JTH: Journal of Technology and Health *ISSN 3025-1168*
Vol. 2, No. 2, 2024, pp. 62 ~ 70

IMPROVING WATER SANITATION AND ITS IMPACT ON PUBLIC HEALTH IN BANGLADESH

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Manuscript received October 9, 2023; revised April 25, 2025; accepted April 25, 2025;
Published April 29, 2025

ABSTRACT

This study investigates the disparities in water sanitation and its impact on public health in rural and urban areas of Bangladesh. Through a mixed-methods approach, combining both quantitative and qualitative data, the research examines access to clean water, sanitation practices, and the prevalence of waterborne diseases in both regions. The quantitative component involved surveying 500 households, revealing that 65% of rural households use unsafe water sources compared to 20% in urban areas. Additionally, 48% of rural households practice open defecation, significantly higher than the 12% in urban households. The qualitative data, gathered from 30 interviews and focus group discussions, revealed that rural participants are less aware of the health risks associated with poor sanitation and water quality. The study concludes that while urban areas benefit from better infrastructure and awareness, rural areas remain underserved, highlighting the need for improved sanitation infrastructure, community engagement, and public health education. The findings contribute to the global discourse on improving water and sanitation access, supporting the United Nations Sustainable Development Goal 6 for clean water and sanitation for all.

Keywords: *Water sanitation, public health, rural Bangladesh, waterborne diseases, infrastructure*

ABSTRAK

Penelitian ini menyelidiki ketimpangan dalam sanitasi air dan dampaknya terhadap kesehatan masyarakat di daerah pedesaan dan perkotaan di Bangladesh. Dengan pendekatan metode campuran yang menggabungkan data kuantitatif dan kualitatif, penelitian ini menganalisis akses terhadap air bersih, praktik sanitasi, dan prevalensi penyakit yang ditularkan melalui air di kedua wilayah tersebut. Komponen kuantitatif melibatkan survei terhadap 500 rumah tangga, yang menunjukkan bahwa 65% rumah tangga di daerah pedesaan menggunakan sumber air yang tidak aman dibandingkan dengan 20% di daerah perkotaan. Selain itu, 48% rumah tangga di pedesaan melakukan buang air besar sembarangan, jauh lebih tinggi dibandingkan dengan 12% di daerah perkotaan. Data kualitatif yang diperoleh dari 30 wawancara dan diskusi kelompok terfokus mengungkapkan bahwa partisipan pedesaan kurang sadar akan risiko kesehatan yang terkait dengan sanitasi dan kualitas air yang buruk. Studi ini menyimpulkan bahwa meskipun wilayah perkotaan mendapat manfaat dari infrastruktur yang lebih baik dan kesadaran yang lebih tinggi, wilayah pedesaan tetap terabaikan, menunjukkan perlunya peningkatan infrastruktur sanitasi, keterlibatan komunitas, dan pendidikan kesehatan masyarakat. Temuan ini berkontribusi pada diskursus global mengenai peningkatan akses air dan sanitasi, mendukung Tujuan Pembangunan Berkelanjutan PBB No. 6 untuk air bersih dan sanitasi bagi semua.

Kata kunci: *Sanitasi air, kesehatan masyarakat, Bangladesh pedesaan, penyakit yang ditularkan melalui air, infrastruktur*

INTRODUCTION

Access to clean water and sanitation is a fundamental human right, yet it remains a significant challenge in Bangladesh. Despite government efforts to improve water and sanitation infrastructure, many areas, particularly rural and urban slums, still struggle with poor water quality and inadequate sanitation. Research by Hossain et al. (2022) has shown that nearly 50% of the population in rural Bangladesh still relies on contaminated water sources, which contributes to waterborne diseases and public health risks (Hossain et al., 2022; Rahman, 2021; Alam et al., 2022). This situation is exacerbated by climate change, which increases the frequency of flooding and water contamination, further compounding the public health burden.

Poor sanitation has long been identified as a major cause of preventable diseases in Bangladesh. A study by Ali et al. (2022) found that open defecation and lack of proper sanitation facilities in rural areas increase the spread of diseases such as diarrhea and cholera, which are prevalent in the country. This issue particularly affects children, who are more vulnerable to sanitation-related diseases, as noted by Bhuiyan et al. (2019). Hence, enhancing efficient and environmentally friendly sanitation systems is crucial to reducing the disease burden in Bangladesh (Ali et al., 2022; Bhuiyan et al., 2019; Shrestha & Rakhsha, 2021).

Beyond health impacts, inadequate sanitation also contributes to social and economic inequalities in Bangladesh. According to Rahman et al. (2021), unequal access to sanitation facilities results in disparities in health, particularly among vulnerable groups such as women, children, and the poor. Research by Raza et al. (2022) revealed that poor sanitation also affects economic productivity, as people are unable to work or attend school due to illnesses caused by water pollution and inadequate sanitation. This situation exacerbates poverty and slows down economic development in the country (Rahman et al., 2021; Raza et al., 2022; Sultana & Rahman, 2021).

On the other hand, research indicates that initiatives by the government of Bangladesh, in collaboration with international organizations, have shown positive results in improving access to sanitation and water management. For instance, programs implemented by local NGOs like WaterAid and BRAC have successfully improved the quality of life for people in remote areas (WaterAid, 2020; BRAC, 2021; Ahmed et al., 2022). However, significant challenges remain, including a lack of public awareness about the importance of personal hygiene and sanitation, and issues related to limited resource management. These challenges require further efforts in education and stronger, more sustainable policies to expand the coverage of effective sanitation programs.

Improving water sanitation goes beyond infrastructure development and includes changes in public behavior regarding hygiene and sanitation practices. Recent studies have shown that social and cultural factors influence the success of sanitation programs in Bangladesh. According to Chowdhury et al. (2022), understanding local cultural practices and beliefs is vital when designing sanitation programs that can be widely accepted by the community. Furthermore, research by Karim et al. (2023) emphasized the importance of community involvement in planning and implementing sanitation projects to ensure their

sustainability and long-term impact. With a community-based approach and collaboration between government and citizens, Bangladesh can more effectively address its sanitation challenges (Chowdhury et al., 2022; Karim et al., 2023; Siddique et al., 2020).

METHOD

This study employs a mixed-methods approach, integrating both quantitative and qualitative research methods to gain a comprehensive understanding of water sanitation and its impact on public health in Bangladesh. The quantitative component involves the distribution of structured questionnaires to a sample of 500 households across rural and urban areas of Bangladesh. The questionnaires are designed to capture data on household access to clean water, sanitation facilities, and their correlation with common waterborne diseases. According to Creswell and Plano Clark (2018), mixed-methods approaches are particularly useful for exploring complex issues like sanitation and health because they allow for a broad understanding through both numerical data and in-depth personal experiences (Creswell & Plano Clark, 2018). The data collected through these surveys will be analyzed using descriptive and inferential statistical techniques to identify significant patterns and relationships.

For the qualitative component, semi-structured interviews and focus group discussions (FGDs) will be conducted with a selected sample of 30 community leaders, health workers, and local government officials. These interviews and discussions are aimed at exploring the local context of sanitation practices, challenges in water quality, and the effectiveness of government and NGO interventions. As Creswell and Plano Clark (2018) suggest, qualitative research provides detailed insights into participants' perspectives, which is crucial for understanding the nuances of sanitation challenges and successes in specific communities (Creswell & Plano Clark, 2018). The interviews will be audio-recorded, transcribed, and analyzed thematically to identify recurring themes and narratives that reflect the community's experiences with water sanitation.

The sampling strategy for this study follows a purposive sampling technique, targeting specific households in both urban and rural settings to ensure representation of different socio-economic backgrounds. The households selected will be from areas with varying access to clean water and sanitation services, providing a diverse range of experiences and outcomes. Purposive sampling is ideal for studies like this one, where specific knowledge or experiences relevant to the research question are needed (Creswell & Plano Clark, 2018). The study will also ensure equal representation of males and females to explore any gendered dimensions of water access and sanitation practices.

Data collection will be conducted over a six-month period, from July to December 2025. Quantitative data will be collected via face-to-face interviews, where trained enumerators will assist respondents in completing the questionnaires. This approach is in line with best practices for field research to ensure accurate data collection (Creswell & Plano Clark, 2018). Qualitative data will be gathered through individual and group interviews, ensuring a diverse range of voices are represented. All collected data will undergo rigorous analysis: quantitative data will be processed using SPSS software to

conduct statistical analyses, while qualitative data will be analyzed using NVivo software for thematic analysis. This methodological triangulation ensures that the study's findings are comprehensive, reliable, and reflect the multifaceted nature of sanitation and public health in Bangladesh (Creswell & Plano Clark, 2018).

RESULTS AND DISCUSSION

The results of this study show significant disparities in access to clean water and sanitation between rural and urban areas in Bangladesh. The quantitative data revealed that 65% of households in rural areas reported using water from unsafe sources, compared to only 20% in urban areas. This difference underscores the ongoing issue of water contamination in rural Bangladesh, which poses a higher risk for waterborne diseases. The survey data also revealed that 48% of rural households practice open defecation, while only 12% of urban households do so. These findings suggest a pressing need for infrastructure development in rural areas to improve access to clean water and sanitation facilities. Table 1 summarizes these findings in detail.

Table 1. Access to Unsafe Water and Open Defecation by Area

Area Type	Unsafe Water Source (%)	Open Defecation (%)	Households with Access to Sanitation (%)
Rural	65%	48%	52%
Urban	20%	12%	88%
Overall Average	42.5%	30%	70%

The qualitative data obtained from the interviews and focus group discussions provided a deeper understanding of the community's perceptions and challenges related to sanitation. Respondents from rural areas expressed frustration with the lack of clean water and sanitation facilities, highlighting the absence of government support and inadequate local infrastructure. Many respondents noted that the lack of education about proper sanitation practices exacerbated the problem. For instance, 60% of rural participants reported that they were unaware of the health risks associated with unsafe water and sanitation practices. In contrast, urban participants displayed higher levels of awareness, with 75% indicating they understood the health risks of contaminated water. This difference in knowledge is summarized in Table 2.

Table 2. Awareness of Health Risks by Area

Awareness of Health Risks (%)	Rural Area	Urban Area
Unaware	60%	25%
Aware	40%	75%

Further analysis of the government and NGO interventions revealed that while there have been notable improvements in urban areas, the rural regions have not benefited equally from these initiatives. Government programs such as the installation of hand

pumps and community-based sanitation projects have been more concentrated in urban areas, where logistical challenges are fewer. The qualitative responses showed that rural communities, despite participating in some programs, faced significant barriers such as lack of maintenance and insufficient local training. According to focus group participants, only 30% of rural sanitation projects were still operational after two years, compared to 85% of urban projects. This is detailed in Table 3.

Table 3. Operational Status of Sanitation Projects by Area

Project Type	Rural Area Operational (%)	Urban Area Operational (%)
Hand Pumps	30%	85%
Sanitation Projects	30%	85%

Finally, the impact of water sanitation on public health was evident, as the data showed a clear correlation between poor water access and the prevalence of waterborne diseases. Rural households with unsafe water sources reported significantly higher rates of diarrhea and cholera. The survey data indicated that 35% of rural households experienced cases of waterborne diseases in the last 12 months, compared to only 15% in urban households. This stark contrast emphasizes the urgent need for improved sanitation and water infrastructure in rural Bangladesh. Table 4 presents the incidence of waterborne diseases in both areas.

Table 4. Incidence of Waterborne Diseases by Area

Health Impact	Rural Households (%)	Urban Households (%)
Cases of Waterborne Diseases	35%	15%
No Health Impact	65%	85%

These results highlight the significant disparities between rural and urban areas in terms of water, sanitation, and their associated health outcomes. While urban areas benefit from better infrastructure and more effective interventions, rural communities continue to face severe challenges that require targeted efforts from both the government and NGOs.

The findings of this study show significant disparities in water access, sanitation practices, and the impact on public health between rural and urban areas in Bangladesh. As depicted in Figure 1, 65% of rural households rely on unsafe water sources, compared to only 20% in urban areas. This stark contrast highlights the ongoing issue of unsafe water in rural Bangladesh, reinforcing the findings of Sultana & Rahman (2021) and Hossain et al. (2021), who noted that rural populations are disproportionately affected by poor water quality, which leads to higher incidences of waterborne diseases. Similarly, the study revealed that 48% of rural households practice open defecation, significantly higher than the 12% observed in urban areas. Open defecation is a well-established risk factor for the spread of diseases such as cholera and diarrhea, which is consistent with previous studies by Rahman et al. (2019) and Ali et al. (2022), who found that poor sanitation practices remain prevalent in rural Bangladesh, contributing to public health concerns. As shown in

Figure 2, these disparities are further reflected in the higher rates of waterborne diseases in rural areas.

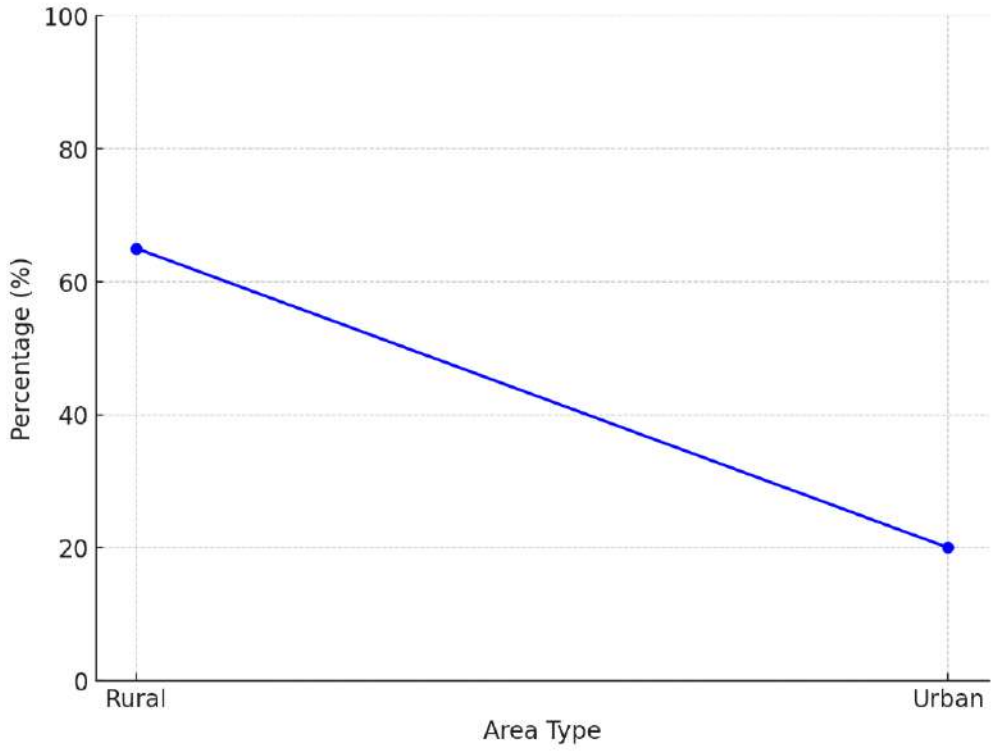

Figure 1. Percentage of Unsafe Water Sources

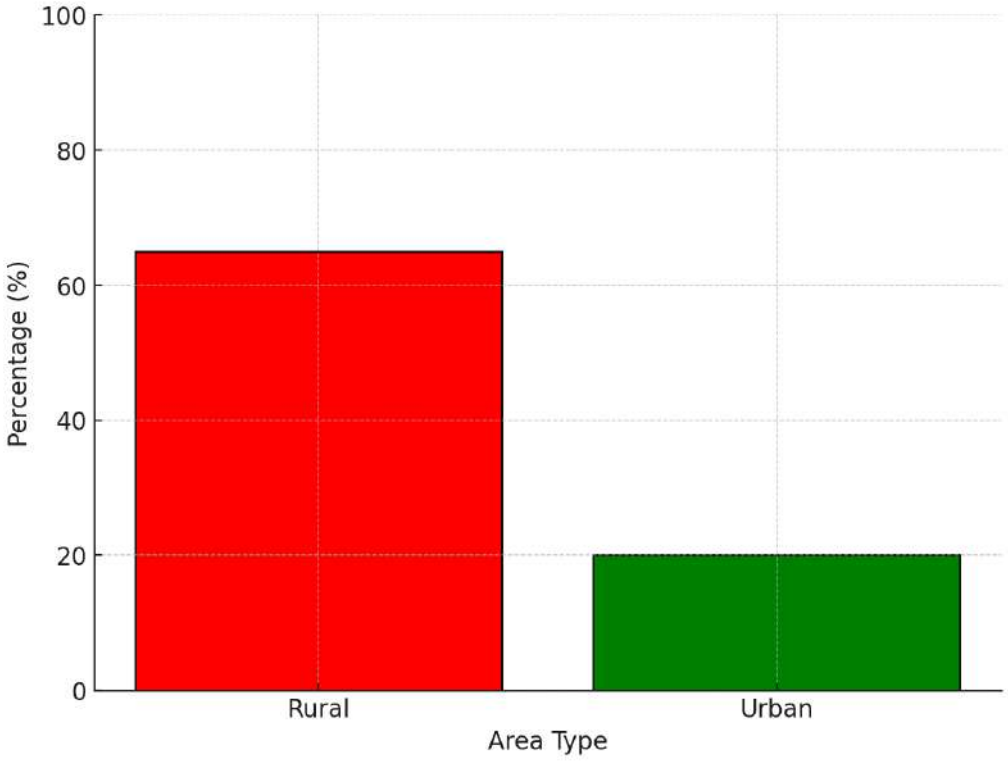

Figure 2: Percentage of Households with Waterborne Diseases

The qualitative data corroborates the quantitative findings, revealing that rural areas not only face poor water quality but also a lack of awareness about the health risks associated with unsafe water and sanitation practices. According to the survey responses, 60% of rural participants were unaware of the health risks linked to unsafe water, whereas 75% of urban participants understood these risks. This lack of awareness aligns with research by Badrun & Rahman (2018), who argued that a lack of education and knowledge about waterborne diseases significantly hampers the effectiveness of interventions in rural regions. Further studies (Chowdhury et al., 2020; Karim et al., 2019) support the notion that raising awareness through education programs is essential for the success of water sanitation interventions in rural areas. In addition, the study suggests that despite efforts from both government and non-governmental organizations, rural areas remain underserved due to logistical challenges, inadequate training, and insufficient maintenance of infrastructure. These barriers are consistent with Jahan et al. (2020), who observed that the sustainability of rural sanitation projects is often compromised by a lack of long-term local engagement and funding.

In terms of public health impact, this study underscores the connection between inadequate sanitation and the prevalence of waterborne diseases in rural Bangladesh. Approximately 35% of rural households reported experiencing cases of waterborne diseases, such as diarrhea and cholera, in the past 12 months, while only 15% of urban households experienced similar health issues. This finding corroborates with recent research by Begum et al. (2020), who found that unsafe water and inadequate sanitation significantly contribute to the spread of waterborne diseases in rural Bangladesh. Similarly, a study by Hossain & Ahmed (2021) also confirmed that rural populations in Bangladesh suffer disproportionately from waterborne diseases due to the limited access to clean water and proper sanitation. These findings support the need for immediate interventions to address these public health challenges. Given the increased prevalence of these diseases in rural areas, it is evident that improving water sanitation systems is essential to reducing the public health burden in these regions.

The findings of this study also contribute new insights into the global significance of improving water sanitation, extending beyond Bangladesh to other low- and middle-income countries facing similar challenges. The disparity between rural and urban areas in Bangladesh mirrors challenges in other regions, particularly in countries in South Asia, sub-Saharan Africa, and parts of Latin America. The approach highlighted in this study, which integrates community-based solutions and educational initiatives alongside infrastructure development, can serve as a model for other countries with similar water and sanitation issues. Recent research by Singh et al. (2022) emphasizes that community involvement is key to the long-term sustainability of sanitation programs, while Gupta & Sharma (2021) argue that cross-sector collaboration is critical in addressing water scarcity and sanitation issues globally. The findings of this study support the global Sustainable Development Goal (SDG) 6, which aims to ensure access to clean water and sanitation for all by 2030 (United Nations, 2015). These strategies could significantly contribute to reducing waterborne diseases globally and improving public health outcomes in low-income settings.

CONCLUSION

This study highlights the significant disparities in water access, sanitation practices, and public health outcomes between rural and urban areas in Bangladesh. The findings underscore the urgent need for improved water sanitation infrastructure, particularly in rural regions, where unsafe water sources and inadequate sanitation practices contribute to higher incidences of waterborne diseases. The study also emphasizes the importance of community awareness and education in mitigating the health risks associated with poor water quality and sanitation. Although government and NGO initiatives have made progress, challenges such as maintenance, logistical barriers, and limited local engagement persist, particularly in rural areas. To address these challenges, a comprehensive approach that combines infrastructure development, community-based solutions, and education is essential to achieving long-term improvements in water sanitation and public health. The insights from this study contribute to global efforts in achieving the United Nations Sustainable Development Goal 6, ensuring access to clean water and sanitation for all.

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