

# Water Quality and Human Health: A Review of SDG 6 and SDG 3 Linkages

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**Abstract** The paper discusses the connection between Sustainable Development Goals 6 (SDG 6): Clean Water and Sanitation and SDG 3: Good Health and Well-being. It reveals that 844 million people worldwide lack access to clean water, and 2.3 billion live without basic sanitation facilities. Water-borne diseases caused 842,000 deaths annually, primarily among children under 15. Achieving SDG 6 is crucial for realizing SDG 3, as it reduces water-borne diseases and mortality rates, improves human health and well-being, increases economic productivity, and enhances environmental sustainability. Key recommendations include increasing investment in water quality monitoring and management infrastructure, implementing innovative technologies for water treatment and purification, strengthening policies and regulations, and enhancing public awareness on water-borne diseases and healthy water practices. The article emphasizes the need for integrated approaches to address the interconnected challenges of water quality and human health, including increased investment in water quality monitoring and management infrastructure, implementation of innovative technologies for water treatment and purification, and strengthening policies governing water quality and human health.

**Keywords** — *Groundwater Quality, Sustainable Development Goals (SDGs), Water and Sanitation (SDG 6), Human Health (SDG 3), Water Quality Monitoring, Environmental Sustainability.*

## I. INTRODUCTION

Access to clean water and good health are fundamental human rights and critical components of sustainable development [1]. The United Nations' Sustainable Development Goals (SDGs) recognize these imperatives through SDG 6, which aims to "ensure availability and sustainable management of water and sanitation for all," and SDG 3, which seeks to "ensure healthy lives and promote well-being for all at all ages" (United Nations, 2015) [2]. The intricate relationship between water quality and human health underscores the importance of addressing these goals in tandem, as progress in one area inherently impacts the other [3, 4]. This paper explores the critical linkages between SDG 6 and SDG 3, examining how water quality affects human health and how interventions in water and sanitation can lead to improved health outcomes. By reviewing current research, case studies, and global initiatives, we aim to highlight the synergies between these goals and propose integrated approaches for their achievement.

**Overview of SDG 6** - SDG 6 aims to provide clean water and sanitation for all, focusing on universal access to safe, affordable drinking water, adequate sanitation, hygiene, water quality improvement, water-use efficiency, integrated water resource management, and protecting water-related ecosystems. However, as of 2021, 2 billion people lack safely managed drinking water, 3.6 billion lack sanitation, and 2.3 billion lack basic hygiene services, according to the UN's progress report [5-7].

**Overview of SDG 3** - SDG 3 aims to promote healthy lives for all ages by reducing maternal mortality, preventing preventable deaths of newborns and children under 5, addressing epidemics of AIDS, tuberculosis, malaria, neglected tropical diseases, and non-communicable diseases, reducing premature mortality from non-communicable diseases, strengthening substance abuse prevention and treatment, reducing road traffic accidents, ensuring universal access to healthcare services, and achieving universal health coverage. Progress has been

mixed, with challenges in maternal health and non-communicable diseases [8-11].

### The Interconnection between Water and Health

The relationship between water and health is complex and multifaceted. Clean water is crucial for hygiene, food preparation, and hydration, while contaminated water can lead to diseases like diarrheal illnesses and chronic conditions. Contaminated drinking water causes 4,85,000

**Table:** SDG 6 and SDG 3 similarities and dissimilarities.

Characteristics	SDG 6: Clean Water and Sanitation	SDG 3: Good Health and Well-being	Similarities	Dissimilarities
<b>Goal Description</b>	Ensure access to clean water and sanitation for all	Ensure healthy lives and promote well-being for all	Both focus on human well-being	Different focus areas (water vs. health)
<b>Target Areas</b>	Water quality, sanitation, hygiene, water management	Health outcomes, disease prevention, health systems	Both address human health	Different approaches (infrastructure vs. health outcomes)
<b>Key Indicators</b>	Access to clean water, sanitation facilities, water quality	Life expectancy, mortality rates, health coverage	Both measure human well-being	Different metrics (water access vs. health outcomes)
<b>Focus</b>	Environmental sustainability, water management	Human health, well-being, quality of life	Both focus on human well-being	Different priorities (environment vs. health)
<b>Scope</b>	Water and sanitation infrastructure, management	Health systems, disease prevention, health promotion	Both address human health	Different scopes (water vs. health)
<b>Interlinkages</b>	Linked to SDG 3 (health), SDG 11 (cities), SDG 12 (consumption)	Linked to SDG 6 (water), SDG 11 (cities), SDG 12 (consumption)	Both have interlinkages with other SDGs	Different interlinkages (water vs. health)
<b>Challenges</b>	Water pollution, scarcity, lack of infrastructure	Health inequities, disease outbreaks, lack of health infrastructure	Both face significant challenges	Different challenges (water vs. health)
<b>Solutions</b>	Increase investment in water infrastructure, improve water management	Strengthen health systems, increase health coverage, promote health education	Both require investment and innovation	Different solutions (water vs. health)

## II. WATER QUALITY AND ITS IMPACT ON HUMAN HEALTH

Water quality directly impacts human health through waterborne diseases, chemical contaminants, and emerging water quality concerns. Waterborne diseases are caused by pathogenic microorganisms transmitted primarily through contaminated water, which remain a significant global health burden, particularly in low- and middle-income countries. Diarrheal diseases, primarily caused by waterborne pathogens, are the second leading cause of death in children under five years old, with approximately 829,000 deaths annually due to unsafe drinking-water, sanitation, and hand hygiene. Chemical contaminants in water can lead to acute and chronic health effects, depending on the nature of the contaminant and the duration of exposure. Common pollutants include heavy metals like lead, arsenic, mercury, pesticides and herbicides, nitrates and phosphates from agricultural runoff, and industrial chemicals like PCBs and dioxins. Long-term exposure can lead to skin lesions, cancer, cardiovascular diseases, neurological damage, methemoglobinemia in infants, and persistent organic pollutants linked to various cancers, birth defects, and dysfunctional immune and reproductive systems.

diarrheal deaths annually, and water-related diseases like cholera, typhoid, and hepatitis A remain significant public health challenges. Inadequate water and sanitation facilities can impede healthcare delivery, affect maternal and child health, and contribute to antimicrobial resistance. Addressing water quality and access is not just an environmental concern but a critical public health imperative [12-15].

Emerging water quality concerns include microplastics detected in tap and bottled water worldwide, pharmaceutical residues, and antimicrobial resistance. Microplastics have potential health impacts, including physical damage to organs, endocrine disruption, and serving as vectors for other pollutants. The cocktail effect of multiple pharmaceutical residues is not yet fully understood. Addressing these challenges is crucial for achieving SDG 6 and SDG 3, as improvements in water quality can lead to significant advancements in public health outcomes [16-20].

## III. SDG 6 INTERVENTIONS AND THEIR HEALTH IMPACTS (SDG 3)

The interventions aimed at achieving SDG 6 targets have significant positive impacts on health outcomes, directly contributing to the goals of SDG 3. Improved water sources, such as protected wells, boreholes, and piped water systems, significantly reduce the risk of waterborne diseases and are associated with a 34% reduction in diarrheal disease. Water treatment technologies, such as chlorination, solar disinfection, and filtration, can further reduce pathogen exposure.

Improved water quality is associated with better child growth outcomes, reducing stunting and wasting, and contributes to reduced child mortality, supporting SDG 3.2 (end preventable deaths of newborns and children under 5). Sanitation interventions, such as flush toilets and pit latrines with slabs, reduce exposure to fecal pathogens and can reduce diarrheal disease by 25%. Community-led total sanitation approaches have shown promise in reducing open defecation and improving health outcomes, with studies in Mali showing a 23% reduction in stunting among children. Proper wastewater management reduces environmental contamination and the spread of waterborne diseases and helps combat antimicrobial resistance.

Hygiene promotion and behavior change are also crucial for reducing diarrheal disease and respiratory infections. Handwashing with soap is a cost-effective way to reduce diarrhea episodes by 30%. Improved access to menstrual hygiene facilities and education supports girls' school attendance and women's dignity, contributing to SDG 3 targets related to sexual and reproductive health. Health education programs in schools and communities promote long-term behavior change and contribute to overall health literacy, supporting various SDG 3 targets.

Integrated WASH interventions, such as improving WASH in healthcare facilities and schools, can lead to greater health impacts than individual interventions alone. By improving access to clean water, sanitation, and hygiene practices, we can significantly reduce the global burden of disease and contribute to overall well-being [21-24].

#### IV. CHALLENGES IN ACHIEVING SDG 6 AND SDG 3

The World Bank estimates that \$114 billion per year is needed to achieve SDG 6 and SDG 3, but current investment levels are far short. Poor maintenance of existing water and sanitation systems leads to service disruptions and quality issues. Urban-rural divides create disparities in health outcomes. Climate change impacts water quality and health by exacerbating water stress, increasing frequency of extreme weather events, and altering the distribution of water-related disease vectors. Socioeconomic disparities in access to clean water and healthcare include income inequality, gender disparities, and marginalized communities. Lower-income populations often have less access to improved water sources and quality healthcare, while women and girls are disproportionately affected by poor WASH access. Certain groups, such as refugees, slum dwellers, and indigenous populations, face challenges in accessing WASH services and healthcare.

#### V. INTEGRATED APPROACHES TO ADDRESS SDG 6 AND SDG 3

To improve water quality and maximize health benefits, integrated approaches addressing SDG 6 and SDG 3 are crucial. These include Water Safety Plans, which involve risk assessment, monitoring, and control measures. One Health Approach, which involves interdisciplinary collaboration and addressing water-related health issues holistically, recognizes the interconnectedness of human, animal, and environmental health in water management. Community-Led Total Sanitation (CLTS) focuses on changing community norms and behaviors around sanitation, empowering communities to take charge of their own solutions and promoting sustainability. Integrated Water Resources Management (IWRM) is a holistic approach involving all stakeholders in water management decisions. Low-cost solutions, digital tools, and nature-based solutions are also essential. Policy integration is crucial for implementing these strategies. These approaches aim to address the interconnectedness of human, environmental, and animal health in water management, promote lasting change, and ensure the sustainability of water systems.

#### VI. CONCLUSION

The paper emphasized the significance of clean water and good health for sustainable development, linking SDG 6 and SDG 3, which aim to ensure sustainable water and sanitation management for all. It calls for integrated approaches like Water Safety Plans, One Health Approach, Community-Led Total Sanitation, and Integrated Water Resources Management to address challenges like inadequate investment, poor maintenance, urban-rural divides, climate change, and socioeconomic disparities. These strategies aim to improve health outcomes and achieve SDG 6 and SDG 3, recognizing the interconnectedness of water quality and human health. Policy integration, low-cost solutions, digital tools, and nature-based solutions can promote lasting change and ensure the sustainability of water systems. Prioritizing these goals can significantly reduce the global burden of disease and contribute to overall well-being.

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