URBAN DEVELOPMENT DIRECTORATE (UDD)
Ministry of Housing and Public Works
Government of the People's Republic of Bangladesh

PREPARATION OF PAYRA-KUAKATA COMPREHENSIVE PLAN FOCUSING ON ECOTOURISM

Report on Sub-Regional Water Resource System and Policy Guidelines of the Project Area

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Institute of Water and Flood Management

Bureau of Research, Testing and Consultation
Bangladesh University of Engineering and Technology

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1 INTRODUCTION

1.1 Background

Kuakata, locally known as Sagar Kannya (Daughter of the Sea) is a sea beach of rare scenic beauty on the southernmost tip of Bangladesh. The most important attraction of the beach is that one can see both sunrise and sunset from some of its locations. Situated 320 km from DHAKA and 70 km from the PATUAKHALIdistrict headquarters, Kuakata is part of the Latachapli union of KALAPARAupazila. The best way to reach Kuakata from Dhaka is to first travel to BARISAL by road, water, or air, and then to take the bus or boat/launch for the destination. The Bangladesh Road Transport Corporation introduced a direct bus service from Dhaka to Kuakata via Barisal.

The name Kuakata originated from Kua-Well dug on the sea shore by the early Rakhine settlers in quest of collecting drinking water, who landed on the Kuakata coast after being expelled from Arakan by Mughals. Afterward, it has become a tradition of digging Kua-Well in the neighborhood of Rakhine homestead for the collection of water for drinking purposes and general use. The beach at Kuakata is 18 km long and 3 km wide. This sandy beach slopes into the BAY OF BENGAL. Other attractions at Kuakata include blue sky, a huge expanse of water, the evergreen forest in surrounding areas, rows of coconut trees, boats of many different kinds and their colorful sails, and surfing waves. The main tourist season is in winter but all over the year, tourists visit this place.

Kuakata is truly a virgin beach-a sanctuary for migratory winter birds, a series of coconut trees, a sandy beach of the blue bay, and a feast for the eye. Forest, boats plying in the Bay of Bengal with colorful sails, fishing, towering cliffs, surfing waves everything here touches every visitor's heart. The unique customs and costumes of the 'Rakhine' tribal families and Buddhist Temple of about a hundred years old indicate the ancient tradition and cultural heritage, which are objects of great pleasure. Kuakata is the place of pilgrimage for the Hindus and Buddhist communities. Many people visiting Kuakata find interest in the Buddhist temples located at nearby places such as Keranipara, Misripara and Amkholapara, while many others find the place interesting because of the unique customs and traditions of the Rakhine community. Kuakata is also a place of pilgrimage for Hindus and Buddhists. Devotees arrive here during the festivals of Rash Purnima and MaghiPurnima. A major ritual on these occasions is dipping in the holy waters of Kuakata. Visitors also enjoy the traditional fairs organized to mark these celebrations.

The study area consists of seven Upazilas in Barguna and Patuakhali Districts namely Patharghata, Amtali, Taltali and Barguna Sadar Upazilas of Barguna District and Galachipa, Kalapara and Rangabali Upazilas of Patuakhali District (Figure 1.1). The coastal plains of Bangladesh are subject to tidal inundation twice a day by the semi-diurnal tide originating from the Bay of Bengal. During the low flow season, the tide penetrates far inland. The whole area is predominantly under tidal influence throughout the year. The area has been formed by a sedimentary deposit in the recent geologic time by the Ganges-Brahmaputra system. The area is highly vulnerable due to hydrological hazards especially monsoon floods and coastal floods. Coastal floods can arise from tidal floods as well as storm surge-induced floods. The area is also vulnerable due to extreme precipitation, especially during cyclones that occur during the pre-monsoon and post-monsoon periods. The extreme precipitation and storm surges can cause drainage problems in the area as well.

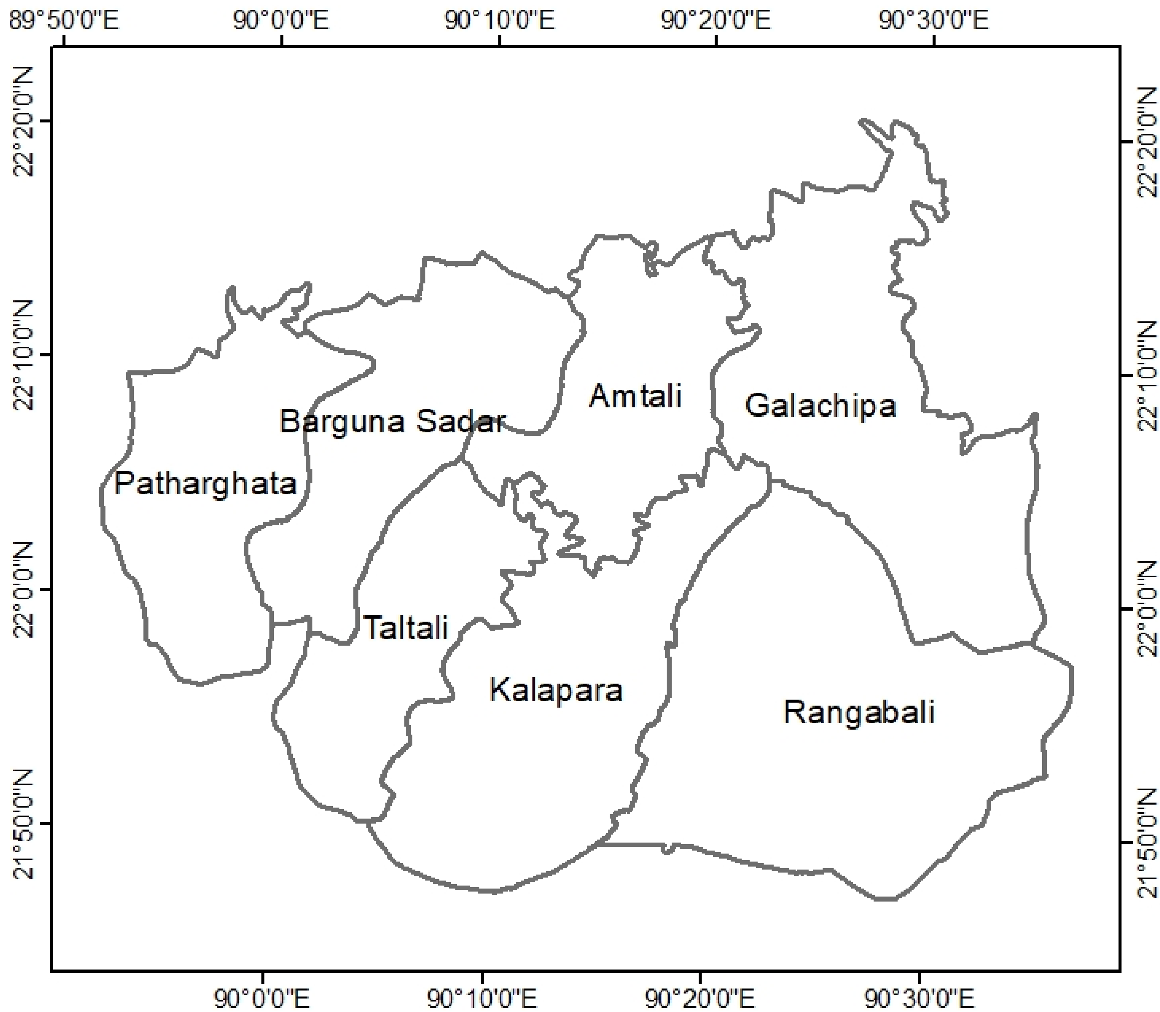

Figure 1.1: Project area showing seven Upazilas in Barguna and Patuakhali Districts.

1.2 Objectives of the Study

The objective of the project is to optimize coastal resources and activities for the sustenance of marginal people. The coastal activities and resources are very important to the economy and life of the people of Bangladesh whose living conditions are inextricably linked to the productivity and sustainability of the coastal zone. There is no long-term Holistic Development Plan for the coastal zone. The coastal zone needs to be integrated with the mainstream development process of the country. So, an interdisciplinary development planning approach is urgent to optimize the livelihood of the coastal zone. The Physical development planning problems, that need attention, are as follows:

(i) Translation of outputs from the upper-tier plan at Regional Plan to integrate coastal zone with the mainstream development process of the country.

(i) Assess functional and land use requirements for a Regional Plan in an area with hazard vulnerability.

(ii) Formulate Strategic Development Plan for Regional Plan considering functional and land use requirement with hazard vulnerability.

(iv) Formulation of urban area plan and action plan at the local level

1.3 Scope of Work

(i) To study sub-regional water resource systems;

(ii) To study the efficiency of the existing drainage system;

(iii) To prepare land use planning guidelines considering the hydrological situation of the project area;

(iv) To make a study on hydrological hazards of the area and prepare guidelines for hazard mitigation;

(v) to prepare flood prediction model of long, medium and short term (100, 50, 20, 5 and 2.33 year period) for Project area;

(vi) Formulate a regional drainage plan (retention areas, pumping station, etc.)

(vii) Any other related job assigned by the PD.

1.4 Approach and Methodology

Drainage and flood management are important considerations for assessing the development prospect of the project site. The hydrological assessment would be based on flood level analysis as well as drainage analysis. The flood analysis would focus on the estimation of the design flood level. The analysis involves the frequency analysis with different probability distribution functions for the selected design return period.

As the area lies in the coastal region facing the Bay of Bengal, the area is highly vulnerable due to hydrological hazards especially monsoon floods and coastal floods. Coastal floods can arise from tidal floods as well as storm surge-induced floods. The hydrological assessment would be based on flood level analysis as well as drainage analysis. The flood analysis would focus on the estimation of the design flood level. The analysis involves the frequency analysis with different probability distribution functions for the selected design return period. The historical data on annual peak water levels are used for the purpose. The water level data of the gage station nearest to the project site would be collected from the Bangladesh Water development Board. These data would be used to assess the extent of inundation due to floods. For flood inundation analysis, the topographic data in the form of a digital elevation model (DEM) would be required.

The area is also vulnerable due to extreme precipitation, especially during cyclones that occur during the pre-monsoon and post-monsoon periods. The extreme precipitation and storm surges can cause drainage problems in the area as well. The drainage analysis would require the estimation of design rainfall. The rainfall analysis involves the determination of intensity-duration-frequency (IDF) curves and the development of hyetographs. The IDF curves and hyetographs are used for rainfall-runoff analysis to estimate peak runoff rates. The IDF curves are used for rainfall-runoff analysis by the rational method. The rainfall intensity used is for a duration equal to the time of concentration. The time of concentration is the time required for a drop of water falling on the most remote part of the drainage basin to reach the basin outlet.

The gage station nearest to the project site is located at Khepupara and Patuakhali and is maintained by Meteorological Department (BMD). This station measures only daily rainfall. The daily rainfall data is available since 1974. These data would be processed and analyzed for developing IDF curves and hyetographs. The Extreme Value Type I (Gumbel) distribution would be used for the development of IDF curves for the different return periods. For flood inundation and drainage analysis, the topographic data in the form of a digital elevation model (DEM) would be required.

2 SUB-REGIONAL WATER RESOURCES SYSTEM

2.1 Background

The sub-regional water resources system in the project area predominantly consists of rivers and estuaries. In general, the hydrology of the coastal plains of Bangladesh presents a complicated interaction of freshwater flow from the upstream, the tides and tidal flows from the Bay of Bengal Tropical Cyclones, storm surges and other meteorological effects from the sea and the physiography of the coastal plains. Projects concerned for these areas have to be planned and designed to utilize the available resources and to stand against constraints (FAO, 1995). The major rivers in the project area are the Baleswar, the Bishkhali, the Buriswar, the Andharmanik and the Rabnabad Channel. Figure 2.1 shows the major rivers in the project area. The water level gauge stations of the major rivers are shown in Table 2.1.

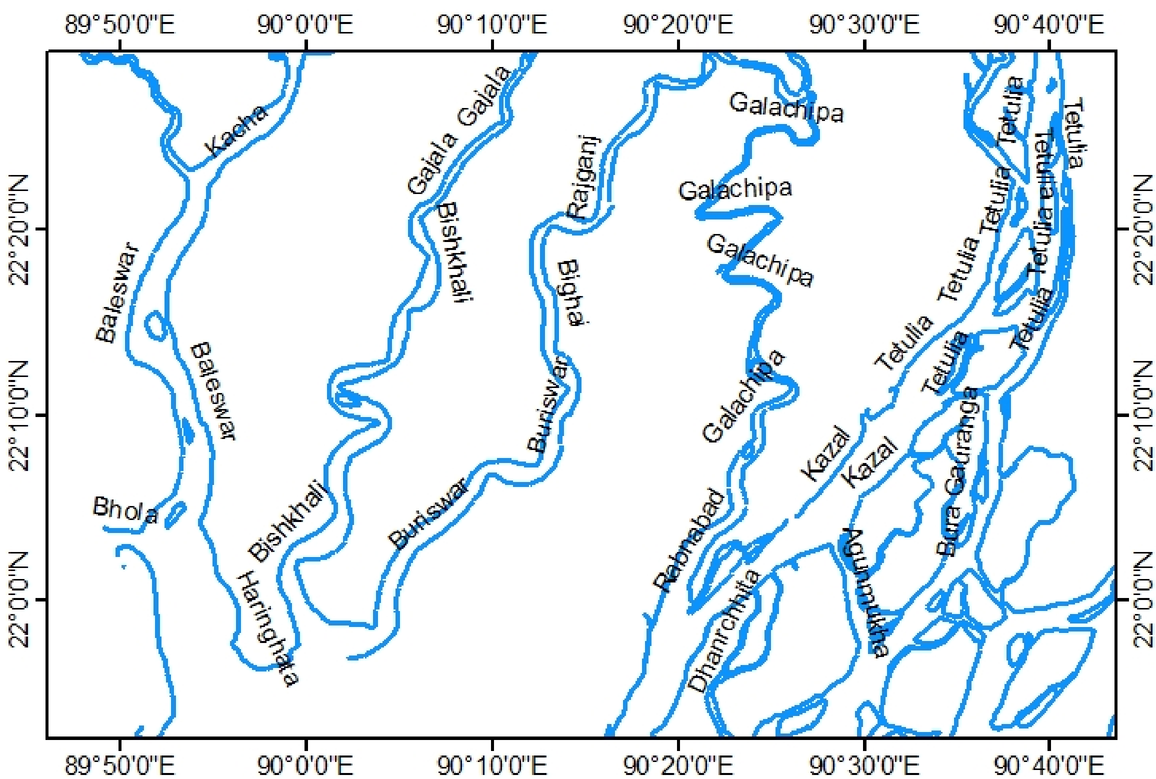

Figure 2.1 Major rivers in the project area.

Table 2.1 Water level gauge stations of the major rivers in the study area

River system	Name of the gauge station	ID of gauge station
Gorai-Madhumati-Haringhata-Baleswar	Rayenda	SW107.2
Bishkhali	Barguna	SW38.1
Bishkhali	Patharghata	SW39

Barisal-Buriswar	Amtali	SW20
Andharmanik	Khepupara	SW220

2.2 Baleswar River

The Baleshwari River is located in coastal Bangladesh, forming part of the eastern border of Bagerhat District and the western border of Barguna District. It borders on the east the largest mangrove forest in the world, in the Ganges-Brahmaputra delta, the Bangladesh part of which is set aside as the Sundarbans Reserve Forest. The Baleshwar River flows south into the Haringhata River, which flows into the Bay of Bengal. A typical hydrograph of the Baleswar River at Rayenda is shown in Figure 2.2. The highest tidal level of the river was found to be 2.25 m PWD which occurred on 9 September 1985. The mean difference between high tide and low tide is 1.77 m. According to BWDB (2011), the Baleswar River originates from the Kaliganga River. The river falls into the Bay of Bengal. It is a perennial river with a length of 146 km, a width of 3000 m and a depth of 9.0 m. The catchment area is 486 sq. km.

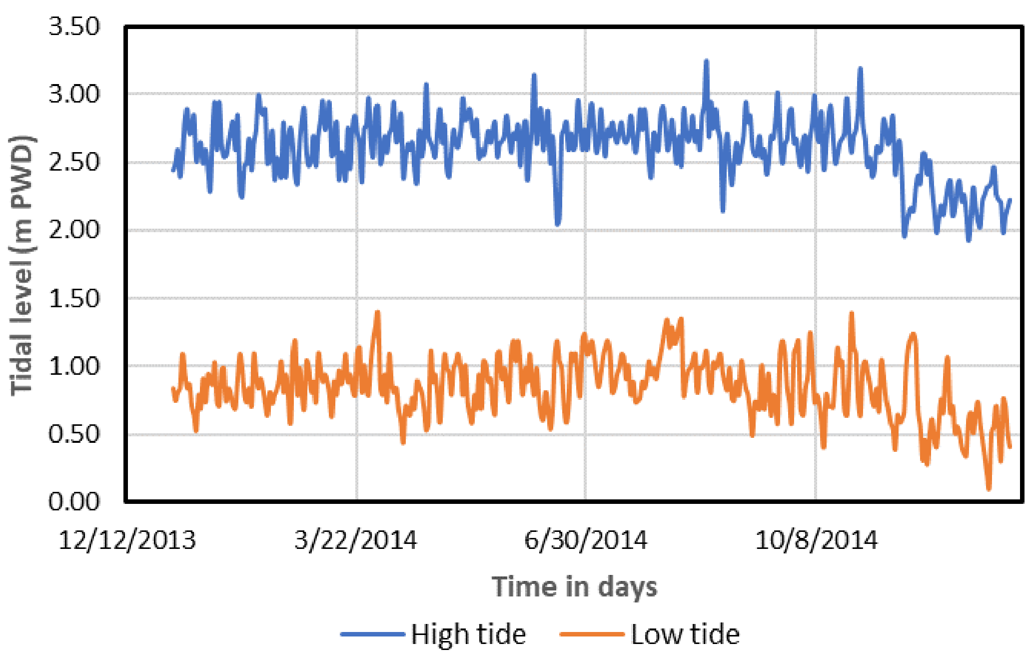

Figure 2.2: A typical water level hydrograph of the Baleswar River at Rayenda.

2.3 Bishkhali River

The Bishkhali River is the continuation of the Kirtankhola and the Nalchity rivers. According to Banglapedia (2003), the Arial Khan picks up the name 'Bhasani Char' as it enters into Bhasani Char of the Barisal Sadar Upazila. Similarly, it changes her name as the Kirtankhola at 5 km north of Barisal town, as Nalchity in Nalchity Upazila (Jhalokati district) and as Sugandha in Jhalokati Sadar

Upazila. The Sugandha turns into Bishkhali after entering Jhalokati town. At this point, after creating a great meander the river flows south into the Bay of Bengal. The Bishkhali receives the water of the Madhumati and Katcha through the Kaukhali and the Gabkhan Khal (canal) joining with the river near the meander. The river maintains a connection with the Burishwar river system through the Bakdugh, Ayla, etc at the lower reach of Bamna Upazila and falls into the Bay of Bengal through the mouth of the Baleswar-Haringhata at 13 km down of Patharghata. The total length of the river is 96 km. The average width of the river from its origin to the first 30 km is about 1 km and the rest is about 2 km. The average depth is about 16 m.

The river is fully influenced by tide and ebb. The water level is collected at Betna, Bamna, Barguna and Patharghata stations. Bangladesh water development board (BWDB) has constructed an embankment to prevent floods and salinity. The deposition process and char (island) formation are active at various parts of the river. Some of the chars are under settlement and cultivation. The Badankhalikone and Khakdone, two of the offshoots of the Bishkhali are about to die due to a lack of sufficient flow.

According to BWDB (2011), the Bishkhali is a perennial river. The high flow months are generally from July to September. Low flow months are from February to April. The stations are tidal water level gauge stations of BWDB. The water level hydrograph of the Bishkhali River at Barguna and Patharghata stations are shown in Figures 2.3 and 2.4, respectively. The highest recorded water level for the Barguna station is 3.80 m PWD which was observed on 19 August 1997. The river experiences bank erosion, Bangladesh Water development Board has constructed revetments to protect Patharghata Upazila from the erosion of the right bank of the Bishkhali River (Figure 2.5).

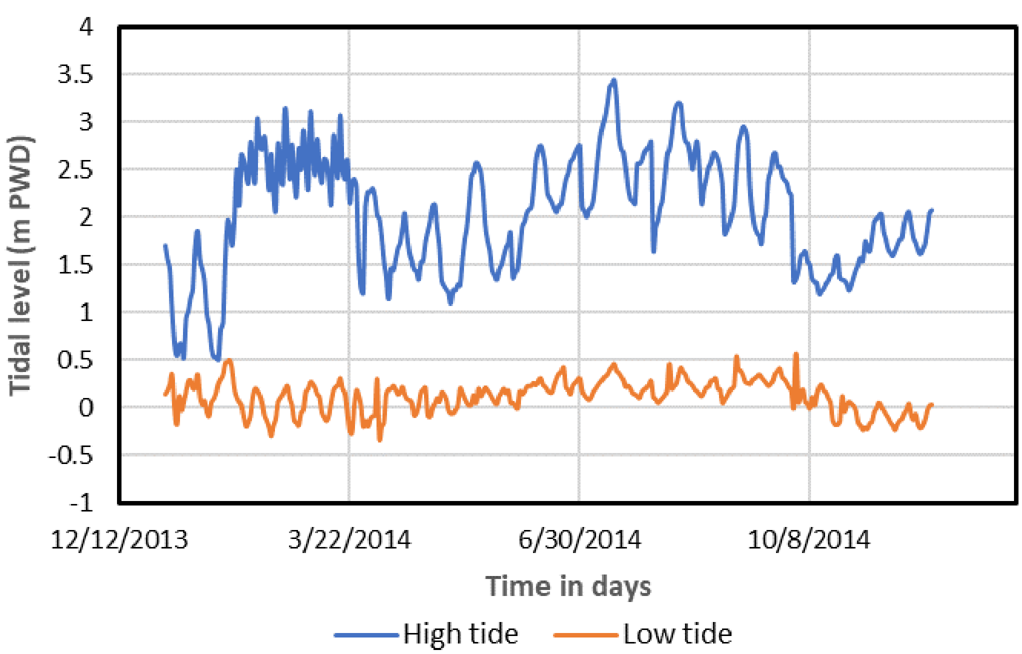

Figure 2.3: Time series plot of the annual maximum and minimum water level of the Bishkhali River at Barguna.

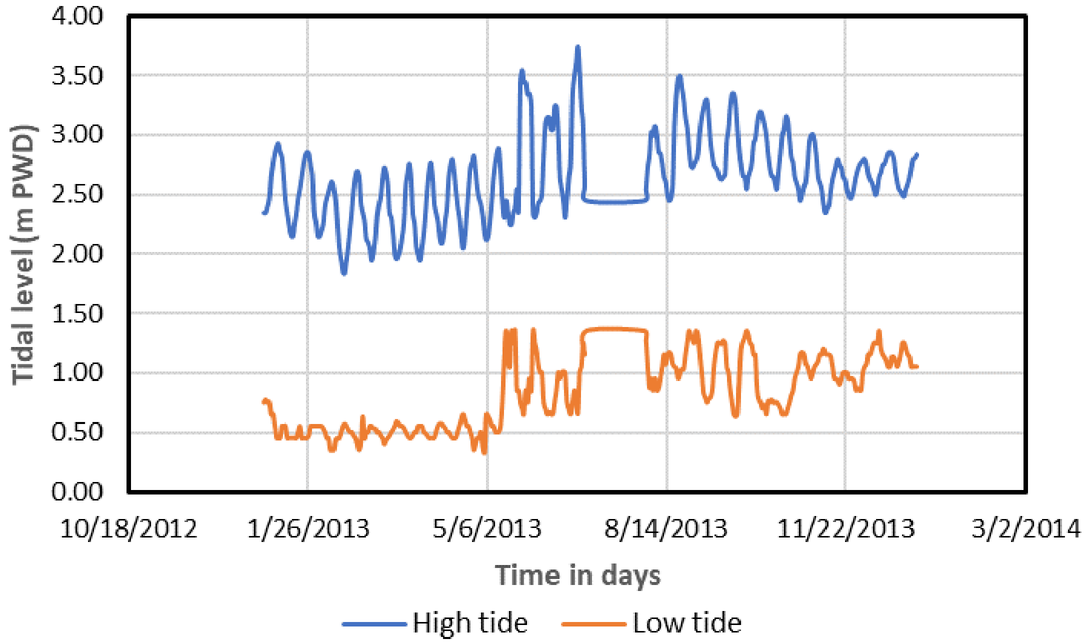

Figure 2.4: Time series plot of the annual maximum and minimum water level of the Bishkhali River at Patharghata.

Figure 2.5: Bank protection works along the right bank of the Bishkhali River in Patharghata Upazila implemented by BWDB.

2.4 Buriswar River

Burishwar River originates from the river Kirtankhola at Dapdapia of Bakerganj Upazila under Barishal district. It flows over Ranirhat, Halta, Khairabad, Bakerganj, Lebukhali, Alki, mirzaganj, Karabunia, Ayla, Buraghata, Amtali and falls into the bay of bengal at amtali upazila in barguna district.

Actually, the Burishwar is the down reach of the Arial Khan River and receives the main discharge from it. At the Tentulia confluence, the Arial Khan creates a complex network system and one of these branches divides into two channels at Bakerganj. One distributary named the Lebukhali flows through Patuakhali district and meets the Laukathi. Another arm falls into the Bay of Bengal after receiving the names Bakerganj, Angaria, Katcha, Chighai and finally Burishwar. The Burishwar receives various small channels like the Subidkhali, Ayla, Gulishakhali, Pangasia (Golbunia), and Chargachhia on its course. According to Banglapedia (2003), the total length of the river is 158 km and is under tidal influence. There are meanders at some places of the river, which also shows an erosional tendency. Ranirhat, Bakerganj, Mirzaganj and Amtali are some important places on the banks of the Burishwar. A typical hydrograph of the Buriswar River at Amtali is shown in Figure 2.6.

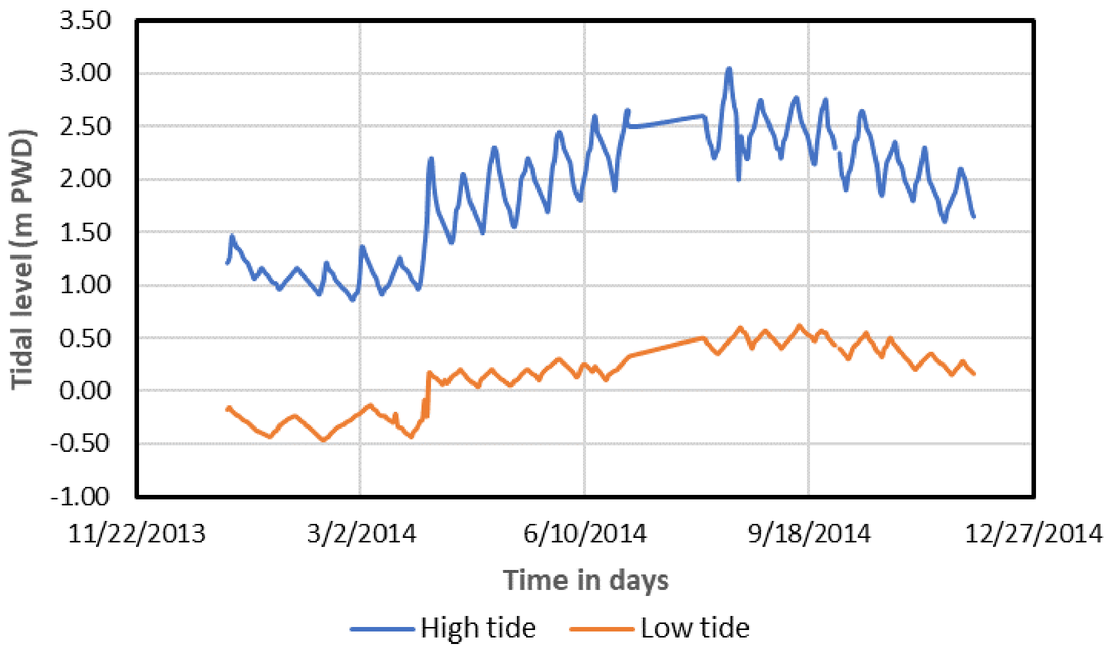

Figure 2.6: Time series plot of the annual maximum and minimum water level of the Buriswar River at Amtali.

2.5 Andharmanik River

The Andharmanik River is one of the major rivers of Kalapara Upazila in Patuakhali District. The river is tidal in nature. It is also known as the Nilganj River. In recent years the people of Kalapara have raised their concerns regarding the gradual drying up of the river. From a total length of about 40 km, the river has permanently dried out due to the sedimentation and rise of new alluviums (Banglapedia, 2003). The causes of the sedimentation include the illegal occupancy of canals, unrestricted farming in river areas, etc. In late 2013, the government announced that a new seaport would be established on the bank of the Andharmanik river. Since then, the river has been gaining importance. A typical water level hydrograph of the river is shown in Figure 2.7.

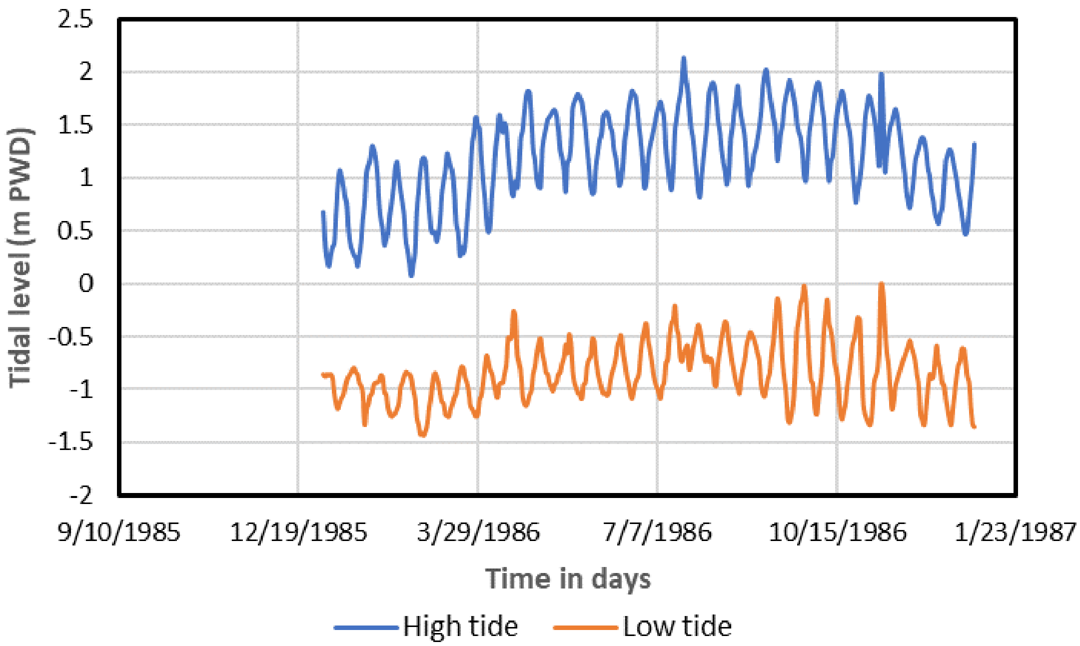

Figure 2.7: Time series plot of the annual maximum and minimum water level of the Andharmanik River at Kalapara.

2.6 Precipitation

There are two rain gage stations in the project area namely Khepupara and Patuakhali. The rain gauge stations are maintained by Bangladesh Water Development Board. The mean annual rainfall in Khepupara and Patuakhali is 2607 mm and 2492 mm, respectively which are higher than the national average of 2300 mm. Annual rainfall shows considerable variability from year to year. The rainfall also varies considerably within a year (Figures 2.8 and 2.9), with 82% and 83% of rainfall occurring within the five months from May to September in Khepupara and Patuakhali, respectively. The mean annual one-day precipitation in Khepupara is 185 mm. Table 2.2 shows the rainfall statistics in the project area.

Table 2.2 Rainfall statistics in the project area

Parameter	Khepupara	Patuakhali
Total	2607	2492
Mean	217	208
Max	594	511
Min	6	6
Rainfall in May-Sep	2137	2061

% Rainfall in May-Sep	82%	83%

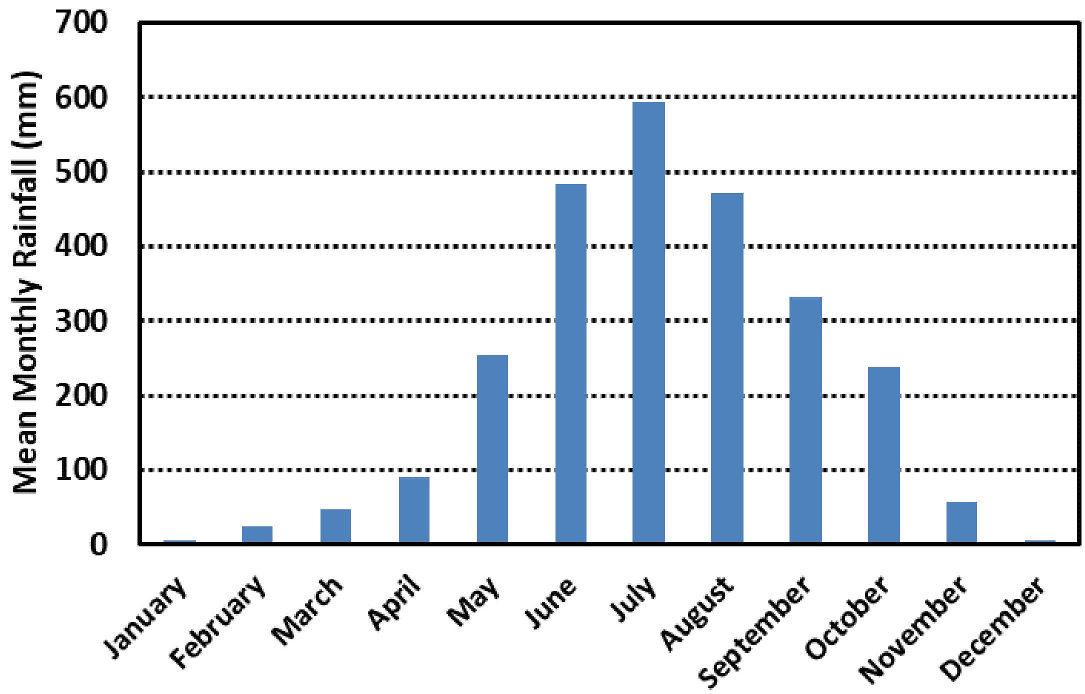

Figure 2.8: Distribution of mean monthly rainfall at Khepupara.

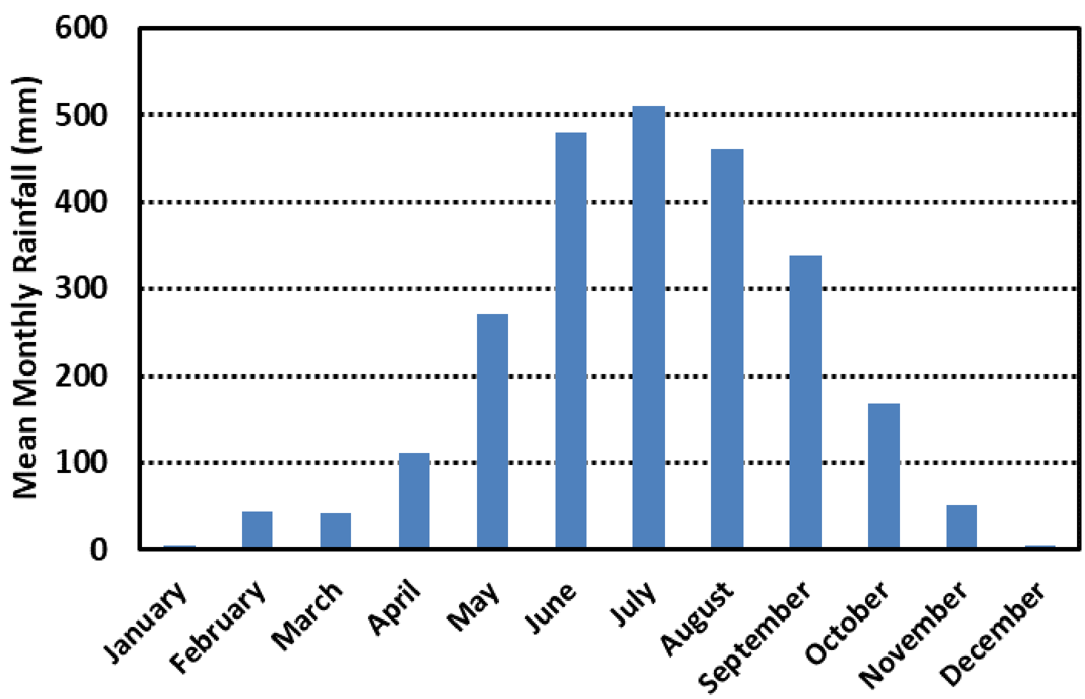

Figure 2.9: Distribution of mean monthly rainfall at Patuakhali.

3 FLOOD AND DRAINAGE IN THE PROJECT AREA

3.1 Types of Floods in the Project Area

As the project area lies in the coastal zone, it experiences coastal floods. Coastal floods are of two types: tidal floods and storm-surge-induced floods. Tidal floods occur due to high tide while storm-surge-induced floods occur due to cyclonic storms. The coastal areas consist of large estuarine channels, extensive tidal flats, and low-lying islands. The high tides regularly inundate large tracts of coastal land. Saline inundation during tidal floods causes damage to standing crops. Storm surges generated by tropical cyclones cause widespread damage to life and property. Tropical cyclones are most likely to occur before and after the monsoon (April-May and October-November respectively). In addition to coastal floods, the area, especially urban centers suffer from urban floods due to high-intensity rainfalls.

3.2 History of Flood Management in Bangladesh

History provides quite elaborate evidence of ancient flood management practices in the Bengal. Although much of the development is recent, floods and “living with floods” has been part of life in Bangladesh for ages. Before the advent of “modern” government administration, local management of flood control and drainage (FCD) systems was a traditional feature. Well-known examples include the construction of submersible embankments by landlords in the Northeast region and the low flood protection embankments in the coastal areas in the Southwest, dating to the 1800s or before. Local flood protection works on the Gumti date even farther back.

The interest in FCD and irrigation diminished in the colonial period when the emphasis was placed on navigation for trade. The Mughals had set up an independent department, whereby local landlords, in cooperation with the traditional local councils (panchayats) were empowered to levy land taxes for activities such as river dredging and maintenance and new construction of embankments, roads, and bridges. During the colonial period, this system was formally abolished, although informally, landlords remained occupied with these activities, being the largest landholders in the area. Nevertheless, the lack of central support to panchayats and these types of works started a process of slow decline, which was reversed only in the “modern period”.

3.3 Chronology of Flood Management Strategy in Bangladesh

Krug Mission Report (1956): Following devastating floods in 1954 and 1955, a United Nations mission, called the “Krug Mission” after its leader Mr. J.A. Krug, investigated the possibilities for flood control measures in erstwhile East Pakistan. The mission prepared a report in 1956 and recommended establishing an autonomous organization for data collection and flood studies and a Master Plan for flood control. On the UN missions’ recommendations, the East Pakistan Water and Power Development Authority (EPWAPDA) was created in 1959. The Authority was responsible for the planning, design, operation and management of all water development schemes.

The First Master Plan (1964): The real beginning of water sector planning in what is now Bangladesh was marked by the completion in 1964 of a 20-year Water Master Plan, prepared by EPWAPDA with USAID assistance. The consultant of the Master Plan was an American consulting firm, International Engineering Co. (IECO). It proposed the undertaking and implementing of such long-term structural measures as embankments, channel improvements by dredging, river training and cutoff, and construction of bypass or floodways. In the plan, 58 large-scale projects were proposed, covering 5.8 million ha, comprising embankments, pumping stations, and canal irrigation. One of the main principles underlying the master plan was that full flood control was the key to increasing agricultural production by excluding river flood water from agricultural land and draining excess rainwater from the embanked areas by sluicing or pumping. It quickly became clear, however, that the plan severely underestimated local complexities, both social and hydrological.

The Land and Water Study (1972): The International Bank for Reconstruction and Development (IBRD) prepared a report in 1972 on the land and water sector study. After reviewing the Master Plan of 1964, the report emphasized the need for reorientation of policy for flood control, drainage and irrigation programs. The report recognized the problems of large-scale flood control, drainage and irrigation schemes in a setting with high population density and a complex water regime due to flooding during the wet season and scarcity in the dry season. It recommended quick yielding small-scale projects that emphasized the use of agricultural inputs, winter irrigation and quick drainage of low-lying areas for cultivation of winter *boro* paddy. But in the meantime, many of the large-scale projects proposed in the Master Plan of 1964 were implemented or were under implementation.

The National Water Master Plan (1986-91): To respond to the need for the development of an integrated land and water development strategy, the National Water Plan (NWP) project was initiated in 1983 with assistance from UNDP and the WB. The project was given the task to formulate a perspective water development plan for the period 1985-2005 based on a comprehensive assessment of all natural, human and financial resources, and with the objective to maximize agricultural growth and production and contribute to achieving food grain self-sufficiency while ensuring allocations of water to other users. The project was carried out by setting up a Master Plan Organization (MPO) and by appointing an American consulting firm Harza Engineering Co. Int. as the principal consultant. Phase-I of the NWP study was completed in 1986. In Phase-II, completed in 1991, the Phase-1 report was updated. Neither the 1986 master plan nor the 1991 update was adopted by the government of Bangladesh. The first major shift was to come about during the period of the Flood Action Plan (FAP).

The Flood Action Plan (1990-1995): In 1987 and 1988, Bangladesh experienced two of the most severe floods on record. Widespread damage was caused to crops, roads railroads, cities and towns, and more than 3000 people lost their lives. The flood of 1988 stimulated the Government to undertake a comprehensive review of the planning approach of ongoing activities and work began on a flood policy study and a flood preparedness study. The flood policy study by the Government of Bangladesh and the UNDP set eleven guiding principles for future flood management studies. Ultimately an Action Plan for Flood Control was undertaken and subsequently, it was termed as the Flood Action Plan (FAP). The WB coordinated the support of several donors. An organization called Flood Plan Coordination Organization (FPCO) was formed in 1990 to coordinate the 26 FAP studies.

The FAP studies followed a multi-criteria analysis that has brought costs, benefits, and social and environmental impacts in a single framework. At the initial stage of FAP, the focus was on flood mitigation. Gradually, it was recognized that FAP components should deal with the complete hydrological cycle and develop an integrated flood and water management plan that would include issues of drainage, irrigation, navigation, environment and the socio-economic fabric. The FAP has introduced a concept of compartmentalization that involved controlled flooding and controlled drainage in a protected area. This would be achieved by means of water regulating structures along the peripheral embankment and road.

Water and Flood Management Strategy (1995,1997): Based on the outcomes of the Flood Action Plan, the government concluded that reformulation of the national water planning goals and objectives has now become necessary to guide future planning efforts and to produce an integrated national water plan. This resulted in the Bangladesh Water and Flood Management Strategy in 1995 and updated in 1997.

The National Water Policy (1999): The government declared the National Water Policy (NWPo) in 1999. The six national goals of the NWPo were economic development, poverty alleviation, food security, public health and safety, a decent standard of living for the people, and protection of the national environment. The policy emphasizes living with, rather than controlling, floods and stresses the incorporation of social and environmental concerns in all FCD development. Major emphasis is placed on floodproofing, minimal disruptions to the drainage network and fish migration patterns, and disaster preparedness.

The National Water Management Plan (2004): The National Water Management Plan (NWMP), finalized in 2001, is the first plan developed after the National Water Policy was issued and reflects the change in approach. The NWMP was prepared by Water Resources Planning Organization (WARPO) in 2001 and accepted by the Government of Bangladesh in 2004. The plan is to be updated every five years.

The Bangladesh Delta Plan (BDP) 2100: The Bangladesh Delta Plan (BDP) 2100 is a long-term integrated techno-economic mega plan that integrates all delta-related sector plans and policies, enveloping a Delta Vision and strategies that make it possible to integrate sector plans and policies for the long term and to present actionable interventions with a roadmap for realization. The government of Bangladesh has approved the Delta Plan 2100 on September 4, 2018, to secure the future of water resources and mitigate the likely effects of climate change and natural disasters.

3.4 Urban Flooding and Drainage Issues in the Project Area

As mentioned earlier that the project area comprises seven Upazilas. Galachipa Upazila of Patuakhali and Amtali Upazila of Barguna are two of them. AECOM (2013) conducted a study on urban drainage modeling for three selected coastal towns of Bangladesh considering climate change. Two of the three towns were Galachipa and Amtali. There is a polder surrounding Galachipa Pourashava. However, the Pourashava Complex itself has been constructed outside of the Polder. It is a matter of concern that Pourashava Complex is remaining unprotected. In fact, one-third area of Galachipa Upazila is not yet protected by polder from future disasters like AILA and SIDR. The Ramnabad River is shifting away from its present position leaving away a lot of space for Galachipa Upazila to be extended further and a lot of settlements have been developed in the newly developed area. The present polder functioned quite well and people and properties were saved during past SIDR and AILA events. The embankment height of the polder was about 30 cm higher than the storm surge height during the disasters. However, people suffered from in-polder drainage congestion. The residential area of blocks 4, 5, 6, 7 and 8 of Galachipa Pourashava usually suffers from drainage congestion during rains and needs to clear the drainage network using its own local technologies.

The main drainage network and its existing condition are not in good condition. The drainage system got reduced in both horizontal and vertical dimensions in the city area. Encroachment and siltation have turned the large canal into almost a non-distinguishable small drain, through which once plied upon local launches and country boats. At present, the drain is clogged with market garbage, water hyacinth, etc. Once it was a natural drainage system, but now is blocked at several points and later construction of the polder by BWDB turned it fully blocked. These locations are to be opened up again to make the drain more effective and to drain water towards the Ramnabad River. There is one closed junction for blocks 4, 5, 6, 7 and 8 which needs to open to eliminate drainage congestion during rain events.

At the outfall of the Mujib Nagar to Arambagh Khal, there exists one vent Sluice Gate. The sluice gate drains water to the Ramnabad River. The existing sluice gate is to be modified for a larger drainage opening. This point is to discharge the drain water from the proposed improved main drainage under construction. Several drainage canals are under construction with a vertical wall. Photograph 2.1 shows the Shantibag Sluice Gate No. 3 towards Galachipa Pourashava while Photograph 2.2 shows Galachipa Khal in the market area logged with garbage.

Photograph 2.1: Shantibag Sluice Gate No. 3 towards Galachipa Pourashava


Photograph 2.2: Galachipa Khal in the market area logged with garbage.

The Amtali Pourashava is protected by a polder. But during SIDR, the entire Amtali was over flooded and three people are reported to die at Basaki Sluice Gate over the Basaki drainage canal. 7 people died in another location during the SIDR event. Amtali Pourashava has a large water body and runs through the Pourashava. It functions as a storage reservoir during rain or other extreme events. Two main roads cum bundhs run through the water body in two locations. In one location, the water body has been filled up with sand. The newly filled-up area is prepared for use of EID Ghah. But no drainage provision has been considered yet. The challenge is that again a drainage canal is to be excavated along the border of the filled-up land to connect the existing water body to the outfall of the culvert towards the Paira (Buriswar). The provision for a drainage canal could be kept during the filling up of the existing water body. The existing large water body is an asset for the people of Amtai Pourashava.

There is a drainage canal named Basaki that runs towards the Paira (Buriswar). The Basaki drainage canal has a Sluice Gate at its outfall. The condition of the Basaki drainage canal is quite good. Small country boats ply through the canal. The Basaki is the main drainage canal for the Pourashava area. The Challenge includes the further strengthening of the Sluice Gate. A recreational lake is under construction close to the BWDB Sluice Gate to Paira River. The BWDB Sluice Gate is connected with the existing large water body by a narrow drainage canal. The BWDB Sluice Gate regulates the drainage flow towards the river Paira (Buriswar) as well as from the Paira side.

The existing polder and adjacent people are prone to the SIDR effect. Several people died during SIDR as their settlements were very close to or outside of the polder and storm surges hit them at the outset of the SIDR. Some secondary drainage canals are under construction with a vertical wing. Challenge is vertical wing wall is to be considered for many drains needed for the Pourashava. Photograph 2.3 shows an existing large water body, part of which was filled up at Amtali Pourashava while Photograph 2.4 shows an existing culvert on-road cum bundh through the large water body at Amtali Pourashava.


Photograph 2.3: Existing large water body, part of which was filled up at Amtali Pourashava.


Photograph 2.4: Existing culvert on-road cum bundh through the large water body at Amtali Pourashava.

3.5 Large-scale Projects on Floods and Drainage Issues in the Coastal Region

Bangladesh Water Development Board has so far contracted 139 polders in the coastal region in order to manage floods as well as to prevent saltwater intrusion. The total length of the polders is 4765 km with more than 1400 water control structures (sluices/regulators) covering an area of 1.22 million ha. The existing polders can prevent only tidal floods. However, when storm-surged-induced floods hit the area, they can no longer prevent it and frequent overtopping happens. In order to address the issues, the Government of Bangladesh took the initiative to increase the height of the existing polders so that they can prevent both tidal floods as well as storm surge-induced floods of a certain magnitude.

The Coastal Embankment Improvement Project (CEIP), funded by World Bank, is being implemented by Bangladesh Water Development Board. The objectives of the first phase of CEIP are: to (a) increase the protected area in selected polders from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; (b) to improve agricultural production by reducing saline water intrusion in selected polders; and (c) improve the Government of Bangladesh's capacity to respond promptly and efficiency to an eligible crisis or emergency. The project has five components: (1) Rehabilitation and Improvement of polders to increase community resilience to tidal flooding and storm surges; (2) Implementation of social and environmental management frameworks and Rehabilitation of persons affected by the project, as well as environmental assessment of the polder system; (3) Construction supervision, monitoring and evaluation of project and coastal zone monitoring; (4) Project management, technical assistance, training and strategic studies to support the Bangladesh Water Development Board in implementing the project; and (5) A contingent emergency response component (CERC) which allows for rapid reallocation of uncommitted project funds toward urgent needs in the event of a crisis or emergency.

The first phase of CEIP (CEIP-I) has selected 17 out of the 139 polders in the coastal zone for the improvement of an embankment system that will withstand severe cyclones and climate change impacts. The project includes a detail design of 5 polders in Khulna (polders 32 & 33), Bagerhat (polder 35/1 & 35/3) and Pirojpur (polder 39/2C) for the first-year construction package. The first-year construction includes 33 km of the new embankment, 6.7 km of the forward embankment and 26.35 km of the retired embankment. Following CEIP Phase 1, within Phase-2 of CEIP is intended to access the remaining 122 polders and select the next batch of 13 polders for implementing infrastructure improvement works.

Blue Gold Program (BGP): The overall objective of the Blue Gold Program is to reduce poverty for 190,000 households living in 119224 ha areas of selected coastal polders by creating a healthy living environment and sustainable socio-economic development. The twenty-two polders were selected for interventions through Blue Gold covering around 115,000 ha in the districts of Patuakhali, Khulna, Satkhira and Barguna.

4 POLICY GUIDELINES ON HYDROLOGICAL ISSUES IN THE PROJECT AREA

4.1 Background

Hydrological issues are a cross-cutting field relating to water, environment, eco-system and bio-diversity, fisheries, agriculture, etc. Some of the policies and plans are discussed in the context of hydrological aspects in the study area. There are quite a number of public policies and plans addressing the hydrological issues in Bangladesh. National Water Polices, Coastal Zone Policy, Guidelines for Participatory Water Management, National Water Management Plan, Participatory Water Management Rule-2014, Bangladesh Water Act-2013) and the Bangladesh Delta Plan-2100 are some of the important policies and plans of the Government of Bangladesh in addressing water resources management. National Water Policy, Bangladesh Water Act and Bangladesh Delta Plan 2100 are briefly discussed in the context of addressing floods and drainage issues in coastal Bangladesh in general and in the project area in particular.

4.2 National Water Policy 1999

The National Water Policy, formulated by the Ministry of Water Resources (MoWR) in 1999, aims to provide direction to all agencies and institutions relevant to the water sector in Bangladesh, to achieve the targeted objectives of the sector. Objectives include addressing issues related to the development of all forms of surface water and groundwater and managing these resources in an efficient and equitable manner and ensuring water availability to all elements of society, particularly the poor, women and children. The policy addresses the planning and management issues of water resources as below:

“Planning and Management of Water Resources: The Government recognizes that the process of planning and managing water resources requires a comprehensive and integrated analysis of relevant hydrological, topographical, social, political, economic, environmental and institutional factors across all related water-using sectors. The intricate nature of drainage systems within the country requires that activity for planning and management of the nation's river systems is undertaken within the context of hydrological regions. Develop early warning and flood-proofing systems to manage natural disasters like flood and drought. Designate flood risk zones and take appropriate measures to provide desired levels of protection for life, property, vital infrastructure, agriculture and wetlands. In this regard the following principles will guide future action:

i. Regions of economic importance such as metropolitan areas, sea and air ports, and export processing zones will be fully protected against floods as a matter of first priority. Other critical areas such as district and upazila towns, important commercial centers, and places of historical importance will be gradually provided reasonable degree of protection against flood. In the remaining rural areas, with the exception of those already covered by existing flood control infrastructure, the people will be motivated to develop different flood proofing measures such as raising of platform for homesteads, market places, educational institutions, community centers, etc., and adjusting the cropping pattern to suit the flood regime.

ii. In future all national and regional highways, railway tracks, and public buildings and facilities will be constructed above the highest ever-recorded level of flood in the country. This principle will also apply in cases of reconstruction of existing structures of this nature.

iii. All plans for roads and railways embankment will adequately provide for unimpeded drainage.

Undertake survey and investigation of the problem of riverbank erosion and develop and implement master plans for river training and erosion control works for preservation of scarce land and prevention of landlessness and pauperisation."

River flood, cyclonic storm surge flood, drought and river bank erosion are familiar water-related natural hazards in Bangladesh. Socio-economically vulnerable groups are the worst sufferer of these hazards. Most of the water management projects in Bangladesh belong to flood control and are intended to prevent flooding of the floodplain from river floods. The area covered by flood control projects is nearly two-thirds of the country. But flood control projects have not been able to bring benefit to all sections of the society because of a lack of environmental and equity considerations in project planning. Flood control projects have brought economic benefit to one section of the society while causing economic hardships to another section, particularly the poor section. Also, structural intervention in managing floods in the form of constructing embankments actually transfers flood risk from one place to another.

In the context explained above, the national water policy gives appropriately more emphasis on non-structural interventions in addressing the flood management issue in contrast to earlier emphasis on structural interventions. The policy rightly asserts the importance of flood-proofing as an important element in managing floods in a floodplain country like Bangladesh where 80% of her land area is floodplain. It is vitally important to ensure that all future programs be taken in sync with the national water policy.

4.3 Bangladesh Water Act 2013

It is an act to make provisions for the development, management, abstraction, distribution, use, protection and conservation of national resources in an integrated approach. The act is applicable to the surface water, groundwater, seawater, rainwater and water in the atmosphere in the territory of Bangladesh. For the purpose of this act a small council which is called "National Water Resource Council" presided by the Prime Minister has been constituted.

Ensuring normal flow is vital in the context of flood management and drainage. The natural flow ensures the passage of flood flow without any obstruction thus moderating the flood risk. It also ensures proper drainage. The act ensures the normal flow of water course as its states that:

"No person or organization shall, without the permission of appropriate authority, stop natural flow of any water course or create obstacle to such flow or divert or attempt to divert the direction of any water course by constructing any structure, whether it is in the bank or not, of any water source, or by filling any water source or by extracting sand or mud from any water sources.

Provided that for the interest of the development of a water source or of the prevention of erosion of bank thereof, any kind of structure on such water sources may be constructed, or any water source may be fully or partly filled, on the basis of the results of necessary survey and with the permission of appropriate authority.

Provided further that, without prejudice to the generality of section 21, any flood control embankment may, with the permission of the appropriate authority, be built in a water source to save the people and their properties from natural flood."

In Bangladesh, the flood damage occurs even in an area protected by flood control embankment. This is mainly due to the lack of proper maintenance of the flood embankment and inoperability of the associated water control structures such as sluice gates. Sometime, the embankment is cut by the people with vested interest. In this context, protection of flood control embankment is of utmost necessary for proper management of flood. The act addresses the protection of flood control embankment:

"Protection of flood control embankment. – (1) To ensure the sustainability of the flood control embankment, no person shall, without the permission of the appropriate authority, be allowed to construct any house, establishment or any other structure on, or on the slope of such embankment. (2) Notwithstanding anything contained in sub-section (1), to make the flood control embankment strong and to materialize the tree plantation guidelines, be planted alongside the embankment in a well organized and planned manner. (3) Notwithstanding anything contained in sub-section (1), a flood control embankment may, with the permission of appropriate authority, be used as a street or road for the best use of land thereof. (4) In violation of the provision of sub-section (1), if any person, without the permission of appropriate authority, construct any house, establishment or other structure on flood control embankment, the Executive Committee may notwithstanding anything contained in any other law for the time being in force, issue a removal order in the manner prescribed by rules. (5) To ensure the sustainability of the flood control embankment, the Executive Committee may, subject to the provisions of this Act, impose any restriction by issuing a protection order.

Conservation of water sources is important in the context of flood and drainage. The water source acts as a retarding basin for holding excess water for drainage purposes. Retarding basins are low-lying areas of land, set aside to temporarily store stormwater during heavy rain. Thus water source act as the retarding basin which holds the excess runoff for proper drainage. The Act ensures the conservation of water sources:

"Conservation of water source and management thereof. – (1) Notwithstanding anything contained contrary in any other law for the time being in force, it appears to the Executive Committee from the results of any enquiry, security or survey: - (a) that it is an urgent necessity to ensure the water of a dighi, pond, or any other similar water source of potable water due to severe scarcity of such potable water for any natural or other reason; or (b) that it or an urgent necessity to conserve a haor, baor or any other similar water source for seasonal birds to stay or move safely and to keep their sanctuary safe. (2) In the order issued under sub-section (1), the boundary of the water source shall be specified by referring the mouza map and plot numbers thereof. (3) The Executive Committee may, subject to the provisions of this Act, impose any restriction by issuing a protection order for ensuring the proper management of the water source."

4.4 Bangladesh Delta Plan 2100

Bangladesh faces substantial downside risks from the interface of its deltaic geographical configuration, high population density, and regular episodes of a range of natural disasters including flooding, river bank erosion, sea-level rise, salinity intrusion, tidal surge, cyclones and water-logging. Moreover, dry season water shortage and wet season water surpluses; vulnerability from being a lower riparian to much of the river inflows are important characteristics. In addition, the growing water demand from rapid urbanization and industrialization; rapid depletion of groundwater owing to over-exploitation in many areas; arsenic poisoning of groundwater; and a range of water quality issues emerging from industrialization and urbanization all combine to make the effective management of the Delta challenge a major driver of national development. In view of the special long-term challenges for development outcomes presented by climate change and natural hazards, the Government of Bangladesh has adopted a long-term integrated techno-economic plan 'Bangladesh Delta Plan 2100' (BDP2100) which was approved by the National Economic Council (NEC) meeting, presided over by the Hon'ble Prime Minister and Chairperson of the NEC, on 4 September 2018.

BDP 2100 seeks to integrate the short to medium-term aspirations of Bangladesh to achieve upper middle income (UMIC) status and eliminate extreme poverty by FY2031 and developed country status by 2041 with the longer-term challenge of sustainable management of water, ecology, environment and land resources in the context of their interaction with natural disasters and climate change. The BDP2100 looks primarily at the medium-term delta agenda (2016-40) but is concerned that the decisions taken today have implications for the longer-term agenda for 2040 and beyond. In this regard, it sets up a long-term vision for the evolution of the Bangladesh Delta by the end of the 21st Century but defines short and medium-term goals as steps to reach that vision. These goals, associated strategies, policies, institutions and investments are moving targets and adaptive in nature. They are adaptive to changing natural events in order to respond appropriately and stay the course on the path of the long-term Delta vision.

One of the strategies of the BDP 2100 is flood risk management. It has included six hotspots including a coastal zone. Priority areas are flood protection, river erosion control, river management including river training and navigability, urban and rural water supply and waste management, and urban flood control and drainage. Currently, the following projects of BDP 2100 IP are being implemented by the GOB: Dredging and Excavation of Canals and Small Rivers in 64 Districts (1st Phase); Dredging/Re-excavation of Bangali-Karatoa-Fuljor-Hurasagor River System & Bank Protection Project, Urir Char Cross Dam in Noakhali project.

5. SUMMARY

This report discusses the hydrological aspect of the project highlighting the sub-regional water resource systems in the project area. It critically reviews the issues of flooding and drainage and associated policies and plans of the government of Bangladesh. The flood and drainage issue is an important consideration and input to the planning of land use in the project area. The vulnerable areas should be identified for different flood magnitudes which would assist the planner to propose an appropriate land-use plan. In case the project area becomes vulnerable for the design return period, appropriate measures would be suggested to mitigate the hydrological hazards concerning the development of an eco-park on the project site.

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