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Evaluating the Environmental & Socioeconomic Effects of Insufficient Water & Sanitation in Afghanistan

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study explores the current access to drinking water and sanitation in Afghanistan and identifies considerable differences in the coverage between urban and rural settings. About 30-33% of the population has access to safely managed drinking water sources and 68% has access to improved sanitation facilities. The study used the most recent and relevant literature, reports, and online data

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portals to explore the current water and sanitation situation and depict the importance of country-specific intervention strategies to address these critical challenges. The study notes the harmful social and environmental results of inadequate water and sanitation, including a threat to sensitive ecosystems, the prevalence of waterborne disease, and hunger. The Afghan government and development partners continue to work towards improving these conditions, but deficiencies in finance, institutional capacity, stakeholder coordination, and policy implementation remain. Local ownership and participation have been identified as key factors in ensuring the sustainability of the interventions in this research. The results underscore that community empowerment can potentially yield better results if its inclusion is ensured. The study highlights the need for greater community engagement in developing water and sanitation projects and gender-specific strategies, given that inadequate facilities often adversely affect women and girls. The study concludes with its recommendations to improve water and sanitation services through community-driven technologies, blended financing models, and need-based capacity-building initiatives. Through strengthened stakeholder collaboration and high priority on gender inclusion, Afghanistan can greatly improve access to safe and sustainable water and sanitation facilities and services, helping the country advance sustainable development progress in this vital sector.

Keywords: Water; sanitation; Afghanistan; public health; environment; sustainable development; waterborne disease.

1. INTRODUCTION

Providing clean water and sanitation is a global challenge essential for sustainable development, affecting socioeconomic development, environmental management, and public health (Aditi et al., 2023). Unfortunately, many vulnerable communities and developing countries, including Afghanistan, are behind this curve (Jenkins, 2006). Afghanistan, mired in decades-long political instability and violence, is dealing with a crisis in water and sanitation (Habib, 2014). Failure to provide these basic services impedes the country's development, leading to multiple socioeconomic barriers and health risks (Bisung & Elliott, 2017). The water and sanitation-related challenges in Afghanistan must be tackled to ensure the survival and welfare of its people, establish a conducive environment that enables development, stimulate economic growth, and protect the environment. Through a collaboration between the government, private sector, and community, sustainable solutions to Provide universal access to clean water and sanitation in Afghanistan can be delivered.

Access to clean water and sanitation in Afghanistan is a major challenge with just 55% of the population having potable drinking water services and 43% having basic sanitation facilities (Shakir & Danishmal, 2023). The country's arid climate, with scarce water, and damage to water infrastructure during years of conflict compound the problem (Rafiq Shah Ansari & Rawat, 2023). Increased waterborne diseases, environmental degradation, the continuation of socio-economic inequalities, and obstruction of global Visions of sustainable development, all of these things are the result of the lack of required access to drinking water and sanitation (Daqiq et al., 2022). Programs like Ru-WatSP have made strides toward clean drinking water, especially in rural settings, however, long-term solutions to Afghanistan's water quality and availability issues will require comprehensive policies and interventions on a larger scale (Noori & Singh, 2022). These studies reveal the necessity of facilitating sustainable groundwater management policies, extending the water supply network, quality monitoring, and effective wastewater management practices to minimize potential health threats and provide the population with a healthier environment (Hamidi et al., 2023).

This review article aims to provide a comprehensive investigation into the social and environmental impacts of Afghanistan's limited access to clean water and sanitation. This paper aims to analyze the existing condition of water resources and sanitation infrastructure in light of these challenges, explore the resulting cascading impacts on the environment and local communities, and build on the lessons learned from case studies in similar regions to inform a critical assessment of the current policy and intervention landscape, to promote constructive pathways for action. The overall objective is to inform the stakeholders, development organizations, and politicians so that they can develop evidence-based plans to combat this

major issue and promote sustainable development in Afghanistan.

1.1 Study Area

Afghanistan is located in southern Asia, a land-locked nation, and according to the (Nations, 2024b) it is classified as a Least Developed Country. Afghanistan's population was 41,128,771 people in 2022, with a population density of 60 people per square kilometer (Nations, 2024a). Only 25% of this population lives in urban centers and about 70% are scattered throughout rural areas (Nations, 2024a). These rural communities face great difficulties obtaining clean water and sanitation, which are essential for public health and individual well-being. According to (Ru-WatSP, 2024) the database of the Rural Water Supply and Sanitation Program water supply coverage for rural areas is about 33%. Fig. 1 shows the geographical map of Afghanistan and how different provinces have disparities in access to water resources and sanitation facilities. There is an urgent need to make targeted investments at these sites to improve the provision of water and sanitation.

2. METHODOLOGY

2.1 Data Collection

This study uses a secondary data collection method, by a comprehensive review of the most recent literature and reports on water and sanitation issues, and existing policies or programs. The literature review gives background information on some difficulties in Afghanistan, showing how historical and socio-economic factors have influenced access to water and sanitation.

Data was collated from respectable international agencies including the World Health Organization (WHO) and UNICEF. The UN-Water SDG 6 Data Portal was searched for appropriate data sets. The data collected then has been modified to make greater clarity and relevancy, so that the provided information adequately reflects what is currently happening in Afghanistan.

2.2 Data Analysis

A combination of qualitative and quantitative data analysis approaches was used to provide a complete picture of the issues that needed to be addressed in the project. Thematic analytics was used to understand trends, issues, and opportunities related to water and sanitation, from gathered reports, policy documents, and literature. Furthermore, statistical tools were used in the quantification of the numerical data collected from different international agencies for determining access to water and sanitation services, health risks arising from the lack of amenities, and aspects of socio-economics to water resource management.

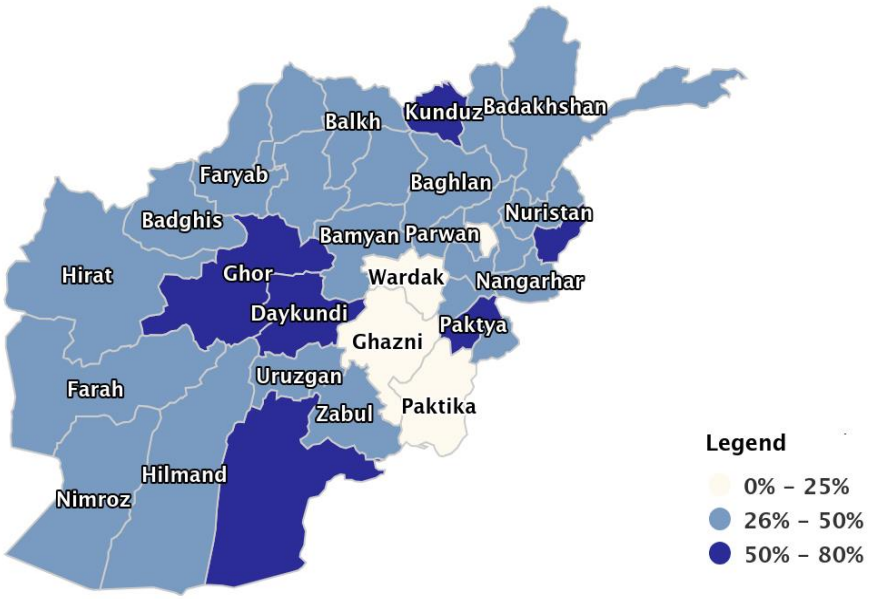

Fig. 1. Map of the study area with percentage of water supply coverage in rural areas

This methodology offers a strong foundation to address the complex situation of water and sanitation in Afghanistan and would lead to the formulation of needs-based recommendations. Combining multiple data types and methods of analysis, the study seeks to provide useful suggestions for policymakers and practitioners targeting meaningful improvements in the water and sanitation sector.

3. WATER AND SANITATION IN AFGHANISTAN

3.1 Water Resources and Access to Clean Water

Afghanistan is facing a crucial water scarcity challenge combined with an unequal distribution of surface and groundwater resources (Daqiq et al., 2022). The country depends squarely on cyclical precipitation patterns for its estimated 65 billion cubic meters of renewable water supply annually, and water availability remains erratic (J. Shokory et al., 2023). The majority of the nation's water resources exist in the north and east; the middle and south are perpetually beset by water scarcity (J. A. Shokory et al., 2023). Climate change impacts such as glacier shrinkage and rising temperatures, which in turn increase evaporation, are having an increasingly destabilizing effect on Afghanistan's water supply (Chen et al., 2023). Efforts to improve access to clean water, such as a Ru-WatSP program, boost the population's access to clean water from 20% to 67% in a decade (Rafiq Shah Ansari & Rawat, 2023). According to data provided by UNICEF & WHO, and downloaded from the UN-Water SDG 6 data portal, 83% of the population uses improved water sources, and only 30% of people use safely managed drinking water services Fig. 2. Water management strategies and practices and implementation of sustainable development should be recommended to achieve water security in the country to face these challenges.

However, formidable challenges remain, with only 30% of the population having access to safely managed drinking water services, with significant contrasts between urban (36%) and rural (28%) areas (Nations, 2024a). The natural source of pollution by drinking water, agricultural runoff, and the absence of treatment facilities leads to outbreaks such as cholera, typhoid, and hepatitis, which are waterborne diseases (Rafiq Shah Ansari & Rawat, 2023). Environmental inventories in Kabul of different water contaminants show that its drinking water quality fails to the WHO criteria in excessive levels of scaling pollutants such as nitrate, high levels of E. coli and 35% of shallow groundwater samples do not meet the criteria for good drinking water quality (Hamidi et al., 2023). In Afghanistan, sustainable groundwater management policies, extended water supply networks, quality monitoring, and advanced waste management are the key to addressing these challenges.

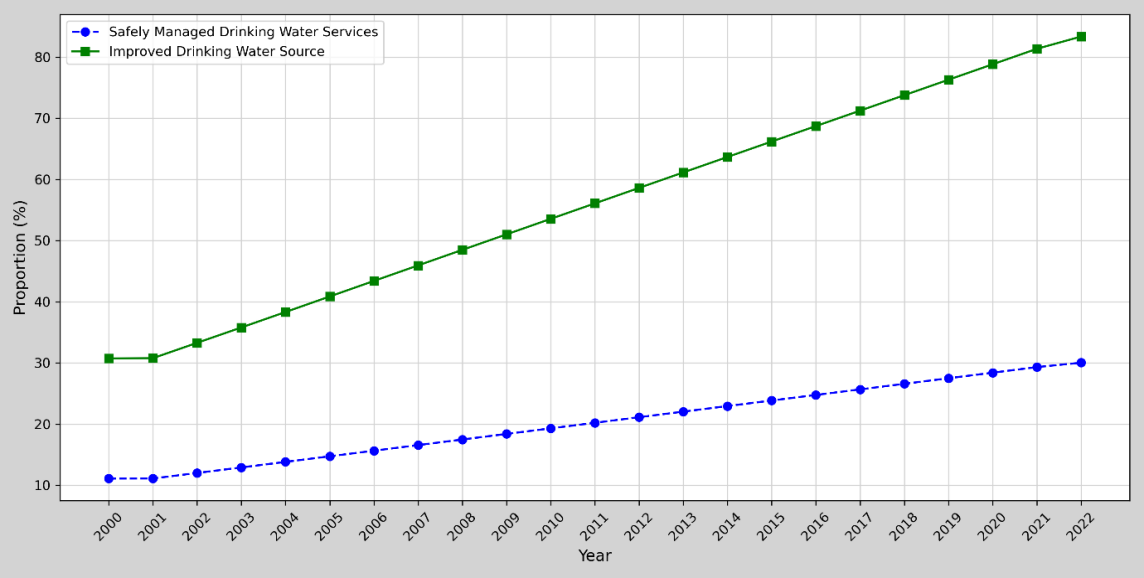

Fig. 2. Proportion of population using safely managed and improved drinking water services in Afghanistan

Extensive damage to water infrastructure accrued through decades of war, a lack of funds for maintenance of treatment plants, wasteful usage of water in agricultural activities, and the impacts of climate change such as droughts and erratic patterns of rainfall are the key dilemmatic factors resulting in Afghanistan's limited access to clean water (Nabavi & Mohammadi, 2024).

3.2 Access to Advanced Sanitary Infrastructure

Access to sanitation in Afghanistan is poor; there is no data about the percentage of the population using safely managed sanitation facilities, while 68% of the population has access to only improved sanitation services, with a stark urban-rural divide evidenced by 93% coverage in urban areas compared to 59% in rural areas (Nations, 2024a). Most people still depend on antiquated sanitation systems such as open defecation and pit latrines, which pose serious health and environmental risks (Rafiq Shah Ansari & Rawat, 2023). According to data provided by UNICEF & WHO, and downloaded from the UN-Water SDG 6 data portal (Nations, 2024a), 68% of the population using improved sanitation facilities Fig. 3. The sanitation crisis is compounded by the insufficiency of wastewater treatment in the country, underscoring the need for better sanitation infrastructure and the improvement of sanitation services nationwide (Rahmani & Anuar, 2019). In populous cities like Kabul, where anthropogenic activities have contaminated shallow aquifers, it is critical to address these challenges and implement sustainable sanitation practices (Mangal et al., 2023). While initiatives like the Ru-WatSP program have reported advancements in providing access to clean water for rural communities, the sanitation crisis is only treatable with comprehensive measures throughout Afghanistan (Hamidi et al., 2023).

In Afghanistan, more than 95% of the population lacks access to proper sewerage, and wastewater treatment plants and fecal sludge management services have never been built, leading to the contamination of water bodies, soil, and groundwater with pollutants such as heavy metals, in addition to bacteria, nitrates, and fluoride (Hamidi et al., 2023). Such contamination can have severe public health impacts, with increased waterborne pathogens associated with higher concentrations of E. coli, nitrate, and arsenic in drinking water (Khan, 2024). Irrigation with contaminated water bodies raises serious concerns over bioaccumulation, as heavy metals including lead have also been detected in the soil and crops (Sachan et al., 2007). Groundwater contamination is a reflection of overexploitation, poor management practices, and pollution and thus demands immediate attention in the form of inherently sustainable groundwater management policy, quality monitoring, and wastewater treatment strategies for safeguarding public health and environmental sustainability in Afghanistan (Khalil et al., 2020). Another strategic risk due to terrorism or bioterrorism activity demonstrates the need for active risk management in certain sectors, protecting scarce water resources from the potential threat of intentional contamination of water supplies (Meinhardt, 2005).

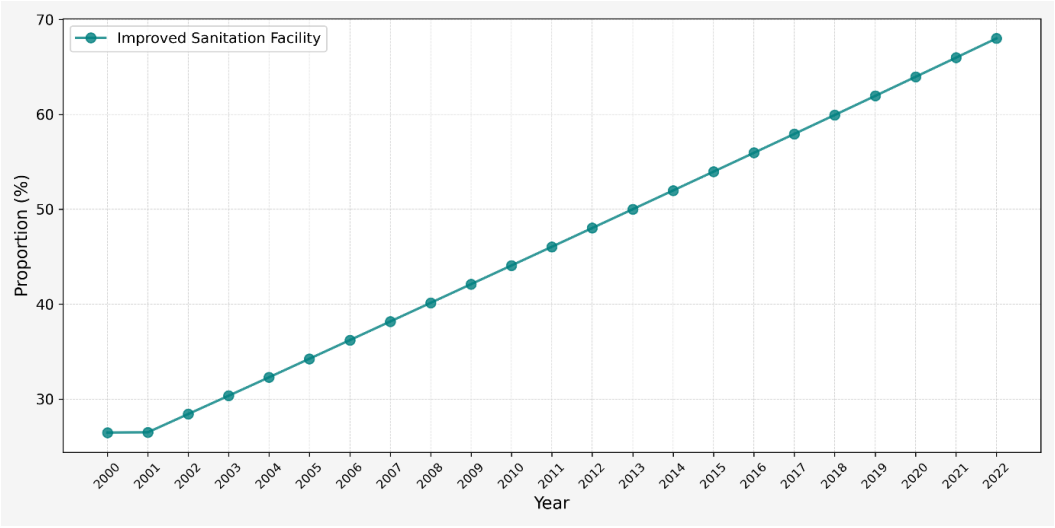

Fig. 3. Proportion of population using improved sanitation services in Afghanistan

This poor sanitation is caused by the destruction of existing infrastructure during the years of conflict, the scarcity of financial resources and institutional capability in the sanitation sector, and the low priority of the method of sanitation in the National Development Plans. Findings in this study indicate that socioeconomic and cultural barriers to the adoption of better Sanitation practices play a vital role in Afghanistan's sanitation.

3.3 Environmental Impacts

Afghanistan's access to water and sanitation is poor, exerting a negative impact on the national environment, polluting water supplies and land, and disturbing fragile ecosystems (Habib, 2014).

3.4 Degradation and Contamination of Water Bodies

It significantly relates to the causes and effects of polluted water bodies in Afghanistan, especially the Kabul River, which resulted from improper disposal of solid waste and raw wastewater disposal into rivers, threatening aquatic life, agricultural production, and its use for drinking (Ahmed et al., 2022). Continuous irrigation with wastewater containing heavy metals has resulted in bioaccumulation in various crops, raising food safety concerns, as shown in studies (Obaid et al., 2023). Furthermore, the pollution status of River Kabul is assessed which specifies elevated heavy metals concentration and geno-toxicological impacts on aquatic organisms (Rafiq Shah Ansari & Rawat, 2023). In addition, programs such as Ru-WatSP have also been implemented in their efforts to maintain better access for the rural populace to clean water, further evidence of strides taken toward improved water quality for the general public (Baidar et al., 2022). There is a dire need to address the water crisis in Afghanistan, otherwise, surface water will increasingly deteriorate in quality, which will affect the future of water resourcing. It needs to be a sustainable resource for generations to come, and proper management of water is crucial in that aspect (Irfan et al., 2023).

3.5 Land Degradation and Soil Pollution

In Afghanistan, inadequate sanitation infrastructure and poor waste disposal practices have resulted in soil contamination that poses health risks, heavy metals leaching into soil from waste accumulation and other solid organic waste, untreated sewage infiltration, and poor solid waste management (Obaid et al., 2023). In Kandahar and Kabul, this related to heavy metals including lead, exceed speculated levels in soil and crops with adverse effects on agricultural productivity and public health respectively (Nafees & Amin, 2023). Soil and water pollution issues have also been linked, with groundwater contamination in Kabul attributable to anthropogenic activities showing the presence of pathogens, such as E. coli (Mangal et al., 2023). This calls for robust waste management protocols, sustainable groundwater management policies, and better sanitation practices to protect soil fertility, agricultural productivity, and human health.

3.6 Depletion of Groundwater Resources

Aquifers are being depleted in the central and southern regions of Afghanistan due to a combination of low rainfall, poor water management, and surface water pollution (Sarwary et al., 2023). Poor surface water management overexploiting and poor groundwater recharge methods have worsened the situation leading to falling groundwater levels and poor-quality groundwater (Rahmani et al., 2022). These impacts include dried-up springs and flumes, failing water levels, and impaired water quality, with arsenic contamination, posing a serious health risk. Overall, the dependency on groundwater for domestic and agricultural use in the country drives an immediately apparent need for sufficient policies, legislation, and sustainable management to preserve and protect this resource for future generations.

3.7 Impacts on Biodiversity and Ecosystem Services

As demonstrated through some research studies, water resources and soil contamination in Afghanistan have indeed shown damaging effects on the ecosystems that have been built on these resources. According to these studies, continuous irrigation with wastewater has caused the accumulation of heavy metals in water, soil, and plants, endangering food safety and human health (Obaid et al., 2023). The implications of climate change such as glacial shrinkage and decreased snowfall can threaten the stability of the water supply, the affect both agriculture productivity and availability of water (J. Shokory et al., 2023). While over-exploitation of underground water is a factor, quality is also a major concern: groundwater gets contaminated

with heavy metals such as arsenic, aggravating the situation by polluting drinking water sources and risking human health (Sarwary et al., 2023). Inadequate watershed management, land degradation, and water pollution in the Kabul River Basin have caused soil erosion, the loss of aquatic biodiversity, and disruption of natural hydrological cycles, all having a bearing on ecological services vital for the livelihoods and well-being of local communities (Bazarov et al., 2023). As illustrated in Fig. 4, using the data provided by UNEP, and downloaded from the UN-Water SDG 6 data portal, the water ecosystem has shrunk significantly in the last decade (Nations, 2024a).

In Afghanistan, the poor sanitation and water situation has led to soil contamination, groundwater resource depletion, extensive water body pollution, and disruption of fragile ecosystems (Zahid et al., 2019). These environmental implications are crucial to tackling if sustainable development and the long-term sustainability of Afghanistan's natural resources, and the communities that rely on them, are to be maintained.

4. SOCIOECONOMIC IMPACTS

The dire state of water and sanitation in Afghanistan has adversely affected social sectors such as public health, education, gender parity, and economic productivity, among many other socioeconomic challenges.

4.1 Public Health and Disease Prevalence

Access to clean drinking water and sanitation remains limited in Afghanistan, leading to the high prevalence of waterborne diseases including cholera, typhoid, hepatitis, and diarrheal diseases, especially among children (Rafiq Shah Ansari & Rawat, 2023). In Kabul city, where 8 million people are dependent on contaminated groundwater, higher levels of E. coli and nitrate show signs of anthropogenic activities affecting water quality and linked to the spread of waterborne diseases (Baidar et al., 2022). According to the infectious disease surveillance report by the World Health Organization (WHO) in Afghanistan (WHO, 2024), surveillance shows that Acute Watery Diarrhea (AWD) has significantly increased in the current year as compared to previous years Fig. 5, this demonstrates the serious effect of poor quality of water and sanitation on the health of the people.

The suspension of healthcare funding to Afghanistan has led to reduced health service uptake and, this may lead to excess preventable morbidity and mortality, including maternal, neonatal, and child deaths (Safi et al., 2023). Overcoming these challenges necessitates urgent solutions focused on sustainable groundwater management policies, the expansion of water supply networks, and continued interventions to decrease waterborne diseases and ease pressure on the health system (Neyazi et al., 2023).

4.2 Disruption to Productivity and Learning Outcomes

Waterborne diseases are widespread in Afghanistan, especially in rural areas, and have a major detrimental impact on children's health and school attendance (Ntokou et al., 2023). The major source of drinking water in the country is groundwater, which is frequently contaminated by geogenic and anthropogenic factors that can pose several health problems (Hayat & Baba, 2017). Unfortunately, limited access to safe drinking water and adequate sanitation adds to this global health burden (Tarrass & Benjelloun, 2012). In water-scarce contexts, such as Afghanistan's rural areas, children face direct and indirect threats to their well-being, including water-related illnesses and the burden of water collection (Kamya et al., 2021). These challenges have far-reaching implications not just on children's education and future productivity but on the nation's productivity and economic progress.

The challenges to water and sanitation in developing countries weigh more heavily on women and girls (Larson, 2020). That is because their part in water-gathering work means they struggle to access education and other work (Larson, 2020). This burden is compounded by limited access to safe water and sanitation facilities, especially during menstruation and reproduction (Kayser et al., 2019). When using shared facilities, women and girls experience physical and sexual harassment and sexual assault (Kayser et al., 2019). Women have a large role to play in overcoming these issues because overwhelming evidence shows that they tend to use the benefits of water supply and management decisions to improve the situation of their households and communities (Bouman-Dentener, 2017).

4.3 The Financial Toll on Society

In addition to these public health implications, poor water supplies and sanitation carry

economic costs in Afghanistan, such as the costs of treating water-borne diseases, productivity loss from illness, and the disruption of economic activities (Alim, 2006). These outcomes are compounded by poverty, which permeates work, literacy, nutrition, and health (Hakim Haider et al., 2018). The damaged infrastructure and institutional failures that underpin the country's water scarcity issues only further deepen these challenges (Akhtar & Shah, 2020). Environmental issues like drought and over-extraction of water for agriculture exacerbate the situation (Habib, 2014). These factors alone place a huge burden on households, the healthcare system, and the country's economic development, exacerbating existing socioeconomic disparities.

In Afghanistan, inadequate water and sanitation conditions had a considerable adverse impact on gender equity, public health, education, and economic output. It is crucial to address some socioeconomic challenges as part of a sustainable future for Afghanistan and the well-being and development of the population.

5. EXISTING POLICIES AND INTERVENTIONS

Given the importance of enhancing access to clean water and sanitation facilities, Afghanistan has developed various policies, plans, and initiatives to tackle these challenges. Both promise major advances in the efficacy and implementation of these therapies, but their promises have been major obstacles.

5.1 Policies and Strategies

The Afghan government has introduced several critical policies and strategies concerning water and sanitation focusing on sustainable resource management, infrastructure development, and involvement of various stakeholders (WASH Implementation Policy, National Water Law, National Water Sector Strategy). These are firm re-affirms of national priorities for better development results, as included in the Afghanistan National Peace and Development Framework (ANPDF 1 & 2). However, challenges remain, including armed conflict and its exploitation of water resources and the need for public awareness and human resource development (Alim, 2006). Integrated Water Resources Management (IWRM) is encouraged, and stakeholder participation is promoted, all of which are in line with global best practices (Mahmoudzadeh Varzi & Wegerich, 2008).

5.2 Programs and Interventions

For this purpose, the Afghan Government has launched and implemented several programs, with assistance from development partners and foreign donor organizations. To meet this urgent need for safe water and adequate sanitation nationwide, each program has specific goals along with targeted areas and activities.

Fig. 4. Changes in the extent of water-related ecosystems in Afghanistan

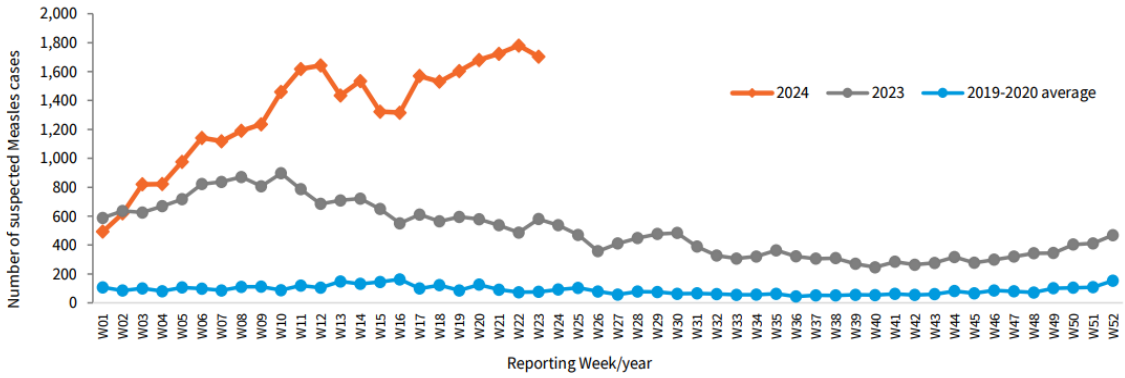

Fig. 5. AWD with dehydration cases in 2024 compared to 2023 and average of (2019 & 2020)

The Rural Water Supply & Sanitation Program (Ru-WatSP) has been administered by the Ministry of Rural Rehabilitation and Development (MRRD) since 2003 with an emphasis on the construction of water supply projects, water wells, and latrines and with the aid of hygiene education to promote overall health in the community (MRRD, 2023).

The other significant initiative is the Community Led Total Sanitation (CLTS) program which is a joint program of MRRD, USAID UNICEF, and some other NGOs. This program started in 2008, promotes the establishment of open defecation-free (ODF) communities, which mandates citizens to improve their sanitation practices and establish nationally aligned benchmarks for ending open defecation by 2025 ((IDS), 2016).

UNICEF's continuing WASH Program focuses on the installation of solar-powered and gravity-fed piped schemes with community participation in rural areas and, the provision of WASH in schools and health centers. It is also responding to menstrual hygiene informational needs, moving to improve water access and safety for girls (UNICEF, 2023).

The Afghanistan Urban Water Supply and Sewage Corporation (AUWSSC), established in 2009, is responsible for the supply of water in urban areas including Kabul, and leading pipeline projects to improve service levels as well as future water transfer plans ((AUWSSC), 2022).

USAID and UNICEF also launched the Rural Water, Sanitation, and Hygiene initiative in 2016, targeting 16 rural provinces, enabling access to water and hygiene programs in health centers and schools for people there ((USAID), 2020b).

USAID and Tetra Tech ARD carried out the Afghan SWSS program focusing on water supply and hygiene promotion, increasing thousands of wells and latrines and creating numerous ODF communities ((USAID), 2020a).

Implemented for years in Afghanistan, these programs have improved access to water and sanitation, addressing crucial health and hygiene challenges. Table 1 presents more detailed information about these programs and initiatives that each are designed to reduce morbidity and mortality, enable communities, and implement sustainable behaviors for better health and well-being.

6. CHALLENGES AND GAPS

Despite these works, the proper implementation and effectiveness of water and sanitation activities in Afghanistan have encountered several challenges including:

- ✓ Insecurity and political instability: The continuing violence and instability in the country have impeded the implementation of the programs, destroyed infrastructure, and limited access to some areas for both government and development partners (Groninger et al., 2015).
- ✓ Weak institutional and technical capacity: Especially at the local level, the incapacity of Government organizations to design, implement, and maintain water and sanitation projects (Thomas et al., 2011).
- ✓ Insufficient funding and resource allocation: The water supply and sanitation sub-sector associated with the creation of Infrastructure, provision of services, Operation, and Maintenance have received insufficient funding (Hogg et al., 2013).
- ✓ Absence of coordination and integrated approach: The settlement of a well-integrated strategy for water and sanitation

settlement has also not been very effective and not achieved primarily due to displacement and absence of coordination between the various federal ministries and government agencies and with the development partners (Groninger et al., 2015).

- ✓ Sustainability and Community Engagement: Aspects of community participation and ownership have always been challenging to ensure when formulating water and sanitation programs for use to provide services (Ngilambi & McCubbin, 2017).
- ✓ Policy restrictions on women: Ban on women's employment with NGOs prohibits their involvement in water and sanitation programs, and the ban on their education has been crippling and undermined attempts at inclusive and effective programming.
- ✓ Interference by the de facto government: the Taliban policies and governance interrupted the continuity and effectiveness of some programs, bringing uncertainty and wavering among international partners in terms of committing resources and support.

Table 1. Programs for enhancing water, sanitation, and hygiene in Afghanistan

Program Name	Implementing Organization	Year(s) Implemented	Target Area	Key Activities	Outcome/Impact
Rural Water Supply & Sanitation Program (Ru-WatSP)	Ministry of Rural Rehabilitation and Development (MRRD)	2003-Ongoing	Nationwide	Water supply, sanitation, hygiene education	Water wells and latrines construction; water supply projects, hygiene training
Community Led Total Sanitation (CLTS)	Ministry of Rural Rehabilitation and Development (MRRD), USAID, UNICEF	2008 – Ongoing	Nationwide	Promote ODF communities, improve traditional latrines, hygiene promotion through Family Health Action Groups	Communities declared ODF; national plan to end open defecation by 2025
WASH Program	UNICEF	Ongoing	Rural Afghanistan	Solar water pumps, community engagement, menstrual hygiene support	Improved water access, empowered communities, enhanced safety for girls
Afghanistan Urban Water Supply and Sewage Corporation (AUWSSC)	AUWSSC	2009-Current	Urban areas of Afghanistan, especially Kabul	Water supply management, pipeline project	Reduced service levels; future water transfer plans
Rural Water, Sanitation, and Hygiene	USAID, UNICEF	2016-2020	16 rural provinces in Afghanistan	Improve water access, hygiene education, health center support	525,000 people with improved water; hygiene programs in 50 health centers; water access in 200 schools
Afghan SWSS	USAID, Tetra Tech ARD	2009-2012	Rural Afghanistan	Water supply, hygiene promotion	3,011 wells, 42,129 latrines, 611 ODF communities

Some strategic priorities include strengthening the institutional capacity, enhancing the community engagement system for better delivery of essential WASH services, strengthening the inter-sector coordination to provide integrated services, and ensuring the financing of the sector. Addressing more general political and security challenges facing the country will be vital to creating an enabling environment for sustainable progress in the water and sanitation sector.

7. CASE STUDIES FROM SIMILAR REGIONS

When reviewing the water and sanitation interventions it is useful to consider successful case studies from countries with a similar context to inform recommendations. Studying such best practices from these nations will help enhance of water and sanitation sector in Afghanistan.

Many community-based water projects also have been implemented in Bangladesh, including rainwater harvesting which has made a significant change in access to safe drinking water, particularly in rural areas (Karim, 2010). This approach helps build structures for sustainable local water resource management, concerning human requirements. A public-private partnership, where the government provides funds while private organizations come in with their funds, has been used in Asia and the Pacific to finance water and sanitation projects (Sulakadze, 2022). Nepal has invested a great amount of money in awareness-raising campaigns and strengthening local capacities, including commitments of government officials and community members' responsibilities in managing WASH systems (Adhikari et al., 2018). In Uzbekistan, the interdisciplinary approach of the collaboration of the stakeholders as well as the implementation of data-sharing practices has enhanced greatly the decision-making regarding water management (Ul Hassan & Hornidge, 2010). More importantly, gender-inclusive policies have been emphasized in these efforts to ensure that women are given an insight into decision-making processes (Scherer et al., 2021). Not only does it improve the success rate of water management but it also fosters gender equality and empowering of women in these communities (Naiga et al., 2024). Hearing such voices makes interventions fairer and more capable of catering to the needs of the population in focus (Assefa et al., 2021).

The experiences learned from Bangladesh, Nepal, Uzbekistan, Asia, and Pacific regions offer valuable lessons to be drawn by Afghanistan in the context of the water and sanitation sector. Afghanistan can greatly enhance the delivery of sustainable, safe, and equitable WASH interventions when the country embraces emerging technologies, researches new financing models, invests in staff development, and engages stakeholders in collective commitment to change. Since integrating gender-sensitive policies forms a major part of this transformative shift for achieving more sustainable WASH services, Afghanistan stands to gain so much for the entire populace, in terms of social justice as well as economic development. For Afghanistan to develop more appropriate and fair solutions to the problems it faces in the sectors of water and sanitation, the country has to involve women in these processes actively.

8. WATER & SANITATION SECTOR OPPORTUNITIES AND RECOMMENDATIONS FOR AFGHANISTAN

Despite the numerous challenges facing Afghanistan's water and sanitation sector, there are a range of opportunities and recommendations that ought to be pursued to fill existing gaps and extend access to these essential services.

8.1 Opportunities

8.1.1 Emerging technologies and management practices

Afghanistan's severe water and sanitation challenges require a multi-faceted approach (Opryszko et al., 2010). Decentralized small-scale solutions, including rainwater harvesting systems solar-powered water pumping systems, and composting toilets, can be effectively implemented in disadvantaged communities (Tahera et al., 2020). Localization is a promising way to allow people to genuinely feel ownership, cope with sustainable services, and have access to community-based services (Ferati et al., 2023).

Reduction of electricity costs, as well as the application of intelligent water management systems that increase productivity and quality of the service. Using automated controls, leak detection, and sensor-based monitoring, these

systems optimize water use, minimize wastage, and help reduce water costs (P N et al., 2023). By adopting emerging technologies, Afghanistan can unlock the opportunity for more reliable and resilient water and sanitation infrastructure.

In addition to those technology solutions, there should be robust support for the expansion of market-based, neighborhood-based companies in the water and sanitation sector. Also, by utilizing these local service providers, they can provide longer-term delivery and intervention for the initiatives and create a better sense of local ownership to ensure the sustainability of the interventions. By integrating decentralized solutions, smart technology, and community-driven initiatives, it is possible to have a holistic strategy that will provide all Afghans, no matter where they live and what their socioeconomic background is, with equitable and resistant access to water and sanitation services.

8.1.2 Mechanisms for sustainable financing and mobilization of resources

Finding sufficient funding is critical to addressing Afghanistan's water and sanitation challenges. To do so, it is important to develop creative finance methods. Water and sanitation infrastructure and service provision can be funded through blended financing arrangements that mix public and private sector donations (Seema & Kibuuka, 2017).

Exploring the use of performance-based contracts and results-based financing may serve to incentivize and hold service providers accountable for revenues, increasing service delivery (Eldridge & TeKolste, 2016). By aligning financial incentives to the desired outcomes, these approaches could lead to more efficient and successful water and sanitation solutions.

Equally, it is necessary to support the capacity of local governments and communities to secure and manage funds from a range of sources, including international donor organizations and national budgets. Providing these stakeholders, with the information needed to access and utilize available funding may enhance the sustainability and scalability of water and sanitation projects.

By leveraging a diverse set of innovative financing mechanisms, Afghanistan can access the resources needed to establish a robust water and sanitation infrastructure, ensure uninterrupted service delivery, and achieve sustainable outcomes in this critical sector. Through this multidisciplinary approach, all Afghans can achieve resilient and equitable access to water and sanitation facilities.

8.1.3 Capacity building and community-based initiatives

To accomplish this, collaborative efforts will be required to enhance the capacity of local actors, including government representatives, service providers, and community-based organizations, to respond to Afghanistan's challenges related to water and sanitation (Groninger et al., 2015). These players must, therefore, invest in training and developing technical and management skills to ensure they can plan, build, and manage water and sanitation systems.

Equally important is supporting and encouraging community-based organizations, particularly those led by women who actively manage and monitor local water and sanitation services (Allen et al., 2018). Decentralizing the water and sanitation task to local entities may help in ensuring long-term sustainability.

Incorporating WASH education programs into the formal education system has a transformative effect (McMichael, 2019). By raising awareness and facilitating behavioral changes from an early age, these efforts can contribute to a more informed and active citizenry better equipped to engage in the management and guardianship of water and sanitation resources.

Afghanistan can also give local actors the power to create, implement, and manage sustainable water and sanitation systems for more stable and equitable access to these crucial services. This will be made possible by investing in capacity building, community engagement, and WASH education.

8.1.4 Coordination and collaboration among stakeholders

Addressing Afghanistan's water and sanitation challenges requires a coordinated engagement of all relevant stakeholders, including the corporate sector, civil society organizations, development partners, and government entities. Strengthening coordination and cooperation among these varying players is crucial to providing a coherent and aligned strategy for the management of water and sanitation (Koncagül & Connor, 2023).

The establishment of robust routines for collecting, sharing, and coordinating the delivery of interventions may substantially improve the quality of the evidence and the processes used to guide decision-making (Hepworth et al., 2022). It will lead to more sustainable and effective solutions because stakeholders will leverage their resources and expertise by providing a collaborative environment.

It is not only vital to facilitate the participation of diverse stakeholders in the oversight, planning, and implementation of water and sanitation projects but also that these stakeholders include women and marginalized groups. Inclusive governance leads to more equitable and responsive delivery of services by ensuring that the needs and perspectives of all members of the community are considered (Bayu et al., 2020).

Quality leans on stakeholder cooperation and participatory decision-making, giving Afghanistan the synergies, it so needs to manage, these complex water and sanitation concerns. A diversified approach can help ensure that water and sanitation services are available, reliable, and responsive to the diverse needs of the Afghan population.

8.2 Recommendations

8.2.1 Policymakers

To formulate a unified and coherent approach to water and sanitation governance, there needs to be more coordination and collaboration between corporations, civil society actors, development partners, and government agencies (Hardoy et al., 2005). Efficiency in information sharing, collection of data, and plans will not be possible without creating systems. The use of such technologies will not only improve the quality of evidence but massively facilitate the decision-making process (Hepworth et al., 2022). By minimizing duplication and ensuring that resources are effectively utilized, enhanced coordination facilitates a more sustainable and efficient response to water and sanitation challenges.

Projects related to water and sanitation must include various stakeholders, especially women and marginalized communities, in the planning, implementation, and monitoring stages (Water). This can lead to the consideration of a wider range of perspectives and needs, resulting in solutions that are more inclusive and functional. The impact of these programs is greatly based on the unique insights and backgrounds of women and underrepresented groups often possess. Because their involvement can produce a more equitable delivery of services and a stronger sense of ownership of the community, both of which are critical to the sustainability of water and sanitation initiatives.

By facilitating vertical and horizontal coordination across sectors and engaging diverse stakeholders, water and sanitation management can be significantly improved and attain better performance, in terms of being efficient, equitable, and sustainable.

8.2.2 Development agencies and international partners

Water and sanitation initiatives must prioritize community ownership and local capacity building, therefore requiring sustained, long-term support (Ngai et al., 2013). Sustainable development in this sector is also about empowering local communities to manage and sustain their water and sanitation infrastructure and services in contextually appropriate ways (Dery et al., 2020). Adopting what worked, best practices and innovative solutions from other countries and contexts will contribute to designing effective interventions in Afghanistan. Learning from the broad spectrum of experience can offer powerful insights and approaches that are tailored to the specific needs and challenges faced by Afghan communities.

Support considerations should be aligned with national goals and plans, even as they are appropriate to coordinate and invoice a credible response to the various development operations being funded in the water and sanitation sectors. This ensures initiatives do not get lost or diverted and that they contribute to the broader objectives set by national policy. The coordination of government agencies, development partners, and local communities is important to avoid duplication of efforts and create synergies.

Engaging with local stakeholders in project planning, execution, and monitoring ensures that their needs and perspectives are adequately represented (Tsekleves et al., 2022). Such engagement is extremely crucial for ensuring country ownership, accountability, and sustainability of the projects. By continuing to

emphasize the importance of information sharing, building national capacity, and aligning with national policies, it may be possible to realize more efficient and long-lasting water and sanitation solutions in Afghanistan.

8.2.3 Civil society organizations and community-based groups

Advocacy and awareness-raising campaigns on the importance of gender-responsive, inclusive, and sustainable interventions should be developed (Macura et al., 2023). By emphasizing the critical importance of such services, the efforts hope to boost public and political will for the needed funding. Engagement in the design, execution, and monitoring of water and sanitation programs ensures that the needs and views of local populations, particularly those of women and marginalized groups, are properly incorporated (Water). Solutions are designed with the input of the community; therefore, they are inherently equitable and tailored to the individual needs of all members of the community.

Sustainability and community ownership of water and sanitation services are also reinforced through coordination with development partners and government entities (Hardoy et al., 2005). By coordinating efforts, such organizations may scale their total impact through the avoidance of overlap, sharing of knowledge, and pooling of resources. Teamwork is necessary to create solutions that last and that communities will eventually be able to sustain and manage themselves.

Taking these opportunities and implementing the suggested actions will greatly extend sustainable and safe water and sanitation services to the people of Afghanistan. Ultimately, these innovations will promote social justice, enhance public health, and drive economic growth. Using advocacy, inclusive participation, and strategic partnership, Afghanistan can make substantial progress in improving water and sanitation outcomes for the entire population.

9. RESULTS AND DISCUSSION

The results of water and sanitation analysis in Afghanistan identified that for safe drinking water, the general population percentile is at only 30% to 33% and showers a great disparity as many rural citizens have restricted access to clean drinking water. Access to sanitation facilities paints a similar picture and the use of improved (not safely managed) facilities was estimated to range 68%. This means lack of proper sanitation facilities is a major cause of waterborne diseases among the most vulnerable groups of people. To this end addressing these disparities is crucial to enhancing the health of the citizens in the country.

In this study; the involvement of the community in water and sanitation projects was also emphasized. Those areas that engaged the local people in decision-making and implementation processes noted a strong sense of ownership and high user satisfaction. This implies that participatory processes not only create a sustainable environment for the implementation of solutions but also make those solutions more relevant to the target population.

The results reflect the pressing need for specific interventions about water and sanitation, and more attention should be paid to a range of efforts in rural areas where access is still worse than in urban areas.

One of the most important considerations in these interventions is gender mainstreaming. The negative impact of the lack of proper water and sanitation infrastructure is inversely borne by women and girls, who spend a lot of their time collecting water and they also suffer the effects of poor sanitation. It simply means if a gender inclusion strategy is integrated into water and sanitation activities, projects achieve their goals, resulting in increased overall health for families and, more broadly, communities.

Enhancements in the availability of water and sanitation have a great positive impact on the health status of people, improved access to these resources has the potential to reduce incidences of waterborne diseases. The enhancement of access to water and sanitation can also improve overall productivity and stability of the economy, especially at the local level.

Key interventions identified for the enhancement of water and sanitation in rural communities are listed in Table 2 with their proposed target area and expected outcomes.

Table 2. Overview of key strategic approaches to improve water and sanitation

Intervention	Target Area	Description	Expected outcome
Rainwater Harvesting Systems	Water scarce regions	Collect and store rainwater for domestic use or groundwater recharge	Increased water availability particularly in dry seasons
Awareness Raising Programs	Community leaders and women	Training sessions on better water and sanitation management and hygiene practice	Improved resource management capacity and better hygienic behavior
Blended Financing Models	Rural and urban areas	Combining public and private investment in providing services	Reduce dependency on a single funding stream
Sanitation and Hygiene Promotion Campaign	Communities and schools	Awareness-raising and educational programs on sanitation and hygiene	Reduced waterborne disease and improved hygiene practice
Gender Inclusion Initiatives	Women and Girls	Including women's perspective in the decision-making process of WASH interventions	More effective and sustainable solutions and women's empowerment

10. CONCLUSION

Analyzing Afghanistan's current water and sanitation policies, plans and programs highlights the progress that has been made in this critical area but also identifies some of the existing challenges which must be addressed. While the Afghan government and its development partners have made strides towards expanding access to water and sanitation services, there is a litany of problems which include insecurity, weak institutional capacity, financing challenges, and poor coordination of interventions, that have prevented successful implementation and effectiveness of these interventions.

In Afghanistan, insufficient access to safe water and sanitation affects the environment and the economy. Inadequate access to clean drinking water and sanitation facilities has been linked to poor health and the prevalence of waterborne diseases, particularly among vulnerable populations, including women and children. Improper waste management and a widespread absence of a steady supply of water are all jeopardizing the nation's fragile ecosystems, exploratory growth, and agricultural production.

The problems of water and sanitation in Afghanistan are both environmental and human health sustainability problems but are also critical issues for the growth and prosperity of the country. While this might not seem obvious at the outset, this increased access to water and sanitation provision can have a massive impact, creating improved standards of living, better opportunities for employment and education, and strengthening communities.

These problems must be tackled without delay. Water and sanitation sector investments could be a building block of sustainable development for better social development, environmental conservation, and economic development of the country at this time when Afghanistan is grappling with political, security, and economic crises. This can happen only through collaborations between governments, development agencies, and other stakeholders, therefore, the potential of innovative technologies, sustainable funding strategies, community-based development, and enhanced coordination can be fully exploited.

By prioritizing water and sanitation as a key development area and implementing a comprehensive, multisectoral plan, Afghanistan can have an enormous impact on the lives of its people and build a more sustainable and prosperous future for the country. The long-term social, economic, and environmental impacts of inaction will exacerbate the challenges facing the Afghan people, so the time to act is now.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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