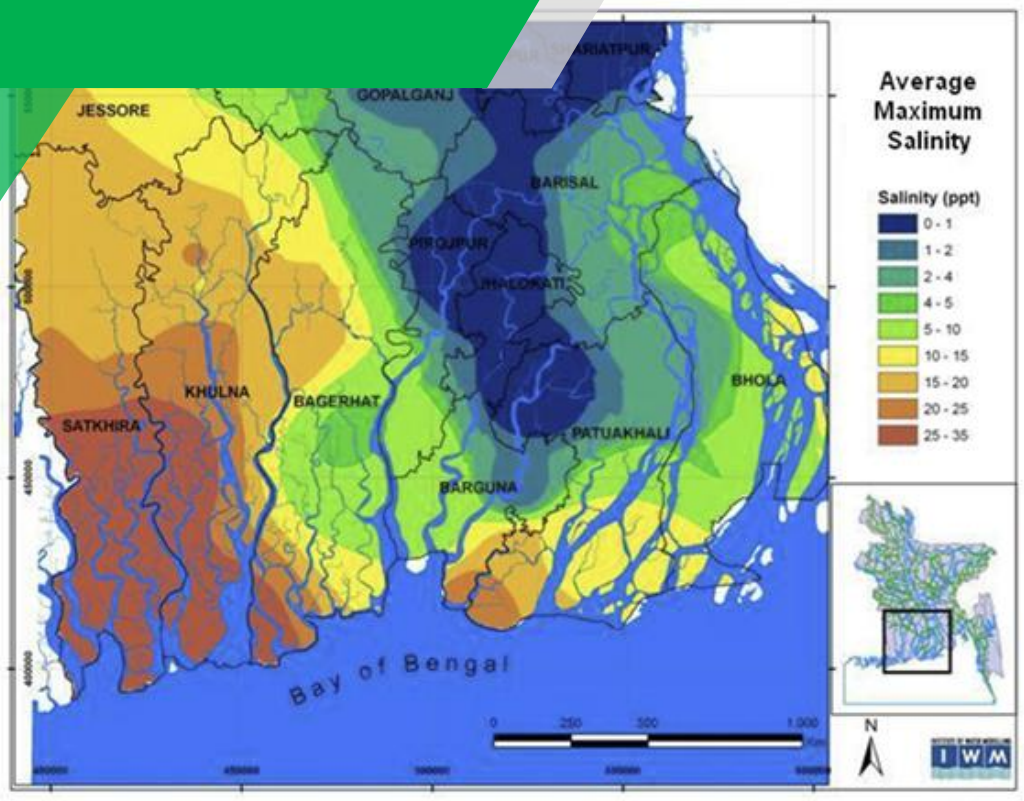
URBAN DEVELOPMENT DIRECTORATE (UDD)

Ministry of Housing and Public Works

Government of the People's Republic of Bangladesh

Report on Projection of water requirement with seasonal variation



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1.1 Introduction

Coastal zones and Deltas are under pressure worldwide. High water demand in these regions puts pressure on the availability of freshwater resources and on coastal ecosystems. This leads to problems like water shortage, overexploitation of groundwater resources, saltwater intrusion, and degradation of wetlands. Lack of safe drinking water has been identified as the number one issue in the daily life of the coastal population (Islam and Ahmad, 2004). In some areas, tube wells are not successful, especially in the coastal belt, because of saline water intrusion in the aquifer to a depth of 700-1000 feet (DPHE and UNICEF, 1989). Community people, with the help of local government institutions, are digging ponds and canals to store rainwater. They also clean existing surface water sources to reduce their dependence on groundwater. The major water problems facing the are (1) Provision of safe drinking water. (2) Water requirements for further agricultural, hydroelectric, and industrial developments. (3) Sustainability of water development projects. (4) Development of water resources shared by two or more states.

In coastal aquifers, fresh groundwater discharges to the ocean along with the freshwater–seawater interface. Under field conditions, the interface moves in response to tidal fluctuations, groundwater pumping, and changes in recharge, creating a transition zone or zone of dispersion. Coastal aquifers are groundwater systems that cross land-ocean boundaries. These systems represent a nexus of the world's geologic, hydrologic, and marine systems. Coastal aquifers provide freshwater to more than one billion people who live along the coast and interact with coastal hazards and coastal ecosystems alike. Saltwater intrusion can occur in aquifers near coastlines when fresh groundwater in the aquifer is displaced by salt water. Coastline aquifers become more vulnerable to saltwater intrusion when freshwater recharge rates are low, or withdrawal rates are high.

According to the UNDP, within 2050, one out of four people will suffer massively from the water crisis, and to address the problem, the United Nations has already included the issue in its sustainable development goal-6, which will ensure safe and affordable drinking water by 2030. Every year on March 22, world water day is celebrated, whose core focus is to support the achievement of SDG goal-6 and tackle the global water crisis. World Water Day is going to be celebrated this year with the theme-- "Groundwater-- Making the invisible visible." The main purpose of this theme is to ensure the best use of the groundwater, which is seen as a hidden treasure to deal with the problem of water across the globe. But does the theme fit for the south-western coastal region of Bangladesh, where the people are already suffering from the rampant destruction of natural disasters, poverty, and salinity? According to a Union Parishad (UP) official of the region, "the water problem is not an issue the people have the time to deal with. They are preoccupied with many more problems."

1.2 Hydrogeological condition

The hydrogeological conditions of the coastal area vary considerably even within short distances. In the main aquifer, groundwater flows from north to south, having localized outflow into rivers and ponds in dry season and inflow into the aquifer from surface water sources in the rainy season. The groundwater gradient in the coastal area of Bangladesh is about 1:20 000. Transmissivities of the main aquifer in the coastal area range from 250m2/ day to 10000m2/day, with an average value of 1000m2/ day. The storage capacity of the aquifer generally increases with depth with the increase in the size of aquifer materials. The entire area is underlain by thick water-bearing formations of varying depths, and the regional hydrogeology is very complex. Shamsuddin (1986) observed that the salinity distributions in Khulna, Barisal, and Patuakhali regions were not in agreement with the Ghyben-Herzberg theory. In the coastal area, brackish groundwater is available within 0 to 2.5m below the ground surface. In some regions, low saline groundwater is available in deep aquifers at a depth greater than 200m. It is believed that a continuous flow of fresh water in these deep aquifers from north to south has pushed saline water towards the sea. Pockets of fresh water are also

available around low. Saline surface water sources are usually beneath the old ponds and the rivers. The lens of fresh water has been formed due to the outflow of freshwater or accumulated rainwater from the surface water source into the aquifer for years. The thickness of the lens of fresh water beneath the pond has been found to be directly related to the age of the pond. The low saline water in and around most of 81 000 ponds in the coastal area is considered a potential source of low-cost water supply in the coastal area.

1.3 Water quality

The quality of water is the main constraint affecting the water supply system in the coastal area. Saltwater intrusion in the surface and ground waters in the dry season is a major problem. The indiscriminate use and unhygienic sanitary practices of the people have polluted the available low saline surface water sources and made them unsafe for domestic uses. The application of organic and inorganic fertilizers for fish cultivation in ponds has aggravated the deterioration of water quality. Surface waters in rivers and unprotected ponds often show Faecal Coliform counts between 500 and 3000 per 100ml. Groundwater, from a bacteriological point of view, is a more dependable source in Bangladesh. But in the coastal area, the presence of chlorides and dissolved iron in excess of acceptable limits is the main water supply problem. Ahmed (1981) and Choudhury (1985) assessed people's general opinions about the quality of water they drink. The people in the problem area use tubewell water having 5mg/1 of iron and 1000mg/1 of chlorides, without much hesitation, but the water of such quality is not acceptable in other regions of the country. Since these water quality parameters normally do not involve health risks, people's acceptance receives priority in water supply in the coastal area. Taking this into consideration, DOE (1991) recommended the maxim limits of 1000mg/1 for chlorides and 5mg/1 for iron in case of handpump tubewell in the absence of a better alternative source in problem and coastal areas of Bangladesh. Water quality parameters include chemical, physical, and biological properties and can be tested or monitored based on the desired water parameters of concern. Parameters that are frequently sampled or monitored for water quality include temperature, dissolved oxygen, pH, conductivity, ORP, and turbidity.

1.4 River Salinity in Coastal Bangladesh

River water salinity in coastal Bangladesh depends on the volume of freshwater discharges from the upstream river systems, the salinity of the Bay of Bengal near the coast, and the circulation pattern of the coastal waters induced by the ocean currents and the strong tidal currents in the coastal waters. A reduction in freshwater inflows from the transboundary Ganges River, siltation of the tributaries of the Ganges, and siltation of other rivers following the construction of the polder system has resulted in a significant increase in river salinity in coastal Bangladesh during the dry season. For example, salinity increased from 2ppt to 20ppt at Mongla in the Pussur River from 1962 to 2008. A map displaying the distribution of maximum river salinity from field measurements during the 2010-2011 dry season (October 2010 to May 2011) is shown in Table 1.

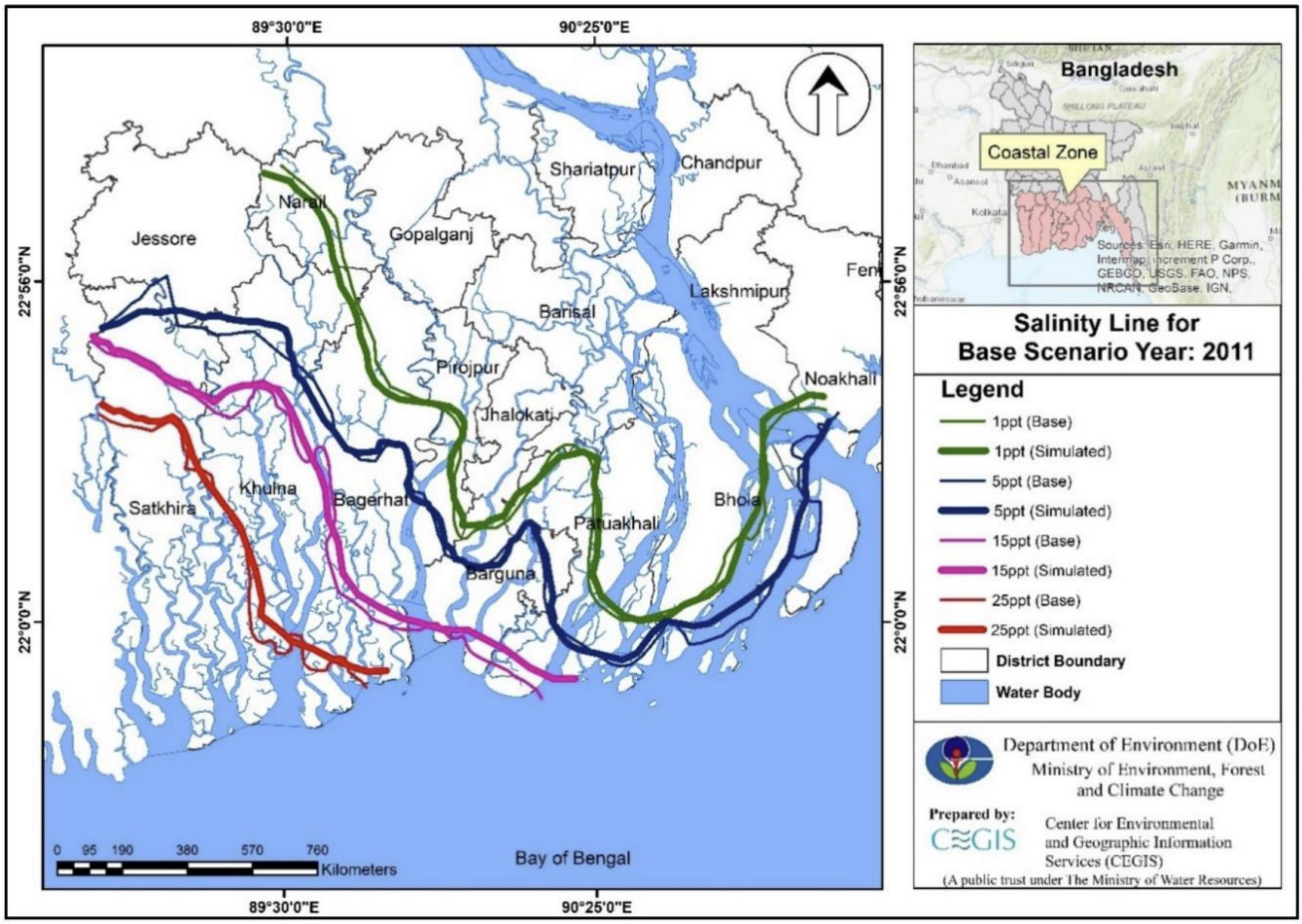

Figure 1. Salinity Isohalines for Observed and Simulated Period (2011).

Table 1: Maximum River Salinity in Coastal Bangladesh River salinity displays temporal and spatial variation in coastal Bangladesh. Temporal Variation of Salinity

Location	River	Maximum measured Salinity (ppt)
Amtali	Burisuar	0.9
Badurgasa	Darunmollik	22.9
Bamni/ Char Elahi	Meghna	19.8
Bardia/ Nabaganga	Noboganga	9.8
Bashantapur	Ichamoti	22.6
Bhairab	Hospital ghat/fulbari ghat	16.9
Bishkhali DS	Bishkhali River	11
Burhanuddin	Tetulia	3.5
Chapailghat	Modhumati	5.3
Chandpur	Meghna	0.1
Char Doani	Baleswar	8.5
Daulatkhan	Meghna	6
Gangrail	Shundor mohol	23.2
Habour Khali	Darunmollik Miea Ghat	9.9
Haridashpur	Madaripur Beel Route	2.1
Hilsha	Ganeshpura	4.6
Hiron Point	Pussur	27.3
Kaikhali	Modan Gauga	28.2
Khepupara Kolapara	Adhanmanik	19.8
Khulna	Rupsha	16.8
Kobadak	Kobadak	27.3
Madaripur	Arialkha	0.2
Madhupara	Andharmanik	13.9
Mohipur	Shibbaria Khal	22.8
Moju Chowdhury Hat	Meghna	1.5
Mongla	Pusure	20.7
Musapur	Little Feni	21.2
Nalian	Shibsha	23.4
Patgati	Modhumati	3.9
Pirojpur	Baleswar	0.6
Ramgati Jarirdona Regulator	Meghna	12.7
Shalta	thanibuina	20.3
Sharankhola	Vola	5.3
Swarupkathi	Swarupkati	0.2

1.5 Water Security

Water Management is important since it helps determine future Irrigation expectations. Water management is the management of water resources under set policies and regulations. Water, once an abundant natural resource, is becoming a more valuable commodity due to droughts and overuse.

Sustainable water management means using water in a way that meets current, ecological, social, and economical needs without compromising the ability to meet those needs in the future

1. Educate to change consumption and lifestyles.
2. Invent new water conservation technologies.
3. Recycle wastewater.
4. Improve irrigation and agricultural practices.
5. Appropriately price water.
6. Develop energy-efficient desalination plants.

7. Improve water catchment and harvesting.
8. Advance Technology Related to Water Conservation.
9. Improve Practices Related to Farming.
10. Less Use of Chemicals in Farming.
11. Improve Sewage Systems.
12. Better Water Distribution Infrastructure.

Figure.2. Different drinking water sources in the study areas (A: Collection of pond water for drinking; B: Plastic container for rainwater harvesting; C: Pond Sand Filter (PSF); D: Deep tube well with the overhead tank for water treatment).

1.5 Conclusions

Groundwater is the most preferred source of water supply in the coastal area of Bangladesh. The VSST and SST are low-cost alternative technologies for the abstraction of groundwater from very shallow floating aquifers and fine-grained sandy aquifers, respectively, for water supply to scattered communities. The STW and DTW are relatively costly but reliable for pumping out low saline groundwater from shallow and deep aquifers, which were available in the coastal area. In some

locations, community-type iron removal plants are required to be installed to remove excess dissolved iron. In areas where groundwater of salinity lower than the acceptable level is not available, community-managed SSFs are recommended to treat available low saline surface water to produce potable water for water supplies. In most difficult areas, where low saline water from a single source is not open, an integrated system based on more than one technological option is recommended for uninterrupted water supply for all domestic purposes. Rainwater is a potential supplementary source in the integrated water supply system in the coastal area.

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