Chapter 1

Foundations of Smart Water and Artificial Intelligence Technologies

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ABSTRACT

The increasing global demand for water, compounded by the challenges posed by climate change, urbanisation, and population growth, necessitates the adoption of innovative solutions for water management. Smart Water technologies, which encompass the integration of advanced sensors, data analysis, and automated systems, offer a promising approach to optimising water use and enhancing sustainability. While challenges remain, the benefits of adopting these technologies are substantial, warranting further investment and research. As global water challenges intensify,

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the role of Smart Water systems will become increasingly critical in ensuring the sustainable management of this vital resource. This chapter explores the components, benefits, and challenges of Smart Water systems, providing a comprehensive overview of their role in modern water management.

1. INTRODUCTION

Water management in cities faces unprecedented challenges due to scarce water resources, climate change, rapid urbanisation, and increasing demand. These interrelated factors have created an urgent need for smart solutions that optimise water use and distribution in urban environments.

The improvement in quality of life and economic development has also increased the demand for water in sectors such as agriculture, industry, and domestic use (Bertel et al., 2014). Competition for water between these sectors can lead to conflicts and tensions, making integrated water resources management more crucial than ever (Amorós et al., 2014). Smart solutions, including the use of Information and Communication Technologies (ICTs), can facilitate more efficient and equitable water management, helping to balance the needs of different users (Carvajal & Mazo, 2019; Maestre-Góngora, 2015).

The intersection of water scarcity, climate change, urbanisation, and growing water demands underscores the urgent need for Smart Water Management solutions. These solutions not only optimise the use of water resources but also promote sustainability and resilience in cities in the face of future challenges.

Smart Water Management refers to the integration of advanced technologies, particularly ICTs, into urban water systems to enhance efficiency, sustainability, and resilience. This concept has emerged as a critical response to the challenges posed by urbanisation, climate change, and water scarcity. Smart Water Systems utilise real-time data collection, analytics, and automated controls to optimise water supply, distribution, and treatment processes, thereby improving overall water management (Aivazidou et al., 2021; Lassiter & Leonard, 2022). The International Water Resources Association defines Smart Water Management as a means to achieve sustainable urban water systems through the application of innovative technologies (Aivazidou et al., 2021).

The role of smart water in urban water management is multifaceted. It encompasses the management of various water sources, including drinking water, stormwater, and wastewater, through a holistic approach that integrates both natural and engineered systems (Popartan et al., 2022). By employing smart technologies such as sensors, machine learning algorithms, and IoT devices, urban water managers can monitor water quality, predict demand, and respond to leaks or contamination events

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