Chapter 5

The Critical Role of Water Quality:

Health Impacts, Contaminants, and Sustainable Solutions for Environmental and Human Well-being

Shalom Akhai
https://orcid.org/0000-0002-7533-457X
MMEC MM(DU), Mullana, India

Tanu Taneja
https://orcid.org/0009-0004-3183-2819
Department of Civil Engineering, RIMT University, India

ABSTRACT

Clean water is essential for human health and environmental sustainability. This paper explores the intricate link between water quality, public health, and ecosystem stability, highlighting the dangers posed by contaminants such as heavy metals, pathogens, and chemicals. It examines the health risks associated with polluted water and emphasizes the urgent need for sustainable solutions to mitigate these threats. By addressing water contamination through advanced treatment technologies, policy reforms, and community-driven initiatives, this work underscores the critical role of clean water in fostering a healthier, more sustainable future for all.

DOI: 10.4018/979-8-3693-8074-1.ch005

1. INTRODUCTION

Water is a vital resource for life, ecosystems, agricultural productivity, and human well-being. It plays a crucial role in agriculture by transforming sunlight and soil nutrients into nourishment that sustains human existence. However, our water sources are increasingly vulnerable to contaminants such as bacteria, viruses, toxins, and heavy metals, which affect their overall quality. The advancement of technology has resulted in the buildup of chemical pollutants, while the rapid expansion of urban areas has strained sewage systems, leading to the presence of hazardous microbes. The unintended consequences of intensive farming efforts include the contamination of rivers and aquifers due to the discharge of excessive fertilisers and pesticides.

Water's most detrimental property is its capacity to create a discrepancy between appearances and reality, making it difficult to perceive the danger presented by contaminated water. Preserving the purity of drinking water is crucial, as it directly impacts our well-being and general quality of life. Access to clean water is not only essential for maintaining good health but also considered a fundamental human right (Barzilay, Weinberg, & Eley, 1999). Extended exposure to contaminants can lead to subtle but broad effects, such as slight cognitive impairments, minor hormone abnormalities, or low-grade inflammation. Contaminants present in seemingly innocuous water sources may potentially cause significant health hazards, such as gastrointestinal illnesses and long-lasting chronic conditions (Bozorg-Haddad, Delpasand, & Loáiciga, 2021). The scope of these health hazards is extensive, including organisms such as E. coli or Giardia that may lead to severe diarrhea, rapid dehydration, and potentially life-threatening outcomes in children. Lead exposure may result in developmental delays, learning difficulties, and behavioral problems. Per- and polyfluoroalkyl substances (PFAS) are often known as “forever chemicals” because they can induce liver damage, thyroid disease, and certain forms of cancer. Water testing is an essential technique for identifying water contamination, enabling proactive measures to avert possible hazards and allowing for focused and cost-effective interventions (Zhang et al., 2023; Kumar & Puri, 2012). The complexity of water contamination arises from the many interconnections between rivers, aquifers, soil, air, and living organisms. Chemical pollutants from industrial output, agricultural practices, and domestic waste pose additional health risks, including acute toxicity and long-term diseases like cancer. Heavy metals, such as lead, mercury, and arsenic, can cause severe harm to human health, including neurotoxicity, cardiovascular problems, and increased susceptibility to cancer. Thorough water testing is crucial for safeguarding the health and welfare of people and maintaining the integrity of the environment. Interdisciplinary collaboration, including public and private sectors, and international cooperation can contribute to the preservation

Related Content

Comparative Flood Inundation Mapping Utilizing Multi-Temporal Optical and SAR Satellite Data Over North Bihar Region: A Case Study of 2019 Flooding Event Over North Bihar

Gaurav Tripathi, Arvind Chandra Pandey, Bikash Ranjan Paridaand Achala Shakya (2020). *Spatial Information Science for Natural Resource Management (pp. 149-168).*

www.irma-international.org/chapter/comparative-flood-inundation-mapping-utilizing-multi-temporal-optical-and-sar-satellite-data-over-north-bihar-region/257701

Challenges and Opportunities in Implementing AI for Smart Water

Alejandro Fuentes-Penna, Raúl Gómez Cárdenasand Anayeli Silva Aguilar (2025). *Smart Water Technology for Sustainable Management in Modern Cities (pp. 31-50).*

www.irma-international.org/chapter/challenges-and-opportunities-in-implementing-ai-for-smart-water/370435

Sentinel SAR Data and In-Situ-Based High-Resolution Above-Ground Carbon Stocks Estimation Within the Open Forests of Ramgarh District

Akash Anand (2020). *Spatial Information Science for Natural Resource Management (pp. 180-205).*

www.irma-international.org/chapter/sentinel-sar-data-and-in-situ-based-high-resolution-above-ground-carbon-stocks-estimation-within-the-open-forests-of-ramgarh-district/257703

Analysing the Role of Artificial Reefs in Blue Tourism: Vilamoura Artificial Reef (South Portugal)

Joana Costa, Jorge Ramosand Francisco Leitão (2024). *Scientific Innovations for Coastal Resource Management (pp. 229-252).*

www.irma-international.org/chapter/analysing-the-role-of-artificial-reefs-in-blue-tourism/354930

GIS-based Multi-Criteria Analysis for Delineation of Groundwater Potential Zones: A Case Study from Jodhpur District, Rajasthan, India

Raghib Raza, Gajendra Kumar Chawlaand Chandra Shekhar Dwivedi (2020). *Spatial Information Science for Natural Resource Management (pp. 24-43).*

www.irma-international.org/chapter/gis-based-multi-criteria-analysis-for-delineation-of-groundwater-potential-zones/257695