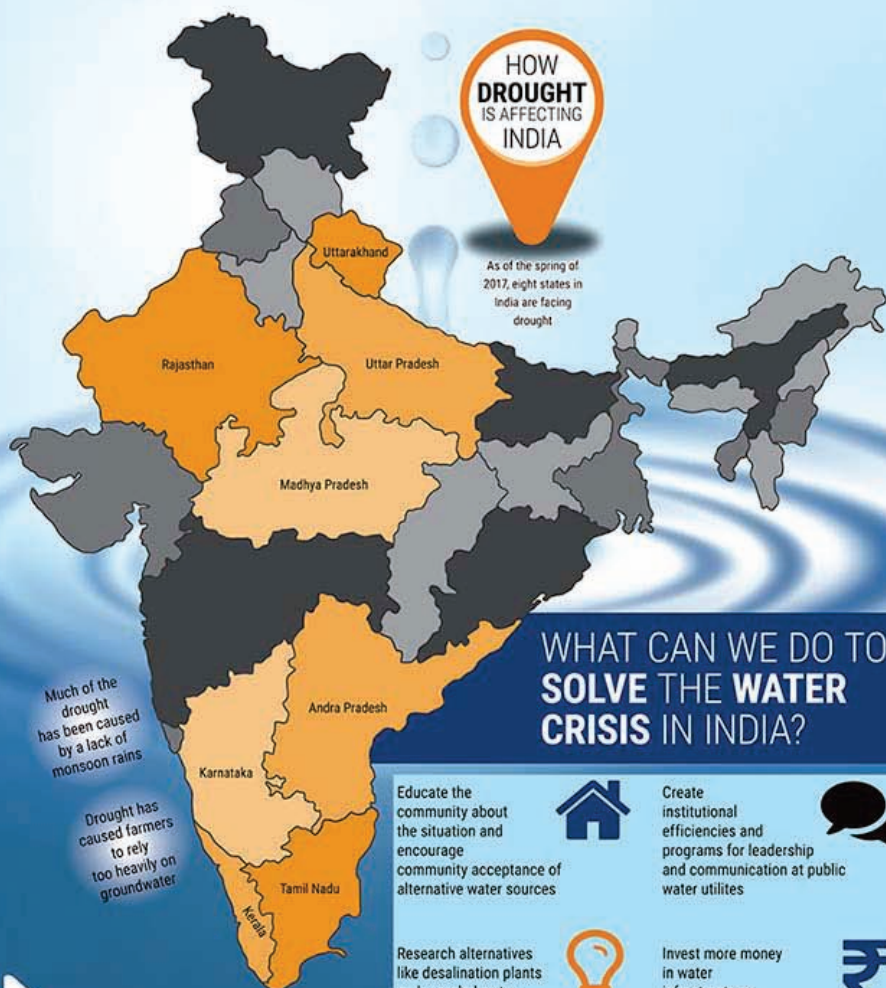


# DRINKING WATER QUALITY ASSESSMENT AND MANAGEMENT

S.K. Gupta • I.C. Gupta



## WHAT CAN WE DO TO SOLVE THE WATER CRISIS IN INDIA?

Educate the community about the situation and encourage community acceptance of alternative water sources



Create institutional efficiencies and programs for leadership and communication at public water utilities



Research alternatives like desalination plants and recycled water



Invest more money in water infrastructure



Redistribute the water network



Improve the detection of unaccounted water flow





# DRINKING WATER QUALITY

## Assessment and Management

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1971, besides holding scientific positions, he has been Head, Division of Drainage and Water Management, Head, Indo-Dutch Network Project, Head, Division of Irrigation and Drainage Engineering and Project Coordinator (AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture). After superannuation, Dr. Gupta worked as Emeritus Scientist (ICAR) and INAE Distinguished Professor at the same institute. Dr. Gupta has been engaged in conducting researches in surface and subsurface drainage for land reclamation, irrigation water management, hydrology of salt affected soils, leaching and use of saline water in agriculture. He has published more than 150 research papers in high impact factor journals and published 15 books. Currently, he is an independent Researcher pursuing his own interests in research and writing books. Dr. Gupta has been consultant to WAPCOS-Louis Berger, MoWR, MoRD, UP-Dutch Tube Well Project, ActionAid International, Synergics Hydro India-Oromia Water Works Enterprise, Ethiopia and others. He has been bestowed with Rafi Ahmad Kidwai Award by ICAR. Besides he is recipient of several awards from NAAS, ISAE, IE (India), CBIP and MoWR among other organizations. He is the Chief Editor of Journal of Water Management of the Indian Society of Water Management.



Dr. I.C. Gupta (b. 1941), was awarded Ph.D. on a subject thesis of environmental soil science by CAZRI/University of Jodhpur in 1968. He worked at Central Soil Salinity Research Institute from 1970 to 1986 (Principal Scientist). Dr. I.C. Gupta served Central Arid Zone Research Institute from 1986 to 2001 where he worked as Head of Regional Research Station, Bikaner and Head, Division of Natural Resources and Environment. A Life Fellow of Indian Water Works Association, Dr Gupta was elected as Councilor of Management Committee successively from three terms. He was also elected President of Jodhpur Chapter of Indian Society of Soil Science.

A Fellow of United Writers Association of India & Indian Society of Salinity Research Scientists, Dr. Gupta was elected Vice-Chairman of Arid Zone Research Association of India. He has been working as Secretary of Indian Society of Salinity Research Scientists & Chief Editor Current Agriculture since 1977. Dr. Gupta had been conferred several awards notable being Glaxo Scientific Honours Club, Dr. Rajendra Prasad Puraskar, First Prize, Outstanding Book Award by ISAE, Dr. Gorakh Prasad Puraskar First Prize, S.P. Unvala Memorial Prize by IWWA and Life Achievement Award by IARS. He was nominated as member of the 'Environment Conservation Council of Rajasthan' and of 'Special Committee on Environment Impacts' of INCID, Ministry of Water Resources, Govt. of India. He has about 250 publications including 34 books and two inventions (Jaltripti and Jalshuddhi). Dr. Gupta was appointed Ph.D. examiner by ten universities. He was also nominated for one of the 100 most INTRIGUING PEOPLE of 2003 by American Biographical Institute, North Carolina, USA, after close scrutiny of biographical archives of over one million individuals.

# About the Book

Sustainable Development Goal 6 (SDG 6) of the UN General Assembly states that 'Governments to ensure availability and sustainable management of water and sanitation for all'. It concentrates on all aspects of the water cycle: water; water resources management; water-use efficiency; water quality; waste water management; sanitation and health; and protecting freshwater ecosystems'. Contrarily, we daily witness the most perplexing paradox of merciless waste and pollution of water despite being aware that water is inadequate and is not going to last for long. Water inadequacy, be it physical, economical or quality related, is spreading fast to cover every continent. Although allocation of water to domestic sector in terms of total water use is quite less yet as per United Nations statistics water is impacting over 2 billion people who live in countries experiencing high water stress and about twice this number experience water scarcity at least for a month every year. The current book dwells upon the water quality issues and its impact on water supply scenario in general and domestic sector in particular. The book has been divided into seven chapters namely: Water Resources: Supply and Demand; Water Pollution; Water Quality Parameters and Standards; Laboratory Analysis of Water Samples; Raw Water Treatment; Treatment of Polluted Water; and Tips for Water Conservation. The topics covered in this book are quite relevant to civil engineers in general and public health engineers in particular, environmental specialists, agricultural engineers and all those concerned with water in any manner. It should prove to be a valuable reference for field practitioners, researchers, and policy makers. The topics/chapters included in the book have direct relevance to several Government sponsored programs such as National Rural Drinking Water Programme (NRDWP) and *Namami Gange* Programme of the Ministry of *Jal Shakti*, Development and Promotion of Clean Technologies of MoEF, and Many schemes of CGWB and CPCB. It can prove to be a valuable academic asset for libraries of colleges and universities worldwide.

**Authors**

# Preface

Water is a precious resource on the earth without which no living thing, plant, animal or human, can survive. It is also the most abundant commodity covering about 71% of the earth's surface making earth, the blue planet. Besides, huge amount of water is in circulation in a solar-driven hydrological cycle, which has no beginning and no end. The problem arises when water quality comes into picture. Approximately 97% of water available on earth is salt water, which cannot be used unless treated to make it fit for any pre-decided activity. Most of the remaining fresh water is frozen at the Poles or is too deep to be harnessed using presently available technologies or too polluted to use. The water in circulation commonly referred as replenishable resource is finite, inelastic and has large spatio-temporal variations. With increasing population, urbanization and industrialization, this source of water is increasingly becoming scarcer and has gone beyond the reach of many people in under developed and developing countries. Two recent hot spots namely Cape Town in South Africa and Latur in India clearly brought forth the issue of water scarcity. The addition of water quality dimension makes the issue more complex and the commodity even precarious. To understand this, we just have to see the pollution of our rivers, lakes and oceans and even ground water, all of which have already lost their pristine quality.

The term water quality describes the chemical, physical and biological characteristics of water and decides its suitability for its many uses. Although natural geogenic factors were in operation since time immemorial, the current concerns on water quality emanated mainly from anthropogenic activities that introduced nutrients, heavy metals, radioactive materials, pathogens, and sediments into the water besides causing acidification of the resources. Moreover, water quality is not a question of simply saying good or bad, but one needs to define its best use with or without treatment. For example, water quality related to drinking is more stringent and different than that for aquatic life, or for that matter for industrial or agricultural use. Agriculture sector is capable of absorbing large quantities of conventionally categorized poor quality water without or with minimal treatment.

Initiative to write this book stems from the fact that there is an increasing water supply-demand gap both as a result of reducing per capita availability as well as due to water quality degradation. The gap is likely to accentuate in future. Although domestic sector consumes the least quantity of the total water consumed in India, yet it is emerging that lot of water savings can be made even in this sector. This book focusses on this most topical issue of the twenty-first century. The main objectives of the book is to sensitize the people who in spite of the knowledge that water is scarce and its quality is decreasing, are knowingly or unknowingly wasting water than never before. Secondly, the sensitization should begin in life at the early stages. Thus, the book attempts to address most issues taught to engineering and environmental science students in the subjects of water supply management, sanitation and environmental management.

The book comprises of well-defined 7 chapters namely Water Resources: Supply and Demand, Water Pollution, Water Quality Parameters and Standards, Raw Water Treatment, Treatment of Polluted Water and Tips for Water Conservation. While Chapter 1 addresses



the issue of water demand and supply, it also briefly mentions the strategies to develop unconventional resources that will help to extend the existing supplies. Surface and ground water pollution and initiatives of the government to tackle the problem are included in Chapter 2. Important constituents that impact the water quality, various pathways through which these enter the water resource and national and international standards and guidelines of water quality are included in Chapter 3. Laboratory methods for the analysis of selected constituents form the subject matter of discussion in Chapter 4. Chapters 5 and 6 discuss the important issue of water treatment dealing respectively with raw water and polluted water respectively. Finally, Chapter 7 lists various tips to save water in the domestic sector. The authors emphasize that it is high time that we manage our domestic water requirement in less than 100 litres per capita per day. To achieve this, decentralized source of water through rooftop rainwater harvesting has been discussed in a detailed manner. Contents of all the chapters dovetail with the requirement of the civil/agricultural engineering, and environmental science students who are concerned with water supply, water management and the environment.

The book heavily draws from direct and indirect contributions of many national and international organizations and individuals. Although, it is difficult to name each and everyone in this small brief, we tried to include several important contributions by referring the work in the references. We might have inadvertently missed few of them. We place on record our appreciation for all the contributors who have researched and developed the relevant processes and technologies especially the laboratory methods of analysis. The authors at the end express their heartfelt thanks to their respective family members and friends. Without their full support, it might not have been possible to bring this project to its logical end.

In our view, this book should be helpful to the teachers and students to have a better teaching/learning experience. We are sure that the book will be a cherished possession of the faculty and students of civil, agricultural engineering and environmental sciences and prove to be a valuable academic asset for libraries of colleges and universities worldwide. In addition, it should prove to be a valuable reference for field practitioners, researchers, and policy makers as many topics/chapters of this book have direct relevance to several Government sponsored programs notably National Rural Drinking Water Programme (NRDWP) and *Namami Gange* Programme of the Ministry of *Jal Shakti*, Development and Promotion of Clean Technologies of MoEF, and Many schemes of CGWB and CPCB.

**Authors**



# Contents

<i>Preface</i>	(v)
<b>1. Water Resources: Supply and Demand</b>	<b>1–24</b>
<b>2. Water Pollution</b>	<b>25–56</b>
<b>3. Water Quality Parameters and Standards</b>	<b>57–90</b>
<b>4. Laboratory Analysis of Water Samples</b>	<b>91–140</b>
<b>5. Raw Water Treatment</b>	<b>141–172</b>
<b>6. Treatment of Polluted Water</b>	<b>173–206</b>
<b>7. Tips for Water Conservation</b>	<b>207–226</b>
<i>Annexure: I to VIII</i>	<b>227–240</b>
<i>Glossary of Terms</i>	<b>241–258</b>
<i>References</i>	<b>259–270</b>
<i>Subject Index</i>	<b>271–273</b>