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

Printed and Published by:
Urban Development Directorate
82, Shegun Bagicha, Dhaka,
Bangladesh.

First Edition: June, 2023
Price: BDT 3000.00

রেজিস্টার্ড নং ডি এ-১

বাংলাদেশ গেজেট

অতিরিক্ত সংখ্যা

কর্তৃপক্ষ কর্তৃক প্রকাশিত

বৃহস্পতিবার, আগস্ট ২৯, ২০২৪

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার

গৃহায়ন ও গণপূর্ত মন্ত্রণালয়

পরিকল্পনা শাখা-৩

প্রজ্ঞাপন

তারিখ: ০৬ ভাদ্র ১৪৩১ বঙ্গাব্দ/ ২১ আগস্ট ২০২৪ খ্রিষ্টাব্দ

নং **২৫.০০.০০০০.০৩২.১৪.০১৬.১৫(অংশ-১)/৩৬৪**—তদানিন্তন পূর্ব পাকিস্তান সরকারের ১৭ জুলাই ১৯৬৫ তারিখের ৪৬৪ নং স্মারকে গঠিত 'Urban Development Directorate' এর কার্যাবলির ২নং ক্রমিকে বর্ণিত "to prepare and co-ordinate regional plans, master plans and detailed layout and site plans for the existing as well as the new urban centres excluding the areas covered by the present town development authorities of Dhaka, Chittagong and Khulna" এর প্রদত্ত ক্ষমতাবলে গণপ্রজাতন্ত্রী বাংলাদেশ সরকার "পায়রা বন্দর নগরী ও কুয়াকাটা উপকূলীয় অঞ্চলের পরিবেশ পর্যটনভিত্তিক সমন্বিত পরিকল্পনা প্রণয়ন" শীর্ষক প্রকল্পের আওতায় মাস্টার প্ল্যান (১টি রিজিওনাল প্লান, ০৭ টি স্ট্রাকচার প্ল্যান, ০৭টি রুরাল এরিয়া প্ল্যান, ০৬টি আরবান এরিয়া প্ল্যান এবং এ্যাকশন এরিয়া প্ল্যান ফর সোনার চর এক্সক্লুসিভ টুরিস্ট জোন) প্রণয়ন সম্পন্ন করিয়াছে।

অতএব, সরকার অত্র প্রজ্ঞাপন দ্বারা বরগুনা জেলার ০৪টি উপজেলা (বরগুনা সদর, পাথরঘাটা, আমতলী, তালতলী) এবং পটুয়াখালী জেলার ০৩টি উপজেলা (কলাপাড়া, গলাচিপা ও রাঙ্গাবালী) সহ মোট ০৭টি উপজেলার জন্য ১ (এক) টি রিজিওনাল প্ল্যান, ০৭ (সাত) টি স্ট্রাকচার প্ল্যান ও ০৭ (সাত) টি রুরাল এরিয়া প্ল্যান এবং বরগুনা সদর, আমতলী, পাথরঘাটা, গলাচিপা, কলাপাড়া পৌরসভা এবং কুয়াকাটা পৌরসভা ও পার্শ্ববর্তী এলাকা নিয়ে গঠিত কুয়াকাটা টুরিজম সেন্টার মাস্টার প্ল্যানসহ ০৬ (ছয়) টি আরবান এরিয়া প্ল্যান এবং সোনার চরকে কেন্দ্র করে আশেপাশের আরও ০৬ (ছয়) টি চর (সোনার চর, চর মন্তাজ, চর হেয়ার/কলাগাছিয়া, আন্ডার চর, চর-তাপসী ও টাইগার দ্বীপ) নিয়ে "এ্যাকশন এরিয়া প্ল্যান ফর সোনার চর এক্সক্লুসিভ টুরিস্ট জোন" অনুমোদনের বিষয়টি সংশ্লিষ্ট সকলের অবগতির জন্য প্রকাশ করিল।

মূল্য : টাকা ৪.০০

বিশেষ দ্রষ্টব্যঃ অনুমোদিত প্ল্যানসমূহ নগর উন্নয়ন অধিদপ্তরের প্রধান কার্যালয়, বরিশাল আঞ্চলিক অফিস, বরগুনা ও পটুয়াখালী জেলার জেলা প্রশাসকের কার্যালয় এবং সংশ্লিষ্ট উপজেলা ও পৌরসভা কার্যালয়ে জনসাধারণের পরিদর্শনের সুবিধার্থে সংরক্ষিত থাকিবে।

রাষ্ট্রপতির আদেশক্রমে

মোহাম্মদ খাদেমুর রহমান
সহকারী সচিব।

মোঃ তাজিম-উর-রহমান, উপপরিচালক (উপসচিব), বাংলাদেশ সরকারী মুদ্রণালয়, তেজগাঁও, ঢাকা কর্তৃক মুদ্রিত।
মোঃ নজরুল ইসলাম, উপপরিচালক (উপসচিব), বাংলাদেশ ফরম ও প্রকাশনা অফিস, তেজগাঁও, ঢাকা কর্তৃক প্রকাশিত। website: www.bgpress.gov.bd

Executive Summary

The Structure Plan is basically a policy document that sets the ground and serves as the guideline for subsequent local level plans. This report provides detailed findings from the regional plan level and guideline at structure plan level. Predominantly the purpose of the Structure Plan of Kalapara Upazila is to promote long-term, comprehensive development of the Upazila through integrated planning and implementation involving several organizations ensuring community participation.

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 that are used in the Structure Plan as well as other plans. Besides this, with the help of secondary database, relevant analyses for decision making have been conducted at interim phase and survey report phase. In-depth analysis and findings have been presented in several working paper. To prepare the base map and primary reference map of the plan, all mouza maps of the project area have been digitalized. The entire procedure has been described in planning approaches section of this report, and database were prepared in Geographic Information System compatible format.

Kalapara upazila has 12 unions, and two paurashava. In 2011, the population of the project area was 237831 (BBS, 2011). The Structure plan report is prepared for a twenty-year plan period considering its population projection. The projected population is 572048 for the year 2041.

The critical planning issues are vital for proposing the strategic zones. Demography, Forest and plantation, Natural Resources, Transportation, Topography, Cropping Pattern, Disaster, geological and hydrogeological condition etc. are considering critical issues for Kalapara Upazila. These issues are discussed in chapter 2.

Socio-spatial Forecasting and development prospects are discussed in Chapter 3. Population projection, Housing, water, electricity demand etc. are discussed here. Moreover, Traffic and Transportation, Drainage and Flooding, Basic services area discussed as development prospects.

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 underground 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. Two types of suitability maps were prepared after analysing 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 Dhulasar union near the Bay of Bengal.

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.

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. From the existing land use survey, it is found that agriculture occupies about 48.34% of the land, 12.01% used as residential, water bodies about 21.76% and beach area occupies 0.12% of the total. Natural disaster, lack of adequate embankment facilities, water logging, communication network among unions (mostly katcha road) and transportation problems like narrow and earthen roads, recreational facilities, solid waste management system are major problems in the upazila.15 zones have been proposed in the Structure Plan. In this structure plan about 30.92% area is proposed as agriculture zone, 22.49% as rural settlement, 15.50% for water body, 10.26% for circulation network, 10.11% area is proposed as coastal afforestation foreshore area.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

1.1 Introduction

Structure Plan of Kalapara Upazila is a comprehensive plan that has been developed to ensure sustainable and integrated development of this upazila. The success of developing the region as a vibrant area depends much on good communication facilities and availability of modern amenities. Moreover, it is predicted that the Payra sea port would generate many port related new activities including huge vehicular traffic such as air, rail, road and water. This phenomenon would have both positive and negative impact on the socio-economic condition and existing land use pattern of the region. The proposed plan would guide such probable changes in the socio-economic condition and land use pattern of the Upazila. This plan will also address the adverse impact of such changes.

1.2 Definition of the Structure Plan

The term Structure Plan includes a full analysis of the existing scenarios, highlight the existing condition of different infrastructures, identification of sectoral issues and interventions, prescription of solution for each sector and setting proposal and recommendations for the future action to be taken within the mentioned period, say 20 years. This is a longer-term plan. 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.

1.3 Objective of the structure plan

The overall goal of this structure plan is to lead the development or redevelopment of Kalapara 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 under the guideline of regional plan considering functional and landuse 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.

1.4 Component of the structure plan

To inspect the comprehensive circumstances, multiple components have been taken into account. The plan has been prepared taking into account Physical development of the Upazila, Socio-economic status, Condition of Transportation Network, Disaster and Vulnerability, Hydro-geological attributes, Geologcal scenario, Hydrology, Forest as well as Natural Resources.

1.5 APPROACHES TO PLANNING

Structure Area Plan is the Second-tier plan for this "Payra-Kuakata Comprehensive Plan". This is the lower-tier plan after the Regional Plan. The Structure Area Plan is done for the specific Seven Upazilas of the project. It is a reflection of the Upper-Tier Plan and give direction to the lower-tier plans. Here are the approach and methodology that have been followed to prepare the structured plan for Kalapara Upazila-

Establish goals and objectives: Based on the needs assessment, establish clear goals and objectives for the plan. These should be specific, measurable, achievable, relevant, and time-bound (SMART), and should reflect the priorities and aspirations of the people and communities of Bangladesh.

For assessing the overall scenario of Kalapara Upazila several primary surveys are conducted- Several transport related surveys- Hydrological survey, Geological and Geo-Physical investigation, Cropping Pattern Survey, PRA, Physical Feature Survey, Formal Informal Survey and Socio-economic Survey. Strategic Environmental Assessment (SEA) has been conducted to prepare a framework to assess the environmental and social implications of development policies, plans and programmes (PPPs) of the plan.

Available data collection from secondary sources i.e., hydrographic chart, water level, water flow, meteorological and disaster data;

Preparation of map to identify the important features such as existing embankments, khals, wetlands, regulators, bridges of the proposed area, satellite images and preparation of the map showing all the features;

Agriculture PRA provides data on cropping patterns such as single-cropped, double-cropped or triple-cropped lands;

Collection of the tentative plan for the economic zone and other government proposals in the project area.

Statistical analysis of time series simulated storm surge level and significant wave height and assessment of storm surge level for different return periods around the proposed area;

Assessment of significant wave height of cyclonic as well as flood wave for different return periods around the proposed area and assessment of embankment crest level for fifty/hundred-year return period considering tide, storm surge level and cyclonic wave; Fixation of crest level considering simulated results with climate change scenario.

Morphological analysis i.e., bank-line shifting characteristics by time series satellite images, erosion-deposition pattern by model result and data analysis.

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;

Rakhine Ethnic community culture conservation and development.

Recommendation for improvement of existing communication facilities in the study area;

Develop a detailed implementation plan that outlines specific actions, timelines, resource needs, and responsibilities for achieving the goals and objectives of the plan.

Overall, the structure plan approach to planning can help identification of critical problem and issues of Kalapara Upazila, address the complex challenges it faces and achieve sustainable, inclusive development that benefits all of its people.

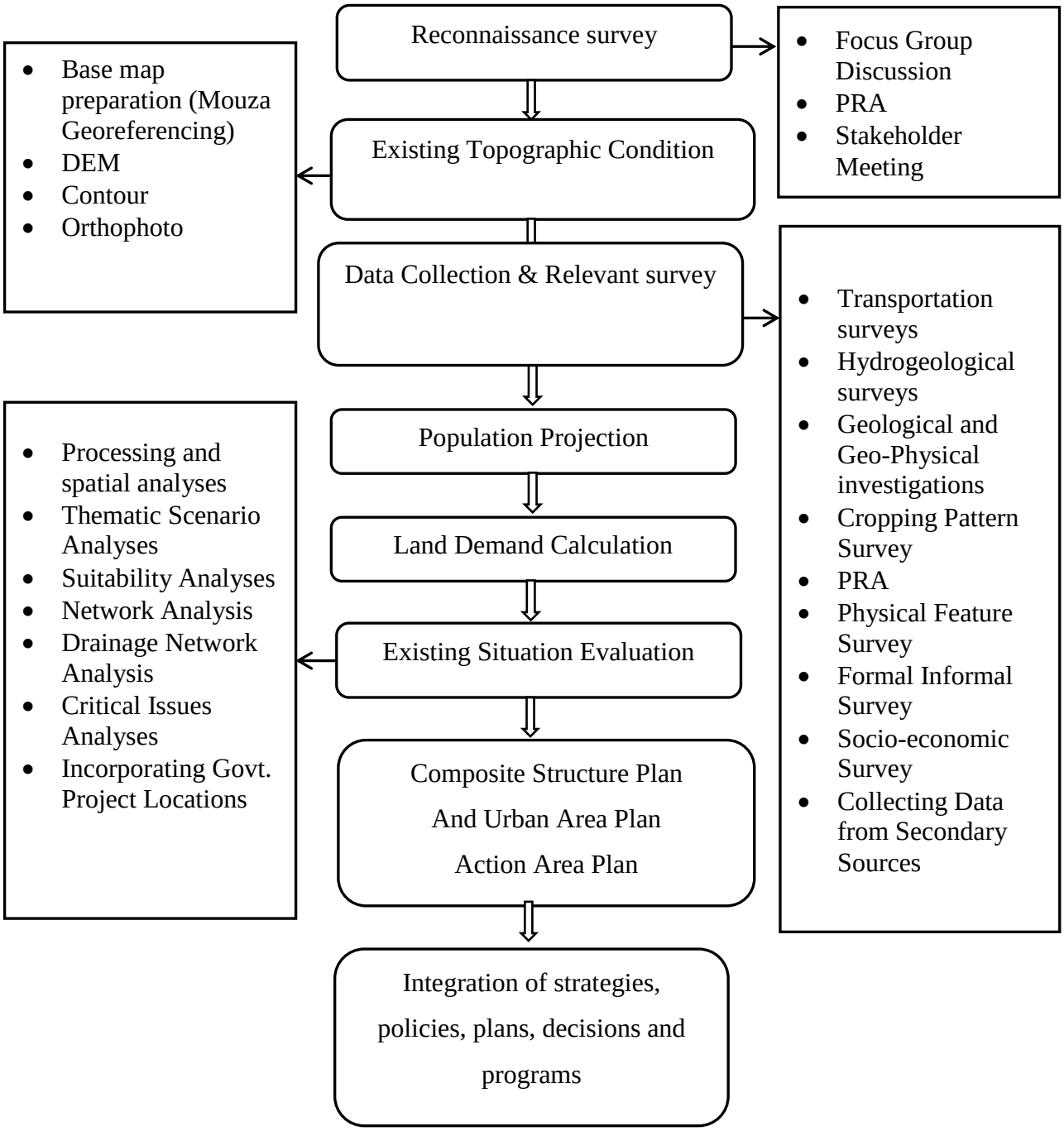


Figure 1: Technical Methodology of Structure Plan Preparation
Source: PKCP Project, UDD, 2019

1.6 Background of the study area

Administration of Kalapara thana was formed in 1906 and it was turned into an upazila in 1983. Kalapara Upazila (patuakhali district) area 492.102 sq km (National Web Portal), located in between 21° 59.156' and 21° 48.937' north latitudes and in between 90°13.633' and 90°7.288' east longitudes. It is bounded by amtali upazila on the north, Bay of Bengal on the south, Rabnabad Channel and galachipa upazila on the east, Taltoli upazila on the west.

Kalapara Upazila is divided into Kalapara Municipality, Kuakata Municipality, and 12 union parishads: Baliatali, Chakamaia, Champapur, Dalbugonj, Dhankhali, Dulaser, Lalua, Latachapli, Mahipur, Mihagonj, Nilgonj, and Tiakhali. The union parishads are subdivided into 58 mauzas and 239 villages.

Table 1: Area profile of Kalapara Upazila

Area		**Union (Nos.)**	**Mouza (Nos.)**	**Village (Nos.)**	**Pourashava (Nos.)**	**Population**	**Density**	
Sq.Km.	Acre						Sq.Km.	Acre
491.89	121549	12	58	239	2	237831	483.50	1.96

Source: BBS, 2011

Kalapara Upazila is located inside the district of Patuakhali and is located on Bangladesh's outer coast. The upazila is renounced for its iconic and diverse coastline. With over 10 kilometres of coastline, local community values the recreational and lifestyle opportunities that the coast provides. It offers a range of economic benefits and attracts industries and businesses reliant on the coastal resource. Kuakata beach, Lebur Bon, Gangamati Lake Forest attracts domestic and international visitors keen to experience a slice of paradise. The coastline long the upazila are dynamic and distinctive. These distinct environments bring their own unique challenges and this requires strategies to understand the characteristics, opportunities, and solutions that are best matched to each area. 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 resources.

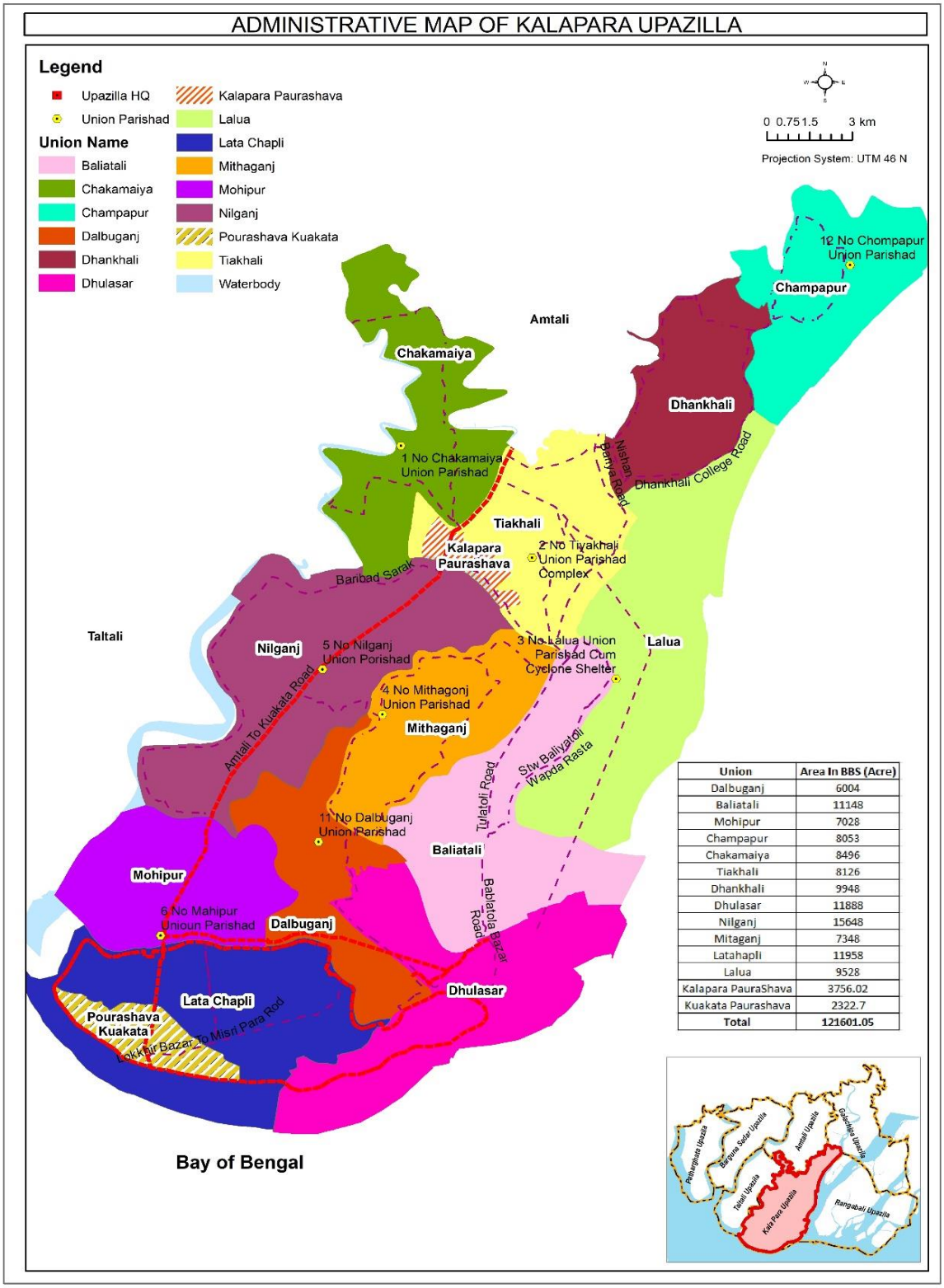


Figure 2: Administrative Boundary of Kalapara Upazila
Source: PKCP Project, UDD, 2019

CHAPTER TWO: CRITICAL PLANNING ISSUES

It is necessary to investigate the existing and past scenario in order to plan for the future. In this chapter particular issues and key challenges are discussed to guide physical development of Kalapara. In doing so, we combined various types of primary and secondary survey, conduct PRA, Strategic Environmental Assessment (SEA), analyse various future and ongoing projects of Govt. departments with spatial analyses of urban and rural land use plans, as well as current and future urban land cover maps derived from Geographic Information Systems and remote sensing.

2.1 Demographic setting of the Upazila

In 2011 the total population of Kalapara Upazila is 237831, of which 120514 are males, and 117317 are female. The sex ratio of Upazila was 1.03. Therefore, insight could be drawn that in the coming year Kalapara needs more employment opportunity to sustain residence's livelihood and to support elderly dependent population.

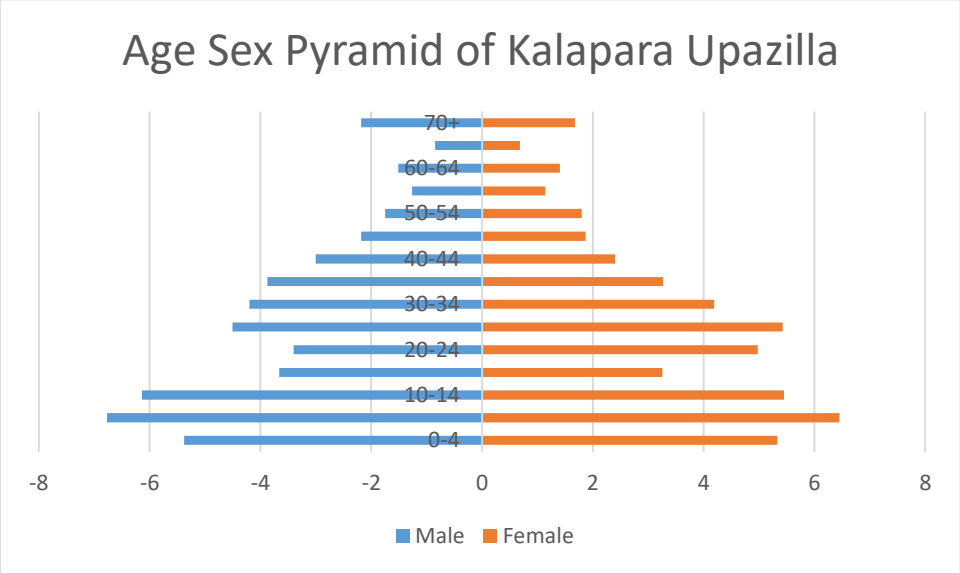


Figure 3: Age-sex pyramid of Kalapara Upazila
Source: BBS,2011

2.2 Forest, Plantation and Agriculture

The communities of Kalapara Upazila under Patuakhali coastal districts are vulnerable to different natural disasters because of their proximity to the Bay of Bengal, surrounded by Andharmanik and Galachipa River. It is commonly known that excessive human exploitation and habitat destruction in coastal areas compromise ecosystem integrity and cause natural

degradation that is far below the threshold for recovery, leading to irreversible degradation. The observed and anticipated effects of climate change, including sea level rise, increasing salinity trends, growing drainage congestion, more monsoonal rains and reduced dry season precipitation, will increase the vulnerability of the local population in the near future. Tropical cyclones and storm surges will become increasingly frequent and intense, soil and coastal embankments will be eroded, and coastal ecosystems will deteriorate. These have a significant negative impact on life, property, and the economy of coastal Bangladesh, particularly on agriculture and fishing industries. Therefore, Therefore, coastal communities are seeking alternative income sources to diversify their income sources, reduce susceptibility to environmental changes, and enhance their resilience to climate-related challenges. Consequently, safeguarding the ecosystem is a crucial element of any comprehensive coastal zone management strategy.

Beside these, Coastal ecosystems exhibit a wide range of diversity and resilience, encompassing various aquatic environments such as saline, brackish, and freshwater aquaria, as well as terrestrial features like mudflats, sand dunes, flatlands, and undulating terrain. This diversity of ecosystems supports a wide variety of flora and fauna, including genetically diverse species, and maintains good environmental services - both protective and regulatory.

The adoption of coastal afforestation in the coastal areas and offshore islands of Bangladesh is an economically viable and ecologically sound strategy to protect these regions from the adverse effects of cyclones and storm surges. The establishment of extensive forests along the chars and river banks of the shoreline serves as a natural barrier, offering protection to human habitation, lives, property, and agricultural crops against severe weather events such as storms and tsunamis. Mangrove plantations are widely acknowledged as highly productive ecosystems, providing a diverse array of ecological, biophysical, and socioeconomic benefits that enhance the welfare of coastal communities and uphold ecosystem integrity. Mangrove forests play a crucial role in facilitating the reproduction and providing a suitable environment for a diverse range of economically significant marine species, such as mud crabs, mollusks, and prawns. In addition, coastal plantations present considerable prospects for local communities to enhance their revenue streams by engaging in various activities such as trading carbon credits, harvesting non-timber forest resources including honey, medicinal plants, and shellfish, as well as implementing eco-tourism initiatives. Coastal plantations play a crucial role in mitigating the impacts of climate change and environmental degradation

while simultaneously empowering local communities through the provision of diverse revenue streams.

Plantations along the coast, especially those with verdant mangrove forests, are fascinating natural landmarks that bolster local ecotourism initiatives. Tourists are drawn to these lush landscapes by their scenic beauty and curiosity about the diverse range of wildlife and unique ecosystems they support. Through exhibiting the inherent charm of mangrove plantations, local communities cultivate a profound appreciation for these essential coastal habitats and generate sustainable revenue streams, thereby supporting economic growth and conservation.

After Aman, the prime agricultural crop of the district —watermelons have now become the second choice for Patuakhali as well as Kalapara's farmers. Due to the favourable weather and other environmental factors, watermelons grown here are tasty and in high demand. Various pulses, specially Mug bean cultivation is expanding in this area. Coconut and betel nuts are grown abundantly in the Upazila.

2.3 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 is 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 in structure.
- CGI/plain metal sheets are used as wall and roofing material.
- The timber was used as door and window frames.

- Both pucca and semi-pucca plinths are found in the structure.
- Bamboo mats/ tarpaulins are used under roofs in order to mitigate the heating.
- An additional semi-outdoor space known as "Pashchati" surrounds the main core house and helps in accommodating various service-oriented functional households' requirements.

2.4 Neighbourhood Characteristics

Neighbourhood resident's surrounding kalapara upazila generally have similar incomes, as well as similar social characteristics such as education level, housing preference, occupation and life style. Kalapara Upazila and sourrounding areas are very much vulnerable to natural disasters like Cyclone.

2.5 Historical Sites

The Rakhain tribe of Bangladesh first settled in this upazila. A section of the people belonging to the Buddhist Rakhain tribe of Arakan came to this upazila in quest of better living and first settled at Khepupara and Kuakata. Tradition goes that the Rakhains on excavating wells traced fresh water in the area and thereby settled there. The place was subsequently renamed as Kuakata (digging of well) after the wells dug out by the Rakhanis. The upazila though named as Kalapara, the upazila sadar is known as Khepupara. Misripara rakhaine palli is a main historical site.

2.6 Erosion and accretion

Different Landsat images has been collected and analysed the land cover changes that have occurred over this period. It has been observed that forest cover has decreased while urban areas have expanded and agricultural land has been converted to natural vegetation in kalapara upazila.

From the image analysis data there found the erosion area beside the kuakata beach. There almost 500m eroded from 1988 to 2022.

Table 2: accretion and erosion areas between 1989 and 2021 of Kalapara Upazilla

Upazila	1989-1999		1999-2009		2009-2021		1989-2021	
	Accretionon	Erosionon	Accretionon	Erosionn	Accretionon	Erosionn	Accretionon	Erosion
Kalapara	11.89	11.01	15.15	11.01	6.86	7.96	16.08	14.28

Source: PKCP Project, UDD, 2022

Figure 4: Andharmanik River (1985)

Figure 5;Andharmanik River (2021)

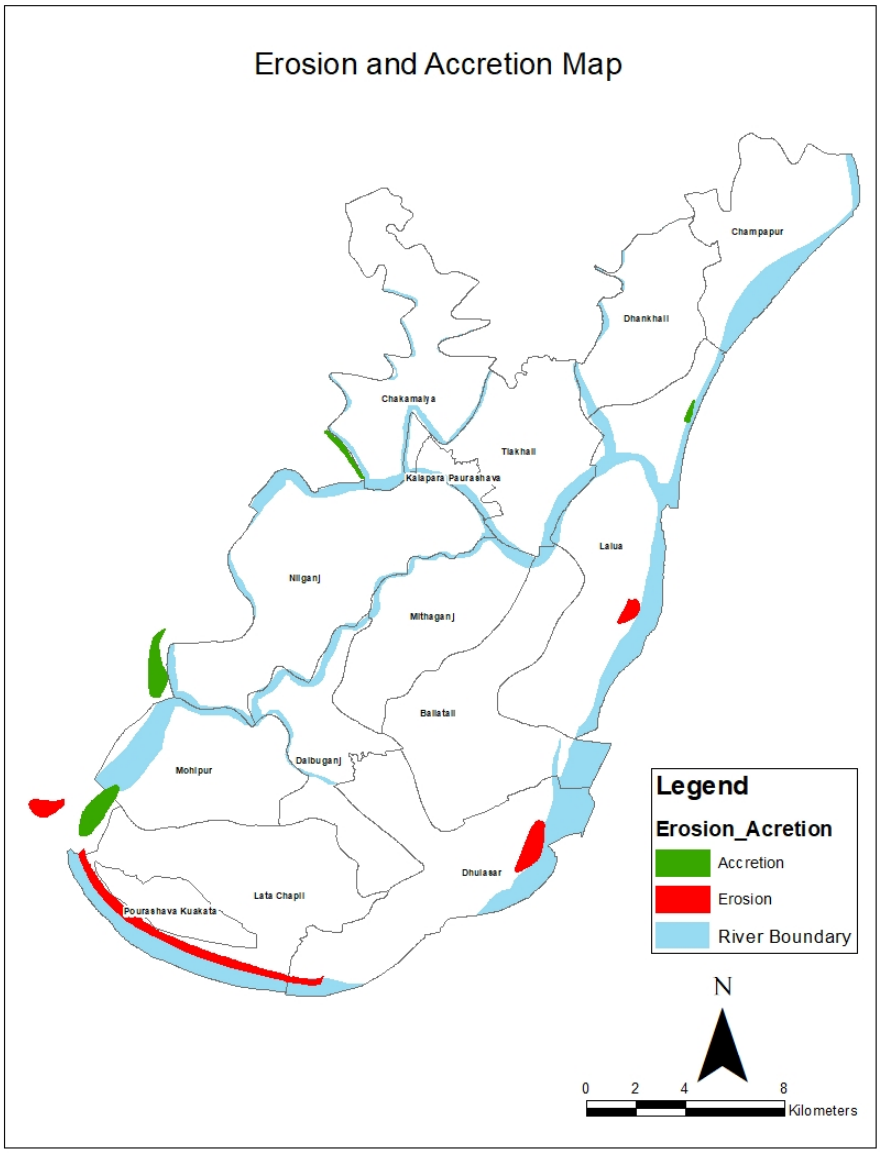


Figure 6: Erosion and Accretion map of Kalapara Uapzilla
Source: PKCP Project, UDD, 2022

2.7 Kuakata beach erosion and protection measures

Bangladesh Water Development Board (BWDB) conducted a detailed feasibility study for sea beach protection and development namely 'Feasibility Study for Protection and Development of Kuakata Sea Beach' by the Institute of Water Modelling (IWM) in 2020. The study assessed the erosion and accretion of the Kuakata beach area from 2010 to 2020. The report found that over the last 10 years, the maximum shoreline shifting from Gangamati Khal to Lebu Bagan is 147 meters. The Kuakata beach falls under Polder 48 which is one of the 17 polders considered for rehabilitation under the Coastal Embankment Improvement Project (CEIP) funded by the World Bank. The ongoing renovation works of Polder 48 are re-sectioning of the embankment, slope protection, bank protection and afforestation on the foreshore area.

Based on the analysis of wave and tide dynamics, the study derived a number of hydraulic design parameters for the protection works. The study also conducted a frequency analysis of the maximum significant wave height along the Kuakata beach. The study considered two options for coastal erosion protection. Option 1 is a series of groyne and multifunctional dyke while option 2 is sleeping defense 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.

2.8 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.

Kalapara Upazila is located in vulnerable coastal areas that are exposed to various natural hazards. The major hazards are flood, storm surge, cyclone, salinity intrusion, riverbank erosion, and waterlogging. Cyclone with storm surge causes colossal damages to the people of Kalapara in terms of physical infrastructures, settlements, deaths, shocks to the natural system etc. Mangrove forests, Sand dunes, Rivers and creeks, perform as natural barriers to

mitigate the impact of those hazards and protect the local population and their livelihoods. Human activities like deforestation, pollution, and changes in land use are weakening these natural barriers, which might make the region more vulnerable to natural disasters. Living with natural hazards is an everyday issue as changing seasons bring different kinds of unpredictable hazards to their livelihoods.

From the analysis the Dhulasar union under the Kalapara Upazila are mostly vulnerable for different natural hazard because the villages are surrounded by the Andharmanik River, Galachipa River and closer position to the Bay of Bengal. This fact is taken into account in structure planning of this upazila.

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.

The salinity levels in Kalapara 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.

According to a study conducted by the Bangladesh Water Development Board, the salinity levels in Kalapara 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.

Table 3: Salinity Label

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)	%
Kalapara	482.63	100	482.63	100	417.41	86.48	482.63	100	0	0	169.08	35.03

Source: PKCP Project, UDD 2022

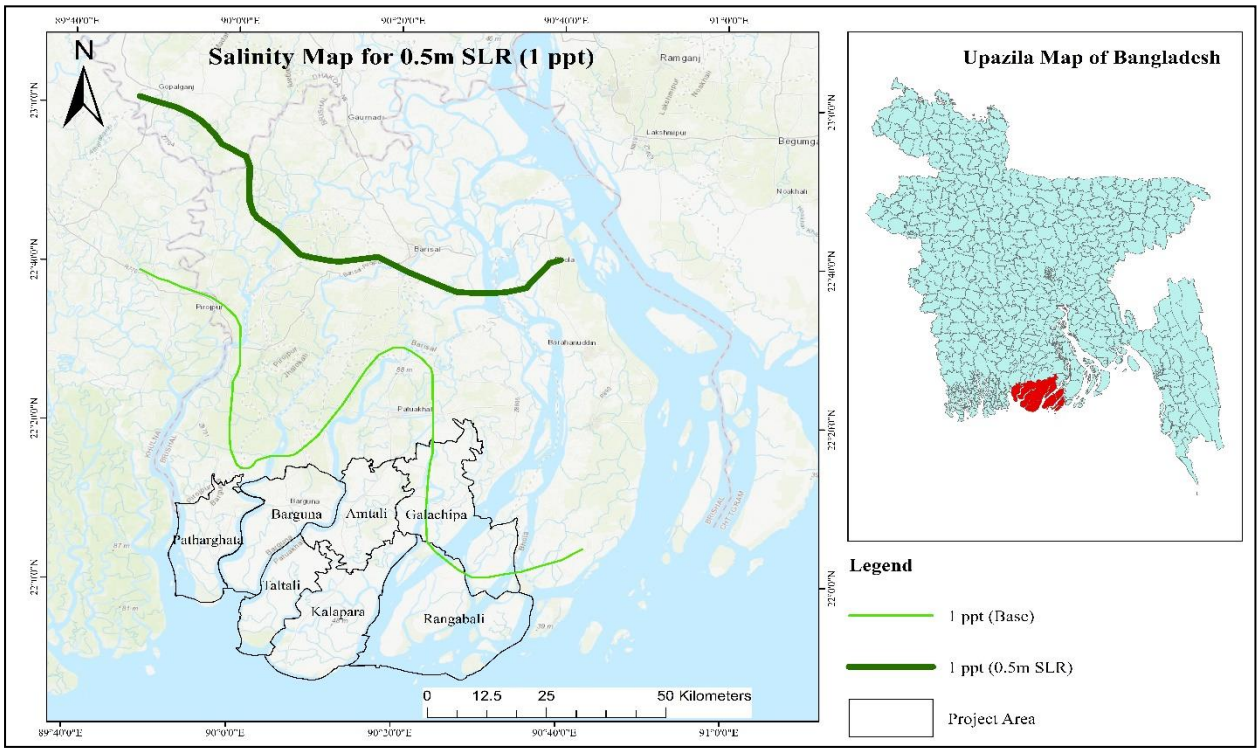


Figure 6: Salinity Map of 1 ppt for 0.50 m SLR
Source: PKCP Project, UDD, 2022

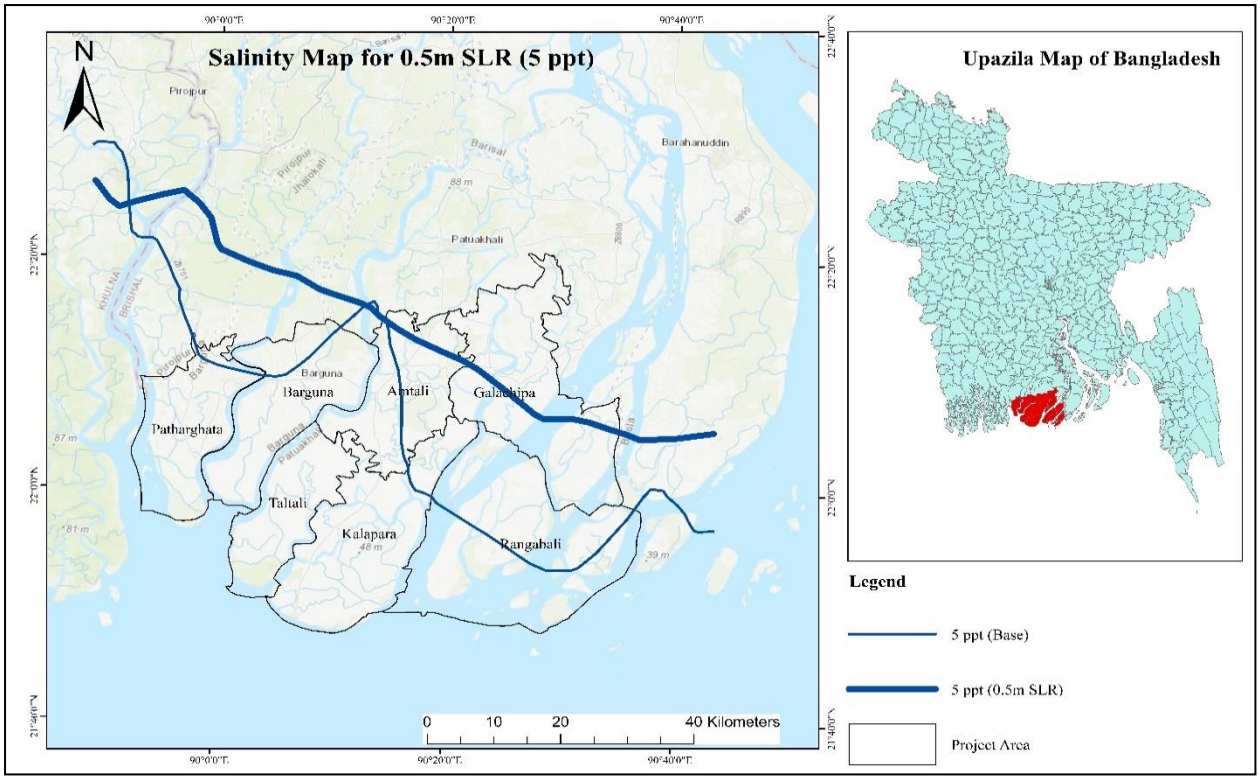


Figure 7: Salinity Map of 1 ppt for 0.50 m SLR
Source: PKCP Project, UDD, 2022

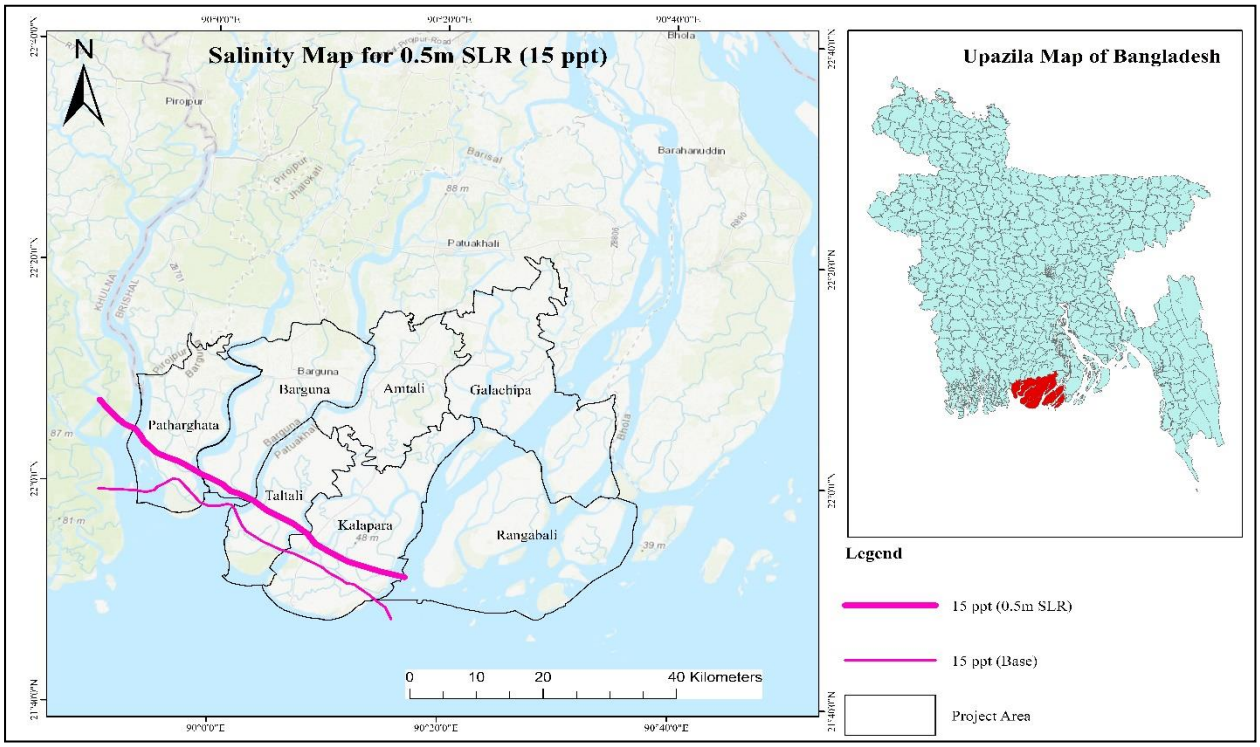


Figure 8: Salinity Map of 1 ppt for 0.50 m SLR
Source: PKCP Project, UDD, 2022

2.9 Key Features in this Upazila

The Motso Obotoron Kendro (Mohipur, alipur) support fishermen in the collection, conservation and marketing of marine fish in Kalapara Upazila.

Pyra port is the 3rd sea port in Bangladesh which has been established with a vision of enchance international maritime trade of country. Port development means the uplift on the prosperity of the nation.RPCL, Pyra thermal power plant is also known as the kalapara power station (BPCL) is a 1320 megawatt coal fired power plant.BNS Sher e Bangla Navy camp,Kuakata Sea Beach, Helipad, Kuakata Tourism Park are also major features in kalapara upazilla.

2.10 Land use Pattern

In Kalapara Upazila, major landuse is Agriculture (48.37%). Residential occupies (12.01%) and waterbody occupies 21.76% of the category. A negligible percent (1.27%) land is using for Transportation network (Field Survey: 2022). Though, agricultural landuse dominates a major portion land use of the Upazila but, after the preparation of Master Plan, more residential development will be preceded. In consideration of such concept, the Master Plan will be delighted in favor to save the agriculture land.

2.11 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 1989 to 2021. Changes of different types of land use classes are assessed using satellite data. A summary of the whole upazila changes in water bodies, forests, bare land, cultivable land, and build-up areas in the study area are presented in Table-04

Future changes of LULC are predicted for 2041 using the Cellular Automata (CA) with Markov model. The Cellular Automata(CA) model is a discrete model with a spatially extended dynamic system based on a defined transition rule that relates the new state to the previous state of the LULC type (Guan et al., 2011). CA-Markov model develops with a combination of Cellular Automata and the Markov Chain to predict spatiotemporal changes of LULC. Figure 08 and Table 04 shows CA-Markov model simulated LULC map of study area for the year of 2010, 2021 and 2041.

Table 4: Land use/ Land cover (LULC) changes for all Upazilas from 1989 to 2021.

LULC type	1989	1999	2009	2021	Change	(%)
Water body	61.7877	64.602	65.1438	67.023	5.2353	8.47
Forest	18.5508	24.4251	52.0146	51.8481	33.2973	179.49
Bare land	333.2538	298.3176	267.3819	249.318	-83.9358	-25.19
Cultivated land	87.1371	110.7333	110.8791	123.5034	36.3663	41.73
Built up area	0.7254	3.3768	6.0354	9.7623	9.0369	1245.78

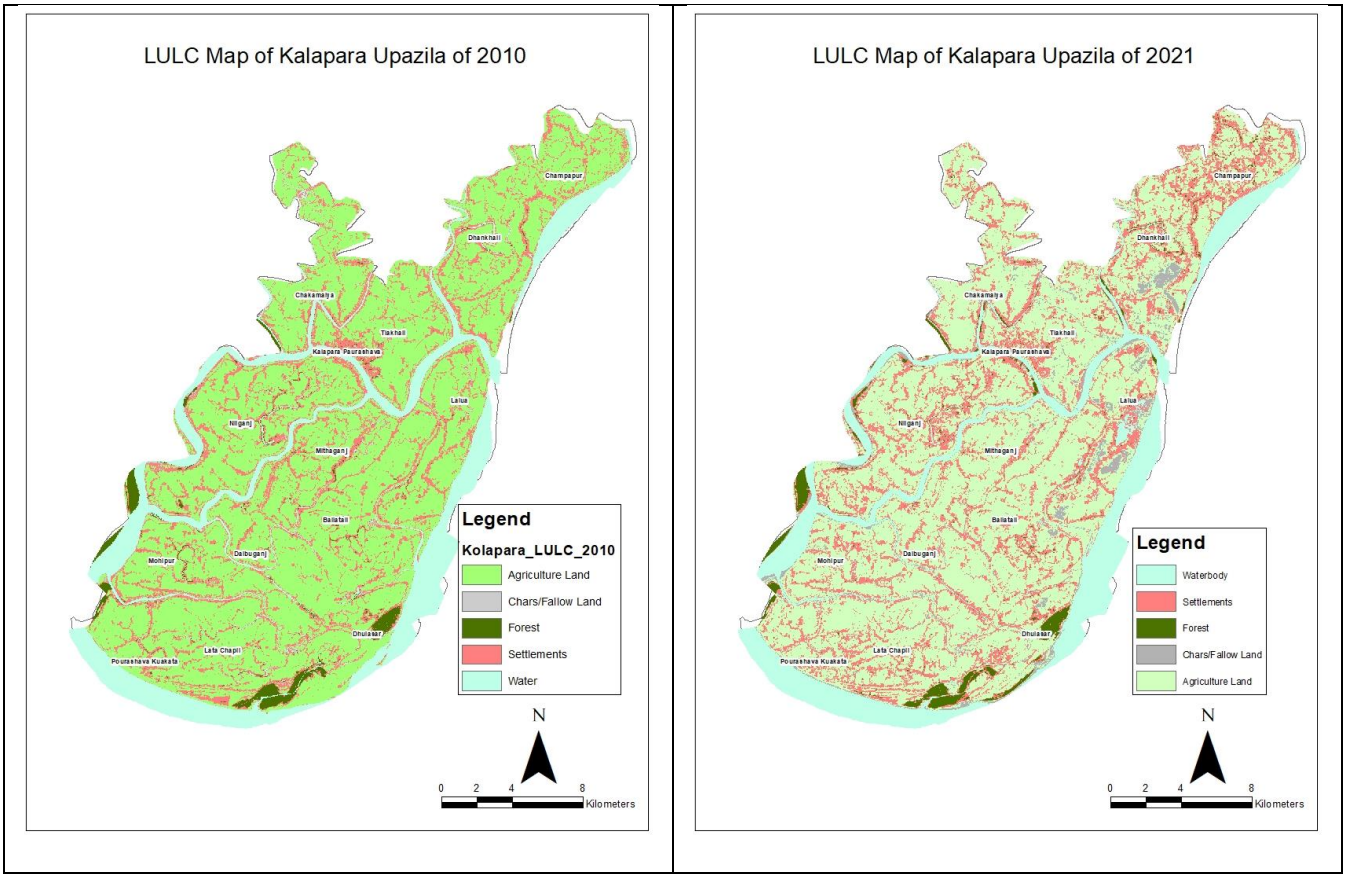


Figure 9: LULC map of Kalapara upazila in 2010 and 2021
Source: PKCP Project, UDD, 2022

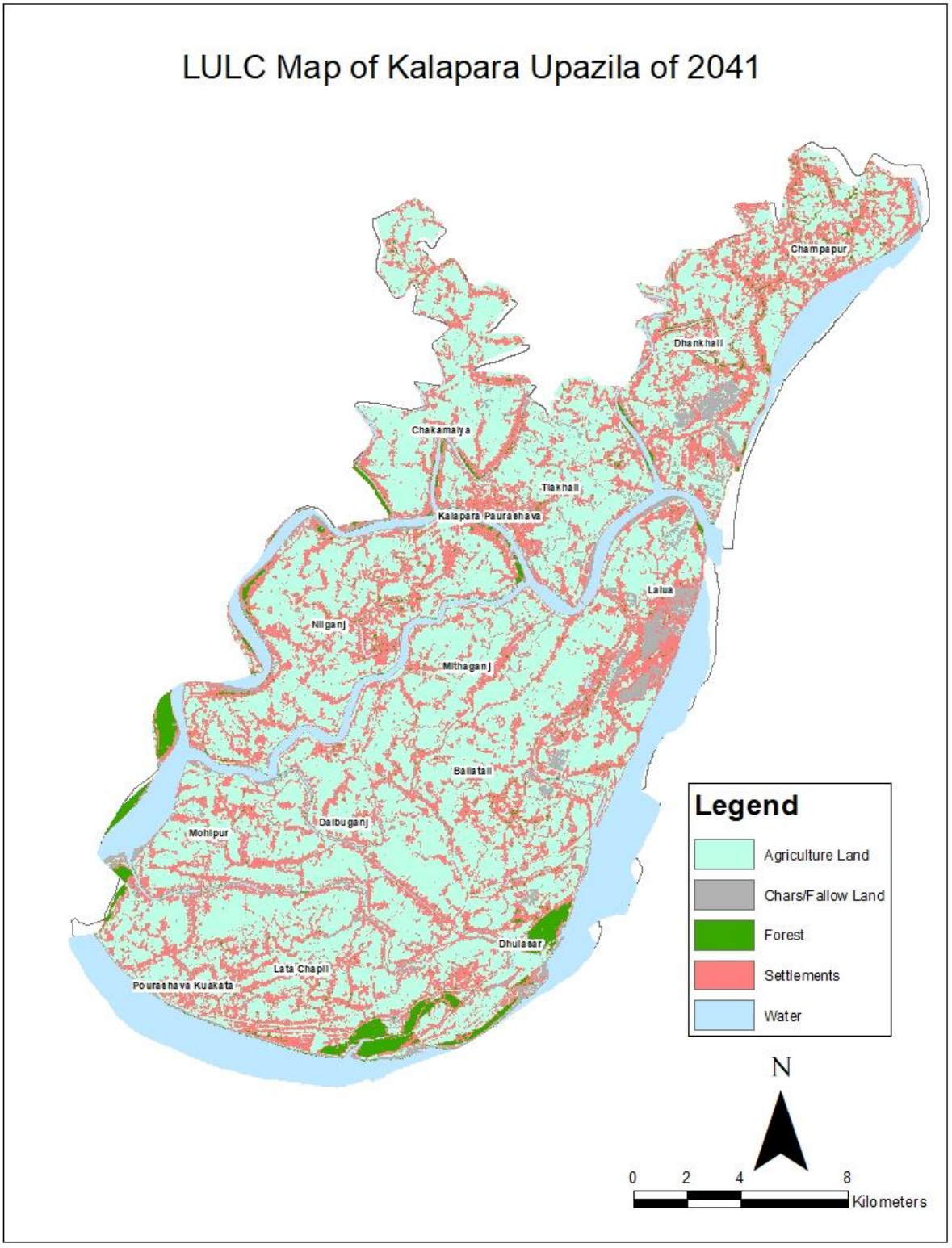


Figure 10: LULC map of Kalapara upazila in 2041
Source: PKCP Project, 2022, UDD

2.12 Natural Resources

Mineral Resources: the inhabitants searched for sulphuric substances by digging soil in their village of the Upazila in 1970. No mineral resources were found in the Upazila.

Forest Resources: Kalapara Upazila was originally part of the Coastal belt area. People started clearing forests for planting. Forests are reproduced for human needs. Lebur bon, Dhulasar Mangrove Forest, Gangamati Lake Forest are high densely covered by different types of plants.

It is obvious that unplanned development activity will lower the amount of tree cover in the area, which will result in an increase in greenhouse gas emissions. Furthermore, it will have an impact on the existing environment and will contribute to the reduction of local flora and fauna. However, it is possible to address the climate change challenges while also enhancing the socio-economic development of the local community by providing suitable greening and ecotourism facilities in a coordinated manner.

Fisheries Resources: Fisheries are one of the natural resources of Kalapara Upazila. The livelihood of most people of this Upazila is dependent on fishery resources. In the Kalapara Upazila, the amount of fish resources extracted from the sea is higher than that of freshwater fish. The Motso Obotoron Kendro (Mohipur, alipur) support fishermen in the collection, conservation and marketing of marine fish in Kalapara Upazila. Through this centre, thousands of tons of hilsa and other fish are exported abroad and shipped within the country. Due to the coastal Upazilas, sea fish are more available here.

Livestock Resources: Due to the gradual decline of pasture land, the number of cattle in the Upazila has decreased compared to the past. Cattle farm is 84, poultry farm 74.

2.13 Natural Barriers

Kalapara Upazila in Bangladesh is located in a vulnerable coastal area that is exposed to various natural hazards. Despite this, there are some natural barriers in place that help protect the area from these hazards. Some of these natural barriers are:

Mangrove forests: Kalapara Upazila has extensive Lebur Bon, Gangamati Lake side forest, Dhulasar Mangrove forest that act as a natural barrier against tidal surges, storm surges, and other coastal hazards. These forests can absorb large amounts of water and reduce the impact of flooding.

Sand dunes: The coastal areas of Kalapara also have natural sand dunes that act as barriers against tidal surges and storm surges. These dunes can reduce the impact of flooding by absorbing and dissipating the energy of the waves.

Rivers and creeks: The area is crisscrossed by numerous rivers and creeks like Gangamati lake that act as natural drainage channels and help to reduce the impact of flooding. These waterways also provide a source of livelihood for the local population, through fishing and other water-related activities.

Overall, while Kalapara Upazila is vulnerable to natural hazards, the presence of these natural barriers helps to mitigate the impact of these hazards and protect the local population and their livelihoods. However, these natural barriers can be degraded by human activities such as deforestation, pollution, and land use change, which can increase the area's vulnerability to natural hazards.

2.14 Eco-tourism Potentiality

Kalapara Upazila in patuakhali District, Bangladesh, has significant eco-tourism potential due to its rich natural resources and cultural heritage. Some of the main eco-tourism potentialities in kalapara Upazila are:

Coastal beaches and riverbank: The coastal areas of kalapara Upazila have some beautiful and pristine beaches, such as kuakata beach, Gangamati Lake, Lebur ban. **Kuakata Sea Beach** is one of the main sea beaches situated in the southernmost area of Bangladesh. The sea beach is known as the “Sagar Kannya” (Sea Maiden). This is the only sea beach in Bangladesh where both sunset and sunrise can be seen.

Other attractive tourist places:

- ***Gangamati Forest*:** Gangamati Forest (or Gajmati Forest, according to some locals) is situated on the east side of the sea beach.
- ***Alipur Port:*** The Alipur Port, which has been considered one of the busiest fishing ports, is about 4 kilometers away from the Kuakata sea beach.
- **Misripara Buddhist Temple*:*** The temple, located about 8 kilometers from Kuakata, has drawn the attention of numerous tourists from all across the country.

- ***Well of Kuakata*:** An ancient well is built near the Rakhine village of Keranipara . Legend has it that the name Kuakata has been derived from the "Kua" (well), as the locals call it, of Kuakata.
- **Char Bijoy**- It is located on the Bay of Bengal at around 30 km southeast corner of Kuakata sea beach.
- **Payra port** and thermal power plants: Newly established Payra port and thermal power plants are some attractive places in Kalapara upazila

Adventure tourism: Kuakata Tourism centre has opportunities for adventure tourism, such as trekking, hiking, deep- sea driving, paragliding, flyboarding, wind surfing, parasailing and kayaking on the sea beach and in the forests and waterways.

Overall, the eco-tourism potentiality of Kalapara Upazila is significant, and with proper planning and development, it can contribute to the local economy while also promoting conservation and sustainable development practices.

2.15 Economic Growth of the Area

Growth Centres (GC) are those areas where maximum economic growth in a certain region is expected. For the study area, it is assumed that most economic activities in the present scenario take place in the major growth centres. Considering existing economic function growth centers has been scored to identify major growth centers, where function includes commercial activity, service facilities and manufacturing and processing. Functional hierarchy has been explored considering union wise population-which means the ration between union population and economic functions (Figure-4). However, it is expected that lower scored GCs will gradualy gain higher score based on population's demand. Following are some gross findings on existing growth centers:

- **Catchment Area:** Growth centres serve mainly the nearest and surrounding villages and unions.
- **Road Network:** Every growth centre is connected with mainly Upazila or union roads. Some GCs are accessible via waterway. Some other village roads are connected with the prominent access road. These connected roads ease the accessibility to other areas.
- **Road Condition:** Most of the road conditions are so bad that it becomes risky for motorized vehicles to move on the roads. Pavement depleted at many points with a lot of holes and shattered. Most of the roads are Katcha and Brick soling roads, which are not in

good condition. During a flood, the road goes under and becomes muddy. Roads are also so narrow. The condition of the culvert is also miserable. Condition of launch ghat is not also good.

- **Traffic Congestion:** Traffic congestion is noticeable mainly on typical hat days. Most business activities are done in hat day/ days. Goods loading and unloading occur on that day, and many people come for different purposes on the hat day, so the growth centre becomes crowded on that day. The volume of vehicles also becomes high. So traffic congestion occurs on typical hat days rather than on other days of the week. On-street parking encroaches the road, which leads to traffic jams.
- **Parking Facility:** There is no parking facility in the growth centres. Vehicles are parked on the street. There are some bus depots where people can access the growth centre by bus. There are also some ghats for goods loading and unloading, especially fish products.
- **Mode of Travel:** The major modes of travel are motorbike, tomtom, easy bike, auto-rickshaw, three-wheeler, Mahindra, cycle-rickshaw, bicycle, borak, passenger pickup, tempo, bus etc. In the waterway, trawler, boat and launch areas are available to travel.

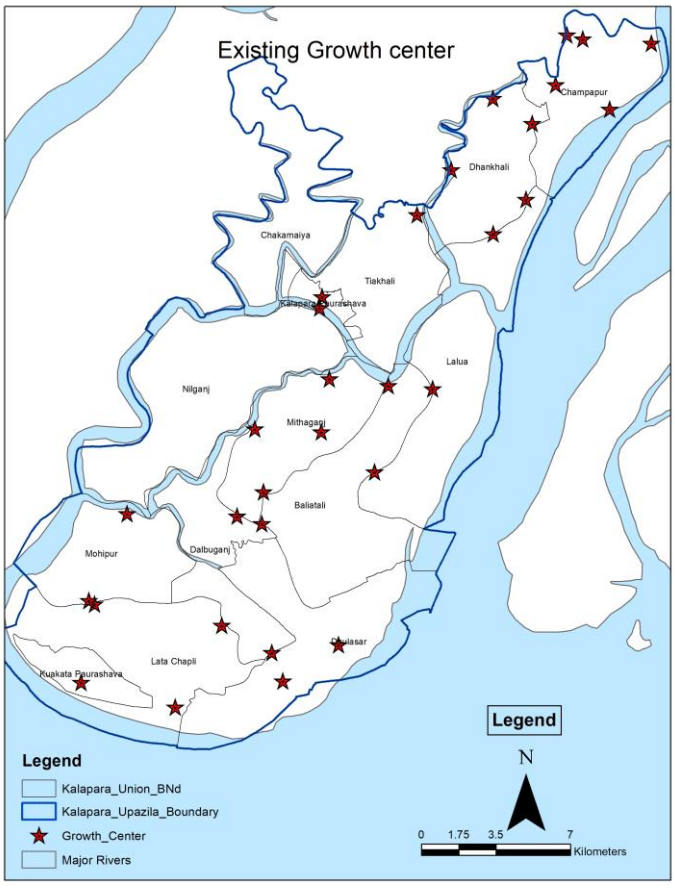


Figure 11: Existing Growth Center of Kalapara Upazilla
Source: PKCP Project, UDD, 2022

2.16 CROPPING PATTERN

The economy of the Kalapara Upazila is dominated by agricultural activities. Most the households are engaged in farming activities that produce varieties of crops, namely local and HYV of rice, vegetables, spices, cash crops, pulses and others. Various fruits like Watermelon, coconut, betel nut, banana etc are grown. Watermelon and Rice are grown abundantly in Upazila. Conducting a workshop with union level agricultural officer it is explored that 71.0 percent of total Agro-land are double cropped, 15.3 percentage are triple cropped, and 13.6 percent land are single cropped land (Figure 12).Local HYV rice is single crop. Rice and vegetable is double crop. Rice, watermelon and Vegetable are triple cropped.

Table 5: Cropping pattern of Kalapara Upazilla

Cropping pattern	Acre	%
Single cropped	5777.5	13.6
Double cropped	30152	71.0
Triple cropped	6513.3	15.3

Source: PKCP Project, UDD, 2022

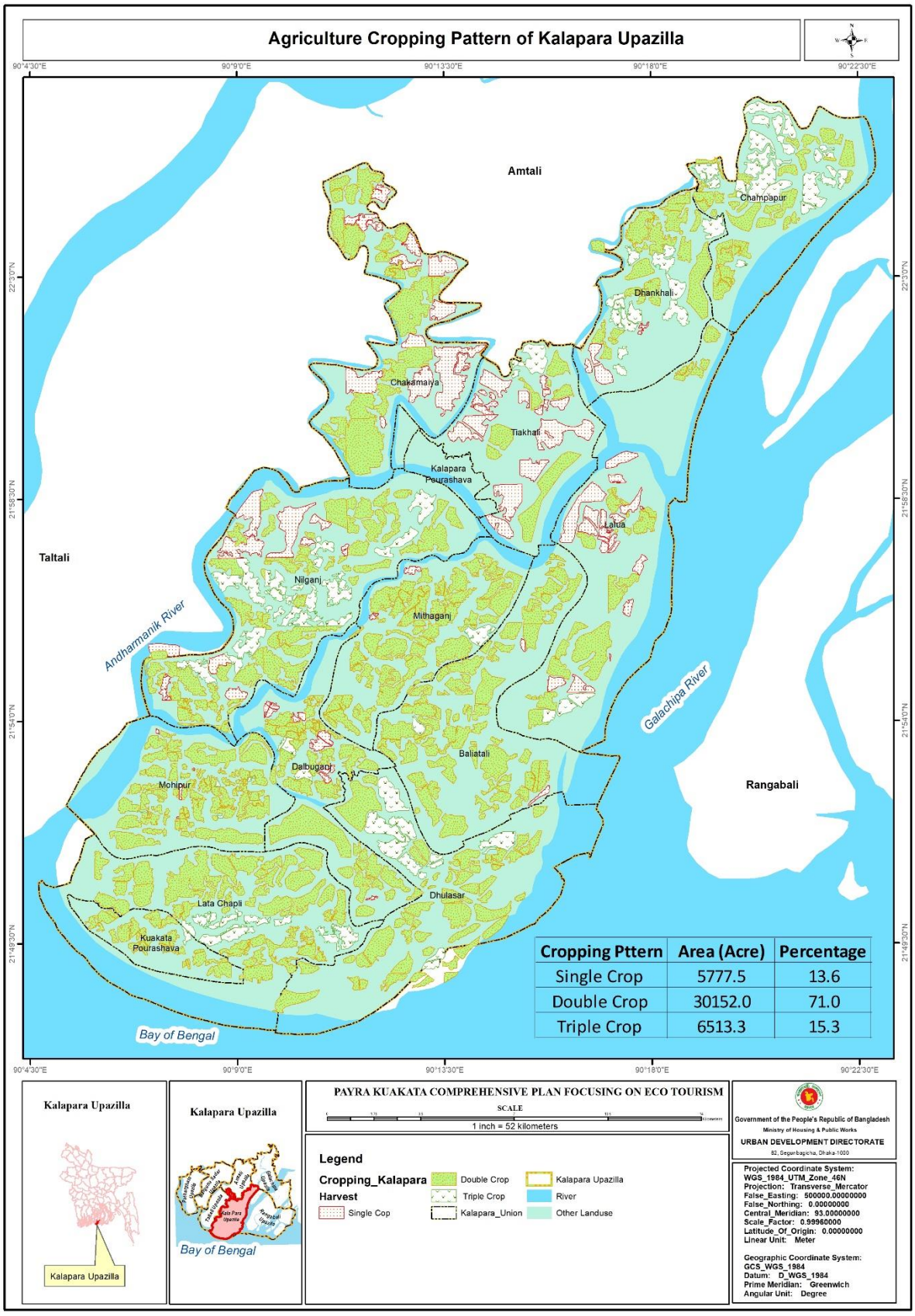


Figure 12: Cropping pattern map of Kalapara Upazila
Source: PKCP Project, UDD, 2022

2.17 Language and Culture

The geography and geographical location of the Upazila have played a role in the formation of the language and culture of the people of this Upazila. Cultural events are spread in Kalapara Upazila on the basis of seasonal events such as Rakhaine Mela etc

2.18 Water, Sanitation and Hygiene

From a physical feature survey, it is found that most of the toilets are in average condition.

Based on tube-well vs walking distance of household, it is spatially calculated that only 87.27 per cent of a household has somewhat access to a quality drinking water source while only 6.74 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. 6.74%*
	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. 87.27%
	Limited accessibility to a water source: drinking water from an improved source for which collection time exceeds 30 minutes for a roundtrip, including queuing. - 5.99%

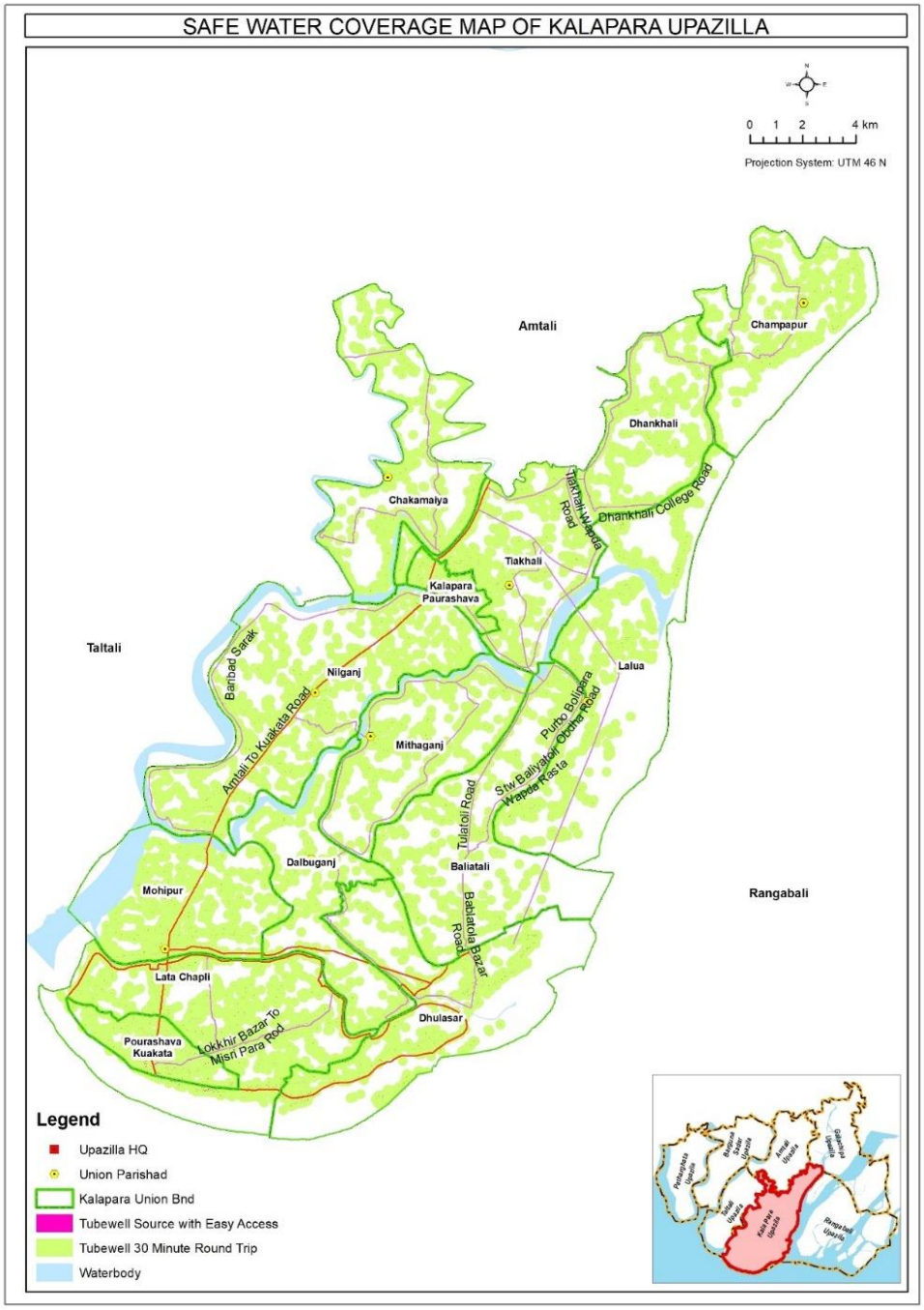
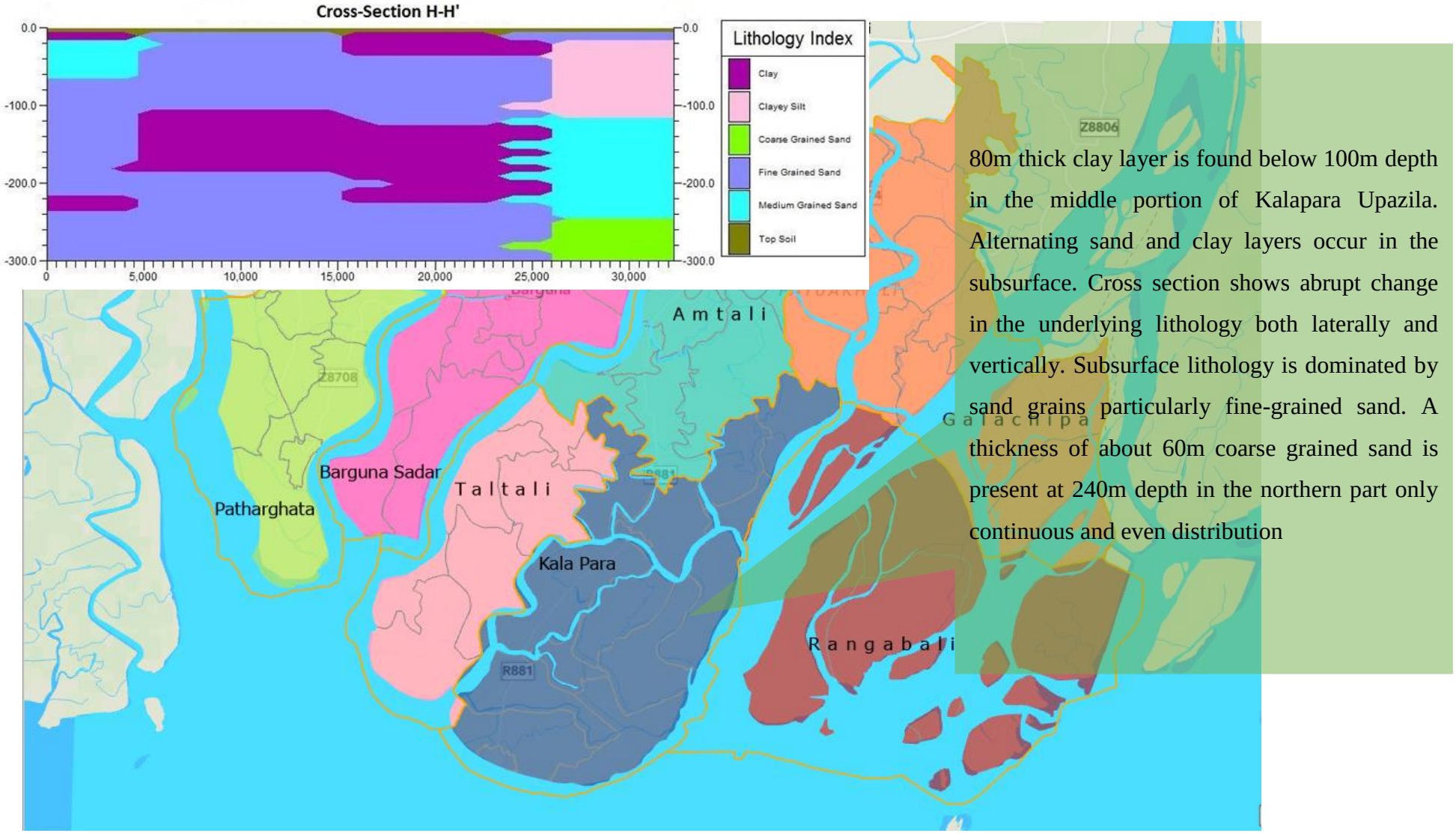


Figure 13: Safe Water Coverage Map of Kalapara Upazilla
Source: PKCP Project, UDD, 2022

2.19 Hydro-geological Attributes

Groundwater in the study area is found in deltaic sediments and is highly heterogeneous, with three depth zones. The shallow aquifer is connected to surface water bodies and receives less than 300 mm of recharge annually from rainfall. During the rainy season, groundwater flows from topographic high to low areas and towards the river or sea, while during the dry season, it flows towards pumping sections. The intermediate aquifer seems to be connected to the

shallow aquifer, and the deep aquifer is completely isolated from the overlying aquifers, likely receiving recharge from the regional aquifer system. Water quality and quantity were evaluated through WQI and slug tests to explore the conditions in the Kalapara Upazila area.



80m thick clay layer is found below 100m depth in the middle portion of Kalapara Upazila. Alternating sand and clay layers occur in the subsurface. Cross section shows abrupt change in the underlying lithology both laterally and vertically. Subsurface lithology is dominated by sand grains particularly fine-grained sand. A thickness of about 60m coarse grained sand is present at 240m depth in the northern part only continuous and even distribution

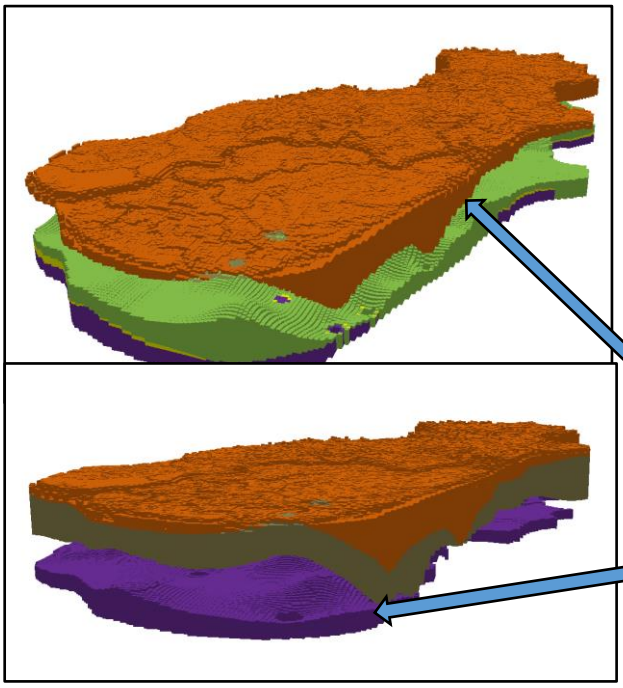
Figure 14: Subsurface lithology of Kalapara Upazila
Source: PKCP Project, UDD, 2019

2.20 Flooding and Drainage

As the area lies at the southernmost tip of Kalapara 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.

2.21 Geological Attributes

Geomorphological units of the study area are covered by recent sediments divided into tidal deltaic and mangrove swamp deposits. Layer 4 and Layer 6 are considered the deep foundation layers based on the SPT-N value of boreholes. Seismic hazard maps for the study area are presented showing the spatial distribution of PGA and PSA, with PGA ranging from 0.167g to 0.239g for a 0% probability of exceedance in 50 years and from 0.339g to 0.509g for a 2% probability of exceedance in 50 years. A building height map is produced using PSA, representing low-rise and high-rise buildings



Row Labels	Min of SPT	Max of SPT	Average of SPT	Min_AVs30	MAX_AVs30	Avarage_AVs30	Min Depth	Maximum Depth
Layer-1	1	18	3	84.0	162.6	117.3	0	27
Layer-2	1	38	10	100.1	260.4	167.1	0	26
Layer-3	1	27	7	84.0	212.6	153.1	5	28
Layer-4	6	57	22	146.4	323.4	214.7	8	28
Layer-5	2	45	10	113.4	251.7	165.3	18.5	28
Layer-6	10	118	42	190.4	330.5	256.9	21.5	28
Layer-7	5	21	13	138.3	215.9	171.8	27.5	28

Figure 15: Profile of subsurface layers of Kalapara, Amtali and Taltoli Upazila
Source: PKCP Project, UDD, 2019

2.22 Socio-economic status of the sample population

Family type of the respondent: In total, 84.18 percent of the respondent lives in nuclear families in Kalapara Upazila.

Religion: More than 93.46 percent of the respondent was Muslim, 6.13 are hindu and the rest of the respondent was Christian or Buddies in Kalapara Upazila.

Status of living outside: In total, 96.85 percent of respondent lives with their family member in the locality, 3.15 percent of family member lives abroad.

Land and housing status: More than 89.32 percent of the respondent lives on their own land/house. Among them, 52.45 percent of respondent lives in Tinshed house, and 23.83 percent lives in Katcha structure-among.

Plinth Height of the structure: Considering the plinth height and structure type, primary data shows that the majority of the structure's plinth height is 2 feet.

Plan Approval Status: In total, 71.3 percent of the owner do not have building plan approval which is mainly because of a lack of knowledge about the rule of building approval.

Problem faced in the main road: Respondents claimed that narrow road width is the key problem of the main road and also mentioned the worse condition of the main road. Almost 100 percent of the respondent has expressed their dissatisfaction regarding road condition.

Modification of the embankment height-required or not: The majority percent of the respondent has said that embankment height is enough to protect the area, point to be noted that only 41.5 percent of the total respondent has somewhat knowledge regarding the height of the embankment. So, the planning team might need relevant authority or expert opinion.

Drainage facility: 88.7 percent of respondents claimed that this Upazila has almost few man-made drainage facility.

Drinking water source, availability and water quality: Pipeline supply, pond water and common tube-well are the available water source in the Upazila. It is noted that 70.03 percent of the respondent claimed they use common tubewell.

The fuel source for household activity: For fuel sources, people are mainly dependent on natural resources. In total, 76.45 percent of the respondents use firewood, and 23.43 percent of the respondent buy cylinder gas as a fuel source.

Energy source: In total, 69.29 percent of the respondent are connected with electricity. After that, 26.09 percent of the respondent depend on solar power systems for lighting.

Hygienic status of the septic tank: Regarding the hygienic level of the septic tank, 63.80 percent of the respondent claimed that their septic tank is hygienic. Data shows that 46.82 percent of respondents' septic tank is katcha, which are not in hygienic condition.

Waste disposal practice: In the case of waste disposal, the respondents practise an unhealthy way, which is throwing outside of the house. Only 66.71 percent dispose outside of house.

School attending children status and reason for attending school: It is found that 77.53 percent of the respondent are aware of enough to send their child to school, and for 21.35 percent of respondents, this question was not applicable.

Type of entertainment: Kalapara Upazila's respondent's entertainment pattern is irregular. Around 50 percent of the respondent has to travel 1 km to visit a recreational place, and around 36 percent of people have to travel 2 km distance.

Mode of transport, travel time to visit the shopping centre and service quality: To visit a shopping centre majority percent of respondents of Kalapara Upazila equally prefer rickshaw and walking. In total, 76.63 percent of the respondent of Kalapara Upazila travel 10-20 minutes to visit the market, and around 14.31 percent of respondents travel 30 minutes to reach the shopping centre.

Occupation Status of Kalapara Upazila: In Kalapara Upazila majority percent of the respondent claimed that agriculture-related activity is the main source of income.

Landuse change scenario and reason behind the change: In Kalapara, 74.81 percent of the respondent claimed that there is no change in land use of the Upazila.

Willingness to give land for the road: In Kalapara Upazila, a significant percentage of the respondent has expressed their willingness to give land for road development.

2.23 Physical feature

The physical feature survey explored that 77.50 percent of structures were used for residential purposes, and in total, 56.03 precent of the structure were single stories

Table 6: structure use statistics of Kalapara Upazila

Structure Use	Number	Percentage(%)
Administrative/ Public service	95	0.11
Agriculture	1618	1.88
Commercial	4938	5.75
Community Service	1570	1.83
Education and Research	1017	1.18
Manufacturing & Processing	383	0.45
Mixed Use	1372	1.60
Residential	66565	77.50
Service Activity	3560	4.14
Transportation and Communication	373	0.43
Under Construction	4402	5.12
Total	**85893**	**100**
Structure Floor	**Number**	**Percentage**
1	48127	56.03
2	37203	43.313
3	410	0.47
4	112	0.13
5	20	0.02
6	12	0.013
6 and above 9	8	0.009
Total	**46197**	**100**

Source: PKCP project, UDD, 2018

2.24 Transport and communication

From the transportation survey and public consultation in the PRA session, it is unveiled that congestion is caused by on-street parking, a narrow road network, and a lack of parking, according to transport survey and PRA session participants. Land use, environmental quality, economic growth and viability and achieving lifestyle objectives are obvious factors that must be considered in evolving a comprehensive plan. However, there are subtler factors that will have a bearing on the outcome of these comprehensive transportation studies. The condition of existing internal connecting roads is very bad. Traffic congestion, during the rainy season, goes underwater and muddy, no parking facilities for vehicles, lack of public transport facilities, unplanned ghat and terminal design, insufficient numbers of ghats and terminals, access rivers and canals are not properly dredged and narrow roads are major critical issues in transport sector.

It can be easily identified that major modes are walking, Auto-Rickshaw and Motorbike in all over the upazila. People use boat service for crossing one side of the river or canal to other

side. In Kalapara the trips made by bus are good enough, because of the connectivity adjacent to the highway creating greater opportunities for people to travel longer distance to make work trips.

Table 7: Major three modes used

Upazila	Major Three Modes					
	Mode- 1		Mode- 2		Mode- 3	
	Up	Down	Up	Down	Up	Down
Kalapara	*Motor Bike (41.5%)*	*Motor Bike (41.3%)*	Baby Taxi (31.2%)	Baby Taxi (30.6%)	Van (7.5%)	Van (8.0%)

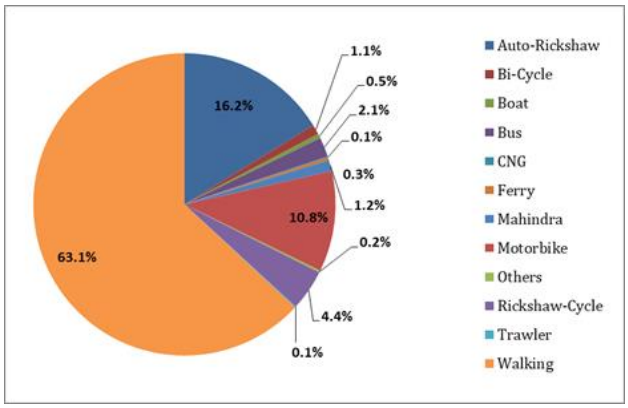


Figure 16: Mode of Travel in the Kalapara Upazila

In Kalpara Upazila, considering road length, it is found that the majority percent of the roads are tertiary category (Table 8) which area mainly Katcha road with narrow road width and bumpy surface Primary roads directly connect this Upazila with Amtali.

Table 8: Road category of Kalapara Upazila

Road Class	Length in Km	%
Path	1022.51	40.32
Primary	30.02	1.18
Secondary	249.39	9.83
Tertiary	1233.66	48.65
Grand Total	2535.58	100.00

Source: PKCP project, UDD, 2022

From Physical feature survey, it is found that according to road type around 76.44% of Roads are katcha in Kalapara upazila and also the total length of katcha roads are longer than others. In Kalapara Upazila, only 15.37% of roads are pucca.

Table 9: Road type based on construction material of roads

Road Type	Length in Km	%
HBB	217.65	8.58
Katcha	1938.12	76.44
Pucca	389.81	15.37
Grand Total	2535.58	100.00

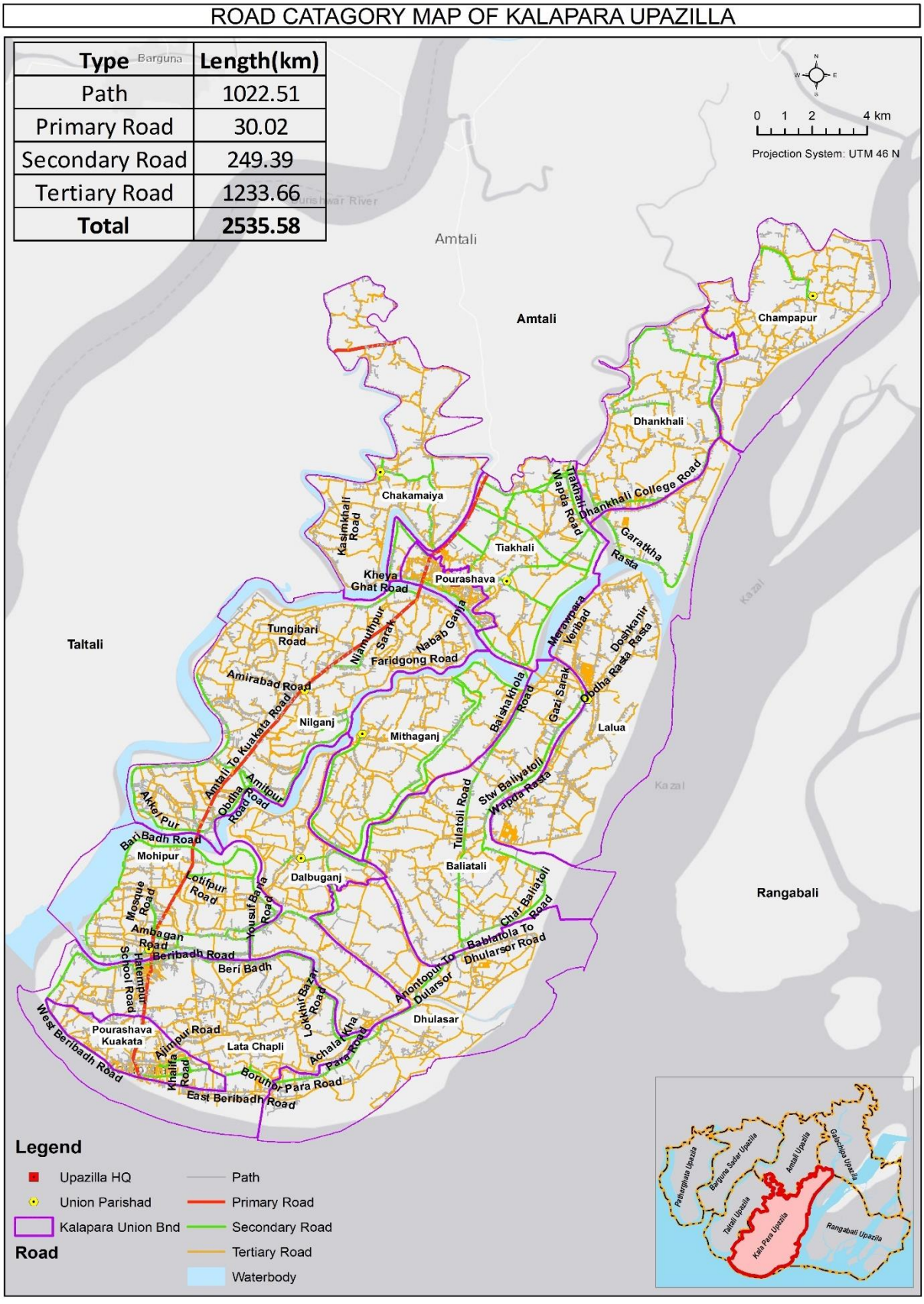


Figure 17: Transportation and communication network of Kalapara Upazila
Source: PKCP project, UDD, 2022

2.25 Waterbodies

Table 10 represents the present scenario of existing waterbody of Kalapara Upazila. There is existence of canal, ditch, fish pond, pond and river.

Table 10: Existing Waterbody of Kalapara Upazila

Waterbody	SQKM	Percentage
Borrow Pit	0.17	0.21
Canal	22.67	28.56
Ditch	3.95	4.98
Fish Pond	18.18	22.90
Lake	0.09	0.11
Pond	4.27	5.38
River	29.94	37.72
Tank (Dighi)	0.10	0.13
Total	**79.38**	**100**

Source: PKCP project, UDD, 2022

2.26 National Parks

As per according to Wildlife (Conservation and Security) Act, 2012, National Park means comparatively large area of outstanding scenic and natural beauty with the primary object of providing public education, research and recreation and managed for preservation of natural state of flora and fauna and outstanding charming scenery, and which is an area declared as such through official gazette notification under section 17 of this Act.

The only Kuakata National Park within the study area was declared in 24 October 2010 under GO No. MoEF/ Forest-Sec-2/2/national park/10/2010/509 dated 24/10/2010. The National Park is located at Latachapli and Gangamari mouzas of Kalapara Upazila and bounded with the WAPDA embankment at north, at south and east the Bay of Bengal, and at the west Andharmanik and the Bay of Bengal. It is Coastal plain land filled with mangrove and non-mangrove forest. The national park is surrounded by many canals and creeks. All over the year these waterways flow with high and low tide.

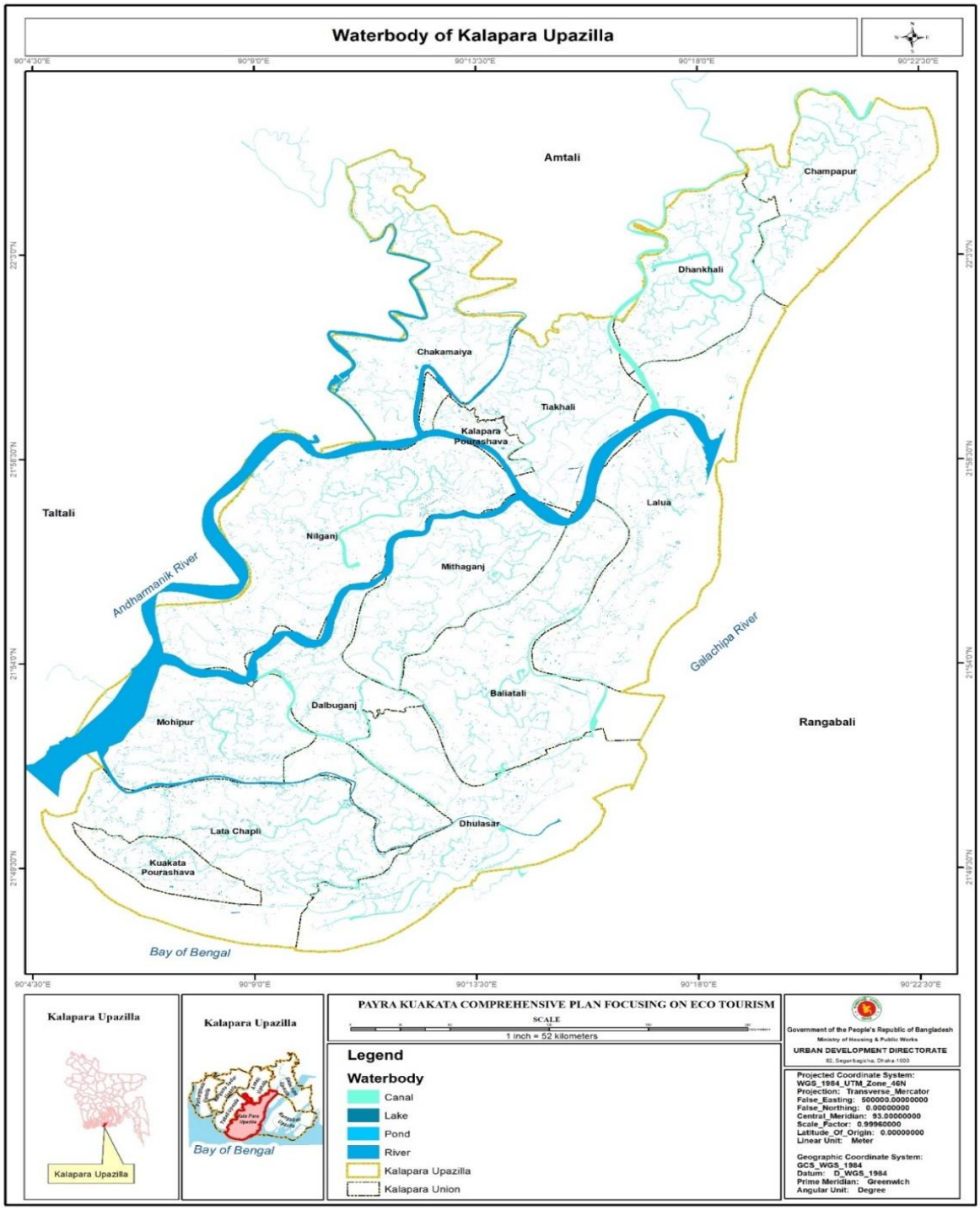


Figure 18: Waterbody Network Of Kalapara Upazilla
Source: PKCP Project, UDD, 2022

CHAPTER THREE: SOCIO-SPATIAL FORECAST 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 Kalapara Upazila in 2011 was 237831. Table 11 shows that the population in 2022, 2031 and 2041 will be 286993, 469278 and 5723048 respectively. From the regional plan data after 2031 the payra port will fully operate. In that cases there will increase the population 126295 in 2031.

Table 11: Projected Population of 2041

Year	Population
2011	237831 (Sensus,2011)
2022(Provisional)	286993
2031	342983+126295=469278
2041	572048

Source: PKCP project, UDD, 2018-2023

3.2 Housing demand projection

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. From the existing database in kalapara upazilla 286993 people use 85893 structures. In 2041 the population of Kalapara upazila will be 572048. There will need 129716 liveable building considering household size 4.41. (Patuakhali District Dwelling Unit BBS,2011)

3.3 Economy & Employment/Economic Forecasting

From the perspective of the percentage increase from 2003 to 2013, in Kalapara Upazila, basic employment has increased by 49 percent, and total employment has increased by 44 percent. Basic employment contributes to total employment. Basic employment constitutes

49% in Kalapara. So, most of the employment is not export-related, although basic employment contributes to non-basic employment, which can be identified by the economic base multiplier.

Table 12: Employment of 2003 and 2013 Comparison among the Upazilas

Upazila	Basic Employment 2003	Total Employment 2003	Basic Employment 2013	Total Employment 2013	Increase of Basic Employment	Increase in Total Employment
Kalapara	2818	11383	4192	16354	49%	44%

Source: BBS

3.4 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.

Table 13: 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 stormwater 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.

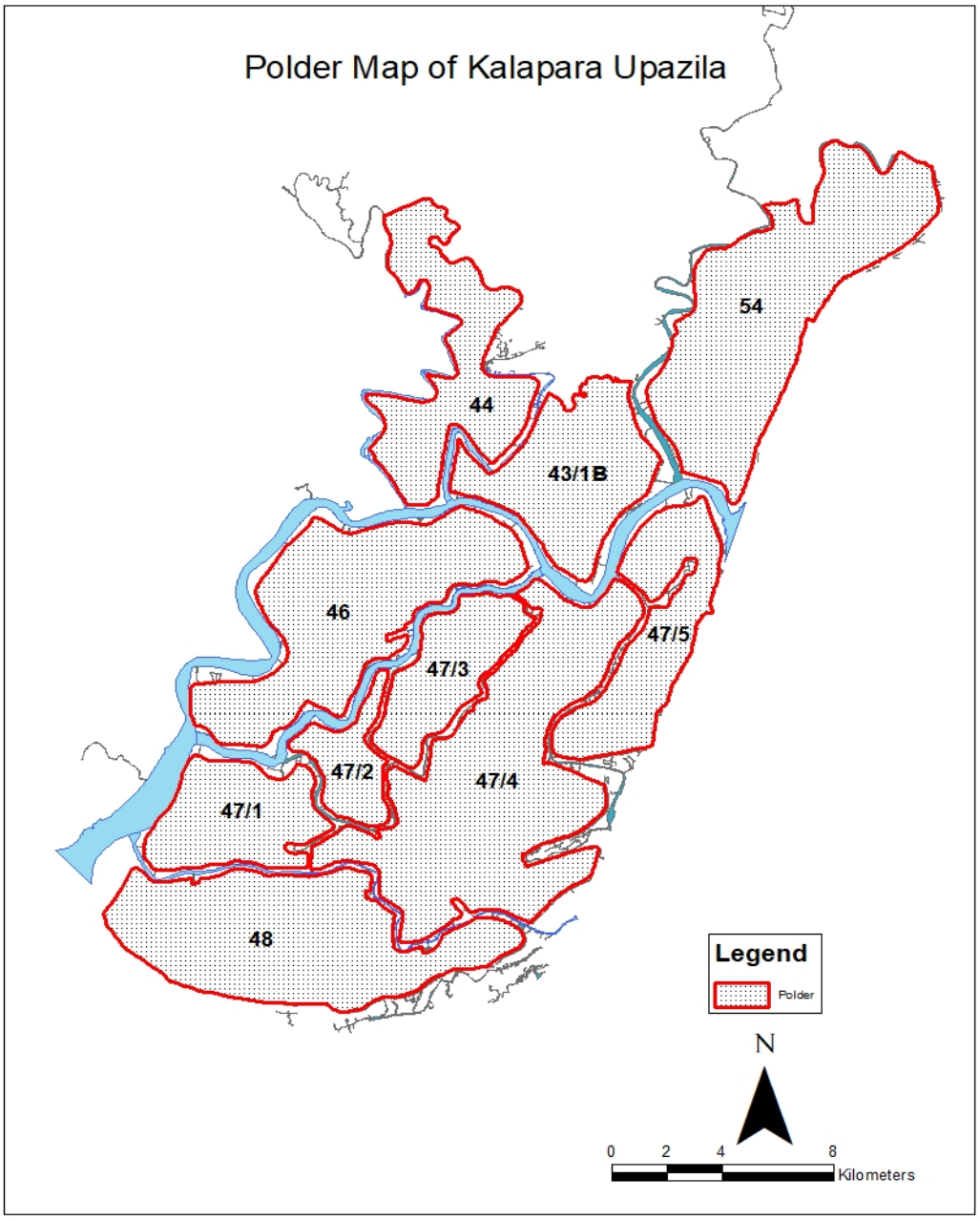


Figure 19: Map of polder area boundary
Source: PKCP project, UDD, 2022

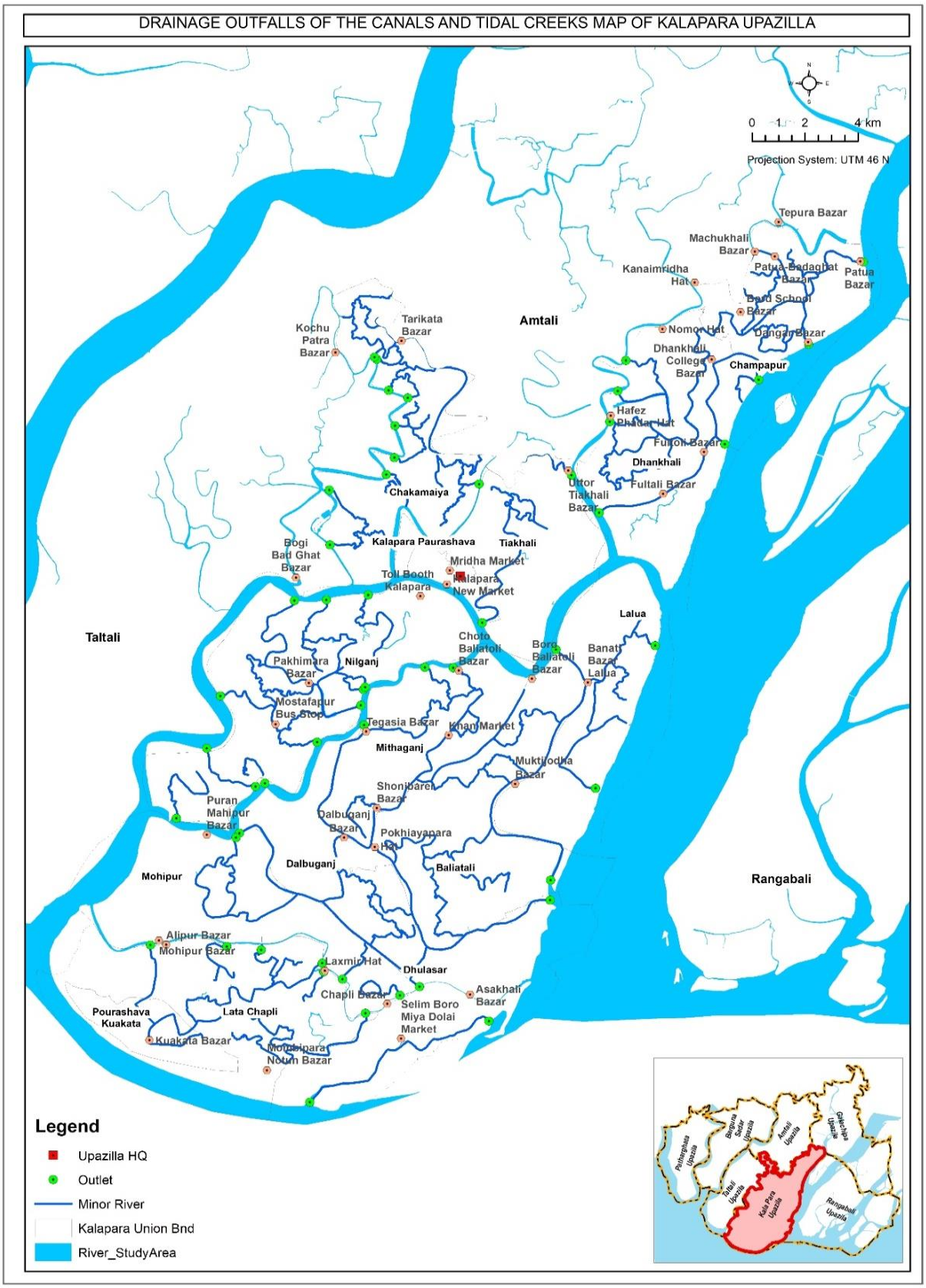


Figure 20: Existing Natural Drainage Network and Outfall

Source: PKCP project, UDD, 2022

Proper maintenances of all outfall and preserve the canal and river side area from encroachment and also preserve the large area waterbody.

From the above figure almost full area is covered by polder. So the assumption implies that a flood event having a flood level less than the prevailing would not be able to overtop the polder. 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 poldered area inside the project area would never be overtopped.

3.5 Tourism Potentiality and Activities

Kalapara Upazilla has Kuakata sea beach, Lebur bon, Misripara Boddhobihar, Gangamati Lake Eco-tourism site. However, no major development activities in this area have to be taken place (excluding the waterbody and forest based eco activities.). As a result, additional areas can be developed as tourist destinations with proper infrastructure development. Local entrepreneurs can be aided in promoting ecotourism. Sm.all 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. Presentation of local cultural events throughout the year can be supported to attract tourists. Additional game-enhancing events, such as sea surfing, sea sky surfing, and skimboarding, should be developed. Traditional indigenous cuisine, as well as other dishes, can be served to entertain tourists. Security must be ensured here, as well as adequate support for connectivity to the rest of the world. The eastern side can be reserved for foreigners as well as high paying national tourists.

3.6 Basic services and facilities forecasting

Existing Facilities: The distribution of existing socio-economic facilities by Upazilas is presented in Table 15, while Table 16 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 Kalapara Upazila, there is only 1.93 high School per 10,000 population.

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 14: 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, 2019

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.

Table 17 presents the projected requirements of socio-economic facilities in different Upazilas in 2021, while Table 18 and Table 19 show the projected requirements of facilities in different Upazilas in 2031 and 2041, respectively.

Table 15: Distribution of Existing Facilities by Upazilas

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]**
Kalapara	46	219	22	2	14	24	10	34	35	6
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 16: 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]**

Kalapara	1.93	9.20	0.92	0.08	0.58	1.01	0.42	1.43	1.47	0.25

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 17: Projected Requirement of Facilities by Upazilas 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]**
Kalapara	37	600	33	1	12	11	7	95	105	9

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 18: 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]**
Kalapara	42	674	36	1	14	12	8	106	118	10

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 19: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]**
Kalapara	47	747	40	2	15	13	9	118	131	11

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 20: 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]**
Kalapara	1.40	22.22	1.19	0.06	0.45	0.39	0.27	3.51	1.40	0.38

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

3.7 Water Demand Projections 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. The water balance calculation is also done for deep acquifer. Table 21 shows the water demand and water resources calculation summary.

Table 21: Water Balance Calculation

Water Balance Calculation for Shallow and Intermediate aquifers in the Payra-Kuakata Project area					
Aquifer	***Set Up***	***Population status***	***Water Demand (million m3/ year)***	***Water Availability (million m3/ year)***	***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 and urban	12,00,000	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.

The water age defines the water in deep aquifers as 10000 years back as per the water age dating of the study area. The observed ground water data indicates that the ground water level in the deep aquifer in all upazila of the project area declines annually by 0.3 to 0.5 m. So the recommendation is to use the water from deep acquirer 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 sea water intrusion. 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.

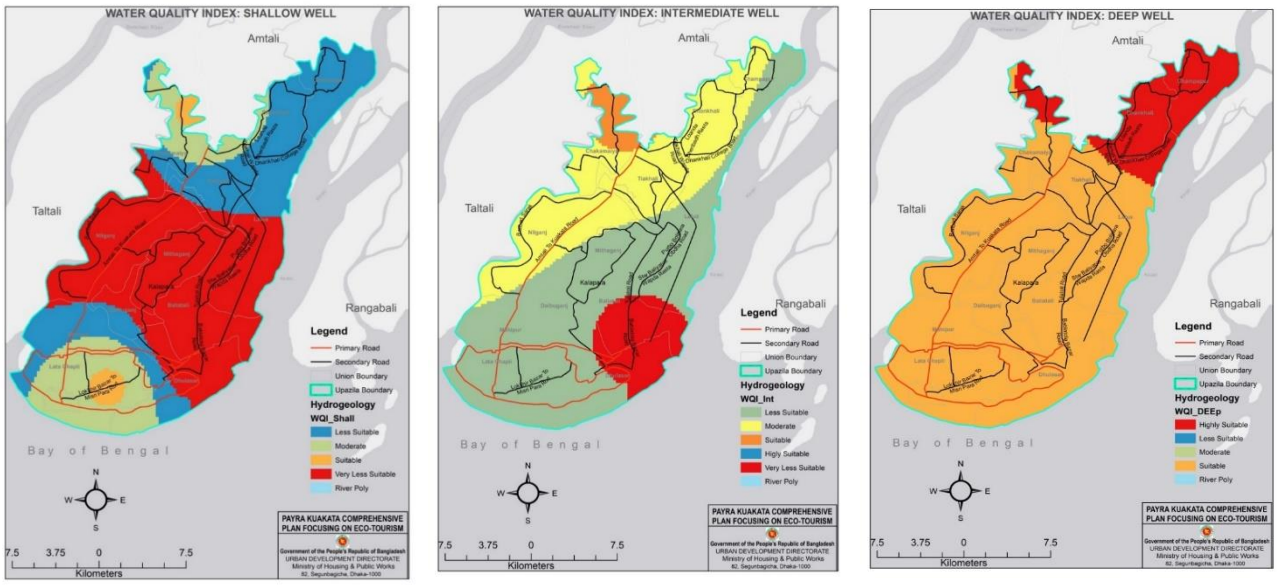


Figure 21 : Water Quality Index Map (Shallow, Intermediate, and Deep)

Source: PKCP project, UDD, 2019

From the figure the most important concern in this area is the potential rise in water demand in the near future. Therefore, one future scenario of higher pumping has been considered. We all are concerned about the Pyra port at Kalapara, Patuakhali, an another large seaport in Bangladesh. When various activities through this port start, this area is expected to become a large commercial area; a large number of people will go there daily for business purposes. Various industries will develop in this area in general. So, it's conspicuous that the demand for water will increase greatly. As groundwater is the only source of fresh water in this area, people will start to pump groundwater at a higher rate than present day. A ten times higher abstraction than the present abstraction rate was considered in the entire model area. From Figure 22, Red colour indicates high recharge area and green colour is low, which should be conserved and permanent construction to be prohibited in this area.

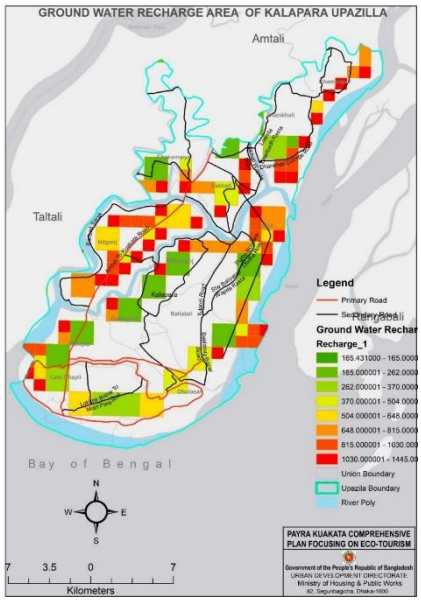


Figure 22 : Ground Recharge Area Kalapara Upazilla Source: PKCP project, UDD, 2019

3.8 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 AusAID 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)

Total consumption- 62.47 (l/D). The planning team uses this rate to calculate water demand for the planning area.

Table 22: Water Demand

Union	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)**
Dalbuganj Union	12240	764632.8	13088	817607.4	14001	874642.5	14869	928866.4	17779	1110654.1
Baliatali Union	18294	1142826.2	19572	1222662.8	20971	1310058	22329	1394893	23510	1468669.7
Mohipur Union	22905	1430875.4	24126	1507151.2	25388	1585988	26507	1655892	27407	1712115.3
Champapur	17043	1064676.2	18170	1135079.9	20134	1257771	21203	1324551	22130	1382461.1
Chakamaiya	18354	1146574.4	19517	1219227.0	20738	1295503	21885	1367156	22857	1427876.8
Tiakhali	15470	966410.9	15818	988150.5	16667	1041187	17670	1103845	18645	1164753.2
Dhankhali	29067	1815815.5	30958	1933946.3	32948	2058262	34806	2174331	36280	2266411.6
Dhulasar	19720	1231908.4	20136	1257895.9	21231	1326301	22611	1412509	24063	1503215.6
Nilganj	31376	1960058.7	32052	2002288.4	33825	2113048	35970	2247046	38107	2380544.3
Mithaganj	12488	780125.4	12749	796430.0	13422	838472.3	14254	890447.4	15097	943109.6
Latachapli	28068	1753408.0	28708	1793388.8	30282	1891717	32155	2008723	33906	2118107.8
Lalua	23192	1448804.2	23650	1477415.5	24837	1551567	26336	1645210	27853	1739976.9
Kalapara Paurashava	18810	1175060.7	19285	1204734.0	20364	1272139	21450	1339982	22397	1399140.6
Total	**267027**	**16681176.7**	**277829**	**17355977.6**	**294808**	**18416656**	**312045**	**19493451**	**330031**	**20617036.6**

Source: PKCP project, UDD, 2022

The total calculated demand in 2041 would be 54,46,443 gallon per day.

3.9 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 given below:

Table 23: Electricity Demand

	Population, 2021	Electricity Consumption(kwh)	Population,2026	Electricity Consumption(kwh)	Population,2031	Electricity Consumption (kwh)	Population,2036	Electricity Consumption (kwh)	Population,2041	Electricity Consumption (kwh)
Dalbugan j Union	12240	6083280	13088	7486336	14001	9198657	14869	11255833	17779	15503288
Baliatali Union	18294	9092118	19572	11195184	20971	13777947	22329	16903053	23510	20500720
Mohipur Union	22905	11383785	24126	13800072	25388	16679916	26507	20065799	27407	23898904
Champap ur	17043	8470371	18170	10393240	20134	13228038	21203	16050671	22130	19297360
Chakamai ya	18354	9121938	19517	11163724	20738	13624866	21885	16566945	22857	19931304
Tiakhali	15470	7688590	15818	9047896	16667	10950219	17670	13376190	18645	16258440
Dhankhal i	29067	14446299	30958	17707976	32948	21646836	34806	26348142	36280	31636160
Dhulasar	19720	9800840	20136	11517792	21231	13948767	22611	17116527	24063	20982936
Nilganj	31376	15593872	32052	18333744	33825	22223025	35970	27229290	38107	33229304
Mithagan j	12488	6206536	12749	7292428	13422	8818254	14254	10790278	15097	13164584
Latachapl i	28068	13949796	28708	16420976	30282	19895274	32155	24341335	33906	29566032
Lalua	23192	11526424	23650	13527800	24837	16317909	26336	19936352	27853	24287816
Kalapara Paurasha va	18810	9348570	19285	11031020	20364	13379148	21450	16237650	22397	19530184
Total	267027	132712419	277829	158918188	294808	193688856	312045	236218065	330031	287787032 =32.85 MW

Source: World Bank Standard

The total calculated demand in 2041 would be 32.85 MW. According to PGCB report power generation in Barisal region is 2242 MW. (Source: Daily Production report, PGCB, BPDB, 2020)

3.10 Waste Generation

Total volume of waste generation per capita per day in Kalapara pourashava is calculated by the PKCP team in 2023 is 0.20 kg/ person/day. With the help of this data waste generation for specific union and pourashava is calculated in different years considering projected population.

Table 24: Waste Projection

	Population,2021	**Waste per day (Kg)**	Population,2026	**Waste per day (Kg)**	Population,2031	**Waste per day (Kg)**	Population,2036	**Waste per day (Kg)**	Population,2041	**Waste per day (Kg)**
Dalbuganj Union	12240	2448	13088	2617.6	14001	2800.2	14869	2973.8	17779	3555.8
Baliatali Union	18294	3658.8	19572	3914.4	20971	4194.2	22329	4465.8	23510	4702
Mohipur Union	22905	4581	24126	4825.2	25388	5077.6	26507	5301.4	27407	5481.4
Champapur	17043	3408.6	18170	3634	20134	4026.8	21203	4240.6	22130	4426
Chakamaiya	18354	3670.8	19517	3903.4	20738	4147.6	21885	4377	22857	4571.4
Tiakhali	15470	3094	15818	3163.6	16667	3333.4	17670	3534	18645	3729
Dhankhali	29067	5813.4	30958	6191.6	32948	6589.6	34806	6961.2	36280	7256
Dhulasar	19720	3944	20136	4027.2	21231	4246.2	22611	4522.2	24063	4812.6
Nilganj	31376	6275.2	32052	6410.4	33825	6765	35970	7194	38107	7621.4
Mithaganj	12488	2497.6	12749	2549.8	13422	2684.4	14254	2850.8	15097	3019.4
Latachapli	28068	5613.6	28708	5741.6	30282	6056.4	32155	6431	33906	6781.2
Lalua	23192	4638.4	23650	4730	24837	4967.4	26336	5267.2	27853	5570.6
Kalapara Paurashava	18810	3762	19285	3857	20364	4072.8	21450	4290	22397	4479.4
Total	267027	53405.4	277829	55565.8	294808	58961.6	312045	62409	330031	66006.2

The total calculated generated waste in 2041 would be 66.01 ton per day. In Kalapara pourashava 4.48 ton per day.

3.11 Identification of flood risk in different areas and capacity of drainage system

As the area lies at the southernmost tip of Kalapara 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. The gage station measures the daily water level. These data would be used to assess the extent of inundation due to floods. For flood inundation analysis, the topographic data in the form of a digital elevation model (DEM) would be required.

The area is also vulnerable due to extreme precipitation, especially during cyclones that occur during the pre-monsoon and post-monsoon periods. The extreme precipitation and storm surges can cause drainage problems in the area as well. The drainage analysis would require the estimation of design rainfall. The estimated values of flood levels for different return periods for the nearby gage stations are interpolated with spline with barrier algorithm techniques embedded in ArcGIS 10.8 and created flood scenario raster images for 2.33-, 5-, 20-, 50-, and 100-year return periods for the projected area. After the preparation of two raster datasets i.e., elevation and the return period-based water levels arranged as input into the Raster Mathematics module of Spatial Analysis Tools in ArcGIS 10.8. The Subtraction operation was implemented by taking away the values of the water level from the elevation

values. The result of the inundation analysis was mapped where negative values of the map indicate the flood/inundated area while the remaining values indicate the non-inundated area. The derived flood inundation maps corresponding to 2.33-, 5-, 20-, 50- and 100-year return periods are shown in Figures respectively. From the figure very less area area are inundated corresponding to 2.33-, 5-, 20-, 50- and 100-year return periods.

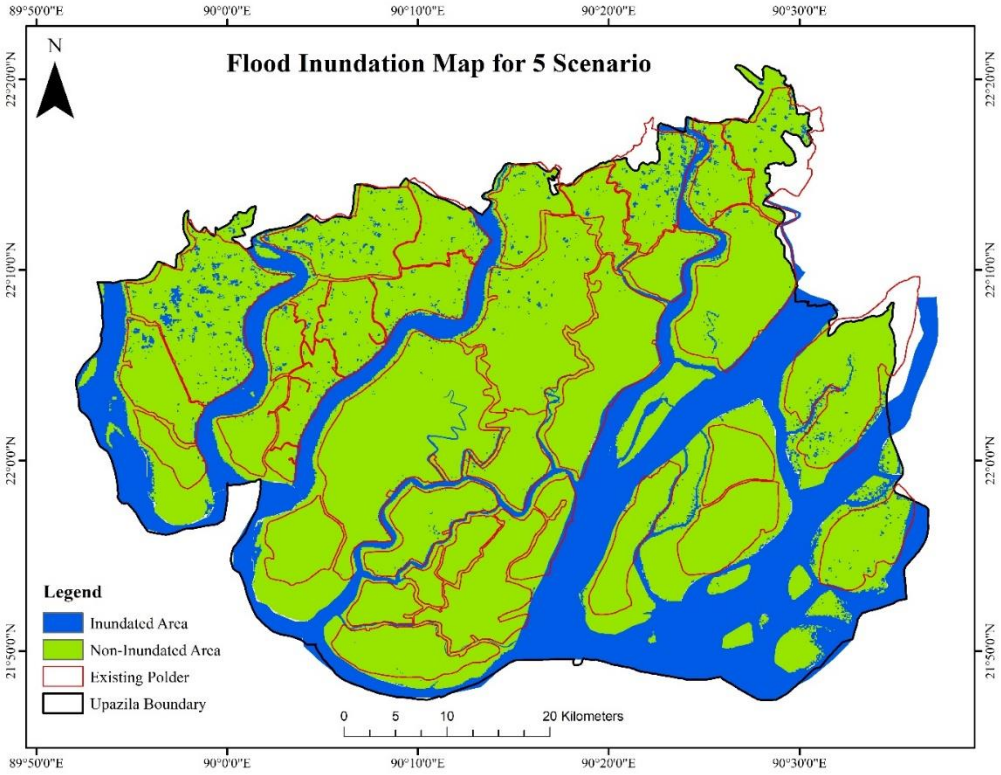


Figure 23 : Flood inundation map for the 5-year return period.
Source: PKCP project, UDD, 2022

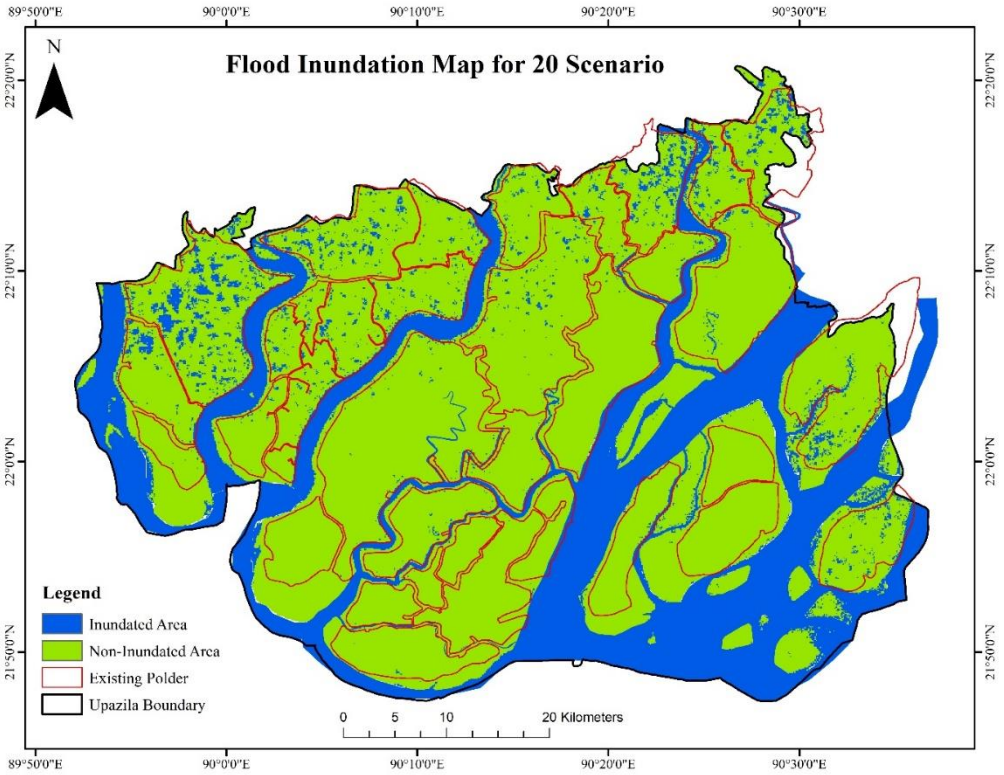


Figure 24 : Flood inundation map for the 20-year return period.
Source: PKCP project, UDD, 2022

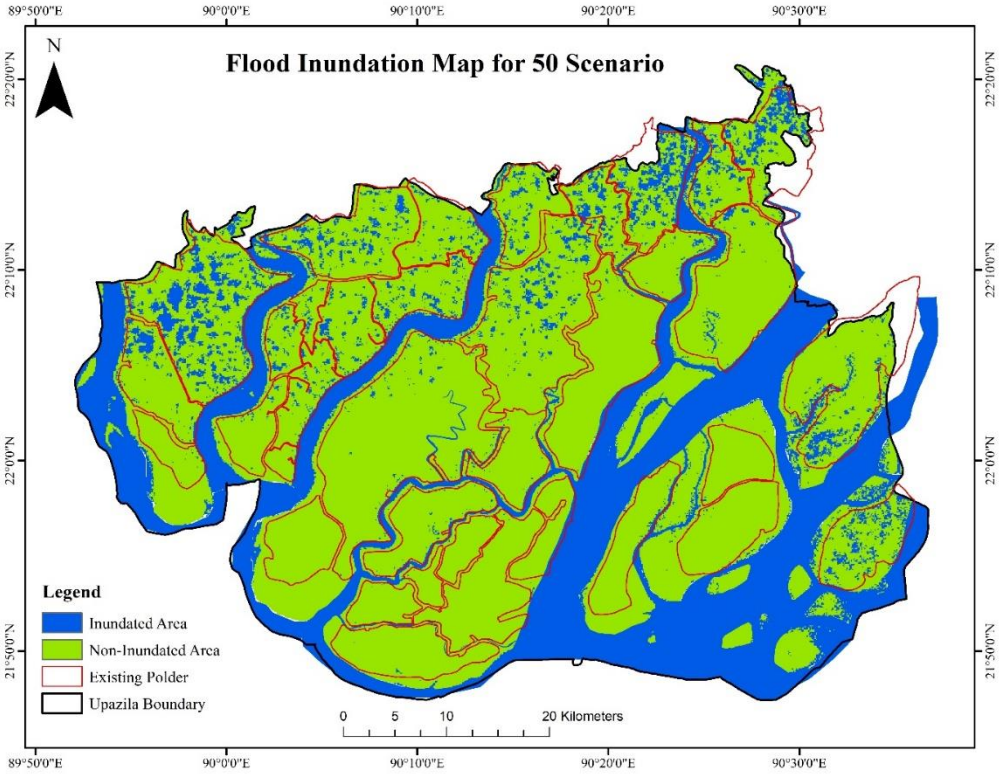


Figure 25: Flood inundation map for the 50-year return period.
Source: PKCP project, UDD, 2022

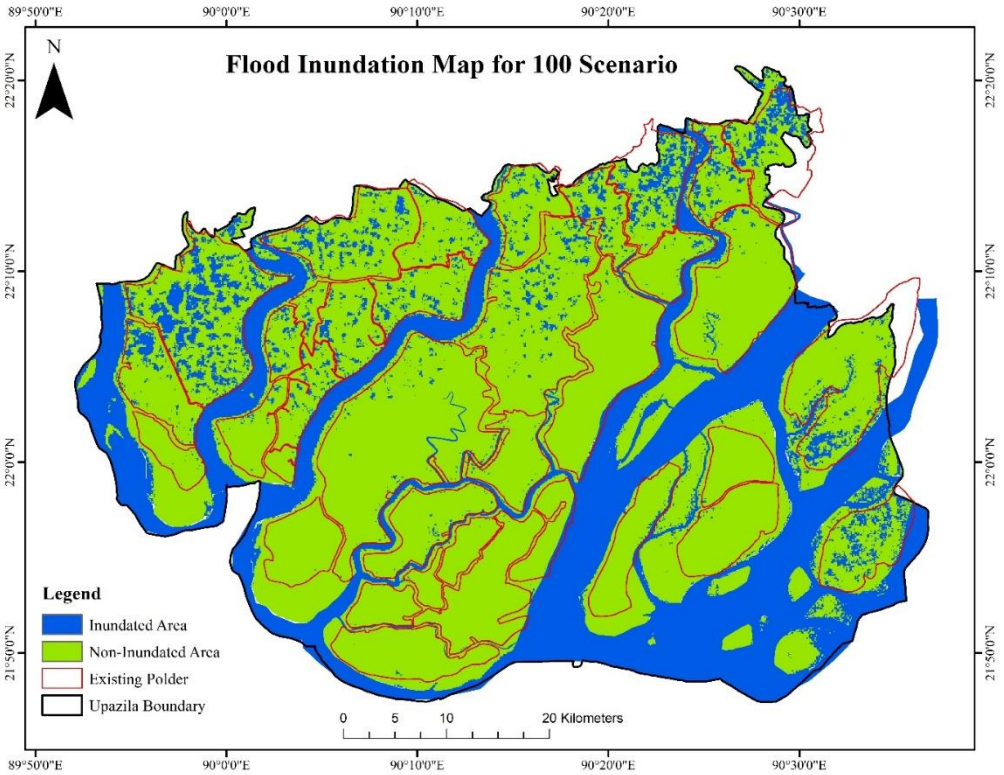


Figure 26: Flood inundation map for the 100-year return period
Source: PKCP project, UDD, 2022

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. From the analysis of composite hazard map, low, moderate and high-risk zone of projected area are found. Composite Hazard map of the Kalapara upazilla is shown in below figur. One union dhulasar were found under High risk area while six unions and two paurasava are under Moderate risk area.

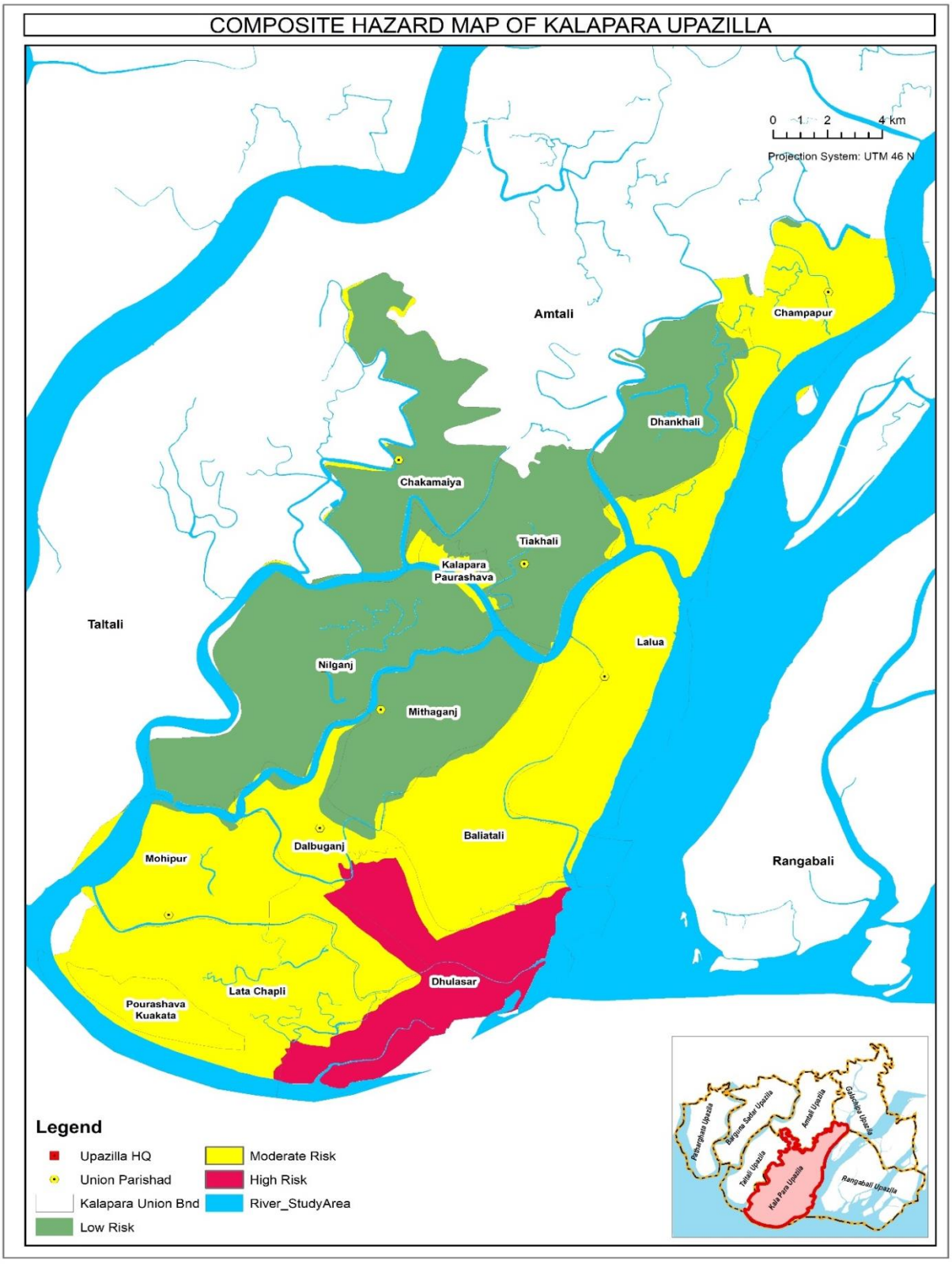


Figure 27: Composite Hazard Map of Kalapara Upazilla
Source: PKCP project, UDD, 2022

3.12 Ecology, Environment and Forest areas

Ecologically Critical Area ecologically defined areas or ecosystems are affected adversely by the changes brought through human activities. Where the ecosystem is considered to be threatened to reach that is consider as a critical area.

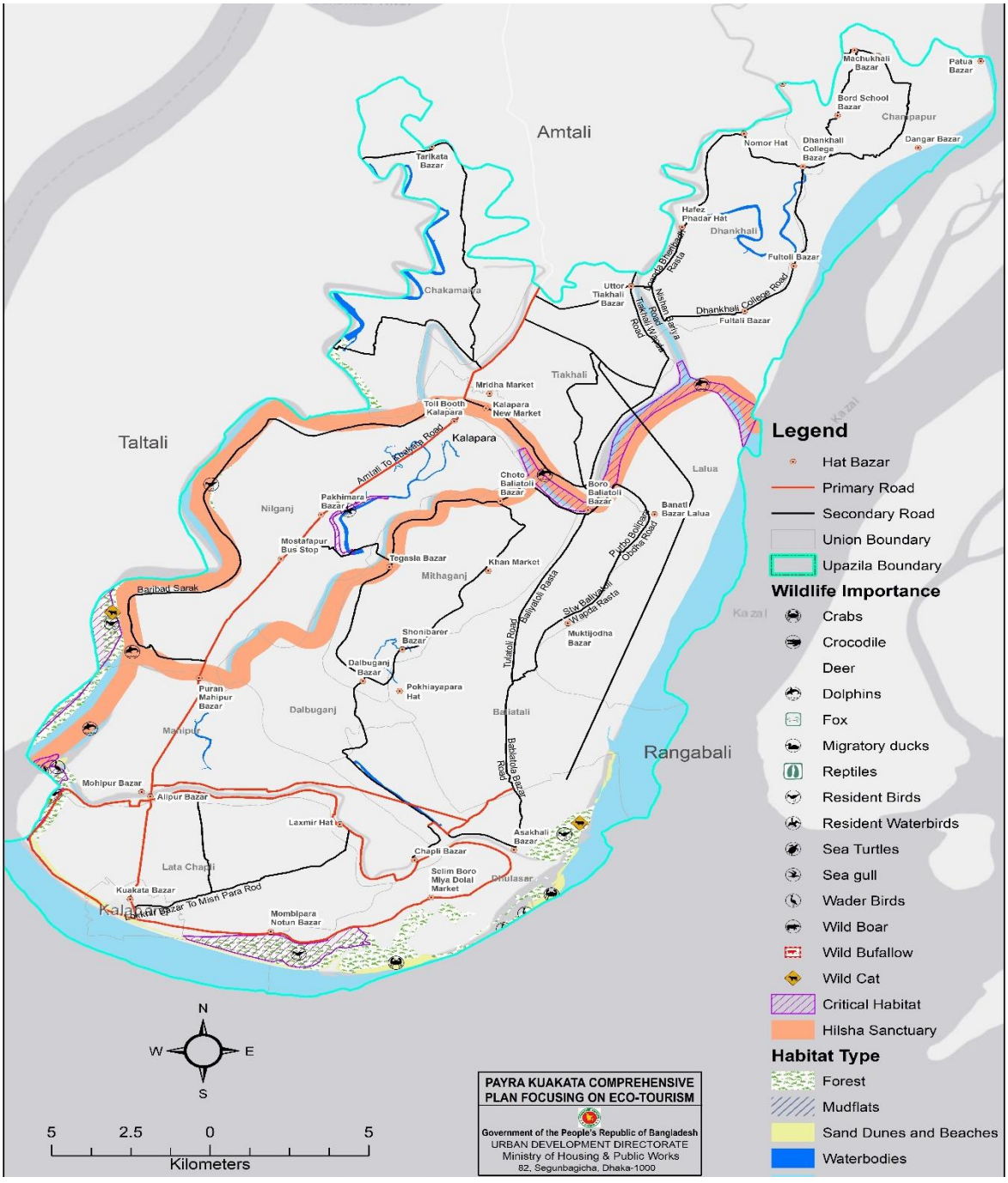


Figure 28: Critical Habitat Area of Kalapara Upazilla
Source: PKCP project, UDD, 2022

Beside the Gangamati Lake Forest at souther portion of kalapara paurashava's river, Lebur bon, Dhulasar mangrove forest are identified as critical habitat area. Hilsha bridging ground

in Andharmanik river is also a critical habitat for hilsha fish. Mangrove forest in Kuakata beach is identified as threatened flora in the area.

3.13 Fisheries

The Meghna River estuary is the largest estuarine ecosystem in Bangladesh which support diverse fisheries. The most important fin fish from an economic perspective are hilsa (Tenualosa ilisha) and the most important crustaceans are tiger shrimp (Panaeus monodon), giant freshwater prawn (Macrobrachium rosenbergii) and mud crab (Scylla olivacea) (Hoq 2008). Other economically important species include silver jew fish (Johnius argenteus), white grunter (Pomadasys hasta), Asian sea bass (Lates calcarife), fatty catfish (Pangasius pangasius), tilapia (Oreochromis niloticus), green back mullet (Chelon subviridis), grey mullet (Mugil cephalus), long whiskered catfish (Mystus gulio), rui (Labeo rohita), catla (Catla catla), common carp (Cyprinus carpio) and silber barb (Barbonymus gonionotus). There are six (06) hilsa sanctuaries that have been declared in Bangladesh. Among them, two (02) hilsa sanctuaries were established in the Andharmanik and Tentulia River which are fall in the study area.

This structure plan has addressed the fishermen's condition, as the development activities in the area will reduce fisheries activities. Numerous fishermen would lose their jobs or will be unable to meet their basic needs. Through communication, infrastructural and tourism sector development, this plan has proposed several alternative sources of income for the local people, which include fishermen and farmers.

3.14 Climate change and vulnerability assessment

Impact of Climate Change

Coastal areas and the resident population are vulnerable to recurrent natural disasters: cyclones, drainage congestion, and floods. Agriculture, irrigation systems, and livelihood activities of the local population are threatened and often disrupted by the erosion of embankments, polders, and other similar infrastructure. presents climate change impacts on key vulnerable sectors in Bangladesh. Recurrent floods caused extensive damage to primary and secondary roads, feeder roads, rural roads, small bridges and culverts, and inland waterway’s support systems, including small jetties. A significant portion of the public sector budget is allocated to meet the replacement investment required to keep the physical

infrastructures in operating condition to prevent further disruption to the economic and livelihood activities of the local population.

Table 25 Climate Change Impacts on Key Vulnerable Sectors in Bangladesh

Sector	Likely impacts of climate change
Water	• Sea level rise • Increased flooded areas due to both sea and river flooding • Reduced water availability for purposes such as drinking water due to saline water intrusion • Increased water shortages, particularly in the northwest and southwest regions • Increased number of droughts, mostly in the western parts of the country • Displacement of coastline population
Agriculture	• Reduced main crop production by 13.9% in 2050, except for Boro rice production • Loss of productive agricultural land due to saline intrusion, coastal erosion, and inundation
Fisheries	• Reduced aquaculture production due to floods • Reduced habitat for freshwater fish due to saline water intrusion
Livestock	• Losses in suitable land for livestock • Increased cattle mortality due to extreme climate events • Reduction of milk, meat and egg production • Feed shortage of animal • Increase disease frequency in livestock and poultry • Reduce grass land due to salinity • Increase probability of zoonotic disease transmission • Increased mortality of livestock and poultry due to extreme climatic events • Increased infertility of cattle
Human health	• Increased water- and air-borne diseases such as malaria, cholera, and diarrhea • Changes in the spatial distribution of diseases and increased incidence zones for diseases such as malaria • Heightened risks to vulnerable groups such as women and children due to saline water
Ecosystems and forests	• Endangerment of species in the Sundarbans mangrove and wetlands due to climate change-induced natural hazards • Loss of forest species and ecosystems in coastal areas due to sea-level rise and inland due to greater moisture stress during dry periods
Infrastructure	• Damage to highways and railways due to flooding
Urban centers	• Increased urban floods and drainage congestion • Increased flash floods and landslides due to urban development (e.g., on hills) • Reduced water quality due to cyclones, storm surges, and floods causing saline intrusion

Source: PKCP project, UDD, 2022

Adaptation to Climate Change

Salinity is a major problem in the region that has been increasing over the years due to climate change. A community-led strategy is sometimes a better option because it is local village people who are often the real experts on climate change. Rather than implementing highly technical, expensive, and outsider-led interventions that have not been tested in the field conditions, priority should be given to using and modifying traditional coping mechanisms developed in the communities in Bangladesh and around the world. In saline areas, this may involve using ancient local technologies such as the huge locally fired clay pots that harvest and store rainwater from roofs, the selection of saline-tolerant rice varieties that have traditionally been cultivated by the sea, or belts of salt-tolerant trees such as mangroves planted along coastal areas to prevent saline intrusion.

Coastal vulnerability usually differs for different communities living in different parts of the coastal belt. Payra-Kuakata region is particularly vulnerable to cyclones associated with tidal surges, mainly in the pre-monsoon months of April-May and post-monsoon months of October-November.

Priority Areas for Adaptation

Area of Focus	Priority Actions
Food security, social protection and health	• Increase the resilience of most vulnerable groups through community-level adaptation, diversification of livelihoods, improved access to services and social protection schemes (e.g., insurance); • Develop climate-resilient cropping systems (including agricultural research), as well as fisheries and livestock systems to ensure local and national food security; • Implement surveillance systems for existing and new disease risks and to ensure health systems are poised to meet future demands; and • Implement drinking water and sanitation programs in areas at risk from climate change, including coastal zones and other flood and drought-prone areas • Expansion of saline tolerant grass cultivation • Climate smart livestock practice • Effective Manure management to face energy crisis (gas and electricity)
Comprehensive disaster management	• Improve the government's and civil society's ability to manage natural disasters and ensure that effective policies, laws, and regulations are in place; • Enhance community-based adaptation programs and ensure they are in place in disaster-prone parts of the country; and • Enhance cyclone, storm surge, and flood early-warning systems
Infrastructure	• Repair existing infrastructure – including coastal embankments, river

	embankments, and drainage systems – to ensure effective operation and maintenance systems; • Plan, design, and construct needed new infrastructure, including cyclone shelters, coastal and river embankments, water management systems, urban drainage systems, etc.; and • Undertake strategic planning of future infrastructure needs, and take into account (a) patterns of urbanization and socio-economic development; and (b) the changing hydrology of the country.
Research and knowledge management	• Improve climate change modeling scenarios for Bangladesh by applying methodologies at the regional and national levels; • Model the likely hydrological impacts of climate change in the Ganges -Brahmaputra-Meghna system in order to assess future system discharges and river levels to feed into flood protection embankment measures; • Monitor and research the impacts of climate change on ecosystems and biodiversity; • Analyze the impacts of climate change on Bangladesh's macro-economy as well as key sectors. • Research the linkages between climate change, poverty, health, and vulnerability in order to ascertain how the the resilience of the most vulnerable households may be improved; and • Create a Centre for Research and Knowledge Management on Climate Change to ensure that Bangladesh has access to the most current ideas and technologies available globally.
Capacity building and institutional strengthening	• Revise all government policies to ensure they consider climate change and its impacts; • Mainstream climate change considerations in national, sectoral, and spatial development planning; • Build the capacity of key government ministries and agencies to move forward on climate change adaptation; • Improve the capacity of the government to undertake international and regional negotiations on climate change; • Build the capacity of government, civil society, and the private sector on carbon financing; and • Build the capacity for education and training of environmental refugees to ease migration to other countries and integration into new societies

Source: PKCP project, UDD, 2022

The projected climate change and variability are likely to have a significant impact on the water supply and sanitation sector in the region. The water supply and sanitation systems, particularly in the coastal region of the country, are vulnerable to such factors as cyclonic and storm surges and flooding. To improve the situation, it is important to:

- Conserve water effectively

- Recycle and reuse water
- Raise tube wells on concrete platforms in order that a clean source of water is available above floodwaters.

Other measures that may significantly improve the adaptive capacity of the coastal communities may include the following:

- Development of coastal green belts as a measure against storm surge
- Improvement of existing cyclone forecasting and warning system
- Analysis of meteorological data to improve prediction of changes in the pattern of cyclonic events
- Ensuring safety by introducing hazard-resistant housing (improved material, alternative design, etc.)

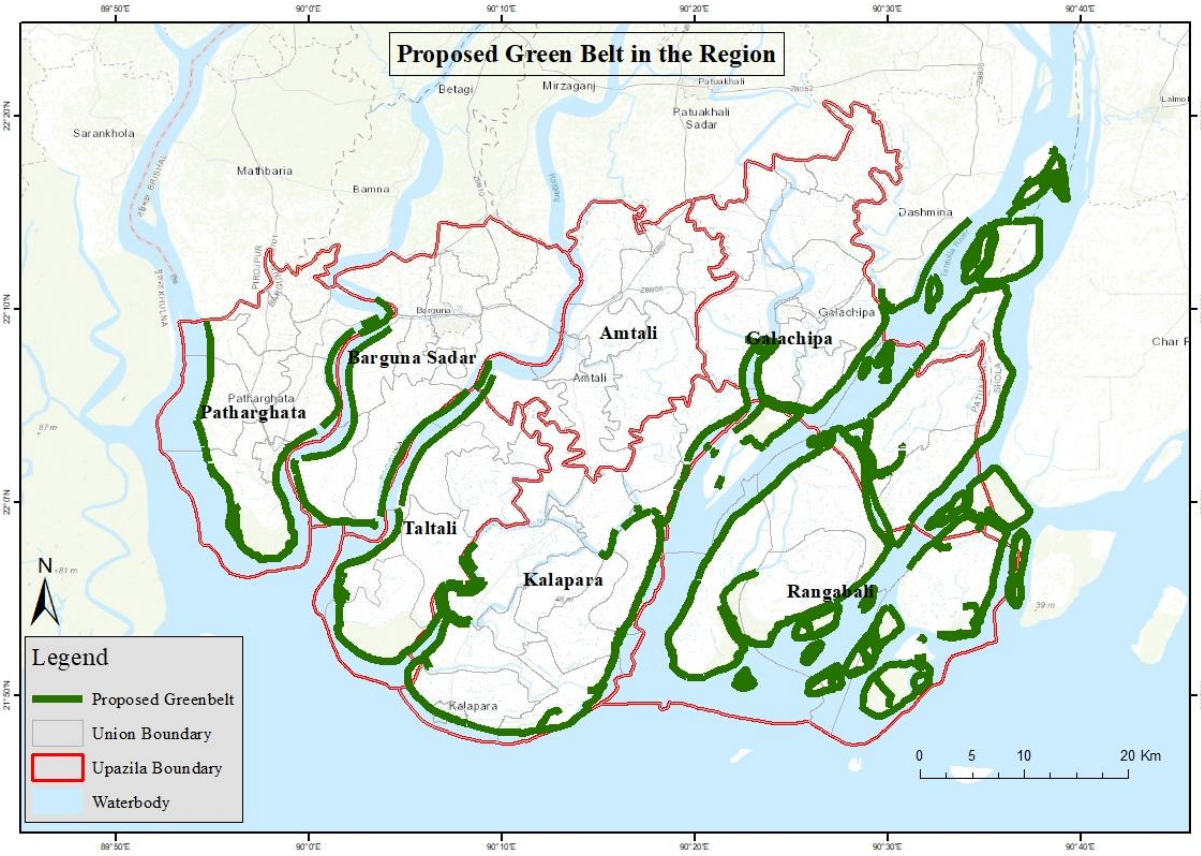


Figure 29: Proposed Green Belt in the Region
Source: PKCP project, UDD, 2022

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 Kalapara Structure Plan area. Some of the important plans and policies that have been reviewed such as the 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 is the key to ensuring sustainable development of urban areas.

PU-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.

PU-02: Limiting urban expansion to the Proposed 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 safeguard urban water bodies, 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.

PU-03: Ensure proper driange, 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 invested in 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.

AP-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 relevent agenciec 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.

AP -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 Kalapara Upazila.

Strategies

Proposals will be made for widening the existing narrow roads and development of new roads where accessibility is poor.

1. 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.
2. Plan should consider integration among road, rail and water way.
3. Establish connectivity with inter-regional highways, economic zone areas, ports, airports, power stations, inland water transport facilities, rail stations and major tourist resorts.

4. 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 aleast one lane.
5. Creation of physical segregation of the primary road from the local activities and local traffic including manually operated vehicles.
6. Establishment of road hierarchy among primary, secondary and tertiary roads.

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 save crop and property, 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 subsurface 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, stormwater 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. Ihe 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 -*1:* 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 necessary steps to promote solar energy, renewable energy and Wind Mill as alternative national power supply. Involve private sector to meet the supply gap through sustainable energy.

Strategies

1. Involve private commercial agencies and energy sector NGOS to supply domestic solar system.
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 Kalapara 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 rive 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. Extension and improvement of multipurpose cyclone shelters. Prepare guidelines for designing climate change resilient infrastructure. Upazila level public sector development agencies to follow guidelines during development of 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-*4:* Identification, protecction 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 ares of crab, crocodile, deer, dolphins fox migratory ducks reptiles, resident birds, resident waterbirds, sea turtles sea gull, wild boar, wild buffallow, 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-*6:* 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 water body. 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 land 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 area to protect 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 Kalapara Upazila in the long run, it is required to encourage the industrial establishment within Upazila area.

Strategies

To control the haphazard in the midst of industrial development, measures will be undertaken as followed

- Following the category of industries as categorized by DOE (Green Category) and Bangladesh National Building Code (low and medium category hazards)
- Following Bangladesh National Building Code, 1993 & 2006 and Building Construction Regulation, 1952 (amendment in 1996) for providing Road, setback before construction of any industrial structures

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

Justification

Kalapara Upazila is dependent on agriculture and small business through direct or indirect involvement. Emphasis is required for accelerating the economic development trend by restoring the economic base. Small growth Center should be developed in different union. Public and private investment should concentrate in this growth center. This policy will create opportunities for developing basic agro-based industries in Kalapara Upazila .

Strategies

Agro-based industries will help the existing producers to increase their earning and increase the employment opportunities through ensuring increased capacity.

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

Justification

Promoting rural growth centers 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

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

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 labor 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 labor 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, 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. Some of the key implementing agencies for forest conservation in Bangladesh include- Bangladesh Forest Department (BFD) Local Government Department (LGD), Bangladesh Forest Research Institute (BFRI), and Community-based Organizations (CBOs).

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 core area of paurashava, topographically, Kalapara Upazila is mainly rural in nature. Some portion are mainly containing urban characteristics. But in recent years, communication development has already impacted the growth and expansion of activities within the paurashava. The existing land use of the Upazila shows that 48.34 percent of the land is used for agricultural activity, and another mentionable land-use area is 12.01 percent Residential, 1.03 percent vacant land and 2.45 percent forest area. Table 26 illustrates existing landuse statistics in detail.

Table 26: Existing Landuse of Kalapara Upazila

Existing Land Use	Are(Acre)	%
Administrative/ Public Service	2288.35	1.92
Agriculture	57655.77	48.34
Beach	137.2922	0.12
Commercial	103.5752	0.09
Community Service	285.9909	0.24
Education and Research	243.4593	0.20
Forest	2915.962	2.45
Health Service	12.81998	0.01
Manufacturing and Processing	3837.568	3.22
Mixed Use	73.82675	0.06
Open Space and Recreational	1997.444	1.67
Residential	14325.26	12.01
Road	1514.031	1.27
Service Activity	132.7905	0.11
Transportation and Communication	6199.28	5.20
Vacant Land	1233.737	1.03
Vegetation	354.3578	0.30
Waterbody	25949.07	21.76
Grand Total	**119260.6**	**100.00**

Source: PKCP project, UDD, 2022

Figure 30: Existing land use Of Kalapara Upazilla
Source: PKCP project, UDD, 2022

5.2 Suitable site ranking-findings from suitability analysis

5.2.1 Ranking Suitable Areas based on Geological Attributes

5 major criteria have been selected for suitability analysis. The 5 criteria are - PGA, Foundation layer depth, Soil Type, Liquefaction Potential Index and Building Height Recommendation. To find out the relative weight of these criteria AHP pairwise comparison have been applied in decision making. Around 58.50 percent area were found moderately suitable and 1.55 percent found good, 32.62 are poor, 7.33 are very poor for infrastructure development such as government buildings, hospitals, cyclone centres etc. These are shown the below map:

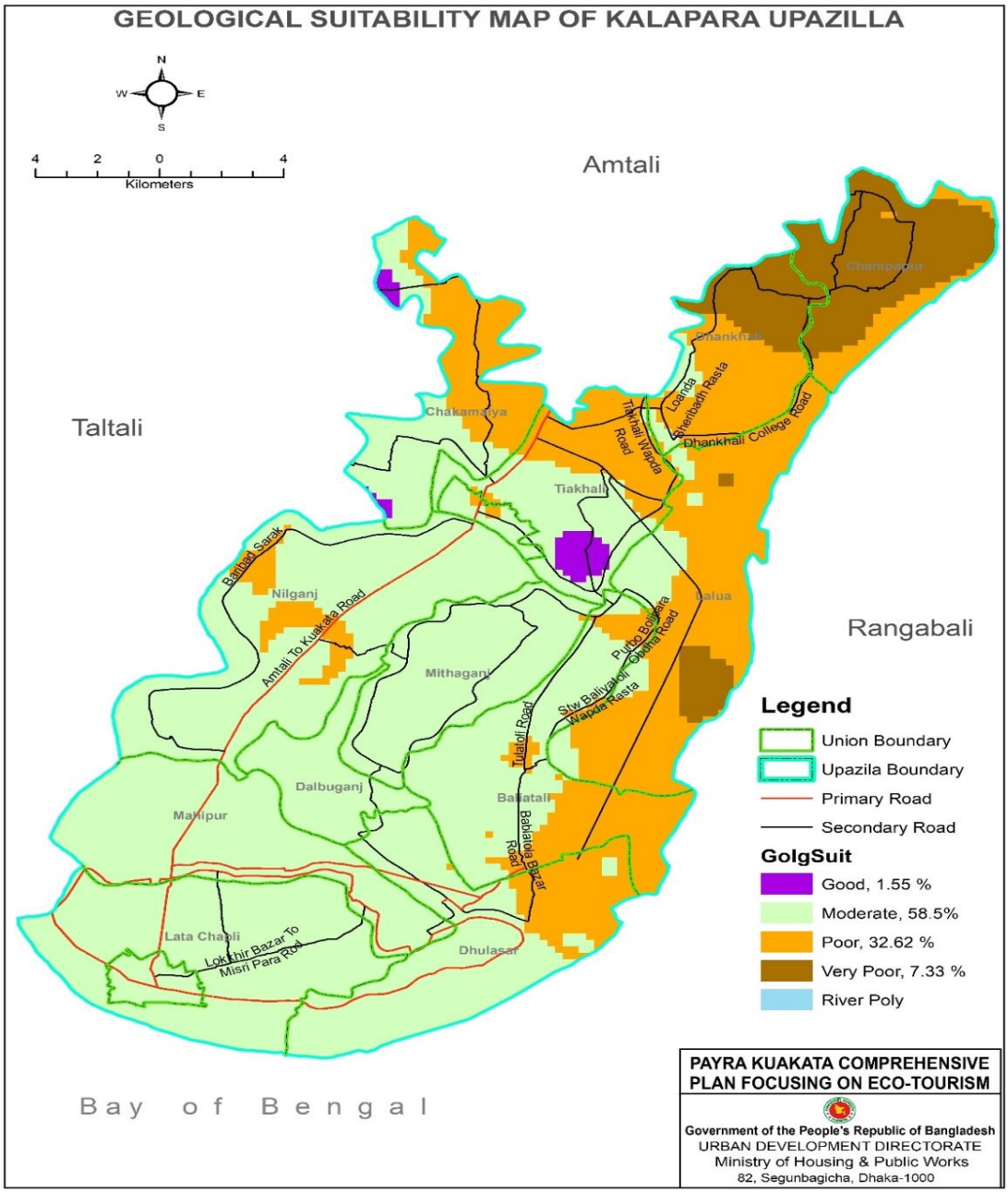


Figure 31: Ranking of suitable sites considering geological attribute

Source: PKCP project, UDD, 2019

5.2.2 Ranking Suitable Areas based on Hydro-geological Attributes: -

Most natural processes rely on water. It shapes the landscape by transporting silt and solutes to lakes and oceans. Hydrogeological 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 ground water 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. In this study, for calculating the WQI of water samples, 13 parameters are taken into consideration which are Na^{+}, K^{+}, Ca^{2+}, Mg^{2+}, $HCO3^{-}$, Cl^{-}, $SO4^{-}$, $NO3^{-}$, Fe, Mn (all in mg/l), EC, pH and TDS .

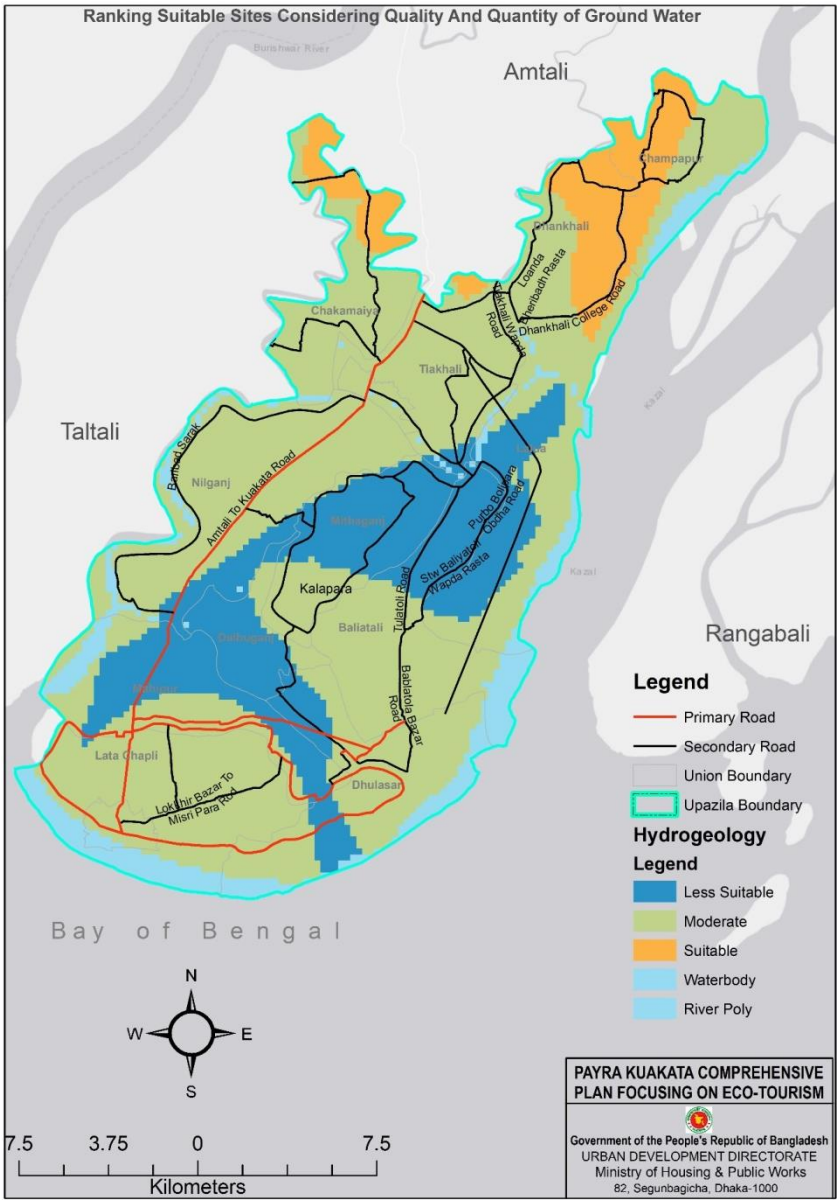


Figure 32: Ranking of suitable sites considering Hydrological attributes
Source: PKCP project, UDD, 2019

Around 67.87 percent areas were found moderately suitable and 22.36% are less suitable, 9.75% are suitable.

5.2.3 Ranking Growth Centres considering existing function

Growth centres have been categorized into rural trade and commerce centres, 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 centres, while public services including health centres, schools, and colleges will be supported inside the various level service centres.

Urban growth centres, often referred to as growth centres, 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 centres. When rating growth centres, 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.

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.

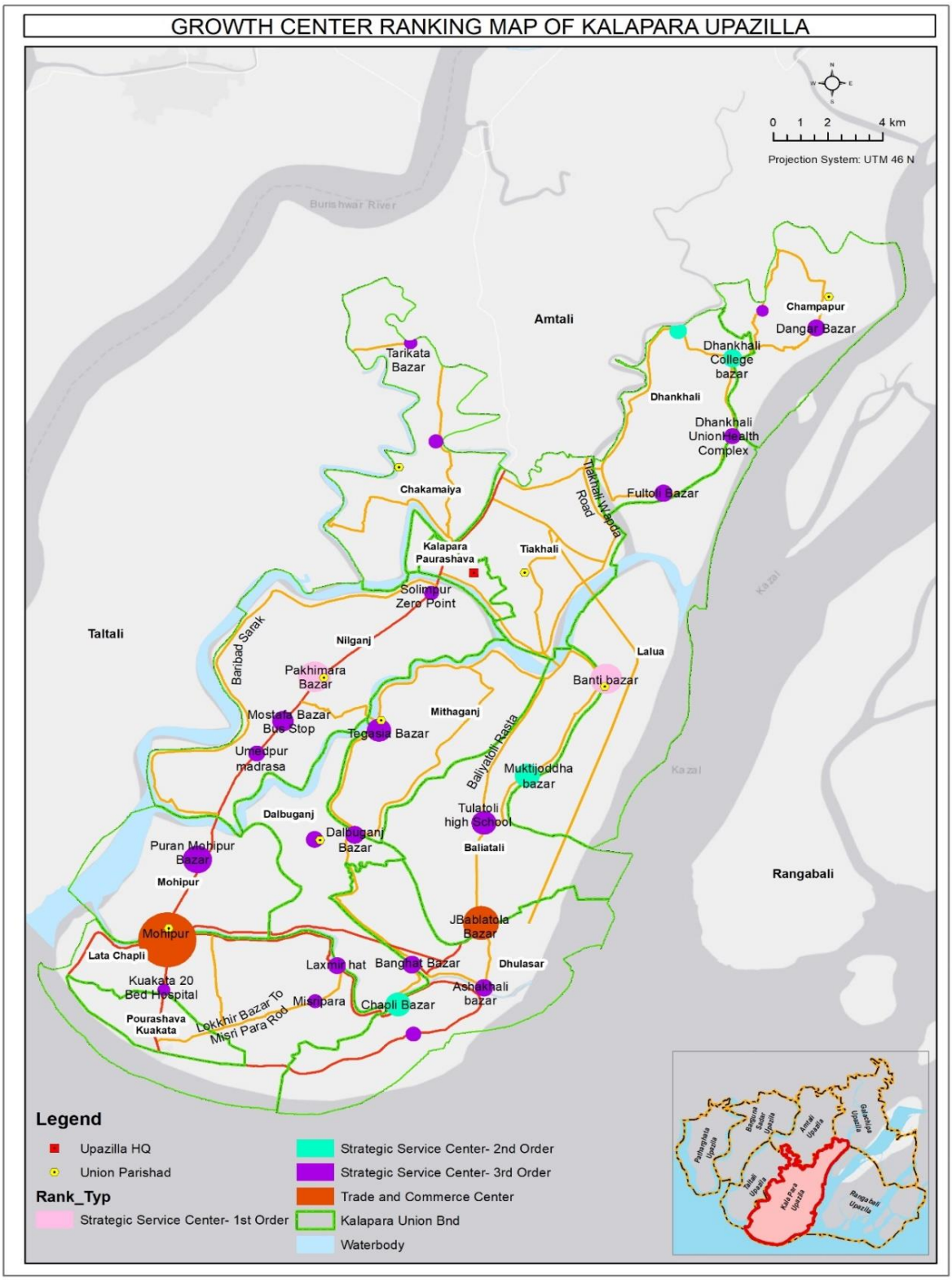


Figure 33: Ranking of strategic Service centers considering existing function
Source: PKCP project, UDD, 2022

5.3 Suitable site ranking- findings from multicriteria 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 attribiture of the upazila, disaster risk, elevation and building height zones have been considered. Due to upgradation of construction technology, it is possible to reach foundation depth 25 to more than 30 m.

5.3.2 Ranking Suitable Areas for Human Settlement

The human settlement environment includes surface spaces that are inextricably linked to human activity and life. Kalapara Upazila is a seaside location with a low level of urbanization. However, it comes with a slew of issues, including a scarcity of high-quality water and the threat of disaster. As a result, development geological attribute of the upazila, Hydro-geology, Road Proximity, Elevation and Disaster risk have been taken into account when ranking human settlement sites (Fig: 33).

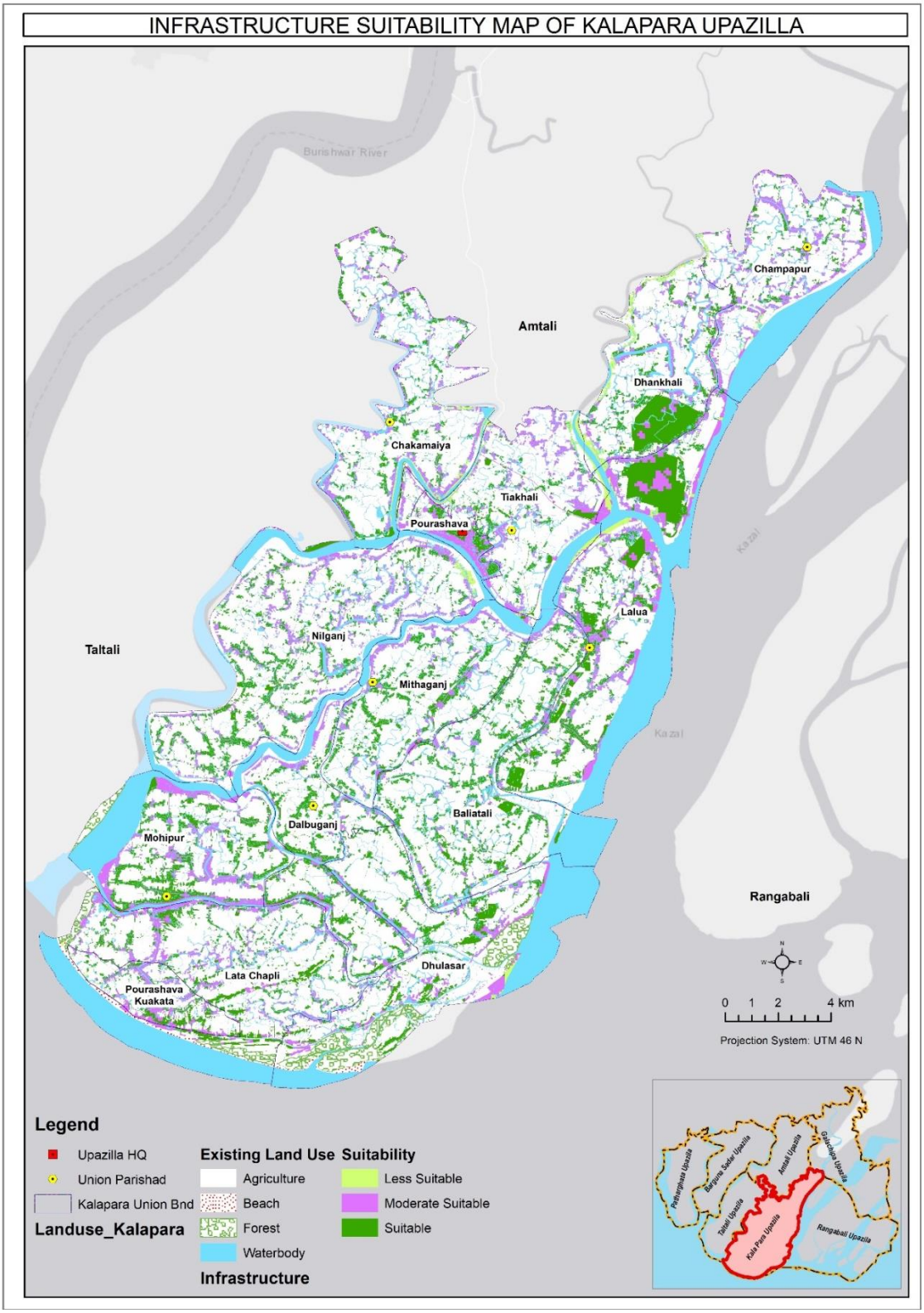


Figure 34: Ranking of Suitabile sites for infrastructure development
Source: PKCP project, UDD, 2022

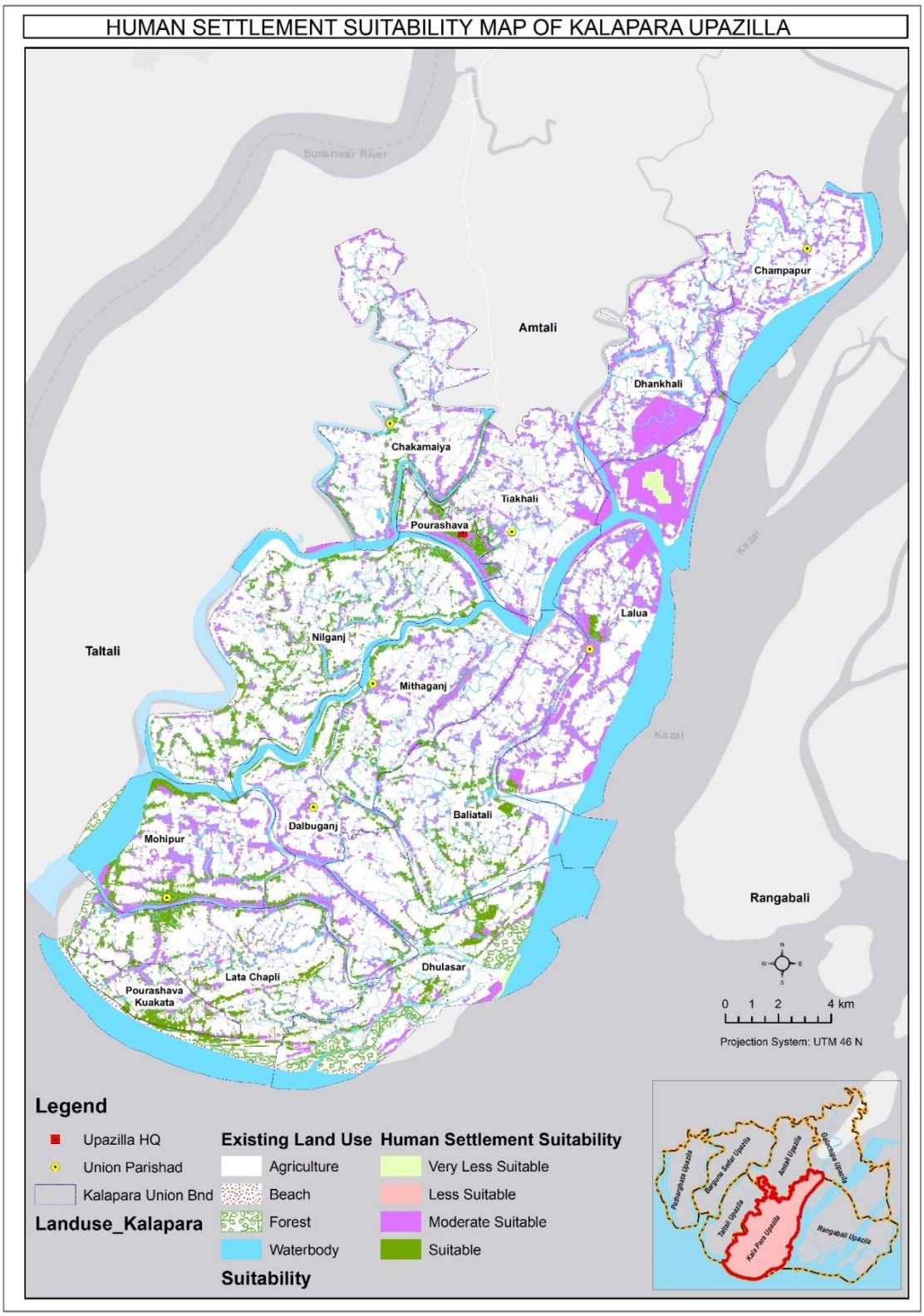


Figure 35: Ranking of suitable sites for human settlement
Source: PKCP project, UDD, 2022

Some portion of Nilganj, Baliyatali, Mohipur union are suitable for human settlement.

5.3.3 Directives From Regional Plan

From regional plan, some proposals are driven and integrate in to structure plan. From analysis, Kalapara was derived from necessary facilities and in structure plan these facilities has incorporated and that's why some zones are proposed as structure plan zones. Below key points are directives from regional plan:

- Conservation of forest resources and protect biodiversity through proposal of
- Ensure sustainable management of natural resources through proposal of Structure plan
- Existing thermal Power plants to promote sustainable energy sources
- Construct polders and coastal green belt to prevent saline water intrusion
- Preference of temporary structures with local raw materials (like floating hotels, eco-resortsetc.)
- Promote eco-friendly water-based transportation for tourists
- Promote employment generation through development of tourism sector and Economic Zone

5.3.4 Various Govt. Project Location

Govt has some project for Kalapara Upazila that is the construction of cyclone shelter, road, port land and coastal afforestation, thermal power plants, EPZ, etc. The project proposal has taken into consideration for preparing plan. List of Govt Project for Kalapara Upazila has given below

Table 27: List of Govt projects of Kalapara Upazila

Name of the Project	Mauza-JL- Sheet	Union
Ashugonj 1320 Megawatt Super Thermal Power Plant	Dhankhali-12-01 Debpur-69-01&2&3, Panch-13-3 &4,	Dhankhali, Champapur
1320 Megawatt Thermal Power Plant	Madhupara-12-1&2&3&4, Nishanbariya-11-01	Lalua
Sena Kollan Organization Power Plant Land Acquisition	Dhankhali-12-04&5&6	Dhankhali,
1320 Mega Watt Super Tharmal Power Plant based on Coal at Patuakhali	Dhankhali-12-07, Nishanbariya-11-02&4,Londa-73-2&5	Dhankhali,Lalua
BNS Sher-E Bangla Patuakhali	Londa-73-1&2&3&4, Banatipara-15-1&2, Golbania-13-1&2&3	Lalua
Radar Station, Obervation Tower with Navy Base	Latachapli-34-14	Latachapli
Payra Port Land Acquisition	Banatipara-15-1&2&3, Lalua-14-4, Nayakata-16-3&4,Chandupata-17-	Baliatali, Dhulasar, Lalua

	2&3&4&5, Char Baliyatali 31-1&2, Dhulasar-32-02&04&05	
Land Acquisition for Coal Terminal	Nishanbariya-11-03	Lalua
Four lane connection road of national highway with Payra port	Rajapara-9-1&4, Itbariya-8-01&2	Tiakhali
Payra Port Watch Tower and Security Barrack	Kawar Char-37-3	Dhulasar
Payra Port Land Acquisition for Truck Terminal	Itbariya-08-02	Tiakhali
Kuakata Duck Banglo construction	Latachapli-34-19	Latachapli
Kuakata police officers mess construction	Latachapli-34-16	Latachapli
Kuakata Sub Divisional Office and compound project	Latachapli-34-16	Latachapli
Mahipur Motsho obotoron kendro	Shibbariya-26-05	Mohipur
Motsho obotoron kendro	Latachapli-34-02	Latachapli
Payra Custom House Authority, Official Building	Lalua-14-04	Lalua
Ship construction and improvement project	Madhupara-12-04, Char Nishanbariya-48-02	Lalua
Construction of Cyclone Shelter Project (2nd Phase)	Panch Jaina-13-4	Dhankhali
Construction of Cyclone Shelter Project (2nd Phase)	Tungibariya-41-04	Nilganj
Exclusive Tourist Zone (ETZ)	Kawar Char-37-1&2&3, Dhulasar-32-03&5, Char Chapli-37-03&04	Dhulasar
Watch Tower and Tourism Centre in Kuakata	Latachapli-34-22	Latachapli
Proposed EPZ	Itabariya-08-1&2&3&4	Tiakhali
Airport	Chakamaiya Nishanbariya	Chakamaiya

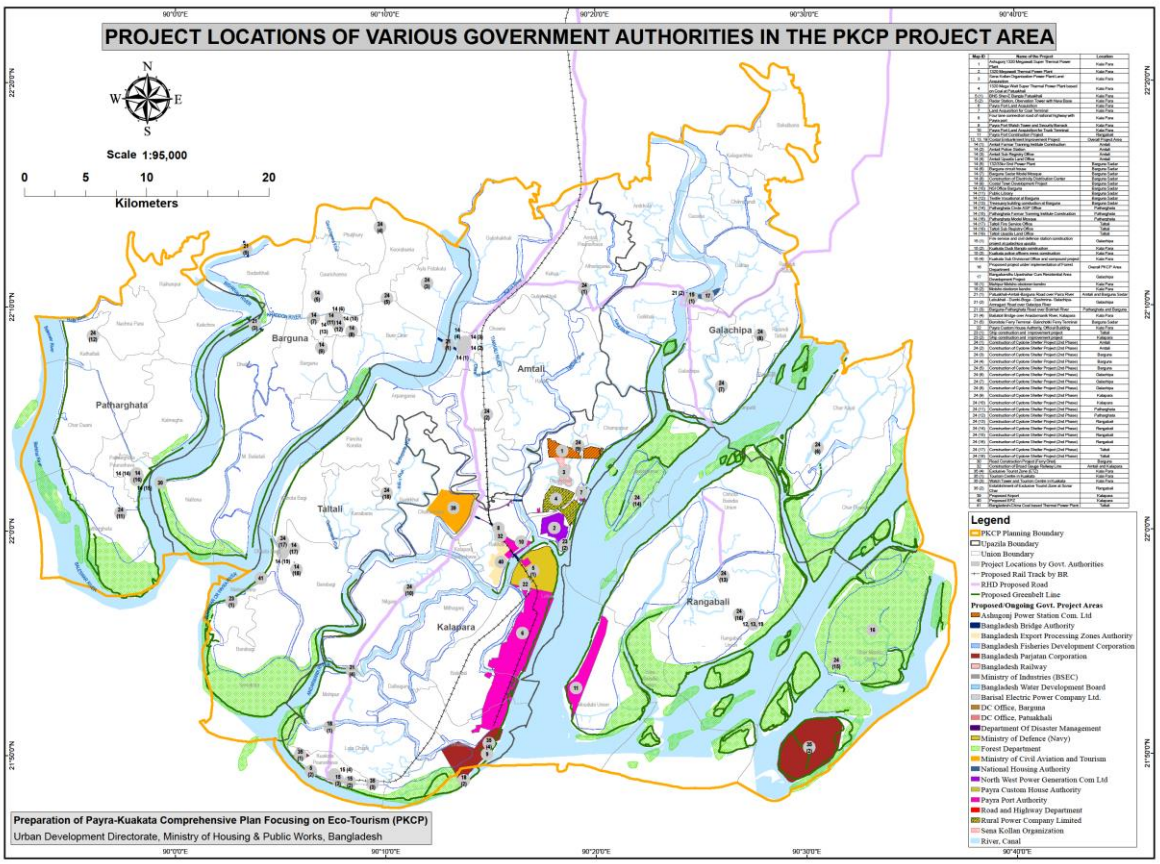


Figure 36: Govt. project location

Source: PKCP project, UDD, 2023

5.4 COMPOSITE STRUCTURE PLAN

5.4.1 Structure plan policy zoning

For future planned development of the upazila 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 15 strategic zones. These are Agriculture, Zone, Circulation Network, Coastal Afforestation and Foreshore Area, Conservation Zone, Core Urban Area, Economic Region, industrial and manufacturing Zone, Potential Urban Area, Rural Settlement, Strategic Service Center 1st Order, Strategic Service Center 2nd Order, Strategic Service Center 3rd Order, Trade and Commerce Zone, Urban Fringe Area and Water Body.

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.

Core Urban Area*:* The term "urban core" 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 Urban Core Area.

Urban Fringe Area*:* The Potential Future Urban, also known as the outskirts, urban, peri-urban, or urban hinterland, is a terrain boundary between town and country, or a transition zone where urban and rural activities mix and frequently clash. According to demographic projections, this zone will require additional land for future urban planning. Existing physical growth patterns and potential areas must be taken into account when planning new urban land development. Road, drain, walkway, west transfer station, and other civic services will be supplied as new facilities and services. In the year 2032, this area is expected to expand. 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 Urban Fringe Area.

Rural settlement: 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 outside 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.

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. 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.

Coastal Afforestation and Foreshore Area: 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 coastal afforestation.

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.

Conservation zone: a sizable area primarily covered in Forest, trees and vegetation. It does not include land that predominantly under agricultural use or other use. This could be natural made or manmade.

Circulation Network: *M*ajor circulation covering primary and secondary roads

Waterbody: A waterbody 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.

Potential Urban Area: The area which has potentiality to be urbanized. The density is increasing in this area. Autorickshaw 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.

Industrial and manufacturing Zone: a location that designated for industry to produce goods or materials.

Other zones are Trade and commerce zone, Strategic Service Center 1st Order, Strategic Service Center 2nd Order, Strategic Service Center 3rd Order Zone. These zones are described in section 5.6 in this report.

5.4.2 Structure plan of Kalapara Upazila

Agricultural lands are cultivated and cultivable lands that have to be protected for food safety of the country; it is about 30.92% of the total upazila area; Circulation network (10.26%) which includes primary and secondary roads. Rural settlement (22.49%) encompasses rural housing structures and surrounding vacant land and vegetations- which is the second heights land use. Core urban core (0.59%) area within pourashava area and Urban Fringe Area (0.3%), Coastal Afforestation and Foreshore Area covers 10.11% area mainly proposed near river side, Conservation Zone 0.59 % and 15.50 % water body that includes canals and ponds with 0.25 acres area. This structure plan has proposed 3.36 % land as industrial and manufacturing 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.

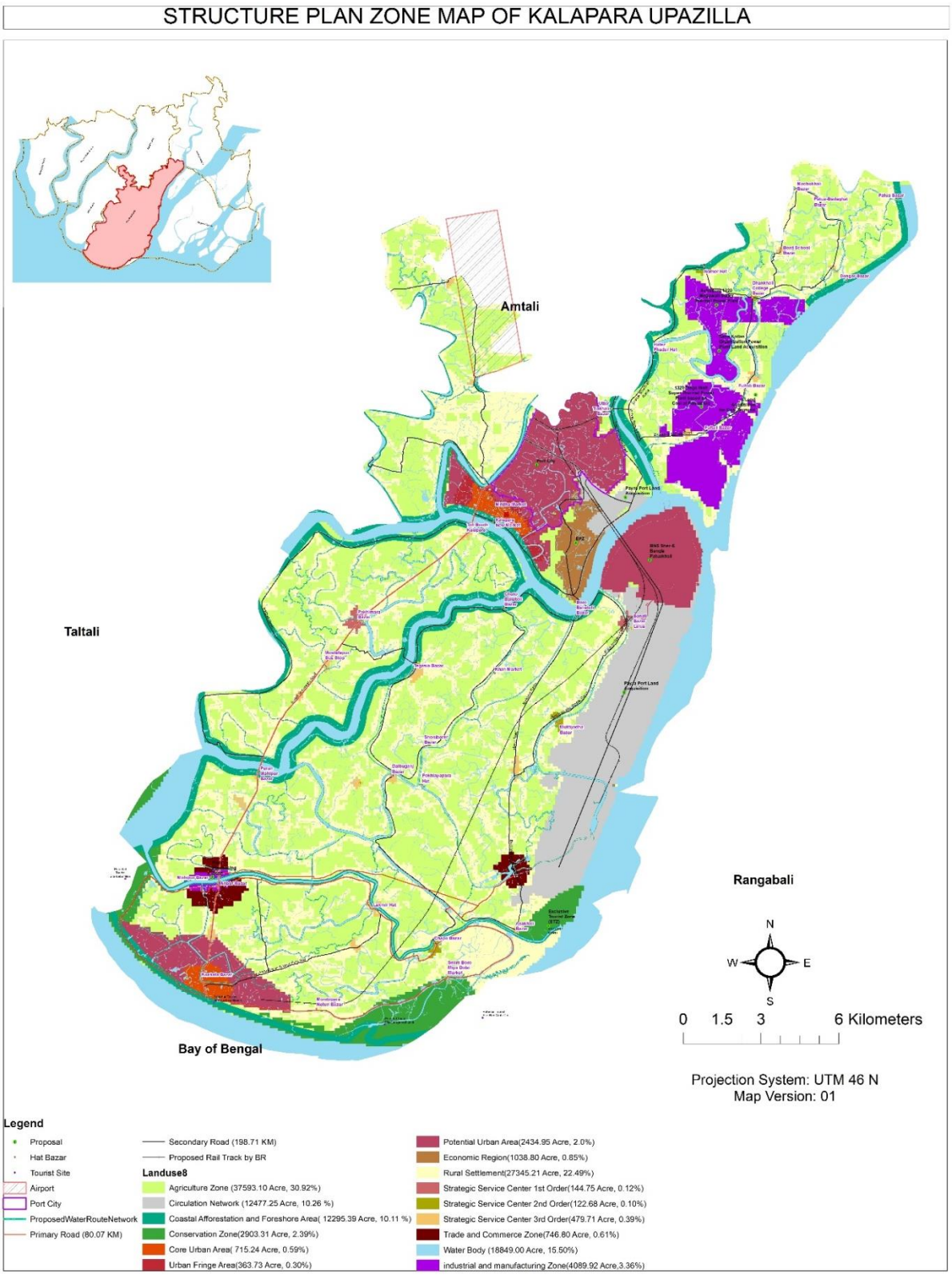


Figure 37: Structure plan map of Kalapara Upazila

Source: PKCP project, UDD, 2022

Landuse Category	Area(Acre)	%
Agriculture Zone	37593.10	30.92
Circulation Network	12477.25	10.26
Coastal Afforestation and Foreshore Area	12295.66	10.11
Conservation Zone	2903.31	2.39
Core Urban Area	715.24	0.59
Economic Region	1038.80	0.85
industrial and manufacturing Zone	4089.92	3.36
Potential Urban Area	2434.95	2.00
Rural Settlement	27345.21	22.49
Strategic Service Center 1st Order	144.75	0.12
Strategic Service Center 2nd Order	122.68	0.10
Strategic Service Center 3rd Order	479.71	0.39
Trade and Commerce Zone	746.80	0.61
Urban Fringe Area	363.73	0.30
Water Body	18849.00	15.50
Grand Total	**121600.1**	**100**

Table 28: Percentage of area of proposed zones

Source: PKCP project, UDD, 2022

5.5 Development Proposals:

The development proposals on the basis of planning standards are provided for land uses in different sectors for various phases of plan period in Kalapara Upazila. Some major development projects with possible guidelines are proposed in this plan. The possible sources of funding the projects have also been identified in the Structure Plan.

Table 29: List of Development proposals for Structure Plan

Proposals Name	*Quantity*	*Location*
Strategic Zones	21	Overall Upazila
Water Dock yard	1	Alipur Kheyaghat
Proposed Water Route	23.10 Km	This network Connected from fatrar char kuakata to rangabali
Eco-Tourism Zones	3	Lebur Ban, Gangamati Lake, Kuakata Beach
Airport	808 Acre (Kalapara part)	An Airport proposed at Chakamaiya union
EPZ	1049.45 Acre	An EPZ proposed Itbariya mauza , this demarcated as a potential Economic Zone in Strauctre plan
Port City	3742 Acre	Potential planned Port City proposed at Baliyatali Union
Agro Fish Processing Zone	145.93 Acre	Proposed at mohipur and alipur Kheyaghat
Forest Area	2290.79 Acre	Near the gangamati Lake Dhulasar union, there proposed forest area. Wooden walk inside the forest area is an attractive event for tourist
Primary Road	80.07 km	Connecting Growth Center
Secondary Road	198.71 km	Connecting Growth Center
Tourism Center in Kuakata	82.52 Sq.km.	Latachapli, Dhulasar, Kuakata Municipality

Source: PKCP project, UDD, 2022

Lebur ban, Gnagamati Lake, Beach kukata can be a good place for ecotourism development due to the visual splendour created by the mangrove plantation. It can provide a sense of seclusion from other regions of the world and has enormous potential for developing eco-tourism destinations. The small single cottage can be developed in association with group tourism by creating a natural barrier. As a result, there would propose to developed Kuakata Tourism Center (KTC) plan. Due to Pyra port, thermal power plant, kuakata beach, Amtali there also increased an unplanned development in this area. Considering this scenario, there also proposed a development authority in the region including Amtali, Kalapara and Talatali upazilla.

Proposed Road Network

From the existing data, it has seen that, the conditions of roads are very poor, narrow. And maximum roads are katcha roads in Kalapara Upazila. And according to perspective plan, road proposals has given in ordet to connect growth centers from union to union and upazila to other upazilas.

Proposed Class	Proposed Width (ft)	Planning Decision
Primary Road	60-80	Widening
Secondary Road	40	Widening
Dhaka –Kuakata Highway	300	Widening

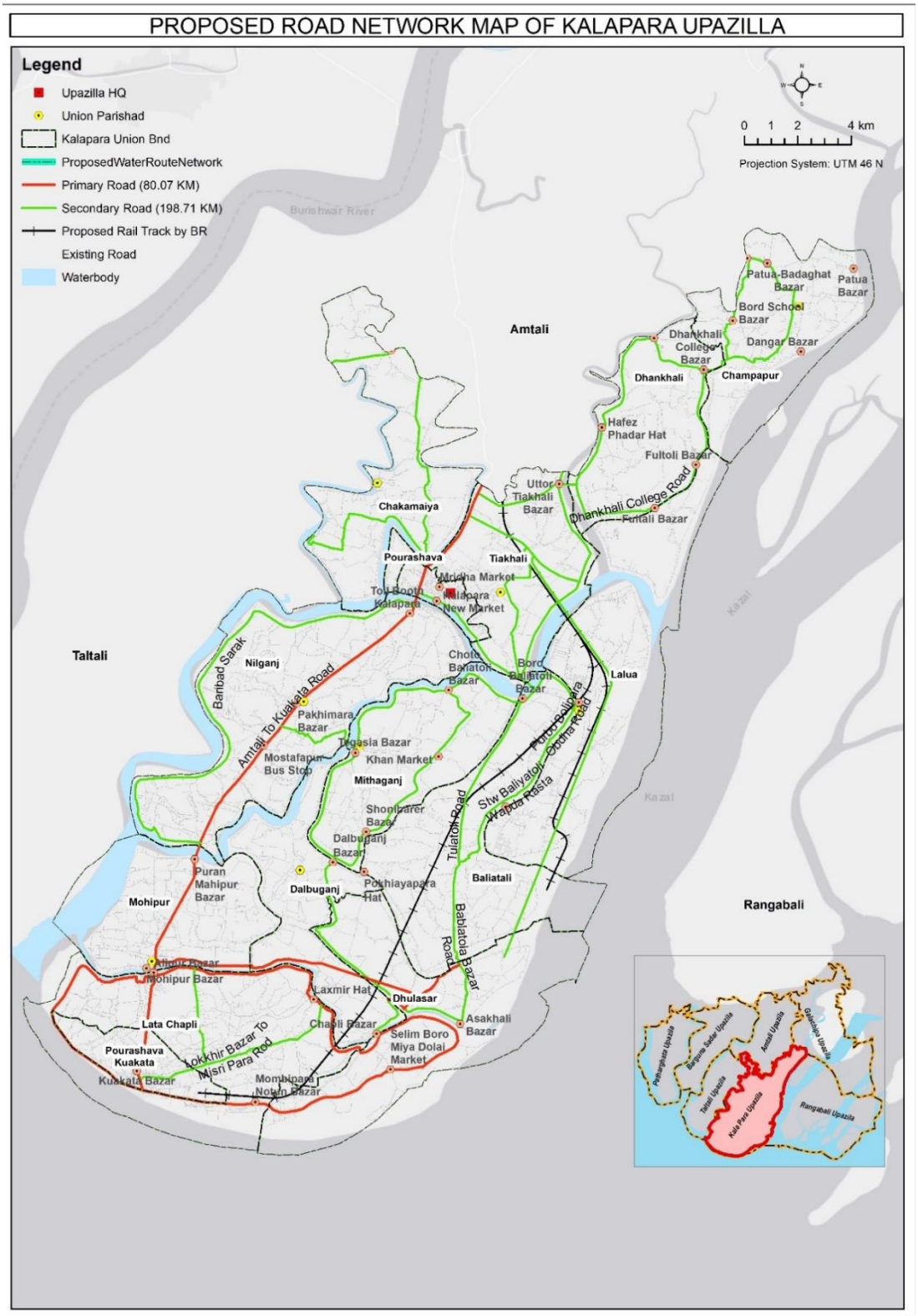
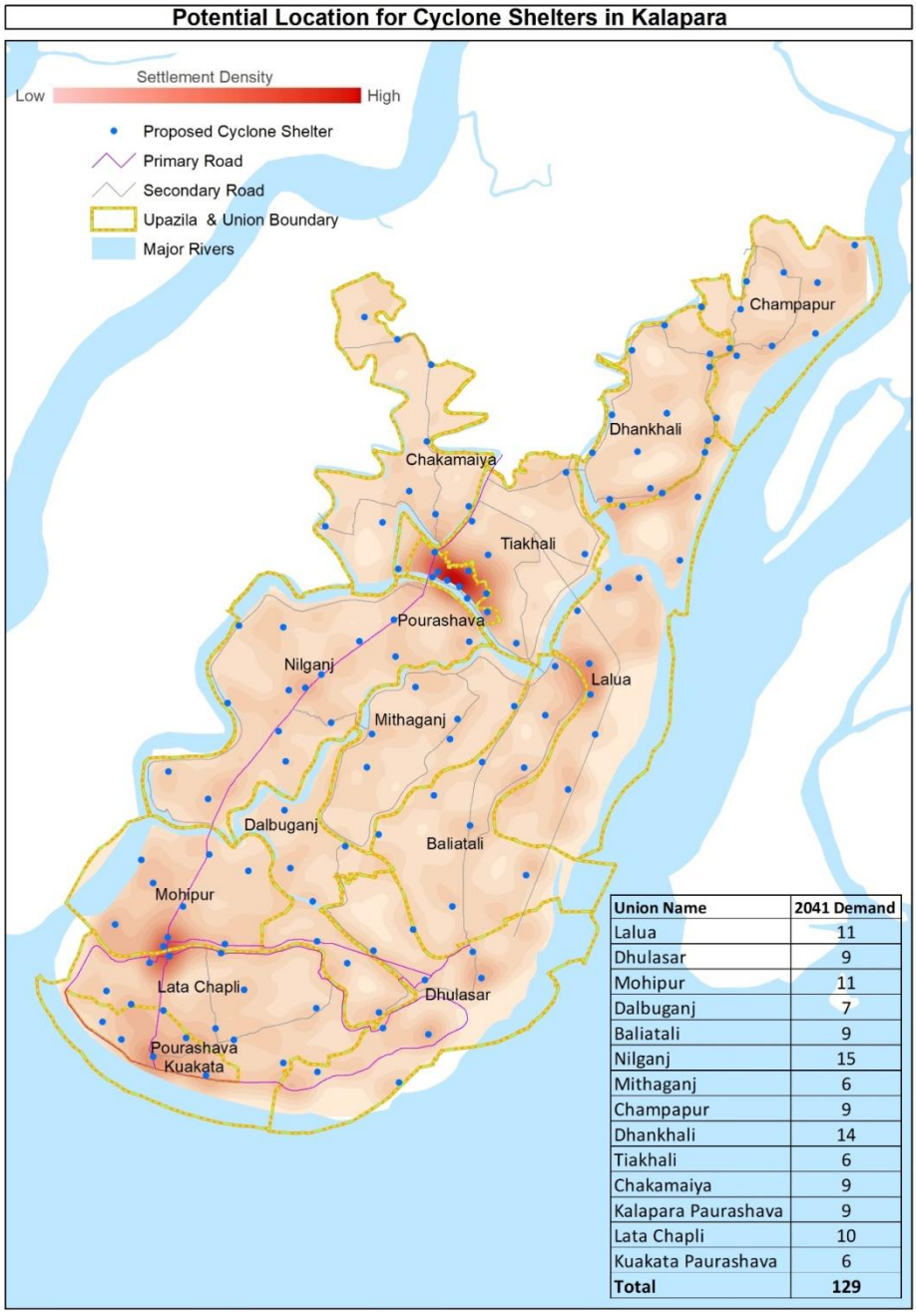


Figure 38: Proposed Road Network map
Source: PKCP project, UDD, 2022

5.6 PROPOSED CYCLONE CENTER

As Kalapara Upazila is just beside the bank of Bay of Bengal, the area has a great threat in the case of life and property loss due to cyclone hazard. On the basis of the local peoples' requirements, location of the present cyclone shelters, structure density, disaster risk and future population several cyclone shelters are proposed in different places all over the Upazila. The proposed cyclone shelters are shown in the below map.



Union Name	2041 Demand
Lalua	11
Dhulasar	9
Mohipur	11
Dalbuganj	7
Baliatali	9
Nilganj	15
Mithaganj	6
Champapur	9
Dhankhali	14
Tiakhali	6
Chakamaiya	9
Kalapara Paurashava	9
Lata Chapli	10
Kuakata Paurashava	6
Total	**129**

Figure 39: Location of the proposed Cyclone Shelters
Source: PKCP Project, UDD, 2022

5.7 Devlopment Centers

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 hierarchy of growth centre created under the conceptual framework is a functional one. To begin with, the whole concept of the upazila area has evolved with the assumption that the key services or functions performed by the trade and commerce centre have spread their influence to outer areas like Banati Bazar and Tulatoli Bazar etc. so as to form a functional relationship with these areas.

Trade and Commerce center

It is the centre of activities in the established of Kalapara 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 Bablatola Bazar and Mohipur Bazar area of the Kalapara 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 Pakhimara, Banati Bazar. Pakhimara bazar hat has a Cow Hat. There need a registered Hat. These are 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 identifies seven places as second order like Nomor Bazar, Dhankhali Bazar, Muktijoddha Bazar, Chapli 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 categorize 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

Table 30: List of Probable facilities with development centers

Growth Center Hiararchy	Probable Facilities	Location Name
Trade and Commerce Center	• Shopping Complex, • Open space to take shelter in disaster event or fire hazard or earth quake, • Waste Disposal Ground	Bablatola Bazar, Mohipur Bazar
Strategic Service Center Zone-First Order	• Retail sale/ Kitchen/ Neighborhood market • Eidgha/graveyard/ Community center/ religious places/ cremation ground • Police station/ Police box/ Post office/Fireservice • Maternity/ Child Care Center/Clinic • College/vocational training center/Nursery School/Primary School/ Kindergarten/Secondary / High School/ public library • Bus stand/truck stand/Rickshaw/ van/Baby taxi/tempo stand/ Fuel/ Filling Station • Neighborhood /Community Park/ Cinema Hall/ Town Hall/ Complex • water supply treatment plant/waste dumping ground/ water booth	Pakhimara Bazar, Banati Bazar
Strategic Service Center Zone-Second Order	• Community center/religious places/cremation ground • Clinic • Nursery School/Primary School/ Kindergarten/Secondary / High School/ public library • Rickshaw/ van/Baby taxi/tempo stand/ Fuel/ Filling Station • small playground / Cinema Hall/ Town Hall/ Complex/ Club House • Waste disposal ground/Waste collection point/ water booth	Nomor Bazar, Dhankhali Bazar, Muktijoddha Bazar, Chapli Bazar
Strategic Service Center Zone-Third Order	• Nursery school, primary school • Religious places • Mainly recreation facilities • Waste collection point/ water booth	Mistri Bazar, Laxmir Hat, Banghat Bazar, Puran Mohipur Bazar, Dalbuganj Bazar, Tutatoli Bazar, Tegasia Bazar, Mostofa Bazar Bus stop,

	Umedpur Bazar, Solimpur Zero Point, Purbo Chakamaiya, Fultoli Bazar, Tarikata Bazar, Board School Bazar, Dangar Bazar, Ashakhali Bazar

Source: PKCP project, UDD, 2022

5.8 PAYRA PORT CITY:

To support port activities a port city is proposed beside Amtali Kuakata highway. Eleven broad based zones are proposed as Urban Residential Zone, Administrative Zone, Canal/ Waterbody, Commercial Zone, Educational zone, Health service zone, Mixed Development Zone, Rail Buffer, Recreational Zone, Road and Transport, Tourist Zone are proposed in this city. Proposed landuse zones area given below:

Table 31: Landuse of Payra Port City

Landuse	Area_Acre	%
Administritive Zone	66.41	1.85
Canal	201.32	5.61
Commercial Zone	129.78	3.61
Educational	29.62	0.82
Health	8.54	0.24
Mixed Development Zone	283.27	7.89
Rail Buffer	22.91	0.64
Recreational Zone	192.03	5.35
Residential	99.66	2.78
Road	405.81	11.30
Tourist Zone	186.78	5.20
Transportation	3.40	0.09
Urban Residential Zone	1961.25	54.62
Total	3590.77	100.00

Source: PKCP project, UDD, 2022

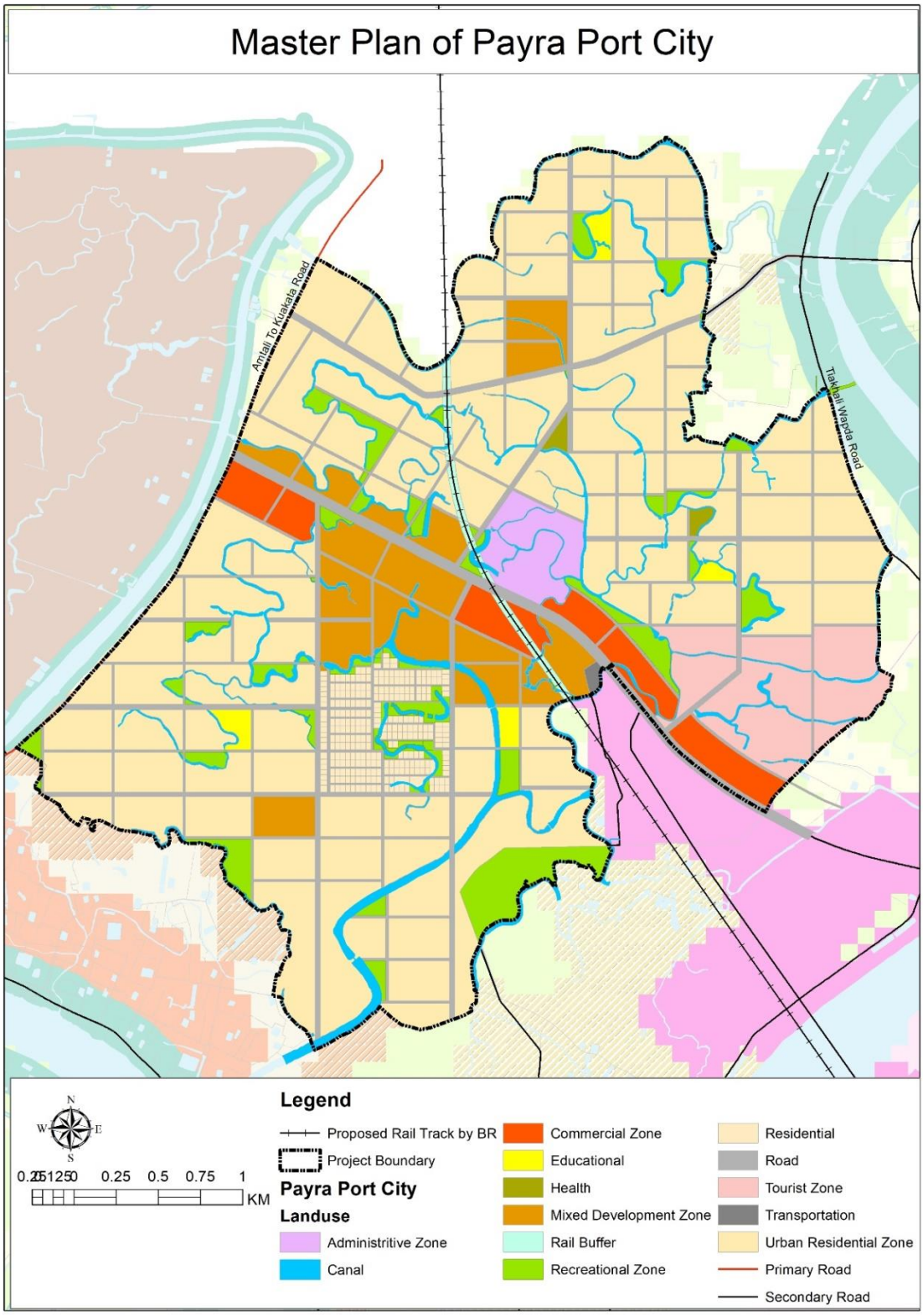


Figure 40: Proposed Payra port city
Source: PKCP project, UDD, 2022

5.9 KUAKATA TOURISM CENTRE (KTC) MASTER PLAN

Kuakata Tourism site is proposed as Kuakata Tourism centre (KTC) in this plan. Kuakata Tourism Center (KTC) area is not simply a small-town center. It contains Kuakata municipal area, entire part of Latachapli union & a part of Dhulashar union. Consequently, it's a combination of urban & rural intrinsic context with strong tourism effect. It needs to consider & calculate tourist people along with the local community or age-old residence. Therefore, KTC master plan is somewhat different than other Urban Area Plan. The plan has an integrated approach targeting the tourists as well of the local people's embodying tourism development as well as socio-economic development respectively. From this perspective, the plan is a unique work out of serving the dual purposes. It's not a typical Urban Area or Rural area plan; rather it can be said as **'Special Area Plan'** a clear land use with the permissible & non permissible act in each Planning zone along with necessary guidelines to protect the sea beach, reserve forest, agricultural land & ecologically sensitive area is also specified in this plan. A detailed planning of KTC is done in this project which would be present in another volume named Kuakata Tourism Center Master Plan.

Figure 41: Map of KTC Master Plan

5.10: 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 Kalapara 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 not- 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.

Table 32: Permitted & conditional uses of different Land use category

P=Permitted Use; C= Conditional Use; R= Plan Review Required; N=Not Permitted

Facilities	**Agriculture Zone**	**Coastal Afforestation and Foreshore Area**	**Conservation Zone**	**Circulation Network**	**Core Urban Area**	**Potential Urban Area**	**Urban Fringe 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**	**Waterbody**
Agricultural Shelter & Gazing	P	C	N	N	C	C	C	P	C	C	P	P	P	N
Agri Business & Services	P	C	N	N	P	P	P	C	P	P	P	P	P	N
Aquaculture & Fisheries	C	C	N	N	N	P	C	P	P	C	P	P	P	C
Arboriculture	P	P	P	C	N	P	P	P	C	C	C	C	C	C
ATM Booth	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Auditorium Meeting Hall	N	N	N	N	P	C	C	N	P	C	N	N	N	N
Automobile Works	N	N	N	N	P	P	P	C	C	P	C	C	C	N
Autorickshaw Stand	N	N	N	N	P	P	P	P	P	N	P	P	P	N
Bank & Financial Institutions	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Billboard (Advertisement Structure)	N	N	N	N	C	C	C	C	C	P	P	N	N	N
Boitanical Garden	N	P	N	N	P	P	P	N	N	C	C	C	C	N
Boarding & Rooming House	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Brick Fields	N	N	N	N	N	N	N	C	N	N	C	C	C	N
Bus/Auto Passenger Shelter/Stops	N	N	N	N	P	P	P	C	P	C	C	P	P	N
Causeways: Road, Railways	N	N	N	P	R	R	R	R	R	R	R	R	R	N
Cash Crop Cultivation	P	C	N	N	C	P	P	P	P	P	P	P	P	N
Carnival & Fair	N	N	N	N	C	C	C	C	C	C	C	C	C	N
Cemetaries/ Graveyard	N	N	N	N	P	P	P	P	N	N	N	N	N	N
Cinema Hall	N	N	N	N	C	C	C	N	N	N	N	N	N	N
Clinics/ Medical	N	N	N	N	P	P	P	P	P	P	P	P	N	N

Facilities	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Core Urban Area	Potential Urban Area	Urban Fringe 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	Waterbody
Clubs, Private	N	N	N	N	N	N	N	N	C	P	C	C	N	N
Colleges/Universities	N	N	N	N	P	P	P	N	N	P	N	N	N	N
Convention Center	N	N	N	N	P	P	P	N	P	P	C	N	N	N
Communication Service Facilities	N	N	N	P	P	P	P	C	P	P	P	P	P	N
Communication Tower with Height	N	N	N	N	C	C	C	C	P	P	P	P	P	N
Community Center	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Cottage Industry	N	N	N	N	P	P	P	N	P	N	P	P	P	N
Cultural Exhibits & Library	N	N	N	N	C	C	C	C	C	C	C	C	C	N
Cyber Café/IT Center	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Dairy Farming	P	C	C	N	P	P	P	P	P	P	P	P	P	N
Deep Tubewell	C	N	N	N	P	P	P	P	P	N	P	P	P	N
Diagonistic Centres	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Docks & Jetties	C	N	N	N	P	P	P	N	P	P	C	C	C	P
Dormitory / NGO Rest House	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Bakery	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Dwellings, Farm	C	N	N	N	N	P	P	C	P	P	P	P	P	N
Dwellings,Minimal Housing	N	N	N	N	P	P	P	P	N	N	N	N	N	N
Dwellings,Single/ MultiFamily	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Educational Facilities	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Electric Sub Station	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Emergency Shelter	C	N	N	N	P	P	P	P	P	P	P	P	P	N
Explosive Manufacture & Storage	N	N	N	N	N	N	N	N	P	N	N	N	N	N
Fire Station	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Food Kiosk	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Flood Management Structures	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Freight Transport Facilities	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Garages/ Workshops	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Garments & Kneeting Factory	N	N	N	N	C	P	P	N	P	P	P	P	P	N

Facilities	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Core Urban Area	Potential Urban Area	Urban Fringe 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	Waterbody
Golf Courses & Golf Club	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Government Office / Guest House	N	N	N	N	P	C	C	N	P	P	P	P	P	N
Green Belt/ Green Space	N	P	P	P	P	P	P	P	C	C	C	C	C	N
Hatchery	P	N	N	N	N	P	P	P	P	P	P	P	P	N
Health Facilities	N	N	N	N	P	P	P	P	P	P	P	P	P	N
High School	N	N	N	N	P	P	P	N	N	P	P	P	P	N
Horticulture	P	N	N	N	N	P	P	P	P	P	P	P	P	N
Hospitals/ Health Centers	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Hotel Guest House	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Hotel International Class	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Husking/ Grinding(Rice, Wheat, Pulse)	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Industrial Class 1	N	N	N	N	P	P	P	N	P	N	N	N	N	N
Industrial Class 2	N	N	N	N	P	P	P	N	P	N	N	N	N	N
Institutions	N	N	N	N	C	C	C	N	N	P	P	P	P	N
Irrigation Facilities (Flood Wall/ Canal)	C	N	N	N	C	C	C	C	C	C	C	C	C	P
Livestock	C	C	N	N	P	P	P	P	P	P	P	P	P	N
Major Development	N	N	N	N	P	P	P	N	P	C	C	C	C	N
Multi stored Car park	N	N	N	N	C	C	C	N	C	C	C	C	C	N
Nursery School	N	N	N	N	C	C	C	N	N	N	P	P	P	N
Offices/ Services	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Open Theatre	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Orphanage	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Outdoor Religious Events	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Parking Facilities, Commercial	N	N	N	C	C	C	C	N	P	P	P	P	P	N
Parking Facilities	N	N	N	P	C	C	C	N	P	P	P	P	P	N
PC Culture	C	C	N	N	N	P	P	C	P	P	P	P	P	N
Petrol Stations	N	N	N	N	P	N	N	N	P	P	P	P	P	N
Plantations	N	P	P	P	P	P	P	C	N	N	N	N	N	N

Facilities	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Core Urban Area	Potential Urban Area	Urban Fringe 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	Waterbody
Mosque/ Temple	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Places of Worship	N	N	N	N	P	C	C	N	N	N	N	N	N	N
Packaging & Processing	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Play Field	N	N	N	N	P	P	P	C	N	N	N	N	N	N
Police Box/ Barrak	N	N	N	N	P	C	C	N	P	P	P	P	P	N
Post Office	N	N	N	N	P	C	C	N	P	P	P	P	P	N
Postal Facilities/ Courier	N	N	N	N	P	C	C	N	P	P	P	P	P	N
Poultry	P	N	N	N	C	C	C	C	P	P	P	P	P	N
Primary School	N	N	N	N	P	C	C	N	N	N	N	N	N	N
Prisons	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Printing/ Publishing House	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Public Uses & Structures	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Public Transport Facilities	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Recreational Facilities, outdoor	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Religious Facilities & Structures	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Repair Shops, Major	N	N	N	N	P	P	P	N	P	N	N	N	N	N
Repair Shops, Minor	N	N	N	N	C	C	C	N	N	P	P	P	P	N
Retail Shops & Restaurants	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Retention Ponds	N	N	N	N	P	P	P	C	N	N	N	N	N	C
Rickshaw Stands	N	N	N	N	P	P	P	P	P	P	P	P	P	N
Salvage, Storage & Processing	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Saw- Mill	N	N	N	N	C	C	C	N	P	C	C	C	C	N
Schools, Private	N	N	N	N	N	N	N	N	N	P	P	P	P	N
Scientific Research Establishment	N	N	N	N	P	P	P	N	P	C	C	C	C	N
Ship & Boat Servicing	N	N	N	N	P	P	P	N	P	P	P	N	N	N
Social Forestry	P	P	P	N	C	C	C	P	C	C	C	C	C	N
Special Function Tent	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Stadium Sports	N	N	N	N	C	C	C	N	P	P	P	P	P	N

Facilities	Agriculture Zone	Coastal Afforestation and Foreshore Area	Conservation Zone	Circulation Network	Core Urban Area	Potential Urban Area	Urban Fringe 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	Waterbody
Swimming Court/ Pool	N	N	N	N	C	C	C	N	P	P	P	P	P	N
Tea Stall/ Coffee Shops	N	N	N	N	C	C	C	C	P	P	P	P	P	N
Tennis Court / Club	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Termminals, Train, Bus, Truck, Freight	N	N	N	C	P	P	P	N	P	P	P	P	P	N
Trade Centers	P	N	N	N	P	P	P	N	P	P	P	P	P	N
Transformer stations	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Transmission Lines	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Utility Installations/ Lines	N	N	N	N	P	P	P	C	P	P	P	P	P	N
Vegetable Cultivation	C	N	N	N	P	P	P	P	N	N	N	N	N	N
Ware Housing & Distribution	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Water pump, Reservoir	C	N	N	N	P	P	P	C	P	P	P	P	P	N
Waste Disposal & Processing / Minarator	N	N	N	N	C	C	C	C	C	C	C	C	C	N
Water Based Recreational Park	N	N	N	N	C	C	C	N	C	C	C	C	C	P
Water Treatment / Purification Plant	N	N	N	N	P	P	P	C	C	C	C	C	C	C
Wood / Iron Furniture Production	N	N	N	N	P	P	P	N	P	P	P	P	P	N
Zoo	N	N	N	N	C	C	C	N	C	N	N	N	N	N
Eco Tourism	C	p	p	N	C	C	C	P	P	C	C	C	C	N

Source: PKCP project, UDD, 2022

CHAPTER SIX: IMPLEMENTATION PHASING OF PROPOSALS, RESPONSIBLE AGENCIES AND RELEVANT ISSUES

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.

Ministry of Housing and Public Works has already proposed Payra-Kuakata Development Authority Act, 2023. According to the proposed Act Kalapara, Amtali and Taltoli Upazila will be included in this Authority. The Authority may extend its area towards Barguna and Patharghata as well as Galachipa and Rangabali. The implementation of Structure Plan, Urban Area Plan, Rural Area Plan, and Action Area Plan will be legally guided by the Act after the enactment of the Act.

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 is applicable for the urban areas, the Rural Area Plan is applicable for the rural area and the Action Area Plan is applicable 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. Kalapara 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 Payra Development 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.

6.5 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

6.6 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.

6.6.1 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.

6.6.2 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.

6.6.3 Private Sector Organizations

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

6.6.4 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.

6.6.5 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.

6.6.6 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:

6.6.8 Community-based organizations (CBOs)

These organizations are formed when neighbourhood residents get organized and join forces to improve local security, housing quality, basic utilities, social services and the neighbourhood 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.

6.6.9 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.

6.6.10 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.

6.7 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.

6.8 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.

6.9 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.

6.10 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

6.11 Development Control

Any unauthorized or unlawful development within the Upazila should be controlled to fulfil 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.

6.12 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

6.13 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.

6.14 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.

CONCLUSION

Structure Plan will give a guideline to develop the area according to the demand of local people. The plan consists of a written statement of objectives and a map or series of maps along with policy guidelines. The planned township and integrated rural development will require infrastructure and service facilities that can be done by the proper utilization of such urban and rural area plan. The Structure Plan for Kalapara Upazila is a policy document aimed at promoting long-term development through integrated planning and community participation. It addresses challenges such as embankments, waterlogging, communication networks, and inadequate facilities. The plan proposes solutions like road widening, economic and agro-fisheries zones, recreational areas, and rural service centers. It follows regional planning guidelines and aims to attract public and private investment for sustainable development and poverty reduction in the area

REFERENCES

Andrews, R. B. (1953). Mechanics of the Urban Economic Base: Historical Development of the Base Concept. In R. B. Andrews, *Land Economics* (Vol. 2, pp. 161-167). University of Wisconsin Press. Retrieved from http://www.jstor.org/stable/3144408

Ahsan, M. E. (2013). Coastal Zone of Bangladesh: Fisheries Resources, and its Potentials.

Lambert Academic Publishing. doi:DOI: 10.13140/2.1.1253.7928

Ahsan, M. N. (2014). Effects of livelihood strategies on mangrove-forest resource: Do the consumption behaviour of households jeopardise the forest resource base? Management of Environmental Quality: An International Journal.

Alam, M. M., Hossain, M. A., & Shafee, S. (2003). Frequency of Bay of Bengal cyclonic storms and depressions crossing different coastal zones. International Journal of Climatology: A Journal of the Royal Meteorological Society, 23(9), 1119-1125.

Alexander, M. J., Rashid, M. S., Shamsuddin, S. D., & Alam, M. S. (1998). Flood control, drainage and irrigation projects in Bangladesh and their impact on soils: an empirical study. Land Degradation & Development, 9(3), 233-246.

Andrews, R. B. (1953). Mechanics of the Urban Economic Base: Historical Development of the Base Concept. In R. B. Andrews, Land Economics (Vol. 2, pp. 161-167). University of Wisconsin Press. Retrieved from http://www.jstor.org/stable/3144408

Bala, B. K. & Hossain, M. A. (2009). Integrated management of coastal zone for food security. Department of Farm Power and Machinery, Bangladesh Agricultural University, Dhaka, 134.

Bala, B. K. & Hossain, M. A. (2010). Modeling of food security and ecological footprint of the coastal zone of Bangladesh, Environ, Dev. Sustain, 12: 511-529

Bangladesh Climate and Disaster Risk Atlas: Hazards—Volume I and Exposures, Vulnerabilities, and Risks—Volume II, 2022, ADB, Bangladesh

Barua, D.K., 1997, the active delta of the Ganges-Brahmaputra Rivers: dynamics of its present formations, Mar. God. 20:1-12.

BBS, 2013, Bangladesh Bureau of Statistics, Government of the People Republic of Bangladesh

BBS. (2011). District Statistics. Dhaka: Bangladesh Bureau of Statistics.

BBS. (2011). Population, and Housing Census 2011: Zila Report Patuakhali. Bangladesh Bureau of Statistics, Statistics, and Informatics Division. Ministry of Planning.

Begum S. and Fleming G., 1997, Climate change and sea level rise in Bangladesh, part II: Effects, Mar. Geod. 20: 55 - 68.

Brammer, H. (2014). Bangladesh's dynamic coastal regions, and sea-level rise. Climate Risk Management, 1, 51-62. doi:https://doi.org/10.1016/j.crm.2013.10.001

Bureau of South and Central Asian Affairs. (2008, March). Background Note: Bangladesh.

Chowdhury, J. U., & Karim, M. F. (1996). A risk-based zoning of storm surge prone area of the Ganges Tidal Plain. J. Civil Eng, 221-233.

De Zoysa, M. (2008). Casuarina coastal forest shelterbelts in Hambantota City, Sri Lanka: assessment of impacts. Small-scale Forestry, 7(1), 17-27.

District Administration Patuakhali. (2017). Zila Branding Book.

Duarte, C. M., Losada, I. J., Hendriks, I. E., Mazarrasa, I., & Marbà, N. (2013). The role of coastal plant communities for climate change mitigation and adaptation. Nature climate change, 3(11), 961-968.

FAO. (1988). Land Resources Appraisal of Bangladesh for Agricultural Development-Report 2: Agroecological regions of Bangladesh. Rome: Food and Agriculture Organization of the United Nations.

GoB (Government of Bangladesh). (2008). Cyclone Sidr in Bangladesh: Damage, loss and needs assessment for disaster recovery and reconstruction.

Haque, S. A. (2006). Salinity problems and crop production in coastal regions of Bangladesh. Pakistan Journal of Botany, 38(5), 1359-1365.

Ibrahim, M., Zaman, M. A., Mostafizur, A. B., & Shahidullah, S. M. (2017). Diversity of Crops and Land Use Pattern in Barisal Region. Bangladesh Rice Journal, 21(2), 57-72.

Iftekhar, M. S. (2006, August). Conservation and management of the Bangladesh coastal ecosystem: overview of an integrated approach. In Natural resources forum (Vol. 30, No. 3, pp. 230-237). Oxford, UK: Blackwell Publishing Ltd.

Indiana Department of Workforce Development. (2006). In Context: Indiana's Workforce and Economy. Indiana. Retrieved November 2017

Islam, M. M., & Sado, K. (2000). Flood hazard assessment in Bangladesh using NOAA AVHRR data with geographical information system. Hydrological Processes, 14(3), 605-620.

Islam, M. R. (2008). ICZM initiatives and practices in Bangladesh. Integrated Coastal Zone Management. Research Publishing Services, Singapore, 81-82.

Islam, M. R. (ed) (2004). Where Land Meets the Sea: A Profile of the Coastal Zone of Bangladesh. University Press Limited, Dhaka, Bangladesh. pp. 317.

Islam, S. A., & Rahman, M. M. (2015). Coastal afforestation in Bangladesh to combat climate change induced hazards. J Sci Technol Environ Inform, 2(1), 13-25.

Islam, S. A., Miah, M. A. Q., Habib, M. A. & Moula, M. G. (2014). Performance of some mainland trees and palm species planted in the coastal islands of Bangladesh. Journal of Asiatic Society of Bangladesh, Science, 40(1): 9-15.

Islam, S. A., Miah, M. A. Q., Habib, M. A., Moula, M. G. & Rasul, M. G. (2013). Growth performance of underplanted mangrove species in Sonneratia apetala (Keora)

plantations along the western coastal belt of Bangladesh. Bangladesh Journal of Forest Science, 32 (2): 26-35.

Islam, T., & Peterson, R. E. (2009). Climatology of landfalling tropical cyclones in Bangladesh 1877–2003. Natural Hazards, 48(1), 115-135.

Isserman, A. M. (1977). The Location Quotient Approach to Estimating Regional Economic Impacts. Journal of the American Institute of Planners, 43(1). doi:10.1080/01944367708977758

IUCN Bangladesh. (2015). Red List of Bangladesh: A Brief on Assessment Result 2015.

IUCN,

International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. 24.

Jones, H. P., Hole, D. G., & Zavaleta, E. S. (2012). Harnessing nature to help people adapt to climate change. Nature climate change, 2(7), 504-509.

Latief, H., & Hadi, S. (2007). The role of forests and trees in protecting coastal areas against tsunamis. In Regional Technical Workshop on Coastal Protection in the Aftermath of the Indian Ocean Tsunami What Role for Forests Trees (pp. 5-32).

Leigh, R. (1970, May). The Use of Location Quotients in Urban Economic Base Studies. Land Economics, 46(2), 202-205.

Miah, G., Bari, N., Ahamed, T., & Saha, U. (2007). Agriculture in the Fragile Environment of Bangladesh: Looking into the Future.

Mondal, M. K., Bhuiyan, S. I., & Franco, D. T. (2001). Soil salinity reduction and prediction of salt dynamics in the coastal ricelands of Bangladesh. Agricultural water management, 47(1), 9-23.

Nandy, P. & Ahamad, R. (2012), Navigating mangrove resilience through the ecosystem based adaptation: lessons from Bangladesh. In: Macintosh, D.J., Mahindapala, R. and Markopoulos, M. (eds). Proceedings and A Call for Action from An MFF Regional Colloquium on Mangrove Restoration. Mamallapuram, India, 30–31 August 2012. pp 243–254.

Nandy, P., Alam, M. J., & Haider, M. R. (2004). Establishment of mangrove seed production area for Sonneratia apetala. Journal of Tropical Forest Science, 16(3), 363-368.

Parvin, G. A., & Ahsan, S. R. (2013). Impacts of climate change on food security of rural poor women in Bangladesh. Management of environmental quality: an international journal.

Paul, B. K., & Rasid, H. (1993). Flood damage to rice crop in Bangladesh. Geographical Review, 150-159.

Potten, D. (1994). The impact of flood control in Bangladesh. Asian Affairs, 25(2), 156-162.

Quadir, D. A., & Iqbal, A. M. (2008). Tropical cyclones: impacts on coastal livelihoods. Gland: International Union for Conservation of Nature.

Rahman, F., Haque, M. F., Bhuiyan, M. A. H., & Rahman, S. (2009). Study of landuse changes and its impact on environment in Chokoria Upazila using remote sensing and GIS techniques.

Rahman, S. (2012, July). Impacts of climate change on ecological composition & biodiversity of Sundarbans, Bangladesh. In A Conference in the Philippines.

Rahman, S., Rahman, S.H. and Ullah, M.W. (2009). Assessment of water-logging extent using RS and GIS techniques and its possible remedial measures at the Kopotaksho basin area, Bangladesh, paper presented at the Geographic Technologies applied to Marine Spatial Planning and Integrated Coastal Zone Management, Ponta Delgada.

Saenger, P., & Siddiqi, N. A. (1993). Land from the sea: the mangrove afforestation program of Bangladesh. Ocean & Coastal Management, 20(1), 23-39.

Santiago, J. L., Martin, F., Cuerva, A., Bezdenejnykh, N., & Sanz-Andres, A. (2007). Experimental and numerical study of wind flow behind windbreaks. Atmospheric Environment, 41(30), 6406-6420.

Sarwar, G.M.M and Woodroffe, C.D., 2013, Rates of shoreline change along the coast of Bangladesh, Faculty of Science, Medicine and Health - Papers, University of Wollongong, Research Online.

Schaefer M., 1993, Health, environment and development: Approaches to drafting country-level strategiesfor human well-being under Agenda 21. Geneva: World Health Organization.

Siddiqi, N. A. (2001). Mangrove forestry in Bangladesh, Institute of Forestry and Environmental Sciences. University of Chittagong, Chittagong, Bangladesh, 201.

Siddiqi, N. A. (2008). Probable impact of climate change and sea level rise on mangrove forests and biodiversity of Bangladesh. Bangladesh Journal of Forest Science, 31(1&2), 1-15.

Siegel, R. A. (1966). The Economic Base and Multiplier Analysis.

Stanley, D. J., & Hait, A. K. (2000). Holocene depositional patterns, neotectonics and Sundarban mangroves in the western Ganges-Brahmaputra delta. Journal of Coastal Research, 26-39.

Takle, E. S., Chen, T. C., & Wu, X. (2006, August). The role of coastal forests and trees for protecting against wind and salt spray. In Workshop on Coastal Protection in the Aftermath of the Indian Ocean Tsunami: What Role for Forests and Trees (pp. 700-00).

Touhiduzzaman, M., & Rahman, S. (2017). Integrated coastal resources management of Saint Martin's Island, Bangladesh. Journal of Coastal Conservation, 21(6), 929-938.

Worm, H. U., Ahmed, A. M. M., Ahmed, N. U., Islam, H. O., Huq, M. M., Hambach, U., & Lietz, J. (1998). Large sedimentation rate in the Bengal delta: magnetostratigraphic dating of Cenozoic sediments from northeastern Bangladesh. Geology, 26(6), 487-490.

Yamazaki, D., Ikeshima, D., Tawatari, R., Yamaguchi, T., O'Loughlin, F., Neal, J. C., & Bates,

P. D. (2017). A high-accuracy map of global terrain elevations. Geophysical Research Letters, 44(11), 5844-5853.

Zhu, J., Matsuzaki, T., Gonda, Y., Sakioka, K., & Yamamoto, M. (2000). Windspeed in a coastal forest belt of Japanese black pine (Pinus thunbergii Parl.)-horizontal wind profile. Bulletin of the Faculty of Agriculture, Niigata University, 52(2), 139-155.

APPENDIX-A

Water Quality of Major Rivers

Table-A1: Status of Physical and Aggregate Properties

Parameters	Unit	Andarmanik (Upstream)	Galachipa-Ramnabad	BD Standards	Remarks
Temp.	^{0}C	33	31	20-30	Within the range
pH	Value	6.6	7.4	6.5-8.5	Within the range
TDS	mg/l	5720	90	1000	Complied the standard except Andarmanik
EC	µS/cm	11420	180	1200	Complied the standard except Andarmanik
Salinity	ppt	6.8	0.1	0	Complied the standard except Andarmanik
TSS	mg/l	8	13	50-150	Within the range
Turbidity	NTU	64	94	50	Higher than the standard
Alkalinity	mg/l	30	18	20-120	Within the range
Hardness	mg/l	470	210	200-500	Within the range

Source: PKCP Project, UDD, 2022

Table-A2: Status of Inorganic Non-metallic Constituents

Parameters	Unit	Andarmanik (Upstream)	Galachipa-Ramnabad	BD Standards/WHO*	Remarks
Chloride	mg/l	4150	20	250	Complied the standard except Andarmanik and Donmanick
Sodium	mg/l	2432	35	200*	Complied the standard except Andarmanik
Potassium	mg/l	128	4	12*	Complied the standard except Andarmanik
Nitrate	mg/l	5.4	6.3	2.5	Higher than the standard
Phosphate	mg/l	0.4	0.3	0.5	Complied the standard
Sulphate	mg/l	212	18	400	Complied the standard

Source: PKCP Project, UDD, 2022

Table-A3: Status of Aggregate Organic Constituents

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

Source: PKCP Project, UDD, 2022

Table-A4: Status of Metal Constituents

Parameters	Unit	Andarmanik (Upstream)	Galachipa-Ramnabad	EPR'86, India	Remarks
Iron	mg/l	0.5	1.0	0.1	Higher than the standard
Zinc	mg/l	0.03	0.03	2	Complied the standard
Manganese	mg/l	0.13	0.07	3	Complied the standard

Lead	mg/l	0.002	0.005	2	Complied the standard
Chromium	mg/l	0.029	0.012	0.05 (BD, Drinking)	Complied the standard
Nickel	mg/l	0.030	0.030	5	Complied the standard
Copper	mg/l	0.030	0.030	1 (BD, Drinking)	Complied the standard
Cadmium	mg/l	0.00015	0.00015	0.005 (BD, Drinking)	Complied the standard except Tetulia

Source: PKCP Project, UDD, 2022

Table-A5: Status of Oil & Grease and Phenol

Parameters	Unit	Andarmanik (Upstream)	Galachipa-Ramnabad	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-A6: 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-A7: 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-A8: Noise Quality of Different Land Use Types in the Study Area

Kalapara					
Location ID	**Zone**	**Morning (dB)**	**Std. (Noise control rules, 2006) (dB)**	**Evening (dB)**	**Std. (Noise control rules, 2006) (dB)**
NL-1	mixed	94	60	84	50
NL-2	mixed	52	60	56	50
NL-3	Commercial	75	70	86	60
NL-4	Commercial	73	70	81	60
NL-5	Residential Area	53	55	61	45
NL-6	Commercial	47	70	86	60
NL-7	Commercial	61	70	76	60

Source: PKCP Project, UDD, 2022

APPENDIX-B

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	
	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	

[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…)
			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) Chief Engineer, DPHE, email: ce.dphe@gmail.com. Phone: 55130752	BWDB Chief Engineer (Civil), Hydrology, email: ce.hydrology@bwdb.gov.bd, Phone: 029550815 DPHE Superintending Engineer (Ground Water Circle), email: se.gwc@dphe.gov.bd, Phone: 02-9342485	Continuous	Measure this in wells. There are a number of monitoring wells. The monitoring is already in place
			27	As above	% of Region:	52.5	As	As above	As above	As above	As above	As above	As above

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

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…)
			(b)		5PPT in SW		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: dg@bbs.gov.bd, Phone: 02-55007056	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), email: mahfuz.bablu@gmail.com, phone: 02-55007331	Annually	
			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 &	RPTI 1. Regional Population Training Institute (RPTI), Barishal 2. Director, Census/computer Wing, Bangladesh Bureau of Statistics (BBS), email: mahfuz.bablu@gmail.com, phone:	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 Bangladesh, Dhaka, Bangladesh.

[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…)
										National Institute of Population Research and Training (NIPORT) Director General, NIPORT, email: dg.niport1977@gmail.com, phone: 9662495	02-55007331		
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
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	

[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…)
		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 Mobile: +8801817508251, Email: dev-5@pd.gov.bd	26	
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	

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…)
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			
			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.	

[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…)
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 dg@bwdb.gov.bd, dg.bwdb.bd@gmail.com Phone: 01318234567	Bangladesh Water Development Board (relevant district office)	Daily	
		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.Abu Saeed Azad
Junior GIS Expert
Payra Kuakata Comprehensive Plan Focusing on Eco-Tourism

Guided by:

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

Md.Mahmud Hossain
Project Manager and Senior Planner, UDD
Payra Kuakata Comprehensive Plan Focusing on Eco-Tourism