Examining the Impact of Climate Variability on Urban WASH Facilities: A Cross-Sectional Study on the WASH-Specific Intervention and Non-Intervention Urban Slums

Submitted by

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Examining the Impact of Climate Variability on Urban WASH Facilities: A Cross-Sectional Study on the WASH-Specific Intervention and Non-Intervention Urban Slums

A Thesis Submitted for Partial Fulfillment of the Requirements for the Degree of Master of Disaster Management

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DECLARATION

I solemnly declare that the thesis entitled "Examining the Impact of Climate Variability on Urban WASH Facilities: A Cross-Sectional Study on the WASH-Specific Intervention and Non-Intervention Urban Slums," is the result of my own original research work. I affirm that this work has not been submitted in whole or in part for any other degree, diploma, or qualification at any university or institution. All sources of information used in this thesis have been duly acknowledged and referenced. Any assistance received during the research process has been acknowledged appropriately.

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ABSTRACT

Objective: This study aims to examine the impact of climate variability on WASH practices and facilities in Dhaka slums. It will assess the current state of WASH practices, explore the specific effects of climate change (temperature and rainfall) and waterlogging on WASH, and investigate the coping mechanisms employed by slum dwellers.

Methodology: The study employed a mixed-methods approach to investigate the impact of climate variability on WASH facilities in three urban slums of Dhaka (Korail, Rayerbazar, and Tongi). A total of 500 quantitative surveys were conducted using a structured questionnaire to collect data on demographics, WASH-KAP, and the impact of climate variability on WASH access and quality. Prior to household data collection, four KIIs with WASH experts, NGO workers, and climate experts were conducted. Additionally, nine In-Depth Interviews IDIs and five FGDs were carried out to gather qualitative insights into WASH challenges and adaptation strategies.

Results: This study analyzed 500 slum WASH KAPs, focusing on climate variability. residents of Korail and Tongi were more aware of the health concerns of poor drinking water than Rayerbazar locals, perhaps due to earlier WASH programs. Residents were generally enthusiastic about WASH and motivated to enhance it, although access to safe drinking water typically fell short. Korail and Tongi had stronger WASH practices than Rayerbazar, perhaps due to initiatives. Handwashing after toilet use was prevalent everywhere, although water filtration and waste disposal were less popular. Pearson's correlation coefficients showed strong variables' connections. A negative correlation occurs between separate sandal usage and shared toilet usage (coefficient = -0.433**, $p < 0.01$). The associations of 0.083 between disease incidence (203) and water purification (217) were modest. In multivariate regression analysis, household water filtration (217) had an Adjusted Odds Ratio (AOR) of 1.361 [0.950 – 1.949], indicating a non-significant trend toward disease reduction ($p = 0.093$). With p-values below 0.05, these data reveal the intricate link between demographics, WASH practices, and urban slum health outcomes.

The majority of respondents thought temperatures had risen in five years. Heat-induced water scarcity hindered chores and hygiene for 60% of people. About 77% reported rainfall shifts that

left sanitation infrastructure vulnerable and water sources polluted. Due to erratic rains, 87.6% of residents experienced waterlogging and flooding, affecting waste disposal. These data demonstrate how climate change undermines WASH in these slums.
The study observed WASH interventions and community satisfaction vary in Korail, Rayerbazar, and Tongi. Korail had 79.8% intervention presence and good satisfaction, while Rayerbazar had 24.8% but great satisfaction. Water reservation and purchasing were widespread adaptations in Korail and Tongi. Korail's main vector-borne disease prevention tool was mosquito nets. Waterlogging regularly destroyed toilets. Waste disposal varied according to Rayerbazar and Tongi preferred pots. Community-based WASH programs were unknown, while TV and online weather information was accessible. WASH training was scarce, but everyone supported it.

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ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
CV	Climate Variability
CVI	Climate Vulnerability Index
FAO	Food and Agriculture Organization
FGD	Focused Group Discussion
GoB	Government of Bangladesh
IDI	In-Depth Interview
INGO	International Non-governmental Organization
KAP	Knowledge, Attitude and Practice
KII	Key Informant Interview
MDG	Millennium Development Goals

CHAPTER 1: INTRODUCTION

1.1 Background

In this decade of global urbanization, millions of people have started to settle in cities for better living standards and basic amenities. This rapid growth has led to an explosion of informal settlements, commonly referred as slums. These slums are overpopulated, with poor infrastructure and have limited access to critical services. According to a report by the World Bank (2022), in Bangladesh around 47.2% of the urban population lives in informal settlements like slums. Rural-urban migration is one of the main driving forces behind the rapid growth of slum population in urban areas of Bangladesh. Multiple rural push factors and urban pull factors merge to trigger urban-rural migration. Poverty and family influence are push factors. However, there are pull factors like greater career prospects, the presence of immigrant relatives, and better job availability. People usually overlook the draw backs of mitigation before entering these slums. They are greeted with new dimensions of difficulties and little prospects for growth.

The well-being of the communities living in slums is severely compromised by a number of challenges, including environmental hazards, insufficient infrastructure, and socio-economic inequality. These slums are more vulnerable to flooding and water logging because they tend to be located in low-lying locations and lack proper drainage systems. Over time, this increases the chance of developing infectious and waterborne diseases. Poor living standards can be seen among these communities due to economic marginalization, inadequate housing conditions and poor sanitation facilities. Even though WASH facilities are essential for maintaining human health and wellbeing, the lack of access to clean water and sufficient sanitation facilities in Dhaka's slums poses a continuous threat to public health. According to a statement of the Millennium Project Task Force on Water and Sanitation, lack of sanitation facilities and safe water in urban areas is a “silent humanitarian crisis” (Bartram, Lewis, Lenton, & Wright, 2005). Limited access to education and healthcare further exacerbates existing disparities.

All over the world, climate change has impacted the human habitats at multiple levels and dimensions. The potential risks associated with climate change in the slums are compounded by the lack of waste disposal systems, capacity-building initiatives, climate-protective housing,

water supplies, and drainage systems (Arifuzzaman, 2020). The urban poor are the most vulnerable populations in Dhaka to the effects of climate change because of their limited capacity for adaptation, the poor and informal nature of their living conditions, and the absence of inclusive municipal facilities. (Arifuzzaman, 2020). The main effects of climate change in slums include damage of housing and other household goods, contamination and lack of water, diseases such as fever, malaria, and diarrhea, concerns regarding sanitation, and loss of income (Amjad & Karisma, 2019).

This study focuses only on the effects of two parameters (change rising temperatures and erratic rainfall) of climate on WASH practices of slum areas in Dhaka. In vulnerable urban contexts, these variables make WASH infrastructure more challenging to utilize and maintain. Raising temperature can accelerate the deterioration of water quality and foster diseases like diarrhea by creating an environment that is favorable to bacterial growth and contamination. On the other hand, inadequate drainage systems of slum areas often cause waterlogging during heavy rainfall, contaminating water sources and submerging WASH facilities. Both high temperature and irregular rainfall disrupts water sources and exhausts the already-existing water delivery systems in slum areas, intensifying the water scarcity and sanitation problems.

In these slums, several government and non-government initiatives to promote hygiene and wellbeing are evident. Government programs such as City Corporation and WASA include provisions for the sewerage system, clean water supply, and safe waste disposal. Besides, WASH facilities are the subject of distinct developmental, educational, and awareness projects run by NGOs and INGOs. In addition, WASH facilities have been enhanced along with other programs related to menstrual health and wellbeing of children.

Urban WASH remains a significant concern even though Bangladesh has made remarkable progress in providing comprehensive coverage of water supply as well as sanitation services. Unfortunately, only 12 to 30% of people living in slums have access to proper sanitation facilities, even though sanitation coverage in urban areas averages more than 90% (basic) and 55% (advanced). (Rahman, Ali, Choudhury, Rahman, Ahmed, & Snehal, 2014, p. 5). Because there are still scopes for attributed policies and differences in development planning and relevant strategies, access to safe water for drinking, sanitation, solid waste disposal in addition to other critical services like healthcare is still very limited. Another major barrier is slum dwellers often

have little to no awareness of the adverse impacts of polluted water, unsanitary toilets, and poor solid waste management, which leads to diseases along with higher medical cost. Furthermore, reliable data on the current situation of WASH is limited in context of urban slums.

1.2 Rationale of the Study

Urban slum areas are characterized by dense populations and inadequate infrastructure, particularly in terms of Water, Sanitation, and Hygiene (WASH) facilities. These communities are highly vulnerable to the impacts of climate variability, such as increased flooding, waterlogging, and the spread of waterborne diseases. While various interventions have been implemented by non-governmental organizations (NGOs) and government entities to address WASH challenges in these areas, the effectiveness of these interventions remains unclear. Furthermore, there is limited understanding of the coping and adaptation strategies employed by slum residents in response to climate-related WASH challenges. This study seeks to address these gaps by conducting a comprehensive assessment of WASH practices in urban slum areas, with a specific focus on the impact of climate variability. By examining the effectiveness of existing WASH interventions and exploring community coping and adaptation strategies, this research aims to provide valuable insights into how urban slum communities navigate WASH challenges in the face of climate variability.

Additionally, the study will investigate knowledge management practices related to weather information dissemination and its utilization in WASH decision-making processes. By identifying barriers to accessing weather-related information and proposing effective knowledge management strategies, this research aims to enhance the resilience of urban slum communities to climate variability. Overall, this study is motivated by the urgent need to improve WASH resilience in urban slum areas, where the intersection of inadequate infrastructure and climate variability poses significant health risks to residents. By generating empirical evidence and proposing practical recommendations, this research aims to contribute to the development of informed policies and interventions that prioritize the WASH needs of urban slum communities in the context of a changing climate.

1.3 Objectives of the Study

The focus of this study is divided into broad and specific:

Broad: To examine the impact of climate variability on water, sanitation and hygiene (WASH) practices/facilities in the slums of Dhaka city.

The specific objectives of this study are;

1. To assess the state of existing KAP regarding WASH among the study population.
2. To examine the impact of climate variability (temperature, rainfall) on WASH practices of the targeted population.
3. To explore the coping and adaptation techniques of the slum dwellers.

1.4 Research Questions

1. What is the current water, sanitation, and hygiene practices among the slum population in the study area?
2. What are the prevailing attitudes and knowledge levels regarding WASH practices among the slum dwellers?
3. How does climate variability, particularly changes in temperature and rainfall patterns, influence water, sanitation, and hygiene practices in the study area?
4. To what extent do climate-related events impact the vulnerability of the slum population to WASH-related issues?
5. What are the key barriers and challenges faced by the slum population in implementing effective coping and adaptation techniques for WASH practices?

1.5 Problem Statement

In urban slum areas, access to adequate Water, Sanitation, and Hygiene (WASH) facilities is often compromised by numerous factors including climate variability and inadequate intervention strategies. Despite efforts by non-governmental organizations (NGOs) and government entities to address these challenges, there remains a gap in understanding the effectiveness of existing WASH interventions and the adaptation strategies employed by

residents to mitigate the impact of climate variability. Additionally, limited knowledge management practices hinder the dissemination of critical weather-related information necessary for informed decision-making in WASH management. Therefore, there is a pressing need to comprehensively examine the state of WASH practices in urban slum areas, assess the influence of climate variability on these practices, explore community coping and adaptation strategies, and propose effective knowledge management strategies to enhance urban WASH resilience.

CHAPTER 2: LITERATURE REVIEW

2.1 Slum: An Overview

The word “slum” was first coined in the 1820s to describe a habitat with the poorest of housing conditions, unhygienic and unsanitary living conditions and a safe place for crimes and drug abuse (Moreno, 2003). Over the centuries, the concept of slums hasn’t evolved that much. The United Nations Program on Human Settlements (UN-HABITAT) defined slums as “ an informal settlement with marginal provision of basic services of life in which the inhabitants can not access adequate housing condition and the part of a city or town which is often remain unrecognized and acknowledged by public authorities as an integral part of that city or town (UN-HABITAT, 2018). UN’s operational definition of slum includes five crucial aspects of life including, a) access to improved water sources, b) access to improved sanitation facilities, c) sufficient living area, d) housing durability, and e) security of tenure. UN identifies a settlement as slum if it lacks one or more of these five provisions (UN-HABITAT, 2018).

It has been projected that, by 2030, more than half of the world population will live in cities across Asia and Africa, joining Latin America in the race (Montgomery, 2008). Rapid urbanization, ever increasing population growth and the expectation for a better living is supposed to bring millions upon million to cities from rural areas (Chen & Rosenthal, 2008). In this context, a proliferation of informal settlements without minimal provision of basic services and amenities of life seems inevitable within the cities – a phenomena which is already been observed in a number of megacities around the globe including Dhaka, Mumbai etc. (German, 2010).

Living conditions in slums are typically precarious, with overcrowding leading to increased health risks and limited access to education and healthcare services. The prevalence of unemployment and low-income levels among inhabitants contributes to the perpetuation of the cycle of poverty. High crime rates, social unrest, and susceptibility to natural calamities are all things commonly associated with slums. Residents of slums confront numerous obstacles, such as a lack of property rights, limited government assistance, and social stigma. Non-governmental organizations (NGOs) and governmental agencies frequently collaborate in endeavors aimed at

enhancing the quality of life in slum areas. Their efforts mostly revolve around facilitating access to fundamental utilities, promoting education, and implementing skill development projects (Bag et al., 2016; Malik, 2019; Sethi, n.d.; Sheuya, 2008).

2.2 Status of Urban Slum in Bangladesh

Based on the preliminary report released by the Bangladesh Bureau of Statistics, the recent population and housing census conducted in Bangladesh reveals that the country is home to over 165 million individuals and over 1.8 million people reside in various slums throughout the country (BBS, 2022). But, according to another report, in 2018, the percentage of the urban population living in slums in Bangladesh was 47.2% (Kameke, 2022). In Dhaka city alone, there are more than 5000 slums providing abode for more than 4 million people which is nearly half of the entire population live inside the megacity (Dhaka Tribune, 2022; Hasan et al., 2022). The census also presented similar facts of Dhaka ranking top amongst the other major cities of Bangladesh in terms of the number of slum dwellers (Angeles et al., 2009; TBS Report, 2022). The following table adequately represents scenario for Dhaka city (Angeles et al., 2009; B. Hossain, 2020).

Table 1: Number of slums in Dhaka city (2005 CMS Data)

Survey Year	Number of Slums and squatter clusters	Number of slum households	Total slum population
1974	—	—	275,000
1986	—	121,328	—
1991	2,156	—	718,143
1996	3,007	—	150,0000
1997	1,579	185,917	754,866
2005	4,966	673,883	3,286,770

The 2005 census and mapping of slums presented before us the growing trend of urban slum household as well as slum population. Numerous studies have demonstrated that people migrate from small cities or villages to large cities in quest of a higher standard of living and other basic amenities (Benson & O'Reilly, 2009; Chen & Rosenthal, 2008; IOM UN Migration, 2017). In

recent times however, climate change has become a strong force behind large-scale migration to cities in Bangladesh (Eriksen et al., 2015; IPCC, 2007). These climate induced migrations are often coined as climate change adaptation, but adequate evidence is yet to be formulated to justify such a claim as the condition of slum dwellers in Dhaka city do not portray an optimistic picture at all. But the factors behind internal displacement and migration to urban slums had been identified in the slum census of 1997 and riverbank erosion was shown to be responsible for at least 17.2% households migrated to various slums throughout Dhaka city (BBS, 1999). In the last decade. According to news article of the Guardian, some 2000 people migrate and settle in the capital and majority of them do so to escape poverty which is often triggered and exacerbated by climate induced consequences (McPherson, 2015).

With limited land areas but having an extensive population growth, and rural-to-urban migration, Dhaka city inevitably lacks in adequate housing and infrastructure leading to the emergence and expansion of informal settlements or slums, as they are commonly known. Accommodating such a large number of populations into small clusters unavoidably leads to multifaceted problems including complexities related to WASH facilities which are yet to be studies in large scale.

2.3 Wash Status in Slums

Urban slums are a significant demographic in today's constantly urbanizing world, where 33% of the world's population resides in these densely inhabited and marginalized communities (World Health Organization & United Nations. Human Settlements Program, 2010). Tragically, in these overpopulated settlements, as much as half of the population suffers from poor access to sanitation and water, which causes severe risks to their health (United Nations Human Settlements Programme, 2003). In these challenging environments, access to Water, Sanitation, and Hygiene (WASH) services takes on unconventional forms, often relying on informal markets and middlemen, highlighting the unique dynamics at play (K. Hossain & Ahmed, 2014). The difficulties experienced by slum dwellers are further exacerbated by city planners' disregard for surface drainage and solid waste collection, which leads to widespread garbage and waste accumulation on the periphery of these communities (Ahmed, 2014). WASH services are generally provided by non-regulated vendors in these settlements, with informality and middlemen-driven provision reflecting the challenges of service delivery in such situations

(Haque et al., 2020). While open defecation and unimproved sanitation technology are rare in Dhaka slums, inhabitants rely significantly on shared or public toilets, contending with the challenges of limited finances and landlords' reluctance to invest in sanitation infrastructure (Haque et al., 2020).

Furthermore, efforts to enhance sanitation services are frequently hampered by the acute lack of space within larger slums, highlighting the difficulties the built environment presents (Haque et al., 2020). Disparities in bathroom facilities are noticeable, with open pits or hanging toilets being more common in larger slums and those on government-owned land. Individual household toilets are pretty uncommon, and flush toilets considered a luxury, are typically only accessible to more affluent households (Haque et al., 2020). In slum houses, access to piped water is familiar. Yet, the lack of direct connections to residential structures demands community systems or public standpipes for water access, indicating the people's adaptation in overcoming these difficulties (Haque et al., 2020). Importantly, these difficult living conditions in urban slums result in poor health consequences for residents. Contrary to popular belief, slum inhabitants frequently have poorer health outcomes than their urban and even rural counterparts, calling into question the common notion of an "urban advantage" regarding healthcare access. Access to sufficient water and sanitation services significantly predicts health disparities in these areas. (Arias-Granada et al., 2018)

2.4 Impacts of Climate Variability on urban slums

Urban slums in Bangladesh face a significant and complex problem from climate variability, which increases the vulnerability of marginalized groups. Bangladesh is particularly vulnerable to the effects of climate variability because of its location, high population density, and significant levels of poverty, as well as the urban sectors' sensitivity to climate change (Roy, 1990). As the only megacity in Bangladesh, Dhaka is subject to various climate-related dangers, such as temperature fluctuations, erratic rainfall, waterlogging, floods, cyclones, and extremely hot and cold waves (Rabbani et al., 2011).

It is essential to understand that the adverse effects of climate change are not fairly spread, with marginalized and poor groups in developing nations being the most vulnerable since they depend on local ecosystems for survival (Swarna, 2022). Among the vulnerable groups, children in

slums emerge as the most at-risk, particularly concerning child protection. This involves increased risks of sexual harassment, child labor, early marriages, and other difficulties (Swarna, 2022). Additionally, the small savings of slum dwellers are eroded by climatic events, including waterlogging, severe rain, excessive heat, cyclones, riverbank erosion, and floods, adding to their financial struggles (Swarna, 2022). The fact that many people living in Bangladesh's slums have migrated from rural areas that have already experienced the effects of climate change is notable. It illustrates how vulnerable rural and urban areas are (*Trapped Population*, 2020).

2.5 Impact of Climate Change on WASH

Climate change poses significant problems for clean water, sanitation, and hygiene (WASH) services, disproportionately harming vulnerable groups particularly women and girl and raising the risk of water-borne diseases (WHO, 2023) Rising temperatures, increased sewage system flooding, prolonged droughts, and rising sea levels contribute to these concerns (Bates et al., 2008).

Climate change affects humans, ecosystems, and the economy primarily through water (Bates et al., 2008). Drinking water supply and wastewater management will be significantly impacted by changes in surface water sources caused by climate change (Howard et al., 2016). These changes can already be seen in many places of the world. Inadequate water storage capacity, such as poorly built reservoirs, may hinder economic progress and render poorer countries more vulnerable to climate change (Brown & Lall, 2006). Freshwater resources, in particular, are highly susceptible, with possible ramifications for availability, quality, and the services they supply (Oates et al., 2014).

Decreased water availability and rising flooding severely impact sewerage and septic systems that depend on water (Howard et al., 2016). Providing enough water for conventional sewer systems to function properly may become difficult (Howard et al., 2010). Even modified sewerage systems may struggle to get appropriate water volumes for cleansing and operation, highlighting the challenges ahead (Howard et al., 2010). The effects on sanitation can be severe in areas experiencing increased rainfall or severe weather events due to climate change (Howard et al., 2016). Flooding, in particular, poses serious public health concerns to on-site sanitation (Howard et al., 2016).

Providing clean water, adequate sanitation, and promoting hygiene practices are crucial for enhancing climate change resilience. Despite its significance, however, the impact of climate change on WASH systems has been largely ignored and financed, according to water aid with only 1% of global climate financing focused towards improving access to clean water. According to the United Nations, one in every four children will live in water-stressed areas by 2040, emphasizing the importance of tackling this issue. Although the effects of climate change on these systems are widely recognized, there is still a lack of funding and focus on the issue. Immediate effort to strengthen WASH services, particularly in water-stressed areas, is essential (Brown & Lall, 2006).

2.6 Health Complexities Deriving from Poor WASH

Global evidence consistently reveals a clear association between inadequate WASH practices and poor health outcomes (Palo et al., 2021). One of the most prominent health problems associated with poor WASH is the prevalence of poor drinking water quality, which is a significant cause of acute diarrheal diseases in developing nations (Kundu et al., 2018). Diarrheal diseases, typically transmitted via the fecal-oral route, pose a serious concern to people living in locations with inadequate WASH infrastructure, increasing their exposure to fecal pathogens across multiple pathways (Esteves Mills & Cumming, 2017). This increased susceptibility is reflected in the shocking fact that nearly 1.6 million people die yearly from diarrhea, with developing countries and economically disadvantaged regions bearing the heaviest impact (Wolde et al., 2022).

Despite significant advancements in the Millennium Development Goals (MDGs), many of the world's impoverished people still do not have access to safe WASH services (UNICEF, 2015). Inadequate sanitation persists, increasing the risk of soil-transmitted helminth (STH) infections (Bethony et al., 2006). STH infections can have serious health consequences, including anemia, listeria infections, and an increased risk of maternal death (Esteves Mills & Cumming, 2017). There is strong evidence that high levels of microbial contamination found on the hands of people are related to the poor quality of stored drinking water (Pickering et al., 2010, 2011, 2012). Additionally Poor sanitation has an impact on child development in addition to individual health. Inadequate WASH practices are connected to gastrointestinal disorders in children, which

can result in stunting, malnourishment, and impaired cognitive development (Coffey et al., 2017).

Unsafe water management techniques can unintentionally promote the development of vector-borne diseases, such as mosquitoes, contributing to the transmission of vector-borne illnesses, including malaria and dengue (Akanda et al., 2020). Additionally, water collecting poses a risk to one's physical health, including the possibility of spine injuries, hernias, genital prolapse, and an elevated chance of spontaneous abortion (Florack et al., 1993; Jørgensen et al., 1994).

Disease transmission in healthcare settings is also impacted by hygiene and water access. Inadequate WASH conditions in healthcare facilities have been associated with the emergence of antibiotic-resistant diseases, exacerbating the global antimicrobial resistance threat (Laxminarayan et al., 2013).

CHAPTER 3: METHODOLOGY

3.1 Study Area

This study explores the impact of climate variability on Water, Sanitation, and Hygiene (WASH) facilities within three urban slums in Bangladesh: Korail, Rayerbazar, and Tongi. Korail, sprawling over 100 acres and housing over 50,000 residents, represents the largest informal settlement in Dhaka, juxtaposed against the affluence of the nearby Gulshan area yet grappling with severe WASH inadequacies. Similarly, Rayerbazar, with its 39.92 acres, faces stark WASH challenges indicative of broader infrastructural deficits experienced by informal settlements. Tongi, though not a slum, is a densely populated township in Gazipur with its unique set of WASH concerns, further intensified by industrial activities and large congregations. By conducting a cross-sectional analysis on the variance of WASH facilities amidst these contrasting backdrops and their respective climate vulnerabilities, this research underscores the urgent need for climate-smart WASH interventions. It aims to elucidate the resilience and adaptive capacities of marginalized urban communities against climate change, advocating for targeted, sustainable WASH solutions to significantly enhance living conditions and promote sustainable urban development.

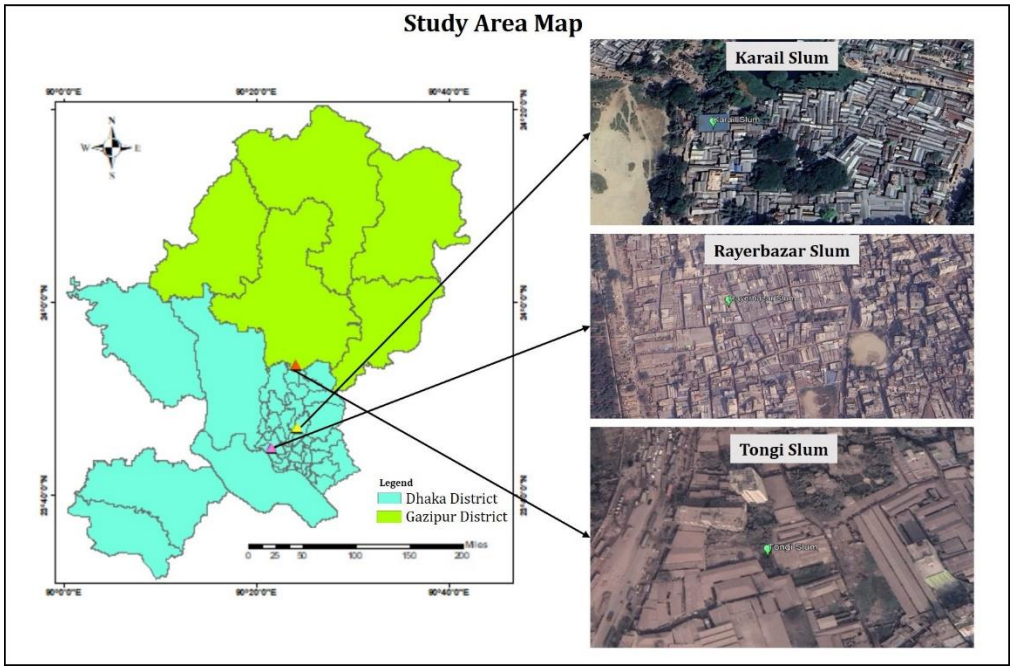


Figure 1: Study area map

3.2 Sampling Method

This study employed a mixed-methods approach to investigate the impact of climate variability on WASH facilities in urban slums. A simple random sampling was employed to select 500 respondents across three slum communities. This approach was chosen to reduce the selection bias and enhance the generalizability of the findings to the broader slum population in these areas.

Qualitative data was collected utilizing purposive sampling through FGDs, IDIs, and KIIs. Purposive sampling was chosen to ensure participation from individuals with diverse experiences relevant to the research questions. This approach helped to provide in-depth insights into WASH challenges, and coping mechanisms employed in response to climate variability.

3.2.1 Quantitative Method

In this study examining the impact of climate variability on urban Water, Sanitation, and Hygiene (WASH) facilities, quantitative data were collected through a structured questionnaire from 500 respondents across Korail, Rayerbazar, and Tongi slums. The questionnaire was designed to capture a comprehensive set of data spanning demographic profiles, WASH-related knowledge, attitudes, practices (KAP), the impacts of climate variability on WASH access and quality, and respondents' coping and adaptation measures. Sections included detailed inquiries into household demographics, awareness of waterborne diseases, sanitation practices, effects of altered temperature and rainfall on WASH infrastructure, and strategies employed by communities to mitigate these impacts. This approach allowed for the systematic gathering of data to analyze the nexus between climate variability and WASH facility efficacy, highlighting the urgent needs and potential interventions to bolster resilience in urban slum areas against the backdrop of changing climate conditions.

3.2.2 Qualitative Method

For the qualitative aspect of the study on the impact of climate variability on urban WASH facilities, a series of Focus Group Discussions (FGDs), In-depth Interviews (IDIs), and Key Informant Interviews (KIIs) were conducted across the selected slums of Korail, Rayerbazar, and Tongi. Specifically, two FGDs were held in Korail, one in Rayerbazar, and two in Tongi, engaging a diverse group of participants to discuss shared experiences and perspectives on

WASH-related challenges and climate impacts. Additionally, three IDIs were carried out in each location to delve deeper into individual experiences and insights regarding WASH facilities and climate variability. Furthermore, one KII was conducted in each slum area with stakeholders who have a broad view of the WASH sector, aiming to gather expert opinions and recommendations for improving resilience and adaptation strategies in response to climate variability.

Table 2: Sampling distribution of the study

Qualitative Data Collection	*Quantitative Data Collection*
FGDs *Korail: 2, Rayerbazar: 1, Tongi: 1* *IDIs* *Korail: 3, Rayerbazar: 3, Tongi: 3* *KIIs* *2 WASH Expert* *1 NGO worker* *1 Climate expert*	Questionnaire Survey: 500

3.3 Data Entry and Data Processing

For the quantitative data collected from 300 respondents across the slums of Korail, Rayerbazar, and Tongi, data entry and processing were carried out using IBM SPSS Version 25. This statistical software enabled the efficient management of large datasets, facilitating systematic coding, entry, and analysis of numerical data. The use of SPSS allowed the research team to conduct a variety of statistical tests to explore the relationship between climate variability and the effectiveness of WASH facilities. Through descriptive statistics, inferential analyses, and complex modeling techniques, the software supported the identification of key trends, patterns, and significant differences among the study areas, contributing to a comprehensive understanding of the quantitative dimensions of the study.

For the qualitative data obtained from Focus Group Discussions (FGDs), In-depth Interviews (IDIs), and Key Informant Interviews (KIIs) in the slums of Korail, Rayerbazar, and Tongi, Nvivo software was employed for data entry and analysis. Nvivo provided advanced tools for organizing, coding, and thematically analyzing textual and multimedia data, enabling researchers to delve into participants' perceptions, experiences, and recommendations regarding WASH

facilities and climate variability. By facilitating the identification of common themes, patterns, and narratives within the qualitative data, Nvivo helped capture nuanced insights and complex dynamics within the urban slum contexts. This approach enriched the study's findings by offering a detailed qualitative perspective on the challenges and potential solutions related to WASH facilities amidst changing climate conditions.

3.4 Data Analysis

This section details the various statistical methods employed to analyze the quantitative data collected through the survey instrument. SPSS version 25 software was utilized to conduct the analyses. Demographic characteristics were explored using descriptive statistics. Relationships between WASH practices and health outcomes were assessed with Pearson's correlation analysis and logistic regression. Descriptive statistics were also presented visually using bar charts created in Excel to further explore survey responses.

3.3 Limitations

This study acknowledges certain constraints related to the techniques employed in the research:

Dynamic Slum Populations and Sampling Frame Challenges:

Urban slum communities are characterized by dynamic populations with frequent movement in and out of the areas. This makes it difficult to establish a precise and up-to-date census of the slum population, which would be ideal for a truly random sampling approach. The dynamic nature of slum structures also posed challenges in locating and identifying potential participants within the communities.

Unequal Sample Sizes Across Locations:

This sampling approach resulted in unequal sample sizes across the three slum communities. Korail, with a larger population, yielded a higher number of participants (248) compared to Rayerbazar (151) and Tongi (101) with smaller populations. While striving for a total sample size of 500, this variation limits the ability to conduct perfectly balanced comparisons between the slum communities.

Gender Bias in Participation:

The study acknowledges a potential gender bias in participation, with a higher representation of male respondents compared to females. This might be due to several factors:

- **Female Reluctance:** Some female residents might be hesitant or reluctant to participate in interviews or discussions, particularly with male researchers. Cultural norms or privacy concerns could contribute to this.
- **Accessibility:** Females might be less readily available for participation due to household responsibilities or limited mobility within the slums. Conversely, males might be more readily available and willing to engage in discussions outside the home environment.

These limitations highlight the challenges of conducting research within dynamic and resource-constrained environments like urban slums.

3.5 Ethical Consideration

In this cross-sectional study of urban slums in Korail, Rayerbazar, and Tongi, examining the influence of climate variability on Water, Sanitation, and Hygiene (WASH) facilities, the adherence to stringent ethical considerations was paramount. Recognizing the vulnerability of the populations within these urban settings, the study was meticulously designed to respect the dignity, privacy, and cultural norms of the participants. Ethical protocols were rigorously followed to ensure the integrity of data collection, the protection of participant identity, and the inclusivity of diverse community groups. The ethical framework guided every facet of the research, from participant engagement to data security, ensuring that the study's conduct was as robust ethically as it was methodologically. This ethical foundation was critical in fostering a trustworthy and respectful environment, enabling an authentic assessment of the impact of climate variability on essential WASH facilities. The following considerations were taken in order to conduct this study.

- **Engagement of Participant**s: The study actively involved all relevant parties, securing genuine involvement in assessing the climate variability's impact on urban WASH facilities.

- **Broad Inclusion**: Opportunities for participation were provided to a diverse demographic, ensuring that the study's insights on climate impacts on WASH facilities are inclusive of all community segments.
- **Integrity in Conduct**: Maintained the highest standards of honesty throughout the research, vital for trustworthy findings on climate variability effects on WASH infrastructure.
- **Respect for Local Context**: The methodology was tailored to fit the community's social and cultural dynamics, essential when evaluating WASH facilities in areas experiencing climate change.
- **Informed Consent**: Consent was obtained from participants, with assurances of their right to privacy and voluntary participation, key when delving into the sensitive aspects of WASH facilities in changing climates.
- **Privacy and Data Protection**: Respondent anonymity was preserved, and data was securely managed to mitigate any risk from disclosure, especially important in studies involving disadvantaged urban populations.
- **Protection and Cultural Sensitivity**: The study was sensitive to the needs and dignity of marginalized groups, respecting cultural, gender, and social considerations when exploring WASH facilities' responsiveness to climate variability.

- **Suitability of Data Gathering**: Data collection methods were designed to be appropriate for various ages and genders, which is critical for an accurate evaluation of the influence of climate variability on urban WASH facilities.

CHAPTER 4: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

4.1 General characteristics of respondents

A total of 500 participants were included in the study. Of them, 64.6% were male ranging from 26 to 35 years and most had primary level of education (1–5 grades) (42.2%). Nearly three out of 10 respondents, 187 (33.4%), were without any formal education. A total of 419 (83.8%) were married. The majority of participants (21.4%) had different occupation from the list provided followed by housewife (20%), small store owner (11.6%) with monthly family income of 10001–15000 BDT (32.6%). Islam is the most common religion of the respondents (97.8%). Majority of the household had no persons with disability (91.4%) and only (0.2%) with 2-4 PWDs.

4.1.1 Socio-demographic characteristics of the respondents

Sample was collected from three different areas. If we do comparison then, Korail had the most of both male (172) and female (76) respondents where Rayerbazar had the least of male (57.4%) and Tongi had the least of female (38.4%) participants. Majority of the respondents were from 26 to 35 years age group in every location. Tongi had more (21.8%) elderly respondents from 46 years to above 56 years where Rayerbazar had the youngest respondents (21.8%) of age 18-25. While most of the respondents were married, Korail had 6 widowed respondents and only Tongi had 2 divorced participants.

Majority of Muslim participants came from Korail while Hindu participants were evident in Rayerbazar. From the table, we can see almost half of the respondents (40.6%) of Rayerbazar were illiterate. On the other hand, almost three forth of the participants (72.9%) of Tongi had been introduced to formal education. For higher education, there were evident gap. Only 2 respondents had done their post-graduation from Korail and Tongi respectively but Rayerbazar hadn’t any. In all three areas, almost 40-45% respondents had only passed the primary level which dropped to 16-20% in SSC level and 5-7% in HSC level. This shows the inaccessibility of higher education among the respondents in all the three survey areas. Lastly Tongi had most number of respondents with family members of with disability (11.2%) followed by Rayerbazar (7.9%) and Korail (7.4%).

Table 3: Socio-demographic characteristics of the respondents

Variable	*Category*	*Korail (N=248)*	*Rayerbazar (N=101)*	*Tongi (N=151)*	*All Location (N=500)*
Age	18 - 25	45 (18.1%)	22 (21.8%)	23 (15.2%)	90 (18%)
	26 - 35	81 (32.7%)	39 (38.6%)	53 (35.1%)	173 (34.6%)
	36 - 45	71 (28.6%)	28 (27.7%)	42 (27.8%)	141 (28.2%)
	46 - 55	37 (14.9%)	7 (6.9%)	25 (16.5%)	69 (13.8%)
	56 and above	14 (5.6%)	5 (4.9%)	8 (5.3%)	27 (5.4%)
Marital Status	Single	41 (16.5%)	12 (11.9%)	12 (7.9%)	65 (13%)
	Married	201 (81%)	88 (87.1%)	130 (86.1%)	419 (83.8%)
	Widowed	6 (2.4%)	1 (0.9%)	7 (4.6%)	17 (3.4%)
	Divorced	0 (0%)	0 (0%)	2 (1.3%)	2 (0.4%)
Sex	Male	172 (69.3%)	58 (57.4%)	93 (61.6%)	323 (64.6%)
	Female	76 (30.6%)	43 (42.6%)	58 (38.4%)	176 (35.2%)
Religion	Muslim	246 (99.2%)	97 (96%)	146 (96.7%)	489 (97.8%)
	Hindu	2 (0.8%)	4 (3.9%)	5 (3.3%)	11 (2.2%)
Education	Can’t sign	19 (7.7%)	8 (7.9%)	17 (11.2%)	44 (8.8%)
	Sign only	65 (26.2%)	33 (32.7%)	25 (16.5%)	123 (24.6%)
	Primary	99 (39.9%)	44 (43.6%)	68 (45%)	211 (42.2%)
	SSC	42 (16.9%)	12 (11.9%)	30 (19.9%)	84 (16.8%)

	HSC	17 (6.8%)	2 (1.9%)	8 (5.3%)	27 (0.2%)
	Graduate	4 (1.6%)	2 (1.9%)	1 (0.7%)	7 (1.4%)
	Post graduate	1 (0.4%)	0 (0%)	1 (0.7%)	1 (0.2%)
	Others	1 (0.4%)	0 (0%)	2 (1.3%)	3 (0.6%)
Number of persons with disability	0	230 (92.7%)	93 (92.1%)	134 (88.7%)	457 (91.4%)
	1	17 (6.8%)	8 (7.9%)	17 (11.2%)	42 (8.4%)
	2 - 4	1 (0.4%)	0 (0%)	0 (0%)	1 (0.2%)

4.1.2 Socio-economic characteristics of the respondents

Rayerbazar had housewives (24.7%) as majority among the participants followed by other occupations in both of the remain locations (20.9% in Korail and 23.8% in Tongi). Some of the major occupations were small store owner (14.9%), vendors (9.7%) and tea seller (6.5%) in Korail. For Rayerbazar the options were rickshaw/van puller (16.8%), small store owner (7.9%) and vendors (5.9%). And lastly in Tongi the notable occupations were small store owner (8.6%), tea seller (5.9%) and vendor (5.3%). On another note, wardboy/hospital worker and bus helper were the least choosen occupations (0.2%) in all the three areas. Considering the socioeconomic condition, Korail had more middle class households (9.7%) with monthly family income of more than BDT 25 thousands while Rayerbazar had the most respondents (2.9%) belongs in lower class with monthly family income of less than BDT 5 thousands.

Table 4: Socio-economic characteristics of the respondents

Variable	***Category***	***Korail (N=248)***	***Rayerbazar (N=101)***	***Tongi (N=151)***	***All Location (N=500)***
Occupation	Housewife	40 (16.1%)	25 (24.7%)	35 (23.2%)	100 (20%)
	Welder	8 (3.2%)	2 (1.9%)	4 (2.6%)	14 (2.8%)
	Electrician	13 (5.2%)	4 (3.9%)	6 (3.9%)	23 (4.6%)
	Plumber	4 (1.6%)	1 (0.9%)	1 (0.7%)	6 (1.2%)
	Carpenter	3 (1.2%)	1 (0.9%)	1 (0.7%)	5 (1%)
	Mason	7 (2.8%)	1 (0.9%)	4 (2.6%)	12 (2.4%)
	Ward boy/Works in hospital	0 (0%)	0 (0%)	1 (0.7%)	1 (0.2%)
	Rickshaw puller/Van puller	14 (5.6%)	17 (16.8%)	3 (1.9%)	34 (6.8%)
	CNG driver	6 (2.4%)	1 (0.9%)	7 (4.6%)	14 (2.8%)
	Laundry man	6 (2.4%)	1 (0.9%)	3 (1.9%)	10 (2%)
	Car mechanic	1 (0.4%)	0 (0%)	3 (1.9%)	4 (0.8%)
	Driver of private vehicles	5 (2%)	4 (3.9%)	4 (2.6%)	13 (2.6%)
	Bus helper	0 (0%)	0 (0%)	1 (0.7%)	1 (0.2%)
	Small store business	37 (14.9%)	8 (7.9%)	13 (8.6%)	58 (11.6%)
	Tea seller	16 (6.5%)	4 (3.9%)	9 (5.9%)	29 (5.8%)
	Works in	6 (2.4%)	2 (1.9%)	4 (2.6%)	12 (2.4%)

	hotel/cafe				
	Repairman of appliances	1 (0.4%)	2 (1.9%)	1 (0.7%)	4 (0.8%)
	Vendor	24 (9.7%)	6 (5.9%)	8 (5.3%)	38 (7.6%)
	House help/care taker	5 (2%)	4 (3.9%)	7 (4.6%)	16 (3.2%)
	Other	52 (20.9%)	18 (17.8%)	36 (23.8%)	106 (21.2%)
Monthly family income	<5000	7 (2.8%)	3 (2.9%)	3 (1.9%)	13 (2.6%)
	5001 - 10000	17 (6.8%)	20 (19.8%)	30 (19.9%)	67 (13.4%)
	10001 - 15000	87 (35.1%)	31 (30.7%)	45 (29.8%)	163 (32.6%)
	15001 - 20000	74 (29.8%)	29 (28.7%)	46 (30.5%)	149 (29.8%)
	20001 - 25000	39 (15.7%)	12 (11.9%)	23 (15.2%)	74 (14.8%)
	>25000	24 (9.7%)	6 (5.9%)	4 (2.6%)	34 (6.8%)

4.2 Demographic analysis

Demographic and socioeconomic characteristics of respondents from Korail, Rayerbazar, and Tongi were thoroughly analyzed. Across all locations (N=500), a diverse age range was observed, with a significant proportion aged between 26-35 (34.6%) and 36-45 (28.2%). The majority were married (83.8%), with males constituting 64.6% of the respondents. Predominantly, the respondents were Muslim (97.8%), and the most common level of education was primary, reported by 42.2% of participants. Regarding occupation, a wide range of jobs was reported, with a noticeable number being housewives (20%) and engaged in small store businesses (11.6%). The monthly family income varied, with a notable concentration in the 10001-15000 (32.6%) and 15001-20000 (29.8%) BDT ranges.

CHAPTER 5: KNOWLEDGE, ATTITUDE AND PRACTICE AMONG THE WASH-FOCUSED INTERVENTION AND NON-INTERVENTION SLUM RESPONDENTS

5.1 Introduction

This study examined the status of Water, Sanitation, and Hygiene (WASH) practices in three slum areas located in Dhaka and Gazipur. It specifically focused on assessing the levels of Knowledge, Attitude, and Practice (KAP) connected to WASH, with the goal of identifying any deficiencies in hygiene practices. The research question focused on whether slums that received specific WASH interventions would demonstrate a disparity in KAP (Knowledge, Attitudes, and Practices) and hygienic practices as compared to slums without such interventions. The key findings indicate a relationship between WASH intervention and knowledge, attitudes, and practices (KAP) levels. Residents in Korail and Tongi, locations with well-established WASH programs, had far greater understanding of WASH principles in comparison to Rayerbazar, where interventions were limited. This discrepancy was seen in all three domains of knowledge, attitude, and practice.

5.2 KAP Analysis

This section explores the Knowledge, Attitudes, and Practices (KAP) of the study population (N=500) regarding Water, Sanitation, and Hygiene (WASH) within the context of climate variability. The operational definitions of KAP used in this study are adapted from (Berhe et al., 2020).

- **Knowledge (K):** The level of understanding and awareness residents possess concerning WASH practices, waterborne diseases, and the impacts of climate change on WASH facilities. A mean knowledge score was calculated based on survey responses, with scores greater than 0.5 considered indicative of good knowledge and scores less than or equal to 0.5 considered poor knowledge.

- **Attitude (A):** Residents' beliefs, perceptions, and feelings towards WASH practices, their importance, and the effectiveness of various hygiene behaviors. Likert scale responses were analyzed to generate a mean attitude score. Scores exceeding 0.6 were considered positive attitudes, while scores of 0.6 or lower were considered negative attitudes.
- **Practices (P):** The specific behaviors residents adopt in their daily lives related to water management, sanitation practices, and overall hygiene habits, particularly in response to climate-related challenges. Survey data was examined to identify the prevalence of various WASH practices employed by residents, and a mean practice score was calculated. Scores above 0.5 indicated good practices, whereas scores of 0.5 or lower indicated poor practices.

5.3 Distribution of Respondents based on Knowledge

Table 5: Knowledge of study population on WASH

Questions	***Category***	***Korail (N=248)***		***Rayerbazar (N=101)***		***Tongi (N=151)***		***All Location (N=500)***	
Sources of drinking water are protected	Yes	164	66.2%	28	27.7%	50	33.1%	242	48.4%
	No	84	33.8%	73	72.3%	101	66.9%	258	51.6%
Drinking polluted water can lead to water borne diseases (Diarrhea/Dysentery/Typhoid/Cholera/Trachoma)	Yes	226	91.1%	87	86.1%	115	76.1%	428	85.6%
	No	22	8.9%	14	8.9%	36	23.9%	72	14.4%
Your water facility should be located in a safe place (e.g., pluvial flood)?	Yes	189	76.2%	60	59.4%	112	74.2%	361	72.2%
	No	59	23.8%	41	31.7%	39	25.8%	139	27.8%
Your Sanitation facility should be located in a safe place (e.g., pluvial flood)	Yes	179	72.2%	48	47.5%	110	72.8%	337	67.4%
	No	69	27.8%	53	52.5%	41	27.2%	163	32.6%

Your Hygiene facility should be located in a safe place (e.g., pluvial flood)?	Yes	188	75.8%	43	42.5%	108	71.5%	339	67.8%
	No	60	24.2%	58	51.1%	43	28.5%	161	32.2%
Important time to wash hands	Before Preparing food	128	51.6%	38	37.6%	80	52.9%	246	49.2%
	Before eating	228	91.9%	82	81.1%	98	64.9%	408	81.6%
	Before feeding your child	80	32.2%	19	18.8%	50	33.1%	149	29.8%
	After handling a child's stool	74	29.8%	20	19.8%	35	23.1%	129	25.8%
	After using latrine/ after defecation	219	88.3%	70	69.3%	97	64.2%	386	77.2%

The table highlights knowledge of respondents regarding WASH across three survey areas. A total of 242 respondents claimed their source of drinking water is protected. The majority of respondents of Korail (66.2%) believed their sources of drinking water were safe, followed by respondents of Rayerbazar (27.7%) and Tongi (33.1%).

Most of the respondents were aware that drinking polluted water could result in water-borne diseases. While nine out of the ten respondents of Korail knew about the health consequences of drinking unsafe water, only seven out of ten respondents in Tongi were well aware. A significant percentage of respondents agreed that water, sanitation, and hygiene services should be located in safe areas to avoid threats like flood.

Almost 80% of respondents believe it is vital to wash hands before eating and after using the toilet. On the other hand, only around 30% believe it is important to wash hands before feeding children and handling their stool. We can see that respondents from Korail and Tongi have more knowledge of WASH than those from Rayerbazar. The reason for this difference is because slums in Korail and Tongi received WASH focused interventions, whereas in Rayerbazar the scope is limited as WASH has been considered only as a subset of educational interventions.

5.4 Distribution of Respondents based on Attitude

Table 6: Attitude of study population on WASH

Questions	***Cate-gory***	***Korail (N=248)***		***Rayerbazar (N=101)***		***Tongi (N=151)***		***All Location (N=500)***	
The water you receive is safe	Yes	129	52%	55	54.4%	71	46.9%	255	51%
	No	119	48%	46	45.5%	80	53.1%	245	49%
Avail safe drinking water (colorless/odorless)	Yes	97	39.1%	45	44.5%	50	33.1%	192	38.4%
	No	151	60.9%	66	65.5%	101	66.9%	308	61.6%
Are you willing to actively participate in community initiatives aimed at improving WASH facilities?	Yes	185	74.6%	71	70.3%	115	76.2%	371	74.2%
	No	63	25.4%	30	29.7%	36	23.8%	129	25.8%
The toilet should be disability friendly?	Yes	243	98%	98	97.1%	147	97.4%	488	97.6%
	No	5	2%	3	2.9%	4	2.6%	12	2.4%
Are you willing to invest in water/sanitation facility or improve the existing facility?	Yes	183	73.8%	55	54.4%	105	69.5%	343	68.6%
	No	65	26.2%	46	45.6%	46	30.5%	157	31.4%

The table presents findings about perception of respondents about water safety. Across all locations, about half of the respondents perceived the water they receive as safe, with a slightly higher percentage in Rayerbazar (54.4%) compared to Korail (52%) and Tongi (46.9%). Later only 38.4% of respondents reported availing themselves of colorless and odorless drinking water, while the majority, constituting 61.6% of the total sample, indicated otherwise. This suggests a widespread issue with the availability or quality of safe drinking water across the surveyed locations. As found in survey, respondents of Korail ensured mostly the water they received is of good quality. Water quality of Rayerbazar was moderate to slightly scented whereas in Tongi the

water quality dropped significantly. This is also evident in the responses as Tongi shows lower percentage of positive attitude.

In terms of community participation, there is a positive trend. Across all areas, about three-quarters of respondents express an interest to participate in such activities, with Rayerbazar at 70.3% and Tongi at 76.2%. Sensitization regarding the needs and rights of people with disabilities was observed in all locations, with almost all (97.6%) agreeing that restrooms should be disability-friendly. There is widespread support for investment in water and sanitation systems, with over two-thirds of respondents (68.6%) expressing their willingness to invest in or improve existing facilities. However, Korail (73.8%) shows a greater willingness to invest in WASH facilities than the other places. One of reasons behind this variation in response is the difference in socioeconomic situation of the survey locations.

5.5 Distribution of Respondents based on Practice

Table 7: Practice of study population on WASH

Questions	***Category***	***Korail (N=248)***		***Rayerbazar (N=101)***		***Tongi (N=151)***		***All Location (N=500)***	
Do you preserve drinking water in secured container?	Yes	225	90.7%	65	64.3%	68	45.1%	358	71.6%
	No	23	9.3%	36	35.7%	83	54.9%	142	28.4%
Do you purify water at home?	Yes	154	62.1%	32	31.6%	40	26.5%	226	45.2%
	No	94	37.9%	67	66.3%	111	73.5%	274	54.8%
Does the drinking water and domestic use water come from the protected source or not?	Yes	235	94.8%	42	41.5%	65	43.1%	342	68.4%
	No	13	5.2%	59	58.5%	86	56.9%	158	31.6%

The toilet you use is private?	Yes	35	14.1%	2	1.9%	32	21.2%	69	13.8%
	No	213	85.9%	99	98.1%	110	72.8%	431	86.2%
Do you use a separate sandal for toilet use?	Yes	51	20.6%	23	22.8%	39	25.8%	113	22.6%
	No	197	79.4%	78	77.2%	112	74.2%	387	77.4%
Is your toilet cleaned regularly (at least twice a week)?	Yes	217	87.5%	70	69.3%	72	47.6%	359	71.8%
	No	31	12.5%	31	30.7%	79	52.3%	141	28.2%
Do you have hand washing facility near/inside latrine?	Yes	184	74.2%	40	39.6%	63	41.7%	287	57.4%
	No	64	25.8%	61	60.4%	88	58.3%	213	42.6%
When do you wash your hands?	Before taking food	213	85.9%	22	21.8%	94	62.2%	329	65.8%
	After taking food	211	85.1%	78	77.2%	105	89.5%	394	78.8%
	After using the toilet	233	93.9%	75	74.2%	70	46.3%	378	75.6%
	After coming from outside	128	51.6%	33	32.6%	35	23.1%	196	39.2%
Do you wash your hands after defecation?	Yes	247	99.6%	93	92.1%	135	89.4%	475	95%
	No	1	0.4%	8	7.9%	16	10.6%	25	5%
Do you wash	Yes	86	34.7%	34	33.6%	33	21.8%	153	30.6%

your hands after decomposing the child excreta?	No	162	65.3%	67	66.4%	118	78.2%	347	69.4%
Do you use soap for washing hands?	Yes	220	88.7%	60	59.4%	72	47.6%	352	70.4%
	No	28	11.3%	41	40.6%	79	52.4%	148	29.6%
Do you dispose your household waste in proper way?	Yes	170	68.5%	41	40.6%	24	15.8%	235	47%
	No	78	31.5%	60	59.4%	127	84.2%	265	53%

The table shows data on various hygiene practices among individuals in three different areas. The majority of respondents (71.6%) across all areas reported storing drinking water in secure containers. However, the percentages fluctuated significantly, with Korail having the highest (90.7%) and Tongi having the lowest (45.1%). When asked, only 45.2% of all respondents used water purifiers at home. The majority of negative responses arise from lack of money, time, and understanding of how the purifier works. According to the data, 68.4% of all respondents reported getting their drinking water from a protected source.

The majority of respondents in all areas (86.2%) reported not having a private toilet where Tongi had the highest number of responders (110) without private toilets. While the majority of respondents reported using a separate space for toilet use (77.4%) and cleaning their toilets on a regular basis (71.8%), but the availability of hand washing facilities near or inside the latrine is very limited (57.4%). Hand washing practices varied across locations. Korail had the highest rates of respondents who washed hands before and after meals (85.9% and 85.1%, respectively). Almost all respondents (93.9%) washed their hands after visiting toilets. While washing hands after using the toilet was relatively high across all locations, washing hands after coming from outside was reported by only four out of ten respondents.

The majority of respondents reported washing their hands after various activities such as defecation (95%) and using toilets (75.6%). However, there is a difference in handwashing procedures following decomposing child excreta, with just 30.6% of all respondents.

Approximately 70.4% of all respondents reported using soap for handwashing. However, individuals who do not use soap wash their hands with only water. Approximately 47% of respondents said they disposed household waste properly. However, there is a notable difference between locations, with Korail having the highest percentage (68.5%) and Tongi the lowest (15.8%). There is a significant role of city corporation behind the higher percentage in Korail and Rayerbazar as they have proper disposal system and household wastes are collected centerally whereas Tongi has no such disposal system.

Korail overall indicated better hygiene practices compared to Rayerbazar and Tongi, which highlighted differences in infrastructure, education, socio-economic factors and targeted interventions influencing hygiene behaviors.

This study is expected to examine the Knowledge, Practice and Attitude (KAP) towards the impacts of climate variability on urban WASH facilities among slum residents of Dhaka. The overall affirmative rate of around 60% on the knowledge questions indicated that most respondents have modest knowledge on this particular aspect.

Across all locations, the majority of the respondents understood the health consequences of drinking contaminated water. A considerable portion of respondents in all areas agreed that water, sanitation, and hygiene facilities should be located in safe places to avoid risks. But there was a disparity in knowledge of respondents of Rayerbazar compared to other areas. Korail had the highest percentage of respondents agreeing to the necessity of safe water facilities, followed by Tongi, and Rayerbazar. Similar trends were observed for sanitation and hygiene facilities.

A prior study indicates that following the educational intervention, people's knowledge of WASH-related concepts improved (Mushota, Mathur, & Pathak, 2021). As observed, government and NGO interventions for sanitation and hygiene are present in Korail and Tongi. On the other hand, WASH-related efforts are limited to menstruation health awareness campaigns in Rayerbazar. This can be added as an attribute for existing discrepancies in specific aspects of knowledge in between the locations.

Stronger positive attitude towards WASH in Korail compared to the other locations surveyed was observed. In Korail, 52% of respondents believed the water they receive is safe, slightly higher than Rayerbazar (54.4%) and Tongi (46.9%). But the actual availability and perception of safe

drinking water seem to be lower. Only four out of ten respondents across all locations agreed on accessing safe drinking water. This shows how the water quality is not actually good despite the positive perception especially in Tongi.

There was a high willingness to actively participate and investigate in community initiatives aimed at improving WASH facilities with a notable difference across surveyed locations. However, this indicates a strong community engagement and mindset to contribute to improve WASH conditions overall. A study on hygiene showed community engagement fosters a sense of responsibility and peer pressure that positively influences hygiene behavior (Talat, Ravenscroft, & Vlaev, 2023). That is why communities that participate in planning, construction, and maintenance, are more likely to properly utilize and maintain the facilities (Perera, Moglia, & Glackin, 2023). Regardless the willingness to invest, their socio-economic status may pose challenges in translating this intention into tangible improvements in WASH infrastructure.

There are variations observed in WASH practices across different surveyed areas. While some practices like handwashing after defecation are widespread, others like purifying water at home and using private toilets show significant differences. Korail and Tongi exhibit higher adherence to WASH practices compared to Rayerbazar, such as preserving water in secured containers, purifying water at home, and washing hands. One of the main reasons behind this disparity in Rayerbazar is the lack of WASH-focused interventions in that area. This highlights the importance of interventions beyond just building WASH facilities (Pradhan, Mughis , Ali , Naseem, & Karmaliani , 2020). Effective multifaceted community interventions can help improving WASH practices in the urban slum areas (Musoke, Ndejjo, Halage, Kasasa, Ssempebwa, & Carpenter , 2018).

Interventions can promote necessary WASH practices by addressing user experience and maintenance. In contrast to other WASH-related practices, Tongi showed the least prevalent proper disposal of household waste compared to the other two areas. The provision of waste collection facility offered by the City Corporation in Korail and Rayerbazar justifies this difference. Discussing the challenges of stagnant WASH progress in urban slums, there is a need for evidence-based interventions (Mackinnon, et al., 2018).

5.6 Correlation and Regression Analysis

Correlation analysis: The correlation matrix provided insights into the relationships between the selected variables, using Pearson's correlation coefficients. Notably, a significant negative correlation was found between using separate sandals for toilet use (221) and shared toilet usage (219), with a coefficient of -.433** ($p \leq 0.01$), suggesting an inverse relationship. Other variables showed weak to no correlation, such as the relationship between disease incidence (203) and water purification practices (217), with a coefficient of 0.083.

These analyses, grounded in statistical rigor, indicate the complex interplay of demographic factors, WASH practices, and health outcomes within urban slums. The confidence levels, intervals, and p-values ranged across analyses, with significant findings marked by p-values less than 0.05 for correlations and regression outcomes, thereby informing the reliability and validity of the study's conclusions.

Table 8: Correlation table

	203	217	219	221
203	1			
217	0.083	1		
219	-.049	-.138**	1	
221	-0.016	0.006	-.433**	1

Regression analysis: The regression analysis focused on variable 203 (incidence of water sanitation and hygiene-related diseases) as the dependent variable, with variables 217 (water purification at home), 219 (toilet usage), and 221 (use of separate sandals for toilet) as independents. The univariate and multivariate analyses revealed Adjusted Odds Ratios (AOR) with 95% confidence intervals, demonstrating varying degrees of association. For instance, purifying water at home (217) showed an AOR of 1.361 [.950 – 1.949] in multivariate analysis, suggesting a non-significant trend towards reducing disease incidence, with p-values indicating the statistical significance levels (p=0.093).

Table 9: Regression analysis for variable 203

Variables	*Univariate*		*Multivariate*	
	AOR (95%)	P-value	AOR (95%)	P-value
217	1.401 [.983 – 1.999]	0.063	1.361 [.950 – 1.949]	0.093
219	.752 [.452 – 1.252]	.274	.719 [.404 – 1.279]	.261
221	.930 [.624 – 1.386]	.722	.828 [.529 – 1.297]	.410

*p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001

5.7 Discussion

This study is expected to examine the Knowledge, Practice and Attitude (KAP) towards the impacts of climate variability on urban WASH facilities among slum residents of Dhaka. The overall affirmative rate of around 60% on the knowledge questions indicated that most respondents have modest knowledge on this particular aspect.

Across all locations, majority of the respondents understood the health consequences of drinking contaminated water. A considerable portion of respondents in all areas agreed that water, sanitation, and hygiene facilities should be located in safe places to avoid risks. But there was a disparity in knowledge of respondents of Rayerbazar compared to other areas. Korail had the highest percentage of respondents agreeing to the necessity of safe water facilities, followed by Tongi, and Rayerbazar. Similar trends were observed for sanitation and hygiene facilities.

A prior study indicates that following the educational intervention, people's knowledge of WASH-related concepts improved (Mushota, Mathur, & Pathak, 2021). As observed, government and NGO interventions for sanitation and hygiene are present in Korail and Tongi. On the other hand, WASH-related efforts are limited to menstruation health awareness campaigns in Rayerbazar. This can be added as an attribute for existing discrepancies in specific aspects of knowledge in between the locations.

A stronger positive attitude towards WASH in Korail compared to the other locations surveyed was observed. In Korail, 52% of respondents believed the water they receive is safe, slightly higher than Rayerbazar (54.4%) and Tongi (46.9%). But the actual availability and perception of safe drinking water seem to be lower. Only four out of ten respondents across all locations

agreed on accessing safe drinking water. This shows how the water quality is not actually good despite the positive perception especially in Tongi.

There was a high willingness to actively participate and investigate in community initiatives aimed at improving WASH facilities with a notable difference across surveyed locations. However, this indicates a strong community engagement and mindset to contribute to improve WASH conditions overall. A study on hygiene showed community engagement fosters a sense of responsibility and peer pressure that positively influences hygiene behavior (Talat, Ravenscroft, & Vlaev, 2023). That is why communities that participate in planning, construction, and maintenance, are more likely to properly utilize and maintain the facilities (Perera, Moglia, & Glackin, 2023). Regardless the willingness to invest, their socio economic status may pose challenges in translating this intention into tangible improvements in WASH infrastructure.

There are variations observed in WASH practices across different surveyed areas. While some practices like handwashing after defecation are widespread, others like purifying water at home and using private toilets show significant differences. Korail and Tongi exhibit higher adherence to WASH practices compared to Rayerbazar, such as preserving water in secured containers, purifying water at home, and washing hands. One of the main reasons behind this disparity in Rayerbazar is the lack of WASH-focused interventions in that area. This highlights the importance of interventions beyond just building WASH facilities (Pradhan, Mughis , Ali , Naseem, & Karmaliani , 2020). Effective multifaceted community interventions can help improving WASH practices in the urban slum areas (Musoke, Ndejjo, Halage, Kasasa, Ssempebwa, & Carpenter , 2018).

Interventions can promote necessary WASH practices by addressing user experience and maintenance. In contrast to other WASH-related practices, Tongi showed the least prevalent proper disposal of household waste compared to the other two areas. The provision of waste collection facility offered by the City Corporation in Korail and Rayerbazar justifies this difference. Discussing the challenges of stagnant WASH progress in urban slums, there is a need for evidence-based interventions (Mackinnon, et al., 2018).

5.8 Conclusion

The findings reveal significant variations in KAP across the three surveyed slum areas. By analyzing these KAP domains, the study aimed to identify potential knowledge gaps, negative attitudes that might hinder behavior change, and existing practices that could be strengthened or promoted to enhance WASH effectiveness in the face of climate variability within the studied slum communities. Residents of Korail and Tongi, which have benefitted from WASH interventions, generally demonstrated higher knowledge, more positive attitudes, and better hygiene practices compared to Rayerbazar, where WASH interventions were limited. This emphasizes the significance of WASH initiatives that extend beyond basic infrastructure construction. To promote sustainable improvements in WASH practices, effective initiatives should focus on user experience, include educational components, and encourage community engagement.

CHAPTER 6: VARIATIONS OF THE IMPACT OF CLIMATE VARIABILITY ON THE WASH-FOCUSED INTERVENTION AND NON-INTERVENTION SLUM

6.1 Introduction

This chapter focuses on the respondents' perceptions of changes in temperature and rainfall patterns over the past five years. This study subsequently investigates the impact of these perceived changes on their WASH practices and overall health. The study conducted a survey to assess the residents' perceptions of the variations in temperature and rainfall patterns that have occurred in the last five years. Additionally, the study examined the resulting effects on their WASH practices and health. These findings compared WASH specific intervention (Korail and Tongi) and non-intervention (Rayerbazar) areas to assess the potential benefits of WASH programs in mitigating climate-related challenges.

6.2 Perceived Changes in Temperature and Impact on WASH

In Korail, out of 248 respondents, 96.37% (239) reported that the temperature of their area has changed in the last 5 years, while only 3.63% (9) said it has not. In Rayerbazar, among 101 respondents, 89.11% (90) stated that the temperature has changed, while 10.89% (11) said it has not. In Tongi, out of 151 respondents, 69.54% (105) reported a change in temperature, while 30.46% (46) said it has not.

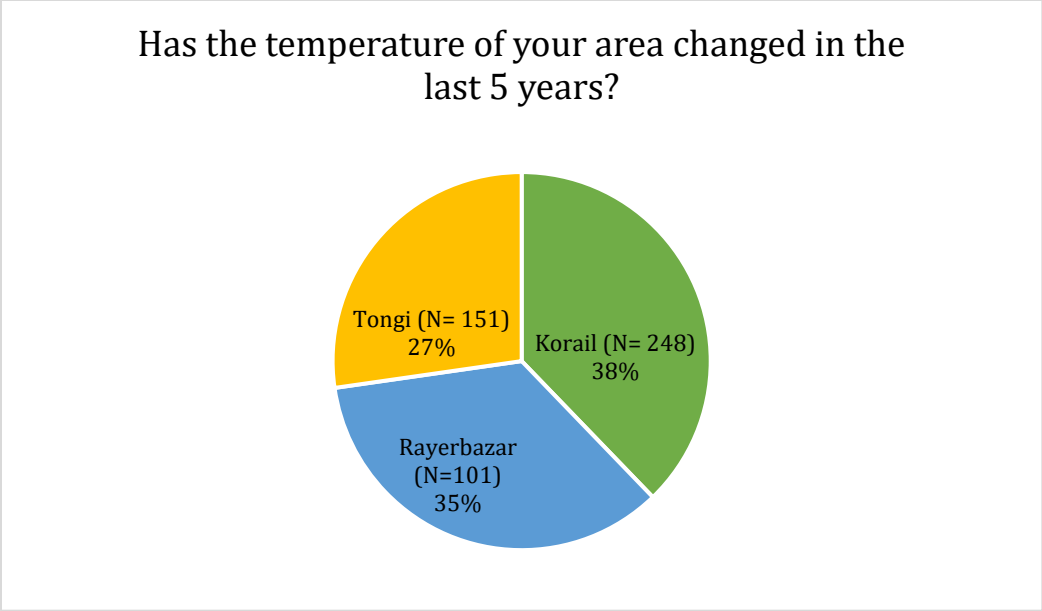


Figure 2: Perceptions on changing temperature

Approximately 59.4% of respondents across all three areas reported noticing scarcity regarding the availability of drinking water due to increased temperature.

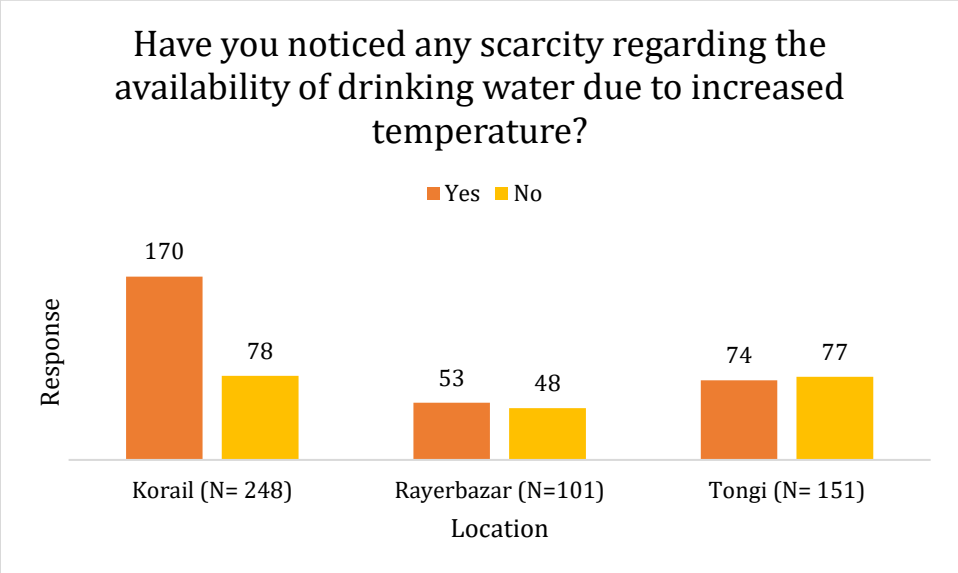


Figure 3: Impact of perceived temperature on water availability

In Korail, out of 248 respondents, 170 noticed scarcity in drinking water due to increased temperature, while 78 did not. In Rayerbazar, among 101 respondents, 53 noticed scarcity, while 48 did not. In Tongi, out of 151 respondents, 74 noticed scarcity, while 77 did not.

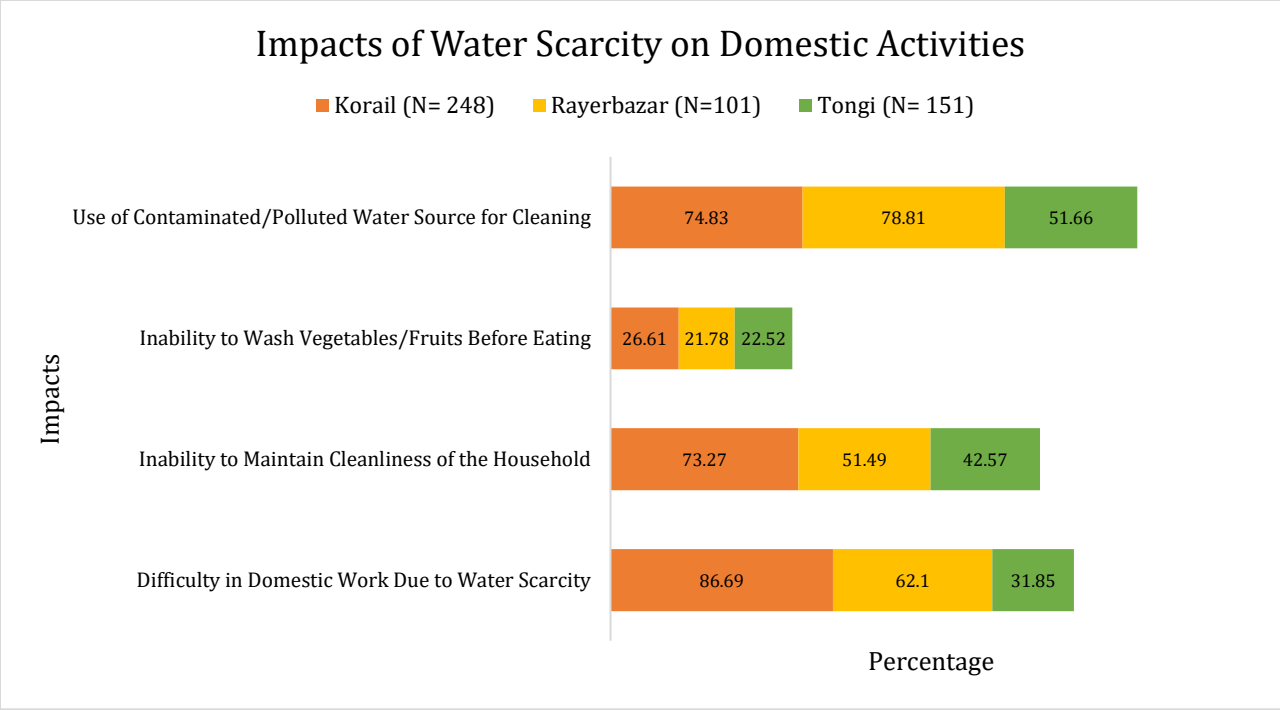


Figure 4: Impact of perceived temperature on domestic activities

The data underscores the profound impacts of water scarcity on various aspects of domestic life across surveyed areas, with a total of 500 respondents. Firstly, a significant proportion of respondents in Korail, Rayerbazar and Tongi reported facing difficulties in domestic work due to water scarcity, with 215 out of 248 respondents (86.69%), 74 out of 101 respondents (73.27%), and 113 out of 151 respondents (74.83%), respectively. Moreover, the inability to maintain household cleanliness was prevalent, affecting 154 out of 248 respondents (62.1%) in Korail, 52 out of 101 respondents (51.49%) in Rayerbazar and 119 out of 151 respondents (78.81%) in Tongi. Furthermore, challenges in washing vegetables and fruits before consumption were evident, with 66 out of 248 respondents (26.61%), 22 out of 101 respondents (21.78%) and 34 out of 151 respondents (22.52%) in Korail, Rayerbazar, and Tongi, respectively, facing this issue. Additionally, there's a concerning trend of resorting to contaminated or polluted water sources for cleaning purposes, affecting 79 out of 248 respondents (31.85%) in Korail, 43 out of 101 respondents (42.57%) in Rayerbazar and 78 out of 151 respondents (51.66%) in Tongi.

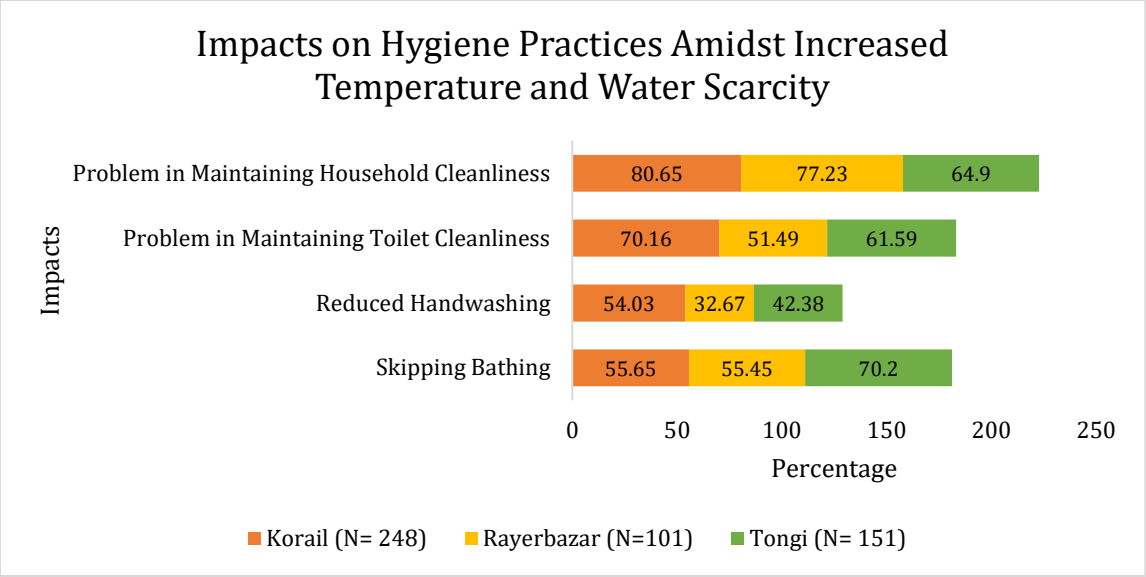


Figure 5: Impact of perceived temperature on hygiene practices

The data reveals significant challenges in maintaining hygiene practices amidst water scarcity across Korail, Rayerbazar, and Tongi. Skipping bathing is reported by a considerable number of respondents in all areas, with 55.65% in Korail, 55.45% in Rayerbazar and 70.20% in Tongi. Reduced handwashing is also evident, with percentages reaching 54.03% in Korail, 32.67% in Rayerbazar and 42.38% in Tongi. Moreover, respondents across all areas face difficulties in maintaining toilet cleanliness, as reported by 70.16% in Korail, 51.49% in Rayerbazar and 61.59% in Tongi. Additionally, maintaining household cleanliness proves challenging, with percentages of 80.65% in Korail, 77.23% in Rayerbazar and 64.90% in Tongi.

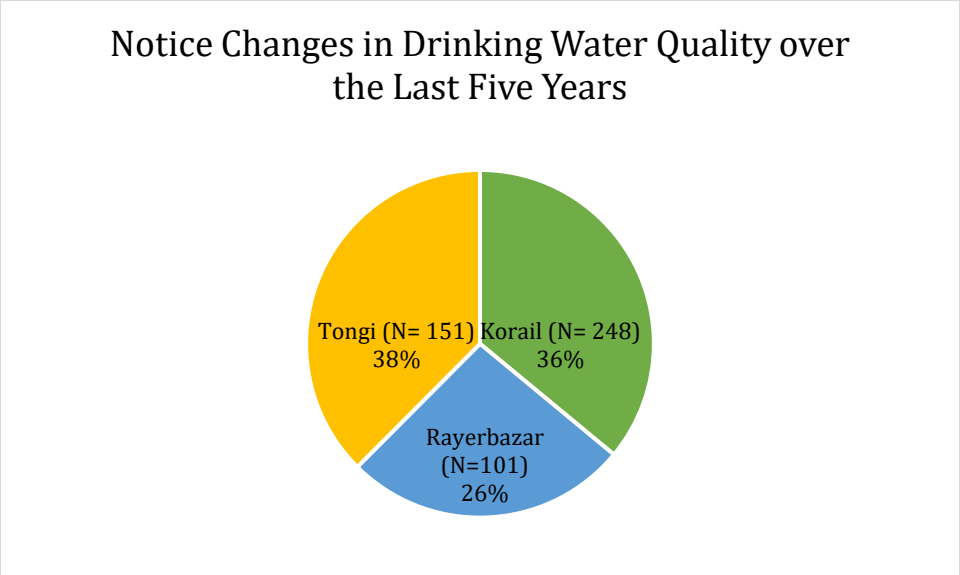


Figure 6: Impact of perceived temperature on drinking water quality

The data reflects perceptions regarding changes in drinking water quality over the last five years across Korail, Rayerbazar, and Tongi. In Korail, out of 248 respondents, 167 (67.34%) reported noticing a change in drinking water quality, while 81 (32.66%) did not. Similarly, in Rayerbazar, 50 respondents out of 101 (49.50%) noticed a change, while 51 (50.50%) did not. In Tongi, 106 out of 151 respondents (70.20%) observed a change, whereas 45 (29.80%) did not. While a majority of respondents in Korail and Tongi noticed changes, the perception was more evenly split in Rayerbazar.

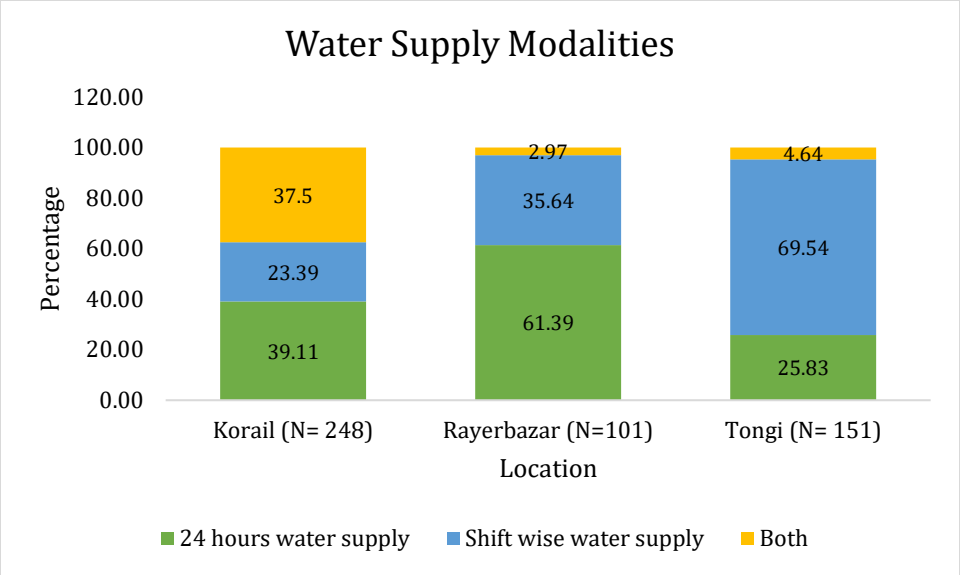


Figure 7: Water supply modalities in three distinct locations

Across the surveyed areas, water supply is primarily distributed through different modalities. In Korail, the most common modality is shift-wise water supply, with 58 respondents (23.39%), followed closely by 24-hour water supply with 97 respondents (39.11%). A smaller portion, 93 respondents (37.50%), reported receiving water through both modalities. In Rayerbazar, the distribution is somewhat similar, with 36 respondents (35.64%) receiving shift-wise water supply, 62 respondents (61.39%) receiving 24-hour water supply and only 3 respondents (2.97%) receiving water through both modalities. In Tongi, the distribution differs slightly, with 105 respondents (69.54%) receiving shift-wise water supply, 39 respondents (25.83%) receiving 24-hour water supply and 7 respondents (4.64%) receiving water through both modalities.

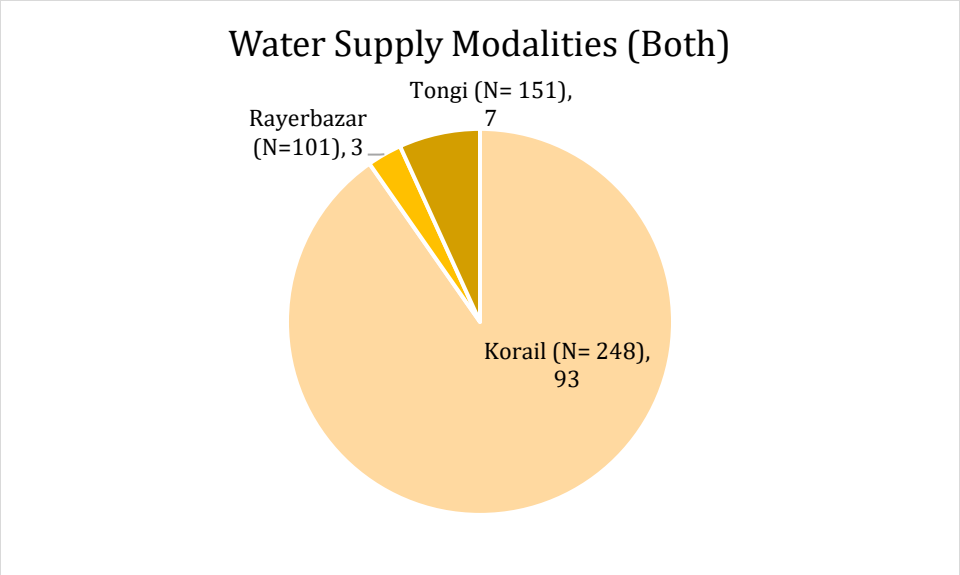


Figure 8: Water supply modalities in terms of shift-wise supply and 24 hours supply

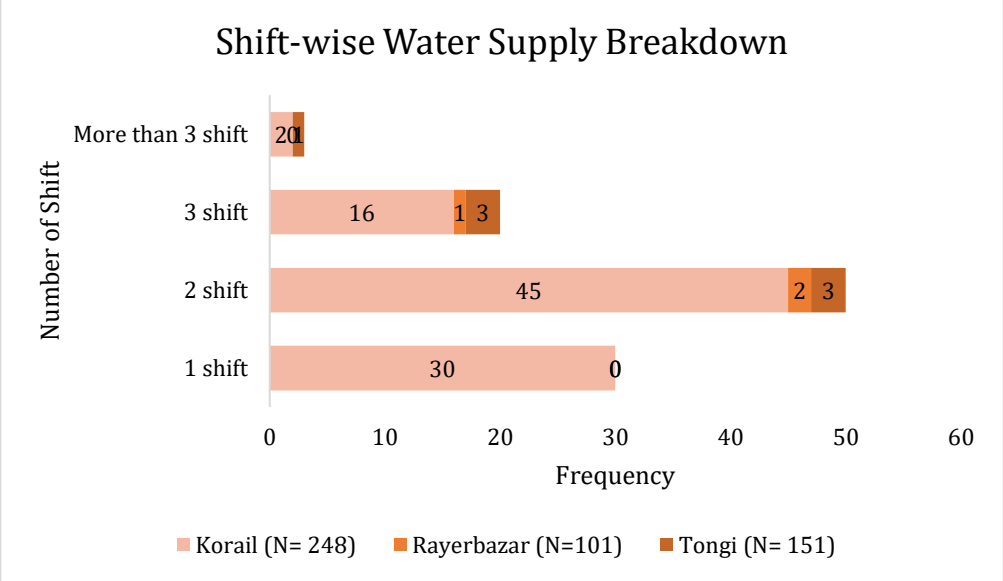


Figure 9: Shift-wise water supply

In Korail, 30 respondents reported receiving water supply for one shift, 45 for two shifts, 16 for three shifts, and 2 for more than three shifts. In Rayerbazar, none of the respondents reported receiving water supply for one shift, 2 for two shifts, 1 for three shifts, and none for more than three shifts. In Tongi, none of the respondents reported receiving water supply for one shift, 3 for two shifts, 3 for three shifts, and 1 for more than three shifts.

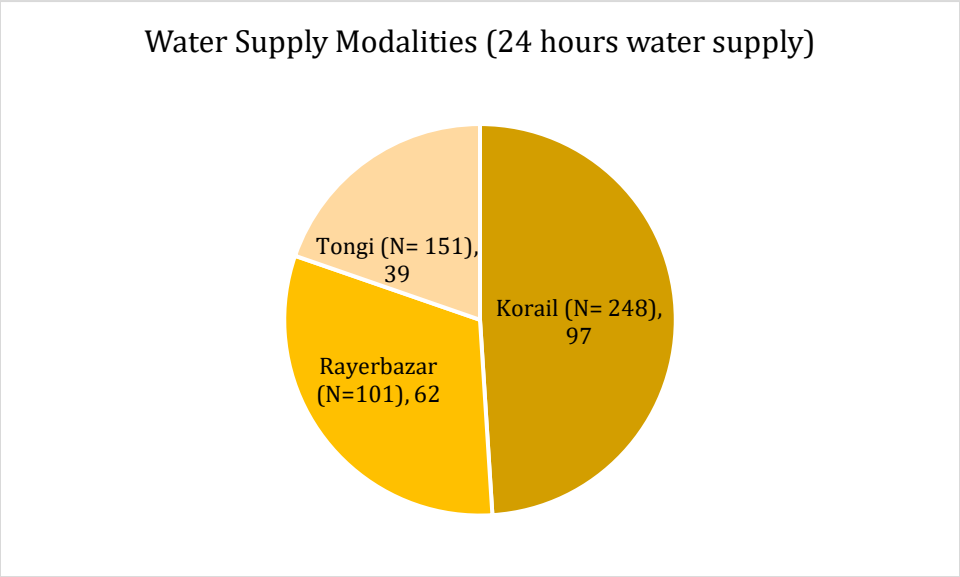


Figure 10: 24 hours water supply

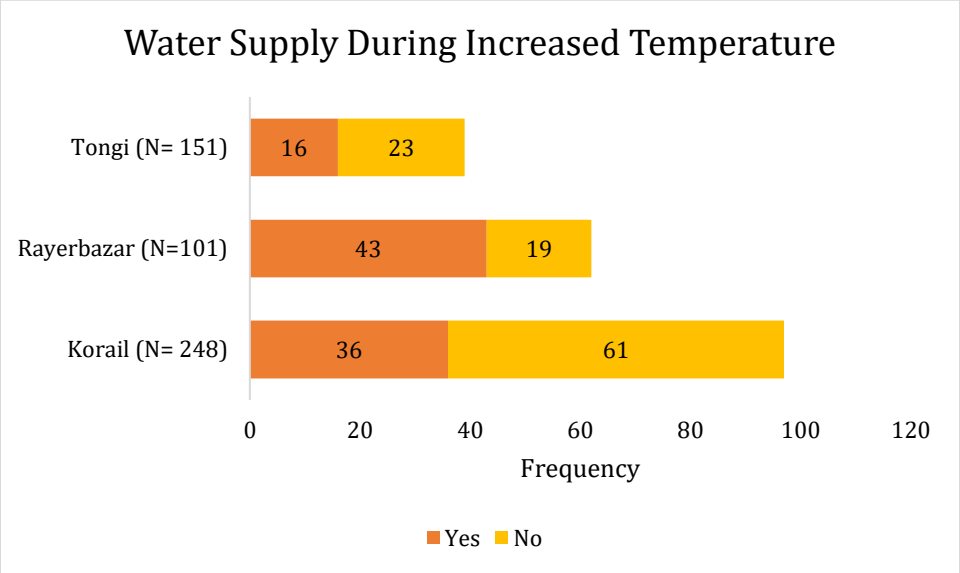


Figure 11: 24 hours water supply during increased temperature

In Korail, out of a total of 97 respondents, 61 reported not receiving 24/7 water during increased temperature periods, while 36 respondents stated that they did receive continuous water supply.

In Rayerbazar, out of 62 respondents, 19 reported not receiving 24/7 water during increased temperature periods, while 43 respondents reported receiving continuous water supply. Similarly, in Tongi, out of 39 respondents, 23 reported not receiving 24/7 water during increased temperature periods, while 16 respondents reported receiving continuous water supply.

The data presents respondents' perceptions regarding the cause of not receiving 24/7 water during increased temperature periods across Korail, Rayerbazar, and Tongi. In Korail, out of 61 respondents facing the issue, 14 did not attribute it to increased temperature, while 47 believed it was due to increased temperature. In Rayerbazar, out of 19 respondents, 2 did not associate the problem with increased temperature, while 17 did. Similarly, in Tongi, out of 23 respondents, 5 did not link the issue to increased temperature, while 18 did.

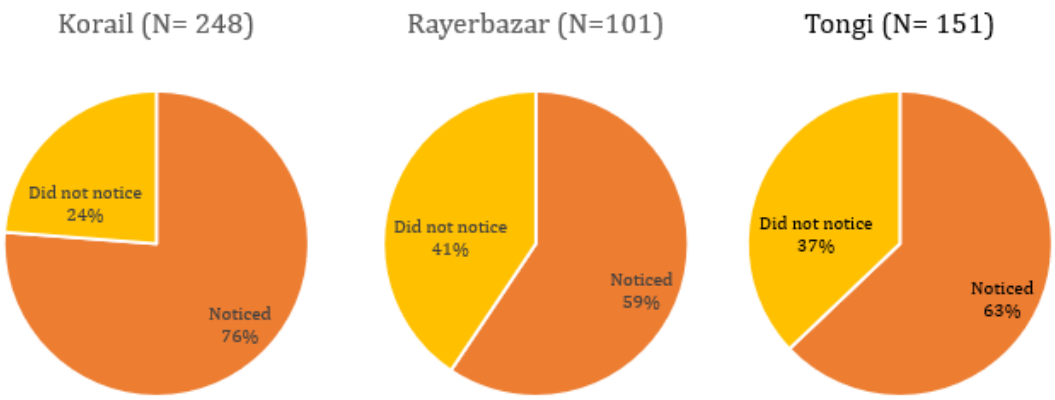


Figure 12: Prevalence of water-borne diseases

The data indicates respondents' observations regarding the prevalence of water-borne diseases during periods of high temperatures across Korail, Rayerbazar, and Tongi. In Korail, 76.21% (189 out of 248) of respondents noticed the prevalence of water-borne diseases during high temperatures, while 23.79% (59 out of 248) did not. Similarly, in Rayerbazar, 59.41% (60 out of 101) noticed the prevalence, and 40.59% (41 out of 101) did not. In Tongi, 62.91% (95 out of 151) noticed the prevalence, while 37.09% (56 out of 151) did not.

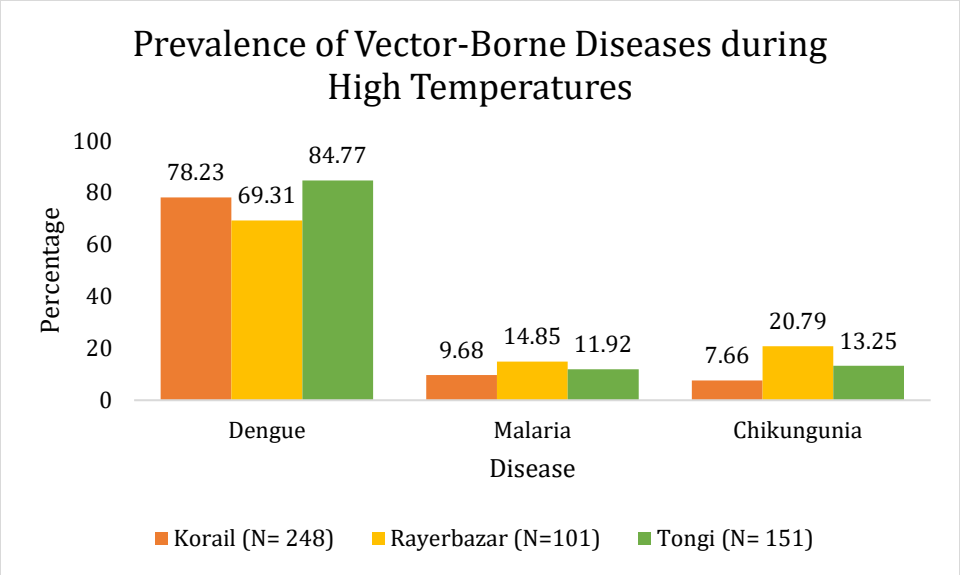


Figure 13: Prevalence of vector-borne diseases

The graph illustrates the prevalence of vector-borne diseases, including Dengue, Malaria, and Chikungunya, during high temperatures across Korail, Rayerbazar, and Tongi. In Korail, 78.23% (196 out of 248) of respondents reported Dengue, 9.68% (24 out of 248) reported Malaria and 7.66% (19 out of 248) reported Chikungunya. In Rayerbazar, 69.31% (70 out of 101) reported Dengue, 14.85% (15 out of 101) reported Malaria and 20.79% (21 out of 101) reported Chikungunya. In Tongi, 84.77% (128 out of 151) reported Dengue, 11.92% (18 out of 151) reported Malaria and 13.25% (20 out of 151) reported Chikungunya. These findings indicate that Dengue is the most prevalent vector-borne disease across all areas during high temperatures, followed by Malaria and Chikungunya.

6.3 Perceived Changes in Rainfall and Impact on WASH

The data reveals respondents' perceptions regarding changes in rainfall patterns over the last five years across Korail, Rayerbazar, and Tongi. Approximately 77.2% of respondents across all three areas reported a change in rainfall pattern over the last 5 years.

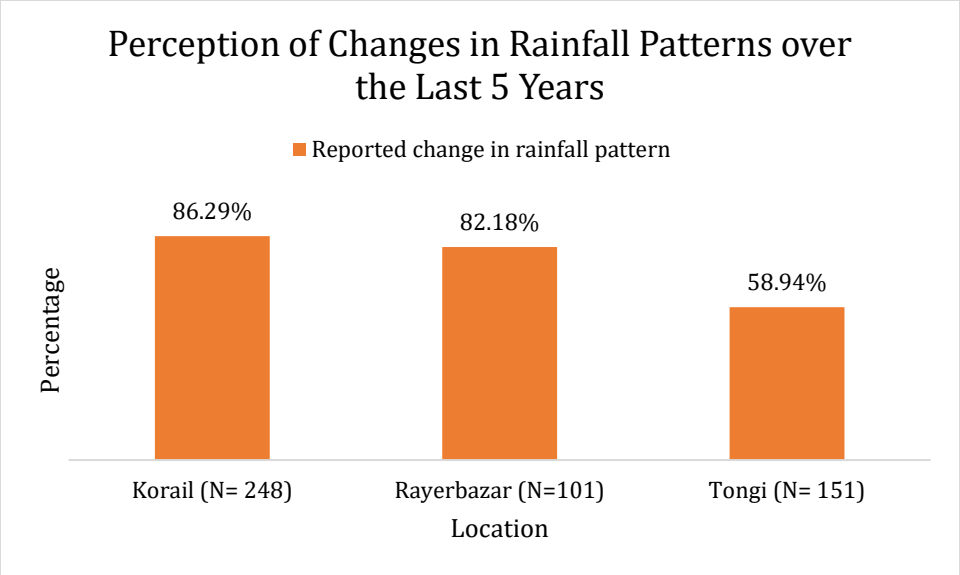


Figure 14: Perceptions on erratic rainfall

In Korail, 86.29% respondents reported a change in rainfall patterns, while 13.71% did not. Similarly, in Rayerbazar, 82.18% repondents noticed a change, while 17.82% did not. In Tongi, 58.94% respondents observed a change, while 41.06% did not. These findings suggest a widespread perception of changes in rainfall patterns across all areas, particularly notable in Korail and Rayerbazar, with the majority of respondents reporting alterations in precipitation trends over the past five years.

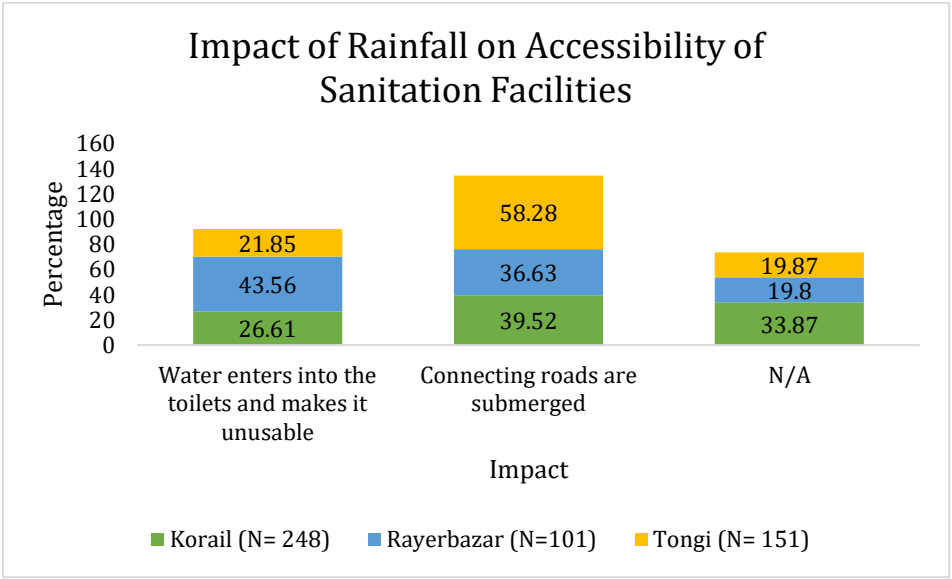


Figure 15: Impact of erratic rainfall on the accessibility of sanitation facilities

The graph reveals the impact of rainfall on sanitation facilities accessibility across Korail, Rayerbazar, and Tongi. In Korail, 26.61% of respondents reported water entering toilets, while 39.52% mentioned submerged roads. Moreover, 33.87% stated they experienced neither water entering toilets nor submerged roads. Similarly, in Rayerbazar, 43.56% reported water entering toilets, with 36.63% mentioning submerged roads and 19.80% not experiencing either. In Tongi, 21.85% reported water entering toilets, 58.28% mentioned submerged roads and 19.87% experienced neither. In Korail, despite facing submerged roads during rainfall, the water dissipates within a short span, alleviating the issue. In contrast, Tongi experiences prolonged periods of water accumulation in submerged roads, exacerbating the problem and amplifying its prevalence in the area.

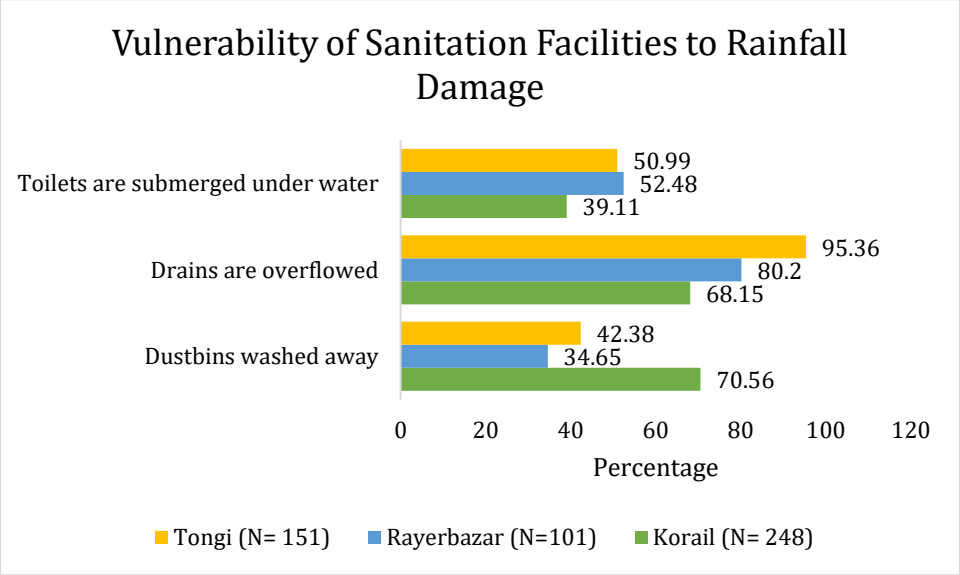


Figure 16: Vulnerability of sanitation facilities due to erratic rainfall

The graph illustrates the percentage of respondents reporting vulnerability of sanitation facilities to rainfall-induced damage or contamination across Korail, Rayerbazar and Tongi. In Korail, 70.56% reported dustbins being washed away, 68.15% reported drain overflow, and 39.11% reported toilets being submerged. In Rayerbazar, 34.65% reported dustbin washouts, 80.20% reported drain overflow and 52.48% reported submerged toilets. In Tongi, 42.38% of respondents reported dustbin washouts, likely due to inadequate waste management practices, with waste being disposed of onto nearby streets. This improper waste disposal contributes to blockages in the drainage system, resulting in 95.36% reporting drain overflow during rainfall, indicating

severe challenges in drainage infrastructure. Furthermore, 50.99% reported submerged toilets, highlighting significant sanitation vulnerabilities exacerbated by rainfall events.

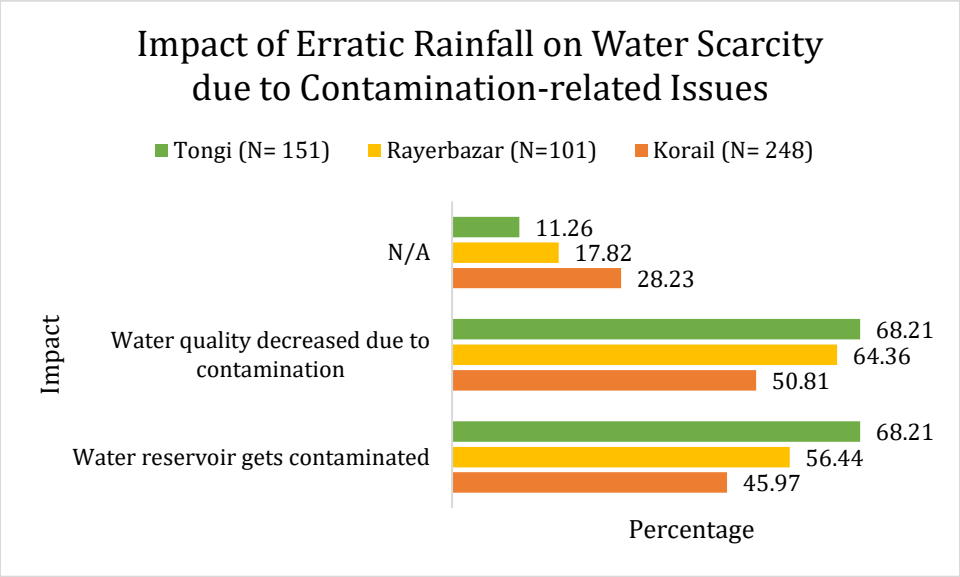


Figure 17: Impact of erratic rainfall on water quality

The data reveals the impact of erratic rainfall on water scarcity due to contamination-related issues across Korail, Rayerbazar, and Tongi. In Korail, 45.97% of respondents reported water reservoir contamination, likely caused by water overflowing and compromising its purity, while 50.81% reported a decrease in water quality, possibly due to pipe leakage leading to unpleasant odors or taste. Notably, 28.23% marked N/A, indicating they experienced neither water reservoir contamination nor decreased water quality. In Rayerbazar, 56.44% identified water reservoir contamination, likely from water overflow, and 64.36% reported decreased water quality, including issues with taste or odor potentially caused by pipe leakage. Additionally, 17.82% marked N/A. In Tongi, 68.21% highlighted water reservoir contamination, possibly due to overflow during rainfall, and 68.21% reported decreased water quality, including unpleasant odors or taste possibly resulting from pipe leakage. Furthermore, 11.26% marked N/A, indicating they experienced neither water reservoir contamination nor decreased water quality.

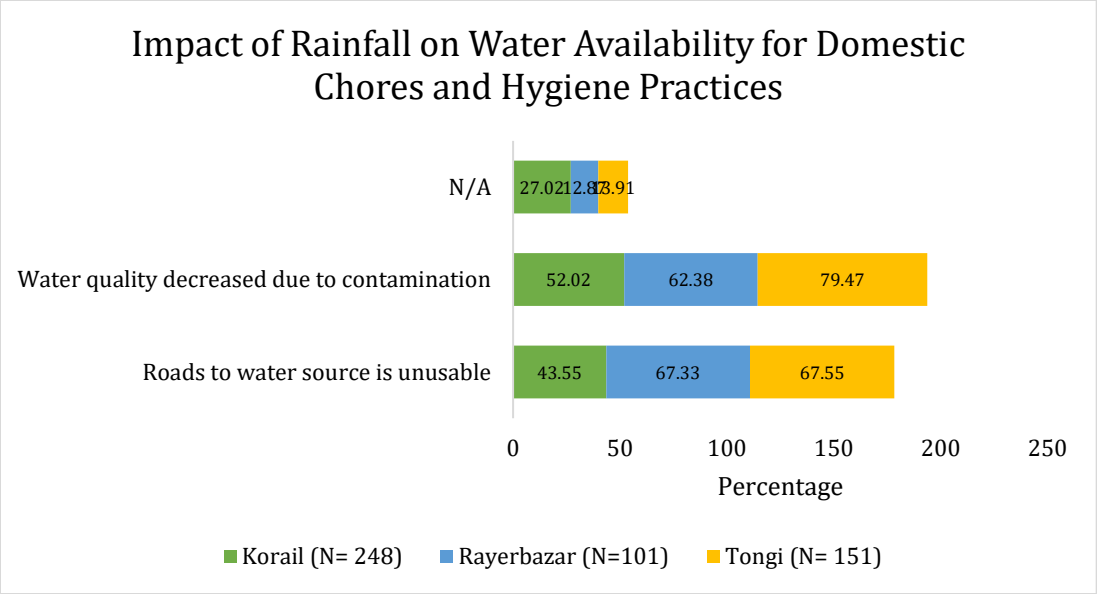


Figure 18: Impact of erratic rainfall on water availability for domestic chores

The graph illustrates the percentage of respondents reporting the impact of rainfall on water availability for domestic chores and hygiene practices across Korail, Rayerbazar and Tongi. In Korail, 43.55% reported unusable roads to water sources, while 52.02% noted decreased water quality due to contamination, with 27.02% marking "N/A". In Rayerbazar, 67.33% reported unusable roads and 62.38% noted decreased water quality, with 12.87% marking "N/A". In Tongi, 67.55% highlighted unusable roads and 79.47% reported decreased water quality, with 13.91% marking "N/A".

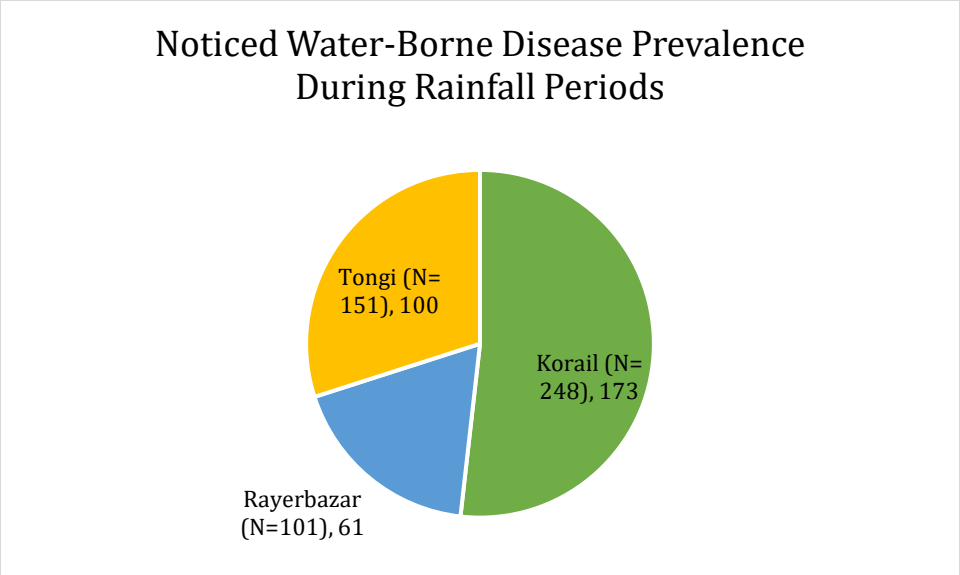


Figure 19: Prevalence of water borne diseases due to erratic rainfall

The graph reveals the frequency of respondents' observations regarding the prevalence of water-borne diseases during periods of rainfall across Korail, Rayerbazar and Tongi. In Korail, 173 out of 248 respondents reported noticing water-borne diseases during rainfall, while in Rayerbazar, 61 out of 101 respondents reported the same. Similarly, in Tongi, 100 out of 151 respondents observed the prevalence of water-borne diseases during rainfall.

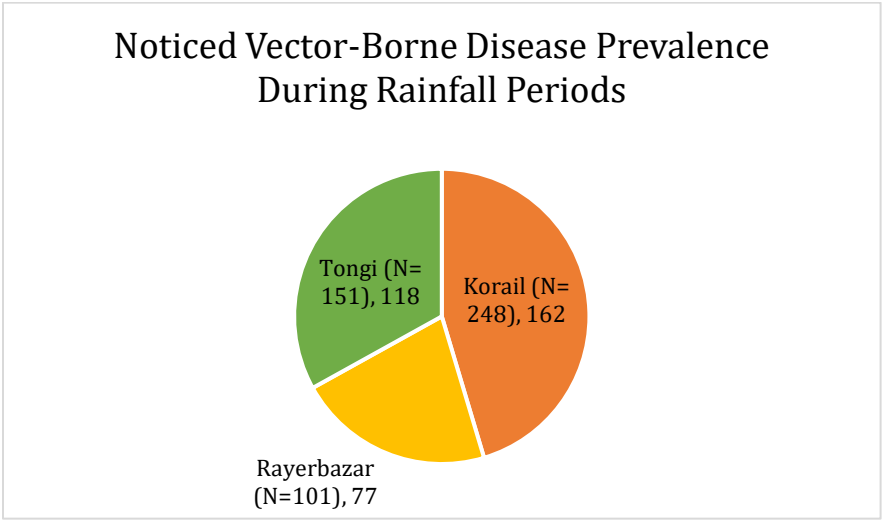


Figure 20: Prevalence of vector-borne diseases due to erratic rainfall

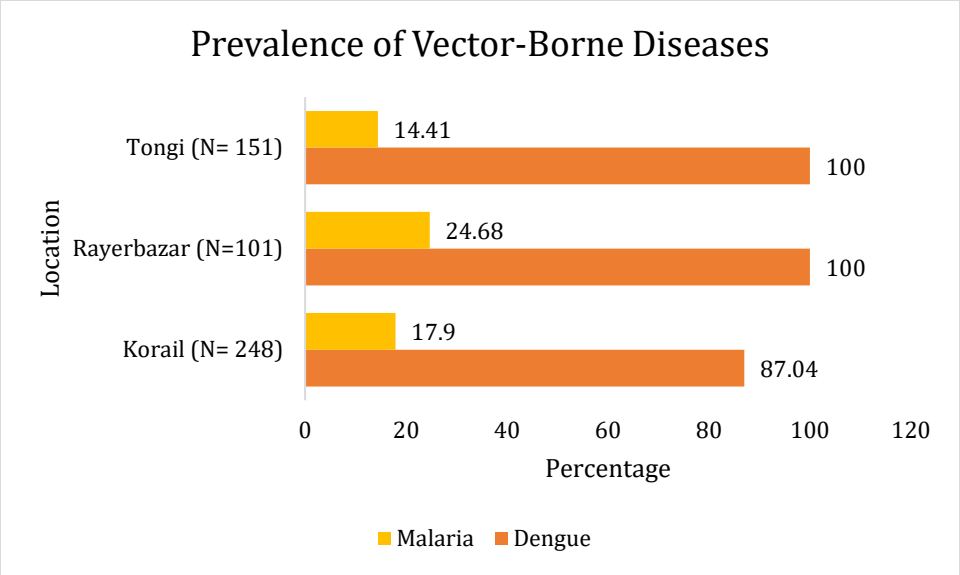


Figure 21: Types of prevalent vector-borne diseases due to erratic rainfall

The data provides insights into the prevalence of vector-borne diseases due to rainfall across Korail, Rayerbazar, and Tongi, as well as the specific diseases prevailing in these areas. Out of 248 respondents in Korail, 162 (65.32%) noticed the prevalence of vector-borne diseases, followed by 77 out of 101 respondents (76.24%) in Rayerbazar and 118 out of 151 respondents (78.15%) in Tongi. Among those who noticed the prevalence of such diseases, dengue was reported by 141 respondents in Korail (87.04%), 77 respondents in Rayerbazar (100%) and 118 respondents in Tongi (100%). Malaria, on the other hand, was reported by 29 respondents in Korail (17.90%), 19 respondents in Rayerbazar (24.68%) and 17 respondents in Tongi (14.41%). These findings underscore the significant impact of rainfall on the prevalence of vector-borne diseases, particularly dengue, across the surveyed areas.

438 out of 500 respondents (87.6%) reported experiencing waterlogging and flooding due to erratic rainfall across all surveyed areas. The data reveals that in Korail, 87.10% of respondents reported experiencing waterlogging and flooding due to erratic rainfall, while in Rayerbazar, 88.12% reported the same. Similarly, in Tongi, 88.08% of respondents reported being affected by waterlogging and flooding during erratic rainfall.

Approximately 80.4% of respondents reported that erratic rainfall negatively affects waste management practices. In Korail, 79.44% of respondents reported negative effects, while in

Rayerbazar, 65.35% expressed similar concerns. Tongi showed the highest percentage, with 91.39% of respondents citing adverse impacts on waste management due to erratic rainfall.

6.4 Discussion

The data presented paints a vivid and intricate picture of the multifaceted impacts of climate variability, particularly erratic rainfall patterns, on the water, sanitation, and hygiene (WASH) conditions in urban slum areas such as Korail, Rayerbazar, and Tongi. These locales, emblematic of many urban slums worldwide, stand particularly vulnerable to the adverse effects of climate change due to their inherent characteristics of poor infrastructure, high population density, and limited access to resources.

A significant majority of respondents in all three regions surveyed had clearly seen temperature fluctuations over the past five years. The statistics are startlingly high 96.37% in Korail, 89.11% in Rayerbazar, and 69.54% in Tongi underscoring the visceral reality of shifting climatic trends. These changes, particularly in temperature, have been a long-term experience for the groups studied. These temperature changes have far-reaching consequences, particularly for drinking water supplies. The data show how these variations have created significant barriers that prevent easy access to a basic necessity: clean water. Nearly 60% of respondents from all regions expressed concern and directly linked their challenges to rising temperatures.

This highlights an important link between climate unpredictability and the availability of critical resources. As temperatures rise, so does the demand for water, exacerbating existing problems in water supply and distribution systems. The consequences go far beyond ordinary inconvenience, penetrating many facets of daily life and exacerbating the vulnerability of these communities. It is a stark reminder of the complex interplay between climate dynamics and basic human needs, and underscores the critical need for proactive action to address these issues (Purohit, 2024).

Water scarcity has far-reaching consequences and casts a shadow over every aspect of daily life in these communities. A significant proportion of respondents, ranging from 73.27% to 86.69% in all the areas surveyed, expressed their dismay at the difficulties they have experienced in carrying out even the simplest domestic tasks as a result of acute water shortages. This common

attitude underscores the universality of the problems encountered, which transcend geographical boundaries and affect the lives of countless people in urban slums.

The inability to obtain an adequate amount of water severely affects the delicate balance of domestic activities and disrupts the rhythm of daily life. Maintaining adequate standards of cleanliness and hygiene in the home becomes a Herculean task under such conditions, as simple tasks such as washing vegetables and fruits or ensuring clean water for general cleaning purposes become burdensome and fraught with difficulties. The frustration and desperation caused by these problems resonate deeply within these communities as people cope with the harsh reality of limited access to a basic resource needed for nutrition and cleanliness (*Sanitation*, 2024).

Indeed, the effects of water scarcity go far beyond inconvenience, penetrating the fundamental fabric of daily life and taking a toll on physical health, emotional well-being, and overall quality of life. The threat of inadequate access to water casts a long shadow, exacerbating vulnerabilities and inequalities among already vulnerable populations. It underscores the urgent need for comprehensive action to address the underlying causes of water scarcity and to ensure equitable access to this vital resource for all members of society. Only by working together to address these structural issues can we expect to reduce the burden on those most affected and pave the way for a more sustainable and resilient future.

The diverse perspectives on changes in drinking water quality over the past half-decade provide a fascinating glimpse into the complex terrain of water, sanitation, and hygiene (WASH) conditions in these urban slums (Lai, 2022). The findings reveal a mosaic of perspectives that represent the nuances of the local environments in Korail, Rayerbazar, and Tongi.

In Korail and Tongi, the majority of respondents reported seeing changes in the quality of drinking water over the time period indicated. This agreement reflects a common experience of change among locals, indicating a noticeable difference in the quality of the water supply. These impressions are most likely the result of direct experience with differences in taste, odor, or clarity of the water, forcing people to notice and recognize the changing character of their drinking water.

In contrast, the opinions expressed in Rayerbazar reveal a more divided landscape. Respondents' perspectives on changes in drinking water quality are evenly divided, indicating a lack of consensus or unanimity about the reported changes. This variation raises important concerns about the underlying processes that influence these different views. It suggests possible differences in water quality management techniques or infrastructure adequacy among the sites studied.

Indeed, the causes of these different impressions could be multiple. They could represent inequalities in the geographic location of water sources, changes in the quality of treatment and distribution systems, or discrepancies in community understanding and participation in water quality issues. In addition, socioeconomic considerations such as access to alternative water sources or the availability of water treatment technology may influence people's views on drinking water quality. This diversity of perspectives underscores the importance of a nuanced and context-specific approach to addressing water quality issues in urban slums. It underscores the importance of personalized solutions that take into account the specific socio-economic, infrastructural, and environmental issues at play in each community. Policymakers and practitioners can strive to improve water quality management techniques, increase infrastructure resilience, and enhance community empowerment and participation in WASH efforts by identifying and addressing the underlying drivers of diverse attitudes. Ultimately, only through such comprehensive and context-sensitive methods can long-term progress be made in ensuring safe and reliable drinking water for all urban slum dwellers (Nachibi & Morgan, 2022).

The distribution of water delivery modalities provides important insights into the complicated dynamics that govern water availability in urban slums. While shift and 24-hour water supply systems emerged as the most popular options, a significant number of respondents in each location expressed dissatisfaction with the lack of continuous water supply during periods of high temperatures, blaming climate change. This disparity underscores the difficulty of ensuring continuous water access in the face of changing environmental conditions, as well as the need for more robust and adaptable water supply infrastructure and management approaches (Hossain, 2021).

The results clearly show a link between climatic unpredictability and negative health outcomes, particularly in terms of vector-borne diseases. Dengue fever is the most common disease in all locations studied, followed by malaria and chikungunya. Erratic rainfall exacerbates these problems by complicating waste management systems, causing waterlogging and flooding, and exacerbating pre-existing health risks. These findings highlight the complex interactions between climatic variables, environmental conditions, and public health hazards, and underscore the critical need for comprehensive strategies to reduce the impact of climate variability on human health in urban slums.

In summary, the data demonstrate the strong link between climate variability and its significant impact on water, sanitation and hygiene (WASH) practices in urban slums. The data underscore the critical need for comprehensive interventions to address these challenges, including improvements in water infrastructure to ensure reliable access to clean water, improvements in sanitation to reduce health risks, improvements in waste management systems to prevent environmental contamination, and the implementation of robust public health initiatives to protect vulnerable communities. Only through coordinated and focused efforts on many fronts can we expect to successfully mitigate the negative impacts of climate change on the most disadvantaged and vulnerable sectors of our society, ultimately leading to the creation of more resilient and sustainable urban environments for all (WEHREY & DARGIN, 2023).

6.5 Conclusion

This study reveals how climate variability disrupts WASH practices in urban slums. Increased temperatures worsen water scarcity, affecting access to clean water for drinking, hygiene, and domestic activities, which in turn harms overall health. Erratic rainfall exacerbates the challenges faced by sanitary infrastructure and waste management, leading to higher health hazards due to waterlogging and flooding. This study emphasizes the need for comprehensive interventions to address the impacts of climate variability on WASH practices. These should include enhancing water and sanitation infrastructure, improving waste management systems, and increasing community awareness on climate change, water conservation, hygiene, and waste disposal. By incorporating these approaches, it is possible to enhance the ability to withstand and recover from challenges and protect the health and well-being of slum residents.

CHAPTER 7: COPING AND ADAPTATION STRATEGIES: ADDRESSING WASH CHALLENGES IN RESPONSE TO CLIMATE VARIABILITY

8.1 Introduction

This chapter investigates the coping and adaptation strategies related to WASH practices in three urban slum areas: Korail, Rayerbazar, and Tongi. The primary objective is to explore how residents manage WASH challenges amidst climate variability and to identify differences in these strategies between slums with and without WASH specific interventions. The research aims to explore community perspectives on the effectiveness of WASH interventions, individual strategies for adaptation, and the overall household and community responses to climate variability. The study demonstrates that there are different levels of presence and satisfaction with WASH interventions in the slums. Korail has a high level of community satisfaction due to significant interventions, while Rayerbazar, which has limited interventions, and Tongi, which has moderate intervention levels, have corresponding levels of satisfaction.

8.2 Community Perceptions of WASH Intervention Effectiveness

The data presents responses from surveys conducted in three areas (Korail, Rayerbazar, and Tongi) regarding WASH interventions initiated by NGOs or GOs. Results show varying levels of intervention presence and satisfaction. In Korail, a substantial intervention presence of 79.8% was reported, indicative of a robust engagement with WASH initiatives. This high prevalence aligns with notable levels of satisfaction, as evidenced by 19 respondents expressing being very satisfied and 122 indicating satisfaction with the interventions. Conversely, in Rayerbazar, the intervention presence was comparatively lower at 24.8%. Despite this, satisfaction among respondents was still evident, with 5 respondents expressing being very satisfied and 12 reporting satisfaction with the interventions. In Tongi, the intervention presence falls between Korail and Rayerbazar, standing at 64.9%. Similar to Korail and Rayerbazar, satisfaction levels

were observed among respondents, with 4 respondents indicating being very satisfied and 36 reporting satisfaction with the interventions.

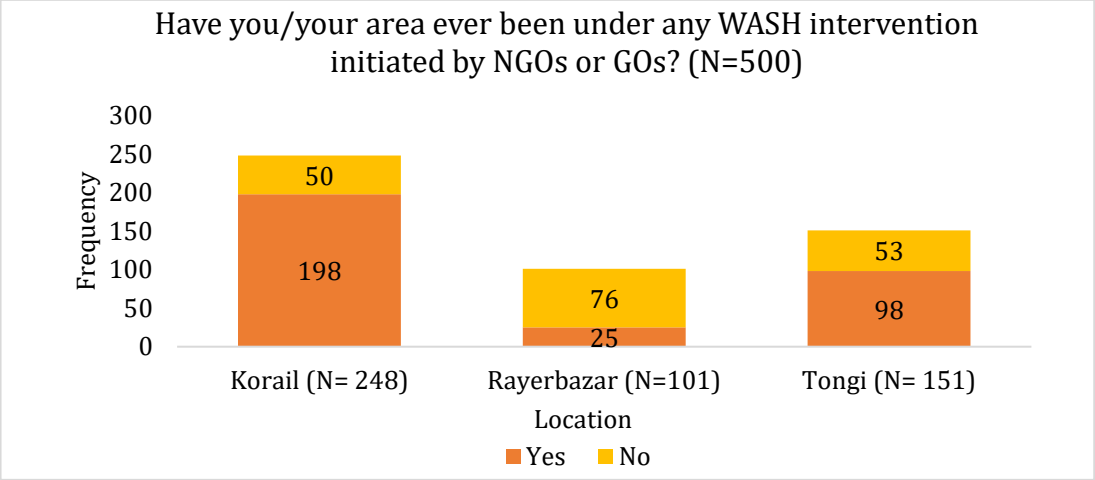


Figure 22: Number of WASH related intervention

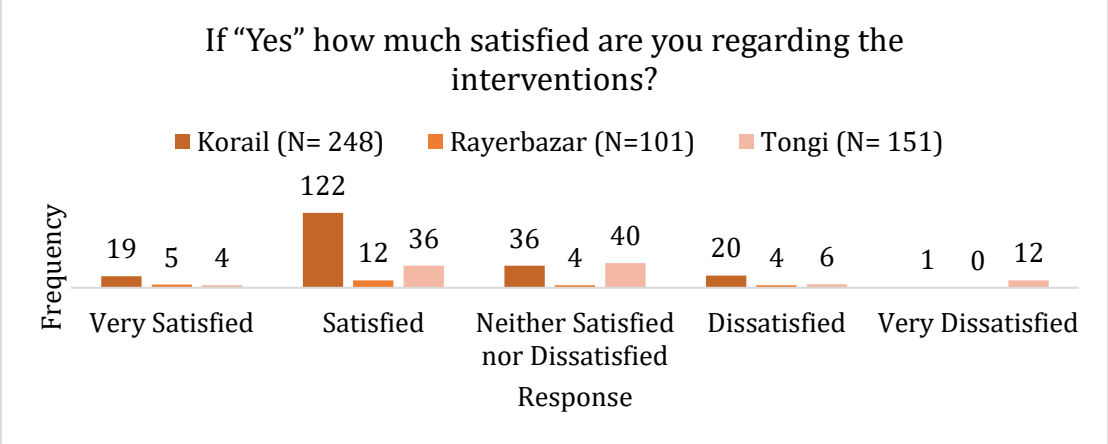


Figure 23: Levels of satisfaction on the WASH related intervention

8.2 Individual Adaptation Initiatives to WASH Issues

The chart depicts the frequency of responses to different methods of overcoming drinking water scarcity across three locations: Korail, Rayerbazar and Tongi. The most popular method was reserving water during supply, chosen by 298 respondents, followed closely by purchasing water with 279 respondents. Purifying contaminated water and drinking contaminated water were also commonly selected, with 58 and 31 respondents respectively. Other methods such as harvesting rainwater, drinking less water, collecting water from the neighborhood, and reporting no scarcity received fewer responses.

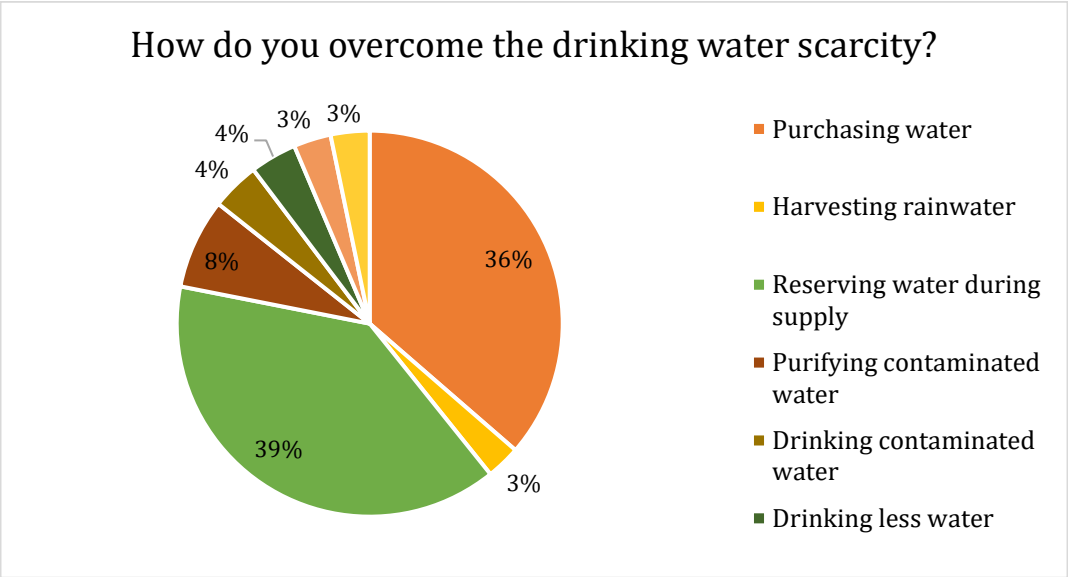


Figure 24: Methods used by total residents to overcome drinking water scarcity

The chart presents responses from three distinct locations (Korail, Rayerbazar and Tongi) regarding strategies for addressing drinking water scarcity. In Korail (N=248), the most prevalent method chosen was purchasing water, with 168 respondents, followed by reserving water during supply with 176 respondents. Other methods included purifying contaminated water (30 respondents), drinking contaminated water (16 respondents), and drinking less water (24 respondents). In Rayerbazar (N=101), purchasing water was also the most common method, selected by 54 respondents, while harvesting rainwater, purifying contaminated water, and drinking contaminated water received fewer responses. Additionally, there were no responses for drinking less water, collecting water from the neighborhood or reporting no scarcity. In Tongi (N=151), similar trends were observed, with purchasing water and reserving water during supply

being the most favored methods. Across all locations, purchasing water and reserving water during supply were the most frequently chosen strategies. While Rayerbazar showed fewer responses overall, Tongi had relatively higher frequencies for harvesting rainwater and purifying contaminated water.

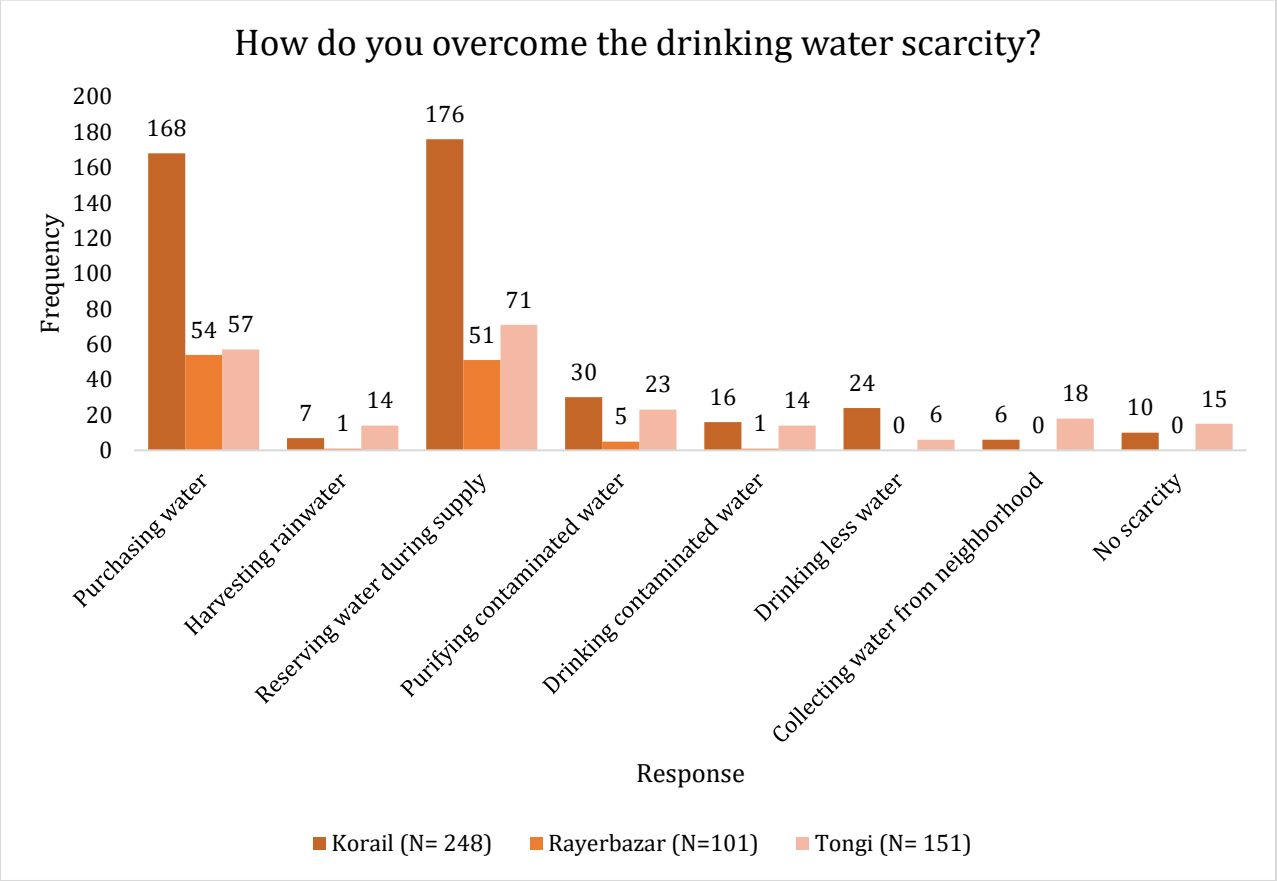


Figure 25: Methods used by residents of three distinct locations to overcome drinking water scarcity

The chart displays responses from three locations (Korail, Rayerbazar, Tongi) regarding methods for addressing water scarcity in domestic use and hygiene. Frequencies for each method include 32 for reusing greywater in Korail, 31 in Rayerbazar and 12 in Tongi. For purchasing water, the frequencies are 75 in Korail, 34 in Rayerbazar and 35 in Tongi. Harvesting rainwater received responses of 15 in Korail, 10 in Rayerbazar, and 19 in Tongi. Reserving water during supply had frequencies of 200 in Korail, 48 in Rayerbazar and 92 in Tongi. Collecting water from the neighborhood had responses of 7 in Korail, 5 in Rayerbazar and 15 in Tongi. Lastly, for reporting no scarcity, there were 7 respondents in Korail, 1 in Rayerbazar and 13 in Tongi. The data

highlights varied preferences with reserving water during supply being most prevalent, followed by purchasing water, while alternative methods like reusing greywater or harvesting rainwater are less common.

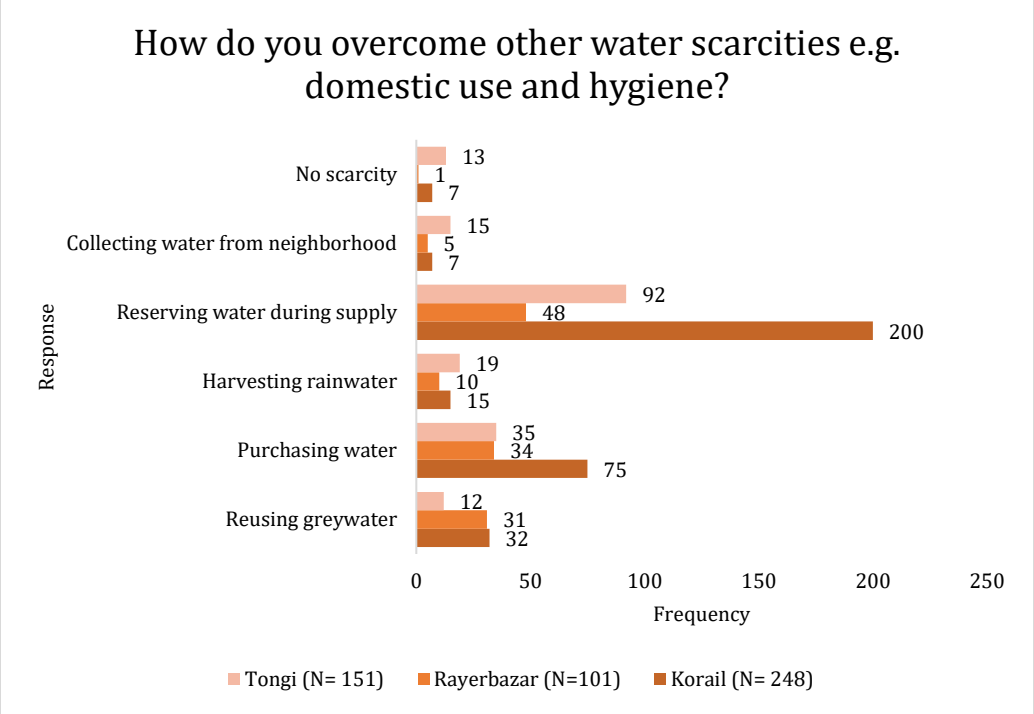


Figure 26: Strategies for Addressing Water Scarcity for Domestic Use and Hygiene

Out of the respondents, 62 have implemented adaptation measures to address WASH challenges, while 438 have not.

To cope with vector-borne diseases, 67% of respondents have used mosquito nets, 19% have kept nearby areas of their households clean and 14% have disposed of accumulated water. The following chart depicts varying degrees of adoption of preventive measures against vector-borne diseases across Korail, Rayerbazar and Tongi, with significant reliance on mosquito nets in Korail and notable efforts in cleanliness and water disposal.

Frequencies for each method include 183 for using mosquito nets in Korail, 62 in Rayerbazar and 133 in Tongi. Additionally, 47 respondents in Korail, 14 in Rayerbazar and 45 in Tongi have kept nearby areas of their households clean. Furthermore, 32 respondents in Korail, 19 in Rayerbazar,and 41 in Tongi have disposed of accumulated water.

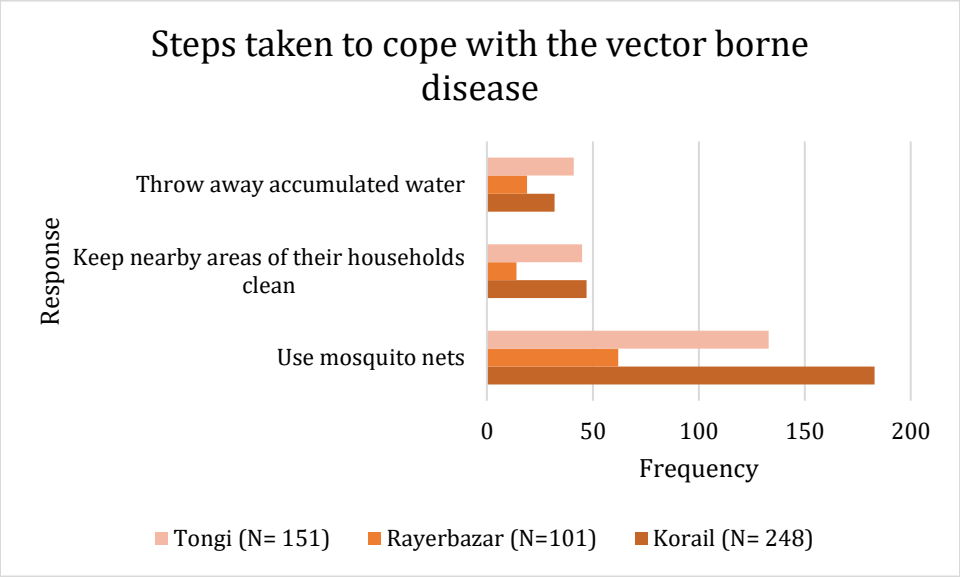


Figure 27: Measures taken to cope with vector-borne diseases

8.3 Household Coping and Community Initiatives to Climate Variability

To cope with damaged toilet facilities during waterlogging, 60% of respondents use damaged washrooms, 15% use public toilets, 36% use neighbor's toilets, 4% use mobile toilets, while none resort to open defecation and 30%-mark N/A. The following chart reveals varied responses across Korail, Rayerbazar, and Tongi to cope with damaged toilet facilities during waterlogging, with the predominant strategy being to use damaged washrooms, while mobile toilets and neighbor's toilets are also utilized with negligible instances of open defecation.

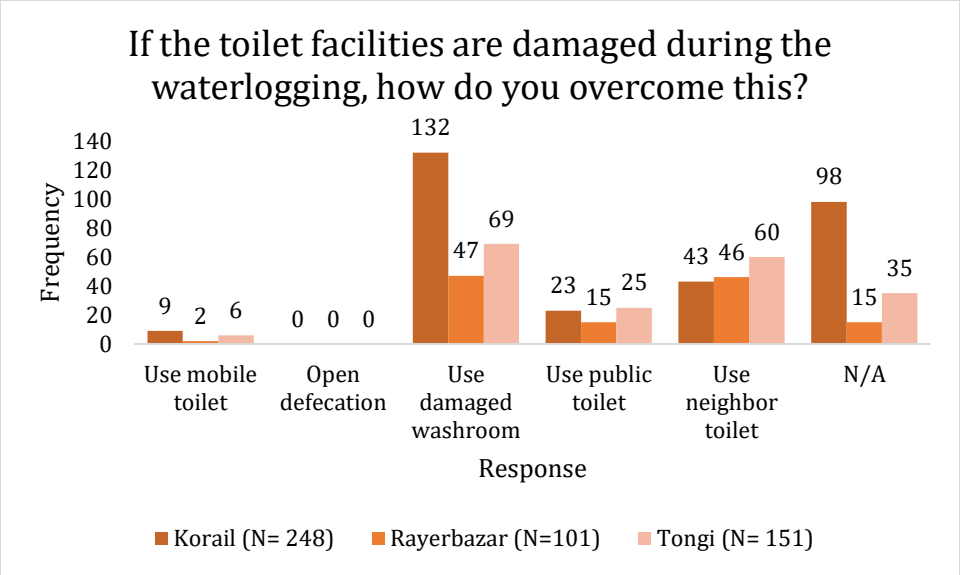


Figure 28: Coping strategies for damaged toilet facilities during waterlogging

Frequencies for each method include 9 for using mobile toilets in Korail, 2 in Rayerbazar, and 6 in Tongi. None resorted to open defecation in any location. The majority of respondents in all locations opted to use damaged washrooms, with 132 in Korail, 47 in Rayerbazar and 69 in Tongi. Additionally, respondents across all locations used public toilets, neighbor's toilets, and marked N/A, with varying frequencies.

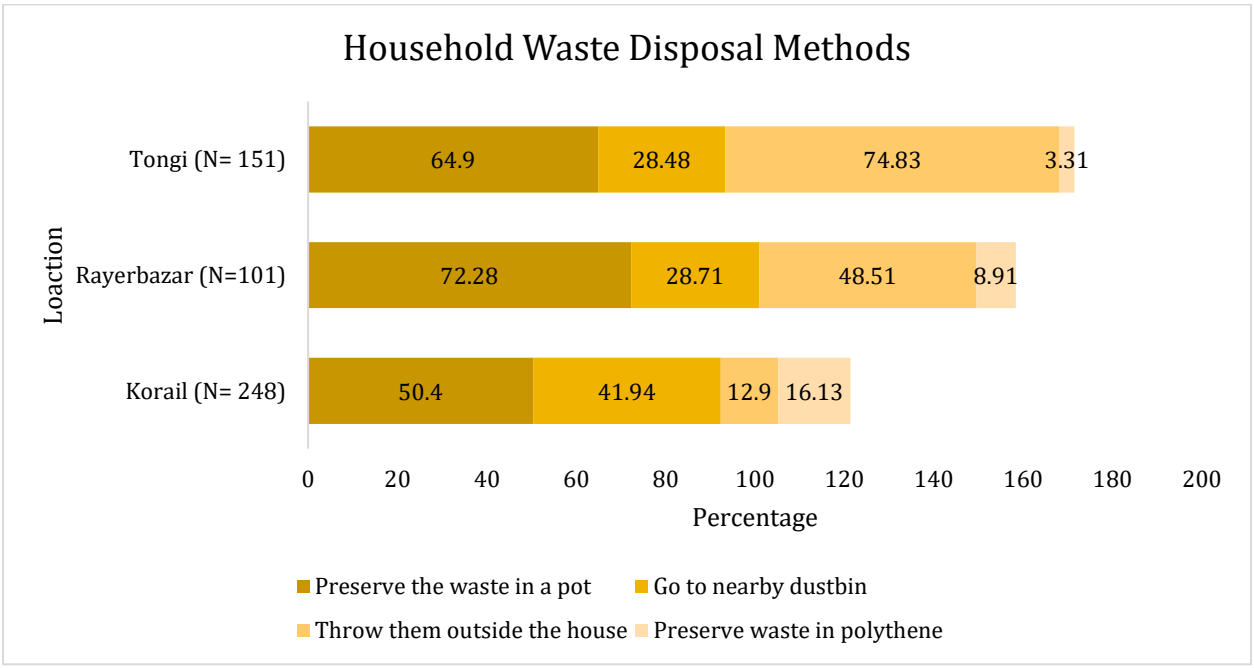


Figure 29: Strategies for household waste disposal during waterlogging

The provided data illustrates the percentages of respondents selecting various waste disposal methods across three distinct slum areas: Korail, Rayerbazar, and Tongi. In Korail, out of 248 respondents, 50.4% opted to preserve waste in a pot, 41.94% chose to go to nearby dustbins, 12.9% indicated throwing waste outside the house and 16.13% preferred preserving waste in polythene bags. In Rayerbazar, with 101 respondents, higher percentages were observed in preserving waste in a pot (72.28%) and throwing waste outside the house (48.51%), while a smaller proportion favored going to nearby dustbins (28.71%) or preserving waste in polythene bags (8.91%). Similarly, Tongi, comprising 151 respondents, reflected comparable trends to Rayerbazar, with 64.9% opting to preserve waste in a pot, 28.48% choosing nearby dustbins, and a substantial 74.83% indicating throwing waste outside the house. Across these areas, preserving waste in pots emerged as a popular choice, particularly pronounced in Rayerbazar. The method of using nearby dustbins showed moderate usage, while significant variability was observed in the practice of throwing waste outside the house, with Tongi displaying the highest proportion of respondents embracing this method. Conversely, preserving waste in polythene bags appeared less prevalent across all areas, with Korail recording the highest proportion of respondents selecting this option.

Among respondents, 180 have raised the plinth of their toilets, with 110 in Korail, 22 in Rayerbazar and 48 in Tongi; while 320 have not, including 138 in Korail, 79 in Rayerbazar and 103 in Tongi. The data indicates that a significant proportion of respondents, particularly in Korail, have raised the plinth of their toilets to mitigate waterlogging risks.

Among respondents, 73 are aware of community-based initiatives or programs related to WASH in their slum areas, with 38 in Korail, 18 in Rayerbazar and 17 in Tongi; while 427 are not aware, including 210 in Korail, 83 in Rayerbazar and 134 in Tongi.

8.4 Knowledge Management Strategies through Weather Data Utilization

Among 500 respondents, 315 (63%) receive weather-related information regularly, with 160 in Korail, 70 in Rayerbazar and 85 in Tongi; while 185 do not, including 88 in Korail, 31 in Rayerbazar and 66 in Tongi.

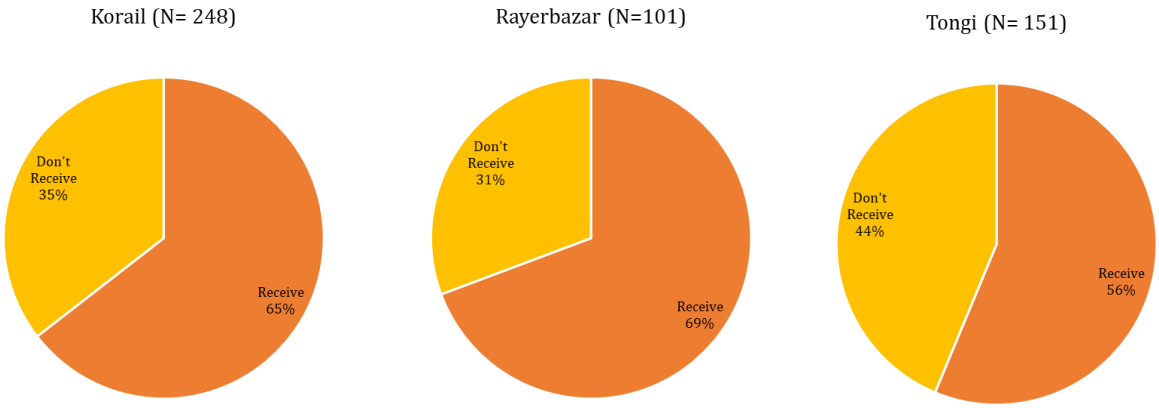
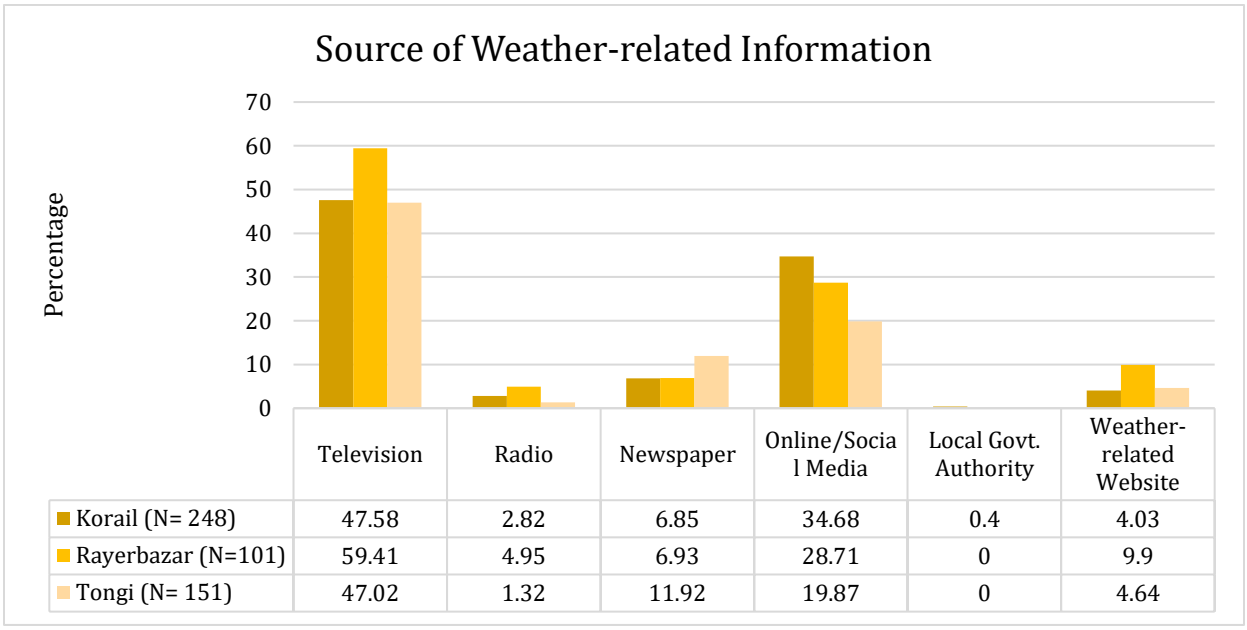


Figure 30: Access to weather-related information

Among respondents, 51% in Korail, 69% in Rayerbazar and 56% in Tongi receive weather-related information on a regular basis, highlighting varying levels of access to such information across the surveyed areas.



	Television	Radio	Newspaper	Online/Social Media	Local Govt. Authority	Weather-related Website
Korail (N= 248)	47.58	2.82	6.85	34.68	0.4	4.03
Rayerbazar (N=101)	59.41	4.95	6.93	28.71	0	9.9
Tongi (N= 151)	47.02	1.32	11.92	19.87	0	4.64

Figure 31: Sources of weather-related information for respondents

The graph illustrates the percentage of respondents from three distinct slum areas (Korail, Rayerbazar, Tongi) who selected various sources for weather-related information. Across the slum areas, the most commonly chosen source appears to be television, with percentages ranging from 47.58% in Korail to 59.41% in Rayerbazar. Radio, on the other hand, shows relatively lower percentages across all areas, ranging from 1.32% to 4.95%. Newspaper usage for weather information is moderate, with percentages ranging from 6.85% to 11.92%. Online and social media platforms emerge as significant sources of weather-related information, with percentages ranging from 19.87% to 34.68%. Interestingly, the local government authority is not a preferred source across any of the surveyed areas, with percentages close to zero. Weather-related websites also exhibit moderate usage, ranging from 4.03% to 9.9%. Overall, the data highlights the varied preferences for accessing weather information in these slum areas, indicating a reliance on traditional media like television and a growing inclination towards online platforms for such information dissemination.

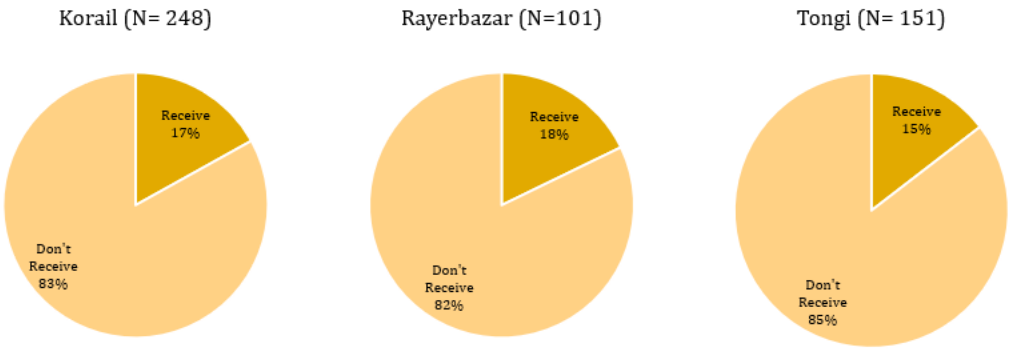


Figure 32: Experience with WASH-related training

In Korail, 16.94% of respondents (42 out of 248) reported receiving WASH-related training, while 83.06% did not receive such training. In Rayerbazar, 17.82% (18 out of 101) of respondents received weather-related training, while 82.18% did not. In Tongi, 14.57% (22 out of 151) of respondents received weather-related training, with 85.43% not having received it.

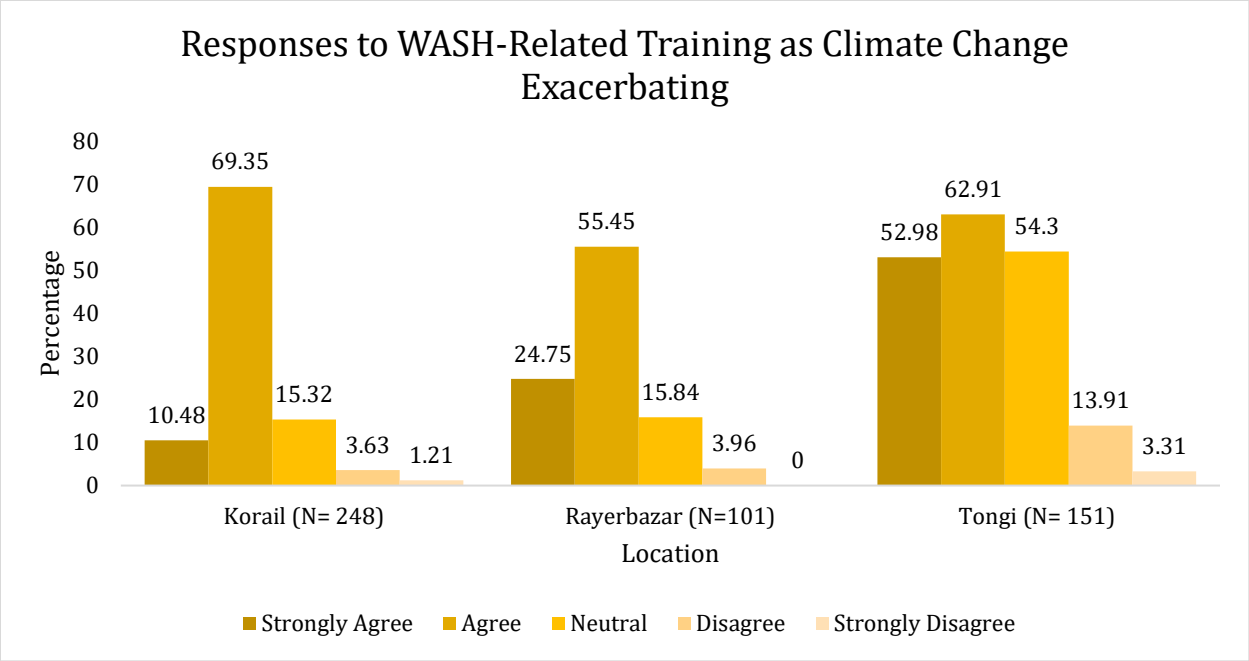


Figure 33: Interest in WASH-related training programs in response to Climate Change Challenges

In Korail, out of 248 respondents, a significant majority expressed agreement, with 10.48% strongly agreeing and 69.35% agreeing to receiving WASH-related training, highlighting a high level of consensus on the importance of such training. In Rayerbazar, among 101 respondents, a positive attitude towards WASH-related training is evident, with 24.75% strongly agreeing and 55.45% agreeing and notably, no respondents strongly disagreed, indicating a generally favorable outlook in this area. Similarly, in Tongi, out of 151 respondents, there is a strong positive inclination towards WASH-related training, with 52.98% strongly agreeing and 62.91% agreeing, emphasizing a widespread endorsement of such initiatives. Notably, Tongi exhibits a particularly high percentage of respondents strongly agreeing, indicating a robust support base for WASH-related training efforts.

8.5 Discussion

The information gathered from all three surveyed areas, gives a comprehensive understanding of the disparities in community participation and satisfaction with WASH intervention. Within Korail, there has been a noticeable impact from direct WASH related interventions. The interventions are well-executed and effectively communicated, leading to a high perception among the community people. On the contrary, there was a fewer and only linking WASH

intervention in Rayerbazar which suggests a possible gap in effectiveness or accessibility. Though the interventions are less prevalent, individuals who have received them have been benefited largely. However in Tongi, prevalence of intervention and satisfaction rate of the community shows moderate level of participation. This indicates the necessity for tailored interventions for every community.

Examining approaches to water scarcity methods reveals that many of them mostly depend on individual efforts like buying and stockpiling water. This extensive dependence highlights the importance of water supply and the ways in which local people are coping to its scarcity. It is interesting to note that less common techniques, like reusing or purifying water, appear to be neglected. This may indicate a lack of resources, expertise, or faith in these alternative strategies. Another finding that is particular alarming is the frequency of consuming water that has been contaminated. This further highlights the need to address the issue of water quality and availability. It is very frightening when such fundamental needs are affected. Moreover, out 500 respondents only 62 demonstrated WASH comprehension and hence it is apparent that there exists a huge gap in understanding of WASH issues. This may be considered as an opportunity to motivate communal activity and awareness campaigns to foster more participation in WASH programs.

The study provides a comprehensive account of multiple coping methods used by households to deal with the effects of climate change including vector borne diseases and poor sanitation facilities. First of all, given that a substantial 67% of respondents use mosquito nets, it is clear that such tools are an essential first line of protection against diseases carried by vectors. This dependence is most noticeable in Korail, where 183 respondents said they regularly use mosquito nets. Although the importance of maintaining cleanliness and properly disposing water is acknowledged but this statistics highlights they are not implemented at the scale where they should. This indicates communities need comprehensive preventive strategies, awareness programs and proper implementation. This study also demonstrates adaptability and resourcefulness the respondents had in dealing with the damaged toilets in the times of water logging. Additionally, use of neighbors' toilets and mobile toilets shows a spirit of cooperation and flexibility in the face of adversity among the communities. Notably, the lack of responses

mentioning open defecation is a sign that the community is dedicated to upholding hygienic standards even in difficult circumstances.

The waste disposal practices differed widely between the study locations. Less environmentally friendly practices are used by the people of Rayerbazar and Tongi, such as discarding waste outside the house and storing it in pots. Korail, on the other hand, demonstrates a balanced approach, as respondents save everyday garbage in pots and use nearby dustbins. The city corporation's garbage disposal facilities in Korail and Rayerbazar have an impact on their preferred practices. Moreover, there is a possible area for intervention to encourage the use of more environmentally friendly waste management techniques. The proactive measure taken to reduce the risk of waterlogging (raising the toilet plinth), especially in Korail highlights the potential efficacy of community based projects. Since the respondents are not fully aware of community-based WASH projects, there is a need for better communication and engagement tactics to promote participation and support for these programs.

Since a significant number of respondents stated that they regularly receive updates about the weather, the findings emphasize the important role that information sharing plays in this regard. This highlights the importance of people being aware of the weather. However, it is worth noting that the level of access varies in areas such as Korail, Rayerbazar, and Tongi, which likely reflects the different socioeconomic and infrastructural contexts of these localities. For many people, television is the primary source of weather information due to its easy availability and wide accessibility. It is interesting to observe, however, that there is not much reliance on local government agencies for weather updates. This suggests a potential area for growth in public communication strategies, where efforts should be focused on establishing trust and collaboration with local authorities regarding the dissemination of weather information.

The usage of social media and internet platforms for weather reports indicates a shift towards digital sources. As more people gain access to the internet, this trend can grow more prominent. However, there is a decreasing interest in traditional media, such as radio and newspapers, as fewer people rely on them for weather information. The data shows that there is a considerable difference in the percentage of people who have and have not undergone WASH training. This emphasizes how urgently more extensive and inclusive training programs are needed in order to give the community as a whole the tools they need to solve WASH issues. In spite of this

discrepancy, respondents from the three regions agree that WASH-related training is important, with Tongi expressing the strongest support. Stakeholders can capitalize on this shared understanding to seize the opportunity for WASH education and training programs, while also expanding and strengthening these efforts.

8.6 Conclusion

This study examines how slum dwellers adapt to WASH challenges due to climate variability. Residents mainly cope with water scarcity by purchasing and storing water, underscoring the need for improved water supply infrastructure and alternative methods like water reuse and purification. A significant portion of the population consumes contaminated water. This indicates a crucial opportunity for WASH training campaigns and awareness programs. The lack of comprehensive WASH training among residents contrasts with their strong support for such education, presenting a significant opportunity for intervention. This study emphasizes the need for multifaceted strategies, including infrastructure improvements and expanded access to weather information, to enhance resilience to changing climatic conditions and climate variability as well.

CHAPTER 9: CONCLUSION

9.1 Major Outcomes of the Research

- Korail demonstrates a high level of involvement and satisfaction with the interventions implemented, whereas Rayerbazar depicts low presence of the interventions but still expresses considerable satisfaction. Tongi falls in-between, suggesting room for improvement but also some positive signs.
- When examining the impact of climate variability on WASH challenges, we observed a notable disparity in the vulnerability and adaptation mechanisms among the three slums studied. Korail, with its higher intervention presence, demonstrated a relatively lower vulnerability to climate variability and showcased better coping and adaptation strategies compared to Tongi and Rayerbazar. Despite Tongi having received WASH-specific interventions, our findings suggest that its residents are less adaptable to climate variability. Conversely, Rayerbazar, lacking adequate WASH-specific interventions, appeared to be the least adaptable among the three slums. These observations underscore the critical role of targeted interventions in enhancing resilience to climate variability.
- While waste disposal practices vary across the surveyed slums, there's a notable preference for preserving waste in pots, indicating the prevalence of informal waste management methods. This underscores the urgent need for improved waste management systems to address the growing waste disposal challenges. Remarkably, despite being the recipient of WASH-specific interventions, Tongi, as a slum outside the Dhaka City Corporation, faces significant deficiencies in waste management practices compared to Korail and Rayerbazar. This highlights a critical gap in infrastructure and governance, resulting in substantial challenges for waste disposal and environmental hygiene in Tongi.
- Accessing weather-related information appears to be a blend of traditional and online media platforms, reflecting the evolving landscape of information dissemination in urban settings. This underscores the significance of having reliable channels through which weather forecasts and updates can reach communities, enabling them to make informed decisions and adapt effectively to changing climatic conditions.

9.2 Concluding Remarks

The disparities in the effectiveness of WASH interventions highlight the need for targeted and context-specific approaches. Understanding the unique socio-economic and environmental factors at play in each slum is paramount to designing interventions that truly make a difference.

Moreover, our exploration of coping and adaptation strategies underscores the importance of community involvement and empowerment. By actively engaging with residents and incorporating their knowledge and experiences into intervention design, we can foster sustainable solutions that resonate with the needs and realities of the people they aim to serve.

Furthermore, our findings underscore the interconnectedness of WASH with broader issues such as climate variability and socio-economic disparities. Addressing WASH challenges requires a holistic approach that considers not only infrastructure but also education, livelihood opportunities, and access to basic services.

Moving forward, it is paramount to capitalize on the momentum fostered by this study and persist in advocating for policies and initiatives aligned with SDG 6 on clean water and sanitation. In particular, these interventions should be designed to address the specific challenges posed by climate variability, ensuring resilience and sustainability in the face of changing environmental conditions. By integrating climate-resilient infrastructure and adaptive measures into water and sanitation projects, we can better withstand the impacts of extreme weather events and shifting climate patterns. This approach not only safeguards public health and dignity but also contributes to broader sustainability objectives by ensuring equitable access to essential resources. Through the implementation of climate-smart solutions, such as rainwater harvesting systems, waterlogged-resistant sanitation facilities, and community-based water management initiatives, we can enhance the resilience of urban slum communities to climate variability while promoting sustainable development.

By rallying collaboration among communities, policymakers, and stakeholders, we can forge a path towards a future where every individual, regardless of socio-economic status or geographical location, enjoys the fundamental human right to access clean water, adequate sanitation, and proper hygiene facilities. This concerted effort not only mitigates the adverse

effects of climate change but also fosters resilient communities and a more equitable and sustainable world.

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ANNEX-A: QUESTIONNAIRE

A1: Survey Questionnaire

Assalamu Alaikum!

I am ……. I am here on behalf of Rafiana Islam Chaiti, from Institute of Disaster Management and Vulnerability Studies, University of Dhaka to assist her in data collection of hert thesis study. I am conducting this interview to Examining the Impact of Climate Variability on Urban WASH Facilities: A Cross-Sectional Study on the WASH-Specific Intervention and Non-Intervention Urban Slums. Your participation is kindly requested for the duration of this interview, which can consume a minimum of ten minutes of your valued time. I will begin the interview immediately if you are willing to participate in order to offer your insightful opinions on various points.

SECTION 1: Demographic Profile		
101	Name of the respondent	
102	Cell phone	
103	Address	Village: Union: Upazila:
104	Age	1. 18-25 3. 36-45 5. 56 and above 2. 26-35 4. 46-55
105	Marital status	1. Single 3. Widowed 5. Divorced 2. Married 4. Separated
106	Sex	1. Male 3. Others 2. Female
107	Religion	1. Muslim 3. Buddhist 5. Others 2. Hindu 4. Christian
108	Education	1. Can't sign 3. Primary 5. HSC 7. Post-Graduate 2. Sign Only 4. SSC 6. Graduate 8. Others
109	Occupation	1.Housewife 11. Car mechanic 2.Welder 12. Driver of private vehicles 3.electrician 13. Bus helper 4.Plumber 14. Small store business 5.Carpenter 15. Tea seller 6.Mason 16. Works in hotel /café 7.Warboy/Works in hospital 17. Repairman of appliances 8.Rickshawpuller/Van puller 18. Vendor 9.CNG driver 19. House-help/care taker 10.laundry man 20. Other
110	Family size	

111	Total earning member	
112	Monthly family income	1. <5000 2. 5001-10000 3.10001-15000 4. 15001-20000 5. 20001-25000 6. >25000
113	Number of persons with disability	1. 0 2. 1 3. 2-4 4. More than 4

Section 2: Knowledge, Attitude and Practice of WASH			
Knowledge			
Sl	Question	Responses	Code
201	What are the main water sources in your locality? (Multiple response)	1. Tube well 2. Piped into yard or plot 3. Public tap/standpipe 4. Rainwater 5. Water from vendors 6. Surface water (River, stream, lake, dam, pond) 7. Bottled water 8. Others	
202	Do you know what are the common diseases caused by polluted water?	1. Diarrhea 2. Dysentery 3. Typhoid 4. Cholera 5. Trachoma 6. Others (Please specify) 99. Don't know	
203	In the last 6 months, is there anyone in the household had water, sanitation and hygiene-related diseases?	1. Yes 2. No	

203.1	If yes, what is/are the disease/diseases?	1. Diarrhea 2. Dysentery 3. Skin diseases 4. Respiratory diseases 5. Recurring fever 6. Parasitism 7. Others (Please specify)	
203.2	If yes, how many adult members got sick?	1. 1 2. 2 3. 3 4. 4 5. More than 4 (Please specify)	
203.3	If yes, how many children got sick?	1. 1 2. 2 3. 3 4. 4 5. More than 4 (Please specify)	
204	Do you think that your water facility should be located in a safe place (e.g., pluvial flood)?	1. Yes 2. No	
205	Do you think that your sanitation facility should be located in a safe place (e.g., pluvial flood)?	1. Yes 2. No	
206	Do you think that your hygiene facility should be located in a safe place (e.g., pluvial flood)?	1. Yes 2. No	
207	When do you think are the important time to wash your hands? (Multiple Response)	1. Before preparing food 2. Before eating 3. Before feeding your child 4. After handling a child's stool 5. After using latrine/after defecation	
208	Do you have any disposal place for used pads in your area?	1. Yes 2. No 3. No comment 96. Not Applicable	
Attitude			

209	Do you think the quality of water you receive is safe?	1. Yes 2. No	
210	What is the quality of your drinking water?	1. Excellent (Colorless, odorless, sweet) 2. Good 3. Moderate 4. Bad (Mildly scented) 5. Very bad (Smelly)	
211	Are you willing to actively participate in community initiatives aimed at improving wash facilities?	1. Strongly Agree 2. Agree 3. Neutral 4. Disagree 5. Strongly Disagree	
212	Do you think that the toilet should be disability friendly?	1. Yes 2. No	
213	Are you willing to invest in water/sanitation facility or improve the existing facility?	1. Yes 2. No	
Practices			
214	What is the main source of drinking water for your household?	1. Water pipe (WASA) inside the household 2. Shared water pipe (WASA) 3. Tube well inside the household 4. Tube well outside the household 5. Others (please specify)	
215	If the water source is outside the house, what is the time needed to fetch water from the water source?	1. Below 1 minute 2. 1-2 minutes 3. 2-3 minutes 4. More than 3 minutes	
216	Do you preserve drinking water in plastic bottle/plastic jug?	1. Yes 2. No	
217	Do you purify water at home?	1. Yes 2. No	

217.1	If 'Yes' what are the methods?	1. Filter 2. Boiling 3. Other (Please specify)	
217.2	If no, what is the reason for not purifying the water? (Multiple)	1. The price of gas is so high 2. Can not afford water purifier 3. Water is already clean 4. Do not know the methods of cleaning 5. Time scarcity	
218	Does the drinking water and domestic use water come from the same source?	1. Yes 2. No	
218.1	If No what is the main source of water for other domestic purposes?	1. Water pipe (WASA) inside the household 2. Shared water pipe (WASA) 3. Tube well inside the household 4. Tube well outside the household	
219	The toilet you use private or shared?	1. Private 2. Shared	
219.1	If the answer is "Shared" how many families are using the same toilet?	1. Less than 4 2. 4-5 3. 6-7 4. 7-8 5. More than 8	
220	What kind of toilet facility do you/members of your household usually use?	1. Latrine with water line 2. Latrine without a water line 3. Pit latrine without a slab 4. Open Field 5. Others (specify:)	
221	Do you use a separate sandal for toilet use?	1. Yes 2. No	
222	Is your toilet cleaned regularly (at least twice a week)	1. Yes 2. No	

223	Do you have hand washing facility near latrine?	1. Yes 2. No	
224	When do you wash your hands? (Multiple)	1. Before taking food 2. After taking food 3. After using the toilet 4. After coming from outside of the house	
225	Do you wash your hands after defecation?	1. Yes 2. No	
226	Do you wash your hands after decomposing the child excreta?	1. Yes 2. No	
227	What do you normally use for washing hands?	1. Soap 2. Ashes 3. Sand 4. Only water 5. Detergent 6. Others	
228	How often do you use cleaning materials while washing your hands?	1. Never 2. Seldom 3. Sometimes 4. Often 5. Always	
229	What challenges you face in procuring drinking water?	1. No challenges 2. Distant source 3. Irregular supply 4. Conflict	
230	Where do you dispose your household waste? (Multiple)	1. Representatives of the city corporation come and collect the household waste. 2. Dispose them in allocated dustbin 3. Throw them in the drain/waterbody/open space near the household 4. Keep them on the walkway	

231	Where do you dump the excreta of your child? (Ask if only there is any infant in the household	1. Representatives of the city corporation come and collect the household waste. 2. Dispose them in allocated dustbin 3. Throw them in the drain/waterbody/open space near the household 4. Keep them on the walkway	
(Ask 233-236 if the respondent is female)			
232	Do the lack of access to clean water hinders proper management of your menstruation?	1. Yes 2. No	
233	Do the lack of access to private toilets hinders proper management of your menstruation?	1. Yes 2. No 3. No Comment	
234	Where do you dispose your menstrual materials after use?	1. Throw them with household waste and representatives of the city corporation come and collect it. 2. Dispose them in allocated dustbin 3. Throw them in the drain/waterbody 4. Burning 5. Didn't need to dispose of menstrual materials	
235	Do you wash your hands after disposing your menstrual materials?	1. Yes 2. No	

SECTION 3: Climate Variability & WASH			
Temperature			
Sl.	Question	Response	Code

301	Has the temperature of your area changed in the last 5 years?	1. No change 2. Very Little 3. Little 4. Medium 5. High 6. Very High 99. Don't Know	
302	Have you noticed any scarcity regarding the availability of drinking water due to increased temperature?	1. No Change 2. Very Little 3. Little 4. Medium 5. High 6. Very High	
303	What are the impacts regarding the availability of water for domestic use (e.g., cooking, cleaning) due to increased temperature?	1. Scarcity of water makes domestic work difficult 2. Can not maintain the cleanliness of the household 3. Can not wash the vegetables/fruits before eating 4. Use contaminated/polluted water source for cleaning 5. Others (Please Specify)	
304	What are the impacts regarding the availability of water for hygiene practices (e.g., bathing, washing hands etc) due to increased temperature?	1. Skip bathing 2. Reduced handwashing 3. Problem in maintaining toilet cleanliness 4. Problem in maintaining household cleanliness 5. Others (Please mention)	
305	Have you noticed any changes in the quality of drinking water in the last 5 years?	1. No Change 2. Very Little 3. Little 4. Medium 5. High 6. Very High	
306	In which modality do you get water supply?	1. 24 hours water supply 2. Shift wise water supply 3. Both	

306.1	If the answer is “Both”, then what is the number of shift?	1. 1 2. 2 3. 3 4. More than 3 shift	
306.2	If the answer in question number (306) is 24 hours water supply, then ask, Do you get 24/7 water during increased temperature periods?	1. Yes 2. No	
306.2.1	If the answer is no, do you think it is due to the increased temperature?	1. Yes 2. No	
307	Have you noticed the prevalence of water-borne diseases during periods of high temperatures?	1. Yes 2. No	
308	What is the vector-borne diseases that are prevalent during the high temperature in your area?	1. Dengue 2. Malaria 3. Chikungunia	
Rainfall			
309	Has the rainfall pattern in your area changed in the last 5 years?	1. No Change 2. Very Little 3. Little 4. Medium 5. High 6. Very High	
310	How does the rainfall impact the accessibility of sanitation facilities (e.g., toilets) in your area?	1. Water enters into the toilet and makes it unusable 2. Connecting roads are submerged 3. Not applicable	
311	How does rainfall affect the quality of water in your area?	Answer:	
312	How does this rainfall affect the vulnerability of sanitation facilities to damage or contamination?	1. Dustbins are washed away 2. Drains are overflowed 3. Toilets are submerged under water	
313	How does erratic rainfall lead to occur water scarcity in your area?	1. Water reservoir gets contaminated 2. Water quality decreased due to	

		contamination 89. N/A	
314	How does rainfall impact the availability of water for domestic chores (e.g., cooking, cleaning) and hygiene practices (e.g., bathing, washing hands etc)	1. Roads to water source is unusable 2. Water quality decreased due to contamination. 89. N/A	
315	Have you noticed the prevalence of water-borne diseases during periods of rainfall?	1. Yes 2. No	
316	Have you noticed the prevalence of vector-borne diseases due to rainfall?	1. Yes 2. No	
317	If "Yes" then what are the diseases that prevail in your area?	1. Dengue 2. Malaria 3. Others	
318	Does Erratic rainfall cause waterlogging and flooding in your neighborhood?	1. Yes 2. No	
319	Does Erratic rainfall negatively affect waste management practices in your area?	1. Yes 2. No	
320	Does the climate variability (e.g., temperature, rainfall) negatively impact your menstruation hygiene practice? (Only ask if the respondent is female)	1. Yes 2. No	
320.1	If "Yes" please define the challenges?		

Section 4: Coping and Adaptation			
Sl	Question	Response	Coding
401	Have you/your area ever been under any WASH intervention initiated by NGOs or GOs?	1. Yes 2. No	
401.1	If yes, please mention the type of		

	intervention		
401.2	If "Yes" how much satisfied are you regarding the interventions?	1. Very satisfied 2. Satisfied 3. Neither satisfied nor dissatisfied 4. Dissatisfied 5. Very dissatisfied	
WASH Specific			
402	How do you overcome the drinking water scarcity?	1. By purchasing water 2. By harvesting rainwater 3. By reserving water during supply 4. By purifying contaminated water 5. By drinking contaminated water 6. By drinking less water 7. Others (specify)	
403	How do you overcome other water scarcities e.g. domestic use and hygiene?	1. By reusing greywater 2. By purchasing water 3. By harvesting rainwater 4. By reserving water during supply 5. Others (specify)	
404	Have you personally taken any adaptation measures to overcome WASH related challenges?	1. Yes 2. No	
404.1	If Yes, what are the measures?	Answer:	
405	What steps have you taken to cope with the vector borne disease?	1. Use mosquito net 2. Keep clean the nearby areas of the household 3. Throw away the accumulated water 4. Others (Please Specify)	
Household Adaptations and Community-Led Initiatives/ Climate-Variability Impact Specific			
406	If the toilet facilities are damaged during the waterlogging how do you overcome this?	1. Using mobile toilet 2. Open defecation 3. Use damaged washroom 4. Use public toilet 5. Use neighbor toilet 6. Others	
407	If the household waste disposal facilities are damaged during	1. Preserve the waste in a pot 2. Go to nearby dustbin which is not	

	waterlogging how do you overcome this?	damaged 3. Throw them outside the house 4. Others	
408	Do you raise the plinth of your toilet?	1. Yes 2. No	
409	Are you aware of any community-based initiatives or programs related to WASH in your slum area?	1. Yes 2. No	
Knowledge Management for Urban WASH			
410	Do you receive weather related information on a regular basis? (e.g., temperature, precipitation related)	1. Yes 2. No	
410.1	If yes, what is the source?	1. Television 2. Radio 3. Newspaper 4. Online/Social Media 5. Local government authorities 6. Weather related website 7. Others	
410.2	If not, what's the reason?	1. Unaware 2. Don't think it is important 3. Don't know where to find it 4. Lack of access to internet 5. Others	
411	Have you ever received any WASH related training?	1. Yes 2. No	
411.1	If yes, what did you learn from it?		
412	As climate change is exacerbating the challenges in WASH facilities of your area, would you be interested in any WASH related training programs?	1. Strongly agree 2. Agree 3. Neutral 4. Disagree 5. Strongly disagree	

A2: KII Checklist

Name:	**Organization:**
Role in Position	Time:

General WASH in Slums:

1. In your experience, what are the biggest challenges slum dwellers face regarding WASH (Water, Sanitation, and Hygiene)?
2. How would you describe the current state of WASH knowledge, attitudes, and practices in slum communities?
3. Have you observed any changes in WASH practices in slums over the past few years? If so, what factors have contributed to these changes?

Climate Change Impact:

4. From your perspective, how has climate variability (temperature and rainfall patterns) impacted WASH facilities and services in slums?
5. What are the most pressing WASH concerns during periods of high temperatures in slums?
6. How do erratic rainfall patterns affect sanitation systems and water quality in slum areas?
7. Have you observed an increase in waterborne or vector-borne diseases due to climate variability in slums?

Intervention and Adaptation Strategies:

8. Are you aware of any WASH interventions currently implemented in slums in Dhaka? If so, what are their strengths and weaknesses?
9. In your opinion, what are the key considerations for designing and implementing effective WASH interventions in slum communities?
10. Have you observed any successful community-based coping or adaptation strategies for WASH challenges in slums?
11. What role do you see local authorities playing in improving WASH resilience in slums in the face of climate change?

Knowledge Dissemination and Capacity Building:

12. How important is raising awareness about climate change and its impact on WASH practices in slums?
13. What are the most effective ways to disseminate WASH-related knowledge and promote behavior change in slum communities?

14. What capacity-building initiatives would be beneficial for slum dwellers to improve their WASH practices and adapt to climate change?

Looking Forward:

15. What are your biggest concerns regarding WASH security in slums in the context of climate change?
16. What are your recommendations for addressing the challenges identified in this study?
17. Are there any ongoing research efforts or initiatives related to WASH and climate change in slums that you are aware of?
18. In your opinion, what are the most promising strategies for creating sustainable and climate-resilient WASH systems in slums?

A3: FGD Checklist

1. What is the common water (drinking and daily use) source in your area? Does the water supply system cater to the need of this areas population? If not, what are the barriers/issues?
2. What is the sanitation practice of this areas population (types of toilets, drainage system etc.)?
3. What is the waste management practice of this area's dwellers?
4. Have anyone from outside (GO,NGO) worked to improve the WASH facilities of this area? If yes, what measures they took? Did it improve the previous condition?
5. Does this area experience climatic variable conditions (extreme temperature, erratic rainfall) in the last 5 years? If yes, has it any major impact in the WASH facilities?
6. Do you think climate change is deteriorating the WASH facilities in your area even more?
7. Did you ever receive any WASH specific training? If yes, what did you learn from it?
8. Did communities ever participate in any endeavors to improve their own WASH facilities?
9. As climate change is exacerbating the WASH facilities, do you think there should be more intervention and trainings regarding the WASH facilities?

ANNEX B: LIST OF FGD, IDI AND KII PARTICIPANTS

FGD 1 - **Korail**			Members: **08**	
Sl	Name	Gender	Age	Occupation
1	Shila	Female	26 - 35	Housewife
2	Laboni	Female	36 - 45	Housewife
3	Hasina	Female	36 - 45	Housewife
4	Sharmin Akter	Female	18 - 25	Unemployed
5	Liza Islam Tania	Female	18 - 25	Tailor
6	Rebu	Female	46 - 55	Janitor at SMC orsaline company.
7	Shumi	Female	36 - 45	Housewife
8	Afia Sultana	Female	46 - 55	Housewife

FGD 2 - **Korail**			Members: **08**	
Sl	Name	Gender	Age	Occupation
1	Kamrul Islam	Male	26 - 35	Small store business
2	Abdul Alim	Male	26 - 35	Tea seller
3	Shohag Talukdar	Male	18 - 25	Student
4	Batil	Male	26 - 35	Mason
5	Md. Jahangir	Male	36 - 45	CNG driver
6	Hashem	Male	36 - 45	Small store business
7	Forhad Hossain	Male	36 - 45	Small store business
8	Md. Abul Hasnat	Male	36 - 45	Mason

FGD 3 - **Rayerbazar**			Members: **08**	
Sl	Name	Gender	Age	Occupation
1	Akbar Ali	Male	46 - 55	Care taker
2	Abdus Sattar Molla	Male	26 - 35	Care taker
3	Salma	Female	26 - 35	Rickshaw puller/Van puller
4	Mamun	Male	36 - 45	Mason
5	Momena	Female	56 and above	Housewife
6	Bimol Chandra	Male	18 - 25	Other
7	Maria	Female	18 - 25	Other
8	Rodela	Female	36 - 45	House-help

FGD 4 - **Tongi**			Members: **08**	
Sl	Name	Gender	Age	Occupation
1	Nahida	Female	18 - 25	Garments worker
2	Hachina	Female	26 - 35	Garments worker
3	Sakina	Female	36 - 45	Garments worker
4	Nilufa	Female	46 - 55	Garments worker
5	Morjina	Female	26 - 35	Garments worker
6	Khadija	Female	46 - 55	Housewife
7	Selina	Female	18 - 25	Housewife
8	Nurjahan	Female	36 - 45	Housewife

IDI – 1 Korail	**Category: Male**
Name: Radha Rani Sikder	Age: 29
Date and Time: 26th June, 2023; 11:10 AM	Occupation: House help

IDI – 2 Korail	**Category: Male**
Name: Chameli Khatun	Age: 25
Date and Time: 26th June, 2023; 12:15 PM	Occupation: Community leader

IDI – 3 Korail	**Category: Male**
Name: Noyon Tara	Age: 43

Date and Time: 26th June, 2023; 3:49 PM	Occupation: Small store business

IDI – 1 Rayerbazar	**Category: Male**
Name: Junaida	Age: 19
Date and Time: 2nd September, 2023; 10:45 AM	Occupation: Resource Center Volunteer

IDI – 2 Rayerbazar	**Category: Male**
Name: Nila	Age: 32
Date and Time: 2nd September, 2023; 11:35 AM	Occupation: Resource Center Volunteer
IDI – 3 Rayerbazar	Category: Male
Name: Dipa Rani	Age: 39
Date and Time: 2nd September, 2023; 2:15 PM	Occupation: Housewife

IDI – 1 Tongi	**Category: Male**
Name: Bristy Khatun	Age: 19
Date and Time: 27th December, 2023; 11:37 AM	Occupation: NGO Volunteer

IDI – 2 Tongi	**Category: Male**
Name: Umayra	Age: 26
Date and Time: 27th December, 2023; 11:10 AM	Occupation: NGO Volunteer

IDI – 3 Tongi	**Category: Male**
Name: Provati Islam	Age: 33
Date and Time: 27th December, 2023; 1:10 PM	Occupation: NGO Volunteer

KII – 1	**Category:**
Name: Afsana Kona	Age: 31
Organization/Institute: Water Aid Bangladesh	
Designation: Program Officer- Urban WASH	

KII – 2	**Category:**
Name: Biplob Kanti Mondol	Age: 38
Organization/Institute: International Federation of Red Cross and Red Crescent Societies	
Designation: Manager- Resilience and WASH	

KII – 3	**Category:**
Name: Md. Milon Akhter	Age: 50
Organization/Institute: Manabik Shahajya Sangstha	
Designation: Deputy Program Manager	

KII – 4	**Category:**

Name: Rezaul Karim	Age: 55
Organization/Institute: Disaster Risk Reduction & Cimate Change Adaptation Program	
Designation: Consultant	