

# 6

## CHALLENGES OF SAFE WATER MANAGEMENT IN SOUTHWEST COASTAL REGIONS OF BANGLADESH

*Syed Ashik-E-Elahi and Khondoker Mokaddem Hossain*

### Introduction

It is anticipated that in Bangladesh, the highest number of people are already facing the impact of frequent disasters and that the country will confront a significant disaster threat shortly. As a result, catastrophe specialists have classified Bangladesh as one of the most disaster-prone countries. It's worth mentioning that Bangladesh's coastal regions are more prone to natural disasters than the rest. A considerable number of people live in coastal belts, and they are struggling much due to frequent disasters. Such disasters are causing loss of shelter, loss of greenery, loss of occupation, loss of domestic animals, loss of preferred cultivation, and so on. Among others, this chapter has focused on one of the most fundamental crises in the coastal regions of Bangladesh. The loss of safe water sources, a lack of adequate management of available sources, and the risks that come with it in Bangladesh's southwest coastal districts. Figure 6.1 shows the study regions of Bangladesh.

Bangladeshi people have always had enough of water – in fact, have never had access to safe drinking water (Pal et al., 2011). Two-thirds of the world's population suffer from a severe lack of safe drinking water for at least one month each year (Hadi, 2019a). Though significant progress has been made toward fulfilling the MDGs, many of the targets, notably those relating to water, have yet to be met. For instance, one out of every ten people in the world lacks access to safe water as of 2015 (Chan, Roy, & Chaffin, 2016). The National Water Policy was established in 1992 to guide public and private efforts to guarantee optimal water resource management and development for the benefit of individuals and society. The strategy outlined six major objectives for ensuring long-term water management by acknowledging that the current water problem is the result of ineffective institutional management, regulatory mechanisms, and unsustainable practices (Hadi, 2019).

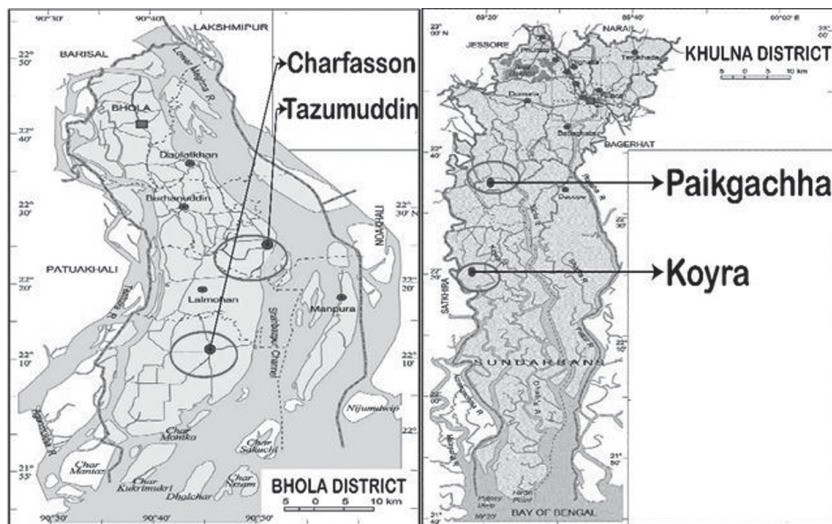


**FIGURE 6.1** Bangladesh, highlighting study areas

*Source:* Self modification (Primarily taken from google map).

The world population is increasing by around 80 million people each year. This growing number is implying a 64 billion cubic meter rise in annual freshwater consumption. The majority of population growth will occur in developing countries, particularly in areas that are already facing water scarcity and lack access to safe drinking water and adequate sanitation (Neto, 2018). Bangladesh's National Adaptation Plan 2005 was developed in response to five climate change challenges: freshwater scarcity, drainage congestion, riverbank erosion, frequent floods, and widespread drought and salinity (Chan, Roy, & Chaffin, 2016). When the Prophet advised, "Do not squander water even if performing ablution on the edge of a fast-flowing (big) river," he meant even in seemingly abundant circumstances (Faruqui, Biswas, & Bino, 2001). Water scarcity affects roughly 2 billion people now, with that number estimated to climb to 4 billion by 2025. According to the World Water Assessment Program, more than 2.2 million people died in 2000 from diseases caused by contaminated water or drought. All of these numbers have come to pass as the water sector faces depletion, contamination, mismanagement, and even being hijacked by multinational corporations (Nurul & Mohammad, 2014).

The United Nations Water Meeting, held in Mar del Plata, Argentina in 1977, was the first worldwide conference dedicated solely to water. The International Drinking Water Supply and Sanitation Decade (1981–1990), for example, was sparked by the Mar del Plata Action Plan. The UN General Assembly declared this decade at the end of 1980 with the primary goal of providing full access to water and sanitation to all people in developing nations (Unesco, 2002). Goal 6 of the Sustainable Development Goals has given special concern to universal access to safe drinking water and sustainable use of water resources (Chan, Roy, & Chaffin, 2016).

Bangladesh is placed 130th out of 139 countries in the World Economic Forum's 2010 Global Competitiveness Report for its network of roads, power, and ports due to poverty and geography. In terms of certainty, urgency, and severity of impact, climate change poses major hazards to Bangladesh's infrastructural weaknesses, notably to its water and coastline resources (Earle et al., 2015).

In 1980, 32 percent of the world's estimated people (1.49 billion) living in rural regions had better access to water. According to recent estimates of rural water availability in "least developed nations," basic rural water access has increased from 43 percent in 2000 to 52 percent in 2015 (Hope et al., 2019). Water is the most essential element for the survival of living being. It affects many aspects of life, including agriculture, industry, domestic life, and all economic operations in general. So, it is highly recommended that water-related field activities have to be included in the management policy (Abou & Djebedjian, 2004). Since 1980, the usage of treated wastewater has increased dramatically in developing countries. This is mainly due to rising population and per capita water use, which has resulted in an increase in wastewater production in both urban and rural areas of emerging countries (Al Khateeb, 2001). In the international debate over water resource allocation priorities, there is a growing consensus. The provision of water for essential human needs should take precedence (Unesco, 2002). Water resources management involves a wide variety of operations, from infrastructure development and water resource distribution to financing arrangements and incentive implementation for efficient water use and protection (Figure 6.2) (Lenton & Muller, 2012).

"Rural people are not fully able to locate and provide answers to all of their problems due to low literacy rates and little exposure to the outside world" (Chadwick & Datta, 2003). So far too many of us cannot apply what we've learned about our existing paradigms. If we imagine ourselves 150 years in the future and then look back, it seems likely that practitioners of that era will smile at our belief systems once more (Mercer, Christesen, & Buxton, 2007). Ma', the Arabic term for water, appears in the Quran 63 times. The throne of God is said to be seated on water, and Paradise is depicted as "Gardens beneath which rivers flow." According to Caponera (this volume), water appears to be the most valuable creation in the Quran after people. The verse "And Allah has poured down the water from the heavens and therewith provides life to the land after its death" reflects the life-giving aspect of water. Water not only gives life, but it is also the source of all

- 
1. Water is a limited, vulnerable, and necessary resource for life, development, and environmental sustainability.
  2. Water resource development and management should be based on a participatory approach, involving users, planners, and policymakers at all levels.
  3. Water provision, management, and conservation are all dominated by women.
  4. Water has a monetary worth in all of its competing uses, and it should be treated as such.
- 

**FIGURE 6.2** The Dublin Principles

*Source:* Loucks & Beek, 2017.

life: “We fashioned every living thing from water” (Faruqui, Biswas, & Bino, 2001). Water governance is defined as “the political, economic, and societal processes and structures through which authorities, civil society, and the private industry make choices about how to best use, grow, and manage water resources,” by the United Nations Development Program (Chan, Roy, & Chaffin, 2016).

Method

Table 6.1 shows the issues emphasized in coastal water policy summary of Bangladesh. The work is based on an empirical study to assess the prevailing challenges and threats in access to safe drinking water in southwest coastal regions of Bangladesh. Different social, cultural, political, and behavioral issues have been taken into account to understand the loopholes in management failure. The study’s primary data were collected by administering mixed methods, and questionnaire survey and key informant interview (KII) techniques have been applied as data collection techniques. After data collection, the researcher processed quantitative data using SPSS software and qualitative data were analyzed as per specification.

TABLE 6.1 Coastal water policy summary of Bangladesh

| Country    | Policy                     | Focal points                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bangladesh | Coastal zone policy – 2005 | The coastal zone policy was developed by the Ministry of Water Resources of the Government of the People’s Republic of Bangladesh in 2005. It mainly discussed multisectoral aspects of coastal zone management, such as economic growth, basic needs of livelihoods, disaster management, empowering women and coastal communities, and ecosystem conservation in coastal areas. One of the components, sustainable management of natural resources, has focused on water management. It has emphasized rainwater gathering and conservation for daily use: ponds, tanks, and local water technology excavation. The policy also focuses on establishing pond sand filtering (PSF) plants in coastal areas where the saltwater intrusion has already occurred. It also focuses on storing freshwater, and the authority will construct an appropriate water management system based on specific areas. It will also ensure that groundwater in coastal areas is used sustainably. Initiatives will be taken by the concerned authority to gather tidal water for irrigation by constructing reservoirs. |

Source: Authors’ compilation 2021.

## Areas Covered in This Study

Out of 64 districts of Bangladesh, 02 southwestern coastal districts (Namely Bhola and Khulna) have been chosen purposely by considering data availability as per objectives of the study. Again, following purposive sampling, 02 coastal Upazila have been selected from each district. Finally, 02 coastal Unions were selected from each Upazila, considering the severity of access to safe drinking water. At last, the researcher collected necessary data following stratified sampling techniques as respondents are diverse.

## Data Analysis

Initially, collected data were sorted and scrutinized for data appropriation. After selecting appropriate data, data coding issues are processed carefully. The researcher then followed a specific cluster data entry procedure completed in SPSS software. After cross-checking and finalizing, data entry necessary statistical equations are administered to validate the study's quantitative data. Besides, the KII technique was used to meet the necessary qualitative data for further study validation.

The quantitative data were then analyzed as per the following equations:

**Cross tabulation:** This equation is applied to compare two different variables as per their ratio in a table. It gives a clear state of the variables and is easy to understand in a nutshell.

**Linear regression:** This equation demonstrates the significance of the variables on each other.

**Cronbach's alpha:** This equation shows the reliability of the variable.

**Chi-square test:** This equation displays the significance of the nominal variable.

**One-sample test:** This equation confirms the significance of specific variables.

**ANOVA:** Analysis of variance shows the significance of a group of variables.

**Correlations:** This equation indicates the significance of numerical variables.

The qualitative data is described as per the following technique:

**KII:** This technique administered on a respondent who is expert or knowledgeable on a certain issue.

## Result and Discussion

### *Challenges of Safe Water Management in Southwest Coastal Regions of Bangladesh*

Bangladesh will be home to around 27 million climate refugees by 2050. Bangladesh government has invested more than 10 billion USD to solve the problem and assure future adaptation of coastal communities (BRAC, 2016). Most of these victims

will come from the country's coastal regions. Bangladesh has been recognized as a role model in disaster risk management by the United Nations. Despite that, there are regulatory flaws in assuring a secure future for coastal residents. The country's coastal residents suffer greatly from daily home issues, and agriculture requires freshwater. According to field experience, negligence and mismanagement are the main reasons for the coastal community's current suffering.

Several studies have highlighted Bangladesh's water governance shortcomings, including (i) a lack of major water users' participation in planning and implementation; (ii) a miscommunication between legislators and interested parties; (iii) an absence of political will to create an enabling environment for effective water governance; and (iv) citizens' exclusion and failure to participate (Chan, Roy, & Chaffin, 2016). During a discussion at a workshop on "People's Participation in the Water Sector: Lessons Learned from Experience" in 1997, respondents confirmed that there had been no real participation in water sector operations in Bangladesh, reflecting the arising consensus on the failure of prior participatory approaches. They suggested that local government and community leaders, as well as people from all walks of life, be involved at every stage of the process, from problem recognition to needs assessment, viability testing, project plan, execution, and operation and maintenance, to ensure authentic stakeholder engagement. According to the text, the following three factors should be considered when determining meaningful involvement: What is the expected level of participation? Who is involved in the procedure? What is the method for participation? (Chadwick & Datta, 2003). Geographical circumstances, excessive sedimentation owing to river morphology, climate-induced SLR, and other variables all contribute to a rise in salt intrusion, notably in Bangladesh's coastal region. Climate warming has hastened the salinization process (Hadi, 2019).

Local pond, tubewell, river, and deep tubewell are the four examined regions' reliant sources of safe drinking water, as shown in Table 6.2. According to the table value, the maximum number of respondents in Goroikhali union were reliant on a local pond for safe water collection, accounting for 50 percent of all respondents in this category, while the second highest respondents in Uttar Bedkashi union are in the same category. Furthermore, it is seen that tubewell usage is high in Char Kukri Mukri and Sonapur unions, with 60 percent and 29 percent, respectively. Furthermore, the Char Kukri Mukri and Sonapur unions have the most reliance on river water, with 43 percent and 36 percent, respectively. The only exception is the use of deep tubewells, which are used exclusively in Sonapur union and account for 100 percent of this category. We may deduce from this data that coastal people in Khulna district rely more on small ponds, whereas people in Bhola district rely more on tubewells, deep tubewells, and rivers.

Due to the blatant exclusion of political opposition from a rightful role in democratic debate, undue influence of state institutions to pursue political goals, and the general politicization of bureaucracy, the current political system is basically a "winner take all" society. Administrative operations hampered by bureaucratic challenges are common in Bangladesh. Therefore, few effective check and

**TABLE 6.2** Drinking water source before installation of safe water plant in the study areas

| <b>Drinking water before * Union (Cross tabulation)</b>    |               |                                | <i>Union</i>                   |                  |                         |                | <i>Total</i> |
|------------------------------------------------------------|---------------|--------------------------------|--------------------------------|------------------|-------------------------|----------------|--------------|
|                                                            |               |                                | <i>Uttar Bedkashi</i>          | <i>Goroikhal</i> | <i>Char Kukri Mukri</i> | <i>Sonapur</i> |              |
| Drinking water source before safe water plant installation | Local pond    | Count                          | 85                             | 101              | 3                       | 13             | 202          |
|                                                            |               | % within drinking water before | 42.1%                          | 50.0%            | 1.5%                    | 6.4%           | 100.0%       |
|                                                            | Tubewell      | Count                          | 14                             | 1                | 93                      | 45             | 153          |
|                                                            |               | % within drinking water before | 9.2%                           | 0.7%             | 60.8%                   | 29.4%          | 100.0%       |
|                                                            | River         | Count                          | 3                              | 0                | 6                       | 5              | 14           |
|                                                            |               | % within drinking water before | 21.4%                          | 0.0%             | 42.9%                   | 35.7%          | 100.0%       |
|                                                            | Deep tubewell | Count                          | 0                              | 0                | 0                       | 39             | 39           |
|                                                            |               | % within drinking water before | 0.0%                           | 0.0%             | 0.0%                    | 100.0%         | 100.0%       |
|                                                            | Total         | Count                          | 102                            | 102              | 102                     | 102            | 408          |
|                                                            |               |                                | % within drinking water before | 25.0%            | 25.0%                   | 25.0%          | 100.0%       |

Source: Field survey 2020.

balance practices result petty corruption and crime across the water management sector (Chan, Roy, & Chaffin, 2016). Human activities raise benefit from rivers and floodplains. But several destructive activities causing physical, economic, environmental, and social costs and harms to these bodies. Such loss arises as a result of a misalignment between what humans expect or demand and what nature provides (Loucks & Beek, 2017). Changing the social and institutional components of water resource systems is frequently the most difficult since it requires individuals to change their thinking and behavior. Any reform process will necessitate a shift in our institutions and the rules by which we operate as a society. Individuals are the ones who are primarily accountable for and adjust to changing political and social circumstances. Sustainability necessitates public and private organizations to adapt to the changing requirements of individuals and society across time (Loucks & Beek, 2017).

According to the results of the linear regression, the researcher discovers that plant damage has a considerable impact on water irregularity (Table 6.3). The value

**TABLE 6.3** Water abnormality and plant damage: a linear regression analysis

| Model summary <sup>b</sup>                          |                   |                             |                   |                            |               |                   |
|-----------------------------------------------------|-------------------|-----------------------------|-------------------|----------------------------|---------------|-------------------|
| Model                                               | R                 | R square                    | Adjusted R square | Std. error of the estimate | Durbin-Watson |                   |
| 1                                                   | .157 <sup>a</sup> | .025                        | .022              | 1.370                      | 1.303         |                   |
| <sup>a</sup> Predictors: (Constant), kind of damage |                   |                             |                   |                            |               |                   |
| <sup>b</sup> Dependentvariable: Kind of abnormality |                   |                             |                   |                            |               |                   |
| ANOVA <sup>a</sup>                                  |                   |                             |                   |                            |               |                   |
| Model                                               |                   | Sum of squares              | df                | Mean square                | F             | Sig.              |
| 1                                                   | Regression        | 19.338                      | 1                 | 19.338                     | 10.296        | .001 <sup>b</sup> |
|                                                     | Residual          | 762.535                     | 406               | 1.878                      |               |                   |
|                                                     | Total             | 781.873                     | 407               |                            |               |                   |
| <sup>a</sup> Dependentvariable: Kind of abnormality |                   |                             |                   |                            |               |                   |
| <sup>b</sup> Predictors: (Constant), kind of damage |                   |                             |                   |                            |               |                   |
| Coefficients <sup>a</sup>                           |                   |                             |                   |                            |               |                   |
| Model                                               |                   | Unstandardized coefficients |                   | Standardized coefficients  | t             | Sig.              |
|                                                     |                   | B                           | Std. error        | Beta                       |               |                   |
| 1                                                   | (Constant)        | 1.302                       | .121              |                            | 10.777        | .000              |
|                                                     | Kind of damage    | .086                        | .027              | .157                       | 3.209         | .001              |

<sup>a</sup> Dependentvariable: Kind of abnormality

Source: Field survey 2020.

of R square, in this case, is around .157 (the “**R Square**” column), indicating that the independent variable explains 15.7 percent of the total variation in the dependent variable. The dependent variable is significantly predicted by the ANOVA table regression model. Because the significant value here is .001 (the “**Sig.**” column), the result is significant. Finally, the coefficients table shows that the B value of the type of damage is .086 (the “**B**” column) and the P-value is .000 (the “**Sig.**” column), indicating that damage has a highly positive significant impact on water abnormality.

Large river systems have already been classified as being in a state of severe water stress in many regions of the world, implying that extracting further water from these systems may cause irreparable environmental harm (Lenton & Muller, 2012). Since surface water availability varies seasonally and regionally, the use of tube wells to elevate shallow groundwater was advocated in rural and urban areas to enable intensive agriculture and provide safe drinking water. Groundwater is used to provide about 95 percent of drinking water and 68.5 percent of agricultural water (Chowdhury, 2010). Mismanagement of river resources, on the other hand (for example, haphazard infrastructure development), has exacerbated the harmful consequences of seasonal flooding, compounding already widespread pollution issues. As a result, Bangladesh has relied heavily on groundwater for irrigation, drinking, and manufacturing (Chan, Roy, & Chaffin, 2016).

Table 6.4 demonstrates that the most common cause of illness is fungal contamination, with 95 percent of males and 5 percent of women suffering. The second greatest group of responders addressed water plant maintenance carelessness, with women suffering the most from this problem, accounting for 91 percent of the total. Point source pollution, salinity, and fecal from domestic animals are among the other notable issues raised by the responders.

Though Bangladesh’s Cabinet approved a national water strategy more than a decade ago, it is remarkable that the policy has yet to be implemented. This must be done as a first step in correcting the current state of misunderstanding in the country’s water resource management (Pal et al., 2011). According to the study, there is a shortage of resources and planning to ensure that coastal residents have a secure livelihood. Furthermore, the lack of appropriate policy and strategy puts the minimum investment at risk. Though there are difficulties in combating coastal crises due to a lack of enough investment opportunities, it is possible to alleviate coastal people’s suffering by ensuring proper planning and management authority.

### ***Problems Prevailing in Coastal Regions of Bangladesh***

In Bangladesh’s coastal regions, salinity in the surface water is a widespread issue. Due to the constant presence of saline water in the surface water of coastal regions, such suffering occurs daily. People are mostly living hand to mouth in Bangladesh’s coastal regions. Because of their poverty, most residents cannot afford potable water. As a result, many suffer from various health difficulties due to a lack of freshwater. In addition, they are unable to perform their agricultural operations due to a lack

**TABLE 6.4** Gender-sensible suffering to different surface water contamination

|                              |                                   |                                   | <i>Gender suffering</i> |             |                     | <i>Total</i> |
|------------------------------|-----------------------------------|-----------------------------------|-------------------------|-------------|---------------------|--------------|
|                              |                                   |                                   | <i>Female</i>           | <i>Male</i> | <i>None of them</i> |              |
| The problem in surface water | Fungal contamination              | Count                             | 184                     | 10          | 0                   | 194          |
|                              |                                   | % within problem in surface water | 94.8%                   | 5.2%        | 0.0%                | 100.0%       |
|                              | Point source pollution            | Count                             | 54                      | 7           | 0                   | 61           |
|                              |                                   | % within problem in surface water | 88.5%                   | 11.5%       | 0.0%                | 100.0%       |
|                              | Maintenance problem               | Count                             | 88                      | 9           | 0                   | 97           |
|                              |                                   | % within problem in surface water | 90.7%                   | 9.3%        | 0.0%                | 100.0%       |
|                              | Domestic animal nursing           | Count                             | 5                       | 0           | 0                   | 5            |
|                              |                                   | % within problem in surface water | 100.0%                  | 0.0%        | 0.0%                | 100.0%       |
|                              | Salinity                          | Count                             | 10                      | 0           | 0                   | 10           |
|                              |                                   | % within problem in surface water | 100.0%                  | 0.0%        | 0.0%                | 100.0%       |
|                              | Oyster grows and rotten           | Count                             | 3                       | 0           | 0                   | 3            |
|                              |                                   | % within problem in surface water | 100.0%                  | 0.0%        | 0.0%                | 100.0%       |
|                              | Frog in the water body            | Count                             | 1                       | 0           | 0                   | 1            |
|                              |                                   | % within problem in surface water | 100.0%                  | 0.0%        | 0.0%                | 100.0%       |
|                              | Death animal body                 | Count                             | 2                       | 0           | 0                   | 2            |
|                              |                                   | % within problem in surface water | 100.0%                  | 0.0%        | 0.0%                | 100.0%       |
|                              | Iron                              | Count                             | 3                       | 0           | 0                   | 3            |
|                              |                                   | % within problem in surface water | 100.0%                  | 0.0%        | 0.0%                | 100.0%       |
|                              | Do not face any problem           | Count                             | 27                      | 3           | 2                   | 32           |
|                              |                                   | % within problem in surface water | 84.4%                   | 9.4%        | 6.2%                | 100.0%       |
| Total                        | Count                             |                                   | 377                     | 29          | 2                   | 408          |
|                              | % within problem in surface water |                                   | 92.4%                   | 7.1%        | 0.5%                | 100.0%       |

Source: Field survey 2020.

of fresh water supplies, as evidenced by the current situation. Moreover, people are fighting for survival.

Climate change, land erosion, arsenic-contaminated aquifers, and water contamination are among the natural and man-made risks that have harmed the coastal population's livelihood (Hadi, 2019). To undertake a project, improved water

resource planning, management review process quality, a focus on outcomes rather than output should be addressed. A better understanding of some of the linkages between diverse human actions and the hydrology and ecology of the basin, estuary, or coastal zone should be among the benefits (Loucks & Beek, 2017). Even though the Bangladeshi government has developed initiatives to mitigate water governance issues, little attention is given to how these regulations are carried out on a local level. According to Mandal, most policies are based on political objectives that lack empirical evaluation and a vision for large-scale implementation. A fundamental hurdle to promoting sustainable development and holistic water governance changes is the lack of real execution and evaluation of results (Chan, Roy, & Chaffin, 2016). According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, the water sector would be one of the most vulnerable to climate change. Climate change manifests itself in extreme weather events, rising sea levels, and salty intrusion into aquifers and rivers (Hadi, 2019).

Table 6.5 shows that Cronbach's alpha acceptance values range from .7 to .8. The table value is .770 in this case. As a result, we can confidently state that variables (drinking water sources before and after plant installation) are widely recognized. These study variables are highly significant to the research objectives in terms of the outcome. For the past 40 years, excessive groundwater withdrawal has resulted from a lack of effective tubewell planning. The absence of effective water resource management has resulted in a variety of stressors that have the potential to cause conflict among different groups of rural society. The government's failure to ensure rural people's participation in the formulation and execution of water resource management policies (Safiuddin et al., 2003). WARPO was created by the GoB to oversee the country's comprehensive water sector planning. WARPO's objective is to develop and implement national water policies and strategies to ensure that water resources are managed efficiently by a variety of users, including agriculture, fisheries, navigation, public health, and industry. WARPO is also in charge of collating information from other water sector agencies. WARPO, on the other hand, is widely acknowledged to have struggled to meet its sectoral planning and coordination tasks, and individual line ministries frequently rely on their own planning offices, which sometimes work in isolation from other sectors (Chadwick & Datta, 2003).

The P-value is .000, and the Pearson Chi-square value is 408.000, as seen in Table 6.6. As a result, statistical evidence suggests that respondents' disease and the condition of water sources are highly reliant on one another.

**TABLE 6.5** Reliability test of the source of drinking water before and after plant installation

| <i>Reliability statistics</i> |                                                     |                     |
|-------------------------------|-----------------------------------------------------|---------------------|
| <i>Cronbach's alpha</i>       | <i>Cronbach's alpha based on standardized items</i> | <i>No. of items</i> |
| .770                          | .778                                                | 2                   |

Source: Field survey 2020.

**TABLE 6.6** Significant test result of illness and reasons

| <i>Chi-square tests</i>      |                      |           |                              |
|------------------------------|----------------------|-----------|------------------------------|
|                              | <i>Value</i>         | <i>df</i> | <i>Asymp. sig. (2-sided)</i> |
| Pearson Chi-square           | 408.000 <sup>a</sup> | 3         | .000                         |
| Likelihood ratio             | 322.661              | 3         | .000                         |
| Linear-by-linear association | 163.985              | 1         | .000                         |
| N of valid cases             | 408                  |           |                              |

a 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 7.41.

Source: Field survey 2020.

**TABLE 6.7** The impact of political influence on plant installation

| <i>One-sample test</i> |          |           |                        |                        |                                                  |              |
|------------------------|----------|-----------|------------------------|------------------------|--------------------------------------------------|--------------|
| <i>Test value = 0</i>  |          |           |                        |                        |                                                  |              |
|                        | <i>t</i> | <i>df</i> | <i>Sig. (2-tailed)</i> | <i>Mean difference</i> | <i>95% confidence interval of the difference</i> |              |
|                        |          |           |                        |                        | <i>Lower</i>                                     | <i>Upper</i> |
| Political influence    | 40.850   | 407       | .000                   | .804                   | .77                                              | .84          |
| Kind of impact         | 27.903   | 407       | .000                   | 1.784                  | 1.66                                             | 1.91         |

Source: Field survey 2020.

By 2010, the government has promised to provide everyone with access to clean water and sanitation. Currently, 74 percent of Bangladeshis have access to safe drinking water, while just 33 percent have access to sanitation (Chowdhury, 2010). Several water-related policy instruments in Bangladesh have become obsolete due to a lack of integration of climate change issues. To ensure long-term water resource management and IWRM implementation, climate change policy must be included in surface water-groundwater planning (Chan, Roy, & Chaffin, 2016). Climate change, according to World Bank forecasts (2000), will cause widespread inundation in low-lying areas, adding to an increase in the rate of saline intrusion (Hadi, 2019).

Table 6.7 shows that the *t*-value is 40.850 and the *P*-value is .000, both of which are highly significant. As a result, it can be inferred that political influence has a major impact on plant installation in the research areas, such as plant location, maintenance, and monitoring.

Bangladesh's water management is disjointed, and citizen engagement in water provision is uncommon, if at all. A continuous conflict to overcome basic hurdles to reaching water-related MDG targets, such as considerably inadequate quality of public water services and inefficient practices for operations and maintenance of

existing facilities, can be attributed to the lack of focus on IWRM and effective water governance. Regional socioeconomic gaps, access discrepancies, and poor institutional ladders exacerbate these flaws (Chan, Roy, & Chaffin, 2016). Water utilities' dominance has had a significant impact on the form of this organization and its impact on governance. Water utility resource planning techniques have been studied, and it has been discovered that they tend to use low or no risk strategies, preferring to stay "invisible" socially and politically rather than maximizing their approach on estimated risks (Walker, 2014). Analysts' models and simulations of water resource systems are frequently far more complex than they can handle. The issue is that we don't fully know the myriad interconnected physical, physiological, ecological, social, legal, and political (human) elements that control the behavior of such water resource systems (Loucks & Beek, 2017).

The P-value for a one-tailed test is .000, as seen in Table 6.8. As a result, the observed differences among the category means can be attributed to random ability to influence various disorders. As a result, we can conclude that after the establishment of a safe water plant, diseases such as diarrhea, hypertension, eye irritation, and diabetes are greatly reduced in the study unions.

Determining what the notion of the right to water means in practice could be the most helpful step in seeking to solve the problem's core issues. Rather than disputing whether or not the water right is a human right, it is more important to get an agreement on who has a right to water and who has priority access to water. Is there a right to water for a single citizen, a community, a state, or a corporation, and if so, what kind of right does it have, and what is the sequence of precedence? Is it required to own property to have water access? (Hukka, Castro, & Pietila, 2010). The information and knowledge that actors use to interpret a situation are referred to as cognition. Infrastructure-focused bureaucracy, a lack of employees and talents, a faulty monitoring system, and an erroneous poverty classification – all led to the implementation gap (Hueso & Bell, 2013). The water industry is no exception to the world's fluctuating and difficult-to-predict social, economic, and environmental situations. This uncertainty creates a difficult climate in which to construct policies and institutions (Funke, Claassen, & Nienaber, 2013).

**TABLE 6.8** Evidence of disease reduction following the establishment of a clean water plant

| <i>ANOVA</i>   |                       |           |                    |          |             |
|----------------|-----------------------|-----------|--------------------|----------|-------------|
| <i>Union</i>   |                       |           |                    |          |             |
|                | <i>Sum of squares</i> | <i>df</i> | <i>Mean square</i> | <i>F</i> | <i>Sig.</i> |
| Between groups | 254.835               | 8         | 31.854             | 49.810   | .000        |
| Within groups  | 255.165               | 399       | .640               |          |             |
| Total          | 510.000               | 407       |                    |          |             |

Source: Field survey 2020.

**KII – 01**

MostainUddin

Sonapur, Tazumuddin, Bhola

October 10, 2020

Age: 75

Teacher (Retired)

Educational Status: Honors

The outcome of KII:

Rainwater and pond water, according to the respondent, are the main sources of drinking water for his union's general population. He added that few people purify water by boiling it or processing alum. However, most people drink water directly from the pond without filtering it. During the rainy season, usually, people collect and store rainwater for drinking. But, he said during the wet session, it's more difficult to find fresh water. He further added people were habituated to collecting drinking water from a neighboring government pond. Since a lease mechanism has been imposed on this pond, fish food and medicine are imposed for fish farming. As a result, pond water becomes contaminated and unsafe for drinking.

There are few ponds available in the village to provide fresh water for the majority of the villagers. He mentioned that such private pond owners have expressed privacy concerns and imposed barriers for others to collect water to some extent. However, a few small size ponds at the community level are dry up during the winter season. As a result, during the crisis, the poor residents had to rely on privately owned large ponds to meet their daily needs. Deep tube wells are not available in this area, he added. Instead, local people depend on three to four shallow tube wells. However, saline water contamination is making these available water sources unbearable. Furthermore, due to the frequency of natural disasters, the sufferings of local coastal people are escalating. The pond's water became contaminated after sudden storms or flooding and further worsened the crises.

Usually, they store drinking water in pitchers to survive in emergency situations. He mentioned a pond sand filter (PSF) had been installed beside the government pond at Union Sadar with the help of Oxfam and BRAC to excel pure drinking water supply for the locals. But those who reside far away from Union Sadar are deprived of the facility. He further added in November 2020 the government agency declared a "drinking water reservoir Project" to meet the water crisis. Another provision he has noticed is a water tank supply for the poor household to preserve and use rainwater for certain months of the year. During the wet season, they can store rainwater in this tank. The capacity of each tank is 3,000 liters. He stated that installing a new water supply plant would benefit the middle and lower classes of his community.

|            | <i>Before purification plant installation</i>                                                                                                                                                                       | <i>After purification plant installation</i>                                                                                                                                                                                                              |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Health     | People were more susceptible to waterborne diseases in the past such as diarrhea, dysentery, typhoid fever, and so on. Several infections wreaked havoc on children in particular.                                  | The number of waterborne diseases has significantly decreased. The health of those living near the purifying facility, in particular, has improved.                                                                                                       |
| Livelihood | <ol style="list-style-type: none"> <li>1. Treatment costs would have been higher.</li> <li>2. Boiling water used to take longer in the past. Furthermore, it would have cost more kerosene at that time.</li> </ol> | <ol style="list-style-type: none"> <li>1. As a result of the decrease in waterborne diseases, medical costs have decreased.</li> <li>2. People in the neighborhood have saved time and gasoline since the installation of the purifying plant.</li> </ol> |

Source: Field study 2020.

The association between initial ignorance and types of challenges in using new technology among respondents is shown in the above statistical result. The correlation is .974, indicating that there is a positive and extremely significant association between respondents' knowledge and the induced technology, as seen in Table 6.9.

Groundwater contamination can occur as a direct result of waste discharge through wells or because of surface material filtration into aquifers with no upper containment. In many aquifers accessible to surface drainage, irrigation is the source of the most contamination. Because large volumes of salty water naturally occur near fresh water supplies, a fall in aquifer level caused by pumping may cause the brine to infiltrate a previously fresh supply. This is a particularly common problem

**TABLE 6.9** Relation between difficulties of using new technology and kind of troubles

| <i>Correlations</i>              |                     | <i>Difficulties in using technology</i> | <i>Kind of difficulty</i> |
|----------------------------------|---------------------|-----------------------------------------|---------------------------|
| Difficulties in using technology | Pearson correlation | 1                                       | .974**                    |
|                                  | Sig. (2-tailed)     |                                         | .000                      |
|                                  | N                   | 408                                     | 408                       |
| Kind of difficulty               | Pearson correlation | .974**                                  | 1                         |
|                                  | Sig. (2-tailed)     | .000                                    |                           |
|                                  | N                   | 408                                     | 408                       |

\*\* Correlation is significant at the 0.01 level (2-tailed).

Source: Field survey 2020.

at the coast, where rising sea levels or extraction of freshwater from an aquifer adjacent to saltwater can result in saltwater intrusion. Chlorides and dissolved sediments find their way into what was once a freshwater aquifer (Wescoat, White, & White, 2003). It is still unclear whether authorities should ensure water service availability in sparsely inhabited areas or whether governments in developing economies should spend significantly on the water industry (Hukka, Castro, & Pietila, 2010).

**KII – 02**

Md. NasirHawaladar  
Uttar Bedkashi, Koyra, Khulna  
October 10, 2020

The outcome of KII:

According to the respondent, tube wells are the only way for people to get drinking water. Since it is low land and there are no dams to safeguard the area, other water sources (such as ponds) are quickly polluted by river water intrusion. Due to the tainted river water and the tube well mixing up, collecting water from the available sources becomes more difficult during the rainy season. He noted that drinking water contains mud and other contaminants, frequently resulting in a horrible odor. Another problem is that they frequently can't find a nearby tube well that drains floodwaters, exacerbating the situation. When queried about the "purification" procedure, he said he had never heard of it before. He states that just a few people are familiar with the notion of "filtration," and most residents have never heard of it. People frequently use a piece of cloth as a filter in front of the tube well's mouth to collect clean water. Despite their ignorance of the water purification process, individuals routinely use alum to cleanse water during the rainy season since their neighbors' practice this mechanism.

**Age: 29**

Business  
Educational Status: SSC

As per the respondent's experience, seven or eight homes, with on an average 30 to 40 family members, rely on a single tube well as their sole source of drinking water throughout the year.

**Key issues:**

1. Most people are unaware of water purification.
2. No one has ever shown up to help with the drinking water issues during the wet season.
3. They are unaware of their rights, as seen by their failure to notify the authorities of their difficulties.
4. They can't afford to set up new tube wells on their own because they are financially needy.

They are doubtful, however, whether this procedure can filter the water. They used to drink water that has boiled for two to three minutes on occasions. No governmental or non-governmental organizations have attempted to examine their circumstances to address the current challenges, and locals must be concerned about the situation. As a result, the purification system remains in the dark, and installing a water purification project at the union level remains a mystery

---

*Source:* Field study 2020.

The concept of environmental and ecological sustainability originated as a result of growing concern about the long-term health of our planet. There is rising evidence that our current resource management and usage activities and actions, even at the local level, can have a considerable future impact on the welfare of those living in considerably larger regions. Water resource management concerns at the river basin level are rarely technical, and they are only of concern to those who live in the river basins. They're getting entwined with societal institutions, expectations, and goals (Loucks & Beek, 2017). For Muslims, the Prophet was the ideal human role model and leader, and the society he constructed around him is a paradigm of compassion and equity. In Islam, the Prophet is held in such high regard that it may not be found in other religions. If the Quran serves as a compass for Muslims, the Sunnah serves as a more detailed map of humanity's path on this planet (Faruqui, Biswas, & Bino, 2001). Droughts, floods, and other natural calamities substantially impact (i) the availability of healthy drinking water and irrigation water in Bangladesh, along with (ii) an alarming increase in pollution due to uncontrolled industrialization (Chan, Roy, & Chaffin, 2016). Forecasts for sea-level rise vary from 30 to 50 centimeters in 2050 and 105 centimeters in 2100, indicating a potentially significant impact on the social and economic issues of the coastal community (Hadi, 2019).

According to the research, women and children in Bangladesh's coastal regions have more difficult survival issues. They can't go far to achieve their necessities since they can't travel far. Furthermore, this population cannot meet their basic needs due to a lack of financial resources. Moreover, due to the regular mega-disasters, people's misery worsens day by day. Residents in KoyraUpazila, for example, are still dealing with the aftermath of storm Ayla in 2009. Salinity in surface water and land fertility loss is the most vulnerable outcomes of this cyclone.

### ***Possible Way Out***

Bangladesh stands as an example of disaster risk reduction. Now it is time to set another example in coastal management. As a delta country, it has ample opportunities in a blue economy. It has to set up a holistic approach to exploring every possible way out in doing so. In doing so, it is time to set proper planning and management to grab the future flourishing.

Culture, especially religion, has a significant impact on how people view and manage a resource like water. Even though local culture and values were previously overlooked in development initiatives, development agencies are increasingly recognizing the importance of local culture and values in their policies (Faruqui, Biswas, & Bino, 2001). Regardless of how powerful or well-coordinated the administrative machinery of commissions, boards, committees, or executive directors is, it cannot prevent or address the water problem. Understanding of the hydrologic environment, within which their power is exercised, and an informed public whose goals and demands are known are both essential for such officers to be effective (Leopold, 1959). To reduce the number of people without adequate water access, international and national water law would have to favor water use over other uses, as many countries now do. Indeed, there is a clear need to prioritize water consumption, with community water supply being the main concern (Hukka, Castro, & Pietila, 2010). Transparent and responsive political, organizational, and administrative systems must also result in consensus on effective and efficient, equitable, and inclusive techniques and practices for protecting and sharing our shared legacy, which includes both national and international water resources (Hukka, Castro, & Pietila, 2010). A dynamic and adaptive strategy for water resource development, management, and usage is a critical necessity for environmental sustainability in the face of certain changes with unknown consequences (Loucks & Beek, 2017). Imams are better at reaching out to the general people than water experts. Although they are normally well-versed in *fiqh*, *sunnah*, and *sharia*. Their understanding of water resources and conservation measures are frequently insufficient for them to serve as instructors on the issue. As a result, water specialists must not only teach, educate, and advise imams about water shortages, water conservation measures, and the need to involve the public, but also about audiovisual methods and resources to assist them in reaching out to the public (Faruqui, Biswas, & Bino, 2001).

In the study, two major religious responses are shown in Table 6.10. The Char Kukri Mukri union has the highest percentage of Muslim respondents, accounting for around 95 percent of all respondents. On the other hand, the biggest proportion of Hindu respondents is found in the Uttar Bedkashi union, which accounts for only approximately 18 percent of all respondents. In general, the study's respondents are 90 percent Muslim and 10 percent Hindu.

BDP 2100 is a long-term strategic plan for land and water resource management for the next few decades. "Ensure maximum water and food security, economic expansion, and environmental sustainability while effectively managing natural catastrophes, climate change, and other delta concerns through rigorous, adaptive,

**TABLE 6.10** Religious ratio of respondents as per study unions

| <i>Union * Religion (Crosstabulation)</i> |                  |                      | <i>Religion</i> |              | <i>Total</i> |
|-------------------------------------------|------------------|----------------------|-----------------|--------------|--------------|
|                                           |                  |                      | <i>Muslim</i>   | <i>Hindu</i> |              |
| Union                                     | Uttar Bedkashi   | Count                | 84              | 18           | 102          |
|                                           |                  | % within union       | 82.4%           | 17.6%        | 100.0%       |
|                                           | Goroikhali       | count                | 92              | 10           | 102          |
|                                           |                  | % within union       | 90.2%           | 9.8%         | 100.0%       |
|                                           | Char Kukri Mukri | count                | 97              | 5            | 102          |
|                                           |                  | % within union       | 95.1%           | 4.9%         | 100.0%       |
|                                           | Sonapur          | count                | 95              | 7            | 102          |
|                                           |                  | % within union       | 93.1%           | 6.9%         | 100.0%       |
|                                           |                  | count                | 368             | 40           | 408          |
|                                           | Total            | % within union count | 90.2%           | 9.8%         | 100.0%       |
|                                           |                  |                      |                 |              |              |

Source: Field survey 2020.

integrated, and inclusive water governance,” according to the delta plan’s goal (Hadi, 2019). In Bangladesh, 79 percent of rural people consume groundwater drawn from shallow tube wells. It is difficult for them to make the transition to using surface water and/or rainwater swiftly. As a result, the use of groundwater from shallow tube wells with permitted arsenic concentrations should be continued until alternate water sources with acceptable levels of acceptability are found. Parallel to this, arsenic-free groundwater sources must be sought (Safiuddin et al., 2003). Interfering as little as possible with natural life cycles in river basins, estuaries, and coastal zones is one of the most successful ways to accomplish future generations’ desires (Loucks & Beek, 2017). Many of the concerns and issues that water resource planners and managers face now are identical to those that they faced previously. There are a few exceptions to this rule. Two trends are responsible for the majority of the new ones: (1) an increasing recognition of the need for a bottom-up, “grassroots” participatory approach to planning, management, and decision-making, and (2) a growing concern for natural ecosystem sustainability (Loucks & Beek, 2017). The section on water and the environment discussed policies for restoring, conserving, protecting, and preserving water resources through regulatory, planning, and management measures. None of these themes included climate change (Hadi, 2019).

Table 6.11 demonstrates that, except Goroikhali union, respondents often collect water from tube wells. On the other hand, the pond sand filter, which is only found in the Uttar Bedkashi union, is the least accessible water source. The table data reveal that the nature of clean water sources in Bhola and Khulna districts is notably diverse.

“The basic dignity to water is essential for living a dignified existence.” It’s a requirement for the exercise of other rights. The Declaration of the United Nations (General Commentary No. 15 of the United Nations Committee on Economic,

TABLE 6.11 State of drinking water sources among unions following plant installation

Drinking water after \* Union (Crosstabulation)

|                            |                                       |                                     | Union             |            |                        |         | Total  |
|----------------------------|---------------------------------------|-------------------------------------|-------------------|------------|------------------------|---------|--------|
|                            |                                       |                                     | Uttar<br>Bedkashi | Goroikhali | Char<br>Kukri<br>Mukri | Sonapur |        |
| Drinking<br>water<br>after | Pond sand<br>filter                   | Count                               | 3                 | 0          | 0                      | 0       | 3      |
|                            |                                       | % within<br>drinking<br>water after | 100.0%            | 0.0%       | 0.0%                   | 0.0%    | 100.0% |
|                            | Rainwater<br>harvesting<br>(personal) | Count                               | 0                 | 90         | 0                      | 5       | 95     |
|                            |                                       | % within<br>drinking<br>water after | 0.0%              | 94.7%      | 0.0%                   | 5.3%    | 100.0% |
|                            | Rainwater<br>harvesting<br>(charity)  | Count                               | 0                 | 12         | 0                      | 0       | 12     |
|                            |                                       | % within<br>drinking<br>water after | 0.0%              | 100.0%     | 0.0%                   | 0.0%    | 100.0% |
|                            | Tubewell                              | Count                               | 99                | 0          | 52                     | 28      | 179    |
|                            |                                       | % within<br>drinking<br>water after | 55.3%             | 0.0%       | 29.1%                  | 15.6%   | 100.0% |
|                            | Deep tube<br>well                     | Count                               | 0                 | 0          | 50                     | 69      | 119    |
|                            |                                       | % within<br>drinking<br>water after | 0.0%              | 0.0%       | 42.0%                  | 58.0%   | 100.0% |
| Total                      | Count                                 |                                     | 102               | 102        | 102                    | 102     | 408    |
|                            | % within<br>drinking<br>water after   |                                     | 25.0%             | 25.0%      | 25.0%                  | 25.0%   | 100.0% |

Source: Field survey 2020.

Social, and Cultural Rights) added a new dimension to the global debate by recognizing access to drinking water and sanitation as a fundamental right (Neto, 2018). It is also critical to recognize that variables both inside and outside the water sector play a role and that the water sector does not develop in a vacuum, but rather as an integral and crucial element of a larger development process (Hukka, Castro, & Pietila, 2010).

The policy aims to create a robust framework for distributing human water rights, providing water for the environment, and developing implementation and operational plans. These procedures are crucial because they define the characteristics of consumer and environmental entitlements, determine when and how water can be returned to the environment, and provide the parameters for water markets. These are the following: (i) Identify the types and behaviors

of surface and groundwater resources, resource availability under various climate scenarios, and environmental values and their water requirements within a specific water system, watershed, or aquifer. (ii) Participate in the process with important stakeholders and communities. (iii) Defining and clarifying the rights of existing consumers, particularly about water availability. (iv) Determine the agreed-upon share of water for environmental reasons; establish implementation plans for seasonal water allocation for consumption and environmental purposes, system operation, ecological obligations, and, if appropriate, market procedure and financing (Doolan & Hart, 2017). Experts believe that converting a consolidated database into a management tool is one of the most effective approaches to solving water scarcity, water stress, and diminishing quality (Tundisi, 2008).

Bottom-up planning must seek for all stakeholders to have a clear or “shared” vision of goals and priorities. It must be aware of all applicable laws and regulations and follow them. It should attempt to discover and analyze a variety of alternatives and performance criteria, including sustainability criteria, while avoiding creating a wish list of everything each stakeholder wants (Loucks & Beek, 2017). Bangladesh was one of the first LDCs to develop a long-term climate change strategy with a ten-year timeframe (2009–2018). To be successful, a policy must first be properly aligned with official and informal power systems (to avoid political impediments). Second, the strategy’s design and implementation must be sufficient to achieve the targeted result (suitable instruments) while keeping any unwanted consequences (spillovers) of the policy’s implementation within acceptable bounds (Martin & Williams, 2013).

Bangladesh’s seashore is noted for being a zone of both vulnerabilities and opportunity. Natural calamities such as cyclones, storm surges, and floods are common. As a result, the government has developed this coastal zone policy (CZP), which will provide general guidelines to all parties involved in the management and development of the coastal zone in such a way that coastal residents can live and work in a safe and conducive environment (Islam, 2015). Agenda 21 was approved at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. Chapter 18 on freshwater is very interesting for water managers. To properly utilize limited water resources and protect those resources from pollution, innovative technologies, including the upgrading of indigenous technology are required. It then goes on to say – The widespread shortage, slow degradation, and worsening contamination of freshwater resources in many parts of the world, as well as the progressive encroachment of incompatible activities, necessitate integrated water resource planning and management. Agenda 21 is a list of activities that all nations will focus on in the following decades, as the name suggests (Unesco, 2002). When you tell someone about a water management problem and ask how they would address it, you will most likely hear one of the two responses. One, consider the sources of the problem, as well as who is involved; consider the problem’s effects on others; consider several different solutions; evaluate the effectiveness, costs, and benefits of each solution; and finally, adopt the best solution. Two, invite all stakeholders and ask them what they think about the problem, allow them

to provide solutions, and look for compromises that all parties can agree on. The first method emphasizes the problem's scientific examination, whereas the second emphasizes the process that should lead to a solution. Water resource management is a combination of the two (Unesco, 2002).

Indicators and indices have been employed to provide a meaningful summary of factors such as economic return on water utilized, number of species per area, and so on. More developed indices, such as the Water Poverty Index and the more extensive Climate Vulnerability Index, provide a clearer understanding of the relationship between water availability, abstraction ease, and welfare, and they integrate numerous data to identify five basic components (resources, access, capacity, use, and environment). It is feasible to aggregate and characterize the water resource situation using this information (McDonnell, 2008). Area-specific experiments will occasionally survive to tell the tale of the past discursive debate on the basics of water management; then, the tensions between these "new" and "old" policy arrangements will become key issues. Is the paradigmatic scenario implying a more inclusive and far-reaching shift in discourse hegemony in favor of welcoming water? (Backes, 1999). Experience suggests that the primary cause of apparent policy failure, or community dissatisfaction with proposed changes, is a misinterpretation of the policy problem. Hydrologists and economists can help policymakers be more consistent by defining supply and demand configurations that fit within system features (Loch, Adamson, & Mallawaarachchi, 2014). Researchers propose three periods of rural water policy in Africa and Asia between 1980 and 2030 to (i) identify key principles of rural water policy formation, (ii) analyze how they have changed, and (iii) offer progress priorities to ensure that everyone has access to at least basic drinking water by 2030 (Hope et al., 2019).

Even though Bangladesh has been independent for nearly 50 years, the government is still working to develop a comprehensive strategy to ensure the safety of coastal residents. The coastal territory is home to around 40 million people. As a result, the government must immediately begin a strategic plan to achieve a long-term outcome from this large workforce. Along with development preparation, stakeholders must ensure mutual respect and regularity with the beneficiary groups.

## Conclusion

From the study, it is evident that drinking water sources in two coastal districts are significantly different. Classified data show before the safe water plant installation, people of Khulna district used to collect water from local ponds, whereas inhabitants of Bhola district mostly depended on shallow tube well. Another analyzed data show a significant relationship between the damage of water plants and the illness of the coastal inhabitants. Data show that respondents of the study areas have noticed nine different problems. Remarkably in coastal regions of Bangladesh, women counterparts are suffering more as they have limited scope to go far away from home. Another result shows that the condition of water sources is highly responsible for waterborne diseases of coastal inhabitants.

Significant sample test shows in coastal regions of Bangladesh; political influence plays a remarkable role in selecting the place of water plant installation and its maintenance work. Another significant test result shows that the implementation of drinking water plants remarkably reduces several waterborne diseases among residents of coastal regions. The outcome of KII 01 shows that waterborne diseases are remarkably reduced after installing a water plant. In addition, it is observed that coastal residents' expenditure on medical and gasoline was reduced due to availing of freshwater. Moreover, people enjoy spare time and get relief from managing safe water for daily living. On the other hand, KII 02 shows a scarcity of many tube wells compared to the number of residents in some coastal areas. In addition, an acute shortage of safe water arises during the dry season. Moreover, ignorance is a vital issue as many coastal people are not aware of safe drinking water even though they do not get enough support from the concerned authority.

Another result shows that imposed technology made trouble for the inhabitants. People welcome new technologies that are socially, culturally, and economically suited. Religious value has an impact on using surface water even if it is contaminated. Finally, tube well installation is on top of other water purification plants installed among coastal regions of the study regions. But remarkably, there are few deep tube wells installed in coastal regions of the Bhola district, but none of it noticed in the coastal regions of Khulna district. On the other hand, rain-water harvesting systems are mostly noticed in the coastal regions of the Khulna district. However, in the end, it is noticeable that by ensuring proper management of remaining installed plants and ensuring further necessary plant installation, it is possible to boost the healthy livelihood of coastal residents. Therefore, the concerned authority should address the above-mentioned issues to ensure a sustainable coastal economy. Though Bangladesh has a large coastal region, the nature of its coastal resources is diverse. Considering this fact, stakeholders must assess individual places' unique culture, habits, and socioeconomic realities to ensure policy success. However, it is possible to tackle current challenges in water management in Bangladesh's coastal zones by considering all the factors mentioned above.

## References

- AbouRayan, M., & Djebedjian, B. (2004, May). Egypt's water demand, supply and management policies. *International Water Demand Management Conference, Dead Sea, Jordan* (Vol. 30).
- Al Khateeb, N. (2001). Sociocultural acceptability of wastewater reuse in Palestine. *Water management in Islam*, 79–84.
- Backes, C. W. (1999). Towards international water boards and cross-border spatial plans. *The State of Water. Koninklijke Vermande, Lelystad*, 179–194.
- BRAC. (2016). 27m Bangladeshis at risk of sea-level rise by 2050. *Dhaka Tribune*, 1.
- Chadwick, M., & Datta, A. (2003). Water resource management in Bangladesh. *Policy Review Paper*, 1.
- Chan, N. W., Roy, R., & Chaffin, B. C. (2016). Water governance in Bangladesh: An evaluation of institutional and political context. *Water*, 8(9), 403.

- Chowdhury, N. T. (2010). Water management in Bangladesh: An analytical review. *Water Policy*, 12(1), 32–51.
- Coastal Zone Policy. (2005). Ministry of Water Resources. *The People's Republic of Bangladesh*, 1–14.
- Doolan, J., & Hart, B. T. (2017). Water resource policy, planning and management in Australia—an overview. *Decision Making in Water Resources Policy and Management*, 3–19.
- Earle, A., Cascão, A. E., Hansson, S., Jägerskog, A., Swain, A., & Öjendal, J. (2015). *Transboundary water management and the climate change debate*. Routledge.
- Faruqui, N. I., Biswas, A. K., & Bino, M. J. (2001). *Water management in Islam*. Ottawa, IDRC.
- Funke, N., Claassen, M., & Nienaber, S. (2013). Development and uptake of scenarios to support water resources planning, development, and management: Examples from South Africa. *Water Resources Planning, Development and Management*, 1–27.
- Hadi, T. (2019). An analysis of water policies and strategies of Bangladesh in the context of climate change. *Asia-Pacific Journal of Rural Development*, 29(1), 111–123.
- Hope, R., Foster, T., Koehler, J., & Thomson, P. (2019). Rural water policy in Africa and Asia. *Water Science, Policy, and Management: A Global Challenge*, 159–179.
- Hueso, A., & Bell, B. (2013). An untold story of policy failure: The Total Sanitation Campaign in India. *Water Policy*, 15(6), 1001–1017.
- Hukka, J. J., Castro, J. E., & Pietilä, P. E. (2010). Water, policy and governance. *Environment and History*, 16(2), 235–251.
- Islam, Mazharul. (2015). Water resource management and policy in Bangladesh. *ACADEMIA*, 1–21.
- Lenton, R., & Muller, M. (2012). *Integrated water resources management in practice: Better water management for development*. Routledge.
- Leopold, L. B. (1959). Water resource development and management. *Journal American Water Works Association*, 51(7), 821–827.
- Loch, A., Adamson, D., & Mallawaarachchi, T. (2014). Role of hydrology and economics in water management policy under increasing uncertainty. *Journal of Hydrology*, 518, 5–16.
- Loucks, D. P., & van Beek, E. (2017). Water resources planning and management: An overview. *Water Resource Systems Planning and Management*, 1–49.
- Martin, P., & Williams, J. (2013). Water governance: A policy risk perspective. *Water Resources Management*, 7(171), 73.
- McDonnell, R. A. (2008). Challenges for integrated water resources management: How do we provide the knowledge to support truly integrated thinking? *International Journal of Water Resources Development*, 24(1), 131–143.
- Mercer, D., Christesen, L., & Buxton, M. (2007). Squandering the future—Climate change, policy failure and the water crisis in Australia. *Futures*, 39(2–3), 272–287.
- Neto, S. (2018). Territorial integration of water management in the city. *Water challenges of an urbanizing world*. IntechOpen.
- Nurul, S., & Mohammad, I. (2014). State of water governance in Dhaka Metropolitan city of Bangladesh: Evidence from three selected slums. *International Journal of Interdisciplinary and Multidisciplinary Studies*, 1(2), 19–38.
- Pal, S. K., Adeloye, A. J., Babel, M. S., & Das Gupta, A. (2011). Evaluation of the effectiveness of water management policies in Bangladesh. *Water Resources Development*, 27(02), 401–417.
- Safiuddin, M. D., Karim, M. M., Murphy, T., & Guo, J. (2003). Water resources management in the remediation of groundwater arsenic contamination in Bangladesh. *Aquatic Arsenic Toxicity and Treatment*, 1–17.

- Tundisi, J. G. (2008). Water resources in the future: Problems and solutions. *Estudos avançados*, 22(63), 7–16.
- Unesco, Y. (2002). *Knowledge for sustainable development-an insight into the encyclopedia of life support systems*. Oxford: EOLSS Publishers/UNESCO.
- Walker, G. (2014). Water scarcity in England and Wales as a failure of (meta) governance. *Water Alternatives*, 7(2).
- Wescoatt Jr, J. L., White, G. E., & White, G. F. (2003). *Water for life: Water management and environmental policy*. Cambridge University Press.