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Women's Access to Water, Sanitation and Hygiene Services among Climate Migrants in Khulna City, Bangladesh

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Abstract

The factors that affect to assess the accessibility of WASH facilities for the women of climate displaced households in Khulna city is the main concern of this research. Both rural and urban areas suffer from inadequate WASH facilities, with women, disabled groups, and displaced populations most affected. To combat this, Bangladesh is focusing on climate-smart cities, resilient infrastructure, and innovative WASH solutions. The study was explanatory in nature because it explained the factors that affecting women's WASH facilities accesses. This study assessed the accessibility of WASH facilities for climate displaced women in 21 no ward of Khulna city-corporation in Bangladesh. The study area, located in the south-western coastal Bangladesh, has been significantly discriminated through getting proper facilities. Data on demographics, knowledge about climate change, access in water, sanitation and hygiene of the respondents were collected through a survey of 400 households in that area. A convenience sampling technique was used to collect primary data from the study area through a structured questionnaire. The binary logistic regression model was used to determine the factors affecting the access on WASH facilities while descriptive and inferential statistics were used to identify their condition. The researcher use frequency, chi-square tests and binary logistics regression. The ($p<0.05$) value is counted as the significant. The result shows that there is a strong relationship between access in WASH facilities and their ownership of tube-well, sanitary latrine, accessible reproductive equipment and consistent water supply. The respondents who are have knowledge about climate change and are aware about it they are 1.679 percent less vulnerable to lose their resources than others. There is a positive relationship. This finding will help the policymaker to understand the awaken factors and the areas where adaption and mitigation is needed. Climate-displaced women in Khulna City face severe hardships in accessing proper WASH facilities due to limited resources, poor infrastructure, and inadequate awareness of climate change. Addressing these challenges requires targeted interventions that ensure sustainable access on water, sanitation and hygiene support for their well-being.

Introduction

Bangladesh is among the countries that are particularly susceptible to the impacts of climate change due to its geographical positioning, precarious socioeconomic state, expanding populace, extreme poverty, and restricted technological and resource accessibility**.** The global community of water, sanitation, and hygiene (WASH) practitioners, policy makers, and researchers has thus far allocated inadequate attention to the issue of vulnerability concerning access to water and sanitation in the contexts of humanitarian disasters and development (Chowdhury et al., 2022a).Climate change is a significant issue that threatens the sustainability of modern advancement. Alterations in weather patterns, encompassing the reliability and predictability of seasonal rainfall, and the repercussions of extreme events, have created an unprecedented demand for water resources, particularly in areas susceptible to flooding and drought (Adams et al., 2016).Ensuring that forcibly displaced individuals have access to water, sanitation, and hygiene (WASH) services is essential for achieving Sustainable Development Goal 6, which aims for universal and equitable access to key WASH services by 2030 (Likecker et al. 2021). Climate change act as an environmental push factor for the marginal rural poor to

migrate to urban areas, particularly in the coastal belt .An estimated 40% of the population in Bangladesh will reside in urban areas by 2020, compared to the current 28% urban population. Acting as a threat multiplier, climate change fuels tensions and increases the risk of conflict, particularly in vulnerable nations such as Bangladesh. In coastal areas, rural poor are often forced to migrate to urban centers, with projections showing 40% of the population living in cities by 2020, compared to 28% earlier. Research emphasizes the urgent need for improved infrastructure, education, and resources to address climate-induced WASH and health challenges in Khulna City (Md. A. Khan, 2022). According to the Joint Monitoring Program for Water Supply and Sanitation, a mere 98% of urban inhabitants and 85% of rural inhabitants have access to essential drinking water services. The issue of sanitation is of considerable concern in Bangladesh, specifically in the rural regions. 61% of urban women's and 43% of rural women's, according to the same survey, had access to fundamental sanitation services (Adams et al., 2016).The decline of public health in metropolitan areas is attributed to inadequate "WASH" systems, mismanagement of non-biodegradable menstrual hygiene waste, the widespread use of single-use medical items, and the presence of plastic in slum zones. The disabled and women living in neighborhoods are often adversely impacted by insufficient care, resulting in insecure conditions (Chowdhury et al., 2022b). Moreover, insufficient WASH conditions are widespread in metropolitan areas worldwide. The coastal region of Bangladesh is especially vulnerable to a variety of natural disasters, including cyclones, tidal surges, and flooding. The region's current population of 35.08 million is projected to increase to 41.8 million by 2015 and 57.9 million by 2050. Additionally, the proportion of individuals residing below the poverty line is greater in the northern (Rajshahi) and southern (Khulna, Barisal) regions of Bangladesh. It surpasses 45 percent, with Chittagong and Dhaka following suit. Degradation of the environment is a significant contributor to the localized destitution in this area. Predominantly modest farmers, fishermen, and agricultural laborers make a living off of the region's natural resources. Furthermore, the convergence of poverty, resource scarcity, population expansion, and institutional failures renders individuals more vulnerable to natural catastrophes, ultimately culminating in the displacement of populations (T. Akter, n.d.).The convergence of poverty, resource scarcity, and weak institutions increases vulnerability to disasters and forces migration from rural to urban slums. As a result, climate-displaced households in Bangladesh's cities face daily struggles, compounding the cycle of vulnerability and marginalization (Alhassan & Hadwen, 2017). There are numerous consequences associated with climate change, including the potential to induce displacement, deteriorate living conditions, and impede the repatriation of individuals already displaced. In numerous refugee-hosting regions of the globe, scarcity of scarce natural resources, including potable water, is intensifying. In extreme heat and aridity, as well as extreme cold and wetness, the viability of crops and livestock is compromised, thereby endangering livelihoods (Arif et al., 2010).

Objectives:

1. To Identify the main challenges and barriers that climate displaced Women's faces to utilize available WASH facilities in Khulna city

2. To assess the accessibility of WASH facilities of Women for climate displaced households in Khulna city.

Research Questions:

- What is the current accessibility status of Women's WASH facilities for climate displaced households in Khulna city?
- What are the main challenges and barriers that climate displaced women's faces to utilize available WASH facilities in Khulna city?

Review of Literature

A review of the literature analyzes and explains the current state of knowledge on a specific topic as found in scholarly books, journal articles, and other sources relevant to the research question. Its goal is to inform your readers how your research fits within the larger field of study and to provide an outline of the sources you have looked at when studying a specific issue (Lenshie et al., 2022).

Programs for climate-induced resettlement are currently in existence in regions of the world where communities are very vulnerable to the effects of climate change. Growing bodies of literature are examining the moral implications of migration and climate change in general, but moral and political theorists have not paid enough attention to the relationship between the two challenges, particularly in relation to climate-induced community-resettlement (Richard Black, 2011). The provision of domestic water, sanitation, and hygiene (WASH) facilities remains a substantial public health concern in low and middle-income countries. Access to all three fundamental WASH components (basic water, sanitation, and hygiene facilities) was unavailable to a small number of households in Bangladesh. However, there is some variation among households in terms of the provision of essential water, sanitation, and hygiene facilities. A comprehensive WASH strategy in Bangladesh has the potential to reduce the disparity and improve the quality of WASH facilities (Md Sabbir Ahmed, 2021). A basic human right is access to clean, inexpensive drinkable water, a hygienic facility, and the means and resources to exercise hygiene. Urban climate change, combined with rising economic, social, and health disparities, has heightened the importance of providing WASH, particularly to the urban poor and those who are already vulnerable to spatial, social, and other vulnerabilities. According to the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment for 2022, a lack of WASH infrastructure increases health, economic, and social concerns for urban people, particularly those living in informal settlements. This is primarily due to climate change-induced floods and weather events (Corburn, 2022). The difficulties encountered by WASH service providers are further complicated by migration in multiple respects, especially when addressing the requirements of migrants could potentially compromise or be perceived as a reduction in service quality for long-term residents (Jobbins et al., n.d.). Women bear a larger part of the WASH burden among groups with similar socioeconomic level. Furthermore, the research group exhibited characteristics such as poor income, a history of immigration, overpopulation, unemployment, instability, and illiteracy. When the average number of family members in each household was considered, as well

as the minimal salary, the average monthly income per household was less than the hunger threshold. Compared to Bangladesh's adult population, the women and their husbands were less educated. In addition, the average household size was smaller than the average number of residents. The poor and impoverished urban populations are reflected in the disadvantaged migrant population, which faces a number of issues such poverty, overcrowding, lack of education, unemployment, and gender roles coexisting (Simsek et al., 2024). Women also face gender-specific societal standards, or taboos, which frequently prevent them from practicing good hygiene during their periods and, as a result, not only compromise their health but also their dignity. Menstrual hygiene and women's unique needs for sanitary facilities have been shown to be among the most overlooked topics in the field of WASH (Kohler et al., 2019). A cumulative of 2.2 billion individuals worldwide were still devoid of access to potable water that was managed safety, 4.2 billion were deprived of sanitation that was also managed safely, and 3.0 billion were deprived of basic home hand washing services. Access "for all" is a key principle of the SDGs, with particular attention given to the most marginalized and vulnerable populations. To guarantee that no one falls behind, targeted initiatives are necessary to address the continuous lack of WASH services in communities (Lenshie et al., 2022). Bangladesh is one of the most vulnerable nations to climate change due to its distinctive geographical features, insecure socioeconomic situations, increasing population, extreme poverty, and constrained financial and technological resources. Bangladesh is undergoing a gradual rise in average temperature, anticipated to attain 1.0°C by 2030 and 1.4°C by 2050 due to climate change. In terms of adverse meteorological conditions, it ranks as the sixth most vulnerable state worldwide (Hossain et al, 2022). The political and paperwork status, exclusion, vulnerability, and marginalization of migrants collectively create numerous barriers to their access to safe and essential WASH services. The sustainable provision of WASH services constitutes the principal challenge for utility corporations, commercial vendors, and charitable groups. Generating money to sustain WASH services and mobilizing capital for investment are critical problems; yet, service supply may also involve political dimensions. Migration intensifies the challenges faced by WASH service providers when addressing the needs of migrants, as this may jeopardize or be considered to jeopardize the service quality for long-term inhabitants (Jobbins et al., n.d.). Displaced or migrant individuals face a significant lack of human rights protections, fierce competition for equitable access to resources, the effects of rapid urbanization, water shortages, power outages, hardship, and the increasing occurrence and intensity of natural disasters (Barua et al, 2017). The effects of climate change on environmental deterioration and socio-economic systems dependent on the environment will persistently escalate, potentially resulting in considerable population relocation. Significant challenges in Less Developed Countries (LDCs) would encompass substantial economic loss, flooding of coastal areas, deterioration of land and freshwater resources, and risks to food security and public health (K. Warner, 2009).

Methodology

The study was explanatory in nature because it explains the factors that affecting WASH facilities access to women (climate displaced households). In the study area most of the women were deprived of proper WASH facilities for different purposes. This study was include quantitative and descriptive

analyses. The information was taken from climate migrants who had resided in the slum areas of Khulna City for at least five years. The Khulna City slum area seemed to be a better study site because of its proximity to extremely vulnerable climate change affected areas, which is important because the research objective was understand the factors affecting climate-induced displacement and the author intended to deal with the environmental hazards of the target group in their new destination. Once more, the city offers improved living conditions for women, employment prospects, and facilities for health and education. Additionally, the city's business and industrial districts draw visitors. The largest slum region in Ward No. 21 was deemed eligible for use as a study location under the KCC. The slum colony of Surzor Hasi was also included by the researcher (Roy et al., n.d.) .

The method of selecting a subset of people from a population to take part in a study is called sampling. It involves choosing a number of participants so that they are representative of the big group from which they were picked. In this study, sample of respondents was selected through simple random sampling. In this research, the sample size was determined by using the following rule:

The formula is –

$$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1} + \mathbf{N}\,(\mathbf{e})^{\mathbf{2}}}$$

Here,

N = Total household of the study area

n = Sample size

e = Margin of error = 5% = .05

$$\mathbf{n} = \frac{37304}{1 + 37304\,(0.05)^{2}}$$

=395.84

[In this study, the sample was taken as a round figure 400 for the advantage of the data analysis.]

Variables of the study

Table 3.1 Features of dependent and independent variable

Nature	Description	Unit
Dependent Variable	Access in WASH facilities	Dummy; 1 = Yes, 0 = No
Independent Variable	Age group (Years)	Dummy; 1 =>65, 2 = 45-65, 3 = <45
	Years of schooling	Dummy; 3 = Tertiary, 2= Secondary, 1 = Primary, 0 = No education
	Residential status	Dummy; 1 = Own, 0 = Rented
	Tube well ownership	Dummy; 1 = Yes, 0 = No
	Sanitary latrine ownership	Dummy; 1 = Yes, 0 = No
	Access in extension services	Dummy; 1 = Yes, 0 = No
	Heard the term climate change	Dummy; 1 = Yes, 0 = No
	Aware about climate change	Dummy; 1 = Yes, 0 = No
	Affected household by climate change	Dummy; 1 = Yes, 0 = No
	Loses resources by climate change	Dummy; 1 = Yes, 0 = No
	Loses livelihood due to climate change	Dummy; 1 = Yes, 0 = No
	Reliable source of drinking water	Dummy; 1 = Yes, 0 = No
	Consistent water supply	Dummy; 1 = Yes, 0 = No
	Sources in reasonable distance	Dummy; 1 = Yes, 0 = No
	Store water for household activities and drinking	Dummy; 1 = Yes, 0 = No
	Proper functional toilet	Dummy; 1 = Yes, 0 = No
	Clean sanitation regularly	Dummy; 1 = Yes, 0 = No
	Maintain hygiene practice	Dummy; 1 = Yes, 0 = No
	Practice handwashing properly	Dummy; 1 = Yes, 0 = No
	Wash hands after toilet	Dummy; 1 = Yes, 0 = No
	Wear shoes before toilet	Dummy; 1 = Yes, 0 = No
	Experienced health issues	Dummy; 1 = Yes, 0 = No
	Faces challenges in hygiene practice	Dummy; 1 = Yes, 0 = No

The Primary Data was collected directly from the respondent of the study area. The survey was conducted through interview and the source of secondary data and information were includes: Bangladesh Bureau of Statistics (BBS) data, Khulna city corporation (KCC) data, Relevant journals, articles etc.To analyze and interpret data, the researcher was both descriptive (mean, standard deviation, percentage, frequency) and inferential (chi-square, binary logistic, regression model) statistics. The researcher was used some software's like -Microsoft Word, Excel, SPSS etc. to computerize, analyze and interpret the data. The results of descriptive and inferential statistics has shown through tables, graphs, charts and diagrams. In Hypothesis testing (significance level of 0.05) Pearson's Chi-square test, Binary logistic regression was also be used. The ethical norms were followed to the maximum extent possible during the study. Participants' consent was obtained before commencing to fill out the interview schedule, and their names were kept private. The interviewer described the goal of the study to all participants. The dataset also provided anonymity and secrecy. At the same time, the complete study received ethical approval from Khulna University's Research and Innovation Center (KURIC).

Results

4.1. Background information

The research covered a diverge group of respondents. The majority of the respondents were women (62.7%), highlighting the gendered nature of participation and vulnerability in the study area. The average age of the respondents was 37.6 years (SD = 9.22, range 20-60 years), indicating that most of the participants were in their economically active years, responsible for both livelihood activities and household management. In terms of housing, a significant proportion (60.5%) lived in rented houses, suggesting a large share of community lacked secure land tenure which may limit their capacity to invest in improved WASH facilities. Regarding water and sanitation infrastructure, only 27.3% of the households owned a tube-well, while 47.8% having a sanitary latrine. These figures underscore persistent challenges in achieving universal access to safe water and sanitation, despite ongoing development initiatives. Access to institutional support also appeared limited. Only 27.3% of the respondents had access to extension services, indicating that more than two-thirds of the households were excluded from formal information and support systems that could facilitate improved hygiene practices and institutional gaps that shape households' capacity to secure reliable WASH facilities and adapt to environmental stressors.

Major Components	Sub-Components	Unit	Value (Maximum-Minimum)
Background Information	Percent of female respondents	Percent	62.7% (100-0)
	Age of respondents	Mean ± SD (years)	37.59 ± 9.22 (60-20)
	Percent of respondents living by rented house	Percent	60.5% (100-0)
	Percent of respondents with tube-well ownership	Percent	27.3% (100-0)
	Percent of respondents with sanitary latrine ownership	Percent	47.8% (100-0)
	Percent of respondents with access on extension services	percent	27.3% (100-0)

4.2 Hypothesis testing between Access on WASH facilities and related independent variables

Analysis o cross-tabulated data (showed in Table 4.1) revealed clear disparities in access to water, sanitation and hygiene (WASH) facilities across different social and environmental conditions. Gender was not found to be meaningfully associated with WASH access, indicating that men and women experienced relatively similar conditions. Marital status showed a clear association where married women were considerably more likely than single women have adequate access to WASH facilities, reflecting the role of household structure and stability in shaping resource availability.

Ownership of tube-wells emerged as an important determinant as households with their own tube-wells enjoyed better water and sanitation services than those dependent on shared or rented sources. Similarly, respondents with access to extensive services reported improved WASH conditions compared to those without such support.

Awareness of climate change showed a strong and consistent relationship with WASH outcomes. Respondents who were aware climate change or had previously heard of its impacts tended to be better prepared and more proactive in securing safe water and maintaining hygiene. By contrast, households lacking such awareness often reported poor access, unsafe practices and greater difficulties in meeting basic needs. Moreover, health and disaster related variables revealed further differences to WASH access. Households where respondents faced challenges or had experienced health issues or diseases showed disparities in WASH access. Similarly, households affected by natural disasters as well as those lost resources or livelihoods due to climate change, reported poorer access to WASH than unaffected households.

Table 4.1: Hypothesis testing between Access on WASH facilities and related independent variables

Characteristics	Access on WASH facilities		x^2 (df)	Cramer's V	P value
	No n (%)	Yes n (%)			
Gender			3.737 (1)	0.155	0.053
Female	400 (41.5)	400 (21.3)			
Male	400 (19.8)	400 (17.5)			
Marital Status			6.277 (1)	0.388	<0.001**
Single	400 (34.3)	400 (10.8)			
Married	400 (20.5)	400 (34.5)			
Residential Status			1.275 (1)	0.056	0.249
Own	400 (23.0)	400 (16.5)			
Rented	400 (31.8)	400 (28.7)			
Tube-well ownership			6.413 (1)	0.341	<0.001**
No	400 (41.5)	400 (28.7)			
Yes	400 (6.5)	400 (23.3)			
Access on extension services			18.324 (1)	0.541	<0.001**
No	400 (34.0)	400 (25.3)			
Yes	400 (14.0)	400 (26.8)			
Aware about climate change			18.324 (1)	0.541	<0.001**
No	400 (22.3)	400 (15.0)			
Yes	400 (25.8)	400 (37.0)			
Heard about climate change			28.855 (1)	0.254	<0.001**
No	400 (17.5)	400 (7.5)			
Yes	400 (30.5)	400 (44.5)			
Respondents facing challenges			2.077	0.116	0.149

No	400 (12.9)	400 (9.7)	(1)		
Yes	400 (33.5)	400 (43.9)			
Experienced any health issues or diseases			26.216	0.256	0.001**
No	400 (34.8)	400 (17.2)	(1)		
Yes	400 (20.0)	400 (27.8)			
Household affected by natural disaster			8.157	0.413	0.002**
No	400 (28.2)	400 (9.8)	(1)		
Yes	400 (19.8)	400 (42.2)			
Loses resources due to climate change			5.855	0.364	<0.001**
No	400 (32.5)	400 (10.5)	(1)		
Yes	400 (22.3)	400 (34.8)			
Loses livelihood due to climate change			6.877	0.517	<0.001**
No	400 (32.5)	400 (15.8)	(1)		
Yes	400 (13.8)	400 (29.5)			
Access on reliable source of drinking water			7.094	0.410	<0.001**
No	400 (30.3)	400 (7.0)	(1)		
Yes	400 (24.5)	400 (38.3)			
Get consistent water supply			16.453	0.441	<0.001**
No	400 (30.3)	400 (7.0)	(1)		
Yes	400 (24.5)	400 (38.3)			
Experienced health issues			11.495	0.528	<0.001**
No	400 (42.0)	400 (10.8)	(1)		
Yes	400 (12.8)	400 (34.5)			
Access in proper functional toilet			11.810	0.540	<0.001**
No	400 (38.0)	400 (7.0)	(1)		

Yes	400 (16.8)	400 (38.2)			
Properly maintain hygiene practice			17.504	0.240	0.002**
No	400 (33.5)	400 (7.5)	(1)		
Yes	400 (21.3)	400 (37.8)			
Practice hand washing properly			9.224	0.478	<0.001**
No	400 (30.5)	400 (4.5)	(1)		
Yes	400 (24.3)	400 (40.8)			
Wash hand after using toilet			5.233	0.285	0.002**
No	400 (24.3)	400 (4.3)	(1)		
Yes	400 (30.5)	400 (41.0)			
Wear shoes at the time of going toilet			17.279 (1)	0.040	0.053
No	400 (27.3)	400 (4.0)			
Yes	400 (27.5)	400 (41.3)			
Face challenges in practicing good hygiene			4.615	0.534	<0.001**
No	400 (41.3)	400 (19.3)	(1)		
Yes	400 (13.5)	400 (26.0)			
Household affected by climate change			27.480	0.421	0.023*
No	400 (37.0)	400 (21.0)	(1)		
Yes	400 (17.8)	400 (24.3)			
Access to menstrual hygiene products			9.187	0.488	<0.001**
Always	400 (43.5)	400 (16.3)	(1)		
Sometimes	400 (5.0)	400 (2.5)			
Rarely	400 (6.3)	400 (5.5)			

Water availability factors were particularly critical. Households with access to reliable source of drinking water and consistent water supply were significantly better positioned in terms of safe WASH access.

Where water was irregular or distant, access to WASH facilities was significantly constrained. However, hygiene-related practices also played a major role. Households with access to proper functional toilets and those that who maintained hygiene practices properly demonstrated stronger WASH outcome. Likewise, respondents who practiced handwashing properly, washed hands after using the toilet, and wore shoes when going to the toilet showed clear differences in WASH access. In contrast, those faced difficulties in maintaining hygiene practices frequently belonged to households with inadequate or disrupted facilities. Additionally, exposure to climate-related disasters was another major determinant. Households those affected by climate change reported significantly poorer WASH conditions compared to unaffected households. These households often faced long-term challenges in rebuilding water infrastructure and maintaining hygiene, leading to higher risks of health problems. Finally, for women, access to menstrual hygiene products was strongly related to overall WASH outcomes. Women who could consistently access these products had better hygiene and sanitation conditions than those with occasional or rare access to menstrual hygiene products.

4.3 Parameter estimates of the binary logistic regression for determining the factors of women's access on WASH facilities

The binary logit model examined the influence of livelihood, resource availability, climate change awareness, and WASH related factors on respondent's outcome. Respondents who lost their livelihoods were somewhat more likely to experience adverse outcomes compared to those who did not, though this effect was not statistically significant. Similarly, those reporting loss of resources showed an increased likelihood of negative outcomes, but the relationship was not statistically significant.

Access to a consistent supply of water was a very strong predictor with respondents enjoying such access being 9.306 times more likely to achieve positive outcomes. Likewise, those who stored water were also considerably more likely to have favorable outcomes and both of these effects were statistically significant. However, awareness related factors were highly influential. Respondents who had heard about climate change were much more likely to show positive outcomes compared to those who had not. Being aware of climate change also showed a positive association, although this relationship was not statistically significant.

Table 4.2: Parameter estimates of the binary logistic regression for determining the factors of women's access on WASH facilities

Explanatory variables	Coefficient	OR [95% CI]	p-value
Loses livelihood			
No [Ref.]			
Yes	0.323	1.381 [0.781-2.441]	0.321
Loses of resources			
No [Ref.]			
Yes	0.730	2.074 [1.087-3.959]	0.448
Consistent supply of water			
No [Ref.]			
Yes	2.231	9.306 [3.474-24.927]	0.000**
Store water			
No [Ref.]			
Yes	1.181	3.259 [1.330-5.098]	0.002**
Heard about climate change			
No [Ref.]			
Yes	2.261	9.589 [4.331-21.230]	0.000**
Aware about climate change	1.679	4.619 [2.89-12.341]	0.628
No [Ref]			
Yes			
Reliable distance of sources			
No [Ref.]			
Yes	0.955	2.597 [1.218-5.539]	0.027*
Tube-well ownership			
No [Ref.]			
Yes	1.461	2.232 [1.330-5.146]	0.004*
Household affected	7.221	5.939 [2.425-9.621]	0.228
No [Ref]			
Yes			
Sanitary latrine ownership			

No [Ref.]			
Yes	0.918	2.505 [1.303-4.817]	0.114
Extension services access			
No [Ref.]			
Yes	-.482	0.159[0.339-1.124]	0.159
Respondents aware about climate change	1.679	1.972[1.299-2.296]	0.000**
No [Ref]			
Yes			
Clean sanitation facilities	2.682	14.619[3.892-54.911]	0.001**
No [Ref.]			
Yes			
Maintain hygiene properly	1.720	5.583[15.227-2.047]	0.003**
No [Ref.]			
Yes			
Practice hand washing properly	6.121	3.281[3.213-5.722]	0.237
No [Ref]			
Yes			
Experienced health issues	23.751	2.357[1.232-3.479]	1.432
No [Ref]			
Yes			
Challenges faced by the respondents	-8.679	1.415[1.624-2.299]	0.000**
No [Ref.]			
Yes			
OR: Odd Ratio; CI: Confidence Interval; Ref.: Reference			
p-value obtain from binary logistic regression, **p-value <0.01; *p-value <0.05			

Infrastructure related factors were important as well. Having a reliable distance to water sources was statistically associated with better outcomes, and tube-well ownership also contributed positively, with owners being more likely to benefited compared to non-owners. However, whether the household was affected did not show a statistically significant association. Sanitation and hygiene factors demonstrated strong effects. Sanitary latrine ownership was positively related to outcomes but not

statistically significant. By contrast, the availability of clean sanitation facilities and the ability to maintain hygiene properly were both strongly and significantly associated with positive outcomes. While hand washing practices and experienced health issues also showed positive tendencies, these were not statistically significant. Finally, respondents who faced livelihood or environmental challenges were significantly more likely to experience adverse outcome compared to those who did not report such challenges. The findings highlighted several persistent challenges facing communities in the study area. Disaster and climate-related hazards continue to damage water and sanitation infrastructure, leaving many households dependent on unsafe or inconsistent supply. Limited resources, particularly among the households without tube-wells or reliable sanitation, exacerbate vulnerabilities. Health problems linked to poor hygiene and unsafe water were also widespread, further deepening community hardship. At the same time, the results point to key opportunities. Households with tube-wells, reliable water supply, and clean sanitation facilities consistently reported better WASH outcomes, showing that targeted infrastructure improvements can yield substantial benefits. Climate change awareness and knowledge also emerged as enabling factors, suggesting that education and extension services can empower households to take proactive steps. Moreover, positive hygiene practice was associated with improved outcomes, indicating that community-level campaign and behavioral interventions can complement infrastructure solutions.

Overall, the results suggest that while WASH access is currently constrained by disaster exposure and infrastructural gaps, opportunities exist to improve conditions through a combination of reliable water supply, sanitation investments, awareness programs, and the promotion of safe hygiene behaviors.

Discussion

Climate displacement refers to the movement of people from their homes or communities due to the adverse impacts of climate change, such as rising sea levels, extreme weather events, droughts, and other environmental changes. This displacement often leads to significant challenges, including the disruption of access to basic services like water, sanitation, and hygiene (WASH) facilities. The relationship between climate displacement and WASH facilities is profound. Displaced populations often face inadequate access to clean water, proper sanitation, and hygiene services.

Improved access to water, sanitation, and hygiene (WASH) is one of the most important global health priorities, along with sustainable public health. According to a 2015 WHO report, approximately 2.3 billion people lack access to basic sanitation (either by practicing open defecation, using a pit latrine without a slab, or using a hanging latrine), and poor WASH systems in homes and communities contribute to the spread of numerous diseases. About 19% of people worldwide used soap when washing their hands after coming into contact with excreta, according to the health status of millions of people living without access to clean drinking water, improved WASH facilities, or soap. WASH knowledge and practices are primarily influenced by education, community norms, racial and cultural behaviors, and laws and regulations (Md. S. Khan & Paul, 2023).In this research the researcher also states that water, sanitation and hygiene are most important necessities for every household. But the

people of 21 no ward are facing some challenges for their access on them, some factors also affecting like the inconsistent water supply during the whole year, insufficient functional latrine and inadequate availability of hygiene practice equipment. Most of the people uses pit latrine which is not well maintained. For this reason, every year the people of that area face and experienced several health issues.

The research undertaken on 21 no ward in Khulna city in Bangladesh's southeast zones women's access on WASH facilities who are climate displaced. Khulna is a land of large number of water body in early stage of the independence of Bangladesh people used to collect water from surface water sources as time changes the city used to adapt to sallow tube-wells but there were severe arsenic and salinity problem in this region. Residential water abstraction attempts to bridge the gap left by the inadequacy of the municipal water supply. People attempted to construct deep tube wells, pipe water sources, and boreholes in this regard as time went on(Bristy et al., 2020).In this research this author also wanted to state that Khulna WASA (Water supply and sewerage authority) committed to supply water during the whole year, but it's a matter of great sorrow that the climate displaced households who are living in the slum cannot get consistent water supply during the whole year. In the dry season they face more hassle for drinking water. For this reason, they store the water for drinking and other purposes.

One of the main components of an urban area that has a significant impact on the environment and quality of life is its sanitation services. The third-biggest city in Bangladesh, Khulna, has 8.14% of its total area made up of slums with inadequate sanitary services. In Khulna city's slums, many government and non-governmental organizations operate sanitary latrines under various sanitation projects, although these hardly satisfy the needs and aspirations of the slum dwellers (Alam2018.Pdf, n.d.) In this authors study he also stated that sanitation facilities of Khulna slum specially who are climate displaced they have limited access so that they cannot maintain proper hygiene.

This section provides specific information and supporting arguments that bridge the current findings with empirical evidence. Main factors of women's access on WASH facilities are highlighted, along with supportive arguments. The current study was undertaken to explore the prevalence and determinants that contribute to women's access to WASH facilities. The overall prevalence rate of women's access to WASH facilities was found 62.7%. This prevalence rate is close to the findings of a similar study conducted in West African countries where women reported that they had better access to safe water (56.39%), good sanitation (59.36%), and good hygiene (60.23%) compared to men (Aboah, 2024). Similar findings were reported by a comparative study conducted in the South-Asian countries where the study found that household access to WASH facilities was highest in Nepal (75.3%), followed by Pakistan (59.5%), Bangladesh (50.3%), and lowest in Afghanistan (33.5%) (Islam Jitu & Masud, 2025). The explanatory variables that were shown to have a significant association with women's access to WASH facilities were consistent supply of water, store water, heard about climate change, reliable distance of sources, tube-well ownership, respondents aware about climate change, clean sanitation facilities, maintain hygiene properly, challenges faced by the women. The result of this study suggests that consistent supply of water had positive correlation with women's access to WASH facilities and women

who had consistent supply of water exerted better access to WASH facilities compared to those who had not. Similar type of result was found in a study in Zambia (Thomas-Possee et al., 2024), in Kenya (Simiyu et al., 2025) and in Pakistan, Bangladesh, Ethiopia and Mozambique (DuChanois et al., 2019). This study also found ability to store water has a positive correlation and served as a significant determinant of women's access to WASH facilities. Women who could store water had more access to WASH facilities compared to those who did not have that scope. Similar type of result was found in a study conducted in Nepal where it was found that longer distance to water sourcewas significantly associated with lower access to combined WASH (Dhital et al., 2024), in Bangladesh (Jaren et al., 2022), in Burkina Faso (Anderson et al., 2021) and in Uganda (Colding-Jørgensen et al., 2023). It has found in the present study that heard about climate change has a positive correlation with women's access to WASH facilities and is a significant factor in women's access in WASH facilities and women who had heard about climate change are more likely to have better access to WASH facilities which is aligned with the findings of the previous study conducted in Bangladesh where women in coastal areas are particularly vulnerable to climate change impacts leading to violations of women's rights, including limited access to education, healthcare, and economic opportunities (Shamsuddoha et al., 2024).

Another study conducted in Bangladesh also complimented this findings (M. R. Islam, 2020). This study found that reliable distance of water sources has found as the statistically significant predictor and is positively correlated with women's access in WASH facilities. Similar pattern of result was found in Zambia and Honduras (Jia et al., 2025) along with in Ethiopia where longer distances to water sources are associated with increased risks of waterborne diseases and other health issues (Nygren et al., 2016). It has found in the present study that households with tube-well ownership is positively correlated with the outcome variable and possess higher access to WASH facilities compared to those who don't own any tube-well. Similar type of results was to be found in two different studies conducted in Bangladesh where households with access to tubewells experienced improved access to safe water and better hygiene practices (Nabi et al., 2025; Wu et al., 2011). This study affirmed that respondents' being aware about climate change has positive correlation and is the highly statistically significant associated factor for women's access to WASH facilities which is aligned with the findings of the previous study which also argued that a correlation exists between awareness about climate change and women's access to WASH facilities in Zambia and Honduras (Jia et al., 2025) along with Indonesia and Timor-Leste (Jeremy Kohlitz et al., 2022). According to the present study clean sanitation facilities have positive correlation with women's access to WASH facilities and served as a significant factor. Similar type of result was found in India where women who practice open defecation are twice as likely to face non-partner sexual violence as women with a household toilet (Jadhav et al., 2016). Another study in Turkey highlights the importance of clean sanitation facilities in improving women's access to WASH services (Şimşek et al., 2024).

Maintain hygiene properly is another prime associated risk factor for women's access to WASH facilities and is positively correlated with the outcome variable; this outcome aligns with the findings of prior research in Nepal (Sharma et al., 2025), in Turkish urban area (Şimşek et al., 2024), multiple low- and middle-income countries across Africa, Asia, and Latin America (Kayser et al., 2019).

Challenges faced by the respondents is another prime associated factor and is negatively correlated with this study. Women who had more challenges have less access to WASH facilities compared to those who had less challenges. This outcome aligns with the findings of the prior research in rural Odisha of India (Caruso et al., 2017), in Nairobi, Kenya (Winter et al., 2019), Oromia's region of Ethiopia (Assefa et al., 2021).

The findings highlighted several persistent challenges facing communities in the study area. Disaster and climate-related hazards continue to damage water and sanitation infrastructure, leaving many households dependent on unsafe or inconsistent supply. Limited resources, particularly among the households without tube-wells or reliable sanitation, exacerbate vulnerabilities. Health problems linked to poor hygiene and unsafe water were also widespread, further deepening community hardship. At the same time, the results point to key opportunities. Households with tube-wells, reliable water supply, and clean sanitation facilities consistently reported better WASH outcomes, showing that targeted infrastructure improvements can yield substantial benefits. Climate change awareness and knowledge also emerged as enabling factors, suggesting that education and extension services can empower households to take proactive steps. Moreover, positive hygiene practice was associated with improved outcomes, indicating that community-level campaign and behavioral interventions can complement infrastructure solutions.

Overall, the results suggest that while WASH access is currently constrained by disaster exposure and infrastructural gaps, opportunities exist to improve conditions through a combination of reliable water supply, sanitation investments, awareness programs, and the promotion of safe hygiene behaviors.

Policy Recommendations

The majority of the respondents from 21 no ward has no well-established access on WASH facility. They become hampered by different factors. The access on WASH facilities of the climate displaced households varies from person to person in the study, it is found that most of the respondents have no access on proper WASH facilities. But they have knowledge about climate change and they are also practicing proper hygiene. From the study the researcher has some recommendations for determining the factors and their impact on access of WASH facilities. Advocate for policies that explicitly recognize the unique needs of climate-displaced households regarding WASH facilities in urban planning, disaster response, and resilience-building strategies. So that they can maintain hygiene practice regularly**.** The findings also highlight that women and children are the most affected due to the lack of safe sanitation and clean water. Many households reported spending a significant portion of their limited income to buy safe drinking water. Inadequate facilities further increase the risk of waterborne diseases such as diarrhea, cholera, and dysentery. Moreover, the long distance to collect water makes it even more difficult for families to sustain daily hygiene practices. The study emphasizes that the shortage of WASH services not only affects health but also reduces overall productivity and well-being. Respondents expressed a strong desire for community-based interventions that could improve their access to safe water and sanitation. Collaboration between local government, NGOs, and international donors is

necessary to address this pressing issue. Awareness programs alone are not sufficient unless accompanied by infrastructural improvements. Improved WASH facilities would not only safeguard public health but also strengthen resilience against future climate shocks. Therefore, immediate actions must be taken to integrate WASH facility development into broader climate adaptation strategies.

Limitations and Future Directions

Although respondents have heard of climate change, they have a limited understanding of it and mostly the women are unaware about it. A research focus could be on investigating effective educational methods or interventions to bridge this awareness gap. By examining the effects of storing water due to inconsistency in supply, such as examining the quality changes or health implications of stored water over time. By assessing the impact of limited access to hygiene and reproductive equipment on the community's ability to maintain proper hygiene practices, particularly in light of climate-related challenges. Investigating the strategies used by Khulna City communities to cope with climate induced displacement, with a focus on women's WASH-related aspects and their effectiveness. Several woks on WASH facilities already been operated but any of them were not conducted in 21 no ward in Khulna city and did not focused on women's specically. Previous studies were not focused on climate displaced households and their conditions and access on WASH facilities. The researcher made all possible attempts to minimize the study's limitations, yet some constraints remained despite using conventional techniques and tools. For instance, in several households, the heads were not available due to their daily activities and work commitments, which required the data enumerators to collect information from the eldest available members instead. Moreover, the south-west coastal region of Bangladesh is vast, but the study was conducted only in one ward of this region, which does not fully represent the entire area. Another limitation was the relatively small sample size selected for each ward, which posed challenges in achieving broader generalizations. Additionally, there were certain limitations related to the analysis, which further restricted the overall scope of the study.

Concluding Remarks

Bangladesh is among the countries that are particularly susceptible to the impacts of climate change due to its geographical positioning, precarious socioeconomic state, expanding populace, extreme poverty, and restricted technological and resource accessibility **.**Climate displacement is a familiar term to all. Due to climate change people from different areas of the country shifts in the cities slum. This research was carried out in 21 no ward of Khulna city corporation, which is densely induced with climate displaced households. This study found the affecting factors of women behind the access on WASH facilities. Climate induced issues also included in this study.

The study illuminates critical challenges faced by the women of climate-displaced households in Khulna City concerning access to Water, Sanitation, and Hygiene facilities. Despite a baseline awareness of climate change, there exists a pervasive lack of comprehensive understanding among respondents. This knowledge gap, coupled with the profound loss of resources, livelihoods and health due to climate-induced or natural disasters, underscores the urgent need for targeted education and awareness initiatives. In this research, most of the respondents heard about climate change but they are not aware about it. They have lost their resources and livelihood due to climate change or natural disasters. Those area people do not get consistent water supply during the whole year so that they sometimes store water for drinking and other purposes. They share latrine and most of the latrine are not well functional sanitary based. They cannot maintain hygiene practice properly for the limited access in hygiene equipment, in another word they cannot afford the reproduction equipment. So that, they experienced several health issues which is related to climate change. By assessing the effectiveness of interventions, enabling adaptive management and improvement over time this problem can be solved.

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Figures

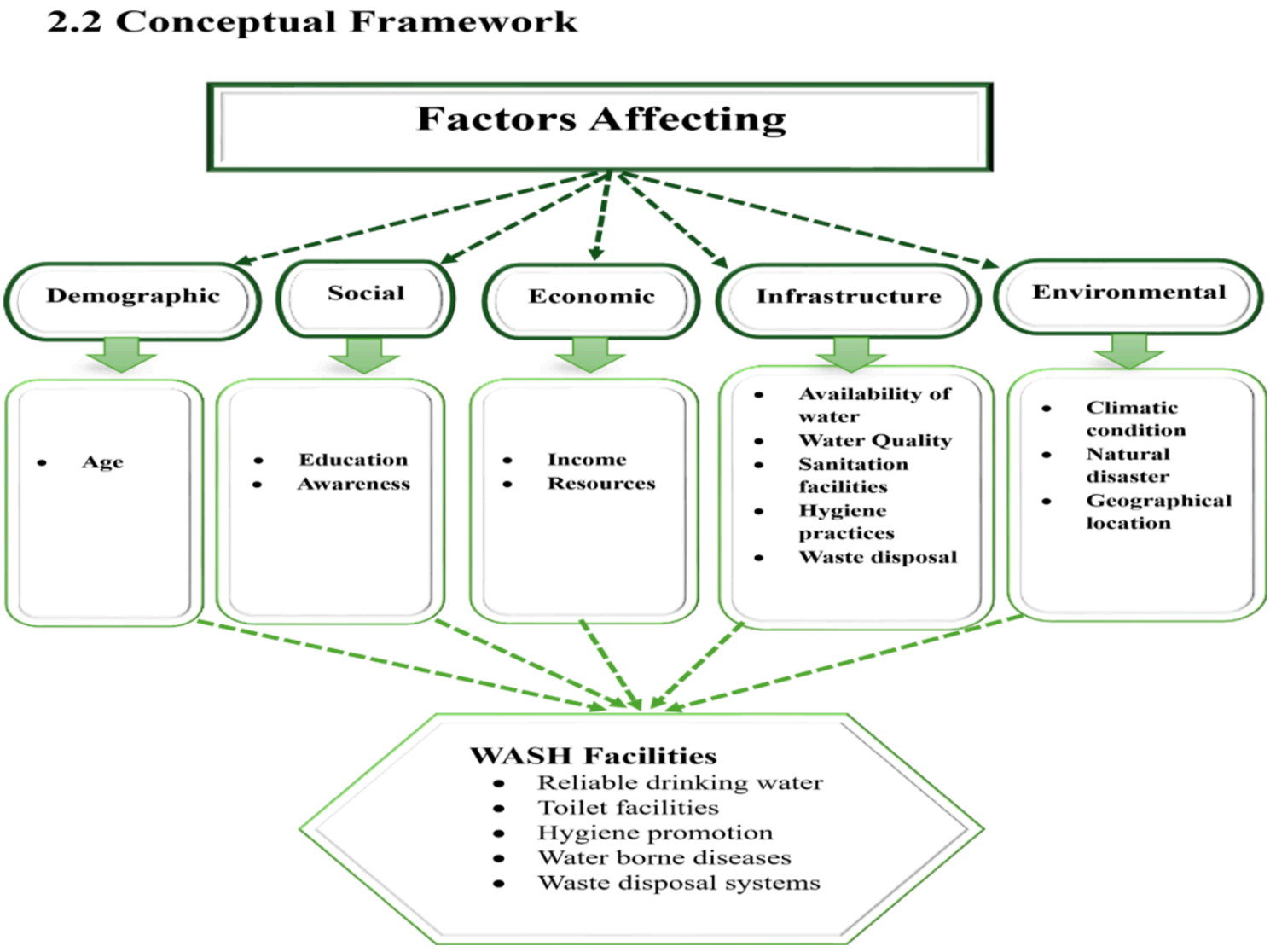


Figure 1

Legend not included with this version.

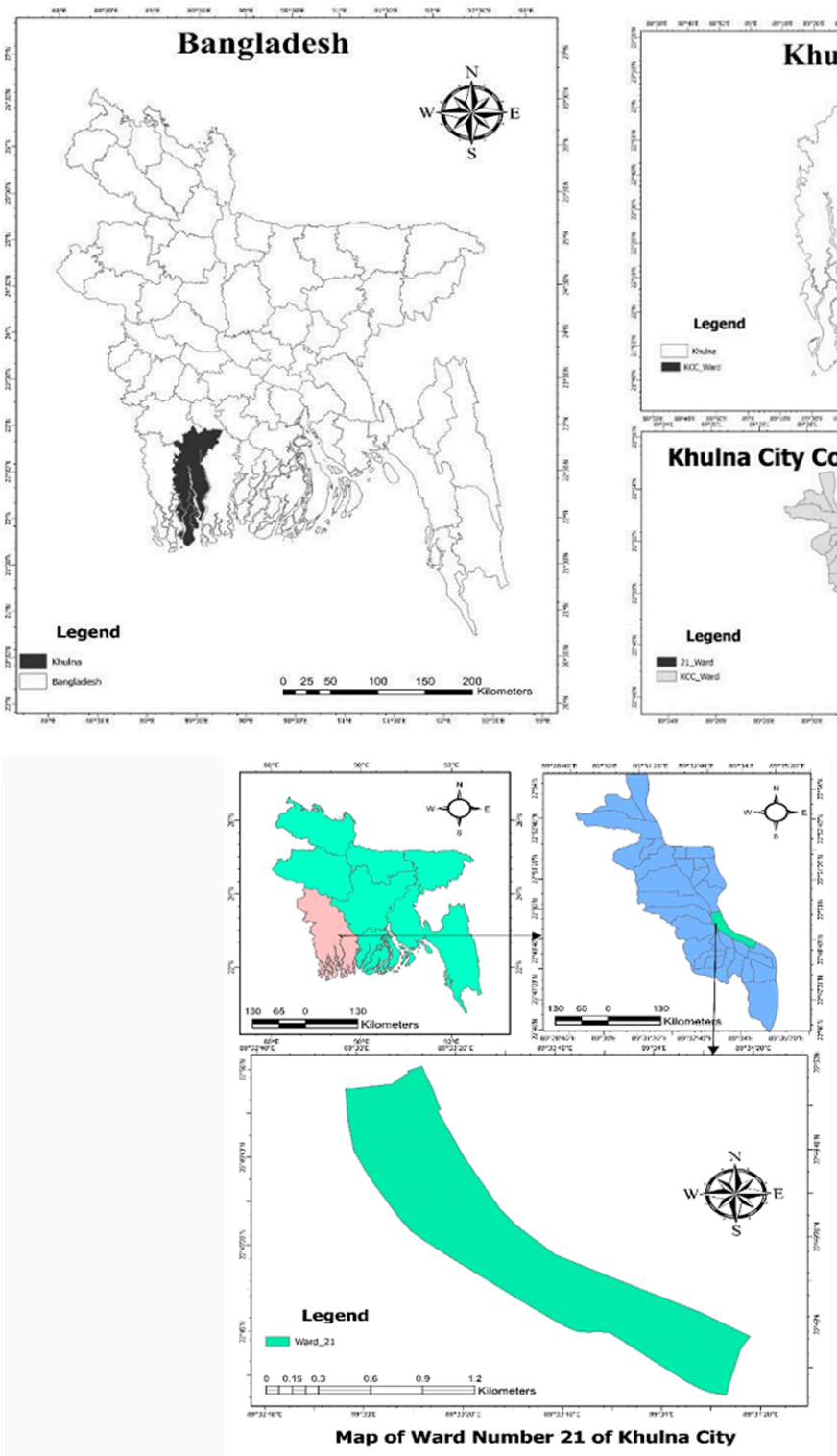


Figure 2

21 no ward map (developed by the author)