Payra-Kuakata Comprehensive Plan Focusing on Eco-Tourism
Structure Plan: 2021-2041

Printed and Published by:

Urban Development Directorate

82, Segun Bagicha, Dhaka,

Bangladesh.

First Edition: June, 2023

Price: BDT 1000.00

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EXECUTIVE SUMMARY

The Structure Plan provides a long-term strategy for the 20 years 2021 to 2041 for the development of Rangabali Upazila. It is a policy document that sets the ground and serves as the guideline for subsequent local-level plans. The overarching purpose of the Structure Plan is to promote the long-term, comprehensive development of the Rangabali Upazila through integrated planning and implementation involving several organizations and community participation for optimal resource utilization and poverty reduction.

Rangabali Upazila is situated in the Patuakhali District with an area of 696.08 sq. km including 88.79 sq. km of forest area. It is located between 21°46' and 22°05' North latitudes, and 91°15' and 90°37' East Longitudes. This Upazila consists of Six Unions, 53 Mauzas, and 65 Villages. Moreover, the planning area includes six unions, namely Bara Baisdia Union, Chhota Baisdia Union, Char Montaz Union, Char Biswas Union, Moudubi Union, and Rangabali Union. Rangabali Upazila is a newly created upazila that is isolated from the mainland and surrounded by several rivers and the Bay of Bengal.

The report presents summary information and discussion on the survey results of various aspects of the Upazila. The survey on Land Use, Physical Features, Socioeconomic conditions, Topography, Hydrology, Hazards, Environment, Agriculture, Drainage and Flood Control, and Transportation have provided useful data and information and are used in the Structure Plan. A structure Plan is prepared to provide flexibility through laying down the development strategies. This stratum of the plan is developed for the whole project area. It has duration of 20 years.

In 2011, the population of the project area was 97,072 (BBS, 2011). The Structure plan report used population data for a twenty-year plan period in the future from the estimates of the cohort method for Upazila, Union, and Potential Urban Area. The projected figure of the population is 134311 for the year 2041.

Different types of thematic maps were prepared based on 6 types of surveys during the survey stage. Each survey has a distinct output. The outputs of survey works were presented in the form of thematic maps. The thematic maps are Digital Elevation Model (DEM), existing Land Use, Road type, cropping pattern, Salinity level in deep water, groundwater recharge area, foundation depth, etc.

Suitability analysis is a prime requirement for the preparation of the structure plan of any urban and rural area. Several types of suitability maps were prepared after analyzing the suitability of the existing features. Through this analysis, suitable areas for infrastructure, economic region, human settlement, and development potentiality were identified. Tourism suitability had been carried out for identifying tourist spots for exclusive tourist zone at Sonar Char and the surrounding area.

The stakeholder's views were gathered through meetings at Upazila and Union levels for consideration in the planning decisions. Based on the analysis of survey information, critical planning issues of the Upazila have been identified. Estimates on the future growth pattern

for potential sectors have been useful in planning decisions and land use allocations following planning standards.

The Structure Plan provides the policies that will guide the future development of Rangabali Upazila. In the Structure Plan, 16919 acres (9 %) of land is kept as a rural settlement area, and 28741 acres (16 %) of land is kept as a forest area. Besides, the economic zone (1 %), circulation network (1 %), potential urban area (1 %), water-body (46 %), and foreshore and coastal afforestation zone (2.52%) areas are earmarked on the Structure Plan to support the future need for food and other development purposes of the Upazila. This plan also includes information on the Zones of the Structure Plan's Permitted and Conditional Uses.

By integrating planning and implementation with government authority, private investor involvement, and community involvement, the overall goal is to achieve eco-tourism for foreign tourists and eco-friendly development of Sonar Char and the surrounding char for the best possible use of resources and reduction of poverty in this area. Five Char from the Patuakhali district in Rangabali Upazila are included in the Structure Area Plan: Sonar Char, Char Montaz, Andar Char, Char Taposhi, and Char Hare.

From disaster risk, Andar Char and Sonar Char have a low disaster risk. The majority of Sonar Char and Char Taposhi/Kolagasi are covered with forests. Development suitability and tourism suitability have been done to identify a suitable location. From tourism suitability analysis, is found that 48.04% of areas are less suitable areas according to tourism potentiality. Only 1.5% area is suitable for tourism and all proposals are given based on suitable sites. The community-based tourism proposed in the plan by considering the potentiality of the Rakhine Ethnic Community and Fisherman community.

It sets a long-term indicative strategy that will show the future pattern or direction of coordinated urban development and will serve as the framework for local-level plans. The Structure Plan consists of a report which is a policy document with various supporting maps and an appropriate scale composite map depicting the key elements of the major strategic decisions. It also includes future broad functions of different strategic zones. The report identifies the order of magnitude and direction of anticipated urban growth and defines a broad set of sectoral policies considered necessary to achieve the overall plan vision and objectives.

CHAPTER ONE: INTRODUCTION

A structure plan is a comprehensive and strategic land-use planning document that provides guidance and direction for the development of Rangabali Upazila. It sets out the long-term vision, goals, objectives, and policies for the Upazila area, and identifies the location, scale, and nature of future development for 2041. The plan typically addresses a wide range of issues, such as housing, transportation, infrastructure, environmental protection, and economic development, and aims to ensure that development is sustainable, socially equitable, and environmentally responsible. Structure plans are usually prepared by government bodies, such as local or regional authorities, and provide a framework for decision-making and regulation related to land use and development.

In addition to the comprehensive guidance and direction provided by a structure plan, it also serves as a crucial tool for managing growth and development in a coordinated and strategic way. By outlining specific policies and development standards, the plan helps to ensure that new development aligns with community goals and values, and that it is compatible with existing infrastructure and land uses.

A structure plan typically involves a significant amount of community engagement and stakeholder input, as it seeks to reflect the aspirations and needs of the community. It is also subject to review and amendment over time, as circumstances and priorities change. Overall, a structure plan plays an important role in shaping the built environment, promoting sustainable development, and ensuring the long-term viability of a specific geographic area.

1.1 Background of The Study Area

Rangabali Upazila is located inside the district of Patukhali District and located on Bangladesh's outer coast. It is bounded by Kalapara on the west and Galachipa upazilas on the north, Bay of Bengal on the south. It offers a range of economic benefits and attracts industries and businesses reliant on the coastal Resource. Sonar Char mangrove forest attracts domestic and international visitors keen to experience a slice of paradise. The coastline along the upazila is dynamic and distinctive. The impacts of climate change and inevitable pressures caused by land use and development need to be carefully considered along with ways in which the community as well as the authority can ensure sustainable management of natural and physical coastal resources, now and for future generations.

The background of this strategic plan is to propose a strategic and integrated landuse zones considering its hydrological, geological, disaster risk sensitiveness, socioeconomic, and other relevant facility settings, for managing the protection, use and development of the upazila environment.

Past and Present Administration of Rangabali Upazila:

The exact history of naming of Rangabali upazila is not known. However, it is said that due to the creation of new shelf in the sea, the sand of this shelf was red in the evolution of time. The word 'red' is locally known as 'ranga'. This is the origin of the name "Rangabali".

Historians say that in 184, some Rakhine people fled the state of Arakan and settled in the area. From then on, settlement started in this area. The administrative approval of Rangabali Upazila was given on 6 June 2011 at the 105th meeting of Nikar (National Implementation Committee for Administration Reform). Following this, Bangladesh Gazette was published on 13 June 2011. Happy inauguration, February 25, 2012 AD.

Among eight upazilas of Patuakhali Zila, the newly created of Rangabali Upazila is one of them. It is located in between 21°46' and 22°05' north latitudes and in between 91°15' and 9 0°37' east longitudes. It is bounded by Galachipa Upazilas on the north, Bay of Bengal on the south, Char Fasson Upazilas on the east, Kalapara Upazila on the west. Previously, whole of Rangabali upazila was under Galachipa upazila. The newly created of Rangabali Upazila consists of six union Parishads. These are Bara Baisdia union, Chhota Baisdia union, Char Montaz union, Char Biswas union, Moudubi union and Rangabali union. The upazila occupies an area of 696.08 sq.km. and its Population are 1,18,377(BBS). The average literacy rate of the upazila is 30.98%. Important place of Rangabali Upazila is Sonar Char. The most important attraction of Sonar Char is that one can see both Sunrise and Sunset from some of its locations. Main crops are Paddy, watermelon, Ground Nut, Chilli, Betel leaf etc.

Table 1 Study Area Overview

Rangabali Upazila							
Number of Union	Upazila Area(Sq.Km)	Population(BBS, 2011)	Number of Mouza	Number of Village	Total Household	Community Clinic	Education Institution
06	696.08	98000	53	65	29550	5	97

Source: National Portal, 2023

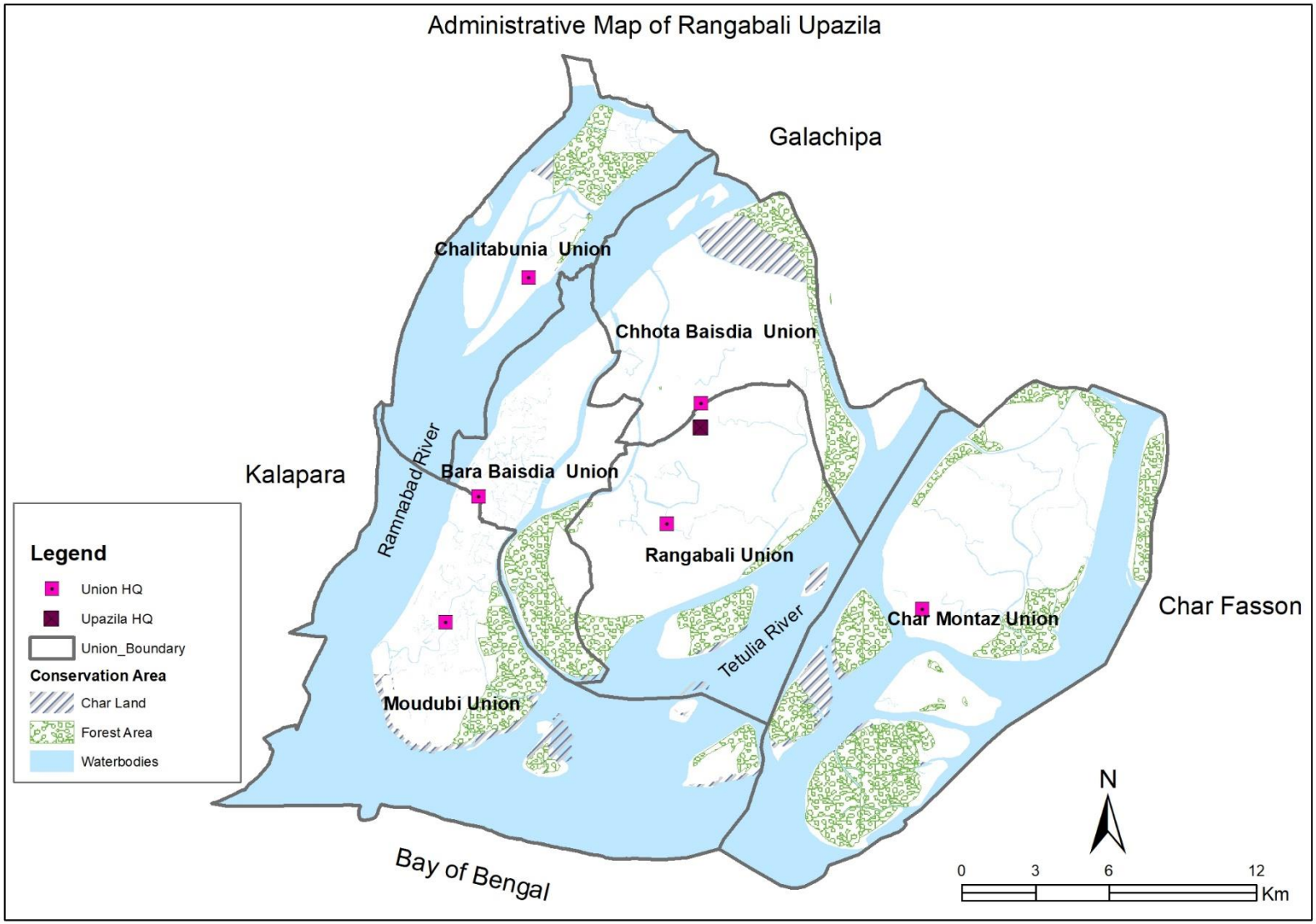


Figure 1 Administrative Boundary of Rangabali Upazila Source: PKCP project, UDD, 2018

1.2 Goal and Objective of the Structure Plan

The overall goal of this structure plan is to lead the development of Rangabali Upazila in order to enhance the residents' socioeconomic position by following the guidelines laid out in the regional plan and focusing on eco-tourism.

Specifically, the objective of this structure plan is to formulate strategic development plan for regional plan considering functional and land use requirement with hazard vulnerability.

To reach the objective the plan has been prepared considering existing Physical features, Socio-economic scenario, Transportation, Disaster, Hydro-geology, Geology, Hydrology and Natural resources like Forest, River, Char etc.

1.3 Component of the Structure Plan

In order to prepare the structural plan, not only the above-ground scenario but also the below-ground scenario was examined. To inspect the comprehensive circumstances, multiple components have been taken into account. These components are forest, hydro-geology, geology, transportation, disaster, socio-economic and physical feature survey.

1.4 Approaches to Planning

In Bangladesh, approach to planning can be particularly important given the country's rapid population growth, urbanization, and other economic and social challenges. Here are some issues that can be taken to prepare a structure plan for Rangabali upazila of Bangladesh.

- Selection of the project area for sustainable planning and development.
- Collection and Geo-referencing of the entire upazila mouza map and preparation of basemap.
- Available data collection from secondary sources i.e. hydro graphic chart, water level, water flow, meteorological, disaster data and any research conducted on study area.
- Review of available data and reports.
- Field survey for Hydrological, Geology, Transport, Agriculture and Physical feature survey.
- Collection of tentative government project at the project area.
- Identify the source of sweet water for industrial, Agricultural, Residential and other uses;
- Planning of the proposed development work considering the natural beauty of this area for tourism;
- Devise the plan for development work keeping the wetland, khals and other natural resources uninterrupted in order to preserve the environmental balance.
- Reserve the rain water for different uses.
- Rakhine Ethnic community and fisherman culture conservation and declare as eco-tourism spot.
- Provide service facilities to the char area and include their livelihood opportunities.

- Recommendation for improvement of existing communication facilities in the project area.
- Provision for recreational facilities would be entertained while designing the coastal protection facilities.
- A mega plan to develop villages to have a range of civic amenities and growth centres around the country is on the targeted project under “My village My Town Project”.

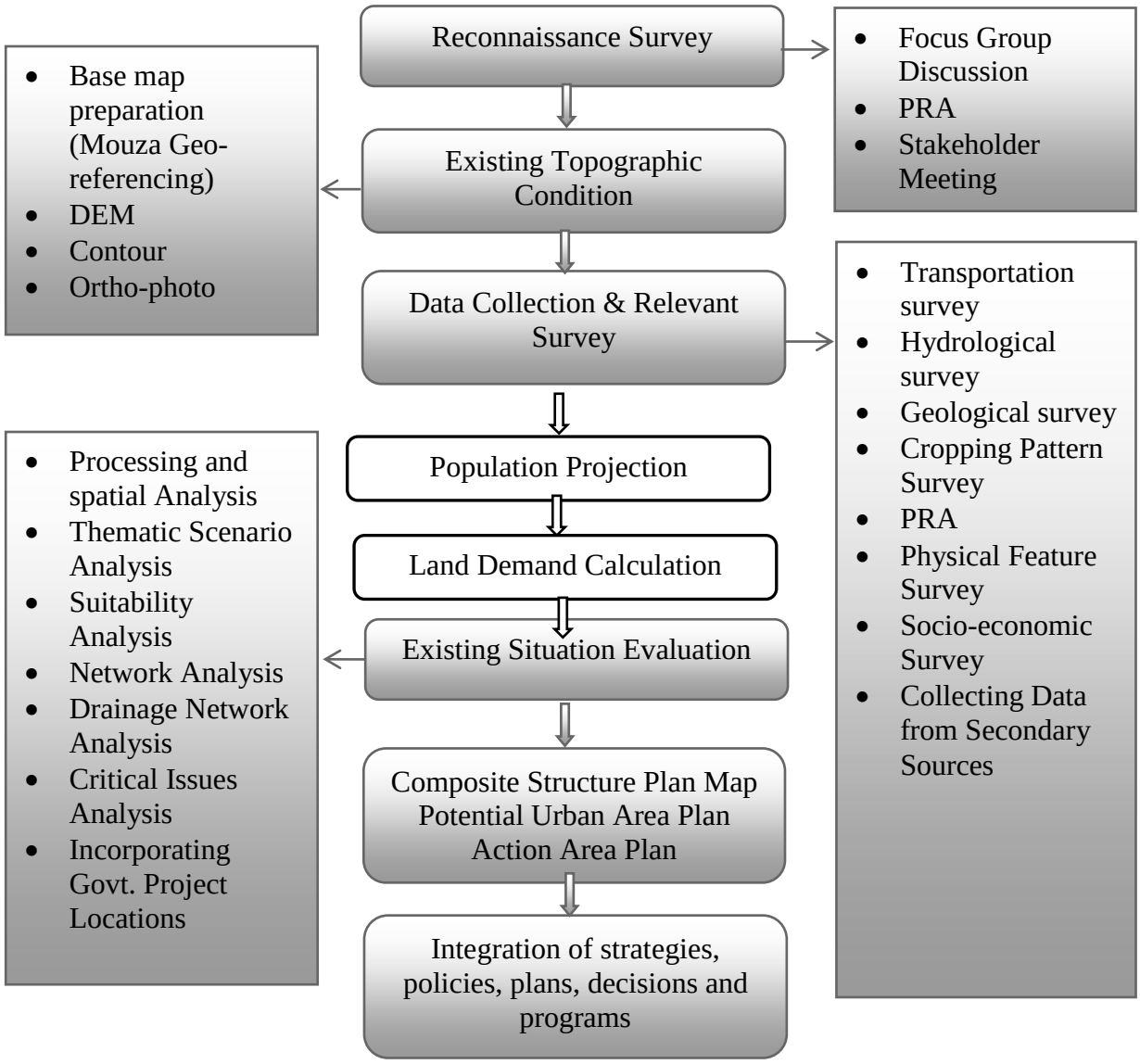


Figure 2 Technical Methodology of Structure Plan Preparation

Identify the key needs and challenges facing Bangladesh in terms of social, economic, and infrastructure development. This can involve analysing demographic data, assessing infrastructure gaps, and conducting surveys and stakeholder consultations to gather input from communities, businesses, and other stakeholders. Identify and prioritize strategies and

policies that will help achieve the goals and objectives of the plan. Engage with stakeholders throughout the planning process to ensure that their needs and concerns are taken into account and to build support for the plan. Overall, the structure plan approach to planning can help Rangabali Upazila problems, address the complex challenges it faces and achieve sustainable, inclusive development that benefits all of its stakeholder.

CHAPTER TWO: CRITICAL PLANNING ISSUES

2.1 Overview of the Planning Issues

It is necessary to investigate the past scenario in order to plan for the future. In this chapter, demographic, topographic and socio-economic aspects have been investigated to learn about natural and anthropogenic expansion. Paying attention to efficient planning and the frameworks that direct the upazila's trendy expansion is a crucial component of the development strategy for the upazila. One of the primary reasons to consider promoting the suitability of cities is the effects of the increased construction to the environment. There necessitates an understanding that upgrading of the facilities promotes a sustainable existence.

2.1.1 Demographic Setting of the Upazila

In 2011 the total population of the Rangabali upazila was 97,072 of which 49,426 were males and 47,645 were females. The sex ratio of the Upazila was 104 which have remarkably increased in 2011 compared to 99 in 2001. Analysing the population growth history, it is explored that in 1991, the total population of the Rangabali upazila was 75,020 of which 40,757 were males and 34,263 were females. The total population of Rangabali upazila is 118377 at the year of 2022. (Note: In 2011, Rangabali Upazila was the part of Galachipa Upazila. After declaration of Rangabali as Upazila, there are subtle difference in population calculation due to newly created union).

Table 2 Demography of Rangabali Upazila

Union Name	Population, 2011(BBS)	Population, 2021	Population,2022 (BBS) Provisional	Population, 2031	Population, 2041
Bara Baisdia Union	13,943	15,553	20383	17,625	19428
Chalitabunia Union	7,400	8,181	8535	9,206	10097
Char Montaz Union	19,569	21,754	25997	24,675	27298
Chhota Baisdia Union	20,070	22,426	22104	25,363	27932
Rangabali Union	29,490	32,821	32371	36,866	40360
Moudubi Union	6,600	7,362	8987	8,343	9196
Total	97,072	108,097	118377	122,078	134,311

Source: BBS,2023

2.1.2 Forest and Plantation

The study area consists about 19,000 ha of mangrove forest coverage (CEGIS Land Use Analysis, 2022). Most of the forests are lies within the intertidal area and south facing along the coastal part of the forest area of the PKCP. In last 5 years in Patuakhali and Barguna districts under Coastal Forest Division, Patuakhali total 1164.5 seedling kilometre plantation had been raised under social forestry program which cover 60 km area of Rangabali Upazila. Mangrove forest covers area of 9609 ha, mudflats 706 ha, sand dune and beaches 195 ha.

Rangabali is an upazila located in the Patuakhali District of Bangladesh. It is known for its beautiful forests and plantations, which add to its natural beauty and ecological significance. Sonar char on the shores of the Bay of Bengal full of amazing natural beauty. It is located in the southern boundary of Rangabali Upazila of Patuakhali, close to the Bay of Bengal. There is a vast forest as well as a seven-kilometre long beach, there are red crow. When the tidal waters rise in the sea, a unique beauty develops in Sonar Char. Small and big waves crashed on the shoreline. Sunrise and sunset can also be seen standing on the beach of Sonar Char like Kuakata. Besides, there are various species of wild animals including deer, monkey, and pig in Sonar Char. As well as 12793 ha of reserved forest land. In 2004, Sonar Char woke up along the Bay of Bengal.

2.1.3 Housing and House Building Material

It has been observed that people do not want to leave their houses for group shelters due to concern for their belongings and livestock. This causes higher casualties during cyclones. People in these disaster-prone areas make their own ways of surviving through house building techniques and settlement patterns. Since traditional houses are made of indigenous materials with crude methods, the loss of life and property are enormous. With proper construction techniques, houses will be able to withstand storm surges, possibly increase survival rates and decrease property damage. The catastrophe is especially severe in this area because of the shape and nature of its coastline.

A typical cyclone forms in the deep sea passing over one of the largest continental shelves along the coastal area of Bangladesh. Because of the shallow depth of the continental shelf, the energy of the cyclone is forced to come to the shore with a sea surge and is further constricted because of the funnel-shaped coastline of the northern Bay (Sadeque, 2018).

Following house construction characteristics were found:

- RCC post and metal/wooden frames are dominant in structure.
- CGI/plain metal sheets are used as wall and roofing material.
- Timber used as door and window frames.
- Both pucca and semi-pucca plinths are found in structure.
- Bamboo mats/ tarpaulins are used under roofs in order to mitigate the heating.

2.1.4 Land use Erosion and Protection

The coastal zone of Bengal delta is very dynamic because of the continuous erosion and accretion at the coastline. An estimated load of 1 billion tons of sediment carried out by the

GBM basin which resulting accretion in the Bengal basin; on the other hand, tidal forces and wave action cause erosion to coastal lands (after Sarwar et al., 2013). Ahmed et al. (2018) published a study on coastal geospatial analysis which identified a total of 2693.80 km² of coastal lands that experienced erosion and/or accretion (or both erosion and accretion) over the past thirty years from 1985 to 2015. The same study reported that out of the entire coastal area about 0.59 % (266.32 km²) and 0.02 % (10.01 km²) of the coastal lands exhibit high and very high susceptibility to erosion, respectively which is noteworthy for the densely populated coastal area of the country.

Coastline analysis shows more sedimentation in the mouth of Tetulia channel comparing to estuary of Baleshwar or Bishkhali-Burishwar Payra system. This sedimentation occurs mainly due to the upstream combined flow of Ganges-Brahmaputra-Meghna System.

According to CEGIS estimate, the rate of erosion along the major river varies between 38.13 ha/year to 0.2ha/year. The high erosion was observed in Ramnabad river. The accretion rates vary between 56ha/year to 0.2ha/year. The highest accretion was observed in Lohalia river. In general, erosion is dominating in Ramnabad channel. Based on the analysis of wave and tide dynamics, the study derived a number of hydraulic design parameters for the protection works.

Table 3 Upazila-wise accretion and erosion areas between 1989 and 2021

	1989-1999		**1999-2009**		**2009-2021**		**1989-2021**	
Upazila	Accretion(Sq.Km)	Erosion (Sq.Km)	Accretion(Sq.Km)	Erosion (Sq.Km)	Accretion(Sq.Km)	Erosion(Sq.Km)	Accretion(Sq.Km)	Erosion(Sq.Km)
Rangabali	52	23	49	20	23	12.23	79	26

Source: PKCP, UDD, 2018

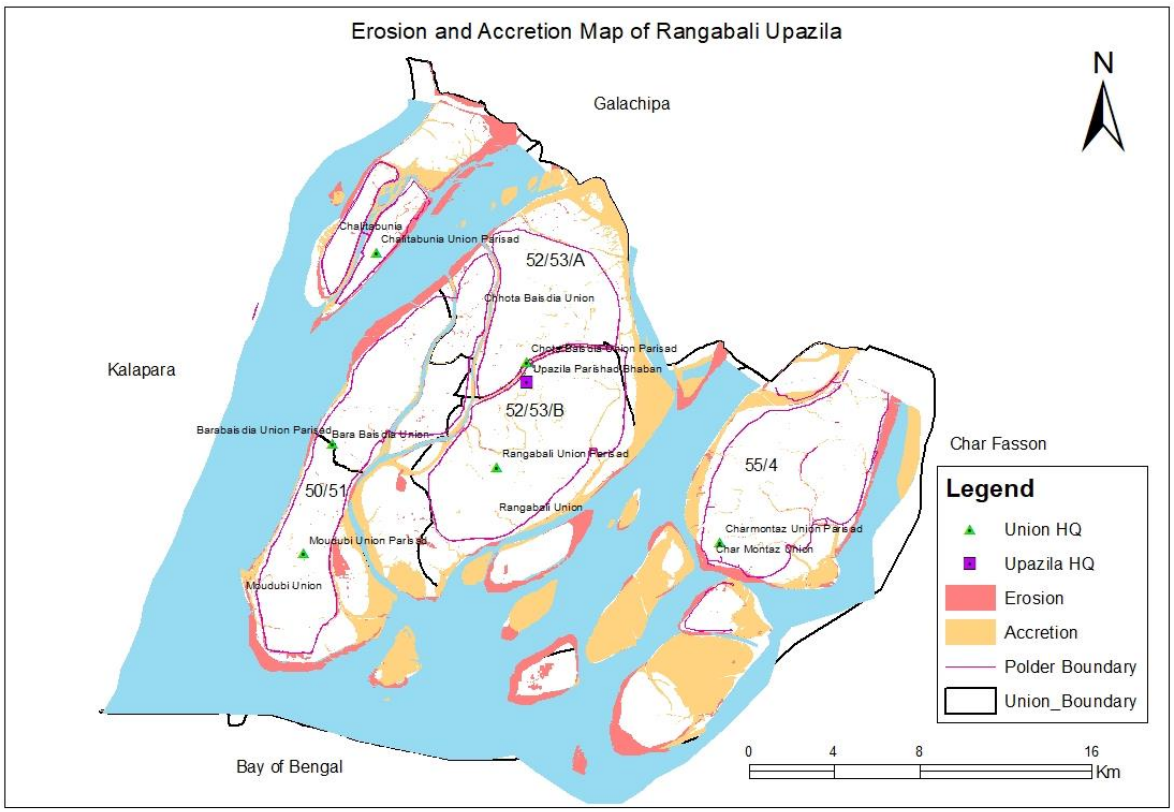


Figure 3 Erosion and Accretion Map of Rangabali Source: PKCP, UDD, 2018

The study also conducted a frequency analysis of the maximum significant wave height along the shoreline. The study considered two options for coastal erosion protection. Option 1 is a series of groyne and multifunctional dyke while option 2 is sleeping defence such as coastal armouring, sand nourishment, and multifunctional dyke. Based on the multi-criteria analysis, the study opted for Option 1 as the most feasible option. As Option 1 entails groyne and multifunctional dyke, the study designed the different parameters of groyne structures. The layout of the groyne is designed in such a way that it would not discontinue the beach entirely, rather it is proposed to protrude 70 meters offshore which will provide ample space for tourists.

2.1.5 Disaster and Vulnerability

The PKCP area is typically exposed to cyclone, storm surge, erosion, lightning, drought, etc. According to the INFORM sub-national risk index of 2022 Barguna district is ranked at 4th and Patuakhali is ranked at 11th according to the multi-hazard risk level within the country. For the PKCP area, cyclone, storm surge, are river bank erosion are strategically important natural hazards.

One of the most devastating disasters to hit Rangabali Upazila in recent history was Cyclone Sidr, which struck the area in 2007. The cyclone caused widespread damage to infrastructure, including roads, bridges, and buildings. Thousands of hectares of agricultural land were destroyed, and many people lost their homes and livelihoods.

In recent years, efforts have been made to improve disaster preparedness and response in Rangabali Upazila. Early warning systems have been installed to alert residents to impending disasters, and evacuation plans have been developed to ensure the safety of those in high-risk areas.

Climate Change

The coastal area of Bangladesh is facing most climatic hazards and disasters. Due to climate change, sea level rise and associated increase in salinity and cyclonic storms is threatening the study area. Bangladesh has been in process of preparing National Adaptation Plan and has already prepared the Bangladesh Delta Plan 2100, 8th Five Year Plan, Sector Action Plan and is updating the Bangladesh Climate Change Strategy and Action Plan. Based on these policies and plans the future development in the study area will be guided. This baseline report presents an overall scenario of climate and hazards in the study area along with potential future impacts.

Deforestation, soil degradation, and loss of biodiversity are some of the significant environmental vulnerabilities of Rangabali Upazila. These environmental issues can have adverse effects on the livelihoods of local communities and the sustainability of the area's natural resources.

Salinity Intrusion

The salinity levels in Rangabali Upazila vary depending on the time of year and the location within the upazila. During the dry season (November to April), when there is less rainfall and freshwater flowing into the area, salinity levels tend to be higher. Conversely, during the Monsoon season (June to September), when there is more rainfall and freshwater, salinity levels tend to be lower.

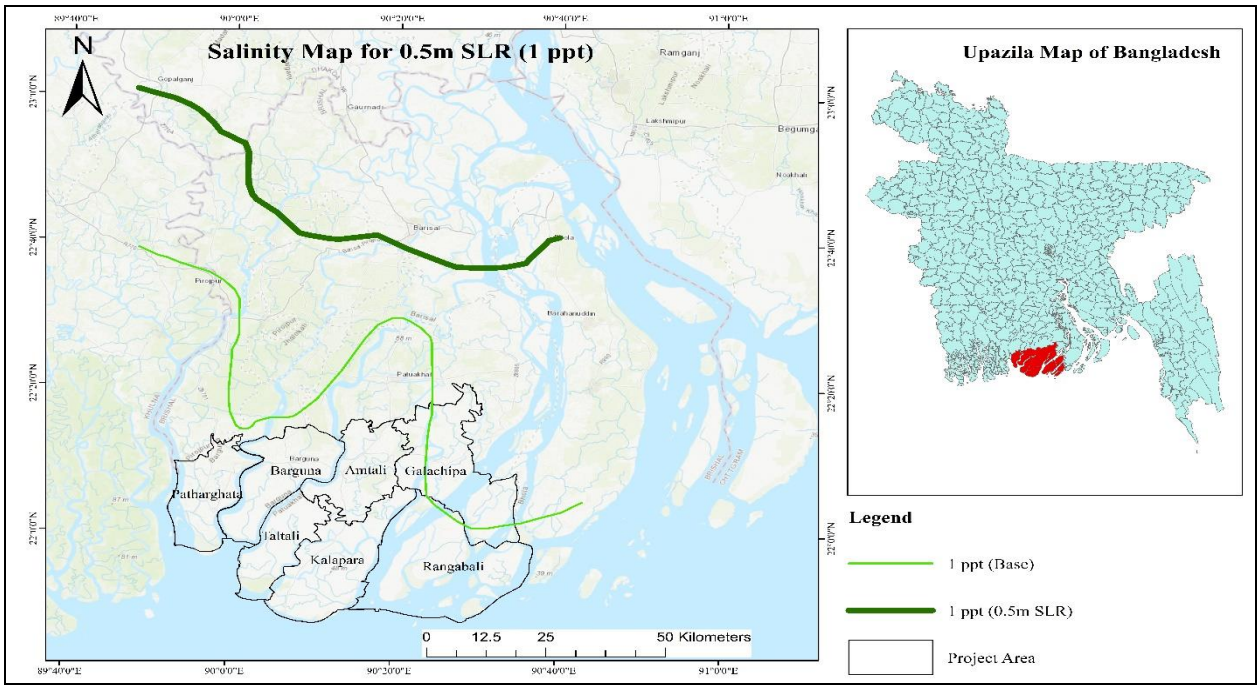


Figure 4 Salinity Map of 1 ppt for 0.50 m SLR

Source: PKCP, UDD, 2018

According to a study conducted by the Bangladesh Water Development Board, the salinity levels in Rangabali Upazila range from 5 to 20 parts per thousand (ppt) during the dry season and from 0.5 to 5 ppt during the monsoon season. These levels can vary depending on factors such as distance from the coast, elevation, and proximity to freshwater sources such as rivers and canals.

The Sea Level Rise would increase the salinity ingress. According to CEGIS analysis, the 1 ppt salinity affected areas will be increased by 7.5% in midterm, while the 5 ppt salinity area will increase by 9%. The situation will be worse on the western coast. This scenario of gradual salinity intrusion into the coastal areas of Bangladesh is very threatening to the primary production system (consist 30% of the country's cultivable land), coastal biodiversity and human health.

Salinity intrusion in the southwest region reduces the freshwater supported area, resulting in decreased agricultural production in many parts of the coastal zone, especially the Khulna and Patuakhali region and small areas in the Noakhali and Chattogram.

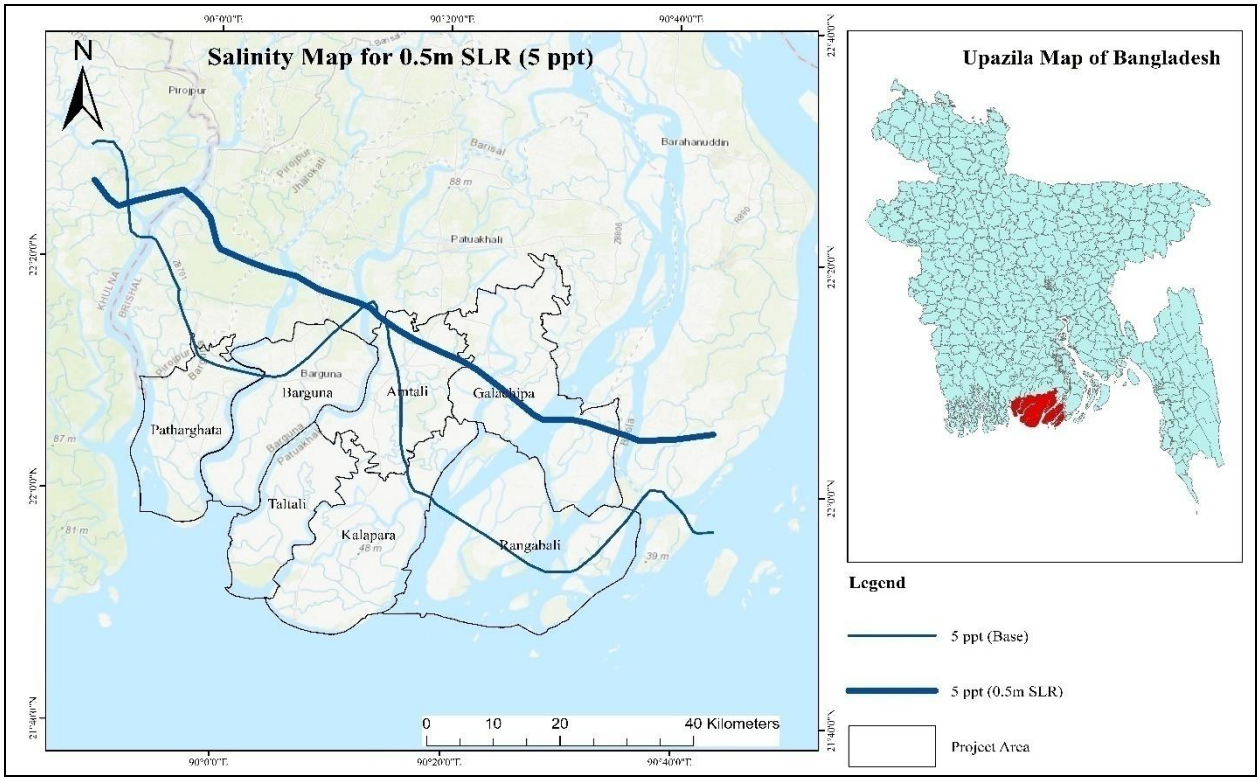


Figure 5 Salinity Map of 5 ppt for 0.50 m SLR

Source: PKCP, UDD, 2018

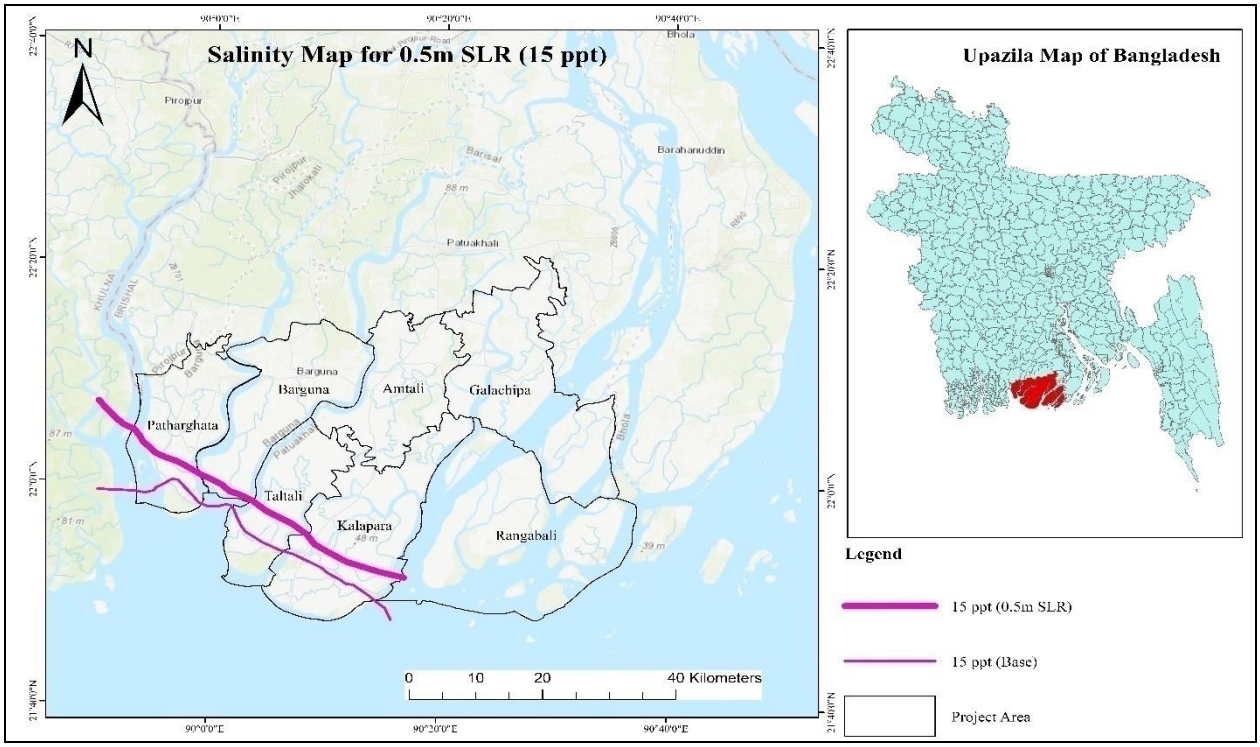


Figure 6 Salinity Map of 15 ppt for 0.50 m SLR. Source: PKCP, UDD, 2018

Table 4 Salinity coverage of Rangabali Upazila for different scenario of 0.5m SLR.

Upazila	1 ppt				5 ppt				15 ppt			
	baseline		0.5 SLR		baseline		0.5 SLR		baseline		0.5 SLR	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Rangabali	696.08	98	696.08	100	319	44.21	696.08	100	0	0	169	35

Source: PKCP, UDD, 2018

Sea Level Rise

According to various studies and reports, the sea level in Bangladesh has been rising at a rate of around 7 millimetres per year, which is higher than the global average. This rise in sea level has significant impacts on the coastal communities of Rangabali Upazila and the surrounding areas, including increased coastal erosion, inundation of low-lying areas, and saltwater intrusion into freshwater sources.

The impacts of sea level rise are particularly severe during cyclones and storm surges, which are becoming more frequent and intense due to climate change. These events can cause widespread damage to infrastructure, homes, and crops, as well as loss of life.

2.1.6 Rakhine Ethnic Community

Rakhain Palli is a place where Rakhain people live. Rakhine is a small ethnic community in Rangabali Upazila, migrated from Arakan of Myanmar some 200 years back. Rakhine Palli

consists of several villages including Midupara and Hong Chong Para. A visit to this place gives an opportunity to see the lifestyle, culture, and tradition of Rakhine people. There is a Buddhist Temples. They produce various types of handicrafts including decorative clothes by using hand loom. Rakhains had three types of home, made of bamboo, wood and stone. Their house is mainly two storeyed and the ground floor is kept vacant. They live on the platform of first floor dividing it into various compartments. In the entrance, the room is earmarked for the guests. The second room is for the master, the third one for the male children, and the fourth and rear room is earmarked for the young un-married daughters. There are two holes measuring 6' to 8' on the fence or wall of this room so that the young girls can talk to their respective lovers through these whole at night. Rakhains are engaged in various professions. Beside the main occupation of farming and fishing, they are engaged in trading, shop-keeping, boat and ship building, weaving etc. Many of them work as artisans with the professional group like goldsmith, blacksmith, carpenter, painter, wood-carver, mason and metallurgical technician.

Figure 7 PRA with Rakhine Ethnic Community Source: PKCP, UDD, 2022

2.1.7 Char land

Char Montaz is a larger char of Rangabali Upazila that is located on the south side of Rangabali Union. It is home to several thousand people who live in small villages and make their living primarily through fishing and farming.

Sonar Char is a relatively new island that formed through the process of accretion, which is the gradual accumulation of sediment and other materials. The island emerged in the early 2000s and has since grown to a size of around 9 square kilometres.

Between Sonar Char and Char Montaz, this is the closest Char. This Char is expected to be created solely for international tourists, with a variety of modern facilities. The population of

this Char is currently around 3782 people. A small wooded area can be found in the northern part of the Char.

The Sonar Char and Char Andar are located to the west of Char Taposhi/Kolagasi. This Char is ideal for a jungle adventure. The Char is densely forested with mangroves. Water, plants, and fauna are available to foreign visitors. It would be ideal to spend time in a tree house. In Char Taposhi/Kolagasi, there are no people.

Char Hare is one of many chars in the coastal region of Bangladesh that are vulnerable to the impacts of climate change, including sea level rise, coastal erosion, and increased frequency and intensity of cyclones and storm surges. The island is also prone to flooding during the monsoon season, which can make it difficult for residents to access basic services such as healthcare and education.

2.1.8 Community Tourism

Rakhine and fishermen communities in Bangladesh's coastal areas, including Rangabali Upazila and Hatiya Upazila, have started to explore the potential of community tourism to generate income and improve livelihoods. One example of community tourism with Rakhine and fisherman is the development of homestay programs in these areas, where visitors can stay with local families and experience their way of life. Visitors can participate in fishing trips, learn traditional fishing techniques, and enjoy locally prepared seafood dishes. They can also learn about Rakhine culture, including their traditional crafts, music, and dance.

2.1.9 Economic Growth of the Area

The economic growth of Rangabali Upazila has been influenced by several factors, including agriculture, fishing, and the growth of small and medium-sized enterprises.

Agriculture is the primary source of income for the people of Rangabali Upazila. The fertile land and favourable climate in the area make it ideal for crop cultivation. Farmers in the area mainly cultivate watermelon, paddy and pulse. The production of these crops has increased significantly in recent years due to the availability of better seeds, fertilizers, and irrigation facilities. As a result, the income of farmers has also increased, leading to overall economic growth in the area.

Fishing is another significant source of income for the people of Rangabali Upazila. The area is surrounded by the Bay of Bengal, which provides abundant fish and seafood resources. The local fishermen use traditional methods such as gill netting and shrimp trawling to catch fish. The government has also introduced several initiatives to support the growth of the fishing industry in the area, such as providing training and financial assistance to fishermen.

Small and medium-sized enterprises (SMEs) have also contributed significantly to the economic growth of Rangabali Upazila. Many people in the area have started their own businesses, such as grocery stores, tailoring shops, and small manufacturing units. These businesses not only provide employment opportunities but also help to meet the local demand for goods and services.

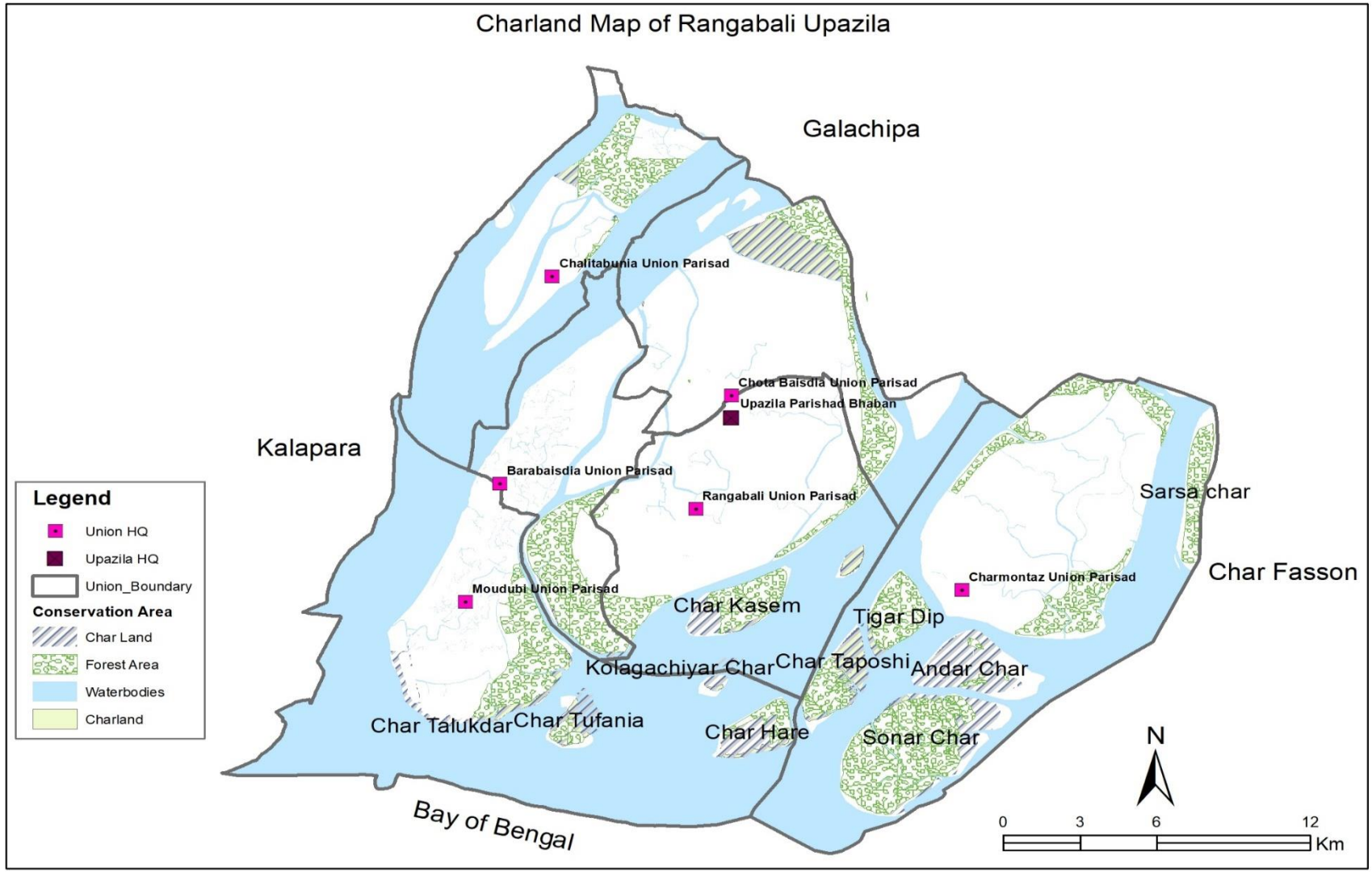


Figure 8 Char Land Map of Rangabali Upazila

Source: PKCP project, UDD, 2018

2.1.10 Natural Resource

Forest Resources

Rangabali Upazila was originally enriched with char land and forest resources. Forests are reproduced for human needs. The forest department declared Sonar char as a reserve forest in 2011. At present, deer, wild boar, monkey, forest rooster, fox, beige, guisap, guest bird of different species lives in the forest.

Agricultural Resources

Agriculture is the main livelihood in the area although the maximum amount of land cannot use for cultivation due to drainage constraints. Transplanted Aman rice followed by pulses is the main cropping pattern of this region. Nowadays, the Department of Agricultural Extension (DAE) emphasizes oil crops (sunflower, soybean, etc.) production to meet up-country demand. Due to their coastal locality, Rangabali Upazila area is vulnerable to natural disasters such as floods, cyclones, tidal surges, salinity, etc. Recently, climate change triggered these natural disasters both in terms of occurrence and intensity. Climate-smart crop varieties, crop diversification, agricultural mechanization, use of modern technologies, etc. interventions are needed to combat climate change as well as sustainable crop production.

Land ownership for agriculture, 53.25% of people own land, and 46.75% do not. Main crops Paddy, wheat, potato, onion, pulse, vegetables. Extinct or nearly extinct crops Sesame, linseed, Kaun. This Upazila has a number of fisheries, dairies and poultries. Traditional bullock cart transportation is extinct or almost extinct. Renowned manufacturers: cold storage facility, rice mill, and welding plant, Cottage industries weaving, blacksmith, potteries, wood work.

2.1.11 Language and Culture

The geography and geographical location of the upazila has played a role in the formation of the language and culture of the people of this upazila. Cultural events are spread in Rangabali upazila on the basis of seasonal events such as Nowkabaich (boat recessing), Baishakhi Mela, Pausch Sanchini, Maharram Mela etc

2.1.12 Water, Sanitation and Hygiene

From physical feature survey it is found that 82.97 percent toilets are in average condition, 15.44 percent are in poor condition, only 1.59 percent were in good condition. This scenario clearly illustrates the sanitation facility is low in quality. Based on tube-well vs. walking distance of household, it is explored that only 70.69 percent household has somewhat access to quality drinking water source only 3.77 percent has easy accessibility.

Easy accessibility to a water source: drinking water from an improved water source that is accessible on premises, available when needed 5.45%.

Somewhat accessibility to a water source: drinking water from an improved source,

provided collection time is not more than 30 minutes for a roundtrip, including queuing 73.47%.

Limited accessibility to a water source: drinking water from an improved source for which collection time exceeds 30 minutes for a roundtrip, including queuing 21.08%.

From socio-economic sample survey it is explored that Tube-well (64.69%) is the main water source for the people of Rangabali potential Urban Area. The second main source of water in potential Urban Area area is pond water (35.31%). Without these two sources in potential Urban Area area people collect water from own Deep tube well, rain water and pump. Pipeline water service is not available in Rangabali Upazila. Tube well is the main water source for the people of Rangabali Upazila.

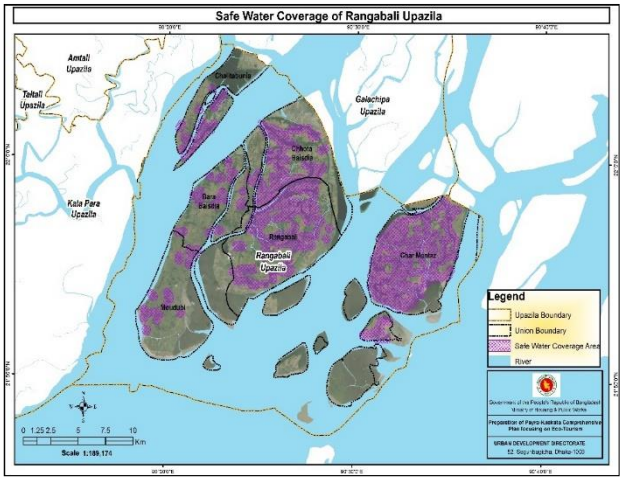


Figure 9 Safe water coverage of Rangabali

2.1.13 Hydro-geological attributes

Rangabali Upazila is located in the coastal area of Bangladesh and is surrounded by the Bay of Bengal on the south and west. The hydrogeology of Rangabali Upazila is complex, with a combination of different aquifer systems; including unconfined, confined, and mixed aquifers. The unconfined aquifer is the most common and is found in the upper layer of the soil. It is mainly composed of sand, silt, and clay, with a thickness varying from a few meters to tens of meters. This aquifer is recharged by rainfall and infiltration from rivers and canals.

The confined aquifer is found at a deeper level, beneath the unconfined aquifer. It is composed of sand, gravel, and clay, and is confined by impermeable layers of rock or clay. This aquifer is generally under high pressure, and the water quality is relatively good.

The quality of the groundwater in Rangabali Upazila is generally good, but some areas may be affected by salinity intrusion due to the proximity of the Bay of Bengal. The groundwater table is also affected by seasonal variations, with the water table rising during the monsoon season and declining during the dry season.

Top soil is not available throughout the whole area. It is available only in the northern part of the Upazila. Underlying sediments are dominated by fine grained sand layer throughout the Rangabali Upazila. A continuous non-uniform clay layer has been found under 180m depth. Clayey silt layer, Coarse grained sand layer and medium grained sand layer is absent in this area.

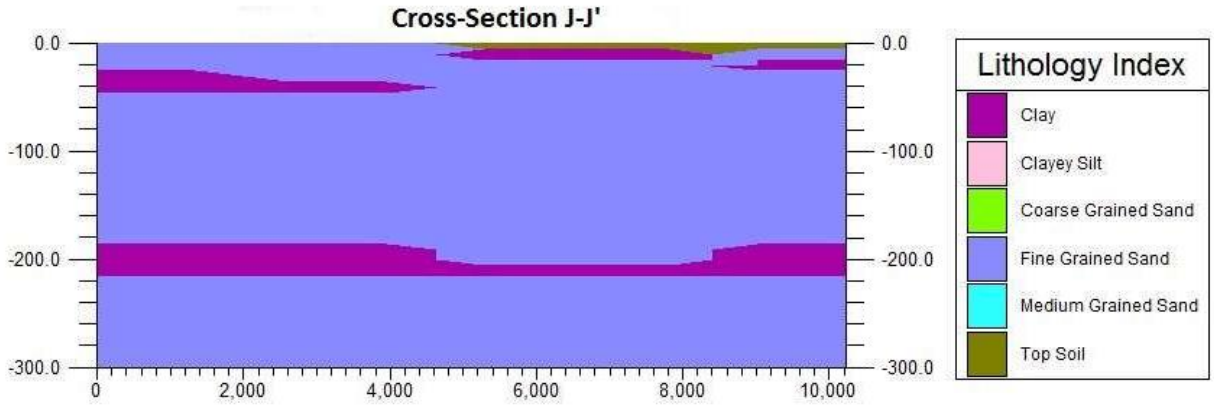


Figure 10 Subsurface lithology of Rangabali Upazila Source: PKCP, UDD, 2018

2.1.14 Existing Drainage

As the area lies at the southernmost tip of Rangabali 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 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.In the Rangabali Upazila, there is no drainage system in the Upazila areas. All small drains are connected to the main drainage network, and the drainage outlets mainly depend on the main river system and adjusted canals near the main drainage site.

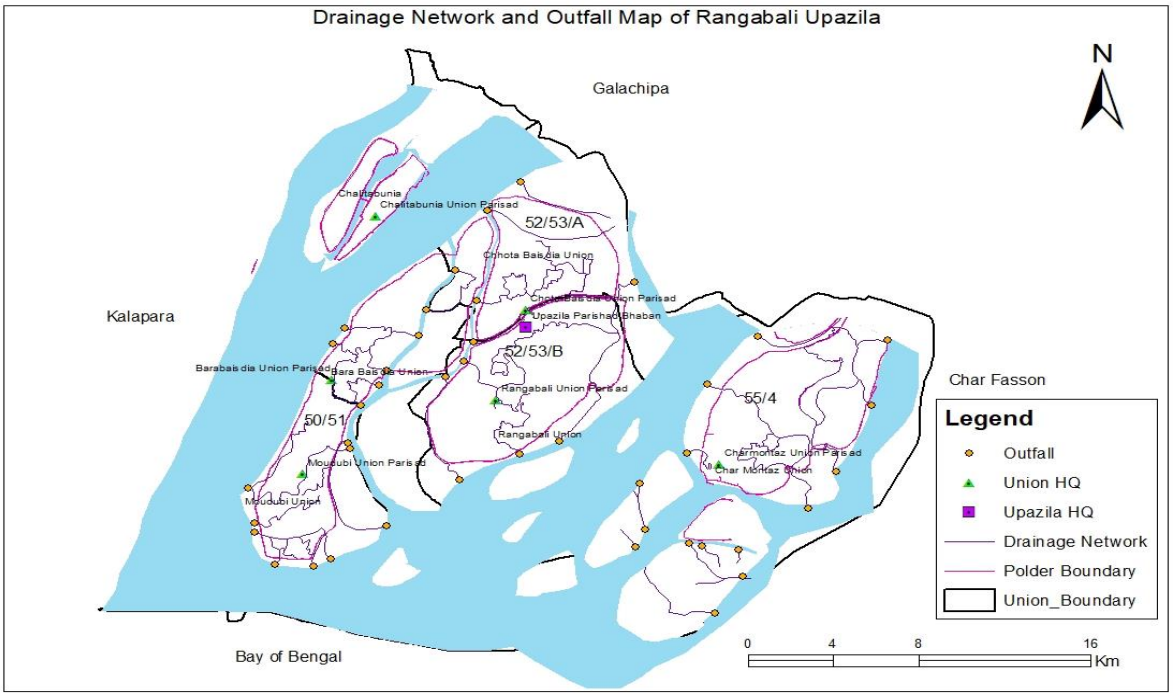


Figure 11 Drainage outfalls of the canals and tidal creeks Source: PKCP, UDD, 2018

2.1.15 Geological Attributes

The study area shows three prominent geomorphological units such as 1) Fluvio-Tidal Deltaic Plain, 2) Natural Levee, and 3) Intertidal/Supratidal units. The surface of the study area is fully covered by the recent sediments, which are divided into two major surface geological units, i.e., 1) Tidal Deltaic Deposit and 2) Mangrove Swamp Deposit.

2.1.16 Physical feature

Structure use: The physical feature survey explored that 92.09 percent of structures were used for residential purposes, and in total, 86.81 percent of the structure were single stories.

Table 5 Structure use statistics of Rangabali Upazila

Structure Use	Number	Percentage
Administrative	48	0.08
Agricultural	92	0.35
Commercial	2940	5.88
Community Service	881	0.67
Education & Research	247	0.50
Healthcare Service	19	0.03
Industrial	68	0.00
Mixed Use	26	0.19
Non-Government Services	6	0.01
Residential	25077	92.09
Service Activities	55	0.11
Transport & Communication	2	0.00
Under Construction	46	0.09
Total	29797	100.00

Structure Floor	**Number**	**Percentage**
1	23227	86.81
2	6538	13.13
3	27	0.05
4	2	0.00
5	3	0.00
Total	29797	100.00

Structure Type	Number	Percentage
Katcha	27802	97
Tin Shed	263	0.2
Pucca	620	0.8
Semi Pucca	1110	2
Total	29797	100.00

Source: PKCP project, UDD, 2018

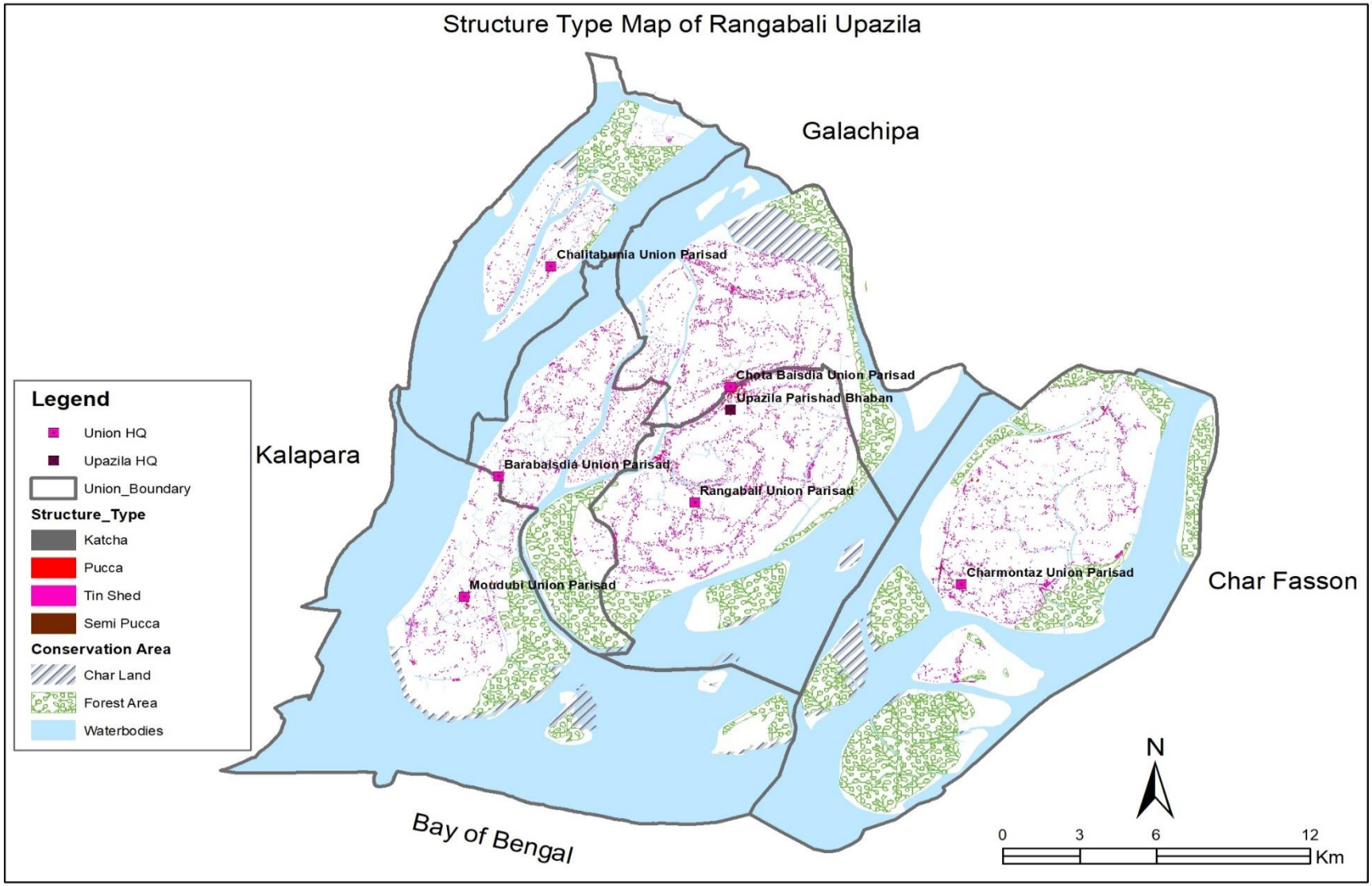


Figure 12Structure Type Map of Rangabali Upazila

Source: PKCP project, UDD, 2018

Road: From Physical feature survey, it is found that according to road type around 86.32% of Roads are katcha in Rangabali upazila and also the total length of katcha roads are longer than others. In Rangabali Upazila, only 9% of roads are pucca.

Table 6 Total Road Network according to Road Type

Road Type	Road_Length (Km)	Percentage(%)
Bitumen	4.00	0.22
Earthen	1564.96	84.46
HBB	208.46	11.25
RCC	75.72	4.09
Total	1853.14	100

Source: PKCP project, UDD, 2018

In Rangabali Upazila, considering road length, it is found that the majority percent of the roads are tertiary category which area mainly Katcha road. On the other hand, Primary roads directly connect this Upazila with north to south direction and east to west direction.

Table 7 Total Road Network according to Road Class

Road Class	Road Length (Km)	Percentage (%)
Primary Road	14.52	0.78
Secondary Road	252.75	13.64
Tertiary Road	1585.87	85.58
Total	1853.14	100

Source: PKCP project, UDD, 2018

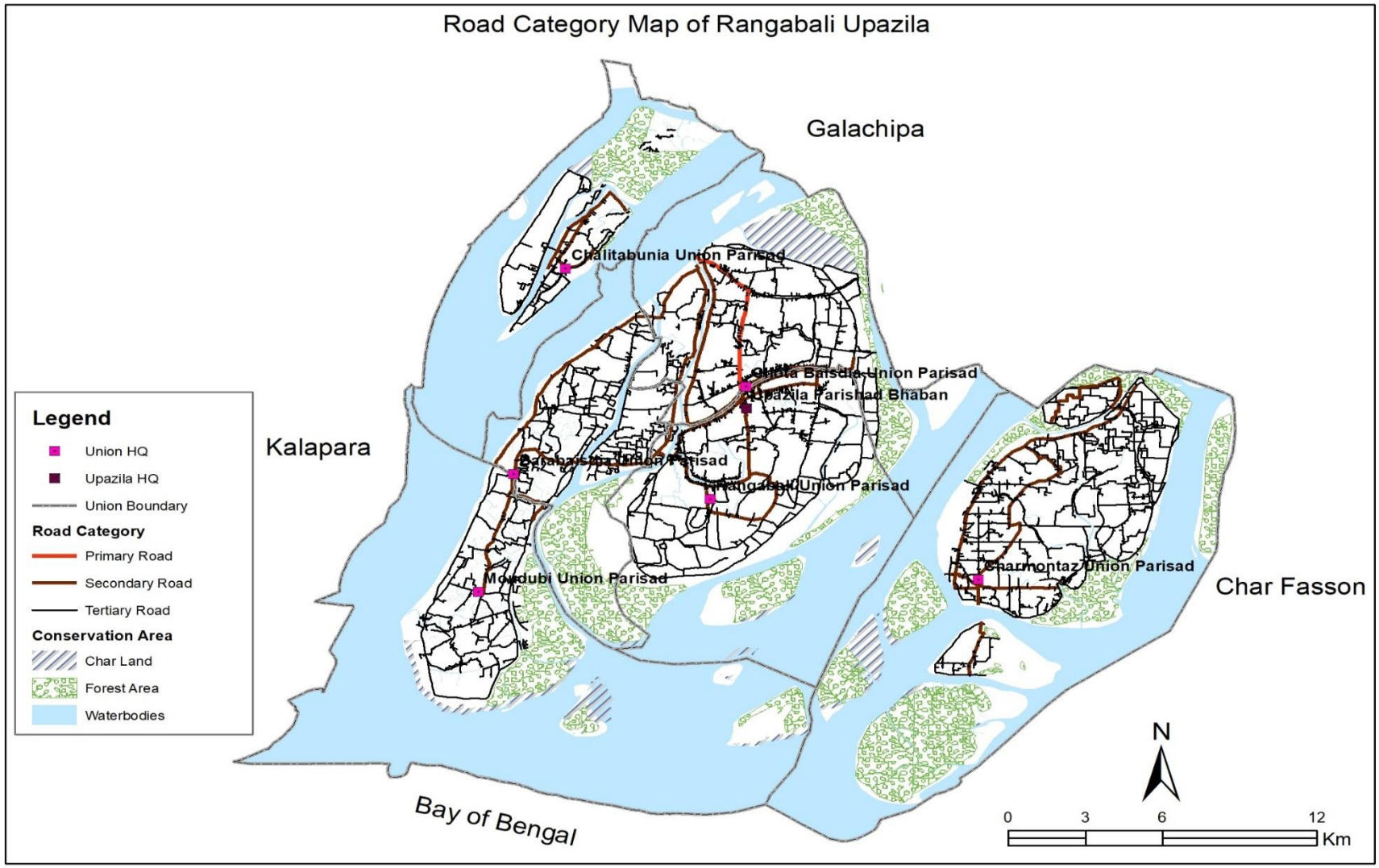


Figure 13 Road Category of Rangabali Upazila

Source: PKCP project, UDD, 2018

2.1.17 Transport and communication

The connectivity of Rangabali Upazila with other areas is very poor. Speed boats, boats, and ferries are the only ways to cross the river to get to the mainland. Although there is a proposed bridge but the work has not started yet. There is a proposed RHD road (80 feet) which is connected Koralia bazar to Rangabali Upazila parishad. Majority number of the Roads of this Upazila is katcha and tertiary roads. Moreover, there are no bus Terminal and CNG Stations. The vehicles are stopping here and there which creates problems to the local life. To predict for the future, several traffic surveys have been conducted.

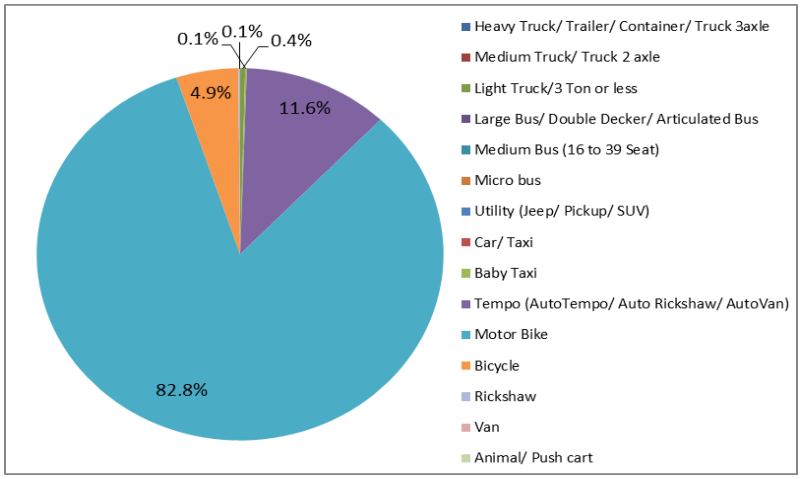


Figure 14 Modal share of vehicles on Rangabali Upazila (Up Direction)

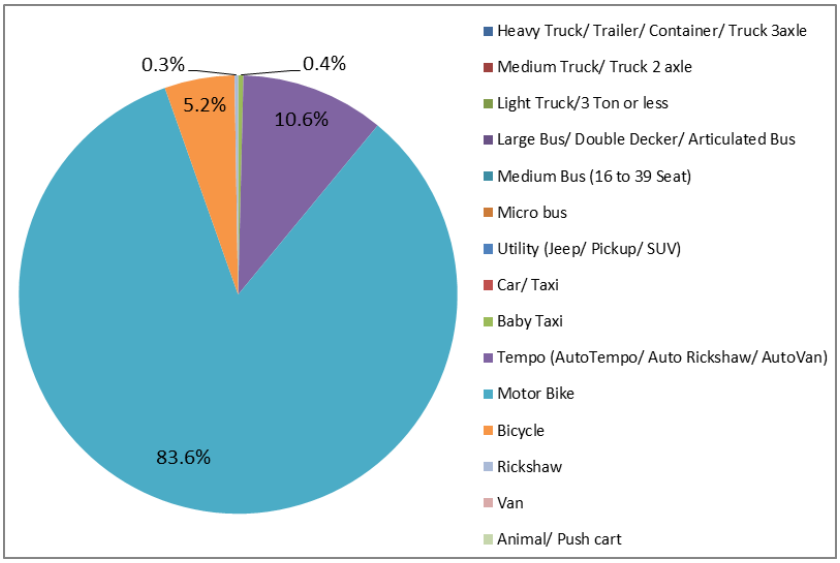


Figure 15 Modal share of vehicles on Rangabali Upazila (Down Direction)

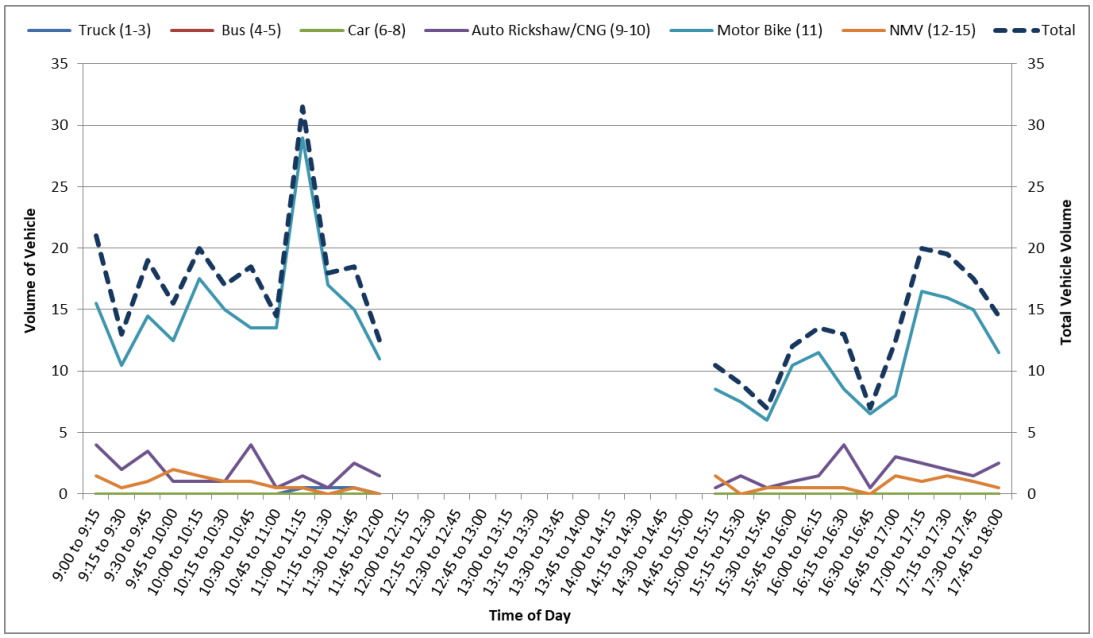


Figure 16 Travel Pattern of Rangabali Upazila Source: PKCP project, UDD, 2018

Firstly, it provides an idea about the existing traffic demand and available supply in the form of infrastructure and services. Secondly, it acts as the input for the travel demand forecasting model that is to be constructed as the output of the project, which will enable to analyze various scenario with respect to changed networks (road, rail and water) as well as land-use scenarios. Rivers and Canals are not properly dredged and narrow roads are major critical issues in the transport sector. The most prominent mode of transport is motorcycle that used as public transport.

2.1.18 Embankment

Total length of existing Embankment in Rangabali Upazila is 350 km. As Rangabali Upazila is circled around rivers so embankment is a major element of this upazila to protect inhabitants from storm surge, cyclone and flood. Being located within the coastal region, embankment is a common feature that constructed during the polderization in 60's decade. Embankment save the resources within the polder from the tidal inundation. The embankment has great contributions for rural communication and creates supporting habitats for various resident birds' rodents and reptiles.

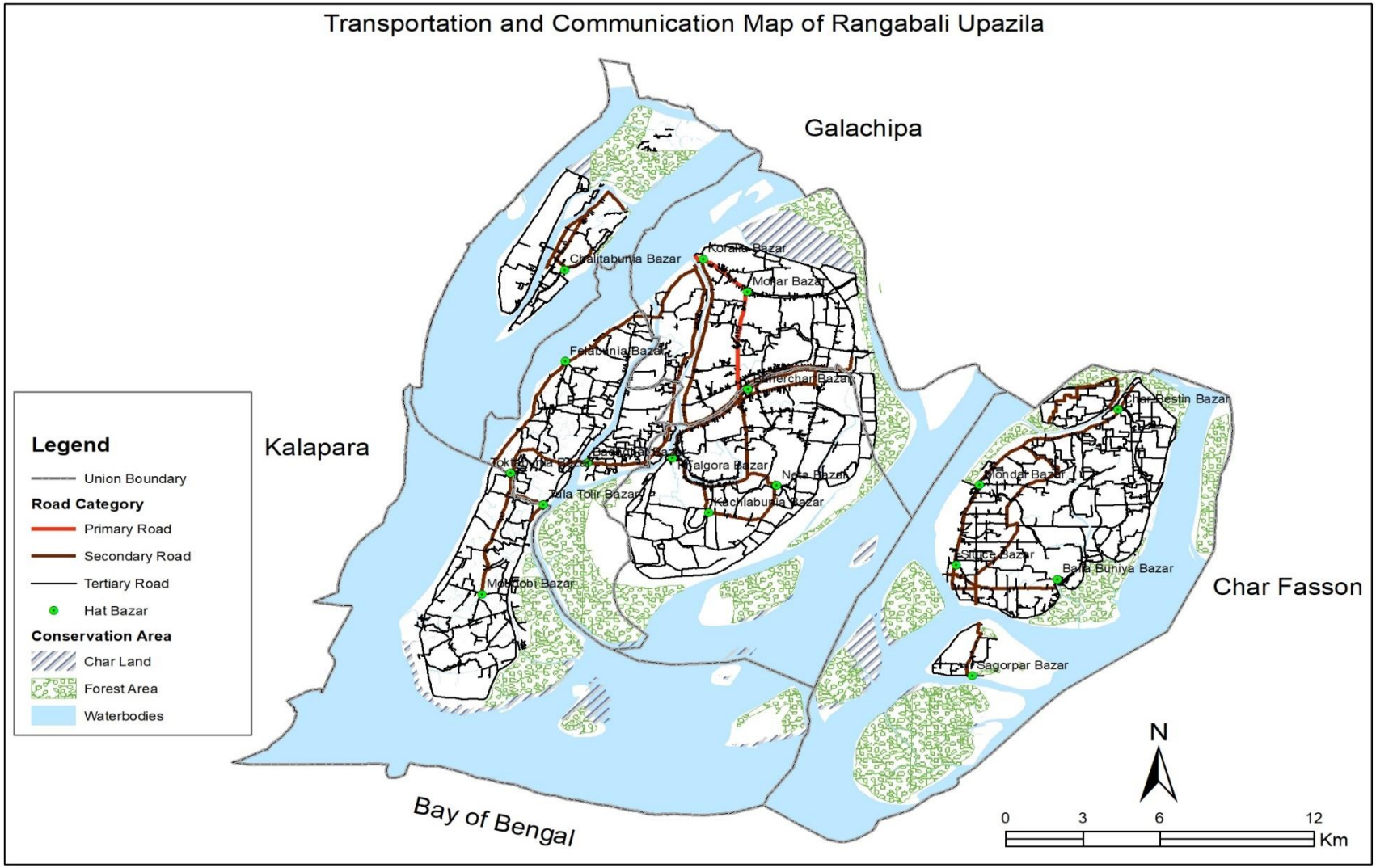
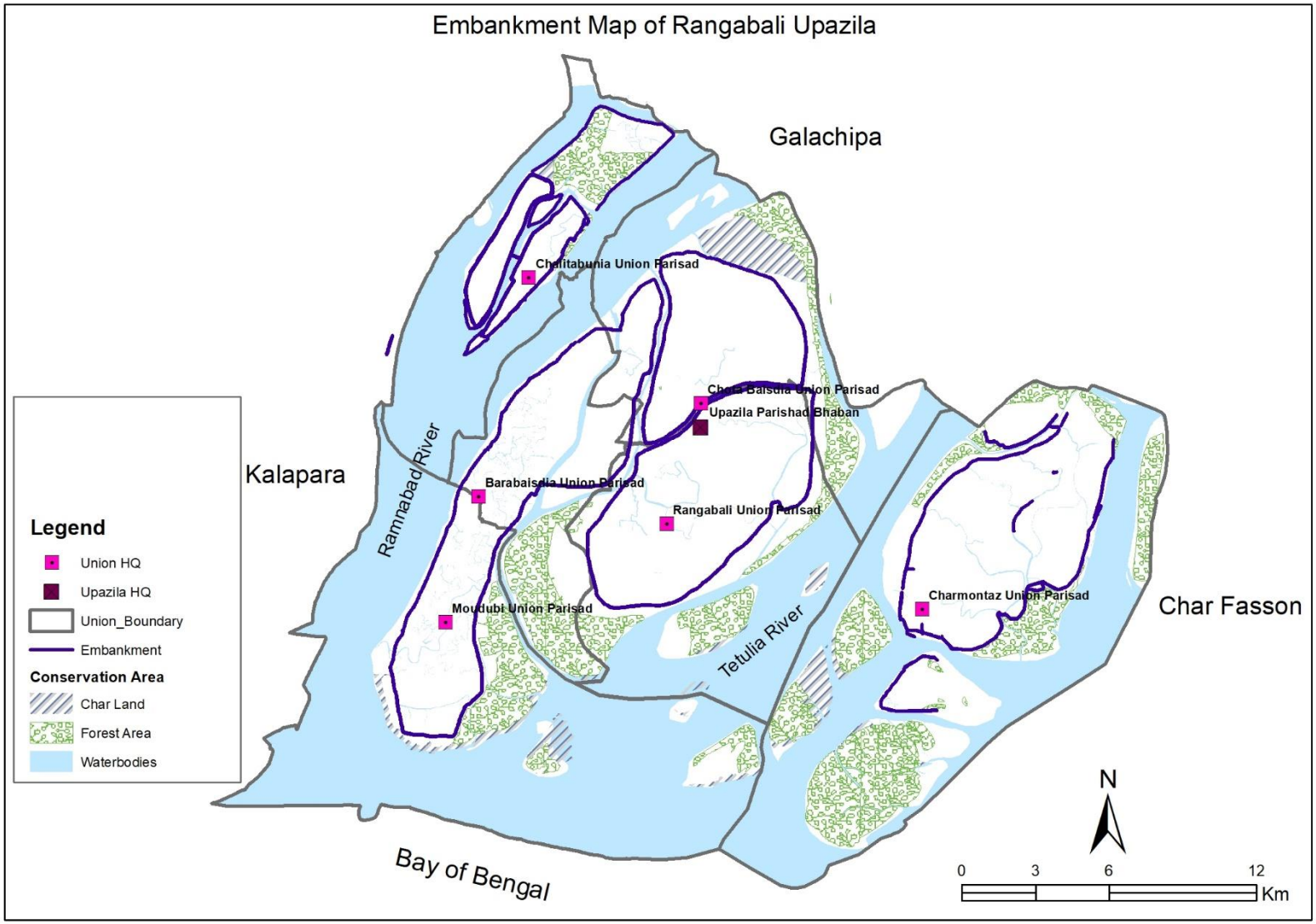


Figure 17 Transportation and communication network of Rangabali Upazila

Source: PKCP project, UDD, 2018



Source: PKCP project, UDD, 2018

Figure 18 Embankment map of Rangabali Upazila

2.1.19 Water bodies

The current state of Rangabali Upazila's water body is depicted on the map below. There is existence of canal, ditch, fish pond, pond and river. Majority of water body of this upazila covered with River which is 95.17% and Ramnabad River is the major river flowing through this Upazila.

Table 8 Existing Water body of Rangabali Upazila

Water body Type	Area (Acre)	%
Canal	2590.12	2.69
Ditch	177.55	0.18
Fish Gher	3.85	0.00
Gher	240.10	0.25
Pond	1634.81	1.70
River	91482.51	95.17
Total	96128.94	100.00

Source: PKCP project, UDD, 2018

2.1.20 Endangered Wildlife

During the major field investigation, the Survey team has identified that there are several threats to the wildlife/fauna in their natural habitats e.g. urbanization on the natural habitat, extension of agricultural practices to forestland including the mangrove ecosystem, pollution on air and waterways, increasing of grazing/pasture land to forest peripheries, hunting pressures, and degradation of forestland through felling trees. In addition, recent natural disaster also took place on fauna habitat degradation. Oil spills and plastic pollution also responsible to creates threats to fauna both in the terrestrial and aquatic even in the intertidal zone of this coastal area. Unplanned tourism practices also slightly responsible for threatening the wildlife. The marine mammals e.g. dolphins (Irrawaddy Dolphin) sometimes find entangled in a fishing net of open water fishing. Therefore, various threats have been in this coastal districts for decades. Rangabali Upazila has some hotspot area of Birds and Dolphin which declare as Wildlife sanctuary.

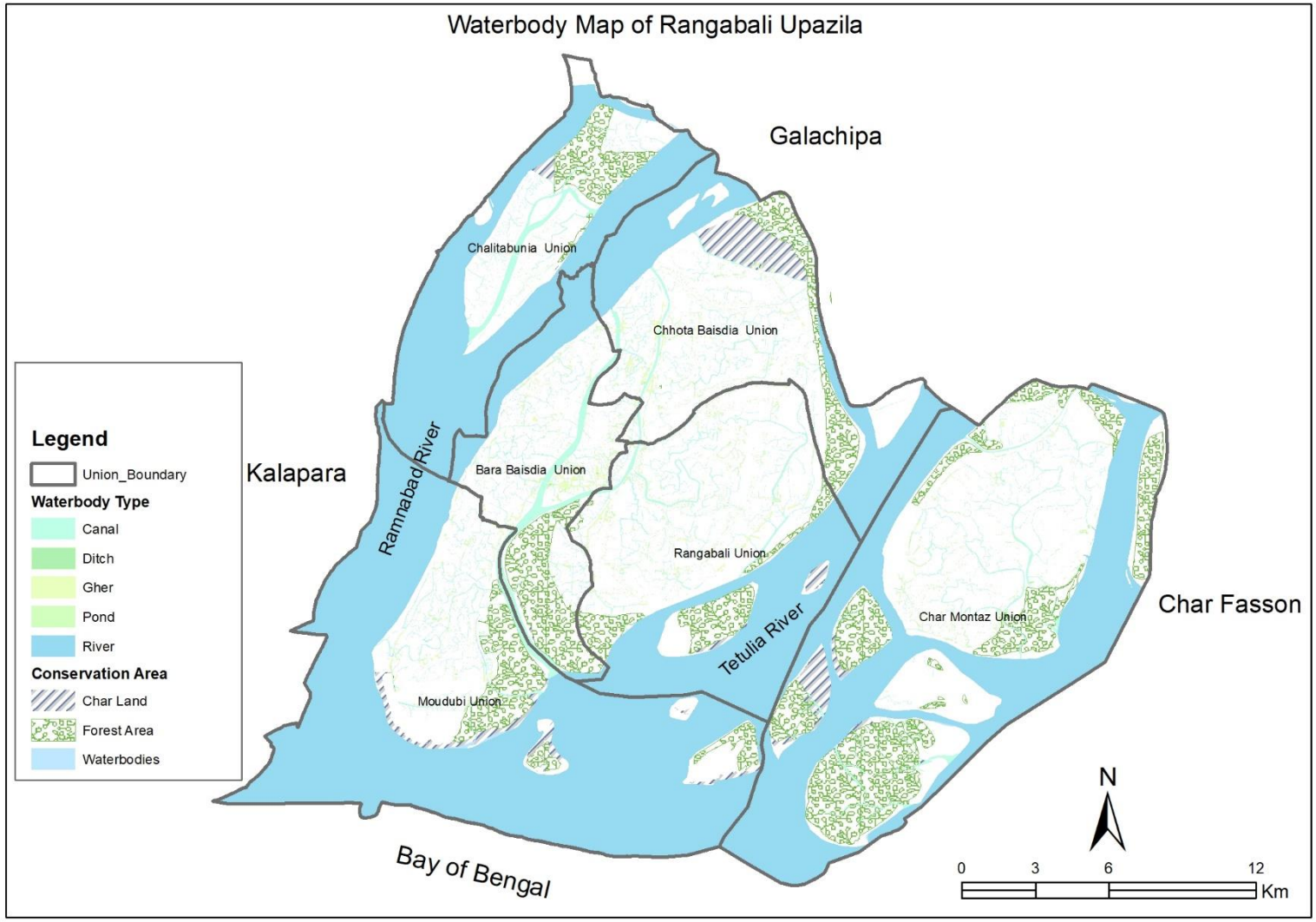


Figure 19 Existing Water bodies of Rangabali Upazila

Source: PKCP project, UDD, 2018

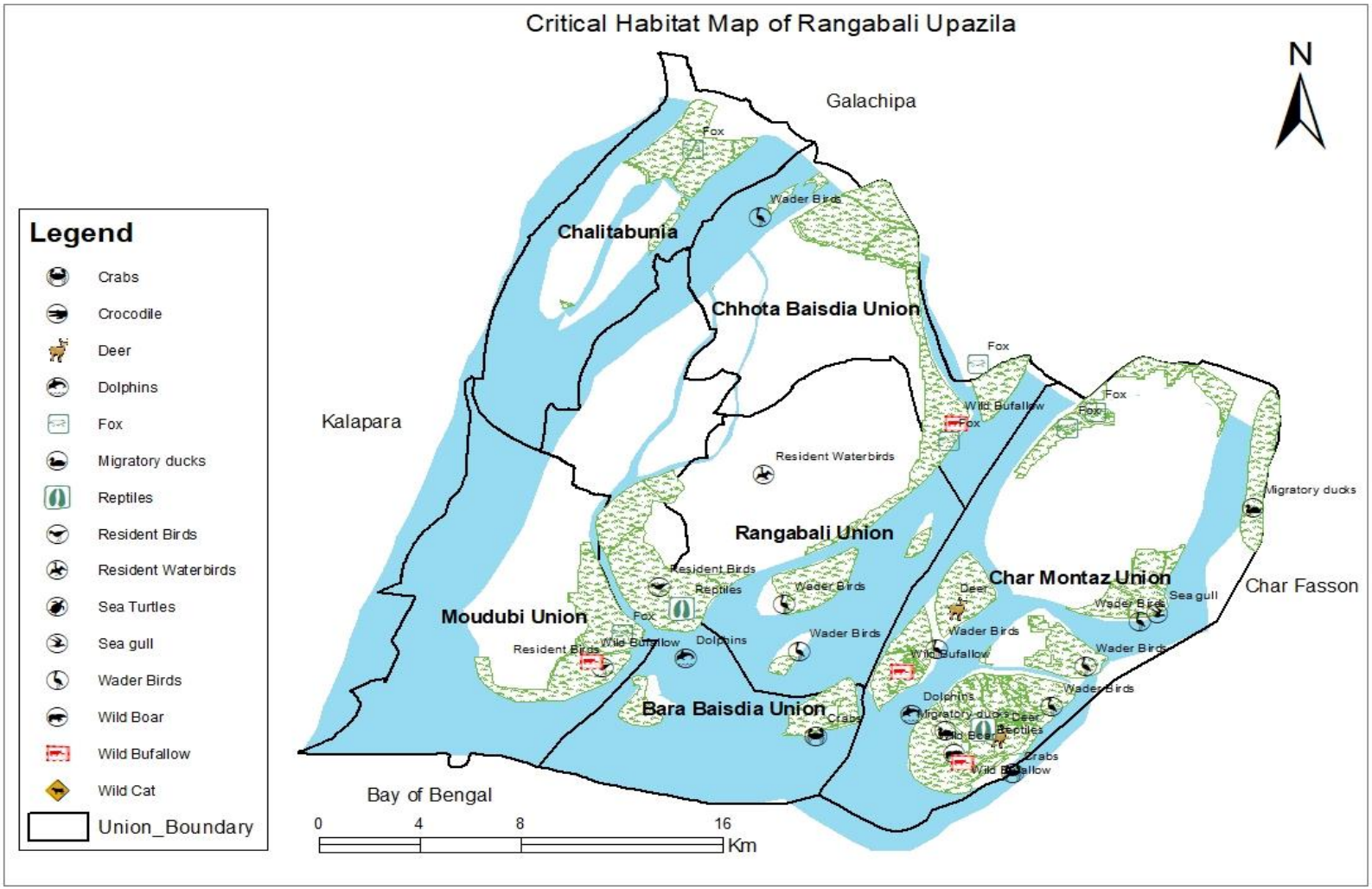


Figure 20 Critical Habitat Map of Rangabali Upazila

Source: PKCP project, UDD, 2018

2.1.21 Scope of Eco-tourism

Sonar Char and the neighboring Char offer a plethora of tourist development potential. The region is home to a diverse range of flora and fauna, as well as numerous scenic wonders. The region is perfect for tourist development because of its forests, beaches, lakes, and rivers. An Action Area Plan was created based on a number of tourist-friendly areas. It finds five unique Chars with essential traits that may entice domestic and international tourists. The distinctive traits and facilities of five of these destinations make them appealing.

Sonar Char is around 18 square kilometers in size. The trees had been uprooted, leaving Sonar Char bare. Recognizing Sonar Char's tourism potential, Bangladesh Parjatan Corporation (BPC) suggested a tourist complex that would contain a youth inn, a café, picnic huts, an outdoor party area, and eco-cottages. However, due to a lack of communication infrastructure, inadequate lodging, and inadequate utility services, the project is now unviable. Sonar Char is developing an ecotourism industry with unique foreign visitor amenities like private cottages, pavilions, and tents.

Unlike the Sonar Char and Char Taposhi/Kolagasi, Char hare is geologically stable. A mangrove cover can be seen on the Sonar Char's southern side. Plenty of flat ground is accessible for construction along the Char's southern reaches. On the southern side of the Char Hare River, there is a long and magnificent beach. Camping and meditation are both allowed in this

Between Sonar Char and Char Montaz, this is the closest Char. This Char is expected to be created solely for international tourists, with a variety of modern facilities. The population of this Char is currently around 3782 people. A small wooded area can be found in the northern part of the Char.

2.1.22 Wet-land Encroachment

The result of economic growth means that almost any land would be lucrative for physical development and construction because there would be demand for it. While it opens the opportunity of flourishing urban development and others, it has been threatening the existence of environmentally sensitive areas. Because of the weak control mechanism or ‘police power’ of the institutions to prevent encroachment into those areas, there has to be a stake for those areas at least as powerful or more to counter the open market forces.

2.1.23 Cropping Pattern

Most of the households are engaged in farming activities that produce varieties of crops namely local and HYV of rice, cash crops, pulses and others. Various fruits like mango, jackfruit, coconut, betel nut, banana etc. are grown. Coconut and betel nut are grown abundantly in the Upazila. Watermelon is widely produced in the whole area of Rangabali Upazila. Fish of different varieties abound in this district which enjoys the advantages of marine fishing. Moreover, Bangladesh Fish Development Corporation in this Upazila has influence for the development of fish processing industries. Hilsa fish is abundantly available in this Upazila. About 49% are Triple cropped, 42% are double cropped and 8% are single crop of land and its cropping intensity is 194%.

2.1.24 Existing Hat-Bazar

There are 16 existing growth centers in Rangabali Upazila.Among the hat bazar of Rangabali Upazila, Baherchar and Khalgora is the most prominent bazar of this area due to its geographical location.The government infrastructure are developed around the baherchar bazar.

Table 9 Existing Bazar List of Rangabali Upazila

Growth center name	Unoin Name	Growth center name	Unoin Name
Baher Char Bazar	Rangabali	Koralia Bazar	Chhota Baisdia
Bestin Bazar	Char Montaz	Mollar Hat	Chhota Baisdia
Chalitabunia Bazar	Chalitabunia	Montaj Sluij Bazar	Char Montaz
Char Naluar Hat	Char Montaz	Mowdubi Hat	Moudubi
Felabunia Bazar	Bara Baisdia	Neta Bazar	Rangabali
Gohin Khali Bazar	Chhota Baisdia	Pulghat Hat	Rangabali
Kachia Bunia Hat	Rangabali	Takta Bunia Bazar	Bara Baisdia
Kata Khali Bazar	Bara Baisdia	Tulatali L.Ghat Bazar	Bara Baisdia

Source: PKCP project, UDD, 2018

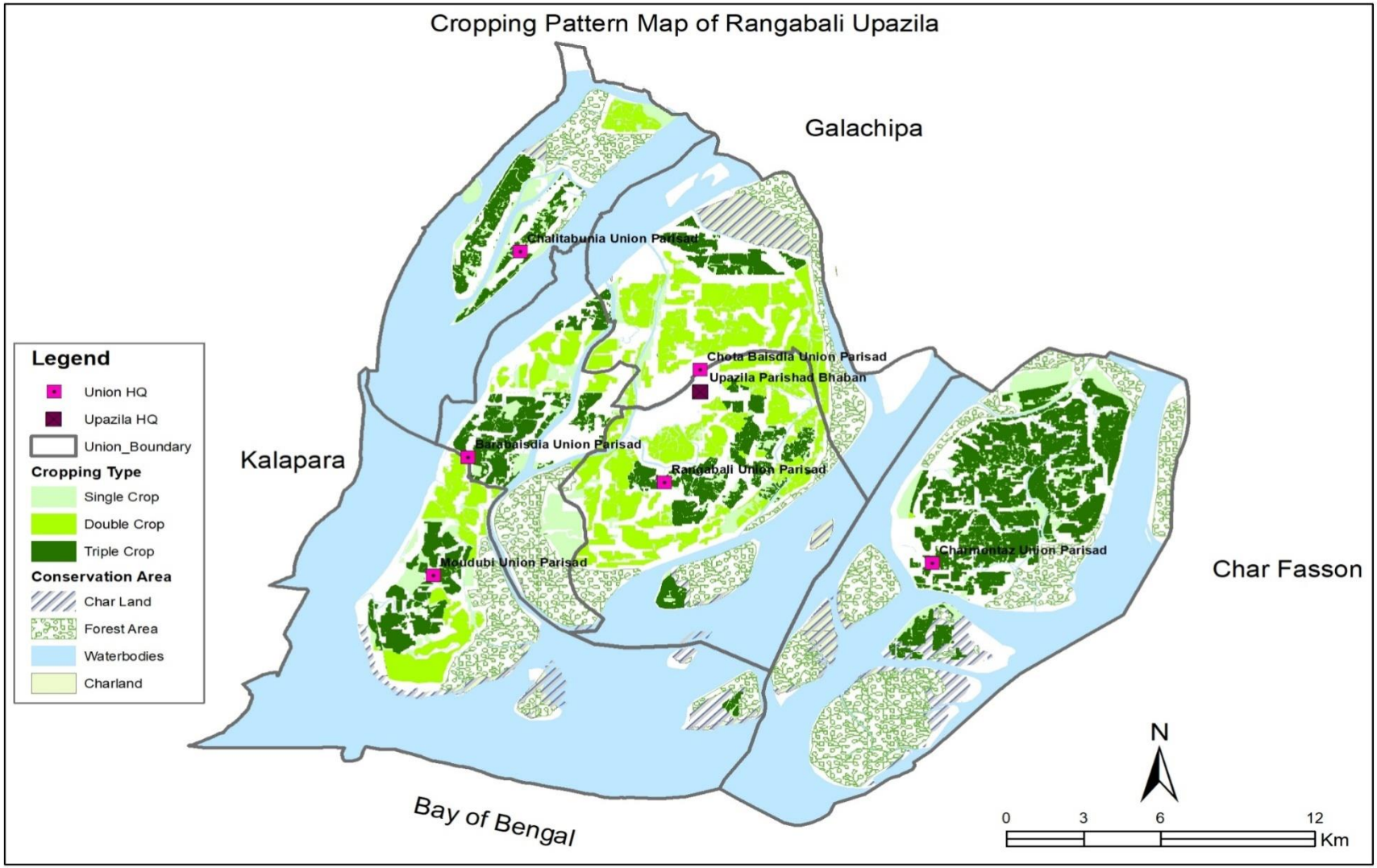


Figure 21 Cropping Pattern Map of Rangabali Upazila

Source: PKCP project, UDD, 2018

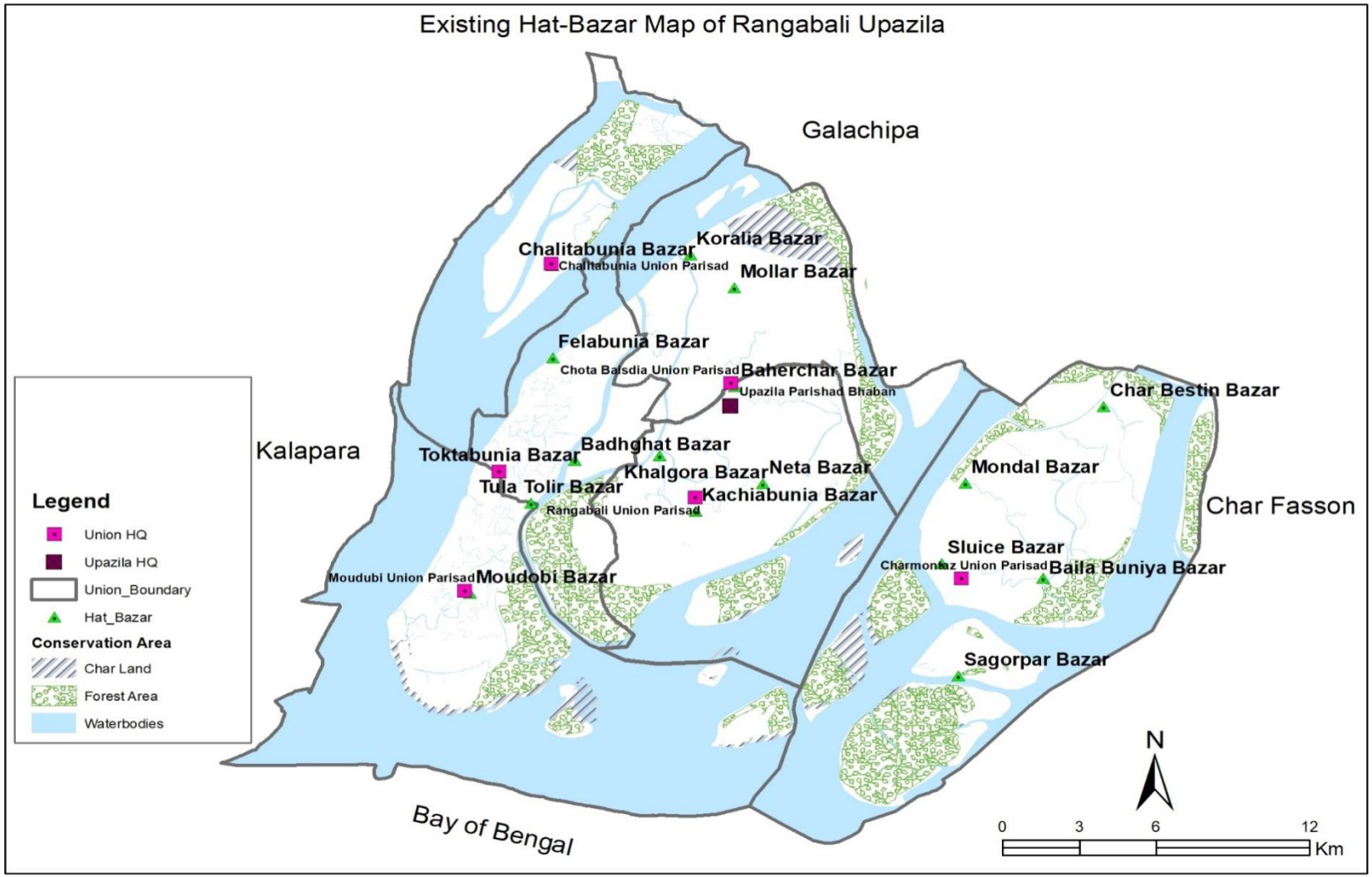


Figure 22 Existing Hat Bazar Map of Rangabali Upazila

Source: PKCP project, UDD, 2018

2.1.25 Changes in Land use and Land cover

The study area has observed rapid changes in land use and land cover in the last 4 decades. Landsat satellite images of historical data over the study area are assessed from 1999 to 2041. Changes of different types of land use classes are assessed using satellite data. A summary the upazila-wise changes in water bodies, forests, bare land, cultivable land, and build-up areas in the study area are presented respectively.

Table 10 Land use/ Land cover (LULC) changes for all Upazilas from 1999 to 2041.

LULC type	Upazila	1999	2010	2021	2041	Change	(%)
Waterbody	Rangabali	339.51	327.73	315.29	304.43	-35.08	-10.33
Forest	Rangabali	37.00	71.85	87.70	118.73	81.73	220.90
Bareland	Rangabali	275.88	213.95	216.09	220.73	-55.15	-19.99
Cultivate Land	Rangabali	41.22	77.57	73.81	49.80	8.58	20.83
Build-up Land	Rangabali	2.43	4.95	3.14	2.35	-0.08	-3.32

Source: PKCP project, UDD, 2018

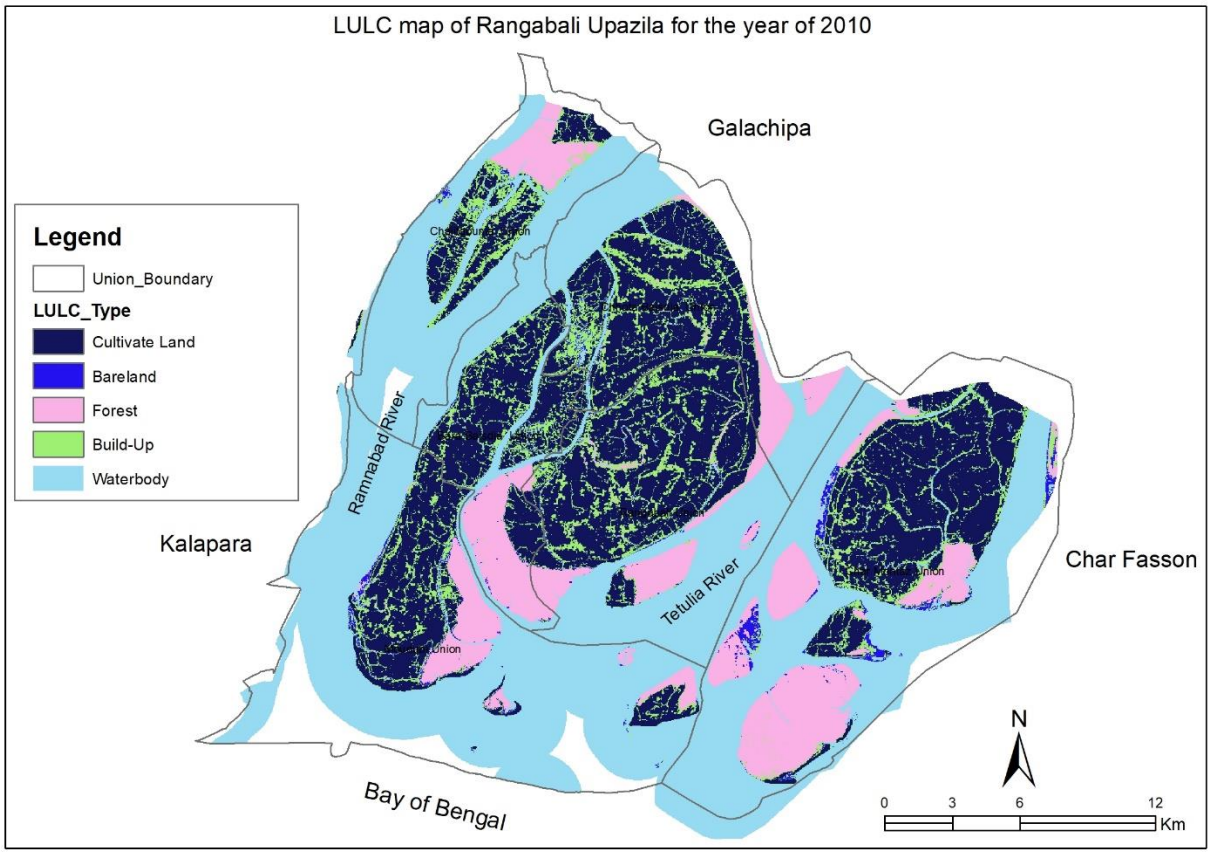


Figure 23 LULC map of Project area for the year of 2010. Source: PKCP project, UDD, 2018

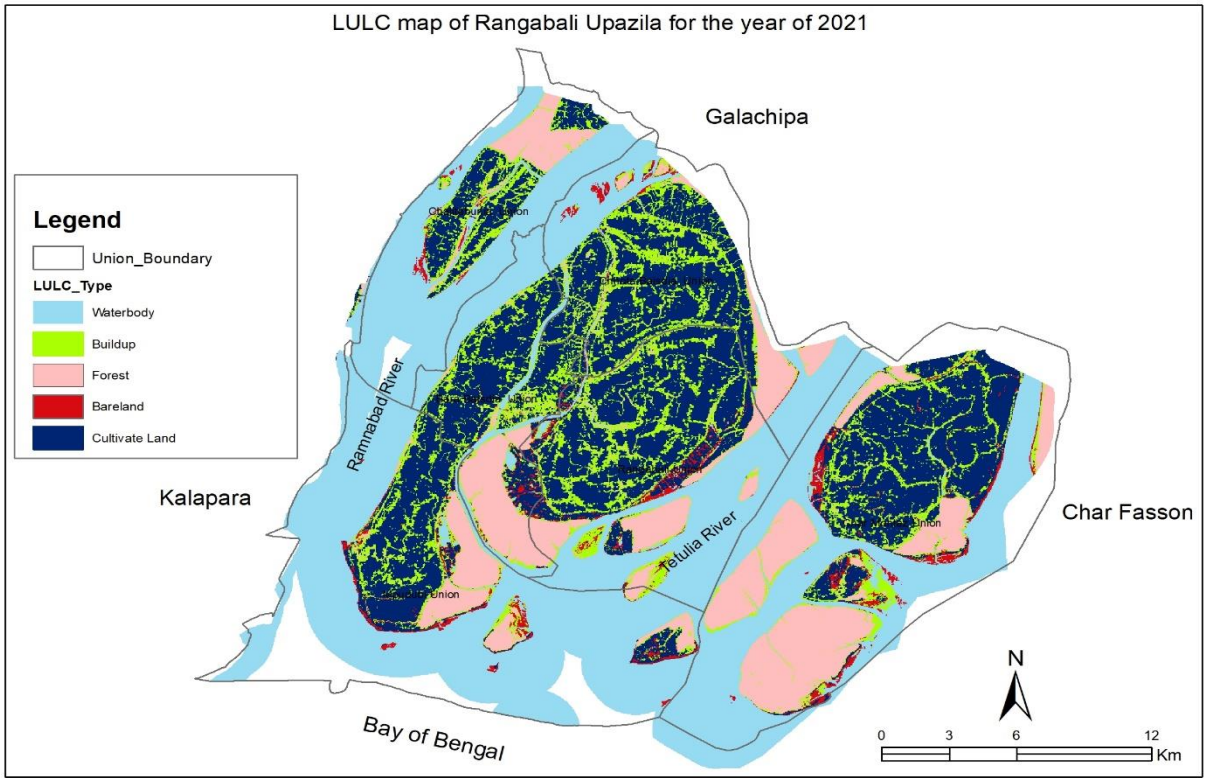


Figure 24 LULC map of Project area for the year of 2021 Source: PKCP project, UDD, 2018

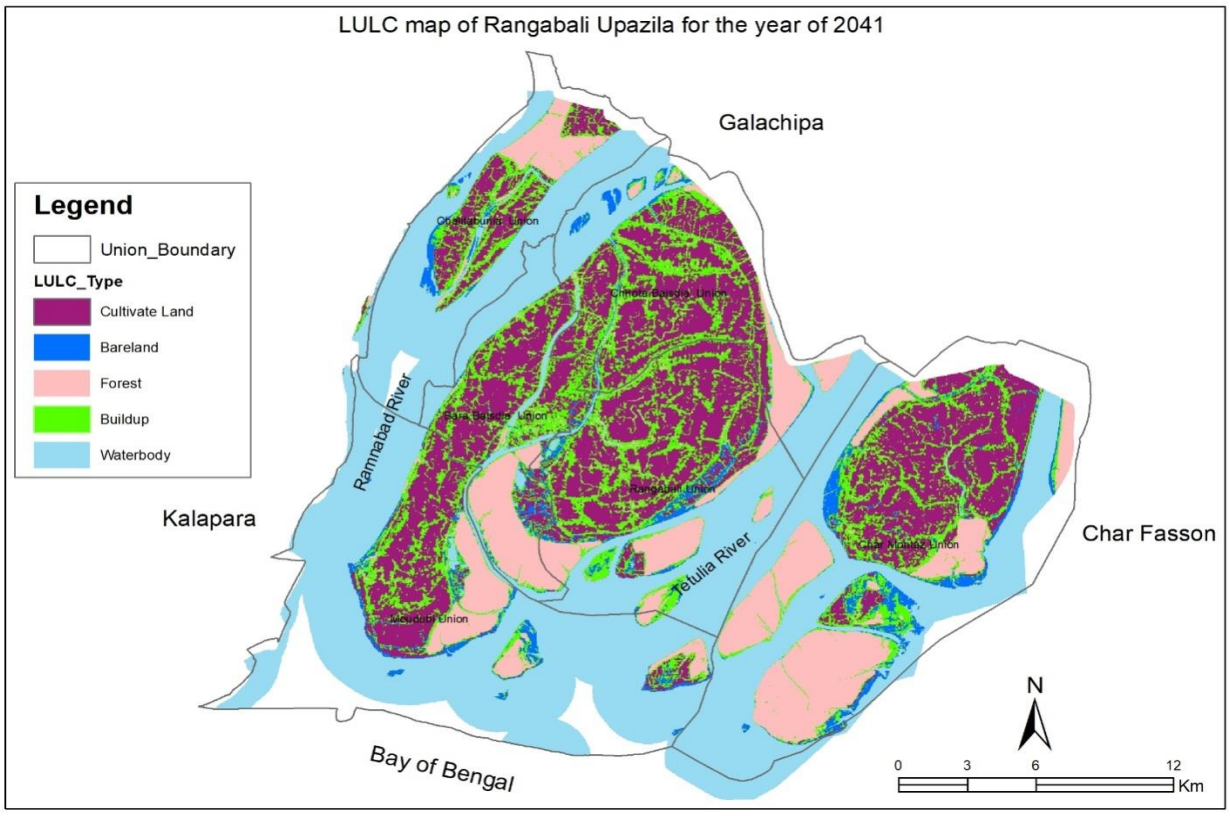


Figure 25 LULC map of Project area for the year of 2041. Source: PKCP project, UDD, 2018

2.1.26 Flood Inundation

The flood inundation mapping approach adopted in this study is based on the spatial association between the digital elevation model (DEM) of the project area and flood levels as obtained from flood frequency analysis using measured daily water level data of the nearby gage stations maintained by Bangladesh Water Development Board (BWDB). The estimated flood levels with respect to mean sea level (MSL) in all five water level gage stations for 50, and 100-year return periods.

The area is mostly protected from the tidal flood by polders (Figure 35). Out of 139 polders in coastal Bangladesh, 35 are located in the project area. The elevation of all the polders in the project area varies from 4.04 m MSL to 5.54 m MSL. As the maximum flood level corresponding to the 100-year return period (3.80 m MSL) is less than the minimum elevation of the polder (4.04 m MSL), the polder area inside the project area would never be overtopped.

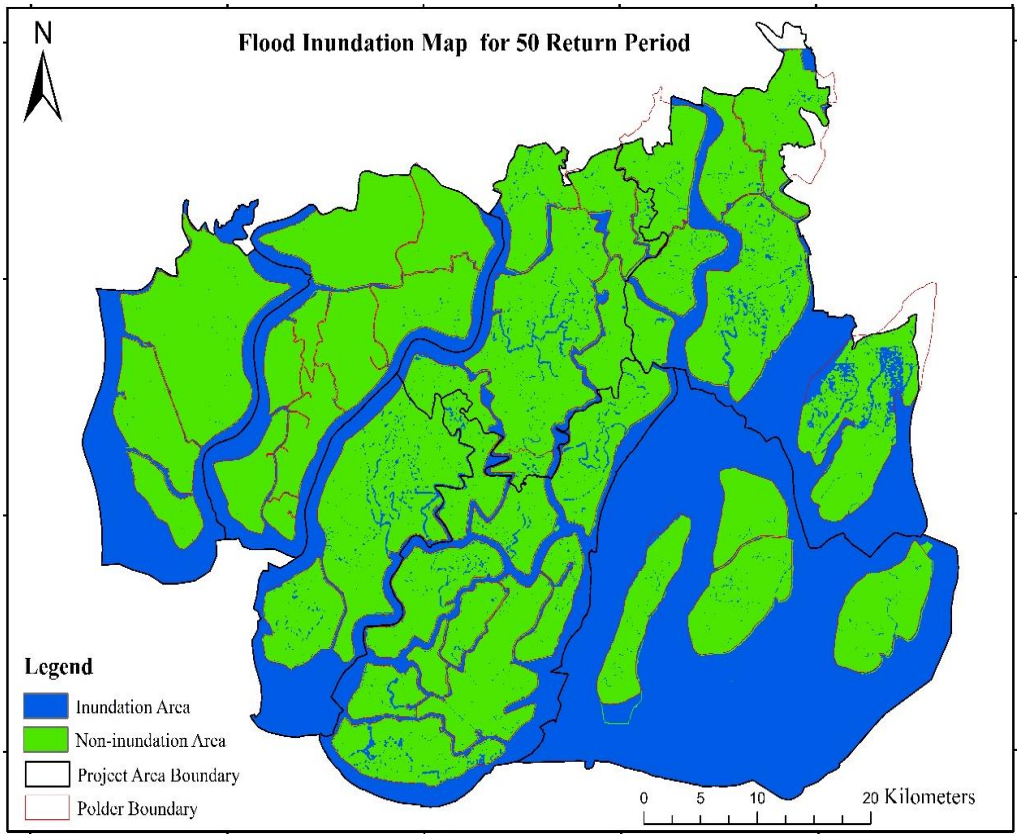


Figure 26 Flood inundation map for the 50-year return period Source: PKCP project, UDD, 2018

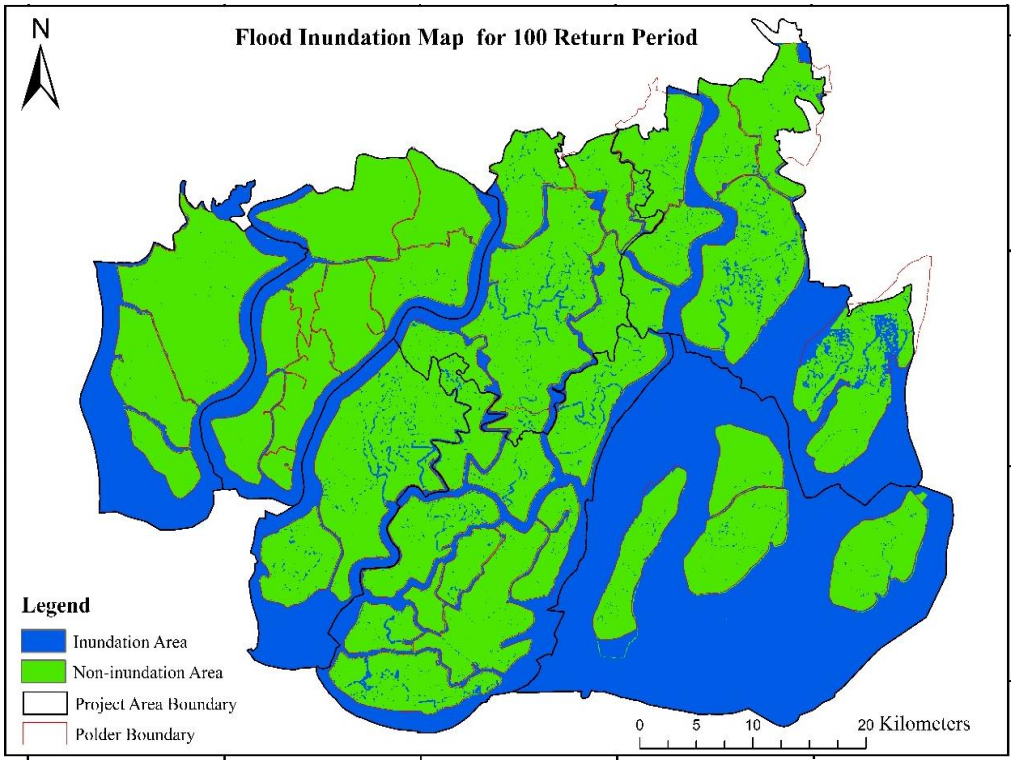


Figure 27 Flood inundation map for the 100-year return period Source: PKCP project, UDD, 2018

Thus, according to the flood inundation mapping, the project area which polder is free from river flooding. However, it can be vulnerable due to inundation caused by cyclonic storm surges.

2.1.27 Composite Hazard Scenario

As the project area is one of the hazard prone areas of Bangladesh, a composite hazard map is prepared considering the above scenarios. The composite hazard map is prepared using four main hazard components that are prominent in the study area. These are – 1) Salinity level of 1ppt, 5ppt, 25ppt for 0.5m SLR, 2) Maximum inundation of Strom surge water level (m), 3) Erosion- Accretion from 1989 to 2021 and 4) Flood inundation for 20-year return period. A normalization statistics equation is used to convert all the layer values from 0 to 1. After normalizing all values, all the layers of hazard component are reclassified into three classes i.e., 0.0 to 0.329, 0.33 to 0.67, 0.67 to 1. The reclassify score of all hazard layers are given in table below.

Table 11 Scores of different major hazards after normalizations

Salinity		**Erosion-Accretion**		**Strom surge inundation**		**Flood Inundation**	
Reclass	Score	Reclass	Score	Reclass	Score	Reclass	Score
0.0 -0.33	1	0.0 -0.33	3	0.0 -0.33	1	0.0 -0.33	3
0.33-0.67	2	0.33-0.67	2	0.33-0.67	2	0.33-0.67	2
0.67-1.00	3	0.67-1.00	1	0.67-1.00	3	0.67-1.00	1

Source: PKCP project, UDD, 2018

The weighted overlay technique is used to prepare the final composite hazard map. As Salinity and Erosion- accretion processes are mainly dominated in the projected area, the influence factors i.e., 35% for Salinity, 35% for Erosion-Accretion process, 15% for Strom surge inundation and 15% for Flood Inundation are sequentially assigned.

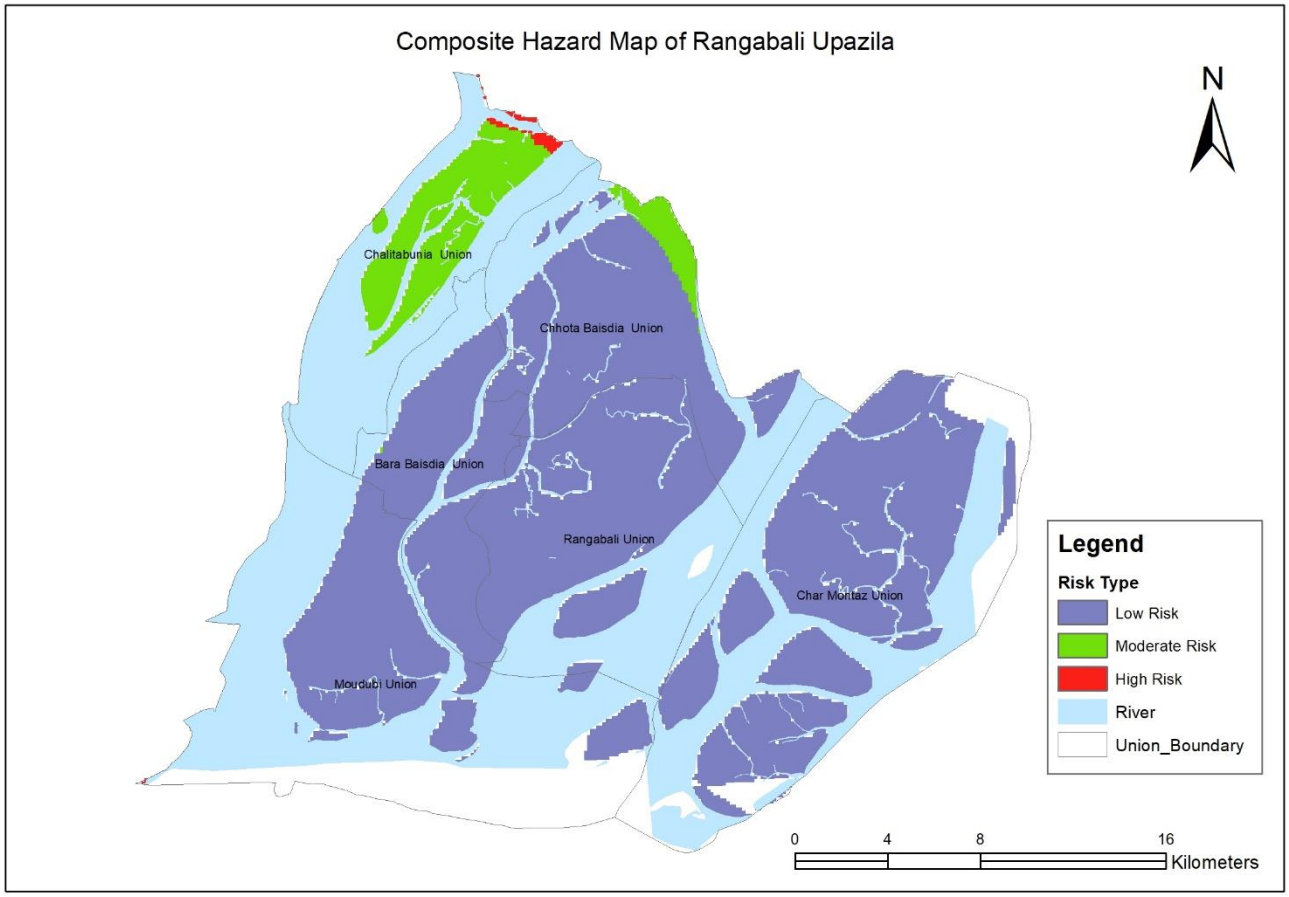


Figure 28 Composite Hazard map of Rangabali Upazila Source: PKCP project, UDD, 2022

CHAPTER THREE: SOCIO-SPATIAL FORECASTING AND DEVELOPMENT PROSPECTS

3.1 Population Projection

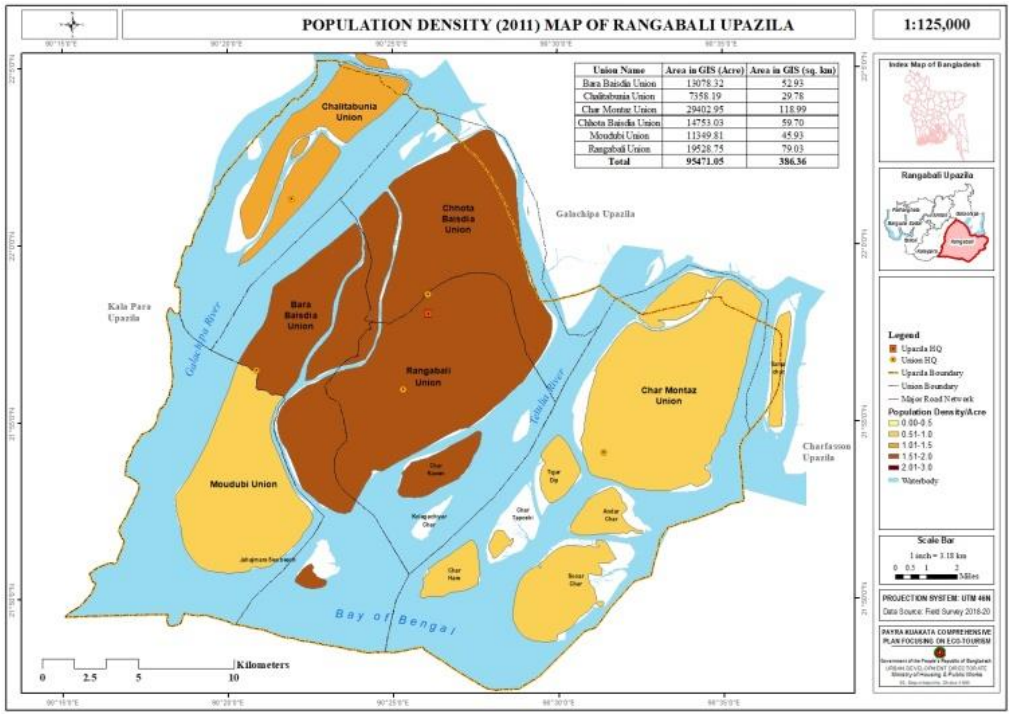
Population has been forecasted applying cohort method. The cohort-component method segments the population into age-sex groups or birth cohorts and accounts for the fertility, mortality, and migration behaviour of each cohort.

Projected population: According to BBS, the population of Rangabali Upazila in 2011 was approximately 98000 and annual growth rate was 1.05. It shows that the population in 2021, 2031 and 2041 will be 1, 08,097; 1, 22,077 and 1, 34,309 respectively.

Table 12 Projected Population and annual growth rate

Year	Projected Population	Annual Growth Rate
2016	102210	1.06
2021	108097	1.14
2026	114967	1.23
2031	122077	1.29
2036	128623	1.30
2041	134309	1.28

Source: PKCP project, UDD, 2018



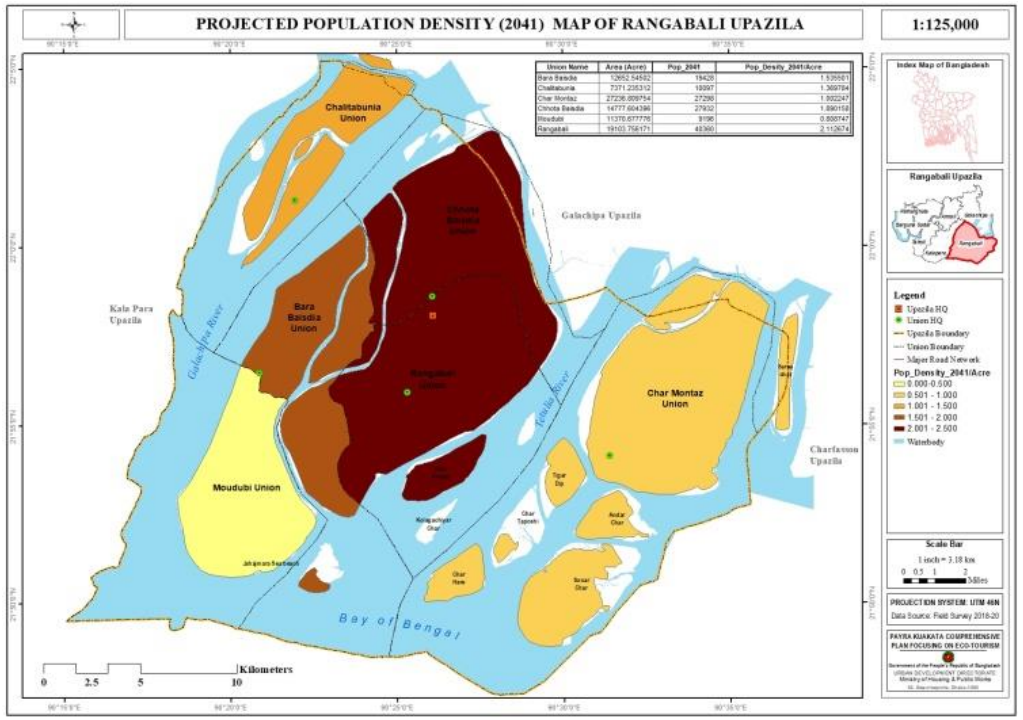


Figure 29 Population Projection Map of 2011 and 2041

Source: PKCP Project, UDD, 2018

3.2 Housing Demand Projections

The use of historical data to project future housing demand is known as demand forecasting. It gives an estimate of the number of dwelling units that people are likely to desire in the future over a specified time period. Based on the existing population and the number of structures, the threshold population has been calculated. After that, considering the projected population, future demand for housing units has been quantified. There are about 25077 residential structures in the upazila overall, of which 96% are tin sheds and 2% are semi-puccas considering the household size is 4.41. So, the demand of housing unit is 30456 for 2041. (Patuakhali District Dwelling Unit BBS,2011). Only 10% structure used as commercial purpose and other structure used as residential purpose.

3.3 Economy & Employment/Economic forecasting

Findings from Basic and Non-Basic Employment

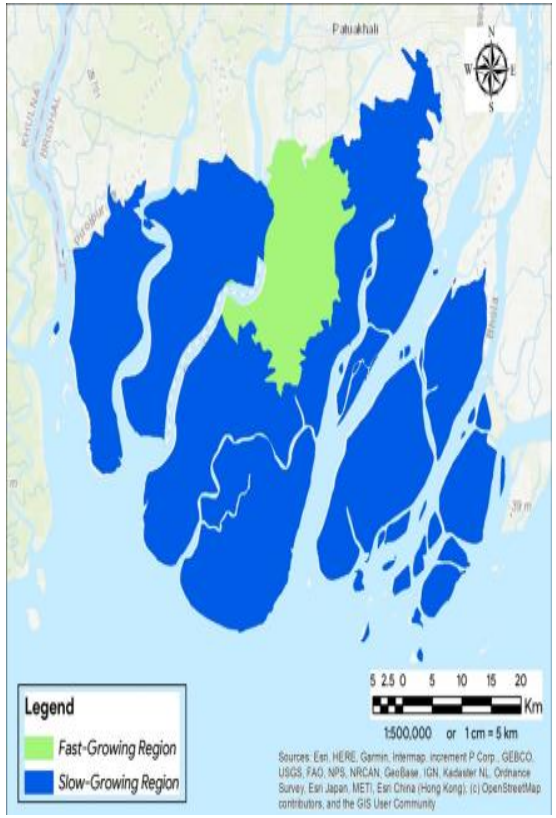
From the perspective of the percentage increase from 2003 to 2013, in Rangabali Upazila, basic employment has increased by 108 percent, and total employment has increased by 71 percent. Basic employment contributes to total employment. Basic employment constitutes 27% in Rangabali.

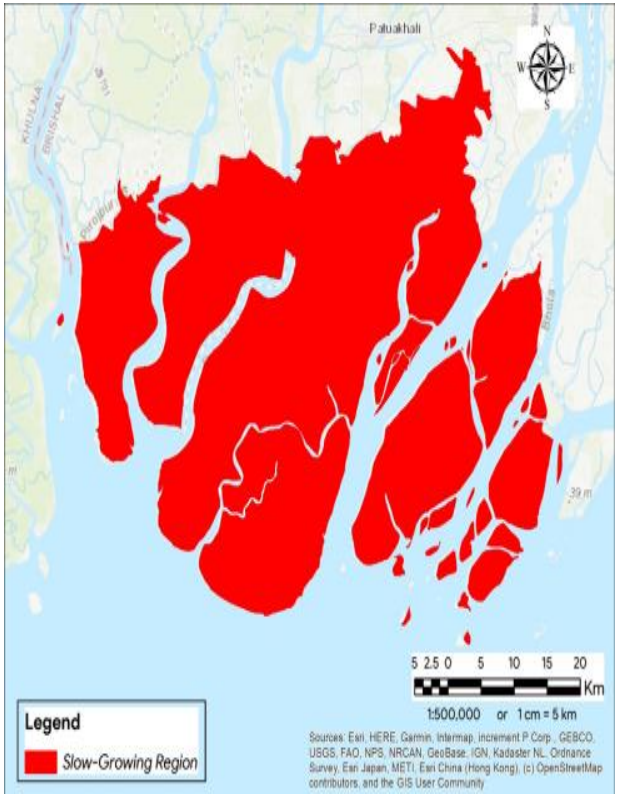
Table 13 Employment of 2003 and 2013 Comparison among the Upazila

Upazila	Basic Employment 2003	Total Employment 2003	Basic Employment 2013	Total Employment 2013	Increase in Basic Employment	Increase in Total Employment
Rangabali	1401	5114	2911	8748	108%	71%

Source: PKCP project, UDD, 2018

Findings from Economic Base Multiplier/ Findings from Shift-Share Analysis:
Economic base multiplier is used to evaluate employment as a measure of activities and can be used for projection purposes. The future total employment of a region can be evaluated by estimating the future prospects of the basic activities in the regional economy and by using a multiplier. The growth of a region can be attributed to a national trend or unique regional factors. The industry combination of the nation or the region itself may play a role in the regional growth also.





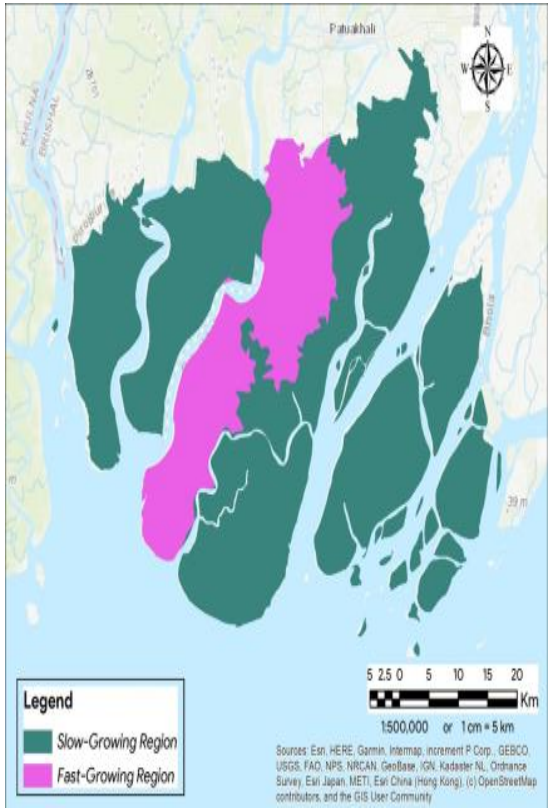


Figure 30 Delineation of Fast Growing and Slow Growing Regions

Source: PKCP Project, UDD, 2018

3.4 Traffic & Transportation

Household Survey: From the survey, it is observed that, on average, 6.76 trips per household are generated within the Rangabali area per day.

Table 14 Average trips per household

Zone ID	Union/ Zone	Total Households	No. of Trips per day	Avg. trips/ HH
51	Rangabali	6830	51054	7.48
52	Chhota Baisdia	4521	33568	7.43
53	Bara Baisdia	5669	37699	6.65
54	Chalitabunia	1646	9053	5.50

Source: PKCP project, UDD, 2018

Trip Purpose– For ease of analysis, the consultant team categorized all purposes into five categories: Educational, Shopping (trips to Bazar are also included), Work, Recreational and others (personal, treatment etc.)

Table 15 Trip purpose of Rangabali Upazila

Union/Zone	Educational	Work	Shopping	Recreation	Home Based	Others
Rangabali	14%	28%	5%	2%	50%	1%
Chhota Baisdia	13%	27%	5%	4%	49%	2%
Bara Baisdia	13%	26%	4%	6%	50%	1%
Chalitabunia	15%	24%	7%	4%	50%	0%
Rangabali Average	14%	26%	5%	4%	50%	1%

Source: PKCP project, UDD, 2018

Mode Choice – In the overall scenario for the whole Study area, people make most of the trips by walking, which is 79.9% of total trips. These trips are generally short-distance trips. Again, 11.5% are made by Motorbike, 2.6% by easybike and 2.3% by Small Launch. Among the other modes, except walking water modes is in total 3% (where boat 2.6% and trawler 0.4%).

Travel Cost and Time – The below table represents the average travel cost (in Taka) and travel time (in minutes). The travel cost is lower in the zones where major modes of trip are walking and cycling, though their travel time may be higher. Also, people in the study area use multiple modes, including water transport.

Table 16 Travel Cost and Time

Union/Zone Name	Avg. Trip Length (minutes)	Avg. Travel Cost (tk.)
Rangabali	22.14	18.60
Chhota Baisdia	21.61	10.05
Bara Baisdia	24.38	8.08
Chalitabunia	31.11	30.36

Source: PKCP project, UDD, 2018

Type of Trip – The below table illustrates the type of trips in each zone. The higher number of intra-zonal trips in most cases may be due to the fact that most of the facilities such as rural markets, educational institutions, health facilities, administrative and other offices etc. are available within most zones, and the local inhabitants do not usually have to move to other zones or distant places for their day-to-day activities.

Table 17 Type of Trip

Zone ID	Zone Name	Intra-zonal Trips (%)	Inter-zonal Trips (%)
		83	17
	isdia	84	16
	dia	84	16
	nia	93	7

Source: PKCP project, UDD, 2018

Travel behaviour in Dry and Rainy Season (Travel Time and Cost) – As the study area is surrounded by a river network and the most disaster-prone area, so the travel pattern is not as same as the dry season in the rainy season. The consultant team tried to find out the change in travel patterns in both dry and rainy seasons. Three criteria: Mode, Travel time and Cost, have been taken into account to determine the change.

Table 18 Trip length covered and cost spent by local people

Zone ID	Union/ Zone	Dry Season		Rainy Season	
		Avg. Trip Length (minutes)	Avg. Travel Cost (tk.)	h (minutes)	t (tk.)
51	Rangabali	22.14	18.60		
52	Chhota Baisdia	21.61	10.05		
53	Bara Baisdia	24.38	8.08		
54	Chalitabunia	31.11	30.36		

Source: PKCP project, UDD, 2018

Traffic Volume Count Survey –The major travel mode of Rangabali is mainly Motorbike. People use Motor Bike for their daily movement as there is no public transport such as bus service. For Short distance travel and travelling for surrounding areas motorbike is used.

The graphical presentation of modal share and temporal vehicle volume (average) distribution is shown below. Also, modal share and temporal distribution of Rangabali have been represented.

Table 19 Traffic volume of Rangabali

Upazila	Major Three Modes					
	Mode- 1		Mode- 2		Mode- 3	
	Up	Down	Up	Down	Up	Down
Rangabali	Motor Bike (82.8%)	Motor Bike (83.6%)	Tempo (11.6%)	Tempo (10.6%)	Bicycle (4.9%)	Bicycle (5.2%)

Source: PKCP project, UDD, 2018

On the Union Road, the volume of vehicles is 787 vehicles per hour. On the Union road, the volume of unconventional modes and non-motorized vehicles is high. Volume is too low on the major road because of the rural characteristics and discontinuity of road connectivity by river network and people's dependency on water transport. The figure below shows traffic volume at different survey stations in Rangabali:

Table 20 Traffic volume of Rangabali

Survey Station	Traffic Volume			Road Type
	Up-Direction	Down-Direction	Total	
Site 46	371	416	787	Union
Site 47	379	358	737	Union

Source: PKCP project, UDD, 2018

Origin Destination Survey: Rangabali Upazila is like an island totally surrounded by river network and there is no other alternative route accept waterway. So people use only vehicle within the upazila. Among all the unions major trips occur in Rangabali and Chhota Baisdia. Major vehicular trips are seen within the unions or near the surrounding unions of the same Upazila or other Upazilas.

3.5 Drainage & Flood Control

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 drainage analysis. The flood analysis would focus on the estimation of the design flood level. The analysis involves the frequency analysis with different probability distributions functions for the selected design return period. The historical data on annual peak water levels are used for the purpose. The gage station measures the daily water level. These data would be used to assess the extent of inundation due to floods and drainage problems.There are two rain gauge stations in the project area, namely Khepupara and Patuakhali. The rain gauge stations are maintained by Bangladesh Water Development Board. Table 07 shows the rainfall statistics in the project area. The mean annual rainfall in Khepupara and Patuakhali is 2607 mm and 2492 mm, respectively, which is 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, 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.

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%

Source: PKCP project, UDD, 2022

Rapid urbanization contributes to the increase of impervious areas, which in return increases storm water runoff peak and volumes. Rapid urbanization leads to intense land-use change and an increase in impervious surfaces (Guan et al., 2015). The increased runoff volumes and peak flows associated with faster response time result in urban flood risks (Zhou, 2014). In order to assess the efficiency of the existing drainage system, rainfall-runoff analysis is required.

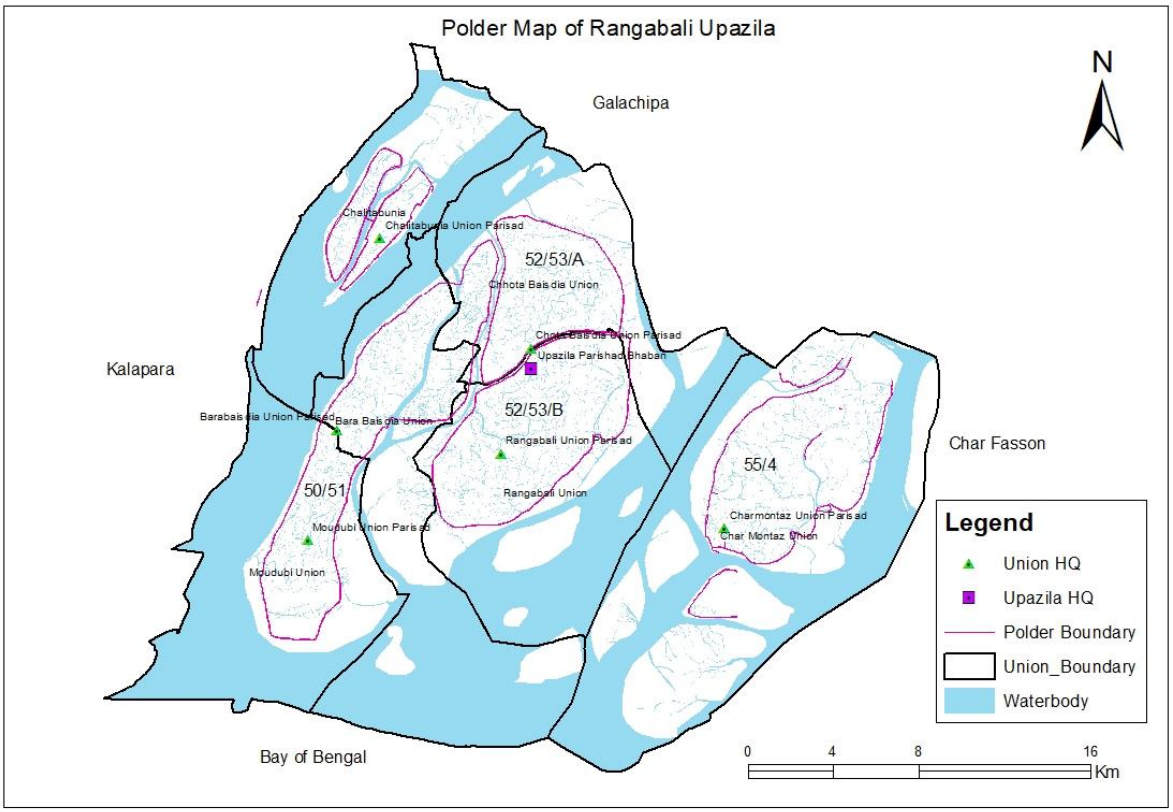


Figure 31 Polder Map of Rangabali Upazila

Source: PKCP project, UDD, 2018

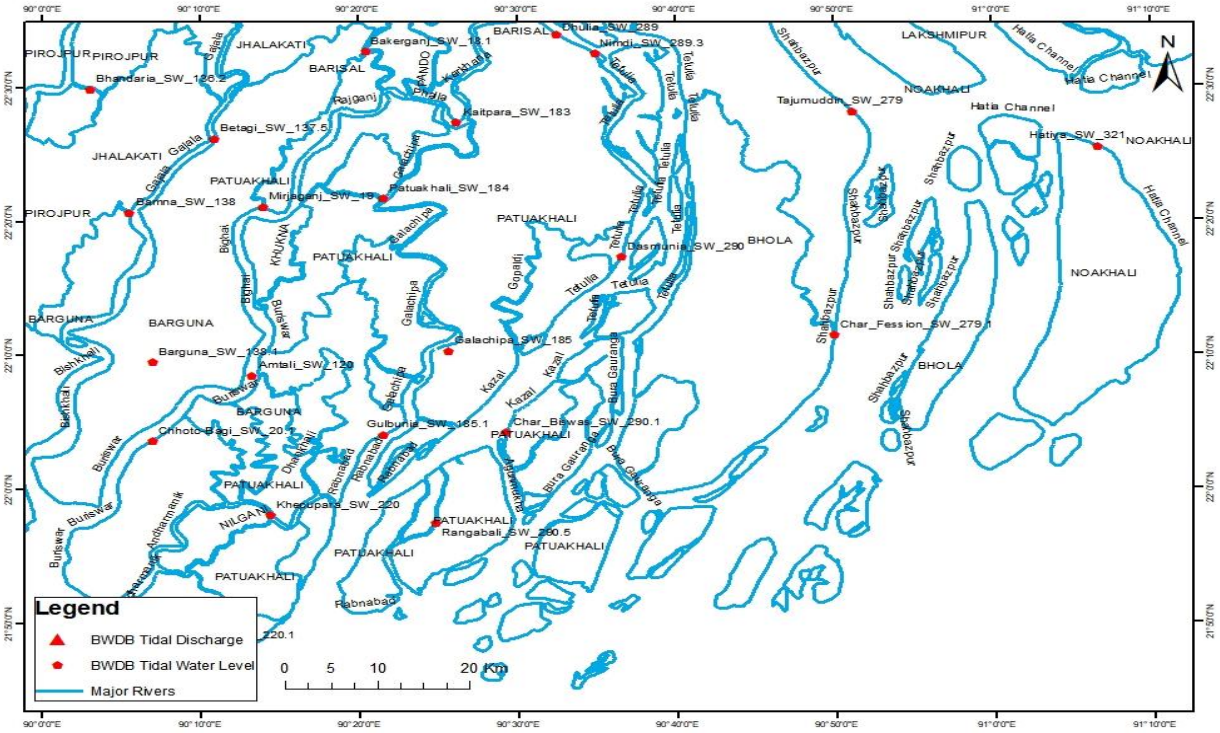


Figure 32 Location of Surface Water Gauge Station for collecting water level and discharge.

Source: PKCP project, UDD, 2018

3.6 Tourism Potentiality and Activities

Rangabali Upazilla has some Eco-tourism sites such Sonar char, andar char, char kashem. However, no major development activities in this area have taken place. As a result, additional areas can be developed as tourist destinations with proper infrastructure development. Local entrepreneurs can be aided in promoting ecotourism. Small family cottages for isolation, as well as group cottages for group tourism, can be developed using locally sourced construction materials. Additionally, the representation of local housing can be used as a tourist attraction site.

3.7 Basic Services and Facilities Forecasting

Existing Facilities: The distribution of existing socio-economic facilities by Upazilas is presented in the below Table, while it presents the distribution of facilities per 10,000 people, which gives a relative picture of the Upazila in terms of availability of facilities. For example, in Rangabali Upazila, there is only 1.55 or less than two high School per 10,000.

Requirements of Social Facilities in Future: Requirements of socio-economic facilities have been determined on the basis of the threshold population for each facility, as discussed above. The threshold population of each facility in the study area as calculated on the basis of the Reed-Muench method is shown below:

Table 21 Estimated threshold population for a particular facility

Facility	Threshold Population
Primary school	450
Madrasa	8315
High school	7217
College	31783
Upazila health complex/ hospital	208403
Family welfare centre	22001
Community clinic	24975
Growth centre	38202
Rural market	2850
Cyclone shelter	2569

Source: PKCP project, UDD, 2018

For calculating threshold population, Mouza, Union and Upazila level population data are required. That is why population data from the 2011 population Census have been used for this purpose.

The Table presents the projected requirements of socio-economic facilities in different Upazilas in 2021, while show the projected requirements of facilities in different Upazilas in 2031 and 2041, respectively. It indicates that if facilities are provided on the basis of threshold population, then there would be very little disparity by comparing with other Upazilas of the project region in terms of the availability of facilities under study. Rangabali has been deprived from basic facilities due to geographical location and administrative problem.

Table 22 Distribution of Existing Facilities by Upazila

Facility	Total Number of Existing Facilities									
	HS[1]	PS[2]	MDSA[3]	UHC/H[4]	FWC[5]	CC[6]	GC[7]	RM[8]	CS[9]	COL[10]
Rangabali	16	78	13	0	3	2	1	21	17	0

1=High School 2= Primary School 3=Madrasa 4=Upazila Health Complex/Hospital 5=Family Welfare Centre 6=Community Clinic 7= Growth Centre 8=Rural Market 9= Cyclone Shelter 10=College

Table 23 Existing Facilities per 10,000 People in Different Upazilas

Facility	Number of Existing Facilities per 10,000 People									
	HS[1]	PS[2]	MDSA[3]	UHC/H[4]	FWC[5]	CC[6]	GC[7]	RM[8]	CS[9]	COL[10]
Rangabali	1.55	7.57	1.26	0.00	0.29	0.19	0.10	2.04	1.65	0.00

1=High School 2= Primary School 3=Madrasa 4=Upazila Health Complex/Hospital 5=Family Welfare Centre 6=Community Clinic 7= Growth Centre 8=Rural Market 9= Cyclone Shelter 10=College

Table 24 Projected Requirement of Facilities by Upazila in 2021

Facility	Total Number of Facilities Required by 2021									
	HS[1]	PS[2]	MDSA[3]	UHC/H[4]	FWC[5]	CC[6]	GC[7]	RM[8]	CS[9]	COL[10]
Rangabali	15	247	13	1	5	4	3	39	43	4

1=High School 2= Primary School 3=Madrasa 4=Upazila Health Complex/Hospital 5=Family Welfare Centre 6=Community Clinic 7= Growth Centre 8=Rural Market 9= Cyclone Shelter 10=College

Table 25 Projected Requirement of Facilities by Upazilas in 2031

Facility	Total Number of Facilities Required by 2031									
	HS[1]	PS[2]	MDSA[3]	UHC/H[4]	FWC[5]	CC[6]	GC[7]	RM[8]	CS[9]	COL[10]
Rangabali	17	271	15	1	6	5	3	43	47	4

1=High School 2= Primary School 3=Madrasa 4=Upazila Health Complex/Hospital 5=Family Welfare Centre 6=Community Clinic 7= Growth Centre 8=Rural Market 9= Cyclone Shelter 10=College

Table 26 Projected Requirement of Facilities by Upazilas in 2041

Facility	Total Number of Facilities Required by 2041									
	HS[1]	PS[2]	MDSA[3]	UHC/H[4]	FWC[5]	CC[6]	GC[7]	RM[8]	CS[9]	COL[10]
Rangabali	18	294	16	1	6	5	3	46	51	4

1=High School 2= Primary School 3=Madrasa 4=Upazila Health Complex/Hospital 5=Family Welfare Centre 6=Community Clinic 7= Growth Centre 8=Rural Market 9= Cyclone Shelter 10=College

Table 27 Facilities per 10,000 People if Required Facilities are provided

Facility	Number of Facilities per 10,000 People in 2041 if Required Facilities are Provided

	HS[1]	PS[2]	MDSA[3]	UHC/H[4]	FWC[5]	CC[6]	GC[7]	RM[8]	CS[9]	COL[10]
Rangabali	1.36	22.23	1.21	0.08	0.45	0.38	0.23	3.48	1.36	0.39

1=High School 2= Primary School 3=Madrasa 4=Upazila Health Complex/Hospital 5=Family Welfare Centre 6=Community Clinic 7= Growth Centre 8=Rural Market 9= Cyclone Shelter 10=College

Source: PKCP project, UDD, 2018

3.8 Water Demand Projection Based on Aquifer

Scenario prediction: According to the model simulated recharge assessment, the water balance calculation was done for shallow and intermediate aquifers, which are recharged by rainwater. It shows the water demand and water resources calculation summary for the whole PKCP area. The groundwater model was calibrated using aquifer specific storage value of 1x10-4.

Table 28 Water Balance Calculation

Water Balance Calculation for Shallow and Intermediate aquifers in the Payra-Kuakata Project area					
Aquifer	Set Up	Population status	Water Demand	Water Availability	Comments
Shallow and Intermediate	Rural	1,144,505.00	25.06	199.37	Current water abstraction rate is OK
Shallow and Intermediate	Urban	1,144,505.00	83.55	199.37	Current water abstruction rate is OK
Shallow and Intermediate	Rural	2,289,010.00	50.13	199.3662	Double water abstraction also Ok
Shallow and Intermediate	Urban	2,289,010.00	167.10	199.3662	Double water abstraction also Ok
Deep aquifer	Rural/Urban	1200000	23	13	The difference of 13 million m3/y, which must be added to the aquifer via vertical flow that will affect deep aquifer quality by salt water intrusion and consequent subsidence of the area

Source: PKCP project, UDD, 2018

There is no visible recharge area in/near the project area, and it is supposed to be far from there. The water age defines the water in deep aquifers as 10000 years back as per the water age dating of the study area. So actual water reserve calculated and recommended to use the water only for drinking purposes. If the deep water is used for industrial purposes, the water reserve of the deep aquifer will be finished as there is no active recharge area for this aquifer, and the people may face water scarcity of fresh drinking water, which may cause seawater intrusion. The observed groundwater level data indicate that the groundwater level in the

deep aquifer in all Upazila decline annually by 0.3 to 0.5 m. Since, sample from shallow and intermediate mostly brackish, water conservation practices should be encouraged, such as implementing rainwater harvesting systems to reduce the demand for water resources. Moreover, water treatment technologies such as desalination technologies that remove salt from water can be incorporated.

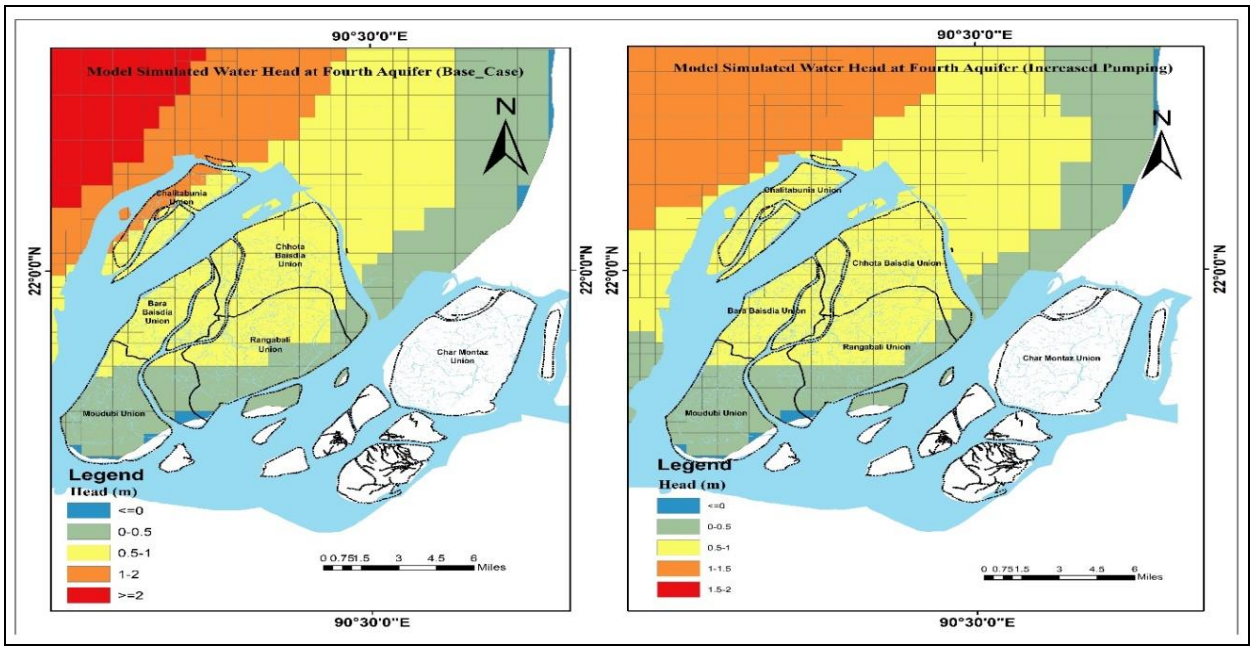


Figure 33 comparison between deep aquifer in Base Case condition in December 2019 (left) and in increased pumping condition in December 2025 (right)

Source: PKCP project, UDD, 2022

3.9 Water Demand based on Population

For the purpose of future planning of the water supply system in the upazila, estimates of water demand over the plan period are determined. According to Journal of Water and Health published by IWA and funded by Aus AID in 2006 water consumption pattern of rural area of Bangladesh has been calculated as following-

1. Drinking purpose- 3.53 (l/D)
2. Cooking -6.71(l/D)
3. Bathing -27.26 (l/D)
4. Domestic washing -12.18 (l/D)
5. Toileting and cattle feeding- 12.75 (l/D)

Table 29 Water Demand Projection in Rangabali Upazila

Union Name	Population, 2021	Water demand (litre)	Population, 2026	Water demand (litre)	Population, 2031	Water demand (litre)	Population, 2036	Water demand (litre)	Population, 2041	Water demand (litre)
Bara Baisdia Union	15,553	955421	16,570	1017895	17,625	1082704	18,592	1142107	19428	1193462
Chalitabunia Union	8,181	502559	8,681	533274	9,206	565525	9,686	595011	10097	620258
Char Montaz Union	21,754	1336348	23,159	1422657	24,675	1515785	26,085	1602401	27298	1676916
Chhota Baisdia Union	22,426	1377629	23,877	1466764	25,363	1558049	26,734	1642269	27932	1715862
Rangabali Union	32,821	2016194	34,836	2139975	36,866	2264678	38,726	2378938	40360	2479314
Moudubi Union	7,362	452248	7,843	481795	8,343	512510	8,800	540584	9196	564910
Total	108097	6640399	114966	7062361	122078	7499251	128623	7901311	134311	8250724

Source: PKCP project, UDD, 2018

Water demand and consumption in the coastal regions of Bangladesh can vary depending on several factors, including population density, economic activities, climatic conditions, and access to water resources. Coastal regions in Bangladesh face unique challenges due to their vulnerability to natural disasters, such as cyclones and tidal surges, as well as issues related to salinity intrusion into freshwater sources. Rangabali Upazila projected water demand consumption for 2041 is 2179610 gallons.

3.10 Electricity Demand

Provision of Electricity is most essential for supplying power and energy to the Upazila. In the urban area people are highly dependent on the electricity for both domestic and commercial consumption. For smooth functioning of the community services by public and private sectors, electricity supply has to be ensured round the year. With the growth of population and increase in the level of urbanization, electricity consumption will also increase in the future. From the World Bank standard, at present Energy consumption per capita is around 497 kWh of electricity. As the growth of our country people's lifestyle, its

assume that every year this demand will increase 3% per year. An estimation of electricity consumption for the Upazila is made.

Table 30 Electricity Demand Projection in Rangabali Upazila

Union Name	Population,2021	Electricity Consumption (kwh)	Population,2026	Electricity Consumption (kwh)	Population,2031	Electricity Consumption (kwh)	Population, 2036	Electricity Consumption (kwh)	2041	Electricity Consumption (kwh)
Bara Baisdia Union	15,553	7729841	16,570	9478040	17,625	11579625	18,592	14074144	19428	16941216
Chalitabunia Union	8,181	4065957	8,681	4965532	9,206	6048342	9,686	7332302	10097	8804584
Char Montaz Union	21,754	10811738	23,159	13246948	24,675	16211475	26,085	19746345	27298	23803856
Chhota Baisdia Union	22,426	11145722	23,877	13657644	25,363	16663491	26,734	20237638	27932	24356704
Rangabali Union	32,821	16312037	34,836	19926192	36,866	24220962	38,726	29315582	40360	35193920
Moudubi Union	7,362	3658914	7,843	4486196	8,343	5481351	8,800	6661600	9196	8018912
Total	108097	53724209	114966	65760552	122078	80205246	128623	97367611	134311	117119192

Source: PKCP project, UDD, 2018

The electricity demand of an Upazila, which is a subunit of administrative regions in Bangladesh, can vary widely depending on factors such as population, economic activities, industrial development, and energy consumption patterns. According to the BPDB and PGCB report, the Barisal Region's total consumption rate is 2250 MW, whereas Rangabali Upazila's anticipated consumption demand is 13.37 MW to meet the need.

3.11 Solid Waste Generation

Solid waste management is a major concern to local governments to protect human health, the environment and to preserve natural resources. The design and operation of an effective solid waste management system requires accurate estimation of future waste generation quantities. The main objective of this study was to develop a model for accurate forecasting of solid waste generation that helps waste related organizations to better design and operate effective solid waste management systems. The waste generation unit is 0.09 kg per person per day. According to survey, Rangabali Upazila produced 13 tons of solid waste in 2021 as opposed to 16.28 tons in 2041.

Table 31 Solid Waste Generation Projection in Rangabali Upazila

Union Name	Population, 2021	Waste Generation (kg/day)	Population, 2026	Waste Generation (kg/day)	Population, 2031	Waste Generation (kg/day)	Population,2036	Waste Generation (kg/day)	2041	Waste Generation (kg/day)
Bara Baisdia Union	15,553	1711	16,570	1823	17,625	1939	18,592	2045	19428	2137
Chalitabunia Union	8,181	900	8,681	955	9,206	1013	9,686	1065	10097	1110
Char Montaz Union	21,754	2393	23,159	2547	24,675	2714	26,085	2869	27298	3002
Chhota Baisdia Union	22,426	2467	23,877	2626	25,363	2790	26,734	2941	27932	3072
Rangabali Union	32,821	3610	34,836	3832	36,866	4055	38,726	4260	40360	4440
Moudubi Union	7,362	809.82	7,843	862.73	8,343	917.73	8,800	968	9196	1011
Total		11890		12646		13429		14148		14774

Source: PKCP project, UDD, 2018

3.12 Identification of Flood Risk in Different areas and capacity of Drainage System

As the area lies at the southernmost tip of Rangabali 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 drainage analysis. The flood analysis would focus on the estimation of the design flood level. The analysis involves the frequency analysis with different probability distributions functions for the selected design return period. The historical data on annual peak water levels are used for the purpose.

3.13 Ecology, Environment and Forest areas

Floral Diversity

The findings from the conducted study on existing flora has been provided information basically on terrestrial and aquatic ecosystems, and mangrove ecosystem (an ecosystem of the inter-tidal zone) with an account of 190 species having different life-forms including

herbs, shrubs, climbers and trees. The distribution of these flora species are noted as homestead, cropland, roadside, shorelines, canals, rivers and small water bodies like fish culture ponds.

Faunal Diversity

Species diversity of fauna is low comparative to the other tropical area. Naturally, mangrove does not support a variety of wild fauna on its mangrove ecosystem. Moreover, coastal flooding is a common scenario that destroys the core habitats of the wild fauna. Therefore, habitat disturbance is a question that does not offer suitable habitat to allow betterment of their survival or success of living. While conducting this field work the study team has explored that there are 14 different habitats or ecosystem exist and have been supporting a good number of fauna to provide ecosystem services and or retain integrity of the ecosystem functions. During the recent field visit 201 species of fauna were recorded in this study area.

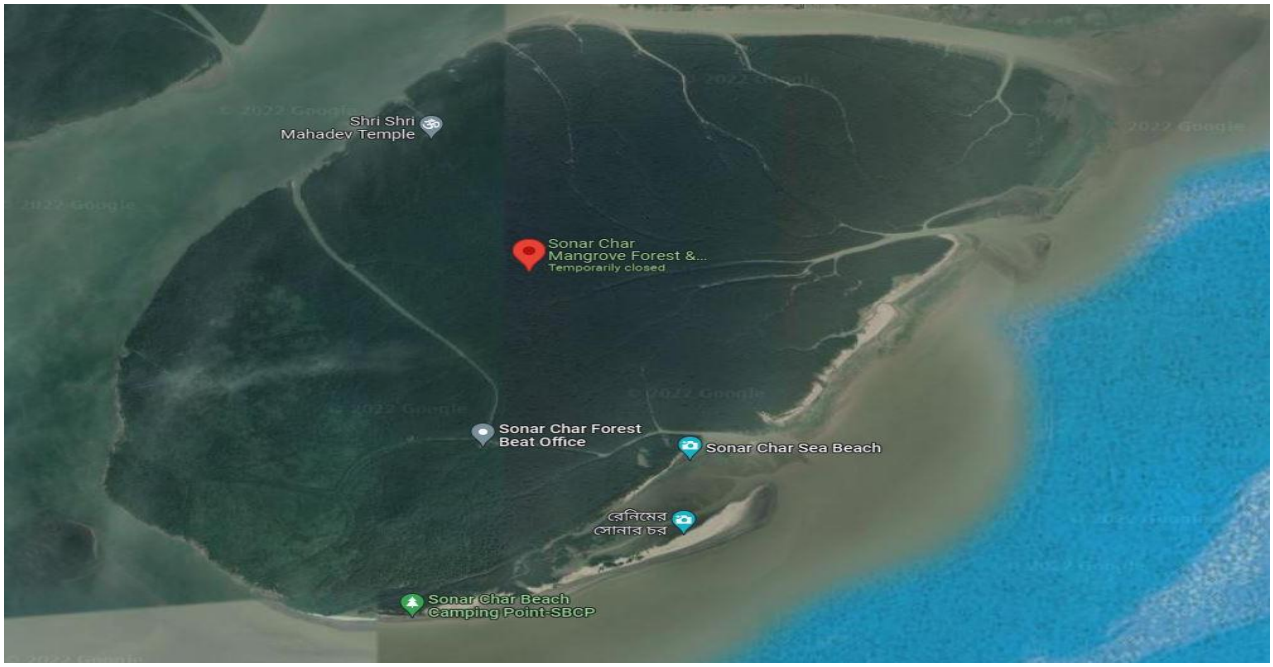


Figure 34 Sonar Char forest of Rangabali Source: PKCP project, UDD, 2018

The Rangabali Upazila contains some areas of mangrove plantation, particularly in Sonar Char forest and char lands.

Conservation initiatives for wildlife and forests

Habitat improvement initiatives

Patuakhali Forest Division has managed four Protected Areas (PAs) to conserve wildlife within there. These four PAs are Kuakata National Park, Sonarchar Wildlife Sanctuary and proposed Laldia Wildlife Sanctuary. Some of the wildlife are Monkey, Wild boar, porcupine, Fox and Jackal, bat, dog, Mongoose, rat, Monitor lizard, Cobra, squirrel, Python, Haldi pakhi, Babui, owl, Bou kotha kao, kyte, shalik, shyama, tuntuni, dove, kingfisher, white stroke, Dahuk, Magpai, robin, nightingale and many others. According to the IUCN list, some species mentioned above are identified as rare and endangered species. During winter many

migratory birds make their temporary residence in the sanctuary which attracts the tourists. To enrich these habitats, Patuakhali forest division has taken initiatives of habitat improvement plantation under SUFAL project. Till last financial year, 40.0 ha. of mangrove fodder plantation have been raised in Patuakhali Forest Division.

Awareness build-up

Forest Officers and staffs have been offered training for knowledge and skill development on PA management. Training have been offered to the forest officials and staffs on Wildlife management and wildlife crime control matters. Smart patrolling has been introduced in PA area. Shark and Ray including other species conservation strategy and non-detrimental findings are prepared.

Afforestation and reforestation at degraded land and Newly accreted char land

More than 4,000ha accreted coastal areas have been covered by afforestation to create coastal green belt of trees as a barrier against sea borne storms. Moreover, 1,000 ha of reforestation at degraded forest land have been done as restoration program in Patuakhali Forest Division.

Livelihood development of Forest dependent people

Institutionalizing collaborative Forest Management (CFM): The aim of the collaborative forest management is to give forest dependent communities a stake in the management and preservation of the quality of the forests over the long term and to foster local stewardship forests.

3.14 Freshwater and Marine Fisheries

The estimated total fish habitat area is about 172,792 ha, which is an assemblage of open water fishery and aquaculture by about 98% and 2% respectively. The open water fisheries are dominated by floodplain habitat followed by river and canal, and mud flat/inter tidal area. In view of fisheries biodiversity, 47 fish species were listed covering 28 families of which Cyprinidae was found as the most dominant family which contains 9 species under 7 genera followed by Bagridae having 5 species belonging to 3 genera and Engraulidae also containing 3 species under 3 different genera. The study described 7 vulnerable, 5 endangered and 2 critically endangered species out of 42 finfish species. Diversity indexes were calculated for the present finding of which Margalef's index (d) was 5.13 for species available.

Due to unawareness and indiscriminate fish caught with a small mesh size net, diversity of fish species in the river is under threat. Thus, public awareness and adequate knowledge on use of appropriate fishing gear with appropriate mesh size could contribute to sustainable fisheries diversity in the river and the improvement in livelihood of the fishermen in the adjacent area. Some of these fish are dried before being marketed in the dry season while others are sold fresh. With the opening of Padma Bridge, the transport crisis will be over and traders will be able to make more profit by bringing fresh fish to the market.
There are six (06) hilsa sanctuaries that have been declared in Bangladesh. Among them, two (02) hilsa sanctuaries were established in the Andharmanik and Tetulia River which are fall in the study are

CHAPTER FOUR: SECTORAL AND STRUCTURE PLAN POLICIES

4.1 Development Planning Strategy and Sectoral Policies Proposed in the Structure Plan

Several national plan policies have been reviewed to determine the strategies for Rangabali Structure Plan area. Some of the important plans and policies that have been reviewed that are the following: Perspective Plan (2021-2041), 4. Perspective Plan (2010-2021) the 8th Five-Year Plan, 7th Five Year Plan, the Bangladesh Climate Change Strategy and Action Plan (2009), Bangladesh National Conservation Strategy (2016-2031), National Adaptation Programme of Action (NAPA) 2009, Coastal Development Strategy 2006, National Food Policy 2008, Coastal Zone Policy 2005, the Country Programming Framework (2010), Coastal Environment and Management Plan for Bangladesh 1988, Environment Policy and Implementation Plan 1992, National Environmental Policy 1992, Environmental Court Act 2000, National Water Policy 1999, Bangladesh Water Act 2013, National Agriculture Policy 1999, Land Use Policy 2001, Tourism Master Plan of Bangladesh, the Tourism Master Plan of Bangladesh, the Bangladesh Water Act 2013, Environmental Conservation Act 1995, National Environmental Management Plan 1995, the Bangladesh Delta Plan 2100, the National Adaptation Plan and the Sustainable Development Goals.

Urban Sector

In the urban sector the policy recommends strategies to promote sustainable urban development, including the creation of adequate and affordable housing, the provision of basic urban services such as water supply and sanitation, and the development of sustainable transportation systems. This also recommends the adoption of policies that encourage the use of renewable energy, the reduction of greenhouse gas emissions, and the promotion of green spaces and public parks. Additionally, effective land use planning is critical to ensure proper urban development and sustainable economic growth. The policy strategy highlights the importance of developing effective land use plans to ensure that land resources are utilized in the most efficient manner.

The government's lone effort in resources, capabilities and initiatives is inadequate to resolve the ever-increasing housing problem. As a result, the gap between housing demand and supply becomes wider. The genesis of the problem remains in the fact that the development of housing and related infrastructure can't cope with the growth of the population. Affordable, equitable and accessible urban services are the key to ensuring sustainable development of urban areas.

US-01: Prepare more detailed land use zoning for pourashava/urban areas.
Justification
Land use development is more intensive in urban areas. So, more detailed zoning is necessary for urban part of the upazila.

Strategies

1. Apply urban area land use zoning for controlling building permission in the potential urban area.
2. Maintain maximum possible flexibility in the land use to enable development where pressure high for development permission.

US-02: Limiting urban expansion in the Potential Urban Area

Justification

Limiting urban expansion to the proposed urban area is an important aspect of urban planning and development to ensure sustainable growth and management of cities.

Strategies

For Upazila, infill construction is recommended. Every land proposal is made in close proximity to an already developed area. To safe guard urban waterbodies, playgrounds, and high-value urban agriculture, however, due consideration has been provided.

Implementing Agency

The UDD is a government agency under the Ministry of Housing and Public Works that is responsible for urban planning, development, and management at the national level in Bangladesh. Local government authorities, such as city corporations, municipalities, and pourashavas, are responsible for the planning and development of urban areas at the local level in Bangladesh.

US-03: Ensure proper drainage, modern sewerage, proper waste management and clean air in cities.

Justification

To promote sustainable urban development, the creation of adequate and affordable housing, the provision of basic urban services such as water supply and sanitation, and the development of sustainable transportation systems are utmost important.

Strategy

Waste management should include prevention, minimization, recycling and reuse of wastes, biological treatment, incineration, and landfill disposal. Prioritize nature-based solutions to ensure proper drainage, simultaneously protecting and enhancing the environment and minimizing management cost. By adopting multifunctional sustainable drainage systems, it is possible to create new habitats and mitigate climate change impacts in collaboration with stakeholders while minimizing management costs. Additionally, the installation of modern sewage systems should be based on need and feasibility assessments.

Implementing Agency

The UDD is a government agency under the Ministry of Housing and Public Works that is responsible for urban planning, development, and management at the national level in Bangladesh. Local government authorities, such as Development Authority, municipalities

are responsible for the planning and development of urban areas at the local level in Bangladesh.

Rural Sector

RS-1: Ensuring urban services into rural areas incorporating the government agenda "My Village My Town"

Justification

Development of infrastructure, like, road, power, irrigation, prevention of river erosion and flood protection will boost rural economy. Surplus rural capital will be investe agricultural and non-agricultural activities creating new jobs.

Strategies

Gear up infrastructure development activities with domestic and foreign funding.

Implementing Agency

Greater role to be played by REB, BADC, Krishi Bank, LGED, BWDB by taking up more development projects.

RS-2: Improve the coverage of primary education, health, sanitation and safe drinking water facilities

Justification

This approach takes into consideration various factors such as social, economic, environmental, and cultural aspects of rural areas to ensure that development initiatives are sustainable, inclusive, and aligned with existing rural settlement patterns.

Strategies

- Only fundamental services in the areas of health,education, social safety,and communication infrastructure may be taken into account for inclusion in the plan.
- Facilities are often located 500 meters or less from union headquarters or current growth centers.

Implementing Agency

Ministry of Agriculture, Ministry of Housing and Public Works, Ministry of Education, Upazila and Zila Parishad.

Agriculture Sector

For the sake of food production, there is a need to conserve high-yielding agricultural lands against severely competing non-farm land use demand. In disaster prone areas, strategies are recommended to protect agricultural land. Investing in agro-based industries and food processing are key steps to move forward to secure food supply and agricultural growth.

AS-1: Intensification of agriculture and crop diversification to increase food security; develop salt tolerant crop varieties.

Justification

Diversifying crops can help increase crop intensity by growing different crops in the same field or rotating crops between seasons. This practice can help reduce pest pressure, increase soil fertility, and optimize water use, leading to higher crop yields without expanding agricultural land.

To save the agricultural land for food security in the country, it is necessary that further loss of agricultural land is prevented

Strategies

Cropping pattern information, ground water quality and quantity and interpolated surface geology information will assist relevant agencies to take adaptive strategies.
Save and protect at least double and triple cropped agriculture lands.
The strategy has identified upazilas affected by salinity at various levels due to 0.50m, 0.62m, 0.95m, and 1m SLR, which will let pertinent agencies make decisions to increase productivity; cropping pattern of the region has been surveyed which will help to conduct R&D to shift in agriculture paradigm; emphasis on the necessity of coastal polders for protecting agricultural fields from saltwater incursion

Fish stocks must be managed responsibly by utilizing the bounty of the ocean, lakes, and rivers to produce food and nourishment, or else the resource will go extinct and negatively impact both people and the aquatic environment. Agro-fisheries equipment should be environment friendly and affordably priced and simple to use, which can increase yields.

AS -2: Prevent non-agricultural use of the fertile agricultural lands.

Justification

Bangladesh is an agricultural country. Its economy is mostly dependent on agriculture. But in order to provide housing, most of the agricultural lands are converting to residential areas. As a result of expansion of residential areas, the total amount of agricultural lands is decreasing day by day which is harmful for future food production. So it is the demand of the time to discourage residential expansion in the agricultural land and Keep suitable agriculture lands free from any kind of encroachments.

Strategies

Keep suitable agriculture lands free from any kind of encroachments particularly from human settlements.
The plan should identify the cropping pattern of the study region in order to identify high productive fields and restrict non-agricultural use of such resources through defining them as Agriculture zone.

Transportation and Traffic Management

TT-01: Develop an integrated network of communication including highways, rural roads, railways and water ways.

Justification

The first step would be to establish a comprehensive transportation plan that considers the needs and demands of local, regional, and national transportation systems. This would require coordination among various government agencies. Development of local transportation network will help build up improved internal road and waterway transport system within the Rangabali Upazila.

Strategies

1. Proposals will be made for widening the existing narrow roads and development of new roads where accessibility is poor.
2. Infrastructure like, terminals, parking spaces for motorized and non-motorized vehicles, traffic signals, automobile workshops and garages, pick up and drop off spaces for passengers and goods, etc. should be developed depending on the needs.
3. Plan should consider integration among road, rail and water way.
4. Establish connectivity with inter-regional highways, economic zone areas, ports, airports, power stations, inland water transport facilities, rail stations and major tourist resorts.
5. Upgrade all inter-district roads to atleast 4 lane facilities and upgrade/extend existing bridges; Upgrade zilla and upazila roads to atleast 2 lanes; Convert village roads to asphalt standard with atleast one lane.
6. Creation of physical segregation of the primary road from the local activities and local traffic including manually operated vehicles.
7. Establishment of road hierarchy among primary,secondaryandtertiaryroads.

Implementing Agency

Ministry of Road Transport and Bridges, Road Transport and Highways Division, Bridge Division, Roads and Highways Department (RHD)

TT-02: Promote bike lanes and pedestrian walkways, recommend light transports, tourist-oriented sightseeing electric bus/ boats.

Justification

For achieving a better quality of life in the Paurashava and other urban area, safe sidewalks and bicycle paths are required along the road system. An exclusive bicycle trails can also be created in suitable areas or along the roads with low traffic volume for supporting healthy lifestyle of local communities.

Strategies

1. Walking and bicycling facilities should link all the important services, community facilities and recreational spaces in the Paurashava and and other urban area. The width of the roads/right of ways for roads should be designed with required planning standards to accommodate the sidewalks and bicycle paths.

2. Proposal of water cruise route from Sonar Char to Sundarbans connecting Kuakata would be considered.

3. Tourist-oriented sightseeing electric bus/ boats etc. would be considered for Kuakata Tourism area and for other tourist area.

Implementing Agency
Ministry of Road Transport and Bridges, Local Government Division, Pourasava.

TT-03: Prioritize inter-regional river connectivity to facilitate trade, commerce and tourism; improve the navigability and river port infrastructure.

Justification

Bangladesh being a country with many rivers, Inland Water Transport (IWT) is a major mode for the transport of goods and people. IWT is the cheapest mode of transport compared to road or rail. The study region is well connected with inland water transportation system.

Strategies

1. Conduct regular dredging activities to maintain river transportation; Develop and maintain river ports, ferry ghats and terminal facilities in ports/ ghats.
2. Provide modern water vessel/ ship in these routes.

Implementing Agency
Ministry of Shipping, BIWTA, BIWTC

Water Resource and Drainage

Water resource planning and management is concerned with hydrology, water supply, sanitation, sewerage and drainage etc. Ensuring sustainable management of surface and ground water is the key to enhancing efficiency in water use and in an equitable manner. Conservation and preservation strategies are highlighted for supply of safe water. Industrial development in recharge areas is to be restricted to prevent water pollution. Water treatment plants and regular monitoring is needed to maintain the quality of water. Application of 3R policy, preservation of recharge areas, rainwater harvesting schemes are some of the proposed strategies.

WR-01: Promote rainwater harvesting in coastal areas, Preserving and maintaining the existing natural water bodies for drainage, to savecropandproperty, flood control and environmental purposes

Justification

The only economically reasonable alternative of groundwater is rainwater. The most important advantage of rainwater harvesting is that it has no connection with sanitation problem and it requires no or minimal treatment for drinking. If peoples of the study interested about the rainwater harvesting and do it spontaneously then it will largely decrease the groundwater abstraction pressure from sub surface water bearing zones.

Rainwater harvesting boosts soil fertility, lessens the need for chemical fertilizers, increases well water use, replenishes groundwater, and makes better use of all the water that falls on the farm to increase crop yield. The most crucial factors in the optimization of Rain Water Harvest systems is the tank location and the distribution technique selected.

Strategy:
Strategies such as wetland conservation, storm water management, watershed management, floodplain management, ecosystem restoration, monitoring and enforcement, and education and outreach can help ensure the sustainability and health of natural water bodies for current and future generations.
Implementing Agency
Public health Engineering Department, pourashava, NGOs/CBOs

WR-2. Provision of safe and affordable drinking water supply with special attention to salinity prone coastal areas.

Justification
Safe in context of salinity, arsenic contamination etc. is a basic requirement of people. It is also a crucial need of the people of coastal area.

Strategy
Long-term water resource management strategies documented by the Govt. following IWRM concept (such as examine large-scale O&M activities in embankments and polders to prevent salinity intrusion, identify and implement the best option and undertake desalinization activities) should be incorporated. Coastal embankments also need to be rehabilitated. Arsenic mitigation measures should be taken. Industrial development in water recharge areas should be restricted to prevent water pollution.

The plan ranks sites based on availability of quality ground water which will help to make proper use of ground water; the plan identifies surface water network by analyzing DEM and field survey. In Urban area plan the location of water treatment plant should be located.

It should be given priority to conserve, manage and re-excavate the wetlands.

Implementing Agency

Public health Engineering Department, pourashava, NGOs/CBOs

WR-3. Reduce dependency on groundwater and ensure natural and artificial recharge of groundwater.

Justification

To reduce groundwater dependency, demand-side management interventions and supply-side engineering measures is important. Aquifer recharge improvement with excess surface runoff, urban wastewater reuse and complementary local supply-side steps like rainwater harvesting should always be promoted.

Strategy

The plan should identify heights recharge area; to maintain the areas unpaved. Coastal Afforestation zone may be proposed in this area.

Implementing Agency

Plan implementing agencies like Implementing Agency like Public Health Engineering Department, pourashava, Development Authority, NGOs/CBOs

Renewable Energy

Power is a part of modern living. Progress in all respect cannot be moved forward without adequate power supply.This is an essential part of everyday life. Target has been set in Bangladesh Delta Plan 2100 for at least 30% energy production from renewable sources by 2041 in the context of being a prosperous country.

RE-1: Extension of power supply to unserved rural areas/char land

Justification

Government has to take steps to extend power supply to rural areas through REB.Necessary budget should be sanctioned in this regard.If it is delayed alternative measures may be promoted.

Strategies

1. Take up power supply as major national development policy.
2. Crush program by REB with necessary budget allocation.

RE -2: Emphasis on development of renewable energy, particularly solar homes and biogas plants; Include energy saving devices in all infrastructure; Reduce the use of fossil fuel; Investment to harness wind energy particularly in coastal areas.

Justification

Take the required action to transition to renewable energy, solar energy, and wind mills as an alternative national power supply. Engage the private sector to close the supply gap with renewable energy.

Strategies

1. Utilize energy sector NGO's and private commercial agencies to supply homes with

solar power.

2. Introduce soft credit facility for users to purchase solar system.
3. In addition to grid supply renewable energy use such as solar plants, bio-gas plant and wind mills should be given priority; the plan should identify suitable locations for eco-town development to lower carbon impact.

Implementing Agency

In Bangladesh, several agencies and organizations are involved in the implementation of renewable energy initiatives. Some of the key implementing agencies for renewable energy in Bangladesh include: Sustainable and Renewable Energy Development Authority (SREDA), Infrastructure Development Company Limited (IDCOL), Bangladesh Power Development Board (BPDB) and Grameen Shakti.

Disaster Mitigation and Climate Change Aspect

Disaster arising from climate change or non-climate change phenomena is very common in Bangladesh. People of the country are highly resilient to disasters like, flood, cyclone, and river bank erosion. Remarkable disasters that strike Rangabali Upazila are tropical storm, Salinity and monsoon flooding.

DPM-01: Ensure better flood control, Control riverbank erosion, Control sea water intrusion and reduce salinity.

Justification

Natural disasters, such as floods, inundation of water, cyclones, erosion etc, are threats to safety and loss of human life and properties. This has to be given due consideration in the development processes.

Strategies

Building new and enhancing existing drains; identified inundation area and depression area to take necessary measure for infrastructure development; facilities such as water treatment plant, septic tanks, toilets etc should be constructed above flood level to avoid inundation level. The strategy of implementing disaster-resilient infrastructure can be adopted to face the challenges of future disasters.

Implementing Agencies

The local government authorities, particularly the Upazila Parishad should work through different committees formed as per National Disaster Management Plan at the local levels. The Disaster Management Directorate under the Ministry of Disaster and Relief should be monitoring such actions for people's safety and national security purposes.

DPM-02: Construct adaptive and flood-storm-surge resilient building; Extension and improvement of multipurpose cyclone shelters.

Justification

As proactive action sustainable infrastructure is necessary to tackle climate change impacts.

Multipurpose cyclone shelter should be a solution to comprehensive use of structure.
The plan should propose embankment construction considering people who live in the area between the river and the wall (strategies or compensation provision to their homes, farms, animals, pastures, livelihoods); the plan should also recommend to include protection from saline water, river bank and khal protection schemes, rehabilitation of polders, as well as an extension of polders, canal excavation, construction of new embankments, protection and extension of irrigation systems, excavation of river and branch channels, multipurpose cyclone shelter centers.

Strategies
Infrastructure should be built higher above the flood plain. Build Using Flood Resistant Materials – Materials that can withstand contact with floodwaters for at least 72 hours without suffering major damage are considered flood resistant.
Construct coastal embankments and polders to control flooding; construct sluices to facilitate drainage

Flood proofing the critical infrastructures such as hospitals, power stations, industrial plants, major communication networks by development of embankments, barriers, water control structures. Expanding and enhancing multifunctional storm shelters. Establish guidelines for the design of climate-resilient infrastructure. Upazila level public sector development agencies are required to adhere to regulations while building infrastructure.

Implementing Agencies
The local government authorities, particularly the Upazila Parishad should work through different committees formed as per National Disaster Management Plan at the local levels. The Disaster Management Directorate under the Ministry of Disaster and Relief should be monitoring such actions for people's safety and national security purposes.

CLI-1: Take necessary measures to educate people about the dangers of climate change in all spheres of life.

Justification
Awareness would cause people to take proactive measures to create resilience against the negative impacts of climate change.
Strategies
Program initiative by the Upazila Parishad in collaboration with the Department of Disaster Management to educate people about climate change and its consequences.

CLI-2: Adopt climate change resilient production technology in agriculture including seed.
Justification
To avoid disaster in agricultural production, prior action to evolve new agro-tech in agriculture is necessary to cope with climate change.

Strategies

Research program initiative by BADC and BRRI to evolve new technology and paddy Resilient to climate change.

CLI-3: Identification, protection and management of environmentally sensitive and biologically potential areas.

Justification

Preservation of environmentally sensitive areas can serve as safe guard to bio-diversity and disaster.

Strategies

1. Identified critical habitat areas of crab, crocodile, deer, and dolphins fox migratory duck's reptiles, resident birds, resident water birds, sea turtle's sea gull, wild boar, wild buffalo, wild cat, hilsha sanctuary etc. proposal has been made considering the mentioned areas to remain undisturbed

2. Earmark environmentally sensitive areas in the master Plan.
3. Control development in those areas; take over land if possible to preserve the areas.

CLI-4: Organize and keep activated the disaster management committees at various levels of the administration

Justification

Regular meeting of Disaster Management Committees will keep members conscious about their responsibilities.

Strategies

Hold regular meeting of Upazila, Union Disaster Management Committees.

Implementing Agency

In Bangladesh, the implementing agency responsible for addressing climate change is the Ministry of Environment, Forest and Climate Change (MoEFCC). The MoEFCC is the primary government body in Bangladesh responsible for formulating and implementing policies, plans, and programs related to environmental conservation, forest management, and climate change mitigation and adaptation.

Conservation Zone

CZ-1: Conserve natural/environmental resources like water body, Forest and Char land.

Justification

Conserving natural and environmental resources, such as water bodies, forests, and char lands (riverine islands), is critical for maintaining ecosystem services, supporting livelihoods, and preserving biodiversity.

Strategies

River and Khal protection zone has been created to protect existing waterbody.50m buffer zone has been created from the edge of the river and 10m buffer zone has been created from the edge of the khals. Continental embankment, road and beautification with tree plantation have been proposed in this buffer zone. It will protect the river and khal from further development.

CZ-2: Execute and use planning for the enhancement of ecosystem and species diversity.

Justification

Land use planning plays a crucial role in enhancing ecosystem and species diversity by promoting sustainable and responsible land management practices. Here are some steps that can be undertaken to execute land use planning for the enhancement of ecosystem and species diversity.

Strategies

Conservation Zone has been created in the char is at protecting char area from further development. This zone will preserve the natural condition and attract tourist more.

Implementing Agency

There are some of the key agencies involved in conservation zone protection in Bangladesh. However, it's important to note that conservation efforts in Bangladesh also involve collaboration and partnerships among various stakeholders, including government agencies like Ministry of Environment, Forest and Climate Change (MoEFCC), Department of Forests (DoF), Bangladesh Forest Research Institute (BFRI), Bangladesh Wildlife Conservation Trust (BWCT), Bangladesh Forest Department (BFD), National River Conservation Commission (NRCC), NGOs, local communities, and other relevant organizations.

Economic Zone

EZ-01: Light industries need to be developed to flourish the industrial sector development

Justification

In order to accelerate the economic development of Rangabali Upazila in the long run, it is required to encourage the industrial establishment within Upazila area.

Strategies

To control the haphazard in the mid to find us trial development, measures will be undertaken as followed

- Following the category of industries as categorized by DOE (GreenCategory) and Bangladesh National Building Code (low and medium category hazards)
- Following Bangladesh National Building Code,1993&2006 and Building Construction Regulation,1952 (amendmentin1996) of or providing Road, setback before construction of any industrial structures

EZ-02: Promote Agro based Industries in the Growth Centres

Justification

Rangabali Upazila is dependent on agriculture and small business through direct or indirect involvement. In order to restore the economic basis and accelerate the trend of economic development, emphasis is needed. A separate union should develop a small growth centre.

Both public and private capital ought to be focused on this hub of growth. Opportunities to promote agro-basic industries in Rangabali Upazila would be created by this policy.

Strategies

By guaranteeing increased capacity, agro-based industries will assist current producers in raising their yields and expanding their employment opportunities.

EZ-03: Promotion of Rural Growth Centres as Trading Hub of the Rural Area.

Justification

Promoting rural growth centres as trading hubs in rural areas can contribute to the economic development of rural communities by facilitating trade and commerce, creating employment opportunities, and promoting local entrepreneurship.

Strategies

The Upazila will assist the central government in promoting Upazila as a potential location for inward investments. If National Businesses can be encouraged to locate in promoting Upazila, they will provide earning capacity for their locally recruited employees and the opportunity for services to be offered to support the businesses.

EZ-04: Employment Generation through Development of Potential Sectors

Justification

Generating employment opportunities through the development of potential sectors can be a key strategy for economic growth and poverty reduction.

Strategies

In order to sustain economic activity of the Upazila for longer period with proper sustenance, the area is disposed towards Agriculture and small scale business in some extent. Proper planning and coordination among these sectors and future potential sectors would be possible to engage active labour force. Following measures will be encouraged to implement this policy implication:

- Industrial Zone declaration in Land Use Zone (mainly light industries)
- Infrastructure development to flourish agro industry (Market, Storage facility, electricity etc.)
- Involvement of active labour force and community participation in different management activities of Upazila such as solid waste management in transferring the wastes from Solid-waste transfer sites, road maintenance, and public sanitation.

Implementing Agency

In Bangladesh, the implementing agency for economic zones is the Bangladesh Economic Zones Authority (BEZA). BEZA is a government agency under the Ministry of Industries, responsible for planning, development, operation, and management of economic zones in Bangladesh.

Forest Area

Policy FA-01: Conserve forest resources and improve bio-diversity, Foster development through conservation, increase forest cover and protect biodiversity; Forest regeneration and afforestation; Bring coastal areas under mangrove rehabilitation program; Give priority to the creation of a coastal green belt.

Justification

The forest area in Bangladesh is approximately 2.62 million hectares, which is about 17% of the country's total land area. Perspective Plan (2021-2041) has set the target to achieve 20% area under forest resources by 2041. However, it's worth noting that the forest cover in Bangladesh has been declining over the years due to various factors such as deforestation, illegal logging, encroachment, and infrastructure development.

Preserve trees and forests, especially large trees and mature forests, as they serve as habitat for a variety of species, store carbon, uphold water quality, regulate climate, and offer areas for recreation and contact with nature.

Strategies

1. Forest, char areas and areas which are still on Geological formation stage has been proposed as Conservation Zone for forest resources.
2. Establishment of parks and discourage detrimental suburban sprawl and other development in order to preserve forests; Reforestation is a crucial component of the fight against climate change, and recovering ecosystems that have been damaged creates vital habitat for endangered species.
3. Expand social forestry program

Implementing Agencies

Several agencies and organizations are involved in forest conservation efforts in Bangladesh. Bangladesh Forest Department (BFD), Local Government Department (LGD), Bangladesh Forest Research Institute (BFRI), and Community-based Organizations (CBOs) are a few of the major organizations that carry out forest conservation in Bangladesh.

Tourism Development

The PKCP area has been identified as having high potential for attracting tourists. One of the key strategies to increase tourism in the PKCP area is through ecotourism. Ecotourism is a form of tourism that focuses on visiting natural areas in a way that is ecologically sustainable and socially responsible. In addition to a massive tourism marketing strategy should be developed to promote the PKCP area as a tourist destination. The marketing strategy should emphasize the unique features of the PKCP area, such as its natural beauty, cultural heritage, and recreational opportunities. Capacity building in the tourism sector is also an important instrument for expanding tourism in the PKCP area. Expanding tourism in the PKCP area can have a significant impact on the local economy by creating jobs, boosting GDP growth, and

supporting conservation efforts. To achieve this, a combination of strategies is required as mentioned above.

TD-01: Encouraging eco-tourism development

Justification

Investments in eco-tourism can be positive for environmental conservation as well as income generation. The natural sites at the Upazila level have potential for such investments and development.

Strategies

Eco-tourism development prospects in the Upazila should be explored for investment in ecotourism. Attractive natural sites will be identified and offered for eco-tourism development.

Implementing Agencies

Bangladesh Parjaton Corporation and the National Tourism Development Board should be supporting and guiding tourism development at local levels by enacting favourable policies and laws. Local and regional trade associations are important for promoting tourism development in the Upazila.

TD-02: Promoting and attracting public and private investments in Tourism Development

Justification

Tourism can be an important sector for revenue earning by the local authorities. The process of development in this sector attracts investments in various services. There is scope for promoting tourism development in the Upazila.

Strategies

Identifying, demarcating and developing suitable locations within the Upazila for creating attractions may be potential for attracting investment. Investment can be encouraged by creating attractive sites for development in the tourism locations. The local and regional investors can be attracted with possible options of incentives.

Conclusion

The policies set for various sectors in this chapter commensurate with the broad national sector policies. The strategic measures suggested are targeted to achieve these policies at Upazila level. The implementing agencies are identified in consideration of direct and indirect involvement in the plan implementation process. The diverse supportive role of many local stakeholders and local and national agencies will also be important for implementing the plans.

CHAPTER FIVE: COMPREHENSIVE STRUCTURE PLAN

5.1 Existing Land Use

Except for the central area of Rangabali Union, topographically, Rangabali Upazila is mainly island in nature. Some unions are mainly containing rural characteristics. But in recent years, communication development has already impacted the growth and expansion of activities within the upazila. The existing land use of the Upazila shows that 26.77 percent of the land is used for agricultural activity, and another mentionable land-use area is 7.36 percent rural settlement, 4.24 percent Char land and 13.11 percent forest area. It illustrates existing land use statistics in detail.

Table 32 Existing Land use of Rangabali Upazila

Land use Type	Area in GIS(Acre)	Area_SqKm	Percentage
Administrative	22	0.08	0.01
Agricultural Land	47408	191.85	26.77
Char Land	7513	30.40	4.24
Circulation Network	577	2.33	0.33
Commercial	91	0.37	0.05
Community Service	30	0.12	0.02
Education and Research	43	0.17	0.02
Forest	23215	93.95	13.11
Healthcare Service	2	0.01	0.00
Homestead Vegetation	186	0.75	0.11
Industrial	1	0.01	0.00
Mixed Use	1	0.00	0.00
Non-Government Services	1	0.00	0.00
Others	6	0.02	0.00
Residential	13033	52.74	7.36
Service Activities	3	0.01	0.00
Water body	84951	343.78	47.98
Total	177063	716.55	100.00

Source: PKCP project, UDD, 2018

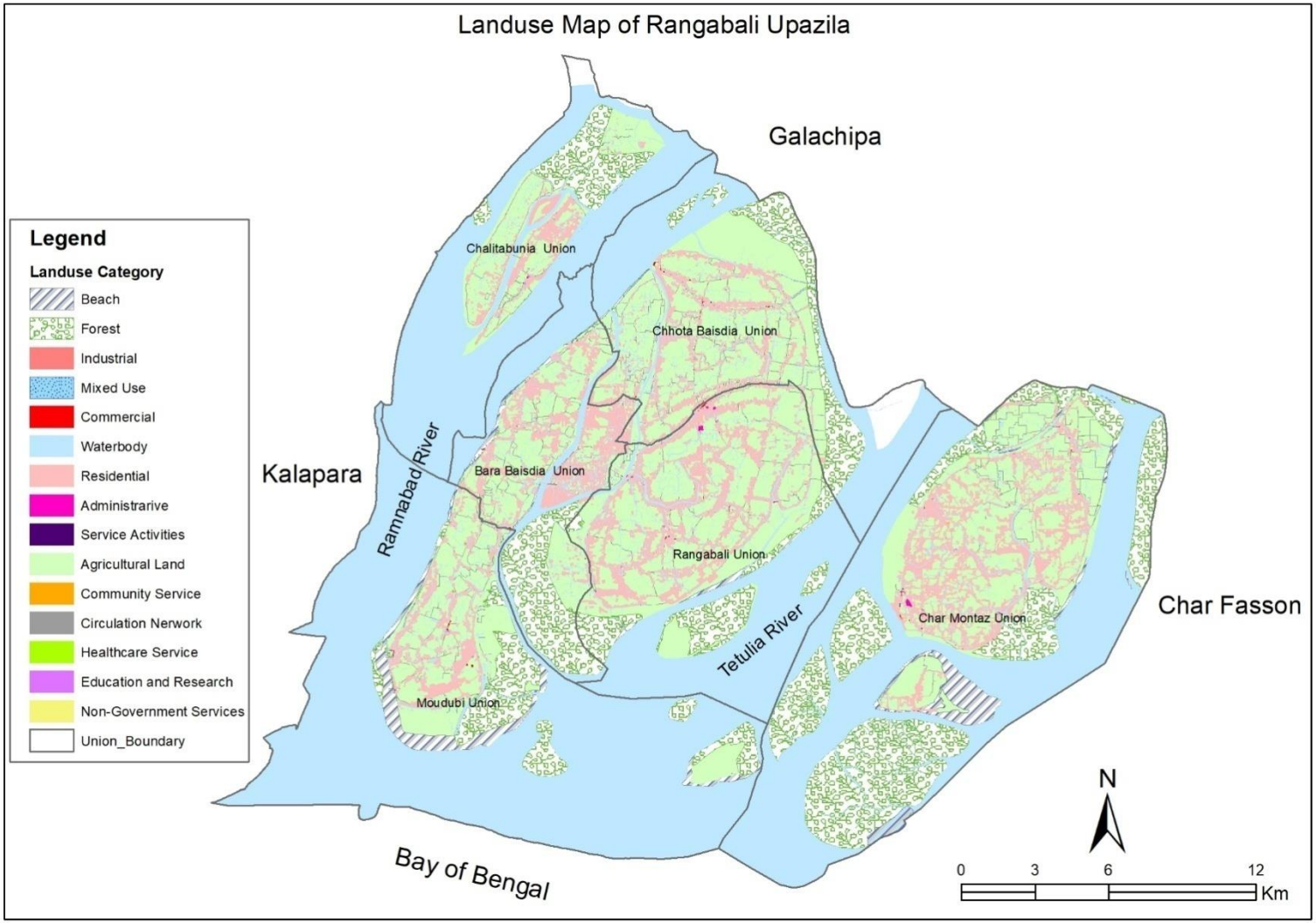


Figure 35 Existing land use

Source: PKCP project, UDD, 2018

5.2 Suitable Site Ranking Findings from Suitability Analysis

5.2.1 Ranking Suitable Areas based on Geological Attributes

Geological attributes are important to ensure safe, stable and economic design and construction of government's or authorities' project. Geological heterogeneity has a strong influence on the distribution of physical properties related to earth resources such as the concentration of economic minerals, porosity and permeability. Therefore, the process of identifying and building a geological architecture, including the location of important geological bodies and their relationships, is usually established before spatially populating them with physical properties (Strebelle and Remy 2005; Zhang et al. 2006; de Almeida 2010). This conventional workflow has proven to be effective in both the exploration and exploitation phases of natural resources. For example, ground motion is more directly related to damage to buildings and infrastructure in an earthquake than the magnitude of the earthquake itself. Construction technology commonly employs pile foundation in a variety of scenarios, such as when there is an unstable layer of soil beneath the surface which is incapable of supporting the weight of the building in case like earthquake- in such case the load must be transmitted to the layer of firmer soil or rock beneath the weak layer. Beside earthquake, liquefaction phenomenon which is an unsupportive environment of built structures by altering previously solid ground into a liquefied softened condition. These damages increase during earthquakes.

Two-step multi-criteria decision making (MCDM) technique has been applied to rank Geological suitability sites. PGA, Foundation layer depth, Soil Type, Liquefaction Potential Index, and Building Height Recommendation has been considered as important dependent variable and to find out the relative weight of these variable AHP pair wise comparison has been applied. After getting the weighted value, the weighted sum model was applied to find the final suitability map (Figure-16), Around 0.12 percent area were found moderately suitable and 68.65 percent found less suitable for infrastructure development such as government buildings, hospitals, cyclone centres etc.

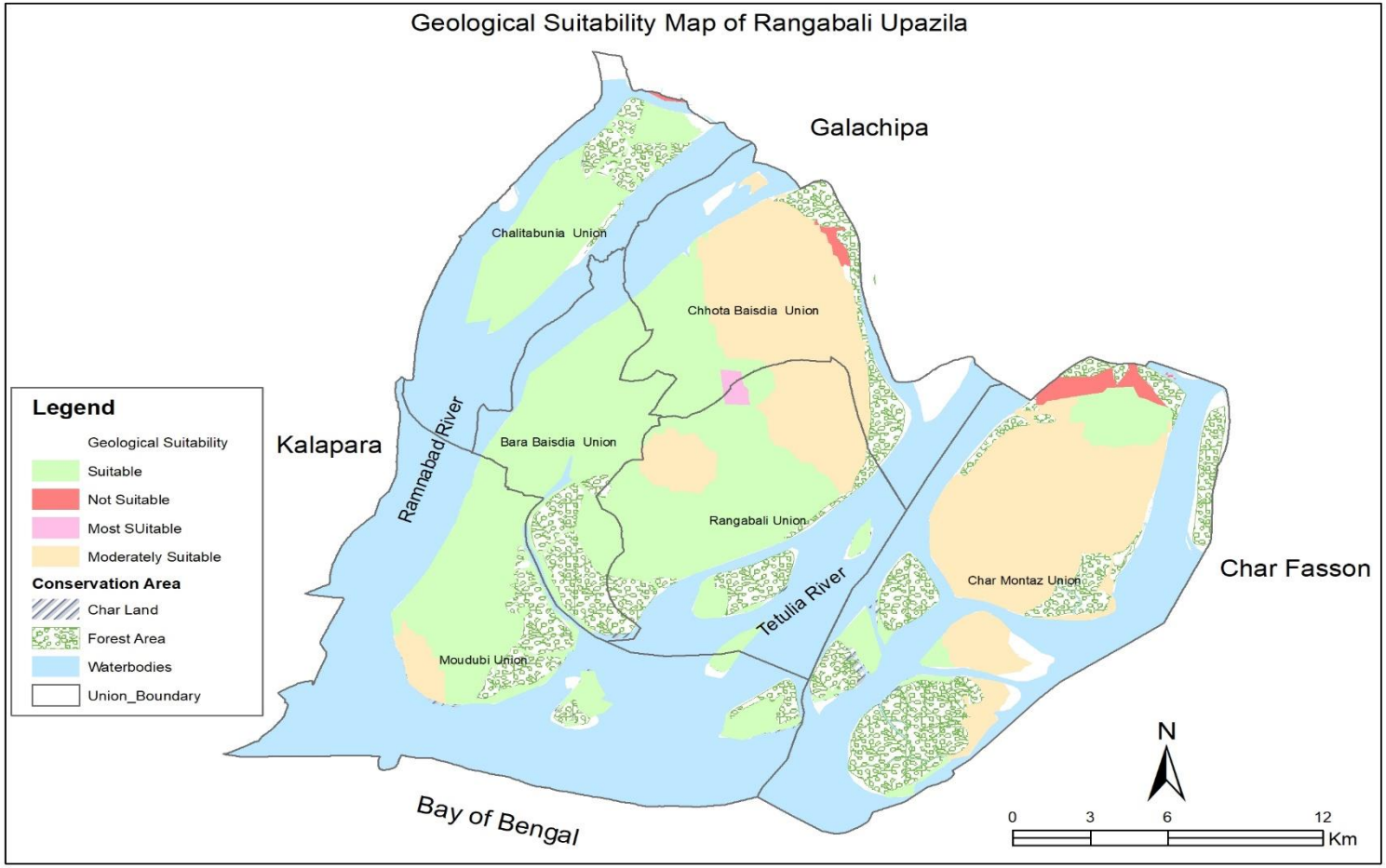


Figure 36 Ranking of suitable sites considering geological attributes

Source: PKCP project, UDD, 2018

5.2.2 Ranking Suitable Areas based on Hydro-geological Attributes

Hydro geologic areas are conceptualized as a control volume consisting of three hydro geologic components: the soils and streams, basin fill, and consolidated rocks. The soils and streams hydro geologic component consists of all surface-water bodies and soils extending to the bottom of the plant root zone. The basin-fill hydro geologic component consists of unconsolidated and semi consolidated sediment deposited in the structural basin. The consolidated-rocks hydro geologic component consists of the crystalline and sedimentary rocks that form the mountain blocks and basement rock of the structural basin. Investigations have also been made at larger spatial scales to gain a regional synthesis and understanding of water resources information for the Upazila.

Most natural processes rely on water. It shapes the landscape by transporting silt and solutes to lakes and oceans. Hydro geological study has been conducted to understand water flow and distribution below the earth's surface Suitable sites based on hydrological attributes have been judged considering the availability of quality groundwater for human use. To rank the water quality, WQI has been taken into account and to rank the availability of freshwater findings from slug tests and water head depth in the dry season has been considered. Illustrates the findings of the suitability analysis. It is found that the 94.47 percent of the area was found hydro-geologically moderately suitable, only 5.22 percent of the Chalitabunia union and Rangabali Union were with good attributes.

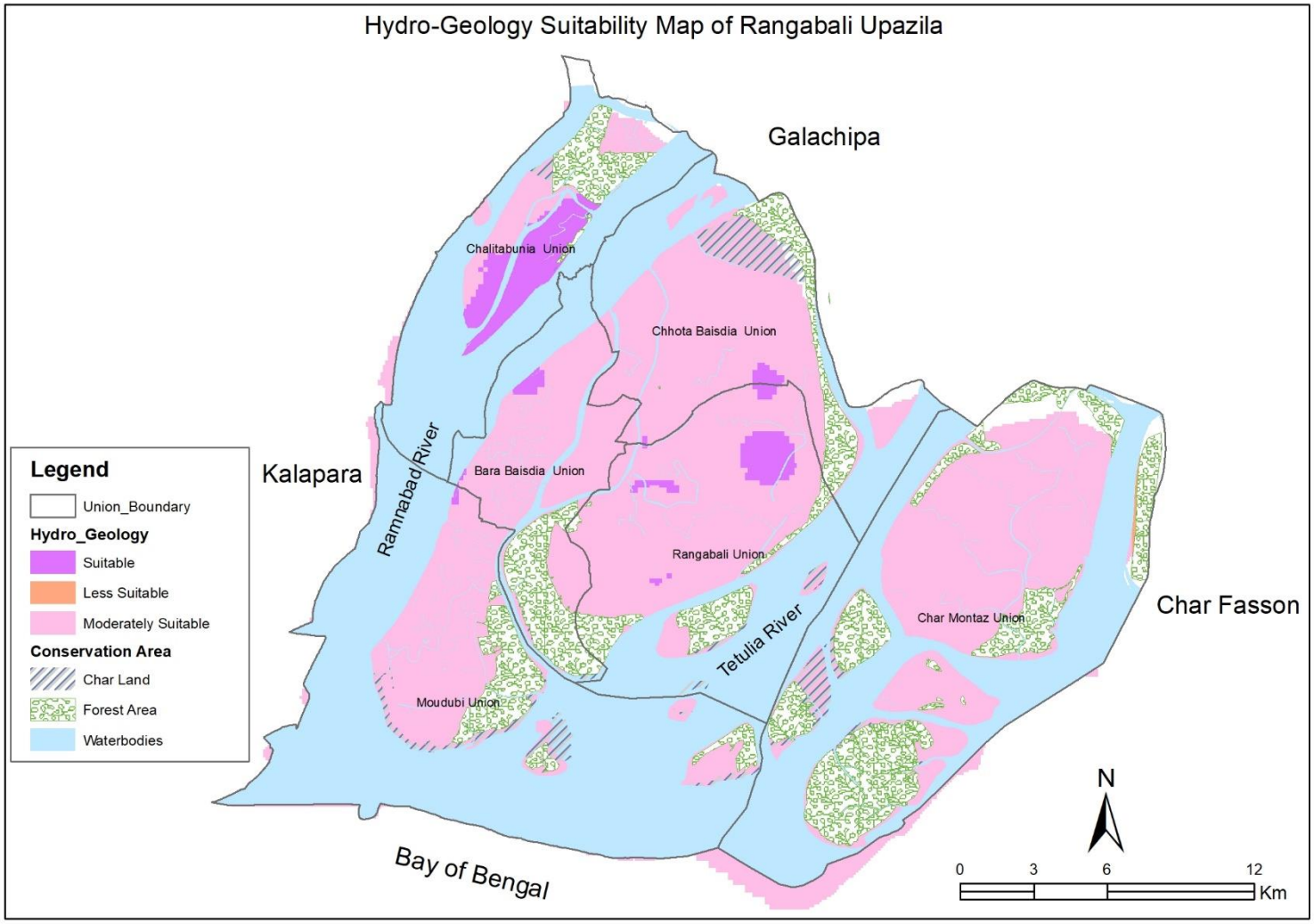


Figure 37 Ranking of suitable sites considering quality and quantity of ground water

Source: PKCP project, UDD, 2019

5.2.3 Ranking Growth Centres considering existing function

Growth centers have been categorized into rural trade and commerce centers, Strategic Service Centers-1st Order, Strategic Service Centers-2nd Order, and Strategic Service Centers-3rd Order based on scores using a numerical range that has been investigated. Major economic activities will be promoted in rural trade and commerce centers, while public services including health centers, schools, and colleges will be supported inside the various level service centers.

Urban growth centers, often referred to as growth centers, are usually ranked based on their potential for future expansion as well as their current activities. Depending on the objectives and top concerns of the government or entity conducting the evaluation, several criteria and methodologies may be used to evaluate growth centers. When rating growth centers, however, a few similar characteristics are taken into account, including economic activity, infrastructure, population and demographics, land use and zoning, workforce and education, accessibility, and government policies.

Growth center hierarchy has been determined taking into account functional and geographical relevance, as recommended in "My Village, My Town." The hierarchy will be taken into account when establishing road connectivity. other facilities such as telecommunications, including internet connectivity, health centers, sanitation and waste management, market infrastructure, quality education, safe drinking water, information technology facilities and high-speed internet, as well as better sewage facilities, community space and recreation, banking, rural resources, power and energy supply, modernization and mechanization of agriculture would be provided on the basis of the hierarchy of growth centers.

The specific weight and importance of these factors may vary based on the specific goals of the ranking process. Different organizations or governments may prioritize different aspects of growth centres depending on their strategic objectives.

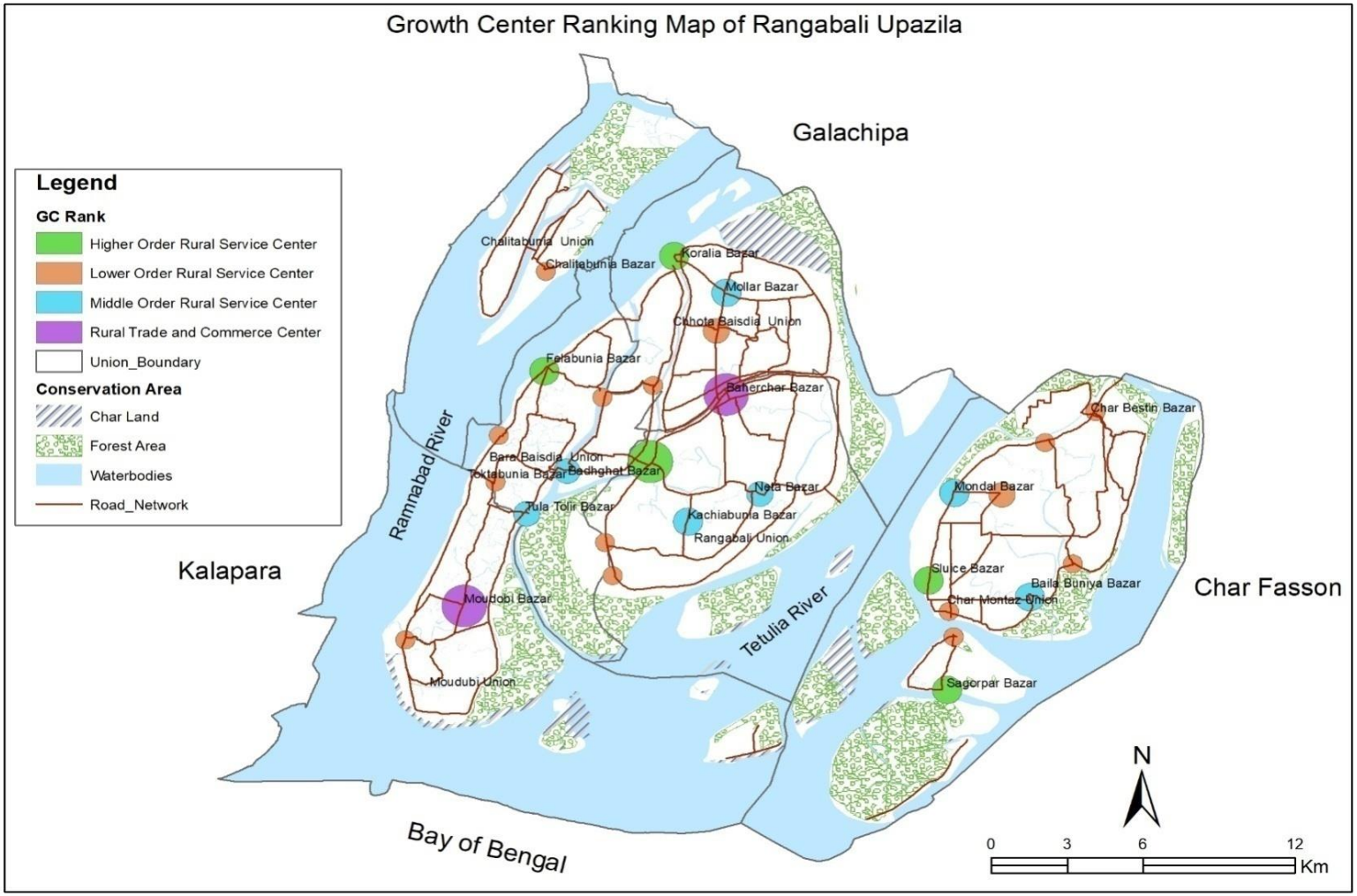


Figure 38 Ranking of growth centers considering existing function

Source: PKCP project, UDD, 2019

5.3 Suitable site ranking- findings from multi-criteria analysis

5.3.1 Ranking Suitable Areas for Infrastructure Development

Infrastructures are the basic facilities and equipment required to produce a product or deliver a service. Infrastructures should supply the necessary conditions and equipment to carry out the necessary business tasks and operations, as well as aid in reaching the intended product and service conformance. As a result, it is intimately linked to the product or service and has a direct bearing on its quality. The primary purpose of a suitability analysis for infrastructure development is to ensure infrastructure are intact, sustainable and stable; will support organization in achieving quality targets and plans. Infrastructures encompass all of the tools, applications, interfaces, and facilities required to bring products or services to market, from concept to delivery and post-delivery. To rank suitable sites for infrastructure development geological attribute of the upazila, disaster risk, and elevation and building height zones has been considered. Due to up gradation of construction technology it is possible to reach foundation depth 25 to more than 30 m. side by side the Upazila's soil condition is suitable for low-rise and high rise building construction (

Table 33 Area percentage of ranks and other land uses

Ranks	Area in percentage
Suitable	0.10%
Moderately suitable	13.38%
Less suitable	3.05%
Other land uses	
Agriculture	24.15%
Char	12.36%
Forest	2.60%
River	44.35%
Grand Total	**100.00%**

Source: PKCP project, UDD, 2018

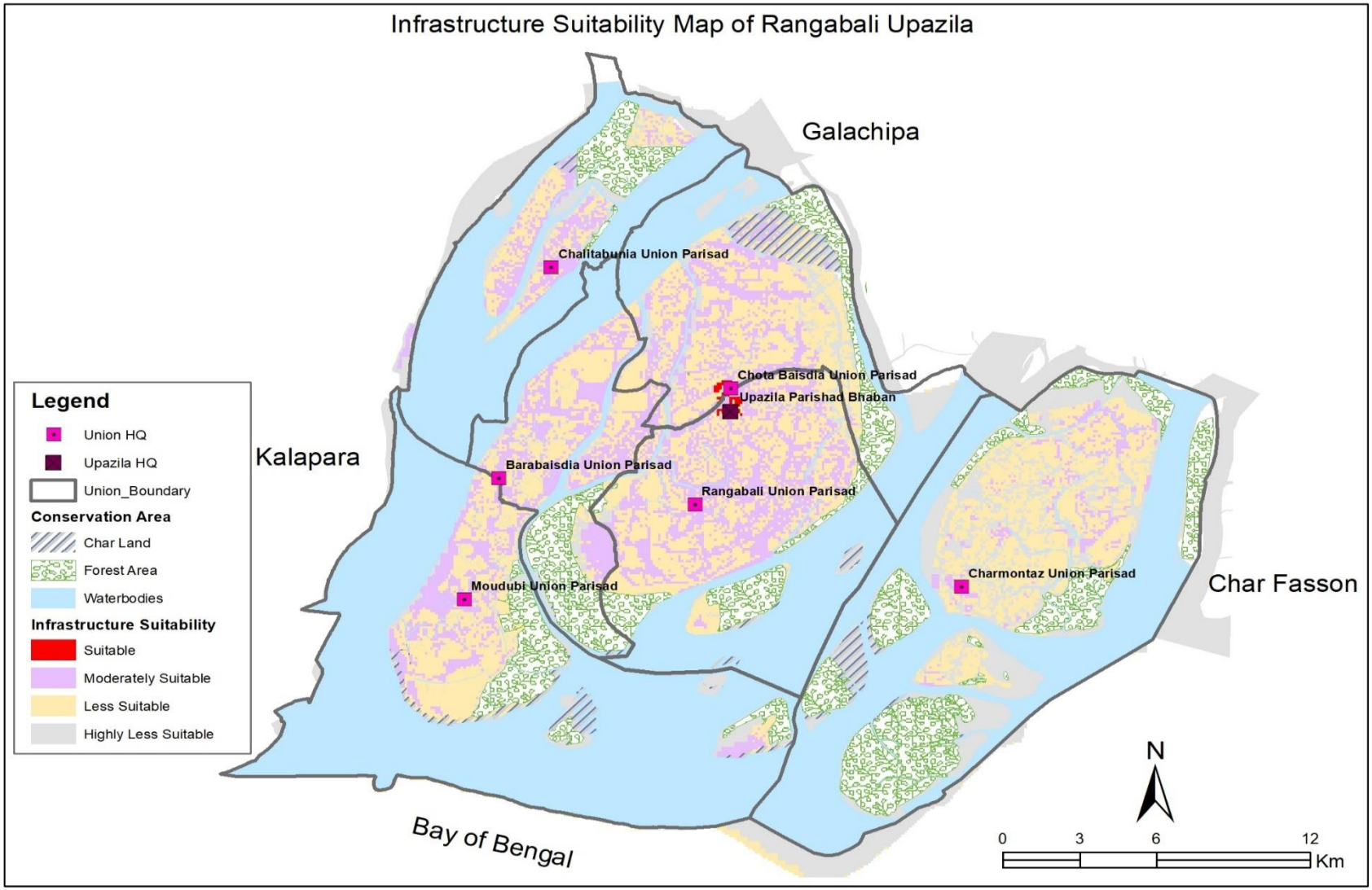


Figure 39 Ranking of Suitable sites for infrastructure development

Source: PKCP project, UDD, 2018

5.3.2 Ranking Suitable Areas for Human Settlement

Human settlement environment is space places closely related to human production and life, and also surface spaces inseparable from human activities. As a coastal city in the southern side has a relatively low level of urbanization. However, it also along with many problems at the same time, among which the problem of human settlement environment has attracted more and more general attention from people. The suitability evaluation of human settlements over time and space is essential to track potential challenges towards suitable human settlements and provide references for policy-makers. This study established a theoretical framework of human settlements based on the nature, human, economy, society, and residence subsystems. Evaluation indicators were determined with the consideration of the coupling effect among subsystems.

As a result, hydro-geological and geological features, proximity to roadways, elevation, and disaster risk level have all been taken into account when ranking human settlement sites.

Table 34 Area percentage of ranks and other land uses

Ranks	Area in percentage
Suitable	1.41%
Moderately Suitable	15.13%
Other land uses	
Agriculture	24.15%
Char	12.36%
Forest	2.60%
River	44.35%
Grand Total	**100.00%**

Source: PKCP project, UDD, 2018

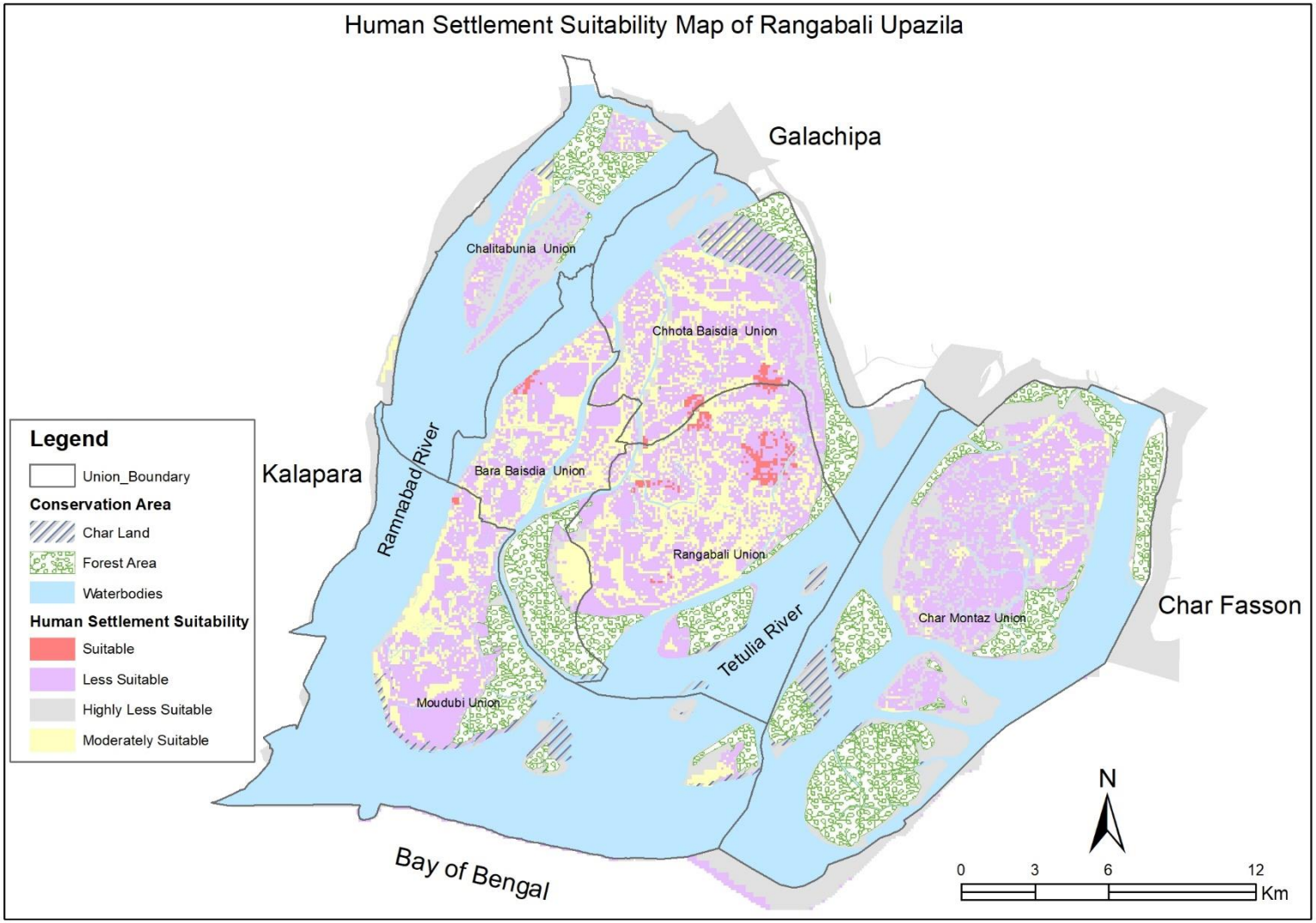


Figure 40 Ranking of suitable sites for human settlement

Source: PKCP project, UDD, 2018

5.3.3 Ranking Suitable Areas for Potential Economic Region

The Bangladesh Economic Zone Authority (Beza) is set to classify the country's economic zones into bronze, silver, gold, and platinum tiers, aligning with international standards to enhance the environmental sustainability of the production process. The initiative has been undertaken with a focus on meeting the demand for environmentally friendly production in the global market and attracting future investments.

Location of growth centers directly affects the land use and ecosystem. Rapid infrastructure development and the uncontrolled growth of cities' economic hubs result inefficiencies of infrastructure facilities, loss of agricultural land, water bodies, open spaces, and a variety of microclimatic changes. The upazila's exceptional rise of growth centers will result in an uneven distribution of basic services such as transportation and communication. Geological and hydro-geological attributes of the upazila, disaster risk lebel, existing growth center location, and existing road proximity.

Table 35 Area percentage of ranks and other land uses

Ranks	Area in percentage
Suitable	6.41%
Moderately suitable	9.22%
Less suitable	0.34%
Highly less suitable	0.57%
Other land uses	
Agriculture	24.15%
Char	12.36%
Forest	2.60%
River	44.35%
Grand Total	**100.00%**

Source: PKCP project, UDD, 2018

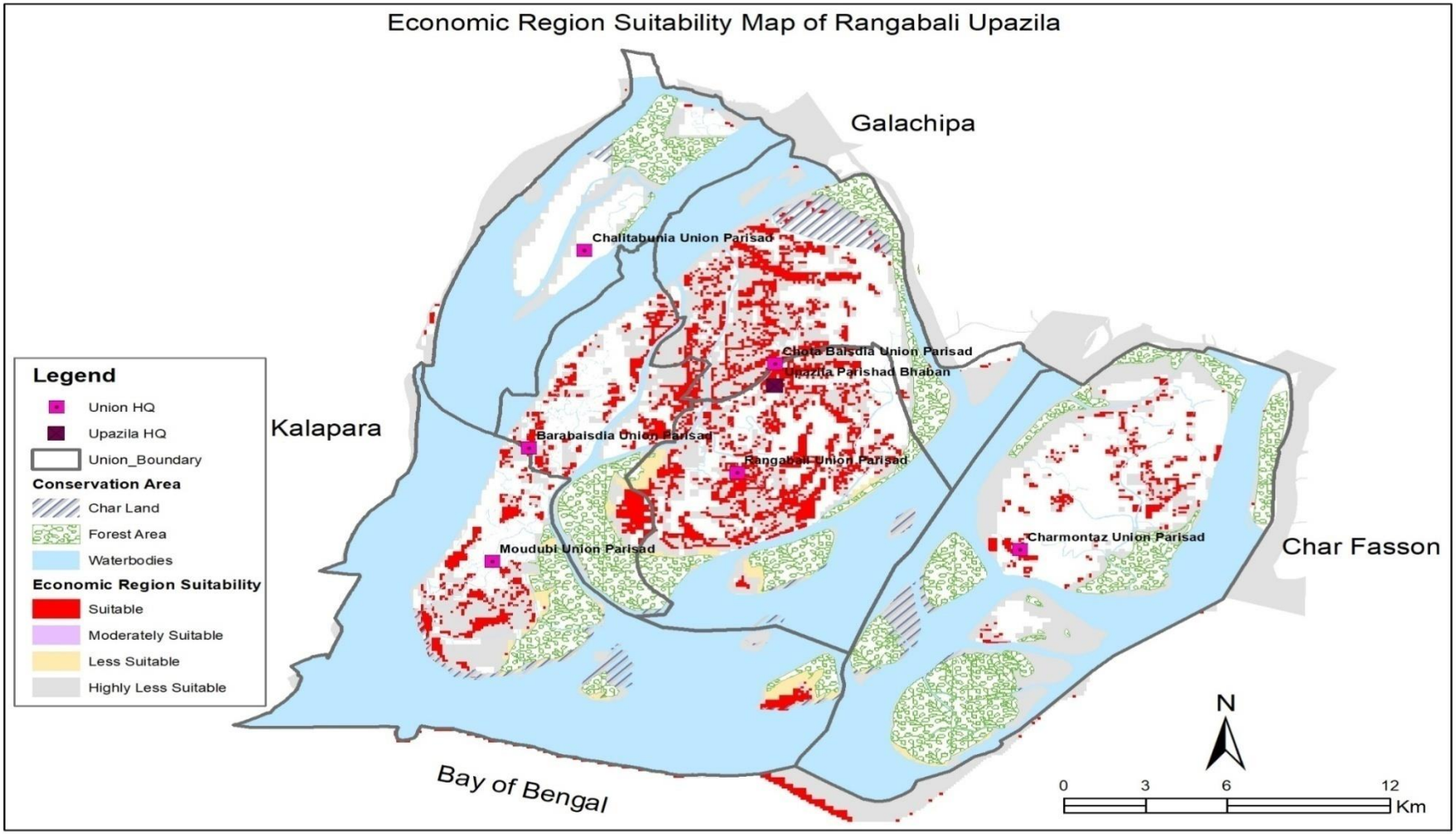


Figure 41 Ranking of suitable sites for potential economic region

Source: PKCP project, UDD, 2018

5.3.4 Ranking Suitable Areas for Potential Development

The speed and scale of urbanization brings challenges, such as meeting accelerated demand for affordable housing, viable infrastructure including transport systems, basic services, and jobs, particularly for the nearly 1 billion urban poor who live in informal settlements to be near opportunities. Rising conflicts contribute to pressure on cities as 50% of forcibly displaced people live in urban areas.

Once a city is built, its physical form and land use patterns can be locked in for generations, leading to unsustainable sprawl. The expansion of urban land consumption outpaces population growth by as much as 50%, which is expected to add 1.2 million km² of new urban built-up area to the world by 2030. Such sprawl puts pressure on land and natural resources, resulting in undesirable outcomes; cities represent two-thirds of global energy consumption and account for more than 70% of greenhouse gas emissions. The development potential of Rangabali upazila carried on based on the several factors. This Analysis will help to distribute the service facilities in a balance way.

Table 36 Area percentage of ranks and other land uses

Ranks	Area in percentage
suitable	5.05%
Moderate Suitable	34.19%
Less Suitable	0.40%
Not suitable	5.05%
Other land uses	
Char	8.36%
Forest	2.60%
River	44.35%
Grand Total	**100.00%**

Source: PKCP project, UDD, 2018

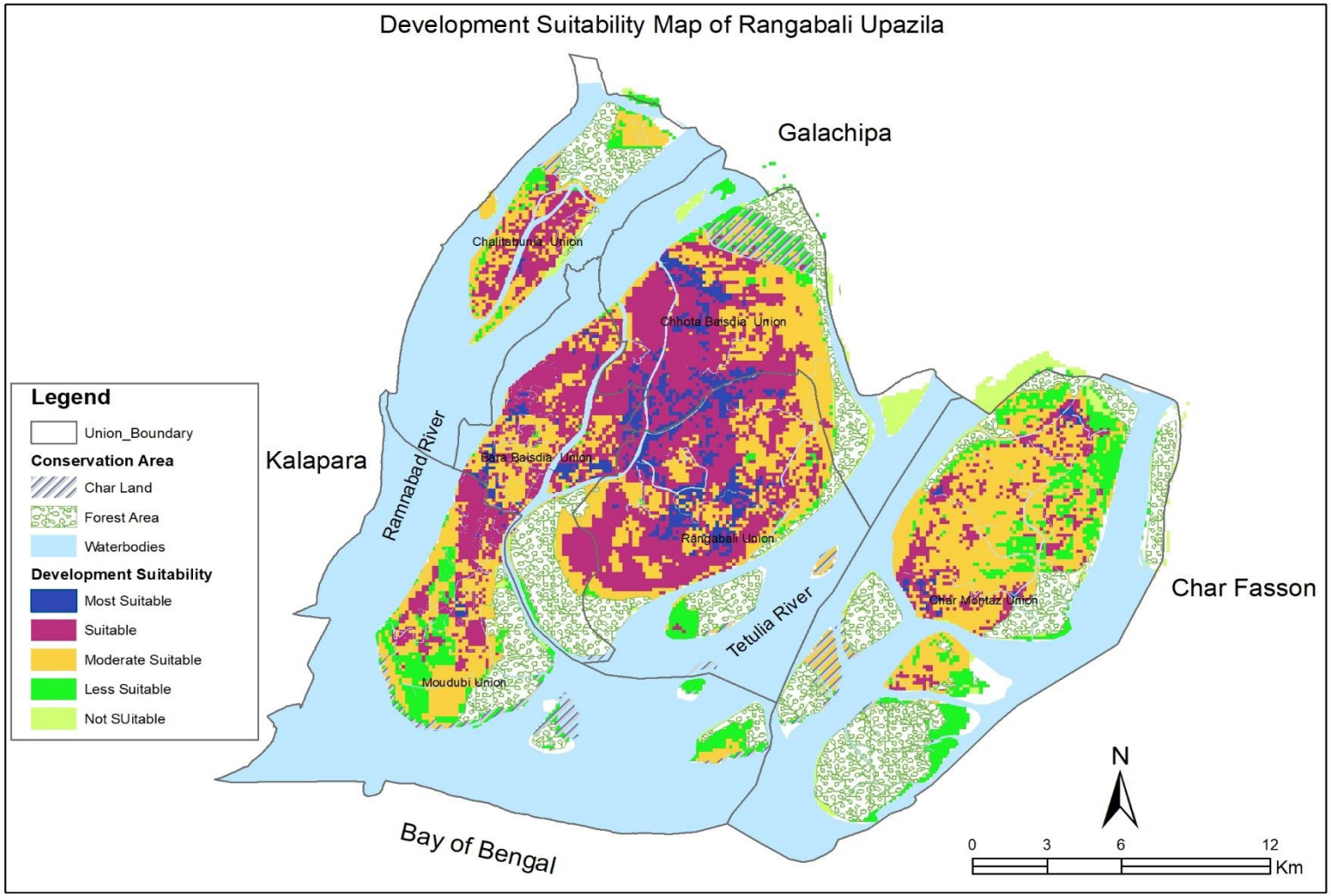


Figure 42 Ranking of suitable sites for potential Development

Source: PKCP project, UDD, 2018

5.4 Composite Structure Plan

For future planned development of the upazila and as well as to protect natural resources including agriculture and major water body, a strategic land use zoning plan has been prepared for the entire upazila. The Upazila has been divided into 12 strategic zones, these are, Agriculture, Char land, Forest, coastal forestation, Agro-Fisheries Economic region, Road Network, Rural settlement, urban core area, and water body.

5.4.1 Plan zone definition

Agriculture Zone: Agricultural zoning is a type of zoning that allows people to keep their farming tradition. The term "agriculture zone" refers to area that is ideal for agricultural production, including both crops and livestock. Land used for annual crops such as cereals, other technical crops, potatoes, vegetables, and melons, as well as land left fallow, land used for permanent crops such as fruit plantations, and land used for natural grasses and livestock grazing. The permissible activities in the agricultural zone are: Vegetable Cultivation, Livestock, Horticulture, Dairy Farming, Cash Crop Cultivation, Botanical Garden, Aquaculture and Fisheries, Agricultural Shelter and Gazing.

Potential Urban Area: The term "Urban Area" refers to places with high population density, as well as strong roadways, pathways, and market share. The built-up area is another name for this area. The location with the greatest concentration of services is referred to as this. It also has the population density and concentration at its highest point. There are disparities in the amount of service provision within this area, especially between the formally constructed and planned areas and the majority of unplanned areas. In the planned area, the level of service should be maintained. Auto rickshaw stands, banks and financial institutions, bus and auto passenger stop, highways, garages, retail shops, restaurants, rickshaw stands, educational facilities, electric substation, fire station,health facilities,high school, hospitals, parking facilities are all permitted activities in the Potential Urban Area.

Rural Settlements: People living in a vast landscape with a few houses with greeneries where people are often depending on agriculture, farming and fishing activity for their sustainability. the areas with relatively low density of population and located ourside the paurashava area, rural roads, or high way where there are isolated houses or open ground are called rural settlement area. This zone will be facilitated with all type of amenities so that people can live healthy and happy life. Any kind of activities that will not hamper natural and

cultural environment and will follow national laws and regulation will be allowed within the zone. Basic facilities for living will be provided within the zone. .

Water body: A water body is defined as any natural or manmade collection of water, including rivers, streams, creeks, ditches, swales, lakes, ponds, marshes, wetlands, and ground water. This category includes water with an area equal to or more than 0.25 acres, excluding canals, irrigation canals, and rivers. Development and building activities are prohibited within 10 metres on either side of the canal in this region. There is no development or industrial activity allowed within 50 metres on both banks of the river.

Economic Region: Potential economic zone is a specially marked territory within the Upazila that has attributes to attract national as well as foreign investment to generate employment opportunities. In this zone, the investor will get geological, hydrological and better communication facility benefit to earn profit within short time. The zone has been declared in order to facilitate rapid economic growth and to connect the Upazila with the mainstream of national economy. Authority will offer special incentives and security to attract local, national and international investment, EPZ, Autorickshaw stands, banks and financial institutions, bus and auto passenger stops, highways, cottage industry, dairy farming, garages, garments, kneeting factories, industrial classes 1, industrial classes 2, retail shops, restaurants, and rickshaw stands are all permitted activities in the potential economic zone.

Conservation Zone: The conservation zone of Rangabali Upazila Include the Char land and Forest Area.

Char Land: Any deposit in a river course or estuary that is surrounded by the waters of an ocean, sea, lake, or stream is referred to as a "char." Char refers to riverine sand and silt landmasses in Bengali. This is also a landmass that may be seen in rivers and oceans for a certain amount of time each year. Living in the chars is risky and insecure since these areas are prone to violent and unexpected flooding as well as erosion and land loss. Vegetable cultivation, livestock, dairy farming, cash crop cultivation, agricultural shelter, and gazing for a set length of time in a year are all permitted activities in the char.

Forest Area: a sizable area primarily covered in trees and vegetation. It does not inclused land that predominantly under agricultural use or other use. This could be natural made or man-made.

Foreshore & Coastal Afforestation: By stabilising coasts and creating a green belt, coastal afforestation attempts to improve climate-resilient ecosystems and livelihoods. The landmass is also successfully protected from excessive flooding and erosive processes by this green belt. To establish well-stocked plantations, vacancy filling and sometimes replanting are done. Furthermore, during land quiver recharging, a green belt along the coastline acts as a filter. Botanical garden and gardening are permitted activities in the Foreshore Area.

Circulation Network: It includes major circulation covering primary and secondary roads.

Trade and Commerce Centre/ Strategic Service Order: It includes Wholesale market, Bazar, Hat and other service activities under Rangabali Upazila.

Tourist Zone: It includes the potential sites for tourist such as Sea beach, Park, other recreational facilities.

Renewable Energy Zone: It includes the potential sites for generating energy such as Solar Energy, Wind Energy.

Exclusive Tourist Zone: Exclusive tourist zone is a place where Tourists are looking for a luxury trip want their dreams to become reality. They look for something unique, above their expectations with superb service where their needs and wants are fulfilled. This includes exclusivity, privacy, and everything from relaxation to adventure, with pampering and extras.

- Exclusive tourist zone has hotels, cottages, beach villas, night clubs, a convention hall and an amusement park.
- Watch towers, shopping malls, food courts, Cineplex's and swimming pools can be found
- Well-connected by Road, Air, Water

Beach Area: A beach is a narrow, gently sloping strip of land that lies along the edge of an ocean, lake, or river. Materials such as sand, pebbles, rocks, and seashell fragments cover beaches. Most beach materials are the products of weathering and erosion. Over many years, water and wind wear away at the land. The continual action of waves beating against a rocky cliff, for example, may cause some rocks to come loose. Huge boulders can be worn town to tiny grains of sand.

5.4.2 Structure plan of Rangabali Upazila

Agricultural lands are cultivated and cultivable lands that have to be protected for food safety of the country; it is about 21.37 % of the total upazila area; circulation network (0.69%) which includes primary and secondary roads. Rural settlement (9.46%) encompasses rural housing structures and surrounding vacant land and vegetation's- which is the fourth heights land use. Potential Urban area covers 0.97% of the Upazila which includes densely developed area named as urban core area, Foreshore Area covers 2.52 % area mainly proposed near river side, forest area 16.10 % and 45.97 % water body that includes canals and ponds with 0.25 acres' area. This structure plan has proposed 0.19 % land as Renewable Energy Generation Zone, 0.55% land as Potential Economic Zone and 0.61% land as Tourist Zone. It is expected this zone will assist and encourage government and private investor to invest. Investment for industrial development will help to achieve the objective of the structure plan that is to enhance the residents' socioeconomic position.

Table 37 Percentage of area of proposed zones

Strategic Zones	Area (Acre)	Percentage (%)
Agriculture Zones	38137.09	21.36
Conservation Zone	32337.18	18.11
Foreshore & Coastal Afforestation	4491.30	2.52
Economic Region	1146.87	0.64
Potential Urban Area	1734.04	0.97
Circulation Network	1227.62	0.69
Rural Settlements	16894.93	9.46
Strategic Service Center-1st Order	170.16	0.10
Strategic Service Center-2nd Order	208.87	0.12
Strategic Service Center-3rd Order	104.53	0.06
Trade and Commerce	9.83	0.01
Water body	82058.28	45.97
Total	**178520.72**	**100.00**

Source: PKCP project, UDD, 2018

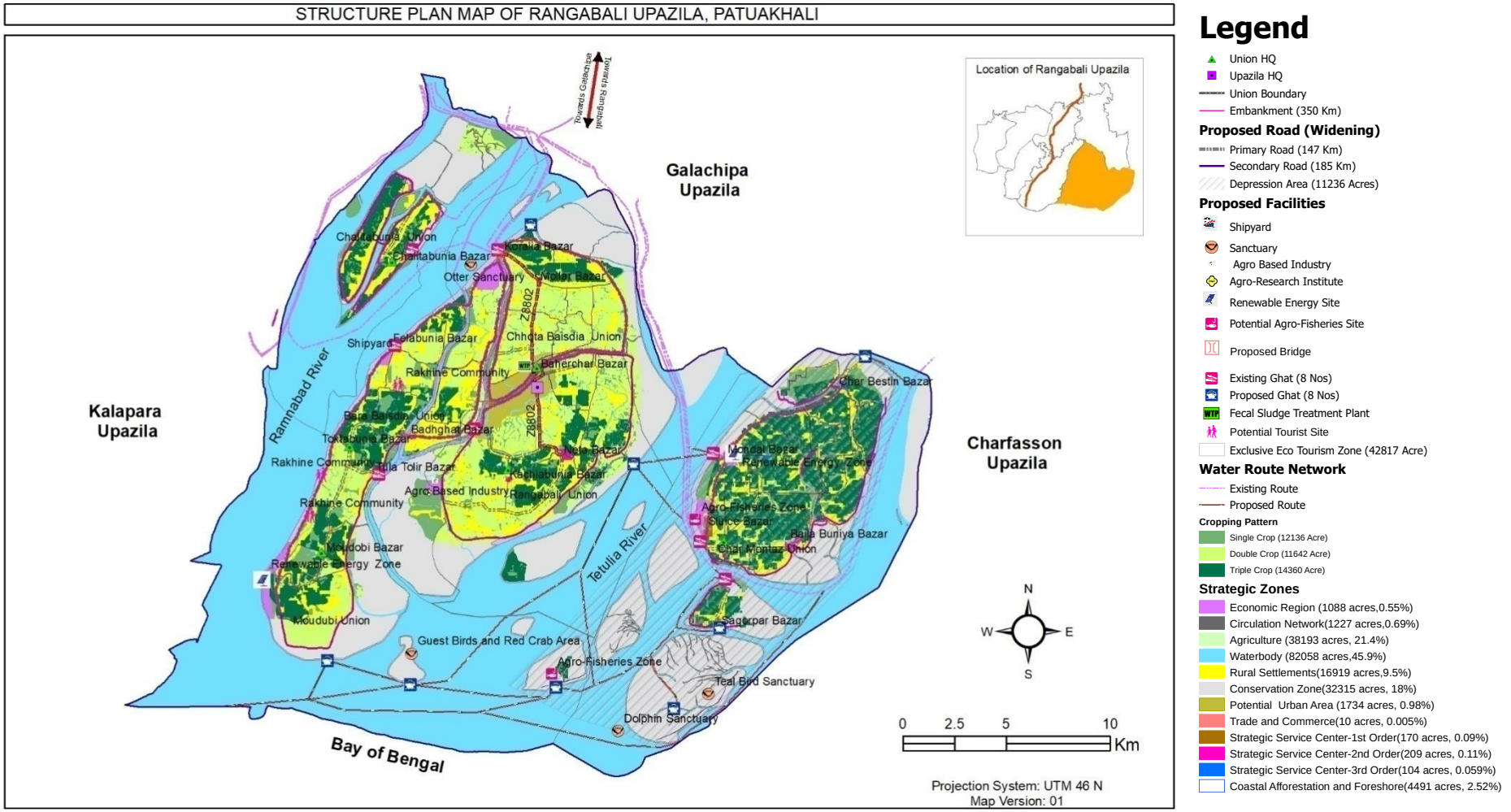


Figure 43 Structure plan map of Rangabali Upazila

Source: PKCP project, UDD, 2022

5.5 Structure Plan recommendation

The Structure Plan identified some strategic areas where future development will take place and provided strategies and techniques for future spatial development. Designation criteria for each strategic management area are provided in structure plan proposal Table. They are more substantive over the 12 categories of zones selected in the Rangabali Upazila structure plan. The proposed zones are as following and are shown in structure plan map. It is to be understood that preparation of structure plan will only be needed in the Baherchar area and in the Growth center area, as no new urban activities are going to be allowed in the Agriculture and Conservation Areas. The proposal of structure plan descriptions has been given below:

Potential Urban Area

Baherchar and Khalgora Bazar of Rangabali Upazila are one of the fastest growing urban areas in this upazila. The structure plan recommends the area as future urban area for the development. Its comprises the area of 1960 acres. The government organization had developed surrounding the Baherchar and Khalgora Bazar.At the same time, this area is the centre point of communication with other growth center, hat-bazar and union.

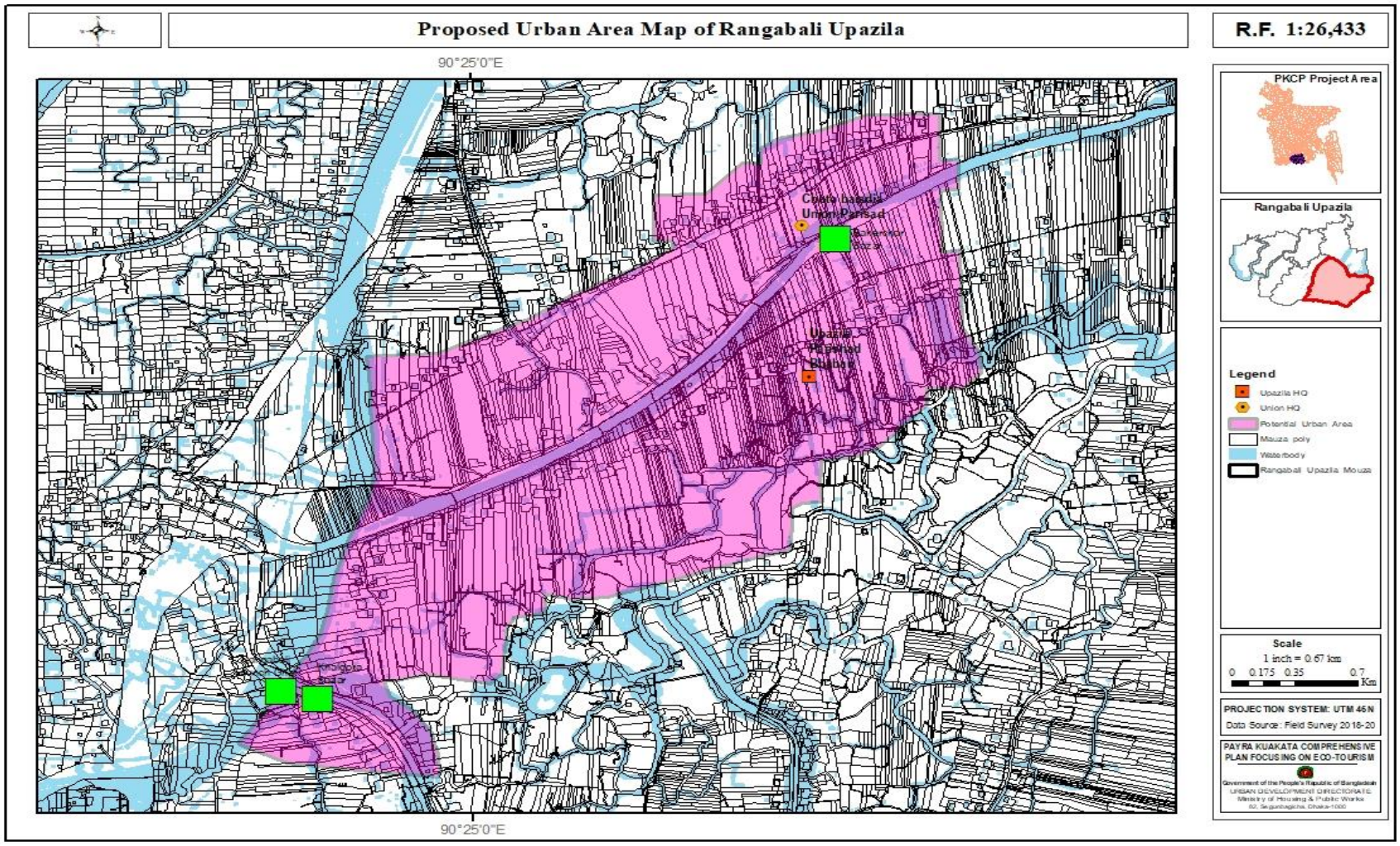


Figure 44 Proposed Urban Area map of Rangabali Upazila

Source: PKCP project, UDD, 2018

Renewable Energy Zone

A reliable, affordable and secure supply of energy is important for socio-economic development. As a country of acute power crisis Bangladesh is now looking forward to develop its renewable energy sources in addition to its traditional sources of fossil fuel. It has very limited non-renewable energy sources of its own but it's endowed with renewable energy sources like biomass, wind, hydro and solar insolation. Renewable energy is energy that comes from a source that won't run out. They are natural and self-replenishing, and usually have a low- or zero-carbon footprint. Examples of renewable energy sources include wind power, solar power, bio energy (organic matter burned as a fuel) and hydroelectric, including tidal energy. The most popular renewable energy sources currently are:

A. Solar energy.
B. Wind energy.

Currently, renewable energy sources have a very low share in the total generation (<2%). Besides traditional combustion of biomass (biogas), which plays the dominant role among renewable energy sources and has significant further potential, the most important form of renewable energy in Bangladesh is solar power: photovoltaics (PV), solar home systems (SHS), nano-grids and mini-grids. Such small-scale renewable energy solutions for energy generation are promising alternatives for the scattered communities. Solar home system is a success story in Bangladesh and day by day its popularity is increasing in the rural areas, especially in the remote regions. Since Rangabali Upazila char's area is still not in the main grid line, solar energy is a good choice for this char area. As there is good sunshine supply and there is demand of energy, solar power is a good alternative to other energy sources as it is renewable and environment friendly.

Bangladesh has significant potential for harnessing wind energy, particularly in coastal areas and certain regions with favourable wind conditions. The country's coastal areas, in particular, have high wind speeds, making them suitable for wind energy projects.

Potential Economic Region

a.Agro Based Industry

Rangabali Upazila economy is primarily an agrarian. By considering the nature of the crops, the structure plan recommends an agro based industry for the development and conservation of agro products. The demand for food in Bangladesh and around the world is changing rapidly. Driven by economic growth, rising incomes, and urbanisation, demand is shifting away from traditional staples toward high-value food commodities. High value agricultural commodities include fruits, vegetables, spices, fish, and livestock products, many of them processed before reaching the market. This represents an enormous opportunity for food

producers, processors, and sellers. Owing to the greater labour intensity characteristic of high value agricultural production, it also provides an opportunity to generate rural employment and raise rural incomes. The main products of Rangabali Upazila is beetle, water-melon, Fish and rice. The agro-based industry can manufacture and process any type of agro product for the betterment of the employment opportunities. The agro-based industry can be-

Agro-produce processing units – These units are not involved in manufacturing and mainly deal with the preservation of perishable products and utilization of by-products for other uses. Rice and Dal processing mills are perfect examples of these kinds of units.
Agro-produce manufacturing units – These units engage in the manufacturing of new products where the finished goods are entirely different from the raw materials used. Sugar factories, solvent extraction units and textile mills are some of the examples of these kinds of units.
Agro-inputs manufacturing units – These units are engaged in the manufacturing of products, either for the mechanization of agriculture or for increasing agricultural productivity. Some examples of these units include agricultural implements, seed, fertilizer and pesticide manufacturing units.
Agro Service Centres – Agro service centres are workshops and service centres, which are engaged in the repairing and servicing of pump sets, diesel engines, tractors and other types of farm equipment.

b.Agro-fisheries Zone

Local people catch fish from sea and river during Rainy season. It's one of the main professions of the majority people. The marine fisheries sector contributes significantly to the country's food and nutrition security as well as economy through direct income, employment and foreign exchange. So, the agro-fisheries area of char montaz area is place of abundant supply of fisheries and agricultural products. For this reason, the structure plan recommends to develop the place as a hub of agro-fisheries area according to the divisional workshop.

C.Shipyard

Shipyards are constructed near the sea or tidal rivers to allow easy access for their ships. The proposed place of Rangabali upazila located on the bank of Galachipa River. A shipyard, also called a dockyard or boatyard, is a place where ships are built and repaired. These can be yachts, military vessels, cruise liners or other cargo or passenger ships. Dockyards are sometimes more associated with maintenance and basing activities than shipyards, which are sometimes associated more with initial construction. This proposed place is near the port of pyra port. So, it has high potentiality to be grown as a ship making place for light and heavy ship.

D. EPZ

Bangladesh has established several Export Processing Zones (EPZs) to promote the foreign investment and generate employment opportunities in Bangladesh. Bangladesh Export Processing Zone Authority (BEPZA) is an authorized agency and responsible for promoting,

attracting, and facilitating foreign investment in Bangladesh. The Rangabali Structure plan has proposal on EPZ for making the economic growth and employment opportunity. Its located besides Koralia Bazar.

Growth Center

They are mostly transitional areas changing from rural to urban, and could have much potential for future urbanization and development activities. It is understood that new land conversion will continue to occur, particularly in locations adjacent to presently developed and developing areas and in spite of high flood risk and a paucity of infrastructure services and other social and community services provision.

The growth center hierarchy established inside the conceptual framework is a useful one.The idea of the upazila area has changed over time, starting with the premise that the important activities or services provided by the trade and commerce center have moved to neighboring areas such as Baila Bunia and Moudubi, in order to establish a functional relationship with them.

Trade and Commerce center

It is the centre of activities in the established of Rangabali Upazila having its service area in the whole upazila area.This is the place for high density mixed used structure, public and private structure and services. It is mainly Baherchar Bazar and Moudubi bazaar area of the Rangabali Upazila. The following facilities can be developed in the Trade and Commerce center.

A. Commerce and Shopping
B. Open Space and Recreation
C. Miscellaneous
D. Utilities
E. Transportation

Strategic Service center-1st Order

This type of growth centre is the main retail, business and employment centre for its community. It supports local employment and provides goods and services of a wide range to meet the local demand. It has high levels of health and education services to cater to the needs of the local demand. It also has better communication network. These are Khalgora, Felabunia, Koralia, Sluize Bazar and Sagorpar Bazar. This is the major facilities which have the potentiality for development.

A. Community Facilities
B. Government Services
C. Health
D. Education

E. Transportation
F. Open Space and Recreation
G. Residential
H. Miscellaneous
I. Utilities

Strategic Service center-2nd order

It has an economic activities and public gathering place for the local community. It is basically an employment destination providing work for a specialized sector e.g. manufacturing / service industry, health facilities etc. The growth center analysis identify seven place as second order like Mondol Bazar, Baila Bunia,Neta, Kachibunia and Mollar Bazar. The second order service center include the following facilities-

A. Community Facilities
B. Health
C. Education
D. Transportation
E. Open Space and Recreation
F. Residential
G. Miscellaneous
H. Utilities

Strategic Service center-3rd order

Centre to support the convenience of residents; designated community centre with consideration of accessibility by transportation, adjacency to other centres. The rest of the hat and bazar are categorizing as third order and include the following categories service.

A. Health
B. Education
C. Community Facilities
D. Transportation
E. Open Space and Recreation
F. Residential
G. Miscellaneous
H. Utilities

Beach Area

Rangabali Upazila is an attractive place for natural beauty with 4 km sandy beach. The beach facility will be provided at two locations for the tourist. The beach facility will include showers, sun loungers, water sports, eating & drinking facility etc. Sandy beaches of Jahazmara Sea beach are a habitat for the depleting red crabs, nesting sites for endangered sea

turtles and also serve as high tide roosting sites for the birds. Another Sea Beach Located at the Char Montaz Union of proposed exclusive tourism area.

Figure 45 Jahazmara beach

Source: PKCP project, UDD, 2018

Improvement of Existing Road and Embankment

Bangladesh Water Development Board (BWDB) built coastal embankments along the coast of the Rangabali Upazila for the safety of the people and their property against natural disasters in the early 1970s.Part of the embankment about 350 km embankment is within the study area. The present condition of this embankment is very poor even most of the part is not suitable for walking. This embankment-cum road needs huge repair. If this embankment-cum road will be renovated and repair properly, the communication will improve which enhance the attraction of this area for eco-tourism.

The Rangabali Upazila is isolated area of Bangladesh. Only Ferry, Sea-bus and Boat is the medium of communication with mainland. There are well connected internal road network among the union. But, some char and Island are located in the Bay of Bengal. Most of the road has widening proposal in the plan.

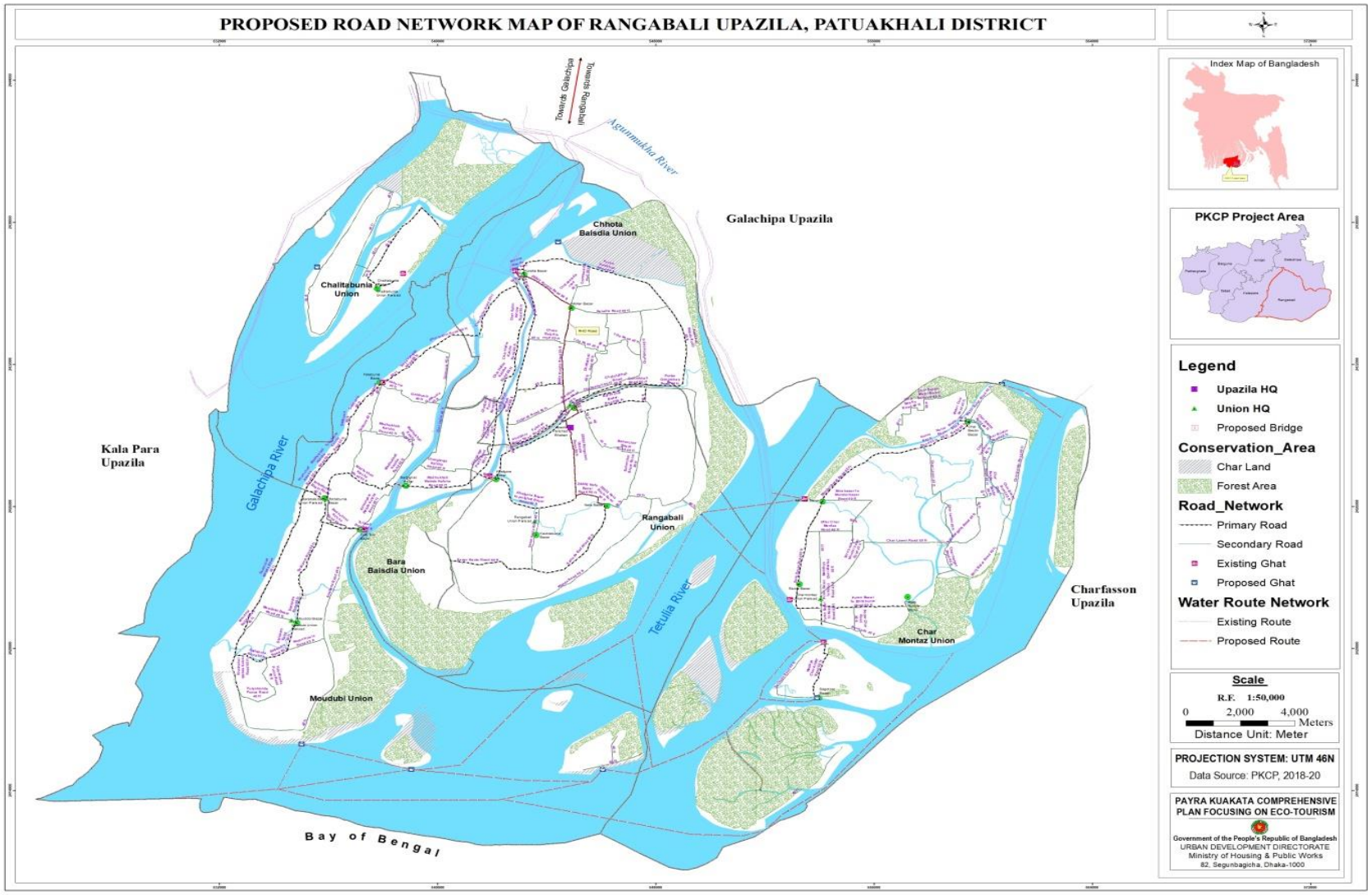


Figure 46 Proposed Road Network

Source: PKCP project, UDD, 2018

Water Route Network

The river network of Rangabali Upazila as the most important transport artery in the isolated areas communication sector plays a vital role in their daily life. Almost all char area of the Rangabali Upazila grew up in the middle part of the rivers and sea. For the betterment of waterways communication system, the structure plan recommends several route to set up the easy network among the char for the attraction of tourist as well as local people.

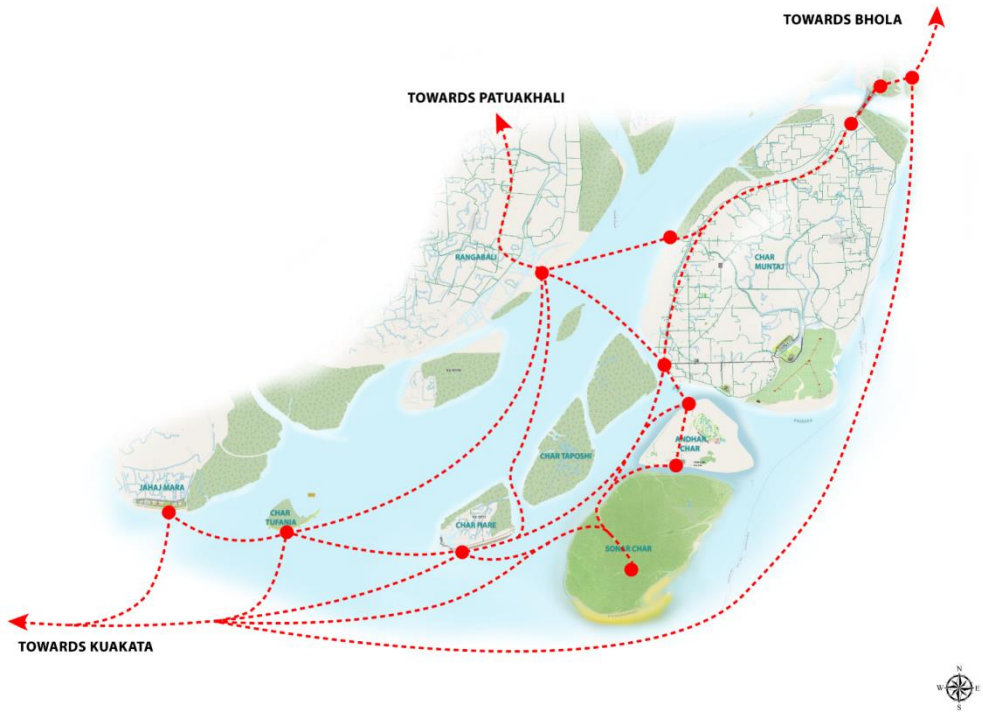


Figure 47 Proposed Water Route Network

Source: PKCP project, UDD, 2018

Ferry Ghat and Bridge

Communication is time consuming and difficult in the Rangabali Upazila as the area is cut off from mainland. To ease travelling, their need to introduce new ferries and modern sea truck-cum-ferry services on Boalia and Panpotty routes. Currently, Speedboat is the fastest medium for communication. Patuakhali's Rangabali has potentiality of sea truck-cum-ferry. Patuakhali's Rangabali upazila is located in the chars of the Bay of Bengal with Chalitabunia and Agunmukha rivers and Char Biswas in the north, Ramnabad Channel and Kalapara upazila in the west, Char Kurri-Mukri in Char Fasson upazila in the east and Bay of Bengal in the south. There are eight proposed bridge on river, two ferry route and canal to establish internal smooth network.

Coastal Afforestation

Mangrove afforestation and tree plantation are very much beneficial for environment. Mangroves are a group of trees and shrubs that live in the coastal intertidal zone. These roots allow the trees to handle the daily rise and fall of tides, which means that most mangroves get flooded at least twice per day. The roots also slow the movement of tidal waters, causing sediments to settle out of the water and build up the muddy bottom. Mangrove forests stabilize the coastline, reducing erosion from storm surges, currents, waves, and tides. The intricate root system of mangroves also makes these forests attractive to fish and other organisms seeking food and shelter from predators.

Rangabali Upazila is appropriate location for mangrove afforestation as it has huge char area. Bangladesh forest department has already planted mangrove most of the area of Rangabali Upazila. Mangrove afforestation is recommended in the suitable location. The proposed mangrove afforestation location is shown in Structure Plan. The recommended area for new mangrove plantation is about 4443 acres. This area is along the bank of the river and coast of the sea. The Structure plan contain 250 m for coastal afforestation to protect from erosion and storm surge.

Wildlife Sanctuary is an area maintained as an undisturbed breeding ground for wild fauna and where the habitat is protected for the continued well-being of the resident or migratory fauna. At present, the study area possesses one wildlife sanctuaries such as the Sonar Char Wildlife Sanctuary.

Bangladesh is one of the most climatic vulnerable countries due its geographical location especially in the coastal region. The current study area is one of the vulnerable compared to other coastal districts. Coastal flooding takes a great loss frequently in this coastal vulnerable area. Recent research found that frequent inundation through coastal flooding takes place which leads a less diversification of plant community. A 20-years research indicates that intrusion of saline water has imposed great threat to plants growth, and survival including the mangrove species richness, too. Moreover, tidal surge or natural calamities are gradually taking the toll on the coastal mixed and mangrove vegetation. The recent field study provides information that a good number of species are in rare condition due to natural and human induced impacts including urbanization in the forestland, conversion of natural forestland into agricultural land, and tree felling practices.

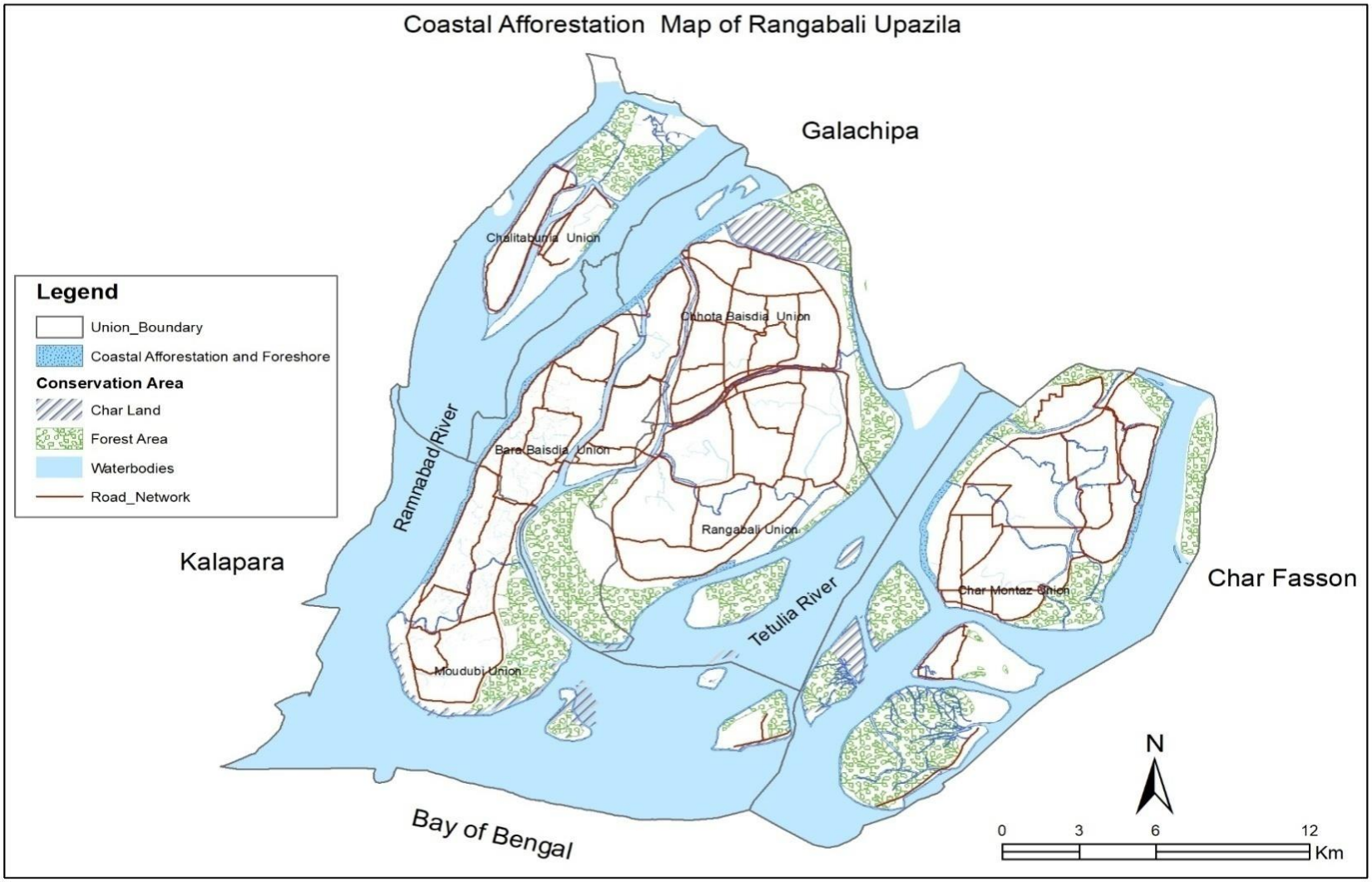


Figure 48 Proposed Coastal Afforestation

Source: PKCP project, UDD, 2018

Eco-Tourism at Rakhine Palli

Community tourism with ethnic people of Rangabali Upazila, also known as ethnic or tribal tourism, is a form of tourism that involves visiting and engaging with ethnic or tribal communities in Bangladesh, in a responsible and sustainable manner. It aims to promote cultural exchange, empower ethnic communities, and provide economic opportunities while respecting their traditions, customs, and rights. Rangabali Upazila has three place which area has 12 to 20 rakhine families. They are interested in community tourism for the economic activity.

Figure 49 Traditional pattern of house Source: PKCP project, UDD, 2022

Eco- Tourism at Sonar Char and Surrounding Area

Sonar Char and the neighbouring chars offer a plethora of tourist development potential. Action Area Plan can be prepared focusing on the distinctive traits and facilities of the five chars that may entice both domestic and international tourists.

Sonar Char is an ecologically sensitive area as well as a low-salinity animal sanctuary and reserve forest. Tourists can enjoy loungers, watch towers, tree houses, jungle safaris, rafting boats, exclusive floating docks, and flutes in this char. Near Sonar Char, a movable dock must be constructed. Beach nourishment, may be a viable option for protecting the beach from erosion. A large number of red crabs may be seen on the beach.

Char Montaj is the largest among the five chars in this region. To enhance the attractiveness of this char, natural roadside landscaping can be promoted. On the southern shore of this char, there is a boat dock. A hotel-motel zone can be promoted in this char for its well connectivity. Apart from luxury hotels for foreigners, budget hotels should also be promoted

Andar Char: This is a perfect location to develop luxury and modern facilities for tourists as this char is geographically stable. Eco-resort, villa type tent, traditional resort, entertainment and sports area, multifunctional sports complex (gym, swimming pool), mini golf ground, mud bath pond, BBQ place, party square, security facilities, police station, fire service

facilities, health care facilities, and an adjustable dock for boats are among the amenities that could be built in this char.

Community based tourism is tourism in which local residents (often rural, poor and economically marginalized) invite tourists to visit their communities with the provision of overnight accommodation. It is a growing market as new generations of travelers worldwide seek more meaningful experiences from their leisure time.

Exclusive Tourist Zone

Exclusive tourist zone is a place where Tourists are looking for a luxury trip want their dreams to become reality. They look for something unique, above their expectations with superb service where their needs and wants are fulfilled. This includes exclusivity, privacy, and everything from relaxation to adventure, with pampering and extras.

- Exclusive tourist zone has hotels, cottages, beach villas, night clubs, a convention hall and an amusement park.
- Watch towers, shopping malls, food courts, Cineplex's and swimming pools can be found
- Well-connected by Road, Air, Water

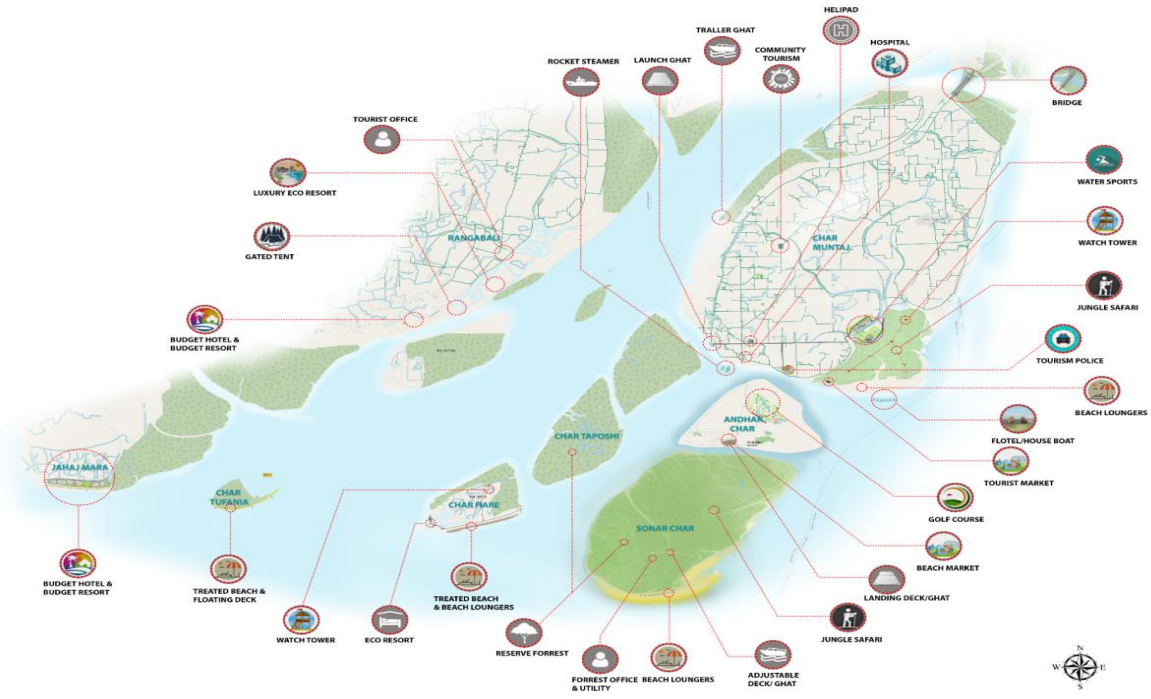


Figure 50 Exclusive Eco-tourism

Source: PKCP project, UDD, 2018

5.6 Development Management

Existing agricultural land has been classified by cropping pattern in order to promote the high agricultural value of high yielding agricultural land. In order to secure food security, the structure plan recognizes high agricultural value lands. Given the expected future population growth in settlement areas, high agricultural lands, such as triple and double-cropped land, will continue to be used for agriculture.

It is recommended that the urban sub-central area and rural sub-central area settlements areas in diverse places of the urban and rural sections of Rangabali Upazila be preserved in order to accommodate future population expansion. It is necessary to specify existing rural settlement areas to be kept in their morphological characteristics during the Structure Plan period in order to achieve compact development and preserve high-value agricultural fields.

According to the Structure Plan's policy and strategy, developed in the sub-central zones will be regulated, and only limited interventions in service demand will be permitted in the intermediate zones. Non-agricultural activity expansion will be discouraged, and the development of non-permitted land uses will be regulated.

Any non-compatible development will be controlled in the central area of the urban area and rural trade and commercial zones. Activities, as specified in the sector policy in Structure Plan Report, will be allowed only in the national interest/societal interest.

Land use Control

Land use zoning is an evitable element of development plan that regulates the haphazard land use and ensure enough space for proper uses and creates homogeneous land uses. Land use zoning practices have practiced in local planning system since the beginning of the post-World War II in the form of physical planning approach. The aim of land use zoning is outlined below:

Land use control or regulation and land use development will ensure sustainable development of the environment and urban growth. Enables issuance of land use clearance for development.

The land use development proposals are prepared considering the permitted, conditional and non- permitted uses of land in the Structure Plan Zones (SPZs). The matrix (Below Table) prepared in this respect will guide the development process in the Upazila in general. The projects that are required for major development interventions at the Upazila level are considered in the structure plan of the Upazila. The details of the priority projects are provided in the Action Area Plan of the Paurashava and the Urban Promotion Areas (UPAs) at union level of the Upazila.

Table 38 Permitted & conditional uses of different Land use category

Permitted Use **P** **Conditional Use** C **Plan Review Required** R **Not Permitted** N	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Potential Urban Area	Rural Settlement	Economic Region/ Industrial Zone	Trade and Commerce Center	Strategic Rural Center Zone-1st Order	Strategic Rural Center Zone-2nd Order	Strategic Rural Center Zone-3rd Order	Water body
Agricultural Shelter & Gazing	P	C	N	N	C	P	C	C	P	P	P	N
Agri Business & Services	P	C	N	N	P	C	P	P	P	P	P	N
Aquaculture & Fisheries	C	C	N	N	P	P	P	C	P	P	P	C
Arboriculture	P	P	P	C	P	P	C	C	C	C	C	C
ATM Booth	N	N	N	N	P	C	P	P	P	P	P	N
Auditorium Meeting Hall	N	N	N	N	C	N	P	C	N	N	N	N
Automobile Works	N	N	N	N	P	C	C	P	C	C	C	N
Autorickshaw Stand	N	N	N	N	P	P	P	N	P	P	P	N
Bank & Financial Institutions	N	N	N	N	P	N	P	P	P	P	P	N
Billboard (Advertisement Structure)	N	N	N	N	C	C	C	P	P	N	N	N
Boitanical Garden	N	P	N	N	P	N	N	C	C	C	C	N
Boarding & Rooming House	N	N	N	N	P	C	P	P	P	P	P	N
Brick Fields	N	N	N	N	N	C	N	N	C	C	C	N
Bus/Auto Passenger Shelter/Stops	N	N	N	N	P	C	P	C	C	P	P	N
Causeways: Road, Railways	N	N	N	P	R	R	R	R	R	R	R	N
Cash Crop Cultivation	P	C	N	N	P	P	P	P	P	P	P	N
Carnival & Fair	N	N	N	N	C	C	C	C	C	C	C	N
Cemetaries/ Graveyard	N	N	N	N	P	P	N	N	N	N	N	N
Cinema Hall	N	N	N	N	C	N	N	N	N	N	N	N
Clinics/ Medical	N	N	N	N	P	P	P	P	P	P	N	N
Clubs, Private	N	N	N	N	N	N	C	P	C	C	N	N
Colleges/Universities	N	N	N	N	P	N	N	P	N	N	N	N
Convention Center	N	N	N	N	P	N	P	P	C	N	N	N

Permitted Use P **Conditional Use** C **Plan Review Required** R **Not Permitted** N	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Potential Urban Area	Rural Settlement	Economic Region/ Industrial Zone	Trade and Commerce Center	Strategic Rural Center Zone-1st Order	Strategic Rural Center Zone-2nd Order	Strategic Rural Center Zone-3rd Order	Water body
Communication Service Facilities	N	N	N	P	P	C	P	P	P	P	P	N
Communication Tower with Height	N	N	N	N	C	C	P	P	P	P	P	N
Community Center	N	N	N	N	P	N	P	P	P	P	P	N
Cottage Industry	N	N	N	N	P	N	P	N	P	P	P	N
Cultural Exhibits & Library	N	N	N	N	C	C	C	C	C	C	C	N
Cyber Café/IT Center	N	N	N	N	P	N	P	P	P	P	P	N
Dairy Farming	P	C	C	N	P	P	P	P	P	P	P	N
Deep Tubewell	C	N	N	N	P	P	P	N	P	P	P	N
Diagonistic Centres	N	N	N	N	P	P	P	P	P	P	P	N
Docks & Jetties	C	N	N	N	P	N	P	P	C	C	C	P
Dormitory / NGO Rest House	N	N	N	N	P	N	P	P	P	P	P	N
Bakery	N	N	N	N	P	C	P	P	P	P	P	N
Dwellings, Farm	C	N	N	N	P	C	P	P	P	P	P	N
Dwellings,Minimal Housing	N	N	N	N	P	P	N	N	N	N	N	N
Dwellings,Single/ MultiFamily	N	N	N	N	P	P	P	P	P	P	P	N
Educational Facilities	N	N	N	N	P	P	P	P	P	P	P	N
Electric Sub Station	N	N	N	N	P	P	P	P	P	P	P	N
Emergency Shelter	C	N	N	N	P	P	P	P	P	P	P	N
Explosive Manufacture & Storage	N	N	N	N	N	N	P	N	N	N	N	N
Fire Station	N	N	N	N	P	N	P	P	P	P	P	N
Food Kiosk	N	N	N	N	P	P	P	P	P	P	P	N
Flood Management Structures	P	P	P	P	P	P	P	P	P	P	P	P
Freight Transport Facilities	N	N	N	N	P	C	P	P	P	P	P	N
Garages/ Workshops	N	N	N	N	P	N	P	P	P	P	P	N
Garments & Kneeting Factory	N	N	N	N	P	N	P	P	P	P	P	N
Golf Courses & Golf Club	N	N	N	N	C	N	P	P	P	P	P	N

Permitted Use P **Conditional Use** C **Plan Review Required** R **Not Permitted** N	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Potential Urban Area	Rural Settlement	Economic Region/ Industrial Zone	Trade and Commerce Center	Strategic Rural Center Zone-1st Order	Strategic Rural Center Zone-2nd Order	Strategic Rural Center Zone-3rd Order	Water body
Government Office / Guest House	N	N	N	N	C	N	P	P	P	P	P	N
Green Belt/ Green Space	N	P	P	P	P	P	C	C	C	C	C	N
Hatchery	P	N	N	N	P	P	P	P	P	P	P	N
Health Facilities	N	N	N	N	P	P	P	P	P	P	P	N
High School	N	N	N	N	P	N	N	P	P	P	P	N
Horticulture	P	N	N	N	P	P	P	P	P	P	P	N
Hospitals/ Health Centers	N	N	N	N	P	N	P	P	P	P	P	N
Hotel Guest House	N	N	N	N	C	N	P	P	P	P	P	N
Hotel International Class	N	N	N	N	C	N	P	P	P	P	P	N
Husking/ Grinding(Rice, Wheat, Pulse)	N	N	N	N	P	P	P	P	P	P	P	N
Industrial Class 1	N	N	N	N	P	N	P	N	N	N	N	N
Industrial Class 2	N	N	N	N	P	N	P	N	N	N	N	N
Institutions	N	N	N	N	C	N	N	P	P	P	P	N
Irrigation Facilities (Flood Wall/ Canal)	C	N	N	N	C	C	C	C	C	C	C	P
Livestock	C	C	N	N	P	P	P	P	P	P	P	N
Major Development	N	N	N	N	P	N	P	C	C	C	C	N
Multi stored Car park	N	N	N	N	C	N	C	C	C	C	C	N
Nursery School	N	N	N	N	C	N	N	N	P	P	P	N
Offices/ Services	N	N	N	N	C	N	P	P	P	P	P	N
Open Theatre	N	N	N	N	C	N	P	P	P	P	P	N
Orphanage	N	N	N	N	P	N	P	P	P	P	P	N
Outdoor Religious Events	N	N	N	N	P	C	P	P	P	P	P	N
Parking Facilities, Commercial	N	N	N	C	C	N	P	P	P	P	P	N
Parking Facilities	N	N	N	P	C	N	P	P	P	P	P	N
PC Culture	C	C	N	N	P	C	P	P	P	P	P	N
Petrol Stations	N	N	N	N	N	N	P	P	P	P	P	N

	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Potential Urban Area	Rural Settlement	Economic Region/ Industrial Zone	Trade and Commerce Center	Strategic Rural Center Zone-1st Order	Strategic Rural Center Zone-2nd Order	Strategic Rural Center Zone-3rd Order	Water body
Permitted Use P **Conditional Use C** **Plan Review Required R** **Not Permitted N**												
Plantations	N	P	P	P	P	C	N	N	N	N	N	N
Mosque/ Temple	N	N	N	N	P	P	P	P	P	P	P	N
Places of Worship	N	N	N	N	C	N	N	N	N	N	N	N
Packaging & Processing	N	N	N	N	P	N	P	P	P	P	P	N
Play Field	N	N	N	N	P	C	N	N	N	N	N	N
Police Box/ Barrak	N	N	N	N	C	N	P	P	P	P	P	N
Post Office	N	N	N	N	C	N	P	P	P	P	P	N
Postal Facilities/ Courier	N	N	N	N	C	N	P	P	P	P	P	N
Poultry	P	N	N	N	C	C	P	P	P	P	P	N
Primary School	N	N	N	N	C	N	N	N	N	N	N	N
Prisons	N	N	N	N	P	N	P	P	P	P	P	N
Printing/ Publishing House	N	N	N	N	C	N	P	P	P	P	P	N
Public Uses & Structures	N	N	N	N	P	N	P	P	P	P	P	N
Public Transport Facilities	N	N	N	N	P	C	P	P	P	P	P	N
Recreational Facilities, outdoor	N	N	N	N	P	C	P	P	P	P	P	N
Religious Facilities & Structures	N	N	N	N	P	N	P	P	P	P	P	N
Repair Shops, Major	N	N	N	N	P	N	P	N	N	N	N	N
Repair Shops, Minor	N	N	N	N	C	N	N	P	P	P	P	N
Retail Shops & Restaurants	N	N	N	N	C	N	P	P	P	P	P	N
Retention Ponds	N	N	N	N	P	C	N	N	N	N	N	C
Rickshaw Stands	N	N	N	N	P	P	P	P	P	P	P	N
Salvage, Storage & Processing	N	N	N	N	P	N	P	P	P	P	P	N
Saw- Mill	N	N	N	N	C	N	P	C	C	C	C	N
Schools, Private	N	N	N	N	N	N	N	P	P	P	P	N
Scientific Research Establishment	N	N	N	N	P	N	P	C	C	C	C	N
Ship & Boat Servicing	N	N	N	N	P	N	P	P	P	N	N	N

	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Potential Urban Area	Rural Settlement	Economic Region/ Industrial Zone	Trade and Commerce Center	Strategic Rural Center Zone-1st Order	Strategic Rural Center Zone-2nd Order	Strategic Rural Center Zone-3rd Order	Water body
Permitted Use P **Conditional Use** C **Plan Review Required** R **Not Permitted** N												
Social Forestry	P	P	P	N	C	P	C	C	C	C	C	N
Special Function Tent	N	N	N	N	C	N	P	P	P	P	P	N
Stadium Sports	N	N	N	N	C	N	P	P	P	P	P	N
Swimming Court/ Pool	N	N	N	N	C	N	P	P	P	P	P	N
Tea Stall/ Coffee Shops	N	N	N	N	C	C	P	P	P	P	P	N
Tennis Court / Club	N	N	N	N	P	N	P	P	P	P	P	N
Termminals, Train, Bus, Truck, Freight	N	N	N	C	P	N	P	P	P	P	P	N
Trade Centers	P	N	N	N	P	N	P	P	P	P	P	N
Transformer stations	N	N	N	N	P	N	P	P	P	P	P	N
Transmission Lines	N	N	N	N	P	C	P	P	P	P	P	N
Utility Installations/ Lines	N	N	N	N	P	C	P	P	P	P	P	N
Vegetable Cultivation	C	N	N	N	P	P	N	N	N	N	N	N
Ware Housing & Distribution	N	N	N	N	P	N	P	P	P	P	P	N
Water pump, Reservoir	C	N	N	N	P	C	P	P	P	P	P	N
Waste Disposal & Processing / Minarator	N	N	N	N	C	C	C	C	C	C	C	N
Water Based Recreational Park	N	N	N	N	C	N	C	C	C	C	C	P
Water Treatment / Purification Plant	N	N	N	N	P	C	C	C	C	C	C	C
Wood / Iron Furniture Production	N	N	N	N	P	N	P	P	P	P	P	N
Zoo	N	N	N	N	C	N	C	N	N	N	N	N
Eco Tourism	C	p	p	N	C	P	P	C	C	C	C	N

CHAPTER SIX: PLAN IMPLEMENTATION

6.1 Introduction

The most important responsibility for the stakeholders is to implement the plan. This chapter outlines the numerous steps that must be followed to carry out the plan's recommendations. The whole planning process's most crucial step is effective implementation.

6.2 Legal Framework for Implementation

The implementation of Structure Plan, Urban Area Plan, Rural Area Plan, and Action Area Plan will be legally guided by the Local Government Acts of all Local Government Units within the Upazila - (i) Local Government (Upazila Parishad) Act, 2009; (ii) Local Government (Paurashava) Act, 2009; and (iii) Local Government (Union Parishad) Act, 2009.

Some other Acts are relevant for taking actions in matters of preserving and conserving the water bodies and environment of the Upazila. The Water Act 2011 and Act 2000 for protecting the water bodies, playfields, and environment are particularly important.

There are national policies for most of the sectors. The relevant sector policies are consulted in this project for the preparation of Structure Plan of the Upazila, Urban Area Plan for the urban areas, and Rural Area Plan for the rural area and Action Area Plan for the selective areas. These sector policies will be important for adopting measures of executing development projects as indicated in the plan documents. For further details of the policies and strategies, the implementing agencies may consult the national policy documents for any sector.

6.3 Custodian of the Plan

The Urban Development Directorate (UDD) under the Ministry of Housing and Public Works is the custodian of the Plan prepared under the current project. The present planning project of the Urban Development Directorate (UDD) addresses all aspects of development within the Upazila. There are multi-sectoral tasks to be carried out by multiple stakeholders at the Upazila including Upazila Parishad, Paurashava, and Union Parishad.

All the stakeholders must be involved in carrying out the implementation of the plan proposals. Planning proposals are essentially much time-bounded, therefore, execution of the proposals should move ahead once the government formally approves the plan. Rangabali Upazila will be the main custodian of the total plan package. It will also be responsible for executing the monitoring and implementation phase of the development projects by other development as well as Upazila Nirbahi Officer (UNO).

The Agricultural Extension Department of the Ministry of Agriculture, the Ministry of Water Resources and the Ministry of Fisheries and Livestock with the help of Upazila Parishad will

play the key role to control development in the Urban Promotion Control Area (UPCAs). For any non-agricultural development within the UPCAs will require No Objection Certificate (NOC) from these authorities.

The Upazila Parishad have the overriding tasks of supervising the implementation of the Action Area Plans across the UPAs within the Upazila with the help of Union Parishads. The governmental agencies performing diverse sectorial responsibilities within the Zila, Upazila, Paurashava and Union Parishads have to coordinate their functions with the local governments of the respective areas of jurisdiction. The Urban Development Directorate (UDD) is to assist this implementation process and provide No Objection Certificate (NOC) for governmental projects.

The Rangabali Plan implementation authority will be responsible for the implementation of the Structure Area Plan of the Upazila as per the Local Government Act.

6.4 Institutional Strengthening

In Bangladesh, the central Government Grant is an important source of income for the Paurashavas. Such grant supplements the income of a Paurashava from local sources in order to fulfil its functional responsibilities. At present, Central Grants are of the following types:

a. Direct grants (non-development grants)
b. Subvention (Salary Support)
c. Matching grants (Linked to Projects)
d. Development grants (Block grants)

The priority areas constituting coastal development strategy need to be translated into programs and projects. Projects must be formulated through an institutional process. These projects intended for implementation over a specified duration will form part of the Investment Plan to be updated on an annual basis. Projects will have indicative budget requirements and duration of implementation, as well as implementation arrangements.

6.4.1 Priority areas

The Coastal Development Strategy puts forward a set of priority areas that should constitute the Investment Strategy which has a direct correspondence to the objectives of the investment strategy spelt out in the coastal zone policy as indicated above. These are as follows:

- Mitigation of natural disasters, safety and protection.
- Environmental management – protection and regeneration of the environment.
- Water resources management.
- Rural livelihoods and sustainable economic opportunities for coastal communities.
- Productive economic activities and focused development of tourism and fisheries sectors

6.5 Capacity Building of Local Actors

Local governments lack the capacity and resources to carry out their responsibilities properly. To raise working capability, training programs should be arranged and modern office and working equipment should be installed.

6.5.1 Local actors

They represent the public and the private sectors. The public sector encompasses all relevant central government agencies, Paurashavas and city corporations, while the private sector includes formal and informal enterprises and services, local communities and relevant NGOs.

Local Government Bodies

Capacity building of local government bodies needs to focus on strengthening managerial, technical, financial and regulatory capabilities. Capacity building in holding tax administration is also vital as it is a major source of revenue. Further, enhanced capacity in cost accounting systems is needed to control service and monitor cost-effectiveness and efficiency.

Private Sector Organizations

Both formal and informal private sector enterprises need to build capacity in various aspects affecting urban development.

6.5.2 Capacity building tools

Appropriate capacity building tools need to be developed to acquire the skills related to urban development and management. Public sector training and technical assistance programmes would be very useful for local government technical and managerial staff. Public information and outreach programs can be designed by local governments and NGOs to promote public participation and support.

6.5.3 Institutions for capacity building

Undergraduate and post-graduate level education in managerial, technical, financial and regulatory aspects is offered by various Universities and Institutes in the public and private sectors. Particular emphasis should be placed on planning education. Steps should be taken to strengthen planning education and increase the output of graduate planners. Steps should also be taken to train various professionals, especially engineers, in various aspects of urban planning so that they can carry out development activities in conformity with urban planning principles and regulations.

6.5.4 Involving Local Stakeholders in Urban Development

Effective partnerships between local governments and the private sector can generate considerable benefits. Private companies, informal sector enterprises, CBOs, and NGOs can provide urban services, mobilize finance (or voluntary labour), introduce innovative technologies and undertake land development activities. Private sector actors with whom partnership arrangements can be made include the following:

6.5.5 Community-based organizations (CBOs)

These organizations are formed when neighborhood residents get organized and join forces to improve local security, housing quality, basic utilities, social services and the neighborhood environment. Municipal community partnership (MCP) has now emerged as an innovative institutional model. MCPs are particularly suitable for delivering specific goods and services, e.g. sanitation, refuse collection, roads and environmental maintenance, social housing etc. MCPs should be developed as part of an overall municipal strategy.

6.5.6 Non-governmental Organization (NGOs)

Unlike CBOS, Non-governmental organizations usually originate outside of the communities with which they work. NGOs may be understood as a "third system" between the public and private, concentrating their support at the community level while at the same time mediating between the community and the government. NGOs are effective agents for building local awareness, mobilizing community action, enabling access to credit, strengthening CBOs etc. In the context of vast needs, limited capacity and constrained financial resources, the local governments should recognize the role of NGOs as partners in urban development and management activities.

6.5.7 Private Enterprises

These include informal workers and small-scale enterprises as well as large-scale business firms that may be entrusted with the task of operating or developing infrastructure facilities and urban services. The private sector enterprises can play more productive and sustainable roles in urban development by working in partnership with local government, especially in delivering certain urban services, formulating and implementing local economic development strategies and taking part in Philanthropic activities for the promotion of social good and environmental quality.

6.6 Role of Urban Development Directorate

The multifaceted professional requirements of the plan for execution make it difficult to implement the Structure Plan. For the plan to operate effectively, an appropriate authority to oversee the tasks undertaken under the plan would be needed.

Urban Development Directorate (UDD) is directly involved with the Upazila development plan and UDD is currently doing the Upazila Development Plan. The role of the Urban Development Directorate (UDD) should expand to monitor and evaluate the development plans of Upazilas directly to make it more practical and fruitful. Urban Development Directorate (UDD) can provide technical services for the effective implementation of the plan.

6.7 Monitoring, Review and Updating of the Plan Components

Planning is always a continuous process. The plan package needs to be updated regularly to make it respond to the spatial changes over time. Urban Development Directorate (UDD) being the custodian of this plan should always monitor the implementation of the plan. The review will aim to analyse the status of implementation of plan provisions, the changing

physical growth pattern, infrastructure development, and the trend of public and private physical development including growth direction. The Structure plan documents should be reviewed periodically once in every 10 years. The aim of the review will be to analyse the status of implementation of plan provisions and the changing physical growth pattern. The level of infrastructure development in terms of population and economic growth in particular needs to be assessed for actions during the remaining period of the plan period. For regular updating and changes and plan implementation monitoring, the Upazila should immediately set up a planning section with planners and staff.

6.8 Circulation of the Plan Documents

The strength of the statutory plan is yet to be established among the stakeholders including common citizens and the public sector development agencies. As the custodian of the plan, Urban Development Directorate (UDD) will be responsible to disseminate and establish the true spirit of the plan. UDD will remain responsible to inform all the government organizations that a statutory plan has been prepared for the corridor, because of its statutory nature; it has to be followed by all. It should be adhered to by them while taking up development programs and projects within the jurisdiction of the plan area.

To achieve the objective of the plan, it has to be disseminated among all the government agencies. Copies of the plans including maps and reports will have to be sent to them with a letter stating under what legal authority the plan has been prepared.

The plan would be uploaded on the UDD website so that people can download, study, and be aware of the plan. Besides, hard copies of the document would be made available for sale at a reasonable price. UDD can also contact the line agencies through the letter to make them aware of the projects proposed under this plan and the role of the respective line agencies to implement the same.

6.9 Plan Review Committee

A Plan Review Committee would be required for reviewing the cases of demand for change the plan special plan requirements. A Plan Review Committee can serve this purpose following the recommending made by UDD Composition of this Plan Review Committee can be as follows:

Convener – Secretary, Ministry of Housing and Public Works

Member – Joint-Secretary (Local Government Division), Ministry of Local Government, Rural Development and Cooperatives

Member – Joint-Secretary, Ministry of Agriculture,

Joint-Secretary, Ministry of Land,

Joint-Secretary, Ministry of Environment,

Joint-Secretary, Ministry of Water Resources,

Joint-Secretary, Ministry of Road Transport and Bridges

Member – President, Bangladesh Institute of Planners (BIP)

Member – Head, Department of Urban and Regional Planning, BUET.

Member – Deputy Commissioner (DC), Patuakhali District

Member-PD, PKCP Project, Urban Development Directorate (UDD)

Member Secretary – Director, Urban Development Directorate (UDD), Ministry of Housing and Public Works

6.10 Development Control

Any unauthorized or unlawful development within the Upazila should be controlled to fulfill the aim of planned development. Following are some measures that the concerned Local Government Authority may apply.

Restrictions on development are required in certain cases in order to stop illegal construction and encroachment. For example, no low land can be filled up and no obstruction to drainage system will be allowed. Prior permission of the Local Governments in the respective areas of jurisdiction will be required for filling of any low lands. Ponds should not be allowed to fill up as they are a good source of urban water supply as well as serve as open space.

Infrastructures are developed by public sector agencies for public benefit. But in case of some developments, it is observed that major benefits are reaped by a particular section of the community where development takes place. This is particularly true for road construction.

In the BC Rules 1996, specific provisions are made for parking in housing and commercial areas. But no provision has been suggested for mixed use areas. According to the rules in commercial area, 23 sq.m area has to be reserved for every 200 sq. m of commercial space. The BC Rules for parking in the commercial area can also be applied for mixed-use areas under the current plan.

6.11 Execution of Development Proposals

The government agencies should respect the plan provisions and the legal provisions of EBBC Act 1952. When the plan will be ignored by the government agencies, the general public will have little respect for it and plan will gradually lose its credibility as a statutory document.

Many public agencies will be responsible for carrying out infrastructure development. The Local Governments within the Upazila will execute many projects for public interests. The extent of execution of proposals by public sector agencies will largely depend on the size of resources made available for implementing the development schemes. The PPP approach for execution of development projects can be adopted by the local governments.

It should be recognized that planning is an integral part of administration. It should not be expected that planned development would be highly remunerative in the immediate future,

but it is sure that execution of development proposals, in the long run, will accrue positive dividends. It will improve health and comfort of the people that will lead to increased comfort for living and efficiency for working.

The plan proposals are time-bound and proposals that are not executed in time will lose their viability over time. As development proceeds, it will be difficult to find suitable vacant land for infrastructure development, which may negatively impact on physical and social environment. Timely execution of development project is therefore important

6.12 Resource Mobilization for Development

Implementation of development projects proposed in the plan will be a challenging task as they will require huge amount of resources. The development projects are expected to be executed by a number of agencies. However, it is beyond doubt that the Local Governments will have to shoulder the heaviest financial burdens. The Local Governments suffer from resource constraint. This calls for increasing revenue earning by generating new revenue sources.

6.13 Scope for Land Acquisition

Due to low supply and higher demand, land value is higher in urban areas compared to rural hinterland. As a result, land acquisition through legal process is cumbersome and lengthy in urban areas.

Land acquisition is expensive in the urban areas as land owners are generally unwilling to offer their lands for development as it is a lucrative source of income in urban areas. It is comparatively easier to acquire land in fringe than in the core areas. Fringe areas are usually characterized by low density, where land value is also comparatively low.

CHAPTER SEVEN: CONCLUSION

7.1 Concluding Remarks

The Structure Plan study summarized the general state of affairs, significant planning concerns, and anticipated population growth in the Upazila. If carefully implemented, national policies and initiatives are seen to have significant effects. The strategic measures suggested are targeted to achieve these policies at the Upazila level. The implementing agencies will have an important role to play once the Development Plan gets approval of the government for execution.

The success of the plans will depend on the capacity of the local governments in implementing the plans. The supports of the national government for the execution of the plans are always necessary. The national government should be increasingly engaged with the local governments at the Upazila level in improving the policy and legal framework for the implementation of local physical plans. This will enhance the institutional strength of the local governments in the execution of the planned development process.

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APPENDIX-A

Water Quality of Major Rivers

Table-A1: Status of Physical and Aggregate Properties

Parameters	Unit	Galachipa-Ramnabad	Tetulia	BD Standards	Remarks
Temp.	^{0}C	31	30	20-30	Within the range
pH	Value	7.4	7.2	6.5-8.5	Within the range
TDS	mg/l	90	340	1000	Complied the standard
EC	µS/cm	180	700	1200	Complied the standard
Salinity	ppt	0.1	0.1	0	Complied the standard
TSS	mg/l	13	22	50-150	Within the range
Turbidity	NTU	94	60	50	Higher than the standard
Alkalinity	mg/l	18	20	20-120	Within the range
Hardness	mg/l	210	200	200-500	Within the range

Source: PKCP Project, UDD, 2022

Table-A2: Status of Inorganic Non-metallic Constituents

Parameters	Unit	Galachipa-Ramnabad	Tetulia	BD Standards/WHO*	Remarks
Chloride	mg/l	20	22	250	Complied the standard
Sodium	mg/l	35	20	200*	Complied the standard
Potassium	mg/l	4	5	12*	Complied the standard
Nitrate	mg/l	6.3	1.5	2.5	Higher than the standard
Phosphate	mg/l	0.3	0.6	0.5	Complied the standard
Sulphate	mg/l	18	40	400	Complied the standard

Source: PKCP Project, UDD, 2022

Table-A3: Status of Aggregate Organic Constituents

Parameters	Unit	Galachipa-Ramnabad	Tetulia	BD Standards	Remarks
DO	mg/l	6	6	5 or more	Within the standard
BOD	mg/l	1	4	Less than 10	Complied the standard
COD	mg/l	4	11	Less than 25	Complied the standard

Source: PKCP Project, UDD, 2022

Table-A4:Status of Metal Constituents

Parameters	Unit	Galachipa-Ramnabad	Tetulia	EPR'86, India	Remarks
Iron	mg/l	1.0	1.0	0.1	Higher than the standard
Zinc	mg/l	0.03	0.03	2	Complied the standard
Manganese	mg/l	0.07	0.24	3	Complied the standard
Lead	mg/l	0.005	0.005	2	Complied the standard
Chromium	mg/l	0.012	0.010	0.05 (BD, Drinking)	Complied the standard
Nickel	mg/l	0.030	0.069	5	Complied the standard
Copper	mg/l	0.030	0.011	1 (BD, Drinking)	Complied the standard
Cadmium	mg/l	0.00015	0.013	0.005 (BD, Drinking)	Complied the standard

Source: PKCP Project, UDD, 2022

Table-A6:Status of Oil & Grease and Phenol

Parameters	Unit	Galachipa-Ramnabad	Tetulia	Standards	Remarks
Oil & Grease	mg/l	<2.0	<2.0	10 (ECR'2017 ammed.)	Within the standard
Phenol	mg/l	<0.5	<0.5		-

Source: PKCP Project, UDD, 2022

Table-A7: Soil pH, EC and Soil Texture of the sampling sites

Sampling site	Soil pH	Electrical conductivity(EC) (dS/m)	Soil Texture			
			Sand	Silt	Clay	Type
Agricultural field	6.3	1.74	39.46	38.34	22.2	Loam
	4.5	1.34	43.61	36.25	20.14	Loam
	8.1	5.26	44.9	44.89	10.2	Loam
	7.7	2.24	41.47	44.4	14.13	Loam
	5.0	6.63	48.15	40.61	18.27	Loam
	8.0	4.30	55.38	34.48	10.14	Sandy Loam
Urban area	7.6	4.69	43.55	28.22	28.23	Clay Loam
	5.5	1.35	44.79	38.85	16.36	Loam
Peri urban area	7.3	5.29	48.51	39.13	12.36	Loam
	8.0	5.23	53.25	36.58	10.16	Sandy Loam
	4.1	0.78	47.1	42.73	10.17	Loam
Mangrove forest	7.3	1.47	57.19	32.62	10.19	Sandy Loam

Source: PKCP Project, UDD, 2022

Table-A8: Air Quality of the Study Area

Unit	PM_{10} $\mu g/m^3$	$PM_{2.2}$ $\mu g/m^3$	SO_2 $\mu g/m^3$	NO_x $\mu g/m^3$	CO mg/m^3	VOC $\mu g/m^3$
Averaging Period	24h	24h	24h	24h	8h	-
AAQ-1	82.6	41.6	6.8	32.6	0.75	<4.2
AAQ-2	79.6	39.6	6.2	30.2	0.65	<4.2
AAQ-3	86.2	44.6	7.3	35.6	0.56	<4.2
AAQ-4	75.6	40.8	6.5	32.5	0.65	<4.2
AAQ-5	78.4	42.5	6.2	28.2	0.72	<4.2
AAQ-6	77.3	39.2	<6.0	26.9	0.68	<4.2
AAQ-7	79.4	38.6	<6.0	26.4	0.62	<4.2
AAQ-8	80.7	40.8	6.5	30.2	0.66	<4.2
AAQ-9	83.9	45.2	6.3	30.8	0.73	<4.2
AAQ-10	82.7	42.7	6.2	29.8	0.78	<4.2
AAQ-11	81.2	41.3	6.4	29.7	0.72	<4.2
AAQ-12	86.3	44.7	7.4	36.5	0.69	<4.2
Standard (National)	150	65	80	80 (Annual)	5 (8 Hr)	-
Standard (International)	150	75	125	200 (1Hr)	-	-

Source: PKCP Project, UDD, 2022

Table-A9: Noise Quality of Different Land Use Types in the Study Area

Rangabali					
Location ID	**Zone**	**Morning (dB)**	**Std. (Noise control rules, 2006) (dB)**	**Evening (dB)**	**Std. (Noise control rules, 2006) (dB)**
NL-1	Mixed	82	60	76	50
NL-2	Commercial	57	70	68	60

Source: PKCP Project, UDD, 2022

Appendix B: ESO Objectives, Indicators and Institutions Responsible for Monitoring

This table is an updated table for the Final SEMP, and will require to be further developed, and kept under rolling review throughout the next 20 years.

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
Forest, Protected areas and biodiversity	1	Reduce over-exploitation degradation of habitats, loss of biodiversity and ecosystem(s) integrity and services	1	Status of the mud crab (*Scylla spp*.) as a key indicator of aquatic biodiversity in the PKCP region	None yet	None yet	None yet	None yet	Ministry of Fisheries and Livestock (MoFL) Secretary, MoFL, email: secretary@mofl.gov.bd, Phone: 9545700 & Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Department of Fisheries (DoF) Director General, DoF email: dg@fisheries.gov.bd, Phone: 9562861 & Bangladesh Forest Department (BFD) Chief Conservator of Forests, BFD email: ccf-fd@bforest.gov.bd, Phone: 01999000001	Department of Fisheries (DoF) 1. Director, Finance & Planning, DoF. email: ddfinance@fisheries.gov.bd Bangladesh Forest Department (BFD) 2. Conservator of Forests, Wildlife and Nature Conservation Circle, BFD, Dhaka. email: mihir_fd@yahoo.com, Cell: 01712566001	Annual	Survey needed and the SCU will finalize all the need assessment.
			2	Status of suitable habitat for dolphin (in sanctuaries & hotspots)	Poor Good Very good[1]	Very good	2018-19	BFD, 2020	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Bangladesh Forest Department (BFD) Chief Conservator of Forests, BFD. email: ccf-fd@bforest.gov.bd Phone: 01999000001	BFD 1. Conservator of Forests, Wildlife and Nature Conservation Circle, BFD, Dhaka. email: mihir_fd@yahoo.com,	Propose Every 3 years	
			3	Area of Protected (PA) Forests and other designated areas	Hectare	Reserve forests 43,453	2022	BDF 2022	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Bangladesh Forest Department (BFD) Chief Conservator of Forests, BFD. email: ccf-fd@bforest.gov.bd Phone: 01999000001	BFD 1. Conservator of Forests, Wildlife and Nature Conservation Circle, BFD, Dhaka. email: mihir_fd@yahoo.com,	Propose Every 3 years	
Waste and Pollution	2	Reduce poor management and unsafe disposal of solid and liquid waste (urban & industrial)	4	Capacity of recycling plants in the PKCP Area	Very good/Good/ Moderate / Poor/ Very poor[2]	0	2022	Local consultations	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Department of Environment (DoE) Director General, DoE email: dg@doe.gov.bd Phone: 8181800	DoE 1. Director, NRM, DoE, email: dirnrm@doe.gov.bd, Cell: 01718114188 2. Director, Barishal Divisional Office, DoE,	Annually	
			5	Total volume waste per capita in Amtali, Kalapara and Brguna Sadar	Kg/ person/ day	0.11, 0.20, 0.24 respectively	2022	Calculated	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Department of Environment (DoE) Director General, DoE email: dg@doe.gov.bd Phone: 8181800	DoE 1. Director, NRM, DoE, email: dirnrm@doe.gov.bd, Cell: 01718114188 2. Director, Barishal Divisional Office, DoE,	Annually	

Source: PKCP Project, UDD, 2022

[1]. **Poor: Where the environmental factors and food accessibility for dolphins is not enough for basic life cycle requirements and where interference by fishermen and boat movement disturbance is high.**

Good: Where the environmental factors and food accessibility for dolphins is enough for basic life cycle requirements, and interference by fishermen and boat movement disturbance is low.

Very good: Where the environmental factors and food accessibility for dolphins is abundant for basic life cycle requirements, and there is no interference by fishermen and boat disturbance.

[2]**Very good =**The state where all the municipal solid waste in urban areas of PK Region is recycled and properly managed without posing any threats to environment, and 70-90%) of waste is converted into resources.
Good = The state where all the municipal solid waste in the urban areas of PK Region is recycled and properly managed without posing any threats to environment, with 50-69% of waste converted into resources.

Moderate = The state where 50 –75% of the municipal solid waste in the urban areas of PK Region is recycled and properly managed without posing any threats to environment, with 30-49% of waste converted into resources.

Poor = The state where around 25% of the municipal solid waste in the urban areas of PK Region is recycled and properly managed only, with no waste comverted into resources.
Very Poor = The state where less than 25% of municipal solid waste in the urban areas of PK Region is recycled and properly managed, with no waste converted into resources.

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
	3	Reduce all forms of pollution (air, , water, noise etc.)	6	Dry season water quality (nitrate) in the Galachipa river (Horidebpur Bazar near Ferry ghat)	mg/litre	2.0-3.0	2022	CEGIS 2022	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Department of Environment (DoE) Director General, DoE email: dg@doe.gov.bd Phone: 8181800	DoE 1. Director, NRM, DoE, email: dirnrm@doe.gov.bd, Cell: 01718114188 2. Director, Barishal Divisional Office, DoE,	Annually	
			7	Dry season water quality (phosphate) in the Galachipa river (Horidebpur Bazar near Ferry ghat)	mg/litre	0.5-1.0	2022	CEGIS 2022	Same as above	Same as above	Same as above	Annually	
			8	Dry season water quality (BOD) in the Galachipa river (Horidebpur Bazar near Ferry ghat)	mg/litre	1.0	2022	CEGIS 2022	Same as above	Same as above	Same as above	Annually	
			16	Dry season water quality (phosphate) at Tetulia river (Bonnatoli Kheya Ghat)	mg/litre	0.5	2022	CEGIS 2022	Same as above	Same as above	Same as above	Annually	
			17	Dry season water quality (BOD) at Tetulia river (Bonnatoli Kheya Ghat)	mg/litre	3-4	2022	CEGIS 2022	Same as above	Same as above	Same as above	Annually	
			18	No hrs. in which noise exceeds 45dBA in the ‘Silent Zone’ in the reserve forests)[3]	Hrs./day	0 [4]	2022	CEGIS 2022	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Department of Environment (DoE) Director General, DoE email: dg@doe.gov.bd Phone: 8181800	DoE 1. Director, Department of Environment, Dhaka Laboratory Office E-mail: dhakalab@doe.gov.bd, Cell: 01712125880 2. Director, Air Quality Management, Department of Environment. Mail: nazmul@doe.gov.bd, Cell: 01819427358	Methodology, duration and coverage to be revised	Survey needed
Climate change and disasters	4	Reduce vulnerability to climate change and natural disasters (floods, storm surges, etc.)	26	Storm surge inundation	% of PK Region	Cyclone Sidr: 10	2007	WB, 2011	Ministry of Disaster Management and Relief (MoDMR) Secretary, MoDMR email: secretary@modmr.gov.bd Phone: 9540877	Department of Disaster Management (DDM) Director General, DDM email: dg@ddm.gov.bd, Phone: 8835495	DDM 1. Deputy Director (Research) Disaster Management Division, email: nurulhaquechowdhury@gmail.com, Mobile: 01711399633	Event based – the data are only collected after the event	Storm surge inundation
			27 (a)	Salinity intrusion (Surface water & ground water)	% of Region: 1PPT in SW	71.5	2011	CEGIS Bay of Bengal Model	Ministry of Water Resources (MoWR) Secretary, MoWR email: secretary@mowr.gov.bd, Phone: 9576773 & Ministry of Local Government, Rural Development & Co-operatives	Bangladesh water Development Board (BWDB) Director General, BWDB email: dg@bwdb.gov.bd, Phone: 222230011 & Department of Public Health Engineering (DPHE)	BWDB Chief Engineer (Civil), Hydrology, email: ce.hydrology@bwdb.gov.bd, Phone: 029550815 DPHE Superintending Engineer (Ground Water	Continuous	Measure this in wells. There are a number of monitoring wells.

[3]Bangladesh standard (Environmental Conservation Rule-ECR-1997) for Silent zone (45 dBA)
[4]Discontinuously when Cargo and ships move and honk

Source: PKCP Project, UDD, 2022

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
										Chief Engineer, DPHE, email: ce.dphe@gmail.com. Phone: 55130752	Circle), email: se.gwc@dphe.gov.bd, Phone: 02-9342485		The monitoring is already in place
			27 (b)	As above	% of Region: 5PPT in SW	52.5	As above	As above	As above	As above	As above	As above	As above
			28	Number of Households severely affected5 during cyclone, storm surge, extreme flood or related climate change event	No.	31,228 on average per annum (from 2015-2020)	2015-2020	BBS, 2022	Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481	Bangladesh Bureau of Statistics Statistics and Informatics Division Ministry of Planning	Bangladesh Bureau of Statistics Statistics and Informatics Division Ministry of Planning	calamity/ event based Data collated every 5 years	Existing monitoring system already in place
Economic growth	5	Ensure significant economic development and diversification, and increase in economic growth	29	Per capita GDP for PK Region (in constant price of 2010)	PPP[6] international $	2096	2018-19	BBS, 2019	Ministry of Planning Secretary, Statistics and Informatics Division (SID) email: secy@sid.gov.bd, Phone: 02-55007373	Planning Commission Director General, Planning, Commission, E-mail: hamidul.haque@imed.gov.bdPhone (Office): 9180677, Mobile: 01718022712 & Statistics and Informatics Division (SID), Additional Secretary, Informatics Wing, SID email: addlsecy@sid.gov.bd, Phone: 55007377	Bangladesh Bureau of Statistics (BBS) Director General, BBS, E-mail: dg@bbs.gov.bd, Phone: 02-55007056	Annually	
			30	GDP for PK Region (in constant prices of 2010)	PPP international $ billion	44.29			same as above	same as above	same as above	Annually	
			31	GDP in PK Region as share of national GDP	%	14	2018-19	Est.	same as above	same as above	same as above	Annually	
			32	Industry as share of GDP of PK Region	%	24.08	2018-19	BBS, 2019	same as above	same as above	same as above	Annually	
Employment	6	Enhance opportunities for employment and new/improved livelihoods (particularly for fisheries, agriculture, eco-tourism)	33	People employed in industry in PK Region	% of total people employed	5	2012	BBS, 2012	Ministry of Industries (MoI) Secretary, MoI, email: indsecy@moind.gov.bd, phone: 02-47120800	Bangladesh Industrial Technical Assistance Centre (BITAC) Director General, BITAC email: dg@bitac.gov.bd, phone:8870700	Bangladesh Industrial Technical Assistance Centre (BITAC)	Annually	
Health and sanitation	7	Improve health services and health of society (e.g. by reducing vulnerability to diseases)	34	No of health service providing organization	No.	352 beded 5 hospitals in five Upazilas, 60 bedded private hospitals in two upazila	2021	PKCP Regional Plan	Ministry of Health and Family Welfare (MoHFW) Secretary, Health Service Division, MoHFW email: secretary@hsd.gov.bd, phone: 9577199	Directorate General of Health Services (DGHS) Director General (Health), email: alamdr2003@ yahoo.com, phone: 55067172 & Bangladesh Bureau of Statistics (BBS) Director General, BBS, E-mail:	DGHS 1. Director DGHS, Khulna Division Email: kdho@ld.dghs.gov.bd Mobile: 01711195754, 01716821339 BBS 2. Director, Census/computer Wing, Bangladesh Bureau of Statistics (BBS),	Annually	

5Severely affected means: house, crops, livestock, fish farms destroyed

BBS (2022). Bangladesh Disaster-related Statistics 2021: Climate Change and Natural Disaster Perspectives—Final Draft. Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Banglade

Source: PKCP Project, UDD, 2022

[6] PPP: purchasingpowerparity

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
										dg@bbs.gov.bd, Phone: 02-55007056	email: mahfuz.bablu@gmail.com, phone: 02-55007331		
			35	Life expectancy	Yrs	72.10	2018	BBS, 2019	Ministry of Health and Family Welfare (MoHFW) Secretary, Health Service Division, MoHFW email: secretary@hsd.gov.bd, phone: 9577199	Directorate General of Health Services (DGHS) Director General (Health), email: alamdr2003@ yahoo.com, phone: 55067172 & National Institute of Population Research and Training (NIPORT) Director General, NIPORT, email: dg.niport1977@gmail.com, phone: 9662495	RPTI 1. Regional Population Training Institute (RPTI), Barishal 2. Director, Census/computer Wing, Bangladesh Bureau of Statistics (BBS), email: mahfuz.bablu@gmail.com, phone: 02-55007331	Annually	
Education. skills and training	8	Improve access to education for all, increase attendance (by reducing drop-out rates), and improve skills development and training	36	Enrolment in higher secondary education (16+ years)	% of population	22.42	2019	PKCP Regional Plan, 2019	Ministry of Education (MoEDU) Secretary, MoEDU, email: Secretary@moedu.gov.bd Phone: 9576679	Directorate of Secondary and Higher Education (DSHE) Director General, DSHE, email: dg@dshe.gov.bd, Phone: 9553542 & BANBEIS Director General, BANBEIS, email: dg@banbeis.gov.bd, phone: 02-9665457	DSHE 1. Deputy Director, DSHE, Khulna Email: ddkhl@yahoo.com, Mobile: 01712141429 BANBEIS 2. Chief Statistics, BANBEIS, email: alamgir_asif@yahoo.com, phone: 02-55151815	Annual	
Migration	9	Reduce migration from rural (including disaster-prone and risk-prone) areas to urban areas	37	Rate of migration to urban areas in PK Region	%	3.24	2019	BBS, 2019	Ministry of Planning Secretary, Statistics and Informatics Division (SID) email: secy@sid.gov.bd, Phone: 02-55007373 & Ministry of Expatriates' Welfare and Overseas Employment	1. Bangladesh Bureau of Statistics (BBS) Director General, BBS, E-mail: dg@bbs.gov.bd, Phone: 02-55007056 2. Bureau of Manpower, Employment and Training (BMET) Director General, BMET, email: dg@bmet.gov.bd, phone: 49349925 3. Statistics and Informatics Division (SID) Additional Secretary, Informatics Wing, SID email: addlsecy@sid.gov.bd, Phone: 55007377	Statistics and Informatics Division (SID) 1. Additional Secretary, Informatics Wing, SID email: addlsecy@sid.gov.bd, Phone: 55007377 BBS 2. Joint Director, BBS, Khulna, Email: mostofa43@gmail.com, Mobile: 01720212215 2. Refugee and Migratory Movements Research Unit (RMMRU), University of Dhaka E-mail: info@rmmru.org, Tel: + 880-2-9360338	Annually	Rate of migration to urban areas in PK Region
Conflicts and security	10	Reduce conflicts over use of land	38	No of fisher-farmer land-related disputes / clashes	No.	None yet	None yet	http://peaceobservatory-cgs.org/#/division/district	Ministry of Public administration (MoPA) Secretary, MoPA, email: secretary@mopa.gov.bd, Phone: 02-9570100	Divisional Commissioner, Khulna Division email: divcomkhulna@mopa.gov.bd, phone: 01713400394	Divisional Commissioner office. 1. Additional Divisional Commissioner (Revenue)	Annual	Need Study to cover both reported and unreported cases

Source: PKCP Project, UDD, 2022

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
Food	11	Improve food security	39 (a)	Status of food security - as measured by availability,	Very good[7]	Moderate	2020	https://foodsecurityindex.eiu.com/Index	Ministry of Food Secretary, Ministry of Food, email: secretary@mofood.gov.bd, phone: 029540088	Directorate General of Food Director General, Directorate of Food, Dhaka, emial: dg@dgfood.gov.bd, phone: 02-9584834	Regional Controller of Food Regional Food Department, Barishal Division	annual	
		Improve food security	39 (b)	quality	Good	Moderate	As above	As above	As above	As above	As above	As above	
		Improve food security	39 (c)	safety food to all people at all time	moderate	Moderate	As above	As above	As above	As above	As above	As above	
Power and energy	12	Enhance the capacity of power generation and distribute sustainable power to the consumer.	40	At present total power Generation in the Barishal Region (PKCP is the part of Barishal Region)	MW	2265	2020	BPDB, 2020; Daily Production Report, PGCB	Ministry of Power Energy and Mineral Resources (Power Division) Secretary, Power Division, email: secy@pd.gov.bd, phone: 02-9511030	Bangladesh Power Development Board (BPDB) Chairman, BPDB, email: chairman@bpdb.gov.bd, Phone: 9562154 Bangladesh Rural Electrification Board (BREB) Chairman. BREB Mobile: 88028900007 Email: chairman@reb.gov.bd	BPDB 1. Member, Generation, BPDB, email: member.generation@bpdb.gov.bd, phone: 9564667 2. Deputy Secretary, Development-5, Power Division Mobile: +8801817508251 Email: dev-5@pd.gov.bd	Standing indicator – only changes when a new power station is built	
		Increase production and consumption of energy	41	Power production per capita (installed capacity	W / capita	122	2020	BPDB, 2020 and Expert Judgement	Ministry of Power Energy and Mineral Resources (Power Division) Secretary, Power Division, email: secy@pd.gov.bd, phone: 02-9511030	Bangladesh Power Development Board (BPDB) Chairman, BPDB, email: chairman@bpdb.gov.bd, Phone: 9562154	BPDB 1. Member, Generation, BPDB, email: member.generation@bpdb.gov.bd, phone: 9564667 2. Deputy Secretary, Development-5, Power Division Mobile: +8801817508251 Email: dev-5@pd.gov.bd	25	
	13	Increase access to affordable energy	42	Power production per GDP (installed capacity)	W / 1000 $ international (PPP, constant prices of 2010)	58.1	2020	BPDB, 2020	Ministry of Power Energy and Mineral Resources (Power Division) Secretary, Power Division, email: secy@pd.gov.bd, phone: 02-9511030	Bangladesh Power Development Board (BPDB) Chairman, BPDB, email: chairman@bpdb.gov.bd, Phone: 9562154	BPDB 1. Member, Generation, BPDB, email: member.generation@bpdb.gov.bd, phone: 9564667 2. Deputy Secretary, Development-5, Power Division	26	

[7]Very Good: Food affordability, availability, quality and safety is good enough or surplus to all people at all time. It includes safe and nutrition food to meet dietary need.

Good: Food affordability, availability, quality and safety is sufficient or just enough to feeding all the people at all time.

Moderate Good: Food affordability, availability, quality and safety is not enough to feeding all the people at all time.

Poor: Food affordability, availability, quality and safety is insufficient or deficit to meet demand and need improve access to sufficient, safe and nutrition food to meet dietary need.

Link SEA

https://en.wikipedia.org/wiki/Global_Food_Security_Index

https://foodsecurityindex.eiu.com/Index

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
											Mobile: +8801817508251, Email: dev-5@pd.gov.bd		
Tourism	14	Improve tourism management and behaviour to limit noise, pollution and other negative impacts and remain within the carrying capacity of the Exclusive Tourist Zone (ETZ)	43	Visitors to the various destinations of the project area. Like: • Number of visitors to the Exclusive Tourist Zone, Sonar char • No. of tourists for river/sea cruising	No.	On the weekend, Sonar Char was visited by 80-100 tourists, compared to 30-40 tourists on Sunday through Thursday. Still there were no river or sea cruising facilities	Jan 2023	Union level Consultation	1. Ministry of Environment Forest and Climate Change (MoEFCC) Secretary, MoEFCC, email: secretary@moef.gov.bd, Phone: 9540481 2. Ministry of Civil Aviation & Tourism (MOCAT) Secretary, MoCAT, email: secretary@mocat.gov.bd, phone: 02-9514884	A K Shamsuddin Chairman, Char Montaz 01715332567 Md. Mosaref Hossain Union Parishad Member, 7 no. ward 01735727636 1. Bangladesh Forest Department (BFD) Chief Conservator of Forests, BFD. email: ccf-fd@bforest.gov.bd Phone: 01999000001 2. Bangladesh Parjatan Corporation (BPC), Chairman, BPC, email: chairman@parjatan.gov.bd, phone: +88 02 44826504	BFD 1.Conservator of Forests, Barishal Circle. MOCAT Deputy Secretary (Tourism 1) Email: dstourism1@mocat.gov.bd	Daily	
Infrastructure, transportation and communications	15	Improve connection of communities, and improve access to infrastructure, services and facilities	44	Number of Educational Institute (Primary School, Secondary school, College, Technical and Vocational institutes)	Nos	1230	2021	UDD, 2021	Ministry of Education (MoEDU) Secretary, MoEDU, email: Secretary@moedu.gov.bd Phone: 9576679 Ministry of Primary and Mass Education (MoPME) Secretary, MoPME, email: scy@mopme.gov.bd Phone: +88-02-55100484 9576679	Directorate of Secondary and Higher Education (DSHE) Director General, DSHE, email: dg@dshe.gov.bd, Phone: 9553542 & BANBEIS Director General, BANBEIS, email: dg@banbeis.gov.bd, phone: 02-9665457		Standing figure until new railway is built Update figure	
			45	Density of roads in PK Region	Km roads per 100 Km^2	22.13	2022	RHD & LGED 2022	Ministry of Road Transport and Bridges Secretary, Road, Transport and Highways Division, email: secretary@rthd.gov.bd, phone: 02-9511122	Road, Transport and Highways Division Secretary, Road, Transport and Highways Division, email: secretary@rthd.gov.bd, phone: 02-9511122	Roads and Highways Division Deputy Secretary, Estate Branch, Roads and Highways Division, Email: dsestate@rthd.gov.bd, Mobile: 01716442348	Standing indicator – only changes when a new road is built	
	16	Optimize the existing and future physical footprint of transport services (rail, road, air, waterways)	46	Extent of railways in PK Region	Km	214	2022	BR, 2022	Ministry of Railways (MoR) Secretary, Ministry of Railways, email: secretary@mor.gov.bd, phone: 9578199	Ministry of Railways (MoR) Secretary, Ministry of Railways, email: secretary@mor.gov.bd, phone: 9578199	Addl. Director General (Infra), Bangladesh Railway, Email: adgi@railway.gov.bd, Mobile: 01711505301	Standing figure until new railway is built Update figure annually	
			47	Ships carrying coal handled at Payra Port	Nos	102	2022[8]	PPA website	MoS	Traffic Department, Payra Port Authority			
			48	Amount of Coal handled at Payra Port	Metric Ton	28,12,669	2022	PPA website	MoS	Traffic Department, Payra Port Authority			

Source: PKCP Project, UDD, 2022

[8] Data available up to December 31, 2022

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
			49	Other Commercial Cargo Ships handled at Payra Port	Nos	19	2022	PPA website	MoS	Traffic Department, Payra Port Authority			
			50	Other Commercial Cargo Handled at Payra Port	Metric Ton	210,387	2022	PPA website	MoS	Traffic Department, Payra Port Authority			
			51	Domestic Lighterage/Bulkhead ships handled at Payra Port	Nos	825	2022	PPA website	MoS	Traffic Department, Payra Port Authority			
			52	Domestic Lighterafe/Bulkhead cargo handled at Payra Port	Metric Ton	980,909	2022	PPA website	MoS	Traffic Department, Payra Port Authority			
Urban area expansion	17	Sustainable and eco-friendly development of urban area	53	Existing urban area (Paurashava)	%	1.38	2023	Payra Kuakata Comprehensive Plan Focusing on Eco-Tourism	Ministry of Housing and Public Works Ministry of Housing and Public Works Secretary, Ministry of Housing & Public Works secretary@mohpw.gov.bd, phone: 55100465 (office)	UDD Director, Urban Development Directorate director.UDD1965@gmail.com Phone: 223382728 (Office)		Standing figure until new plans are implemented.	
Agriculture	18	Increase agricultural productivity	54	Milk demand	M M Ton/yr	0.21	2018	DLS, 2018	Ministry of Fisheries And livestock (MoFL) Secretary, MoFL, email: secretary@mofl.gov.bd, phone: 9545700	Department of Livestock Services (DLS), Dhaka DG, DLS	Upazila Livestock Officer (ULO), of respective Upazila	Annually	
			55	Meat demand	M M Ton/yr	0.20	2018	DLS, 2018	Ministry of Fisheries And livestock (MoFL) Secretary, MoFL, email: secretary@mofl.gov.bd, phone: 9545700	Department of Livestock Services (DLS), Dhaka DG, DLS	Upazila Livestock Officer (ULO), of respective Upazila	Annually	
			56	Rice and Non-Rice crop production	Million Metric (MM Ton)/yr	Rice – 451,578 MT; Non-rice – 352,202 MT	2021-22	DAE field report and CEGIS calculation based on field survey, 2022	Ministry of Agriculture (MoA) Secretary, MoA, email: secretary@moa.gov.bd, phone: 9540100	Department of Agriculture Extension (DAE) Director General, DAE email: dg@dae.gov.bd,	Deputy Director of Department of Agricultural Extension (DDDAE) of Barguna and Patuakhali District email: dg@dae.gov.bd, Phone: 55028369 Upazila Agriculture Officer (UAO) of the respective upazila	Annually	
Fisheries	19	Promoting inland fisheries	57	Fish production in PKCP Region	MT/yr	0.81	2018	DoF, 2019	Ministry of Fisheries and Livestock (MoFL) Secretary, MoFL, email: secretary@mofl.gov.bd, Phone: 9545700	Department of Fisheries (DoF) 1. Director General, DoF email: dg@fisheries.gov.bd, Phone: 9562861	District Fisheries Officer (DFO) Director, Finance & Planning/ PSO(FRSS), DoF Email: ddfinance@fisheries.gov.bd, Mobile: 01712581599	Annually	
		Promoting inland fisheries	58	Fish production in PKCP Region	MT/yr	0.81	2018	DoF, 2019	Ministry of Fisheries and Livestock (MoFL) Secretary, MoFL, email: secretary@mofl.gov.bd, Phone: 9545700	Department of Fisheries (DoF) 1. Director General, DoF email: dg@fisheries.gov.bd, Phone: 9562861	District Fisheries Officer (DFO) Director, Finance & Planning/ PSO(FRSS), DoF Email: ddfinance@fisheries.gov.bd, Mobile: 01712581599	Annually	
Water Resources	20	Increase dry season freshwater flow in rivers	59	Average daily dry season (Jan-May) discharge on Gorai at Railway Bridge	Cumec	84	1997-2019	BWDB	MoWR	Bangladesh Water Development Board 1. Director General	Bangladesh Water Development Board (relevant district office)	Daily	

Source: PKCP Project, UDD, 2022

Themes	Objective		Indicator		Unit	Baseline figure	Year of baseline data	Source	Concern Ministry	Institution responsible for data Gathering	Supported by	How often	Resources needed (budget, equipment, training, etc…)
										dg@bwdb.gov.bd, dg.bwdb.bd@gmail.com Phone: 01318234567			
		Reduce high/peak water level in Tetulia channel during monsoon season	60	Average daily monsoon (Jul-Aug-Sept) WL in Tetulia Channel	mPWD	2.75	1989-2002	BIWTA	MoWR	Bangladesh Water Development Board 1. Director General dg@bwdb.gov.bd, dg.bwdb.bd@gmail.com Phone: 01318234567	Bangladesh Water Development Board (relevant district office)	Daily	

APPENDIX-C: PROJECT TEAM

Prepared by:

Md.Marazul Islam
Junior Urban Planner
Payra Kuakata Comprehensive Plan Focusing on Eco-Tourism

Guided by:

Dr.Sarwar Jahan
Professor (Rtd), Department of Urban and Regional Planning, BUET
Regional Planner
Payra Kuakata Comprehensive Plan Focusing on Eco-Tourism

Khandakar Masudur Rahman
Urban Planner
Payra Kuakata Comprehensive Plan Focusing on Eco-Tourism

Reviewed by:

Sharif Mohammed Tariquzzaman

Project Director, Senior Planner, UDD

Uday Sankar Das

Deputy Project Director, Senior Planner, UDD