URBAN DEVELOPMENT DIRECTORATE (UDD)
Government of the People's Republic of Bangladesh

Review Report
on
Data, Information, and Reports of Geological and Hydrogeological Surveys under Preparation of Payra-Kuakata Comprehensive Plan Focusing on Eco-Tourism

Submitted by
Dr. Md. Zillur Rahman
Professor
Department of Disaster Science and Climate Resilience
University of Dhaka
June 2022

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1. Background

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

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

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

Historical Events: The Rakhine tribe of Bangladesh first settled in this Upazila. A section of the people belonging to the Buddhist Rakhine tribe of Arakan came to this Upazila in quest of better living and first settled at Khepupara and Kuakata. The tradition goes that the Rakhine excavated wells, traced fresh water in the area, and settled there. The Rakhine word 'Kansai' means beach of fate, and the place was named Kansai after this. The site was subsequently renamed Kuakata (digging of the well) after the Rakhine dug out the wells.

Main occupations: Agriculture 45.63%, fishing 5.67%, commerce 10.01%, service 3.56%, agricultural laborer 18.89%, wage labourer 4.57%, others 11.67%. Land use cultivable land 45328 hectares, fallow land 93 hectares; double-crop 10.59%, triple cropland 3.19%. Cultivable land under irrigation 1.75%. The average distribution of cultivable land per head is 0.259 hectares.

Value of land: The market value of the first-grade arable land is Tk 2000 per 0.01 hectare. The main crops are paddy, pulse, sugarcane, watermelon, and vegetables. The main fruits are banana, papaya, coconut, guava, and plum.

Communication facilities: Pucca 20 km, semi pucca 58 km, and mud road 860 km. Traditional transport Palanquin and bullock cart. Most of these means of transport are extinct or nearly extinct. Manufactories Flour mill 6, rice mill 35, ice mill 25, sawmill 6. Cottage industries goldsmith 25, blacksmith 50, woodwork 12. Hats, bazars, and fairs hats and bazars are 17, most noted of which are Kalapara hat, Mahipur hat, *Kuakata*; fair 1 (rash-purnima mela), Main export goods are paddy, hilsa fish.

NGO activities: Operationally influential NGOs are BRAC, CARITAS, ASA, Urban, Solve, SIKODA, KODEK, Samkalpa. Health centers: Upazila health complex 1, satellite clinic 1, family planning center nine, and private clinic 1.

Climate Change: Squalls and cyclonic storms sometimes pass over the area in May-June and September-October, and the tidal bore accompanies the worst of the type. In recent years low atmospheric pressure in the Bay of Bengal led to frequent storms causing considerable scale damage throughout the district.

On the 12th of November, 1970, the district was swept away by an unprecedented cyclone and tidal bore. It took a heavy toll on human life and property and made a tragic record in the district's history. Previous to the onslaught of the cyclone, the gusty wind blew from the 10th to the 11th of November. On the 12th of November, at about 8 pm., the stormy wind started to blow from the northeastern side. From 9 pm, it changed its course, and the storm came from

the south-eastern side at a speed of 70 to 80 miles per hour and the tidal bore at the height of 15 to 18 feet swept over the district. At about 10 pm, the storm raged at a lower speed, but by about 11 pm., the stormy wind blew at a rate of 100 to 120 miles per hour from the west and north-western sides. The terrifying speed of the storm and the tidal bore destroyed many human lives; trees were uprooted, and houses were damaged, making an unprecedented record in the district. The loss of human life by this calamity in Kalapara thana is 4,609. The worst-hit area of the community was the Golachipa Police station, where 28,718 persons were killed by the cyclone and tidal bore. Under the same Police station, the situation in Bara-baishdia, Chhotobaishdia, Charkazal, and Rangabali was beyond description. In Char Momtaz, under Rangabali union council, only seven persons remained alive.

Consequences of Climate Change and Adaptation Strategies: Inundation from the bay during the passage of cyclones is not infrequent in the southern part of the district and does great damage. They usually occur in June before the breaking of the monsoon or in October or November after the monsoon is over. Smaller inundations affect the coast for several miles inland and deposit a layer of sand, which not only destroy the crops of that season but reduce the fertility of the soil for some seasons afterward. Incidental effects felt in that portion where the wave is at its height are the destruction of lives and the impregnation of all tanks that supply water with salt. At infrequent intervals, storms and waves of great magnitude occur, which are liable to cover the entire district or the more significant portion of it with salt water and therefore affect the fertility and throw a great deal of the land temporarily out of cultivation.

The proposed project would be prepared from a regional development perspective considering the Payra-Kuakata coastal region as a part of the whole of Kalapara, Galachipa, Rangabali, Amtali, Taltali, Barguana Sadar, and Patharghata Upazila. Amtali Upazila has been included in the development planning package since its location is strategically important in the regional context because Amtali Upazila is situated on the way to Barisal-Kuakata highway as the highway runs through Amtali Upazila.

Taltali and Pathargata Upazilas have situated within the same ecological region as that Kalapara and Amtali Upazilas. Besides, Sonar Char is located within Rangabali Upazila, which was further a part of erstwhile Galachipa Upazila. Hence, Galachipa and Rangabali Upazila are also included in the project area to prepare the Payra-Kuakata Comprehensive Master Plan Focusing on Eco-Tourism in an integrated and comprehensive development planning context. SRFA_ PS3 02-09-09 9

Furthermore, the third seaport has been established at Kalapara Upazila. This large establishment would change the existing land use pattern of the region abruptly. This development planning package is essential to forecast likely changes in existing land use patterns and accommodate such massive establishment and related changes in the region's existing land use pattern. The proposed project would also attempt to address the issue of the impact of climate and would make a recommendation on the possible adaptation strategies.

1.2. Objectives

The project's objective is to optimize coastal resources and activities for the sustenance of marginal people. The coastal activities and resources are essential to the economy and life of the people of Bangladesh, whose living conditions are inextricably linked to the productivity and sustainability of the coastal zone. There is no long-term Holistic Development Plan for the coastal area, and the Coastal zone needs an interdisciplinary development planning approach is urgent to optimize the livelihood of the coastal area. The physical development planning problems needing attention are as follows:

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

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

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

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

1.3. Location of the Project Area

Barguna district (Barisal division) area of 1831.31 sq km, located between 21°48' and 22°29' North latitudes and between 89°52' and 90°22' East longitudes. It is bounded by Jhalokati, Barisal, Pirojpur, and Patuakhali districts on the North, Patuakhali district and Bay of Bengal on the South, Patuakhali district on the East, Pirojpur and Bagerhat districts on the west. Amtoli, Taltoli, Patharghata, and Barguna Sadar Upazila are selected as a project areas from Barguna district. On the other hand, Patuakhali district (Barisal division) area of 3220.15 sq km, located between 21°48' and 22°36' North latitudes and in between 90°08' and 90°41' East longitudes. It is bounded by Barisal district on the North, Bay of Bengal on the South, Bhola district on the East, Barguna district on the west. The community's land is composed of alluvial sedimets of the Meghna Basin and several small char lands. Galachipa (including the newly

created Rangabali Upazila) and Kalapara Upazila are selected as a project areas from Patuakhali District. Kuakata is a scenic sea beach in the South of Bangladesh. The most crucial attraction of the beach is that one can see both sunrise and sunset from some of its locations. Situated 320 km from Dhaka and 70 km from the Patuakhali district headquarters, Kuakata is part of Latachapli and Dhulasar unions of Kalapara Upazila.

On the other hand, Amtali Upazila of Barguna District is on the way to Kuakata from Barisal. The only highway towards Kuakata from Barisal runs through Amtali Upazila. Due to this reason, both Kalapara and Amtali Upazila have been undertaken for "Preparation of Eco-Tourism Development Plan for Kuakata Coastal Region" to develop tourism in the area in an integrated and comprehensive manner on a regional planning concept. The best way to reach Kuakata from Dhaka is to first travel to Barisal by road, water, or air, then take the bus or boat/launch for the destination. The Bangladesh Road Transport Corporation introduced a direct bus service from Dhaka to Kuakata via Barisal. Besides, on the west of Kuakata is a reserve forest, Fatrar Char by name, which is part of the Sundarbans and is a unique location for tourism development. Sonar char of Rangabali Upazila is also a place of panoramic beauty. There is ample opportunity for tourism development in the area. Moreover, Payra Bandar, the third seaport, has already been established at Ravnabad Channel near Kuakata, which would act as a catalyst for radical change in the overall urbanization in the region.

Table 1: Area, Population, and Density of the Project Area

Name of District	Name of the Upazila	Area		Population	Density of total Population per Sq.Km
		Sq. Km	Acre		
Barguna	Barguna Sadar Upazila	454.38	112279.74	261343	575
Barguna	Pathargata Upazila	387.36	95718.74	163927	423
Barguna	Amtali Upazila (Including Taltoli Upazila)	720.75	178101.2	270802	376
Patuakhali	Galachipa (Including New Created Rangabali Upazila)	1268.37	313421.05	361518	285
Patuakhali	Kalapara Upazila	491.89	121548.67	237831	484
Total		**3322.77**	**821074**	**1295421**	**389.86**
Source: BBS, 2011					

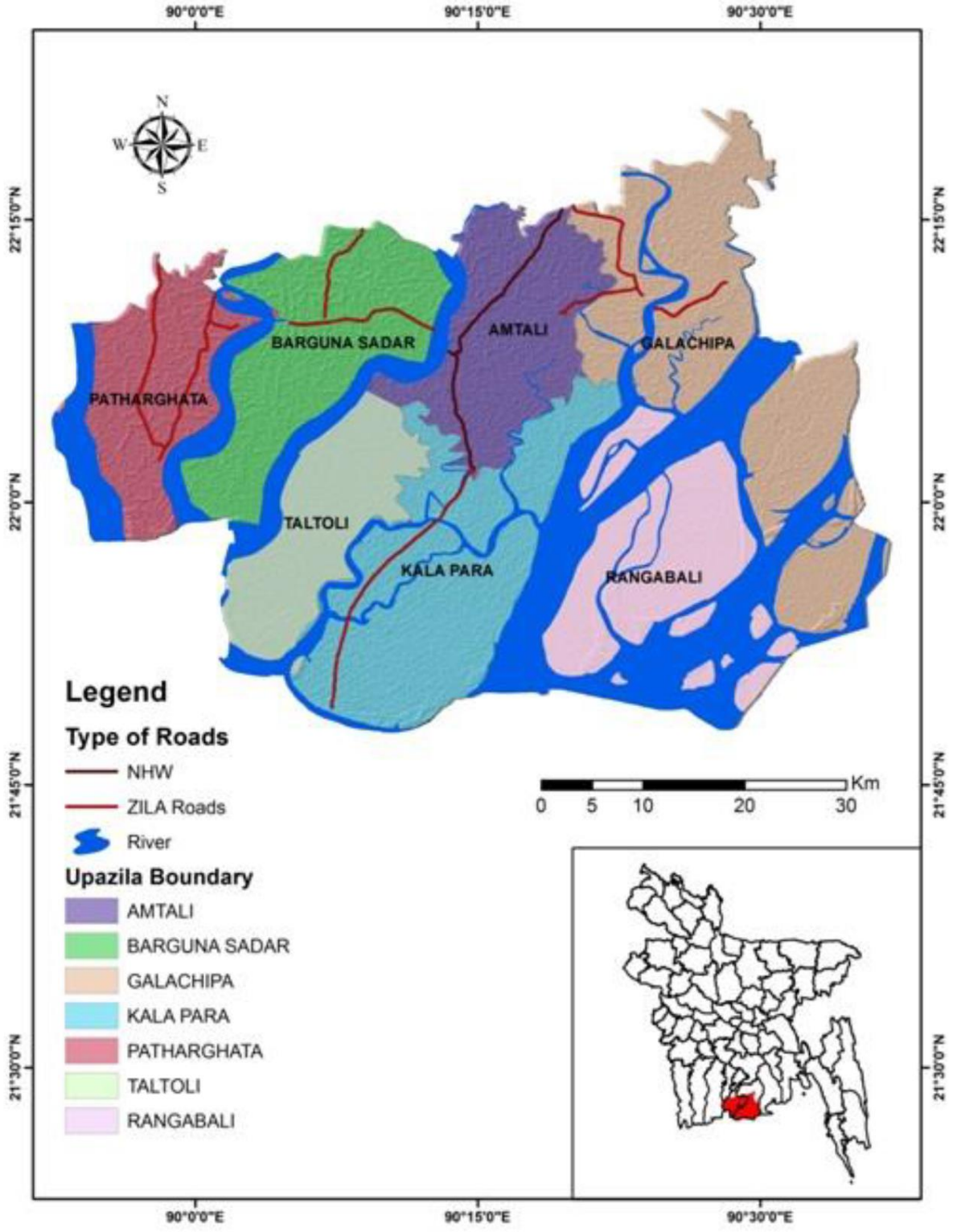

Figure 1: Location map of the project area

2. REVIEW COMMENTS

2.1. Review Comments on the Report of the Geological and Geophysical Surveys

The step-by-step review comments on the report of the geological and geophysical surveys are given in the following sections.

2.1.1. Executive Summary

The study area's major geomorphological and geological units need to be mentioned. The general geotechnical and dynamic properties of the significant geological units are necessary for the executive summary. The seismic ground motion parameter values should be summarized here.

2.1.2. Introduction

The background, location and accessibility, and aims and objectives are well explained in the introduction.

2.1.3. Methodology

The methodology for collecting geotechnical and geophysical data through field investigations is straightforward and self-explanatory. Other methods, such as laboratory tests, and seismic hazard assessment, are missing from the methodology.

2.1.4. Geology of the Study Area

The surface geological map and the description of the surface geological units are acceptable to interpret the geological processes acting in the study area. However, a geomorphological map can be prepared to identify the geomorphic units of the deltaic river system in the lower part of the Ganges-Brahmaputra Delta.

The subsurface geological units with the geological and geotechnical properties (Standard Penetration Test Blow Counts, SPT) are well represented in finding the deep foundation depth of the study area.

2.1.5. Seismic Hazard Assessment

In seismic hazard assessment, the deterministic and probabilistic hazard assessments were performed to estimate the ground motion parameters, and shear wave velocity in the top 30 m (Vs30) is used to estimate the site response. The seismic ground motion parameters of both deterministic and probabilistic should be summarized for comparison.

2.1.6. Liquefaction Potential Index Assessment

The liquefaction hazard maps prepared using SPT-N value and shear wave velocity data are well explained and clear

2.1.7. Settlement of Soil (Clay Soil)

The settlement analysis performed using the consolidation test of the clayey samples indicates that the soil deposits at the shallow subsurface are compressible and collapsible. Therefore, the shallow foundation is not suitable in most parts of the study area.

2.1.8. Geological Suitability and Recommendation

The geological suitability and recommendation are acceptable. The ranking system for suitability analysis is sound.

2.1.9. Policy-based on Seismic Hazard Assessment

The policy recommendation based on seismic hazard assessment, foundation depth, soil type determination using Vs30, building height, and geological suitability are explained well.

2.1.10. Conclusion

The geological units, geotechnical parameters, and seismic ground motion parameters should be summarized here.

2.2. Review Comments on the Report of the Hydrogeological Investigation

The step-by-step review comments of the hydrogeological report have been provided in the following sections.

2.2.1. Executive Summary

The executive summary is clear and well organized. However, the prediction of the aquifer's long-term water production capacity needs to be included for future urbanization in this area.

2.2.2. Introduction

The introduction of the report is well organized. However, there are some typos in the text, such as the first letter of the district name should be in Capital. Please check for such typos in the text and correct them accordingly.

2.2.3. Materials and Method

The methodology is standard and clear to accomplish the objectives of the study.

2.2.4. Characteristics of the Aquifer System

The subsurface geology has been interpreted using vertical electrical resistivity sounding (VES) and lithological borehole logs. The cross-sections prepared to observe the subsurface lithological conditions are very general and hardly represent the actual lithological conditions of the area. The cross-section should be more accurate to describe the aquifer characteristic of the area. The borehole locations should be indicated in the hydro-stratigraphic models of the study area. The unit colors of the models are not corresponding with the legend colors. These models are very uncertain in understanding the hydro stratigraphy of the study area. The models prepared by the software are inferior.

The aquifer and aquitard thickness can be represented more clearly and accurately, showing some bore logs of the study area. The cross-sections and fence diagrams prepared using interpolation by software in most of the cases are wrong.

The boreholes should be overlaid on the aquifer contour maps. Overall, the data and diagrams do not represent the actual aquifer characteristics of the study area.

2.2.5. Groundwater Level Dynamics

The interpretations of the groundwater dynamics are clear.

2.2.6. Water Quality

Values of different parameters of water chemistry should be represented in a tabular format with various standards (WHO, BDWS).

2.2.7. Groundwater Model Development

It is tough to represent an actual situation through modeling using this limited amount of borehole data for such a large area of deltaic environment. The model should be prepared for a small space to represent the actual condition of the study area.

2.2.8. Effect of Climate Change on Water Resources in Coastal Areas

The description is generalized from literature; no analysis is performed.

2.2.9. Summary, Discussion, and Recommendation

The water budget and water balance analysis should be conducted to forecast the future groundwater condition of the study area for urban development in this area.

The borehole logs of the area should be included in the report.