Raiqa Rayhan

A.W. Dreyfoos School of the Arts

West Palm Beach, Florida

Bangladesh, Climate Volatility

**Salinity in Bangladesh’s Waters**

The threats of climate change and overpopulation pose risks far beyond just the surface level of rising temperatures and increased carbon emissions. In Bangladesh, coastal regions experience detrimental effects on their soils and drinking water. The issue for the people of coastal Bangladesh is not a lack of access to clean drinking water, but rather the contamination of accessible water by salt. At the root of the problem is the mixing of river water from regions like the Himalayas with seawater from the Indian Ocean into the Bay of Bengal due to rising sea levels. Saltwater intrusion breaches dams, causing the contamination of fresh water and increasing the salinity of coastal aquifers, negatively affecting water quality. The water is a risk not only for human health but also for the farmers of Bangladesh, who struggle to grow their seasonal crops and vegetation, which in turn affects food production. The unfortunate fate for many residents on the coasts is being surrounded by water but not being able to use a single drop.

Bangladesh is one of the most densely populated countries in the world, ranking tenth with a population density of 1,115.62 people per square kilometer (World Population Review). High fertility rates, low contraception use, and poverty contribute to the growing overpopulation. Citizens reside under a parliamentary form of government in a unitary state. The rural-to-urban population ratio shows a high difference, with 68.34% of the population residing in rural areas, as reported by the Population and Housing Census 2022. The prime weather conditions, a subtropical region with high temperatures, monsoon seasons, and fertile soil, are also seen as components attracting people to settle in farming villages. Although the country plays a vital role in the global economy of the garment industry as the second-largest garment exporter, it is also heavily involved in the agricultural industry. More than 70% of the land is devoted to agriculture, with 48% of the population working in the agricultural sector (Food and Agricultural Organization). Even while being significantly agriculturally focused, 88.5% of farm sizes are less than 1 hectare due to the high population density. There is a clear disparity when compared to the average 178 hectares in farm sizes in the U.S. to Bangladesh.

In coastal Bangladesh, there are rural villages along the shores with paddy fields stretching for miles on the land, with rice being one of the major exports in the nation, along with jute and tea. In this coastal region of Bangladesh specifically, the majority of the people are poor, with an estimated 12 million living in poverty (The World Bank). A typical family living on one of these coasts consists of a mother, father, children, and extended families living in one home. The most common jobs range from fishing, farming the paddy land, or hunting crabs. Shrimp farms are also thriving in these areas, which in turn play a role in the saltwater intrusion that will be investigated later. The residents’ homes may be surrounded by water, but the saltwater that breaks through from dams makes the water undrinkable. Wells from public spaces, such as schools, may be used as an entire village’s source of water. The staple food is rice and fish; however, the salinity that seeps into local fields puts crop yields in jeopardy.

The crisis of saltwater intrusion puts more lives at risk every day. Farmers who made a livelihood from rice production and shrimp farms are forced to turn to other occupations. The Sundarbans, a mangrove forest on the edge of the Bay of Bengal, is dying alongside crops and even cattle. The very shrimp farms that provide income to the coastal communities also contribute to the saltwater that intrudes into the people’s lives. Saltwater began to spread through rivers and canals when brought in to sustain the shrimp farms, ultimately facilitating the movement of salt inland. Exacerbating this intrusion are the rising sea levels that cause saltwater to penetrate groundwater and coastal aquifers. Furthermore, salinity and food insecurity are deeply interconnected, with the long-term effects of saltwater intrusion lasting for multiple generations. The effects of salinity flow deeper than just economic problems for the people along the coast. Because of soil salinity affecting crop growth as a result of ion toxicity, food production is heavily impacted. Of the arable land available for cultivating agriculture, 30% lies in coastal zones (Sultan). Crop yields put not only farmers in jeopardy but threaten the food security of the hundreds of thousands of people across the nation who rely on the food produced from these lands.

Climate volatility is not the only factor in this crisis; transboundary rivers shared between Bangladesh, India, and Nepal have contributed to this rising issue. The Ganges Water Treaty, signed in 1996 between India and Bangladesh, was to build the Farakka dam on the Ganges River in order to divert the water. However, recently, India has made plans to link the Brahmaputra and Ganges Rivers to store excess water from the Brahmaputra River, which in turn will affect groundwater resources, reduce surface water availability, and affect the total drainage basin by 50% due to saltwater intrusion (The Business Standard). This violates the ‘No harm principle’ of international law, which protects national territory boundaries from developmental activities, as the construction of these dams is leading to a shortage of irrigation water and soil moisture.

The price of relying on the rivers and ponds where salinity has intruded has led to significant health issues. Bathing, washing, and drinking the water that mixes with saltwater significantly exceed the dietary salt intake guidelines set by the World Health Organization. With rising salinity levels comes hypertension, introducing a variety of health issues for both the young and elderly alike, including heart failure, increased blood pressure, and fatal organ damage (Chakraborty). Long term, the lasting effects of increased exposure to saltwater can lead to detriments such as stillbirths, miscarriages, and even death. Children born under the condition of pre-eclampsia are often born underweight and prone to falling victim to other diseases later in life as a result of malnutrition during fetal development (Begum). Furthering this issue is the lack of awareness of the severity of salinity, which prevents the implementation of better health practices.

In the villages directly affected by the issue, most residents are not aware of the severe health effects that come with the salt in their water and do not recognize it as a national health issue. As a result, they unknowingly continue to utilize the contaminated water in their everyday lives, increasing the already persisting health issues. In order to deter this, the first step is to implement widespread education and create organizations specifically to bring light to this overlooked issue, which is hidden by the surface issues of climate change, such as air pollution. Saltwater intrusion persists not just in Bangladesh, but in countries all over the world, bringing food insecurity, water scarcity, and leaving a lasting impact on the lower class who are often forced to deal with this matter.

Reverse osmosis (RO) is a water purification method created to combat osmosis, which is a key factor in saltwater intrusion. Osmosis is the biological process of the tendency of freshwater to travel towards higher concentrations of dissolved water containing salt. Because of this, RO technology separates water from other molecules through a semipermeable membrane (About Saltwater). This is a convenient method not only due to the relatively low costs but because it can separate salt molecules as well as filter out other molecules that can contribute to the contamination of water. A drawback, on the other hand, is the limitation of how wide of a scale the technology can be available and operate in hundreds of villages on the coast.

Another possible mitigation strategy could be the establishment of water reserves and the implementation of water conservation policies. An especially low-expense strategy, rainwater harvesting is another viable option for coastal Bangladesh to turn to, as the country is known for its heavy monsoon rain seasons. Accessible to any home, the rainwater harvesting system collects rainwater through a piping arrangement and a basin containment (Ziaul Islam). The system was installed in Patkhelgata and produced outcomes of $24 expenses monthly for an average family of five. With the main source of water reserve systems being the coastal aquifers that are at times contaminated by the saltwater intrusion, these underground reservoirs can still be adapted to contain freshwater so that there is not a forced reliance on surface water that is more susceptible to salinity.

However, in addition to the issue of drinking water, agricultural needs must also be addressed. A solution for irrigation in the face of saltwater intrusion is dredging, a process that removes sediments and material from the bottom of bodies of water. During monsoon rain seasons, this reduces the risk of flooding and helps protect saltwater from reaching the root zones of crops, as this process deepens canals and rivers and acts as a storage for excess water. Alongside dredging, parallel canals can be implemented as an integrated approach to the salinity crisis. Similar to rainwater harvesting, these canals can be utilized for collecting rainwater to be used as a source for irrigation for crops, especially helpful during dry seasons. Combined, these management systems can prove to be an innovative strategy for the coastal villages.

Ultimately, what will be key in fighting against this crisis is to hold international river laws strictly so that India can cooperate with Bangladesh in their water-sharing management and ensure that dams created are not harming soil and villages. Introducing more diplomacy between the two countries with organizations like the World Bank and increasing political harmony can eventually allow for agreements to benefit both countries. Additionally, the solution that will prevent this issue from furthering lies in the confrontation of climate change upfront. By addressing the root of the problem itself, we can reduce our carbon footprint and the greenhouse gas emissions released every day and prevent the worsening of the spreading

**Works Cited**

“About Saltwater Intrusion - NOLA Ready.” *Nola.gov*, 2024, ready.nola.gov/incident/saltwater-intrusion/about-saltwater-intrusion/#:~:text=Desalination%20%2F%20Reverse%20Osmosis&text=RO%20works%20by%20passing%20the. Accessed 2 May 2024.

“Bangladesh.” *LandLinks*, Nov. 2010, www.land-links.org/country-profile/bangladesh/#:~:text=With%20a%20population%20density%20the.

*BANGLADESH BUREAU of STATISTICS STATISTICS and INFORMATICS DIVISION MINISTRY of PLANNING POPULATION & HOUSING CENSUS 2022 PRELIMINARY REPORT GOVERNMENT of the PEOPLE’S REPUBLIC of BANGLADESH*.

“Bangladesh | FAO Regional Office for Asia and the Pacific | Food and Agriculture Organization of the United Nations.” *Www.fao.org*, www.fao.org/asiapacific/perspectives/agricultural-statistics/global-strategy/results-in-the-region/bangladesh/en/.

Begum, Thaslima. ““Headaches, Organ Damage and Even Death”: How Salty Water Is Putting Bangladesh’s Pregnant Women at Risk.” *The Guardian*, 2 Apr. 2024, www.theguardian.com/global-development/2024/apr/02/headaches-organ-damage-and-even-death-how-salty-water-is-putting-bangladeshs-pregnant-women-at-risk. Accessed 26 Apr. 2024.

Blair, Jenny. “Understanding Dredging and Other River Management Options | Lake Champlain Sea Grant.” *Uvm.edu*, 2024, www.uvm.edu/seagrant/news/understanding-dredging-and-other-river-management-options. Accessed 2 Sept. 2024.

Chakraborty, Rishika, et al. “Health Implications of Drinking Water Salinity in Coastal Areas of Bangladesh.” *International Journal of Environmental Research and Public Health*, vol. 16, no. 19, 1 Oct. 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6801928/#, https://doi.org/10.3390/ijerph16193746. Accessed 21 Apr. 2020.

“Climate Change Poses Urgent Threat to Poor of Coastal Bangladesh.” *World Bank*, 24 June 2016, www.worldbank.org/en/news/feature/2016/06/24/climate-change-poses-urgent-threat-to-poor-of-coastal-bangladesh.

Dasgupta, Susmita. “River Salinity in Coastal Bangladesh in a Changing Climate.” *World Bank Blogs*, 31 Mar. 2014, blogs.worldbank.org/en/developmenttalk/river-salinity-coastal-bangladesh-changing-climate. Accessed 23 Apr. 2024.

Frisbie, Seth H, et al. “Sea Level Rise from Climate Change Is Expected to Increase the Release of Arsenic into Bangladesh’s Drinking Well Water by Reduction and by the Salt Effect.” *PLOS ONE*, vol. 19, no. 1, 17 Jan. 2024, pp. e0295172–e0295172, https://doi.org/10.1371/journal.pone.0295172. Accessed 8 Feb. 2024.

Proma, Maliha . “How India Is Violating “No Harm Principle” in Case of Transboundary Rivers.” *The Business Standard*, 10 May 2021, www.tbsnews.net/foreign-policy/how-india-violating-no-harm-principle-case-transboundary-rivers-244429. Accessed 2 Sept. 2024.

McIntyre, Peter. “The Threat from Salt Water in Bangladesh – We May Have Been Here Before: 8,000 Years Ago :: IRC.” *Ircwash.org*, 2014, www.ircwash.org/blog/threat-salt-water-bangladesh-%E2%80%93-we-may-have-been-here-8000-years-ago. Accessed 23 Apr. 2024.

Sagar, Shuvroneel . “Climate’s Cruel Toll: The Agonizing Quest for Coastal Food and Livelihood Security.” *Asia.fes.de*, 21 Nov. 2023, asia.fes.de/news/bangladesh-coastal-livelihood. Accessed 24 Apr. 2024.

Scheelbeek, Pauline. “Salinisation: The Silent Threat of Salty Water in South Bangladesh | LSHTM.” *Www.lshtm.ac.uk*, Mar. 2024, www.lshtm.ac.uk/newsevents/expert-opinion/salinisation-silent-threat-salty-water-south-bangladesh. Accessed 23 Apr. 2024.

Sultan, Md. Tipu, et al. *Addressing Soil Salinity for Sustainable Agriculture and Food Security: Innovations and Challenges in Coastal Regions of Bangladesh*. Dec. 2023, www.sciencedirect.com/science/article/pii/S2666833523000461#:~:text=Soil%20salinity%20disrupts%20plant%20growth,especially%20with%20rising%20sea%20levels.

World Population Review. “Bangladesh Population 2020 (Demographics, Maps, Graphs).” *Worldpopulationreview.com*, 2021, worldpopulationreview.com/countries/bangladesh-population.

Ziaul Islam, Kamal, et al. “Low Cost Rainwater Harvesting: An Alternate Solution to Salinity Affected Coastal Region of Bangladesh.” *American Journal of Water Resources*, vol. 2, no. 6, 13 Nov. 2014, pp. 141–148, https://doi.org/10.12691/ajwr-2-6-2. Accessed 10 May 2020.