

Volume Preface

Despite magnificent advances in many facets of human life, access to safe drinking water and adequate sanitation still remain beyond the reach of much of the world's population. Across the globe acute and chronic diseases caused by the consumption of contaminated water affect millions of people. Many urban and rural regions suffer from water scarcity and require long-distance transportation of water to meet potable water needs. This increased demand strains energy resources needed for both water treatment and transport. Additionally, providing safe drinking water to many rural and lightly populated areas remains cost prohibitive.

This volume by no means presents all complex issues related to potable water. However, it presents a timely and comprehensive glimpse of current and emerging issues of concern related to potable water access and presents possible alternative ways and solutions to alleviate current and emerging global potable water problems. Themes and issues discussed in this book include the following: (1) historical perspective of the evolution of drinking water science and technology, standards and regulations, and global potable water problems; (2) emerging issues of drinking water quality, water distribution, and energy demand for water treatment and transportation; and (3) using alternative water sources and alternative methods of water treatment and distribution that could resolve current and emerging global potable problems.

This book contains eight chapters. The chapter, "Potable Water Quality Standards and Regulations: A Historical and World Overview," presents an overview of the evolution of drinking water technology and standards from ancient to modern times. The chapter, "Global Potable Water: Current Status, Critical Problems and Future Perspectives," presents potable water access as a human rights issue and discusses problems relating to providing global potable water including social and political factors. The chapter, "Coping with Emerging Contaminants in Potable Water Sources," provides an overview of the types of emerging contaminants found in potable water sources, their removal in treatment plants, and a social perspective of emerging contaminants in potable water. The chapter, "Drinking Water Distribution: Emerging issues in Minor Water Systems," provides an overview of drinking water distribution systems with a focus on emerging issues in minor systems, i.e., plumbing systems in homes and other buildings, and contaminant intrusion in minor systems. The chapter, "The Effects of the Water–Energy Nexus on Potable Water Supplies," discusses energy demand for water treatment and

delivery and an overview of the ways in which the water–energy nexus creates challenges and opportunities in meeting potable water demands. The chapter, “Municipal Wastewater: a Rediscovered Source for Sustainable Water Use,” discusses municipal wastewater as a viable source and provides an appraisal of the varying qualities and characteristics of municipal wastewater affecting water reuse. The chapter, “Advances in Desalination Technologies: Solar Desalination,” discusses seawater as a potable water source, provides an overview of desalination technologies, and discusses methods and advantages of small- and large-scale solar desalination technologies. The chapter, “Bottled Water: Global Impacts and Potential,” discusses problems associated with bottled water production and consumption and the potential advantage of bottled water as a decentralized system for delivering potable water.

In “Potable Water Quality Standards and Regulations: A Historical and World Overview,” Kroehler provides an overview of drinking water in ancient times and the development of water treatment systems and discusses the evolution of water analysis and drinking water standards. The chapter also includes examples of current standards and regulations around the world, emerging standards and regulatory challenges, and global drinking water goals.

In “Global Potable Water: Current Status, Critical Problems and Future Perspectives,” Grady, Weng, and Blatchley provide an overview of critical problems related to providing potable water in both developed and emerging countries. Issues discussed include acute and chronic health issues attributed to unsafe drinking water; natural and human influences that will alter our current water supply in the coming decades; the technical limitations to water treatment in both developed and emerging economies; social and political factors influencing potable water access such as government capacity, competing interests, and the influence of food choices on water availability; and some current innovative approaches and suggested strategies for future water management.

In “Coping with Emerging Contaminants in Potable Water Sources,” Gall and Mina discuss emerging contaminants, such as pharmaceuticals and hormones, their sources, and their pathways to drinking water systems. Authors provide an overview of the types of emerging contaminants found in potable water sources, issues associated with their removal in water treatment plants, and a social perspective of the public’s concerns regarding emerging contaminants in potable water.

In “Drinking Water Distribution: Emerging issues in Minor Water Systems,” Lee and Farooqi discuss emerging issues in minor drinking water systems (in-building plumbing) along with general characteristics of drinking water distribution systems as a whole. The authors describe experimental studies which demonstrate that hydraulic transients triggered from water mains result in low-pressure occurrences in service lines. Such occurrences can allow possible intrusion of microbial and chemical contaminants at the service line. Lee and Farooqi conclude that structural integrity of service lines and hydraulic integrity at drinking water distribution systems should be maintained so that any public health risks will be minimized.

In “The Effects of the Water–Energy Nexus on Potable Water Supplies,” Lawson, Zhang, Joshi, and Pai discuss complicated interactions between water and energy in potable water systems. A rising global population will increase energy demand for treating and delivering water and may necessitate the energy-intensive treatment of alternative water sources such as wastewater and saline water for potable use. Authors also discuss the impact of electricity production and climate change on potable water sources. The chapter provides an overview of the ways in which the water–energy nexus creates challenges and opportunities in meeting potable water demand.

In “Drinking Water Distribution: Emerging issues in Minor Water Systems,” Mohan, Speth, and Garland argue that while significant progress has been made in building new water infrastructure, there exists a considerable difference between the supply of and demand for high-quality water. They assert that both the cost and unsustainable nature of diverting large volumes of water to water-stressed areas have become difficult to justify. The authors state that municipal wastewater has been identified as a viable alternative water source, and they provide an appraisal of the various qualities and characteristics of municipal wastewater affecting its reuse. Conventional and advanced technologies used for treating municipal wastewater to meet reuse standards are then evaluated; several case studies demonstrating water reuse schemes in different parts of the world are described in brief.

In “Advances in Desalination Technologies: Solar Desalination,” Abou-Rayane and Djebedjian provide an overview of desalination technologies and state that advances in these technologies clearly show that potable water can be obtained from desalinated water. The authors state that introducing solar energy as the power source in the desalination process has opened a new way to expand desalination technology. For countries suffering from freshwater shortages, particularly in rural and isolated areas, they argue for the importance of solar desalination. The chapter highlights existing solar desalination technologies and case study projects in several countries.

In “Bottled Water: Global Impacts and Potential,” Younos discusses the rationale beyond global expansion of bottled water and the problems associated with its production and consumption, energy demands, health concerns, and plastic pollution. The authors conclude that the current bottled water industry is not part of a sustainable solution to the overall challenge of providing potable water worldwide. However, bottled water could become part of an overall future solution to global lack of potable water shortages and community development. This would involve the bottled water industry to incorporate innovative water treatment technologies, renewable energy, and biodegradable plastics (or similar materials) in bottled water production and infrastructure systems.

Key issues will continue to influence access to potable water in both developing and developed countries: population growth, human migrations, competing demands among various water consumers such as agriculture, water infrastructure that has deteriorated or is wholly absent, energy constraints, and climate change. As scientific investigations and water treatment technologies continue to evolve, potable water shortages can be more efficiently addressed by developing alternative

sources such as treated municipal wastewater and desalinated brackish and seawater. Likewise, as renewable energy technologies advance and water infrastructure becomes decentralized, treatment and delivery of potable water will become less dependent on fossil fuels.

Avenues of research not addressed here include analysis of the life cycles of potential solutions and evaluation of social and political facets of sustainable potable water access and water use. There is a critical need worldwide to consider innovative procedures that will enable policy and decision-makers to consider bold intellectual and financial investments that will provide potable water to unserved communities.

We hope this volume serves as a valuable resource and reference for graduate and undergraduate students and for researchers concerned with global potable water sustainability. Equally, we hope it will be a useful guide to those affiliated with international agencies working to provide safe water supplies to communities around the world.

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