Management Issues of Ecologically Critical Areas in and around Dhaka City: A Case Study of Gulshan-Baridhara Lake

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Thesis submitted to the Department of Geography and Environment, University of Dhaka in partial fulfillment of the requirement for the degree of M.Phil

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CERTIFICATION

This is to certify that Syeda Raihana Akhter, Reg. No.: Ha-3659 Session: 2012-13, has prepared the thesis entitled " Management Issues of Ecologically Critical Areas In and Around Dhaka City: A Case Study of Gulshan-Baridhara Lake" under my supervision. I do hereby approve the style and content of this thesis. This is for the partial fulfillment of the requirement for the degree of M.Phil at the Department of Geography and Environment, University of Dhaka, Bangladesh.

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DECLARATION

It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma. The work reported within this manuscript has been executed by me, unless otherwise stated.

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ABSTRACT

The earlier areal expansion and excessive urban growth of Dhaka city in the last few decades is causing the loss of natural vegetation, loss of open spaces, and a general decline in the spatial extent and connectivity of wetlands and wildlife habitat. The current loss of wetlands in and around Dhaka city has become a prime issue that result many adverse impacts on the environment. Due to various natural and human induced reasons, the wetlands of the city have been shrinking with the passage of time. Wetlands constitute a part of human heritage. It has played a significant role in the development of human culture and society. Moreover, it contains very rich components of biodiversity of local, national, and regional significance. This study attempts to evaluate the existing state of wetland degradation in Dhaka city emphasizing on the extent of their changes and subsequent impacts on ecological and social environment of the area. The study mainly focuses on the comprehensive analysis of the various issues leading to wetlands degradation of Gulshan-Baridhara Lake and its management issues. Gulshan-Baridhara Lake is the northernmost lake in a chain of water bodies (Gulshan Lake, Hatirjheel, Begunbari Khal, Balu River and Shitalakhya River) in Dhaka, suffering from highly significant pollution, illegal grabbing, ineffective waste management and loss of ecosystem. The lake was declared an Ecologically Critical Area (ECA) in 2001. It is one of the lifelines of Dhaka city and therefore sustainable management and protection of the lake through integrated approach of concerned authorities has become a prime concern.

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LIST OF ABBREVIATIONS

BELA : Bangladesh Environment Lawyers Association

BUET : Bangladesh University of Engineering and Technology

CBA : Community Based Adaptation

DCC : Dhaka City Corporation

DO : Dissolve Oxygen

DoE : Department of Environment

DWASA: Dhaka Water Supply & Sewerage Authority

DU : University of Dhaka

ECA : Ecologically Critical Area

EM : Executive Magistrate

JICA : Japan International Cooperation Agency

POBA : Poribesh Bachao Andolon

RAJUK : Rajdhani Unnayan Katripokkho

SPARRSO: Space Research and Remote Sensing Organization

CHAPTER 1
INTRODUCTION

1.1 Statement of the Research Problem

Dhaka City, due to unplanned and excessive growth of and industrialization, lake water utilization and quality deterioration has been increased fast with the contribution to serious environmental degradation. Dhaka faces water challenges that include the availability of pure drinking water, drainage system functionality, industrial waste discharges in rivers and water bodies and insufficient solid waste disposal facilities (Browder 1992; Pandey 1997; Islam 2009). The city of Dhaka, previously known for its canals and lakes as the 'Venice of the east' (Islam 2011), a drastic replacement of lakes, canals and wetlands by urban structures over the last 30 years (Hasan, 2006). Beginning in the early 1980s, canals that previously lined many areas of Dhaka have been transformed into an underground sewer system (Alam and Aurangageb, 1995). These removed canals and lakes were once a part of the City's natural drainage system. In 2006, Zaman studied the area around Gulshan, Banani and Baridhara, and the importance of lakes to their relative success in enticing new residents. It was found that, while individuals originally moved to these areas to acquire lake-front property, later infill and land speculation caused an extensive quantity of pollution to be spilled into the lakes. Lakes in Dhaka have been the focus of extensive scientific enquiry over the past decade because of the social and environmental implications of degrading water quality, with many studies examining their increasing levels of pollution (Muntasir and Akter, 1986; Ali et al. 1998; Ahmed et al. 2005; Shiekh et al. 2006; Quraishi 2009; Islam 2011). The sources of these lakes flow through the middle of Dhaka, becoming polluted with industrial effluents, municipal wastes, agricultural run-off, sewage and other hazardous substances (Hossain, 1993), with many human health and economic implications, particularly regarding the poor and slum dwellers (Marr and Dasqupta, 2008). Aquatic biodiversity also is threatened, with many zooplankton being at risk of extinction (Yokoyama and Park, 2003). Muntasir and Akter (1986) and Bangladesh Poribesh Andolon (BAPA, 1999), for example, conducted studies that examined river water quality in and around Dhaka, all finding that industrial wastes had reduced the quality of water in Dhaka. The study of Muntasir and Akter (1986) found that water hardness, pH and ammonia concentrations in 1986 were already higher than the minimum standards set by the Bangladesh National Standards, with

these conditions becoming progressively worse as we enter the 21st century (Smith et al. 2000) and so wetland issues and its degradation in Dhaka city has become a major concern for the researchers.

Wetlands are defined as low-lying ecosystems where the groundwater table is always at or near the surface, including areas of marsh, fen, bog, floodplain, and shallow coastal areas (Alam and Chowdhury 2003). In other words, wetlands are transitional lands between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land is covered by shallow water (Mitsch and Gosselink 1986). The haors, baors, and beels are of fluvial origin and are commonly identified as freshwater wetlands. Manmade wetlands include lakes, dighis, ponds, etc. (GOB 2001). Wetlands are precious for the environment, ecology, and biodiversity. They are an integral part of the local ecosystem and closely related with local cultures, and also support the livelihoods of millions of people based on diverse activities such as fishing and agriculture. Values of wetlands are increasingly receiving attention as they contribute to a healthy environment in many ways. The values of the wetlands of Bangladesh can be classified into three major groups: environmental, economic, and social. Storage and recycling of nutrients and organic waste, recharge and discharge of groundwater and storage of surface water, natural drainage, flood control and flow regulation, fish breeding ground, and maintaining ecological balance are some examples of the environmental value of wetlands. Wetlands agriculture, freshwater, fish, wild foods, forest resources, agricultural land, and biomass are some examples of the economic value of wetlands. Transportation, human habitat and settlement, research, education, and aesthetic are some examples of the social value of wetlands in Bangladesh. Therefore, it is crucial to preserve the wetlands for the ecology of environment.

The capital's Gulshan-Baridhara lake focused on this study was officially labeled an Ecologically Critical Area (ECA) 17 years ago to save the water body from becoming further polluted and to protect it from encroachment. But over the past 17 years, there has not been a single day when sewage and household wastes did not flow into the lake. The government failed to take any effective steps to stop waste disposal into the lake. The government's negligence for its proper management has pushed aquatic species, including fish, to the brink of extinction. Beautification of the Gulshan- Baridhara Lake also missed the deadline as the Rajdhani Unnayan Kartripakkha failed to recover land from illegal possession. In 2003 the Supreme Court had directed Rajuk to

restore the Gulshan-Baridhara Lake by recovering all the land on its fringes from the grabbers. In May 2006 the High Court in it order directed the authorities to stop the grabbers from filling up the Gulshan Lake and on April 2012 the HC directed the government to demolish in 15 days all the buildings erected on the encroached Gulshan Lake. However, Rajuk claimed the delay in work for land recovery and pending court cases. Rajuk expects to complete the project by 2014. An executive engineer of Rajuk said that 11 cases were pending with the court relating to the lake's land stretching from the Manarat School at Gulshan Road 106 to Sahajadpur Connecting Road. Rajuk has taken no initiative until now to recover 69.144 acres of land of the Gulshan-Banani Lake of which 46.64 acres are under the possession of Bangladesh Telecommunication Company Limited and the remaining 23. 58 acres are under illegal private possessions.

1.2 Aim and Objectives of the Study

The aim of the study is to evaluate the existing state and the management issues of Ecologically Critical Areas in and around Dhaka city emphasizing on sustainable management for the conservation of Gulshan Baridhara lake.

Based on the aim the specific objectives of the study are:

1. To explore the nature and process of loss of wetland mainly the Ecologically Critical Areas in and around Dhaka city and associated consequences.
2. To find out the comprehensive analysis of the various issues leading to wetlands degradation of Gulshan-Baridhara Lake.
3. To address the adverse social, ecological and economic impacts behind this loss of ECA of Gulshan-Baridhara Lake.
4. To explore the sustainable management issues regarding the conservation of Gulshan –Baridhara lake.

1.3 Significance of the Study

Dhaka city has facing challenges to protect urban water bodies. Increasing proportion of urban features have encroached the lake boundaries and converted the land of water bodies into residential or commercial zone. The reduction of urban lakes and water quality decline is a threat for biological diversity, underwater plant and wildlife security. Wetlands of Dhaka city are

shrinking day by day and as a result the pollution has become a great hazard for the existence of aquatic lives. Degradation of lake water quality has negative impacts on the ecosystem and aesthetic features also. Wetland ecosystem of Dhaka city has facing the anthropogenic challenges due to the changes of land use, climate change, over harvesting of natural resource, development of transport services mainly around urban areas, high dependency on technological innovations, intensive use of pesticide, unplanned development of urban or rural housing system, improper management of waste water discharge and lack of willingness to conserve the wetlands by some of the responsible authorities and urban local habitats. The Gulshan-Baridhara lake is declared as the Ecologically Critical Area by the Department of Environment in 2001 and the lake boundary is surrounded by residential, commercial and some industrial units as well. The illegal utility connection, toxic discharges from the nearby industries causes the degradation of lake water environment. Many researchers have given priority and presented the amount, quality and types of the water quality degradation in the study area but it is necessary to focus on the actual causes which are responsible for the conversion of the natural lake water environment. So, for safeguarding of wetland ecosystem and aquatic life it is very necessity to study and make a research on the ecological critical areas and with the special spotlight upon the management issues. This study is expected to provide a comprehensive framework and a better understanding of the management issues for the sustainable development of Gulshan-Baridhara lake.

1.4 Limitations of the study

In conducting this thesis project the following limitations have been faced:

- Sometimes it was difficult to get schedule from the experts, professionals and policymakers;
- The household respondents were a bit reluctant to provide information because in some cases they were doubtful of whether it is only for research purpose or not;
- Lack of reliable data from secondary sources which create difficulties to find out the explored materials;
- The government officials were somehow unwilling to provide the actual data;
- It was primarily difficult to identify with the charter of duties and responsibilities among DCC, WASA and DoE regarding the management of lake because one is likely to blame others.

- The field visit continued indeed from the very first pilot survey till the last stage of write up to analyze any changes or development of the study area. So it takes time with limited resources to complete this thesis work.

1.5 Organization of the Study

Chapter one discusses the background and statement of the problems, aim and objectives, significance, organization and limitations of the research. Chapter two consists of literature review and conceptual development of the research. Chapter three discusses the research design and methodology the study approaches. Chapter four outlines the basic profile and environmental condition of the study area including environmental degradation and its impact on of Gulshan-Baridhara Lake. Chapter five converses about the management issues and policy guidelines for the conservation and sustainable management of the ECA declared lake and the neighboring area.

1.6 Conclusion

In this research it has been attempted to find out the past and present status of the ECA areas in and around Dhaka city and mainly focuses on the management issues of Gulshan-baridhara lake. The purpose of the research is to identify the existing reasons which are responsible for the degradation of the ecological balance in and around the lake water environment and to create a policy framework for the sustainable development of such lakes. Gulshan-baridhara lake is a resource for Dhaka city and the city developed on and around such water bodies have lots of potentialities to make Dhaka as a garden city. So the issues by this study are expected to bring some sorts of sources and advantages to the knowledge, research and educational perspectives.

Chapter 2

LITERATURE REVIEW AND CONCEPTUAL DEVELOPMENT

2.1 Introduction

A literature review is an account of what has been published on a topic by recognized scholars and researchers. An extensive literature review was carried out to have better understanding on the issues we are working and to broaden up our perspective and conceptual development. A systematic literature review was conducted to identify the relevant issues of wetland degradations mainly focused on the issues and challenges in ecologically critical areas. For this purpose different secondary sources have been used like library materials, abstracts, bibliography, websites, books, journals, reports, governmental and non-governmental documents, maps, written interviews, diagrams, and other printed resources from the concerned institutions. This study has reviewed the work carried out by several organization, institutions, researches such as DoE, RAJUK, BUET, POBA, BELA Vitti Sthapati and other Public Works.

2.2 Meaning of the term Ecology and Ecosystem

Ecology is the branch of biology which studies the interactions among organisms and their environment. Objects of study include interactions of organisms with each other and with abiotic components of their environment. Ecology is the scientific study of relationships in the natural world. It includes relationships between organisms and their physical environments (physiological ecology); between organisms of the same species (population ecology); between organisms of different species (community ecology); and between organisms and the fluxes of matter and energy through biological systems (ecosystem ecology). In other hand an ecosystem is an ecological system in which organisms interact with each other and with the environment (Park, 2003). According to Tansley ecosystem is being composed of two parts-

- The biome is the entire complex of organisms (both plant and animals) that live together naturally in harmony.
- The habitat is the physical environment within which the biome exists.

The term was first introduced by British ecologist Aurther Tansley in 1935. An ecosystem is a community made up of living organisms and nonliving components such as air, water and mineral soil, all interacting as a system. The biotic and abiotic components interact through nutrient cycles and energy flows. Ecosystems are the network of interactions among organisms and between organisms and their environment. Ecosystems can be of any size but one ecosystem has a specific, limited space. On a larger scale, some scientists view the entire planet as one ecosystem.

2.3 Definition and Types of Wetland

Wetlands are among the world's most productive environments. They are wellsprings of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival. They support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. Wetlands are also important storehouses of plant genetic material (Ramsar, 2016). Wetland**s** are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Water saturation (hydrology) largely determines how the soil develops and the types of plant and animal community's livings in and on the soil. Wetlands may support both aquatic and terrestrial species. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation and other factors, including human disturbance (EPA, 2017).

According to the Ramsar Convention in the article 1 of the Convention states that "wetlands are areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Hence, as defined by the Convention, wetlands include a wide variety of inland habitats such as marshes, peat lands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves, intertidal mudflats and sea grass beds, and also coral reefs and other marine areas no deeper than six metres at low tide, as well as human made wetlands such as dams, reservoirs, rice paddies and wastewater treatment ponds and lagoons (Ramsar, 2016).

According to IUCN wetlands are one of the world's most important environmental assets, which are considered as the home of large biota diversity. Wetland provides significant economic, social and cultural benefits related to timber, fisheries, hunting, recreational and tourist activities, etc. In general they present a wide array of useful and appreciated ecosystem services related to water quality preservation, erosion shore protection from wave action, nurseries for fish and other freshwater and marine animals. Wetlands can be critical to groundwater recharge, carbon sequestration, and reductions of storm and flooding damages (IUCN, 2017). Wetlands have been called "nature's kidneys" because of their ability to filter impurities from water. Sediment settles out of runoff and dissolved contaminants bind to plant surfaces or are transformed, resulting in improved water quality (Ohio Environmental Protection Agency, 2017).

In Ramsar convention the following wetland types are generally recognized-

- marine (coastal wetlands including coastal lagoons, rocky shores, seagrass beds and coral reefs) estuarine (including deltas, tidal marshes and mudflats, and mangrove swamps)
- lacustrine (wetlands associated with lakes)
- riverine (wetlands along rivers and streams)
- palustrine (meaning "marshy" – marshes, swamps and bogs).

In addition, there are human-made wetlands such as fish and shrimp ponds, farm ponds, irrigated agricultural land including rice paddies, salt pans, dams, reservoirs, gravel pits, wastewater treatment ponds and canals. The Ramsar Convention has adopted a Ramsar Classification of Wetland Type which includes 42 types, grouped into three categories: Marine and Coastal Wetlands, Inland Wetlands, and Human-made Wetlands. Marine wetlands are considered to be wetlands up to a depth of six metres at low tide. A marsh is a wetland that dominated by herbaceous rather than woody plant species. Marshes can often be found at the edges of lakes and streams, where they form a transition between the aquatic and terrestrial ecosystems. A swamp is a wetland that is forested. Many swamps occur along large rivers where they are critically dependent upon natural water level fluctuations. Other swamps occur on the shores of large lakes. Some swamps have hammocks, or dry-land protrusions, covered by aquatic vegetation, or vegetation that tolerates periodic inundation. A bog is a wetland that accumulates peat, a deposit of dead plant material often mosses, and in a majority of cases, sphagnum moss. In wetland ecology the most important factor producing wetlands

is flooding. Flooding is the important factor which determines whether the resulting wetland has aquatic, marsh or swamp vegetation.

Other significant factors comprise fertility, natural disturbance, competition, herbivory, burial and salinity. When peat accumulates, bogs and fens arise. Generally fen is one of the main types of wetland, the others being grassy marshes, forested swamps, and peaty bogs. Along with bogs, fens are a kind of mire.

2.4 Significance of Wetland Ecology Conservation

Ecosystems are the complex of living communities (including human communities) and non-living environment (Ecosystem Components) interacting (through Ecological Processes) as a functional unit which provides a variety of benefits to people (Ecosystem Services). "Ecosystem Services" are provisioning, regulating, and cultural services that directly affect people, and supporting services which are needed to maintain these other services (Davidson et al. 2005). The several roles of wetland ecosystems and their value to humanity have been increasingly understood and documented in recent years. At present wetlands are known as ecosystems that are very important for biodiversity conservation, as well as for sustainable development of the natural environment. These "ecosystem services" and the "ecosystem components" can only be maintained if the ecological processes of wetlands are allowed to continue functioning. Unfortunately, in spite of important progress made in recent decades, wetlands continue to be among the world's most threatened ecosystems, owing mainly to ongoing drainage, conversion, pollution, and overexploitation of their resources. In a recent assessment by WWF (*Living Planet Report 2014: Species and spaces, people and places*. Gland, Switzerland), aquatic ecosystems were found to have lost 76% of their species populations between 1970 and 2010, while in the State of the World's Wetlands report published by Ramsar in 2015, it was estimated that 64% of the world's wetlands have been lost since the year 1900.

Wetlands play an important role in educating people about biodiversity and natural processes. However, many wetlands across the world have undergone significant degradation with negative impacts on biological diversity and peoples' livelihoods. Many of their resources are considered under risk as a result of anthropic impacts related to water management, damming, fishing,

farming, oil exploitation, agriculture and forestry, etc. The losses are larger and faster on inland than on coastal natural areas. Wetlands perform other valuable functions including reducing flood flow and shoreline erosion control (Millennium Ecosystem Assessment, 2016) Wetland are valuable because they have habitually provide remarkable economic benefits such as water supply (quantity and quality); fisheries (over two thirds of the world's fish harvest is linked to the health of wetland areas); agriculture, through the maintenance of water tables and nutrient retention in floodplains; timber and other building materials; energy resources, such as peat and plant matter; wildlife resources; transport; a wide range of other wetland products, including herbal medicines; and last but not least, recreation and tourism opportunities. It is estimated that more than a billion livelihoods worldwide are wholly or largely dependent on wetlands (Ramsar Fact Sheet 7 "Wetlands: Source of sustainable livelihood). Wetlands are essential for the health, welfare and safety of people who live in or near them. They are among the world's most productive environments and provide a wide group of benefits. The interactions of physical, biological and chemical components of a wetland, as part of the "natural infrastructure" of the planet, such as soils, water, plants and animals, enable the wetland to perform many vital functions, for example: water storage; storm protection and flood mitigation; drought buffering; shoreline stabilization and erosion control; groundwater recharge and discharge; water purification; retention of nutrients, sediments, and pollutants; and stabilization of local climate conditions, particularly rainfall and temperature. The Economics of Ecosystems and Biodiversity (TEEB) for Water and Wetlands (Russi et al. 2013) emphasized inter alia the critical importance of wetlands in the water cycle. The report found that "water-related ecosystem services and wetlands are being degraded at an alarming pace." Wetland loss and degradation result in "an enormous social and economic impact (e.g. increased risk of floods, decreased water quality – in addition to impacts on health, cultural identity, and on livelihoods)." So, it is essential to conserve the wetland and surviving ecosystem to stay away from wetland loss and dreadful conditions and to make stronger wetland assessment, monitoring and restoration efforts to ensure the wise use of the wetlands.

2.5 Concepts of Ecologically Critical Area (ECA)

The geophysical position and climatic condition of our country support to build up an enriched biodiversity. At present the increasing population and rising demand upon the natural resources and continuously changing climatic condition results in endangering existence of human beings along with the other living biodiversity. So, this alarming rate of biodiversity defeat, loss of food production and soil fertility, decreasing environmental quality and growing life threat is a matter of discussion in very seriously to protect the country.

The Ecologically Critical Areas are ecologically defined areas or ecosystems affected adversely by the changes brought through human activities. An Ecologically Critical Area (ECA) is an environmental protection zone in Bangladesh (DoE, 2015). The Bangladesh Environment Conservation Act, 1995 has provision for Ecologically Critical Area (ECA) declarations by the Director General of the Department of Environment in certain cases where ecosystem is considered to be threatened to reach a critical state. If the government is satisfied that due to degradation of environment, the ecosystem of any area has reached or is threatened to reach a critical state, the government may by notification in the official gazette declare such areas as Ecologically Critical Areas. The government shall specify, through the notification provided in sub-clause (1) or by separate notification, which of the operations or processes cannot be initiated or continued in the Ecologically Critical Area. The Government has till now declared thirteen areas as ECA. They are as follows-

Table 2.1: List of ECA Declared by the Government

No	Name of the ECA	Types of Ecosystem	Location	Area(ha)	Year of Declaration
1	Cox's Bazar-Teknaf Peninsula	Coastal-Marine	Cox- Bazar	20,373	1999
2	Sundarbans (10 km landward property)	Coastal-Marine	Bagerhat, Khulna, Barguna, Pirojpur and Satkhira	292,926	1999
3	St.Martin'sIsland	Marine island with coral reefs	Teknaf Upazila,cox's BAzar	1,214	1999
4	Sonadia Island	Inland freshwater wetland	Sylhet and Moulavibazar	40,466	1999
5	Hakaluki Hoar	Marine – Island	Moheshkhali Cox's Bazar	10,298	1999
6	Tanguar Haor	Inland freshwater wetland	Tahirpur,sunamganj	9,727	1999
7	Marjat Baor	Oxbow lake	Kaliganj upazila of Jhenaidah and chaugacha upazila of Jessore	325	1999
8	Gulshan–Baridhara Lake	Uban wetland	Dhaka City	101	2001
9	Buriganga River	River	Around Dhaka	1336	2009
10	Turag River	River	Around Dhaka	1184	2009
11	Sityalakhya River	River	Around Dhaka	3771	2009
12	Balu including Tongi canal	River	Around Dhaka	1315	2009
13	Jaflang-Dawki	River	Jaflong,Sylhet	1493	2015

Source: (DoE, 2015)

Conserving and sustaining the biological diversity of our country have been facing a great challenge because of the huge population ratio and their increasing dependency on the natural resource or the natural environment for their lives and livelihoods. As a result, all the ecosystems –aquatic and terrestrial, large or small, natural or manmade or even semi-natural have been facing the problems of degradation (CBA-ECA project, 2015). Bangladesh has several conservation efforts in place. This efforts both follows in situ (conserving species within their habitats) conserving measures and ex-situ (conserving species outsides their habitats) conservation measures. The ECA zones are included in Ex-situ conserving measures on the concentration of the government. Bangladesh has a wide variety of ecosystems that include over 300 rivers that creates marine and fresh water environments. There are a multitude of areas that have been considered ECAs. Cox's Bazar is on the borders of Bangladesh and Myanmar in the southeast corner of Bangladesh. The Teknaf Peninsula is 80 km of sandy beach and holds a variety of species as one of the longest beaches in the world. The Sonadia Islands are home to some of the last mangrove forests that house distinct species that can tolerate the high salinity of the mangrove forests in this area. The Sundarbans also contain mangrove forests and was named an ECA because it continues to suffer from over-exploitation and illegal urban development. St. Martin's Island is known for its coral-algal that overwhelms its rocky reefs. The island is a refuge for globally threatened marine species. Finally, the Hakaluki Haor found in greater Sylhet is an ECA because it has an extensive amount of wetland habitats that support a wide variety of life. The Hakaliki Haor and Marjat Baor are also considered as the ECA zone due to the critical condition of the wetland ecosystem.

Gulshan-Baridhara Lake was declared an ECA in 2001 which is the main concern of this study. In September 2009, the four rivers around the capital city Dhaka—Buriganga River, Shitalakshya River, Turag River and Balu River—have been declared by the Department of Environment as ECAs. The Department of Environment has declared to exclude these following activities for managing the conservation of ECA-

- To structure pollution creating industry or institutions.
- Deforestation activities.
- Hunting of all types of wildlife animals.
- Hunting and gathering of Coral, Turtle, Oyster and other endangered species.

- To generate any activities which directly change the quality of water and soil.
- To produce any actions which threat for fisheries and specially for the aquatic animals.
- To construct and discharge solid, liquid waste and storm sewerage from the household, industry and institution into the rivers, water bodies and wetlands.
- To use manual or mechanical equipments for assembly natural resources.

2.6 Ecologically Critical Areas in and around Dhaka City

Bangladesh being a land of enormous resources is noted for diversified flora and fauna and their habitats. Over population, urbanization, changing climatic condition are some of the factors having detrimental effects on ecosystems that are responsible for extinction of many rare species of flora and fauna. Vested with the power under Bangladesh Environment Conservation Act, 1995 and to improve the condition of ecosystems and protect and conserve the ecological and biological diversity Department of Environment has declared the ECA areas (Nazneen, 2015). The Government declared seven ECAs in 1999 with varied levels of degradation, comprising coastal areas, island and wetlands in different parts of the country. During 2001-2009, five other ECAs were declared. These include four rivers around Dhaka city emphasizing the impacts of rapid urbanization and industrialization around the capital.

Dhaka city, the nerve center of all activities in our country which is very rich in both ground and surface water resources. The water bodies located in the periphery of the city cover sufficient water even in the dry season. But domestic and industrial wastes generated in the city are deteriorating the water bodies gradually. So, the city having a natural problem of surface water pollution (Rahman et.al., 2012). Pollution in the surface water of Bangladesh is principally due to uncontrolled disposal of untreated industrial and domestic wastes. The population density is extremely high in and around the city areas. Of the chemical pollutants, heavy metal being non-biodegradable, they can be concentrated along the food chain, producing their toxic effect at points after far removed from the source of pollution (Tilzer and Khondker, 1993).).The river ECA comprises of the four rivers around Dhaka city. The names of the rivers are Buriganga, Shitalakhya, Balu and Turag. Full extents of these rivers have been included in the river ECA. As per the gazette notification published on 3 February, 2011 by the Ministry of Environment

and Forest the four rivers in and around Dhaka city and their foreshore areas have been declared as ECA. These areas have been declared as ECA for the following purposes-

- For the resettlement, recovery and conservation of the degraded ecosystem.
- Proper utilization of water for various purposes (i.e- industry, fisheries, agriculture).
- For the conservation of endangered and susceptible Ecosystem.
- For the maintenance of environment sustainability of such rivers.
- To maintain ecological balance for the sustainable use of rivers.
- To build up interrelationship among the natural environment, biodiversity, human settlement and economic development.
- To ensure effective management of declared ECA through the public participation.

Table 2.2 presents the areas of the river ECA around Dhaka city. Area of the ECA includes area of the river plus area of its foreshore.

Table 2.2. Area of the river ECA

Name of River	**Area of river under the River ECA (Hectare)**	**Area of the ECA (Hectare)**	**Length of river under the River ECA (Km)**
Balu River	269.96	995.41	72.64
Turag River	450.44	1183.82	71.00
Shitalakhya River	2526.49	3770.93	118.78
Tongi Khal	97.88	319.18	21.35
Buriganga River	879.18	1335.50	41.35

Source: CWBMP, 2011

Figure 2.1 below shows the areas of the river ECA. Along with the rivers, the river ECA includes a buffer of 50 m as foreshore of the rivers.

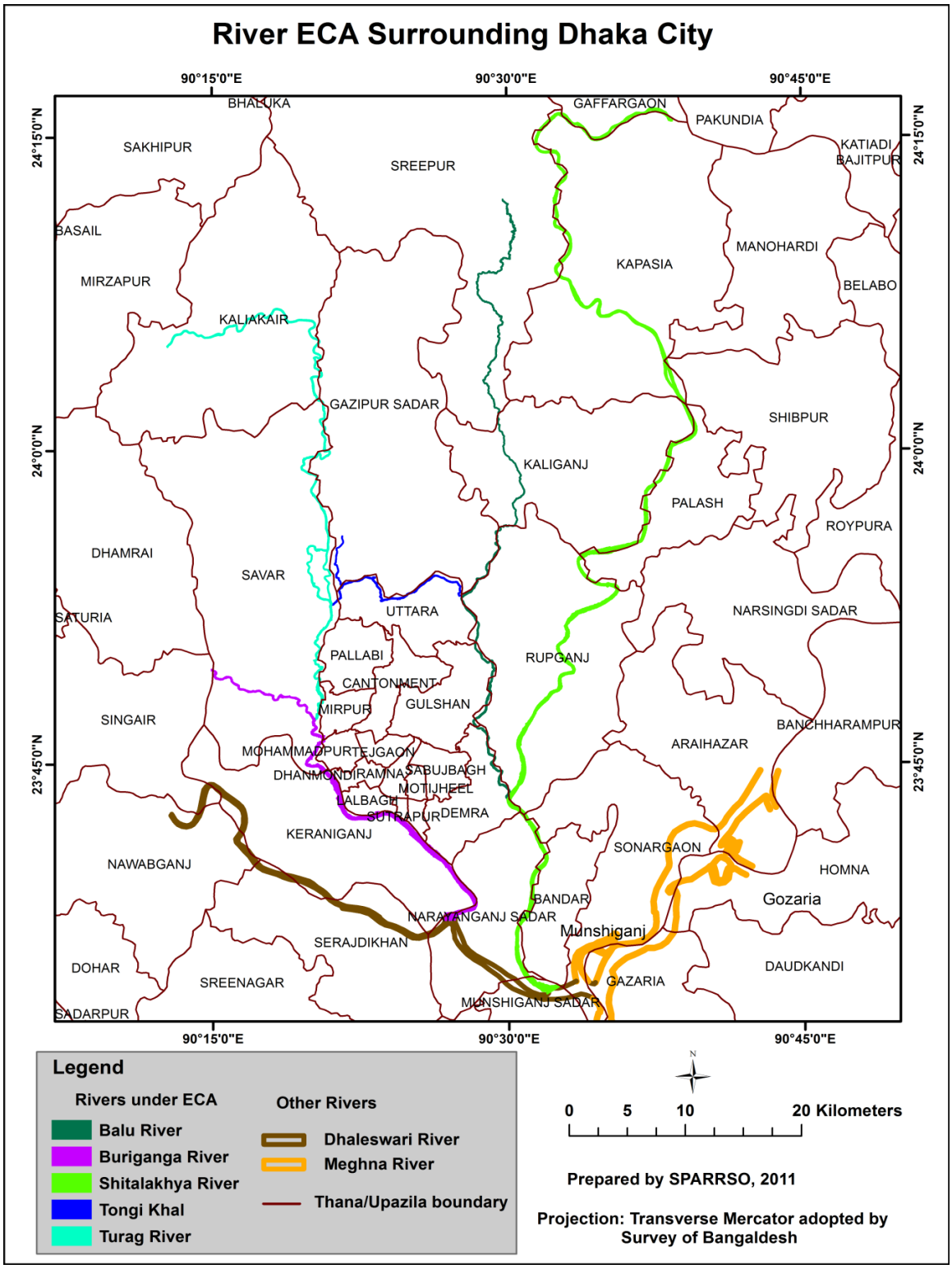

Figure 2.1: Showing the position of the river ECA. Source: DoE, 2011 (Prepared by SPARRSO)

2.6.1 Buriganga-Turag-Balu-Shitalakhya River ECA

All river in and around Dhaka City is increasingly being polluted with the city's thousands of industrial units and sewerage lines dumping huge volumes of toxic wastes which contain lots of heavy metal into it day and night (Islam et al., 2006). The pollution and water quality level of the rivers in and around Dhaka city are increasing day by day. Dhaka is enclosed by the Tongi Khal on the north, the DND embankment on the south, the Balu river on the east, and the Turag and Buriganga rivers on the west. The local surface water hydrology around Dhaka is complex. The Buriganga is a tributary of the Dhaleswari river which empties into the Meghna. It originated from the Dhaleshwari near Kalatia. This river is only 27 km long (Rahman et al.,2012). The River Buriganga running by the side of the Dhaka City, the capital of Bangladesh, is one of the most polluted rivers in Bangladesh. Many industries have set up in and around the Dhaka city during the last decade, and the number of new industries are continually increasing. Of the chemical pollutants, heavy metal being non-biodegradable, they can be concentrated along the food chain, producing their toxic effect at points after far removed from the source of pollution (Tilzer and Khondker, 1993). Saha and Hussain (2011) found the concentrations in the total sediments are as follows: 60.3-105.6 mg/kg for Pb, 0.4-1.6 mg/kg for Cd, 52.8- 139.6 mg/kg for Cr, 70-346 mg/kg for Cu and 245-984.9 mg/kg dry weights for Zn and fine portion of sediments contain higher heavy metal concentration compared to total sediments. To find out the pollution ratio frequently, Dissolved Oxygen is the most important parameters. A research has shown by POBA that these four rivers around Dhaka city is degraded the level of DO under 1 m.g which should be 5 m.g in a minimum consideration. According to the General Secretary of POBA there are three major sources of pollutant of river water pollution in Dhaka and the main factor is discharges from sewerage lines. According to their research the generating ratio of sewerage waste of Dhaka is 140000 cube meter and only 50000 cube meter faces the recycling process where rest of them reaches the river boundary. The second source is the Hazaribag tannery which producing 22000 cubic meter liquid waste and the third source of pollutant are the surrounding industries producing 1,20,000 cubic meter of waste (Daiy Prothom Alo, March 2016). The major pollution aspects of Hazaribagh are tannery wastewater, solid wastes, sludge, bad odor, narrow zigzag roads and lanes/bilanes, unplanned drainage system, over flow of drains, stack of garbage from tannery and municipal by the side of road, transportation of raw and semi processed hides, unplanned construction of residential buildings, slum dwellings, densely populated area etc. It is

to be noted that a total of about more than 15 thousand cubic meter liquid tannery waste is discharged everyday from the Hazaribagh area (Ahmed, 2005). According to the survey of POBA, the level of DO was as follows –

Table 2.3: The level of Dissolve Oxygen of River ECA around Dhaka City

Station	Ratio of DO (in percentage)	Year /Month
Sadarghat-Buriganga River	0.15%	March 2014 to February 2015
BIWTA ,Turag River (Ashulia)	1.11%	February 2014
Shiddhirganj Electrical Power Station,Shityalakkha River	0.19%	2014 to March 2016
Demra Bazar, Balu river	0.11%	2014

Source: Daily Prothom Alo, March 2016

The Turag River is the upper tributary of the Buriganga, a major river in Bangladesh. The Turag originates from the Bangshi River, the latter an important tributary of the Dhaleshwari River, flows through Gazipur and joins the Buriganga at Mirpur in Dhaka District (Mohamed, 2008) . It is navigable by boat all year round. Exemplifying the river character of Dhaka, the Turag is abundant in fish but suffers from acute water pollution. While attempts have been made to marginally widen the river, the majority of industry has made little effort to follow environmental law and the water has become visibly discolored (Rabbani and Sarkar 2017). There are very common to observe small/ big establishments like hospitals, clinics, industries, factories etc. with permanent & temporary (slum/ squatters) building structures areas on the bank of the Turag River. The main reason behind this spatial pollution pattern in the Turag within above mentioned area is that huge load of untreated toxic liquid chemical waste is directly dumped into the river from Hazaribagh tanneries through the Bashila Khal at the downstream and from the Tongi Industrial Area at Tongi Bridge and Iztema Field area. This very high pollution concentration literally diffuses to other parts of the river through upstream flow during the rainy season and some tidal activity during the dry season (Rahman, 2008). According to the study of Rabbani and Sarkar, 2008 in these areas Turag River receives water, wastewater from storm sewers (in the form of pipes, channels), which usually carry storm run off, wastewater, sewerage from domestic/commercial (including hospitals and clinics)/industrial sources. Besides,

wastewaters are also discharged into the River directly through a large number of small/ big private (industries, hospitals, commercial, domestic establishments) outfalls (i.e. small/ big diameter pipes, small channels etc). For Turag River, the major types of outfalls of the study areas discharging into the River have been classified as: (i) Storm sewer pipes (ii) Open channels and (iii) Small / big private outfalls.

Balu River runs mainly through the extensive SWAMPS of Beel Belai and that east of Dhaka, joining the Shitalakhya near Demra. It has a narrow connection through the Suti Nadi near Kapasia with the Shitalakshya, and also by way of the Tongi Khal with the Turag; there is also a link with the Shitalakhya near Kaliganj. Although it carries floodwater from the Shitalakhya and the Turag during the flood season, the Balu is of importance mainly for local drainage and access by small boats (Banglapedia). Balu River is one of the impotent water resource in Dhaka district especially Tongi. This river water is used for domestic, agricultural and residential purposes. But Balu river are being polluted through a number of pointed and non-pointed sources including untreated sewerage inputs from the town of Dhaka and Tongi, waste water and other numerous contaminated sources, such as small-manufacturing facilities (e.g., tannery and battery factory) and significant non-point agricultural activities. Moreover, other important pollution sources such as industrial inputs from a paint factory, power station, building materials factory and municipal solid wastes that drain directly into the river and receive sewage effluents from the sewer system of the town. The ultimate result of these pollution is loss of aquatic biodiversity, adverse impact on agriculture and increased water borne diseases and adverse effect of public health. (Hasan et.al,2014). Biological Oxygen Demand and Dissolve Oxygen in water varies from place to place because of their variations in the content of organic wastes and industries like textile dyeing industries, lather, soap; oil industries discharged their untreated effluents, various colored substance, septic water and untreated domestic sewage (Peavy,1985 and Sawyer 2005).

Shitalakshya River is a distributaryof the Brahmaputra. In its initial stages it flows in a southwest direction and then east of the city of Narayanganj in central Bangladesh until it merges with the Dhaleswari near Kalagachhiya. A portion of its upper course is known as Banar River. The river is about 110 kilometres (68 mi) long and at its widest, near Narayanganj, it is 300 metres (980 ft) across. Its flow, measured at Demra, has reached 74 cubic metres per second (2,600 cu ft/s). It remains navigable year round. The river flows through Gazipur district forming

its border with Narsingdi for some distance and then through Narayanganj District. The river Sitalakhya is one of the most prominent rivers in the flood plain region of Bangladesh. It is located in Narayanganj City, the second most vital industrial zone of the country. Various types of industrial units have been established on the bank of the Sitalakhya River; most of these industries directly or indirectly discharging a huge quantities of wastes and effluents into the river without any treatment and also municipal and domestic sewage sludge's from Narayanganj urban area, find their way untreated into this river. Moreover, the river is the route of the communication with Chandpur, Chittagong as the port of cargo. Besides these, the people live on and around the Sitalakhya River utilizing its water for their household washing, bathing and other necessary daily works. Therefore, the risks of pollution impact are rising upwards sequentially (WARPO, 2000b). The Sitalakhya River herself and other interlinked rivers were likely to be significant sites of chemical pollution. Based on this evaluation, the river system was divided into two zones based on geological and other factors: zone I, the upstream and zone II, the reach downstream above the Meghna River. Zone I and zone II center on the Sitalakhya River and includes untreated sewage inputs from the town of Narayanganj Sadar and Bandar; waste water and air emissions from a large working smelter; and numerous other contaminant sources, such as small – manufacturing facilities (e.g., a tannery and battery factory) and significant non – point agricultural activities. Moreover, other important pollution sources such as industrial inputs from a paint factory, an electric power station, a building materials facility, and the solid waste. It also has multiple open sewage discharges from combined sewers that drain directly into the river, and receives sewage effluents from the sewer system of the town (Alam et.al, 2006). Among the polluted areas, the worst problems are in the second most polluted river is the Sitalakhya, flowing from the east of Dhaka. The major polluters of the river are Ghorashal Urea Fertilizer Factory and an oil terminal situated on the bank of the river. Industrial units at Narayanganj and Demra are also sources of the pollution. Monitoring data of the DoE demonstrated that the concentration of dissolved oxygen in the river Sitalakhya beside the fertilizer factory varies between 2.1 to 2.9 mg/l during low tide (Saad, 2000) and pH varies between 7.1 to 6.5 at 1981 to 1990 (BCAS, 2000).

2.6.2 Gulshan-Baridhara Lake ECA

The study intends to explore the nature and process of loss of wetland mainly the Ecologically Critical Areas in and around Dhaka city and associated consequences. The four river ECA around Dhaka city has been discussed earlier where Gulshan-Baridhara lake in Dhaka city is the major concern of this study. Gulshan-Baridhara lake is an artificial lake of Dhaka Metropolis. As a part of the natural drainage system this lake still plays an important role and simultaneously the lake is also one of the major sources of water to recharge the ground water. Bangladesh Government has declared it as an "Ecologically Critical Area" in 2001 under the Environment Preservation Act and Environment Preservation Rules. The Gulshan-Baridhara lake ECA comprises of the Gulshan-Baridhara lake and extended over Gulshan, Badda South and Cantonment thanas of Dhaka city (Figure 2.2). The Gulshan-Banani –Baridhara and Badda area are combined with residential and commercial zone. Table 2.4 presents the area of the Gulshan-Baridhara lake ECA.

Table 2.4: Area of the Gulshan-Baridhara lake ECA

District	Thana	Area (Hectare)	Remarks
Dhaka	Gulshan	86.86	Declared ECA
	Badda south	13.39	Declared ECA
	Cantonment	0.75	Declared ECA
	Total	101	Total of Gulshan-Baridhara Lake ECA

Source: RAJUK, 2011

Figure 2.2 below shows the position of the Gulshan-Baridhara lake ECA.

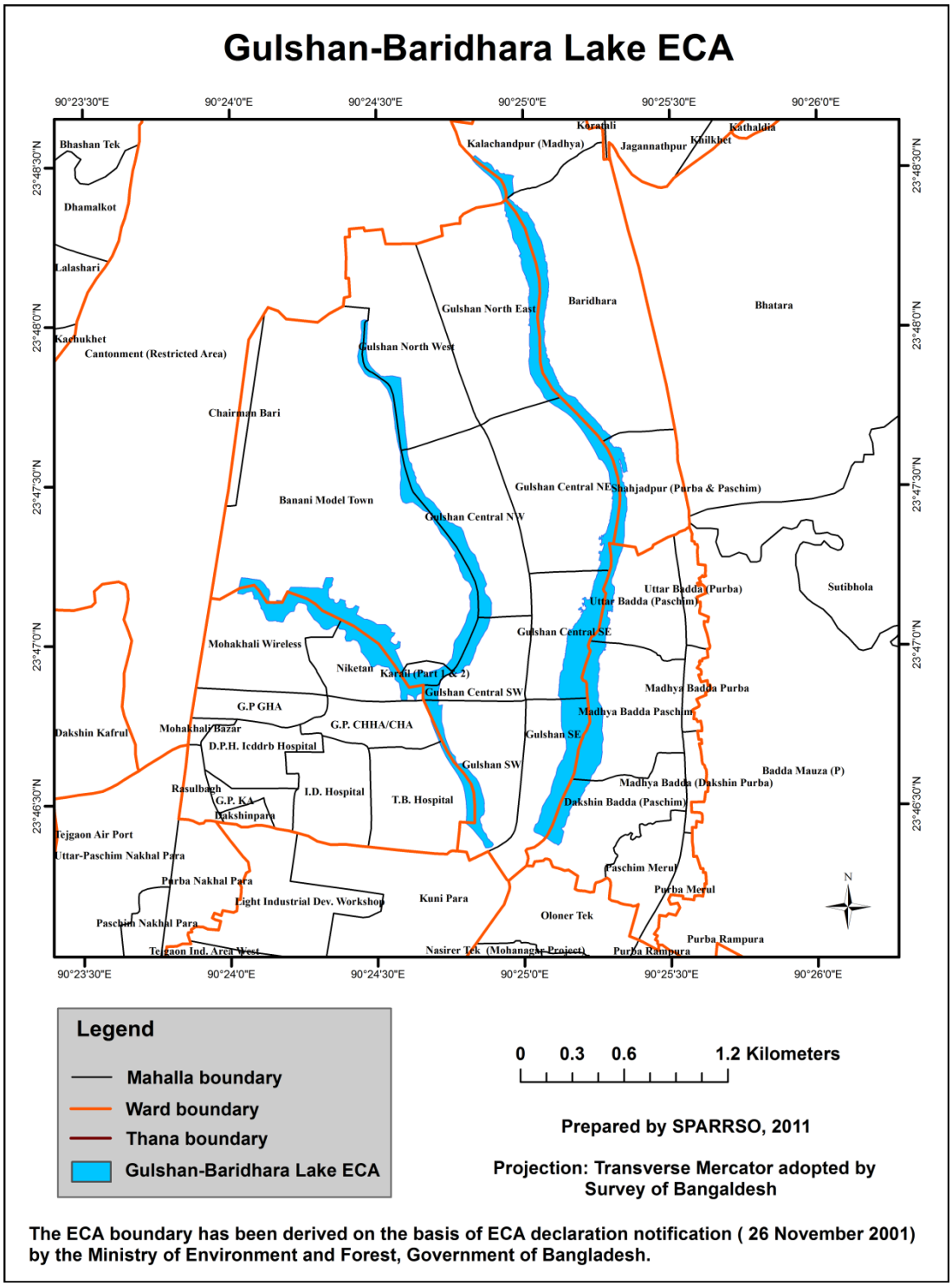

Figure 2.2: Map showing Gulshan-Baridhara Lake ECA

Source: DoE, 2011 (Prepared by SPARRSO)

Gulshan-Baridhara area was generated as a model town for the residential development though with the change of time these areas are converting as a mixed land use zone. The lake surrounding area has a mixed land use tendency and as a result the population density have also a mixed character. The density of lake part A and B differs due to the variation of the economic, social status of the residents. The area includes Gulshan Model Town, Baridhara Diplomatic zone, Banani Model Town, and in other side the Badda –Mohakhali and part of tejgaon and Khilgaon thana which consists the gathering of low income peoples residents and even many illegal slums also. The Gulshan South Park , Gulshan Lake View Park at North East in Baridhara residential zone is acting as densely relief zone.

The green space of the study area is declining due to the change of land use pattern. Some portion of the lake area have thin layer of unplanned and unmanaged green strip which is near the lake boundary. In some cases the green boundary inaccessible by barriers such as installing fences and accumulated housing construction materials. In Baridhara area some part are formed in a planned manner which is served as the neighborhood park Gulshan Park View. The inaccessible green edges are pointed near the Gulshan 1 circle to Bir Uttam A.K.Khandakar road and west part of Lake.

The lake is elongated in a north-south direction and surrounded mainly by residential area. Sewage from Badda, Baridhara, Gulshan-Banani residential area and toxic discharge from the nearby industries have polluted the lake water. Open dumping of solid waste and illegal utility connections into lake increase the rate of pollutant gathering on the lake. The water body of lake from Gulshan road no 1 to Bir Uttam A.K Khandakar road has turned into a marshland due to pollution (RAJUK, 2011). The lake is a channel-like elongated water body which is located in the northern fringe of the main part of Dhaka city. The lake is an old left back river channel but excavated later on in two phases. The western side of the lake was excavated during 1959-1960 and the eastern side during 1962-1964 for building residential areas. The lake has inlets through which it is connected with some old river channel and is, therefore, affected by flood water during peak flooding seasons (Kabir, 2005). Figure 2.3 presents a satellite image map showing the extent of water bodies in the Gulshan-Baridhara lake ECA.

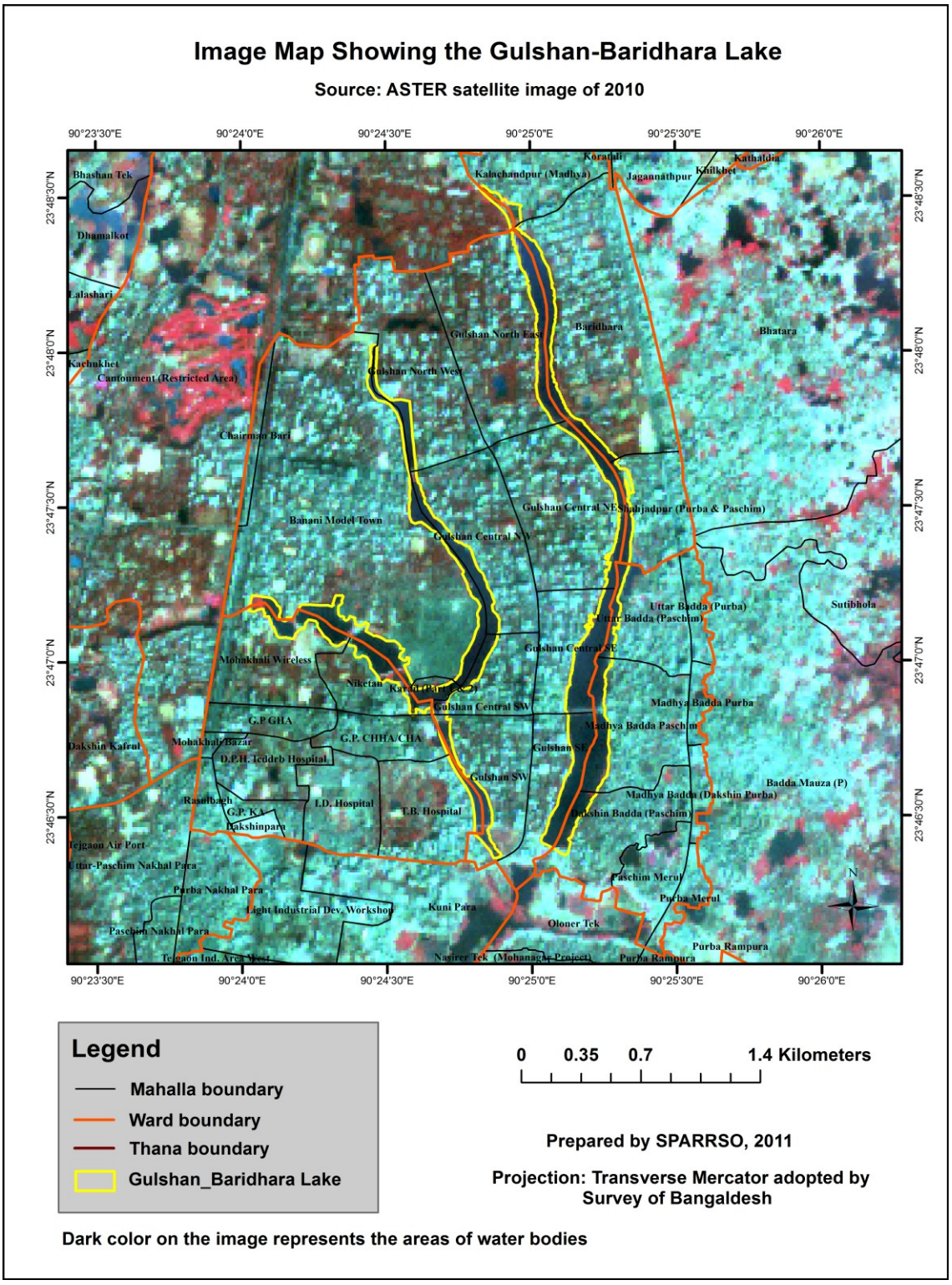

Figure 2.3: Water bodies in the Gulshan-Baridhara lake ECA.

Source: Prepared by SPARRSO, 2011

According to the inception report of RAJUK (2011) west part of the lake was accessible by pedestrian pathway and vehicle roads at some parts (Map 2.3). At the side of the lake vehicular roads from Gulshan 1and 2 residential area have been ended near the lake edge conditions. The Baridhara part has declared green edge with walkways but at the Badda part lake edge is unidentified. In the east part of the lake B defined walkways from Gulshan South Park to Biruttam A.K Khandakar road (road towards Gulshan 1 circle). After that the edge is undefined upto road no.34.The west side of the lake edge is undefined at Karail slum part. After Banani 11 no.bridge there is a pedestrian walkways and vehicular roads facing the lake.

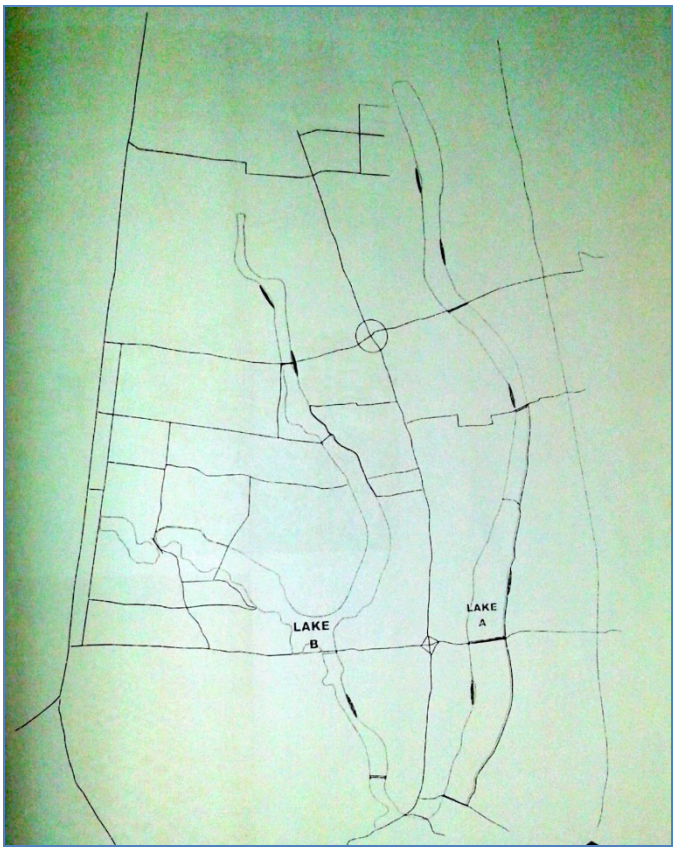

Figure 2.4: Accessible position of Gulshan-Baridhara Lake (Source, RAJUK, 2011)

Many portion of the lake edges are unprotected, risky for the passersby. In some parts of the lake edges are being destroyed due to the open dumping from the household areas, Continuous lake development and construction work around the lake periphery. The lake pathways near Badda, Karail slum area are vulnerable to erosion and illegal land encroachment and land filling makes the path more narrower and zigzagged. According to the authorities of RAJUK the edges should

be maintained with the designed slope. Some portion of the lake part forms a Kacha road. Water pollution due to human activities is also causing serious ecological problems in the lakes. The indiscriminate discharge of domestic sewage, industrial effluents, and open dumping of solid wastes in the lake has become a great concern from the point of water-environment degradation.

2.7 Conclusion

Gulshan-Baridhara lake has great potentialities to develop as a communications body as well as a natural breathing zone within the dense urban fabric of Dhaka city. According to the field survey it has identified that Waste dumping in the lake, land grabbing, sand and construction debris around the lake boundary, direct connection with storm surge and sewerage line into the lake, open dumping of the solid and liquid waste, of soil quality and vegetation coverage is a combined of intimidation for the survival of the aquatic lives. The study intends to reveal all these issues and attempts to analyze planning practice regarding the conservation of Gulshan – Baridhara lake.

Chapter 3

RESEARCH DESIGN AND METHEODOLOGY

3.1 Introduction

The aim of any research is to generate information, data and accretion of knowledge in case of searching and producing new acquaintance. To fulfill the aim of inclusive analysis of research dilemma it is necessary to find out the basic conditions of the respondents who have played a vital role through different types of activities to change the character and qualities of the lake. The study about their socio economic conditions have to. Several reasons have worked behind the environmental degradation of the Gulshan-Baridhara lake. It is very essential to identify the management issues for the sustainable development sand safeguard of the lake water ecology. This chapter focuses on the research design and environmental issues of the study area based on a comprehensive questionnaire survey, focus group discussion and in-depth interview of experts, professionals and policymakers.

3.2 Research Design and Methodology of the Study

Research design is a descriptive and investigative learning. The aim of research methodology is to find out the solution of research problem with mixed methods of data collection and analysis – both quantitative and qualitative. Methodology is the systematic study of method which is very important for the determination of research technique. It is very important in a research work which is mainly guided by the topics the study approaches. This study is mainly based on primary field survey. However, secondary sources of information have also been used. In collection of primary data this study intends to conduct questionnaire survey at household level and in-depth interview on professionals and policymakers. Different books, journals, documents, newspapers and articles have also been searched to collect secondary data.

3.2.1 Study Area Selection

Gulshan-Baridhara Lake is one of the major of few remaining water bodies of Dhaka city; not only is its presence important for the sustenance of the eco-system, it is also considered as major

main source of groundwater recharge at those area. Since 1960's the lake area was never been planned rather this is abused by the local area people and turned into a dumping zone in the heart area of the city. In 1990's a project was taken by the responsible authority to improve the lake area but it was neglected.

Gulshan-Baridhara Lake is the northernmost lake in a chain of water bodies (Gulshan Lake, Hatirjheel, Begunbari Khal, Balu River and Shitalakhya River) in Dhaka, suffering from highly significant pollution. The Lake with an area of about 100 ha and is located at 23º48' N and 90º25' E of Dhaka city. The length of the lake is 3.8 km which covers an area of 0.0160 km2. It has an average depth of 2.5 m and a volume of 12 ×105 m3 (Nishat et al. 2000). Gulshan *thana* was formed in 1972 with an area of 8.85 km^2. It consists of both wards 18 and 19, including Gulshan Model Town, Gulshan circle 1 and circle 2, Banani Model Town, Baridhara Diplomatic Zone, and Mohakhali. Gulshan was founded as a planned model town in 1961, while the neighboring Banani Model town was founded in 1964. The commission of creating urban settlement in the whole area of Dhaka City fell upon the newly established Dhaka Improvement Trust− DIT which was come into being in August 1956 under the Town Improvement Act of 1953. The function of the Trust was to carry out the development of the city in general; and this primarily meant improvement of old areas including slum areas, widening of the roads and creation of new areas for residential, commercial, industrial and other purposes. (Ahmed, 2013). It exercised control over construction of buildings, lay outs of roads and usage of lands in various zones according to a Master Plan. This led to a more or less planned extension of the city. In the period between 1950s and the mid 1980s Banani, Gulshan, Baridhara gradually developed. The built-up development was limited to the highlands available and the low lying areas and water-bodies were very profitably used, which no doubt added to the beauty of the areas as upper class residential enclaves (Chowdhury et al, 2009). Then came the 'growth rush'.

Gulshan (ward 19) is one of the high-class residential areas in Dhaka City. This area was planned and developed in the early sixties to provide residential accommodation for the high and higher-middle income people of Dhaka City. But within the next two decades, the characteristics of its residential area changed. It was gradually invaded by non-residential uses

like commercial, administrative, health, and educational, etc (Ahmed, 2009). Gulshan was planned as a site and services scheme. It has grid pattern of roads and almost all the plots are rectangular, and of the same size. Three types of roads were designed for the area, *viz*. major thoroughfares, secondary roads, and access roads. Ward 18 is also located in Gulshan *thana*. Ward 18 comprises Baridhara residential area, as well as the Shahzadpur and Kalachadpur. Most foreign diplomatic missions in Bangladesh are located in the Gulshan and Baridhara Diplomatic Zones. Baridhara residential area started to develop after the late 1980s. Baridhara is a planned residential area with a grid-iron pattern of road network. The roads are wide and properly laid out as per the norms of formal road hierarchy. On the other hand, Shahzadpur and Kalachadpur areas started to develop from the late 1990s. These are mainly unplanned residential areas. The streets here are narrow and poorly constructed. These areas are growing rapidly by encroaching on the wetlands and water bodies of the eastern part of Dhaka City (Ahmed, 2014).

At present the peripheral sides are, northern at Baridhara, southern at Tejgaon- Hatirjheel, western at Gulsan-Banani and eastern at Badda area. The west part of the Gulshan lake separates the areas from Banani model town and the east part of the lake separates the area from Baridhara and Badda locality. Both the lake terminates near Hatirjheel at south. It is now inevitable that the lake connected with the Hatirjheel lake thus expands its validity as a waterway communication channel. It is a labyrinth shaped lake with undefined edges in many places (RAJUK, 2011).According to the inception report of RAJUK the adjacent neighborhood of Gulshan Lake has spontaneously turned in to a mixed used area. In 1961 Gulshan was designed as a planned model town with the residential character. At present the area is considered as new Dhaka where most of the foreign missions are located. Due to the huge population density, increasing land encroachment, raising new residential and commercial structures, lake of environmentally concerned community facilities, improper waste disposal in the Gulshan-Baridhara and Banani area causes the serious degradation of the lake water quality and the creating life threat of lake water ecosystem. The important connected point of this lake area are Shahajadpur Khal, Gudara Ghat, Amzader Ghat, Badoler Ghat, Gulshan-Banani to Gulshan-Badda link road .The lake is in a dilapidated condition and the lake edges are not in proper physical condition. The lake is connected with the Banani-Karail, Dhaka Cantonment, Baridhara DOHS, Kalachandpur,

Mahakhali area and many major part of the lake connectivity are being polluted and being narrowed day by day due to many reasons. As per law the water body in the project of RAJUK is not yet defined as lake rather some parts of the lake is defined as Governmental designed lake. Some other part is yet private and demarcated as low laying land. So, the lake was defined according to their inception report as the "Urban Water Body Protection Law, 2001".

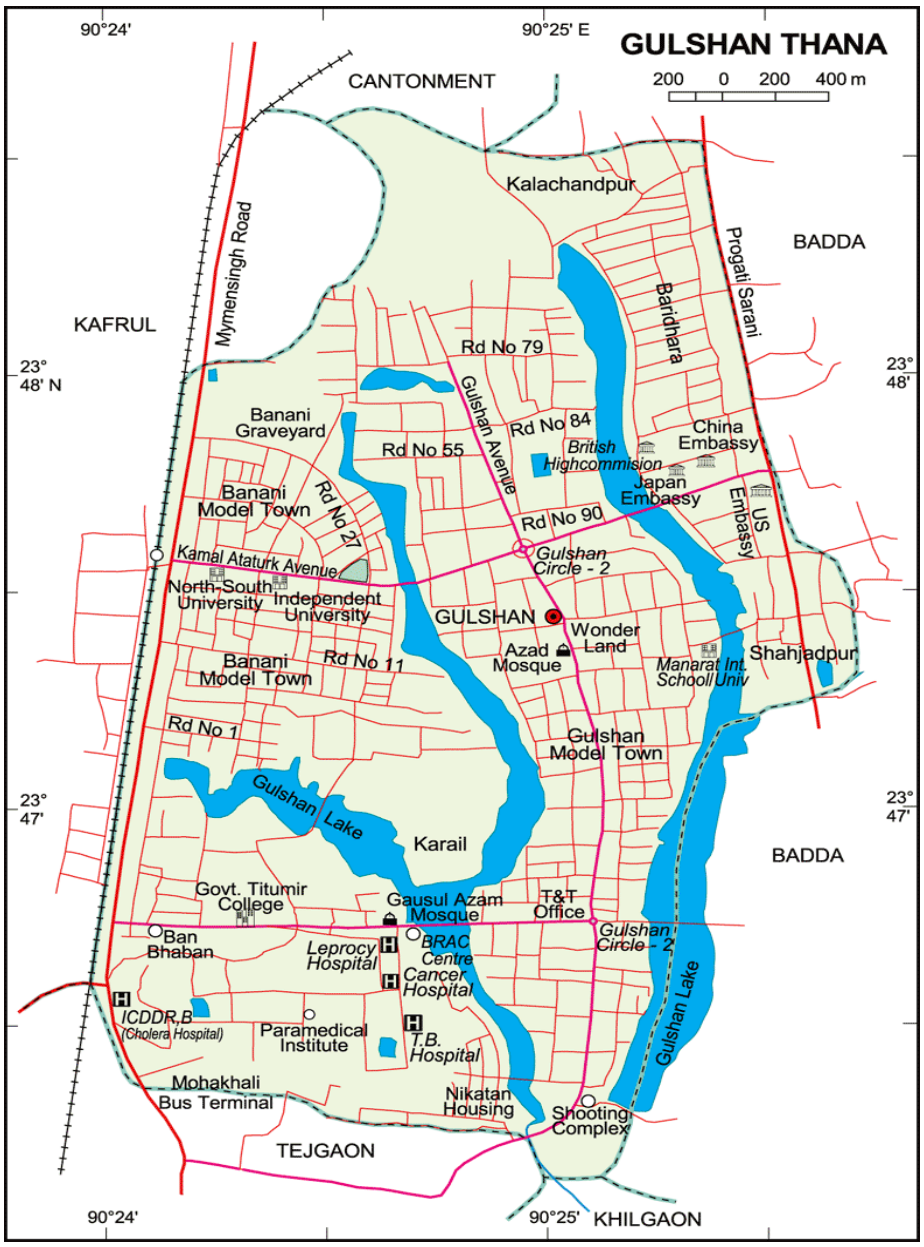

Figure 3.1: Gulshan thana showing the location of Gulshan Baridhara Lake

Source: Google Earth and Wikipedia

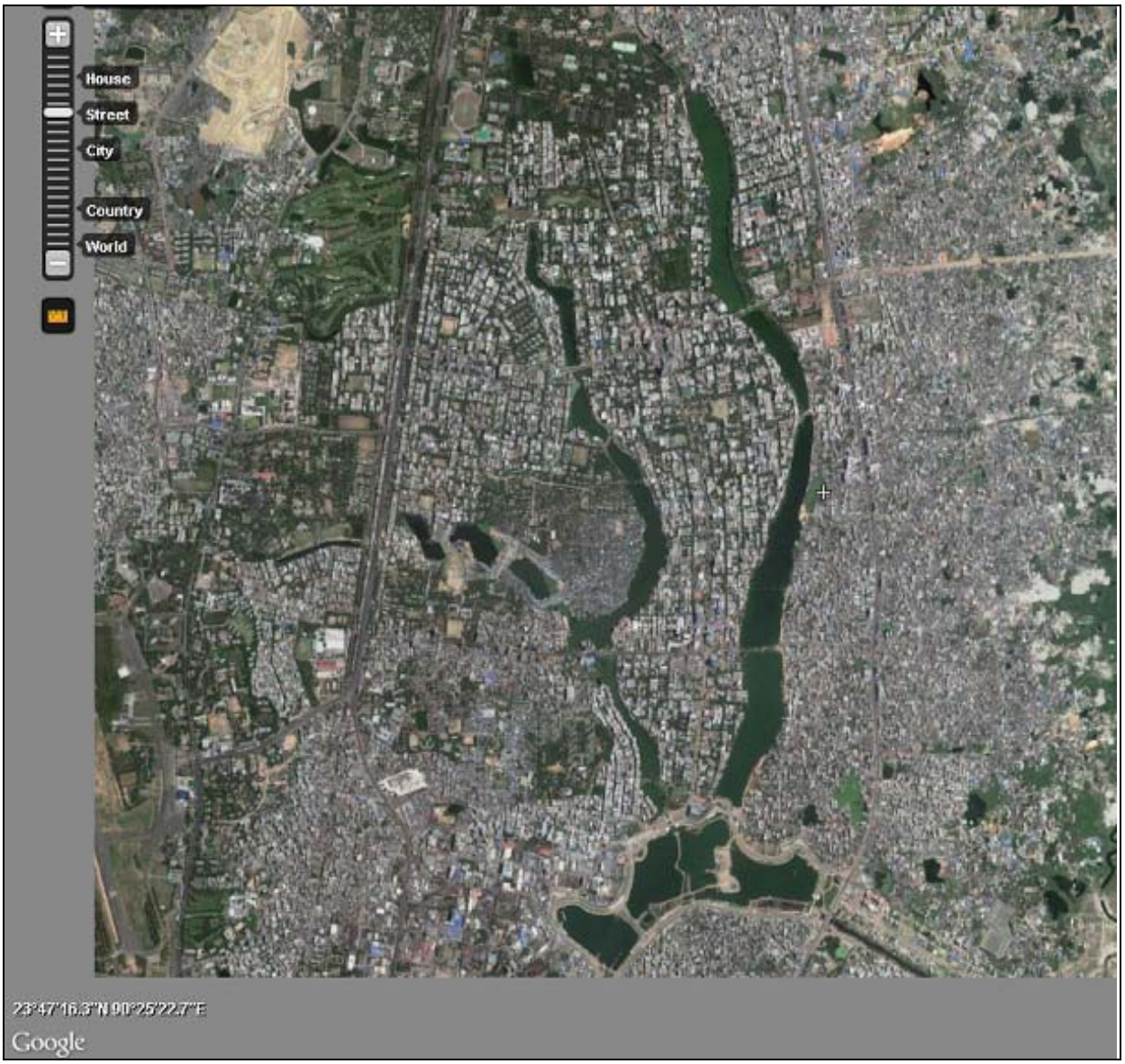

Figure 3.2: Physical Extension and Catchments of Two Important Lakes (Banani Lake and Gulshan Lake) of North Dhaka Shown through Satellite Image, [Google Image, 2013]

Source: Ahmed and Mohuya, 2013

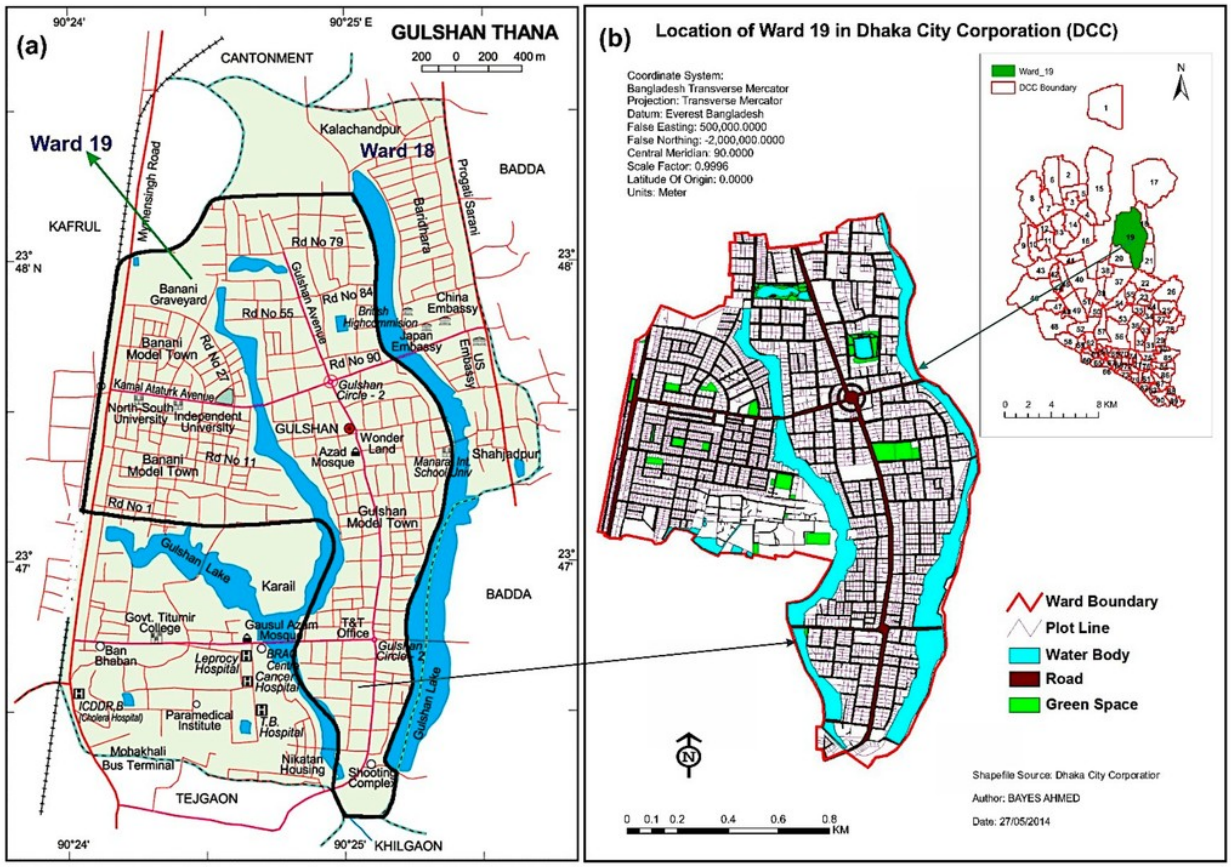

Figure 3.3: Location of ward 19 (a) in Gulshan *thana* and (b) in DCC.

Source: National Encyclopedia of Bangladesh, 2014.

3.2.2 Sources of Data

Both the qualitative and quantitative data have been used to fulfill the aim and objectives of this research.

3.2.3 Primary Data Collection

This study is mainly based on primary field survey. The primary survey has been conducted in successive stages of pilot survey, questionnaire development, household survey, Focus Group Discussion and in-depth interview.

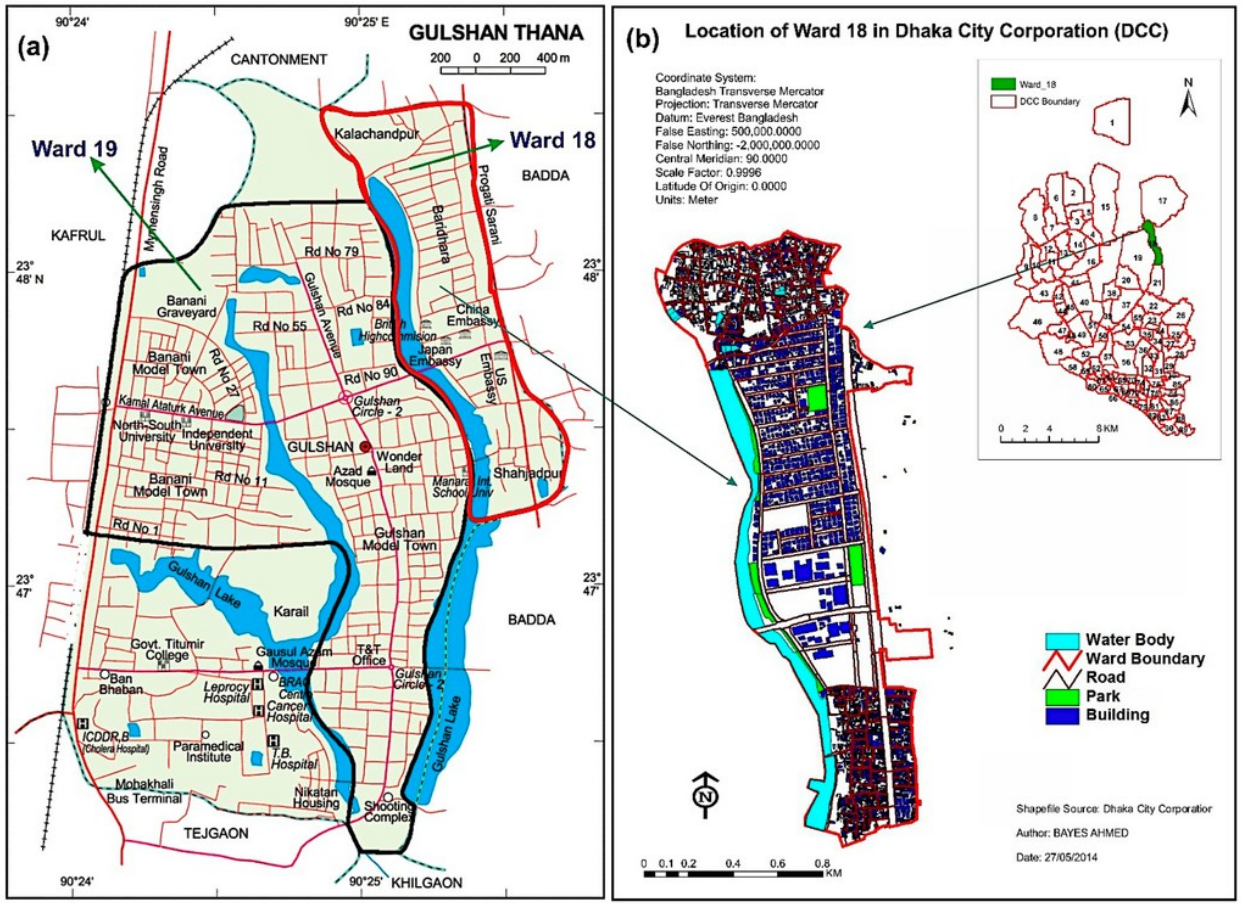

Figure 3.4: Location of ward 18 (**a**) in Gulshan *thana* and (**b**) in DCC.
Source: National Encyclopedia of Bangladesh, 2014.

I. Pilot Survey

Before starting the final field work, a pilot survey was conducted to have a preliminary impression about the study area and to conduct a questionnaire survey successfully. During this survey period, leading features for such conditions of wetland areas in and around Dhaka city, previous and existing situation of the Gulshan-Baridhara Lake, consequences of the ECA degradation in the study area have been noted down.

II. Questionnaire Development

To conduct the research two types of questionnaire have been developed. The first questionnaire has been developed to conduct a survey at household level in the study area and the second questionnaire has been developed to know the in-depth information from experts, professionals, policymakers, public representatives and local elites. The questionnaire of household (see Appendix-1) is mainly emphasized on the basics of the causes and effects of ecological, environmental, sociological loss in and around the lake boundary. The household questionnaire survey is also gives focus on the accumulation of policy guideline from the local residents and authorities. The questionnaire developed for in-depth interview (see Appendix-2) is mainly framed out to know the impacts of degradation of wetland mainly the ECA area, and recommendations for the best approach to prevent the existing problem.

III. Questionnaire Survey

It is difficult to survey each household in the study areas. Therefore, a simple random sampling method has been followed for selecting each household and the in the questionnaire survey in and around Gulshan-Baridhara lake. The respondents have selected with considering their period of living in and around study area, place of living origin and working destination, social and economic status that reflects the actual perception and information about the research topics. The sample size was 120 in number. In 1961, DIT (present RAJUK) had taken the project of "Gulshan Model Town Project" and "Gulshan –Baridhara Lake Project" .The project had received 200 acre of land. Around 60% portion of the land was integrated as Gulshan-Baridhara lake and rest of the 40% contained as Gulshan-Banani lake. In 1961, DIT (present RAJUK) had taken the project of "Gulshan Model Town Project" and "Gulshan –Baridhara Lake Project" .The project had received 200 acre of land. Around 60% portion of the land was integrated as Gulshan-Baridhara lake and rest of the 40% contained as Gulshan-Banani lake. In this survey, the sample from Gulshan have been taken 42.9% portion of respondanr ratio where Baridhara zone have covered 30.8% of respondents. The Gulshan-Banani lake is connected with Gulshan-Baridhara lake and have a strong ecological relationship. Though the Banani lake is not included as ecologically critical area, but it is necessary to study about this area and around 26.4% of data collection from this zone. The respondents are selected from the neighborhood area of Gulshan-

Baridhara lake i.e Gulshan-1 and 2, Badda, Shahjadpur lake, Hatirjheel, Cantonment, Baridhara to Kalachandpur, Banani, Korail-Mohakhali slum area. During the questionnaire survey, household sample has been collected from the family head. But in the absence of the household head, other responsible family members were selected for the interview. In some cases respondents like daily worker, migrating people, students, day labors, drivers, local member and representatives of different officials are selected as the respondent. A face-to-face questionnaire method has been followed. To fulfill the purpose of research methodology 4 Focus Group discussions have been taken in the study area.

IV. In-depth Interview

With a view to having a detailed understanding about the management issues and the policy development about the ecologically critical area an in-depth interview was conducted on experts, professionals, policymakers, public representatives and local elites using an open-ended questionnaire (see Appendix-2). The sampling technique was purposive. Some experts have been found out by snow-balling process. Snow-balling technique refers to finding the next respondent(s) by the information of a key informant. All the interview of the experts has been conducted face to face. In some cases like Department of Environment (DoE) or Rajdhani Unnayan Kartripakkha (RAJUK), heads and seniors have been given emphasized to take the interviews. In choosing Urban Geographer, planner and specialist, scientist, senior experts on the respective and authorities from related fields have also been given priority. Experiences on that relevant field have been kept in mind in selecting the rest of the respondents conducted for in-depth interview. Table 3.1 below shows a list of respondents conducted for in-depth interview-

Table 3.1: Respondents conducted for in-depth interview

SL.	Profession	Number of Respondents
1	Urban Geographer	1
2	Urban Planner of CUS	2
3	Architect and chairperson of URP Department of BUET	1
4	Executive Engineer of WASA	1
5	Executive General Secretary of POBA	1
6	Chairperson of POBA	1
7	Authority from management committee of BELA	1
8	Soil Scientist of department of Soil, Water and Environment (DU)	1
9	Botanist (Department of Botany, DU)	1
10	Executive Magistrate of Dhaka City Corporation (North)	1
11	PD, Executive Engineer from environment, climate , waste management and disaster circle of DCC North	1
12	Project Director of RAJUK	1
13	Project Manager of RAJUK	1
14	Assistant town planner URP-DTL of RAJUK	1
15	Executive civil engineer of WASA (sewerage and drainage system management)	1
16	Architect of Vitti Sthapoti brindo	1
17	Director general of DoE	1
18	Deputy director of natural resource management of DoE	1
19	Deputy director of DoE	1
20	Environmental activist of BAPA	1
21	Public representatives	1
22	Executive Magistrate of BCS (Administration) Cadre	1
23	Local social activists (Gulshan-Baridhra society and club)	2
Total		25

3.2.4 Secondary Data Collection

The secondary data were collected from various sources such as books, conference proceedings, journals, thesis, newspapers, photographs, albums, studies, office works of government, semi-government and non government offices to prepare a conceptual framework for the study. In order to collect the statistical data of the study area Bangladesh Bureau of Statistics (BBS) has been used as a data bank. Other materials and related information about the study topics is collected from the responsible authorities like RAJUK, DCC, WASA, DoE and other environment protection organizations.

3.2.5 Data Processing and Analysis

The collected data from household survey have been processed and analyzed by using SPSS software where as the data collected from in-depth interviews have been transcribed later for analysis and presentation.

3.3 Conclusion

To decide on an appropriate methodology is the approach to attain at the goal of this research work and to find out the answers of the research questions. In this research work it has the aim to control the degradation of environment quality and ensure the better solution. Sustainable Ecosystem Management is an enormous confronts to conserve the ecological process and the natural resources of Gulshan-Baridhara lake, in existing circumstances. To find out better policy guideline, it is indispensable to learn about all reasonable facts which create disturbances for the sustainability of the ecological development.

CHAPTER 4

SOCIO ECONOMIC AND ENVIRONMENTAL PROFILE OF STUDY AREA

The basic profile including the socio-economic condition of respondents helps to express the understandable attribute about research area and provide supports to find out the answer of research gap. The aim of this research is to find out the human activities and the causes behind those activities which are directly or insubstantially responsible for lake water degradation in the study area. The respondents have been selected from different categorized such as- very former to recent local residents, migrating populations, young aged people, visitors, working people of different economic classes and educational level etc. The general socio-economic profile of the respondents are conferred here-

4.1 Profile of the Respondents

At early sixties Gulshan-Baridhara zone was developing as new residential area for economically stable people. Many people have migrated in that area as climate refugee and scattered slum formation creates new account of settlement discrimination at the same land. In 1961 the residents or migratory people have owned their family property near the present Badda, Gulshan area. Baridhara was already built-up as residential zone at that time. In 1980's many families had settled themselves and built permanent settlements near the lake edges. Various vacant areas or cultivated lands were bought and settled by the new migrants and the government also acquired land and urbanized areas for settlement. As a result the new residents have been formed near the lake periphery and these areas have turned into a mixed land use zone. Many illegally grabbed land areas have been evicted due to the development and recovery of the encroached ground but the homeless population resettled themselves again in many ways. These huge and continuous growing of population pressure helps to increase the number of slum and many temporary housings near the Gulshan, Badda, Shahjadpur khal and Banani-korail ares. People are occupied in both Government, non-government organization and public-private sectors such as multipurpose offices, educational, social, economic and religious institutions, diplomatic and

embassy sectors, health organizations, industry, local bazaar to multipurpose shopping mall around the lake area. Some people have direct dependency on the lake to earn livelihoods from lasting and non permanent economic activities such as fisheries, boat sailing, collecting and selling household waste near the lake boundary, gardening and agricultural activities in the lake shore area and selling vegetables into market and so on. The neighborhood residents, migrating local and non local people are engaged in different types of economic activities such as day labor, rickshaw puller, driver of auto car and public transport to personal transport, household servant, retail businessmen, worker of nearest industries or shopping mall, boatman, workers of local housing sector, gateman, temporary worker of infrastructure development companies, permanent worker of neighboring political or non political organization.

To identify the basic profile of the respondents the study has attempted to find out the education level of the respondents. Great portions of respondents are literate and 32% of them are graduate as study reveals. They have provided the logical and relevant information about research questions. In generally they are getting the educational facilities from traditional method and some of them are occupied in vocational and special technical studies. Some of them hesitate to provide appropriate information because of their personal issues and they were confused of whether it is only for research purpose or not. Lack of better educational facilities and fragile economic condition has also been found out as the main cause of illiteracy. Some of them have dropped out from early stages of getting primary level education. To identify the basic profile of the respondents the household survey reveals the following information that is summed up in the following table:

Table 4.1: Basic profile of the Respondents

Criteria	Sub-Criteria	Percentage in 100%)	Remarks
Education level	Illiterate	16%	Gulshan-Baridhara is the zone where local residents have the opportunities of taking better education from surrounding educational institutions, though this matter is dependent on the economic and social status of the respondents and this is why the percentage of SSC/HSC and Graduate/MS
	Primary level	12%	
	Junior high level	4%	
	S.S.C/H.S.C	25%	
	Graduate / Ms	32%	

	Others	11%	is high.
Working Status	Employed	57.3%	Female and aged group respondents are involved in household work. The student group and rest of the population have tendency to be engaged in any work for temporary or seasonal manner.
	Unemployed	10.7%	
	Household Work	5.8%	
	Students	14.6%	
	Others	11.7%	
Habitat of the respondents	Study area	81.1%	The lowest living cost around the lake area, easy access to the land with other community facilities helps low income populations to live in study area and rest of them are the migratory population in daily affairs who are not living here but commuters for their economic activities.
	Other areas	18.9%	
Reasons of Migrations	Social inequality	21.1%	Lack of proper social and community facilities, misbalanced social status, economic inequality, loss of wealth and living properties due to natural disaster and in search of better living facilities people have choice and forced condition to migrate study area.
	Economic problem	28.7%	
	Natural disaster	40.3%	
	Better facilities in study area	4.6%	
	Others	5.3%	
Duration of living /working	1-9 month	2.5%	The respondent ratio is mixed with very early residents to recent local migrants to investigate several attribute.
	1-5year	17.7%	
	6-10 year	21.4%	
	15 year	30.2%	
	20+ year	28.6%	

Source: Household Survey 2015-16

4.2 Past and Present Condition of Gulshan-Baridhara Lake

After the liberation war an unplanned growth of urban area and settlement in the centre part of Dhaka city made the grounding of new urban plan. In early 1990s, a new plan was prepared by RAJUK with the assistance of UNDP/UNCHS. Dhaka Metropolitan Development Plan (DMDP) was finally prepared during 1992-95. Detailed Area Plan is one of the "Three tier plan" of DMDP. According to the Detailed Area Planning there are 26 Strategic Planning Zones (SPZ) to develop any specific area in a micro level .The areas of Gulshan, Banani, Baridhara and Badda are located in SPZ 6 and this zone is served by two commuter corridors namely Progati Sarani and Airport Road. Gulshan-Baridhara lake is the significant wetland ecosystems of our natural possessions which is originated at the centre inhalation zone of the Gulshan-Banani-Baridhara zone.

The study has attempted to explore the views of experts by conducting in-depth interview. To describe the past condition of Gulshan-Baridhara lake the Researcher and Soil Scientist of the Department of Soil, Water and Environment from the University of Dhaka said that-

"In 1960 there was a scattered settlement pattern originated at Gulshan –Baridhara area with spacious boundary. There was no illegal encroachment of surrounding land although lake water resources and free flow of water expressed with crystal clear appearance. In 1977 the lake was not connected with Badda and people came to visit lake bank area as picnic spot. Actually lake was a better way of transportation. In 1980 there were few two-stored residential buildings formed for the elite people"

According to the Assistant Town Planner (Urban and Regional planning specialist DTL-2, 1981 to 1994) of RAJUK the previous improvement of lake water boundary is as follows-

"At the earlier period of 80's the Gulshan –Badda area was developed by the excavation of the lake which causes the pollution and the process is still now continuing. The earliest Gulshan-Badda-Banani areas were very low lying, jagged and undeveloped in condition and so that the southern part of the lake were dogged out. The present Gulshan-Banani-Badda residential area has originated throughout this way, although the Baridhara area was previously subsisted."

The Focus Group Discussion (FGD) of local residents has given views about the area of present Gulshan-Baridhara lake. A member of FGD who is a local worker of Badda pointed out that-

"Gulshan-Baridhara was a low land area in 1981. The surrounding lake area of Badda khal, Begunbari khal, Gulshan-Banani-Mohakhali lake were connected and obtain the instant storm water. The Gulshan –Baridhara lake boundary was extended from present Gulshan Shooting complex to the Kalachandpur area and the lake was used for boat transportation. Numerous small tents were built around the lake bank portion and the migrant population makes re-settlement though they were evicted from time to time".

After 80's the huge population increased around the lake surrounding area which leads the extreme level of pollution and the illegal growth of slum. The internal migrants have chosen this area to be settled due to lowest cost of living in the new slum areas. Some people try to grab open land with long time vision and they have continuously throw garbage to specific points around lake shore area. As a results many vacant land have fulfilled with the chunk of waste materials and then they have made a tea stall or small shop on it. This was the easiest way to take hold of any release land. Open vacant land was grabbed unlawfully by socially and politically empowered group of people to rent small tent which are turned into small corrugated or tin shaded hut housings. A member of management committee of BELA said that–

"The climate refugees who have easy access play an active role to develop illegal settlement around the lake boundary. These huge populations make demands on the natural resource of the lake and so it is very necessary to make sure improved resettlement amenities to manage the contamination".

Regarding the origination of the lake bank side encroachment, the chairman of POBA opined that-

"Many rootless people have achieved the authorization to build settlement with the help of politically powerful group of people. The actual tendency to throw garbage day by day was to control that ignored land zone with a vast goal in future. They have planted a tree on that polluted area as the starting of the infringement and continuing the process through making

small tea stall, local shop to a big bazaar and thus gradually grab the land. The growth is very much similar to the growth of fungus".

To illustrate the role of RAJUK as the development authority of the project for Gulshan-Baridhara lake, the project director of RAJUK said –

"In 1994 High court has given the direction to conserve the Gulsha-Baridhara lake as a low laying land area and RAJUK has initiated the project. Controlling the pollution, ensuring the better water quality, developing walkway, conserving the lake park area and managing the environmental balance was the core duty of that project. Subsequently the Banani development project was planned upon the same goal and after 4 year in 1998 the project was started ".

The expert interview also reveals that the lake was connected with the Balu river and the polluted water passed through the backside of Hotel Radisson to the area of Baridhara DOHS, Navana Headquarter and finally reached at the Kalachandpur zone. The northern part of Dhaka city such as Banani Railway, Grave yard and culvert area was connected with the toxic waste water of gulshan lake and when the lake being polluted the contaminated water passed under the Banani decorator and one chain of that polluted water go by the Karail slum area, Bangladesh Telecommunication Office and Badda-Shajadpur area.

Figure 4.1: Connection of polluted lake water under the drainage of Banani railway area
Source: RAJUK-2014

The local residents and respondents have also expressed their perception about the past and present condition of the study area. Around 51% of them have given their opinion that the past 5 to 10 years the condition of the lake was not satisfactory. They have claimed that the Gulshan-Baridhara lake area has been changing day by day due to manmade activities. The present condition of lake water environment is not well enough. The study ranked huge population pressure, the ignorance for the conservation of the lake water environment and the improper management of ecological balance as the major causes for dilapidation of the physical environment.

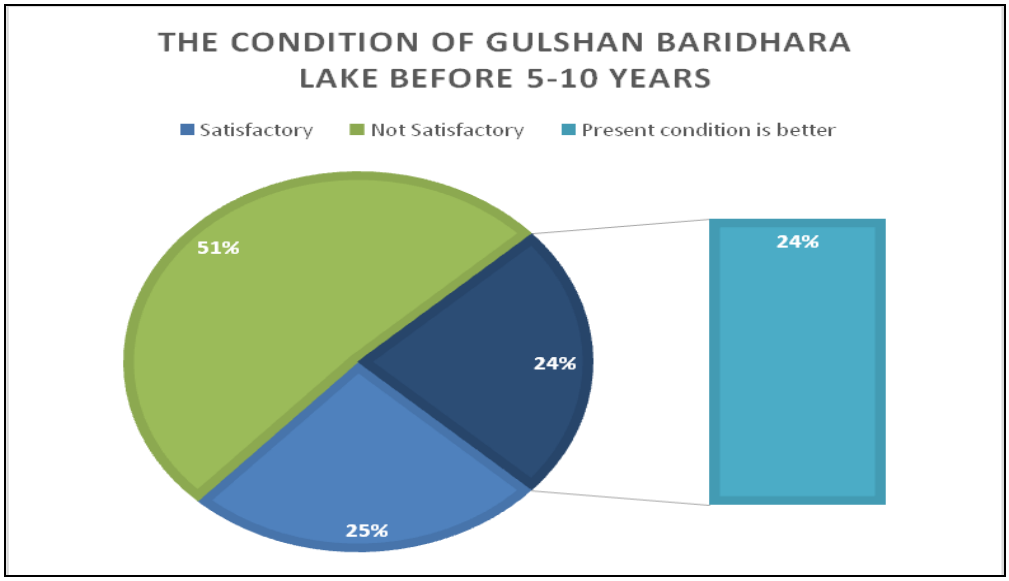

Figure 4.2: Condition of Gulshan-Baridhara lake before 5-10 years
(Source: Field survey, 2016)

Illegal occupation of the lake side land, open dumping of domestic waste, haphazardly throwing of garbage from local market or industries in and around the lake area, incessant generation of rubbish from daily household works are not properly disposed off in local collection bins and even these are always found scattered around the dust bin. The lake water is odor full, waste materials are floating on the lank. The level of pollution is being so high and consequently the threats of lake water fisheries, the small fungi and bacteria are in a high risk. Many deceased animals like poultry, fish, pet animals such as dog, even cat are visible in floating on the polluted lake water. The vegetation coverage is also being a reduced amount of than the past due to the

encroachment of the lake area. Only few of the respondents have positive appearance about the past and present condition of the lake area. About 25% respondents have gone with this opinion that the local responsible authority and governmental authorities have taken proper steps to improve the lake water environment. Many of them are biased with the local political power and many of them are the local representatives of conscientious authority. Some of them think that the ongoing development project is developing the present condition in more satisfactory manner than the past situation and they have contained around 24% of the total percentage.

4.3 Previous Major Environmental Issues in the Study Area

Gulshan-Baridhara lake is an imperative non-natural lake in our city. According to the urban morphological study of Dhaka city in space syntax analysis (Ahmed et al*, 2014)* study it found that this capital city has grown in size, scale, and area as the urban function of this city evolved and altered according to its political and commercial status. The research also has shown that, space syntax is performed to recognize the global-local incorporation, connectivity, and the spatial relationship between different syntactic measures in relation to the changing pattern of urban settlement patters. The morphological analysis helps to explain the development pattern of urban spaces as well as the significance of street network, both locally and internationally. In according to this study it is identified that the urban development pattern in the Gulshan Baridhara area have been extending with the growth of population and the land utilization pattern makes the lake surrounding area more and more shrinkage. The following map is showing the settlement pattern of the study area with time difference. In ward 19 it is identified that a figure of planned settlements which are slightest connective and incorporated with the local and worldwide roads. In ward 18 there is a mixed settlements stretch out in connecting the organic and mixed settlements. The lake surrounding settlement growth is increasing with planned manner at the earlier period but with the change of time the excessive demand for land and housing many portion of the lake is being encroached by local and social people and organizations. This unplanned growth of population and settlement make changes in the lake water environment. The lake was started from the Gulshan shooting club at the earlier stage. At present the shooting club area have turned

into a commercial zone where the maximum land is filled for the urban development and the lake boundary become more slender.

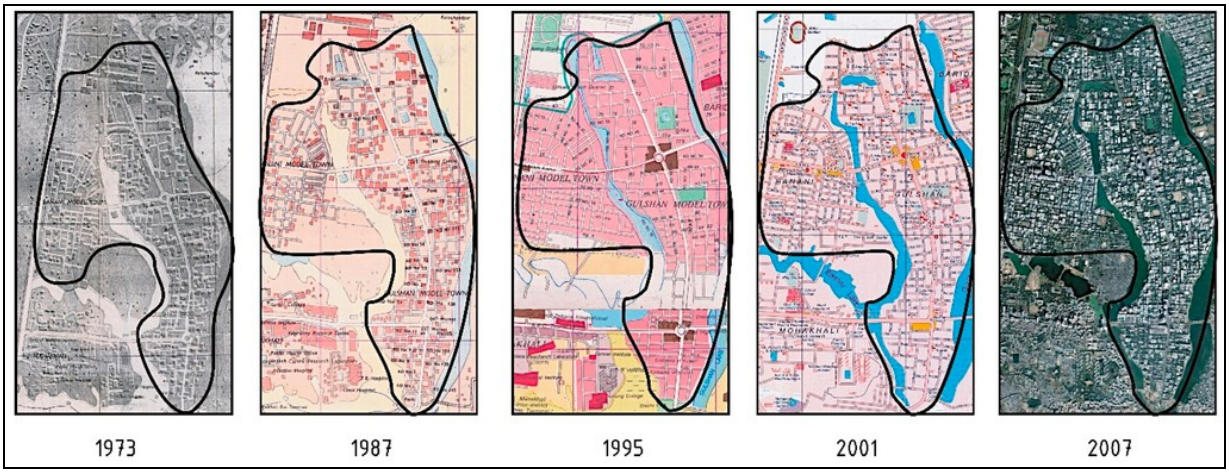

Figure 4.3: Base maps of ward 19 (Gulshan) for syntactic analysis (not to scale).
Source: Survey of Bangladesh and Google Earth Image, 2007.

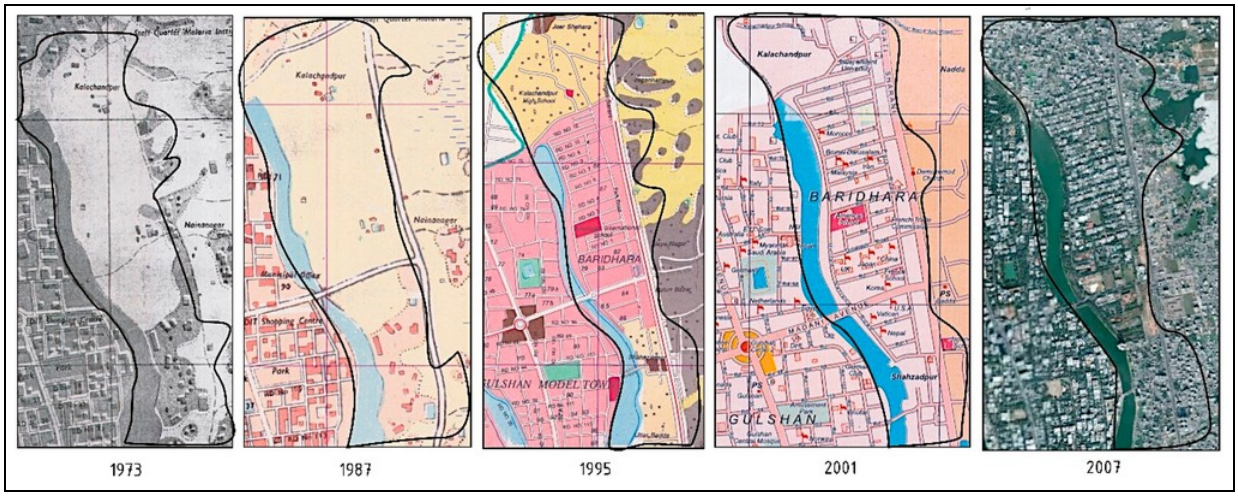

Figure 4.4: Base maps of ward 18 (Baridhara) for syntactic analysis (not to scale).
Source: Survey of Bangladesh and Google Earth Image, 2007.

4.4 Major Issues before 5 to 15 Years Responsible for Changing Lake

Ecosystem is the functional unit where humans play an integral part. The lake water ecosystem of Gulshan-Baridhara area has also an influence of manmade activities to control the general ecosystem services. The lake is situated at the pose area but the local increasing slum populations have a great dependency upon the lake water which causes the serious water pollution and loss of natural balance in and around the lake water ecology and environment.

According to household survey it is found that the study area is being used and encroached by many development activities like formation of housings and other community facility centre which have created a life threat for the aquatic resources. Many portion of the lake area has already been leased by the powerful group of people. The household survey identified the major environmental issues responsible for changing the condition of lake before 5 to 15 years. The percentage of improper drainage and sewage system is high that may be for the gradual increase of population surrounding the lake area. 50% of the respondents said that people around the lake consider it as a dumping site and thus throwing waste and consequently polluting the lake. The findings are summarized in table below with their percentage found from the household survey and each issue has been described separately with the views of the experts that have been found from conducting the in-depth interview:

Table 4.2: Previous major environmental issues in and around Gulshan-Baridhara lake

Previous Major Environmental Issus	Percentage (%)
Improper drainage and sewage system	70
Throwing waste in lake water	50
Bad odor and polluted water	46
No transport facility in lake	45
Destroying lake boundary	30
Formation of new shop, market, hotel and house	30
Threat for plant and animal	17
People sell water hyacinth from lake	9

(Source: Field survey, 2016)

(Note: Multiple responses are considered)

4.4.1 Improper Drainage and Sewage System

Gulshan –Baridhara lake area had huge vacant surrounding lands which are being used and encroached day by day. With the increase of new settlement pattern in both planned and unplanned manner there is an increasing needs of sewerage and drainage system. In actual figure most of the housing have poor drainage system which are directly connected with lake water with many hidden underground pipe. Several planning have been taken by the responsible authority but still now this problem is yet to be solved which causes serious environmental problem. Direct release of untreated sewage and open dumping of solid wastes into the lake are the main cause of water pollution. Increasing level of pollutant materials in the lake water is happening due to the improper management of sewerage and drainage system .

Figure 4.5: Hidden sewerage pipe connecting with Baridhara lake
(Source: Field survey, May, 2016)

4.4.2 Throwing Waste in Lake Water

The Gulshan –Baridhara lake is surrounded mainly by residential areas with many industrial and commercial units. People who are living in that area have fewer tendencies to dump household waste in a proper way which leads serious water pollution. In every day many people visit the lake boundary area as recreational purposes and they throw away the plastics, empty packet of chips or foods, bare canned of drinks, cigarettes, used tissue papers and so many garbage in

anywhere of the lake boundary. Open dumping of industrial and hospital waste is responsible for air, water and soil pollution also.

Figure 4.6: Open Dumping of waste materials at Gulshan lake

(Source: Field survey, May, 2016)

4.4.3 Bad Odor and Polluted Water

Gulshan-Bridhara lake is declared as Ecologically critical area and water pollution is one of the main causes to devastate the quality of natural and ecological balance. The lake water is full of polluted environment with dire odor. The main reason of this problem is haphazardly waste dumping and peoples' habit to throw garbage in and outside of the lake. Nonstop household solid and liquid discharge through the hidden sewerage and drainage connection into the lake water have active role to decrease the level of DO (Dissolve Oxygen).

4.4.4 No Transport Facility in Lake

During 1980's the lake had a wonderful environment for transportation in the waterways and many people enjoy their leisure time to fish cultivation and they liked to do fishing from this lake. Boat riding was a continuous way of transport from Gulshan 1, Shajadpur, Badda to Kalachandpur portion of the lake edge near Baridhara. The area of Mohakhali and Banai lake was also included where at present people are engaged in boating as a local business. Many

people were dependent on boating to earn livelihood. Now these group of people and their generation become unemployed and leading a helpless life.

4.4.5 Destroying Lake Boundary

Unplanned growth of settlement and commercial zone around the study area has been creating excessive pressure on the land area. Many portion of the lake boundary are being destroyed now due to the illegal formation of housings without maintaining the actual plan of responsible authority. Lots of new high rise buildings have been formed without following the building code act and construction design. A local representative of a housing development organization said- *"At present it is very difficult to make a good planning to build up housings and construction work because many owners have illegal affinity and request to increase their housing boundary which creates conflicts with the architectural design. Good planners and architects always follow the rules of RAJUK but some of them have ill mentality to earn more and pay no attention to the conservation of the lake edges".*

4.4.6 Formation of New Shop, Market, Hotel and House

Formation of new shop, market, hotel, settlement and offices in the region of Gulshan-Baridhara lake is a common phenomena. It creates great challenges for the conservation of biodiversity. The continuous construction development makes the soil polluted and non fertile and consequently the vegetation coverage is being lost. The common birds and animals which were dependent on the soil of lake edges and lake water ecosystem are facing difficulties to survive. Around 30% of the respondents said that these problems are acute now compared to 15 years back when the lake area was not very narrow.

Figure 4.7: Continuous construction work near the lake boundary causing the threat for sustaining biodiversity; (Source: Field survey, June 2016)

4.4.7 Threat for Ecosystem

Gulshan - Baridhara lake has already been identified as an ecologically critical area due to the increasing vulnerability and loss of natural balance which create a big threat for the living ecosystem. In the recent past it was a wonderful wetland for the gathering of various birds and animals. The lake area was a wide green space and splendidly enclosed with many types of crops, vegetation, medicinal and herbal plants. At present it is very difficult to find out natural beauty instead of artificial practice of lake development. From the interview of a resident living in this area for a long time said that-

"*During 1980's to 90's many species like fish cock, green parrot, guinea snake, mongoose, Raj hass, egret, conch and other rare fishes were found in the lake area. They are extinct now with the increase of the man made development around this area and areal shrinkage of the lake boundary. Tremendous pollution is the key factor for the extinction of these biodiversity.*"

4.4.8 Selling Water Hyacinth from Lake

The flora and small grasses are the necessary part for the ecosystem of the lake water eco cycle. Water hyacinth is also a common lake water element which plays an important role to protect the underwater fauna, small insects and fishes because it works as treatment plant against the domestic waste water. Some local poor and migratory ferryman people collect and sell these water hyacinth, small grasses and plants which destroy the natural quality of water to keep freshness. Around 9% of the respondents have given their opinion that this event makes the water level dull and odor full.

Figure 4.8: Illegal collection and selling of water hyacinth or lake side plants by passersby at Baridhara lake side area.

(Source: Field Survey, May 2016)

4.5 Dependence on Gulshan-Baridhara Lake

Gulshan Baridhara and Banani lake is one of the important veins of Dhaka city. The lake is being lost due to the excessive pollution and illegal encroachment by the lakeside inhabitants. The lake water is turning dark in color which indicates the presence of pollutant materials. The infrastructure development of the surrounding area has been done by land filling of lake water and as a result during rainy season the lake cannot hold and recharge the overloaded water. The construction of amphitheater, open ground for public gathering, roads and new settlements by

using concrete and bricks makes the lake area narrower for water retention capacity. As a result the lake has been losing the natural capability to keep the ecological stability, mitigate the problem of water scarcity and water logging in the northern part of the capital city. An Executive Engineer of RAJUK said,

"The social activities are not currently occurring around the lake area and very few portions are utilized by local residents. Baridhara zone are mainly used as service corridor. People can use the walkway for jogging or morning walk. Badda and Karail area are used as informal Nouka ghat. People indeed have less interest to depend on the lake and lakeside area."

Regarding the use of Gulshan –Baridhara –Banani lake water the Deputy Director of DoE said,

"Gulshan-Baridhara and Banani lakes are interlinked and the imprudent use of the slum and urban dwellers makes the lake polluted. Most of the poor people are using lake water for daily household affairs despite knowing it to be unhygienic. Local businessmen from roadside temporary bazaar are using lake water to clean raw vegetables and also use it as a dumping zone instead of using dust bin. They should change their mentality to stop these situations".

4.6 Reasons of Dependency and Non-dependency on the Gulshan-Baridhara Lake

The field survey identified that the total lake area is not used in a proper manner. Unauthorized formation of tea stall, nursery, small clay pottery shops, temporary and isolated vegetable or fish market have been found near Shahjadpur, Badda to link road, Merul Badda to Gulshan 1 and Banani link road area. Illegal car parking and rickshaw stand zone have been rising because of peoples' dare to break the rules and mismanagement of the responsible authority. The household survey attempted to explore whether they use the lake or not. 68.9% of the respondents do not use the lake where as the rest 31.1% of the respondents are directly using the lake or its water.

Figure 4.9: Unauthorized clay utensils shop near Gulshan lake

Respondents have given their opinion that they are using the lake water or lake boundary. Some people don't think that it is not disinfected; rather they are using the lake water as the earlier family tradition. They have been using the water for household work like washing cloths and utensils, cooking purposes, bathing, boat riding and so on. The group who are working in car or rickshaw garage can use the lake water to clean their vehicles. In the neighboring bazar of Shajadpur lake area a shopkeeper said that,

"Lake water is used to clean the vegetables. There is no slaughterhouse in the bazar and so we have to use the lake water for the processing of raw meat".

Figure 4.10: People cleaning household materials in Shahjadpur lake area.

(Source: Field Survey, May 2016)

Some portions of the lake area have been taken lease by private and powerful authority for fisheries and as a result they also have dependency on the lake. People also have a choice to use the developed walk ways such as students, children's and job holders for going to educational institutions and offices. Other aware group of people have no dependency on the lake water. Around 68.9% of them have no willingness to use the lake water and the surrounding land area in illigal manner in anyway due to the extreme level of pollution and unplesent condition of the lake water. In according to this survey it is also surprisingly identified that some people have strong disagree to express anything about this research queastion. Some of them only explained that it is very personal or they have no permission from the head of the family to say anything about it , even they wanted to skip the question during survey. Very few of them have given the information that they are engaged in lake development related economic activities and that's why it should not be revealed for their security.

4.7 Impact of Lake Water Utilization

Gulshan-Baridhara lake was considered as the centre of life for the city dewellers of capital city. The lake have the capability to conserve the biological diversity which is now turned as the ecologically critical area due to various damaging activities of human beings. Regarding this survey it is identified that people are using the lake water for different unnecessary and improper work without considering the sustainable improvement of the lake environent. They have no care to protect the lake rather they think that it is their legal right to use the lake in accordance to their wish.

Around 49% of them have expessed that the use of lake water by them is causing no harm and thus no impact is happening at all. Some of them have the tendency to avoid their role to protect themselves from any difficulties. People who are not dependent on the lake have also given the reaction that as they are not using the lake that's why they have no role to create any negetive impact. A large number of people in around 51.1% of the respondents said that they have an active role to the negetive change in the lake water environment by their utilization. Many of them acknowledge that it brings harmfull results but they have no alternative way to mitigate this problem.

4.8 Present Environmental Issues of Gulshan-Bridhara Lake

Lakes are the natural resource for any city which helps to maintain the relation of artificial environment to the natural environment with a well steadiness. Gulshan-Baridhara lake is the man made urban wetland of Dhaka city, have a great ecological value along with the territorial importance for recreational purposes. To fillup the research gap, it is a very important step to recognize the types and factors of different environmental issues which are responsible for creating ecological imbalance. Ranking is one of the required technique to get out the level of respondents awareness and experts opinion about the current ecological issues. In the table below two types of ranking have been measured. The second column shows the response from household survey where as the thired column indicates the ranking of the respondents from in-depth interviews.

Table 4.3: Ranking of present environmental issues in Gulshan-Baridhara lake

Present Environmental Issues	**Ranking by respondents**	**Ranking from in-depth interview**
Water pollution	1	1
Inaffective waste management	2	2
Enchroachment of land	3	4
Reduction of wetland area	4	5
Loss of ecology	5	3
High population pressure	6	9
Unsustainable urban planning	7	7
Inappropriate community facilities	8	10
Lake of proper management	9	6
Others	10	8

Source: Household Survey and In-depth Interview, 2015- 2016

According to this ranking the most serious environmental issue is the polluted water. Respondents of both category thinks that it is the leading issue which have a great influence for the damages of ecological balance in Gulshan-Baridhara lake.

The open dumping of household and industrial waste and direct discharge of strom water into the lake accelerates the ineffective waste management around the lake area. Both group of the responses have a common choice for this criteria in the second position. They think that this is one of the major issues that help to increase the level of pollution in and around the lake area.

In according to the household survey the encroachment of land is identified as the thired ranked issue. It is also acknowledged that local respondents have seriousness about the illigal land grabbing which makes the lake boundary narrower. The experts have given priority to the loss of ecology rather than the land grabbing and so they ranked it at number three.

Most of the household respondents have the opinion that reduction of wetland is a present problem having an extensive impact on the lake water ecology. Continuous construction work is responsible for the decline of lake boundary and they focus the problem in number four in ranking. On the other hand experts, stake-holders or proper authority have given preference to the illigal encroachment of lake land area as number four in ranking. Reduction of wetland area is ranked in number five from the in-depth interview where loss of ecology is considered as number five by the household respondents.

The local resident have an experience that the increasing population and their continuous dependency upon the lake water and the surrounding environment is a guide to the present fragile condition of Gulshan-Baridhara lake. They have given this criteria at number six in the ranking. But the otherwise picture was found from the experts because they think that proper management can mitigate the problems of high population pressure and that's why they have chosen the category at number nine.

The in-depth interview explores the lack of proper management by the reponsible authorities. They ranked it at six in number. Many of them claims about the improper role of the

management team and some of them have blamed to each other. In case of household review this criteria is not focused at all. They have chosen the rank for it in number nine.

Both group of respondents mostly in number have decided that unsustainable urban planning is a present problem that can be ranked in number seven. Inappropriate community facilities is eighth position by local residents where the other group have selected them as number ten in ranking.

The lower deepthness of water level, high pH level in water, loss of soil quality, less flow of water, changes in water color, loss of vegetation coverage, extinction of rare biodiversity near lake side area, evidently presence of floting pollutants, chemical discharge in lake water are the other identified environmental issues that have been found through the field survey.

4.9 Gulshan-Baridhara Lake: An Ecologically Critical Area

Gulshan-Banani-Baridhara was a low lying zone, developed as artificial wetland to ensure the areal environmental progress, increase natural beauty and provide good environmental benefits to the urban dwellers of Dhaka city. During 1962-1967 the area was used to cultivate crops like rice and cereals. After the liberation war the trends had changed and the areal development happened to turn a new formation. The protection of the private land area was considered in focus by the Gulshan society and they wanted to conserve that low lying private parts of the land. The project director and caretaker engineer of RAJUK sketch out the preliminary development project of Gulshan-Baridhara lake and he said,

"For the period of 1994 the introduction of a new word had started as "lake" by the activities of Gulshan society. They had taken the steps to preserve the low down area of Gulshan-Baridhara area and also applied for the direction of High Court. RAJUK got the direction from High Court in 1994 to conserve the area as lake region. According to this direction RAJUK has taken the "Gulshan-Banani-Baridhara Lake Development Project" to protect the lake boundary, ensure good water quality, create walkways and maintain the environmental balance. The layout plan of the project was prepared in 1998 and the final proposal was ready in 1999. The project was finally approved in 2010."

The project has taken a long time to be approved and by this time the lake area started to face the serious damaging situation. The lake area was in progress to use as the drainage outlet from the surrounding residential area. The Baridhara area was not included in Dhaka WASA sewerage system and as a result the lake water pollution becomes the intolerable headache for the residents, environmentalists and urban planners. The City Corporation is another responsible authority to keep the environment clean and healthy but it was not going well due to the irresponsibility. The lake was turning out to be a well known waste dumping zone of the north Dhaka. The aesthetic beauty of the lake was destroying also. Mainly the lake was losing the natural quality of the ecological balance. In this adverse environmental condition the lake was declared as the "Ecologically Critical Area "in 2001 by Department of Environment. Regarding the declaration of Gulshan-Baridhara lake as ECA, the director general of DoE said,

"Evidently it can be said that the lake is trailing the natural capability as lentic ecosystem. Lake water ecosystem has two types of function such as working like pulling agent and ensuring natural beautification. But in reality the Gulshan-Baridhara- Banani and even the interlinked Begunbari lake to Dasherkandi area the water quality have been losing the physical function and the life supporting capacity. According to the public interaction and direction from High Court DoE have declared Gulshan-Baridhara lake as ecologically critical area with the gazette notification from the concerned ministry. We have made the management guideline for Bananai lake area though this part is not directly declared as ECA through gazette notification. DoE will be thinking to state Banani lake as the part of ECA in upcoming gazette notification."

Respondents Concern about Study Area as ECA

Gulshan–Baridhara lake is being contaminated and the biological quality of lake water is degrading day by day. Continuous land grabbing, land filling, direct disposal of waste water to and fro into the lake, construction work all the year round, disconnectivity of the natural route of lake water flow, water logging are the severe ecological issues that have been clearly identified. The responsible governmental authorities like RAJUK, DCC (North), Dhaka WASA, DoE have the accountability for the management of this ECA area. The Department of Environment has permanently displayed the governmental declaration by sign board. The non-governmental self motivated management authorities are like Gulshan Society, Baridhara Society, Gulshan Youth

Club, Gulshan Health Club, Gulshan Ladies Club, Gulshan Amateur Fish Hunting Association, United Hospital authority have also hanged up awareness building sign board in lake side area to make people concern about this problem. But many people don't even see it or ignore the notification in according to their wish. Majority percentages of them have no clear idea about the term "Ecologically Critical Area" rather they feel that it is very rampant topic to them. Around 57.3% of the respondents have given answer that they don't know anything about the concept of ecological imbalance in the Gulshan-Baridhara lake. The temporary workers, migrating people, visitors are included in this group. People from the slum areas of Karail-Mahakhali,Badda-Shahjadpur lake side area have lack of knowledge about the research topic. A construction worker and resident of Gulshan-2 said about the concept of ECA that,

"We don't think that the lake is facing serious environmental problem. It is a common factor that any natural water resource will be used by the surrounding residents and lake have the own ability to restore the water in natural way. Sometimes people from governmental organization have come here for development work but we do not listen anything like the term "Ecologically Critical Area"

It is also a surprising matter that many educated and working group of people have no apparent idea about the shown notification or even about the declaration of the government and their percentage is around 58. Some of them have simple confession that they don't have seriousness about this current problem; rather it is not their responsibility.

Around 27.4% of the respondents said that the term ecologically critical area is very well known to them. They are aware of the present degrading environmental condition and they think that the government should be serious about a sustainable management. These groups of people have taken part in the several seminars, meetings by responsible authorities and even many of them have strong activities into awareness building program. The students, young aged people, permanent residents and employees, members from different governmental and social organizations, social activist and workers from government development institutions are included in this group. The rest 15.3% of the respondents has no specific opinion about the ecologically critical condition. They have no comments for the answer of the research question.

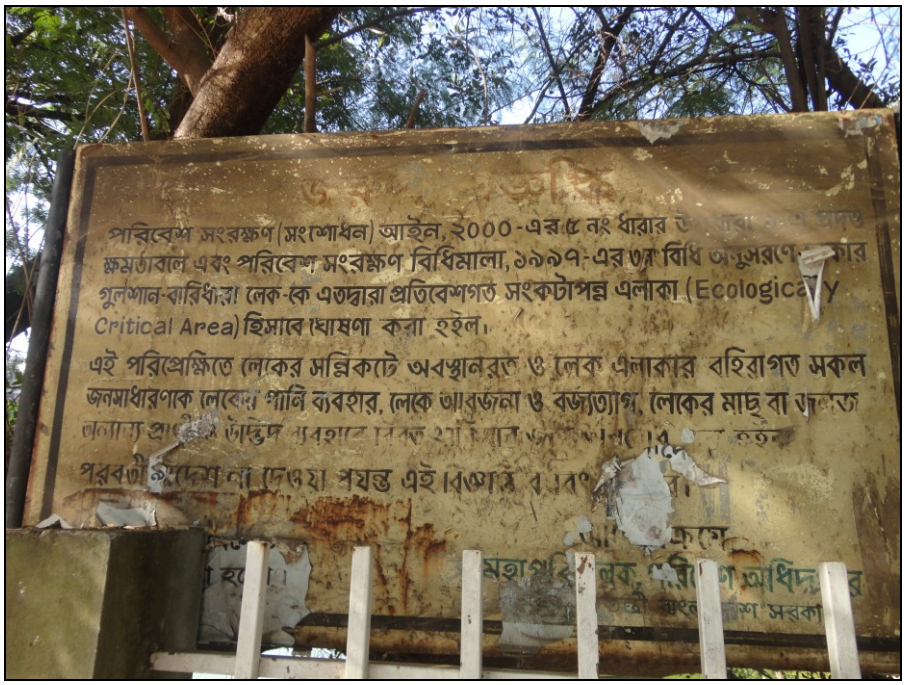

Figure 4.11: Governmental sign board of ECA declaration by DoE in Gulshan-Baridhara lake side area. (Source: Field Survey, 2016)

Figure 4.12: Official notification (left) and awareness building sign board (right) by Gulshan society in Gulshan lake side area.

Source: Field Survey, 2016

4.9.1 Major Ecological Issues and Impacts

Bangladesh is the country having the favorable condition for wetland. The man made wetlands have an extensive ecological, social, cultural, trade and industrial values in our country. Gulshan-Baridhara lake is the simulated lake of Dhaka city having great influence on the flora and fauna of the lake water ecosystem. Dilapidation of lake water environment caused several harms such as extinction of wildlife, reduction of vegetation coverage, loss of different types of native aquatic plants, herbs, shrubs and weeds, indiscriminate regulatory of water flow, loss of soil quality, loss of natural capacity to reserve excessive rain water, extinction of species and the habitats of fish diversity and so on. Gulshan-Baridhara lake was declared as ECA in 2001 but the lake had started facing environmental pollution after 90's.

Department of Environment has declared the lake as ECA according to the Environmental Conservation Act 1995. According to the act ecosystem means the inter-dependent and balanced complex association of all components of the environment which can support and influence the conservation and growth of all living organisms (Bangladesh Environmental conservation act, 1995, Clause-g). In reality the inter dependency, evenhanded and complex association of all components of the environment is absent in the present condition of Gulshan-Baridhara lake. To conserve the lake in a natural way, make out a sustainable policy guideline and to stop the obstacle related with ecological loss DoE has acknowledged the verifications of the ecologically critical problems. DoE has also identified the spatial boundary and made the Mouza map of ECA by SPARSO. According to the field survey including the household survey, FGD, in- depth interview the major ecological issues of the Gulshan-Baridhara lake have been recognized and all are discussed below.

High level of Pollution

According to the Environmental conservation act 1995 "pollution" means the contamination or alteration of the physical, chemical or biological properties of air, water or soil, including change in their temperature, taste, odor, density, or any other characteristics, or such other activity which, by way of discharging any liquid, gaseous, solid, radioactive or other substances into air, water or soil or any component of the environment, destroys or causes injury or harm to public

health or to domestic, commercial, industrial, agricultural, recreational or other useful activity, or which by such discharge destroys or causes injury or harm to air, water, soil, livestock, wild animal, bird, fish, plant or other forms of life; (Clause -b). The pollution is the first categorized environmental issue of Gulshan-Baridhara lake. Indiscriminate discharge of domestic sewerage from the hidden and direct drainage connection from the surrounding planned urban residential and slum area is the key factor to join pollutants in the lake water in a very easy way. Open dumping of solid waste, unsystematic effluent disposal from the lake nearest industries and institutions are creating the high level of water, soil and air pollution of the lake area. Degradation of water level, leaching of pollutants in the ground soil level, change in geo-chemical composition in ground water level, declining the standard amount of dissolve oxygen in the lake water, degradation of water reservation capacity and free flow of water, presence of contaminant materials in the soil particles, odor pollution are the ecological issue strongly related with increasing pollution.

Figure 4.13: The air and water pollution in and around Gulshan-Baridhara
(Source: Field Survey, March 2016))

Direct Connection of Sewerage and Drainage line

After 1980 the huge growth of population demands more settlement for the growing people. The development of Gulshan Model Town and the formation of numerous slum houses had formed in an unsustainable manner. Many residential and other institutional housing have no planned sewerage system. According to the "Identification of the sources of storm sewerage line report -

2014" of RAJUK it have been recognized that the sewerage line is directly connected from the following area-

1) Mohakhali D.O.H.S and Dhaka Cantonment area to southern part of Banani NAM vila.
2) Dhaka Cantonment, banani D.O.H.S to Neval area .
3) Baridhara D.O.H.S, Golf Club and Surrounding zone.
4) Direct sewerage line from Mohakhali-Karail to Badda area into the lake.

Due to the direct connection of sewerage line, hidden and open position of temporary hanging toilet in lake surrounding slum area, the lake water is being polluted. Many portion of land under BTCL, Public works and Ministry of ICT has numerous slum houses. The illegal connections of electricity and water line from these slum areas are connected under the lake water of Gulshan area and as result the line diversion process became tough by RAJUK.

Figure 4.14: Picture showing the direct sewerage connection in the Gulshan 1 (left) and Gulshan-Banani (right) area (Source: Field survey, April 2016)

Though it was the responsibility of DWASA to take proper measure about these problems but the actual picture is totally opposite. DWASA have taken the initiatives to sewerage and storm line diversion from Badda –Baridhara zone into the Shajadpur lake and Hatirjheel area but it was not successfully done. The executive engineer of WASA has given a self-defended expression about their role. He said-

"The present water quality of Gulshan-Baridhara lake is comparatively better than earlier stage. WASA has disconnected the illegal sewerage and drainage connection from the lake. We have taken the challenges to ensure clean water but it is difficult to control problem in slum area. Huge population pressure and their hide and seek tendency of connecting water and drainage line in illegal manner is the main obstacle for us. The permanent relocation of that population will help the eviction process."

According to the report of WASA they have taken the project of building storm sewerage line, formation of drainage and set up of manhole cover in the Gulshan-Bridhara lake area. The project was approved in the meeting of ECNEC on 2nd November 2010. The project was administratively declared by the local government in 9th November 2010. The total cost of the project was 4949.00 lakh taka and the project implementation duration was fixed in between 2010 to 2013. The main aim of the project was to build up 750 mm diameter to 1830 mm diameter pipe drainage and total 15 km coverage of sewerage line around the Gulshan-Baridhara area. Another plan was to set up total 750 number of manhole cover supply to control the high level of water pollution. According to this project the sewerage line and manhole distribution pattern was as follows-

Table 4.4: Sewerage distribution by WASA in Gulshan-Baridhara lake area

Diameter (mm)	Length (km)	Number of manhole	Area of sewerage coverage
1830	0.913	30	Gulshan shooting club to Gulshan circle-1
1680	1.282	41	Gulshan circle-1 to road no-116
1524	0.975	30	Road no-116 to Saudi embassy
1370	0.228	8	Saudi embassy to City corporation region 5
1200	0.465	23	City corporation region 5 to 88

			number road
1050	2.55	127	88 number road to United hospital and Baridhara
900	3.833	212	Shahjadpur, South Badda, North Badda, Middle Badda
750	4.754	243	Shahjadpur, South Badda, North Badda, Middle Badda
Total	15.00		

(Source: WASA, 2015)

The project become lengthy to full fill the main aim due to the uneven cost rising, change in the selection of diameter of the sewerage pipe, penalty cost for the reformation of roads by DCC and for many other reasons. As a result WASA extended the time of implementation in 2014 but the output is not so satisfactory. Still now in many portion of the lake area have the direct connection with open sewerage line which makes the lake water seriously contaminated.

Open Dumping of Waste

Open disposal of solid and liquid waste into the lake water is another important fact for water quality degradation in the study area. Many hanging toilets are turned out by RAJUK but some hidden hanging toilets are still now present in the Badda, Karail slum area. The rickshaw puller and passerby sometime use the lake side for toilet purposes which creates an unhealthy environment.

The adjacent industrial units have played active role to waste dumping in the lake. In the Tejgaon-Hatirjheel, Kalachandpur area, the industrial waste disposal ratio is very high. In the following diagram the ratio of the respondents have shown about their choice to find out the causes for the open dumping of waste.

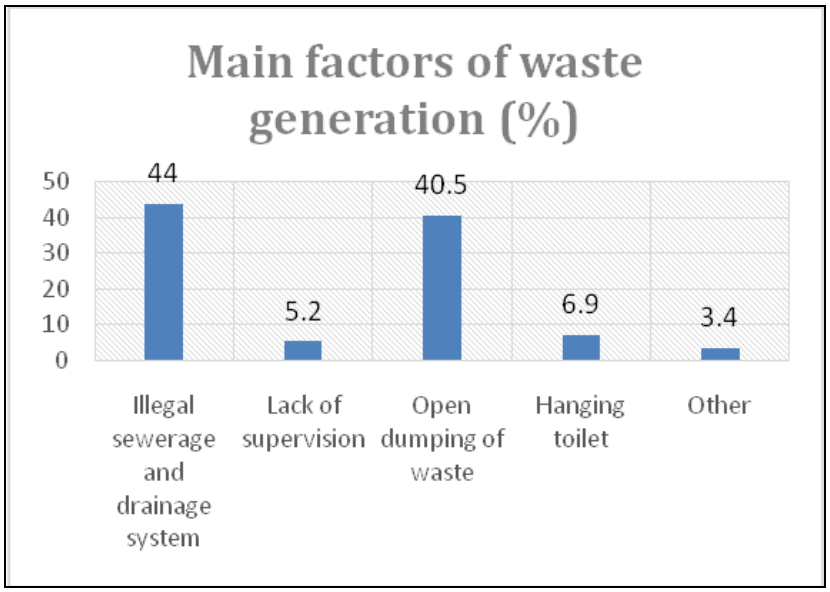

Figure 4.15: Factors of waste generation (Source- Household survey 2015-16)

The throwing away of household garbage is turned into a common habit of the residents of Gulshan-Baridhara area. A local residential guard said,

"The owner and servants of the housing area have no willingness to use any specific dumping bin rather they gather all the waste into plastic packet and throw away it into the lake directly from the rooftop by their watch man, driver or house servant at the night."

Figure 4.16: Household waste throwing into the lake by home servant.
(Source: Field survey, November, 2015)

Broken and unused household, electronic, plastic materials, medicinal equipments, packets of beverages are floating in the lake water and this accumulated waste is the obstacle for the living of ecosystem components.

Figure 4.16: Thrown waste materials accumulated in the Gulshan lake boundary.
Source: Field survey, November, 2015

The car repairing agency located near the Banani area have been polluting lake water by cleaning dirty cars and car parts. The use of petrol, oil and mobile of the car or vehicles are also getting mixed with the lake water.

Figure 4.17: Car washing at Gulshan 2 lake side area. (Source: Field survey, November, 2015)

The temporary and permanent bazar of raw meat and vegetables are also the source of waste generation into the lake area. The groups of people from worker union of the market have given their opinion in FGD as,

"We are working in the area for 15 to 10 years. It has become a culture to use lake water for the maintenance of the raw foods mainly vegetables, fresh meat and poultry products. We have no facilities to dump the waste in a specific large garbage dumping zone or to process the raw materials in a unit."

Figure 4.18: Rotten vegetable and poultry waste dumping from local Kaccha Bazar .
(Source: Field survey, November 2015)

The DCC (North) is another lake management authority working for the waste management and pollution control measures. Strom waterline was formed in different part of the lake but it is not clearly defined. DCC (North) has taken initiatives to clear huge amount of water hyacinth and floating waste from the lake water however it is not done properly. As a result during rainy season the overflow of water is happening by the diversion and the water quality of the lake is being polluted also. According to DCC (North), they are taking necessary steps for the cleaning of household waste, underground and sewerage line maintenance in the lake area and establishment of dust bin in the lake surrounding and residential area to ensure the lake water environment sound and natural. However, after implementing these types of activities no well outputs have been revealed. To express the difficulties about to solve the problem of water pollution, the Executive Magistrate and P.S of the DCC (North) Mayor said,

"Gulshan-Baridhara lake is polluted from the previous time of the lake development activities. The inactive role of local residents and immature behavior of the illegal slum dwellers have made the lake environment harmful for the living aquatic plant and animal. DCC (North) have played a vital role to evict the illegal population but it is not permanently done due to many political and social factors. It is also necessary to change the mentality of people to keep them away from haphazard waste dumping around the lake area."

High pH level and Water Pollution

Water pollution is the major ecological issues for Gulshan –Baridhara lake having great impact on the ecosystem. Pollution can be caused by inorganic and organic compounds and microorganisms often play a vital role in determining the degree of this pollution (Higgins and Burn, 1975). Organic pollution happens when large amount of organic pollutants release in the water body. Organic pollutants included fat, carbohydrate, protein, nucleic acid originated from domestic waste, industrial toxic discharge, storm water disposal, urban runoff and many others. They work as substrates for microorganisms (Mason, 2002). The improper solid and liquid waste disposal, using the lake area for toilet purposes, bathing of human beings and pet animals, using pesticides in the lake nearest vegetation cultivation area and nursery, unwise use of lake water for household work, construction work, using medicine, insecticides for cultivation, improper management of fish firming etc are the responsible causes of water pollution in the study area.These causes are the sources of serious water born diseases of human beings and the life threat of the ecosystem. In this research respondents have a choice to find out the causes behind the pollution and they have given priority to the following reasons.

Table 4.5: Major causes of water pollution in Gulshan-Baridhara lake

Main causes of lake water Pollution	Frequency	Percent
unwise use of lake water	40	33.3
Direct discharge from household/industry/hospital	61	50.8
Hidden sewerage and drainage system	19	15.8
Total	120	100.0

Source: Household Survey, 2015-2016

Professor Dr Mihir Lal Shaha, from the Department of Botany at University of Dhaka, have shown the research about the pH level, bacteriological and Physiochemical properties of Gulshan lake. According to his research it can be said that the proper water quality management should not be overloaded with organic and inorganic nutrients or other toxic or other unacceptable substances. Seasonal variation on bacterial load irrespective of heterotrophic and enteric bacteria was observed in Gulshan lake. In the following table the physio-chemical properties of water sample collected from Gulshan lake and the pH level with the seasonal and temperature variation have been presented.

Table 4.6: Level of pH with temperature and seasonal variation

Season	Sampling Size	Temperature (Degree Celsius)	pH level	Ammonium N(Mg/l)	Nitate – N(mg/l)	Phosphorus (mg/l)
Summer	GL 1	29.0	6.99	Highest - 13.73 Lowest-5.76	Highest - 13.02 Lowest- 0.63	Highest- 1.54 Lowest - 0.98
	GL2	28.4	7.05			
	GL3	29.2	6.78			
	GL 4	27.8	7.05			
	GL 5	28.2	7.12			
Rainy	GL 1	27.4	6.54	Highest - 10.81 Lowest - 8.62	Highest- 5.45 Lowest - 0.32	High -1.16 Lowest – 0.81
	GL 2	27.8	7.02			
	GL 3	28.1	6.62			
	GL 4	27.8	6..88			
	GL 5	28.05	7.05			
Winter	GL 1	26.2		Highest – 12.31 Lowest-3.06	Highest – 10.44 Lowest- 1.30	Highest – 1.16 Lowest-1.48
	GL 2	24.5	7.02			
	GL 3	26..0	6.79			
	GL 4	25.5	6.90			
	GL 5	24.3	7.11			

Source: Mihir et al, 2011

Lower Level of Water and Dissolve Oxygen

Dissolve oxygen is the essential element for the living of aquatic resources and the good quality maintenance of water. The ratio of dissolve oxygen in per liter water should not be less than 5mg because it creates pressure on the aquatic animals. Fish can die within an hour if the ratio of

dissolve oxygen in per liter of water becomes lower than 1-2 mg in any water resource. In according to some research it have been identified that the level of dissolve oxygen must be 4-5 mg in per liter water for the life sustain of fisheries. Even the aerobic have important role for the recharge of the natural water flow which is also dependent on the balanced ratio of dissolve oxygen.

Figure 4.19: Serious level of pollution degrading the ratio of dissolve oxygen in lake water. (Source: POBA, 2015)

To identify the level of dissolve oxygen in different points of Gulshan –Baridhara lake, Poribesh Bachao Andolon (POBA) have collected and examined the water samples in 2015 and provided the following results –

Table 4.7: Ratio of dissolve oxygen in Gulshan-Baridhara area

Area of water collection	Ratio of Dissolve oxygen(mg/in per liter water)
Gulshan-1,Road no-1 (under the bridge)	0.25-1.44
Gulshan-1,Road no-8 (drainage)	0.47-2.49
Gulshan-1,Road no-13	0.23- 4.59
Gulshan-Banani connected bridge	0.66-4.76
TV gate, Ghat no-1	0.27-4.51
Badoler Ghat	0.24-3.98

Amzader Ghat	0.76-4.09
Near Airtel office	0.44-2.44
Gulshan-2,Road no-18	1.14-2.63
Gulshan-1,Road no-135	1.19-4.66
North Badda, middle road	0.25-4.06
Shahjadpur	1.39-3.98
Gudara Ghat	0.52-5.24
Centre of the road no 7	0.29-1.17
Opposite portion of the 20 stored building	1.10-4.95
Gulshan-2,(under the bridge)	0.99-3.00
Gulshan nursery	2.15-3.90
In the drainage of Kalachandpur	0.25-0.40

Source: POBA, 2015

The pH level of Gulshan-Banani lake was 7.47-9.94 and in Gulshan-Baridhara lake area was 7.42-10.14. According to the Environment Conservation Act 1995 the standard level of dissolve oxygen should be 5 mg and more than in the ground water for the fisheries and recreational use of water. The level of pH should be 6.5-6.8. But the continuous decrease of level of water and the loss of dissolve oxygen is the ecological issue for the Gulshan-Baridhara lake.

Interrupted Free Flow of Water

The lake development activities and the construction work make the lake surrounding area congested and narrower. The illegal land grabbing, lake water area filling by land, roads and walkway are creating obstacle for the easy and natural flow of water. As a result the natural way of producing dissolve oxygen is being slowed down and the life of aquatic resources also faces a great challenge. The accumulations of the waste materials are also the result of the low flow of the lake water.

Figure 4.20: Free flow of water facing challenges due development activities.

(Source: Field survey, March 2016)

Encroachment of Land

Gulshan- Baridhra lake has been known as a ecologically critical area for many years, but the lake is still now under the control of land grabbers. RAJUK have taken many eviction and development steps to control the land grabbing and to solve the problem of lake boundary reduction. In 2003 Supreme Court has given direction to RAJUK to regain the illegally grabbed land from the grabbers. During 2006 High Court has given another direction to all the responsible authorities to recover the land. In 2012 High Court has imposed rule to evict all the illegal housings and to stop the continuing land filling. RAJUK is the main authority to plan and construct the lake development area. The lake development has been approved by ECNEC on 6 July 2010 and the main objective was to protect the lake from illegal encroachment, maintenance the water reservation capacity and protection of the lake, development of environment by allowing cruising and other recreational facilities, enhancing aesthetic beauty of the lake and preserving the lake surrounding environment. The consulting firm *Vitti Stapati Brindo Ltd* has been engaged for the detailed design drawing for this project. In this project the lake side development activities includes the formation of 2500 feet walk way, 5000 tree plantation in the lake shore area and construction of driveway to control the land filling and land grabbing in the lake side area. The ongoing project cannot control the problem of illegal land encroachment due

to many socio-cultural factors. Regarding the steps of encroachment control, the Project Manager and Engineer of RAJUK said,

"RAJUK has taken necessary steps to stop the illegal land grabbing. Many local people, politician, social organizations strongly work against the plan of lake development project because the possibility of land grabbing, over gathering of the public was controlled by the infrastructural development. The plan of building walk way was prepared to restrict the huge outsider's cars parking and easy excess of the people to make harmful activities. But the unauthorized structure building, illegal land filling and land grabbing problem is not fully mitigated which makes the lake boundary more vulnerable and narrow."

The local residents consider the lake water area as their family property and already 40 feet area of the road has taken under their control in an excuse of construction work. These groups of people also try to influence the authorities to provide huge bribe and to get better facilities. The lake area is grabbed by the slum area formation in the lake shore area. Many local people have demand for the land as the private land owner in Badda- Shahjadpur area. In the Karil – Mohakhali zone mainly in the land of Bangladesh Telecommunication Department, the illegal slum and temporary rent housing are developed by the land filling in the lake. The house renting business becomes easier to the land lord and they try to control the lake development activities to grab the lake land in a huge rate. Many suits and of writ petitions are pending in the high court against the land grabbers. Some powerful social personality has taken a big portion of land as lease process which makes the lake narrower. The unauthorized settlements, small industries, market, bazar, tea stall, nursery, tent house of construction labors, private fisheries project are the examples of land encroachment in the Gulshan-baridhara lake area. RAJUK have taken the eviction steps in that areas under the direction of High Court in 2013 but faced the barrier from high politically powerful and economically rich organizations. The illegal owners have the tendency to buy the land in any way and to fight against the eviction. Many land and housing owner also have the tendency to make a bias contact with the architect and housing development agency to increase their settlement boundary without following the building code act. They also have mentality to change the architectural plan and to encroach the lake water boundary.

Figure 4.21: Huge portion of land area grabbed by the construction workers with the influence of powerful group of people.

(Source: Field survey, March 2016)

In 2016 it was started to evict and cancel the license of many illegal infrastructure like guest house, bar house, coaching and spa centre, *boutic* shops, private university, restaurant and unauthorized car parking zone near the residential area. Even then the encroachment of lake area could not be fully controlled.

Land Filling and Reduction of Wetland Area

The illegal land filling in the Gulshan-Baridhara area is a big challenge for the lake environmental development. The land filling is occurring near the Badda to Shahjadpur area in a huge motion. This illegal activity is done by the influence of the powerful group of people and many labors are engaged in land filling activities at night. The land filling is clearly identified in the Gulshan lake shore area to the Hatirjheel area and Shahjadpur to Marium tower.

Figure 4.22: Marium tower 1 and 2, the great example of land filling and land encroachment. (Source: Field survey, March 2016)

The case about eviction of this illegal settlement is still now ongoing due to the political pressure of powerful owner as the study explores. Around 10 to 12 feet area is under their control in the study area. A group of people have already filled 40 feet area into the lake water and consequently the lake become narrower day by day. This reduction of lake boundary is the vital cause of ecosystem loss in the Gulshan-Baridhara lake.

Continuous Construction Work and Soil Pollution

The infrastructure development and the ongoing construction work around the lake area is creating the problem of soil quality degradation. The construction of new settlements, roads, bridges over the lake area, enhancement of walkway, repairing of driveway and other lake development activities are doing under the supervision of RAJUK, DWASA and DCC.

Figure 4.23: Continuous construction work being responsible for the loss of soil quality.
Source: Field survey, April 2016

The construction materials like bricks, concrete, sand, chemical elements are mixing with the top soil. As a result the leaching capability of the soil, productivity and soil quality is also degrading with the development work. All these ecological and environmental issues are having adverse impact on Gulshan-baridhara lake and consequently making the lake devastation in the long run.

Loss of Vegetation Coverage

Gulshan-Bridhara is a built up area where the thin layer of vegetation coverage was noticed in the lake side area. Only few specific areas have greenery and most of the lake side area is under construction work. Disorganized green strip is visible near the Gulshan 1 and 2 area to Circle 1 to Bir Uttam A.K Khandokar road and Baridhara area. Many lake boundary area is filled by land and turned into residential area. In the earlier period this area was used for crop cultivation and many medicinal and herbal plants were also seen here. In present condition the contaminated and infertility soil quality is the reason for losing the vegetation coverage.

Threat to Ecology

The Gulshan-Baridhara lake is manmade lake of Dhaka city having great ecological value for the maintenance of environmental balance in the city wetland area to the lake surrounding area. The lake has played an active role in the ecological functions such as reservation of rain water, natural drainage and free flow of water for balanced level of dissolve oxygen, natural flood control measures, creating fish breeding grounds and safe living ground for plants and animals.

The depriving lake water environment is an increasing threat for the living of lake water organisms. The presence of several plant species like small grasses, mosses, shawla, under water plants, water hyacinth are declining due to insufficient free flow of water. The large trees like Banayan, Shimul tree, Coconut and Jackfruit tree are being lost to the urban development plan in the lake shore area. The crop and vegetation cultivation is only noticed there for personal use and some horticulture farms have been developed under the supervision of RAJUK. The lake was a resource for fresh water fisheries which is now turned as commercial fisheries zone. To explain about fish diversity, an old resident of the study area said that,

"My family has been living here for 37 years. Fishing was a popular recreational part in our young age. We captured many tasty fishes like Ruhi, Pangash, Tegra, Puti, Telapia, Koi and other small Pona fishes from the lake. The dance of native fishes in fresh lake water is now rarely seen; rather it has now turned as the Lake of dead fishes."

Figure 4.24: Dead cat getting its final destination in lake water.

Source: POBA, 2015

The respondents also have given their finding about the causes of losing aquatic resources in the study area. According to the following diagram 56% of them think water pollution is the key factor for the loss of aquatic resources. The waste dumping is another fact for the death of lake water fisheries and around 21% of the respondents has strong support to point out this factor. They also think that the lack of monitoring, inactive role of local people and other social complications are responsible for the arising of ecological problems.

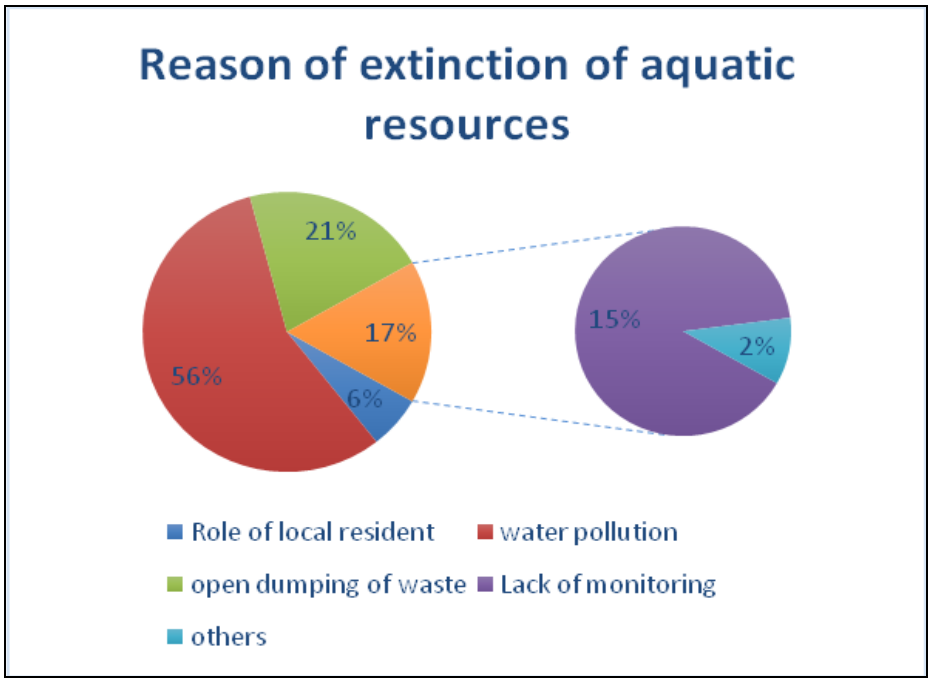

Figure 4.25: Reasons of extinction of aquatic resources (Source: Household Survey, 2015-16)

The biodiversity of plants and animals are being lost due to the uneven urban development and the quality degradation of the lake water environment. Birds and animals like Piggy birds, white and black Pigeon, Sand poultry, Fish rocks, Kakatua, green Parrot, white Egret, Snakes, Beige, Lizards are not widely visible near the lake area. The loss of Biodiversity of these valuable plant and animal species is a big threat for the future of the physical environment. The extinction of migratory birds, loss of flora and fauna, loss of water holding and flood controlling capacity of the lake as water reserve unit, heavy siltation, destroying wetland aquatic resource and fisheries habitat, deterioration of surface water quality, acidic and poisonous water contamination in food chain all are the negative impact for the increasing ecological critical condition in and around Gulshan-baridhara lake.

High Population Pressure and Human Activities

The increasing population pressure in the lake surrounding area makes a challenge for the sustainable development of the lake area. The inactive, arrogance, indifferent role of the local residents and daily migrating population have an influence over the change in the lake

environment. People have not proper willingness to maintain a sound environmental condition rather they have direct role to increase the level of pollution in air, water and soil of the lake area.

Figure 4.26: People using polluted lake water for cleaning electronins like Air conditioned and washing vegetables in the polluted lake water. (Source: Field Survey, April 2016)

Unsustainable Urban Planning

Gulshan-Baridhara residential zone itself is a planned area but the lake was not planned initially. RAJUK has taken the detailed area plan for the Dhaka Metropolitan Area and the Gulshan-Bridhara lake is also under that development project. The urban planning is not well defined to the urban people and there is a lacking of co operation to find a successful output from the approved plan. First of all it is important to make plan for the priority basis criteria of the problems related with the population and spatial demand. Lacking of working combination among the related organizations and personalities is another barrier to achieve the actual results from any desire urban plan. To make a successful urban planning and implementation it is very necessary to ensure working adjustment among all the stockholders, planners, architect, management authority and local residents. The planning authority should have a focus on the sustainability to make any plan. For example in the Banani-Mohakhali portion of lake area, the Ministry of Housing and Public works has taken the plan to top up 43 acre of land and build 3360 number of flats. This plan breaks the “Wetland Conservation Act-2000” which will be very destructive for the future of the lake environment.

The costly project of "Pollution Control Measures of Gulshan-Baridhara lake by Diverting the Drainage Outlet" have been taken by WASA, but still now it has not become completed. The lack of accountability of management authorities like RAJUK, DCC, WASA for the implementation of development plan in Gulshan-baridhara lake area is the important reason for the unsustainable development with prolonged time.

Inappropriate Community Facilities

High population pressure and their increasing demand cannot be managed if the community facilities are improper compared to their needs. The people of the slum portion near the Gulshan-Baridhar lake are suffering from basic community facilities like better housing system, sanitary facilities, specified waste dumping units, good electrical, water supply and sewerage connection. So, these helpless people have to depend on the lake to fulfill demands and their utilization has the direct negative impact on the lake.

Lack of Proper Management

The lake management authorities have been trying to improve the lake environment but it becomes very difficult for their lack of unity in working. The lake development projects had been approved with a huge cost but most of them are not properly finished with the fulfillment of expected goals. Some projects are hanged in undone situation due to political factors and make the lake development process more slow and unreliable.

The interesting finding of expert interview is that most of the lake improvement authorities have the tendency to blame each other's institutions which is a big challenge for finding out a better output. To explain the role of management authorities a renowned Urban planner and Head of Centre for Urban Studies (CUS) said,

"The citizen and authority-both groups of people are unaware of the lake related problem. It is a combined duty of the city dwellers, planners, and project implementing and management authorities to working in a chain of command in cohesive way. All the responsibilities should be equally distributed and done by the community based concept. This is the only way to ensure the better management in every types of difficulties".

Social Obstacles for Lake Development

The socio- political influences of the powerful group of people have the undeviating impact on the lake development progress. Illegal house renting business, business of drugs, smuggling, social anarchy, political unrest, cultural diffusion, lack of people's awareness to control pollution, extorting and bribe culture, economic discrimination of people and many other unlawful activities are the main obstacles to ensure the proper management of the Gulshan-Baridhara lake. The governmental authorities and the local lake development authorities have to face these obstacles also.

Conclusion

At the finishing of this chapter it can be summarized that the Gulshan-Banani Baridhara lake is under the great threat of ecological loss. The sustainable management of the lake should be ensured by the implementation of appropriate plan with the special consideration of peoples demand and conservation of natural environment, otherwise the problem will act as a throat thorn for any kind of urban development.

CHAPTER 5

CONCLUSION AND RECOMMENDATION FOR SUSTAINABLE MANAGEMENT OF ECOLOGICALLY CRITICAL AREA IN DHAKA CITY

5.1 Introduction

Wetlands are the transitional areas between global and aquatic boundary. Wetland plays a vital role to provide several benefits, concerning to the ecosystem, environment, biodiversity, economy and to aesthetic excellence. The conservation of wetland especially ecologically critical wetland area and the species of that area should be given priority for the sustainability of environmental development and the natural resource management. Sustainable Environment Management program is the key method for the conservation of ECA in and around Dhaka city to protect against wetland degradation and ensure the better management.

5.2 Respondents Opinion about Present Development Activities

Community based development plan and implementation of the projected preparation is essential for the sustainable management of ecologically critical area. The lake management authorities have taken wide-ranging steps and planning for the improvement and conservation of wetland ecosystem. The authorities should give priority to the group of people who have influencing role in the development of ecologically critical area. The findings from household survey and FDG have shown that people have a mixed opinion about present lake management activities. Some people have lack of awareness and mentality despite the responsibilities as the part of ecosystem.

Around 15.7% of the respondents have less interest to restore the lake water ecology. The big ratios of population (84.3%) have strong compliance to re-establish the quality of present Gulshan-Baridhara lake as ECA. To identify the management issues and recover the critical condition of the lake, the management authorities have designed many plan. Focused Group Discussion on slum population have shown a different idea about the recent development plan. They said,

"The ongoing development activities are being done for the fulfillment of demand of rich residents of the lake area .We are deprived and considered as cursed group of people who have no engagement with the lake development activities, rather we are always facing the eviction as a reward for being rootless."

It is an interesting findings regarding the perception of respondents like a fifty-fifty game. Around 50.5% of the local residents thinks that the present plan are being implemented with a good flow and rest 49.5% of them have many complains againts the ongoing project. Lack of regular supervision, biasness of planners, socio-economic and political pressure of powerful group of people like land buyer, seller and owner, sluggish and descriminated mentality of the authorities, lack of peoples participation are the negetive side explored from the study regarding present development activities.

The respondents have also given their opinion about the role of responsible local authority to put into action of projected plan. Multiple responses have been considered during data analysis. Around 72% of them have been supporting the role of residential welfare committee and 62% of them have dependency upon the role of ward commisioner. Around 51% of them have relaiability on the other governmental and non-governmental institutions. Respondents have faith in government rather then their own role. They think that it is necessary to introduce an integrated approach for the plan implementation. The government should be more strict about the proper mainteinance of law and rules. They also said that public participation can help to achieve the desired success.

5.3 Expert Opinion on Sustainable Development of Gulshan-Baridhara lake

Gulshan-Baridhara lake is the defined ECA area of Dhaka city suffering from many environmental and social issues. The integrated development approach is necessary for the solution of ecological problems. The present lake development planning and projects are going on by the responsible governmental institutions like RAJUK, DWASA, DoE, DCC (North). Gulshan Society, Baridhara club, Gulshan Youth Club, Gulshan Health Club,Gulshan Ladies Club, Gulshan Amateur Fish Hunting Association, Horticulture club, non-governmental and self motivated management authority. The opinion of experts, stake holders, planners, management authorities about the present development activities and the policy guidelines for the sustainable management of ECA are presented here.

The Gulshan-Banani-Baridhara lake development project is the ongoing under the supervision of RAJUK to maintain the ecological balance, water retention, recreations, social integrity and density relief in and around the lake area. The estimated cost of the project is Tk. 41025.52 Lac. The consulting farm *Vitti Sthapati Brindo Ltd* are engaged in the project work to design drawing and plan. Gulshan Society and Gulshan club are involved to exhibit of the project presentation to address the necessary information and suggestions. According to the inception report of RAJUK it is shown that they have plan to construct 30000 feet walk way and land acquisition of 70.22 acre land is under process for approval. Land acquisition of 10.76 acre land at the study area is approved and 5000 tree plantation, regular eviction against illegal encroachment, making cross over, operation of sludge, enhancing aesthetic beauty of the lake by building recreational facilities and park, lake side green space development and forming lake connected bridges are included in the projected development plan. Regarding the development progress of RAJUK, the architect and urban planner of Vitti Sthapati Brindo Ltd said,

"The aim of this project is to protect the lake from pollution by constructing walkway, removal of sludge, clay soil and garbage. If the project is successfully completed, the city dwellers will realize that Dhaka is the city of free flow of water stream. Even our honorable Prime minister have a desire to overview the natural beauty of wetland in Dhaka city by riding boat from Hatirjheel to Kalachandpur area."

To analyze the role of RAJUK, the Director of CUS said,

"RAJUK is the main authority for managing lake and so it should be their major concern that how can they recover the lost tradition of wetland environment. They have given big priority on the technical or structural development rather than the natural development of ecology. The planners of RAJUK should not act like a money transaction unit with the greedy land lords, relatively they should work with accountability to introduce a new Dhaka, the city of wetland."

To present the role and suggest the policy guideline, the Deputy Director of natural resource management sector of DoE said,

"DoE has declared the ECA of Bangladesh and also provided the specific map of the affected ecosystem zone. For the sustainable management of ECA area, mainly in case of Gulshan-baridhara lake, DoE gives the suggestion to apply their well known Community Based Adaptation (CBA-ECA) method. It is also necessary to develop Participatory Action Plan to aware the local residents about the necessity of ECA conservation. Identifying the value of ECA resources and providing proper training to the affected people will help to ensure the sustainable management."

Regarding the role of DoE, the consultant of WASA have given the suggestion as,

"The role of DoE should not be limited only to declare ECA, making map or to introduce the policy guidelines in written document. They should be more restricted about the violation of any environment conservation related act. They should give proper punishment in according to the law to make people more and more responsible."

DWASA is the responsible management authority to maintain the sewerage and drainage connectivity around Gulsha-Baridhara lake who have taken the "Pollution Control Measures of Gulshan-Baridhara lake by diverting the Drainage Outlets" project to control pollution of Gulshan-Baridhara lake. The schemed cost of the project was 50 million, but it became unsuccessful to achieve the stipulated goal. Other development activities were discussed in the

previous chapter. To criticize the role of WASA, Urban Planner and Chairperson of the Department of URP, BUET said,

"The artificial storm water drainage system are very nominal according to our needs. The Gulshan –Baridhara lake cannot operate like a water retention unit due to unplanned development of utility services. The present development project of WASA are economic benefit oriented having no consideration over the concept of environmental and social equity. WASA should take the Service Integrated Land use Planning and Risk Sensitive Land Use Planning to make sure better utility services. Actually we should have the support to go with nature and design with nature."

DCC (North) is working as the guardian authority for quality building status of Northern part of capital city. They have multipurpose mission such as mitigating the environmental problems by developing integrated drainage network, improving waste management services by promoting waste recycling method, increasing the infrastructural development and public amusement facilities to ensure desire civic facilities to the citizens. To address the role of DCC (North) to improve for the protection of Gulshan-Baridhara lake, the Supervisor and Engineer of Environment, Climate, Waste Management and Disaster Circle have said,

"DCC have taken the mission to change the polluted condition of Gulshan-Baridhara lake and the surrounding area. Waste management is the important function including the activities such as collecting solid waste from household, industries, hospitals, public toilet, drains, roads and lake side area, providing waste bin in different portion of Gulshan-Baridhara area, cleaning the sewerage, drainage line etc. We also have taken community waste management activities in collaboration with JICA. Managing private solid waste management and NGO based waste management is the way to establish the community based waste management method. All these activities are having important role to control the pollution of Gulshan-Baridhara lake."

Regarding the role of WASA, the Urban Planner and Professor of the Department of geography and Environment, University of Dhaka said,

"WASA should include all types of community in participatory approach to find out a better result. They should take proper care of slum area and the planned residential area without any discrimination."

The other non-governmental organizations have also played a role in lake development project by self motivation. Building awareness is the key concern for most of the organizations goal. According to the Executive Magistrate of Administrative Sector,

> *"It is not only the duty of governmental organization to protect the lake. The non-governmental organization should also work with the government lake management authority to increase the strength of the management projects. The enforcement of law should be ensured to enhance the awareness to the local people."*

5.4 Recommendations for Sustainable Management of ECA in Dhaka City

Sustainable development means the combined focus on environmental development, ensuring social equity and improving economic status and it is the development that meets the need of the present without compromising future generation. To mitigate the ecological criticality and sustainable management of ECA of Dhaka city, especially in case of Gulshan-Baridhara lake the recommendations found from the study are presented below-

- Biological management of the lake is the way to the sustainable management of ECA development in Dhaka city. RAJUK have taken the biological lake management process to control the pollution in lake area.
- Watershed Management techniques is a way to protect the surrounding lake area.
- Proper treatment plant and well connectivity of sewerage should be designed by WASA.
- To improve the lake restoration, it is necessary to give focus on "In-lake treatment techniques."

- The development project should have the vision to consider the welfare of ecology. The plan should not be profit oriented.
- The Gulshan and Baridhara society should not act like the authority for merely developed group of people; rather they should have the accountability for the slum dwellers.
- There is a need of integrated approach to plan for any development project.
- The eviction of slum area is not only the process to solve the problem of illegal settlement; rather it is necessary to relocate them in better place.
- RAJUK should be more careful to implement the development project in according to the time boundary; otherwise the proper aim of the plan will not be successful at all.
- It is necessary to specify the duties or responsibilities by the governmental and non-governmental authority and organizations to help people in accurate way.
- The flood control and water retention capacity should be focused in case of managing the sewerage system.
- The planners should plan a long term project for 20-30 years, not for only 5 to 6 year vision.
- The fund development and involving of local people in action plan should be ensured.
- The floating population should be in consideration for the lake development project because they are also responsible to pollute the ECA.
- DoE should protest against the harmful activities of industries, officials and persons to maintain the management process.
- The management authority should build artificial treatment reservoir for controlling the sources of toxic water discharge.
- All the ECA in and around Dhaka city should be identified by mouza map and to take in a good supervision with balanced initiative.

- Biodiversity conservation is the important component of Community Based Adaptation method. Dependency on ECA of local people should be reduced. The effected biodiversity and extinct species should be taken care by respective experts or botanists, soil and vegetation, microbiology and ecological conservation unit.
- The management authority of RAJUK, WASA, DCC, DoE should have a good relationship to introduce the integrated approach instead of blaming each other.
- More awareness building program should be organized by the government including social media, print media, NGO, social organization.
- It is necessary to keep the natural environment safe for the living of endangered species of plant and animal.
- The role of local responsible authority and local resident should be more reliable to control the criticality.
- Risk sensitive unit of ECA should be prepared to save the ecosystem and lake water environment.
- Separate waste disposal unit should be constructed for the safeguard of lake water ecosystem.
- To control the illegal land grabbing and land filling RAJUK should make a contact with DoE to ensure better law enforcement.
- Wetland Conservation Act should be followed in making all the plans,

5.5 Conclusion

Wetlands are the most affected ecosystem of our county. Appropriate land and water use policy with the concentration of ecology protection is necessary for the conservation of wetland from the environmental criticality. To ensure the sustainable development of the Gulshan –Baridhara lake it is very urgent to consider the problem of ECA in national level. Dhaka city has got a wetland like Gulshan-baridhara lake which is a great resource for the city indeed. Most of the developed cities in the world are developed based on water bodies. Considering it as a resource all walks of people have to come forward to save the Gulshan-baridhara lake. It is high time blaming to each other by the responsible authority has to be stopped and all in a body need to come ahead with responsibility to develop this Gulshan-Baridhara lake. Moreover, Dhaka city can be made as a garden city by protecting such type of wetlands.

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APPENDIX-I

(Questionnaires)

M.Phil (session: 2012-2013)

Sample No

Department of Geography & Environment, University of Dhaka

Study Area: Gulshan-Baridhara Lake

Management Issues of Ecologically Critical Areas in and Around Dhaka City: A Case Study of Gulshan –Baridhara Lake

[This empirical study is based on primary and secondary data collection in order to get some information on Management issues of ecologically critical areas in and around Dhaka city, specifically about Gulshan –Baridhara Lake. The collection of data is the part of thesis to accomplish the degree of M.phil in Department of Geography and Environment, University of Dhaka. Information collected from the stockholders, planners and local residents and will be treated strictly as secret and be used for research purpose only.]

Household Survey/Focus Group Discussion / In-depth interview(Local residents)

Study area/ Address: ……..……Date……..……..…

1. Please provide the following information as respondent:

a) Name .....

b) Age.....c) Sex.....M / F

d) Education level.....i)Illiterate ii) Primary level iii) Junior high iv) SSC pass v)HSC pass vi)Graduate /Masters / vii) Others (specify).....

e) Marital status.....i) Unmarried ii) Married iii) Widow(er) iv) Divorced v) Separated

f) Working status.....i)Employed ii)Household work iii)Student iv)Unemployed v)Others

g) Current place of living or working.....i) Study area ii) Other area.....

h) Year of living /working-.....

2. What was the previous condition of Gulshan- Baridhara Lake? (land use /water quality /environmental management etc).

a) Satisfactory b) Not satisfactory c) Present condition is better d) Others.....

➢

3. Please identify the earlier major environmental issues of the lake and surrounding area?

a)

b)

c)

d)

4. Do you or your family use this Lake?

Yes /No	Reason of using	Reason of not using
	a) b) c)	a) b) c)

5. Do you think that your utilization or infrastructure position have any impact on this Lake?

a) Yes (specify)……..……. b) No

➢

6.. What are the major issues of present Gulshan-Baridhara Lake? Please Rank the problems below.

Problems	Rank	Comment
Encroachment of land		
Reduction of wetland area		
Water Pollution		

Ineffective waste management		
waste management		
Unsustainable urban planning		
High population pressure		
Inappropriate community facilities		
Lack of proper management		
Others		

6. What is your opinion about ecologically critical area?

……

……

.....

.....

7. What are the causes of this ecological issue?

a)

b)

c)

d)

8. What are the Impact of this ecological issue?

a)

b)

c)

d)

8. Why it is necessary to restore the ecology of this lake? (please specify the reason)

a)Yes..... b) No.....

9.Do you have any suggestion to restore the ecological process of Gulshan-Baridhara Lake?

a) Yes (specify) …….b) No……..

10. Please give your opinion about these following problems around the Gulshan-Baridhara Lake?

a) What are the reasons of extinction of aquatic resources?

i) Role of local resident ii) water pollution iii) Open dumping of waste

iv) Lack of monitoring v) Others

b) What are the main causes of lake water pollution?

i) Unwise use of lake water ii) Direct discharge from household/industry/hospital etc

iii) Hidden sewerage and drainage system iv) Others

c) Please identify the main factors of waste generation into the lake and surrounding area?

i) Illegal sewerage and drainage system ii) Lack of supervision

iii) Open dumping of waste from.....(please specify) iv) Hanging toilet v)Others

d) What is your opinion on encroachment of land around the lake area?

i)

ii)

iii)

iv)

e) Do you think that the present development plan is satisfactory?

i) Yes..... ii) No (Please specify).....

f)What is your judgment on the lake management and monitoring system?

i)

ii)

iii)

iv)

g) What are the mentionable local social obstacles related with the destruction of Lake Environment?

i)

ii)

iii)

iv)

11. What is the role of local authority to improve the present condition?

Local Authority	Role	constrains
Residential area welfare committee		
Ward commissioner		
Others		

12. What is the role of you or your organization / institution to protect the Gulshan – Baridhara Lake and the surrounding area? Mention the objectives of development plan by your institution (if taken any).

Ans-

Development activities	Time/Duration	Constrains	progress

13) What types of development services you want from other institutions?

a)

b)

c)

d

14) What is your suggestion to protect the lake ?

a)

b)

c)

d

15) How can we implement these entire plans?

a)

b)

c)

THANK YOU

M.Phil (session: 2012-2013)

Sample No

Department of Geography & Environment, University of Dhaka

Study Area: Gulshan-Baridhara Lake

Management Issues of Ecologically Critical Areas in and Around Dhaka City: A Case Study of Gulshan –Baridhara Lake

[This empirical study is based on primary and secondary data collection in order to get some information on Management issues of ecologically critical areas in and around Dhaka city, specifically about Gulshan –Baridhara Lake. The collection of data is the part of thesis to accomplish the degree of M.phil in Department of Geography and Environment, University of Dhaka. Information collected from the stockholders, planners and local residents and will be treated strictly as secret and be used for research purpose only.]

In-depth interview (Planner)

Study area/ Address: ……Date……..…….

Name of the Interviewer…….……Year of working……..……

Designation of respondent ……..…..…….Age……..….

1. What is your opinion about the past and present condition of Gulshan-Baridhara Lake?
   Past condition (area/water quality /environmental management etc)

   .....

   .....

   .....

   .....

   .....

   .....

   Present condition…….....

   .....

   .....

   .....

.....……

……..

……..

2. What are issues of present Gulshan-Baridhara Lake? Please Rank the problems below.

Problems	Rank	Comment
Encroachment of land		
Reduction of wetland area		
Water Pollution		
Ineffective waste management		
Unsustainable urban planning		
High population pressure		
Inappropriate community facilities		
Lack of proper management		

Others		

3. What is your opinion about the existing development plans and implementation for the improvement of present condition of Gulshan Baridhara Lake?

Development plan	Implementation	Suitability /Weakness	Comments

4. Please give your opinion about the existing development plans and implementation for the improvement of present condition of Gulshan Baridhara Lake?

Development plan	Implementation	Suitability /Weakness	Comments

5. What do you suggest to restore the ecological process of Gulshan-Baridhara Lake?

…….....

.....

.....

…….

6. Please give your opinion about these following problems around the Gulshan-Baridhara Lake?

Problems	Sources /Reasons	Solutions	Comments
Extinction of aquatic resources/Biodiversity loss			
Water pollution			
Waste management			
Encroachment of land			
Unplanned urban development			
Inappropriate community facilities			
Lake of monitoring /supervision			
Others			

7. What is the role of your organization / institution to protect the Gulshan – Baridhara Lake and the surrounding area? Mention the objectives of development plan by your institution (if taken any).

Development activities	Time/Duration	Constrains	Progress

8. What would be the role of other institutions to protect this Lake?

Institutions	Role of institutions	Time/ constrains	Comments

9. In the Lake surrounding area how can we develop better community facilities for the safe guard of the Lake?

……..

……..

……..

……..

……

10. Please give your opinion about the overall development of the Lake.

……..

……..

……..

……..

……

Thank you

M.Phil (session: 2012-2013)

Department of Geography & Environment, University of Dhaka

Study Area: Gulshan-Baridhara Lake

Sample No

Management Issues of Ecologically Critical Areas in and Around Dhaka City: A Case Study of Gulshan –Baridhara Lake

[This empirical study is based on primary and secondary data collection in order to get some information on Management issues of ecologically critical areas in and around Dhaka city, specifically about Gulshan –Baridhara Lake. The collection of data is the part of thesis to accomplish the degree of M.phil in Department of Geography and Environment, University of Dhaka. Information collected from the stockholders, planners and local residents and will be treated strictly as secret and be used for research purpose only.]

In-depth interview (Administration Sector)

Study area/ Address: ……...… Date…….

Name ……..……Year of working……..……

Designation of respondent ……..……...Age……..…….

6. What is your opinion about the past and present condition of Gulshan-Baridhara Lake?
   Past condition (area/water quality /environmental management etc) …….
   .....
   .....
   .....
   .....
   .....
   Present condition……
   .....
   .....
   .....
   .....

7. What are the issues of present Gulshan-Baridhara Lake? Please Rank the problems below.

Problems	Rank	Comment
Encroachment of land		
Reduction of wetland area		

Water Pollution		
Ineffective waste management		
Unsustainable urban planning		
High population pressure		
Inappropriate community facilities		
Lack of proper management		
Others		

8. Gulshan-Baridhara Lake was declared as ECA in 2001. What is your opinion about the critical condition of the ecology in this Lake?

.....

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……

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9. What do you suggest to restore the ecological process of Gulshan-Baridhara Lake?

……

……

……..

.....

.....

.....

10. Please give your opinion about these following problems around the Gulshan-Baridhara Lake?

Problems	Sources /Reasons	Solutions	Comments
Extinction of aquatic resources/Biodiversity loss			
Water pollution			
Waste management			
Encroachment of land			
Unplanned urban development			
Inappropriate community facilities			
Lake of monitoring /supervision			

Others			

6. What is the role of your organization / institution to protect the Gulshan – Baridhara Lake and the surrounding area? Mention the objectives of development plan by your institution (if taken any).

Development activities	Time/Duration	Constrains	Progress

7. Please give your opinion on the role of other institutions to improve the lake ?

Institutions	Contributions	Time/ constrains	Comments

8. In your opinion what should be the role of others institutions to protect this Lake?

Institutions	Contributions	Time/ constrains	Comments

9. In the Lake surrounding area how can be developed better community facilities for the safe guard of the Lake?

.....

.....

.....……

……...

……..

10. Please give your opinion about the overall development of the Lake.

……...

……..

.....

.....

Thank you

APPENDIX-II

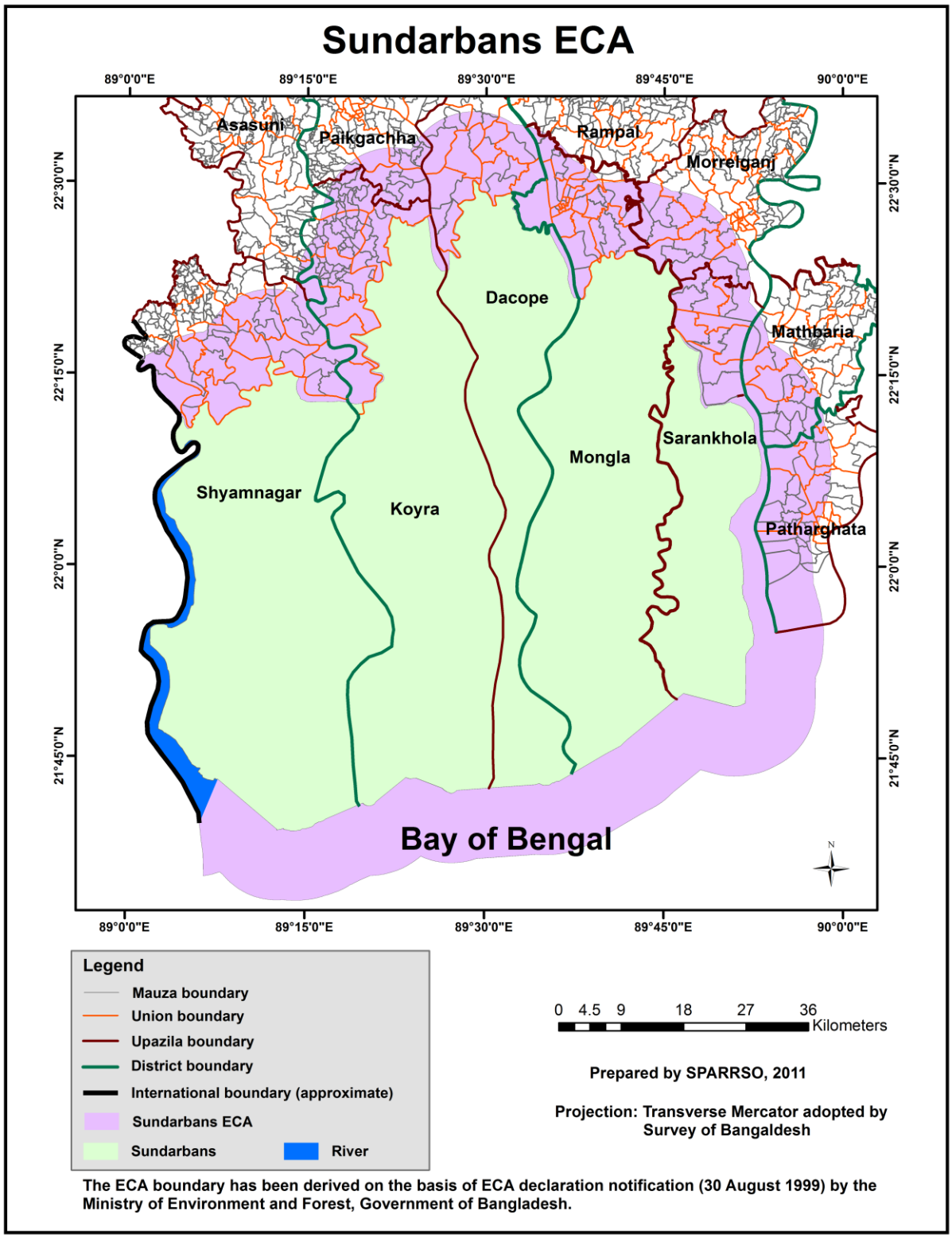

Figure: Map showing the extent of the Sundarbans ECA.
Source: DoE , 2011 (Prepared by SPARRSO)

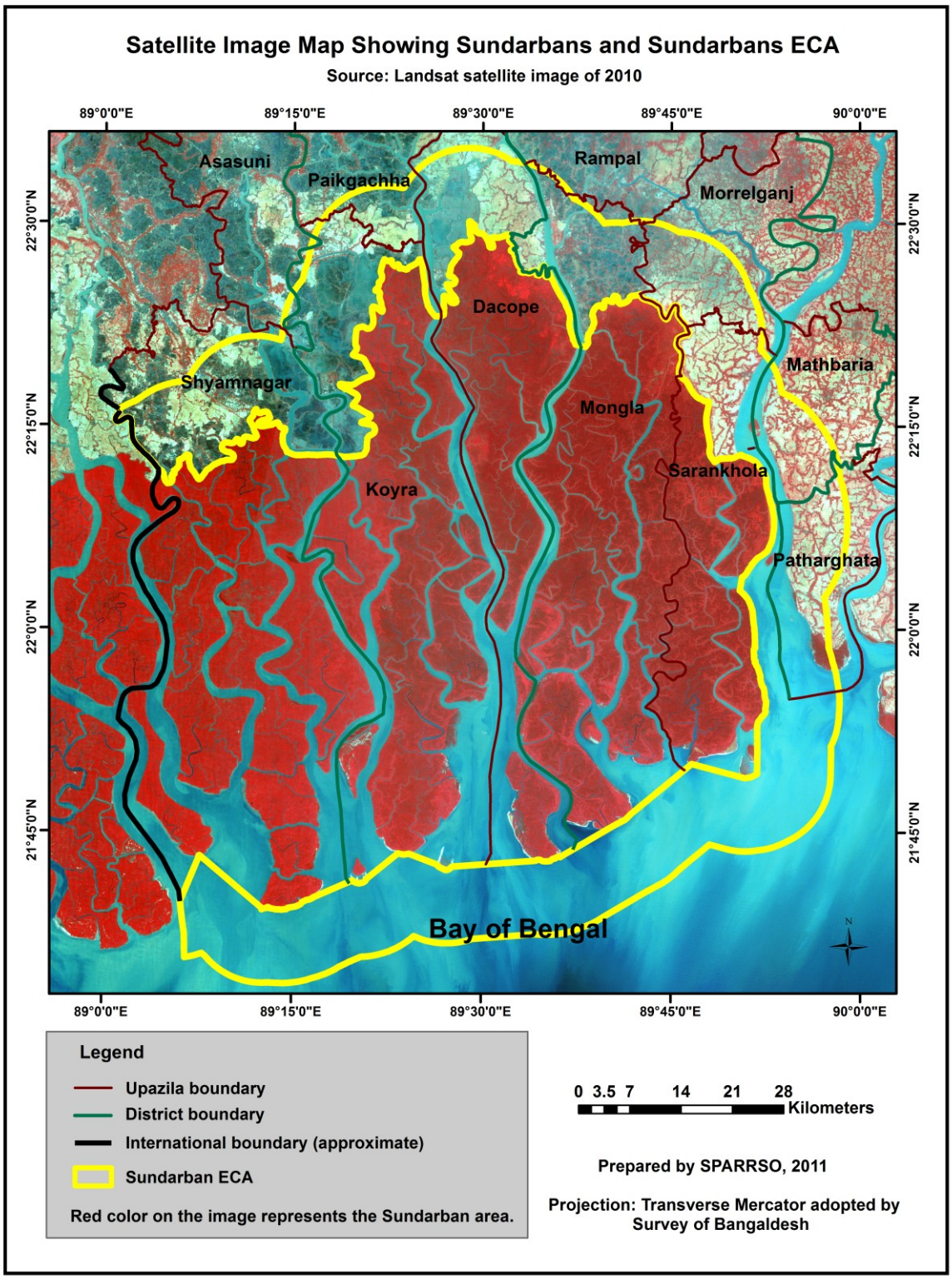

Figure: Image map showing the Sundarbans reserve forest and the Sundarbans ECA

Source: DoE , 2011 (Prepared by SPARRSO)

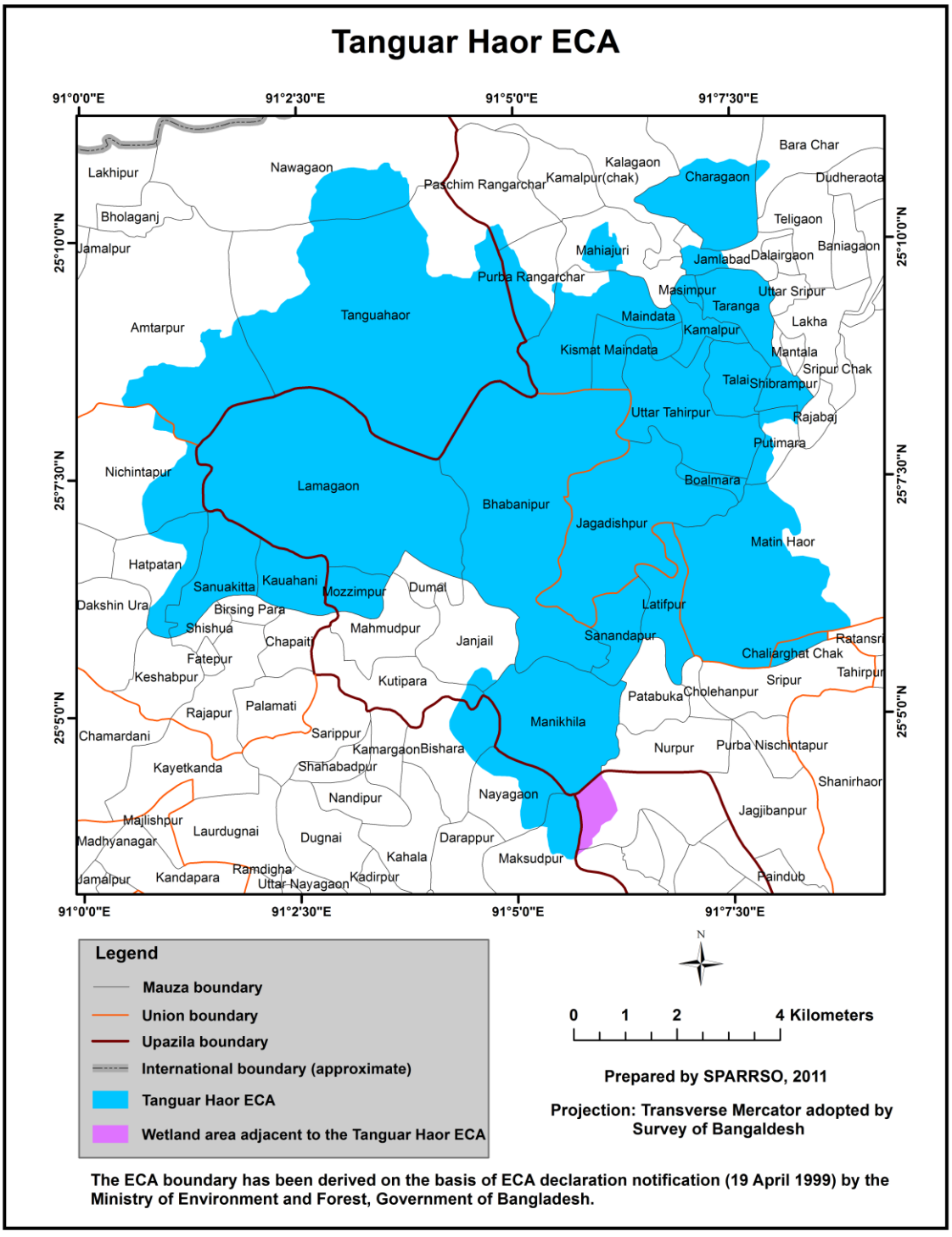

Figure: Map showing the extent of the Tanguar Haor ECA.
Source: DoE , 2011 (Prepared by SPARRSO)

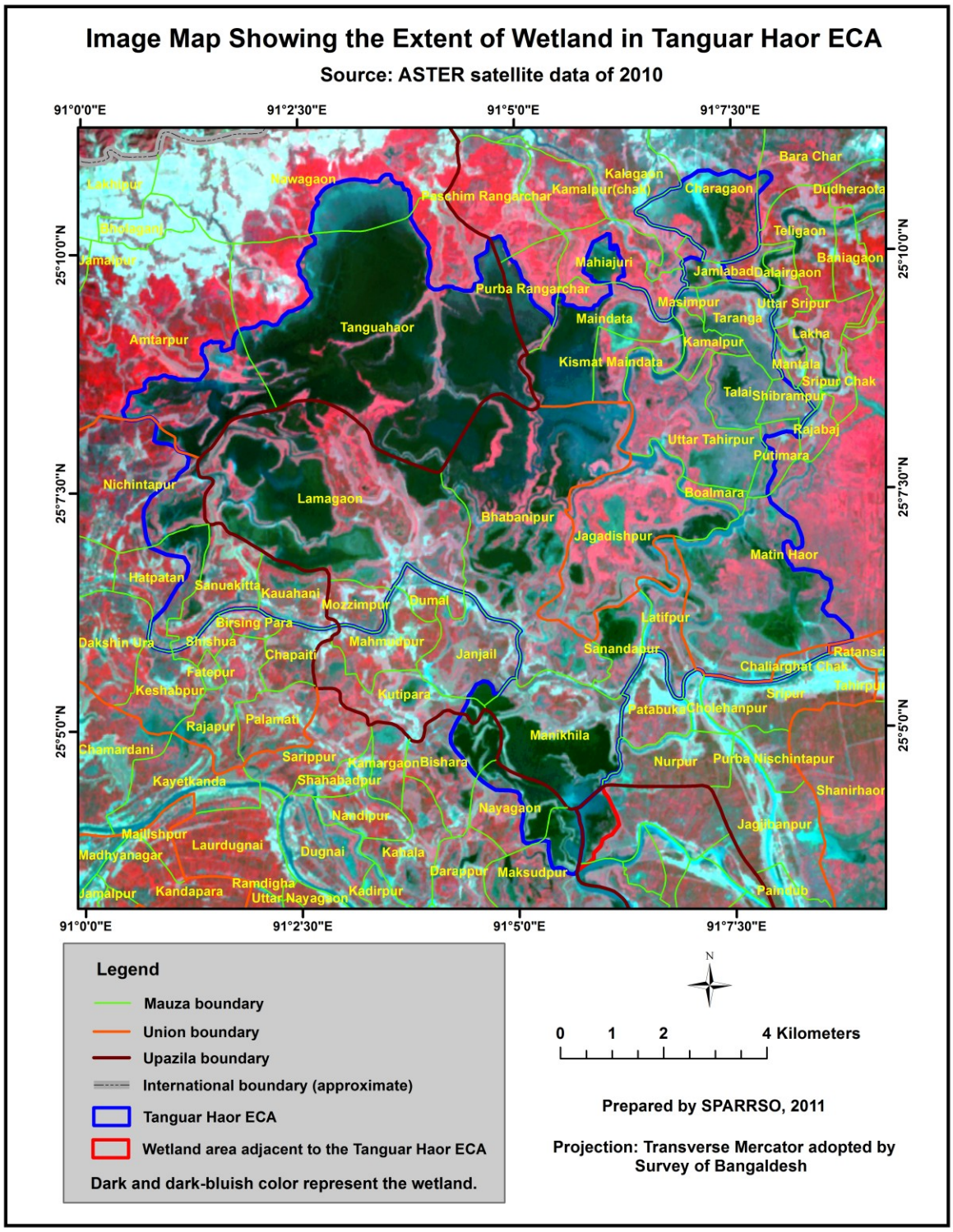

Figure: Satellite image map showing the extent of wetland in the Tanguar Haor ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

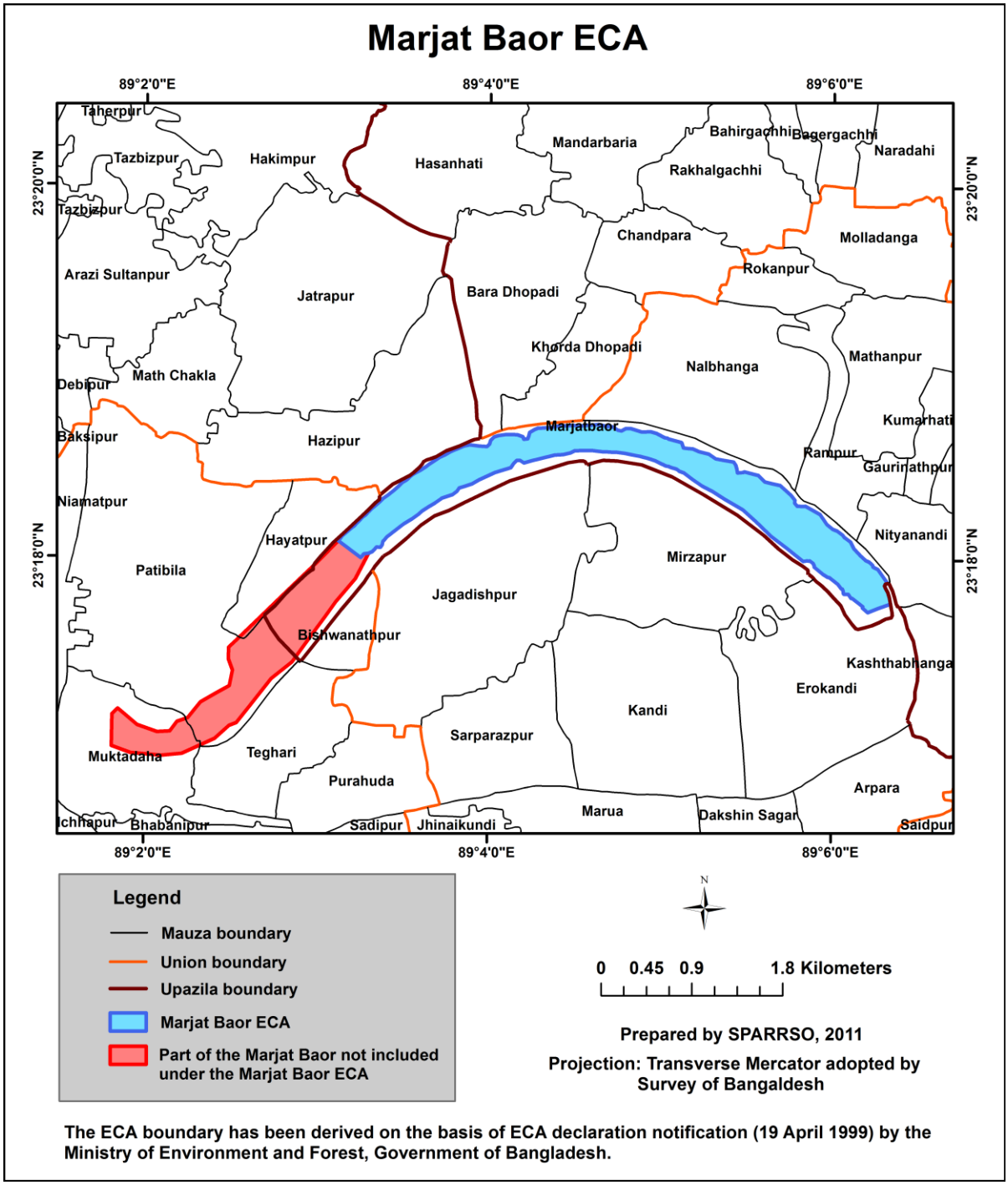

Figure: Map showing the position of the Marjat Baor ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

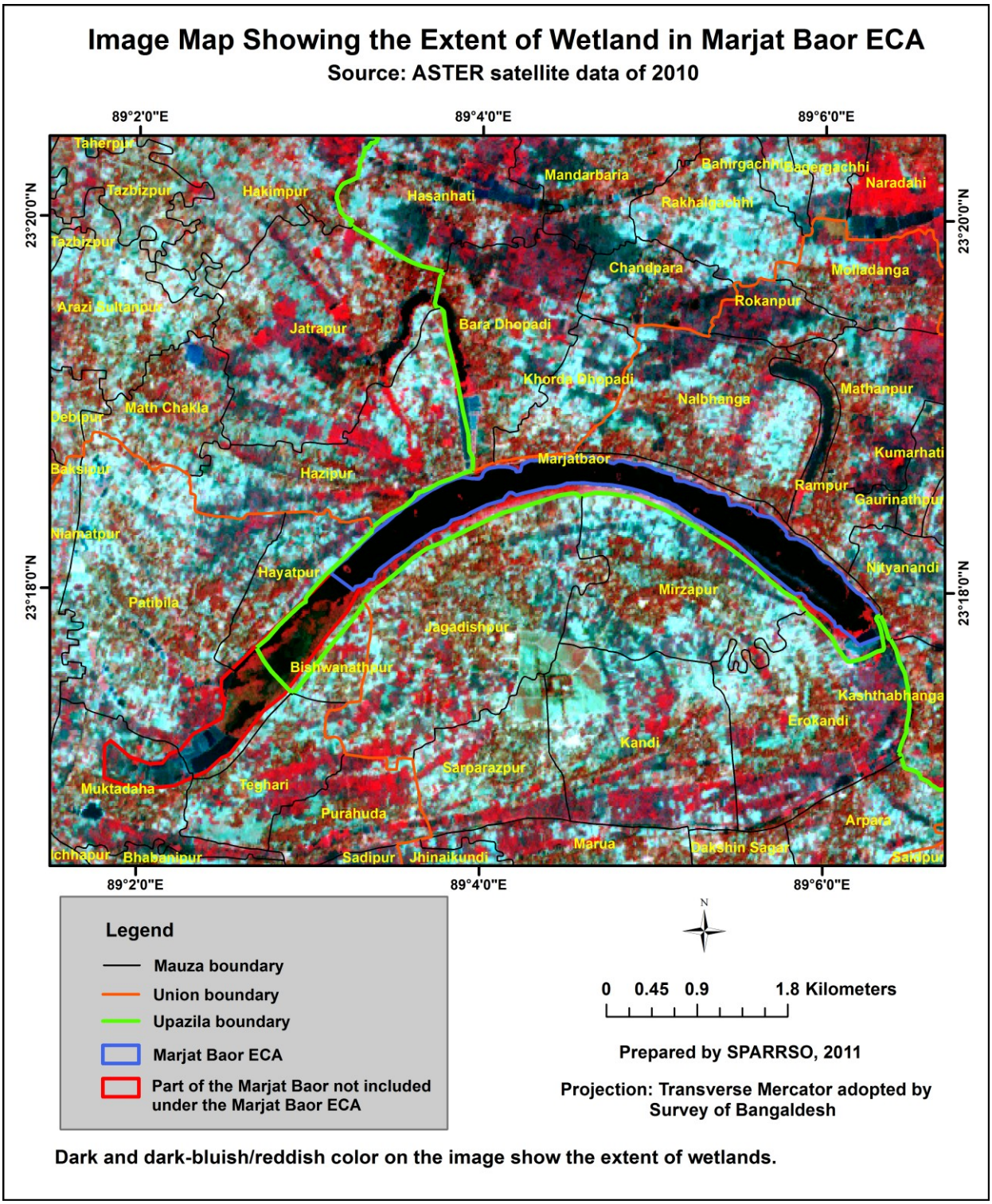

Figure: Satellite image map showing the extent of wetland in the Marjat Baor ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

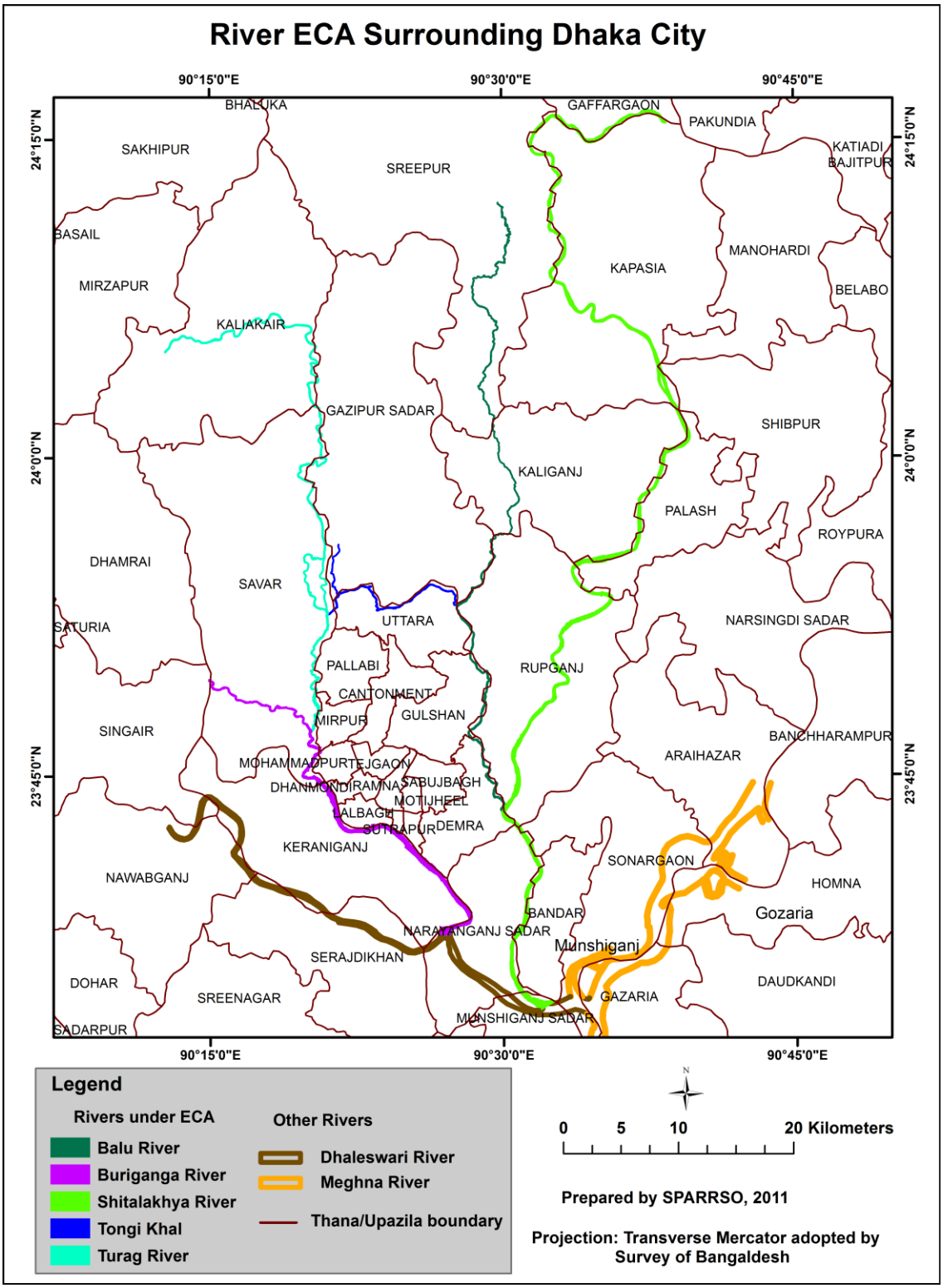

Figure: Map showing river ECA

Source: DoE , 2011 (Prepared by SPARRSO)

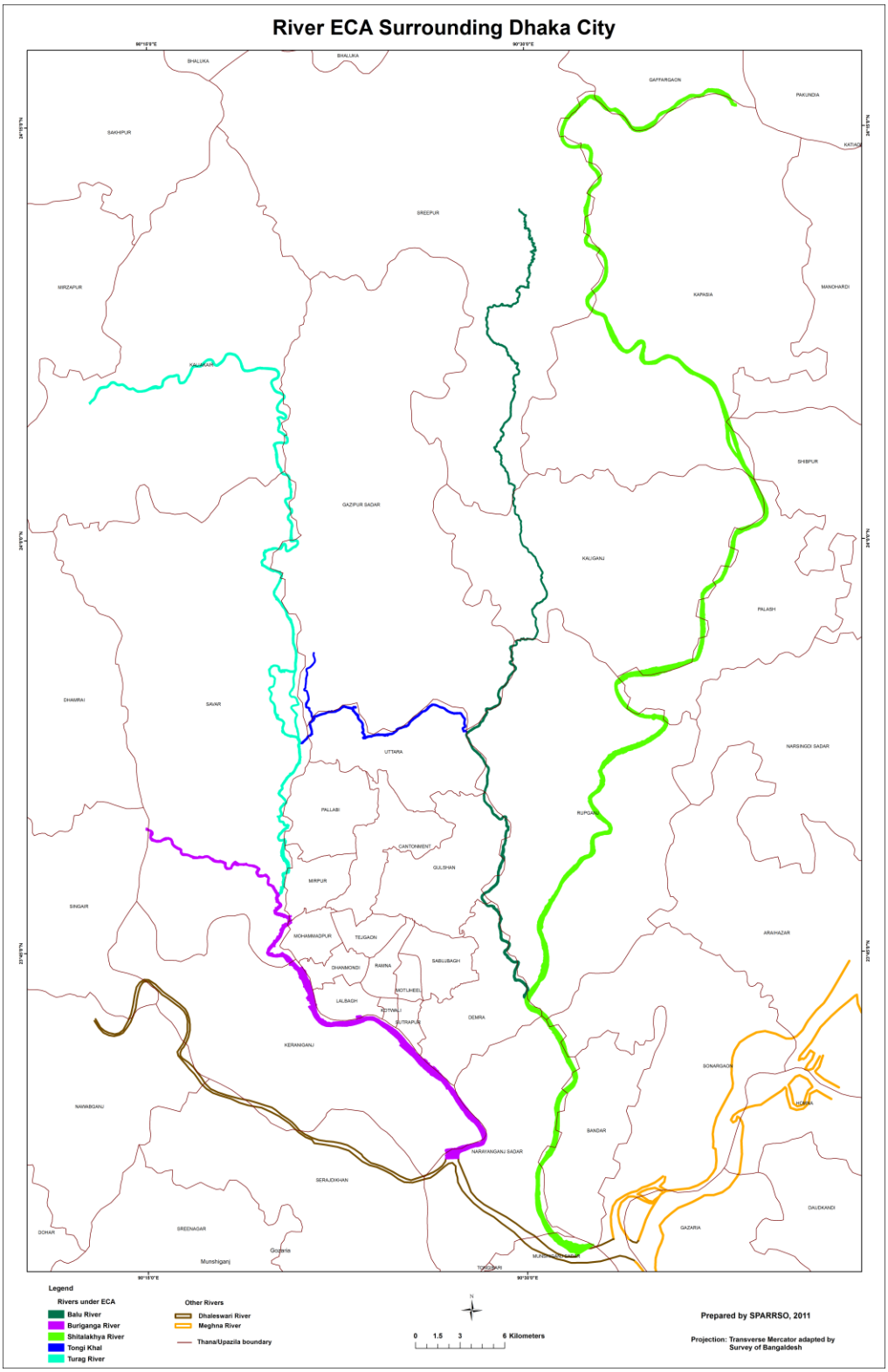

Figure: Map showing the position of the river ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

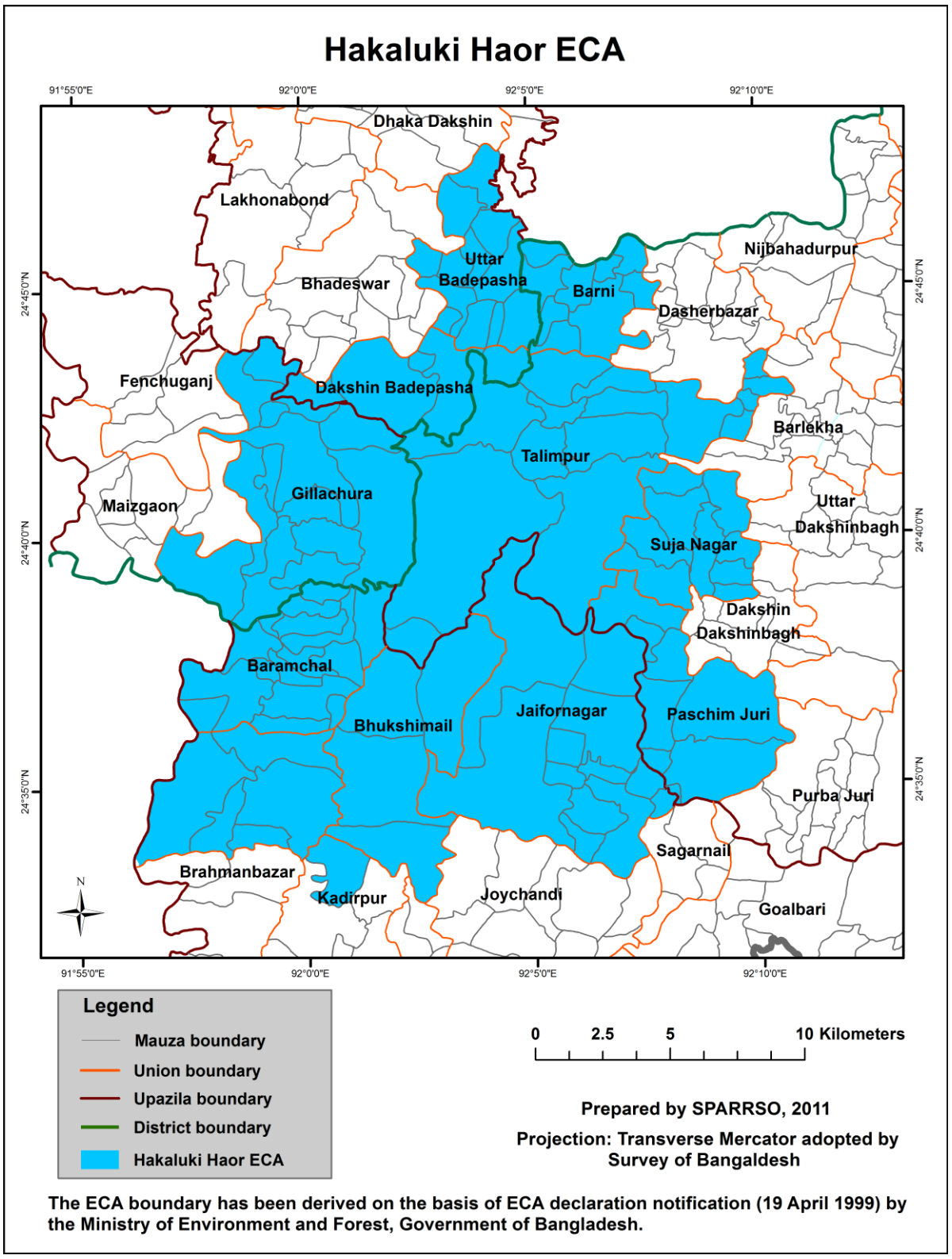

Figure: Map showing the position of the Hakaluki Haor ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

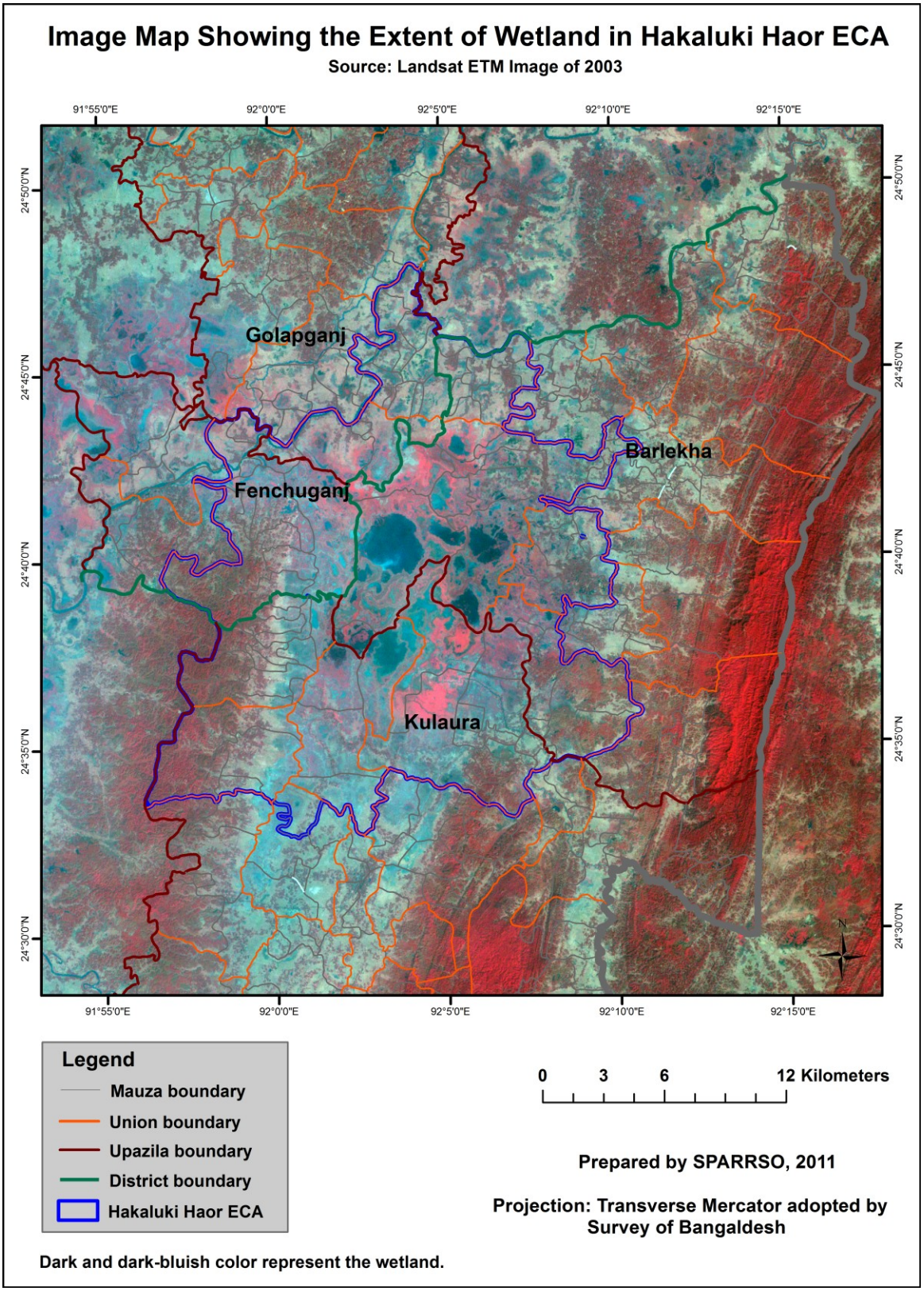

Figure: Satellite image map showing the extent of wetland in the Hakaluki Haor ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

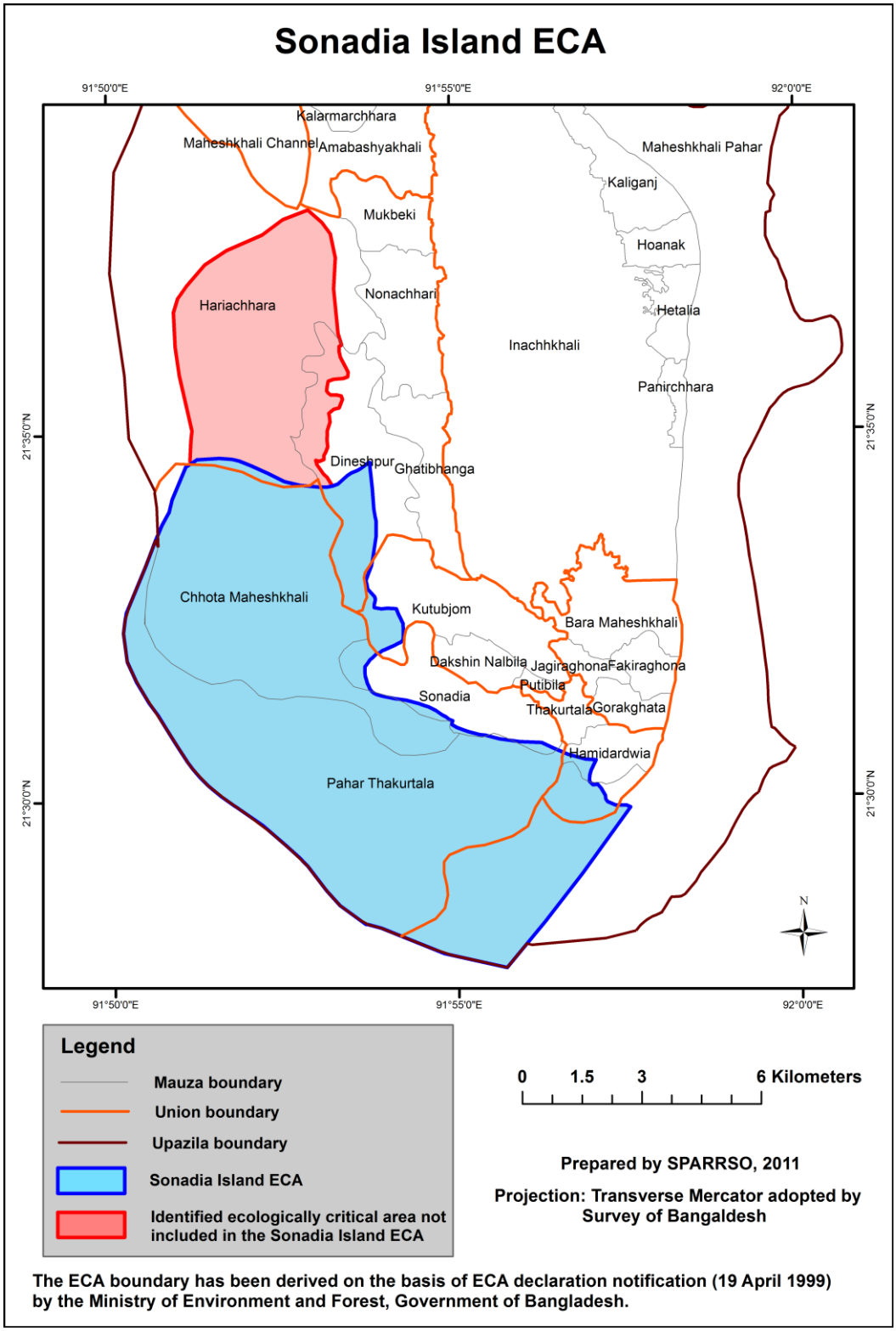

Figure: Map showing the position of the Sonadia Island ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

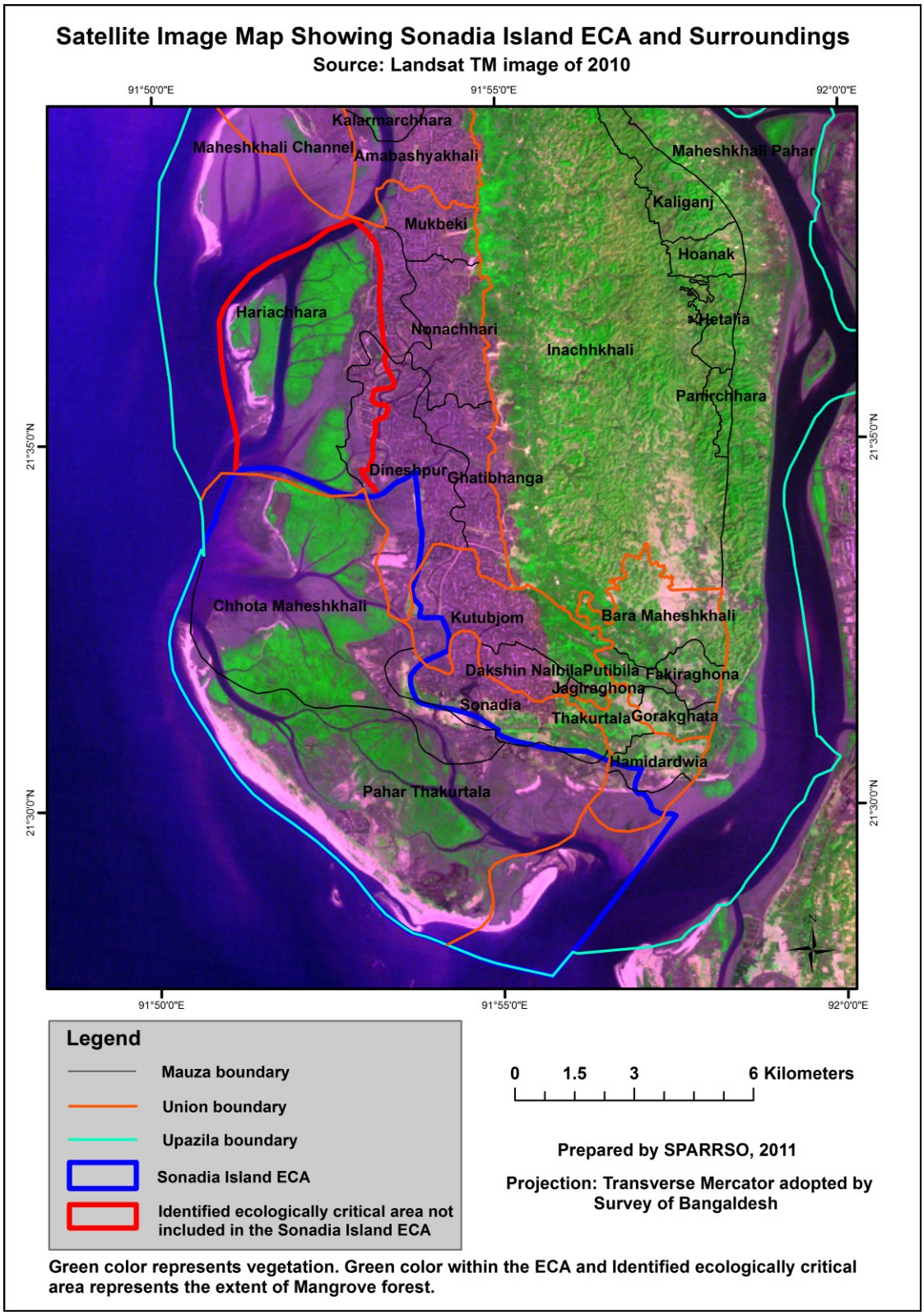

Figure: Image showing the position of the Sonadia Island ECA.

Source: DoE , 2011 (Prepared by SPARRSO)

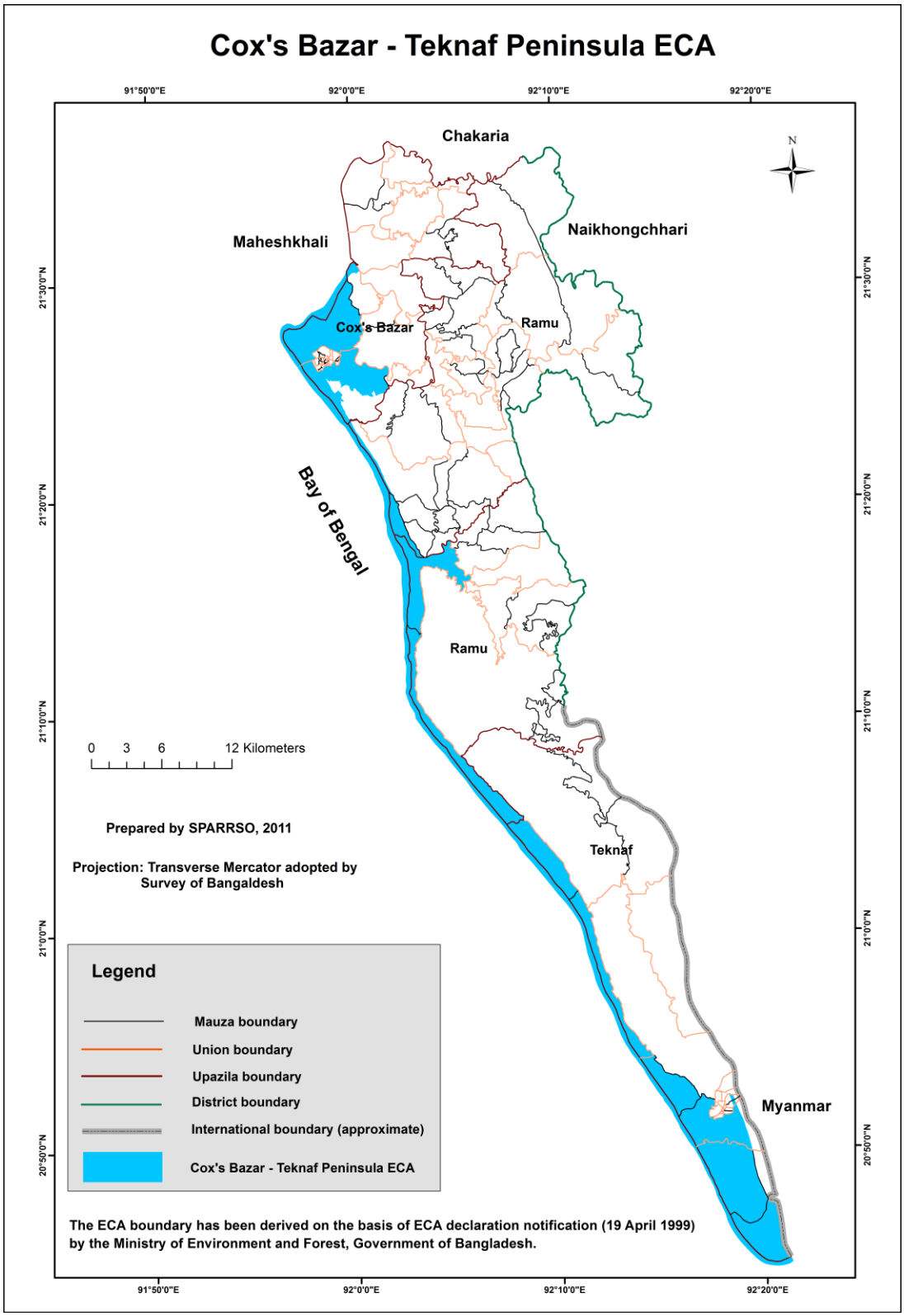

Figure: Map showing the position of the Cox's Bazar - Teknaf Peninsula ECA

Source: DoE , 2011 (Prepared by SPARRSO)

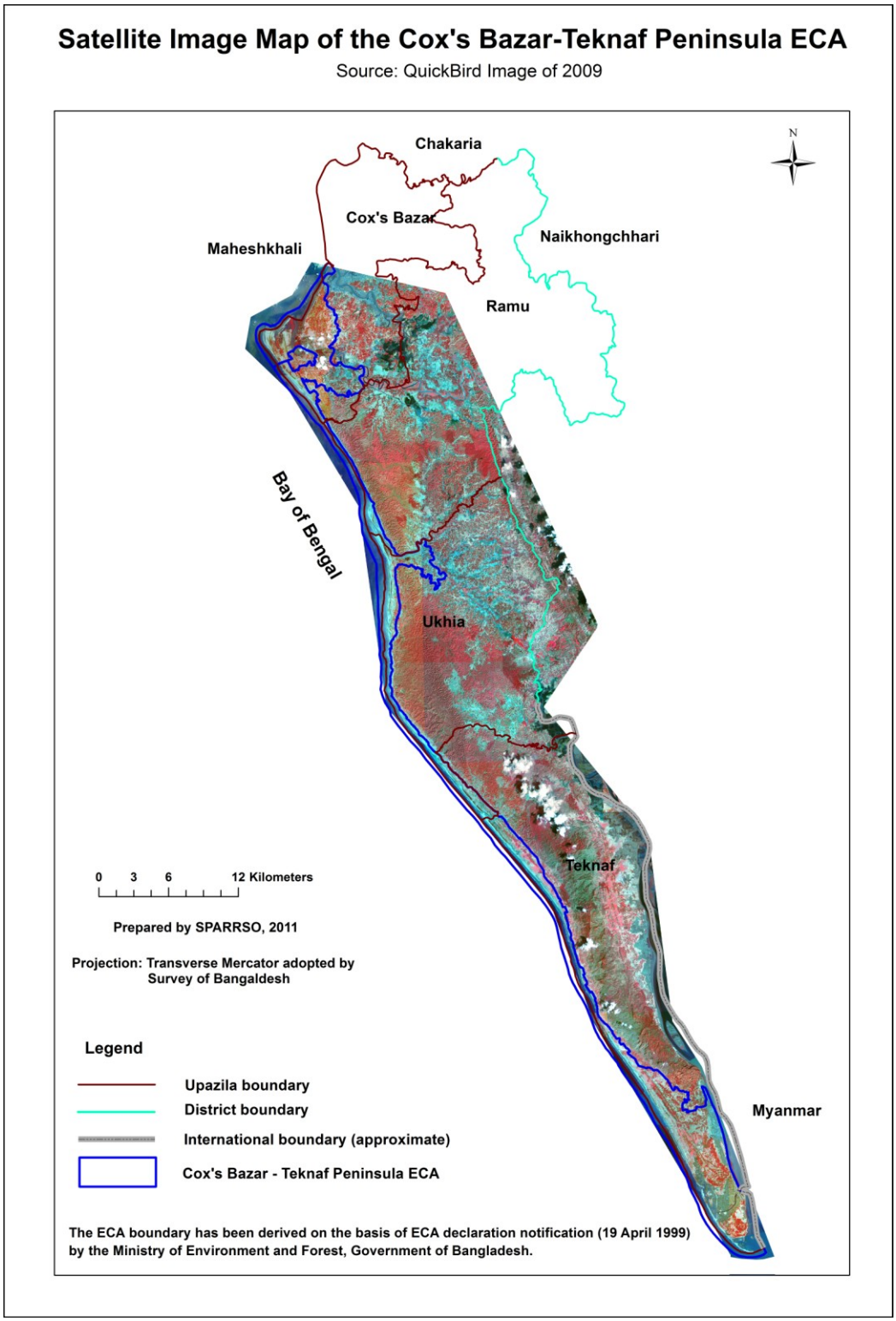

Figure: Satellite image map of the Cox's Bazar - Teknaf Peninsula ECA and its surroundings.

Source: DoE , 2011 (Prepared by SPARRSO)

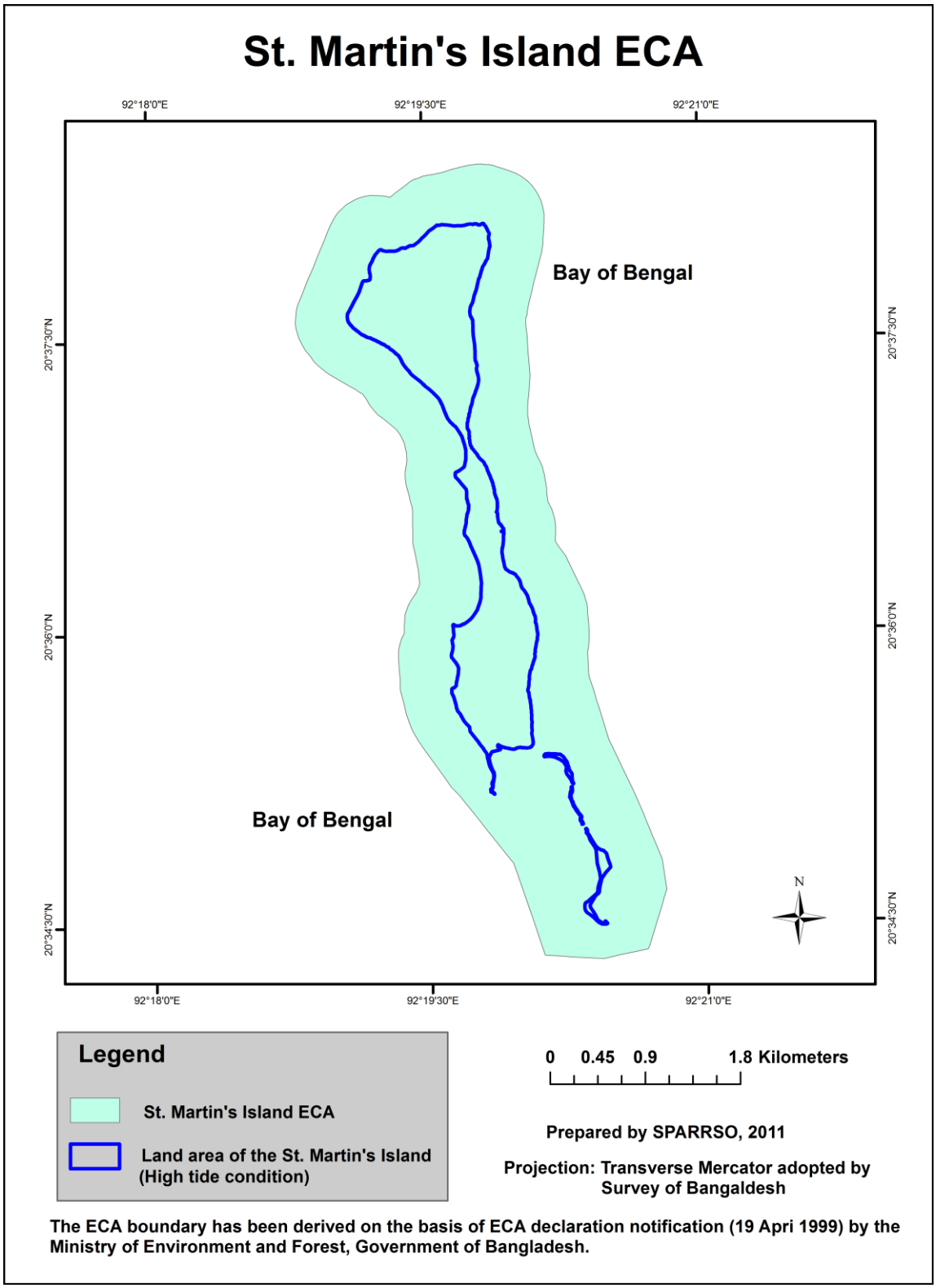

Figure: Map shows the position of the St. Martin's Island ECA

Source: DoE , 2011 (Prepared by SPARRSO)

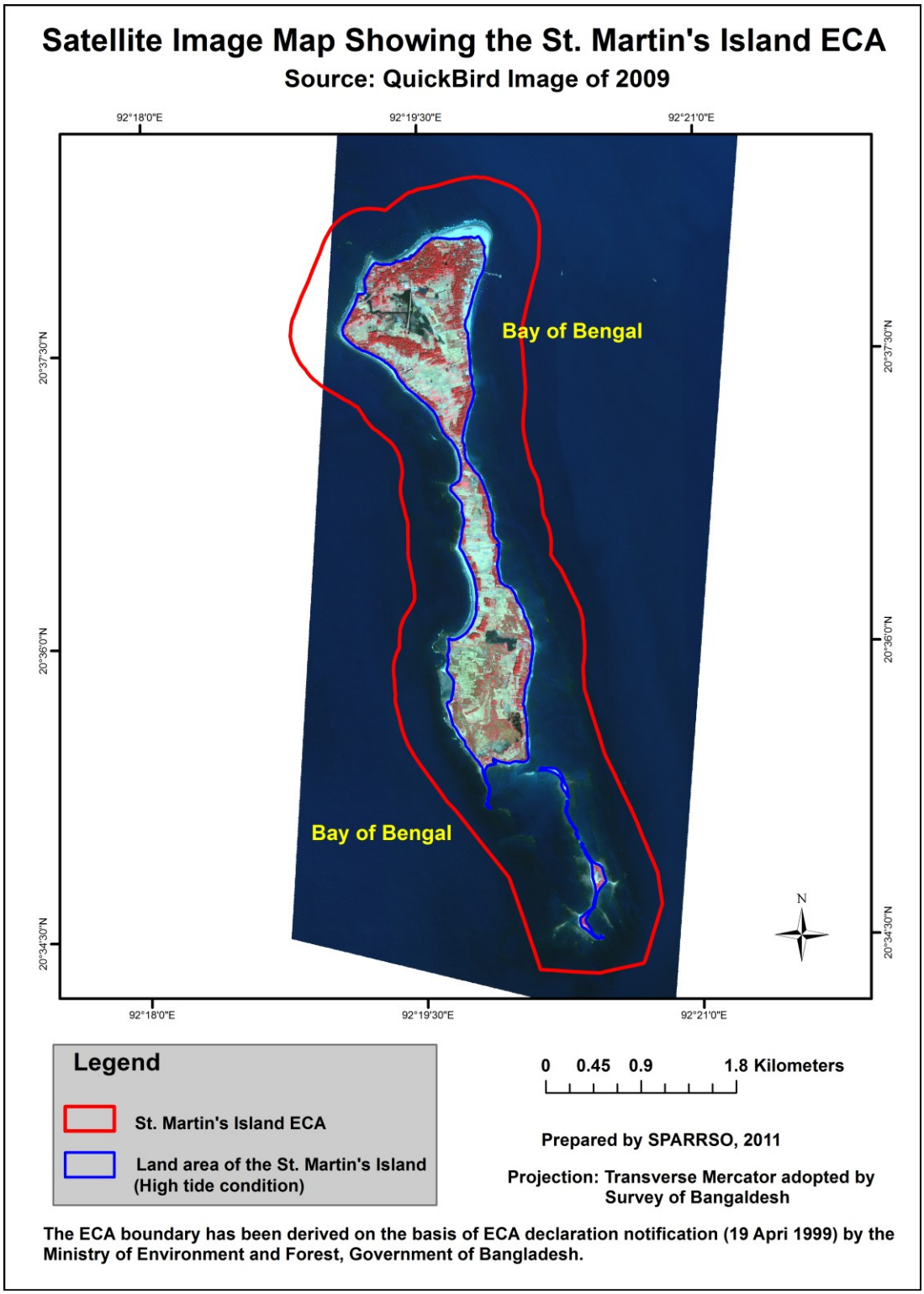

Figure: Satellite image map showing the St. Martin's Island and its surroundings.

Source: DoE , 2011 (Prepared by SPARRSO)

APPENDIX 3

Figure: Gulshan residential area at present (Source: Field survey, 2015)

Figure: Connection of polluted lake water through the culvert of Banani railway area

Source: RAJUK-2014

Figure: Contaminated lake water connectivity to the Baridhara DOHS areas

Source: RAJUK, 2014

Figure: Polluted water of Gulshan-Baridhara lake with bad odor.

Source: Household survey, May, 2016

Figure: Boats at Banani lake area which are totally unused at present due to change of lake transportation environment. (Source: POBA)

Figure: High level of pollution causing the decline of fisheries.
(Source: Field Survey, May 2016)

Figure: Unconstitutional seed and insecticide selling shop and illegal rickshaw stand at the bank of Gulshan lake Source: Field Survey, March 2016

Figure: Dumping of market waste at the bank of Gulshan-Baridhara lake

(Source: Field Survey, May 2016)

Figure: A hidden and broken evidence of hanging toilt at Gulshan lake area
(Source: Field survey, April 2016)

Figure: Empty waste bin not properly used by residents
(Source: Field survey, April 2016)

Figure: The temporary market at Gulshan-Banani link contribution to garbage generation into the lake. (Source: Field survey, November 2015)

Figure: Disposal of pollutants at the Shahjadpur lake part area.
(Source: Field survey, November 2015)

Figure: Lake land Filling and slum formation at the Mohakhali –Banani lake area.
Source: RAJUK, 2011