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A Study on How Climate Change Affects the Water, Sanitation, and Hygiene (Wash) Sectors in Barguna Sadar Upazila, Bangladesh

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Author's contribution

Author AKK is the author of this study. He led the study design, tools development, data collection and analysis process, drafted the report and submitted it to journal.

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ABSTRACT

Aims and Study Area: A study conducted to identify how climate change affects water, sanitation, and hygiene (WASH) sector for Barguna Sadar Upazila.
Methodology: This study applied inductive reasoning methods with inductive and statistical generalization criteria. Used mixed method approach where both qualitative and quantitative data were collected from study areas. However, this study also triangulated findings from literature review and conducted Geo Spatial Analysis that enhanced the strength of the study findings.
Results: From the quantitative findings it was identified that 32% reported they don't even know what the risk factors of climate change are, among them 41% female which is very alarming for WASH. However, from the KII respondents reported to have waterlogging, increase of temperature, heavy rainfall, and scarcity of water in their locality. 37% of respondents reported to not available the drinking water in all year round and they mentioned it happens due to lower groundwater level, increase salinity in water, damage of water source and draught. 60% of the respondents reported that their latrines were destroyed by a cyclone/tidal surge/water lodging and 33% reported to

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experience water borne disease in the past three months. Only 10% of respondents agreed that they have sufficient knowledge of the result of climate changes in the WASH sector. Only 5% of women agreed they have access to WASH Management systems during cyclone/tidal surge/water lodging**.** A total of 30% respondents reported that climate change resulted in extra burden for women and girls in WASH sector.

Conclusion: This study identified that mostly climate change impacts women and girls as have less knowledge on impacts of climate changes in WASH. From those findings this study identified some recommendations which can improve the conditions in WASH sector in Barguna as well as Coastal belt of Bangladesh.

Keywords: Climate change affects; water; sanitation; global warming and climate change.

1. INTRODUCTION

Bangladesh is already evidencing the adverse impacts of global warming and climate change. From several studies it was evident that coastal areas are mainly affected by the impact of climate change, especially Khulna, Bagerhat and Barishal. It is also identified from different research reports and GIS Data that Barguna District of Barisal Division was affected more due to its geographical settings and experienced several natural disasters including Sidar and Aila. Those natural calamities seriously impacted on their WASH, Health and Livelihood Sectors. However, increasing salinity in natural drinking water resources and destruction of sanitation systems impacted their safe sanitation systems mainly for women and girls. Scarcity of drinking water also influences the extra burden for women as they are primarily responsible for collecting water for HH.

Barguna is one of the most affected areas due to its geographical setting. The historical dataset (1877-2003) of land falling storm track in Bangladesh developed applying the Global Tropical Cyclone Climatic Atlas (GTCCA) revealed that thirty-five depressions, storms, and cyclones hit Barguna district during the last 130 years [1]. Along this Barguna was also affected by hard-hit severe cyclones during 1935, 1965, 1970 and the most recent cyclone in SIDR in 2007. The Barguna district is susceptible to tidal surges and flooding with a variable degree considering the distance from the ocean and the elevation [2].

After analyzing some patterns of meteorological data, it was identified that the coastal zone of Bangladesh, specially Barguna, is under vulnerabilities of salinity intrusion and flood porn. Those disasters critically impacted on the livelihood of the people and major areas are water sources, sanitation systems, health, and crops. The below maps are representing the vulnerabilities of Coastal areas in salinity intrusion and flood.

Map 1. Salinity risk areas in Bangladesh & Map 2 flood prone areas in Bangladesh
Source: Bangladesh Climate and Disaster Risk Atlas

From the existing research we identified some implications of the WASH sector in Barguna due to the results of climate change. According to experts, 41% of the population still lacks access to safe water facilities, while a staggering 61% lack access to safe sanitation facilities at home (TBS Report, 2023).

A study titled "Analysis of changes in climatological condition: a perspective from Barguna district of Bangladesh" identified that, The Barguna district of Bangladesh is susceptible to cyclones and storm surges and subjected to severe damages frequently. According to a study of IUCN more than 83% of the population in the districts of Barguna are under medium risk due to climate change vulnerabilities. This study also identified that the people of Barguna District need to adapt technical options like Pond Sand Filter (PSF), Protected Dug well etc. according to the types of hazards [3].

According to a study titled "Assessing the Impacts of Climate Change on Water-Borne Diseases: A Comparative Study on Taltali Upazila of Barguna District" identified that - The multiplication of climate variance on both food security and water is the utmost negative health dominance in a coastal region like the Barguna district. Barguna district is experiencing climate variance dominance as the result of the gradual increase of the sea level and temperature (Indhumathi, 2021) [4].. Most of the people are passing vulnerable life especially, in the rainy season in this district. Repeated cyclones, floods, and excessive rain are very common in this area. Tidal surges or floods overwhelm tube-well, ponds, and water bodies and pollute the natural emergence of freshwater (Mohankumar, 2022) [5].This scenario is especially hazardous for coastal people like Barguna because most of the people must depend on surface water and groundwater for drinking. As a result, people are chasing an endless crisis of water savings for domestic use and drinking also. Bangladesh's vulnerability to climate change is largely attributed to its geography, which makes the country particularly susceptible to natural disasters and rising sea levels; its dense population, which is heavily dependent on agriculture as a source of livelihood; and, its weak adaptive capacity relative to its high exposure to climate change impacts [6].

Considering the above context, this study was commissioned to determine how climate change affects the WASH sesctor in Barguna Sadar Upazila. Here the study examined their knowledge, and present vulnerabilities of the people of the Barguna Sadar Upazila where focus were women and girls. This study triangulates findings from multiple sections like literature review, quantitative analysis, and qualitative analysis. All findings were validated with the national operational standards so that it can evaluate how far we are from our national standards in WASH sectors.

2. MATERIALS AND METHODS

2.1 Methodology

This study applied inductive reasoning methods with inductive and statistical generalization types. Respondents for quantitative survey identified by applying a simple random sampling method. Conclusions will be drawn from a descriptive analysis and narrative analysis from KII, which will aid in triangulation survey results and identifying the in-depth of the findings. From those analyses it will identify the vulnerability on WASH Sector and Gender Role due to climate change for the targeted areas. Additionally, this study will analyze secondary data from a different research publication to measure the long-term effects on the WASH Sector and validate the choice of the study regions and the results of both a quantitative and qualitative survey. Findings of this study presented with statistical generalization method and presented with % so that it can make specific statements of the population. On the other hand, this study will also conduct geo-spatial analysis for measuring the impact on the WASH Sector due to climate change. Primary quantitative data will be collected from five unions of Barguna Sadar Upazila through online platform Mwater. Qualitative data collected by local M&E Experts who basically conducted the interviews from the respondents. On the other hand, secondary data will be collected from several research papers and statistical data like Gov. Reports, other research from IUCN, WHO, WaterAid, ResearchGate ETC.

2.2 Sampling

As this study was designed with a mixed method approach, here we used both probability and non-probability sampling methods.

To draw the sample first used a stratified sample method to select the pocket areas of the study locations where people are suffering more from

WASH Related Crisis. After selecting the study locations respondents selected randomly from those areas so that it can represent the population of the study area. Here is the method applied to finalize the sample size for this study: According to the website, total Population of Barguna Sadar are 2,37,613 and here we determine confidence interval 95% and margin of error 10%. By applying this method sample size comes to total 97 and we fixed the sample size total 100 respondents. These sample respondents are equally distributed in five unions for collecting quantitative data.

On the other hand, we selected a total of 20 respondents from the study areas by Non-Probability Sampling Method to conduct KII. This information helps us to dig down more about the information that we get from quantitative surveys.

2.3 Tools Development

This study applied participatory methods to develop and finalise tools for quantitative and qualitative tools. First review the existing reports and journals to identify the problem statements, and literature review and from there get initial ideas about the tools. After that, they drafted tools based on the identifications and shared them with the local experts (Coastal specially in Barguna) by conducting a virtual meeting to get their feedback. After incorporating all feedback, share the final tools to experts again and orient data enumerators through virtual training.

2.4 Study Limitations

This study collected quantitative data from 5 unions of Barguna sadar Upazia and study areas selected through stratified sampling method. After identifying the strata 100 respondents were selected randomly and 10 KII that were selected as a non-probability sampling method. Resources and time limitations confined the number of respondents and study areas. However, during collecting the information from the community there are some challenges and limitations of collecting sensitive information from the community and mainly from female respondents. Also, we took consent before collecting data and pictures from the respondents.

3. RESULTS AND DISCUSSION

The study on Water, Sanitation and Hygiene (WASH) was conducted at five unions such as Aylapatakata, Badarkhali, Kewrabunia, M.Baliatoli, and Noltona of Barguna Sadar Upazilla of Barguna District. The sample size of the study was 100 and the study followed a mixed method approach. The five unions share approximately the same percentage of the responses with a very little fluctuation though there are some variations between male and female participants. In this study we selected respondents randomly from the study areas and among the respondents 60% were female. Please find Chart 1 where the gender wise disaggregation of the respondents. On the other hand, only 8% of respondents reported having children with disabilities.

3.1 Respondent's Knowledge on Climate Change of Climate Change in Study Area

This study examined the knowledge of the respondents about risk factors of climate change. From the data analysis it was identified that 82.50% male respondents are reported to be aware of the risk factors of climate change and 41.70% female respondents do not even know the risk factors and among male responses, which is very alarming for their WASH.

From the total 68 respondents who agreed to have knowledge on the risk factors of climate change further asked, did they experience anything about the risk factors due to climate change in their areas? From the data analysis it was identified that total 66% respondents agreed to experience the risk factors of climate change in their areas. In this factor it also identified that male (80%) respondents are more aware about the impact of climate change. However, from the KII respondents reported waterlogging, increase of temperature, heavy rainfall, and scarcity of water in their locality. From the literature review we also identified the same issues that Barguna affected with a series of cyclones and tidal surge in the past few years.

3.2 Affects of Climate Change in Water of Study Area

In this study we examined what are the main sources of drinking water for the respondent's HH. From the analysis it was identified that there was no significant data for any options and only 18% respondents reported that they collect water from

Deep set tube wells. Including finds that the main sources of drinking water in Barguna Sadar are deep tube wells (including deep-set tube well), pond water, and river/khal water which are respectively 32%, 15%, and 13% of the total responses.

Chart 1. Framework of analysis

Types of Data	Research Method	Method of Data Analysis	Areas of Analysis
Survey from Community	Quantitative	Statistical Analysis	For quantitative data this study will conduct statistical analysis to know the descriptive status of the findings from the respondent. Statistical generalization method applied to share the findings from statistical analysis.
Secondary Data from Several Research	Quantitative	Meta-Analysis	From several research it will identify the long-term vulnerability on wash and gender roles in targeted areas that will support to validate our survey findings. From this analysis we will also identify the existing policies ratified by Bangladesh Govt. to support the WASH Sector for Coastal Belt of Bangladesh.
KII from Stakeholders	Qualitative	Narrative Analysis	From the narrative analysis we will analyse their experiences to understand the in-depth about the impact of climate change on wash sector in the targeted communities
Geo Spatial Analysis	Map Analysis	Geographical Information System (GIS) Analysis	The problem statement and literature review share some maps from secondary sources to analyze the trends and patterns of impact of climate change in Barguna. On the other hand, from the quantitative data, there will be some analysis to show the vulnerabilities of WASH in the Map that represents the status of beneficiaries based on their geographical locations.

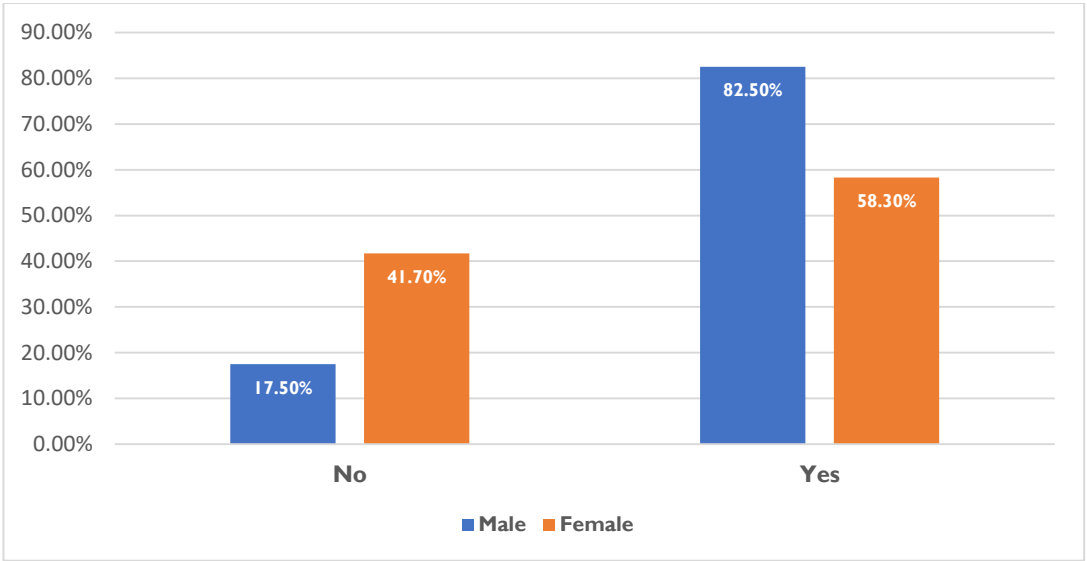


Fig. 1. Respondent's knowledge on climate change

The study demonstrates that a greater majority of the responses (43% of responses) don't know the arsenic contamination test of their main source of drinking water. The below map represents the respondents' locations where we identified their tube well water passed in arsenic test; those are most in the vicinity of purosova. The report of JMP 2013 also identified that for water supply, drinking water is undermined by severe quality issues. For example, 20 percent of the water supply is arsenic contaminated at the source and 12 percent at point of use, and service provision is often unreliable and intermittent [7].

During the survey we examined that their water source has available drinking water all the year around. From the data analysis we identified that 37% of respondents reported to not be able to drink water in their water source. There is less difference between male and female participants which is 45% and 40% respectively.

Again, asking the respondents who reported to not have drinking water available in the water source mentioned that beyond the rainy season they are facing drinking water crisis for winter, pre-monsoon, and post monsoon. They also reported that those challenges happened after the cyclone Sidar, Aila and the rest of the series of cyclones occurred in their locations. When we further examined the reason of the water crisis, they mentioned it happened due to lower groundwater level, increased salinity in water, damage of water sources and drought. From this study it also identified that during the crisis time they mostly depend on multiple sources including rainwater harvesting. From another study it was also identified that just after the disaster, there was a severe shortage of food and scarcity of pure drinking water in the affected areas. Though some families managed to get some food due to a lack of combustible substances, cooking was not easy, and they had to live day after day eating raw food [8]. According to World Bank "Bangladesh is among the most vulnerable countries to climate change impacts. Extreme weather events and climate change affect the WASH sector by reducing drinking water quality and availability [9].

From the KII the respondents also reported because of climate change there is a shortage of safe drinking water in the areas, and water level in the tube well goes down. As a result, they need to consume pond and canal water after boiling and the water they collect from far away must be boiled and drunk. In addition, water must be collected from far away, thus women and children are at risk.

From the data analysis, it identified that there are different opinions from male and female about the primary roles of collecting drinking water in households. The research shows that 41% of the responses represented the role of collecting water for most of the respondents' family is entitled to both adult male and female, which is composed of 60% male responses and 28% female responses. In this perception, the size of female participants is greater, 25%, compared to their male counterpart, 13% of all respondents. Based on the analysis it identified that adult women are the mainly responsible for collecting drinking water for their household, but this is not acknowledged by the male counterparts.

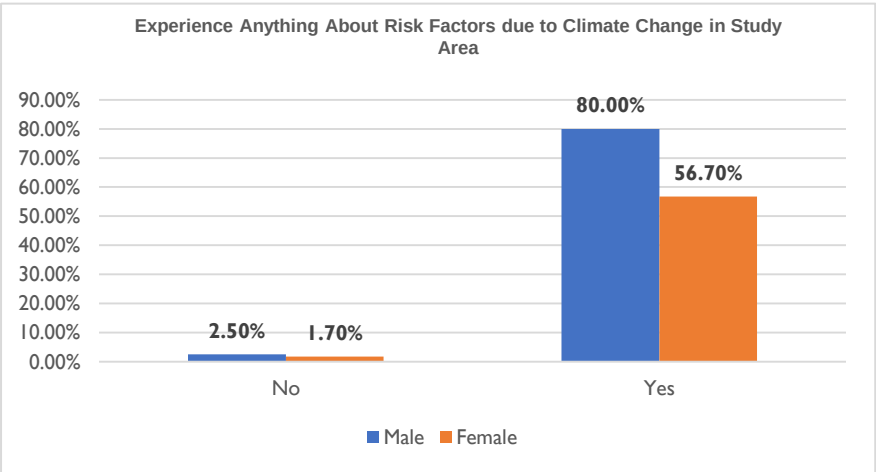
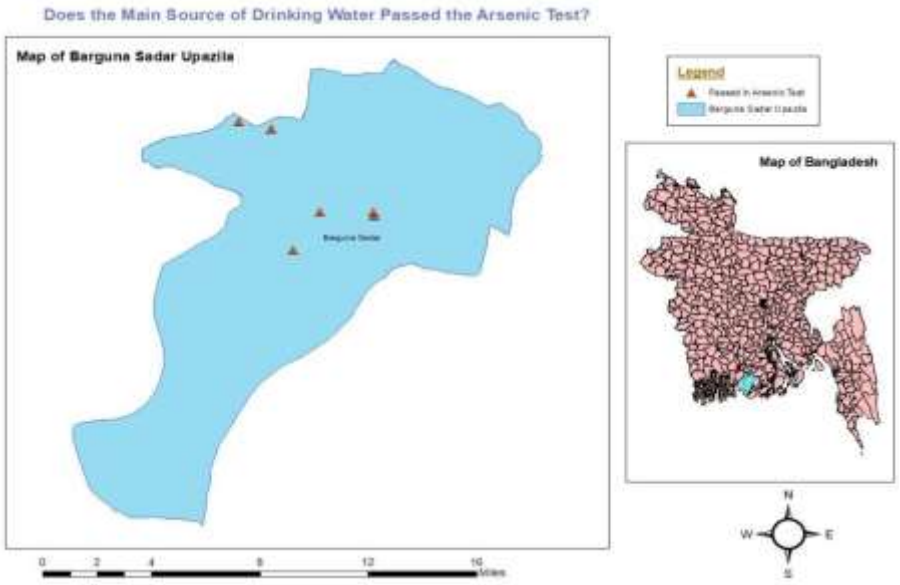


Fig. 2. Experienced anything about risk factors due to climate change in study area



Map. 2. Main sources of drinking water passed in the arsenic test

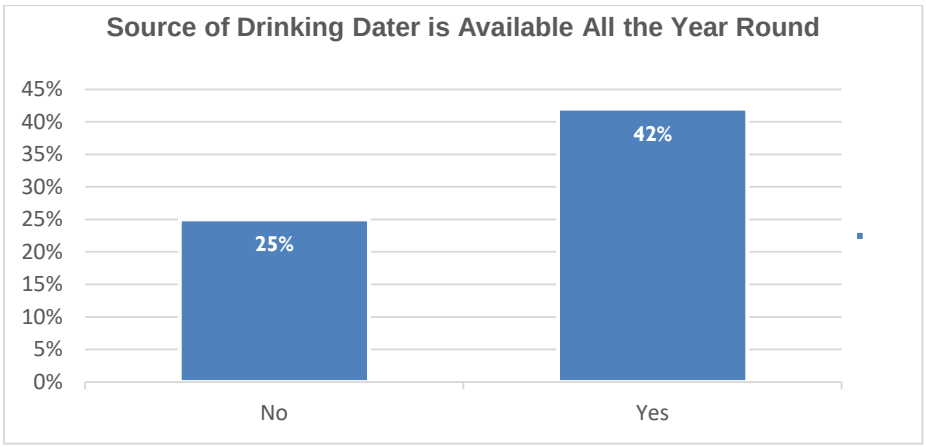


Fig. 3. Source of drinking dater is available all the year round in study area

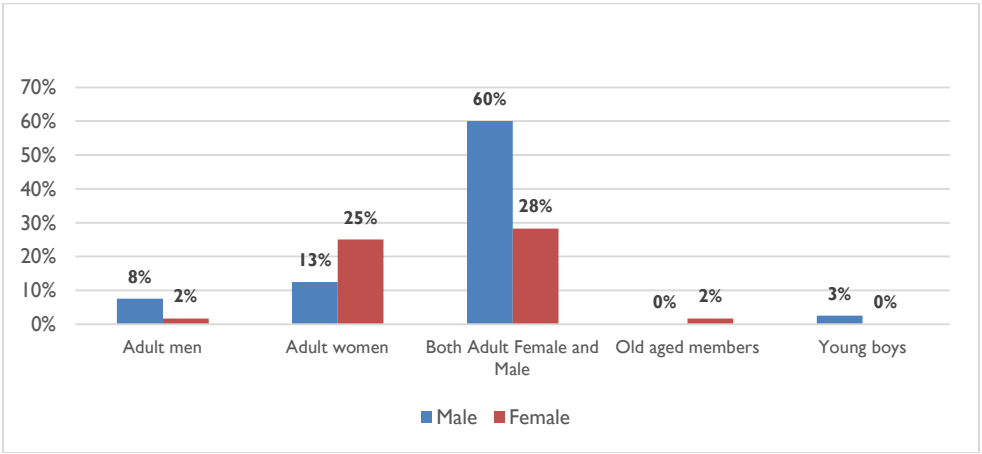


Fig. 4. Primary responsible for collecting water

On the other hand, during further examination the female respondents who were primarily responsible for collecting drinking water identified that most of them are facing challenges of needing to collect drinking water from long distances, facing harassment due to social stigma and need to use unsafe water for bathing, cooking, and washing clothes. Here are the same issues reported by some male respondents in KII where they mentioned that as the female of the HH collecting drinking water from far away from home they are facing challenges of eve teasing and other risks. From the quantitative study it was identified that on average they need 14 minutes to collect drinking water even in a regular period. Also 58% of respondents reported needing to store their drinking water. While examining where they usually store the drinking water, it was identified that mainly they stored in plastic drums, bottles, and pitchers etc. Most of them wash their water pot weekly 2-3 times.

This study further examined the requirements vs availability of drinking water in their areas. From the data analysis it was identified that on average there are requirements of 52 liters of water per household, but they are getting 47 liters and during the scarcity period they are getting only 41 liters. So that means that they are suffering from scarcity of water even in regular time and during the scarcity period the situation becomes more critical. From another study it was also identified that 61.42% households of Barguna sadar are deprived from safe drinking water [10].

3.3 Effects of Climate Change in Sanitation of Study Area

This study examined the sanitation conditions of the study areas. Following are the findings of the sanitation conditions.

The result of the study shows something interesting about the area is that they mostly do not have sanitary latrines. Around 23% of the respondents have slab latrine without water seal, which is followed by the pit latrine without lid and hanging latrine respectively 14% and 12% responses. There are few respondents who provide information that they have other types of rural latrines for their families. The gender variation is that male responses exceeded female responses in some noticeable areas.

On the other hand, this study also examined the impacts of climate change in sanitation. The study finds that 60% of the respondents reported that their latrines were destroyed by a cyclone/tidal surge/water lodging. In this portion, 50% female and 75% male participants acknowledged the statement. They are so vulnerable in crisis time as they do not have sanitary latrines. From the KII, it also represents the same issues where the respondents reported damage to their sanitation system due to effects of cyclone and storm.

3.4 Effects of Climate Change in Hygiene of Study Area

After the data analysis it was identified that, total 33% reported experiencing water borne disease in the past three months. Among the respondents, 47% male respondents and 23% female respondents reported the same issues. After further examination, it was identified that a major portion of the respondents reported getting their treatment from medicine sellers and village doctors which are 10% and 13% of the responses respectively. The research illustrates that around most of the respondents (29%) reported losing their workday due to illness. The workday lost is higher among male participants (42%) than female participants (20%). On average, respondents reported losing their working days for 18 days.

The research finds that 37% of respondents think that changes in climate impact on hygiene in their households which lay gender divisions that are 50% of male and 28% female. This brings devastating results for the families of the area.

3.5 Respondent's Perception Analysis on Effects of Climate Change

This study also examined the opinion of the respondents, especially on the gender roles in WASH. We used Likert scale to measure the perception of respondents about ten statements. Here we are representing only the results where respondents agreed with the statement. Following are the results:

The chart shared the three statements where respondents agreed about the equal responsibilities, access to safe water and burden of climate change for women and girls. In the first statement, 44% of the respondents agreed that both men and women have equal responsibilities to collect water in their households, whereas male respondents (52% of responses) exceeded the female respondents (38%) of the study.

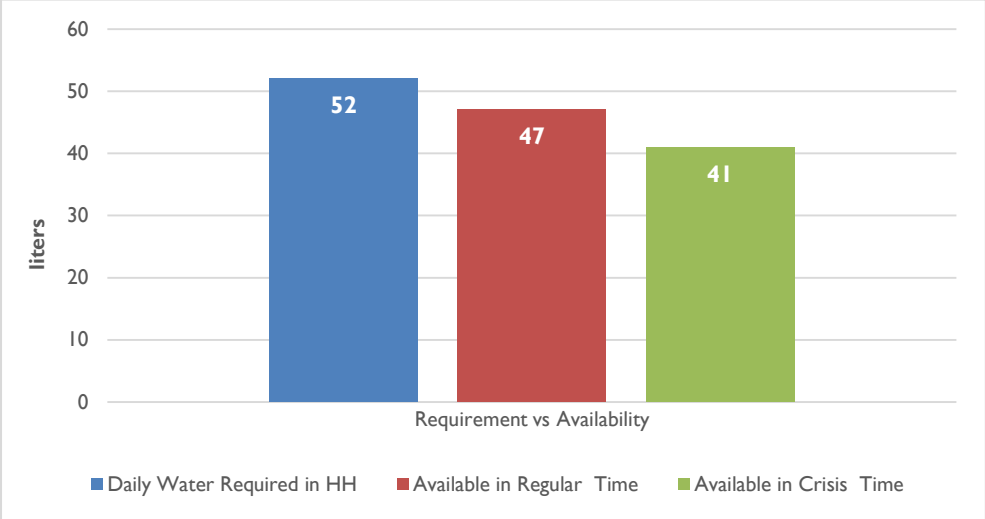


Fig. 5. Average requirement VS availability of water in liter

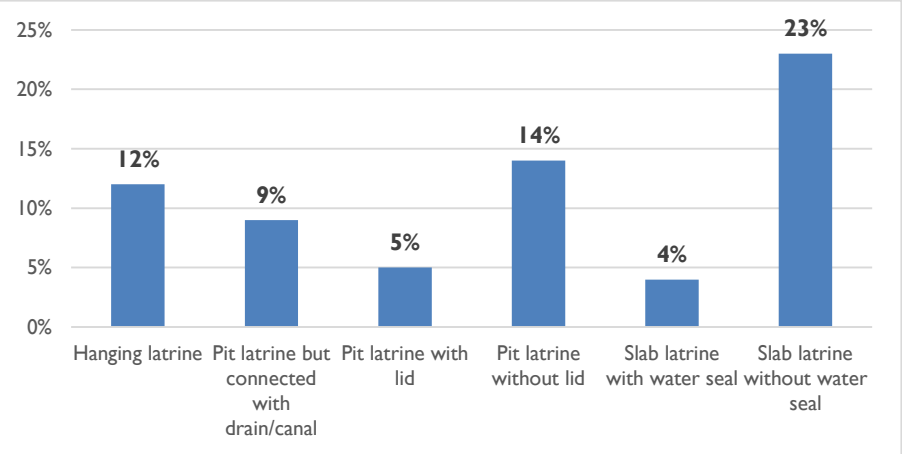


Fig. 6. Types of Latrines Using in HH

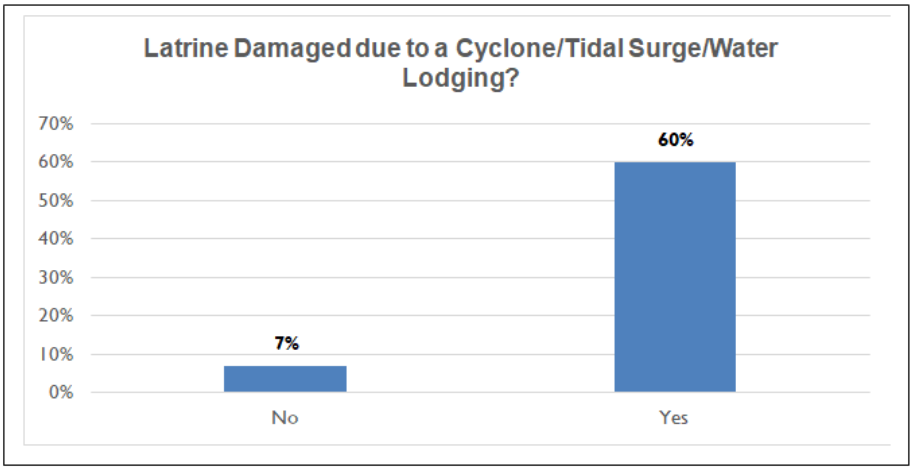


Fig. 7. Latrine damaged due to a cyclone/tidal surge/water lodging?

Table 1. The impact of climate changes on hygiene for their household

Gender	No	Yes	Method
Male	33%	50%	Descriptive Analysis
Female	28%	28%	
Total	30%	37%	

In the second statement, more than half of the respondents, 54%, agreed that women must have access to safe water and sanitation management systems during regular and scarce periods, in which a great number of male participants, 72%, reported more about women than they, 41%, themselves think.

In the third statement, a total of 30% respondents reported that climate change resulted in extra burden for women and girls in WASH sector. Among the comparatively male respondents 38% reported the same issue. It means they are acknowledging the impact of climate change for women and girls.

Statement 4-6 measured their perception of knowledge on impact of climate change, adaptation, and WASH Management System due to climate change. Chart 1 representing the findings.

In Statement 4, measure the do they have sufficient knowledge on the result of climate changes in WASH sector. From the data analysis it was identified that only 10% respondents agreed with the statement where 18% male and 5% female agreed with the statement. It means though overall the knowledge level of people is very low, and the situation is much more vulnerable for females.

In Statement 5, measure do they have sufficient knowledge for adapting with the results of climate change in WASH Sector. From the data analysis it was identified that only 10% respondents agreed with this statement and here the situation is the same for female respondents like statement 4.

In Statement 6, measure do they have sufficient knowledge on safe WASH management during the cyclone/Tidal Surge/Water lodging and we identified that only 7% of female respondents agreed with this statement.

From those above 4-6 Statements we can identify that people of Barguna Sadar Upazila have very poor knowledge about the impact of climate change in the WASH sector and its adaptation systems. For these reasons they become more vulnerable and here there is lots of scope to work to build up their awareness and sensitization.

Statements 7 – 10 are about to measure their access and support from family, communities or other institutions. From the findings it was identified that the people of Barguna have less access and support from family and institutions of their areas to mitigate their challenges.

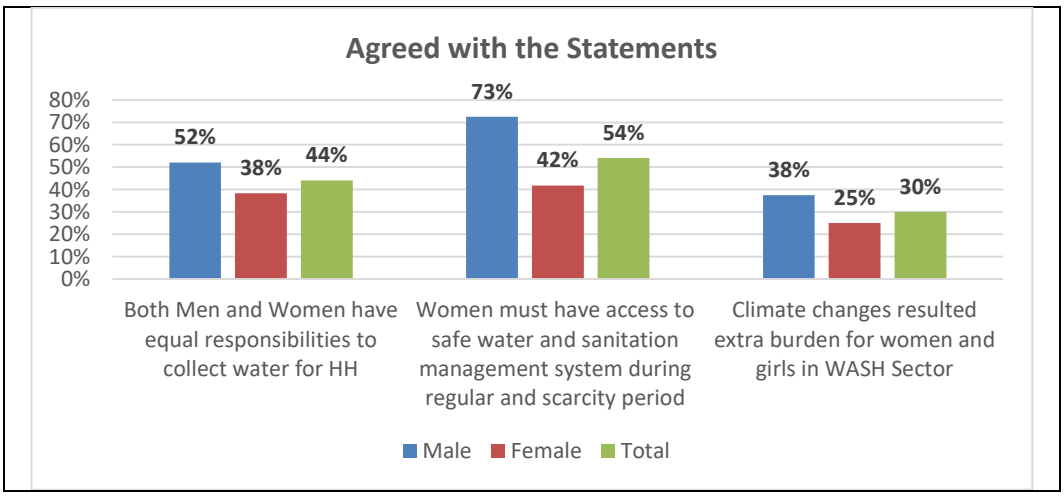


Fig. 8. Agreed with the statement of equal responsibilities, access, and extra burden

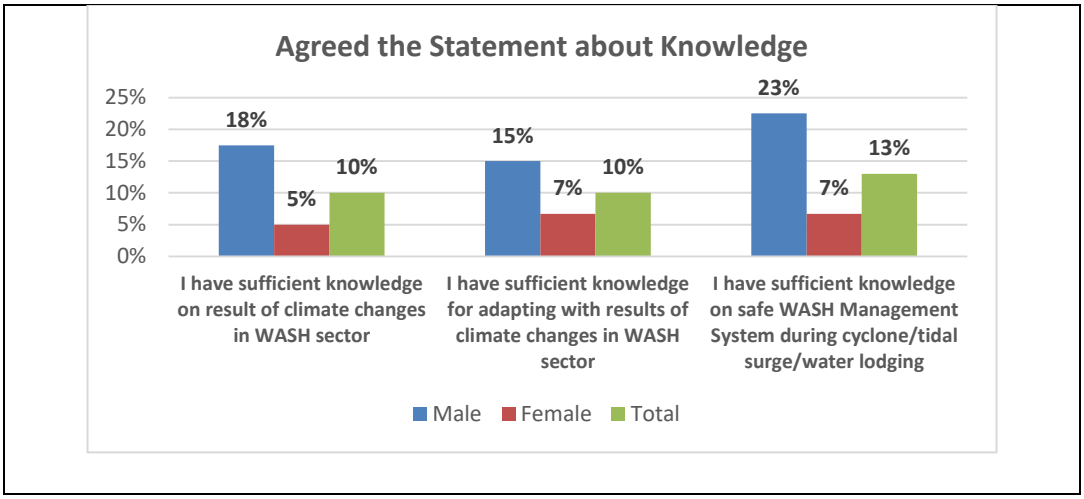


Fig. 9. Agreed with the statement knowledge of effects of climate change in WASH

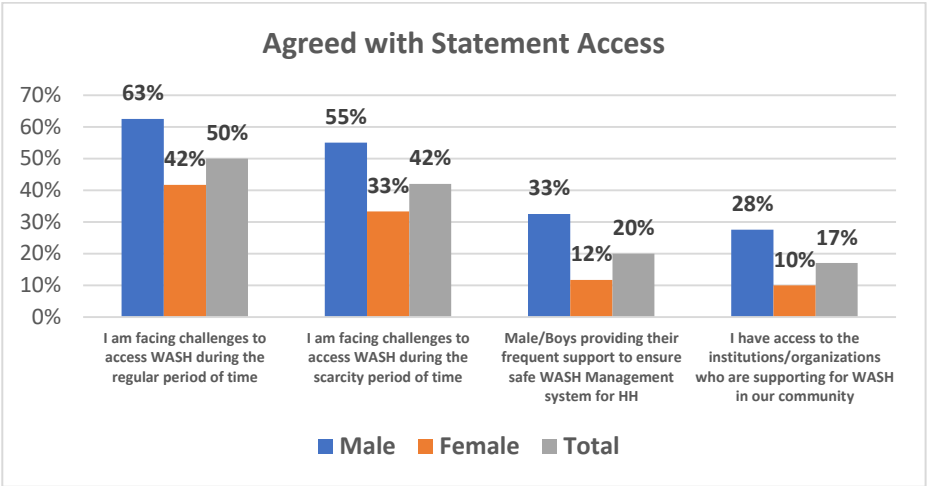


Fig. 10. Agreed with the statement access in service on WASH in study area

Statement 7 measures do they have access to WASH Management system during cyclone/tidal surge/water lodging**.** Only12% of the respondents agreed with the statement and here male participants have better access of 22% but only 5% women.

Statement 8 measures are facing challenges to access WASH during the regular period. Here 50% of the respondents agreed that they are facing challenges accessing WASH during the regular time where male share 63% of all male participants compared to their 42% of women's share of all women participants.

Statement 9 measures do Male/Boys providing their frequent support to ensure a safe WASH Management System for households. Only 20% of respondents agreed with the statement. Here, a very few female respondents (12%) think that male members of the households provide simultaneous support compared to male responses (33%).

Statement 10 measures do they have access to the institutions/organizations who are supporting WASH in our community. The study identified that 17% of the data agreed that they have access to the institutions or organizations who are supporting WASH in their communities. The data shows that at least 10% of the responses strongly disagreed with the statement. There are some fluctuations in respect to male and female respondents.

4. CONCLUSION

This study identified some critical areas in the WASH sector for the Barguna as well as the coastal zones due to the impact of climate

change. The major part is scarcity of drinking water in even regular periods and due to that reason, it results in extra burden to adult women of the family member to collect water that far from their house. This study also identified that currently there is less amount of water available in even regular periods against the requirement and during the scarcity time the situation becomes more vulnerable. Increase the salinity in drinking water, water lodging, regular cyclones damaging their natural sources of drinking water and sanitation system. Mostly it impacts women and girls as they need to use unsafe sanitation as well as consume the unsafe drinking water. This study identified that there is less support service available in communities for WASH and due to social stigma, they are suffering from bullying while collecting water that is located far from their house. Also, it was identified that women and girls have less knowledge on impacts of climate changes in WASH and they are suffering waterborne diseases due to not having the knowledge to adapt with the knowledge of climate change. From the above findings we can draw following recommendations:

- **Sensitize about the Impact of Climate Change:** First, needs to sensitise the community people of Barguna, as well as other coastal belt districts about the impact of climate change and the mitigation strategies. It will help the people and mainly for women and girls about adapting with the changing context. Mostly it will help their water management system in regular and crisis periods.
- **Sensitize about the Safe Water and Sanitation System:** Need to sensitise about the safe water and sanitation systems for the community people and mainly for women and girls as they are mostly affected due to the hygiene issues.
- **Sensitize the Community:** This study also identified the existence of social stigma prevails in communities that barriers to the access of safe water and sanitation for women and girls. To mitigate these challenges, we need to conduct sensitization sessions with community people so that they can understand the challenges of women and girls and ensure necessary support to them. However, we need to conduct mass awareness sessions, campaigns to build up awareness to the people of the community to improve their knowledge on the results of climate change and its mitigation strategies.
- **Activate the Union and Upazila WASH Committees:** There should be another area where we need to provide more concentration. Upazila and Union based WASH Committees can play a vital role in ensuring support, conduct the awareness building sessions, support the referral mechanisms, and conduct advocacy to implement the national policies and strategies for their areas. So first needs to identify the WASH committees and activate them.
- **Adapt Technical Options to Collect Safe Water from Alternative Surces:** People of Barguna District need to adapt technical options like Pond Sand Filter (PSF), Protected Dug well etc. according to the types of hazards. It will support them to get required safe drinking water for both normal and scarcity period.
- **Referral Mechanism:** In community there will be a lot of scopes where the community people can get support in the areas of WASH. For example, there will be some support from union parishad, different development organizations, local elite persons, and corporate sectors. If we can connect the local people with those services, it will help them to ensure support to get the safe water and hygiene systems.
- **Engagement of Male and Boys:** From this study we identify that women are reported to get less support from male and boys regarding the WASH. To mitigate this situation, we can initiate some activities/projects that will sensitize the male and boys about their engagements and role responsibilities to support women and girls and the entire HH for accessing safe drinking water and sanitation systems.
- **Implementation of National Policies and Strategies:** Here we can take some initiatives to implement the national policies and strategies. For example, we can utilize the The National Environment Policy 2018 [11] that considered the impact of climate change holistically across 24 sectors, including water resources management (WRM). This policy can support the conduct of the environmental impact assessment and strategic environmental assessment for developing any project on water resources in Barguna Districts as well as other coastal areas. On the other hand, the National Hygiene

Promotion Strategy for Water and Sanitation 2012 can support the link of poverty, access to WASH, and climate change by prioritizing those living in extreme poverty areas like Barguna.

CONSENT

We take consent to the respondents before starting the data collection. The survey questionnaire was designed with the validation process that if respondents unwilling to participate in the survey, then the questionnaire will move to the last section with SKIP logic and end the survey.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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