Technological Solutions for Water Sustainability: Challenges and Prospects

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Towards a Water-secure India

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Preface

India is soon to become the most populous nation in the world. Also, it is projected that by 2050, more than 800 million people will live in urban areas in India. As the resources are limited, expanding cities have been facing severe crises concerning the pollution of water bodies, the increasing gap between the demand and supply of domestic water, and the widening chasm between the amount of wastewater generated and the installed capacity of wastewater treatment plants. Challenges are also posed by lack of space, monitoring and data acquisition on water quality and quantity, appropriate and sustainable technologies, and vulnerability to climate change. Moreover, the existing infrastructure is aged and dilapidated, urging immediate attention.

Linkages between the right amount of water supply, sanitation, wastewater management, hygiene, and public health have been well established. Water supply and management of wastewater go hand in hand. One has to protect the water sources from getting contaminated and becoming unfit as drinking water sources. In many emerging economies, the absence of appropriate measures for treating wastewater, sullage, and septage from burgeoning septic tanks has contaminated many of the surface water and groundwater bodies. Conventionally, cities have been planned and operated on a linear flow of resources to feed, water, and shelter the growing urban population. However, recently, it has been recognized that the reuse and recycling of treated wastewater are economically viable and are attractive options for bridging the gap between the demand and supply of water. The development of tertiary treatment technologies makes it possible to treat wastewater to a level wherein it can be safely reused and recycled. But there are several concerns regarding the implication of large-scale recycling of treated wastewater from the perspective of emerging contaminants. It has also been recognized in recent times that flood risk and water scarcity can be tackled simultaneously through engineered groundwater recharge. There is an immediate need to develop new materials, processes, and technologies for efficient water and wastewater treatment, wastewater recycling, removal of residual pollution like emerging contaminants, nutrients, etc. Accordingly, appropriate remedial measures should be developed for reclaiming the polluted water bodies and providing safe water supply. Also, there is an immediate need for efficient monitoring and surveillance of water quality to safeguard public health and prevent environmental degradation. The technologies of supply should go hand in hand with the planning, designing, and operation of water infrastructure systems to optimally minimize water consumption, reduce water leakage, and improve water use efficiency.

The present edited volume provides comprehensive information about water and wastewater management, with a major focus on urban areas. Several technologies have been developed in the recent past in the Global North for advanced water and wastewater treatment, as well as for resource recovery and reuse. However, these technologies and processes from Global North may not be applicable directly in India and in other countries in Global South. Planning and installation

of expensive water infrastructure in rapidly expanding urban agglomerations in India are complex because of uncertainties associated with the prediction of urbanization, such as lack of land area, transforming governance structures, limited finances, etc. The intermittent water supply systems have to transition to 24×7 systems. There is a necessity for large-scale monitoring of water quality and water quantity parameters and the employment of easy-to-use and economical sensors to ensure safety. Some of the other key factors are the availability of skilled manpower for operations, maintenance, and socio-economic conditions. The unique feature of the proposed edited volume is that it addresses all the above issues originating from the special perspective of India. It provides information about the adaption of technologies and the development of new technologies and management practices, which are context-driven and region-specific. It also deals with economical and easy-to-use sensors for large-scale monitoring of water quality and water quantity parameters.

The purpose of this book is to provide comprehensive information about water and wastewater management which will help to achieve water circularity in growing urban agglomerations in India. It is expected that this book will be highly valuable to all those who are concerned with technologies, planning concepts, and management practices. It is also expected that the material presented in this book will be of relevance to other emerging economies in Global South. The purpose is achieved by putting together edited chapters authored by academics from India based on studies conducted by them in the last five years. Most of the contributing authors are a part of Water Technology Research and Innovation Centre 'SUTRAM of EASY WATER' (Centre for Sustainable Treatment, Reuse and Management for Efficient, Affordable and Synergistic solutions for Water) funded by Water Technology Initiative (WTI) of the Department of Science and Technology (DST), Government of India (GoI). This is a consortium of nine institutes across India. Authors from other countries who have researched water issues in India and in other nations belonging to the Global South have also contributed.

The book is divided into five sections. Section 1 consists of five chapters and they provide information about the status and challenges for sustainable water management in India, from the perspective of water quality, industrial and domestic waste water treatment, urban water infrastructure and policy and governance towards water security. Section 2 deals with new age materials for water and wastewater treatment. Five chapters in this section discuss new framework solids for water purification; new materials for arsenic and fluoride removal, nano-composites for water and wastewater treatment and removal of hazardous materials, and toxicity of these materials. Section 3 presents the new technologies developed for water and wastewater treatment. It has seven chapters dealing with pulsed power technology, constructed wetlands, nutrient recovery, low-cost filters, and pollution abatement using waste-derived materials. It also has a chapter especially dealing with technology evaluation for sustainability. Section 4 focuses on sensors: the four chapters of this part present the development of low-cost colorimetric sensors for eutrophying ions, sensors for conductivity and flow parameters, and multi-analyte assessment for water quality. The last section of the book has five chapters, which address the issues related to urban water infrastructure, sustainable urban drainage, and integrated flood and water scarcity management. This section also discusses the virtual water and challenges faced in the implementation of new projects and technologies.

This book is intended as a reference book for graduate students, working professionals, and policymakers.

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