme in a foothill village into MUS that would cater to the water needs for livestock and kitchen gardens. Studies found that it would be possible to augment the limited water supplies during lean season through the creation of a large underground reservoir which can tap the spring discharge during the wet season and supply water during summer.

2.6.2 MUS in India: Barriers to Scale-Up[29]

While the vast experience from around the world suggests that MUS systems would be socially and economically more viable than many single use systems,[30] there are multiple blocks at the government level to start designing the system for multiple use such as irrigation and domestic water supply. Wherever such efforts have been made, some barriers to the scale-up process are observed. The following barriers were identified by the locals and NGOs with regard to MUS in Maharashtra:

- Institutional Inadequacy: Although most single use systems are de facto multiple use systems at the level of the water users, government officials still follow the sectoral norms of water supply and distribution as set during the colonial period. Part of the problem lies in the way in which water administration is organised in Indian states.
- Quality and Quantity of Water Required: Due to the conflicting nature of demands vis-à-vis quality, quantity and reliability between sectors (for example, while quality and high dependability is important for drinking water supply, quantity is more important for meeting irrigation requirements), designing and water delivery of the MUS may become difficult.

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[27] Mukherjee (2008) as cited in Khan (2010: 5)

[28] Cited in Clement (2011). Inputs received on 23 February 2011 from Floraine Clement (IWMI) for the query posted on Solution Exchange website, Available at: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Inputs_for_India_Water_Development_Report-Experiences_Advice.pdf [Accessed on: 1 April 2011].

[29] This section is based on the experiences of IDE from the MUS implementation in Maharashtra (Mikhail and Yoder, 2008). This is also in the light of the fact that MUS is a highly understudied subject in India even though there are greater evidences of multiple use water systems in many locations in India.

- Land Use: Due to land use constraints, whatever little land is available may preferably go to agricultural use rather than other uses like homesteads and kitchen gardens
- Time lapse in Completion of Projects: Constraints like the callous attitude of the authorities combined with administrative red-tapism and delayed awarding of contracts due to prolonged rainy season, prevent water delivery schemes from reaching a state of completion in a timely manner. This, in turn, hampers related schemes, which cannot be initiated until the original scheme is completed.
- Community Barriers: Community participation is crucial for the successful running of multiple use water systems. However, due to the water allocation issues often going against the interests of the local population, there is a lack of good rapport between communities and official agencies and NGOs. The reluctance of the local population to contribute to the scheme and its management too acts as a barrier to the successful implementation of such projects.
- Government Barriers: Different policies at the centre and states may lack coherence with ground realities. For instance, water supply schemes in many Indian states are designed with rigid norms regarding per capita water supply for drought-prone areas. Relaxing these norms and making upward revisions would require a high level of coordination within the state administration amongst senior policy makers. A highly centralised bureaucracy makes it difficult for different departments at varied levels to achieve such coordination. Often the officials may also be indifferent if an issue of self-interest is involved.
- Issues of Fund Allocation: While it is understood that MUS would benefit the communities by supplying water for both productive and domestic needs, there would be an increase in the number of agencies contributing to the schemes. For instance, given the fact that dairy, horticulture, fisheries, etc., would be promoted with the improved water supply in rural areas through a well-designed MUS, the concerned departments will have to earmark funds for the implementation of the scheme as against a single agency, that is, the rural water supply department for now. This is not an easy task, as it would involve attribution of different cost components of the scheme to different purposes.

2.7 Summing Up

Meeting the rising water demand is a pressing challenge that India currently faces. Demand side management has been put forward as a viable option but it requires strong political will backed by adequate infrastructural support. Many models of demand side management like the public-private partnership, water pricing, metering, etc., have been suggested and tested. But the 'one size fits all' approach is far from applicable in the context of India. Meeting target ten (halve, by 2015, the proportion of people without sustainable access to safe drinking water) of goal seven (ensuring environmental sustainability) of the MDGs will indeed be a herculean task considering that the water sector suffers from major deficit of funds with almost all schemes failing to recover the operation and maintenance costs, let alone the capital costs for infrastructure. The significant achievements by India in the engineering sphere of water resource development continue to be undermined by the poor demand and supply side management. Agricultural demand for water will continue to dominate. Even as the disenchantment with agriculture continues, it nonetheless remains ‘the backbone of the Indian economy. As the World Bank puts it, the irrigation and hydropower are the 'direct benefits', which in turn generate both inter-industry linkage impacts and consumption-induced impacts on the regional and national economy’ (World Bank, 2005). But the excessive level of groundwater exploitation by the agriculture sector needs to be addressed to ensure the sustainability of the resource. Lost in the rhetoric of development are the voices of the poor and the marginalised at whose expense the country continues to 'develop'. Traditional livelihoods dependent on water are being lost, thus changing the social dynamics of the country. Ecological needs rank fourth on the water allocation priorities in the National Water Policy (NWP) but in practice it remains dismal. The increasing pressure from industries on water resources is for everyone to see but an industrial water policy is still the want of the day. It is imperative that in future, all the sectors , viz., domestic, agricultural and industrial will compete with each other due to a rise in demand. The inter-sectoral conflicts have not yet reached the magnitude of water wars, but have at many places transformed into serious political and developmental issues. Considering the multiplicity of water needs and their linkages with rural livelihoods there is a need to rethink the way in which water supply projects are being planned today. Where problems in the management of water supply schemes exist, they can often be traced back to the fact that some of the existing uses of water were not considered at the time of building the project. No source is generally used for a single purpose and so all potential users must be involved at the time of planning the scheme. As is

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[30] For instance, as a review of the literature shows, many large irrigation schemes in Thailand are designed as multiple use systems catering to fisheries, domestic water supply, recreation, hydropower, and rural industries.

the case with Indian water sector, MUS could be the solution to several problems currently plaguing the sector, including poor maintenance, low cost recovery and poor overall economic and financial viability. Water demand has both quality and quantity dimensions. A factor that severely limits the water availability to different sectors is water pollution, which is dealt with in the following chapter.

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CHAPTER THREE

URBAN WATER AND SANITATION[31]

The 2011 provisional Census of India reports an annual exponential growth rate of the urban population to be 2.76 per cent. The absolute increase in the urban population is more than the rural population in India. What is more surprising is that the number of towns has increased from 5,161 in 2001 to 7,935 in 2011, an addition of 2,774 'new' towns. These trends show that India is becoming increasingly urbanised. With the rise in urban areas, water and sanitation access for the urban poor is an issue of concern. This chapter presents the challenges facing the urban poor because of the disparity in the provision of water services, and a water management approach based on exclusion rather than inclusion

3.1 Urban Population Growth

The urban population of India is now 377.1 million (Census of India, 2011), which is 31.16 per cent of the country's total population. The decadal urban population growth rate during 2001-11 is 31.8 per cent, which is 1.8 times the overall and 2.6 times the rural population growth, and the absolute increase in urban population is more than the rural population (see Table 3.1).

Table 3.1: Population Growth During 1991-2011

Population (in millions)	1991	2001	2011	Addition during 1991-2011
India [Total]	846.4	1028.7	1210.2	363.8
Rural	630.6	742.6	833.1	202.5
Urban	215.8	286.1	377.1	161.3
Share of Urban Population%	25.49	27.81	31.16	44.34

Source: Provisional population totals, Census of India (2011)

Historically, India is known as the country of villages, but the population composition of the country in last two decades has changed significantly. During 1991-2011, the overall population of the country increased by 43 per cent – the rural population increased by 32 per cent while urban population increased by 75 per cent. The share of urban population was 25.49 per cent in 1991, which has increased to 31.16 per cent in 2011. The number of towns (urban centers) have increased from 5,161 to 7,935, an addition of 2,774 towns during 2001-11.

3.2 Slums and the Urban Poor

There is a wide variation in the estimation/reported slum population by various government and other agencies. The Census of India 2001 reported a slum population of 42.6 million from 640 towns of the country which was 14.88 per cent of the total census population (it did not include towns with a population below 50,000 and few town and cities with populations of more than 50,000 where local bodies did not recognise any slum area). Later, it also included towns with populations between 20,000-50,000 and reported slum populations of 52.4 million from 1,743 cities/towns. The reported slum population was less than the Town and Country Planning Organization's (TCPO) estimated slum population of 61.8 million. The UN population report estimated a 158.42 million slum population was less than the Town and Country Planning Organization's (TCPO) estimated slum population of 61.8 million. The UN population report estimated a 158.42 million slum population in 2001 (Ministry of Housing and Poverty Alleviation, 2010).

The Committee on Slum Statistics and Census (constituted by the National Building Organisation,

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Ministry of Housing and Poverty Alleviation, Government of India in 2008) estimated a 75.26 million slum population in 2001 and projected that slum populations would reach 93.05 million by 2011 (which is about 25 per cent of the provisional population of 2011). Further, UN-HABITAT estimated the slum population at 169 million in 2004-5 (Ministry of Health and Family Welfare, 2009). Although the 11th Five Year Plan (2007-12) considered the census slum population (42.6 million, 14.88 per cent) but it is also mentioned in the document that 'almost 30–40 percent of India's urban population lives in slums' (Planning Commission, 2008).

3.3 Urban Water Supply and Sewerage

According to the Census of India 2001, there were 498 Class I and 410 Class II cities in the country; the estimated total population of these cities in 2008 was 257.75 million and total water supply was 48090.88 MLD. Average per capita water supply in Class I and Class II cities was 179.02 and 120.79 l per day (CPCB, 2009).

Water supply is not uniform across all states or cities. The average per capita water supply for Class I cities of Tamil Nadu is 79.9 l and for Maharashtra, it is 310.09 l whereas the average per capita per day water supply for Class II cities of the state is 106.74 l. Among the Class II cities of Maharashtra, water supply ranges between 34.5 LCPD in Malkapur to 464.94 LCPD in Anjangaon. Such variations are common across all the cities and states of the country. One of the major reasons for wide variation in per capita water supply is the mismanagement of the water supply system. Levels of system losses through 'unaccounted-for water' or 'non-revenue water' are often as high as 50 per cent in Indian cities and represent large financial and environmental losses to cities and their economies. A UN-HABITAT supported study for four cities of Madhya Pradesh has revealed that this Non-Revenue Water (NRW) ranged between 31 per cent and 49 per cent in Bhopal, between 37 per cent and 43 per cent in Jabalpur, and between 36 per cent and 66 per cent in Gwalior. Based on the study, city-specific water demand management strategies were developed to minimise water losses and to increase revenue for municipal corporations (UN-HABITAT, 2006).

Discharge of untreated sewage is the most critical water polluting source for surface and groundwater in India. Estimated sewage generation from Class I and Class II cities is about 38,000 million l per day (80 per cent of the water supply) and only 31.5 per cent of the generated sewage can be treated per day on the basis of the installed capacity. Estimated sewage generation by Class I cities is 35,558 MLD and sewage treatment capacity is only 32 per cent of the total sewage generated. Estimated sewage generation from Class II cities is about 2,697 MLD and the treatment capacity is only 8 per cent of the generation. Thus, 70 per cent of untreated sewage from Class I cities and 92 per cent from Class II cities contaminates surface and groundwater on a daily basis (see Table 3.2)

Table 3.2: Sewage Treatment Capacity of Class I and Class II Cities of some States

State	Population (2008 estimated) million		Sewage Treatment Capacity (% of sewage generation)	
	Class I cities	Class II cities	Class I cities	Class II cities
Maharashtra	40.25	2.50	42	13
Uttar Pradesh	25.76	3.38	35	03
Delhi	14.85	–	61	–
Madhya Pradesh	10.79	1.74	15	07
Rajasthan	9.61	1.59	04	–
Odisha	3.33	0.90	08	–
Chhattisgarh	2.51	0.56	20	–
Bihar	5.78	1.10	13	02
Tamil Nadu	16.85	3.25	31	16
Andhra Pradesh	20.14	3.44	37	05
Uttarakhand	1.24	0.06	10	70

Source: CPCB (2009)

3.4 Status of Drinking Water and Sanitation

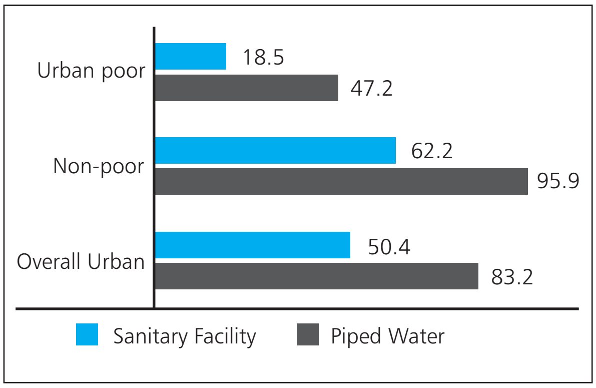
As per census 2011, 70.6 percent of urban households use tap water for drinking, of which 62.0 percent is treated and 8.6 percent remains untreated. 20.8 percent use water from hand pump / tube well, 6.2 percent use water from well, of which 1.7 percent are covered and 4.5 percent uncovered. 71.2 percent of urban households have source of water within the premises while 20.7 percent households have to fetch water from a source located 100 meters from the premises and 8.1 percent household collect water from a source located beyond 100 meters.

The census 2011 data shows that 18.6 percent households in urban India do not have latrines within the premises. 6 percent urban households use public latrines.32.7 percent Pour flush latrine in urban areas connected to sewer pipes. At the same time, pour flush latrine connected to a septic tank is recorded in 38.2 percent of households.It is reported that 95 per cent of urban households have access to improved source of water (NFHS-III, 2005-6)[32] and access to improved source of water is not a reflection of availability of safe drinking water. It is also reported that about 78 per cent of India's urban population has access to safe drinking water (CPCB, 2009).

Location is the deciding factor for source and availability of drinking water. It is reported that 50.7 per cent of urban households have access to piped water supply at home but access in non-slum and slum areas is 62.2 and 18.5 per cent respectively.[33] Further, the disparity on the basis of tenure status is more severe and, generally, households of the non-notified slums are totally deprived from piped water supply in a dwelling unit (see Figure 3.1).

According to NFHS-III, of the total urban households, 50.4 per cent have access to sanitary facilities (either flush or pit), but out of the total urban poor only 18.2 per cent have access to sanitary facilities while 62.2 per cent of the non-slum population has access to sanitation facility.

Figure 3.1: Status of Piped Water Supply and Sanitary Facility for Urban Poor and Non-poor



Source: NFHS III

The sanitary coverage includes individual as well as community toilets. As per NFHS–III, 52.8 per cent of urban households have access to improved but not shared toilet facility, 24.2 per cent have access to shared facility, 0.5 per cent have access to dry toilets and about 16.8 per cent have no facility and defecate in the open. The disparity in access to improved not shared (individual) toilet facility between slum and non-slum households is very clearly visible (see Figure 3.2).

Provision of services and coverage further depends on the tenure status of a settlement; it may be categorised as a legal/illegal, notified/non-notified, listed/non-listed, recognised/unrecognised slum according to the state's slums act. Sanitation conditions in both recognised and unrecognised slums are appalling. For example, Jaipur is the capital of Rajasthan with a million plus people, that is, 86.5 per cent of the population, as per the City Development Plan of Jaipur City (JNNURM, 2011: 13), covered through

Table 3.3: Waste and Sanitation Coverage Details of Selected States

State	% Households with access to piped water supply at home			% Households accessing public tap/handpump			% Households using sanitary facility (flush/pit)		
	Urban poor	Urban non poor	Urban total	Urban poor	Urban non poor	Urban total	Urban poor	Urban non poor	Urban total
Maharashtra	47.8	87.5	81.3	48.2	11.5	17.2	50.1	94.9	87.9
Uttar Pradesh	11.5	40.9	32.2	84.6	58.1	65.9	53.5	96.4	83.8
Delhi	29.8	82.3	75.0	63.3	7.9	15.7	65.6	98.6	94
Bihar	2.8	17.1	11.9	90.3	80.6	84.2	29.5	98.0	72.9
Madhya Pradesh	22.9	60.2	47.1	58.2	36.3	44.2	22.9	93.7	71.2
Rajasthan	51.7	87.3	80.7	44.9	10.5	16.9	44.6	94.6	85.4
All States	18.5	60.2	50.7	72.4	30.7	41.6	47.2	95.9	83.2

Source: Compiled on the basis of key indicators for urban poor, available at http://uhrc.in/module

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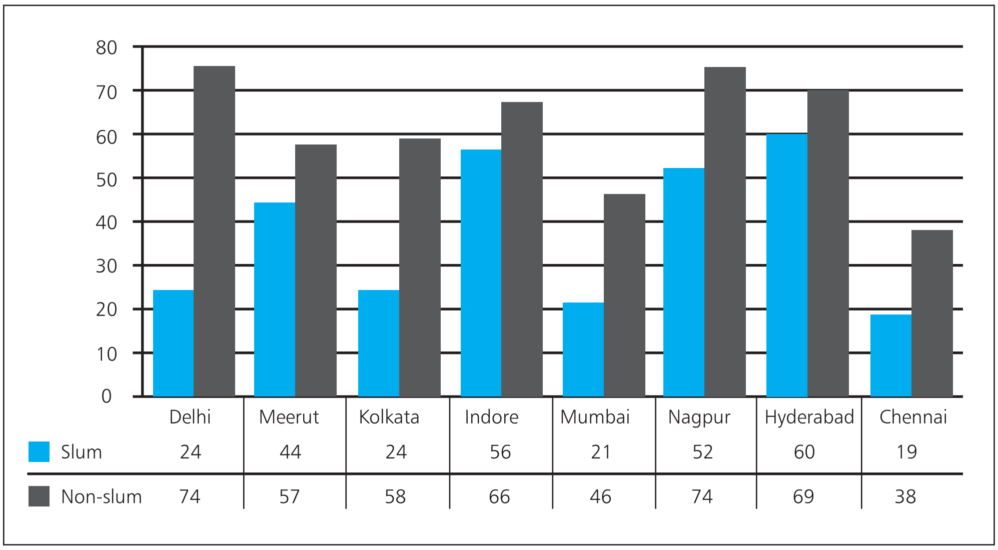
[32] National Family Health Survey (NFHS) – III, 2005-6, available at http://www.nfhsindia.org/NFHS-3%20Data/VOL-1/India_volume_I_corrected_17oct08.pdf (accessed 10 September 2011).

[33] 2005-6, 'Key Indicators for Urban Poor in India', available at http://www.uhrc.in/name-CmodsDownload-index-req-getit-lid-99.html (accessed 16 October 2011).

the Public Health Engineering Department's (PHED) water supply system while the remaining is covered by another system. Further, it is also mentioned that 45 per cent of urban poor families are dependent on community water sources, 39 per cent on private water sources and 16 per cent have no definite source of water. Whereas, according to the study conducted by the Mahila Housing Sewa Trust (2009), 26 per cent of slum households have access to in-house tap connections, 37 per cent are dependent on public taps, 17 per cent are dependent on neighbours, 8 per cent are dependent on private sellers, and about 25 per cent of slum households have no definite source of water. The sewerage facility covers 65 per cent of the city area, and slums/kachchi bastis are neither covered by the sewerage network nor by septic tanks, and 48 per cent of slum households have no sanitation facility and defecate in the open (HUP-IIHMR, 2011).

Figure 3.2: Percentage of households (slum and non-slum) with access to improved individual toilets



	Delhi	Meerut	Kolkata	Indore	Mumbai	Nagpur	Hyderabad	Chennai
🟦 Slum	24	44	24	56	21	52	60	19
⬛ Non-slum	74	57	58	66	46	74	69	38

Source: MoHFW (2009)

A UN-HABITAT supported poverty mapping situation analysis study in partnership with WaterAid India in four major cities of Madhya Pradesh (Bhopal, Gwalior, Indore and Jabalpur) revealed that access to piped water for slum communities range from 28 to 65 per cent, and that 31 to 66 per cent households depend on public standposts and the rest on private sources. Further, it showed that access to household toilets in slum communities range from 48 to 76 per cent, that 6.1 to 8.0 per cent households use community toilets, and that 16 to 46 per cent households defecate in the open (WaterAid, 2006).

The National Capital Territory of Delhi is an example of the provision of the services as per tenure status. It is reported that improved sources of drinking water and improved individual sanitation facility is accessed by 92.6 and 63.9 per cent of households respectively and 75 per cent have piped water supply at home. But only 49 per cent of slum households have piped water at home. In Delhi, slums are broadly divided into two categories: notified slums and non-notified slums. Generally, the jhuggi/jhopari (JJ) clusters are in the category of non-notified/listed/identified slums. The Delhi Shelter Improvement Board reported 685 JJ clusters and 4.18 lakh jhuggies (Delhi Urban Shelter Improvement Board, 2011) and the 65th round of the National Sample Survey (NSS) reported 4,390 slums with 5.77 lakh (0.577 million) households and 2.8 million population. Only 21.7 per cent of the JJ clusters are covered with piped water supply (JNNURM, 2011) and individual tap connections are not allowed in the JJ clusters. According to the 65th round report of the NSS (Directorate of Economics and Statistics, 2010) individual latrine facility is reported from only 7.84 per cent of slums.

There are 377 slums with populations of 308,614 recorded in Bhubaneswar in 2008 and it is reported that none of the slums have piped water supply in the dwelling units and that public stand posts, handpumps/tubewells, open wells, etc., are the sources of drinking water. Of the total slum households, 80 per cent have no toilet facility (HUP-PFI, 2011). As per NFHS 3, urban households in Uttarakhand that have piped water supply in houses is 75.6 per cent and 72.8 percent of the urban household have flush/pour-flush latrines connected to piped sewer system, septic tank, or pit latrine (HUP-Plan, 2011). Similarly, in Jharkhand, tap water is the main source of drinking water for 34.7 percent households and out of total reported urban households 6.9 percent are getting tap water from untreated sources and 16.7 percent are using water from uncovered wells for drinking and out of total households 31 percent have no access to any type of latrine facility and defecating in open (Census 2011). Most of the cities are facing such situation but there is no concerted planning to deal with it.

3.5 Challenges

Urban population growth is much faster compared to both overall population growth and rural population growth; on the other hand, rural population growth is declining compared to urban population growth and the challenges of urbanisation are increasing. There are a number of factors–natural growth, geographical expansion of urban centres, migration from rural to urban areas due to natural calamities, displacement and non-availability of gainful employment-responsible for faster urban population growth.

In the absence of a widely acceptable definition of slums/slum dwellers/urban poor, availability of the authentic data is not possible.[34] Various agencies are involved in estimating slums and slum population on the basis of their own definitions and assessment methods. Generally, every state has its own definition and procedure for the declaration/notification of slums and mostly it is the notified/listed slums that are included for the situation assessment and provision of basic services thereby leaving out about half the slums[35]/human settlements from consideration. The Ministry of Housing and Urban Poverty Alleviation, Government of India, with the support of the United Nations Development Programme (UNDP) have launched a report on the nature and dynamics of urban poverty in the country (UNDP India-Urban Poverty Report 2009) The report estimates that urban poverty in India remains high, at over 25 percent which is about 80 million poor people who live in the cities and towns of India.
Further, the report indicates towards an increasing urbanisation of poverty looking at future projections.

Disposal of untreated sewage into the water streams is adversely affecting the health of the slum dwellers as about 24 per cent of the slums are located around the nallahs and 48 per cent of the slums are usually affected by water logging during monsoon.[36] Safe drinking water, sanitation, and a clean environment are essential needs and basic human rights, and India's policy framework very well recognises this. The provision of adequate drinking water for the entire urban and rural populations is one of the priorities of the National Water Policy (NWP). Provision of clean drinking water, sanitation and a clean environment are vital to improve the health of our people and to reduce incidence of diseases and deaths (Planning Commission, 2008). But disparity in the provision of services and an approach based on exclusion rather than inclusion, results in the urban poor being generally deprived from essential facilities and services of water, sanitation and clean environment.

3.6 Summing Up

The 2011 provisional Census of India reports the annual exponential growth rate of the urban population is tuned to 2.76 per cent, which is almost the same (2.73 per cent) reported in 2001. India's urban population stands at about 377 million with 31.16 per cent people living in urban locations. The decadal urban population growth rate during 2001-11 is 31.8 per cent, which is 1.8 times the overall and 2.6 times the rural population growth. Therefore, the absolute increase in the urban population is more than the rural population. The latest figures corroborate the fact that due to various socio-economic factors, like population pressure and poverty, the urban regions have seen large influx of population from rural areas thus creating new urban centres.

With the rise in urban areas, urban poverty is also on the rise. The Committee on Slum Statistics and Census estimated 75.26 million slum populations in 2001 and projected slum populations to increase to 93.05 million by 2011, which is about 25 per cent of the provisional population of 2011. What is more problematic is that the slum locations where poor people live are hardly served by the water supply systems. Examples from select cities show a skewed number of poor being served in the cities. Another challenge is urban sanitation. With the lack of individual coverage for sanitation, and also poor infrastructure to deal with a city's sewage, wastewater is becoming an alarming problem in almost all cities across India. The government has announced a National Urban Sanitation Policy (NUSP) intended towards making slum-free cities and provisions for safe drinking water, sanitation and solid waste management for entire urban

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[34] The 2001 Census is the first census to provide independent estimates of the population in slum and non-slum areas. Slums were enumerated in 640 cities/towns that had more than 50,000 residents and that reported the existence of slums. For the 2001 Census, the criteria used to designate the area as slum or non-slum (Office of the Registrar General and Census Commissioner, 2005): are - (i) all specified areas in a town or city notified as 'Slum' by State/Local Government and UT Administration under any Act including a "Slum Act"; (ii) all areas recognized as 'Slum' by State/Local Government and UT Administration, Housing and Slum Boards, which may have not been formally notified as slum under any act; and, (iii) a compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities". (Kamla Gupta, Fred Arnold, and H. Lhungdim. 2009:10)

[35] The NSS 65th round estimated that that 51 per cent of the slums are notified and 49 per cent are non-notified. The report is available at http://mospi.nic.in/mospi_nsso_rept_pubn.htm (accessed 04 October 2011).

[36] Some Characteristics of Urban Slums, NSS 65th round report, 2010.

populations.

These are among the targets of the 11th Five Year Plan (2007-12) and reduction of the burden of water born diseases by 50 per cent by the year 2015 is one of the goals of the National Health Policy 2002. The need is to recognise the fact and reduce the disparities in the provision of water and sanitation facilities and services. Considering the fact that water and sanitation are among the essential needs and basic human rights of all people, they should be provided to all, irrespective of the tenure status. Availability of reliable information on slum settlements and populations is essential for planning and providing water and sanitation, and therefore comprehensive counting and mapping is required. Sustainable and effective water and sanitation is only possible though community participation and there is a need to develop strategies based on learning and past experience.

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CHAPTER FOUR
WATER POLLUTION

Water pollution is a cause for increasing concern across the country for it not only affects the availability and quality of water for human beings, but also inhibits aquatic ecosystem productivity and sustenance. This chapter addresses the hazards of water pollution in India, discussing both the natural as well as the anthropogenic factors responsible. Building on available data, it explores the current magnitude of the problem, the contribution of the different sectors to water pollution, and the subsequent impact on health.

Water pollution is adding to India's water woes with almost 70 per cent of surface water and an increasing percentage of groundwater being contaminated by biological as well as chemical, organic, inorganic and toxic pollutants.[37] The sources of such pollution include point sources such as industrial effluents and domestic waste, and non-point sources such as agriculture. The health implications of poor water quality are enormous, and water and sanitation related diseases are responsible for 60 per cent of the environmental health burden in India (Planning Commission, 2008). As discussed later, water pollution is also a serious economic burden. Sector wise, agriculture still ranks the highest in terms of overall impact on water quality. CPCB's (2009a) latest findings reveal 43 out of 88 industrial clusters in India to be 'critically polluted' and reflect the increasing level of industrial pollution. The water resources, especially groundwater reserves, are also polluted due to natural and anthropogenic contamination in many regions.

4.1 Microbial Contamination

The presence of pathogenic microorganisms in drinking water is an extremely important parameter of water quality given the crucial role water plays in healthy lives. The world over, unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated four billion cases of diarrhoeal disease, causing more than 1.5 million deaths, primarily among children under five years of age (WHO 2011). Although the water access figures in India show an increasing trend, access to safe drinking water remains a challenge in rural areas. About 638 million people in India still defecate in the open and 67 per cent of Indian households do not treat their drinking water.[38] Likewise, in urban areas water supply pipelines and open drainage channels running side by side put the safety of drinking water at stake.[39] Surveys have estimated that over one third of rural ground water sources in India may be microbiologically contaminated, much of this contamination is preventable and proper operation and maintenance of water sources coupled with safe sanitation practices (Ministry of Rural development, DDWS, GOI, 2011)

The CPCB's analysis of water quality monitoring results from 1995 to 2009 indicates microbial contamination as the predominant form of pollution in surface water bodies in India (CPCB, 2009d). It was observed that nearly 64 per cent of the surface observations had biochemical oxygen demand (BOD) less than 3 mg/l, 19 per cent between 3-6 mg/l and 17 per cent above 6 mg/l. This has been attributed to two main reasons. First, the municipal authorities are unable to treat the increasing load of the municipal sewage due to which it may end up contaminating water bodies. Second, the receiving water bodies may themselves not have adequate water available for dilution. This severely limits water availability for both human as well as ecosystem consumption. Table 4.1 gives the BOD values of the top five most polluted water bodies in India. It must be remembered that according to the water quality criteria, the level of BOD in water should not exceed 3mg/l. Many stretches of major rivers passing through industrial towns and cities are critically polluted. In the holy city of Haridwar, the river Ganges has been showing the worrying trend of increasing BOD values from about 2 mg/l in 2002 to almost 5.5 mg/l in 2008 (ibid.). The major pathogenic organisms responsible for waterborne

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[37] MoWR (2000) cited in MoEF (2009)

[38] See http://www.unicef.org/india/wes.html

[39] See, for example, Bhunia et al. (2009)

Table 4.1: Top Five Polluted Water Bodies and the BOD Values

Lake/Tanks/Ponds	Location	BOD Value (mg/L)
Kistrareddypet Tank, Kajipalli Tank, Pedda Cheruvu, Asani Kunta, Sai Cheruvu and Noor Mohammad Kunta	Andhra Pradesh	50.0
Durgam Cheruvu	Andhra Pradesh	45.0
Elangbeel System Pond	Assam	42.0
City Lake	Gujarat	42.0
Gandigudam Tank	Andhra Pradesh	38.0
Kankoria Lake	Gujarat	38.0

Source: Data from CPCB (2009c)

diseases in India are bacteria (E. coli, Shigella, V cholera), viruses (Hepatitis A, Polio Virus, Rota Virus) and parasites (E. histolytica, Giardia,) (Khurana and Sen, 2007). Poor waste disposal facilities also contribute to pollution of water bodies by means of leaching.

4.2 Water Pollution and Health

Water and health are intricately related. Unsafe water and poor sanitation contributed 7.5 per cent of total deaths and 9.4 per cent of total disability-adjusted life years or DALYs[40] in India in 2002 (Prüss et al. 2008). One third of all deaths of all children under five years of age in India are due to diarrhoea and pneumonia.[41] Many more children who survive have weakened immune system because of diarrhoea, pneumonia, malaria, and worm infestations, and become underweight and malnourished which has a severe impact on their learning ability throughout their lives. Water and sanitation are key barriers to prevent this, including safe excreta exposure and safe and adequate water supply coupled with good hygienic practices.

While access to improved drinking water sources in India has increased over the past decade, the tremendous adverse impact of unsafe water on health continues.[42] The health impact of chemical contaminants in water has already been discussed under section 3.1. Microbial pollution in water is also responsible for disease burden, especially due to poor sanitation and hygiene practices. Infectious diseases linked to water can be categorised as waterborne, water-related, water-based and water-washed diseases.[43] These pathogenic organisms are transmitted mostly due to contaminated water, improper sanitation and poor hygiene practices exacerbated by large volumes of untreated sewage generated daily in major cities. In the rural areas, due to the widespread practice of open defecation (69 per cent of the rural population, as discussed in Chapter 2) and poor operation and maintenance of water sources, microbial contamination occurs in surface and groundwater bodies. Also, approximately 74 per cent of the rural population does not use any water disinfection method.[44] McKenzie and Ray (2004) show that India looses 90 million days a year due to waterborne diseases. Poor health due to inadequate sanitation is also an economic burden. A recent study conducted by the Water and Sanitation Programme (WSP) estimates that inadequate sanitation causes India 'considerable economic losses' each year equivalent to 6.4 per cent of India's GDP in 2006, that is, US$53.8 billion (WSP, 2010) (see figure 4.2). Figure 4.7 compares this with some economic indicators of the country. It is noteworthy that the total economic loss due to inadequate sanitation in 2006 was equivalent to state income of Tamil Nadu. Out of the total US$53.8 billion about US$ 38.5 billion (Rs. 1.75 trillion) is lost due to health-related impacts. Figure 4.1 gives the health-related economic impact of

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[40] Combination of years of healthy living lost due to morbidity and mortality.

[41] India: Country Profile of Maternal, Newborn & Child Survival, April 2010, UNICEF. Available at http://www.childinfo.org/files/maternal/DI Profile%20-%20India.pdf accessed on 17 February 2012

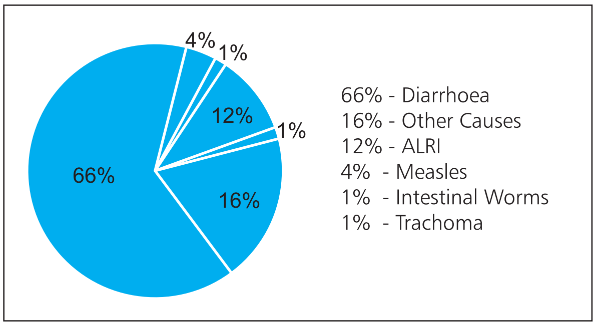
[42] WHO/UNICEF cited in Srikanth (2009: 1).

[43] Ashbolt (2005) cited in Chourey and Prakash (2010).

[44] NFHS (2005-6) cited in Gopal et al. (2008: 234)

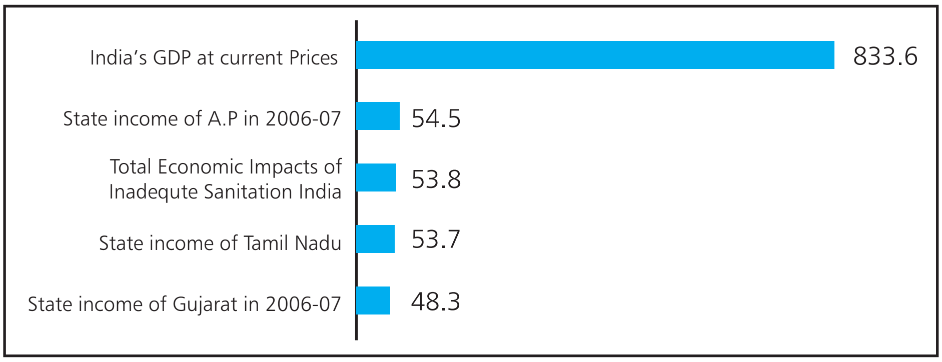
inadequate sanitation with respect to diseases. It also shows that children and poor households bear the brunt of poor sanitation. More than three-fourths of the premature mortality-related economic losses are due to deaths and diseases in children younger than five. Diarrhoea among these children accounts for over 47 per cent (US$18 billion) of the total health-related economic impacts.

Figure 4.1: Distribution of the Health Impact of Inadequate Sanitation by Disease in India (2006)



Source: WSP (2010)

Figure 4.2: Economic Impact of Inadequate Sanitation in India: Comparison with some Economic Indicators



Source: WSP (2010)

Another area of concern is ensuring safe water supply during disasters, like floods. As mentioned in section 1.2, floods occur at regular intervals in the country. The risk of diarrhoeal disease outbreak remains high after natural disasters, as seen in the case of the floods of July-August 2007 leading to an outbreak of cholera in four districts of Orissa and killing more than 100 people (SAARC Disaster Management Center, 2008: 121). In the eastern regions of India affected by arsenic contamination, flooding also enhances the rate of exposure among social and other disadvantaged groups (Khan, et al. 2003).

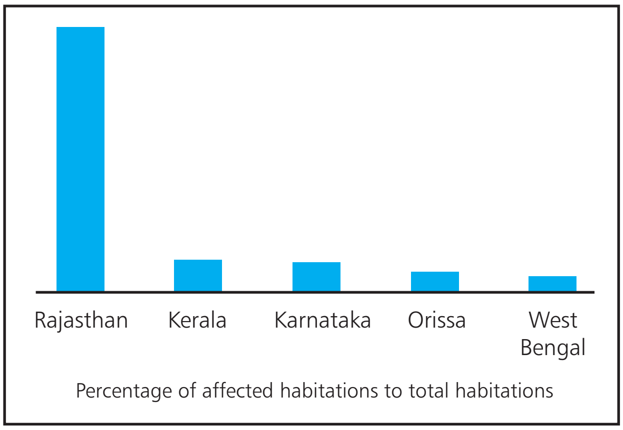
4.3 Natural Sources of Water Contamination

4.3.1 Salinity

Coastal aquifers form a vital source of freshwater along the 7,000 km long Indian coastline. These aquifers are vulnerable to intrusion of saltwater from the sea. The Bureau of Indian Standards (BIS) standard for total dissolved solids in drinking water is 500mg/l which can be extended to 2,000mg/l in case there is no alternate water source. The salt water intrusion in coastal areas is exacerbated by concentrated withdrawal of groundwater and reversal of natural hydraulic gradients. In the Saurashtra region of Gujarat, a total of 700,120 ha area, over 1 million people and 32,750 wells were affected by salinity ingress leading to adverse social and economic consequences (NWRWS, 2010). Increased salinity has also adversely impacted agriculture leading to migration (ibid.). Figure 4.3 graphically represents the top five salinity affected states in the country, as on 1 April 2011, in terms of percentage of habitations affected.

The government and non-government agencies have come together to introduce programmes to combat the challenges. For e.g. in Gujarat, Water and Sanitation Management Organization (WASMO) and Coastal Salinity Prevention Cell (CSPC) have come together to launch a special initiative –Coastal Areas Drinking Water and Sanitation Programme in different coastal districts.

Figure 4.3: Top Five Salinity Affected States

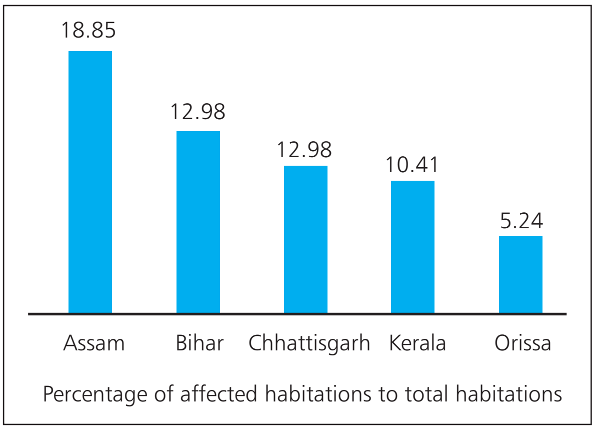


Source: Data from DDWS (2011)

4.3.2 Iron

The acceptable limit for iron in drinking water is 0.3 mg/l and the permissible limit in the absence of any alternative source is 1 mg/l. The World Health Organisation (WHO) does not have any proposed limit for iron in water since it is not considered a health concern at levels found in drinking water. High concentration of iron (>1.0 mg/l) in groundwater has been observed in more than 0.11 million habitations in the country (CGWB, 2010). Figure 4.4 graphically represents the top five iron affected states in the country in terms of percentage of habitations affected as on 1 April 2011.

Figure 4.4: Top Five Iron Affected States

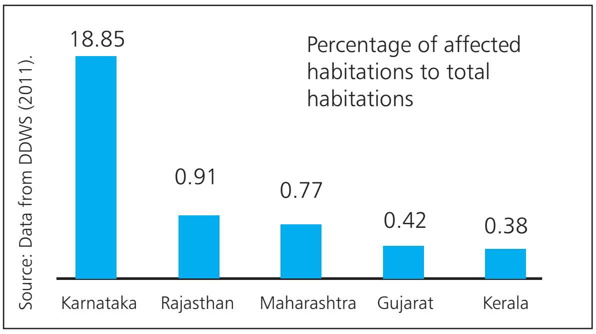


Source: Data from DDWS (2011)

4.3.3 Nitrate

Nitrate is a very common constituent in groundwater, especially in shallow aquifers. The source is mainly from anthropogenic activities like dumping of solid waste on land and run-off from the agricultural fields. The desirable limit of nitrate in water according to Indian standards is 45 mg/l, with no relaxation beyond this limit. High concentration of nitrate in water beyond the permissible limit many lead to health problems like methaemoglobinaemia.

Figure 4.5: Top Five Nitrate Affected States



Source: Data from DDWS (2011)

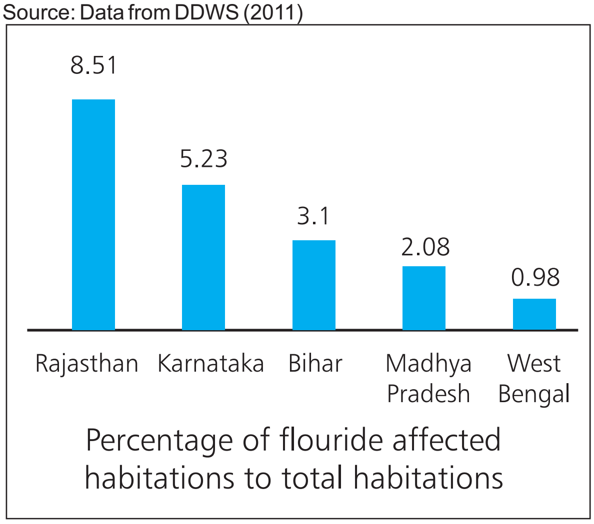
Figure 4.5 graphically represents the top five nitrate affected states in terms of percentage of habitations affected as on 1 April 2011.

4.3.4 Fluoride

Fluoride contamination affects 150 districts in 15 states. The permissible limit of fluoride in water according to Indian standards is 1.0 mg/l, which can be extended to 1.50 mg/l in case no alternative source of water is available. Studies suggest that over the years fluorosis has emerged as a major health problem in rural India.[45] Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis. Figure 4.6 graphically represents the top five fluoride affected states in terms of percentage of habitations affected as on 1 April 2011.

Figure 4.6: Top Five Fluoride Affected States

Source: Data from DDWS (2011)



4.3.5 Arsenic

The desirable limit of arsenic in water according to Indian standards is 0.01 mg/l, while the permissible limit in the absence of an alternative source is 0.05 mg/l. Skin conditions such as increased pigmentation and decrease in normal pigmentation, peripheral neuropathy, skin cancer, bladder and lung cancers, and peripheral vascular disease are observed in populations ingesting arsenic-contaminated drinking water (WHO 2011). Since the first case of groundwater arsenic contamination was reported in the year 1983, from 33 affected villages in four districts in West Bengal, the number of affected villages has increased to 3,417 in 111 blocks in nine districts in West Bengal alone (Ghosh and Singh, 2009).[46] In a joint study conducted by the Indian Institute of Technology (IIT), Guwahati, and Public Health Engineering

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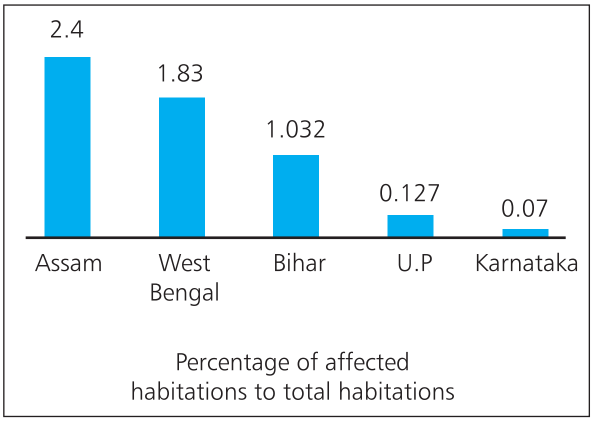
[45] To illustrate, Jaganmohan et al. (2010) report high concentration of fluoride in drinking water of Udaygiri mandal in Nellore district in Andhra Pradesh, ranging from 2.7 ppm to 6.74 ppm. Patel and Bhatt (2008) also observed similar trends in Banaskantha district of Gujarat.

Department (PHED), Assam, 8 per cent of the samples were found to be above the BIS permissible level and 30 per cent were above the WHO permissible limit thus exposing about 0.7 million people to contamination (Borah, 2011). Figure 4.7 graphically represents the top five arsenic affected states in terms of percentage of habitations affected as on 1 April 2011.

Government agencies have undertaken a number of initiatives to combat the issue of arsenic contamination. For example, since 2005, the Government of West Bengal has spent nearly Rs 2,100 crore (Rs 21 billion) on such schemes. Additionally, a number of research studies have been conducted to investigate the various facets of arsenic contamination, like extent, geochemistry, etc.[47]

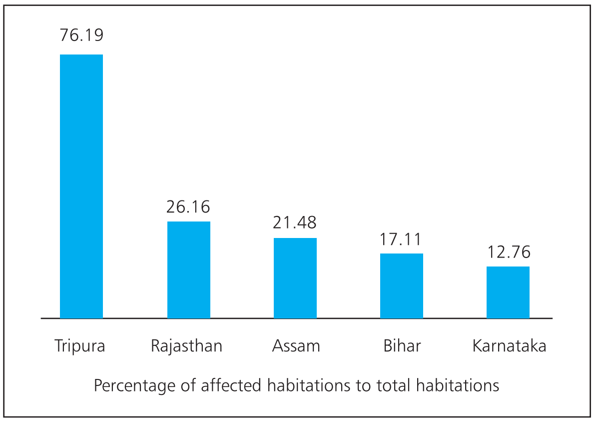
Figure 4.7: Top five Arsenic Affected States



Source: Data from DDWS, April 2011

Figure 4.8: Top Five Water Quality Affected States in India

Figure 4.8 shows those five states in the country, based on the percentage of habitations affected, that are most affected by water quality. Other pollutants include mercury, uranium, etc., which are leached into the water bodies due to excessive mining in many regions of the country. A detailed discussion on them is beyond the scope of this report.



Source: Data from DDWS, April 2011

4.4 Anthropogenic Sources of Water Pollution

4.4.1 Solid Waste Disposal

Annual municipal solid waste generation in India is estimated to be 1,15,000 million tonnes with the collection efficiency ranging from 70 to 90 per cent (in metros) to about 50 per cent (in smaller cities) (Planning Commission, 2008). There exists a considerable gap between the waste generated and waste collected in many cities in India. In the absence of an effective disposal mechanism, run-off from open dump sites containing chemicals contaminates wells and surface water sources of drinking water. Open dumping also affects proper drainage of run-off, thus making areas more susceptible to flooding by blocking the sewerage systems. The leachate released also contaminates the groundwater and surface water sources. The leachate from poorly-managed landfills can also pollute the water bodies and groundwater with toxic substances. Another area of concern is the unchecked disposal of biomedical and other hazardous wastes into the streams. According to CPCB (2009d) there are 36,165 hazardous waste generating industries in the country, generating 62,32,507 MT of hazardous waste every year.

4.4.2 Waste Water

The domestic sector is responsible for most of the waste water generation in India. Statistics reveal that the municipal treatment facilities are not equipped to treat the increasing amount of domestic sewage. Improper disposal of solid waste also leads to water contamination in the nearby water bodies. Out of about 38,000 million l of sewage generated per day, the treatment capacity[48] exists for only about 12,000 million l per day (CPCB, 2009c). About 39 per cent of sewage treatment plants do not conform to the general standards prescribed under the Environment (Protection) Rules. Thirty-five of India's metropolitan cities generate about 15,664 MLD of sewage while the treatment capacity exists for only 51 per cent, that is, about 8,040 MLD (ibid.). In 498 Class I cities, sewage generation is estimated to be 35,558.12 MLD while the total sewage treatment capacity is 11,553.68 MLD which is only 32 per cent of the total sewage generation. The 410 Class II cities generate close to 2,696.70 MLD of sewage

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[46] The figures are till the year 2008.

[47] See, for example, Ghosh and Singh (2009).

[48] It is important to note here that capacity does not mean actual treatment.

while the total sewage treatment capacity is only 233.47 MLD (Table 4.2).

4.4.3 Agriculture

According to MoEF (2009), the agricultural sector has a predominant impact on water quality. Due to heavy subsidies on chemical pesticides and fertilisers, there are no incentives for farmers to limit their overuse, and, as a result, per hectare consumption of fertilisers has increased from 69.8 kg in 1991-92 to 113.3 kg in 2006-7 (ibid.). About 13 per cent of drinking water in rural areas contains chemical contaminants including fertilizers run-off, mainly urea and its decomposition products (Planning Commission, 2011). In a 2009 study on the effects of synthetic nitrogen fertiliser on groundwater pollution in intensive agriculture, Greenpeace found that 20 per cent of all sampled wells had nitrate levels above the safety limit (50 mg/l) for drinking water established by the WHO. Further, the study notes that this nitrate pollution is directly linked with usage of synthetic nitrogen fertilisers (Greenpeace, 2009). Other sources would include human and animal waste and natural mineral sources.

Some of the well-known health effects of pesticide exposure include acute poisoning, cancer, neurological effects, reproductive anomalies, intrauterine growth retardation, and teratogenic effects. Fertilisers and pesticides enter the water supply through run-offs and leaching into the groundwater table and pose hazards to human, animal and plant populations. Some of these substances have been known to bio-accumulate in certain organisms, leading to an increased risk of contamination when used for human consumption and persistence of the chemicals in the environment over long periods of time. The suitability of water for human consumption and other uses is further limited by the decaying organic matter which releases odorous gases; the partially decomposed matter accumulates on the riverbed or lakebed, threatening aquatic life as well. The recent opposition against endosulfan that led to the GoI implementing a phased out ban on the harmful pesticide brought to fore the continued use of harmful chemicals which are banned by developed countries or are strictly regulated.

4.4.4 Industrial

Although the industrial sector accounts for only 2 per cent of the annual water withdrawals in India, its contribution to water pollution, particularly in urban areas, is considerable. According to a recent Central Pollution Control Board (CPCB) study, 43 out of 88 industrial clusters in India are 'critically polluted' while three are 'severely polluted' with respect to one or more environmental components (CPCB, 2009b).[49] These statistics portray a grim picture of the status of industrial pollution in India. Waste water generation from this sector has been estimated at 55,000 million cu m per day, of which 68.5 million cu m are dumped directly into the local rivers and streams without prior treatment.[50] The industrial waste water is often contaminated with highly toxic pollutants which persist in the environment for long. There have been several cases in India where industrial effluents being discharged into the river or stream directly has adversely affected the lives and livelihoods of the people living in the vicinity. In one such case, at Tirupur in Coimbatore, Tamil Nadu, the level of pollution caused by the effluents discharged by the textile industry in the Noyyal river were so high that the state high court had to intervene on behalf of the farmers. The court ordered the industrial cluster to switch to zero discharge facilities or close down (Madhav, 2008). Studies by various civil society groups have also brought to the fore the plight of

Table 4.2: Summary of Water Supply, Sewage Generation and its Treatment

Category	No. of cities	Population	Total water supply (in MLD)	Waste water Generation (in MLD)	Treatment Capacity (in MLD)
Class-I city	498	14,30,83,804	44,769	35,558.12	11,553.68
Class-II town	410	3,00,18,368	3,324.83	2,696.7	233.7
Total	908	25,77,54,640	48,093.88	38,254	11,787.38

Source: CPCB (2009c)

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[49] A moratorium against expansion was imposed on these industrial areas after these findings. However, CSE (2011) reports that since October 2010, as many as 23 industries have been removed from the moratorium list based on action plans submitted by the respective states even as they continue to pollute.

[50] MoWR (2000) cited in MoEF (2009).

people living in the industrial regions suffering from chronic illnesses due to prolonged exposure to toxic chemicals. A recent article by Times of India reports that fluoride discharges from nearby tanneries have lead to bone deformities in people of the some regions of Unnao district in Uttar Pradesh. On an average, at least one member of each family of the affected village has a bone deformity (Kurup 2011). There exist many laws as well as emission standards to minimise the impact of industrial discharge but it is non-compliance and poor monitoring that has aggravated the situation. The industrial water pollution standards in the country are concentration based, which means that they measure the concentration of pollution in a given quantity of water. The result is that an industry can meet the required standard merely by diluting the effluent with clean water. While advocating the 'polluter pays' principle for dealing with water pollution; the National Water Policy (NWP) 2002 does not specifically talk about the extent of the payment. Similarly, there appears to be no incentive or disincentive for the industries to undertake reduction of wastewater discharge under the current arrangement of water tariff. Most of the water used in the industrial process is for cooling or for use in boilers. Even though it is not contaminated in any form, if released in the streams, it can alter the temperature and pH levels thus affecting the aquatic system. Little data exists in the public domain to conclusively establish the impact of industrial pollution on various components of the ecosystem. Reforms of industrial tariffs to reflect the true price of water supply and water treatment would help in regulating industrial water use at the earliest. Box 4.1 gives a compiled account of the pollution hotspots in the country.

4.5 Summing Up

Water quality issues are immensely important concerns from human health and ecological status. The above analysis clearly establishes that water quality issues in India have reached or even passed the critical stage. It also reveals that while increasing access to water is crucial, doing so without addressing quality issues may prove to be a

Box 4.1: Pollution Hotspots in India

🟦 Partial Coverage
⬛ Widespread

	Hot-Spot States																						
	Andhra Pradesh	Assam	Bihar	Chhattisgarh	Delhi	Goa	Gujarat	Haryana	Jammu and kashmir	Jharkand	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Manipur	Meghalaya	Orissa	Punjab	Rajasthan	Tamilnadu	Tripura	Uttar Pradesh	West Bengal
Inland Salinity																							
Inherent Salinity					🟦		⬛	⬛			🟦		🟦	🟦				⬛	⬛	🟦		🟦	
Water Logging under surface irrigated Area								⬛										⬛				⬛	
Coastal Salinity																							
Saline ingress fron tides cyclone and Tsunami							⬛					⬛					⬛						
Sea Water Instrusion							⬛													⬛			
Geogenic																							
Arsenic		🟦	🟦	🟦						🟦												🟦	⬛
Flouride	⬛	🟦	🟦	⬛			⬛	⬛	🟦	🟦	⬛	🟦	🟦	🟦			🟦	⬛	⬛	⬛		🟦	🟦
Iron	⬛	⬛	🟦	🟦		⬛	🟦	⬛	⬛	🟦	⬛	⬛	🟦	🟦	🟦	🟦	⬛	🟦	⬛	🟦		🟦	⬛
Anthropogenic																							
Mining													⬛	⬛			⬛		⬛				
Industrial							⬛	⬛					⬛	⬛				⬛		⬛		⬛	
Tanneries																				⬛		🟦	
Distilliers								⬛					⬛					⬛					
Land fill and Garbage dumbs	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
Agriculture			⬛				⬛										⬛					⬛	
Poor sanitation and wastewater disposal	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦

Source: Romani (2010) cited in Garduno et al. (2011: 10) futile exercise. Development will elude a society where people are not healthy, as excessive man hours are lost due to ill health. Water pollution caused from household, industrial and agricultural sectors affects the quality of surface, ground and coastal waters. Despite investing considerably in sanitation and river cleaning projects (a Rs 7,000 crore or Rs 70 billion Ganga Cleaning Project has been approved recently), water quality continues to deteriorate (CPCB, 2008). As discussed above, waterborne diseases due to inadequate sanitation are serious economic impediments for society. Indeed, Goldman Sachs placed improving environmental sustainability of water and energy as one of the top 10 interventions that India needs to accelerate growth, in order to reach its economic potential (Goldman Sachs 2008). As is evident from the gap between sewage generation and sewage treatment capacities of major cities, there is an immediate need to build appropriate infrastructure. There is legislation in India that addresses the prevention and control of pollution—for example, the Water Prevention and Control of Pollution) Act of 1974, Water Cess Act of 1977 (amended in 1988 as the Water (Prevention and Control of Pollution Cess Act), and the umbrella legislation, the Environment (Protection) Act or EPA (1986). Recently, the Right to Information (RTI) has also been used by activists and people as a potent legislation to deal with discrepancies in the water sector. Although the Indian government is working more proactively on the increasing threat of water pollution, it will take far more than political will for these actions to translate into concrete measures resulting in improved water quality.

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CHAPTER FIVE

GENDER AND WATER

An understanding of the various dimensions of water and related issues is incomplete without delving into the question of gender. Ideally, gender analysis should start from gender disaggregated information that can inform the level of difference between the genders. Unfortunately, in India and elsewhere such data for water-related projects is not readily available on a concerted and aggregate level and therefore all issues relating to gender and water becomes rhetorical without much supporting evidence on the way gender relations are changing from a point in history. This chapter examines the concept of gender and its ramifications with regard to water and shows how gender iniquities in access to water and decision making is linked to the thinking in water sector and the way it gets manifested. It looks at gender issues both in implementation of water projects as well as issues of gender disparity at the organisational level.

Any analysis of water resources management is incomplete without integrating the gender dimension. This is a key part of the larger equity discussion on WASH in India which is a crucial examination of who is gaining access to what services (see Mudgerikar and Cronin, 2012 and UNICEF, 2012). Gender issues form one of the crucial but underestimated aspects of natural resources management, water being no exception. According to the Gender and Water Alliance (GWA, 2006: 1), gender refers to the, 'different roles, rights, and responsibilities of men and women and the relations between them. Gender does not simply refer to women or men, but to the way their qualities, behaviours, and identities are determined through the process of socialisation.' The differential roles and responsibilities of woman vis-à-vis man shape her relation with the environment quite differently, which in turn governs her interaction with the surrounding natural resource base like water. UNESCO's Gender Mainstreaming and Implementation Framework hold a similar view, albeit more pragmatic , puts the same in a more pragmatic way.

Men and women both perform different roles. This leads to women and men having different experience, knowledge, talents and needs. Gender analysis explores these differences so that policies, programmes and projects can identify and meet the different needs of men and women. Gender analysis also facilitates the strategic use of distinct knowledge and skills possessed by women and men (Ruprecht, 2003: 17).

It is precisely these differences that make women an integral part of any natural resource management intervention and hence the thrust worldwide on gendered analysis of the same has gained recognition. The differences in the social privileges enjoyed by men vis-à-vis women, and the implicit assumption that women will benefit from husbands' improved access to water have done much harm to women's rights to water. Upadhyay (2005) argues that it is precisely because of these assumptions that water projects do not focus on the differential power dynamics between men and women or recognise the need for equity in water allocation. The new water reforms aim to usher in changes in the water sector and these are also geared to impact women in this process. Apart from gender differentiation, access to and control over water is also determined by belongingness to a certain class or caste (Ahmed et al, 2008). What is important for us to understand here is how gender relations interact with material and social inequalities and how, together, they influence and determine access to water. The material and social inequalities are manifested in variety of ways—in property relations, inequalities of income, state provisions, rules of access to common social property, and social status (Crow and Sultana, 2002). Caste and class are a major determining factor for one's social positioning in society, which, when combined with the existing gender relations, influence and determine access and control over water. Kabeer (1994) defines four key institutions that produce and maintain social and gender inequalities: state, market, community and family. Each of these have rules (how things get done), resources (what is used and/or produced), people (who is in/out, who does what), activities (what is done), and power (who decides, and whose interests are served), all of which engender social relations.

5.1 Gender and Water Policy Discourse in India

One of the major changes in the water sector over the last few decades has been the enhanced thrust on institutional reforms, including the increasing recognition of the bottom-up approach to management as against the techno-centric top-down one. At the heart of this lies the concept of greater inclusiveness of all stakeholders, including women. Hence the greater need of understanding their differential needs. A need to integrate gender concerns in the water policy discourse stemmed from two facts: one, that women are the primary collectors of water and also responsible for health, hygiene and sanitation (of which water is an integral part) at the household level; two, that historically the above work has been seen as non-productive and women have not had adequate representation in decision making around water .

Consequently, the water sector in India became abuzz with the concepts of 'gender mainstreaming'. Inclusiveness of women became a mandate for projects funded by international and state agencies. At the level of policy formulation, there is no shortage of rhetorical support for gender inclusion by official agencies and governments. Policy makers have used many approaches to address gender concerns. For example, the efficiency approach, based on the premise that if given a chance women can be as efficient in delivering targets as men, or, in some cases, even better; the needs approach, advocating the fact that women have very specific needs related to water; or the equity approach, which makes a case for mainstreaming gender concerns in policies to address equity issues (Cap-Net, SOPPECOM and WWN, 2007). New reforms and programme documents relating to water include sections on women's role in the successful implementation of any policy/plan and the likely benefits accrued to them. While in principle there has been an agreement to mainstream gender issues in water projects, critics have argued that the issue becomes rhetorical if not backed by adequate data collected in a disaggregated manner. Until now, there is virtually no gender disaggregated data on water sectors collected by the main international and state agencies in a uniform way (Seager, 2010). Without support of adequate and reliable gender disaggregated data, it is difficult to track changes in gender relations with respect to water in the different regions of India and, therefore, the issue becomes either rhetoric or speculative. For example, Joy and Paranjpe (2005) reported that the much talked about relationship between women and traditional water management systems did not seem to find backing from the literature available on these systems. In this section, we deal with the issue at two levels. First, at the grass-roots level, on how gender disaggregated data will inform water policies for irrigation as well as drinking water and the sanitation sector. Second, we focus on a rather understudied issue of representation of women professionals in major departments dealing with water. This issue borders directly on gender in organisation and broadens the agenda of gender mainstreaming at not only the grassroots but also at the level of implementing agencies.

5.2 Gender Disaggregated Data: What does it mean for Irrigation and Domestic Water Sector?

5.2.1 Gender in Irrigation Sector

Over the years, the water sector has shifted its focus from a supply driven sector to one that is incentive-based and demand driven (Kulkarni, 2007). This in turn has given birth to the concept of increased stakeholder participation thus giving prominence to the role of women in agriculture and the irrigation sector. Many studies have clearly indicated the linkages between improved access to irrigation and poverty reduction.[51] Thus, women's greater participation is now regarded as a means to achieve the dual objectives of achieving efficiency in irrigation projects and also improving their conditions, especially in rural India. With the institutionalisation of one-third representation in local bodies, women's representation in the water communities, at least numerically, has certainly increased.

Box 5.1: Does Decentralised Water Governance further Gender Justice in India?

In a 2008 study, Kulkarni et al., looked into the impact of the new institutional water management regime on women in the two states of Maharashtra and Gujarat. The study analysed the factors that ensure the participation or exclusion of women from water user and management groups. The research explores that while the introduction of quotas in the WUAs have ensured women's representation in meetings, there exist glaring caste- and economic-based inequalities within women's representation. Women's representation is often tokenistic and the benefits accrued to them are mostly in the form of self-help group (SHG) activities. The NGOs and CBOs often play the role of facilitators but fail to overcome the existing norms of appropriate social behaviour in society which limits women's effective participation.

Source: SOPPECOM (2008)

Some cases of Participatory Irrigation Management (PIM) illustrate the example set by

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[51] See, for example,. ADB and IWMI (2004).

women in taking management initiatives. In Angul district in Orissa, 67 per cent of the membership of the Water User Associations (WUAs) comprises of women. This was not due to some specific legislation or order, but rather due to the lack of interest shown by the male members towards the formation of the WUAs. The task was thus initiated by the women who foresaw its benefits (Joy and Paranjpe, 2005). But some other cases illustrate that mere visibility in user communities cannot be understood as successful participation (see Box 5.1). In its research in the WUAs of Madhya Pradesh and Andhra Pradesh, ADB and IWMI (2004: 6-7) established that women (along with poor farmers) were poorly represented in the WUAs. They were generally present as proxies to their husbands or to garner government aid. While studying the Farmer Management of Irrigation Systems Act, 1997, with reference to Andhra Pradesh, Madhav (2007: 10) noted that 'women along with other indirect beneficiaries, like landless populations and children, do not have any decision-making powers.' Kulkarni (2007) opines that the reforms, based on principles of cost recovery in the irrigation sector in the absence of a rights-based regime over water, can actually do more harm to women. For example, with the increasing thrust on treating water as an economic good, and hence on the pricing and recovery of costs, the use of irrigation water by women for other small-scale but crucial activities in terms of household consumption, cattle rearing and kitchen gardening for example, may be seen as not important. Indeed, the Aga Khan Rural Support Programme, which was involved in six of the 13 PIM pilot projcts in the state of Gujarat from the 1990s, found that canal water was being used for six main activities, viz. irrigation, livestock rearing, washing, bathing, washing utensils, and building of mud houses. While women were using water for all these six purposes, men used it only for two purposes,that is, irrigation and bathing. It shows that in the context of WUAs, women's participation should not be restricted to irrigation alone (Joy and Paranjpe 2005). Women's role as mere members of WUAs will not do justice to the knowledge they have about the other aspects of agriculture, such as knowledge of seeds, traditional crops and so on.

So how does gender disaggregated data help in taking informed decision bordering on the issue of gender and irrigation? First, water for irrigation is directly related with access and control over land. Gender disaggregated analysis of access to land for women and men is the first step in understanding the ownership pattern of a critical resource such as land which is tied up with another key resource, water. Second, women's participation in institutions dealing with irrigation water, such as the WUA, is important. Gender disaggregated data of women's participation in WUAs, collected and analysed at the district and state levels, will help in understanding important facets of gender relations and the impact of women's improved participation in influencing desired outcomes of a project. A recent study conducted by Bina Agarwal (2010) dwells on the issue of women's participation in forestry institutions by asking the question: Would women's inclusion in forest governance, undeniably important for equity, also affect decisions on forest use and outcomes for conservation and subsistence? Using data on community forestry institutions in India and Nepal, Agarwal provides the history behind women's omission from social institutions, the barriers that still prohibit their participation, as well as how these barriers can be overcome. Agarwal argues that women's presence, in the right critical mass, makes a considerable difference to the desired outcomes of forest governance. These insights are based on concerted gender disaggregated data, which is now informing policies for desired change while providing the status of forest dwellers. Third, many gender negotiations are conducted at an informal level and in private and therefore largely ignored by policy initiatives which look for formal means of participation. Thus, looking into the informal and private spheres in which women negotiate their views is important in order to create a true gender sensitive policy that will also include this aspect while formulating policies.[52] Box 5.2 presents the case of a successful women's irrigation group in Gujarat.

Box 5.2: The Women's Irrigation Group of Jambar, south Gujarat

Women in Jambar village of Gujarat were trained by the Aga Khan Rural Support Programme to operate mechanised pump sets and organise themselves into management committees to decide on the water charges, supervise water distribution, collect water fees from the pump operator, and deposit the amount in the bank. The availability of mechanised irrigation enabled them to add one crop to cultivation. The vegetables and fruits grown as such brought monetary benefits to the households. In addition, it translated into greater decision-making power and visibility for the women who were earlier neglected in community decision making.

Source: Koppen, et al. (2001)

5.2.2 Gender in Domestic Water and Sanitation Sector

Rural and urban women of almost all age groups are engaged in collection of water for household needs, including water for livestock. Women balancing pots of water on their heads while

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[52] Based on telephonic discussions with Seema Kulkarni of SOPPECOM, Pune, 27 April 2011.

travelling vast stretches is a common sight in rural India, as is the serpentine line of women standing in queues in urban slums to collect water from a single tap! Indeed, water collection is a responsibility that primarily rests on women. The average distance travelled by women every single day in rural and peri-urban India has been a subject of countless surveys, and the fact that this indeed affects their overall health and decreases productive work hours is established in many research studies.[53] The girl child's educational and overall self-development status suffers a serious setback in a society where they are considered inferior to the male child by getting involved in water collection and other household chores constrained by water supply. Although the policy discourse has recognised this role of women, it has not come without its own peril. Women's role in government water schemes has largely been reduced to water collectors while undermining their potential for involving them in the decision-making process. As per the NRDWP guidelines, the members in VWSC should be selected to represent various groups of society and 50% of which should be women especially those belonging to SCs, STs and OBCs. The efforts were made to involve more and more women in the programmes at a policy level. However, in reality and on the ground, these provisions are hard to implement because of strong gender bias. The technological interventions which do not take into account the social, economic and familial constraints of a society with respect to women, may lead to unfair outcomes for them. For example, while the general impression is that introduction of hand pumps have reduced the burden of women in terms of physical labour, Narain (2003) reported that the relationship may not be as simple as that. In one of the examples from his research in village Mandhana in Haryana, it was seen that the availability of 24-hour water supply by hand pumps was accompanied by change in aspirations of the village men who then started bathing in their own houses, an activity which was earlier done at the village pond or johad. This change increased women's burden, as men expected them to carry home the water for this purpose as well. Joshi (2005), while analysing the success of project SWAJAL for domestic water and sanitation in rural areas of Uttar Pradesh and Uttaranchal, found that all the deep-rooted factors like caste, class and poverty had serious repercussions for women in all aspects of water management projects, viz. participation and decision making, income generation and empowerment. Similarly, women are primarily responsible for looking after the health, hygiene and sanitation in the household. According to Jha, 'Women have, by far, the most important influence in determining household hygiene practices and in forming habits of their children'.[54]

The brunt of inadequate sanitation facilities is borne more by the women due to the social insecurities faced by them. In both rural and urban areas, travelling longer distances in search of privacy to relieve themselves exposes women to both lack of security as well as health hazards. Under the sector reform process, the Total Sanitation Campaign (TSC) was initiated in April 1999 with one of its mandate being to provide privacy and dignity to women. The work done by some NGOs has also demonstrated the benefits associated with improved sanitation for women. In one such case, concerning community managed toilets in Tiruchirappalli, Tamil Nadu, it was seen that associating women with the project greatly empowered them (see Box 5.3). There are important synergies of such interventions with other programmes and policies. For example, lack of hygienic toilets and latrines in schools can have a particularly negative impact on girl's education, as when faced with such a situation they are more likely to drop out of school altogether.

Box 5.3: Community Managed Toilet (CMT) scheme in Tiruchirappalli, Tamil Nadu

The successful implementation of the Community Managed Toilet (CMT) scheme in Tiruchirappalli district of Tamil Nadu not only set precedence for such interventions in the slums of the country but also demonstrated the interlinkages between improved sanitation and women's empowerment. When the onus of management of community toilets was given to the women, not only did they deliver the task to the best of their capacity, but they also used the opportunity for personal and community development. This case proves that keeping women at the focus of water and sanitation related projects not only benefits women in terms of health and hygiene but also creates for them an entry point to work for larger goals of community development.

Source: WaterAid (2008)

This fact will have to be accounted for while looking at the successful implementation of the recently legislated right to education. The Swajaldhara Yojana, launched in December 2002, envisages that at least one third of village water supply and sanitation committees should have women members who get preference in training for repairs to hand pumps. It also lays down the guidelines for setting up of Village Water and Sanitation Committees (VWSC) with at least one third representation of women. A review of the TSC and Swajaldhara schemes in 10 districts in Uttar

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[53] See, for example, Seaforth (2001)

[54] Jha (n.d.) cited in ADB (2009: 20)

Pradesh has revealed that in some sample villages women were using the toilets more than the men, who still defecated in the open (Chand et al., 2004). Target 10 of the seventh goal of the MDGs calls upon countries to halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation. However, the lack of gender disaggregated data makes it difficult to assess the impact this would have had on the women. As Joshi noted: 'There is no project indicator to measure the effectiveness of Dalit representation in the VWSC or to assess gender in Dalit representation' (2005: 145). So far, global commitments made in the area of water and sanitation (including the MDGs) do not specifically address the equitable division of power, work, access to and control of resources between women and men. The current system to assess global progress towards reaching the MDGs, through the Joint Monitoring Programme (JMP), until recently (2008) did not have any gender indicator for the water and sanitation goals; one gender-specific indicator has now been added. This slight representation underscores how critical it is to better mainstream gender perspectives into national and global water and sanitation (WATSAN) planning and monitoring processes to ensure that the different needs of women and men are understood, and that the specific needs and concerns of women are taken into account (SOPPECOM, UN-DESA and UNW-DPC, 2008). In the JMP 2008 report, the data was collected on the person in a household with primary responsibility for collecting water (adult male, adult female, girl, or boy). 'The 2008 database included a ''global' chart on this indicator based on national-level data for 19 countries which concludes that, globally, 64 per cent of water collectors are adult women, another 7 per cent girls. While the JMP report concludes that ''women shoulder the largest burden in collecting water' (JMP, 2008: 37), the actual 19-country database in this report revealed that in seven (of 19) countries, men were responsible for a larger share of water collection than women. The report concludes that ''men appear to play a larger role in collecting water than they were previously given credit for' (JMP, 2008: 37). These dual conclusions—that women collect most water ''globally', but that men in some countries have a surprisingly prominent role in water collection–indicate the problems of making large-scale generalisations on the basis of scant data' (Seager, 2010 :2). The problem occurs because there is no uniform gender disaggregated data on the drinking water sector collected officially by agencies responsible for data collection and analysis. Lack of data provides lack of evidence or status of the relationship between gender and water, and hence one relies on smaller studies which cannot be extrapolated to understand larger gender relations with respect to water.

5.2.3 Gender in Water Bureaucracy in India [55]

The efforts to mainstream gender concerns in water resource management have seen an emphasis on integrating poor rural women in water supply schemes and ensuring sharing of benefits among the different stakeholders. Less emphasis however has been put on the integration of women in the design part of the schemes. The water sector is dominated by male professionals who occupy important positions, such as engineers and senior managers. While women's participation in programmes at the community level is a buzzword in many projects and policies of the governments of South Asia, there is little discussion on the issues of women professionals. This leads us to the following questions: What is women's contribution in the whole process of designing and implementing water programmes? What is the level of participation of women in the water sector? What are their concerns and does their presence make any difference to the gender mainstreaming agenda? Some of these questions were answered by a recent study conducted by SaciWATERs, South Asia Consortium for Interdisciplinary Water Resources study, in association with SOPPECOM. The study covered Bangladesh, Nepal, Sri Lanka, Pakistan (Sindh region) and two states of India (Maharashtra and Andhra Pradesh). The study looked at the data of women professionals (WWPs) in South Asia while interviewing some of the selected women working at different levels in governments across South Asia.

In India, the study was conducted in Maharashtra and Andhra Pradesh, both large states and in some ways recognised as leaders in water management. The study discovered that in the irrigation sector [56] in Maharashtra only 7.53 per cent employees were women, of which a mere 1.93 per cent were employed as technical staff. The low numbers of women staff is shown in Figures 4.1 and 4.2 (see in page no.58) for Maharashtra and Andhra Pradesh respectively. These are representative charts of one department showing women in the technical hierarchy in the MJP[57] and the Irrigation and Command Area Development in Andhra Pradesh. In all these departments women are not present at the top-most level. Except in Andhra Pradesh, women are not even at the superintending engineers' posts. In Maharashtra, only two women

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[55] This section is based on the study 'Situational Analysis of Women Water Professionals in South Asia'. The study was completed in 2009 and published by SaciWATERs in 2011. See reference SaciWATERs, 2011.

[56] Five circle offices of the state out of about 35.

in the executive engineer's position (of which one was promoted just as she was about to retire and the other one is a very dynamic young professional) are in charge of a division. This clearly indicates that the water sector does not look beyond recruitment to engineering posts. And even for the posts for which women are hired, they are seldom considered for field-based or site-based work. A woman's social role, largely seen as a homemaker in our social setting, gives rise to conflicts between professional and private spheres and this also contributes to her decision regarding the choice of work.

Figure 5.1: WWPs in MJP Technical Hierarchy, Maharashtra (State-level data)

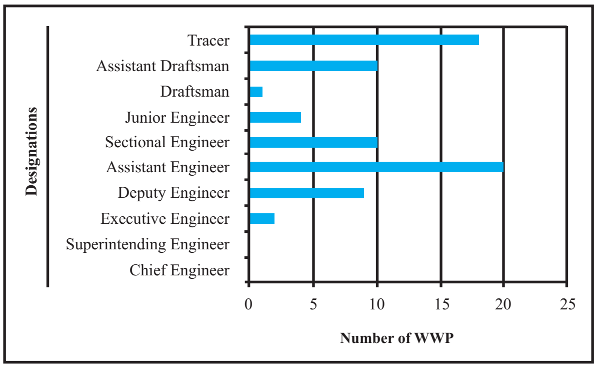
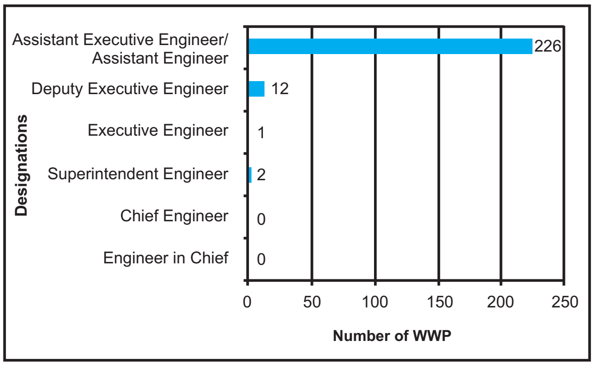


Figure 5.2: WWPs in APSIDC Technical Hierarchy, Andhra Pradesh (State-level data)



These biases are not restricted to the water sector alone but they nonetheless have a strong bearing on the overall way that water is being managed in the country. A woman may be able to infuse a different perspective to an issue vis-à-vis a man. In the above study, too, in Maharashtra, women professionals noted that there is a difference in the way men and women employees think and work.[58] Most of them reported that they believed that generally women are more sincere, hardworking, particularly responsible, non-corrupt, ethical and sensitive towards an issue than men. As one professional noted - 'If a woman is in-charge of the office, the financial transactions are more transparent. On the other hand, women have not acquired capacity to take decisions on sites, because they don't have such exposure' (SaciWATERs, 2011:107). So what could be the way forward? First, there is a need for a positively discriminatory gender policy in the water sector that not only relates to hiring more women staff but also retaining them through affirmative action such as providing gender-specific facilities. An equal policy alone will not achieve this given the current huge imbalance. Flexible hours for women, special leave for childcare and providing childcare facilities in their office space will go a long way in retaining women staff. Second, it is true that only increasing numbers will not make a difference, but once a critical mass of women water professionals are generated, it can lead to a change. It therefore becomes important to bring in a policy of reservation and positive discrimination over selection of women staff in government recruitment, as it is for their political participation. Maharashtra has introduced such a policy of 30 per cent reservation in all new recruitments, which is expected to change the composition of the sector in the years to come. Third, there is an urgent need for training and capacity building of men and women water professionals for gender sensitiveness at both organisational and project implementation levels. Lastly, a network of women professionals is needed that will provide a platform for them to come together and discuss issues and make policy initiatives as a collective (see Box 5.4).

Box 5.4: Women's Collective Action and Sustainable Water Management

The case of Self Employed Women's Association's (SEWA) women, water and work campaign in Gujarat demonstrates how collective action by women can be instrumental in bringing about a sustainable water management intervention. The programme combined rehabilitation of piped water supply and traditional water sources with a micro-enterprise development program for women entrepreneurs. Three broad actions were undertaken at the grassroots level by the women as a part of this campaign namely, (a) revival and upgradation of traditional sources of water, (b) roof rainwater harvesting and (c) SEWA's barefoot water technicians. It elucidates the significant impact of such intervention on the lives and livelihoods of the women and illustrates that ensuring women's participation in projects linking environment with livelihoods can bring true empowerment to them in both social as well as economic sphere serving as an entry point for rural poverty alleviation programmes.

Source: Panda (2007)

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[57] Water Supply and Sanitation Department, Maharashtra, India.

[58] Thirty women engineers were interviewed in Maharashtra.

5.3 Summing Up

Women's representation in the water sector has come a long way from being gender biased. Women are now viewed as a disadvantaged group with respect to access and to decision-making processes around water. Although a welcome departure from the earlier approaches, it has failed to recognise the fact that women can contribute immensely to the decision-making process by their vast unique experience, and therefore they should not only be seen as potential beneficiaries but also as actors. The gendered inequalities are further exacerbated by factors like class, caste and religion , and women are seen as a homogenous group and not as one divided by caste, poverty, geography and wealth (Joshi, 2011; Krishnaraj, 2011). A study co-coordinated by SOPPECOM (2011) in India and Nepal reiterated these facts. The study clearly showed a class and caste bias in access to domestic and irrigation water.

This chapter showed how gender inequity in water access is directly linked with the larger thinking and action in water sector. Water is still a masculine subject in terms of its organisation, artefacts and manifestations. The most important conclusion which can be drawn from this discussion is that a dearth of gender disaggregated data is a huge impediment in the way gender issues are addressed. In both irrigation and domestic water sectors, the performance of projects aimed at addressing equity issues in benefit sharing need to be assessed based on such data. Same is true for achieving the MDG targets. The gender bias also shows in the management regime around water with the bureaucratic set-up suffering from serious gender underrepresentation. This under-representation is at two levels. First, it relates to the educational choices women make. Second, it relates to the major constraints that women face after entering the sector. Challenging the notion that hard sciences are for men and soft disciplines for women could be the first step. At another level, a change in the understanding of women's work too becomes important in changing the existing belief systems that determine women's absence in this sector. Some ways through which women's presence can be improved include making a gender policy for water bureaucracy, providing gender-specific benefits and amenities, training, capacity building and networking.

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CHAPTER SIX

WATER RESOURCES GOVERNANCE AND MANAGEMENT: CHANGING CONTEXTS

India's water sector has undertaken a number of reforms and introduced changes at the policy level to address emerging issues and challenges. This chapter provides a brief overview of the changes that have taken place and the issues which remain to be addressed. It shows that although there have been varied developments in water resource management initiatives, the Indian governance system needs to be strengthened significantly to achieve the intended goals of social equity, accessibility and environmental sustainability. India, as a nation, has probably the best of all written policies, laws and regulations; what remains a challenge is the execution. Rights framework provides a superior framework and a window of opportunity that may help in achieving the goal of water for the poor.

6.1 Existing Institutional Set-up

The current arrangement to manage water in India exists at two levels—central government and state governments. The designated apex body for water resource management is the union Ministry of Water Resources (MoWR), at the centre. The ministry is responsible for the overall development, conservation and management of water, treating it as a national resource. This includes formulating general policies on water resource development and providing technical assistance to all states in irrigation, multipurpose projects, groundwater exploration and exploitation, command area development, drainage, flood control, water logging, coastal and riverbank erosion problems, dam safety, and hydraulic structures for navigation and hydropower. Additionally, it also oversees the regulation and development of inter-state rivers. Various other central ministries also carry out different functions in the water sector.

- Urban Water Supply and Sewage Disposal – Ministry of Urban Development (MoUD)
- Rural Water Supply and Rural Sanitation – Ministry of Drinking Water and Sanitation (MoDWS)
- Hydro-electric and Thermal Power – Ministry of Power (MoP)
- Pollution and Environment Control – Ministry of Environment and Forests (MoEF)

Besides, the Indian National Committee of Irrigation and Drainage (INCID) works in close coordination with its parent organisation, the International Commission on Irrigation and Drainage (ICID), to further promote research in relevant areas. The Ministry of Agriculture and Cooperation (MoAC) contributes by funding and implementing watershed focused development programmes. Water is a state subject and the governments at the state level are primarily responsible for its use, conservation and control. Administratively, the control and responsibility for development of water and water resources lies with the state's various departments and corporations:

- Major and medium irrigation: Irrigation/water resources departments.
- Minor irrigation: Water resources departments, minor irrigation corporations, zilla parishads/panchayats, and other departments like agriculture.
- Urban water supply: Public health/public works department.
- Rural water supply: Gram panchayats.
- Government tube wells: Constructed and managed by irrigation/water resources department or by tube well corporations set up for the purpose.
- Hydropower: State electricity boards.

6.1.1 Policies and Legislations

The National Water Policy (NWP) for India was adopted in 1987 and revised in 2002. The policy focuses on planning and development of water-based resources in the country through governance, taking into account the national perspectives. The emphasis is more on river-based planning for water use. Drinking water is the main priority when it comes to allocation of water, followed by irrigation (agriculture), hydropower, navigation, and industrial or other uses. As mentioned earlier, water resources development is a state-governed subject. Thus, all the states in India are required to formulate their own state water policies within the ambit of the NWP and subsequently set up a blueprint for water resources development.

6.2 Water Governance in Transition

For many centuries, water management in India has been the prerogative of the government. After independence, the Government of India (GoI) has steered the country's water resources rather aggressively, resulting in the present scenario, where the scope for surface and groundwater sources expansion has stagnated. Thus, the challenge for India now lies in the efficient and effective management of existing water resources via a sensible mix of decentralised responsibilities and authority to local institutions and also providing large-scale investment to redirect the surplus water to water deficit areas (James, 2003).

Currently, structural changes are underway in how water is governed and managed in India in order to deal more effectively with emerging challenges. Some of the major challenges include closing water basins where water allocation is equal to or more than the available water (surface water); extraction exceeding recharge (groundwater); rapid urbanisation and industrialisation which give rise to new priorities and demand in water use; and globalisation which influences water policy and politics (Mollinga and Tucker, 2010). There is also sustained pressure from various quarters of society to transform the role of the government from service provider to facilitator so it can provide the requisite level of financial and policy support to communities and community-based institutions, thus fulfilling services at desired levels on a sustainable and equitable basis.These processes are reflected in the Indian government's policy. For example, the mid-term appraisal of the 10th plan, the report of the sub-committee of the National Development Council, and the Eleventh Plan and its approach paper, besides the NWP 2002 which showcased the evolution involved in the thought process on water resources management (ibid.). Some of these policy changes have been converted into action through various water sector reforms.

6.2.1 Water Sector Reforms in India

Almost all the states in India have adopted various approaches to address new challenges in the water sector. These approaches or reforms are primarily meant for enhancing overall efficiency and effectiveness of water governance. All these reforms have however been taken on a pilot basis and their suitability in the Indian context is still under debate. Few of the major reforms include:

6.2.1.1. National Rural Drinking Water Programme (NRDWP)

The first major initiative in the country was the Accelerated Rural Water Supply Programme (ARWSP), which commenced in the year 1972-73. To provide impetus to the coverage, a Technology Mission on Drinking Water was subsequently launched in 1986. This mission was renamed the Rajiv Gandhi National Drinking Water Mission in 1991-92. In the year 1999, the Department of Drinking Water Supply (DDWS) was formed under the Ministry of Rural Development (MoRD), the main objective of which was focused on drinking water and sanitation.

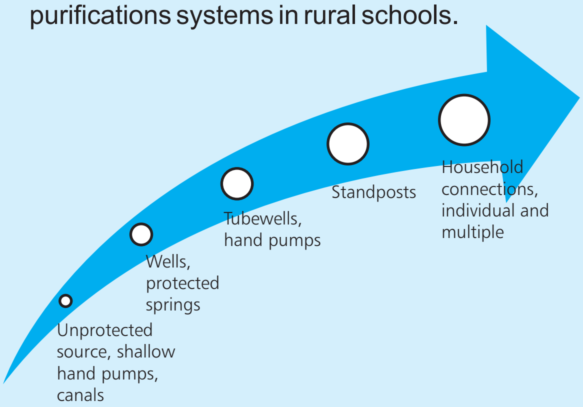
Box 6.1: National Rural Drinking Water Programme

The Rural Water Supply Programme and Guidelines have been revised into the National Rural Drinking Water Programme (NRDWP) with effect from 1 April 2009. It is one of the six components of the Bharat Nirman programme that was to be implemented in four years, from 2005–06 to 2008–09 for building rural infrastructure. The major changes in this new approach have been with respect to the following:

- Source sustainability, community managed programmes and recognition of the gap between infrastructure created and service available.
- Installation of a water source that will not be considered as the criteria for fully covered habitation, but adequate water supply received by all household of the habitations will be the criteria.
- Change the lpcd (litres per capita per day) standard as a means of measuring availability of water, but look at larger and various indicators of water security.
- Focus on ensuring household level drinking water security through preparation of village water security plans and household level water budgeting.
- Conjunctive use of surface and groundwater and focus on rainwater harvesting for recharge. For old and new groundwater schemes, recharge mechanisms to be made mandatory.
- Need for social regulation of agricultural water for meeting the demand for drinking water.
- Revival of traditional systems of water conservation and introduction of catchment protection schemes for surface water.
- Convergence with the National Rural Health Mission (NRHM) on aspects of water quality and health indicators. The guidelines also call for health-based targets as an improvement in

water supply.

- As a part of ensuring sustainability of sources and systems, incentivizing good behaviour in the gram panchayats to create drinking water security in their jurisdictional areas; Swajal Gram Purashkar to be launched.
- Linkage of National Rural Drinking Water Quality Monitoring & Surveillance Programme with the recently approved Jalmani guidelines for implementation of standalone drinking water purifications systems in rural schools.



Progressive Improvements in the service level as envisaged by the NRDWP

The first major sector reform project (SRP) was started the same year. The department was renamed the Department of Drinking Water and Sanitation in 2010. Finally, in 2011, it was conferred the status of a ministry. This ministry is the nodal department for all activities in the sector, ranging from overall policy planning, funding and coordination of programmes focused on drinking water and sanitation in the country.

The Joint Monitoring Programme for Water Supply and Sanitation of UNICEF/WHO states that the level of investment in the water and sanitation sector in India, although low by international standards, has increased during the 2000s. There is a significant increase in the percentage of Indians with access to improved sources of water, from 72 per cent (in 1990) to 88 per cent (in 2008). A key challenge remains, however, in that the local government institutions responsible for operating and maintaining the infrastructure usually lack the capacity and financial resources to execute their functions effectively (World Bank, 2006).

6.2.1.2 Integrated Watershed Management Programme (IWMP)

The IWMP is an initiative of the Department of Land Resources (DoLR) of the MoRD. Other ministries like the the MoA and MoEF are also involved. Till April 2008, DoLR was implementing three watershed programmes, viz. Integrated Wastelands Development Programme, Drought Prone Areas Programme, and Desert Development Programme. Subsequently, during the Eleventh Plan (2007-12), all these programmes were brought under a single entity, the IWMP, which is implemented under the Common Guidelines on Watershed Development, 2008. The aim of the programme is towards restoration of the ecological balance through harnessing, conserving and developing degraded natural resources like soil, vegetative cover and water (DoLR, n.d). Up to the Tenth Five Year plan (2002-7), it has been reported that nearly 51 Mha on watershed basis has been developed (Singh et al., n.d).

DoLR is committed to updating scheme guidelines with periodic inputs from varied institutions including research organisations, voluntary organisations, technical committees, workshops and seminars (ibid.). The modified IWMP (2008 onwards) has adopted a three-tier approach—the upper topography, which is largely hilly and forested, treated with support of the forest department. For slopes, which form part of the intermediate topography and are situated above agricultural land, IWMP would address all issues concerning land treatment by implementing best possible options, including cropping patterns, horticulture and agro-forestry. In the lower tier, consisting of plains and agricultural lands, the IWMP would be integrated with employment generating programmes such as the National Rural Employment Guarantee Scheme (NREGS) (DoLR, n.d.).

6.2.1.3 Participatory Irrigation Management (PIM)

PIM, an integral part of any systemic reforms, aims at involving all stakeholders and is acknowledged as an element of policy. After recognising the need to formulate a sensible legal framework for PIM, the MoWR brought out a Model Act in 1998, which was to be adopted by state legislatures for enacting new irrigation acts or amending existing acts for facilitating PIM. Fifteen state governments (Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Sikkim, Tamil Nadu, and Uttar Pradesh) have enacted a new PIM Act or made amendments to their existing ones. The remaining state governments, including Punjab, Haryana, Himachal Pradesh, Manipur, and Arunachal Pradesh are in the process of taking action (Planning Commission, 2010).

The actual progress in implementing PIM has been dismal, despite the formation of new acts or modification of existing ones. Approximately 20 per cent of the total command area of existing irrigation projects (13.5 Mha) has been covered till the end of 2007 through approximately 56,934 WUAs. Studies on the existing PIMs reveal that there are several potential advantages, including sense of ownership amongst users which motivates them to use water judiciously. These studies also reveal that PIM only works under certain enabling conditions, which has restricted its progress (ibid.).

6.2.1.4 Public Private Partnership

There have been several new developments in the privatisation of water during the past 10-15 years. In the year 1991, GoI announced a policy of opening up the power sector to private players. Subsequently, hydropower was also opened to private sector participation. Although hydropower has been privatised for over fifteen years, it is only now that we are beginning to witness privatisation in other areas of the water sector. The process of privatisation of irrigation is in the initial stages. On the other side, privatisation of water supply, especially industrial water supply, is now a reality and various cases are at different stages of development and implementation (Dwivedi et al., 2007).

The Eleventh Five Year Plan document of the Planning Commission of India emphasises private sector investments improving infrastructure and public utility systems through various Public-Private Partnerships (PPPs). Water supply is an integral part of this infrastructure sector development. The government has slowly but surely initiated the process of distancing itself from the responsibilities for which it was accountable in the past, and is instead relying heavily on the private sector to deliver the service. This is because the service delivery levels of the government have been inadequate, due to low recovery and operational inefficiency levels when compared to the production costs. It has been consistently argued that the correct implementation of the PPP projects will be beneficial for all (ELRS, 2011).

Some of the few success stories of the PPP model are the 24X7 water supply schemes of Karnataka and the waste water treatment plant at Sonia Vihar in New Delhi. But on the flip side, PPP projects have also ignored most of the principles of good governance, viz. public participation and consultation, transparency, accountability, and efficiency. The Tirupur Water Supply & Sewerage Project (Tamil Nadu) and Mysore PPP Project are two examples. Based on these unfortunate experiences, serious concerns and questions have been raised about PPP projects in the water sector and their ability to deliver services without interfering with the idea of human right to water. The debate here is about the state's responsibilities and obligations to control activities which affect public interest. It is also debatable that a fundamental right is a non-negotiable right and no private entity can alter this in connivance with the state (ibid.). Further, the water privatisation agenda in the PPP model needs better scrutiny from the water pricing perspective. Joy et al (2011), discusses the water pricing issues in India. The authors take a mid view of arguing that water is both social as well as economic god and argues not for a withdrawal of the state but for a change in its role. 'The provision of water is a service that serves both functions, a basic service aimed at basic livelihood needs, and also an economic service for conspicuous consumption or surplus generation. Both of these functions also place contradictory demands on how the service should be provided and at what charge. A basic service aimed at basic needs to be provided to all equitably at an affordable price, including the poorest sections, has to be subsidised if need be, through cross subsidy within the sector or across sectors' (ibid: 14-15).

6.2.1.5 Independent Regulatory Authorities (IRAs)[59]

In the last few years, India witnessed some novel changes in the area of water sector regulatory reforms. The advent of the Independent Regulatory Authorities or IRAs at the state level are new mechanisms which are expected to usher in sweeping fundamental and comprehensive changes in governance in this sector (Wagle and Warghade, 2010: 49). The first state to have this new regulatory entity was Andhra Pradesh, which formulated the Andhra Pradesh Water Resources Development Corporation (APWRDC) created under an act of the same name in 1997. However, it is Maharashtra that has till date introduced the most far-reaching institutional reforms in the sector through the Maharashtra Water Resources Regulatory Authority (MWRRA) Act 2005. The acts of some states like Arunachal Pradesh (2006) and Uttar Pradesh (Uttar Pradesh Water Management and Regulatory Commission-UPWMRC Act, 2008) have substantially borrowed from the MWRRA legislation. The larger states of Madhya Pradesh and Andhra Pradesh are still awaiting approval of their pending bills along similar lines as MWRRA.

Rao and Badiger (2010) analysed the organisational set-up and functioning of the IRA, which is focused on five prime areas of governance: (a) tariffs; (b) distribution through entitlements and allotment; (c) resource planning; (d) private sector participation; and (e) public participation.

Water Pricing and Tariff Structures: The proposed changes in water governance under MWRRA (GoM, 2005) and UPWMRC (GoUP, 2008) focus on the empowerment of water regulatory authorities towards establishing a tariff-based

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[59] This section is based on the analysis of IRAs by Rao and Badiger (2010) and Wagle and Warghade (2010).

system, which in turn works on the 'cost recovery' principle to determine and regulate water tariffs. While the MWRRA Act restricts the level of recovery to O&M costs, the UPWMRC Act recommends, along with the recovery of O&M costs, the recovery of part of the capital costs (in the form of depreciation) and the 'cost of subsidy' from water tariffs. This provision for the recovery of capital costs would enable higher commercialisation of water services and would thus create a favourable environment for privatisation in the water governance sector.

Water Entitlements and Allotments: The core of the regulatory framework of the IRA is the creation, management and regulation of the 'Water Entitlement System' (WES). Both the UPWMRC and MWRRA have been empowered through their respective legislations to determine as well as regulate water entitlements to various user groups. Additionally, a framework and criterion has been developed for water entitlements trading, wherein the authority can determine the distribution of various user entitlements. This can further be 'transferred, bartered, bought or sold on annual or seasonal basis within a market system'.

Water Resources Monitoring, Management and Planning: The Integrated State Water Plan (ISWP) is drawn from Integrated Water Resources Management (IWRM). In the case of the UPWMRC Act, the government has been given the responsibility to draft the ISWP and give itself the powers of approval. However, the MWRRA Act delegates the power of approval of ISWP to a wide-ranging committee comprising various ministers. Thus, the role of MWRRA is restricted to monitoring IWSP implementation. It is expected that the five River Basin Agencies (RBA) created in Maharashtra would prepare basin and sub-basin level plans for their respective river basins using a multi-sectoral, participatory approach. Subsequently, the individual RBA plans would be integrated into the IWSP. Further, issues of entitlements, tariffs and prioritising of available water for equitable distribution is reserved for the MWRRA. It is in fact a very brave and futuristic step to have a decentralised river basin approach, which has been highlighted in MWRRA. While the planning part should ideally involve government and citizens, in the case of the UPWMRC the IRA seems to have the last say on the ISWP, which might be troublesome as it puts the planning regime directly under the control of the IRA.

Public Participation: The concept of public participation is more meaningful when, in the true sense, it is the public that controls various aspects of governance. In the case of the IRAs, however, decision making tends to remain with the institutions which are inaccessible to the public. Also, there is no process through which decision makers can be held accountable following their disregard for public views and suggestions, if at all, in their final decisions.

An analysis of the process of formulation of IRA laws by Wagle and Warghade (2010) indicates that the laws in themselves are not transparent, not participatory and not accountable. The credibility of organisations involved in the formulation is low too. Owing to these two factors there is always an uncertainty on the reliability and acceptance of the IRAs for most of the stakeholders.

6.2.1.6 Groundwater Regulation

The requirement for effective regulation with regard to groundwater extraction has been recognised. The MoWR is pursuing all the states and union territories (UTs) for the enactment of a law on groundwater. The Model Bill initially circulated among all states/UTs during 1970, and re-circulated during 1992, 1996 and 2005, enables the enactment of a suitable legislation for regulation and control of groundwater development along the lines of the Model Bill. 'The Model Bill to Regulate and Control the Development and Management of Ground Water was largely ignored by states for about three decades. It is only over the past fifteen years that states and UTs have started adopting groundwater legislation. The states/UTs that have adopted groundwater legislation are: Andhra Pradesh, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Maharashtra (with focus on drinking water), Tamil Nadu, West Bengal; Chandigarh, Dadra and Nagar Haveli, Lakshadweep and Pondicherry. Some states, like Maharashtra and Uttar Pradesh have groundwater bills that are pending for adoption by the legislative assembly. In all the states/UTs that have adopted groundwater legislation, the basic framework is directly derived from the existing Model Bill. The very fact of adopting a law related to groundwater confirms the increasing importance of groundwater. At the same time, groundwater laws adopted in recent years are neither adequate nor satisfactory in large part, because of the shortcomings in the Model Bill, 2005 highlighted above.' (Planning Commission, 2011: 4)

6.2.2. Sanitation

Poor sanitation and hygiene are major causes of poor water quality, as the bacteria from human excreta contaminate drinking water. Hence, interventions promoting proper sanitation are very crucial. Some of the key efforts in the area include:-

6.2.2.1 Total Sanitation Campaign (TSC) for Rural Areas

The Comprehensive Rural Sanitation Programme was restructured by the GoI by launching the Total

Sanitation Campaign or TSC in 1999. The major objectives of the TSC include improving the general quality of life and increasing sanitation coverage in rural areas by access to toilets for all by 2012 through motivation of communities and panchayati raj Institutions. This is being done by promoting sustainable sanitation facilities by creating awareness and health education. Individual household latrines, school toilets, anganwaadi toilets, sanitary complexes and rural sanitary marts have been taken up under the scheme. However, the emphasis on achievement of national and international coverage targets has led to a situation where there is more focus is on latrinisation at least in some states. There seems to be an absence of monitoring of the use of household latrines, hand washing and other hygienic practices in some states (WaterAid, 2006)

6.2.2.2 Integrated Low Cost Sanitation Scheme for Urban Areas:

The Ministry of Housing & Urban Poverty Alleviation (MoHUPA) has a scheme for conversion/construction of low cost sanitation units through sanitary two pit pour-flush latrines with superstructures and appropriate variations to suit local conditions (area specific latrines). New latrines are also constructed where economically weaker section households have no latrines and the inhuman practice of defecating in the open in urban areas exists. The scheme commenced from 1980-81 and was initially implemented through the Ministry of Home Affairs (MoHA), and subsequently through the Ministry of Welfare (MoW). The MoUD implemented the scheme from 1989-90; later, the scheme was shifted to MoHUPA (erstwhile Ministry of Urban Employment and Poverty Alleviation). The scheme guidelines were revised in 2008. This scheme is on an 'All Town' coverage basis (MoHUPA, n.d).

6.2.2.2 National Urban Sanitation Policy:

The National Urban Sanitation Policy was launched by the MoUD in 2008. The ministry also announced an award plan as a policy initiative to motivate cities and urban local bodies to achieve total sanitation. The award, the Nirmal Shahar Puraskar (Clean Cities Award), has been designed in the model of the rural sanitation rewards scheme, and aims to honour cities which achieve total sanitation. This includes Open Defecation-Free (ODF) status and 100 per cent safe waste disposal. The major but positive highlight of the policy and the award plan is that the focus is not just on infrastructure development but also on outcomes and behavioural change. Under this policy, all the states in the country are required to develop state sanitation strategies as per the national guidelines (WSP, n.d.).

6.3 Water and Sanitation as Human Right

Presently, a debate continues to rage on whether or not water is a right. The parties in favour of 'water as right' view adequate access to safe water as a basic individual need, to be treated at par with other human rights, all of which form an integral part of the Universal Declaration of Human Rights. The role of water is irreplaceable. While one can always argue that even if water were declared a human right, it would not lead to more availability of water; it could however institutionalise access to water, specifically for the poor. Subsequently, if the right is justified and can be proved to be constitutional, there is vast scope for it being transformed into a powerful tool for mobilisation (Ballabh, 2008). Further, water rights are strongly linked to land rights. It has also been observed that land rights largely determine water allocations. Ongoing efforts to delink land rights from water rights, although mentioned in the NWP 2002, are yet to be recognised. Prominent and ongoing social movements have termed this delinking as imperative to break the dominance of the rich and powerful over the poor, by improving access to this scarce and essential resource. This is because many livelihoods are dependent on water, irrespective of the landholding size or ownership (Rao and Badiger, 2010). See Box 6.2 for an excerpt on right to water from Ramaswamy Iyer's alternative water policy for India (Iyer, 2011: 201-04).

Endorsing this approach, the United Nations General Assembly adopted a resolution recognising access to clean water and sanitation as human rights on 28 July 2010. India was one of the 122 countries which voted in favour. The resolution text states its concern that an estimated 884 million people lack access to safe drinking water and more than 2.6 billion people globally, constituting 40 per cent of the population, don't have access to basic sanitation.

Box 6.2: Water as a Right

The right to water needs to be distinguished from water rights. The right to water relates to the basic water requirement for life (i e, water for drinking, cooking, washing and personal hygiene, and the essential water needs of livestock), whereas 'water rights' is a term that is generally used in the context of water for irrigation, industrial or commercial use, etc; that is, economic uses of water. The right to water as defined above is a fundamental right by judicial interpretation. The state has a responsibility to ensure that this right is not denied to any citizen or group of citizens. The right to water must include the rights of access of certain tribal and other communities to forests, mountains, rivers, etc; that is, the natural resource base on which they have for centuries depended for sustenance. Between a fundamental right (life-right) and a non-fundamental use-right, the former must always take precedence over the latter; and the exercise of economic rights by some must not be allowed to jeopardise the fundamental rights of others. Water-supply and sanitation are inter-connected. If there is a right to water, there must also be a right to decent sanitation.

Source: Iyer (2011)

6.4 Summing up

The water needs in the country have risen exponentially to an unprecedented scale, especially in recent times. The demand has outstripped supply. The solution to the problems in water across the country lies largely in areas of effective mechanism for conservation, distribution and efficient use and management of this resource. All the states in the country have been initiating various approaches to address new challenges in the water sector. Most of these approaches and/or reforms are focused towards enhancement of overall efficiency and effectiveness in the area of water governance. These reforms have been implemented on a pilot model basis and thus their scalability and suitability in the context of an entire region or on a national scale is debatable.

Although there have been varied developments in water resource management initiatives, the Indian governance system needs to be strengthened significantly to achieve the intended goals of social equity, accessibility and environmental sustainability. India, as a nation, has probably the best of all written policies, laws and regulations; what remains a challenge is the execution. To create an efficient system and environment, integration of policies (both in terms of content and institutions) to guide resource development, allocation and use, especially with regard to local level water supply and management, is required. Coordination is of utmost importance, especially in the field to limit overlap of responsibilities and duties of similar field-level bodies. Besides initiation of policies and their implementation, what is required most is the demand for effective monitoring systems for bodies/institutions formed under the reform process as there are always uncertainties on the transparency of decision making and implementation of policies.

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CHAPTER SEVEN

WATER CONSERVATION AND MANAGEMENT: POSITIVE EXAMPLES AND CASE STUDIES

This chapter presents case studies of successful water management interventions from across the country. The cases are divided into small-scale and large-scale interventions to help understand both community-led as well as state-led initiatives, and learn from them the process of scaling up. Despite the grim picture of water management on a large scale, these examples clearly illustrate how concerted can make a significant impact on both conservation and management of water.

The concerted efforts of government, civil society and external support agencies in the water sector have manifested themselves in the form of various positive cases and examples from across the country. These endeavours, whether on a small or large scale, are steps towards achieving the MDGs or the overarching goal of water for all. India's regional diversity poses unique challenges for water resource management and governance. Each geographical region with its own socio-economic uniqueness demands water resource management intervention suitable to the people's need and, at the same time, offering pragmatic solutions to the constraints set by local topography. In some of the most remote areas of the country, where government interventions have not yet reached, various non-governmental organisations (NGOs) are mobilising communities and brining about developmental changes at the grass-roots level.

One of the goals of this chapter is to bring forth cases from the field on successful water management practices. As part of structuring this report, a case study from each geographical region of the country, that, north, south, east, west and north-east, was documented representing best practices in water resource management.[60] These cases demonstrate the community level solutions applied to address various context specific problems in the study areas. These cases documents both – small and large scale interventions. They illustrate the integrated approach of securing livelihood options through better water resources management. The cases were selected based on their uniqueness and innovation of approach and the fact that they are successful models for replication.

7. 1 Small-scale Initiatives

7.1.1 Drinking Water and Sanitation Issues in Bawana Resettlement Colony

As discussed in Chapter 3, access to water and sanitation is a pressing issue in India's slums. Achieving the targets of the MDGs will be elusive until close to 93 million slum dwellers[61] are integrated in the country's drinking water and sanitation programmes. The case of the Bawana resettlement colony in New Delhi reflects the concerns of the people who have been forcefully evicted on grounds of development. When people of Yamunapushta in New Delhi were evicted from their homes and resettled some 35 km away from the main city, it was done without basic amenities like drinking water or toilets. The women and young girls face harassment by attendants in community public toilets and by the landlords of the nearby fields who viewed the resettled families as encroachers and outsiders. It came to the fore that water and sanitation (WATSAN) is only one of the issues faced by the resettled population. For people without secured land rights and medical facilities, water scarcity and inadequate sanitation is just another issue. The NGO Jagori intervened by working with the women groups in Bawana about various issues like inadequacies in the public distribution system, domestic violence, WATSAN,

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[60] The initiatives of the Community Based Tank Management Programme in Andhra Pradesh; Jagor's initiative in Delhi's resettlement colony; the Dong System in Assam; Gram Vikas's efforts in Odisha; and WASMO's work in Gujarat has been documented by the SaciWATERs team and has been published separately as policy briefs. The information presented here is based on the fieldwork conducted in 2011 in these locations.

[61] Ministry of Housing and Urban Poverty Alleviation (MoHUPA), 2011. Available at : http://pib.nic.in/newsite/erelease.aspx?relid=71733

etc. In 2009, Jagori undertook an action research involving the youth and conducted what are known as safety audits. The aim was to bring forth the inadequacies in the infrastructure of the resettled colonies and the existing gender gap while planning for basic services. They conducted a Rapid Situation Analysis (RSA) with youth in five blocks. This was done to analyse the status of the pipes, drains, toilets, garbage bins, people's perceptions about these, and how/why women are affected. Focus group discussions (FGDs) were also organised with women to develop a deeper understanding on the issue and complement the RSA. Mobilised and empowered by Jagori's intervention the children of Bawana air a community radio show on the issues of health and sanitation which is broadcast on All India Radio. The entire show is conceptualised by the children who go door to door in the colony asking people about the issues that are of concern to them and then prepare the script.

7.1.2 The Dong System: Traditional Water Management System of the Bodo Community in Assam

The Indian subcontinent is rife with examples of community managed traditional water conservation and harvesting systems. In an effort to bring forth one such water management system from the north-east, the case of the dong system was documented from Baska district, Assam. It demonstrates how a community organises itself to manage a crucial resource such as water by building on social capital. Applying the logic of the subsidiary principle of governance, this case brings to light an intuitive solution for water resource planning and management by reducing service delivery intermediaries and improving community welfare. Community participation being the essence of its existence, the dong system has also cemented kinship ties for generations. Various dong committees, spread across a river, work with mutual understanding and co-operation to minimise the conflicts associated with a scarce resource in a precarious terrain. The system illustrates how communities, through an acquired understanding of their environment, devise methods most suitable for indigenous terrain. The dong system has been evolving around a changing socio-economic environment. With the people demanding concretization of bunds and channels (hitherto done by the communities themselves using natural material) to reduce the drudgery of work, there is a scope for more state intervention. While strengthening the physical components that make up a dong, it is imperative to conserve the ethos of this system which binds the community together though a social fabric of co-operation and participation.

7.1.3 Community Managed Drinking Water and Sanitation Programme: Case Studies from Odisha

Gram Vikas is a rural development organisation working with the poor and marginalised communities in Orissa since 1979. Through its help, the communities have not only been able to construct their own toilet and bathroom complexes but also ensure 24x7 water supply. The experience illustrates the willingness of communities to bring fundamental changes for rural welfare as well as act as agents of change. A major achievement of this intervention has been the paradigm shift in the attitude of the rural people towards health and sanitation. In both the study villages–Bahalpur and Kanamana in Ganjam district–the people noted that the children are now at the forefront of creating awareness about environment and health. Integrating the WATSAN scheme with livelihood generation activities has furthered the cause of rural development. The intervention includes many innovative threads which contribute to its success. Constructing toilets without a water supply in the Indian scenario severely compromises the functionality of the system and leads to enhanced burden of water collection on women. Gram Vikas was able to address many problems simultaneously by providing three taps for different water uses. The organisation maintains 100 per cent community participation as a pre-requisite for initiation of the WATSAN scheme. The 'all or none' principle of community participation may make the task difficult but it is by setting such standards that true empowerment is achieved. Gram Vikas has been instrumental in mobilising the people, but it also ensures the sustainability of the system after it moves out.

7.2 Large-Scale Initiatives

7.2.1 Community-based Tank Management Programme in Andhra Pradesh

Tank restoration and management issues in Andhra Pradesh gained attention with the introduction of the Andhra Pradesh Farmers Management of Irrigations Systems Act (APFMIS), 1997, under which Water User Associations (WUAs) were formed for surface irrigation systems with command area of over 100 acres. Desiltation of the tanks has been taken up as a major activity under the programme. Even before government intervention some local NGOs had mobilised villagers and initiated tank restoration activities. Modern Architects of Rural India (MARI), an NGO operational in Warangal district in Andhra Pradesh, has been part of these initiatives, which the authors have visited. Ramachadrapuram, a village in Warangal district, was studied to observe the impact of restoring traditional water harvesting /conservation/ management in the present situation. Prior to this work, water did not stay in the tank thus making it difficult for farmers to cultivate crops like paddy. The construction of weirs, cemented canals and distribution channels undertaken in this project has resulted in a number of changes:

- More than 20 washermen families have benefitted due to better availability of water throughout the year.
- Due to the repair of the tanks and improved roads (improving access to tanks) the condition has improved. As against the Rs 1,500-2,000 per person benefit earlier, per head income in the first year of tank rehabilitation has been about Rs 4,500 per person.
- The groundwater table has gone up, and livestock raising has improved.
- In 2011, 30 tanks from various project sites were selected and farmers trained on various aspects of agri-business.
- The government aims to train the farmers on organic farming selecting five farmers from each tank. So far, about 150 vermicomposting beds have been constructed covering about 25-30 villages. Kisan melas are organised under each tank to provide a platform for government officials and farmers to interact on issues of concern.
- The tank rehabilitation project in Ramachadrapuram has selectively excluded women despite their demonstrated ability to take up management initiatives.

7.2.2 WASMO's Decentralised Demand Driven Water Supply Model

There has been a widespread thrust on decentralised water management interventions across the country. Building on the subsidiary principle, efforts have been made to bring communities to the forefront of management of their own resources, like water. Water and Sanitation Management Organisation (WASMO) was established in 2001 in Gujarat with an aim to achieve a paradigm shift in the role of the state as a service provider to a facilitator for community action in self-governance. At present, it works on demand driven, community managed drinking water systems in rural Gujarat by facilitating rural communities to set up and manage their own drinking water sources. The cases of two villages in Surendrenagar districts of Gujarat reflect the need to design the water supply schemes according to the socio-cultural fabric of the region. Based on the principle of community participation, WASMO has been able to provide sustainable water access to these villages and empower the villagers to manage the scheme themselves by means of Pani Samitis. The scheme, through its provision of household tap connections, has also succeeded in providing equitable access cutting across class and caste. In both villages to date, people from lower castes people are not allowed to enter the village temples and access water from the same source as those from the upper castes. The installation of public standposts or digging of bore wells has been unable to address equity in drinking water provision as physical access to these on the ground is determined by the power relations in society. It was thus imperative in such communities to provide equitable access to water by means of household connections, WASMO's biggest achievement.

7.2.3 Waste water Reuse in Schools of Madhya Pradesh

Dhar and Jhabua are two districts of Madhya Pradesh in the central province of India which suffers recurrent water quantity and quality problems. Lack of water is a major reason for low sanitation coverage in schools here. In many residential schools in Dhar and Jhabua, limited availability of freshwater has prompted UNICEF, in collaboration with the National Environmental Engineering Research Institute (NEERI) and other governmental and non-governmental partners, to explore the use of greywater for appropriate purposes such as flushing of toilets. A holistic water management is adopted in these ashram schools by integrating different water usages and corresponding quality requirements. In the ashram schools, the water requirement is about 60-70 l per student per day as against the drinking/cooking water requirement of 5 l per day. Considering the consumptive use of 20-30 per cent, greywater generation is in the range of 23-35 l per student per day. The greywater treatment plants have been constructed by providing treatment techniques such as screening, equalisation, settling, filtration and aeration. This simple treatment has resulted in the use of treated greywater in flushing the toilets which were otherwise unclean and hence not used by the students (NEERI-UNICEF, 2007).

7.2.4 Andhra Pradesh Groundwater Bore Well Irrigation Schemes Project (APWELL)

The project was implemented from 1995 to assist small and marginal farmers in increasing their agricultural production through the provision of groundwater irrigation facilities. The groundwater irrigation facilities provided by the project brought in an additional 35,000 acres under irrigation thereby uplifting about 14,000 small and marginal farming families, in seven drought-prone districts of Andhra Pradesh. However, the project faced the challenges of depletion of groundwater resources that made them think about environmentally sound interventions than looking only for economic upliftment of the people. APWELL transformed into the Andhra Pradesh Farmers Managed Groundwater Systems (APFMGS) Project in 2003 with support from the Food and Agricultural Organisation (FAO). APFMGS called for a reversal of the present trend of over-exploited aquifers. It backed the traditional methods of water management with a new approach to governance – participatory rather than top-down – in empowering people to develop their own water resources. The project focused on strengthening local institutions at the habitation and hydrologic unit level to bring to centre stage discussions on emerging the water crisis, especially on groundwater. It offered the means to increase their knowledge about the status of their groundwater resources by giving them the equipment and skills to collect and analyse rainfall and groundwater data. The project also facilitates access to information about water saving techniques, improving agricultural practices and ways to regulate and manage their own demand for water. With its innovative approach, the APFMGS project provides some alternatives for groundwater management in India.[62]

7.2.5 Tamil Nadu Water Supplies and Drainage Board (TWAD) Experience

In the year 2004, a programme was launched by the Tamil Nadu Rural Water Supply and Sanitation Programme (TNRWSSP) to bring in institutional reforms in access to water. The Tamil Nadu Water Supplies and Drainage Board (TWAD) was created to supply water to the whole of Tamil Nadu state, barring Chennai city. The reform was triggered by the reality of a growing water crisis and the growing realisation that old technocratic investment focused bureaucratic solutions was not sufficient to deal with the crisis. Another contributory factor was the perception that water engineers were no longer seen as the sole providers of water, rather they were to play a role of being 'social engineers' and 'facilitators' of community participation. In order to meet these challenges, TWAD launched an ambitious process covering the entire state-wide department in an exercise to bring about personal change and institutional transformation. During the first two years, almost the entire population of rural water engineers, numbering over 540 and covering all levels, underwent personal, group and collective exploration. The idea was to work at three levels: attitudinal transformation, perspective change and institutional change. The outcomes were encouraging. There was a much stronger thrust on reaching marginalised sections and a shift from service providers to partners. After the creation of the TWAD board, a large number of areas were reached through the increased partnership between community and engineers of the TWAD board. Further, the issue surrounding sustainability of water was addressed, which has helped the people in getting longer term access to water (Suresh, 2007).

7.3 Sustainable Water Management Initiative by Industry

Bajaj Auto Limited, Aurangabad, is at the forefront of conserving water in its industrial processes, through the three principles of reduce, reuse and recycle. This work won the company the CII-GBC National Award (Within the Fence Category) for Excellence in Water Management in 2008. The company modified its water conservation approach by adding the 3Rs of reduce, reuse and recycle to the earlier approach of conserve, preserve and reserve. It followed the approach of using some innovative projects to achieve its goal. It used automation of localised water storage systems wherein about 140 cu m of water per year was saved by providing a Programmable Logic Controllers (PLC) controlled auto system. Eliminating water wastage by providing a timer for water supply, the company made water available only during lunch, breakfast and dinner in the hand washing area thereby saving some 730 cu m per year. It has constructed rainwater ponds of 7,000 cu m for horticulture purposes thus saving 45,000 cu m water per year. By changing the sludge pit cleaning frequency from quarterly to yearly, the company saved 600 cu m water per year. Further, the installation of a spot cooling system replaced the old system thus saving 1,500 cu m water per year. An installation of the drip irrigation system also saved 150 cu m water per day (CII, 2011).

7.4 Summing up

This chapter documents two kinds of water conservation and management initiatives—small-scale community-based water management and large-scale state-initiated and managed innovative water management systems. Jagori's initiative in Delhi's resettlement colony, the dong System in Assam, and Gram Vikas's efforts in Odisha present the community-based water management initiatives. Jagori's initiative in Delhi's resettlement colony Bawana shows us how advocacy efforts and an empowerment approach for community development enables the community in raising its collective voice for better service delivery. Even though, in a short term, the services may not improve, the approach has a long-term effect in

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[62] Bharati Integrated Rural Development Society, 2011. Available at: http://9848.org/birdsorg.net/index.html (accessed on 27 April 2011).

strengthening the community to voice their opinion and make the service provider responsible. The young children's effort in community radio broacdcasting has also brought in a level of confidence in young girls and boys to the extent that they are now conceptualising the programme and roping in the service provider to help their community be served better by the local authorities. The dong system of Baska district in Assam demonstrates how a community organises itself to manage a crucial resource such as water by building on social capital. Applying the logic of the subsidiary principle of governance, this case offers an intuitive solution for water resource planning and management by reducing service delivery intermediaries and improving community welfare. The case of Gram Vikas from Odisha shows how empowered, communities have not only been able to construct their own toilets and bathroom complexes, but also ensure 24x7 water supply. The experience illustrates the willingness of communities to bring about fundamental changes for rural welfare as well as act as agents of change.

Apart from the community-based initiatives, the large-scale efforts of the government – such as the community-based tank management programme and APWELL projects in Andhra Pradesh, the institutional reform programmes in TWAD and WASMO, the waste water recycle and reuse programme in Madhya Pradesh led by UNICEF and the government of Madhya Pradesh—are prime examples of best practices in water management, use and service delivery. The revival of tanks has brought in multiple benefits to the farmers and fishermen in rural Andhra Pradesh. The APWELL programme, which focused on groundwater irrigation, backed the traditional methods of water management with a new approach to governance – participatory rather than top-down thus empowering people to develop their own water resources. The waste water reuse project of UNICEF in two districts of Madhya Pradesh has explored the use of greywater for appropriate purposes such as flushing of toilets. The institutional reform programmes in terms of creation of WASMO and the TWAD board has lead to new meaning and greater service delivery for water supply in Gujarat and Tamil Nadu respectively.

The efforts by the company Bajaj Auto, for restoring, recycling and reusing water in Aurangabad in Maharashtra, is another example of good practices by a corporate house. All these are examples of how concerted efforts help improve the service delivery of water or the conservation of a precious resource. What is required is a strong political will to implement a programme with the right objective and resources.

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CHAPTER EIGHT

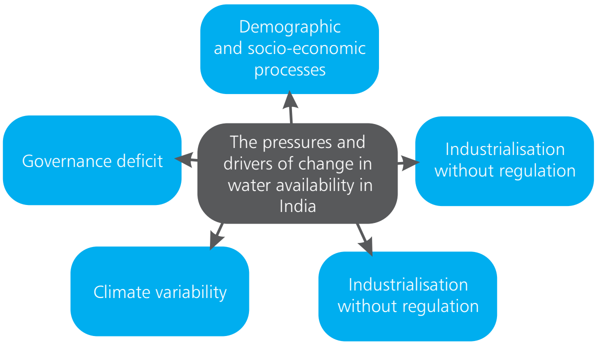
PRESSURES AND DRIVERS OF CHANGE AND THE ROLE OF STAKEHOLDERS IN OVERCOMING THE PROBLEM[63]

This chapter revolves around the following questions: Why does India's water sector require change? What developments affect the resource in terms of quantity and/or quality, and to what extent? What are the underlying mechanisms for each of these drivers of change? Further, it seeks to present the role of each major stakeholder in overcoming the problem. The pressures and drivers are categorised, and the effect of each of the pressures and drivers are then linked to probable solutions. The chapter also discusses the role of state, market, community and civil society in changing the current scenario. Questions relating to an appropriate strategy to deal with the change process are also discussed.

8.1 Pressures and Drivers of Change

The growing water scarcity and lack of access to water for millions of India's poor leads to the the following question: What are the pressures and drivers of change? Five such pressures and drivers are identified – (a) demographic and socio-economic changes; (b) technological development in agriculture; (c) industrialisation without much regulation; (d) climate variability; and (e) governance deficit. Each of these points is elaborated ahead and also presented schematically in Figure 8.1.

Figure 8.1: The Drivers of Change in Water Availability in India



Source: Drawn up from the Multi-Stakeholders' Consultation Workshops in five regions, November 2011

8.1.1 Demographic and Socio-economic Drivers

The demographic pressure on land and water has increased the demand on water vis-à-vis its availability. Cities are growing and lifestyles changing, and this puts additional pressure on water resource availability. This coupled with income disparity between the rising upper-middle and middle class and the urban poor in urban locations results in differential water access and ownership. While the increased middle and upper classes in cities are able to buy water for their continued (read 24X7) water supply, the poor who live in slum locations, or rural inhabitants, suffer from both quality and quantity of water supply. In most urban cities, slum locations are poorly served. In many cities, increasingly most people fetch water from peri-urban locations through tankers, which have become the order of the day. Further, cities are now producing huge amounts of waste water which flows (in most cases) directly into the water bodies and further pollutes the available freshwater. One of the reasons for this is because none of the cities in India have a full-fledged system that treats all the waste that is generated. In the rural areas, the continued and systematic destruction of the ecosystem has led to land use changes, including water harvesting structures and forest cover decline. Further, the cropping pattern changes have led to water intensive agriculture in many locations. There are many drivers to these shifts in agriculture, including incentive and subsidy mechanisms such as free power, minimum support price, fertiliser subsidy, pesticide subsidy, etc. All these have a compounding effect on water supply. Many rural areas in India suffer from water quality and quantity deficit, leading to shortage in water supply, both for drinking and irrigation.

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[63] This section is based on the five consultation workshops organised to cover the length and breadth of the country in 2011. A total of 159 water professionals representing government offices and civil society attended these workshops. This section represents the outcomes of the group discussions held during the workshops.

8.1.2 Technological Drivers

Agriculture and groundwater, two unique changes in technology, have increased the pressure on existing water resources. Changes in agriculture technology include invention of water intensive cash crops in the overall framework of the Green Revolution. This has increased the demand for water which surface water projects have been unable to fulfil. An increased demand for water in agriculture has led to groundwater extraction. Consequently, the groundwater extraction technology, combined with lack of a mechanism to control groundwater access, has led to a secular decline in groundwater bodies in many locations in India. Further, it has led to an absolute problem in sub-surface water flow which had earlier supported drinking water wells for centuries. The geo-physical characteristics of resources such as arsenic, iron and fluoride contaminations have also limited water resource availability and use.

8.1.3 Industrialisation and Water Use

India is urbanising at a rapid pace. Apart from the contribution of industries to the economy, unregulated industrial expansion is also adding to water pollution and scarcity. Many industries need water and natural resources to operate. Most of the time, their water needs are met with groundwater extraction. Industries also discharge waste, the nature of which depends on the type of industry. Untreated or improperly treated waste becomes pollution, increasing not only private costs but also social costs. Industries are hardly regulated on environmental management even though India has some of the most stringent laws against pollution. The environmental degradation caused by industries often tends to become irreversible and imposes damaging social costs. Industries are some of the biggest polluters in India and the ecological and social costs of such unrestrained pollution and degradation have put a big question mark on the perceived notion of industrialisation in India. It has been reported that many areas or ecosystems are more susceptible to adverse environmental impact than others; unplanned and haphazard industrialisation has substantially increased the risk to the availability of water through pollution of water bodies. This has resulted in the diminishing of aquifers near riverbeds and the worsening of water quality. To control water extraction and pollution by industries, regulations and monitoring should be more strict, dynamic and transparent. The focus should be more on the big polluters and huge extractors.

8.1.4 Climate Variability

The climate change process has been identified as one of the components of the drivers of change. It has been reported that micro-climate change is increasingly being recognised as a driver of the changing water scenario in many locations of the country. Climate variability combines with the present mismanagement of water and creates problems, which remain largely unreported. In many areas, localised droughts are changing the way water was traditionally managed. Perceptions are pointing towards an increasing flood situation in the eastern and north-eastern states, a result of the climate change process. Though the contours of climate variability are yet to be understood, this has been a point for discussion that is leading to water scarcity and its increased understanding will help in managing water better.

8.1.5 Governance Deficit

India has an enormous governance deficit when dealing with changing water scenarios. The pressures and drivers that stem from demographic, socio-economic, industrialisation and urbanisation processes could have been better dealt with, if there as a sharp vision for governance of water. Governance of water is divided between the central and state authorities, with categorisation of rules and responsibilities, yet it is seen that the overall sustainable vision for water development, conservation and management remains missing. There are a couple of issues that need to be highlighted here. First, there is a dire need for convergence of laws and legislations; there exist too many laws and this in turn dilutes the water issue. The coordination and synchronisation between departments/implementers and regulators is fragmented leading to each department doing things without much coordination with other departments, and sometime at cross purposes. The regulatory bodies have not been strict in controlling, for example, appropriation of water bodies, industrial pollution, etc. Second, there is lack of data disaggregation and aggregation in important decision making by the body involved in water planning. Data is generated by different bodies and is sometimes contradictory in nature. Overall, there is a weak political will in finding sustainable solutions to water problems and this in turn leads to governance deficit in water. Table 8.1 presents some of the pressures and drivers, and their effects and probable solutions.

8.2 Stakeholders' Involvement

Stakeholders' involvement has become a buzzword in the social development sector. It envisages the partnership of all actors in the water sector—state, community, market and civil society. The term 'partnership' is coined to draw on the

Table 8.1: Pressures and Drivers for Water Availability, Effects and Probable Solutions

Pressures and Drivers	Effects	Effects
Demographic and socio-economic pressure, Socio-economic stratification and inequities resulting in differential land and water ownership	• Increasing demand vis-à-vis availability, equity gets further compromised. • Increased sewage and waste generated from urban areas.Inequity in water supply—the rich get more water, the poor less or no water.	• Prioritise local water use for drinking water and sanitation use and serve the un-served on priority. • Equitable development. • Monitoring water use by different categories of consumers and data disaggregation by classes of users of water is important. • Making minimum basic lifeline water as a human right. • Consumption analysis and water pricing for high end users.
Agrarian change and water intensive agriculture	More water needed for bringing more area under irrigation.	• Benchmarking of irrigation projects considering social and technical projects. • Water efficiency in agriculture.
Agriculture and power subsidy for irrigation	Waste and benefits for those who own land and water.	Ensure that those who are poor are not denied water access in the name of increasing efficiency of water use.
Groundwater access	• Groundwater over-developed in many locations. • Water quality is seriously affecting human health due to increased groundwater use. • Over-exploitation exacerbating geogenic contamination. • Differential access to groundwater in agriculture and for drinking.	• Groundwater laws to be implemented in letter and spirit. • Groundwater regulation and stringent laws to check over-exploitation in urban areas. • Disaggregated approach in managing groundwater • Recognise aquifers as common pool resource • Robust legislation needed that facilitates CPRs and protects resources

Industry and urbanisation	• Increased demand for industry and urban areas. • Urban water supply-highly inefficient in distributing water. • Aquifers getting diminished near riverbeds. • Worsening water quality. • Increased industrial pollution and waste water generation.	• Water audit in industry and urban areas. • Aiming for zero water balance for industry sector. • Water quality monitoring-third party monitoring. • Social and technical audits of water supply. •· Cities to have water audit and become self-sufficient; need for supply and demand side measures to be strengthened. • Water saved as water created-conserve water through proactive laws in urban locations.
Spatial distribution of precipitation	Increased variability.	Environment conservation efforts.
Climatic changes owing to depleting glaciers	Reduced or sudden increase in water flow thus affecting access and availability.	• Proper assessment of climate change impacts. • District level planning for climate risk reduction. • Climate change hotspot areas to be designated and treated in a special way to include climate change impacts.
Governance deficit in dealing with water	Inequity in water supply and differential access for major stakeholders.	• Convergence of laws and legislations. • Coordination and synchronisation between departments/ implementers and regulators. • Regulations and monitoring should be strict, dynamic and transparent. Focus should be more on the big polluters and huge extractors. • Cumulative impact assessment. • Awareness and capacity building. • Political will generation. • Central database, regular updated and public domain.

Source: Drawn up from the Multi-Stakeholders' Consultation Workshops in five regions, November 2011 expertise of various stakeholders' for successful implementation of a project or programme. Critics believe that the impetus for a new rhetoric of partnership has arisen in the wake of free market liberal democracy's victory over state socialism and the command economy of the Soviet experiment in the late 1980s (UNESCO 2005). This section does not dwell on the origin and definitional issues surrounding this debate despite acknowledging the diverse opinions on the same. Instead, it recognises that each stakeholder can strengthen water management 'able' and 'allowed to' participate in the process right from conceptualisation to actual implementation and maintenance of water projects. In doing so, if the state maintains certain safeguards, it would help in strengthening the participation of sections who historically did not participate in this process. Ahead we discuss the role of the major stakeholders.

8.2.1 Role of the State

The role of the state is recognised in formulating people-centred policies, ensuring parity, bringing in regulations, sharing of information, ensuring accountability for all stakeholders' and inter-sectoral coordination. The state is largely seen by many as biased in favour of the rich classes and to the industries. The current levels of service provision in many locations do not meet the minimum rights, and the monitoring of water supply is done in terms of coverage and not end use. This leads to inequitable water supply where the voiceless remain deprived. Water deprivation thus perpetuates poverty. There is a need to address government/political/ administrative structures that deliver facilities on the ground. Increased involvement is also needed in organisations like the water resource authorities that deal with water. Further, there is a dire need for convergence of different departments dealing with water. At the moment, there is a serious lack of inter-departmental coordination thereby leading to conflict of interest among departments. GOI is making efforts for convergence with other stakeholders/departments dealing with water but significant challenges remain. GOI's efforts are still on for following participatory approach among the stakeholders/ various departments at local, regional and national levels. Despite efforts at national level, convergence remains elusive. The state should encourage new innovation and research that will help planners make important decisions on the ground. For example, basin-wide studies are needed, including water budgeting and village water development plans that converge at the district, state and regional levels for better water management. The state could also work on devolution of power to panchayats so that water-related decisions are decentralised, while also building the required capacity necessary to operate and maintain the systems.

8.2.2 Role of the Market

The market is seen mostly as a profit-making entity that diverts water for those who can pay more (for example, industry) and for urban consumption. A good privatised model that combines the efficiency and equity principle for water supply is lacking in India. Therefore, there is an apprehension about the motives of the private sector in water supply and management, especially with regard to drinking water. Under a tight and well defined regulatory body, the market can play a role in water treatment, recycling, distribution and management, especially for water supply in urban locations. The private sector can also invest in research and development of appropriate technology for today's water problems. Another area where market can play a decisive role is water for industrial use. Under the differential pricing system based on the nature of industry and the state, the engagement of the private sector can be explored for commercial use with sustainability of the resource as core.

8.2.3 Role of the Community

It is a well recognised fact that there is no such entity as 'the community'. Communities are divided on the basis of class, caste, gender and age. In many parts of India, water access is defined by one's class and caste position in the community and discrimination around water access and control has been reported from many locations. In this light, the role of community in providing access to water for drinking and irrigation becomes very important. However, wherever a community is more coherent (for example, in tribal areas and north-eastern India), they can organise themselves to assert customary rights for water management. Also, if the community can demonstrate self-regulation for water management (for example, Ralegaon Siddhi and Hiwre Bazar in Maharashtra), it would support people-centred, people-regulated and people-managed water policies. In the wake of corporatisation of water, especially in peri-urban locations, communities have a much stronger role to play in protecting their water bodies from indiscriminate pollution and diversion of water resources for individual profit-making processes. The community also has to value and get involved in ownership and management (O&M) of water sources and stop open defecation through behavioural change. However, this involves not only awareness and social mobilisation, but also responsibility and maturity to look after the precious water resource for the next generations.

8.2.4 Role of Civil Society

Civil society is an umbrella term which represents all non-governmental voices. This report brings in non-governmental organisations (NGOs), media, academicians, and researchers within the ambit of civil society. The role of civil society is varied and is looked at from the viewpoint of providing support, building momentum and supporting movements for democratisation of water resources in the country through research, advocacy, and generation of political will, capacity building and supporting ground swell for demanding water rights in favour of those denied the same. The strategies for achieving each one of the above would be different for each member of civil society based on the main objective of their formulation. However, civil society has the strength to direct positive water policies in favour of the poor and marginalised especially where their rights are denied due to the various nexus that exist around water today. Table 8.2 outlines the roles of each of these actors, as also their responsibilities.

Table 8.2: The Stakeholders and their Roles and Responsibilities

Stakeholder	Stakeholder
The state (including local governments, regional authorities, federal and central agencies) as implementers	• The state, in partnership with civil society organisations, to raise awareness and build capacity of the community. • Creation and enforcement of strong legislations against polluters and violators of norms. • Bring in provisions of strong partnership with communities, including devolution of power and authority pertaining to water. • In partnership with community and civil society organisations, determine needs and gaps. • The state creates space for the market to function through deprivation and degradation of water systems. • Water metering to be introduced and high end water users should be charged pro-rata basis (telescopic tariff system). • Groundwater access and control needs to be regulated especially where over-exploitation is reported. • Reclaim degenerated water bodies and rejuvenate watersheds for conservation of water. • Support research and think tanks that can support innovative implementation, policy and regulation. • Governance and accountability of officials in water supply, checking pollution, etc.
Policy makers as initiators of proactive provisions to protect water rights	• Recognition of water as a basic human rights and work towards the framework in which the same can be implemented in letter and in spirit. • Create provisions for ensuring minimum and equitable access to water for all with an entitlement approach where minimum water is assured by the state. • Work on a framework for better coordination between different departments dealing with water.
Market	• Sporadic water supply vs. 24X7 water supply, which paves the way for creation of formal water markets. This issue needs further examination. • The market can take up the service provider's job under strict regulation by the state. • Use of green and efficient technologies that save water and ensure water conservation

Market	• Understand the relationship between investments in water and its control by a private entity. • The market should not be allowed to determine access and control of water resources. • Bottled water industry and private water suppliers need to be regulated. • Water should be addressed by the community and the service sector (public sector) only, and the market should act in a service mode.
Communities	• Should assert their rights over natural resources. • Should ensure that the available water is distributed without any bias and to the communities who traditionally do not have access under the norms of positive discrimination. • Should recognise that societies are differentiated by class, caste, gender and age, and so participation from all sections of society is necessary for democratic decision making around water. • Should ensure inclusiveness and rights to all.
Water experts and researchers	• In partnership with the state, community and civil society, organisations should maintain and compile databases on water-related issues to support policy making and measure equity and access. • Help government in working for basin-level approaches for planning and management of water with strong in-built decentralisation agenda.
Civil society (including NGOs, media, and people's movements)	• Build momentum to ensure water is viewed as a basic human right. • Can do proper documentation of best practices. • Need to question development, facilitation, inclusive implementation. • Understanding inter-relationships, for example, between natural resources, water, education, etc. • Dealing with corruption, and advocating for good governance. • Building capacity of local communities, help creating political will and helping articulate the demands and interests from different social groups, especially discriminated groups for asserting their right over water.

Source: Drawn up from the Multi-Stakeholders' Consultation Workshops in five regions, November 2011

8.3 Summing up

This chapter dwells on two specific issues. First, the pressures and drivers of change in the water access scenario. Second, the role each major stakeholder plays in changing the current situation. More specifically, the role of the state, market, community and civil society has been discussed in detail. The process of change in water management in India has been fivefold. First, there has been a considerable shift in demography which has created considerable pressure on land and water. This is coupled with income disparity, which has made some groups more powerful than others. However, the issue of distribution and management is more prominent than the shift in demography. This leads to an important question of protecting the ecosystem. Evidence suggests that water bodies are being polluted both by domestic as well as industrial users, without much regulation and management. The withdrawal of water for agriculture in a given area is related to shifts in demography as well as in the way the ecosystem is managed. This leads to the second point of technological changes in agriculture. The increased use of water intensive crops and access to groundwater in many locations has created an extra demand on resources. In many locations, due to overdraft of water, symptoms of arsenic, iron and fluoride have been reported. Third, the increasing, unplanned, and largely unregulated industrialisation in many locations has been causing environmental hazards due to release of industrial waste in water bodies. The fourth issue is of climate variability. Changes in micro-climate coupled with mismanagement of water are creating problems for the livelihoods of millions of people who are directly dependent on agriculture. There is less evidence but increased perception about this which needs to be looked into. The fifth issue that encompasses all borders on the governance deficit in dealing with the present situation. There is a feeling that most of these issues can be tackled with a sharp and forward-looking vision of governance of water. First, there is a dire need of convergence of laws and legislations and synchronisation between various departments dealing with water. Water has to be looked at from a more holistic and integrated perspective. Second, the data generation process in the country is pointing towards its integration, disaggregation and consolidation at an aggregate level for policy makers to be informed about the change processes and find sustainable solutions.

What are the roles of the different stakeholders in the changing present scenario? The prime role of the state is to formulate people-centric policies thus ensuring parity. Also, to bring in strong directives for those violate the existing laws and regulations. The market is seen by many as a profit-making entity that may compromise on the issue of equity and sustainability. Under strong state regulations, markets do play a positive role in water service delivery, research and development, and also water-related technological solutions. There is no single entity known as 'the community'. The community is divided by socio-economic class, caste, tribe, age, gender, etc. Models exist for the community's self-regulation, which needs to be seen in an overall framework of people-centred development with more political and financial powers for the community to implement water-related projects. The role of civil society becomes important here as it helps community capacity building thus enabling community members to manage resources in a decentralised resource management framework. Their role in having a close watch on the water management process is also important for equitable water distribution and sustainable management of the resource.

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CHAPTER NINE

WATER FOR ALL: FROM PROMISE TO A REALITY?[64]

This concluding chapter centres on the following key questions: How do we ensure water for all? What are the gaps in implementation and what is the way forward in bringing in change so that the water needs of all the sectors—domestic, agriculture, industry and ecosystem—are met equitably. The chapter is divided into two sections. Section 1 revisits the key sectoral gap and defines the role of government, community and institutions in filling this gap. Further, it critically looks into changing the framework of water delivery from service delivery to a rights based one for better implementation and outreach. Section 2 discusses the key messages of this report and a way forward to achieve the vision of 'Water for All'.

9.1 Sectoral Gaps and Re-visioning the Present Framework of Implementation

9.1.1 Key Sectoral Gaps

This section looks at the key gaps in implementation for three sectors—domestic, irrigation and industry. Each of these sectors has its own need for water and is inefficient in delivering water for all across all sector and as per the basic requirements. The key gaps as identified for domestic use are many. India has already achieved the Millennium Development Goal on drinking water supply in rural areas. Further, a Strategic Plan for the rural drinking water and sanitation sectors has been prepared for 2011-22 with , inter-alia , the goal of providing 90 % of rural households with 55 lpcd within or near their premises. However, despite this progress, water safety and security remains a key challenge. Community involvement in a structured process is essential to achieve this, right from the planning to implementation level (for example Biswas, 2012). However, the problem is twofold; on one side, the authorities lack planning, and the community, too, is not prepared in getting involved in water supply projects. Wherever the gaps from both ends have been met, the water supply projects have been successful. Other related issues are gaps in technical capacity at the level of the resource, delivery, distribution and O&M, lack of information about the policies and plans, and political interference.

For irrigation systems, the key gap is in choosing the variety of crop based on the water availability. Cropping pattern changes that are independent of water availability is leading to heavy reliance on groundwater and its indiscriminate exploitation. Water bodies and river systems are not protected and are hence leading to decline in local water availability and pollution due to industries in many locations. There are policies in place to protect water resources and the ecosystems but there is lack of political will to implement the policies in letter and spirit. Apart from the political will, the social and economic constraints are one of the major block in policy-divergent actions. Further, the focus of agricultural innovation is more on rice and wheat while dry land agriculture has been neglected. Water use in agriculture is directly related to choice of crops and therefore this area needs special attention. The industrial sector has its own water requirement but the price of water supplied to industries does not reflect the environmental value of conserving water. This is same in agriculture and domestic sector. Also, there is lack of implementation of pollution laws which leads to

Table 9.1: Key Sectoral Gaps

Water for domestic use	Water for irrigation	Water for industry
• Lack of community preparation and involvement in water supply projects.	• Farmers do not follow cropping practices based on water availability; heavy reliance on groundwater for irrigation.	• Water for industry should be priced and should reflect the environmental value of conserving water.

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[64] This section relies heavily on the framework developed by Prof Amita Shah, Director, Gujarat Institute of Development Studies and presented as keynote address to the participants of the fifth Multi-Stakeholders' Consultation Workshop for Western Indian Region on 30 September 2011 at Ahmedabad, India. However, the texts in this section are compiled from the discussions that ensued in the five multi-stakeholders consultation workshops in five regions of India in 2011. The details of the workshop participants are given in Annexure 1.

• Community institutions lacking capacity to take initiatives at various levels. • Lack of awareness on various aspects of programmes and policies among line functionaries and people. • Lack of planning from authorities. • Maintenance of water infrastructure is a serious problem—panchayats do not have a comprehensive plan to maintain assets; no proper handover to GP (no technical support, no convergence among departments to give post-project support), lack of finance to support maintenance leading to lack of ownership by community institutions though recently a Management Devolution Index has been devised by MDWS to map this process. • Gap in technical capacity to deal with changing technology and knowledge. • Political interference in prioritisation and resource allocation. • Drinking water source does not always follow the source sustainability plan.	• Lack of proper regulations or implementation for preventing indiscriminate exploitation of groundwater. • Productivity per unit of water consumed is low. • Lack of proper protection for river ecosystems (sand mining and mineral exploration is a biggest threat to river ecosystems) –despite several conservation laws, the destruction is rampant • Encroachment of water courses and bodies leading to less water flow. • Lack of political will and human resources to implement policies. • Gap between potential and actual area irrigated by irrigation schemes. • Too much reliance on rice and wheat production system with less emphasis on dry land agriculture.	• Effluents should be discharged only after meeting EPA standards. • Recycling and reuse must be made mandatory. • Stringent laws against polluting industries. • State's priority for allocating resources –industry gets priority over drinking water.

Source: Compiled from five multi-stakeholders consultation workshops held in 2011

industries polluting water in an unchecked fashion. Table 9.1 summarises the key sectoral gaps.

The issues raised in table 9.2 are being addressed by the Ministry of Water Resources under "National Water Mission" through setting up Advisory Committee and Sub Committees under the Chairmanship of Minister/ Secretary of Water Resources as well as by incorporation of appropriate changes in guidelines of NRDWP/TSC, Ministry of Drinking Water and Sanitation for Drinking Water and Sanitation Sector. Taking this further, Table 9.2 identifies further gaps at three levels: upstream, which deals with policy gaps (which deals with water policy); midstream, which deals with ground-level implementation; and, downstream, which looks into the issues from a grass-roots perspective. The table further identifies who should these key gaps be addressed to—government, community or institutions. One of the major gaps identified is between the policy and its implementation, with different bodies addressing irrigation, tank systems, watershed development, pollution, etc. This calls for an innovative institutional framework, like the Water Users Associations (WUAs), being federated into organisations at the micro-watershed, watershed, sub-basin and river basin levels. These multi-level institutions emanating from below may be helpful in taking the issue of

Table 9.2: Key Gaps at Government, Community and Institutional Level in Implementation of 'Water for All'

Levels of gap	Government	Community	Institutions
Upstream (Policy)	Multiple ministries (convergence required). Administrative constraints/transfers. Political interference	Demand driven government policies. Participation/ representation of community in policy framing.	Water as common pool resource. Multiple demand of water resource.

Midstream (Implementation)	Disconnect between policy and implementation; better feedback loop and data consolidation for checking on implementation. Slow progress due to civil strife.	Capacity building and skill development of youths. Linkage of communities with implementers.	Conjunctive use of water. Selection of NGOs / CBOs.
Downstream (Grass-root level)	Policy to reflect on local context. Involvement of indigenous peoples and marginalised people.	Limited involvement of community in planning. Communication needs to be in their own language.	Awareness generation/ IEC should precede implementation. Indigenous practice of water conservation.

Source: Compiled from five multi-stakeholders consultation workshops held in 2011

equity and sustainability further if appropriate decision-making powers are given to them.

9.1.2 Right to Water for Basic Needs and Livelihood

The framework in which water governance is operational at the moment looks disintegrated. This report shows that the present framework for managing water has not yielded its desired policy outcomes in terms of supplying water to all and catering to the needs of the poor and marginalised. Enormous policies on water seem isolated and not integrated. Responsibilities for service delivery have been shifting to local bodies—urban local bodies or ULBs and panchayati raj institutions or PRIs. However, most of the time, these local bodies are unable to manage due to paucity of manpower, and lack of awareness and understanding of planning a water resource development and management activity. In most states, institutions created for water management at the community level are not accountable and therefore do not have any legal identity. They also lack capacity in merging multiple programmes and schemes. The question therefore is this: What can be done to change the situation? Would treating water as a basic human right change the way we look at water governance? While there is some recognition of right to water in international human rights, as well as in the Indian constitution, at the level of state legislation and policies in India, different dimensions of right to water do not get much support. This is true even of cases like Maharashtra, where a particular version of rights (for example, entitlement to water) has been put forward.

in the context of Participatory Irrigation Management (PIM). The right to water debate has to tackle many challenges before it is actualised. For example, in India, surface water is a public resource while groundwater is in the private domain, as per the easement act. Delinking water from land tenure may be the first step towards looking at water from a much more equitable lens. Further, redefinition of needs has to become part of public debate, including how much water should be given free, how much should be at an affordable price, and to whom should this subsidy go? There has to be stronger disincentive for polluting the water source which accentuates the scarcity situation while polluting freshwater resources. Thus, infrastructure for waste water management needs urgent intervention. The structure and mechanism for conflict resolution between the sector and states need urgent attention. Unless these concerns are met, the right to water, even if it is guaranteed, will not bring fundamental change in the way water is conserved, managed and delivered.

9.1.3 Convergence of Big Water and Small Water

The big water refers to the dominant system of science for providing water through centralised or corporatized utility purpose with large scale engineering projects such as dams, pipelines, sewage systems etc. Small water refers to the everyday methods of water access, conservation and use. To ensure water security for all, the five dimension of water –household, economic, urban and rural supply, healthy river and clean water bodies need to work in consonance. However, each of these dimensions of water supply is met through small and big water. No single approach to augment water can work and fulfil obligations of providing water for all. Therefore convergence of big and small water systems is essential for providing water security. This report shows in a very distinctive way and with support from data that big and small water is disconnected from each other.

Better integration between the big and small water would be a way to manage water more systematically and sustainably.

9.1.3 Towards a New Water Vision: Confluence of Perspectives[65]

The above discussions show that there are perspectives on how water should be managed, and, therefore, there is no one prototype for managing water. What is needed is a confluence of perspectives. For example, the rights perspective focuses on the fundamental or human right to water, traditional rights of access of communities (tribal or other) to rivers, lakes, forests, and other sources of sustenance and livelihoods. The social justice/equity perspective is concerned with issues of inequity in urban and rural water and sanitation services, injustices to the poor and socially disadvantaged people, forced displacement by major projects and deficiencies or failures in resettlement/rehabilitation, inequities in access to irrigation water in the command areas of projects, etc. The gender perspective focuses on the burden on women of fetching water from long distances as well as managing water in the home, with no voice in water planning or water management institutions. The community perspective questions the right relationship between state and civil society, the empowerment of people vis-à-vis the state, the community management of common pool resources, mobilisation of people for local water augmentation and management, social control of water use and sanctions against misuse, voice in water policy formulation and water management, etc. The state perspective is concerned with legislation, policy formulation, planning, administration, 'governance' at all three levels, ensuring/enforcing rights, providing or facilitating or regulating water supply and sanitation services, preventing or resolving or adjudicating inter-state/inter-sector/inter-use/inter-area water disputes, prescribing and enforcing quality standards, managing water relations with other countries, ensuring compliance with international law, and so on. The economic perspective sees water as economic good subject to market forces, and argues for water markets, the full economic pricing of water, the privatisation of water services, private sector participation in water resource projects, etc. There are strengths in each of these perspectives, but as a single and standalone perspective, they may not do justice to the issue. The right combination of these perspectives is context specific; therefore, the fundamental principle is to have an interdisciplinary perspective to management of water.

9.2 Key Messages of this Report

After the initial presentation of the major issues around water and the key issues and gaps in implementation, this section focuses on the key messages of this report. Each of these messages have implications for the existing framework in which water is managed and an understanding of this would help in devising a way forward paving the way for a paradigm shift in water resource management.

9.2.1 Water Availability and Scarcity[66]

It is not possible to manage water resources effectively without a proper estimation of the availability and use of water. This is where a serious problem exists not only in India, but also in other countries regarding reliably measured data for surface and groundwater availability and use at the local level. While the central and state governments have done commendable work in estimating the availability and use of groundwater fairly accurately at the block level there remains a lack of information at the sub-district level. The estimation of the availability and use of surface water is still largely based on insufficient data. To correctly estimate the availability of surface water we need a much more detailed measurement of stream flows, precipitation, run-off coefficients and evapo-transpiration at the watershed level. Similarly, detailed studies of crop production data have to be conducted to better estimate the agricultural water use. At present, approximate empirical formulae are being used for determining surface water availability and use. For example, despite 85 per cent to 93 per cent of the annual flow of the Brahmaputra (there are no firm estimates) being contributed by its Indian tributaries, there is no flow measurement taking place on these tributaries and the estimates are based only on the measurement of flow in the main river stem at different points. The proper estimation of water availability and use requires a multidisciplinary approach involving hydrology, geology, agriculture, remote sensing, sociology, anthropology, etc. In fact, this has to be done in a campaign mode, involving people also through the panchayats and municipal wards. People have to be made aware of the need for sustainable water management and the importance of good grass-roots level data collection to make this possible. The lack of a comprehensive approach in planning and mismanagement of water resources in India has occurred precisely because of this extremely serious neglect of the need to collect authentic grass-roots level data on both surface and groundwater availability and use and sharing it in

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[65] This section relies heavily on, and is inspired by, Iyer (2010).

[66] The content of this section has been partly contributed by Rahul Banerjee, Dhas Grameen Vikas Kendra, Indore, Madhya Pradesh.

the public domain.

In the situation where data on availability of water has been critiqued and questioned, the data on water scarcity has also come under the scanner. As discussed in Chapter 1 on water availability, there is a dire need to move further from the per capita water availability calculations as they do not capture the socio-economic disparities in water access. Some attempts have been made by the National Family Health Survey (NFHS) (see the chapter on Urban Water) to show water access for the poor in urban slums. Similar work is needed to decode the water availability information. The information on groundwater and irrigation is incomplete. The notions of scarcity (and surplus) are inherently relative concepts. Something is always scarce with respect to an assumed notion or understanding of what is sufficient and there is nothing inherently or absolutely scarce about any given quantum. Standards of scarcity therefore are contingent on subjectively acceptable standards of sufficiency. Hence, a divergent and context-dependent interpretation of scarcity is essential for an assessment of scarcity-induced impacts.[67] There is evidence to suggest that in the situation of scarcity (Ralegan Siddhi and Hiwre Bazar), water availability for irrigation and domestic purpose could be managed if certain management principles are employed. Returning to present indices for calculating water scarcity and further disaggregation would help in a better understanding of water in different agro-ecological zones of India.

9.2.2 Sectoral Allocation: Where's the Operational Mechanism?

The three main sectors that consume water are domestic, irrigation and industry. Apart from allocating water for each of these sectors, water for the ecosystem is also gaining currency in recent debates around water allocation. It is argued that a minimum environmental flow is needed for the ecosystem to rejuvenate and that should also form part of the debate for allocation of water to different sectors. It was discussed that the allocation management framework should take into consideration the cumulative effects of water use and to guarantee that the water allocation is equitable for the users and to all sectors. Allocation limits are set to ensure that water is allocated to users in quantities that are reasonable for the intended uses. The aim is to achieve an acceptable balance between accessibility and reliability of supply, and to provide a basis to share the water source as equitably and efficiently as possible.

The Indian water policy talks about domestic requirements of water to be considered first while allocating the resource. However, in practice, this has hardly been followed as many parts of urban and rural India are still 'un-served' by formal water supply systems. Orissa lists 'ecological systems' as the second priority for consuming water, while in Maharashtra agriculture is third in priority. However, the stated priorities and actual usages are sometime different, as claimed by activists. The case of Hirakud Dam in Orissa proves this point. The dam was designed to supply water for agriculture but research shows that there has been increasing allocation for industry. In rural India, water supply is mainly covered via tuebwell installation while fewer cities have 50 -60 per cent of areas covered by formal water supply systems. In large parts of urban areas, people access water through private tubewells. The same holds true for industries and agriculture. Therefore, an operational mechanism for sectoral allocation based on logic, need and principle of equity seems missing from the Indian scene. This is largely due to the inability of the authorities to undertake regional or basin-level planning based on land and water availability, thereby creating a democratic space for negotiation between sector representatives and those working on water use efficiency in all sectors. Further, there is a lack of incentive for not polluting existing water sources by all sectors—industry, agriculture and domestic users, especially urban users.

The concept of water for ecosystem needs is nascent in Indian debates around water management and utilisation. It has been argued that the basin-wise ecosystem need can be calculated taking into account the minimum environmental flow which is needed for the survival of the ecosystem. To actualise this, one needs legal provisions for ensuring minimum water flow regimes. This concept encompasses many issues, such as recognition of riparian rights, and has a strong community base in monitoring that the right for ecosystem is guaranteed. This understanding however needs more debate and actualisation through pilot projects in India, for example, to see how it will work on the ground. Each of the sectors-domestic, agriculture, industry and the ecosystem-needs water. Due to lack of an operational mechanism, conflicts around water are becoming the order of the day in India. Water conflicts are broadly classified into the following seven categories.[68] These are conflicts over equitable access, competing uses, water quality and pollution, dams and displacements, privatisation of water, industrialization and inter-state conflicts. Each of these conflicts is characterised by a case attributed to it. Therefore, there is a dire need to

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[67] Key note address by Dr Jasveen Jairath, first Multi-Stakeholders' Consultation Workshop for the southern region, Hyderabad, held on 28 June 2011.

[68] This classification is by Paranjape and Joy (2011: 44- 55).

evolve general guidelines, procedures and institutions to determine and regulate water use in an equitable and sustainable manner with better conflict management mechanisms.

9.2.3 Water Pollution

This report shows that India's rivers receive millions of litres of sewage, and industrial and agricultural waste on a daily basis. The most polluting source for rivers is city sewage and industrial waste discharge. Presently, only about 10 per cent of the waste water generated is treated; the rest is discharged as is into our water bodies. Due to this, pollutants enter rivers, lakes and the groundwater. Such water, which ultimately ends up in our households, is often highly contaminated and carries disease-causing microbes. Agricultural run-off, or the water from the fields that drains into rivers, is another major water pollutant as it contains fertilisers and pesticides. A recent report of the Controller and Auditor General (CAG) of India for the year 2011 contains the results of the Performance Audit of Water Pollution in India (GoI 2011). The report has been prepared for submission to the president of India under Article 151 of the Indian constitution. The report contains the performance audit conducted from July 2010 to February 2011. It examined the functioning of the Ministry of Environment and Forests (MoEF), Central Pollution Control Board (CPCB), Ministry of Water Resources (MoWR) and Central Ground Water Board (GCWB) in 25 states. It also examined the state pollution control boards, state environment departments, state urban local bodies, nodal departments and implementing agencies for the National River Conservation Plan and the National Lake Conservation Plan and selected blocks in districts for groundwater. The sample consisted of 140 river projects, 22 lakes and 116 groundwater blocks in 25 states. The report reveals that:

- Water pollution has not been adequately addressed in any policy in India, either at the central or the state level. In the absence of a specific water pollution policy, which would also incorporate prevention of pollution, treatment of polluted water and ecological restoration of polluted water bodies, government efforts in these areas would not get the required emphasis and thrust.

- States falls short of an ideal situation in combating pollution through legislation, policy and implementation. This has repercussions on implementation of programmes for control of pollution and their outcomes.

- There was a paucity of networks for tracking pollution of rivers, lakes and groundwater, as there were inadequate monitoring stations and therefore no real-time monitoring of water quality was taking place and the data on water quality had not been disseminated adequately.

Further, the report states that the inventory of water sources has not been prepared and the overall status of the quality of water in rivers, lakes and groundwater has not been adequately assessed in India. The risks of polluted water to the health of living organisms and its impact on the environment have been not been adequately assessed. Adequate policies, legislations and programmes have not been formulated and effective institutions have not been put into place for pollution prevention, treatment and restoration of polluted water in rivers, lakes and groundwater. These programmes have not been planned, implemented and monitored efficiently and effectively, and the funds have not been utilised in an efficient and economic manner to further the aim of reducing water pollution. Adequate mechanisms have not been put in place by the government to sustain measures to tackle water pollution; and programmes for the control of pollution have not succeeded in reducing pollution levels in groundwater and surface water and restoring water quality. The findings of the present report corroborate the points mentioned in the Government of India's report. That the present level of water pollution in India is like a ticking time bomb which can explode anytime if left unchecked.

9.2.4 Gender Disaggregated Information

New reforms and programme documents related to water include sections on women's role in the successful implementation of water projects and the likely benefits accrued to them. While there has been largely an agreement to mainstream gender issues in water projects, critics have argued that the issue becomes rhetorical if not backed by adequate data collected in a disaggregated manner. Until now, there is virtually no gender disaggregated data on water sectors collected by the main international and state agencies in a uniform way (Seager, 2010). How does gender disaggregated data help in taking informed decisions bordering on the issue of gender and irrigation? First, water for irrigation is directly related with access and control over land. Gender disaggregated analysis of access to land for women and men is the first step to understanding the ownership pattern of a critical resource such as land, which is tied up with another important resource, water. Second, women's participation in institutions dealing with irrigation water such as the WUA is important. Gender disaggregated data of women's participation in WUAs, collected and analysed at the level of the district and state, will help in understanding important facets of gender relations and how their improved participation has or has not influenced desired outcomes of a project. A recent study conducted by Bina Agarwal (2010) dwells on the issue of women's participation in forestry institutions by asking the question: Would women's inclusion in forest governance, undeniably important for equity, also affect decisions on forest use and outcomes for conservation and subsistence? Using data on community forestry institutions in India and Nepal, Agarwal provides the history behind women's omission from social institutions, the barriers that still prohibit their participation, as well as how these barriers can be overcome. Agarwal argues that women's presence, in the right critical mass, makes a considerable difference to the desired outcomes of forest governance. These insights are based on concerted gender disaggregated data collected, which informs policies for desired change while providing the status. Third, many gender negotiations are formed at an informal level and in the private sphere, and are therefore largely ignored by policy initiatives which look for formal means of participation. Enquiring into the informal and private sphere in which women negotiate their views is therefore important for a true gender sensitive policy.

9.2.5 Imparting New Vision of Water for Technocrats through Targeted Capacity Building Programmes

A generic and longstanding problem in the area of education in water resource management in India is the disconnect between university education and professional requirements. First, the complexity of existing water resource management demands integration and interdisciplinarity, education and research continue to function in a disciplinary mode. Second, there is competition from some sectors that provide lucrative job opportunities, such as the IT sector and oil exploration, which distracts students from the equally important area of water management. Third, there is a strongly pronounced 'silo' mentality, in which engineering and science education provides little or no exposure to the social sciences and humanities, although the professionals so created have to plan, design and implement technologies, projects and programmes that have enormous social, environmental and political ramifications. Most education targets “sourcing” and“supply” of water without due consideration to “demand” and “resource characteristics”; social and environmental aspects are also ignored. This silo mentality is largely the result of the over-specialised structure of college education prevailing in India. In this context, several initiatives have emerged over the past decade or so to specifically address the third challenge mentioned above, that is, to inject an element of comprehensiveness into water education in India (SaciWATERs, 2008). These initiatives include those attempting to inject more social science into water engineering, or more water science/engineering into the social sciences, or creating entirely standalone Integrated Water Resources Management (IWRM)-type courses. Assessing the requirements and demands of interdisciplinary water professionals would point towards the level at which support and capacity building is required.

The need of the hour is to educate water professionals and especially the engineers working in departments dealing with domestic water supply and irrigation with integration skills. Present day engineers come from this background of engineering education which is devoid of solving problems of say everyday water supply. Once inducted in the department, these engineers have very limited resources to refresh their knowledge and acquire new knowledge for water management. Apart from the issue of the changing paradigm for water education in India, it was found that there is a lack of coordinated and concerted efforts in training the in-service engineers on the new vision of water management. Most of the engineers have received training from government-funded institutes that lack participatory methodology in imparting key messages and encouraging participants to understand the need for training and capacity building. India's water sector, dominated by engineers, is set for change. Senior officials have often enunciated the need for more 'community involvement' but this has not translated into action on the ground for various reasons:

- Lack of training and understanding of social processes on the part of the engineer-driven water supply bureaucracy that feels there is no need for involving people in their work.
- Lack of adequate understanding among people of water governance and the technical aspects of water supply and management. Business-as-usual scenario will only compound current water shortages, mismanagement, and lead to social unrest as poverty and inequality grows.
- The ingredient of this techno-centric education entails another fact, that education around water resources is gender and equity blind while claiming it as gender and equity neutral. There are very few courses that make students understand ground realities that expose them to the local context. The fact remains that there is still a long way to go and many boundaries to cross to achieve a critical mass of education programmes that have internalised the new water resource management challenges.
- Lack of understanding in imparting participatory methods for training and creating an environment for debate and participation so that the problems are put forth without hesitation in search for a better management practice. Thus,

there is a pressing need to expose the water bureaucracy to social processes, and people to the technical processes, of water management. Both need to see 'the other side' and find a practical way to work together. This will improve the ability to manage water better, and, importantly, in the interest of the poor and the marginalised.

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ANNEXURE 1

Details of the Participants (Consultation Workshops)

HYDERABAD WORKSHOP – June 28, 2011

1.	Vinay Kumar, IFS, State Commissioner, Irrigation and CAD Department, Hyderabad
2.	Jasveen Jairath, Director, Save Our Urban Lakes, Hyderabad
3.	R.P.Kulkarni, Additional Director and Chief Engineer, Karnataka Rural Water Supply and Sanitation Agency, Karnataka
4.	Prabhakar H. Chinni, Chief Engineer, PRED, Bangalore
5.	Ramakrishna, Deputy Director and E/O, Under Secretary to Govt, Bangalore
6.	S.Thirunavukkarasu, Assistant Executive Engineer, PWD TN
7.	T.P Sankaralingam,Deputy hydrologeologist, TWAD Board, Chennai
8.	D Narsimha Reddy,Chief Advisor,"Chetna Society, Hyderabad- 500059,
9.	M Dinesh Kumar Executive Director, IRAP - Institute for Resource Analysis and Policy, 202, Riviera Apartments, Dwarkapur Colony, Panjagutta, Hyderabad – 82
10.	Shrinivas Badiger,Fellow ATREE, Ashoka Trust for Research in Ecology and Environment, Bangalore
11.	Florine Clement, Social Scientist, IWMI, Patancheru , Andhra Pradesh, India
12.	Jyoti Krishnan, Research Associate,TISS- Tata Institute of Social Science, Mumbai , India
13.	G. Sankarsubramaniam, Director, CCDU-TWAD Board, Chennai
14.	M.G Cyriac, Director, CCDU Kerala, Water Resources Department, Govt. of Kerala
15.	K Aruna, Project Director, State Water and Sanitation Mission
16.	R Murali,FANSA Convener, MARI - Modern Architects for Rural India
17.	N.L Narsimha Reddy, CEO PLF, Hyderabad
18.	Goparaju Sudha, Freelance Consultant, Hyderabad
19.	SR Nalli, Water and Sanitation officer, UNICEF, Hyderabad
20.	BV Mudgal, Associate Professor, Center for Water Resource, Anna University , Chennai
21.	Arun Dobhal, Water Sanitation & Hygiene Specialist UNICEF office for Tamil Nadu and Kerala
22.	Seetharam, President, Swami Vivekanand Youth Movement, Karnataka
23.	A Sateesh, Chief Chemist, RWSS - Rural Water Supply & Sanitation Department, Hyderabad
24.	AM Faheem, State Technical Expert (Agriculture), Rural Development Department
25.	B Sada Siva, Team Leader, Dhan Foundation, Hyderabad
26.	Sheela Prasad, Professor, University of Hyderbad, India
27.	Shakeel Ahmed, Chief Scientist, NGRI, Hyderabad
28.	Dr. K.S Rajan, Associate Professor, Head Lab for Spatial Information (LSI), International Institute of Information Technology (IIIT), Gachibowli, Hyderabad

DELHI WORKSHOP – July 20, 2011

1.	Sujoy Majumdar, Director, DDWS - Department of Drinking Water And Sanitation, New Delhi
2.	Sara Ahmed, Senior Program Specialist, Agriculture and Environment, IDRC New Delhi
3.	Mr. Faisal Abbas, Assistant Professor, Department of Economics, South Asian JNU Campus, New Delhi
4.	S.C. Jain , Programme Coordinator,AFPRO Head Office, Action for Food Production, New Delhi
5.	Viren Lobo, Executive Director, SPWD - Society for Promotion of Wastelands Development, New Delhi
6.	Depinder Kapur, India Wash Forum, New Delhi
7.	Usha Raghupathi, Professor, National Institute of Urban Affairs, New Delhi
8.	Lalit Mohan Sharma, Leader (NRM), IRRAD , Haryana
9.	Aidan Cronin, Water and Environmental Sanitation Specialist, UNICEF India Country Office, New Delhi
10.	Nitya Jacob, UNDP Water Comunity, New Delhi
11.	Sunetra Lala, UNDP Water Comunity, New Delhi
12.	Shipra Saxena, WATSAN Specialist, Population Foundation of India, New Delhi
13.	Amit Mitra, Independent Researcher, New Delhi
14.	Hemant Khosla, Consultant, UNICEF India Country Office, New Delhi
15.	Kashindra Yadav,Chief Engineer, CWC - Central Water Commission, Lucknow (UP)
16.	Johnson Jeyaseelan, Programme Officer, WaterAid, Additional Liaison Office North, Lucknow
17.	Sanjay Vijayvergia, Independent Consultant, Lucknow
18.	Prabhu Devender , Divisional Soil Conservation Officer, Patiala
19.	Sunita Rakse, Research Associate, TERI - New Delhi

GUWAHATI WORKSHOP – August 5, 2011

1.	Durga Prasad Sharma, Project Coordinator, The Mountain Institute-India (TMI-India), Gangtok
2.	Ghana Shyam Kharel, IT Manager, NG NREGIA, Rural management and Development, Govt. Of Sikkim, Gangtok
3.	Pema Lepcha, Legal Secretary, Affected Citizens of Teesta , Gangtok
4.	R.K Ranjan Singh, Director, College Development Counsel, Manipur University, Imphal
5.	Ramananda Wangkheirakpam ,Coordinator, Forum for Indigenous Perspectives and Action, Imphal
6.	Chaoba Sharma, Sr. Coordinator, Centre for Social Development, Manipur
7.	Namdithiu Pamei, Programme Coordinator, Centre for Organisation Research and Education (CORE), Manipur
8.	Ravindranath, Director, Rural Volunteer Centre Kepelhusie Teheruja, Nagaland
9.	Bandana Khaitanear, PhD Scholar, Indian Institute of Technology,Guwahati
10.	Chandan Mahanta, Professor & Head, Centre for the Environment, Department of Civil Engineering, Indian Institute of Technology, Guwahati
11.	Nayanmoni Gogoi, PhD Scholar, Indian Institute of Technology, Guwahati
12.	Lalit Saikia, PhD Scholar, Indian Institute of Technology, GuwahatiK
13.	D. Phawa, Dept. of Water Resources, Govt. of Meghalaya, Meghalaya Water Resources,
14.	K. Kharkongor, Assistant Engineer, Dept. of Water Resources, Govt. of Meghalaya, Meghalaya Water Resources, Shillong

15.	R.H. Mishra, Commissioner & Secretary Water Resources, Dept. of Water Resources, Govt. of Meghalaya, Meghalaya Water Resources,
16.	Aiban Swer, Dept. of Water Resources, Govt. of Meghalaya, Meghalaya Water Resources, Shillong
17.	Rushabh Hemani, Wash Specialist, UNICEF State office for Assam, Guwahati
18.	Lalsangola Sai, Research Scholar,Civil Engineering Department, Indian Institute Technology Guwahati
19.	A.B. Choudhary, Assistant Executive Engineer, PHED , Assam secretariat
20.	Rachna Yadav, Research Scholar & Consultant, Indian Institute of Technology, Guwahati
21.	Pranjit Kr. Das, Sup dt. Engineer PHED, Assam, Guwahati
22.	Surajit Dey, EE-PHED , Assam secretariat ,Guwahati
23.	Elise Boileau, Indian Institute of Technology,Guwahati
24.	H.K. Borah, Secretary, PHED , Assam secretariat, Guwahati
25.	Patricia Mukhim,Editor Editor, The Shillong Times
26.	Pushpa Hargowal, ICARE
27.	Partha P. Baruah, UNICEF State office for Assam, Guwahati
28.	Bhupendra Baronoh, PHED, Assam secretariat Guwahati
29.	D.K. Das, Chief Engineer PHED, Assam secretariat ,Guwahati
30.	A.K. Das, Add. Chief Engineer, PHED, Assam Guwahati - 6
31.	D.K. Baruah, PHED, Assam secretariat, Guwahati
32.	Niranjan Kumar Das, Executive Engineer, PHED, Assam ,Guwahati
33.	Nipendra Kumar Sharma,PHED, Assam secretariat ,Guwahati
34.	Partha Jyoti Das, Aaranyak, Guwahati
35.	Arpita Das, Aaranyak, Guwahati
36.	Mr. Binen, PHED, Assam secretariat, Guwahati
37.	Bano Haralu, Journalist, Nagaland
38.	Surajit Baruah, WWF India Assam & Arunachal Pradesh State Office, Guwahati
39.	Anamika Baruah, Indian Institute of Technology, Guwahati
40	Anjan Chamuah, Indian Institute of Technology, Guwahati
41.	Bhupen , Indian Institute of Technology,Guwahati

BHUBANESWAR WORKSHOP – August 17, 2011

1.	S. Peppin, Professor, XIMB - Xavier Institute of Management ,Bhubaneswar
2.	H.R. Marskole, Sup dt. Engineer, PHED, Chattisgarh
3.	Madhurima Masih, Regional Coordinator, CCDU-Public Health Engineering Department, Chhattisgarh
4.	Gopa Samanta, Reader in Geography, The University of Burdwan
5.	Arumngam Kalimuthu, Country Director,Water for People , West Bengal
6.	Ashok Gosh,Professor, Department of Environment and Water Management, Patna
7.	Eklavaya Prasad, Practitioner, Megh Payne Abhiyaan, Patna
8.	S.C. Mishra, Spl. Officer PHED -Bihar State Water & Sanitation Mission
9.	Swetabh Kumar, S.E. Urban Circle, Ranchi DDWS

10.	Sushil Kumar, EE, DW & S.Div DDWS
11.	P.K Mohapatra, SE CGWBA. Choudhary, Asst. Hydrogeologist CGWB
12.	D.P. Singh, Sup. Dt Engineer, PHED
13.	Monojeet Ghoshal, Regional Manager, WaterAid Bhubaneswar
14.	J.B. Patra, Geologist RWSS
15.	P.C Naik, Geologist RWSS
16.	Brecht Mommen, Wash Specialist, UNICEF State Office for Orissa, Bhubaneswar
17.	S. N. Tripathi,Secretary, Department of Rural Development, Government of Orrisa, Bhubaneswar
18.	Ranjan Panda, Convenor, Water Initiatives Odisha, Orissa
19.	Jayadev Dakua, Centre for Youth and Social Development, Bhubaneswar
20.	Smita Mishra Panda, Professor, Human Development Foundation, Bhubaneswar
21.	Indira Chakraborty, Chief Advisor, CCDU-Public Health Engineering Department, Govt. of West Bengal
22.	Satyapriya Brahma, Director, CCDU-Public Health Engineering Department, Govt. of West Bengal
23.	Shashi Bindhani, Swavimanee, Orissa
24.	Biraja K Sathpathy, Water & Sanitation Specialist, Population Foundation India, Bhubaneswar
25.	P.R Choudhary, Baitarani Initiatives, Bhubaneswar
26.	Basant Kumar Jena, Orissa
27.	S.K Mishra, Under Secretary, Panchayati Raj Department, Orissa Government, Bhubaneswar
28.	Jinda Sandbhor, Research Associate, Forum for policy dialogue on water conflicts in India
29.	Bimal Pandia, Programme Manager, Bhubaneswar
30.	Sabarmatee, Orissa
31.	Seema Gupta, Programme Manager, Centre for Youth and Social Development, Bhubaneswar
32.	Monalisa Bhanja, Unit Manager, LWSIT - Lutheran World Service India, Bhubaneswar

AHMEDABAD WORKSHOP – September 30, 2011

1.	Rahul Banerjee, Trustee, DHAS Gramin Vikaskendra, Aarohini, Indore
2.	Sharad Sharma, Project Coordinator, BYVS - (Bharatiya Yuva Vikas Sansthan) Jaipur
3.	Vinay Kumar Mathur, CE ,PHED - Public Health Engineering Department, Rajasthan
4.	B.Krishna, Sr. Engineer, PHED - Public Health Engineering Department, Rajasthan
5.	Mandar Sathe, Senior Geologist, PRAYAS, Pune
6.	Manu Sharma, Social Worker, Sukshma Vikas Sansthan , Jaipur,
7.	Dipak Zade, Researcher, Watershed Organisation Trust (WOTR) The Forum, Pune
8.	Rishu Garg, Regional Coordinator, Association for Rural Advancement through Voluntary Action & Local Involvement, Jaipur
9.	Asad Umar, Programme Officer, WaterAid, Bhopal
10.	Shashak Deshpande, Senior Geologist, Ground water surveys & Development Agency, Pune
11.	Yusuf Kabir, Project Officer WASH, Mumbai
12.	Atul K. Shah, Sr. Consultant, WASMO, Gujarat
13.	R.R.Savdhara, Sr. Consultant (Tech) WASMO, Gujarat
14.	I.K.Chhabra, Project Director, WASMO, Gujarat

15.	B.J. Barodawala, Project Coordinator for Evaluation, WASMO, Gujarat
16.	Sujit G. Kumar, Team Leader, CINI (West), Ahmedabad
17.	R.N. Patel, Team Leader, Foundation for Ecological Security, Gujarat
18.	Amita Shah, Director,GIDR - Gujarat Institute of Development Research, Ahmedabad
19.	Ashok Parik, Consultant, WASMO, GujaratJatin Sheth, Programme Coordinator, VIKSAT, Ahmedabad
20.	Sumit Pathak, President, Paryavaran Suraksha Avam Manav Kalyan Trust, Ahemadabad
21.	Nitin Dhakkar, Pravah, Gujarat
22.	Keshab Das, Associate Professor, Gujarat Institute for Development Research (GIDR)V.
23.	H. Patel, CE,WASMO, Gujarat
24.	Virendra Vaghani, Programme Coordinator, CINI (West), Ahmedabad
25.	Ravi Solanki, Add. Secretary, Gujarat Water Supply Sewerage Board, Gandhinagar
26.	Uday Gaikwad, Sr. Programme Manager, Coastal Salinity Prevention Cell (CSPC), Ahmedabad
27.	Shilpa Vasavad, Independent consultant, Ahmedabad
28.	Alice Morris, UNNATI - Organisation for Development Education, Gujarat
29.	R.Parthasarthy, Professor, CEPT University, Gujarat
30.	Bhupendra .A. Jain, Technical Coordinator, WATSAN
31.	R N shukla, WASMO, Gandhinagar
32.	M.C.Rathod," Gujarat Water Supply Sewerage Board
33.	Meena Bilgi, Specialist, (Gender,Food Security and Livelihood) Core Associate (WOCAN), Steering Committee Member (GWA)
34.	M.Harini Reddy, Student, CEPT University, Gujarat
35.	Naik Malvika, Student, CEPT University, Gujarat
36.	Nikhil, Student, CEPT University, Gujarat

Water in India: Situation and Prospects

This report attempts to provide a comprehensive analysis of the state of water resource development and management in India, based on secondary information and consultations with leading experts, government officials, academicians, activists and grassroot workers. It maps current challenges and suggests feasible alternatives amidst increasing water scarcity and disenfranchisement of resource bases for the poor and the marginalised. It aims at achieving a holistic and dynamic understanding of the level of development around water and looks at the strategic steps required for action. The report encompasses both a depiction of the state of freshwater resources and potential problems and progress towards identified goals, including workable solutions. The key messages of the report are the following:

1. New indices are needed to measure available water resources
2. Water demand is far exceeding supply and leading to inter-sectoral conflicts
3. The time bomb of increasing water pollution is ticking
4. To achieve any headway in gender-sensitive policies, data disaggregation is urgently required
5. Reorientation and capacity building required for technocrats for a new vision for water management

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