

Functional State of Climate Change Policy in Coastal Regions of Bangladesh: Incorporating the Voice of Coastal Communities

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ABSTRACT

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Climate change policy attempts to tackle upcoming disaster risks of a country. Coastal regions of Bangladesh have the potential to become economic hubs because of ample prospects in the blue economy sector. Therefore, the assurance of sustainable livelihoods for the coastal population is an urgent necessity. Although various policy initiatives have been undertaken by the government and nongovernmental agencies, a handful of minor issues are posing challenges to their effective implementation and ultimate success. The researcher reviewed the literature regarding the issue but barely found the voice of coastal communities in research work. Thus, this study's objectives focus on feedback from study respondents on the functional state of the coastal freshwater supply system in selected coastal regions of Bangladesh. The prime objective of the study is to explore whether the government of Bangladesh could support the initiatives with necessary policy measures as part of a sustainable pure-water retention and management system. The study's goals are addressed by analyzing field data collected using the mixed method. The study was conducted from November 2023 to February 2024. The data collection techniques were questionnaire survey and key informant interview (KII). Through a stratified random sampling technique, a rationale sample of 408 respondents was drawn proportionately from the four study locations. In addition, 37 KIIs were conducted for validation of the research. The study results show a possible way out of the prevailing barriers in the execution and implementation of safe water policies and strategies for the sustainable livelihoods of Bangladesh's coastal communities. The planned research findings would contribute to establishing a foundation for the sustained well-being of the communities by addressing appropriate policies and strategies for the implementation of a freshwater supply system in the aforementioned regions.

ADDITIONAL INDEX WORDS: *Climate change policy, functional state, community sustainability.*

INTRODUCTION

Environmental deterioration, government debt, inadequate pricing for water services, and service delivery concerns are prompting governments to investigate how water resources are used in their domains. For example, the Parliamentary Public Bodies Study Committee in Victoria conducted a bipartisan review of water management across the state in the mid-1980s, developing a long-term reform plan that covered practically every area of water resource management (Doolan and Hart, 2017). Systems for managing sustainable water resources are created to be adaptable, strong, and resilient in the face of an uncertain and changing future. Because of shifting demands, management objectives, and supply levels, sustainable water resource systems must operate efficiently. If a sustainable system fails, then it must be able to bounce back and keep working effectively without wasting resources (Martin and Williams, 2013).

To tackle the effects of climate change, the government of Bangladesh has adopted several policies and institutional initiatives, including the preparation of the National Adaptation Programme of Action in 2005 and Bangladesh Climate Change

Strategy and Action Plan in 2009, the formation of Climate change unit, the creation of the Bangladesh Climate Change Trust Fund, and the establishment of a few top-level committees with the ultimate target of implementing a proper adaptation plan. Besides government initiatives, several nongovernmental aid agencies are working to ensure climate change adaptation in Bangladesh (Haque and Rabbani, 2011).

An appropriate policy should also be applied to understand the vulnerable state of women as from Bangladesh perspectives they play key role for securing safewater supply in most coastal households. Moreover, a friendly policy should be incorporated to ensure women's participation (Sharif *et al.*, 2016).

Sustainable Development Goal 14, adopted by the United Nations, is intended to protect the coastal area and its resources. The defense, preservation, and management of coastal ecologies and sources are also addressed, supporting a solid property notion (Neumann, Ott, and Kenchington, 2017). The suggested model is anticipated to increase community participation in disaster education programs and implement a knowledge management strategy that can provide people with the knowledge they need to make the best choice that will save lives (Oktari *et al.*, 2015).

This study makes a case and offers policy recommendations for strengthening gender equality and acknowledging women's active participation as a critical component of the global adaptation to the climate challenge (Alston, 2015).

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We are inclined to smile if we look back 150 years to the paradigms and practices of that time. Because it is seen that many earlier societies with their native mechanisms fulfilled their community water demand. Many of us can see that the belief systems at the time could not explain such significant occurrences that meet their needs. However, far too many of us need help to apply what we have learned about our existing paradigms. If we imagine ourselves 150 years in the future and then look back, practitioners of that era may smile at our belief systems once more (Mercer, Christesen, and Buxton, 2007).

Bangladesh may be prone to disasters, which makes it hard to find places to eat and drink. The most common things that affects food production and consumption are flooding caused by cyclones and salt contamination. For example, several sources reviewed for this study mentioned that around 50,000 people were permanently displaced from the villages hit by Cyclone Amphan in 2020 (IFRC, 2021). Cyclone-based flooding forces people to buy food from many places, which drives up food prices and makes their financial situation worse. Furthermore, global climate change has, in general, slowed economic progress (Islam *et al.*, 2022). The livelihoods of rural and coastal communities have focused on the fishery sectors, which are heavily affected by climate change (Bugis and Hahury, 2022; Dankelman, 2002; Mazuru, 2019; Parvin and Ahsan, 2013).

Climate change does not make people vulnerable equally. Women are more vulnerable than men during disasters, especially women in coastal areas, who are considered the most vulnerable group during temperature variance. Their low adaptive capacity, increased poverty, ascribed gender roles, and lack of natural resources make women more vulnerable during cyclones. They also suffer in the agricultural, health, and livestock production sectors (Habib, Alauddin, and Cramb, 2022; Louis and Mathew, 2020). There is no way to ensure an efficient water management project without establishing culturally conscious leadership, cross-cultural communication, and mutual respect (Anbari *et al.*, 2003).

Sea levels rise as glaciers and ice sheets melt because of climate change, resulting in higher water levels. Sea levels rise as the world warms. The trend of increasing temperature started in the early 1870s. If the present warming rate continues, by 2100, it is predicted that the sea level will rise by 2 m (6.6 ft). If it does, the world's coastal areas will fall in great danger (Harris, Roach, and Codur, 2017; Henderson *et al.*, 2016). Saline intrusion into freshwater sources during low-flow states jeopardizes freshwater access. Furthermore, the rise in sea levels in coastal locations increases salinity in estuaries and groundwater. Because of rising temperatures, this situation is compounded by increased evaporation and evapotranspiration of surface freshwater. Consequently, the drinking water situation worsens (Huq, 2017; USAID, 2017).

Both societal and government engagement are required to address climate change's effects (Sarkodie and Strezov, 2019). In coastal areas, saline water intrusion is caused by both natural and artificial factors. An estuary's frequent huge water flow easily overtakes or breaches coastal embankments. In Bangladesh, this disruption becomes more severe because earthen polders called *ghers* have been built by their

owners around the estuary (Minar, Hossain, and Shamsuddin, 2013).

The effective policy, institutional structure, and implementation strategy needed to address the challenges of safe water supply to coastal regions are lacking (Rahman *et al.*, 2007). Researchers have noticed several health issues because of saline exposure, such as hypertension, miscarriage, skin disease, and risks to coastal women's during menstruation (Khaliquzzaman, 2022; Rahaman, Rahman, and Nazimuzzaman, 2020). Most climate victims will come from a country's coastal regions.

Bangladesh is a role model for disaster risk management in the United Nations. Despite that, there are regulatory flaws in the assurance of a secure future for coastal residents. The country's coastal residents struggle greatly to meet daily household needs, and agriculture requires freshwater (Dhaka Tribune, 2016; Loucks and Beek, 2017). Most Bangladeshi people living in coastal saline-prone areas lack access to adequate health care. As a result, they rely heavily on an herbal therapy system known as *kabiraji* (Zaman, 2017).

Bangladesh's six flood-prone hotspots are coastal zones that have implemented disaster mitigation solutions such as proper flood management, supply of necessary water in the dry season, proper protection of coastal areas, and freshwater for household needs (Hadi, 2019). Research has suggested that local government, community leaders, and people from all walks of life should be involved at every stage of water resource management to ensure genuine stakeholder participation (Chadwick and Datta, 2003).

Water is a renewable resource; it will never be depleted. However, many cultures take the relatively predictable availability of water for granted as they rely on it for their economy and environment (Lenton and Muller, 2012). In Bangladesh, where surface water availability varies seasonally and regionally, tubewells to elevate shallow groundwater were advocated in rural and urban areas to enable intensive agriculture and safe drinking water. Groundwater provides about 95% of drinking water and 68.5% of agricultural water in Bangladesh (Chowdhury, 2010). Mismanagement of river resources has exacerbated the harmful consequences of periodic inundation, compounding widespread pollution issues in the country. As a result, Bangladesh has depended severely on groundwater for irrigation, drinking, and manufacturing (Chan, Roy, and Chaffin, 2016).

To elevate shallow groundwater, one tubewell (shallow or deep) could be placed in the target area's central location so that everyone can easily access it. This tubewell would just provide drinking water. The authorities could set a price for each liter of tubewell water for technical and economic feasibility and seamless management. This price would create a psychological barrier among users, preventing them from wasting water and encouraging direct usage. This approach would also ensure that responsible local communities are committed to building and maintaining their water supply systems (Safiuddin *et al.*, 2003).

If an integrated approach to water resource planning and management is to be accomplished and maintained, all parties must collaborate in the partnership. All parties involved in developing and managing water resources must consider

all points of view and act accordingly (Loucks and Beek, 2017). However, there is no one-size-fits-all approach to the development and connection of management institutions (Neto, 2018).

The abundance of rivers and creeks in Bangladesh's environment is a key strength. Bangladesh's Cabinet authorized a national water plan more than a decade ago, but the policy has yet to be implemented. Nevertheless, it is the first step toward correcting the country's current mismanagement of its water resources (Pal *et al.*, 2011).

The preceding overview reflects the devastating state of climate change, which includes a lack of proper policy measures, vast investment, a lack of coordination, poor management, and more significantly for this study, the impact on the coastal areas of Bangladesh. The destitute state of climate victims because of the impact of disasters indicates policy failure of the government. This research focuses on coastal drinking water supply crises, concentrating on the functional state of the climate change policy by presenting the voices of the people affected.

Background of the Study

In Bangladesh's coastline region, there are 19 districts and 148 subdistricts. This region accounts for 32% of the country's geographical area and 25.7% of the population, implying that nearly 40 million coastal residents are vulnerable to climate change (Displacement Solutions, 2012; MOFA, 2018). By 2050, Bangladesh will face about 27 million climate victims. To address the issue and ensure future adaptation of the coastal community, the government of Bangladesh has invested more than USD 10 billion (Dhaka Tribune, 2016). The research mentioned that 783 million people face a freshwater shortage today. Furthermore, 6 to 8 million people die of contaminated water and waterborne infections yearly. The residents of Bangladesh's coastal areas are concerned about the salinity of their drinking water. Increased salinity levels in drinking water sources can lead to various health issues, including diarrhea and cardiovascular disorders (Adhikary, 2016; Khan *et al.*, 2011). Thus, this study focuses on challenges in policy formulation to address the needs of coastal residents and ensure a sustainable community.

Problem Statement

Study shows that Bangladesh's economy is more vulnerable to climate change than any other country. For example, Cyclone Sidr caused the country a gross loss of USD 1.7 billion in 2007 (Das, 2017). The people of the region are struggling with saline water intrusion and stagnation. This contaminated water has adversely affected water quality, posing severe challenges as the local vulnerable and disadvantaged socioeconomic groups attempt to obtain a stable supply of pure drinking water. Study results show that more than half of the coastal region is an active affected zone because of excessive salinity, which has wreaked havoc on the dwellings, homestead production system, income, and livelihood of the poor and vulnerable inhabitants (Shammi *et al.*, 2019). In addition, saline water intrusion makes Bangladesh's SW region one of the most saline-prone areas, causing various health and hygiene issues. Decreased crop production, infrastructure damage, a significant shift in fish habitat and

breeding grounds, biodiversity loss, and other issues prevail in the area (Shammi *et al.*, 2019). Climate threats are frightening for people in the coastal regions of Bangladesh. Therefore, policy integration of coastal residents' perceptions needs to be addressed carefully to tackle future challenges.

Rationale of the Study

The current political climate in Bangladesh involves the marginalization of opposition parties and the undue interference of several government institutions in the common interest. Bangladesh's administrative operations are hampered, because bureaucratic challenges are common in its democratic governance systems. Moreover, the system shows few checks and balances, and petty corruption and crimes are endemic across the water management sector (Chan, Roy, and Chaffin, 2016).

The inhabitants of the coastal region depend on surface water. However, incessant salinity intrusion pollutes the water bodies and makes people more vulnerable. Tidal surges, storm surges, drainage obstructions, waterlogging, and saline water-based aquaculture contribute to the safe water crisis. Despite an extensive alternative water supply, coastal residents may need help with crop production, drinking water, health, aquaculture, and other water-based aspects (Huq and Easher, 2021). This study focuses on the crucial functional state of prevailing drinking water sources.

Research Objectives

This research aims to incorporate the voice of coastal people to understand the actual situation of coastal policy and practice. The following objectives are stipulated in the study goal:

- (1) To evaluate the effectiveness of present climate change policy in introducing a water purification system.
- (2) To examine the voices of different clusters of people in relation to prevailing drinking water sources.
- (3) To understand the need for specific regional policy that ensures safe drinking water for a specific coastal region.

Theoretical Perspective: Social Vulnerability to Climate Change

Social vulnerability is the stress individuals or groups experience because of the effects of climate change. Interruption of livelihoods for groups or people and forced adaptation to the shifting physical environment are examples of stress in the social sense. In addition, loss of security and interruption of livelihoods are examples of general social vulnerability. Attaining sustainable development goals requires the availability of a drinking water supply.

Rapid climate change affects the quality of drinking water. Water quality deteriorates because of the continuous emission of greenhouse gases, which harms its supply and creates instability (Ma *et al.*, 2022). Both social marginalization and lack of access to decision making by rural women increases their vulnerability specifically. Research addresses how women play dual roles as active players in climate adaptation and the most affected passive victims. They use their talents and skills at implementing wise solutions to lessen hostile effects. They are also profoundly supportive of initiatives

that aim to restore the environment and are worried about environmental challenges.

Significant research gaps exist regarding how vulnerable women are to a changing and unpredictable climate, particularly in desert places (Nyahunda and Tirivangasi, 2022). Yadav and Lal (2018) have suggested that economic emancipation, institutional skills, establishment of outreach and training programs should be part of official strategies and plans for climate change mitigation and adaptation.

A study by Onwutuebe (2019) demonstrated how a patriarchy allows a high rate of exposure of women to the harmful effects of climate change, using Nigeria as a case study. Men are better at adapting and moving around in their careers amid a patriarchy. The study's results suggest that to prevent women from being unnecessarily exposed to climate change disasters, authorities must address sexism and structural issues and this limit women's likelihood of a vulnerable livelihood (Onwutuebe, 2019).

Water-related diseases are rising because of the changing climate, which influences surface and groundwater supplies. Researchers have demonstrated how the lack of pure drinking water contributes to 80% of all diseases in impoverished nations like Pakistan, where it results in 1.8 million deaths yearly, including 3900 children (Ahmed, Zounemat-Kermani, and Scholz, 2020).

In another study on climate change, water scarcity, and health issues, researchers investigated how climate change's impacts on water supplies affect people's health in coastal areas. The research findings indicated the destruction of freshwater supplies because of changes in precipitation, temperature, and rising sea levels, as well as the relationship between drinking water scarcity and 80% of all illnesses (Abedin *et al.*, 2019).

Several social, economic, and political activities can converge with environmental processes in the coastal region. To visually examine indicators that establish asset profiles for towns, de Alencar *et al.* (2020) presented a customized modification of the circles of sustainability method. It serves as the basis for the circles of coastal sustainability framework, which may be applied at various abstraction scales to assess indications of significant policies that enable or restrict the rights of people in coastal zones around the world. This framework aims to direct management by differentiating crucial choices that affect environmental property and human well-being (de Alencar *et al.*, 2020).

Study Area

Two of 19 coastal districts of Bangladesh were selected rationally for the study area, as shown in Figure 1. These two districts (Bhola and Khulna) are located in two divisions (Barishal and Khulna, respectively). Geographical, cultural, socioeconomic, and occupational diversity, as well as climate hazards and disaster threats, were considered in the study area selection. Inhabitants of these coastal regions mostly belong to a lower-income group, and they are living on daily-earning occupations, such as in fisheries and as day laborers.

METHODS

This section narrates the study's methodology, including the specific research method, sample selection procedure, and tools for data collection. The study locations and respondent variations are also discussed here.

Research Design

This study is descriptive and analytical in design. Therefore, a mixed research strategy, *i.e.* triangulation of method, theory, and investigators, has been applied. Both quantitative and qualitative data were analyzed systematically following specific guidelines. Convergent parallel design is used to narrate the mixed research data and vividly portray the research objectives. Besides the questionnaire survey, key informant interviews (KIIs) were conducted to validate the research questions more appropriately.

Sample Population

The data collection technique for the study was disproportionate stratified sampling. Data were randomly collected proportionately from four selected study regions.

Quantitative and Qualitative Data Collection

First, a standard semistructured survey questionnaire was prepared to collect the necessary quantitative data and create a checklist for collecting qualitative data for the study. Then, based on the draft questionnaire, a pilot survey was conducted in two separate study locations to verify the reliability and validity of the research instruments and justify the investigation from an ethical viewpoint. After receiving the feedback on the draft questionnaire, the draft survey questionnaire and checklist were corrected, modified, incorporated, and finalized for the field survey. This study used a stratified sampling strategy to acquire the relevant data and thus achieve the study objectives. The sample size calculation was based on the sample formula proposed by Sekaran and Bougie (2016). Therefore, through the use of statistical evidence and calculation as per the population size of the study regions, the minimum sample size was set at 384 for the quantitative data of the study. To justify the quantitative data, several significant tests were administered, *i.e.* the paired samples test, chi-square test, independent samples test, and cross-tabulation. To attain the qualitative data of the study, 37 KIIs were conducted by the researcher. Both types of data were collected between November 2023 to February 2024. Collected qualitative data were administered using SPSS software and classified systematically.

RESULTS

This section discusses the findings of the research. The results are arranged by the objectives of the study. The researcher maintained rationality and coherence in analyzing the results of the study. The quantitative data of the study comprise 408 respondents, whereas the number of the qualitative data stands at 37. The results of the study are discussed as per the objectives of the study under three sub-headings. Convergent parallel design is applied to explain the mixed data.

Table 1 shows the 22 service categories of the respondents of the study in the quantitative category. Equal numbers of

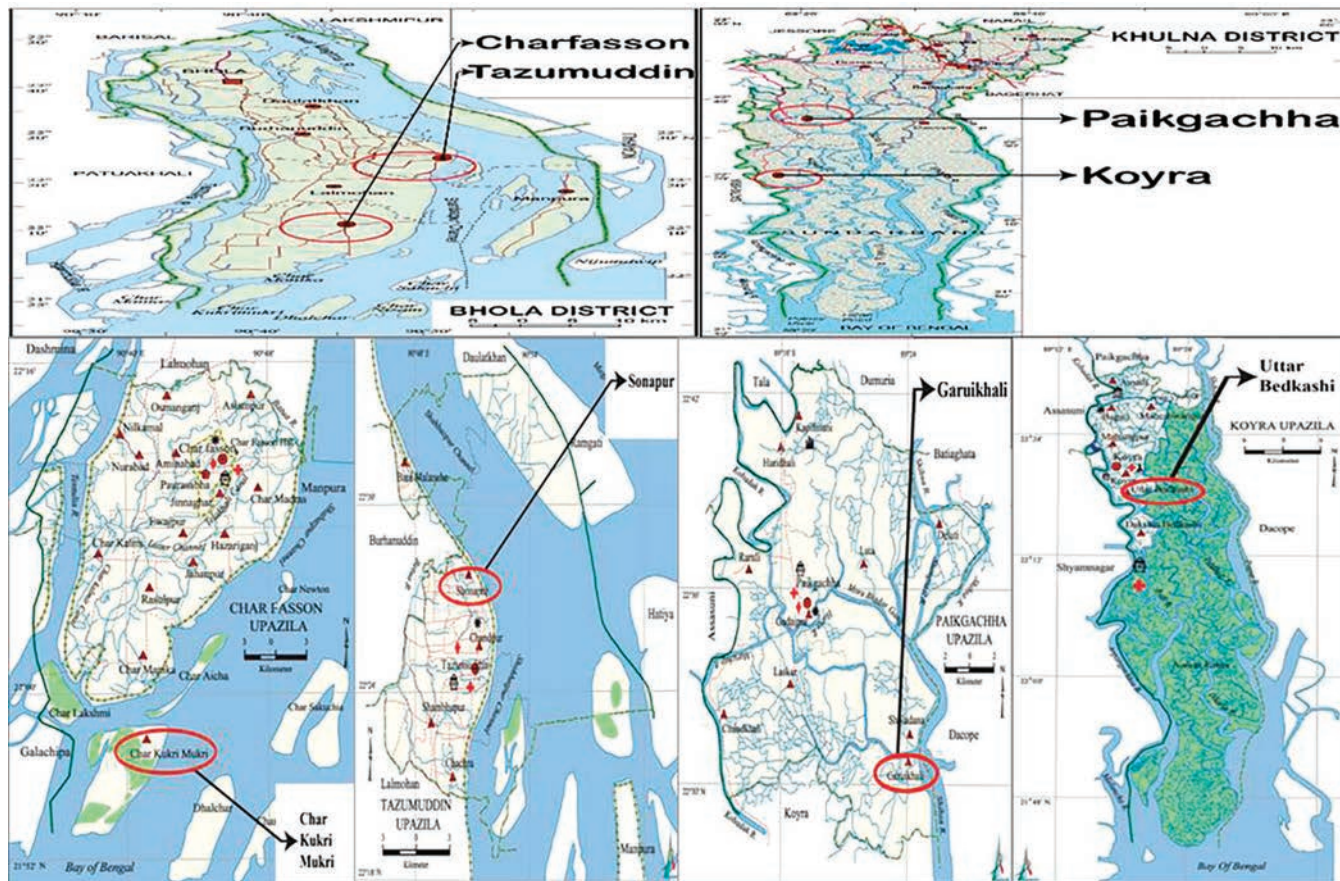


Figure 1. Geographical maps of the study regions. These maps highlight the core coastal unions from two studied districts.

respondents were collected from the four study areas. The highest number of respondents falls in the “Landless poor” category, which stands at 65, whereas the lowest number of respondents falls in the categories of “Van puller,” “Bike rider,” “Shop staff,” “Computer service,” and “Dispensary worker,” each of which stands at 2.

Table 2 shows the 13 service categories of the respondents of the study in the qualitative category. Among them the highest number of respondents falls in the category “Ward member (female),” which stands at 11, whereas the lowest numbers of respondents fall in seven categories from “Day laborer (union member)” to “Farmer (union leader),” each of which stands at 1.

Effectiveness of Present Climate Change Policy

Sharmin Akter (member of Wards 1–3, Char Kukri Mukri Union, Char Fasson, Bhola, KII 3) said:

As a Union member she is well connected to the policy service issues. The freshwater source in their union is a deep tubewell, and only a few households have access to the tubewells. Therefore, though drinking water availability is okay for them throughout the year. However, many low income groups do not get

access to fresh and safe water for drinking and cooking purposes. People who do not have access to tube-well use pond water.

Similarly, Mostain Uddin (teacher, Sonapur Union, Tazumuddin, Bhola, KII 1) said:

As a concerned member he did not hear about the government policy initiative regarding safe water supply in his area. Rainwater and pond water are the primary drinking water sources for the common people of his union. Before drinking, few solvents people filter water by boiling or using alum. On the other hand, some ignorant people drink water directly from the pond without filtering it. He added that they can comfortably collect drinking water during the rainy season. Adversely, it is more challenging to find freshwater during the dry season.

The t value is 11.098, and the p value is 0.000 in Table 3. Thus, the study’s findings demonstrate significant differences in surface water access tenure and associated risks. Here, different health risks arise because of the lack of year-round safe water availability. The lack of policy integration

Table 1. Respondent numbers per union: Occupation and union cross-tabulation.

Occupation	Union				Total
	Uttar Bedkashi	Goroikhali	Char Kukri Mukri	Sonapur	
Large-scale farmer					
Count	4	12	9	10	35
% within occupation	11.4	34.3	25.7	28.6	100.0
Medium-scale farmer					
Count	8	4	8	8	28
% within occupation	28.6	14.3	28.6	28.6	100.0
Small-scale farmer					
Count	4	12	8	10	34
% within occupation	11.8	35.3	23.5	29.4	100.0
Marginal-scale farmer					
Count	8	15	5	10	38
% within occupation	21.1	39.5	13.2	26.3	100.0
Landless poor					
Count	21	7	16	21	65
% within occupation	32.3	10.8	24.6	32.3	100.0
Fisherman					
Count	20	12	14	9	55
% within occupation	36.4	21.8	25.5	16.4	100.0
Boatman					
Count	4	9	4	8	25
% within occupation	16.0	36.0	16.0	32.0	100.0
Female collector of fry fish and crab					
Count	4	4	20	12	40
% within occupation	10.0	10.0	50.0	30.0	100.0
Day labor					
Count	4	5	8	3	20
% within occupation	20.0	25.0	40.0	15.0	100.0
Tea stall worker					
Count	3	3	0	2	8
% within occupation	37.5	37.5	0.0	25.0	100.0
Vegetable vendor					
Count	3	2	0	0	5
% within occupation	60.0	40.0	0.0	0.0	100.0
Brick field worker					
Count	3	0	0	0	3
% within occupation	100.0	0.0	0.0	0.0	100.0
Domestic worker					
Count	0	0	2	1	3
% within occupation	0.0	0.0	66.7	33.3	100.0
Cook					
Count	0	0	6	0	6
% within occupation	0.0	0.0	100.0	0.0	100.0
Van puller					
Count	2	6	2	5	15
% within occupation	13.3	40.0	13.3	33.3	100.0
Trolley driver					
Count	2	0	0	0	2
% within occupation	100.0	0.0	0.0	0.0	100.0
Auto driver					
Count	2	7	0	0	9
% within occupation	22.2	77.8	0.0	0.0	100.0
Bike rider					
Count	3	2	0	0	5
% within occupation	60.0	40.0	0.0	0.0	100.0
Dispensary worker					
Count	2	0	0	0	2
% within occupation	100.0	0.0	0.0	0.0	100.0
Computer service worker					
Count	2	0	0	0	2
% within occupation	100.0	0.0	0.0	0.0	100.0
Shop staff					
Count	0	2	0	0	2
% within occupation	0.0	100.0	0.0	0.0	100.0

Table 1. (continued).

Occupation	Union				Total
	Uttar Bedkashi	Goroikhali	Char Kukri Mukri	Sonapur	
Professional					
Count	3	0	0	3	6
% within occupation	50.0	0.0	0.0	50.0	100.0
Total					
Count	102	102	102	102	408
% within occupation	25.0	25.0	25.0	25.0	100.0

Source: Field survey 2024

and enough access to safe water put people at different risk levels.

Mrs. Maleka (union member, Wards 7–9, Char Kukri Mukri Union, Char Fasson, Bhola, KII 5) said:

Though she noticed policy related issues in different meeting she has participated but found it insufficient for the community people. She mentioned that the only safe water source in their union is tubewell, but not everyone can use it due to the lack of paved roads, and tubewells are far from home. She added that sometimes women face weird situations when moving to a long distance to collect safe water. Moreover, people have to face adverse situations during disasters.

In response to a similar question, Kamirul Hawlader (day laborer and union member, Uttar Bedkashi Union, Koyra, Khulna, KII 8) said:

He never heard about water policy. His family and the rest of the community people collect rainwater during the rainy season to drink throughout the year. They have no other drinking water sources due to the salinity of the surface and subsurface water. They have access to freshwater during the rainy season. In addition, for a few months, they collect water from nearby ponds.

Table 4 shows the 10 reasons for water contamination in prevailing water sources in the study regions. Data show the

Table 2. Qualitative KII survey respondents per profession.

Occupation	Count	%
Teacher (college)	5	13.51
Chairman (Union Porishod)	2	5.41
Ward member (female)	11	29.73
Ward member (male)	7	18.93
Day laborer (union member)	1	2.70
Student (union leader)	1	2.70
Pharmacist	1	2.70
Shopkeeper (union leader)	2	5.41
Local leader	3	8.11
Union secretary	1	2.70
Housewife (ex-union member)	1	2.70
Village police	1	2.70
Farmer (union leader)	1	2.70
Total	37	100

Source: Field survey 2024

number of respondents (194) who said that the water source was contaminated with fungi. Only a few respondents (32) stated that they did not face problems. Therefore, the results show a negligible water supply condition in the study area.

Respondent Perception on Policy Integration

Abdul Malek Gazi (union member, Ward 6, Char Kukri Mukri Union, Char Fasson, Bhola, KII 36) said:

As per policy support they sometimes get tubewells from the government which are insufficient for the residents. The source of safe water in their union is deep tubewell and few households have private access to it. So, water availability is okay for them throughout the year except for people experiencing poverty. Ordinary people struggle daily to manage fresh and safe water for drinking and cooking. Sometimes, poor people use ponds or canal water to meet their daily need.

Similarly, Erani Akhter (female union member, Uttar Bedkashi Union, Koyra, Khulna, KII 34) said:

She noticed supply of water tank to preserve rain water but it is so scanty in comparison to the need of the community people. Their union's source of safe water is rainwater and a deep tubewell. She said that they have water problems throughout the year. For this reason, they buy water tanks, store rainwater and use it throughout the year. She claimed these water tanks are only available in few places. She mentioned that in several areas, tubewell water is salty. Also, a few of its water tested arsenic contaminated.

In a similar question, Zakir Hossain (headmaster, Sonapur Secondary School, Sonapur Union, Tozumuddin, Bhola, KII 33) said:

He heard about the water supply provisions in a central Upazila level coordination meeting but rarely meet its implementation. The primary sources of safe drinking water in his union are deep tubewells. He also said that water is available in his union, but they can manage pure drinking water for 9–10 months a year. Day to day, they are suffering from saline water intrusion in surface and sub-surface water level.

Table 3. Evidence of access tenure to surface water and its associated risks.

Paired Samples Test	Paired Differences					<i>t</i>	df	Sig. (2-tailed)
	Mean	Standard Deviation	Standard Error of the Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1								
Surface water access–problem in surface water	1.713	3.118	0.154	1.410	2.017	11.098	407	0.000

Sig. = Significance

Source: Field survey 2024

The *p* value is 0.000, and the Pearson chi-square value is 119.853 in Table 5. Thus, statistical evidence suggests that negligence to maintenance during emergency and different infections are highly reliant on each other. It is evident that there is lack of an emergency technical team to provide support during disasters.

Dipti Biswas (housewife and union member, Goroikhali Union, Paikgacha, Khulna, KII 6) said:

She never received any supports from any sources regarding safe water collection. She had to travel nearly 2 kilometers away from home to collect daily drinking

water. Despite having a tubewell near her home, the water is not potable due to salinity.

Similarly, M.D. Rahman (shopkeeper and union member, Char Kukri Mukri Union, Char Fasson, Bhola, KII 7) said:

Though he heard about policy support for safe water collection but he did not notices any of its kind in his locality. Tubewell water is used as drinking water in their hometown in Bhola. They use pond water for cooking and bathing and the local people mostly depend on pond or river water. They undertake a variety of functions in

Table 4. Gender-specific response to water contamination: Problems in surface water and gender cross-tabulation.

Problem in Surface Water	Gender		Total
	Female	Male	
Fungal contamination			
Count	22	172	194
% within problem in surface water	11.3	88.7	100.0
Point source pollution			
Count	10	51	61
% within problem in surface water	16.4	83.6	100.0
Maintenance problem			
Count	23	74	97
% within problem in surface water	23.7	76.3	100.0
Domestic animal nursing			
Count	0	5	5
% within problem in surface water	0.0	100.0	100.0
Salinity			
Count	2	8	10
% within problem in surface water	20.0	80.0	100.0
Oyster growth and rot			
Count	0	3	3
% within problem in surface water	0.0	100.0	100.0
Frog in water body			
Count	0	1	1
% within problem in surface water	0.0	100.0	100.0
Dead animal body			
Count	0	2	2
% within problem in surface water	0.0	100.0	100.0
Iron			
Count	0	3	3
% within problem in surface water	0.0	100.0	100.0
Do not face any problem			
Count	2	30	32
% within problem in surface water	6.2	93.8	100.0
Total			
Count	59	349	408
% within problem in surface water	14.5	85.5	100.0

Source: Field survey 2024

Table 5. Negligence to emergency maintenance and its associated risks: significant test.

Chi-Square Test	Value	df	Asymp. Sig. (2-sided)
Pearson chi-square	119.853 [†]	27	0.000
Likelihood ratio	92.336	27	0.000
Linear-by-linear association	24.595	1	0.000
Valid cases	408		

[†]32 cells (80.0%) have an expected count of less than 5. The minimum expected count is 0.01.

Asymp. Sig. = Asymptotic Significance

Source: Field survey 2024

the same pond including bathing cows and goats and cleaning pots and pans.

The *t* value is 3.497, and the *p* value is 0.001 in Table 6. Thus, the study's findings demonstrate a significant relationship between the vulnerable state of primary water source protection measures and its associated risks of disease affection. The results reflect that in the study regions, primary water sources lack of protection measures from pollution. There is no policy provision to look after the water sources.

Mujibur Rahman (village police, North Bedkashi, Koyra, Khulna, KII 12) said:

He noticed such policy provisions but rarely get access to it. The primary sources of freshwater are deep tubewells, water purification plants, rainwater, and ponds. He added that most of the tubewell water is salty. He added that a water plant, namely RO (reverse osmosis), is installed near the bazaar, which is about 30 minutes walking distance from his house. He added that females primarily collect daily drinking water from this distant plant.

Similarly, Mohammad Ali (farmer and union member, Char Kukri Mukri Union, Char Fasson, Bhola, KII 9) said:

He did not meet any such safe water provisions for himself. His family does not possess their own tubewell. Though there are several tubewells in their village, those are mostly self-financed. He added that a tubewell does not run for around the year due to lack of surface water.

In a similar question, Sirajul Islam (UP Upozila Parishod member, North Bedkashi, Koyra, Khulna, KII 23) said:

There are provisions for safe water collection but those are merely meeting the need of the community people. Rainwater is the area's prime source of safe drinking water, but they get access to it 6 to 7 months a year. In this area, people mostly use tubewells. Due to the scarcity of tubewells, they face hurdles in collecting water.

Need for Specific Regional Policy

Abdul Majed (principal, Bedkashi collegiate school, Uttar Bedkashi Union, Koyra, Khulna, KII 35) said:

Access to safe water is a common problem in this locality. The respondent added that iron and other fecal contamination in water are common for tubewell. He suggested that rainwater is the safest source of drinking water for his locality.

Table 7 shows the four unions facing disasters like cyclones, floods, and river erosion. The nature of the disaster varies from one union to another. The results show that the highest number of respondents said that people are mainly affected by floods, representing 61% of the total respondents. Of the four unions, residents of Char Kukri Mukri suffer the most from flooding, which stands about 96% among the three disaster categories. The disaster, *i.e.* river bank erosion, was addressed by only 0.2% of the respondents residing in the Sonapur Union area. Thus, a diverse policy needs to address the needs of the region.

Table 8 shows the six tenures of access to surface water. The results show that surface water is mostly available in the study regions. However, the threatening issue is saline water intrusion, which pollutes the sources severely.

Priyonath Mondal (headmaster, Goroikhali Union, Paikgacha, Khulna, KII 25) said:

The source of freshwater in his union is pond water or rainwater. However, it became more intense at the beginning of summer because the pond water dried up. Most tubewells water in his union is impure for drinking because of saline water contamination. He suggests immediate action plan needed to combat the future threats.

Table 9 shows the four tenures regarding access to rainwater in a year. Here, the highest number of respondents (49.8%) said that they have access to rainwater for 6 mo/y in their regions. Despite that, only 2% respondents of Char

Table 6. Evidence of the state of primary water source protection and its associated risk of diseases.

Paired Samples Test	Paired Differences					<i>t</i>	df	Sig. (2-tailed)
	Mean	Standard Deviation	Standard Error of the Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1								
Disaster type–primary water source protection	0.159	0.920	0.046	0.070	0.249	3.497	407	0.001

Sig. = Significance

Source: Field survey 2024

Table 7. Frequency of disaster: Union and type of disaster cross-tabulation.

Union	Disaster Type			Total
	Cyclone	Flood	River Erosion	
Uttar Bedkashi				
Count	34	68	0	102
% within union	33.3	66.7	0.0	100.0
Goroikhali				
Count	102	0	0	102
% within union	100.0	0.0	0.0	100.0
Char Kukri Mukri				
Count	19	83	0	102
% within union	18.6	81.4	0.0	100.0
Sonapur				
Count	3	98	1	102
% within union	2.9	96.1	1.0	100.0
Total				
Count	158	249	1	408
% within union	38.7	61.0	0.2	100.0

Source: Field survey 2024

Kukri Mukri regarded their availability of rain water as 2 mo/y. Therefore, a rain water harvesting system can play a major role in meeting the water crisis.

Pina Mondal (former female UP Upozila Parishodmember, Wards 7–9, Goroikhali Union, Paikgacha, Khulna, KII 16) said:

Most of the females of her locality have to walk nearly 2 to 3 kilometers to collect safe drinking water. Despite having a tubewell near her home, the water is not drinkable due to groundwater contamination. He suggested

installing purification plant to meet the present safe water need.

Table 10 shows a p value is 0.000. Therefore, it can be concluded that respondents' perceptions of protecting primary water sources from several disasters is highly significant. Residents face freshwater crises more acutely when they lose their habitual sources because of the impact of disasters. Therefore, national policy should address the immediate need to protect coastal primary sources of water.

DISCUSSION

This section argues the rational ground of the study. The argument of the results of the study sets a rational ground for the findings. The discussions enrich the essence of the study. This section divided into three subsections.

Respondent Feedback on Usefulness of Prevailing Climate Change Policy

The study findings explicitly resulted in inadequate policy measures to meet the need of safe water in coastal regions of Bangladesh. For example, KII 32 and 30 said that people suffer a during dry season and disasters. Thus, it is clearly evident the incorporated policy does not have proper guidelines to meet the safe water demands of coastal people during emergency periods. Similarly KII 27, 15, and 21 focused on the long distance of the water plant from the household and said that salinity at the water source is one of the major challenges to collecting safe water. Likewise, KII 18 mentioned that the only safe water source is 5 km from their residence.

Table 8. Availability of surface water: Union and access to surface water cross-tabulation.

Surface Water Access	Union				Total
	Uttar Bedkashi	Goroikhali	Char Kukri Mukri	Sonapur	
1 mo/y					
Count	0	2	0	3	5
% within surface water access	0.0	40.0	0.0	60.0	100.0
% within union	0.0	2.0	0.0	2.9	1.2
2 mo/y					
Count	3	2	2	10	17
% within surface water access	17.6	11.8	11.8	58.8	100.0
% within union	2.9	2.0	2.0	9.8	4.2
3 mo/y					
Count	0	33	65	69	167
% within surface water access	0.0	19.8	38.9	41.3	100.0
% within union	0.0	32.4	63.7	67.6	40.9
6 mo/y					
Count	6	58	35	3	102
% within surface water access	5.9	56.9	34.3	2.9	100.0
% within union	5.9	56.9	34.3	2.9	25.0
9 mo/y					
Count	0	3	0	0	3
% within surface water access	0.0	100.0	0.0	0.0	100.0
% within union	0.0	2.9	0.0	0.0	0.7
All year					
Count	93	4	0	17	114
% within surface water access	81.6	3.5	0.0	14.9	100.0
% within union	91.2	3.9	0.0	16.7	27.9
Count	102	102	102	102	408
% within surface water access	25.0	25.0	25.0	25.0	100.0
% within union	100.0	100.0	100.0	100.0	100.0

Source: Field survey 2024

Table 9. Frequency of rain water: Rainfall in a year and union cross-tabulation.

Rainfall in a Year	Union				Total
	Uttar Bedkashi	Goroikhali	Char Kukri Mukri	Sonapur	
2 mo/y					
Count	0	0	2	0	2
% within rainfall in a year	0.0	0.0	100.0	0.0	100.0
% within union	0.0	0.0	2.0	0.0	0.5
3 mo/y					
Count	38	12	57	88	195
% within rainfall in a year	19.5	6.2	29.2	45.1	100.0
% within union	37.3	11.8	55.9	86.3	47.8
4 mo/y					
Count	0	0	0	8	8
% within rainfall in a year	0.0	0.0	0.0	100.0	100.0
% within union	0.0	0.0	0.0	7.8	2.0
6 mo/y					
Count	64	90	43	6	203
% within rainfall in a year	31.5	44.3	21.2	3.0	100.0
% within union	62.7	88.2	42.2	5.9	49.8
Count	102	102	102	102	408
% within rainfall in a year	25.0	25.0	25.0	25.0	100.0
% within union	100.0	100.0	100.0	100.0	100.0

Source: Field survey 2024

Even then, this only safe water source (a pond) dries up during the dry season. KII 11 and 14 also mentioned the distant location of their safe water source. KII 10 mentioned scanty rain water all year and said that mostly they depend on rain water preservation for drinking purposes. The cross-tabulation, paired samples, chi-square, and independent samples tests also showed significant results that addressed the policy limitations in ensuring safe drinking water for the coastal population of Bangladesh.

Community Impulse on Policy Integration

The study findings clearly show the water crises raised by the study respondents. The government policy should incorporate community members' voices to retain the coastal residents' sustainable livelihood. The respondents to this survey voiced their profound need. For example, KII 24 mentioned the coastal people's timely needs in seasonal crises. Similarly, KII 37 pointed out the limited alternatives for safe water sources and water crises triggered during religious festivals. Likewise KII 19 focused on alternative water sources as surface water becomes contaminated by salt for about 7 mo/y. Similarly KII 31 urged the creation of alternative water sources during the dry season because of saline water contamination. Distinctively, KII 2 focused on the destitute condition of the respondents and said that most of them are unable to pay to collect their daily required drinking water. In

contrast, KII 4 focused on the contamination of free drinking water, because the remaining sources are mostly polluted. Distinctively, KII 22 emphasized illiteracy, which drives people to use impure water. However, KII 20 focused on installing more tubewells in his locality to ensure safe water for all. The significant test results of the study also addressed these issues significantly. In a nutshell, it can be said that national policies should incorporated this feedback from the respondents to ensure coastal community sustainability.

Respondent Views on Specific Regional Policy

The study results show safe water source variations in different coastal regions. Thus, it is quite reasonable to undertake region-specific policy integration to ensure safe water for coastal regions of Bangladesh. As per the study results, KII 17 said that rapid salinity in the region is establishing threats for upcoming days. The cross-tabulation results strongly support this claim, because it is evident that surface water availability among the study regions varies remarkably. In addition, the salinity issues vary from one region to another region. For example, the study results show Goroikhali Union of Paikgacha Upazila is facing a more acute saline water contamination problem than the Sonapur Union of Charfasson Upazila. Even the adaptive scenarios vary from one coastal region to another. Thus, this study suggests regional policy integration to ensure sustainable coastal community.

Table 10. Gender-specific response to primary water source protection using an independent samples test.

Primary Water Source Protection	Levene Test for Equality of Variances		t Test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference	Lower	Upper
Equal variances assumed	89.810	0.000	6.404	406	0.000	0.676	0.106	0.468	0.883
Equal variances not assumed			4.039	62.926	0.000	0.676	0.167	0.341	1.010

Sig. = Significance

Source: Field survey 2024

CONCLUSIONS

To achieve sustainable development goals and to excel in the opportunity to have a blue economy, ensuring a coastal sustainable community should be a top priority for Bangladesh. To tackle the crises, the government has several policies (coastal zone management, Delta Plan 2100, *etc.*). However, none of those prioritize vital issues associated with safe drinking water for the future community sustainability of the coastal population. This study vividly focused on people's perceptions. Both statistical evidence and KII information addressed the improper and unfair water supply policies and strategies in coastal regions of Bangladesh. The voice of the coastal community people must be taken into account to ensure a sustainable community in coastal regions of Bangladesh.

Policy Recommendations

From the study's overall findings, the following policy recommendations are suggested to ensure a functional water supply system for coastal residents of Bangladesh.

Short Term

- (1) The concerned authority should take the initiative to ensure a proper record of disaster and its effect on coastal communities. In this way, recent climate changes can be included in the policy recommendations at the local and national levels.
- (2) The policymakers should take into account the voice of coastal residents.
- (3) The stakeholders must ensure the proper use of the given gadgets (Tools for immediate repairing of the water source such as tap for water tank).
- (4) Immediate actions have to be taken to repair the prevailing water sources.

Midterm

- (1) Functional initiatives should be taken so that coastal people can put their thoughts and experiences into climate change policies.
- (2) Stakeholders should take steps to retain prevailing water sources. For example, digging a pond is well-known way to create a freshwater supply source.
- (3) Policymakers should consider the rational distance for a plant installation so that coastal inhabitants can benefit equally.

Long Term

- (1) The government should focus on the climatic impact on the coastal regions, and necessary policy recommendations should include tackling upcoming threats to the sustainable livelihood of the coastal community.
- (2) Detailed plans and policies are required that focus on the freshwater need of the present and future coastal population.
- (3) Climate change issues should be included and monitored by the central body of policymaking, because coastal people are more vulnerable to climate impact.

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