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Regional Plan for Payra-Kuakata Coastal Area (2021-2041)

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Regional Plan for Payra-Kuakata Coastal Area (2021-2041): A Special Focus on Land Use Sector

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EXECUTIVE SUMMARY

Payra-Kuakata Coastal Region is one of the most flourishing regions of Bangladesh enriched with bio-diversified resources, attractive tourist spots, Payra seaport, and powerplant. The enormous opportunities, potentialities of this region are attracting new industries, residents, and tourists for which the economy of this region is growing rapidly in recent decades. These economic growths and population pressure might alter the existing land use of the region. As this region is growing rapidly and has big potential to grow in the future, a regional land use plan is required to ensure sustainable and balanced development in this region without hampering its critical environment. The vision of the regional land use plan for the Payra-Kuakta coastal area is to efficiently utilize the limited land use resources of the Payra-Kuakata region to make it one of the most prospering, economically viable, and environmentally sustainable coastal regions of the country within 2041. The related goals to achieve this vision are protecting and preserving ecologically endangered and agricultural areas, improving accessibility of the urban and commercial areas, promoting industrial development considering waterbodies, and developing special tourism and economic zones for the future in the coastal region. This plan will help to manage the future growth of this region efficiently and sustainably.

Payra-Kuakata coastal region includes seven upazilas from Patuakhali and Barguna districts namely Galachipa, Kalapara, Rangabali, Barguna Sadar, Patharghata, Amtali, and Taltali. For preparing this plan, existing features of the study area, especially the current scenario of the land use have been analyzed in detail. Agriculture is the major land use in this region. At present, only 2% of its land is using for urban and commercial purposes. However, in the future, this percentage is expected to increase substantially due to increased development pressure and the impact of Payra port and powerplant. The economic structure and activities of the region have impacts on its land use. Therefore, the economic structure of this region is also analyzed using the economic base theory and shift-share method. Bank, insurance and financial activity, wholesale and retail trade, hotel & restaurant are some of the main basic economic sectors of the region. The hotel and restaurant sector which is mainly influenced by the tourism industry have a high multiplier effect. However, tourism is not a basic industry in Kalapara upazila where Kuakata sea-beach situated. This indicates that a special tourism zone is needed and must be incorporated in the land-use plan in the region.

Over time, this region has experienced positive regional growth. However, frequent natural disasters and adverse effects of climate change are some major disadvantages of this region which retards the economic growth of some potential sectors. So, proper policies have been considered in the land use plan for the protection of environmentally sensitive areas which might help to improve this situation. Depressed and low potential areas are to be identified too to propose future land use of the region. Multi-criteria decision analysis has been used to identify the most and least development potential locations in the region. Barguna Sadar Paurashava and Tiakhali are identified as the most development potential areas. This decision also guides to select areas where future urban growth should permit.

The regional land-use plan must delineate probable urban areas for the future. For this, the land suitability analysis technique is used to determine suitable land for urban and infrastructure development. This technique is very important to identify suitable locations considering different criteria. Highly suitable and moderately suitable areas for urban development have been mainly found in Barguna Sadar, Kalapara, and Amtali upazila. According to the projected urban population of 2041, Barguna Sadar and Kalalpara will experience high urban growth in the future. Urban development in Amtali upazila is not proposed in the land use plan as most of the people of this upazila are engaged in agricultural activity and the portion of the suitable area found in Amtali upazila is also comparatively far from the existing urban center. Therefore, urban development in this area might hamper the rural characteristics and agricultural activities. One of the main objectives of this land-use plan is to protect and preserve rural characteristics and agricultural activities. But to support the future urban demand, new urban areas are proposed in Barguna Sadar and Kalapara upazila. A special tourism zone centering the Kuakata sea-beach is also proposed in the land. A special economic zone is also delineated near the Payra port in the land use plan for promoting export activities, agri-based industries, and fish processing and shipbuilding industries. Kalapara upazila may develop as a port city in 2041 which is also delineated in the land use plan. Critical areas of this region: rivers, mangroves, and reserve forests are conserved in this plan to protect and ensure balance utilization of natural resources. All these proposals will help to achieve the vision of this plan which will make Payra-Kuakata one of the most prospering, economically viable, and environmentally sustainable coastal regions of the country within 2041.

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CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

A regional land use plan is presented on a map, providing information about land use in a region or part of it (*Regional Land Use Plans*, n.d.). It sets out the region's principles of land use and community structure, and designates areas as necessary for regional development (*Regional Land Use Plans*, n.d.). The lands in coastal areas of Bangladesh are intensively used for agriculture, settlements, forests, shrimp ghers, water bodies and fisheries, salt production, industrial and infra-structural developments and tourism (Mia & Islam, 2005). The coastal areas are important ecologically, as they provide a number of environmental goods and services to people and contain critical terrestrial and aquatic habitats, such as the mangrove forests, wetlands and tidal flats (Mia & Islam, 2005). Many social–environmental issues such as forest degradation, soil erosion, biodiversity decline, and irreversible cause changes in some land uses (Deng et al., 2009). In addition, pressures from population growth have increased land-use demand for transport, industries, commercial buildings, and housing, resulting in conflicts between different land uses within restricted geographic zones (Yao et al., 2019). Regional land use planning ensures sustainable development and balanced development between different interests in the coastal area.

1.2 Payra-Kuakata Coastal Regional Plan 2021-2041: Vision, Goals and Objectives

Regional plans are made for the economic, social, and environmental enhancement of a region. For the planned growth and development of the coastal areas of the southern part of Bangladesh, a plan named 'Regional Plan of Payra-Kuakata Coastal Area' is to be prepared for the years 2021-2041. The planning area includes seven upazilas from Patuakhali and Barguna district, namely Galachipa, Kalapara, Rangabali, Barguna Sadar, Patharghata, Amtali, and Taltali.

Vision: Considering the current and future potentials of the places, the vision of the land use regional plan is to efficiently utilize the limited land use resources of Payra-Kuakata region to make it one of the most prospering, economically viable, and environmentally sustainable coastal regions of the country within 2041.

Goals: The related goals for the study area are: protecting and preserving ecologically endangered and agricultural areas, improving accessibility of the urban and commercial areas, promoting industrial development considering waterbodies, and developing special tourism and economic zones for the future in the coastal region.

Objectives of the Study:

- To study sectoral development potential of the region, and to prepare proposed land use plan for the Payra-Kuakata coastal area as well as to indicate the limited areas where residential and industrial activities may be permitted.
- To protect, maintain, enhance and restore the overall quality of the coastal zone environment and its natural and manmade resources.
- To assure balanced utilization and conservation of coastal zone resources, taking into account the social and economic needs of the people.

- To formulate development control regulations for the regulation of activities in the environmentally sensitive areas such as forests and sanctuaries and conservation as well as the preservation of natural heritage.
- To take necessary measures so that the land use from green uses such as existing forest, green areas, farms and other environmentally sensitive areas shall not be changed into non-green (non-agricultural) area.

1.3 Scope of the Study

The land use plan includes analysis of current socio-economic and physical situation, strengths-weaknesses and opportunities of the Payra-Kuakata region. It identifies spatial areas that have development potential, marks ecological areas that need conservation, analyzes impact of ongoing and proposed projects on adjacent land uses, identifies areas that need to be restricted for protection and proposes strategies, policies and, measures based on all these issues. It will act as a basis for decision-making and future planning guideline of the coastal region.

1.4 Limitations of the Study

For preparing any kind of plan, conducting reconnaissance survey and thorough physical survey of the selected place are pre-conditions. But it was not possible to conduct any kind of survey due to the ongoing COVID-19 pandemic. All data analyses are based on secondary data of the study area. Besides the socio-economic and physical conditions are analyzed based on the available limited documents, related literature (journals, articles) of the study areas, published on the internet and so, there's a high chance of the data being flawed. The available literature was limited as not much research has been done about the study area and the ones done were not recent. So, the analysis based on these data could be flawed.

1.5 Outline of the Regional Plan

In order to prepare any kind of plan, it is necessary to understand the spatial context of the areas. A detailed study area profile is significant in understanding the demographic, economic, social, cultural and environmental characteristics of the study area. For understanding the concept of economic improvement of the promising sectors like industrial, agricultural etc. of different land uses of the region, it is necessary to understand the performance of the different economic sectors of the individual upazilas over the years. Economic Base and Shift-Share analysis provide an in-depth understanding of the economic activities and the changes in different sectors. Multi-criteria decision analysis is used to identify potential areas for development, which will guide to improve the low development potential areas of this region. Land use suitability analysis reveals the suitability of an area regarding its intrinsic characteristics (suitable or unsuitable) (Jafari & Zaredar, 2010), which is a GIS-based process of determining the fitness of a given tract of land for a defined use (Steiner et al., 2000). So, the next sections will focus on these analyses, starting with a review of the relevant national policies so that the proposed land use plan is compatible with the existing policies for the coastal region of the country.

CHAPTER TWO: REVIEW OF REGIONAL PLAN AND RELEVANT NATIONAL POLICIES

2.1. Regional Planning in Global Context

2.1.1. North Coast Regional Plan 2036

The North Coast is one of the most biologically diverse regions in New South Wales of Australia (NSW Government, 2017). The vision of the North Coast regional plan 2016-2036 is to make the North Coast one of the best regions in Australia. The North Coast has a sensitive coastal strip, endemic plants and animals, and productive farmland, which attracts new residents and visitors and supports the growth of agriculture and tourism sectors. Therefore, this plan has acknowledged the importance of the environment most, and also emphasized several sectors; economy, connectivity, and tourism. Four goals have been set to achieve the vision: the most stunning environment in NSW, a thriving, interconnected economy, vibrant and engaged communities, great housing choices and lifestyle options. The location of new housing, employment center, and other facilities has been identified clearly on the projected regional map. Urban growth area maps for the local government areas are also provided, which has identified the potential areas for urban development in the future. In this plan, the important farmlands are identified for supporting long term agricultural production. This plan also focuses on building sustainable land use, protecting biodiversity and environmental land use (NSW Government, 2017).

2.1.2. Darwin Regional Land Use Plan 2015

Darwin Region that is a prosperous region of the Northern Territory in Australia with high-quality amenity, connectivity, a diverse economy and strong society that promotes innovation and tropical concepts, and holds an enduring connection to the natural environment (Northern Territory Government, 2015). The key purpose of this Darwin Regional Land Use Plan 2015 is to identify the essential characteristics and needs that will shape future growth in the region and establish an overarching framework for future development which will help the region to evolve as a place that is affordable, prosperous and sustainable, integrating existing and new urban areas to provide for individual character, identity, choice and a diversity of lifestyles for residents. This plan provides a strategic framework to anticipate and manage future growth that will result in better integrated land use, transport and infrastructure planning, to deliver more sustainable and cost-effective outcomes, and provide for economic and community growth in balance with protection of the environment (Northern Territory Government, 2015).

2.2. Review of Relevant National Policies for Coastal Area Development

❑ **Coastal Zone Policy 2005:**

Key Policies for Coastal Zone Development:

– The living standard of people will enhance by investing in potential sectors like marine fisheries, salt production, shrimp culture, crab culture, agro-based industries, transport, shipbuilding, and tourism. Labor-intensive and low-technology industries will be promoted to ensure employment of the poor and disadvantaged. Cox's Bazar, Nijhum Dwip, St. Martin Island and Kuakata sea beaches, and Sundarban will be developed as 'Special Zone

for Tourism as well as diversified livelihood options, job opportunities, collateral-free credit will be made available (MoWR, 2005). Basic facilities such as primary education, health care, sanitation, and safe drinking water will be increased and khas land will be provided to the landless (MoWR, 2005). Effective measures will be taken to enhance coping capacity in the coastal zone and to ensure the safety of children, women, disabled, old, and livestock and to encourage planned tree plantation (MoWR, 2005). Sustainable use of land, water, aquaculture, agriculture, livestock, afforestation, and energy will also be ensured (MoWR, 2005). Proper measures will be adopted to raise the capability of the poor and disadvantage through education, health, nutrition, employment-oriented skill training, social interventions and to ensure their accessibility to natural resources (MoWR, 2005). Equal participation of all stakeholders will be ensured and the cultural heritage of different communities must be kept (MoWR, 2005). Gender inequalities will be reduced by prioritizing women's education, training, and employment facilities. Special attention will be paid to ensure land titles to women during the distribution of newly accreted khas lands (MoWR, 2005). Special measures will be taken for heritage sites and biodiversity conservation. Zoning regulations will be established for locating new industries to control effluent discharges and sewage treatment plants will be set up in major cities like Chittagong, Khulna, and Barisal and gradually in other urban centers (MoWR, 2005).

- **National Food Policy: Plan of Action (2008-2015)**

– Agro-Ecological Zones (AEZ)-based land development plans based on sustainable and profitable cropping patterns will be developed both in coastal and mainland districts to ensure adequate supply and sustainable use of agricultural inputs (FPMU, 2008). Disaster preparedness and post-disaster rehabilitation in agricultural systems will be enhanced by developing new resistant seeds, early warning and forecasting systems, and training programs on disaster risk reduction and mitigation in agricultural sectors (FPMU, 2008).

- **The Bangladesh Environment Conservation Act, 1995:**

– An ecologically critical area is environmentally in a critical situation or is threatened to be in such a situation. The Government of Bangladesh also specified the activities or processes that cannot be initiated or continued in an ecologically critical area (GoB, 1995). All kinds of polythene shopping bags or any other article that is injurious to the environment have been banned by the Government (GoB, 1995). Without an environmental clearance certificate, no industrial unit or project will be established (GoB, 1995). Measures will be taken for the discharge of environmental pollutants due to any accident or unforeseen event to mitigate environmental pollution (GoB, 1995).

CHAPTER THREE: STUDY AREA PROFILE

3.1. Existing Features of the Study Area

3.1.1. Administrative Area and Boundary

The area of the region includes seven upazilas from Patuakhali and Barguna districts covering an area of 3442.382 square kilometers. There are 61 unions and 916 villages in this region (Bangladesh National Portal, 2021). The region is bounded by Bhola District on the east, Baleshwar River on the west, Bamna, Patuakhali Sadar and Bauphal Upazila on the north, and the Bay of Bengal on the south (LGED, 2008).

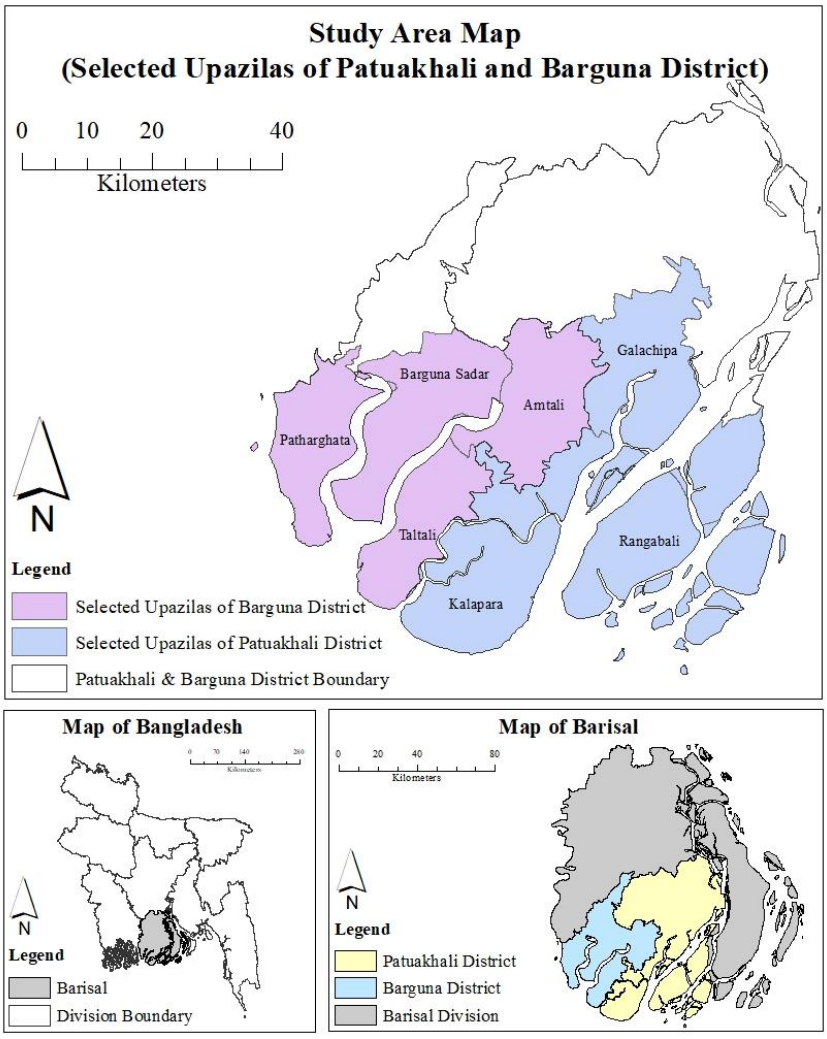


Figure 0.1: Map of the study area (Source: Authors' own construction from *Bangladesh—Subnational Administrative Boundaries,* 2020)

3.1.2. Demographic and Socio-economic Condition

The total population of the region is 12,72,826 **(**Bangladesh National Portal, 2021). The average household size is 4.3. The average literacy rate is 53.86%. The majority of people in this region are engaged in agricultural activities (Figure 3.2). Employment in service activities is found very high in Barguna Sadar Upazila. Almost 75% of people of this upazila are engaged in non-agricultural activities. Employment in service activity is very low in Rangabali upazila

(Figure 3.2). World Bank's Upazila level poverty map 2010 states that almost 20.24% population of this region is poor and 10.42% extreme poor.

3.1.3. Climate & Geology

Temperature, Wind and Rainfall: Temperature during the months of December-January is 8-10 degrees Celsius. The highest temperature can be 41 degrees Celsius during May. Rainfall occurs in this region due to southwest monsoon wind. Average annual rainfall is 2823 millimeters. The highest amount of rainfall occurs during June-October (2281 millimeters) (Upazila Disaster Management Committee, 2014).

Soil type and Salinity: The soil is alluvial and fertile. The salinity in the lands stays at a tolerable amount. But natural calamities increase salinity and affect the agricultural lands (Upazila Disaster Management Committee, 2014).

3.1.4. History of Natural Calamities

On 15 November 2007, cyclone Sidr; on 25 May 2009, cyclone Aila; and in 2013, cyclone Mohashen attacked the coastal region of Bangladesh, hampering the regular lives of the people of this region greatly. Flood and tidal waves attacked this region in 1986, 1987, 1988-1998, 2007, 2009, and 2013. There are 126 cyclone shelters and most of them are schools that are used as cyclone shelters during disasters (Upazila Disaster Management Committee, 2014).

3.1.5. Basic Facilities and Infrastructures

Water, Sanitation and Electricity: The main source of drinking water is tube-well. Around 95% of households of Barguna portion and that of 67% of Patuakhali portion have access to sanitary latrine. On average 27.74% of households have access to electricity (BBS, 2013a; BBS, 2013b).

Housing and other Infrastructures: Most of the houses are kutcha and semi-pucca. Only 2.16% of households have pucca houses. Around 21.12% households are living in jhupri house (BBS, 2013a; BBS, 2013b). There are 6 hospitals, 59 health care centers, 6 clinics, 793 primary schools, and 188 secondary schools (Bangladesh National Portal, 2021).

3.1.6. Transportation and Communication

This region is well connected with other parts of the country by road and waterway (BBS, 2013c; BBS, 2013d). Direct bus service is available from Dhaka to Kuakata via Barisal (UDD, 2018). Available transportation modes are bus, minibus, boat, launch, rickshaw, auto-rickshaw, and van (BBS, 2013c; BBS, 2013d; UDD, 2018). Almost 2642 km of waterways are available in this region throughout the year, which becomes 2968 km in monsoon season. There is no railway connection in this region (BBS, 2013c; BBS, 2013d).

3.1.7. Biodiversity

A total of 265 plant species belonging to 75 families and 204 genera were identified in Kuakata National Park, distributed in different habitats (Rahaman et al., 2017). Medicinal plants, wildlife supporting plants, exotic and invasive plants, and rare plants also exist there. The south-western coastal area of Bangladesh is covered by the Sundarbans, and the mid-central zone is covered by Tengragiri wildlife sanctuary which is in the Barguna district. This

sanctuary is home to Baen, Gewa Goran, Keora, Sundri and Samanea Saman (Raintree) (Mozahidul Islam et al., 2020). Wild animals like wild boar, deer, monkey, and different types of birds are found in Gangamati reserved forest while monkeys, pigs, etc. are found in Fatrar Char forest (Horaira, 2014). Total 114 fish species under 12 orders and 36 families were found in the Payra River (Islam et al., 2015).

3.2. Challenges and Opportunities of the Region:

3.2.1. Tourism

- ***Opportunities***: Kuakata sea-beach, called 'Ocean's daughter', the most attractive sea-beach for tourist attraction after Cox's Bazar, is located in Kalapara upazila. Besides other notable tourist spots include Kuakata National Park, Kuakata Well, Rakhain Polly, Keranipara, Misripara Buddhist Temple, Shima Buddhu Bihar, Jhaubon, Gongamoti Chor, Fatrar Chor, Sonar Chor, Rash Mela, Shutki Polli, Lal-Kakrar Char/ Red crab Island (Zafour, n.d.; Rahman, Rahman, & Nahar, 2015). There are a few historic mosques and tourist spots in Galachipa and Patharghata upazila (UDD, 2018). This region is a place of pilgrimage of the Hindus and Buddhist communities too (UDD, 2021).

Figure 3.3: Kuakata Sea Beach
(Source: Haque, 2020)

Figure 3.4: Jhau Forest (Eco park)
(Source: Jhau Bon: Kuakata, n.d.)

Figure 3.5: Fatrar forest, Kuakata
(Source: Fatrar Char (Kuakata), 2017)

Figure 3.6: Kuakata Buddhist Temple
(Source: Kuakata Buddhist Temple, n.d.)

- ***Challenges***: The tourist facilities are very poor. There are almost no good quality hotels and restaurants for tourists and the services in guest houses are inadequate (Rahman, Rahman, & Nahar, 2015).

3.2.2. Transportation

- ***Challenges*:** It takes 12 hours to travel from Dhaka using ferries in Barisal to Kuakata (Zafour, n.d.; Rahman, Rahman, & Nahar, 2015). The road infrastructure from Kalapara to Kuakata Polli is also poor (Zafour, n.d.).

- ***Opportunities:*** Construction of five bridges: Mawa, Lebukhali (under construction), Khepupara, Hazipur, and Alipur will likely reduce travel time to 4.5 hours (Rahman, Rahman, & Nahar, 2015). Most of the roads (86.94%) are kutcha roads (Bangladesh National Portal, 2021). Besides, direct bus service is now available from Dhaka to Kuakata via Barisal through a single highway (UDD, 2018).

3.2.3. Environmental

- ***Opportunities:*** Rivers in Kalapara are large sanctuaries for hilsha fish. There is a reserve forest in Fatrar char and cow-grazing fields (Directorate, 2018). The coastal region has reserve of sand mining and beach sand minerals, like: crude sand, heavy minerals, zircon, rutile, ilmenite, leucoxene, kyanite, monazite, magnetite, garnet (Islam & Ahmad, 2004; Hussain, Failler, Karim, & Alam, n.d.). Rainwater harvesting was reported to be one of the effective measures against soil water salinity intrusion of Kalapara Upazila of Patuakhali District (Shammi, Rahman, Bondad, & Bodrud-Doza, 2019).
- ***Challenges:*** Natural calamities like squalls and cyclonic storms, tidal bores sometimes pass over the area in the months of May-June and September-October. Inundation from the Bay of Bengal, river erosion, water logging during rain, drainage congestion, arsenic contamination of drinking water, are also very common problems of the region (UDD, 2018; Islam & Ahmad, 2004). Saline intrusion of groundwater of Barguna and Patuakhali districts was found (Shammi, Rahman, Bondad, & Bodrud-Doza, 2019). Due to large-scale polderization to boost rice production, drainage congestion took place and heavy siltation outside the polders made the southwestern area unsuitable both for agriculture, even for human habitation (Islam, 2006).

3.2.4. Economic

- ***Opportunities:*** The region is full of bio-diversified resources, like coastal fisheries, crabs, prawns, dry fishes. Different minerals, forest wood (timber) are important resources. Besides, salt is obtained from the beach. (Rahman, Rahman, & Nahar, 2015; Ahmad, 2019; Islam & Ahmad, 2004). The Payra deep sea-port at Kalapara, which is under construction, will serve the southern part of the country and the neighboring countries, Nepal and Bhutan. (Hossain & Byron, 2020). Moreover, the Payra power plant, a 1,320-megawatt coal-fired power plant, at Kalapara Upazila is in operation as the single largest power plant in the country whose power supply cost from the coal-based power plant is cheaper than LNG and liquid fuel-based power plants. (Rahman, 2021; UDD, 2018).
- ***Challenges:*** The region has a very low density of growth centers (one center per 100 km^2) that impedes women's market access, economic participation and mobility (Islam & Ahmad, 2004). The coastal resources are mostly over-exploited (Ahmad, 2019). Salinity intrusion also affects agricultural productivity (Mahmud, Islam, Sattar, & Saleque, 2010). About 200 ha grazing/fodder crop areas have been affected each year. For this, food shortage is one of the crucial issues for livestock production in this coastal region. Due to intake of salinity affected fodder crops by livestock, several diseases were found such as diarrhea, skin diseases, liver fluke, loss of body weight, and breakdown of immune system (Alam et al., 2017).

CHAPTER FOUR: CURRENT SCENARIO OF LAND USE

Overall, 62.58% of the land of the region is used for rural purposes and 1.77% of the land is used for urban purposes and 35.65% of the land is conservation areas to protect the forests and mangrove forests in the Payra-Kuakata Coastal region (Figure 4.1).

4.1. Rural Land Use

There are two zones under rural land use which are the agricultural zone and the agro-fisheries zone. Around 25% of the land of this region is used for only agricultural purposes and the agro-fisheries zone occupies 37.27% of the land (Figure 4.1). There are 32,042 ponds for fish cultivation in the region (Bangladesh National Portal, 2021). The total agricultural land available in this region is 2174.94 square kilometers and most of the agricultural land use is found in Galachipa and Amtali upazila (Bangladesh National Portal, 2021).

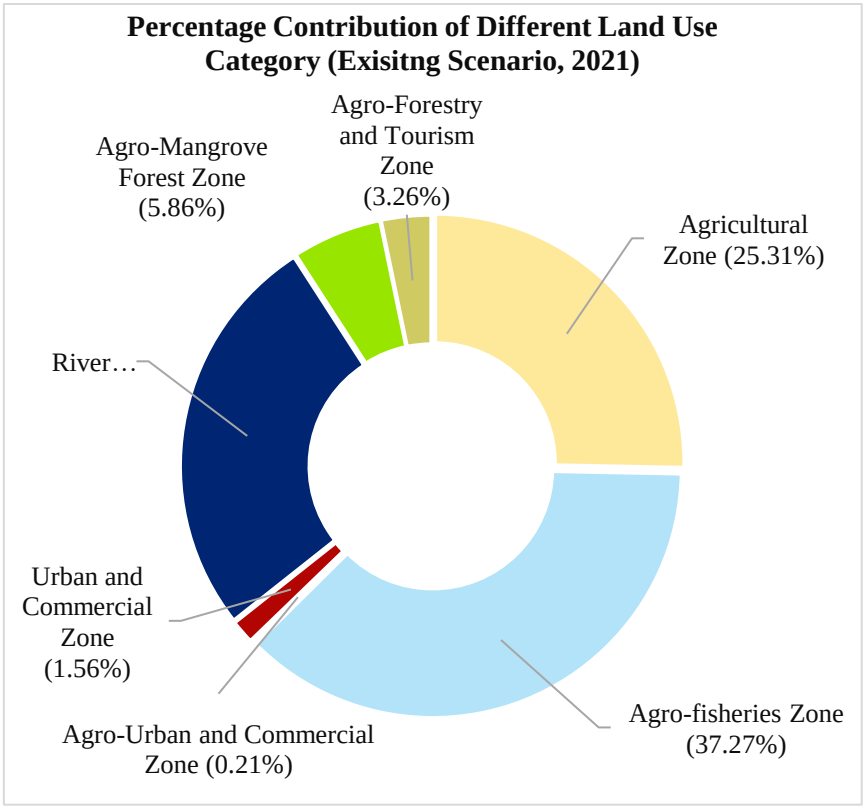


Figure 4.1: Percentage contribution of different land use in Payra-Kuakata coastal region (Source: Author, 2021)

4.2. Urban Land Use

The urban and commercial zone covers only 1.56% of the land while agro-urban and commercial zone covers 0.21% of the land of the region (Figure 4.1). Total non-agricultural land available in this region is approximately 275.6 square kilometers and there are 198 small industries in Galachipa and 781 in Patharghata upazila. Patharghata upazila also has 33 large industries. (Bangladesh National Portal, 2021).

4.3. Conservation Areas

According to Coastal Zone Policy 2005, special measures must be taken to conserve and develop wetland, mangrove, heritage sites, and marine reserves (MoWR, 2005). Therefore,

existing rivers, agro-mangrove and forest, and agro-forestry, and tourism zone are the conservation area of this region. Rivers occupy 26.35% of land as nine rivers flow through this region which are Andharmanik, Agunmukha, Payra, Lohalia, Patuakhali, Tentulia, Bishkhali, Khagdum, and Baleshwar rivers (BBS, 2013a; BBS, 2013b). Agro-mangrove and forest zone has the highest percentage of land (58.6%). Tengragiri wildlife sanctuary which situates in this zone is home to Baen, Gewa Goran, Keora, Sundri, and Plantation trees (Islam et al., 2020). Agro-forestry and tourism zone covers 3.26% of land in this region. A total of 265 plant species belonging to 75 families and 204 genera was identified from Kuakata National Park (Rahman, Rahman & Uddin, 2017). The Kuakata sea beach is in Kalapara upazila, and there are forest areas in Taltoli (Fatrar forest & Eco-park) and Patharghata (Laldia forest) (Bangladesh National Portal, 2021).

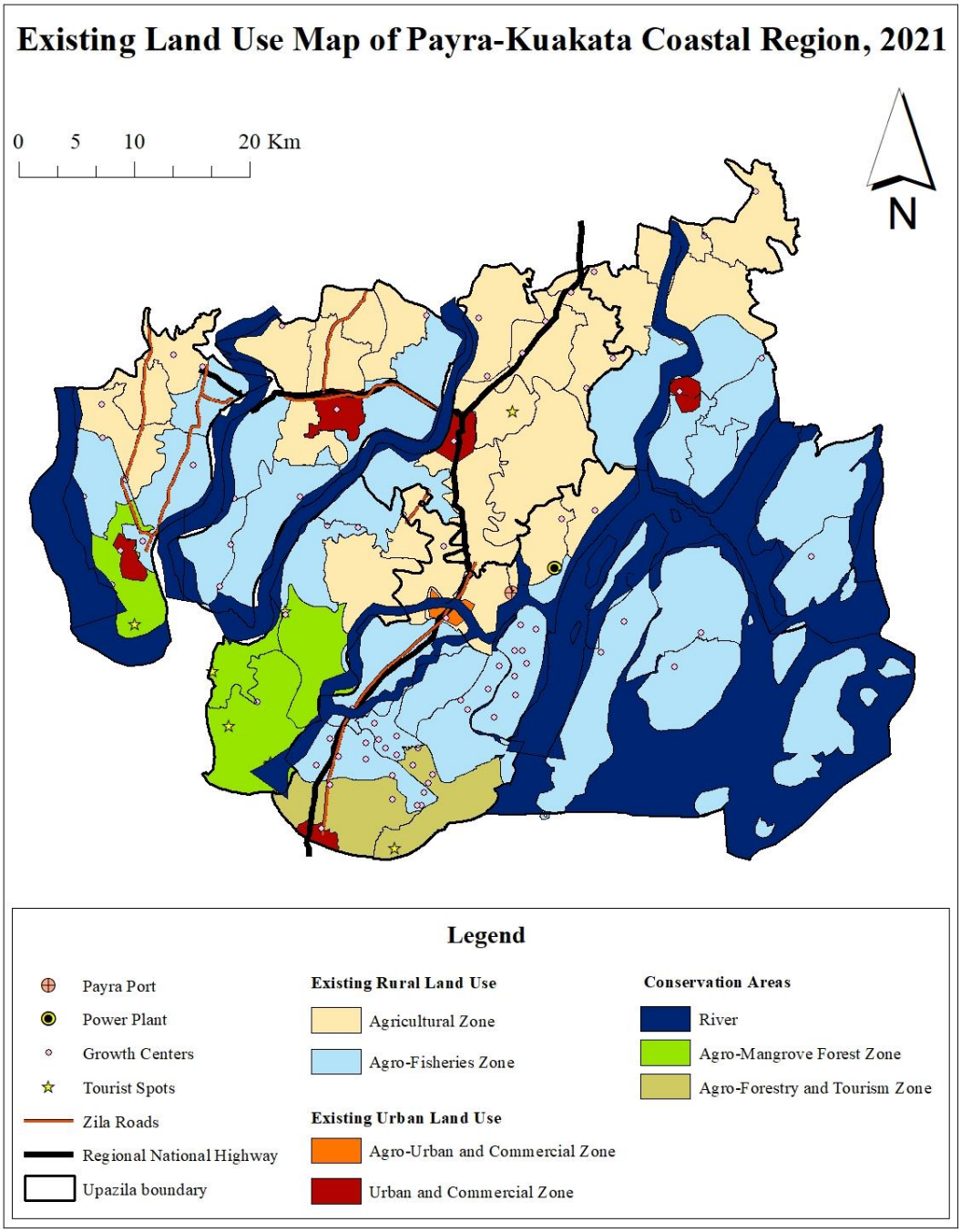


Figure 4.2: Base land use map of Payra-Kuakata coastal region (Source: Author, 2021)

CHAPTER FIVE: SHORT RUN ECONOMIC ANALYSIS: ECONOMIC BASE THEORY

For the economic development of the region, it is essential to invest in the most promising sectors of the place. But before that, it is necessary to understand the performance of the different economic sectors of the individual upazilas over the years. To study the regional economic structure, the economic base theory is used. It is a short-run economic analysis that explains how a regional economy works and how economic development processes shape regional economies and evaluates competing development strategies (Wang & vom Hofe, 2007).

5.1. Methodology

5.1.1. Data Collection

Employment data of 2003 and 2013 of 13 economic sectors for Bangladesh and selected upazilas are collected from the Economic Census of 2003 and 2013 of Bangladesh.

5.1.2. Selection of Projection Method

The simple extrapolation method is most suitable for the employment projection, as it requires fewer data (Thatkar et al., 2018). Among the approaches of simple extrapolation, the Arithmetic projection method is the most appropriate for the projection. This method assumes that the population will change by the same number of persons in the future following the past (Smith et al., 2013). The other two simple extrapolation approaches geometric and exponential leads to very high projections during long-range projections and provides unreliable results (Smith et al., 2013; United Nations, 1952). Therefore, the arithmetic method is most preferable, as it provides more conservative results during long-range projections (United Nations, 1952).

5.1.3. Identification of Basic and Non-Basic Industry Using Location Quotients Value

This quotient provide a method for estimating export employment (or income) (Schaffer, n.d.). The equation is:

$$LQ_i^r = (e_i/e)/(E_i/E)$$

LQ_i^r is the location quotient of region 'r' in industry 'i'; e_i is the total employment of the region 'r' in industry 'i'; e is the total employment of the region 'r'; E_i is the total employment of the nation in industry 'i'; E is the total employment of the nation. Assuming that the benchmark economy is self-sufficient, then a location quotient greater than one means that the area economy has more than enough employment in industry i to supply the region with its product. That economic activity is termed as basic economic activity. A quotient less than one suggests that the area is deficient in industry i and must import its product if the area is to maintain normal consumption patterns. That economic activity is termed as non-basic economic activity (Schaffer, n.d.).

5.1.4. Calculation of Basic and Non- Basic Employment

Location quotient is used to find the number of basic and non-basic employments of each industry in each upazila.

$$BE_i^r = \{(LQ_i^r - 1)/ LQ_i^r\} * E_i^r$$

BE_i^r is the number of employments involved in basic activities. E_i^r is the total number of employments of the region 'r' in industry 'i' (Schaffer, n.d.).

5.1.5. Calculation of Economic Base Multiplier

There is a relationship between basic and non-basic activities. Increase/ decrease in basic activities eventually leads to an increase/ decrease in non-basic sectors. The basic sectors have a multiplier effect on the regional economy. The higher the multiplier the larger the effect of basic job creators on the total number of jobs. The equation used is:

$$k = T/B$$

k is economic base multiplier; T is total employment and B is total basic employment (Schaffer, n.d.). Sector-wise and upazila wise economic base multiplier is determined to identify the potential sectors.

5.2. Results

5.2.1. Sector wise Employment Condition

Total projected employment in 2021 is 46230, which will become 85678 in 2041. Payra deep seaport might generate nearly 23000 employment opportunities. This estimation is predicted based on the employment generation due to the establishment of Chittagong port (Begum, 2003). Thus, total employment in 2041 is expected to become 108,678. In 2021, total employment in electricity, gas and water supply, construction, real estate and renting, and health and social work sector has not increased significantly. In 2041, employment for some sectors will increase in the region. These sectors are hotel and restaurant, bank, insurance and financial activities, education and community, social and personal services (Figure 5.1). Three sectors have no employment opportunities in this region which are mining and quarrying, manufacturing, and transportation, storage and communication (Figure 5.1).

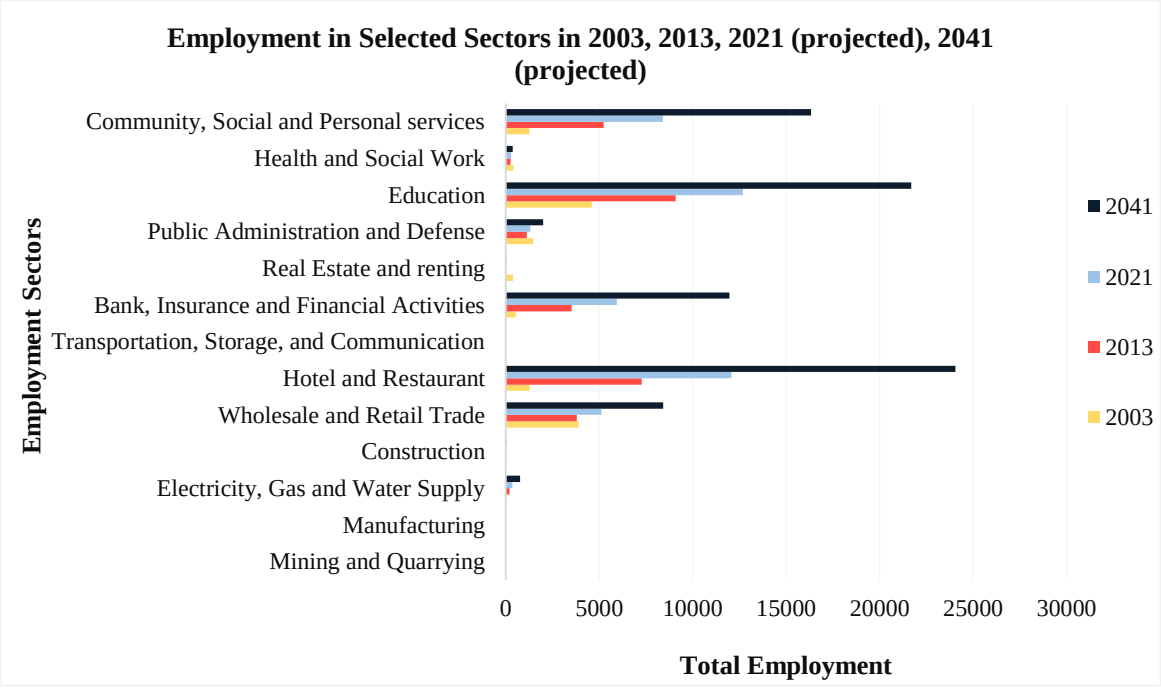


Figure 5.1: Employment in selected sectors in 2003, 2013, 2021, 2041 (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

5.2.2. Basic Economic Sectors

Basic economic sectors are the sectors that produce goods and services for both local and export markets (Rupasingha & Patrick, n.d; Thulin, 2014). In our selected region, bank, insurance and financial activity are found as common basic sectors in five out of seven upazilas (Table 5.1). The table also shows that Barguna Sadar has the highest number of basic economic sectors of all upazilas. Wholesale and retail trade is the main basic economic sector in Galachipa, Rangabali, and Taltali upazila. Mining and quarrying, manufacturing and transportation, storage and communication are the non-basic economic sectors of the region.

5.2.3. Upazila wise Basic Employment

Almost 22% of the region's total employment is basic employment. Galachipa and Barguna Sadar upazila have more employment opportunities than the other upazilas of the region (Table 5.2). Although the total population is lowest for Taltali which results in the lowest employment generation in that upazila, employment per 10,000 people is lowest in Patharghata (Table 5.2). Patharghata also has the least basic employment in terms of both total basic employment and basic employment per 10,000 people. The case is reverse for Galachipa upazila where it has the highest total population, highest total employment in 2021 and employment per 10,000 people, and highest basic employment in 2021, but doesn't necessarily have the highest basic employment per 10,000 people (Table 5.2). It is Rangabli upazila that has the highest basic employment per 10,000 people.

Table 5.1: Upazila wise total and basic employment per 10,000 people in 2021 (Source: Authors' own construction from Bangladesh National Portal, 2021; BBS, 2013e; BBS, 2013f)

Upazila	Total Population in 2021	Total Employment on 2021	Employment per 10,000 population	Total Basic Employment in 2021	Basic Employment per 10,000 population
Amtali	182798	6775	371	809	44
Taltali	88004	3260	370	719	82
Barguna Sadar	237613	9369	394	1955	82
Patharghata	163927	4597	280	672	41
Kalapara	237831	6755	284	1540	65
Rangabali	104128	4119	396	1475	142
Galachipa	258525	11356	439	2903	112

** Gray color represents highest values and blue color represents lowest values*

5.2.4. Sector wise Basic Employment

According to Figure 5.2, wholesale and retail trade sector has the highest number of basic employments. Community, social and personal service, education and bank, insurance and financial activities, these sectors also have high numbers of basic employments.

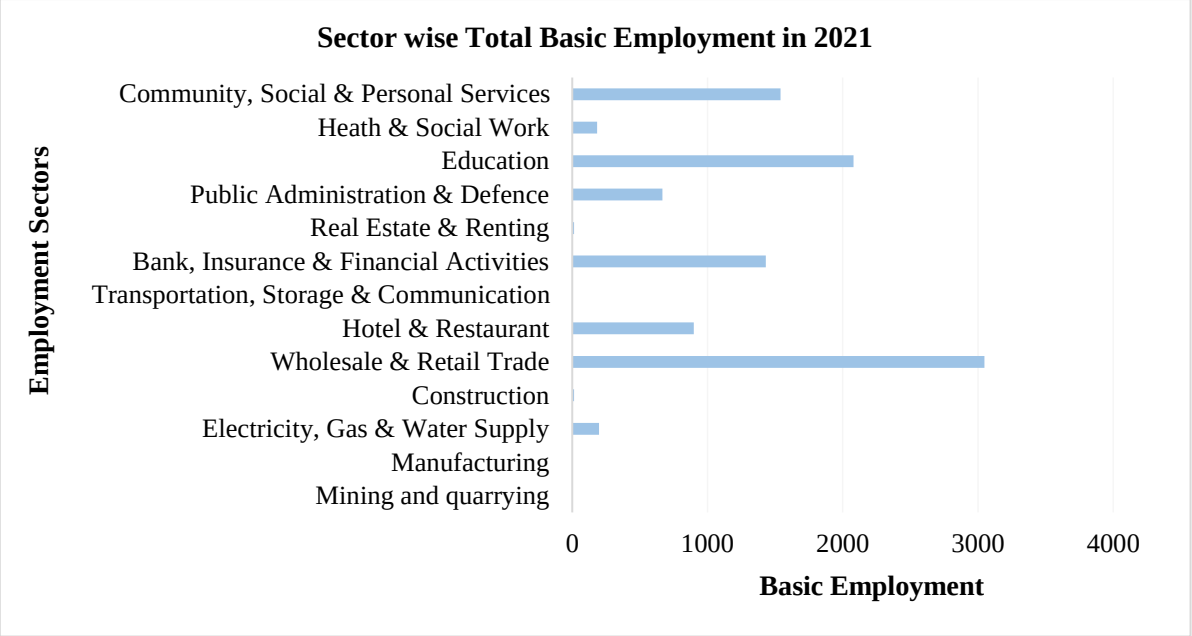


Figure 5.2: Sector wise total basic employment of the region (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

5.2.5. Upazila wise Multiplier Effect

Figure 5.3 depicts that overall multiplier effects are high in Amtali and Patharghata upazila. Therefore any economic investment in these upazilas will bring more employment in the region than the other upazilas. Overall multiplier effects are significantly low for Galachipa and Rangabali upazila.

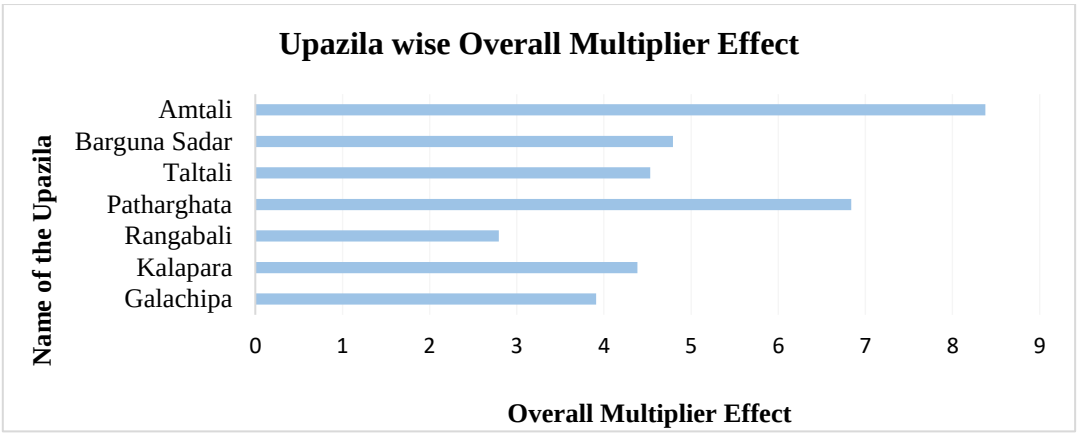


Figure 5.3: Upazila wise overall multiplier effect (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

5.2.6. Sector wise Overall Multiplier Effect

The overall multiplier effect is the highest for the hotel and restaurant sector (Figure 5.4). Investment in this sector will bring more employment in this region compared to other sectors. It is also higher for education, community, social and personal services, and bank, insurance

and financial activities. The lowest overall multiplier effect is found for real estate and renting, and construction sectors (Figure 5.4).

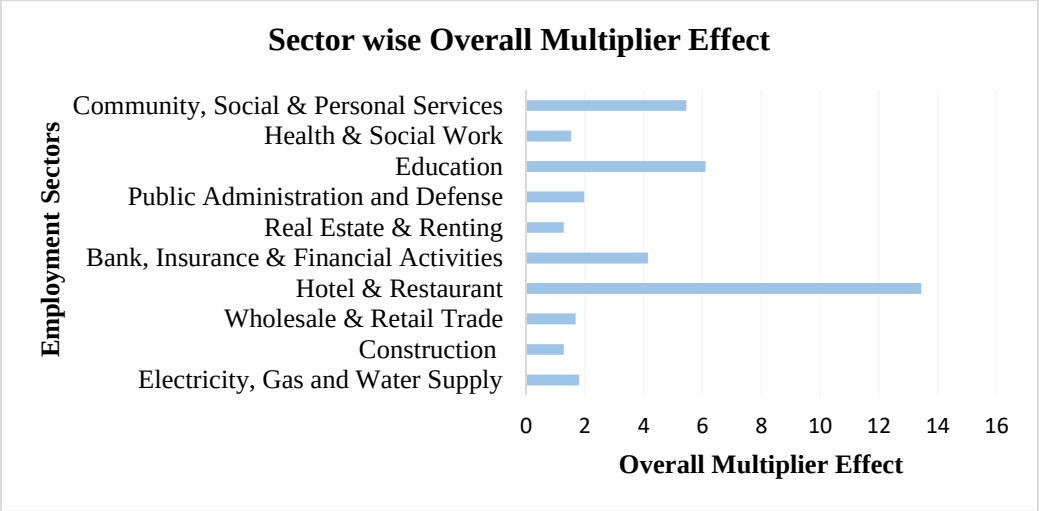


Figure 5.4: Sector wise overall multiplier effect (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

5.3. Major Findings, Interpretations, and Discussions

- Bank, insurance and financial activity, wholesale and retail trade, hotel & restaurant are some of the main basic economic sectors of the region. Local products of this region, especially rice, hilsa fish, dry fishes are exported in vast amounts to the other parts of the country (Bangladesh National Portal, 2021). Commercial activities of the coastal area are mostly related to port, shipping, industry, and agriculture (Rahman & Rahman, 2015). These activities have forward and backward linkages with other sectors and encourage the establishment of banks and insurance companies, warehouses and hotels (Rahman & Rahman, 2015).
- Tourism is not a basic industry in Kalapara in spite of having Kuakata Sea Beach because of some obvious reasons e.g. government never highlighted this industry, there are no international standard tourism education to develop marketing or sales people, weak institutional framework, failure to implement policies strictly, failure to deliver the investment information to the foreign and to local investors in the potential tourist spots and inevestment strategies which do not serve the investors and users effectively (Shamsuddoha & Nedelea, 2008).
- Education is a basic economic sector in this region. The highest literacy rate (61.3%) is found in the Barisal division (BBS, 2013). 47.7% of school-going children receive higher secondary education and 5.5% become graduates (Barisal, n.d.). 5.9% of establishments in both Patuakhali and Barguna zila are educational institutions and 14% of the working population are engaged in the education sector in Patuakhali which is 15.4% in Barguna zila (BBS, 2013c).
- Mining and quarrying, manufacturing are non-basic economic sectors of this region. Kuakata sea beach is a resource for heavy mineral sand (DoE, 2006). Due to the unavailability of extraction facilities, sometimes people illegally extract minerals using hand-held magnets from the beach, which can cause severe threats to water bodies and the

environment (Rahman & Rahman, 2015). This type of illegal extraction work is not recommended for export activity. The biodiversity of this region is very critical, and this might be one reason for which no mining and manufacturing industry exists in this region (Rahaman et al., 2017, Islam et al., 2020; Horaira, 2014). Moreover, Bangladesh has few mineral resources, and most of them are located in Sylhet and Chittagong regions (Bangladesh-Mining, 2021).

- Transportation, storage and communication are another non-basic economic sector of this region. Most of the roads in the coastal region are in vulnerable condition due to frequent natural disasters (Rahman & Rahman, 2015). A four-lane road connecting Payra port with Patuakhali-Kuakata highway has already been constructed (MoF, 2020; Payra port: Construction of four-lane approach road completed, 2020). A high-frequency base station with telecommunication equipment has already been installed (MoF, 2020). These activities already created employment in the region. However, the construction of Payra deep seaport will generate more employment in the transportation and communication sector (Tareq et al., 2020).
- The construction and real estate sector is a basic sector only in Barguna Sadar Upazila. As this analysis is based on the census data of 2003 and 2013, port-related employment is not considered here. Payra port project was started on 1 November 2013 in Kalapara Upazila (Byron & Hasan, 2021). Construction of roads, port infrastructure, housing, port terminals, warehouse of the project has already been created and will create employment opportunities in this upazila (MoF, 2020; MoF, 2017).
- Basic employment is higher in Galachipa and Barguna Sadar upazila. As basic and non-basic and non-basic activities have a cause-and-effect relationship, non-basic employment is also higher in these upazilas (Glasson, 1974). Therefore, total employment is also higher in Galachipa and Barguna Sadar upazila. However, Galachipa has only three basic economic sectors but number of basic employments is highest in this upazila.
- The economic base multiplier is highest for Amtali (8.3) and Patharghata (6.84) upazila. Both upazilas are in Barguna district and has improved access to regional highway (Figure 4.1). The hotel and restaurant sector has a major contribution to this high multiplier. Most of the tourist spots of Barguna upazila are in Amtali, Patharghata and Taltali upazila. Taltali upazila is the adjacent upazila of Amtali upazila. Some renowned tourist spots are Ashar Char (Amtali), Clay Fort (Amtali), Laldia sea-beach (Patharghata), Haringhata Reserve Forest (Patharghata), Sonakata Eco-park (Taltali), Fatrar Char (Taltali), Shuvo Sondha Sea Beach (Taltali) (Google, n.d.; Maynuddin, n.d.). Many tourists come to visit these places thus hotel and restaurant sector has a high demand in these upazilas. The economic base multiplier is lowest for Galachipa (3.91) and Rangabali (2.79) upazila which are in Patuakhali district. The lowest multiplier indicates that basic products of these upazilas don't have high demand and have less contribution to the overall economy of the region.
- The sectors with high multiplier effects e.g., hotel and restaurants, education, community, social and personal services, and bank, insurance and financial activities are potential sectors for investments. Investments in these sectors in the region, especially in Amtali and Patharghata upazila will have larger impacts on the income and employment of this region.

5.4. Policy and Recommendations based on Findings

- This region is enriched with various tourist spots. Though tourist facilities are not adequate, hotels and restaurants are one of the dominant sectors of this region. Further improvement in this sector will facilitate both the economy and tourism sector. Amtali and Kalapara have most of the tourist spots. However, hotel and restaurant is not basic sectors in Kalapara upazila. So, for further development, the tourist spots need to be developed so that the employment in these sector increases.
- Bank, insurance and financial activity, wholesale and retail trade are some flourishing sectors which support the port, shipping, industry and agricultural activity. These sectors need to develop as they have a high contribution to export activity. The sectors which are already developed have to be maintained properly.
- Payra port in Kalapara upazila is expected to have a direct, indirect, and induced effect on the entire region and thus will create enormous employment opportunities for the region. The port will promote export activities, shipping, fisheries, bank, truck, and ferry services more than before. A special economic zone needs to be set up near the Payra port to utilize the export facilities and to attract foreign traders.
- Kuakata sea beach which is one of the most attractive tourist spots of the country should develop as a special zone for tourism which will promote both regional and national economy.
- Attention must be given to the sectors which are of the high multiplier effect that are hotel and restaurant sector, education, community, social and personal services, and bank, insurance, and financial activities sectors.

CHAPTER SIX: LONG RUN ECONOMIC ANALYSIS: SHIFT-SHARE METHOD

In this study, the Shift share analysis is used for the long-run economic analysis of the region. Shift-share analysis analyzes employment growth in a region over a specific period. It explains why regional economic conditions may differ from national-level trends by measuring the changes in a region's performance relative to the nation over a given period (Goodwin, 2018; Sirakaya et al., 1995). The shift-share technique will help to know the contribution of national trends, industrial sector trends, and local conditions and so will guide to understand the sectors to be utilized to achieve the vision of this project.

6.1. Methodology

6.1.1. Data Collection

Employment data of 2003 and 2013 of 13 economic sectors for Bangladesh and selected upazilas are collected from the Economic Census of 2003 and 2013 of Bangladesh.

6.1.2. Data Analysis

Shift-share analysis decomposes local economic growth over a specific period into three effects (Goodwin, 2018; Loveridge, 1995; Sirakaya et al., 1995). They are: 1. National growth/ national share, 2. Industrial mix/ proportional shift, 3. Local share effect/ differential shift/ regional shift/ competitive share. The sum of these three effects is equal to the change in employment over the period of the analysis.

Total Regional Growth = National Share + Industry Mix + Regional Shift

6.1.3. Calculation of National Share (NS)

The NS component is computed by multiplying the regional base-year employment in each sector by the average national employment growth rate and then summing the products. The results show how many of the newly created jobs can be attributed to national economic trends (Sirakaya et al., 1995).

National Share, NS = $\sum_{i=1}^{n} E_{ir}^{t-1} \left[\frac{E_{nation}^{t}}{E_{nation}^{t-1}} - 1\right]$ **;** here, i = Industry subscript, t = Terminal period, t-1 = Base/ Initial period, E_{ir} = Total employment of industry 'i' in region 'r', E^{t}_{nation} = Total national employment at terminal period (Loveridge, 1995; Sirakaya et al., 1995)

6.1.4. Calculation of Industrial Mix (IM)/ Proportionality Shift (PS)

The industrial mix helps to distinguish high-growth regions from low-growth regions based on the underlying growth rates of the region's largest industries (Goodwin, 2018). It is calculated by multiplying the base-year regional employment in each economic sector by the difference between the national growth rate for that sector and the entire economy (Sirakaya et al., 1995). A positive IM component would demonstrate that the local economy has relatively more people employed in fast-growth sectors than the national average and therefore exhibits structural strength (Hustedde et al., 1993; Sirakaya et al., 1995).

Proportionality Shift, PS= $\sum_{i=1}^{n} E_{ir}^{t-1} \left[\frac{E_{i,nation}^{t}}{E_{i,nation}^{t-1}} - \frac{E_{nation}^{t}}{E_{nation}^{t-1}}\right]$ **;** here, $E_{i,nation}$ = Total national employment of industry 'i' (Loveridge, 1995; Sirakaya et al., 1995)

6.1.5. Calculation of Regional Shift (RS)/ Differential Shift (DS)

Finally, the regional shift component indicates the extent to which local forces contributed to economic growth in the region (Loveridge, 1995). It is determined by multiplying the base-year regional employment in each economic sector by the difference between the national and regional growth rates of that sector. After completing this process for all sectors, the results are added to generate the DS effect. The results indicate that the region under study is more or less efficient in securing a larger share of employment than the nation (Sirakaya et al., 1995). The formula for calculating regional shift component is (Loveridge, 1995; Sirakaya et al., 1995):

Regional Shift, RS= $\sum_{i=1}^{n} E_{ir}^{t-1} \left[\frac{E_{ir}^{t}}{E_{ir}^{t-1}} - \frac{E_{i,nation}^{t}}{E_{i,nation}^{t-1}}\right]$

6.2. Results

6.2.1. Upazila wise Overall Shift-Share Component of the Region

Between 2003 and 2013, all upazilas of the Payra-Kuakata region has experienced a positive employment change (Figure 6.1). Therefore, the overall employment of this region has increased over time. More than 60% employment increase of this region has been generated because of national employment growth. Thus, the national share component has a major contribution to the total employment change of this region. Galachipa and Amtali upazilas have experienced the highest positive employment change, whereas Taltali and Rangabali upazilas have experienced comparatively lower positive employment change (Figure 6.1). Overall employment change of Barguna Sadar and Kalapara upazila is comparatively low because of their high negative industrial mix and regional shift value (Figure 6.1). All the upazilas of this region have negative IM values, which indicate that the economy of this region has less employment than it would have if its economic structure were identical to the nation. Overall regional shift component value of this region is negative. Except for Amtali and Taltali upazilas, all upazilas have weak competitive effects (Figure 6.1).

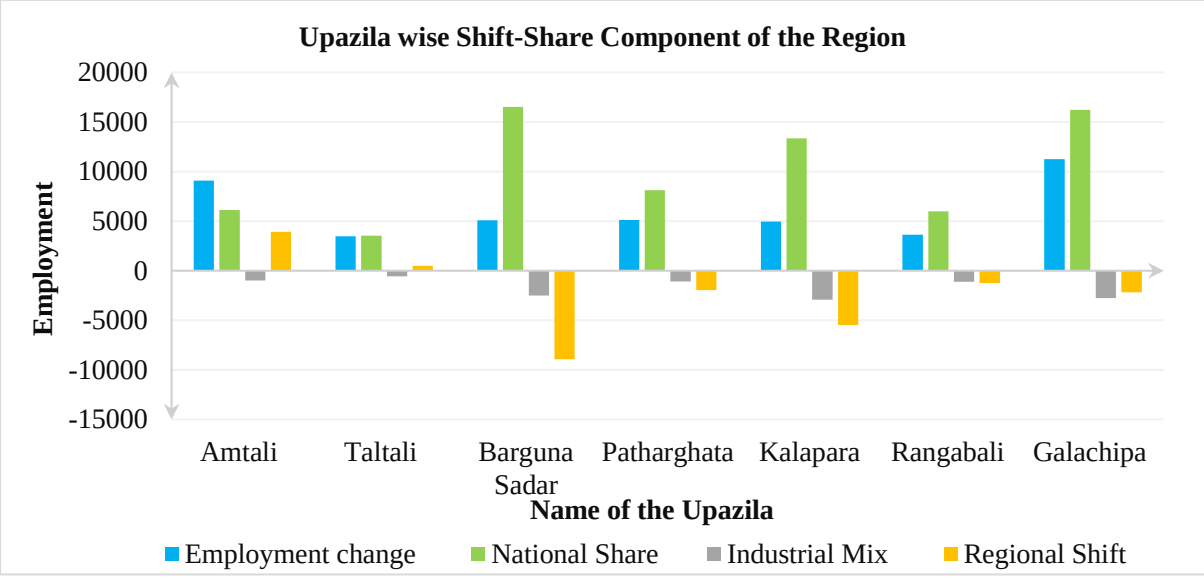


Figure 6.1: Upazila wise overall shift share component of the Payra-Kuakata coastal region (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

6.2.2. Comparison between National and Regional Employment Growth

From 2003 to 2013, the national total employment has increased by 117% which has increased by 72% in the Payra-Kuakata coastal region (Figure 6.2). The percentage employment change in mining and quarrying, electricity, gas and water supply, bank, insurance and financial activities, construction, manufacturing, hotel and restaurant sector in Payra-Kuakata Coastal region is greater than the rate of national level (Figure 6.2). However, the wholesale and retail trade, transportation, storage and communication, public administration and defense education, health and social work, community, social and personal services sector shows a lower growth rate in this region compared to growth at the national level. The real estate and renting sector has a decreasing trend both at the national and regional levels (Figure 6.2).

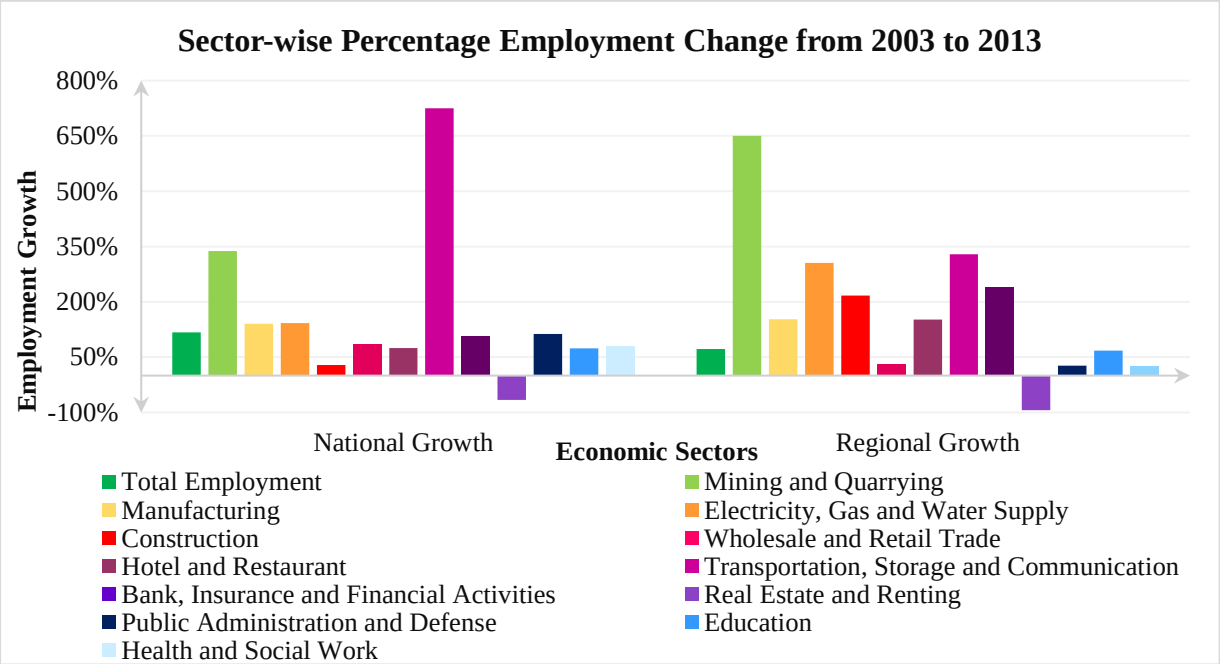


Figure 6.2: Percentage change of employment in each sector from 2003 to 2013 (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

6.2.3. Sector wise Shift-Share Component of the Region

Based on the shift-share component, the economic sectors of the region can be categorized into four types, such as fast-growing, highly potential, developing, and depressed sectors (Astuti et al., 2018). Fast-growing sectors have both positive regional shift and industrial mix value, highly potential sectors have positive regional shift and negative industrial mix value, developing sectors have negative regional shift and positive industrial mix value and depressed sectors have both negative regional shift and industrial mix value (Astuti et al., 2018).

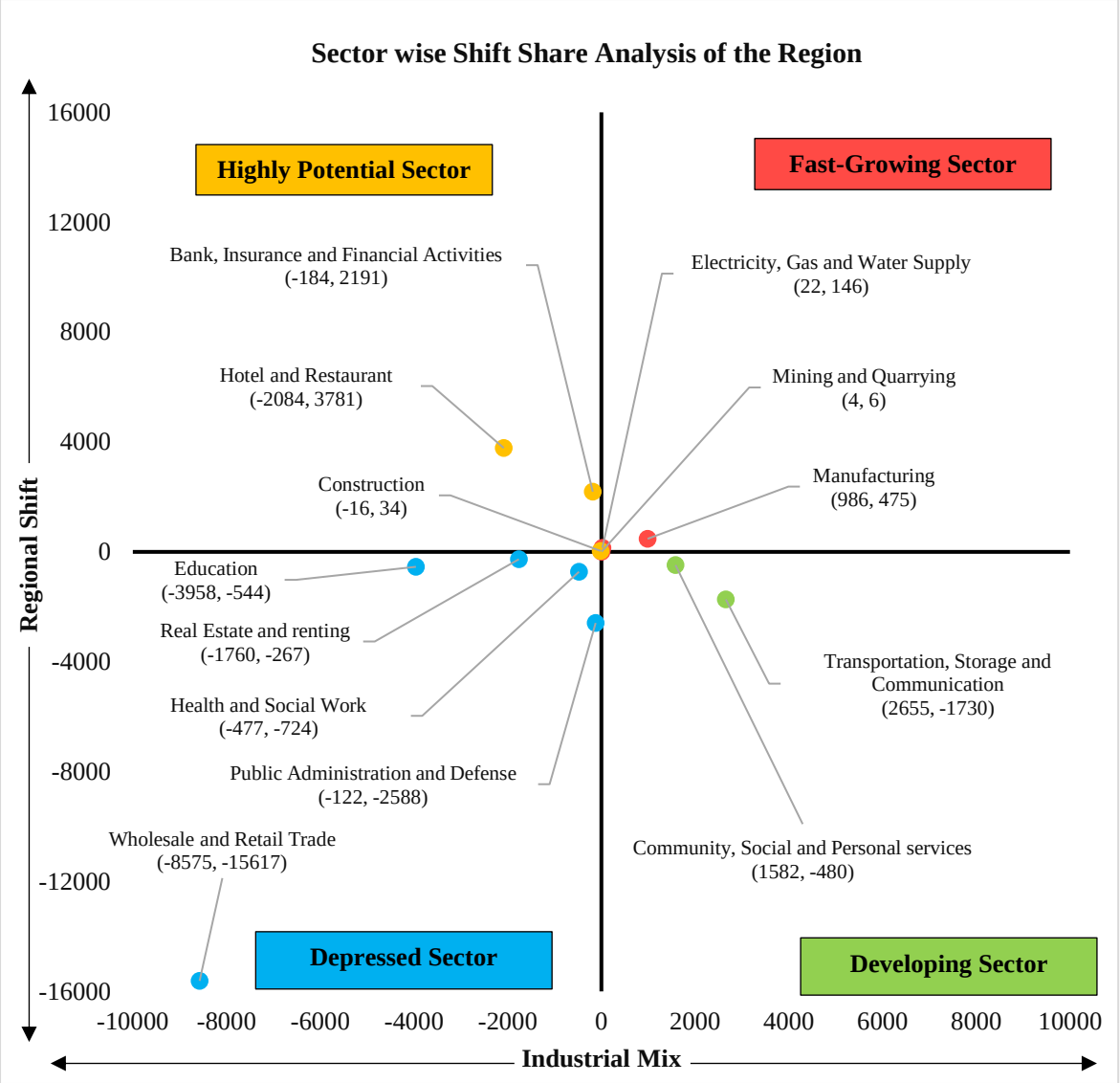


Figure 6.3: Sector wise overall shift share component of the Payra-Kuakata coastal region (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

6.2.3.1. Fast-Growing Sector

Manufacturing, electricity, gas and water supply, and mining and quarrying are the fast-growing sector in this region (Figure 6.3). However, regional shift and industrial mix value of mining and quarrying is not much high. Therefore this sector doesn't have a high competitive effect.

6.2.3.2. Highly Potential Sectors

Hotel and restaurant, bank, insurance, and financial activities, and construction are the most potential sectors of this region (Figure 6.3). Among the potential sectors, hotel and restaurant and bank, insurance and financial activities have strong competitive effects which indicate that the local economy has been successful in attracting investment in these sectors.

6.2.3.3. Developing Sectors

Community, social and personal services, transportation, storage and communication are the developing sectors of the region (Figure 6.3). Though these sectors have negative competitive effects, these sectors are growing faster than the national economy.

6.2.3.4. Depressed Sectors

Wholesale and retail trade, public administration and defense, education, real estate and renting, and health and social work are relatively the lagging sectors of the region (Figure 6.3). These sectors are in a depressed position because of their weak competitiveness and slow growth.

6.2.4. Upazila wise Fast Growing, Highly Potential, Developing and Depressed Sectors

Table 6.1 highlights that most sectors of Amtali and Kalapara have locational advantages and are highly potential. Taltali, Barguna, Patharghata, Rangabali, and Galachipa have mostly depressed sectors with negative industrial mix and regional share. Of all the upazilas, Rangabali has no fast-growing sectors. All the upazilas have hotel and restaurant as highly potential sector, transportation, storage and communication as developing sector and real estate and renting as depressed sector in common. This means this region has locational disadvantages for the transportation and real estate sectors. However, the transportation and communication sector is growing for overall improvement in the transport sector only.

6.2.5. Upazila wise Industrial Mix Component of Different Economic Sectors

All upazila of this region has negative industrial mix component. However, overall negative industrial mix component is relatively lower in Amtali and Taltali upazila and higher in Kalapara, Barguna Sadar and Galachipa upazila (Figure 6.4). Therefore, comparatively less slow-growing upazilas of this region are Amtali and Taltali upazila, Patharghata and Rangabali moderately slow-growing, and Kalapara, Barguna Sadar and Galachipa are very slow-growing upazilas (Figure 6.4).

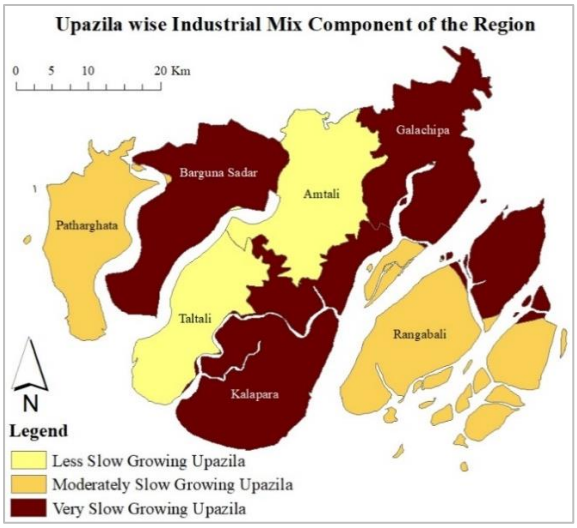


Figure 6.4: Upazila wise industrial mix component of the Payra-Kuakata coastal region

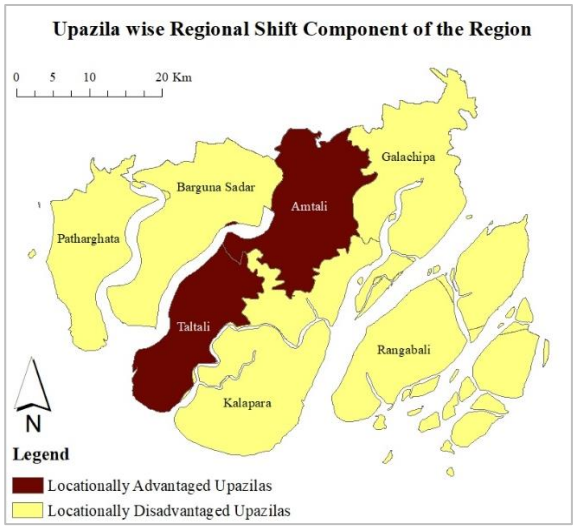


Figure 6.5: Upazila wise regional shift component Payra-Kuakata coastal region

(Sources: Authors' own construction from BBS, 2013e; BBS, 2013f)

Community, social and personal services, manufacturing, and transportation, storage and communication sectors have positive industrial mix component value in all upazilas of this region, which indicates that these sectors growing faster than the national economy in this region (Table 6.2). The mining and quarrying sector is growing faster in Kalapara and Galachipa upazila, and the electricity, gas and water supply sector is growing faster in Amtali, Barguna Sadar, and Galachipa upazila (Table 6.2). Galachipa upazila has the highest number (5 out of 13) of fast-growing sectors in this region (Table 6.2).

Wholesale and retail trade, hotel and restaurant, bank, insurance and financial activities real estate and renting, public administration and defense, education, health and social work, construction sectors have negative values for the industrial mix component in the Payra-Kuakata coastal region (Table 6.2). Therefore, these sectors are growing at a slower rate compared to the national economy.

Table 6.2: Upazila wise Industrial Mix Component of Different Economic Sectors (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

Sectors	Amtali	Taltali	Barguna Sadar	Patharghata	Kalapara	Rangabali	Galachipa
Mining and Quarrying	0	0	0	0	2	0	2
Manufacturing	87	36	339	124	184	51	166
Electricity, Gas and Water Supply	7	0	9	0	0	0	5
Construction	0	0	-3	0	-1	-6	-6
Wholesale and Retail Trade	-608	-440	-1744	-918	-1906	-946	-2013
Hotel and Restaurant	-234	-57	-423	-193	-441	-176	-561
Transportation, Storage and Communication	316	85	608	352	456	194	644
Bank, Insurance and Financial Activities	-7	-13	-75	-17	-18	-14	-41
Real Estate and renting	-205	-20	-301	-83	-708	-33	-411
Public Administration and Defense	-8	-3	-45	-17	-6	-4	-40
Education	-427	-258	-1037	-439	-656	-283	-860
Health and Social Work	-74	-9	-144	-125	-69	-19	-38
Community, Social and Personal services	176	114	305	242	245	117	383

** Gray color represents the positive IM component and white color represents the negative IM component*

6.2.6. Upazila wise Regional Shift Component of Different Economic Sectors

Overall regional shift component is positive only in Amtali and Taltali upazila. Therefore, except Amtali and Taltali upazilas, other upazilas of this region are locationally disadvantaged upazilas (Figure 6.5). Most of the economic sectors (8 sectors out of 13) has locational advantages in Kalapara upazila (Table 6.3). However, the overall regional shift component of Kalapara upazila is negative due to the highest negative competitive effect of the wholesale and retail trade sector (Table 6.3). All seven upazilas of this region have positive differential

shifts in the hotel and restaurant sector (Table 6.3). Except for Galachipa upazila, the other six upazilas have comparative advantages for banks, insurance and finance sector (Table 6.3). On the other hand, all upazilas have locational disadvantages for transportation, storage and communication and real estate and renting sector (Table 6.3). Five upazilas of this region: Barguna Sadar, Patharghata, Kalapara, and Galachipa, Rangabali are severely locationally disadvantaged in the wholesale and retail trade sector (Table 6.3). Rangabali has locational disadvantages for the majority of economic sectors (11 out of 13).

Table 6.3: Upazila wise Regional Shift Component of Different Economic Sectors (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

Sectors	Amtali	Taltali	Barguna Sadar	Patharghata	Kalapara	Rangabali	Galachipa
Mining and Quarrying	0	0	0	0	9	0	-2
Manufacturing	827	-68	-1032	384	403	-86	46
Electricity, Gas and Water Supply	-51	0	44	103	100	0	-51
Construction	0	0	42	0	1	-9	0
Wholesale and Retail Trade	531	157	-5587	-1603	-6231	-1299	-1585
Hotel and Restaurant	847	290	526	525	4	505	1085
Transportation, Storage and Communication	-229	-2	-594	-334	-386	-75	-109
Bank, Insurance and Financial Activities	790	169	334	292	579	57	-30
Real Estate and renting	-38	-4	-10	-15	-118	-6	-76
Public Administration and Defense	167	-51	-1212	-433	519	-28	-1550
Education	643	-29	-602	-20	201	-248	-488
Health and Social Work	-38	38	-225	-405	-117	-23	47
Community, Social and Personal services	487	14	-602	-432	-435	-37	525

** Gray color represents positive RS component and white color represents negative RS component.*

6.3. Major Findings, Interpretations, and Discussions

- Over time, total regional employment has increased by 72% which is lower than overall national employment growth (117%). Total national employment growth has increased due to rapid urbanization, a notable development in export-oriented and ready-made garment industries, increased participation of the female labor force, special employment creation programs through micro-credit (ADB, 2016; PAU, 2008). As the national share component contributes to more than 60% employment change of this region, positive national employment growth might have led to positive regional employment growth.
- All upazilas of this region have negative industrial mix effects which indicate that the economy of this region has less employment than it would have if its economic structure were identical to the nation. Lack of employment opportunities, low budget allocation in the development sectors, lack of capital, skills, education, and technical knowledge could be some of the major reasons behind this (Fakhruddin & Rahman, 2015; Islam & Ahmad, 2004; Jobaid & Khan, 2018; Khan, 2014).

- Overall regional shift component value of this region is negative. Though this region has enormous natural resources and tourist spots, people of this coastal region have to face various natural disasters and the adverse effects of climate change which might be responsible for the locational disadvantages of this region (IMF, 2011; World Bank, 2008). The harmful effect of climate change on this region are sea-level rise, the incidence of devastating storms, wetland loss, and salinity of soil rise (Dasgupta et al., 2014; IMF, 2011). All these negatively affect the economy, agriculture, aquaculture, infrastructure, and ecosystems of this region (Dasgupta et al., 2014).
- Only Amtali and Taltali upazila have an overall positive competitive effect. Most of the tourist spots of Barguna upazila are in Amtali, Patharghata and Taltali upazila (Bangladesh National Portal, 2021; Google, n.d.; Maynuddin, n.d.). Taltali upazila has fish farms in Sonarchar, 3 ice factories around it, and Shutki Pallies (Bangladesh National Portal, 2021). Therefore, these upazilas have comparative advantages which can attract more economic activities. Rangabali has locational disadvantages for the majority of economic sectors (11 out of 13). Communication crisis is might be the main reason behind this (Islam, 2014).
- Manufacturing, electricity, gas and water supply, and mining and quarrying sectors have overall positive regional shift and industrial mix value in this region. Over time, all upazilas of this region show an increasing trend in urbanization which might influence the positive growth of manufacturing and electricity, gas and water supply sectors. Moreover, electricity is used in the largest number of manufacturing establishments as a fuel for production in this region (BBS, 2013b; BBS, 2013c). Though regional shift and industrial mix value of mining and quarrying are positive, the values are not much high. Kuakata sea beach is a resource for heavy mineral sand (DoE, 2006). Due to the unavailability of extraction facilities and to protect the sensitive biodiversity and environment of this region, the mining sector doesn't have a high competitive effect in this region (Rahaman et al., 2017; Rahman & Rahman, 2015).
- All upazilas of this region have locational advantages for the hotel and restaurant sector. All these upazilas have tourist places and attract a lot of tourists throughout the year (Bangladesh National Portal, 2021; Islam, 2016; Rahman et al., 2015). Due to the growing attention of tourists in these areas, accommodation facilities are being constructed (Islam, 2016).
- Bank, insurance and financial activities also have a very strong competitive effect. Except for Galachipa upazila, the other six upazilas have locational advantages for this sector. This is probably due to policy changes related to credit extension and poverty reduction in the coastal disaster-affected areas (Iqbal et al., 2020). Commercial activities of the coastal area are mostly related to port, shipping, industry, and agriculture which has forward and backward linkages with other sectors and encourages the establishment of banks and insurance companies, microcredit institutions, warehouses, and hotels (Rahman & Rahman, 2015; Toyon, 2016).
- The construction sector is also one of the high potential sectors of this region which has positive competitive effects. But this sector is growing at a slow rate which indicates that it is not well-performing in this region. Barguna Sadar Upazila has more locational advantages for this sector. As this upazila is the only Sadar upazila of this region with diversified employment opportunities, many people from other divisions are coming to

settle here. This might be one underlying reason for the locational advantages of Barguna Sadar Upazila in this sector (Toyon, 2016). Kalapara upazila has a very small number of locational advantages for this sector. This upazila has huge potential in this sector. As this analysis is based on the census data of 2003 and 2013 and the Payra port project was started on 1 November 2013, port-related construction of roads, port infrastructure, housing, and the port terminal has not addressed here (Byron & Hasan, 2021; MoF, 2020; MoF, 2017).

- Community, social and personal services, manufacturing, and transportation, storage and communication are the most fast-growing sectors of this region. These sectors have positive industrial mix value in all upazilas of this region. However, these sectors have negative competitive effects which maybe because of the huge loss of infrastructures and employment in the cyclones Sidr and Aila in the years 2007 and 2009 (GoB, 2008; Haque & Jahan, 2016; Kabir et al., 2016).
- Though Barisal shows the best performance in Bangladesh in case of educational achievements, this sector is found as a depressed sector in this region (IMF, 2011). During natural disasters, the educational institutions of this region are damaged severely which might be one major reason behind this (Ahamed et al., 2012). Public administration and defense, real estate and renting, and health and social work are also some depressed sectors of this region as these sectors have both negative industrial mix and regional shift value. Real estate activities are relatively lower in the Barisal division than in the other divisions of Bangladesh (Islam & Arefin, 2009). These sectors are in a depressed position because of their weak competitiveness and slow growth.
- The wholesale and retail trade sector has the highest negative regional shift value in this region. Five upazilas of this region are severely locationally disadvantaged in the wholesale and retail trade sector. Wholesale and retail trade establishments suffered destruction of premises and loss of inventory in the surge-affected area when cyclone Sidr hit the coastal areas in 2007 (GoB, 2008). This resulted in economic loss, amounting to millions. Private businesses lost infrastructure, equipment, and inventory in the cyclone (GoB, 2008).

6.4. Policy and Recommendations based on Findings

- This region has enormous natural resources such as coastal fisheries, crabs, prawns, dry fishes, and minerals. It is also famous for various attractive tourist spots. Despite the immense potentials of this region, the overall industrial mix and regional shift components of this region are negative. Some measures to improve the economic condition of this region can be developing agro-based industries, more salt-tolerant crop production, increasing employment opportunities in non-farm sectors, promoting small and medium scale enterprises and cottage industries, enabling safe and women friendly working environment, and encouraging the involvement of private sectors.
- People of this region are highly dependent on the available natural resources for their livelihood. These people are specialized in agriculture and aquaculture-related activities but don't have enough skill and education to engage in other activities. Over-exploitation of natural resources and more employment in agriculture sectors decrease employment in non-agricultural sectors and locational advantages of this region. Therefore, more emphasis

should be given to human development. More training and educational programs, increasing access to capital and market may help to create more employment in skill based non-farm sectors. Special emphasis must be given to increase the employment opportunities of disadvantaged groups: poor and women.

- Payra port and power plant projects are expected to have enormous employment opportunities in this region. Payra port will promote export activities, shipping, fisheries, bank, truck, and ferry services more than before which not only contribute to the economic growth of Kalapara upazila but also will increase the overall employment generation of this region. Payra powerplant project will encourage the establishment of new industries due to the availability of electricity. However, these activities can create huge pressure on the natural environment. So, these economic activities must be managed properly to protect the biodiversity, agriculture, and aquaculture of this region.
- Frequent natural disasters, adverse effects of climate change, lack of infrastructures, poverty, and limited livelihood opportunities are some major problems in this region. These locational disadvantages might hinder the economic growth of many potential economic sectors. Improving infrastructure, introducing improved technology to minimize salinity of soil and water, enhancing preparedness for natural disasters can be some of the measures that will address the factors that negatively affected the economic activities of this region.
- More development and investment programs targeting the high potential sectors of this region hotel and restaurant, bank, insurance, and financial activities, and construction might strengthen both the economy of the region and the country in long run. Special attention needs to be provided to the depressed upazilas and sectors through equitable budget allocation and increasing diversified employment opportunities and capabilities of the people of this region.

CHAPTER SEVEN: UNION LEVEL DEVELOPMENT POTENTIAL ANALYSIS

In this study, multi-criteria decision analysis (MCDA) is used to identify potential areas for development, which will guide to improve the low development potential areas of this region. MCA techniques can be used to identify a single most preferred option, to rank options, to short-list a limited number of options for subsequent detailed appraisal, or simply to distinguish acceptable from unacceptable possibilities (Dodgson et al., 2009). A key feature of MCA is its emphasis on the judgment of the decision-making team, in establishing objectives and criteria, estimating relative importance weights and, to some extent, in judging the contribution of each option to each performance criterion (Dodgson et al., 2009).

7.1. Methodology

The steps of the MCDA are: 1. Define the context; 2. Identify the options available; 3. Decide the objectives and select the right criteria that represent the value; 4. Measure out each of the criteria to discern their relative importance; 5. Calculate the different values by averaging out weighting and scores (Janse, 2018).

In this report, the unions of the upazilas need to be ranked based on their potential for development using the MCDA method. The selected criteria for this analysis are: 1. Road density; 2. Structure density; 3. Number of facilities per population and 4. Population density.

In our selected study area, there are 61 unions and 7 upazilas. Data of the mentioned criteria are given. To sum up the comparative analysis, Composite Index (CI) method is used which can help us identify the potentials of the unions and upazilas. Composite Index (CI) depends on the method of combining several variables or indicators to reflect the overall assessment.

Each method of combining the component indicators results in different values of CI and different rankings from a given dataset (Chakrabartty, 2017).

For constructing the composite index, at first, data of each criterion need to be normalized. The selected four criteria are positive indicators whose higher values indicate a higher level of potentiality. Therefore the equation for normalizing the criterion for positive variables is used (Podviezko & Podvezko, 2015):

$$\mathbf{r_{ij}} = \frac{(V_i - V_{\min})}{(V_{max} - V_{min})}$$

The symbols from the above equations are:

r_{ij} = Normalized value for that specific indicator.

V_i = The value of the i^{th} city on a specific indicator.

V_{max} = The highest value of that specific indicator among the cities.

V_{min} = The lowest value of that specific indicator among the cities.

The composite index value of potentiality needs to be calculated by averaging the normalized values of the criteria for each union. The CI indicates the overall position of the union and its specific rank. Higher CI means higher potentiality and the lower CI means lower potentiality. The unions are ranked based on the CI value. Then, clustering or regionalization is done in three classification methods. They are: 1. Equal class method; 2. Equal frequency method; 3. Mean standard deviation method. For this study, equal frequency is found to be more appropriate.

7.1.1. Equal Class Method

The equal interval (or equal step) classification method divides the range of attribute values into equally sized classes. The number of classes is determined. The class interval is calculated using the following equation:

$$\textbf{Class Interval} = \frac{Highest\ value - Lowest\ value}{Number\ of\ classes}$$

This method is best used for continuous datasets such as precipitation or temperature (*Data Classification*, n.d.). This classification method is used if the histogram of the data shows a rectangular shape.

7.1.2. Equal Frequency Method

Each class will have the same number of observations. The number of observations in each class is calculated using the following formula:

$$\textbf{Number of observations per class} = \frac{Total\ observations}{Number\ of\ classes}$$

The classes might not be of same width. This method is used when the data has extreme values.

7.1.3. Mean Standard Deviation Method

Standard deviation classification shows you how much a location's attribute value varies from the mean (*Classification Types*, n.d.). This method is used when the histogram of the data shows a bell curve shape.

7.2. Results

7.2.1. Union wise Development Potential Analysis Using Multiple Criteria Decision Analysis and Equal Interval Classification Technique

Under the equal interval classification method, using maximum and minimum values of the CI index, the interval width is found to be 0.259. After classifying the data into three classes with this interval width, only Barguna Sadar Paurashava is found to have the highest development potential in this method. In this criterion, most of the unions (33) have moderate development potential and 27 unions have low development potential in this region.

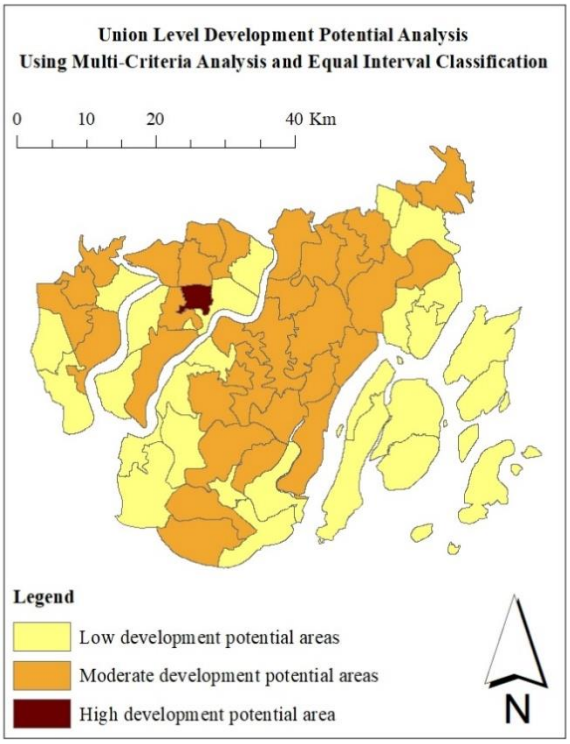


Figure 7.1: Map for union level development potential analysis using multi-criteria and equal interval classification (Source: Author, 2021)

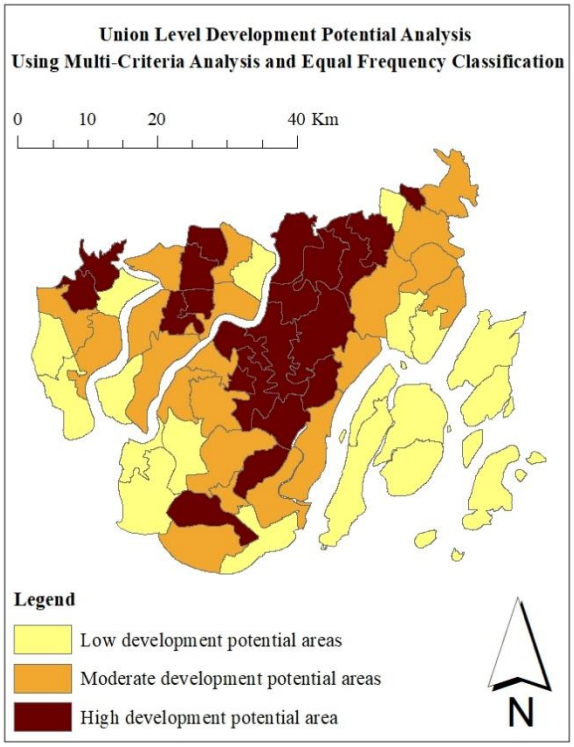


Figure 0.1: Map for union level development potential analysis using multi-criteria and equal frequency classification (Source: Author, 2021)

Figure 7.1 shows that under this classification system, most of the low development potential areas are along the boundary of the Payra-Kuakata region, i.e. just beside the sea, unions having moderate development potential are mostly in the middle portion of the region. Barguna Sadar has the highest number of low development potential areas and so is the most under-developed upazila.

7.2.2. Union wise Development Potential Analysis Using Multiple Criteria Decision Analysis and Equal Frequency Classification Technique

Since the equal class classification technique classifies CI values into classes having equal number of unions, this results in an almost equal number of low potentials, moderate potential, and high potential areas. Figure 7.2 shows that the least development potential areas are all along the boundary of the region, just beside the Bay of Bengal, especially at the south. The high development areas are all clustered together and are in the middle of the whole region. The moderately developed areas are in between the high and most development potential regions, i.e. they segregate these two classified places.

7.2.3. Union wise Development Potential Analysis Using Multiple Criteria Decision Analysis and Mean-Standard Deviation Classification Techniques

The CI (Composite Index) values of the 61 unions are grouped into three classes (High, Moderate, and low development potential) using mean standard deviation for multi-criteria analysis. The first class contains data with values higher than positive one standard deviation and indicates unions that have high development potential. Only 5 unions in this region have high development potential with the highest value for Barguna Sadar Paurashava in this method

(Figure 7.3). The second class contains values between the range of negative one standard deviation and positive one standard deviation and indicates unions with moderate development potential. 47 unions are found moderate development potential. The third class contains values lower than the negative one standard deviation and indicates unions with low development potential. Char Montaz union has the lowest CI value; therefore, it has the lowest development potential in the whole region.

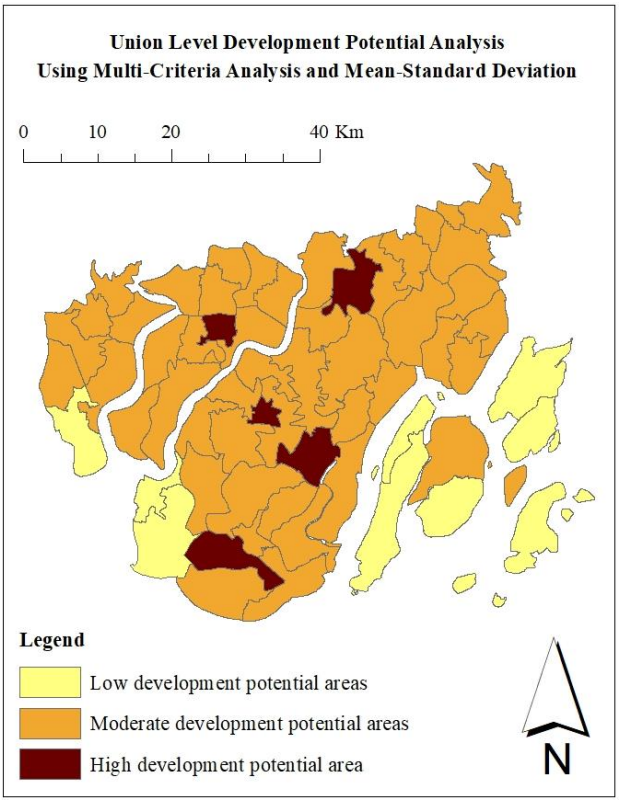


Figure 0.2: Map for union level development potential analysis using multi-criteria and mean standard deviation (Source: Author, 2021)

From figure 7.3, we can see that the six unions with low development potential are situated on the southeast border of the region and three unions are situated on the southwest border of the region. Among the low development potential unions, 4 unions out of nine are from Rangabali upazila. There is no union with high development potential on the border sides of the region.

7.2.4. Comparison of Regionalization Results Using Three Classification Techniques

As the shape of this histogram is not rectangular, the equal interval method is not appropriate for this data. Though this dataset looks like a normal distribution, the significance value of the Kolmogorov-Smirnov normality test is 0.000 which means this dataset is not normally distributed. There exists one extreme value in this dataset which means equal frequency classification technique is the most appropriate for the regionalization of this data (Figure 7.4). Therefore further analysis is done using the results of equal frequency classification techniques.

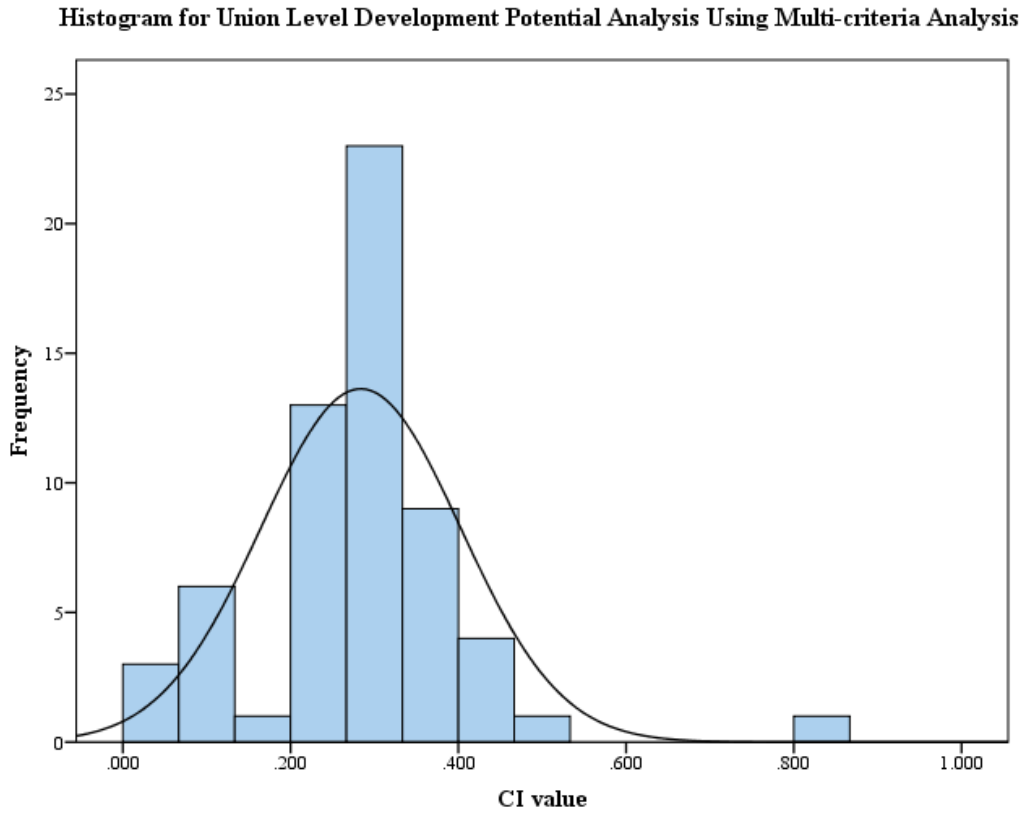


Figure 0.3: Histogram for union level development potential analysis using multi-criteria analysis (Source: Author, 2021)

7.2.5. Upazila wise Development Potential Areas

In this region, all unions of Amtali upazila has high potentials for development (Figure 7.5). Road density, population density, structure density, and socio-economic facilities are higher in Amtali upazila than the other upazilas of the region. The majority of unions of Kalapara and Barguna Sadar upazila have high to moderate potential for development on the contrary percentage of low development potential unions are comparatively higher in Patharghata, Taltali, and Galachipa upazila (Figure 7.5). All unions of Rangabali upazila has low development potential in this region.

7.2.6. Most Development Potential Unions of the Region

Among the most development potential unions of the region, two unions belong to Kalapara upazila, others from Barguna Sadar, Amatli, and Taltali upazila. The normalized value of road density, structure density, population density is very high in Barguna Sadar Paurashava (Figure 7.6). However, the normalized value of the number of facilities per population is very low. The unions from Kalapara upazila: Tiakhali and Mahipur have a relatively high number of socio-economic facilities per population than the other unions but these unions have low value for population density (Figure 7.6).

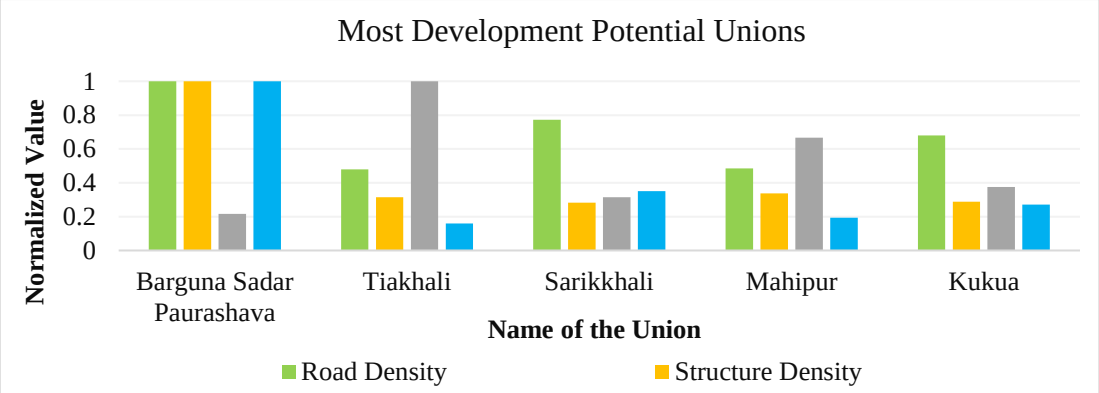


Figure 0.4: Most development potential unions of the region (Source: Author, 2021)

7.2.7. Least Development Potential Unions of the Region

Of the six least development potential unions, four of them belong to Rangabali upazila which is surrounded by the Bay of Bengal (Figure 7.7). The unions other than Rangabali have almost no road, structure, and population density and are the least development potential areas. This is maybe because they are by the sea and are more prone to disasters, and so have the least development opportunities. The other least development unions Nishanbaria belonging to Taltali upazila and Char kajal belonging to Galachipa upazila are also by the sea. (Figure 7.7).

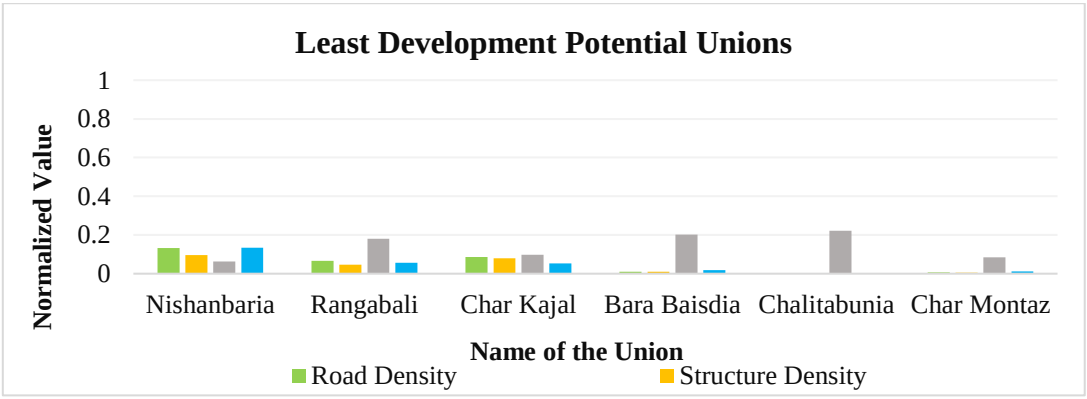


Figure 0.5: Least development potential unions of the region (Source: Author, 2021)

7.3. Major Findings, Interpretations and Discussions

- The majority of unions of this region have high to moderate development potentials. This region has enormous natural resources such as coastal fisheries, crabs, prawns, dry fishes, and minerals (Rahman et al., 2015; Ahmad, 2019; Islam & Ahmad, 2004). It is also famous for various attractive tourist spots (Bangladesh National Portal, 2021; Google, n.d.; Maynuddin, n.d.; Rahman et al., 2015; Zafour, n.d.). People of this region are also specialized in agricultural and aquaculture-related activities (Hossen et al., 2020; Ibrahim et al., 2018; Swapan, 2019). Availability of various natural resources and specialized labor might be one of the reasons for which the majority of unions of this region have high to moderate development potentials.
- All unions of Amtali upazila has high potentials for development on the contrary all unions of Rangabali upazila has low development potential. Road density, population density, structure density, and socio-economic facilities are higher in Amtali upazila compare to

other upazilas of this region. Most of the unions of Kalapara and Barguna Sadar upazila have high to moderate development potentials. Patharghata upazila has low potentials for development. But this upazila has immense potential for tourism in Neelema Point (Hossain, 2020). Rangabali upazila is an isolated island that has no embankment for protecting its several chars. Severe communication crises can be another main reason behind the low development potential of Rangabali upazila (Islam, 2014).

- All high potential areas of this region are clustered together in the middle of the whole region. Most development potentials areas of this region are Barguna Sadar Paurashava, Tiakhali, Sarikkhali, Mahipur, and Kukua. These unions are from Barguna Sadar, Kalapara, Amtali, and Taltali upazila.
- Barguna Sadar Paurashava is a very high development potential union of this region which has a composite index value of 0.804. Barguna Sadar is the only Sadar upazila of this region with diversified employment opportunities which might be the main reason for the high CI (composite index) value of Barguna Sadar Paurashava. The normalized value of three indicators road density, structure density, and population density is equal to one for Barguna Sadar Paurashava which indicates that this Paurashava already has enough road, structure, and population. However, the normalized value of the number of socio-economic facilities per population is very low for this Paurashava.
- Except for two unions, all unions of Kalapara have high to moderate development potential which means the unions of this upazila can be high development potential in the future. Payra port, power plant project, and port-related activities have huge influence to increase the potentials of not only the unions of Kalapara upazila but also the whole country.
- Most of the low development potential areas are along the boundary of the region, just beside the Bay of Bengal. The least development potentials areas of this region are Rangabali, Char Kajal, Bara Baisdia, Chalitabunia, Char Montaz. These unions are highly disaster-prone and have less accessibility to improved road infrastructure and socio-economic facilities.

7.4. Policy and Recommendations based on Findings

- Barguna Sadar Paurashava is already the most developed area of this region. However, the number of socio-economic facilities per population is very low in this area. By increasing the socio-economic facilities of this Paurashava, this Paurashava might become one of the most develop and potential areas of our country.
- Most of the sea-side areas especially the char areas are underdeveloped. Some measures to improve the condition of these areas can be (i) infrastructure development and improvement, (ii) establishment of the embankment, (iii) increasing accessibility of people to socio-economic facilities, (iv) enhancing preparedness for natural disasters, (v) the introduction of more training and micro-credit programs to strengthen human resource.
- More development and investment programs targeting the low and moderate developed areas might strengthen the economy of the region and improve the livelihood of disadvantaged people. More diversified crop production, promotion of small and cottage industries, the establishment of agro-based tourism industries, development of the special economic zone, introducing improved technology to minimize salinity of soil and water can be some of the measures which may highly contribute to increase the capabilities of people and to make the unions of this region as a high development potential area.

CHAPTER EIGHT: LAND SUITABILITY ANALYSIS FOR URBAN AND INFRASTRUCTURE DEVELOPMENT

Land suitability analysis is the process of determining the fitness of a given tract of land for a defined use (Steiner et al., 2000). It is a GIS-based process applied to determine the suitability of a specific area for considered use. It reveals the suitability of an area regarding its intrinsic characteristics (suitable or unsuitable) (Jafari & Zaredar, 2010). Also, this analysis involved considering a wide range of criteria including environmental, social, and economic factors. Suitability is determined through systematic, multi-factor analysis of the different aspects of the problem (Murphy, 2005). Land suitability analysis is important for site selection, impact studies, and land use planning (Edward et al., 2010). In this study, suitable locations for the urban area development activities in the Payra-Kuakata coastal area are identified using land suitability analysis.

8.1. Methodology

The steps of methodology can be divided into the following three steps:

8.1.1. Defining Land Suitability Criteria for Urban Land Area

Based on review of several literature (Aburas et al., 2017; Luan et al., 2021; Ferretti & Pomarico, 2013; Romano et al., 2015; Soltani et al., 2013; Ullah & Mansourian, 2016; Ustaoglu & Aydınoglu, 2020; Wang et al., 2021) and available data, we classified land suitability under nine criteria: slope, distance from regional national highway, distance from zila roads, distance from main rivers, distance from growth centers, population density, exposure to tidal surge, and exposure to earthquake risk. The factors and considered for selection of these variables are based on the context of the study and data availability and the respective weightage are given from extensive review of literature and rational judgment (Table 8.1).

Each selected criterion is ranked into five classes (most suitable to least suitable) and an additional restricted class for two criteria for urban area development of the given study area. The suitability for urban development decreases with increased slope and elevation as it increases construction costs of infrastructures (Bathrellos et al., 2009; Ustaoglu & Aydınoglu, 2020). For this reason, the areas with a slope of more than four-degree are restricted. It has been given the least weightage as the study area is located almost at sea level (Luan et al., 2021; Aburas et al., 2017; Ustaoglu & Aydınoglu, 2020). The criteria distance from national, regional highway, and zila roads are chosen as proximity to the road network enables easier and faster communication in urban areas. They are given relatively higher weightage because urban development closer to the existing transport network increases the accessibility of land uses by decreasing costs of transportation of people, goods, and services (Ustaoglu & Aydınoglu, 2020). Distance from rivers is an influential factor for our study area because the region is located near water bodies and is prone to suffer from seasonal flooding and erosion. For that, the areas away from the main rivers are more suitable and areas within 5 km are restricted for urban area development. Close vicinity to growth centers is important for the exchange of goods and services in the region and for that, suitability decreases with increased distance from these centers (Ullah & Mansourian, 2016). Population density is one of the most influential factors as a threshold population is required to provide certain urban services. Based on the

highest population density of the region, the ranks for the most and least suitability are determined and also given relatively higher weightage. Exposure to earthquake risky and tidal surge areas diminishes the suitability of urban growth and development. Based on this, the areas classified as least risky are most suitable for development (Luan et al. 2021). They are given very low weights as most of the areas of the selected region do not fall under very high risky regions. All the selected criteria with their rank and weightage are presented in the following (Table 8.1. in Appendix)

8.1.2. Data Collection

After selection of desired criteria, vector datasets were collected from websites (Table 8.2). Some information like population density was collected from BBS websites and were later input in ArcGIS.

Table 8.1: Sources of information of data

Data required for selected criteria	**Data format**	**Source**
Slope (degree)	DEM file	(NASA Earth Data, n.d.)
Distance from Regional National Highway (m)	Map	(UDD, 2021)
Distance from Zila roads (m)	Vector Shapefile	HDX. (2018a)
Distance from main rivers (m)	Vector Shapefile	HDX. (2018b)
Distance from growth centres (m)	Vector Shapefile	(UDD, 2021)
Population Density (per sq. km) and Union Boundary	Document, Vector Shapefile	BBS (2013c), BBS (2013d), (UDD, 2021)
Flood risk data	Vector Shapefile	HDX. (2018c)
Earthquake risk data	Vector Shapefile	HDX. (2018c)

8.1.3. GIS-based Land Suitability Analysis

In order to evaluate the suitability of land uses, ArcGIS 10.5 software was used. All the collected vector data were converted to raster format with the help of the Euclidean tool, considering cell size 30m x 30m. Then those raster files were reclassified into five classes from most to least suitable categories (and slope and distance from main river files to restricted class) by the manual method in GIS. After that, with the help of the weighted overlay tool, all the reclassified files were overlayed using selected weights (Table 8.1) as their respective percentage of influence. The following figure 8.1 shows the working procedure of suitability analysis using the GIS software:

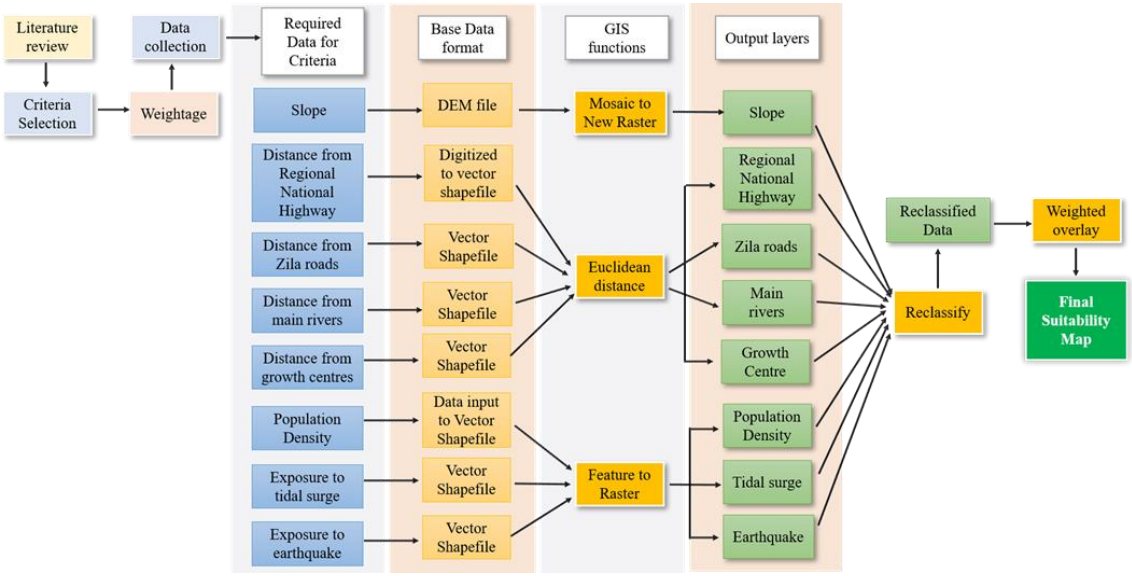


Figure 8.1: Flow chart showing Methodology for selecting Suitable Urban Area (Source: Author, 2021)

8.2. Results

8.2.1. Urban Development Suitability for Slope Criteria

Land with flat zones, lower elevation, and constructions with southern and eastern orientations are highly suitable for urban development (Bathrellos et al., 2011). The steep slopes increase construction costs, also influence slope stability increasing the risks of soil erosion and landslide hazard (Bathrellos et al., 2009). The slope has been considered as a criterion for analysis of urban area development suitability in the Payra-Kuakata coastal region. Slope less than 1 degree for an area in the region is considered most suitable for urban area development. While areas having a slope between 1-1.8 degrees is highly suitable and the slope between 3.4-4 degrees is considered least suitable for urban area development. The area is restricted for urban area development if the slope is greater than 4 degrees. Figure 8.2 depicts that the whole region is in general moderately suitable for urban area development. The region is a floodplain with a gentle slope (Patuakhali, 2021). The beach slope of the Kuakata coast lies between 1:19 to 1:66 and the beach is relatively flattered at both western and eastern ends and the middle part has got steep slope (Rahman, Mitra & Akter, 2013).

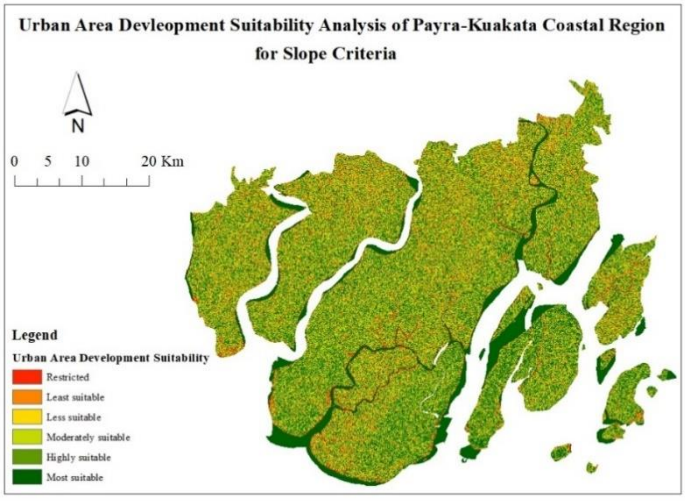
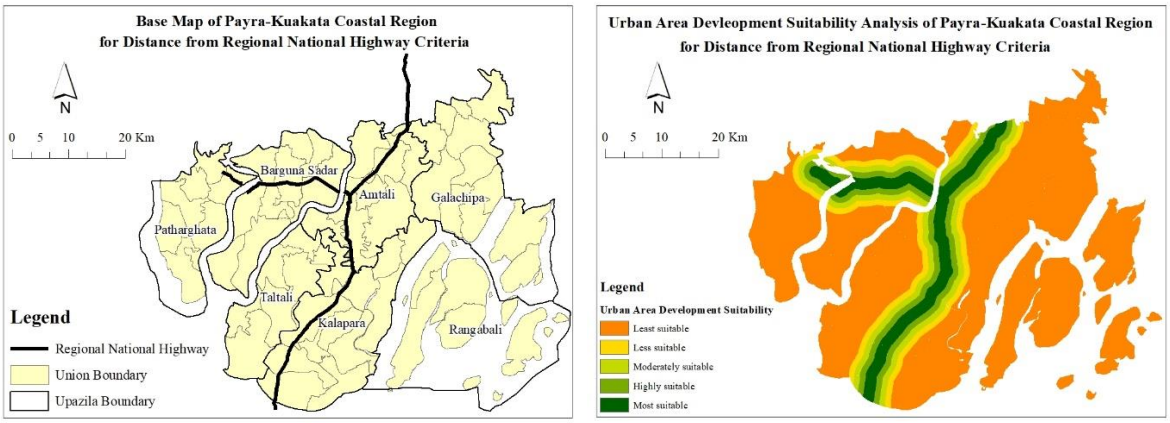


Figure 8.2: Urban area development suitability analysis map for the criteria-slope (Source: Author, 2021)

8.2.2. Urban Development Suitability for Distance from Regional National Highway Criteria

Distance from roads has an important role in urban development (Wang et al., 2021). Areas with easy access and convenient locations are more readily converted into urban land, and these two factors have key effects on urban development (Wang et al., 2021). Distance from the regional national highway has been considered as a criterion for analysis of urban area development suitability in the Payra-Kuakata coastal region. The whole region is classified into five classes based on distance from the national highway where distance less than 1000 meters from the national highway is considered most suitable for urban area development and greater than 4000 meters is least suitable for urban area development. The regional national highway connects Amtali, Kalapara, and Barguna (Figure 8.3). The land near the road is most suitable for urban development. The more distant the land is from the highway, the less suitable it becomes for development.

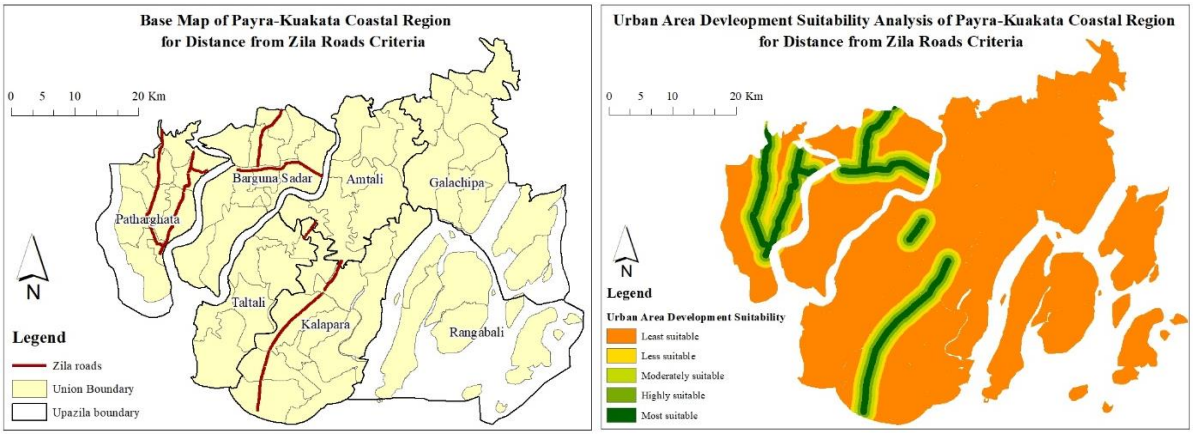


(a) (b)

Figure 8.3: Base map (a) and urban area development suitability analysis map (b) for the criteria-distance from National Regional Highway (Source: Author, 2021)

8.2.3. Urban Development Suitability for Distance from Zila Roads Criteria

Distance from zila roads has been considered as an important criterion for urban development where less than 500 meters distance from zila roads indicates most suitable and more than 2000 meters indicates least suitable for urban area development. From figure 8.4, the region is mostly the least suitable for urban area development according to this criterion because zila roads pass through only Patharghata, Barguna Sadar, Taltali, and Kalapara upazila. The zila roads passing through this region are Bauphal (Kalaiya)-Bogi-Bhola (Debirchar) Road, Kachua-Betagi-Mirjaganj-Patuakhali-Lohalia-Nijbot Kajol-Kalaiya Road, Barguna (Chandukhali)-Betagi-Bakerganj(Padri Shibpur) Road, Barguna (Dakhin Ramna Kheya Ghat)-Dewatala-Mathbaria-Baramasua Road (Zila Road, 2021).

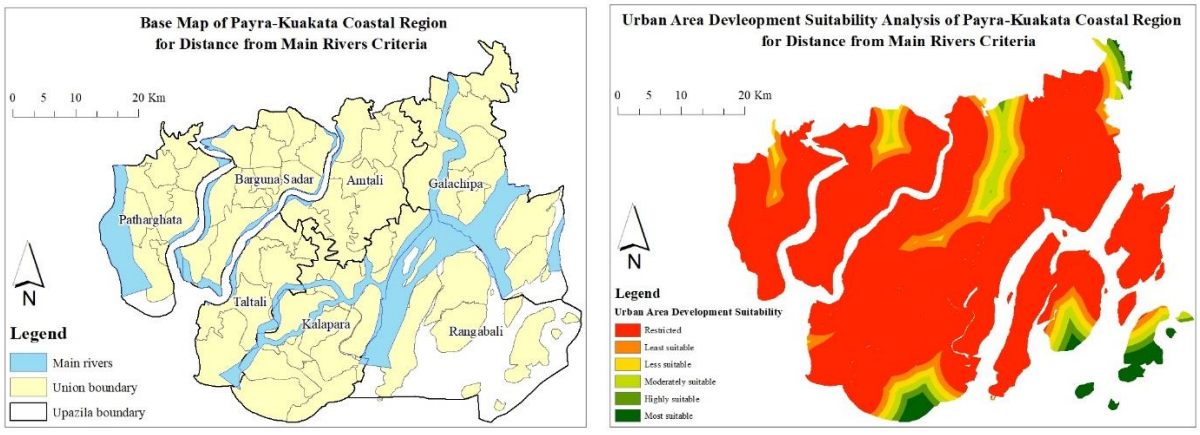


(a) (b)

Figure 8.4: Base map (a) and urban area development suitability analysis map (b) for the criteria-distance from Zila Roads (Source: Author, 2021)

8.2.4. Urban Development Suitability for Distance from Main Rivers Criteria

As this area is coastal and disaster-prone, distance from main rivers must be considered for urban development of any area. An area more than 9000 meters far away from the main rivers is most suitable and distance between 5000-6000 meters from main rivers indicates least suitable. If the distance from the main rivers is less than 5000 meters, then the area is restricted for any urban area development. Figure 8.5 depicts that the region is mostly restricted for urban area development according to this criterion as 9 main rivers flow through this region which are Andharmanik, Agunmukha, Payra, Lohalia, Patuakhali, Tentulia, Bishkhali, Khagdum, and Baleshwar rivers (BBS, 2013a; BBS, 2013b). The southern part of Kalapara upazila, the Southeastern part of Rangabali upazila, and the Northeastern part of Galachipa upazila are suitable for urban area development according to this criteria.



(a) (b)

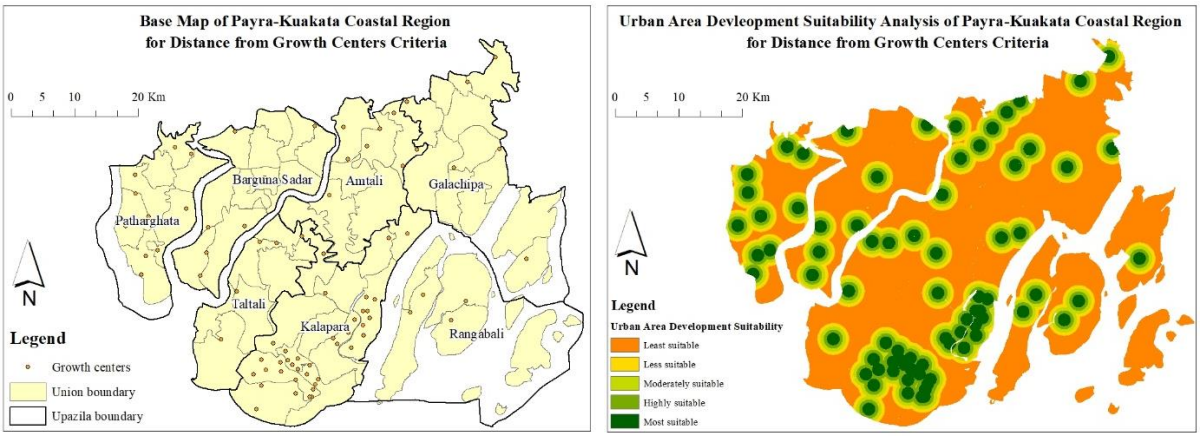
Figure 8.5: Base map (a) and urban area development suitability analysis map (b) for the criteria-distance from main rivers criteria (Source: Author, 2021)

8.2.5. Urban Development Suitability for Distance from Growth Centres Criteria

By designating growth centers, communities can extend the existing pattern of development while maintaining a clear edge between town and countryside (Growth Centers, 2007). For Payra-Kuakata coastal region, distance from growth centers has been chosen as a criterion for urban area development suitability analysis. Areas proximity to growth centers (distance less

than 1000 meters) are most suitable for urban development whereas distance is greater than 2500 meters from growth centers indicates least suitable for urban area development.

Figure 8.6 depicts that most areas of the region are least suitable for urban area development for distance from growth center criteria. Kalapara upazila is most suitable for urban area development as there are 37 growth centers in this upazila. Urbanization is taking place in Kalapara without considering the topographic conditions of the area which has several environmental impacts in the coastal region. Urban areas increased by 111.2 hectares during 1990–2000 and 102.2 hectares from 2000 to 2015 in Kalapara town (Miah & Najiah, 2019). Patharghata and Amtali upazilas are highly suitable, Barguna Sadar and Taltali upazilas are moderately suitable for urban area development, and Galachipa and Rangabali upazilas are least suitable for urban area development in this region according to distance from growth center criteria.



(a) (b)

Figure 8.6: Base map (a) and urban area development suitability analysis map (b) for the criteria-distance from Growth Centers (Source: Author, 2021)

8.2.6. Urban Development Suitability for Population Density Criteria

The high population density in a city increases diversity and makes the city more productive (Fee & Hartley, 2011). For Payra-Kuakata coastal region, population density has been chosen as a criterion for urban area development suitability analysis. Areas which have higher than 400 people per square kilometer are most suitable for urban area development whereas areas with less than 251 people per square kilometer are least suitable for urban area development.

From figure 8.7, Barguna Sadar and Patharghata upazilas are most suitable for urban area development according to population density criteria. Kalapara upazila is highly suitable, Galachipa upazila is moderately suitable, Rangabali upazila is less suitable and Taltali upazila is least suitable for urban development.

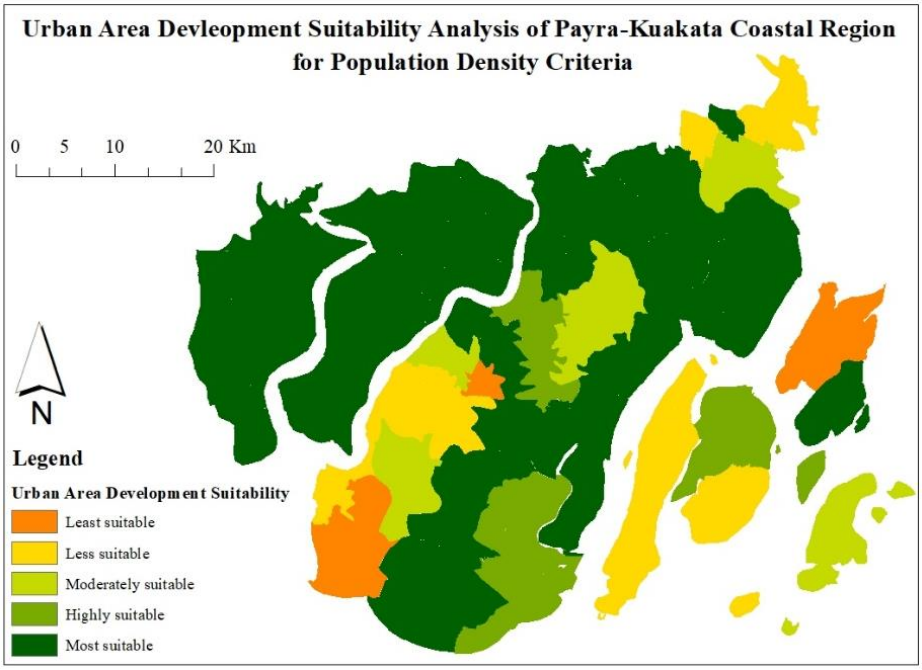
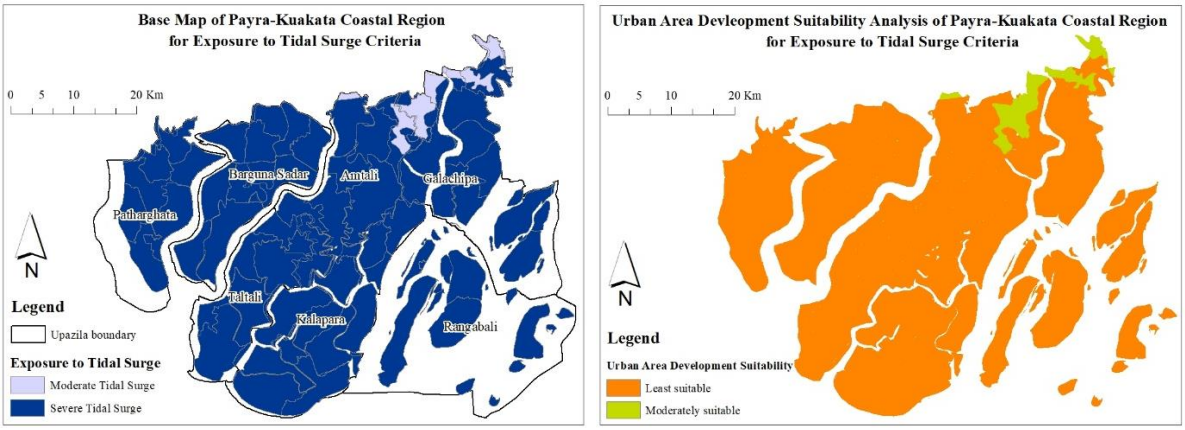


Figure 8.7: Urban area development suitability analysis map for criteria - population density (Source: Author, 2021)

8.2.7. Urban Development Suitability for Exposure to Tidal Surge Criteria

A tidal surge is an abnormal rise in seawater level which occurs in the coastal region of Bangladesh being triggered by a storm in the Bay of Bengal. Exposure to tidal surges has been considered as a criterion for analysis of urban area development suitability in the Payra-Kuakata coastal region. According to this criteria, the whole region can be classified into areas with the risk of being exposed to very low, low, moderate, high, and very high tidal surges. Figure 8.6 depicts that almost 95% of areas of the region are least suitable for urban area development as they are exposed to high or very high tidal surges. This region was struck by tropical storms Sidr, Aila, and Mohaseen, which originated in the Bay of Bengal in 2007, 2009, and 2013 (Alam et al., 2018). Kuakata sea beach, which is a famous tourist attraction place, is exposed to continuous erosion due to wave action and storm surges (Rahman, Mitra & Akter, 2013).

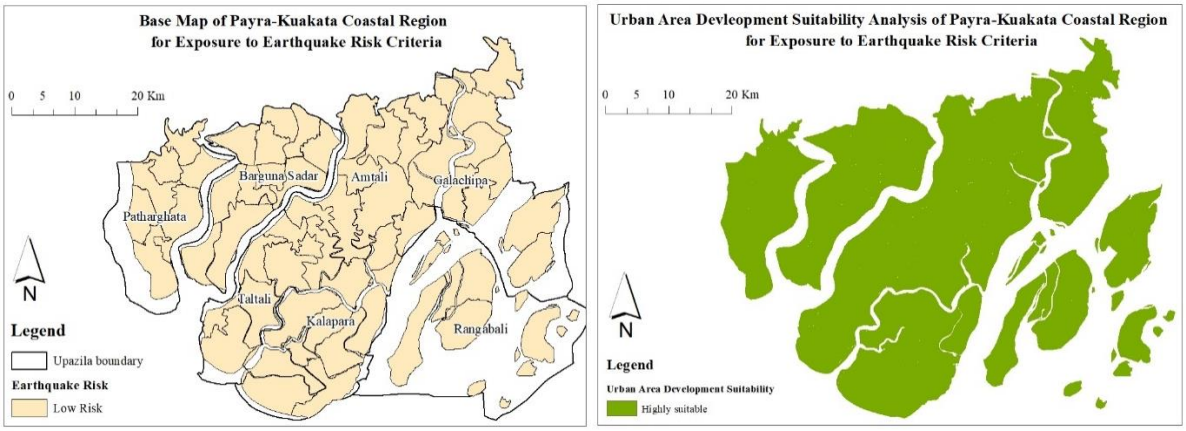


(a) (b)

Figure 8.6: Base map (a) and urban area development suitability analysis map (b) for exposure to tidal surge criteria (Source: Author, 2021)

8.2.8. Urban Development Suitability for Exposure to Earthquake Risk Criteria

Bangladesh is facing a high risk of moderate to strong earthquakes that may result in widespread damage and loss of lives. Exposure to earthquake risk has been considered as a criterion for analysis of urban area development suitability in the Payra-Kuakata coastal region. According to this criteria, the whole region can be classified into areas with the risk of being exposed to very low, low, moderate, high, and very high earthquakes. From figure 8.7, the whole region is highly suitable for urban area development as it has low risks of earthquake hazards. Earthquakes occur most often along geologic faults. Five major faults are significant for the occurrences of earthquakes in Bangladesh, going through the ground in Bogra, Tripura, Shilong, Dauki, and Assam (Al zaman & Jahan Monira, 2017). Payra-Kuakata coastal region is significantly distant from these five areas.



(a) (b)

Figure 8.7: Base map (a) and urban area development suitability analysis map (b) for exposure to tidal surge criteria (Source: Author, 2021)

8.2.9. Urban Area Development Suitability of Payra-Kuakata Coastal Region

Figure 8.9 shows the suitability map for urban area development in Payra-Kuakata coastal region. In this figure dark green color shows the highly suitable area for urban development and the red color indicates the area where urban development is restricted. No most suitable area is found in this study area. Almost 80% of areas found restricted for urban development. These restricted areas are mainly the adjacent areas of main rivers. Only 1% area is found highly suitable area for urban development which is located mainly in Amtali upazila close to the regional national highway (Table 8.3). Population density is also higher in these areas. Moderately suitable areas are found in some areas of Amtali, Kalapara, Patharghata, and Barguna Sadar upazila which are close to the regional national highway, zila roads, existing urban areas, and comparatively far from main rivers. Less suitable areas are found at the periphery of the region.

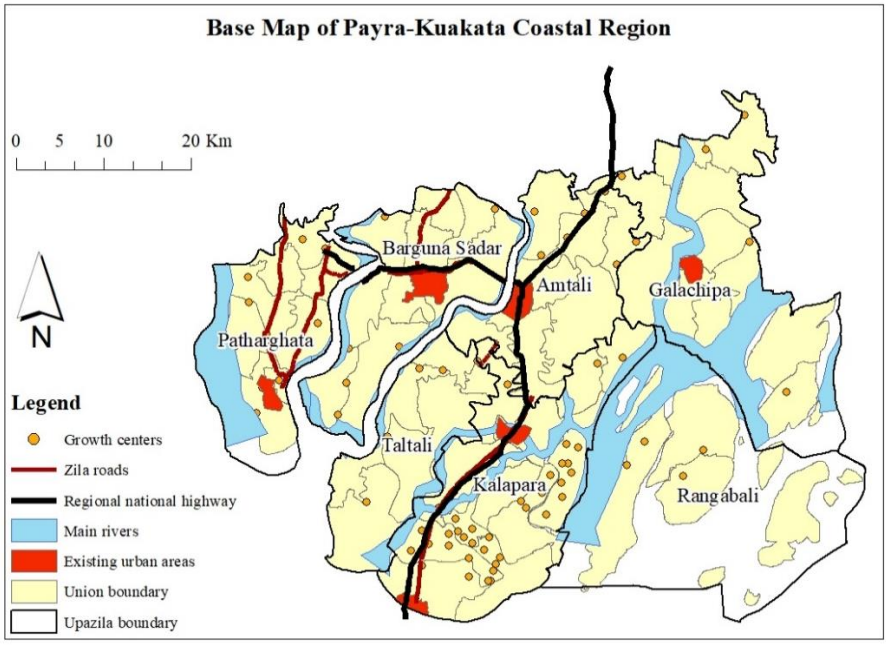


Figure 8.8: Base map of Payra Kuakata Coastal Region (Source: Author, 2021)

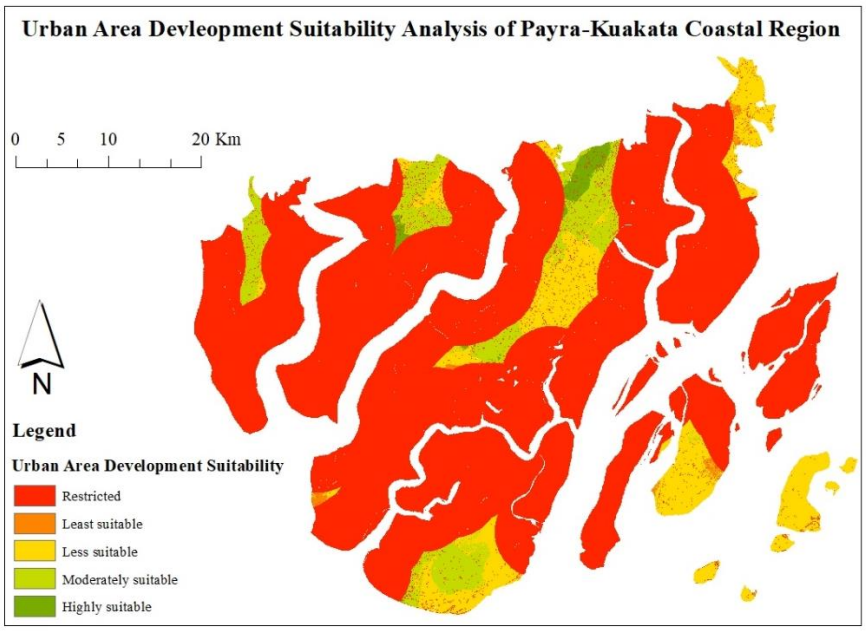


Figure 8.9: Urban area development suitability map of Payra-Kuakata coastal region (Source: Author, 2021)

Table 8.2: Area under various suitability categories (Source: Author, 2021)

Urban Area Development Suitability Categories	Area in km^2	Area in %
Restricted	1607.856	80.77%
Least suitable	8.113	0.41%
Less suitable	220.379	11.07%
Moderately suitable	136.021	6.83%
Highly suitable	18.241	0.92%
Most suitable	0	0.00%
Total	1990.610	100%

8.2.10. Upazila wise Percentage of Suitable Land for Urban Area Development

Most of the area of this region is found restricted for urban area development. Close to main rivers, far from roads, severe tidal surges might be some of the underlying reasons behind this. No most suitable area for urban development is found in this region (Figure 8.10). The highest percentage of highly suitable areas for urban development is found in Amtali (5%) and Barguna Sadar upazila (1%). Patharghata, Rangabali, and Taltali upazila have no highly suitable areas for urban development. However, Patharghata upazila has some moderately suitable area (10.4%) for urban development but Rangabali (0.25%) and Taltali upazila (0.23%) has a very low percentage of moderately suitable area for urban development (Figure 8.10). Some likely reasons behind the condition of Rangabali and Taltali upazila are far from zila roads and highways, severe tidal surges, close to main rivers, less population density, and fewer numbers of growth centers.

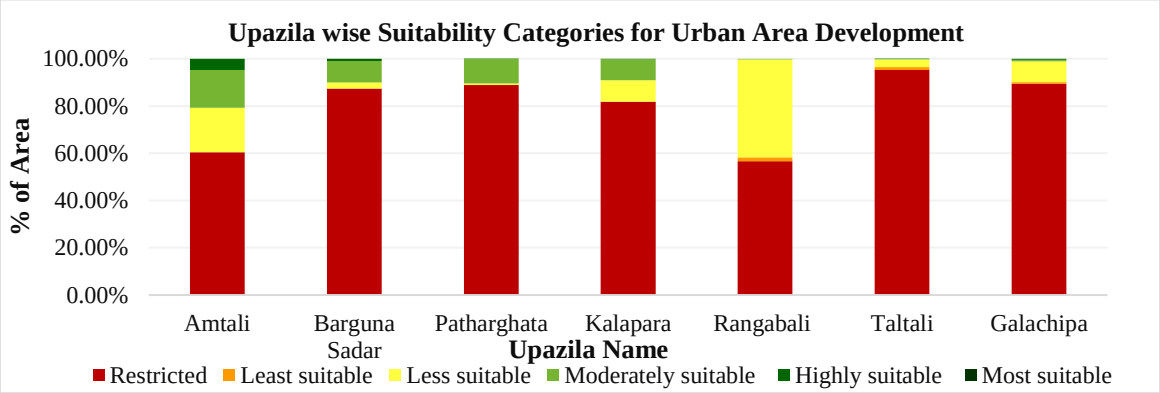


Figure 8.10: Upazila wise percentage of areas under each suitability category (Source: Author, 2021)

8.3. Policy Implications based on Findings

- Highly suitable and moderately suitable areas can be considered for future urban development in this region. These areas are mostly close to zila roads and highway, far from main rivers, has adequate market accessibility and human resources. Considering the sensitive environmental condition of the region this highly suitable and moderately suitable area should be developed for future urban development.
- The highly suitable area of Barguna Sadar has been found very close to Barguna Sadar Paurashava. Therefore, expansion of this Paurashava by providing more improved facilities might help to support future urban development in this region.
- As Payra port and power plant already exists in Kalapara upazila, many urban and industrial activities will establish in this upazila in the future. On the other hand, most of the people in Amtali upazila are already engaged in agricultural activities, and the suitable portion is comparatively far from the existing urban center (Figure 3.2, 4.2 & 8.9). Therefore urban development is recommended in Kalapara upazila to support the growing demand of this upazila in the future.
- Some measures to improve the condition of restricted, least, and less suitable areas can be improving and developing infrastructures, establishing embankments to protect the areas from riverbank erosion, increasing market facilities, and enhancing preparedness for natural disasters.

CHAPTER NINE: FUTURE TREND ANALYSIS FOR LAND USE OF PAYRA-KUAKATA COASTAL REGION

9.1. Impact of Payra Port on Future Land Use

Payra port is on the bank of the Rabnabad channel in Meghna estuary, one of the largest estuaries on the earth in terms of sediment-water discharge and at the central part of the coast of Bangladesh (Mannan, 2020). Since Payra port is a mega project, it will have a huge impact on the land use of the region. The port will require 6000 acres of land for port development and 500 acres of land for the coal terminal and by 2023, the port will have a 16-meter channel, all terminal and associated facilities e.g. an export processing zone (EPZ), airport, a port city, dockyard or shipyard, and eco-tourism facilities (Mannan, 2020). In the future, the port will inspire foreign investments, new employment opportunities, blue economy, economic development, the construction of digital Bangladesh, and the preparation of an e-port because of silk route connectivity and hinterland connectivity with neighboring countries through water (Ahmed, Shaikh & Islam, 2017).

9.2. Impact of Power Plant on Future Land Use

Among several planned coal-fired power plants, five power plants each with 1320-MW generation capacity are expected to be installed by 2030 in areas within a 5-km radius of Payra (Hossain, Ahmed & Ali, 2020). The government aims to make Payra the new energy hub of Bangladesh for the availability of water, low settlements, and port facilities in this region. The sites are surrounded by scattered villages, agricultural land, fallow land, and grazing areas (Hossain et al., 2020). Many new industries will be attracted to these areas due to the availability of electricity. New shops, infrastructure will be developed. Huge pressure may create on agricultural land to support this growing industrial and employment demand.

9.3. Impact of Tourist Spots on Future Land Use

Land use or land cover changes are central to tourism because the land is used in multiple ways as a resource for tourism-focused activities (Boavida-Portugal, Rocha, & Cardoso Ferreira, 2016). Limited land area, growing population, and increasing economic activities in the region may place intense pressure on tourism as this sector will not develop without the involvement of local villages and community members (Safran, 2015). More jobs related to tour guides and hotel housekeeping will be increased. Indirect employment through other industries like agriculture, food production, and retail will be promoted in this region which may alter the existing land use.

9.4. Projected Urban Population of Payra-Kuakata Coastal Region in 2041

Geometric projection method was used to project urban population of the region from BBS data of 2001 and 2011 (BBS, 2013a; BBS, 2013b). At present around 57.6 square kilometers urban area exists in this region where almost 150000 population lives. In 2041, total urban population of the region will be around 250000. Urban growth will be highest in Kalapara and Barguna Sadar upazila (Figure 9.1).

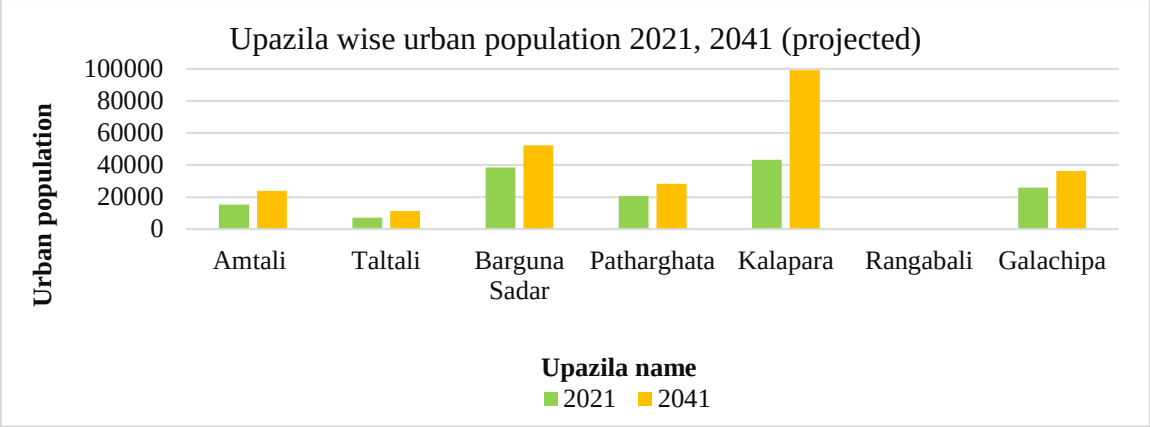


Figure 9.1: Upazila wise urban population 2021, 2041 (Source: Authors' own construction from BBS, 2013a; BBS, 2013b)

9.5. Upazila wise Secondary Sector Employment in 2041

In 2021, there is no employment in electricity, gas, and water supply, construction, and manufacturing sectors in Galachipa, Rangabali, Taltali, and Amtali upazila. Employment in the electricity, gas, and water sector will increase in Kalapara, Patharghata, and Barguna Sadar upazila in 2041 and this increase will be the lowest for Kalapara upazila. There is employment in the construction sector in Barguna Sadar upazila only and the number of employment in the construction sector will increase in 2041 (Figure 9.2). There is no employment in the manufacturing sector in any upazila.

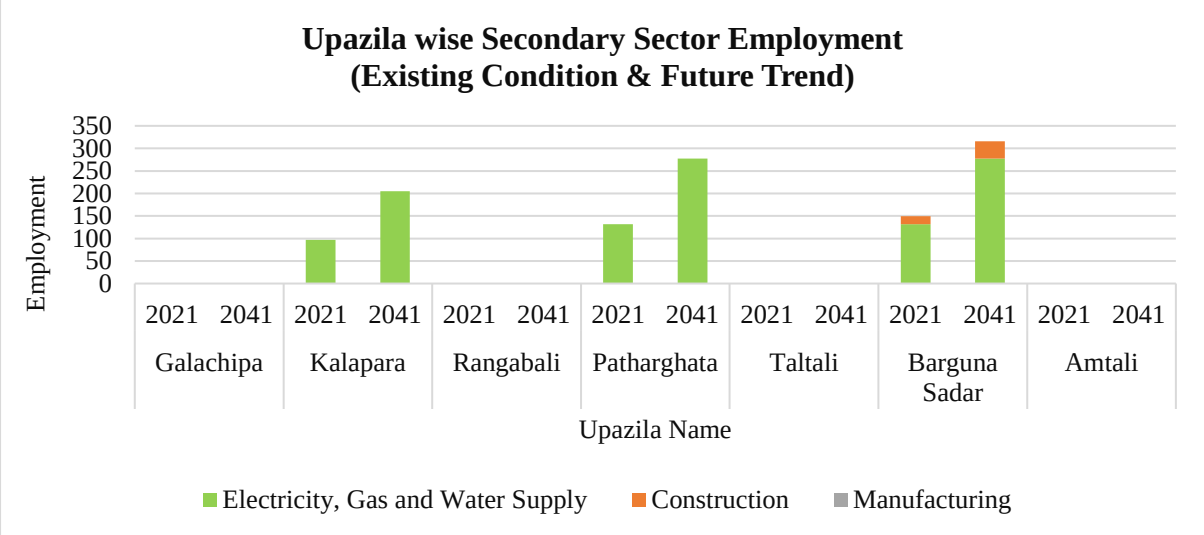


Figure 9.2: Upazila wise secondary sector employment in 2021 and 2041 (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

9.6. Upazila wise Tertiary Sector Employment in 2041

In 2021, the number of employment in tertiary sectors is low in Rangabali, Patharghata, and Taltali upazila, moderately low in Kalapara and Amtali upazila, and high in Galachipa and Barguna Sadar upazila. In 2041, Kalapara, Barguna Sadar and Amtali upazila will have more employment in Banking and public administration sectors (Figure 9.3). The employment in

tertiary sectors will increase in all upazilas. Employment will increase significantly in hotel and restaurant, wholesale and retail trade, and public administration sector.

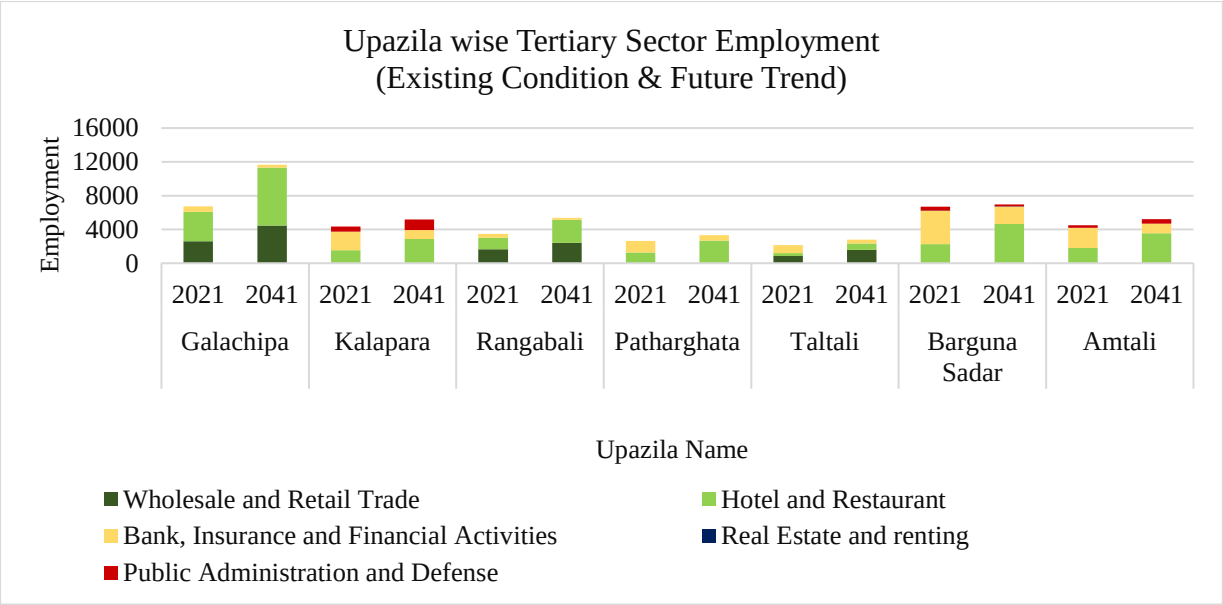


Figure 9.3: Upazila wise tertiary sector employment in 2021 and 2041 (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

CHAPTER TEN: PROBLEM AND CHALLENGES

10.1. Problems

10.1.1. Problems due to Natural Disasters and Salinity

Coastal land is being degraded and lost due to the effects of increased salinity intrusion, inundation of low-lying marshy land, floods and land erosion, cyclones, storm surges and floods, as well as earthquakes, tsunamis, and above all, climate change. These dramatic changes in land use and shift of farming system in the coastal area have induced adverse environment impacts and hampers normal crop production throughout the year. (Parvin et al., 2016). The important urban sectors that suffered severely by the previous floods in Bangladesh include urban infrastructure, industry, trade, commerce, utility services etc (Rahman & Rahman, 2015).

About 60 percent of the land is seasonally inundated to a depth of 30 centimeters or more (Islam, n.d.). 50% of coastal lands faces different degrees of inundation limiting its effective use. (Ahmed, 2011; Mia & Islam, 2005).

10.1.2. Problems due to River Bodies

The river erosion in some areas of Sundarban and over exploitation of the resources has threatened the normal ecosystem and the existence of this world largest mangrove forest (Mia & Islam, 2005).

10.1.3. Problems in Land Uses of Coastal Region

10.1.3.1. Conservation Areas

- ***Agro-mangrove Forest Zone*:** Population growth and economic pressure are two prominent factors leading to the large-scale clearing of forests (Islam, n.d.). Power-brokers with links to local politicians have taken the lead in clearing the forests (Islam, n.d.). Pure *Heritiera* forest of Sundarbans is decreasing at a rate of 0.17 percent per year which indicates that the site is becoming adverse for the less salt-tolerant *Heritiera*. The other mangrove forest types are also diminishing, but at a very slow rate (Iftekhar and Islam, 2004).

- ***Agro-forestry Zone:*** A historical tradition of shrimp farming, polders provided an opportunity for intensive shrimp farming. As a result, crop land and mangroves forest areas were gradually transferred to shrimp farming which created a social conflict in the locality (Ahmed, 2011)**.**

Deforestation is the main problem causing ecological hazard in the coastal belt (Mia & Islam, 2005). The principal cause of deforestation in the terrestrial forests is expansion of agricultural land after clear-cutting the forest areas. (Islam, n.d.; Mia & Islam, 2005).

10.1.3.2. Rural Land Use

- ***Agricultural Zone*:** Important factors affecting land use for agriculture are flooding, tidal surges, physiography, soil salinity, drainage congestion and irrigation facilities. Crop failure due to saltwater intrusion or monsoon flooding had been reported in most areas once

every three years (Nishat, 1988). Fifty percent of coastal lands are subjected to inundation of varying degrees and frequency that limits their effective use. This situation is expected to worsen due to climate changes due to global warming (Ahmed, 2011)**.**

- ***Agro-fisheries Zone*:** Swapan and Gavin (2011) found that the shrimp cultivation had changed almost 90% of the land has been converted from agricultural uses and mangroves into shrimp farms in the southwestern part of Bangladesh. Massive introduction of this shrimp aquaculture by land use change is considered as severe threats to local ecological systems, such as- deterioration of soil and water quality, depletion of mangrove forest, decrease of local variety of rice and fish, saline water intrusion in ground water, local water pollution and change of local hydrology (Kabir et al., 2014; Parvin et al., 2016).

Several studies reported, due to introduction of shrimp farming, a reduction in land for cattle grazing (Maniruzzaman 1998), death of trees and other vegetation (Alauddin and Tisdell 1998), increased salinity of soil and water, and a reduction of drinking water supply. Environmental hazards due to huge collection of snails for shrimp feeding was noticed (Mia & Islam, 2005).

Majid and Gupta (1997) elaborated social and environmental impacts of industrial shrimp culture. As agricultural lands were turned into shrimp polders, the share-croppers and landless wage laborers found themselves losing their livelihoods and began movements to resist the introduction of shrimp in their areas. This often resulted in violence (Mia & Islam, 2005).

10.2. Challenges

10.2.1. Challenges due to Agro-urban, Urban and Commercial Zone

The population is increasing at alarming rate in the coastal areas in Bangladesh. In the coastal zone alone, the population is expected to increase from 36.8 million in 2001 to 43.9 million in 2015 and to 60.8 million in 2030 (Ahmad, 2004; Ahmed, 2011)**.** Present per capita agricultural land of 0.056 ha will be decreased to 0.025 ha by 2050 (Mia & Islam, 2005).

With the increasing population, land is being converted from productive purposes, such as crop cultivation, to other uses. Bangladesh is losing good quality agricultural land by approximately 80,000 ha annually to urbanization, building of new infrastructure and implementation of other development projects (World Bank, 2005; Ahmed, 2011)**.**

The conversion of Land use/ Land cover to various settlements and agricultural purposes causes threats to several ecosystem services (ESs), for example, recreational opportunities, biodiversity and habitat quality, soil formation and nutrient cycling, climate regulation erosion control, and water regulation (Hoque et al., 2020).

10.2.2. Challenges due to Payra Deep Seaport

Payra port might generate nearly 23000 employment opportunities (Begum, 2003). The port requires a huge amount of flat land to construct the port infrastructure. Thus, the Payra port authority (PPA) has to fill up its low-lying area and cut high ground resulting in changes in land terrain. Such terrain will affect local drainage and sewage system in the area as well as the railroad network (Hung, Lu, & Wang, 2010). It may affect the natural river and canal

system creating an adverse impact on the land environment through habitat loss of the terrestrial animal (Mannan, 2020). The impacts of making a new port near to mangrove and wetlands are broad. It has long-lasting impacts on the total ecosystem including biodiversity and habitat loss (Mannan, 2020).

The pollution because of port construction encompasses water, air, land, and noise pollution. Construction of the port may have a huge impact on coastal hydrology including beach erosion, accretion, and current pattern change (Momtaz, 2002).

Dust and emission generated from the vehicles, vessels, industries and construction work may pollute the air environment causing a health hazard to terrestrial and aquatic flora and fauna. Dust, odor and fumes because of cargo handling, ship operation and repair work may also degrade the air environment. At operation phase emission and dust may decrease.The movement of the vessel in the Rabnabad channel and the Bay of Bengal may create a nuisance of underwater noise which could affect both the river dolphins and Hilsha fish resulting displacement of the breeding ground of those species (Hanif et al., 2015). After the construction work, these animals may get back to their normal hearing.

10.2.3. Challenges due to Payra Coal Power Plant

It might be anticipated that the existing agricultural dominant rural land use of the locality will be changed in future due to induced infrastructural and industrial development after completion of the project. Industrial development, township development, new road and communication may take place due to generation and supply of reliable electricity from the proposed power plant (Bhaban & Road, 2015). Farmlands are being acquired for the construction of the coal power plants, threatening the livelihoods of local people who cannot continue their crop production (PPA, 2020).

CHAPTER ELEVEN: PROPOSED LAND USE PLAN FOR PAYRA-KUAKATA COASTAL REGION

For the planned growth and development of the coastal areas of the southern part of Bangladesh, a regional land use plan for Payra-Kuakata coastal area is prepared for the years 2021-2041.

11.1. Methodology

11.1.1. Data Collection

Data have been collected from secondary sources, available reports, plans, and policy documents (e.g., Delta plan 2100, 8th Five-year Plan).

11.1.2. Analyzing the Existing Scenario

The present condition of land use has been investigated in details. Supplementary maps of existing urban land use, rural land use, and agricultural land use, industries, and conservation areas are created based on the collected data. Then, the base land use map for Payra-Kuakata has been prepared combining the existing urban, rural land uses and conservation areas.

11.1.3. Analyzing the Future Trend

Employment projection for 2041 is done considering the development of the port. The upazila-wise urban population has been also projected. The probable future urban and rural areas have been identified using the suitability analysis considering the effect of Payra deep seaport as well as the power plant.

11.1.4. Identifying Problems and Challenges

After analyzing the existing condition and future trends, problems and challenges for the land use of the Payra-Kuakata region have been identified.

11.1.5. Final Proposal Map

The land use map for Payra-Kuakata region for 2041 is prepared. The future expanded urban areas, the location of port cities, and special economic zones are proposed in the map.

11.2. Policy and Recommendations for Future Land Use of Payra-Kuakata Coastal Region

11.2.1. Rural Land Use

Rural land use includes agriculture and agro-fisheries zone. Rural characteristics of this region must be preserved. Any urban development in rural areas at a substantial distance from existing urban areas must be strictly prohibited. Special development programs must be taken for the underdeveloped sea-side areas or char areas preserving the rural characteristics. Some measures can be infrastructure development and improvement, the establishment of the embankment, increasing accessibility of people to socio-economic facilities, enhancing preparedness for natural disasters, and the introduction of more training and micro-credit programs to strengthen human resources.

- **Agriculture**

The main land use of this region is agriculture. Most of the people are engaged in agricultural activities. However, agricultural activities are hampered due to salinity intrusion, frequent natural disasters. Introduction of modern farming technologies, drainage improvement, salt-tolerant crop production might be some solutions.

As this region has huge potential for economic development in the future, demand for urban land and other commercial uses will be increased. These might be controlled efficiently to prevent the conversion of agricultural land. Rural settlements can be promoted in these lands.

- **Agro-fisheries**

Overfishing needs to prevent to save available fish resources. Though shrimp farming has high demand, it creates an adverse impact on agricultural land. Numerous agricultural land is turned into shrimp polders which must be brought under regulations. A separate zone must be created for shrimp farming to protect the agricultural lands.

11.2.2. Urban Land Use

Over time, all upazilas of this region show an increasing trend in urbanization which may demand more urban areas. Moreover, due to the construction of the Payra port and power plant, many people from other districts may come to this region in the future. Many industries may try to set up their industry in this region. All these activities might demand more urban land. However, conversion of agricultural land to urban land must be prohibited especially the agricultural land that is far from existing urban areas. Based on some criteria (slope, distance from regional national highway, distance from zila roads, distance from main rivers, distance from growth centers, population density, exposure to tidal surge, and exposure to earthquake) only some areas near Amtali and Barguna Sadar upazila is found highly suitable for urban development in future. As the highly suitable area in Amtali upazila is comparatively far from the existing urban center and around 82% of people of this region are engaged in agricultural activities whereas almost 75% of people of Barguna Sadar are engaged with non-agricultural activities. Moreover, the highly suitable area found in Barguna Sadar is one of the adjacent areas of Barguna Sadar Paurashava. Future urban growth will be highest in Kalapara and Barguna Sadar Upazila (Figure 8.1). Therefore, to support the growing demand for urban use in the future, Barguna Sadar Paurashava can be expanded by providing more improved facilities. The existing agro-urban and commercial zone of Kalapara can also be expanded, which will support both agro-based industries and urban demand in the future.

11.2.3. Tourism Zone

Kuakata sea-beach is one of the most attractive tourist spots of Bangladesh which is situated in Kalapara upazila of this region. However, tourism is not a basic industry in Kalapara upazila (Table 5.1). Therefore a tourism zone centering Kuakata sea-beach needs to develop in Kalapara upazila. This zone is well connected through the regional national highway and zila roads. Proper maintenance of this infrastructure must be ensured in the future to promote more tourists. As an airport will develop near the port, infrastructure improvement and easy accessibility must be ensured to increase local and foreign tourists. This zone will promote more establishment of accommodation facilities, travel information-related activities (tour

operators, tourist information centers), and recreational activities which will create huge opportunities for the local people.

11.2.4. Special Economic Zone

Special Economic Zone (SEZ) is a geographically delineated area subject to differentiated regulation and administration from the host country in which it resides, to attract foreign direct investment in economic activity that could not otherwise be achieved (Special Economic Zones as A Tool For Economic Development, 2021). SEZs play varied roles in facilitating national, regional, and local economic development and global economic connections. Their primary objective is attracting foreign direct investment (FDIs), generating employment, implementing economic reforms, and experimenting with new policies. An exclusive economic zone near the Payra port will develop which will establish an export processing zone, new garment factories, agro-based industries, fish processing zone, and shipbuilding industries. Commercial facilities (bank, warehouse), accommodation, health, education facilities also have to ensure near the economic zone. This economic zone will also develop in Kalapara upazila as it is close to the port, well connected through surface and waterways, close to the urban center, has a high number of growth centers, has enough accommodation facilities, and commercial centers. So this location is most suitable for this economic zone.

Many upazilas of this region are underdeveloped due to lack of infrastructure facilities, lack of skilled human resources, and proximity to rivers. This economic zone will create thousands of new jobs for the community people and thus will contribute to improving the condition of the depressed upazilas of this region in the future.

Due to locational suitability, many new industries will be attracted to this upazila and there may be a tendency to acquire land of the local people without providing them fair prices. This must be regulated properly that excess industry must not permit in this location as this will create an adverse impact on the critical environment and local peoples' interest must be considered as a top priority.

11.2.5. Port City

The port city simply is a city exerting port and maritime activities by being a communication node between land and maritime networks developing auxiliary activities and having a strong influence on the spatial organization of the outlying region (Ducruet, 2011). The suitable location for developing a port city is the area bordering the waterfront as shore and offshore areas are required for ship operations and onshore areas are needed for port facilities and stocking yards (Radhakrishnan, 2017). So, elements of a port city include transit area, foreign trade, and manufacturing industry, and efficient transport network (Ducruet, 2011). Therefore, Kalapara upazila may develop as a port city in 2041. The agricultural land may be used for agro-urban activities in this upazila in the future. As Amtali upazila also has strong connectivity with Kalapara upazila and regional national highway, this upazila may be included in the port city in the future but not within 2041.

11.2.6. Conservation Areas

Conservation areas include rivers, mangroves, and reserve forests. Tengragiri wildlife sanctuary also exists in this zone. Necessary measures must be taken to protect these areas and to prevent the conversion of this zone in the future. More afforestation programs must be taken

in these areas. Deforestation and forest clearing must be strictly prohibited. A mangrove buffer along the coast can also be created in this zone.

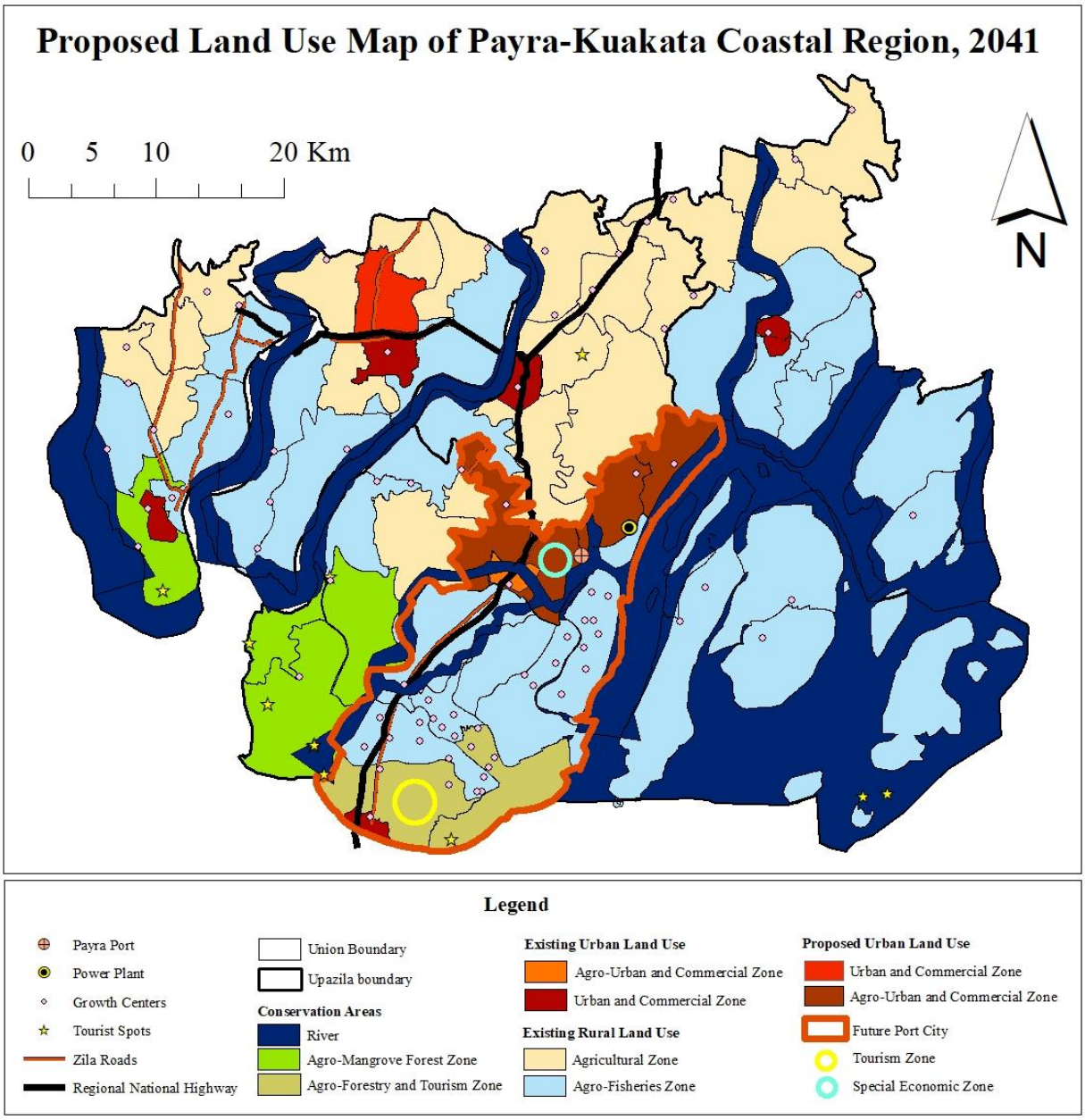


Figure 11.1: Proposed land use map of Payra-Kuakata coastal region (Author, 2021)

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APPENDIX

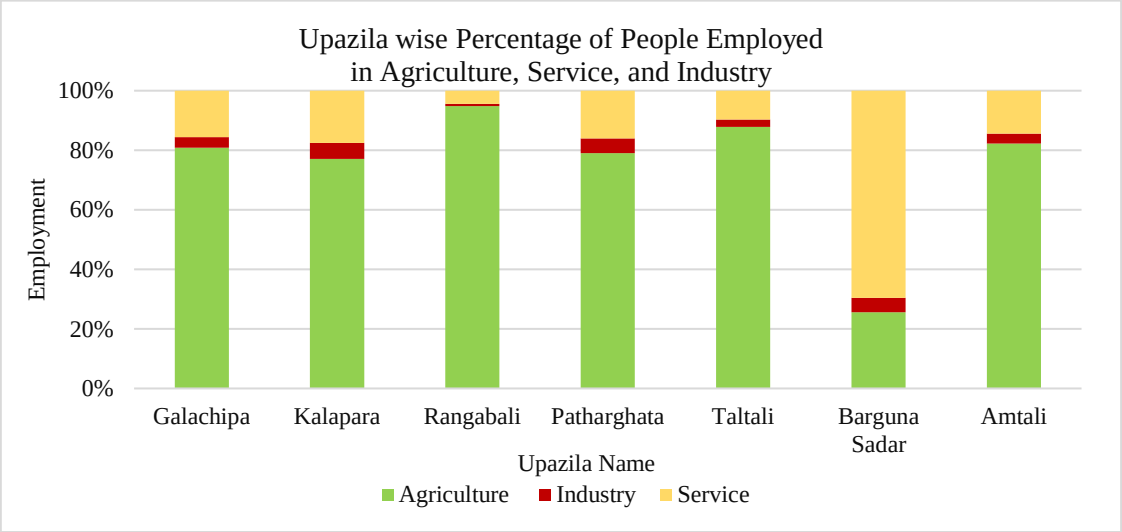

Figure 0.2: Upazila wise existing employment in different fields (Source: Authors' own construction from BBS, 2013a; BBS, 2013b).

Table 5.1: Upazila wise basic economic sectors (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

Upazila	**Basic economic sectors (Ranking based on contribution to upazila's basic employment)**
Galachipa	1. Wholesale & Retail Trade 2. Community, Social & Personal Services 3. Hotel & Restaurant
Kalapara	1. Public Administration & Defence 2. Electricity, Gas & Water Supply 3. Education 4. Bank, Insurance & Financial Activities
Rangabali	1. Wholesale & Retail Trade 2. Hotel & Restaurant
Patharghata	1. Electricity, Gas & Water Supply 2. Community, Social & Personal Services 3. Education 4. Bank, Insurance & Financial Activities
Taltali	1. Wholesale & Retail Trade 2. Community, Social & Personal Services 3. Bank, Insurance & Financial Activities
Barguna Sadar	1. Construction 2. Real Estate & Renting 3. Health & Social Work 4. Education 5. Bank, Insurance & Financial Activities 6. Public Administration & Defense 7. Education

Amtali	1. Health & Social Work 2. Public Administration & Defence 3. Bank, Insurance & Financial Activities 4. Education 5. Community, Social & Personal Services 6. Hotel & Restaurant

Table 6.1: Upazila wise Fast Growing, Highly Potential, Developing and Depressed Sectors (Source: Authors' own construction from BBS, 2013e; BBS, 2013f)

Upazila	Fast Growing Sectors (IM +, RS +)	Highly Potential Sectors (IM -, RS +)	Developing Sectors (IM +, RS -)	Depressed Sectors (IM -, RS -), (IM = 0, RS = 0)
Amtali	▪ Manufacturing ▪ Community, Social and Personal services	▪ Wholesale and Retail Trade ▪ Hotel and Restaurant ▪ Bank, Insurance and Financial Activities ▪ Public Administration and Defense ▪ Education	▪ Electricity, Gas and Water Supply ▪ Transportation, Storage and Communication	▪ Real Estate and renting ▪ Health and Social Work ▪ Mining and Quarrying ▪ Construction
Taltali	▪ Community, Social and Personal services	▪ Wholesale and Retail Trade ▪ Hotel and Restaurant	▪ Manufacturing ▪ Transportation, Storage and Communication	▪ Mining and Quarrying ▪ Electricity, Gas and Water Supply ▪ Construction ▪ Real Estate and renting ▪ Public Administration and Defense ▪ Education
Barguna Sadar	▪ Electricity, Gas and Water Supply	▪ Construction ▪ Hotel and Restaurant ▪ Bank, Insurance and Financial Activities	▪ Manufacturing ▪ Transportation, Storage and Communication ▪ Community, Social and Personal Services	▪ Mining and Quarrying ▪ Wholesale and Retail Trade ▪ Real Estate and Renting ▪ Public Administration and Defense ▪ Education ▪ Health and Social Work
Patharghata	▪ Manufacturing	▪ Electricity, Gas and Water Supply ▪ Hotel and Restaurant ▪ Bank, Insurance and Financial Activities	▪ Transportation, Storage and Communication ▪ Community, Social and Personal Services	▪ Mining and Quarrying ▪ Construction ▪ Wholesale and Retail Trade ▪ Real Estate and Renting ▪ Public Administration and Defense ▪ Education ▪ Health and Social Work
Kalapara	▪ Mining and Quarrying ▪ Manufacturing	▪ Electricity, Gas and Water Supply ▪ Construction ▪ Hotel and Restaurant ▪ Bank, Insurance and Financial Activities	▪ Transportation, Storage and Communication ▪ Community, Social and Personal Services	▪ Wholesale and Retail Trade ▪ Real Estate and Renting ▪ Health and Social Work

		▪ Public Administration and Defense ▪ Education		
Rangabali		▪ Hotel and Restaurant ▪ Bank, Insurance and Financial Activities	▪ Manufacturing ▪ Transportation, Storage and Communication ▪ Community, Social and Personal Services	▪ Mining and Quarrying ▪ Electricity, Gas and Water Supply ▪ Construction ▪ Wholesale and Retail Trade ▪ Real Estate and Renting ▪ Public Administration and Defense ▪ Education ▪ Health and Social Work
Galachipa	▪ Manufacturing ▪ Community, Social and Personal Services	▪ Hotel and Restaurant ▪ Health and Social Work	▪ Mining and Quarrying ▪ Electricity, Gas and Water Supply ▪ Transportation, Storage and Communication	▪ Construction ▪ Wholesale and Retail Trade ▪ Bank, Insurance and Financial Activities ▪ Real Estate and Renting ▪ Public Administration and Defense ▪ Education

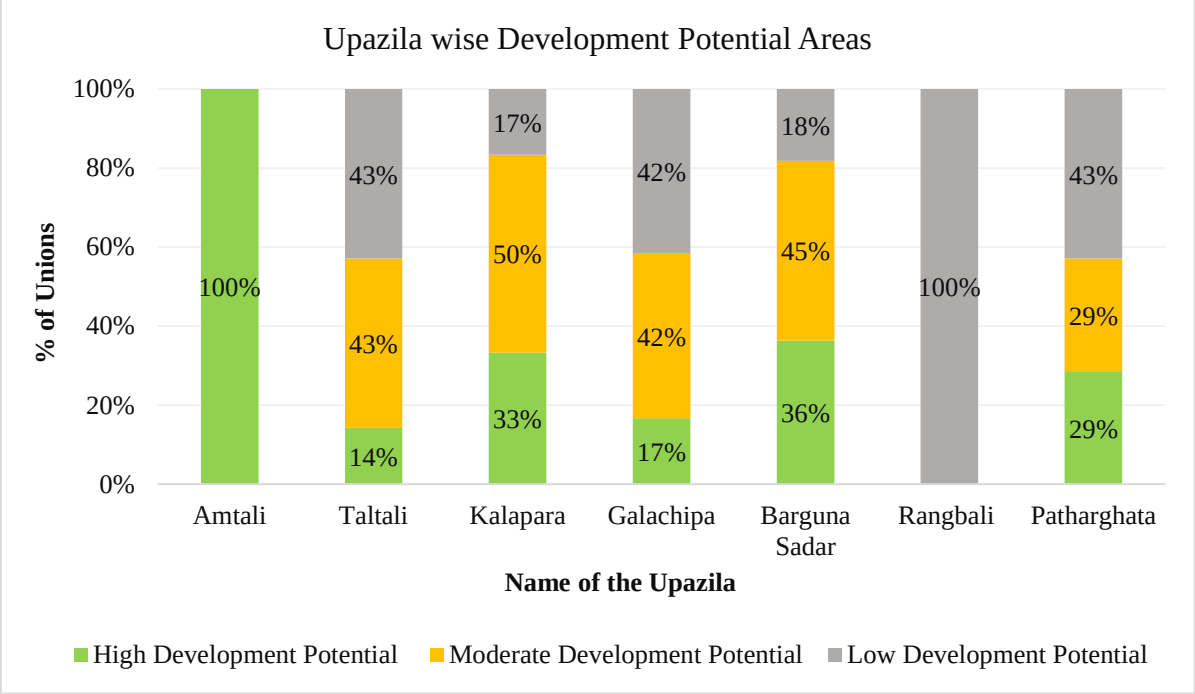

Figure 0.1: Upazila wise development potential areas (Source: Author, 2021)

Table 8.2: Rating of chosen criteria used in the analysis of land suitability for urban area development

Criteria	Weight (out of 100)	Rank						References
		Most suitable 5	Highly suitable 4	Moderately suitable 3	Less suitable 2	Least suitable 1	Restricted 0	
Slope (degree)	3	<1	1-1.8	1.8-2.6	2.6-3.4	3.4-4	>4	Aburas et al. (2017), Luan et al. (2021), Ustaoglu & Aydınoglu (2020)
Distance from Regional National Highway (m)	25	<1000	1000-2000	2000-3000	3000-4000	>4000	-	Aburas et al. (2017), Ustaoglu & Aydınoglu (2020), Wang et al. (2021)
Distance from Zila roads (m)	20	<500	500-1000	1000-1500	1500-2000	>2000	-	Aburas et al. (2017), Luan et al. (2021), Soltani et al. (2013), Ustaoglu & Aydınoglu (2020)
Distance from main rivers (m)	5	>9000	8000-9000	7000-8000	6000-7000	5000-6000	<5000	Aburas et al. (2017), Ferretti & Pomarico (2013), Romano et al. (2015), Soltani et al. (2013), Wang et al. (2021)
Distance from growth centres (m)	12	<1000	1000-1500	1500-2000	2000-2500	>2500	-	Ullah & Mansourian (2016)
Population Density (per sq. km)	25	>400	351-400	301-350	251-300	<251	-	Aburas et al. (2017), Ferretti & Pomarico (2013)
Exposure to tidal surge	5	Very low tidal surge	Low tidal surge	Moderate tidal surge	High tidal surge	Very high tidal surge	-	Luan et al. (2021)
Exposure to earthquake	5	Very low risk	Low risk	Moderate risk	High risk	Very high risk	-	Luan et al. (2021)