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## Safe water crisis and struggle of climate-vulnerable indigenous communities in southwestern coastal Bangladesh

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### ABSTRACT

This study was designed to unearth the beliefs, practices, and management of safe drinking water of Munda and Rajbangshi indigenous communities. To apprehend the safe drinking water-related behaviour and practice, the qualitative approach was followed where 20 in-depth interviews were carried out among the Munda and Rajbangshi communities in Shyamnagar and Kaliganj Upazila (sub-district) of Satkhira district, Bangladesh. Findings indicate that the intrusion of saline water due to climate-induced changes led to a scarcity of potable water for both communities in the last few decades. Despite the existence of centuries-old traditional practices of water purification, the indigenous communities, particularly women, were compelled to collect safe drinking water from, in general, distant sources as the other sources of water were contaminated with saline water. Despite their collective efforts, managing safe water sometimes, particularly in the rainy season, becomes impossible for these marginalized people as it costs a considerable amount of household income. To ensure their access to safe drinking water and to explore the underlying factors, whether social, economic, cultural or environmental, initiatives from both government and non-government organizations are required for a sustainable life for these unheard plain land indigenous communities in Bangladesh.

**Key words:** Bangladesh, Coastal regions, Indigenous minorities, *Munda*, *Rajbangshi*, Safe drinking water

### HIGHLIGHTS

- Rajbangshi and Munda are two climate-vulnerable indigenous communities of coastal Bangladesh.
- The indigenous communities struggle to carry water from long-distance places.
- Indigenous communities rely on rainwater collection during the monsoon.
- Fetching water is recognized as a gender-stereotyped responsibility for women.
- Rajbangshi and Munda people had to suffer water scarcity and water-related health problems.

### INTRODUCTION

Over the past few decades, researchers have conducted studies on the potential of indigenous water management practices to develop an inclusive and sustainable water management policy that incorporates both modern and traditional knowledge as well as sociocultural elements (Ayre & Mackenzie, 2013; Basel *et al.*, 2021; Gaaloul

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*et al.*, 2021; Wilson *et al.*, 2021). For instance, early civilizations in Asia, Oceania, Africa, or Latin America contributed to the development of irrigation systems, which are still in use today in various parts of the world. This reflects indigenous traditions with effective infrastructure and technology that allow for the most sustainable and optimal use of water (Groenfeldt, 1991; Ayre & Mackenzie, 2013). Despite the growing interest in indigenous beliefs, practices, and water management, research on this topic remains largely concentrated and confined in Africa (Thakur *et al.*, 2020; Ncube, 2022), America (Basel *et al.*, 2021; Wilson *et al.*, 2021), Oceania (Finn & Jackson, 2011; Ayre & Mackenzie, 2013; Moggridge, 2021), and some parts of Asia (Gautam *et al.*, 2018; Borthakur & Singh, 2020; Ghorbani *et al.*, 2021).

Surprisingly, there is a paucity of research on the water management practices of indigenous people in Bangladesh, particularly in the south-western coastal areas, where periodic natural disasters, such as cyclones and floods, and environmental degradation, e.g., salinity intrusion and deforestation, are prevalent (Ashrafuzzaman, 2022; Rashid *et al.*, 2023; Tasnuva *et al.*, 2023). Rashid *et al.* (2023), after examining the physiochemical properties of water, i.e., pH, electrical conductivity, total dissolved solids, and salinity, in Ganges–Brahmaputra–Meghna delta of south-western coastal Bangladesh, concluded that from the 1990s onwards, the salinity has increased substantially in water sources, including ponds, *Ghers* (a trench surrounding the rice field consisting of constructed dikes for shrimp and prawn farming), agricultural fields, canals and rivers, as well as in soil, topsoil in particular, which eventually led to a decrease of green vegetation.

Despite an unprecedented increase of brackish water and excessive salinity in the soil (Chowdhoree, 2019; Rashid *et al.*, 2023), there have been only a limited number of empirical investigations regarding the beliefs, practices, and management of safe drinking water among the plainlands' indigenous people in south-western coastal regions. For example, Perucca & Munda (2010) and Nasrin *et al.* (2023), in their respective studies, observed that the indigenous people of the *Munda* community blended their customary beliefs and traditions with modern techniques to manage potable water. Nasrin *et al.* (2023), for instance, found that women from the *Munda* community cover miles to collect potable water during the dry season as groundwater resources had either declined significantly due to overexploitation (Gururani *et al.*, 2023) or became brackish due to saline water intrusion (Chowdhoree, 2019; Abd-Elaty *et al.*, 2023; Rashid *et al.*, 2023), while they harvest rainwater during the rainy season. Prior to the 1990s, they collected rainwater from one corner of a house's roof by funnelling it into a clay pot using the cortex or leaf of a banana tree (Perucca & Munda, 2010). Now, they use modern techniques of using plastic tubes or polyethylene paper to direct rainwater into water tanks (Perucca & Munda, 2010; Nasrin *et al.*, 2023). Yet, they are vulnerable to waterborne diseases, particularly the young, old, and female population, due to their ignorance regarding the properties and quality of drinkable water (Perucca & Munda, 2010; Nasrin *et al.*, 2023).

There is, however, not a single study that has been documenting the water-related beliefs and practices of *Rajbangshi* – another indigenous community living in the south-western coastal areas for generations. Thus, the current study aimed at providing evidence of the beliefs, practices, and management of potable water among two indigenous communities, e.g., *Munda* and *Rajbangshi*, in south-western coastal areas to develop an option to manage and plan water conservation and utilization incorporating both indigenous and modern strategies. This research may contribute to forming a bridge between traditional and modern water management efforts of the government and non-government organizations while protecting the centuries-old beliefs and practices of indigenous communities for a sustainable solution.

### ***Munda* and *Rajbangshi*: The indigenous communities of plainlands in south-western coastal Bangladesh**

In the last two population censuses in Bangladesh (2001 and 2011), no scope or column was available to provide specific information regarding indigenous people (*Adivasi* in Bengali). In contrast, according to the 1991 census,

there were 27 indigenous groups in Bangladesh (Perucca & Munda, 2010), while a study by Save the Children suggested that there was a total of 45 indigenous groups in Bangladesh, including the plainland indigenous people living in the south-western coastal regions (Durnnian, 2007).

Among the plainland indigenous people, the ancestors of the *Munda* community migrated from Chota Nagpur in Bihar, India, to North Bengal in the 18th century. They were later brought to southern Bengal by Indian landlords (*zamindars*) during the British period to reclaim jungle land and make it cultivable (Perucca & Munda, 2010; Sharmeen, 2013). The patriarchal *Munda* people with their language (*Mundari*), food habits (consumption of *Haria* – a local alcoholic beverage), cultural practices (singing, dancing, clothing, and marriage pattern), and faith in animism (later merging with rituals of *Hinduism*) are mostly involved in agricultural farming and fishing, and they are to some extent distinct from that of other *Munda* communities in Northern Bangladesh (Perucca & Munda, 2010; Sharmeen, 2013; Roy, 2020).

Like the *Mundas*, the *Rajbangshis* also migrated from India, particularly from the State of Assam and Cooch Behar to northern Bengal during the pre-British period, and their origin can be traced back to Kutch indigenous communities (Rafique, 2003; Biswas, 2005). The *Rajbangshi* people were animists before the 16th century and later predominantly followed *Vaisnavism*, as Biswas (2005) and Rafique (2003) mentioned. They further note that many among the *Rajbangshis* living in Bangladesh reverted to Islam and, in some cases, converted to Christianity, and a significant percentage of them are residing in northern districts of Bangladesh, e.g., Rangpur, Dinajpur, and Rajshahi, and a few in south-western coastal districts, i.e., Jashore and Satkhira (Rafique, 2003; Biswas, 2005). Under a patriarchal social structure similar to the *Mundas*, they have distinct practices and cultural concepts for birth, death, and marriage and are mostly engaged in farming and fishing in the south-western coastal regions of Bangladesh (Biswas, 2005).

In the last three decades, however, the indigenous people of *Munda* and *Rajbangshi* in south-western coastal Bangladesh have been experiencing frequent natural disasters, such as cyclones, floods, and incessant intrusion of saline water, that contaminated their primary sources of drinkable water, e.g., ponds, canals, and rivers, thus leading to a severe scarcity of potable water (Perucca & Munda, 2010; Roy, 2020). In the long run, this scenario negatively affects their socioeconomic status and livelihood opportunities (Roy, 2020; Rahman *et al.*, 2023).

## METHODOLOGY

This research was conducted by adopting an exploratory approach, aiming to gather indigenous knowledge on safe drinking water and the challenges faced by the two indigenous communities (*Munda and Rajbangshi*) in accessing safe water. Hence, the present study employed a qualitative approach as it was deemed the most appropriate method for gaining a comprehensive understanding of the issue at hand (Creswell & Creswell, 2017) from the point of view of the *Munda* and *Rajbangshi* people. Primarily, we aimed to investigate the perceptions of indigenous communities regarding safe drinking water and sources of pure water, as well as their water management practices. In addition, a gender perspective was explored in relation to water fetching systems. The study also examined the challenges these communities face in accessing safe drinking water. For this reason, qualitative methodologies were useful since those allowed researchers to form a better understanding of the context in which the target group was experiencing such difficulties (Berg & Lune, 2017). This methodology/approach/study additionally facilitates comprehension of the evolution of the water governance framework within indigenous communities spanning over 50 years.

### Study subjects

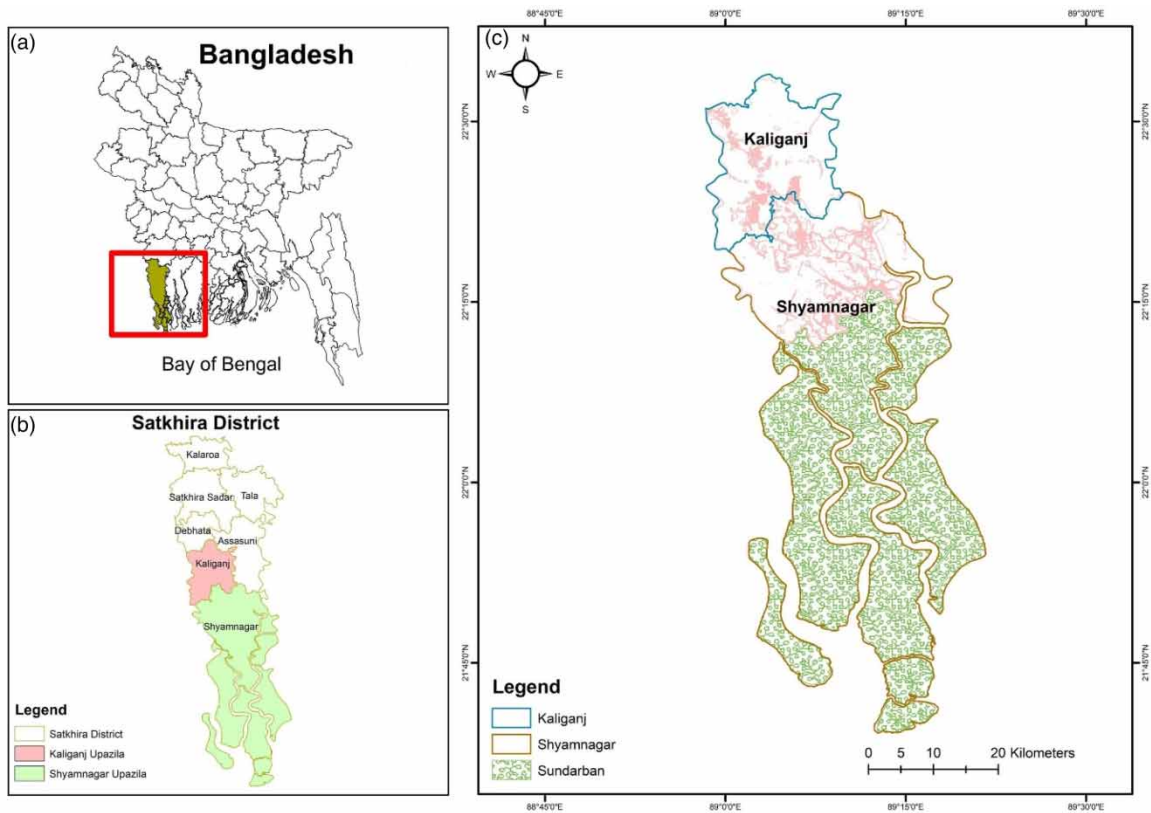
The informants of this study were chosen from two indigenous groups (*Rajbangshi and Munda*; Table 1) living in two *Upazila* (sub-districts), namely, *Kaliganj* and *Shyamnagar*, of *Satkhira* district located in the south-western

**Table 1** | Research informants from *Kaliganj* and *Shyamnagar Upazila* of *Satkhira* district

Sl.	Informants	Age	Sex	Occupation	Ethnicity	Location
1	Informant 1	45	Female	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
2	Informant 2	70	Male	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
3	Informant 3	64	Male	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
4	Informant 4	61	Male	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
5	Informant 5	58	Male	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
6	Informant 6	25	Female	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
7	Informant 7	32	Female	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
8	Informant 8	70	Male	Fishing and farming	<i>Rajbangshi</i>	<i>Kaliganj</i>
9	Informant 9	45	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>
10	Informant 10	22	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>
11	Informant 11	30	Male	Farming	<i>Munda</i>	<i>Shyamnagar</i>
12	Informant 12	45	Male	Farming	<i>Munda</i>	<i>Shyamnagar</i>
13	Informant 13	50	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>
14	Informant 14	30	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>
15	Informant 15	50	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>
16	Informant 16	55	Male	Farming	<i>Munda</i>	<i>Shyamnagar</i>
17	Informant 17	48	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>
18	Informant 18	35	Male	Farming	<i>Munda</i>	<i>Shyamnagar</i>
19	Informant 19	63	Male	Farming	<i>Munda</i>	<i>Shyamnagar</i>
20	Informant 20	65	Female	Farming	<i>Munda</i>	<i>Shyamnagar</i>

coastal region (Figure 1), as our primary focus was on the overall safe water-related knowledge, practice of water management, gender roles in water fetching system, challenges to water management, and support system for safe drinking water of these two indigenous communities. A two-stage sampling procedure was used to determine the sample for both the *Rajbangshi* and *Munda* community populations living in these two localities, with purposeful sampling being used (in the first stage) to select the initial informants in both communities, as this sampling procedure helps the researchers to overcome the limitations of field data collection in different situations (Emmel, 2013). This sampling strategy also aided in the search for credible field data. The remaining informants of the *Rajbangshi* and *Munda* communities were chosen by homogeneous sampling since it is more efficient for describing a narrow subset with detailed information (Patton, 2002). This sampling method allowed the researchers to separate the *Rajbangshi* and *Munda* populations from the other groups in the same locality. Before recording each round of interviews, the researchers obtained verbal consent from the individuals.

It is worth mentioning that the researchers conducted eight interviews with the *Rajbangshi* community people, and after the eight interviews, the present study reached a state of saturation with respect to the theme under investigation, as evidenced by the exhaustive review of secondary literature. Accordingly, Guest *et al.* (2012) state that in many types of qualitative research studies, having 6–12 people in each group is sufficient to produce field-supportive data. Similar to the *Rajbangshi* interviews, 12 interviews were conducted with *Munda* people.



**Fig. 1** | Study area.

### Interview outline

An unstructured interview guideline was prepared via a review of the relevant literature for conducting this research; as such, an interview guideline permits us to realize the perspectives of the two indigenous communities on the problems of their social surroundings (Bryman, 2012). Moreover, by using this guideline, we could trace the history of the indigenous community's water management system. However, several in-depth interviews were done to defend the interview guideline's contents to rectify the errors before the final phase of data collection.

### Data collection

In this study, data were collected in two distinct phases. The first stage of the study involved conducting interviews with eight members of the *Rajbangshi* community residing in *Kaliganj*. These interviews were conducted over 2 months to gain insight into the community's water management system. During the second stage, 12 in-depth interviews were conducted with members of the *Munda* community residing in *Shyamnagar* with the same purpose, and the interviews spanned over 3 consecutive months.

The Bangla language was used for conducting the interviews. The average duration of an In-depth Interview (IDI) was between 35 and 50 min. Following standardized research ethics, all interviews were recorded with the informants' prior informed consent and treated as strictly confidential. Volunteers could withdraw from the study at any time and for any reason. To confirm the reliability of the data and to prevent any impression of partiality in the findings, the researchers were cautious throughout the interview sessions and adhered to

the rules of unlimited acceptance, attentive listening, and explanation. However, the initial thematic saturation point was reached after taking the sixth interview in the *Rajbangshi* community and the ninth interview in the *Munda* community. Seventy percent of all codes were identified after the sixth interview in the case of the *Rajbangshi* people, while such codes were identified for the *Munda* community after the ninth interview. Two additional interviews were conducted with the *Rajbangshi* community, and three more were conducted with the *Munda* community to validate the themes that had been generated. Data collection was halted after the 12th overall interview.

### Data analysis

Immediately after the completion of the interviews, the recorded interviews were transcribed verbatim and translated into English. Codes were then generated using NVivo 12 pro software to organize the transcript's topics. After coding the transcripts, we analysed the data using thematic analysis and narrative. We connected the findings to contextual elements by paying close attention to the presentation style and the recurrence of the topic. In addition, after each interview, we reached a consensus on the inclusion of all relevant issues. In the meantime, following careful consideration and deconstruction, we settled or eliminated any inconsistencies found during the interviews.

## RESULTS

This section focuses on documenting indigenous communities' (*Rajbangshi and Munda*) knowledge, beliefs, and practices around the water management system and the transformation of traditional knowledge. We conducted 20 in-depth interviews in total, ranging over 30 min with an average duration of 25 min. We collected our qualitative data from remotely located indigenous communities (e.g., *Munda and Rajbangshi*) from the southern coast of Bangladesh. Among the informants, with informed consent, we were able to interview 12 from the *Munda* community and 8 from the *Rajbangshi* community. All our informants were followers of the *Sanatan* religion.

The background data of the informants present that the informants from the *Rajbangshi* community earned their livelihoods by fishing and farming. In contrast, informants from the *Munda* community depended solely on agricultural farming. Evidence showed that *Mundas* had no land entitlement as they resided in *khash*<sup>1</sup> lands. In contrast, the *Rajbangshis* had owned their lands for generations. In addition, the *Rajbangshi* people had more favourable economic circumstances than the *Munda* people.

### Development of themes

The thematic findings developed in this section were gathered from the information provided by informants (e.g., both *Munda* and *Rajbangshi*) of our study. Their beliefs, experiences, and practices regarding drinking water's supply and source(s) were documented. These findings reported their current issues and articulated their future hopes for receiving assistance with a safe drinking water management system. Based on our qualitative investigation, we developed five significant themes about *Munda's* and *Rajbangshi's* practices of water management systems. These are as follows:

Theme 1: Supply source of drinking water for the two communities

Theme 2: Perception of water belief system and transformation of practices

Theme 3: Gender perspective of water fetching system

Theme 4: Challenges to water management and belief system

Theme 5: A support system for safe drinking water management

<sup>1</sup> Government owned land that has been leased or given to communities or people for life or cultivation.

### Theme 1: Supply source of drinking water for the two communities

From the qualitative data, we found that *Rajbangshi* and *Munda*'s people have suffered from a severe scarcity of safe drinking water over the last few decades. Specifically, the geographical structure of our study area was characterized by saline-prone soil and water. Furthermore, the underground water was not potable. Given the harsh reality of living around extreme salinity, we examined how the two indigenous communities established safe drinking water systems. We had responses ( $n = 14$ ) from both the *Rajbangshi* ( $n = 8$ ) and *Munda* ( $n = 6$ ) people.

The *Rajbangshi* community responded with their struggle to collect safe drinking water as they had to purchase filtered water at a cost and carry it from a long distance to their residence. The informants informed the researchers that they could use pond water for everyday purposes such as cooking and bathing, but they had to purchase potable water for drinking.

The *Rajbangshi* people considered water equal to life; life is unthinkable without water. The *Rajbangshi* people have emphasized the importance of safe drinking water in all aspects of life, but they also face challenges in obtaining it for daily use. The water is expensive, and the journey to collect it is long. Among the *Rajbangshis*, informant 3 shared her feelings this way:

*Safe drinking water is only accessible if the distance and financial constraints are ignored. We sometimes carry water from a distance to our residence, incurring costs. We are poor people with limited financial resources, so we often use pond water for our needs.*

Another interviewee (Informant 4) further added:

*We collect drinking water from Beledanga Bazar<sup>2</sup>, and we are required to pay there. Moreover, a local transport system takes 15–20 minutes and 40–50 minutes on foot. Sometimes we are unable to afford the carrying cost.*

*Munda* people ( $n = 6$ ) also responded similarly to the *Rajbangshi* people while recounting their past. As a local development organization that has provided a safe drinking water plant, they shared the complicated history of their safe water collection procedure. They said that they had to walk miles to arrange safe drinking water. They also recounted buying water from distant places. As a result, their daily meal (e.g., cooking, eating), bathing, and children's schooling were hampered. They have had water-purifying plant support from a local non-government organization (NGO) for the last 4 years.

A person from the *Munda* community (informant 16) shared his experience of how the safe drinking water support system helped the community:

*We have safe drinking water provided by a local NGO, and our local representative helped us get that. We have a water purifying plant that provides one tank of filtered water support for five families. There are more water tanks for families in our community. We are satisfied with this support.*

### Theme 2: Perception of water belief system and transformation of practices

Indigenous communities such as *Rajbangshi* and *Munda* are marginalized people of southern Bangladesh. Lack of education and knowledge regarding water contamination, coupled with traditional water management systems, made their lives more vulnerable than other communities.

<sup>2</sup> A local marketplace situated miles away from our study location.



Both communities have their own belief systems, water management knowledge, and practices that have been passed down for generations. According to *Mundas* and *Rajbangshis*, safe and drinkable water means water that tastes sweet; is odourless, clean, and transparent; and has no iron. A *Munda* informant (Informant 9) shared her views on safe drinking water:

*Yes, there is a clear distinction between drinkable and non-drinkable water's taste, odor, and color. Polluted water, which we cannot drink, is distinct from fresh drinking water. It may be muddy, have a foul odor, and taste salty. In contrast, pure drinking water is fresh, odorless, transparent, and sweet.*

On the other hand, another informant (Informant 11) shared his experience of how the sources of drinking water have changed with time:

*In my childhood, I used to drink water from ponds. It was clean and clear and also tasted sweet. But after my marriage, I faced severe water scarcity due to excessive salinity in our locality. Once a fresh pond's water was contaminated as well due to pollution and tasted bad.*

Another informant (Informant 12) also told us about the natural sources of safe drinking water:

*Our ancestors used to drink rainwater and water from the nearest ponds and canals. They mostly depended on rainwater and tried to store it for further use. Besides, people depended on pond water mostly because, at that time, pond water wasn't contaminated as it is now.*

Following the aforementioned statements, our study showed that all our informants ( $n = 20$ ) agreed that pond water was a good source of safe drinking water during their childhood. However, everything has changed over time.

The informants also shared their practices of how the contaminated water purification process has been shared with them for generations. As they experienced water pollution for years, they also passed down their traditional water purification knowledge to preserve safe drinking water. The transformation of the water purification system was also noticed in this study. The informants were asked how their parents or grandparents used to purify drinking water during their childhood. They used alum, camphor, water purifier medicines, broken bricks, clean sands and stones, and many other options to purify water.

### **Theme 3: Gender perspective of water fetching system**

The third theme we generated from our study is connected to the perspective of gender in the water fetching system. This study explored that the indigenous community had to carry safe drinking water from nearby or distant sources. The issue that we investigated was the question of who was responsible for carrying drinking water back home. The field investigation showed that women in each household collect and purify the water from different locations and sources. In the case of women members from the *Munda* family, the interviewees' ( $n = 12$ ) responses showed that they tended to fetch water from the selected locality source at a pre-scheduled time. *Munda* women confirmed that water was regularly needed in every family and had to be fetched by them. In joint and extended families, men would never fetch water for the family. They suggested that the male members of the household are preoccupied with earning a living and are therefore not responsible for collecting water.

Informant 11 explained that,

*Female members of our family carried three pitchers of drinking water at a time with the help of an auto van. Besides, we arranged the water for male members of our family for bathing and washroom. It's uncommon in our family that men will arrange the water on their own. Men's participation in water collection is neither a customary practice nor a gender role that has been passed down through the generations.*

The female members of the *Munda* community incorporated water fetching as part of their core responsibilities, and they must comply with their duties. The male members of the *Munda* community had the same view. A male interviewee (Informant 11) shared his experience:

*My daughter-in-law always brought drinking water for our family. She collected and stored water in a plastic bottle, tank, and pitcher. She went two times a day to fetch water, and it took approximately 50 minutes per day to fetch and manage water. I worked outside the home. So I had no time to fetch water. If I start fetching water, who will earn the bread and butter for my family?*

However, this scenario is different for the *Rajbangshi* community people. As the *Munda* community had a selected source for fetching drinking water within their locality, their female members collected the water from the authorities. On the contrary, there was no chosen purified drinking water source for the *Rajbangshi* community. Therefore, they had to travel to distant places to collect drinking water. Hence, the men were responsible for fetching drinking water from a distance. Here, the gender sensitivity and household responsibilities of women and the restriction of their mobility beyond the local community forced the men to collect water for their families. A female *Rajbangshi* (Informant 7) stated that:

*I belong to a nuclear family, and my husband is the only bread earner in my family. I have a young boy who is not old enough to fetch water from a distance. As a woman, I do not have permission to travel long distances from my house. Moreover, I have household responsibilities such as cooking, cleaning, and childcare at home.*

She further added why she used other water sources to manage her family's water needs as women's traditional roles must be carried out despite sanctions on her mobility:

*My husband, therefore, manages time to fetch water. Sometimes he takes a day off to collect safe drinking water for my/our family. However, when he cannot collect water for us, I use pond water to serve our purpose. I am aware it is not healthy and hygienic, but I have no other options.*

#### **Theme 4: Challenges to water management and belief system**

All the in-depth interviewees were questioned as to what types of problems they were facing regarding water management and, in response, shared the sufferings in their daily lives. Almost all the informants in this study agreed that the improved water sources tasted better and healthier than the unimproved ones. However, sometimes they were bound to depend on unimproved water sources. The main reason was their economic condition. The indigenous people in Bangladesh are not very well off. *Rajbangshi* people shared that they depended on their day-to-day earnings, from which they had to spend a portion to purchase and carry the water. Only in the rainy season could they rely on rainwater, but it supported them only 4 months a year. Though satisfied with the drinking water

quality, they faced trouble managing the cost and fetching water on time. Among the *Rajbangshi*, Informant 5 shared his feelings this way:

*We had great suffering from drinking water. We had to carry purified water from a long distance. We had to drink purchased purified water. Otherwise, we had to drink pond water which looked dirty and salty. But we had no other options as we couldn't afford enough money to purchase safe drinking water all the time.*

Besides, the purchased water did not provide complete support for family use every time. An interviewee (Informant 8) stated:

*The collected amount of drinking water wasn't sufficient for fulfilling the needs of our family. We had to compromise with the quantity as we had no options. We are not capable enough to buy more water as our economic condition is not so good.*

In addition, the *Rajbangshi* community faced the challenge of fetching water from a long distance. A female *Rajbangshi* (Informant 7) shared her feelings:

*I always used pond water as I had no supporting hand who would bring water from the Beledanga Bazar. I couldn't go out as my children are too young. Besides, my husband was the only bread earner in my family. He is always engaged in his duties. That's why I tried to purify pond water in my own way and use it.*

Both the *Rajbangshi* and *Munda* community faced water scarcity and the adverse effect of water contamination. The contamination of water in the study areas is caused by human activities and natural factors. Due to excessive salinity intrusion in that specific area, the drinking water level could not be found. For this reason, *Rajbangshi* and *Munda* community people had to suffer water scarcity and water-related health problems. An interviewee (Informant 15) stated:

*The major causes of water pollution in our areas were animal wastage, excessive use of fertilizer and pesticides in agricultural land, a mixture of salt water, and fish enclosures. If we drink filtered water, we aren't affected by waterborne diseases. But we used to suffer more when we drank pond water in the past days.*

Another interviewee (Informant 20) shared that:

*Salinity, animal wastage, and flooding were responsible for water pollution in our locality. We were suffering from severe waterborne diseases after drinking pond water. Stomach pain, diarrhea, and vomiting problems were very common to us as there was no alternative safe drinking water other than pond water. We were used to such poor health conditions.*

Another informant (Informant 12) also added:

*Water scarcity became a severe problem in the summer. I preserve water during the rainy season. And if rainfall is low, then we are forced to buy purified water.*

In addition, all the interviewees ( $n = 20$ ) added that rainwater could be the best alternative for them. However, due to global warming and weather transformation, the average rainfall during the rainy season is decreasing. Drought is the most common natural disaster in Bangladesh at present. If we could preserve rainwater properly, it could greatly support us for up to 6 months. But the lack of a water preserver made it impossible as well.

Moreover, informants from the *Rajbangshi* community ( $n = 8$ ) stated,

*We had to go a long way to bring or buy purified water, which is costly and time-consuming. So, it wasn't possible all the time for us to drink purified water. Then, we were bound to drink pond water. As a result, we encountered waterborne diseases like diarrhea, cholera, stomach pain, sore throat, itching, and so on.*

To sum up, economic problems, non-availability of safe drinking water, lack of reservation materials, and carrying issues should be reconfigured correctly to minimize the sufferings of indigenous (*Rajbangshi* and *Munda*) people's drinking water management. They need proper access to safe drinking water as soon as possible to ensure their sound health and hygiene.

## DISCUSSION

One (goal 6) of the Sustainable Development Goals (SDGs) aims to ensure safe water, sanitation, and hygiene for all. Compared to globally developed countries, Bangladesh is far away from reaching that goal. As the saline-prone south-western zone of Bangladesh is quite shallow and the depth of pure drinking water is quite low, safe drinking water is almost unavailable to the residents of this locality. Though some NGOs are working there to resolve the problem, the situation does not favour getting pure drinking water, which hinders meeting SDG goals.

The indigenous communities of plain lands in Bangladesh, e.g., *Munda* and *Rajbangshi*, have lived in different parts for centuries, including the south-western coastal regions. Due to climate change and frequent natural disasters, the indigenous communities in south-western coastal regions have been experiencing a scarcity of safe drinking water for the last few decades. However, their plight has long been unexplored and remained in the shadows. Thus, the current study disclosed and presented the beliefs, practices, and management of safe drinking water from the indigenous community's perspective.

The first finding of this current study showed how the two different indigenous communities of Bangladesh manage their supply source of drinking water for daily subsistence. The *Rajbangshi* community, recognized chiefly for folk songs, predominantly resides in the northern part of Bangladesh; however, they can also be found in other parts of Bangladesh, including the south-western coastal region of Bangladesh (Chattopadhyay 2021). The *Rajbangshi* community is also found in some parts of India, such as western Assam and West Bengal (Chattopadhyay, 2021; Das, 2014; Barman, 2022; Ashok, 2013). Like *Rajbangshi*, *Munda* is another minor community currently living in Bangladesh that migrated from India over 300 years ago (Dutta & Rahman, 2022). *Munda* has its own language and cultural practices. Historically, the *Munda* community migrated from India and now resides in different parts of Bangladesh, including the coastal zone of Bangladesh, where salinity in soil and water is a dominant threat (Shafie & Mahmood, 2003; Sharmeen, 2015; Roy, 2020; Dutta & Rahman, 2022; Nasrin *et al.*, 2023). Both the communities in the coastal belt used to depend on the Sundarbans mangrove forest, and they usually depend on agriculture and fishing for survival (Roy, 2020; Siddiq *et al.*, 2018; Nasrin *et al.*, 2023).

It is evident that salinity emerges as a curse for the south-western coastal zone of Bangladesh, specifically for drinking water and agriculture (Ahsan *et al.*, 2021). Both communities face challenges in mitigating regular drinking water demand. In comparison to the *Munda* community, the *Rajbangshi* community struggles more to get

access to drinking water. The *Munda* community has limited access to safe drinking water as a local NGO has arranged a source of drinking water adjacent to their locality. However, in the past, they relied on pond water for drinking purposes and had an indigenous water purification system passed down over generations. Due to the water shortage, they used to worship, which was a cultural practice (Nasrin *et al.*, 2023). In the study area, currently, the *Adivasi Munda* community people fetch water from the tank established by the NGO; however, in the past, they used to collect water from a distant place.

In contrast, the *Rajbangshi* community face an extreme crisis of pure drinking water. Consequently, they are bound to fetch water from a distant place. As the geographic zone is prone to salinity, the water is undrinkable. For all other purposes, including bathing, dishwashing, and cooking, they use pond water, putting their health at risk (Miner *et al.*, 2015). Engaging in such activities with unsafe water increases the likelihood of contracting diseases.

Similarly, in terms of cost, safe drinking water is not provided free of cost to them. As both ethnic communities are marginalized and suffering from extreme poverty (Roy, 2020; Nasrin *et al.*, 2023), paying for safe drinking water is quite difficult. Moreover, carrying filtered water from a distant place is complex, specifically for households with no male individuals. The people in the study area face daily challenges in accessing safe drinking water. The severity of the hardship makes it difficult for them to afford to pay for water or to carry it long distances. The *Munda* community had a similar story when there was not a single source of fresh drinking water in their locality, and the water collection system required much hard work. Presently, the *Munda* people are in a comparatively better position than the *Rajbangshi* community as they have a source of freshwater attached to their locality, provided by an NGO. The *Munda* community highly appreciates the service provided by the NGO as it reduces the complexity and hassle of water collection and purification.

The second finding denotes the perception and transformation of the two indigenous communities' water belief systems, practices, and safe water management. The *Adivasi Munda* and *Rajbangshi* communities are vulnerable to poverty, hunger, and malnutrition (Roy, 2020). Their lives are at high risk because of a lack of education, knowledge, and traditional water management practices. In the literature, it is evident that the *Munda* community people have their own beliefs and practices over the generations (Akpabio, 2011; Nasrin *et al.*, 2023). However, both communities have the same level of knowledge regarding safe drinking water, and they believe that fresh water is odourless, iron-free, clean, sweet, and transparent. They can differentiate fresh water from contaminated water. Historically rainwater harvest was one of the best practices for storing drinking water, and they used to preserve it in containers. Both communities also depended on open sources like nearby ponds and canals. However, they reached a consensus regarding the current contamination in ponds and canal water. They can recall that pond water was treated as a better water source in the past as it was almost clean.

The community members maintained their traditional water beliefs and implemented their water purification system. In doing so, they added value to their water culture, where innovation was apparent. Traditionally, over the generations, they used to fetch water from the pond, where they applied indigenous water practices for filtering water. In this regard, they used to apply materials like camphor, medicines, broken bricks, clean sand, alum, and others. However, in recent days, a significant transformation has been observed in the locality (Bayly, 1999; Nasrin *et al.*, 2023). They depend on NGO-provided safe drinking water, which also incurs costs.

The third finding discussed the gender perspective of the water fetching system among the *Munda* and *Rajbangshi* communities. In past studies, it is evident that women are traditionally liable for fetching water, which is also culturally rooted within the communities. This finding is aligned with the literature (Assaduzzaman *et al.*, 2023). Gender plays a crucial role in water management practices. In a patriarchal society like Bangladesh, with other household chores, women primarily collect water from the sources and are responsible for purifying the water (Brewster *et al.*, 2006; Lemke & Delormier, 2017). As the local water source is nearby to the *Munda*

community, the women can easily collect fresh water from the source through the fixed water collection schedule. However, the water demand varies based on the type and size of the family. If more water is required for a particular day, they need to pay for it and collect it from a distant place. The willingness of severely low-income families to pay for pure drinking water is typically low (Ahsan *et al.*, 2021; Assaduzzaman *et al.*, 2023). The male persons are not responsible for carrying and purifying water as they are the ultimate breadwinner for the *Munda* family. Over the generations, they have upheld this custom, and women do not blame their male counterparts for this practice. This finding is aligned with the literature (Houart, 2020).

In contrast, the findings suggest that the *Rajbangshi* community needs to collect water from a distant place; however, gender matters within the mobility dimension. The male person is responsible for fetching water as the women do not usually get permission for such mobility. Considering the cultural aspects of Bangladesh, women are less mobile than men, and they face restrictions from society and religion (Kabeer, 1998). In extreme cases, if a male person does not get the scope for water collection, he needs to take a day off to do it. This situation portrays the water crisis of the locality, the struggle over accessing safe drinking water, and the gender dimensions of water fetching. Nevertheless, women perform all other household duties and responsibilities, including water management and hygiene practices.

The fourth and final findings explained the challenges to water management and belief system of the *Munda* and *Rajbangshi* communities. Without water, life is not survivable. Hence, respecting water is culturally embedded among the *Adivasi* communities as it can be exploited, managed, and owned (Wilson & Inkster, 2018). The study findings suggest that they need help accessing safe drinking water and managing its cost. People from both communities agreed they face challenges in accessing water regarding time allocation and costs. As these people are impoverished, paying for water burdens them (Devi *et al.*, 2009). Water is leaving a footprint in their daily lives. In addition, they were aware that the water provided by the NGO and other organizations had been improved, making it healthier than the unimproved water. However, to some extent, they need to depend on unimproved sources. It is challenging to purchase water when their economic situation is dire. The *Rajbangshi* community faces comparatively more challenges as the source of safe drinking water is situated in a distant place. Like many other tribal communities, the *Rajbangshi* and *Munda* communities rely on rainwater harvesting, which eased their struggle, at the most, for 4 months every year. Storing and using rainwater play a role in reducing the cost for a few months (Nasrin *et al.*, 2023). As their affordability is limited, their freshwater consumption is also compromised. The economic condition of both communities is vulnerable; hence, sometimes, they are bound to compromise their need for safe drinking water, which gives birth to health-related complexities. Moreover, open sources like ponds, canals, and other sources become contaminated with wastage, fertilizers, pesticides, and henceforth. By compromising safety, they are inviting health problems that often create challenges for them (Haseena *et al.*, 2017).

Furthermore, summer brings another challenge to them when the water surface goes down, salinity emerges more significantly, and they mostly need to depend on purchased water. They are also concerned about global warming and its consequences, including irregular rainfall and drought. They also articulated that they were not getting expected rain due to higher temperatures, which could have supported them for at least 6 months a year.

## STRENGTHS AND LIMITATIONS OF THE STUDY

The study was conducted on two different indigenous communities who are different in terms of tradition, culture, and language. Literature comparing the water crisis scenario of these two communities in the past is rarely available; this research gap is explored in this study, which is a unique contribution to the existing literature. Dealing with a real-life water crisis and providing some probable short-term and long-term

mitigation strategies, which may be executable in the study areas, is another strength of this study. This current research may not fully represent the study informants and the location. Both are not randomized while identified. Therefore, the findings are difficult to generalize and lack representativeness of Bangladesh and its indigenous communities. We admit the importance of further research and data from *Munda* and *Rajbangshi* communities spread in our study locations and Bangladesh for more representatives and to declare the findings generally applicable. In addition, this study is purely a qualitative research, which may be triangulated by using a quantitative analysis covering a wide range of quantitative data in some future research. Another limitation of this study is the literature concerned with minority people living on the coast of Bangladesh, which was conducted on the said indigenous communities. Specifically, this limitation affects the discussion section a lot. The limitations of the literature spare a wide range of research gaps and that may be addressed in the future.

## CONCLUSION AND POLICY RECOMMENDATIONS

Access to water is a human right. Nevertheless, due to geographic disparities, people from some parts of the earth are deprived of that right. The south-western coastal region of Bangladesh is an area that is primarily contaminated with saltiness in both water and soil. The study communities belong to the region mentioned earlier; hence, they are exposed and vulnerable to climate change issues. In the study communities, the most triggering issue emerged as poverty, which needs particular attention at the government level to be reduced. The communities depend primarily on agriculture and fishing. Thus, better opportunities can be introduced to safeguard them from escaping poverty. In addition, women are less engaged in economic activity and rely primarily on their male counterparts, who are the ultimate breadwinners. Employment opportunities can be created for women to participate in economic activities even while residing at home such as establishing a cottage industry, fish processing unit, or agricultural food processing unit. Agricultural interventions like adopting salt-tolerant seed varieties and agricultural innovations may be introduced for higher productivity. Thus, enhanced economic capability can reinforce the willingness to pay for pure drinking water.

Another triggering fact they highlighted is the arrangement of improved drinking water sources. The study found that people in the community struggle to access fresh water daily. Arranging new drinking water sources adjacent to their locality free of cost can be the best alternative to reduce the water crisis. In collaboration with local government organizations, NGOs can work to solve the water crisis of the concerned communities. This intervention may include the establishment of new water preservers with sizable capacities and deep tube wells in the locality. Moreover, in the long run, to reduce salinity and temperature, tree plantation programs organized by the local government, NGOs, and personal initiatives can become effective. In this regard, awareness-building programs can improve people's motivation for tree plantation. In addition to that, due to severe poverty, the *Adivasi* people are deprived of a good sanitation and hygiene system, which is crucial for safeguarding their health. Similarly, the educational status of the communities is relatively low due to the severity of poverty, and they get their daughters married off at an early stage of life as they are treated as a burden on their parents. Increased educational enrolment with the incentives provided by the government and NGOs can be an effective tool to avail any socioeconomic opportunities such as the negotiation for safe drinking water in the long run. On the top of it, international research collaboration with sufficient funding is greatly required and extremely appreciated for a better understanding of the water crisis and probable policy undertakings (Table 2).

This research attempts to understand and investigate the water crisis of the two indigenous communities in the south-western zone of Bangladesh. The novelty of this study lies in providing a detailed scenario of the water crisis faced by the two communities and how the communities differ in water fetching, preserving, and financing.

**Table 2** | Glimpse of recommendations

Suggestions	Rajbangshi community	Munda community
Economic support	✓	✓
Arrangement of improved drinking water sources	✓	–
Need for water preserver (large containers)	✓	✓
Infrastructural development	✓	✓
Need for improved sanitation system	✓	✓
Agricultural intervention	✓	✓
Increase tree plantation program	✓	✓
Increase educational enrolment	✓	✓
Increase the health and hygiene-related program	✓	✓
NGOs involvement	✓	–
Awareness raising program	✓	✓
Government initiatives	✓	✓
Research integrations	✓	✓

The prime concerns of this study are how they are coping with the present situation and what can be done in the future to resolve the issues in the long run. To comply with SDG-goal 6, 'ensure availability water and sustainable management of water and sanitation for all' future research on this issue is necessary in both quantitative and qualitative fields, which may provide us with a multi-dimensional perspective and wider representativeness.

### DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

### CONFLICT OF INTEREST

The authors declare there is no conflict.

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