

CHANGING PATTERN OF WETLANDS AND ITS IMPACT ON ENVIRONMENT OF DHAKA CITY



Ph.D Thesis

By

A. K. M. Shahabuddin

Session: 2006-2007

**Institute of Environmental Science (IES)
University of Rajshahi
Rajshahi, Bangladesh**

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Partial Fulfilment of the Requirements for the Degree of

Doctor of Philosophy

in

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**Institute of Environmental Science (IES)
University of Rajshahi
Rajshahi, Bangladesh**

January 2010

Dedicated

To

My Beloved Children

Declaration

I hereby declare that the thesis entitled **Changing Pattern of Wetlands and its Impact on Environment of Dhaka City** is the result of my original research work and submitted to the Institute of Environmental Science, University of Rajshahi, Bangladesh for the degree of Doctor of Philosophy.

I further declare that this thesis has not been submitted in part or full previously for any degree.

Rajshahi,
January, 2010.



23.01.2010

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Certificate

This is to certify that the thesis entitled **Changing Pattern of Wetlands and its Impact on Environment of Dhaka City** submitted by A.K.M. Shahabuddin in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Environmental Science has been carried out by him independently under my direct supervision. I believe that Mr. Shahabuddin has made some distinct contributions in the field of Environmental Science. The thesis or thereof the part of it has not been submitted to any other university for any degree.

I also certify and recommend that the thesis is found satisfactory for submission to the Institute of Environmental Science, University of Rajshahi, Bangladesh in fulfilment for the degree of Doctor of Philosophy in Environmental Science.

Rajshahi,

Dated:

23 Jan 2010

Dr. Raquib Ahmed
Research Supervisor

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Author
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Abstract

Dhaka, the capital city of Bangladesh is one of the populous Mega cities in the world. High density population as well as shortage of land causes intense densification in the existing built up. Rapid population growth creates extra pressure on the land of already over crowded Dhaka city and the city is expanding in an unplanned and uncontrolled manner. One of the major adverse impacts of unplanned growth is destruction of environmentally sensitive areas. Dhaka city had a large number of wetlands both big and small, which includes rivers, canals, lakes, lowlands etc. But the wetlands have been shrinking with the passage of time. In recent years the speed of conversion of wetlands for housing and other infrastructures emerged as an alarming issue considering its adverse impact on environment. This study mainly focuses on three issues: i) Changes of wetlands in and around Dhaka city ii) Problems appeared in the city due to wetland change iii) Government's implications regarding wetland change.

This research documented the extent of wetland change since 1960. To accomplish the work topomaps of 1960 and three images of different years (Landsat TM, 1988; ALOS VNIR, 2008 and Goggle earth, 2008) were used. Findings reveal that a large portion of the wetlands has been lost and the rate of destruction of wetland is alarming. During the total study period (1960-2008), the city has lost 33% of water bodies and 52% of lowlands. During the period 1960-88 the water bodies decreased about 30 hectares per year and between 1988-2008 decreased about 6 hectares per year and lowlands decreased 29 hectares per year between 1960-1988, 315 hectares per year between 1988-2008. It is clearly observed from the analysis of change in land use dimension of selected wetlands areas that wetlands are mainly converted to built-up areas. It is also revealed from this analysis that the rate of transformation of wetland is highly related with urban settlement.

This research tried to apprehend the perception of local people regarding the loss of wetlands through questionnaire survey. It is evident from the views of surveyed respondents mainly real estate companies and government organizations are involved in wetland loss and water logging is the main impact of wetland loss.

The water logging becomes a burden for the inhabitants of Dhaka city and creating adverse social, physical, economic and environmental impacts. Interruption of daily work, children's problem going to school, disruption of electricity, risk of run of motor vehicle, damage of houses, problems in getting drinking water, sanitation problem, creating unhygienic situation and suffering from the disease are the encountered effects of water logging on city life. Respondents viewed that to overcome the waterlogging problem, all illegal structure from the wetlands need to remove immediately.

This research carried out a through assessment of prevailing plans, acts, rules and regulations for wetland management. The present wetland management of the public agencies has been critically analyzed and their overlapping and conflicting areas were identified. Activities of different environmental groups were also reviewed in this study.

The investigation undertaken for this study reveals that the present management practices of government organizations are very weak and not at all systematic. The existing legal tools of different agencies are not exercised properly. Overlapping of functions among the agencies creates conflicts in management. The coordination status of government organizations are poor but the PLDCs, local influential people and others, those are involved in wetland change are highly organized and well coordinated.

This study delivers the essence that combined effort is necessary from the part of involved stakeholders, like local people, NGOs, local government body, central government and civic organization to implement the conservation strategies of wetlands. Political will and government commitment is also needed for this purpose.

In conclusion, some recommendations are made regarding proper demarcation of wetlands, strengthening the relevant GOs, strict development regulation and proper enforcement of laws towards conservation of wetlands.

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List of Abbreviations

AC	Assistant Commissioner
AD	Anno Domini
ADB	Asian Development Bank
ADP	Annual Development Programme
BAPA	Bangladesh Poribesh Andolon
BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Center for Advanced Studies
BELA	Bangladesh Environmental Lawyers Association
BETS	Bangladesh Engineering and Technological Services
BGMEA	Bangladesh Garments Manufacturers and Exporters Association
BSCIC	Bangladesh Small and Cottage Industries Corporation
BWDB	Bangladesh Water Development Board
CBO	Community Based Organization
CNG	Compressed Natural Gas
CPC	Civil Procedure Code
CrPC	Criminal Procedure Code
CS	Cadastral Survey
CSO	Civil Society Organization
CUS	Centre for Urban Studies
DAP	Detailed Area Plan
DC	Deputy Commissioner
DCC	Dhaka City Corporation
DDC	District Development Committee

DGLRS	Director General of Land Records and Survey
DIFPP	Dhaka Integrated Flood Protection Project
DIT	Dacca (Dhaka) Improvement Trust
DMA	Dhaka Metropolitan Area
DMAIUDP	Dhaka Metropolitan Area Integrated Urban Development Plan
DMDP	Dhaka Metropolitan Development Plan
DND	Dhaka- Narayanganj- Demra
DOE	Department of Environment
DOF	Department of Forest
DPHE	Department of Public Health Engineering
DSMA	Dhaka Statistical Metropolitan Area
DWASA	Dhaka Water and Sewerage Authority
ECA	Environment Conservation Act
ECR	Environment Conservation Rules
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standard
ERD	External Resource Division
FAP	Flood Action Plan
FEJB	Forum of Environmental Journalist of Bangladesh
GIS	Geographic Information System
GO	Government Organization
GOB	Government of Bangladesh
GPS	Global Positioning System
HUDA	Hyderabad Urban Development Authority
ICTP	International Convention, Treaty and Protocol
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature and Natural Resources
IWFM	Institute of Water and Flood Management
IWM	Institute of Water Modeling
JICA	Japan International Cooperation Agency

MIS	Management Information System
MOEF	Ministry of Environment and Forest
MOL	Ministry of Land
NEMAP	National Environment Management Action Plan
NGO	Non Government Organization
PIL	Public Interest Litigation
PLDC	Private Land Development Company
PLDHPR	Private Land Development Housing Project Rules
PPS	Probability Proportional to Size
RAJUK	Rajdhani Unnayan Kartripakkha
RHD	Roads and Highways Department
RS	Rivisional Survey
SA	State Acquisition
SEMP	Sustainable Environment Management Programme
SOB	Survey of Bangladesh
SPARRSO	Space Research and Remote Sensing Organization
SPSS	Statistical Package for Social Scientist
TM	Thematic Mapper
UAP	Urban Area Plan
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
VNIR	Visible, Near Infrared
WAPDA	Water and Power Development Board
WB	World Bank
WWI	World Water Institute

Chapter 1

Introduction

Chapter 1

Introduction

1.1 Background

Dhaka, the capital and the most populated city of Bangladesh, is now the member of the “mega-city” family of the world. It is the center of all political, administrative and economic activities. The population of Dhaka city is increasing day by day and the population density of Dhaka City Corporation (DCC) is 19,286 per km² which is more than double of the mega city average of 7,918 per km² (DOE *et al.*, 2006). Area under jurisdiction of different authorities serving Dhaka varies. Dhaka Metropolitan Area (DMA) is somewhat larger than the DCC. Dhaka Statistical Metropolitan Area (DSMA), which is considered as Dhaka Mega city. Rajdhani Unnayan Karttripakkha (RAJUK) has a Strategic Planning Zone-wise definition of Dhaka city which is known as Dhaka Metropolitan Development Plan (DMDP). It currently consists of total 26 zones of which 19 may cover Dhaka Statistical Metropolitan Area, though the total area is about 1528 km² (RAJUK, 1997). However the most people, “Dhaka” generally means the central city only, i.e., jurisdiction of DCC and some adjoining built- up areas (Islam, 2005). But this study does not cover any specific administrative boundary of Dhaka. It covers the wetlands within the Dhaka city, surrounding rivers (considered as permanent wetland) and adjacent wetlands of surrounding rivers.

Urban wetlands have a major significance on its environment, drainage performance, ground water recharging capacity and availability of surface water. These wetlands have a close association with the life, livelihood of the people and natural setting of the city. Dhaka city had a large number of water bodies, both big and small, which includes rivers, khals, lakes, lowlands etc. A few years ago there were numerous lowlands, khals and channels within and around Dhaka city that would drain the city efficiently (JICA, 1991).

Due to the growth of urban population by rural to urban migration and by the natural growth of the city population the Dhaka city has spread over the years in all directions and with such expansion has been added shrinkage of wetlands. The low-lying areas,

depressions, khals and other water bodies are being taken over due to unplanned and uncoordinated urbanization without making provision for adequate drainage facility. The private land developer and real estate companies are filling up the low-lying areas and flood zone areas that were identified in both the 1959 and 1995 Master Plans, through land filling process without considering the free flood flow path and planned drainage for the city.

It is difficult for an urbanized area to deal with heavy rainfall within a short duration. Sufficient amount of retention area and flood flow zones are required to accommodate the excess water. But Dhaka is gradually losing its natural retention areas due to unplanned development.

Dhaka was a city naturally protected from flooding, water logging and related problems. But now, the situation is completely different. Due to rapid unplanned and unregulated urban expansion, Dhaka city suffers, seriously from problems of drainage and stagnation of rainwater. The situation has turned very bad in recent years both in the old city areas and new parts. Unwise closure of natural and old artificial drainage and navigational canals has aggravated the situation. Main streets now go under a meter of water after every heavy monsoon shower (Islam, 2005). The newly developed areas such as Demra, Jurain, Dolaipar, Maniknagar, Mugdapara, Manda, Goran, Rampura, Badda, Baridhara, Mohammedpur, RairBazar, Kamrangirchar, Abdullahpur etc. developed by filling low lying areas and depressions are suffering from the distress of water logging (Shams, 1999).

The recent trend of development in Dhaka has become an alarming threat for the remaining wetlands. Expansion of Dhaka city is engulfing the remaining wetlands disregarding the impact of the change on the environment of Dhaka city. Such land filling would lead to environmental disaster like water logging, decrease of ground water recharge and ground water level, destruction of natural drainage system, scarcity of water retention areas and increase of impervious areas. Thus it needs a comprehensive research work that will provide a clear perspective regarding the process, trend, context and consequences of loss of wetlands in and around Dhaka city.

1.2 Wetlands: General Consideration

“Wetland” is a collective term for ecosystem whose formation has been dominated by water and whose processes and characteristics are largely governed by water (Maltby, 1986 cited in Tatu *et al.*, 1999). Wetlands perform a wide range of functions that are essential for supporting plant and animal life and for maintaining the quality of the environment (Tatu, *et al.*, 1999). Wetlands are clearly distinguishable from other terrestrial and deepwater habitat due to their unique hydrological condition, which again vary significantly in terms of frequency of flooding, duration and depth of water logging. A coastal salt marsh experiences flooding twice a day with a wide variation of depth of water. On the other hand, flood plains all over the world are seasonally inundated with a rise of water level. The nature and timing on flooding depends on season and location of rain and the shape of drainage basin (Dugan, 1993a). A number of mixed shallow- water and terrestrial habitat types share several characteristics and are habitually grouped as wetlands. Wetlands in this sense are typically heterogeneous habitat of permanent or seasonal shallow water dominated by large aquatic plants (Groombridge and Jenkins, 2002). Wetlands are dynamic and complex habitats and rarely be assigned exclusively to just one system. This is borne out by Ramsar sites (Frazier, 1999). Wetlands consist of saltwater or freshwater marshes, swamps, bogs, wet meadows and fens. Wetland describes any area of low lying land where the water table is at or near the surface for most of the time, producing habitats appropriate for extensive shallow, open water and waterlogged areas; they are typically found in estuaries and along low land rivers. They do occur in upland areas, where the natural drainage is blocked by boulder clay deposited in the ice ages (The Environment Encyclopedia and Directory, 2001).

Wetlands are very dynamics in nature. Definition of wetland set by different organizations all over the world was done to serve the purpose of scientific understanding of the system and for the proper management of wetland. Mitsch and Gosselink (1986) have remarked that the precise definition of wetland that can be satisfactory to all users has not yet been developed. This is due to the fact that the definitions have been depended on the objectives and field of interest of the users (Tatu *et al.*, 1999).

Most universally accepted definition has been set by the Ramsar Convention. The Ramsar Convention is an intergovernmental treaty adopted on 2nd February 1971 in the city of Ramsar in Iran. The definition of wetland set by Ramsar Convention (Ramsar Convention Bureau, 2000) has considered as the operational definition for this research because most of the scientific literature on wetland of Bangladesh has used the Ramsar definition. According to Ramsar convention wetlands are defined as " Wetlands includes a wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as salt-marshes, mangroves, and sea grass beds but also coral reefs and other marine areas no deeper than six meters at low tide, as well as human made wetlands such as waste-water treatment ponds and reservoirs (Ramsar Convention Bureau, 2000).

The term " wetland loss" and "wetland degradation" are defined by Ramsar documents. "Wetland loss" is the loss of wetland area, due to the conversion of wetland to non-wetland areas, as a result of human activity. "Wetland degradation" is the impairment of wetland functions as a result of human activity. In practice wetland loss is rarely independent of wetland degradation, since loss of part of a wetland is likely to impair the functions of the remaining wetland area. Conversely, wetland degradation frequently occurs without the loss of wetland area, through upstream impacts on hydrology and water quality, etc.

The definition adopted by Ramsar of "wise use of wetlands" includes, "The wise use of wetlands is their sustainable utilization for the benefit of the human kind in a way compatible with the maintenance of the natural properties of the ecosystem". Sustainable utilization is defined as "human use of wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations" (Dugan, 1993_b).

1.2.1 Status of Wetlands: A Global Scenario

Wetland is a major feature of the landscape in almost all parts of the world and is one of the most important ecosystems on earth. Wetlands exist in both inland and coastal areas, covering 6% of the earth's land surface. Throughout both the industrialized and the developing world wetlands are threatened by drainage schemes, land reclamation and the reservoirs of large dams (The Environment Encyclopedia and Directory, 2001). Major

ecosystems in the world comprise forests, grasslands, agricultural lands and aquatic habitat including wetlands (Kabir and Amin, 2007). Most of the features of the landscape have changed due to human intervention and natural causes. In the last few decades, the changes in different ecosystems have immensely impacted negatively on nature in different ways.

About 56% of the estimated total wetland area is found in tropical and sub-tropical regions of the world (Mitsch and Gosselink, 1986). Mitsch and Gosselink (1986) mentioned that 8.56 million sq. km i.e., 6.4% of the land surface of the world comprise wetlands.

Table 1.1 Estimated area of wetlands in the world by climatic zone

Zone	Climate	Wetland area (sq. km x 1000)	% of total land area
Polar	Humid, semi-humid	200	2.5
Boreal	Humid, semi-humid	2558	11.0
Sub-boreal	Humid	539	7.3
	Semiarid	342	4.2
	Arid	136	1.9
Sub-tropical	Humid	1077	17.2
	Semiarid	629	7.6
	Arid	439	4.5
Tropical	Humid	2317	8.7
	Semiarid	221	1.4
	Arid	100	0.8
World total		8585	6.4

Source: Mitsch and Gosselink, 1986 cited in Tatu *et al.*, 1999.

Unfortunate existence of wetlands all over the world is threatened. Wetlands and their biota are under increasing anthropogenic and natural pressures. Human activities like unchecked vegetation removal, channellisation, filling, draining, dredging, construction of barrages and encroachment of the peripheral areas of the water bodies for residential, commercial and/or industrial purposes are affecting hydrological regime and biotic component of wetlands. Frequent droughts, siltation/sedimentation and eutrophication also impose adverse effects on wetlands (Tatu *et al.*, 1999).

Dugan (1993_b) cited a long list of incidences of loss or alteration of wetland around the globe. Despite the formulation of numerous international, regional and national policies and regulation to conserve wetland, global wetland loss is still alarming. Everyday in all corners of the world, the wetlands are shrinking in size to meet the increasing demand of space for urban uses, industries and for agriculture. It has been estimated by some specialists that the earth has lost 50% of her initial stock of wetland (Dugan 1993_a).

1.2.2 Overview of Wetlands in Bangladesh

Wetlands of Bangladesh are being considered as the invaluable components of the ecosystems in recent period having enormous economic, ecological and commercial importance (Khan *et al.*, 1994; Islam, 1995). They play a vital role in the life and environment of this country. From an environmental point of view, the most influential feature of Bangladesh is the vast amount of water flowing through a flood plain (Chowdhury, 2001). They are rich in biodiversity of floral and faunal composition including migratory birds of global and regional significance. The coastal and inland wetlands cover the vast floodplains and delta system of the Ganges, Meghna and Brahmaputra rivers. Although the country is relatively small, only about 144,000 square kilometers, Bangladesh serves as the drainage path for a catchments area that is nearly ten times larger. The catchment basin of the combined Ganges, Brahmaputra and Meghna rivers covers more than 1.5 million square kilometers. Due to the deltaic character of the country, Bangladesh is composed of numerous wetlands. The total wet season wetland area in Bangladesh has been estimated at about 7.5 million hectares (Chowdhury, 2001).

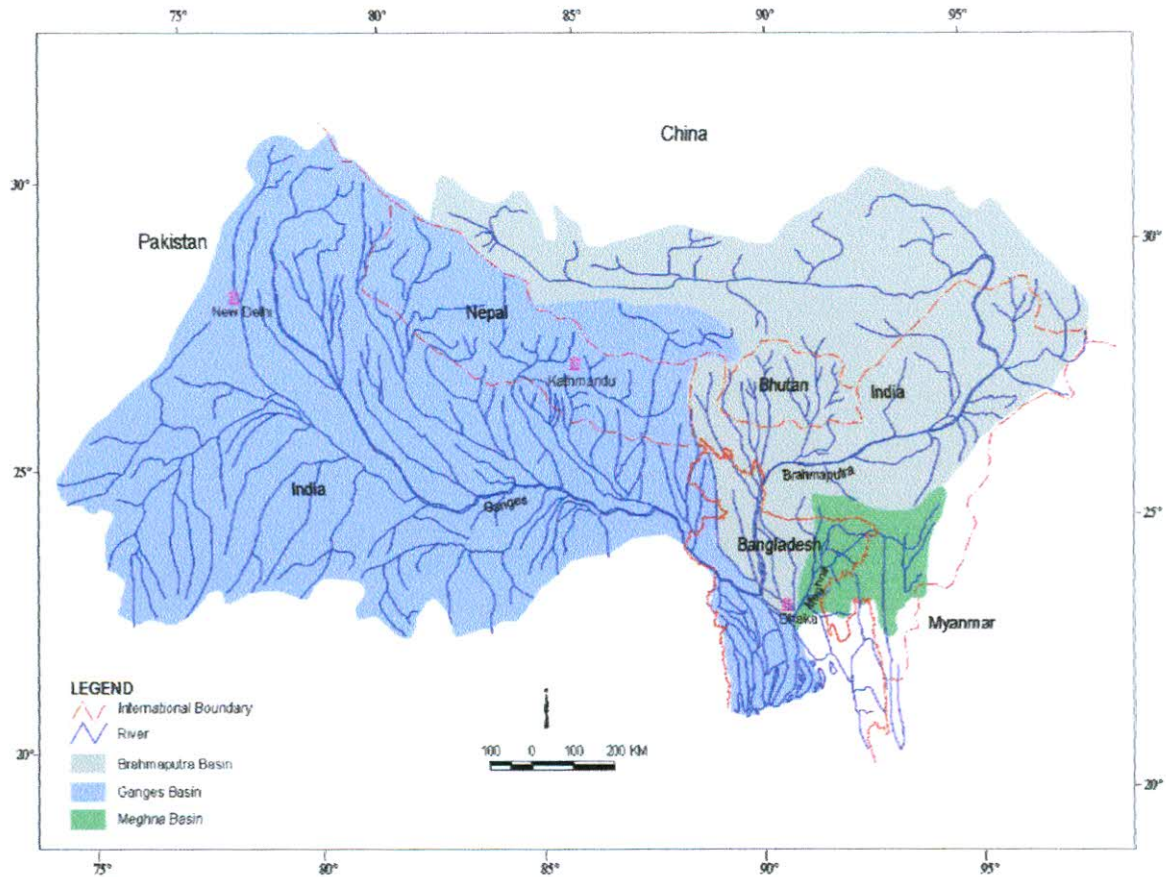


Figure 1.1 The catchments of the Ganges-Brahmaputra-Meghna Basins

Source: Rahman *et al.*, 2005

The total area of the wetlands of the country has been estimated at seven to eight million hectares, which is about 50% of the country's land surface. There are vast wetland areas among which the major ones are rivers, streams, freshwater lakes and marshes including *haors*, *baors*, *beels*, water storage reservoirs, fish ponds, cultivated fields and estuarine systems with extensive mangrove swamps (Nishat *et al.*, 1993; UNEP, 2001). But the total area of wetlands are reducing very fast, and at the same time the remaining areas are being degraded rapidly due to population pressure, excessive exploitation of the resources, changes in land use pattern and various development activities in the wetland areas like construction of flood protection embankment to facilitate agriculture.

In the Ganges-Brahmaputra floodplain alone, approximately 2.1 million ha of wetlands have been lost due to flood control, drainage and irrigation development (Khan *et al.*, 1994).

1.2.3 Wetlands in the Context of Dhaka City

Enormous wetlands in and around Dhaka city area were the cardinal stimuli to emerge the region as the hub of economic, cultural and administrative matters. Buriganga river in the south, Turag in the west, Tongi in the north and Balu in the east are the main river arteries around Dhaka city for navigation of goods and passengers since long (Islam, 2002).

The history culture, economy and splendor of Dhaka, from township up to the existing bustling mega city, have greatly been influenced by the presence of the Buriganga. Only two or three decades ago, the Buriganga provided the city dwellers with sufficient fish from its unpolluted water. But now the river itself is about to die.

On the other hand, the canal system of Dhaka had the agile presence for a long time to make the city breathing in various aspect (Islam, 2002). A number of canal/ khals, narrow creeks interweaved all over since long. In the historical past of the city, Dhaka was regarded as the Venice of east or the city of channels (Dani, 1962). Geddes compared Dhaka city with the modern European cities ((Islam, 2002). Three major historical channels of the city like Dolai Khal, Begunbari Khal and Segunbagicha Khal were very active drainage in the recent past. Besides, Imrahimpur Khal, Mohakhali Khal, Paribagh Khal, Diabari Khal, Degun Khal, Manda Khal, Gazaria Khal played important role maintaining the city breathing. The conditions of some of the canals are very much critical at present and some of them are already vanished. However, all the canals flowing through different areas finally join the river system i.e, Segunbagicha – Jirani- Dholai khal joins with the Balu and Buriganga, Ibrahimpur- Kallayanpur khal joins with the Turag, Dhanmondi- Gulshan-Banani-Mohakhali- Begunbari khal joins the Balu river.

Now Dhaka is a city of high trend of urbanization. Every year there is a great increase of planned and unplanned residential houses, commercial areas, roads and highways etc. And most of the water bodies and low-lying areas are being used for this urbanization in the city. Massive development and settlements like activities of housings societies, construction of residential houses, growth of slums and squatters etc have taken place in low lying areas of Dhaka city.

Due to ineffective city planning accelerating growth of population and associated architectural and environmental issues and all these aspects have reached to a state of imbalance in city development and brought about massive socio-economic and environmental problems (Elahi, 2005).

1.2.4 Types of Wetlands

IUCN has identified a total of thirty-nine categories of wetlands on the basis of biological and physical characteristics, of which thirty are natural and nine are manmade (Dugan, 1990 cited in Kabir and Amin, 2007). World wide commonly recognized categories are bogs, fens, marshes, swamps and floodplains. Among the generalized types of wetlands, bogs are characterized by acidic peat and fens have a less acidic peat layer with predominantly herbaceous vegetation comprising sedges. Marshes are characterized by mineral soils with mainly herbaceous vegetation. Floodplains represent a complex of diverse habitats including marshes, swamps and shallow ox-bow lakes. Wetland habitats also include large lakes with periodically high level of water, and seasonally flooded or permanent shallow water bodies.

According to Ramsar Convention (1971) the definition of wetlands in Bangladesh has been placed in seven categories of landscape units. These are:

- Estuarine
- Open coast
- Flood Plains
- Fresh water
- Marshes
- Lakes peatland
- Swamp forest (Nishat, 1993)

On the basis of hydrological and ecological function and land type wetland can be classified into the following categories (Khan *et al.*, 1994).

Salt-water wetlands

- a) Marine
 - Permanent shallow waters at low tide, e.g. Bay
 - Coral reefs, e.g. St. Martin's reef.
- b) Estuarine
 - Intertidal mud, sand or salt flats with limited vegetation, e.g. newly accreted land
 - Intertidal marshes
 - Intertidal forested wetlands including mangroves e.g. sundarbans
- c) Lagoonal
 - Brackish to saline lagoons with narrow connections with the sea.

Fresh water wetlands

- a) Riverine wetlands
 - Permanent rivers and streams including in some char land.
 - Temporary seasonal rivers and streams.
- b) Lacustine wetlands:
 - These are lake system and include haors, baors and beels.
- c) Palustrine wetlands:
 - Permanent fresh water marshes and swamps with emergent vegetation.
 - Permanent peat- forming fresh water swamps dominated by typha.
 - Freshwater swamp forest.

On the basis of ownership wetland can be divided into two types (Alam, 2007).

- Government's wetlands: Khas wetland has been defined in section 2(A) of the government Fisheries (Protection) Ordinance. Here it has been mentioned that the government is the owner of the khas wetland.
- Private wetlands: Except the government's wetlands, all wetlands whose ownership lied under private authority are called private wetlands.

Manmade wetlands

- Aquaculture ponds.
- Irrigated land and irrigated channels.
- Salts pans.
- Hydro-dams, Kaptai lake.

Table 1.2 Types of inland wetlands and their areas

Open water	
Name of wetlands	Amount (in sq. km.)
Rivers	4,797
Estuaries and mangrove swamps	6,102
Beels and haors	1,142
Inundable floodplains	54,866
Kaptai Lake	688
Closed Water	
Ponds	1469
Baors (Oxbow lakes)	55
Brakish- water farms	1080
Total	70199

Source: Khan *et al.*, 1994 and Alam, 2007

1.2.5 Importance of Wetlands

Wetlands have great ecological, economic, commercial and socioeconomic importance and values. Wetlands perform a series of functions that are extremely beneficial to the ecosystems in which they are located, functions that in turn bring considerable benefits to local communities to the national society as a whole. In their natural state, wetlands perform several functions. They provide food, breeding ground, water and sanctuary for many forms of fish, birds and other animal and plant life. Wetlands also act as a buffer to regulate floodwaters, which spread out before reaching higher ground as a flood or storm tide (The Environment Encyclopedia and Directory, 2001).

In Bangladesh, wetlands serve a wide variety of function, such as flood control, water purification, protection from natural disasters, source of livelihood and habitat for wildlife and fish (Chowdhury, 2001). Some of these benefits provided by wetlands are mentioned below:

a) Water supply

- Water supply to people: In Bangladesh, the rural population is 84.8% of the total national population. A good proportion of this population uses the surface water from wetlands for its everyday needs.

- Water supply to other wetlands: Wetlands can function as a water source for other wetlands. For instance, a river or beel is often the source of water for canals which led to other beels, flood plains, and distributaries.
- Water supply to agriculture: Wetlands serve as a source of irrigation water. About 50 percent of the demand for irrigation to our agricultural fields is supplied by surface water. Out of this, 30 percent is by gravity flow, 48 percent by low lift pumps and 22 percent by traditional method.
- Water supply to industry: Wetlands are water sources for mechanical processes and equipment operation in many industries. The washing and cooling of machines is an example. Wetlands are also water sources when used as one of the raw materials of the final product.

b) Flow regulation

Wetlands provide the routes for water passage through Bangladesh. They serve as collection points for various surface water sources. The Bangladesh river-system is an integrated drainage system and each wetland acts as a drainage component of this system.

c) Protection from natural calamities

Wetland in the coastal areas, such as mangrove forests, provides a buffer to dissipate the energy from strong winds or waves. Wetlands help protect lands from the loss of valuable topsoil by wind or water movement. Wetlands have greater moisture availability in their soil and, therefore, suffer less erosion due to wind action. The presence of wetlands ensures that adjoining areas are moist enough to protect against wind erosion.

d) Sediment deposition

Plants consume soil minerals and nutrients. Over time, this can deplete the soil fertility. Wetlands help to recharge the soil fertility by trapping mineral particle and organic matter settle on the making it more fertile. Thus the soil fertility is recharged for agriculture occurring on these wetlands.

e) Habitat and biodiversity

Wetlands provide shelter, feeding, breeding, and nursery support to wildlife. They support a rich diversity of biological species.

f) Natural cycle

- Hydrological cycle: This cycle describes the movement of water between the earth's surface and the atmosphere. Wetlands serve as a major source of water vapor that enters the atmosphere and eventually returns as precipitation. In addition the wetlands serve as the drainage ways, which channel the precipitation into the rivers and oceans. Wetlands are a principal component of the hydrological cycle.
- Bio-geo-chemical cycle: The bio-geo-chemical cycles describe the cyclical movement of minerals and elements between the biotic and abiotic components of the ecosystem. The amount of available elements in nature affects the life cycle of organisms. Part of each cycle occurs within living biotic organism; other parts occur as chemical actions in the abiotic environment. The flow of elements is cyclical and matter is reused.
- Production cycle: Wetlands are one of the most productive ecosystems of the earth surface. They are a highly productive site for photosynthesis, which converts sunlight energy into bio-mass.

g) Water purification

Nutrients come from a variety of sources such as run-off of fertilizer from agricultural field, human and animal wastes, and industrial discharge. Mostly, these nutrients are inorganic phosphorus and nitrogen. Wetlands plants can neutralize absorb or transform the nutrients into organic plant tissue. For example, the wetland plant duckweed, can take up such inorganic agents. This helps to clean the water and provides improved water quality benefits for communities downstream.

h) Socio-economic and cultural significance

- Livelihood and profession: In Bangladesh, wetlands are an integral part of the life of rural people. Many people live are dependent on the fishery sector. In addition to fishing, wetlands are a site for gathering important plants, animals and raw materials, such as clay, sand.
- Religious and spiritual significance: Wetlands are important sites for religious gathering, ritual bathing and melas. On the banks of river Turag in Tongi, the world second largest Muslim gathering takes place each year. Langalbandh is famous for Hindu ritual bathing ceremonies.

i) Production of food and other materials

Wetlands provide rice, fish, meat and vegetable. Wetlands provide food for animals. Wetland plants are used as medicine for treating various diseases. Wetlands provide most of building materials, such as, sand, timber.

j) Navigation

Wetlands serve as waterways for the movement of people and their goods by water transportation, especially in the wet seasons. Every year a large number of passengers use the waterways to reach their destinations. During the wet season waterways are the principal means of transport in vast areas of Bangladesh.

1.2.6 Importance of Urban Wetlands

Wetlands in urban area have a major significance than the wetlands of rural areas in respect of its environment, drainage performance, ground water recharging capacity and availability of surface water.

- Drainage Management

Wetlands in urban area such as canal, lake, river, and low-lying areas carry wastes, excessive rainwater from one place to another which makes the city clean. Any kind of degradation of such wetlands makes the drainage system of whole city vulnerable.

- Flood Control

The water- bearing capacity of urban wetlands helps to balance water flow following rain events. Wetlands capture rainwater and release the water slowly and evenly to another large water body such as nearby river during the rain and flood season. This reservoir function helps to reduce the intensity of floods and helps to prevent flash flooding. It makes the city free from water logging. The reserve provided by the wetland reservoir helps to meet water needs during the dry season.

- Ground Water Management

Ground water is constantly being naturally discharged through evaporation and transpiration; artificially through extraction by shallow and deep tube wells. Wetlands recharge the ground water supply through infiltration and deep percolation. Wetlands

serve a vital role in maintaining a balanced hydrological cycle, which is important for our survival. Wetlands in and around the city works as a catchments area of ground water recharging. Water in wetlands seep into the ground, helping to replenish underground water reservoirs called aquifers. Urban water bodies play a key role in maintaining ground water level, which ensure smooth water supply to the city.

- Recreation

People like to go to wetland sites for recreation purposes and for spending their leisure time. The urban wetlands offer great relief to the dwellers of a highly congested city like Dhaka. The vast floodplain areas at the periphery of the city are aesthetically pleasant and well visited recreational sites. The city dwellers enjoy its calm flow, panoramic view, fresh breath and recreation.

- Mode of communication

Traffic jam is a serious problem for the inhabitant of urban areas especially urban area like Dhaka city. If the urban wetlands are used in a planned way they can be used as a good mode of communication, such as the circular water body of around the Dhaka city. Communication through water way from one part of the city to another can make it free from congestion and pollution. If it is planned in a proper way the conveyance would be economical as well as it will save the working time.

- Availability of Surface Water

Several fire incidences occurred in urban areas in every year, particularity in dry season. Due to the Shortage of surface water, it delayed control of fire. If the urban wetlands are being alive, the surface water would be available, and that would be helpful for the fire control in the urban area.

1.3 Statement of the Problem

The urban population of Bangladesh was estimated at 38 million in 2005 and is expected to rise to 86.5 million by 2030. While 25% of the population of Bangladesh was estimated to live in urban areas in 2005, current projections indicate that the urban population of Bangladesh will rise to 39.3% by 2030 (Shaik, 2006).

Dhaka is the capital of Bangladesh. Beside this all major activities and facilities are concentrated here. As a result people from all over Bangladesh are attracted towards this city. On the eve of liberation in 1971 Dhaka had a population 1.2 million, which has reached to almost 12.8 million at present (BBS, 2008). Rapid urbanization by filling up of lakes, ponds have been given the city barren and alien look.

Dhaka had an effective and operational naturally designed rain and sewer water management system. There were existence of 35 canals and hundreds of large and small ponds marshlands in and around Dhaka even in the early seventies. These canals were occupied by land grabber and they have made many unauthorized infrastructure, which blocked the flow of water partially or fully (The New Nation, 15 March 2007).

Environmentalists experts expressed utmost concern as Dhaka city is losing 30,000 square feet of wetlands everyday (The Financial Express, 18 February 2007).

Natural water bodies as part of a city's general land cover /use are an integral functional component as well as carries an aesthetic value. Gradual decrease of water body destabilizes the entire synthesis.

There is a huge crisis of safe drinking water for the inhabitants of Dhaka city and this crisis is expected to be deteriorated in the years to come. Present and future water supply and demand scenario of Dhaka city are shown in the following table:

Table 1.3 Present situation and future prediction of water demand in Dhaka city

Year	Water demand	Shortfall (mld) in comparison with present water supply (1500)
2005	1999	499
2010	2485	985
2015	3050	1550
2020	3686	2186
2025	4419	2919

Source: Al-Mamun, 2006

Contribution of ground water and surface water is 83% and 17% respectively of total supplied water in Dhaka city. Due to excessive abstraction of ground water, underground water level is going downwards and at the same time due to change of wetlands

underground aquifer can not recharge proportionately. Ground water depletion is now at alarming rate, more than 3 meter/year at most places (Al- Mamun, 2006). With low ground water levels and insufficient infiltration the capital could slowly start to sink. While this may seem highly implausible now, there is a definite possibility that it may occur (The Daily Star, 22 June, 2007). The water bodies played a part in holding excess water and maintaining ground water level to ensure supply of water to Dhaka city.

The water bodies played a part in holding excess water. Thus largely deprived of this natural drainage system, the city these days suffer chronically from flooding and water logging and the phenomena is turning worse every year.

Water logging in Dhaka city is not a new problem but the frequency of this problem is increasing day by day. Currently 30 minutes of rain is all that is needed to temporarily flood the city (The Daily Star, 22 June, 2007). Flooding due to rainfall is a severe problem for Dhaka City that is inundated for several days mainly due to the illegal filling up of natural wetlands along with alarming unplanned urbanization. The water depth in some of the areas may be as much as 50-70 cm, which creates large infrastructure problems for the city and a huge economical loss in production for the city together with large damages of existing property and goods (Tawhid, 2004). In addition, diseases are spread and gives problems to the population e.g. in terms of diarrhoea.

Thus appropriate measures to conserve the wetlands in and around Dhaka city have become an urgent matter for the sake of livable environment in the city.

1.4 Hypothesis

To begin a research work, setting up a hypothesis is a prerequisite and is considered as a principal instrument in research. A hypothesis at its initial stage may be an assumption or mere a guess, the validity of which needs to be tested. Although it is a guess, but this is an experienced guess based on some facts. Hypothesis is very essential to advance a research work.

Primarily the following problems of the study area have selected:

- Wetlands are encroached or filled up in different ways and areas of wetlands are decreasing.

- Wetlands are converted into built up areas for housing, industries and other infrastructures.
- Due to land filling or encroachment on wetlands, undesirable environmental problems are arising.
- Laps and gaps remain in relevant policy, acts, rules and regulation.
- Problems lie in implementation of concern acts, rules and regulations, such as, overlapping, corruption, lack of coordination.

1.5 Objectives

It is necessary for every researcher to fix up some objectives at the time of beginning of his research to complete the work properly in schedule time and plan.

The general objective of this research is to identify the bottlenecks of urban wetland management, trend of wetland change and its impact.

The specific objectives of this study are:

1. To study the past and present situation of the wetlands in and around Dhaka
2. To investigate the causes of both eventual and policy implications of wetland change in the study area.
3. To find out the impact of wetland change on environmental and social life in Dhaka city.
4. To examine the dimension in the change in land use due to the change in wetlands.

1.6 Justification of the Research

Urban environment management in general and urban wetland management in particular is a recent phenomenon in Bangladesh. The 1959 Master Plan for Dhaka city could not provide solution to the problems created by rapid and unplanned expansion of the city and the strategy plan prepared in 1980 was not formally approved hence no implementation could be made. The Dhaka Metropolitan Development Plan (DMDP) is the prevailing plan for the development of Dhaka. DMDP does not provide detail guidelines to the private sector or other developers. The general guideline has loopholes for the irrational land development activities, because DMDP did not prepare any land use map according to the C.S. Mouza map . The third level of planning, Detailed Area Plan (DAP) is yet

prepared finally. Therefore, the Dhaka city has been growing on its own in a haphazard manner. Due to the rapid increase of population and the non implementation of land use controls suggested in the Master Plan and subsequent plans, urbanization expanded into the low lying areas and depressions. It has also grabbed the natural channels causing the disruption of the hydrologic link with the surrounding rivers and Khals. Land development by land filling process in the depression significantly reduces the “Natural storage area” within the city. The proportion of impervious area has increased reducing the storm water lag time and consequently increased the flood peak. Narrowing of the Khals caused a worsening of the water logging problem by increasing the duration as well as the waterlogged area along the Khals and causing environmental problems and health hazards. Furthermore, illegal land encroachment along the canals, lakes and rivers and uncontrolled development regulation of assigned authorities have made the situation unbearable and gradually reducing the drainage capacity of the city over the years. Most of the canals of the city are dead now due to human intervention, road and box culvert construction, illegal encroachment, land filling, private residential development etc. Somehow the encroachers are getting the legitimacy for such land filling from the concerned authority. Water logging has been identified as one of the major problems of Dhaka city in World Bank (2007) report on Strategic Environment Assessment of Dhaka.

Recently urban wetland disruption has attracted the attention of mass people. Government has enacted some rules and regulation in this regard. Limited number of projects is being implemented with a view to reinstate the water bodies. In spite of this, changing of wetlands in urban areas is going on and the situation is deteriorating.

Urban wetland management demands well-equipped institutions with efficient and honest manpower, well-guided programs, proper laws and regulations with strict enforcement, coordination among the concerned authorities, public- private partnership and above all mass awareness. Thus it needs comprehensive and systematic study about urban wetland change and its consequences. There is a paucity of study focusing on causes or forces active in the conversion of wetland and perception of the local people of surrounding wetland areas about the consequences of wetland change, way of mitigation and conservation programs. The perception of inhabitant of nearby wetlands area is supposed to be an important component while formulating any policy, plan or conservation program.

This study attempts to give an overview of trend of wetland change in Dhaka city and to explore the peoples perception about causes of wetland change, major impacts of wetland change and level of legal status and implication of laws.

1.7 Scope and Limitation

- The study has provided the greater scope to identify the bottlenecks of existing urban wetland management.
- To overcome the water logging problem of Dhaka city it was necessary to find out the inherent causes of this problem considering its associated impacts on the human life. Thus this study has provided a guideline to take appropriate steps for better management of the problem.
- This study will help to promote awareness regarding the conservation of wetlands in the urban areas.
- For the limitation of time and lack of budget it was not possible to analyze all the impacts of wetland loss. The study has focused mainly drainage congestion and water logging and problem.
- Major survey related information on Dhaka is under the jurisdiction of Defense Ministry and it was simply impossible to get the soft copy of this data.
- During the questionnaire survey some interviewee did not want to make any comments against the responsive development authorities even they know the lack of efficiency of those authorities, because they think negative comments can be harmful for them in near future.
- Some respondents believed that this work carried out only for the personal benefit of the researcher and they will not get any benefit from it. So they did not want to show any interest in co-operating with the researcher and investigator.

1.8 Outline of Thesis

The dissertation on changing pattern of wetlands and its impact on environment of Dhaka city has comprised eight chapters including this chapter.

The first chapter contains introductory subject matter of the study which covers background, general consideration of wetlands, statement of the problem, hypothesis, objectives, justification of the research, scope and limitation and outline of the thesis.

The second chapter is theoretical background and literature review, in which relevant literatures from articles in journals, internet sources, books, thesis, manuscripts etc. have been reviewed.

The third chapter is about sources of data and research methodology which has discussed types of research, sources of data, selection of study area, sample size determination and selection of respondents, methods of data processing and analysis and overall research methodology.

The fourth chapter deals about “growth of Dhaka city and wetland disruption” which has focused about study area, profile of the respondents, physical and demographic development, urbanization in Bangladesh and Dhaka city, present hydro-geographical situation of Dhaka city, natural drainage system of Dhaka city, and process and causes of wetland disruption.

The fifth chapter analyses about general land use/cover pattern, maps and images interpretation, changes of wetlands and others features, overlays of wetland map and change detection and land use of changed wetland areas.

Chapter six illustrates about the consequences of wetland transformation mainly environmental degradation such as, declining ground water level, scarcity of natural water retention areas and drainage congestion and water logging.

The seventh chapter deals about “ wetland management and government policy” which describes organization involved in wetland management, existing policies, laws and regulation, international convention on wetlands, respondents opinion on wetland conservation act and enforcement of laws and rules and initiatives and activities of government and different environmental groups for wetland conservation.

The eighth chapter is finally a conclusive chapter. It summarized the findings of the study, conclusion of the research work and recommendation for solving problem related with wetland disruption and sustainable wetland management of the study area. The thesis is also supplemented with the references and appendices at the end.

Chapter 2

Theoretical Background and Literature Review

Chapter 2

Theoretical Background and Literature Review

Review of literature is an important section that links previous knowledge with that of objectives of the work and find out the gap. Some important works relevant to the present research work are reviewed and briefly cited.

2.1 Urban Environment Management

Shaik (2006) has discussed in a research about the impacts of urbanization in Bogra municipal area of Bangladesh. In this research he has identified some social, economic and environmental impacts of urbanization. In the discussion about the environmental impact of urbanization, he discussed about the impact on Flora and Fauna, cultivation, sanitary facilities, sewerage system, pollution, slums, drug addiction, prostitution, and law and order situation.

But in his research he did not discussed about the water bodies or wetlands of urban areas.

Rahman *et al.* (2001) has discussed in a report entitled 'People's Report on Bangladesh Environment 2001' about the people's perception on environmental degradation and their creative options for improving the surroundings they live in. They mentioned that wetland resources are crucial to the environment of Bangladesh. Unfortunately, wetlands habitat is under constant threat through human encroachment and by flood control and irrigation schemes.

The editors discussed different aspects of environmental degradation but did not categorically discuss about the changes of wetlands in urban area.

Dani (1962) "Dacca: A Record and its Changing Fortunes" is a systematic brief historical account of Dhaka city. This book contains the descriptive accounts of Dhaka city and some early urban maps of the city that have proved to be most important source material for the research of this field. Beside, this book provides some geographical and environmental description of the then Dhaka city, which is needed to build up conceptual framework regarding any study of Dhaka city.

Bhuiyan *et al.* (2002) has discussed in a paper titled “Unplanned Waste Disposal and Its Possible Impact on Subsurface Environment of Dhaka City, Bangladesh”. They mentioned that only domestic solid waste are collected and dumped by Dhaka City Corporation (DCC), but other industrial waste are thrown into urban run off or nearby drainage systems. For a long time, it is common practice of the city corporation to dispose solid wastes to fill lands in open low-lying areas in an around the Dhaka city. These types of open dumping and can make a serious threat to the ground water as well as surface water. They also observed that south and southwestern parts of the Dhaka city are most susceptible for ground water contamination from waste disposal site.

Kruger (1996) envisaged a strategic approach to environmental management in his report on “Urban environmental Management in Thailand”, which emphasizing:

- Mechanism to prioritize key issues for attention rather than to cover all issues simultaneously;
- Multiple stakeholders in decision making in and outside government than one decision maker;
- Actions to mobilize rather than command social energies;
- Planning as an interactive process rather than “once-and for all” plan making activity;
- Social, political and economic factors accepted as part of the strategic planning process rather than treated as internal to it;
- Emphasis on clearing bottlenecks rather than on designing comprehensive interventions;
- Focus on breakthrough initiatives with the participation of key stakeholder rather than on government programs alone;
- Capacity building with private sector and civic actors rather than by government alone.

Leitman et al. (1992) identified the most important issue in their paper titled “Environmental Management and Urban Development Issues and Options for Third World Cities” that need to be resolved to improve the urban environmental quality are:

- Poor governance, including weak institutional capacity in planning as well as the managerial and operational aspects of urban service delivery, jurisdictional complexity;
- Lack of public awareness of environmental problems and the unwillingness of environmental authorities to adequately address them;
- Ill conceived regulatory and economic policies that encourage environmental degradation and fail to provide the necessary basis for comprehensive environmental management; and
- Insufficient knowledge and understanding of the extent, impacts and processes of environmental decay.

Mc Carney and Stern (2003) in “Governance on the ground: Innovations and Discontinuities in Cities of the Developing World” focused on city government as raised through relationships between state and the city on the one hand and city and NGOs on the other hand, the social organization of a single neighborhood, various aspects of institutional frame works and reforms, municipal policies in the areas of urban planning, participatory budgeting and social development; municipal resources focusing on the problems of resource generation and housing policies. This is a result of vast research, but discussion about the impacts of urbanization and recommendations are absent here.

Alam (2004) analyzed in a thesis about the effect of informal settlements on urban environment. The author also focused on the causes of growth and origin of informal settlements in the metropolitan city of Khulna, the causes of environmental hazard due to the dwellers of informal settlements, the effects of environmental pollution, some policy measures and guidelines to control the environmental degradation and some short and long term model projects to control the growth of informal settlements. The author focused on the partial impact of urbanization.

Islam and Mahjabeen (2003) focused in an article namely “The Role of Civil Society Organizations in Urban Development in Dhaka City” about the problems of governance and the inadequacy in participation of various stakeholders. The authors considered the following sectors of urban development for their study:

- Poverty alleviation
- Environmental improvement
- Access to housing for the poor
- Provision of water and sanitation, and
- Waste management

They selected the five types of organizations, these were: Non Government Organizations (NGOs), Community Based Organizations (CBOs), Professional Organizations, Advocacy and pressure groups and Media: the print media briefly.

The authors identified and evaluated the contribution of the Civil Society Organizations (CSOs) in urban development. They pointed out that the most significant roles of CSOs are found in the field of poverty alleviation, in urban environment issues, in the field of urban waste management and in advocacy for the poor. But they have the scope to perform also in other fields, particularly, in land use control, in solving traffic congestion problem and in preventing urban crime. In terms of level of performance, the most active are the NGOs, the media and the voluntary civic groups or advocacy groups. The Community Based Organizations (CBOs) have not been found to be very active so far, although they have scope for contribution to the welfare of the city. They emphasized on the necessity of government help in providing scope to CSOs in participate urban development activities.

2.2 Plans for the Development of Dhaka and Wetlands of Dhaka City's

The concept of planning the urban environment and its implementation is very recent in the context of Bangladesh. In colonial and in pre-liberation eras, its significance was not realized to full extent as Dhaka grew at a steady, but inconsequential pace. There are mainly two identifiable reasons behind such a trend of urban growth:

- Dhaka never received the political attention, as it should have, until the 1960s.
- There was no significant development in the industrial and its related sectors during the periods under colonial and Pakistani regimes.

During the colonial period, the process of urban planning initiated with a view to improving the city environment throughout the region in diminutive scales. At that time, the only objective of the local governments was ensuring the basic needs of the urban population (i.e. garbage disposal, improving sanitation systems, supplying water etc.) (Elahi, 2005). Dhaka had to wait until mid- 20th century before the modern planning processes commenced in the region.

2.2.1 The Dacca (Dhaka) City Master Plan, 1959

The Dhaka master Plan, 1959 was prepared on behalf of Dacca (Dhaka) Improvement Trust (DIT) by foreign consultants working with official of DIT and was submitted in 1959. A short report was supplemented by a map of the DIT area at 1:40000 scale and the Dhaka city area at around 1: 20000 (DIT, 1959).

The consultants emphasized that the plan was meant to establish broad planning principles, not lay down a detailed inflexible basis for future development. The need for follow-up detailed plan and continuous review was also noted.

Average annual population increase was assumed at 1.75% and the Dhaka-Mirpur-Tongi (1978) population estimated at 900,000. The plan provided for major expansion areas at Mirpur, Tongi and Gulshan/Banani/Badda and proposed large- scale reclamation at Keranigong, Postogola and part of the DND triangle, to accommodate a population increase of 250,000 between 1958 and 1978. The Dhaka Master Plan has clearly marked and reserved 12 percent of areas for flood retention (Tawhid, 2004).

The results in 1980 show that not all the development areas proposed in the Master Plan, 1959 have been developed yet. Two examples are Uttara Model Town and the proposed development areas north of Tongi. On the other hand, there has been substantial unplanned growth around the edges of city.

The 1959 Dhaka Master Plan was a land use type Master Plan. The major deficiencies of the 1959 Dhaka Master Plan were:

- Its development control framework was not fully formulated nor effectively implemented.
- It did not effectively relate the issue of urban density with its impact on infrastructure.

- It was never linked to the ADP and government budget.
- Its various development components were not prioritized and funding sources were not identified.
- The 1959 plan has been interpreted too rigidly and is not adaptable to the rapidly changing urban circumstance of Dhaka.
- It does not provide a suitable framework for inter-sectoral coordination of spatial planning with the capital budgeting of government development agencies.

2.2.2 Dhaka Metropolitan Area Integrated Urban Development Plan (DMAIUDP), 1981

The work of DMAIUDP study was undertaken in 1979-80 and the final report submitted in March 1981. DMAIUDP evolved from a series of reports and missions concerned with storm water drainage and flood protection. It was funded by ADB/UNDP. ADB strongly recommended that despite all previous studies and partial implementation of a flood control embankment, further flood protection investment should await the outcome of a broad multi-sectoral strategic study to evaluate metropolitan planning alternatives.

The primary objectives of DMAIUDP were:

- To prepare a long -term development strategy to guide and regulate future growth in the Dhaka Metropolitan Area.
- To set out policies to implement the strategy and facilitate implementation of priority projects.
- To identify priority projects and prepare prototype proposals for the low-income housing.
- To develop local staff skills and establish effective institutions for implementation.
- Continuation of current trends-sustained peripheral growth, limited expansion towards Tonigi-Joydebpur.
- Peri-urban development-low-density resettlement with intensive agricultural production surrounding city.
- Comprehensive flood control protection of the city and development areas by embankments.

- Sub-regional dispersal-decentralization of urban development to maximum number of existing towns in the regions.
- Limiting urban growth by reducing investment in favor of rural areas.

The recommendations were made that the northern expansion and peripheral development should be directed towards the flood free land in areas. Moreover, the short and midterm strategies should be undertaken urban development like public increase, transport links within city areas and improve employment situation and so on; therefore the available resources should be applied to:

- The immediate initiation of a public sector land bank in order to reserve in advance at acceptable costs
- The provision of industrial incentives and the promotion of employment generating activities in the Tongi area
- The improvement and extension of transportation links
- The comprehensively planned and integrated extension of physical and social infrastructure.

DMAIUDP is the only comprehensive approach to planning and development in the Dhaka region since the 1958 Master Plan. Many of the constraints, opportunities and issues it considered are equally relevant now. It remains a lucid statement of the urban development issues facing Dhaka. This form of planning is particularly appropriate for metropolitan Dhaka where the growth of population and economic development cannot be determined with any degree of precision.

2.2.3 Dhaka Metropolitan Development Plan (1995 – 2015)

The Dhaka Metropolitan Development Plan (DMDP) 1995-2015 is the prevailing plan for the development of Dhaka with the time frame of 20 years covering 1528 sq. km. Under this Master Plan of Dhaka (Dhaka Metropolitan Development Plan) a comprehensive development plan for the future development of Dhaka city has been prepared with the objective of forming a framework of development planning, preparation of sectoral master plans and feasibility studies for metropolitan infrastructure elements lacking development policies.

The DMDP addressed urban planning issues at three geographic levels: sub regional, urban and sub –urban and covered area now defined as the RAJUK area. It is contained three districts: Dhaka, Narayanganj, and Gazipur. In addition to the DCC and all of the thanas contained partially or wholly within the DCC, the RAJUK area includes all or portions of eight surrounding non-municipal thanas. Gazipur sadar and Kaligonj thanas in Gazipur district; Rupganj, Sonargaon, Bandar and Narayanganj thanas in Narayanganj district; Keranigonj and Savar thana in Dhaka district.

It is published by gazette notification in August 1997 to be used as the guideline for the development of Dhaka city. The DMDP is not intended to present a single land use Master Plan describing plot based land use zoning. Rather it intends to address long term strategic and short-term implementation guidelines along with a set of policies and programs.

The DMDP is comprised of the three following components:

1. Dhaka Structure Plan
2. Urban Area Plan
3. Detailed Area Plan

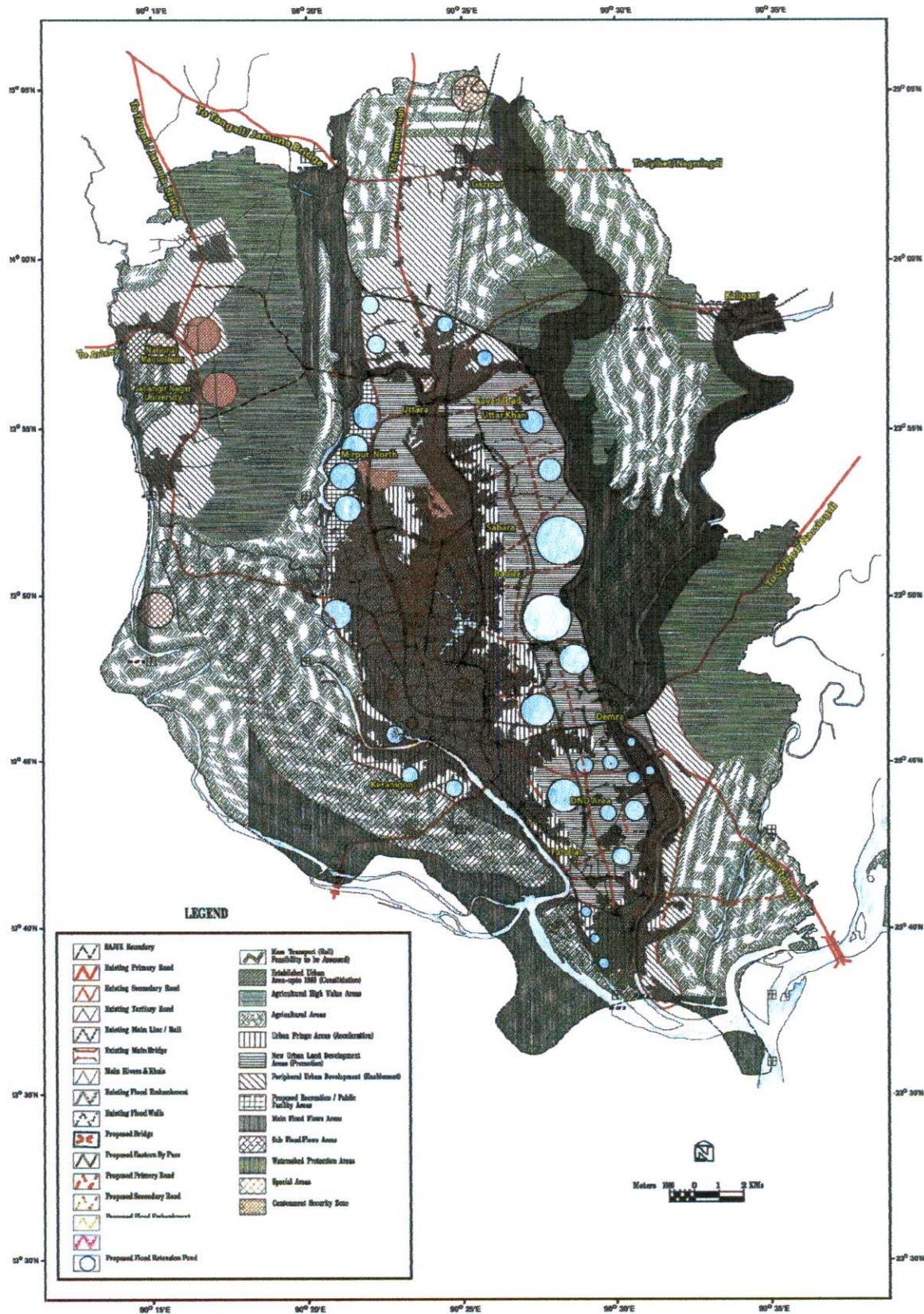


Figure 2.1 Dhaka Metropolitan Development Plan 1995 – 2015

Source: RAJUK, 1997

1. Dhaka structure plan

Dhaka Structure Plan is prepared to provide along term (20-year) strategy for development of greater Dhaka. It projects a population of 15 million by 2015. The Dhaka Structure Plan is presented both in written and graphic form. The documentation is an important as the physical plans- they should be read in conjunction with each other. In this extensive study the future flood protection in Dhaka city (Statistical Metropolitan Area of 1991) along with the future development of urban structure plan, some related aspects of physiographical and hydrological influences on the urbanization process of Dhaka city and its adjoining areas have been discussed. Besides, here the role of topographical conditions of the peripherals of the city has also been highlighted with reference to the future fringe development of the city.

Topics covered by the Dhaka Structure Plan include the following policies and provide guidelines:

- Population
- Land use provision
- Economic development
- Industrial
- Shelter and housing
- Physical infrastructure, social infrastructure
- Flood control and drainage
- Utility services etc.

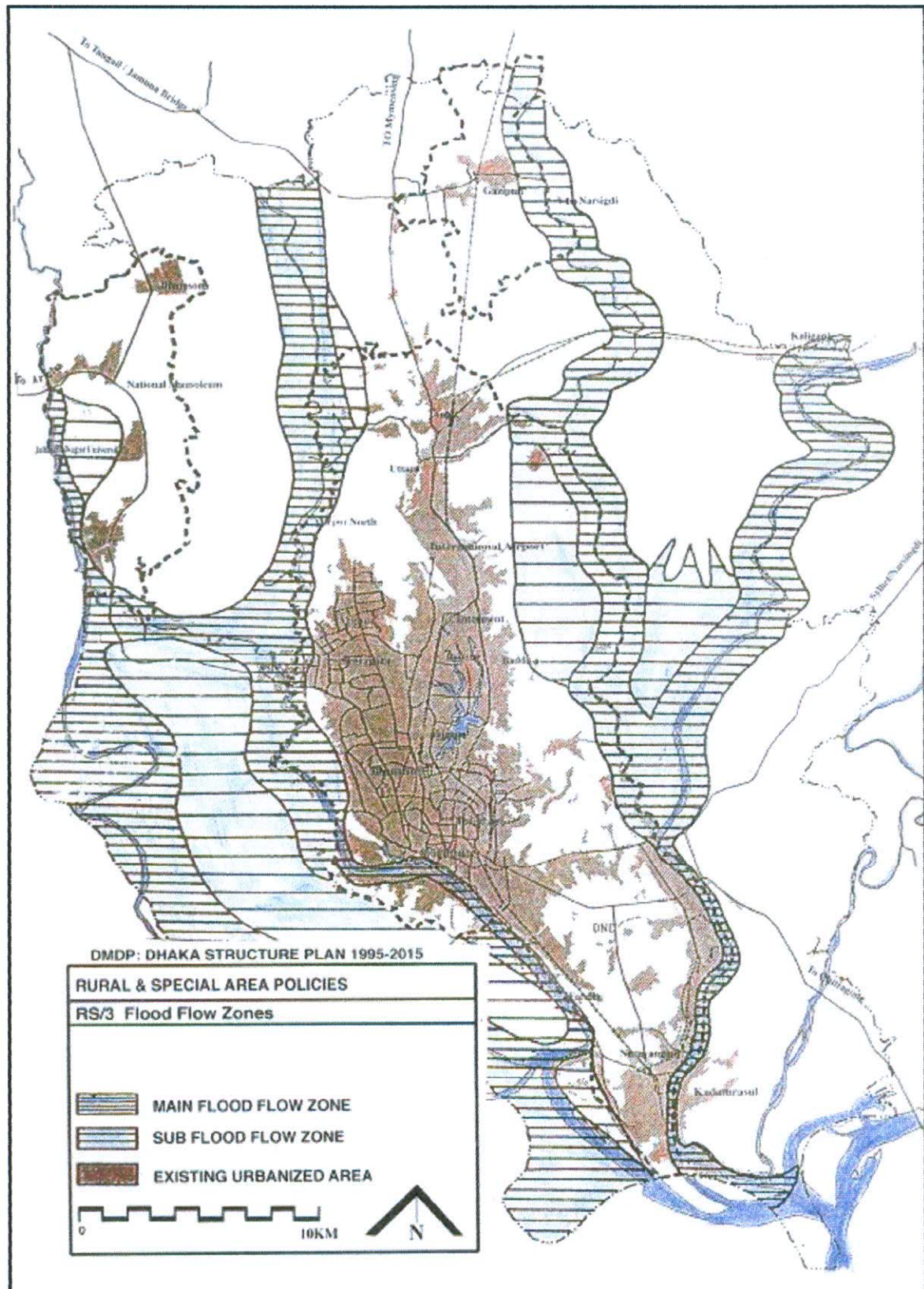


Figure 2.2 Flood Flow Zones in Dhaka Structure Plan

Source: RAJUK, 1997

Dhaka Structure Plan controls the whole RAJUK's development area. The main function includes:

- Interpret national policies
- Establish aims and policies and general proposals to guide metropolitan Dhaka's long-term growth and development
- Provide a framework and the mechanism necessary to ensure that all the public and private agencies coordinate and priorities their respective development planning and investment programs and decision within the metropolitan area, in particular, phasing of development.

Dhaka Structure Plan defines a broad set of policies to achieve the overall plan objectives. It's supporting documentation proposed actions for the preservation of high quality wetlands, agricultural lands and watercourses. It highlights the need for ponds around the city limits for rainwater retention and maintenance of an ecological balance and a healthy environment. Dhaka Structure Plan also calls for the adoption of land use controls and building regulations that would make its storm water retention and other recommendations meaningful. Dhaka Structure Plan calls for plan reviews every five years. Regrettably, no formal plan review or revision has occurred since the publication of the Structure Plan This is spite of the fact at least one of its major features (the Eastern bypass) has been downgraded with profoundly different land use implications. Another major feature with structural implications has been added. Purbachal is a planned new town located in contradiction to the DMDP recommendations.

2. Urban Area Plans (1995-2005)

Urban Area Plans (UAP) is developed for the DCC and its major expansion areas, including the area to the east of the DCC, the DND triangle and for the Tongi, Gazipur, Savar and Damsona areas.

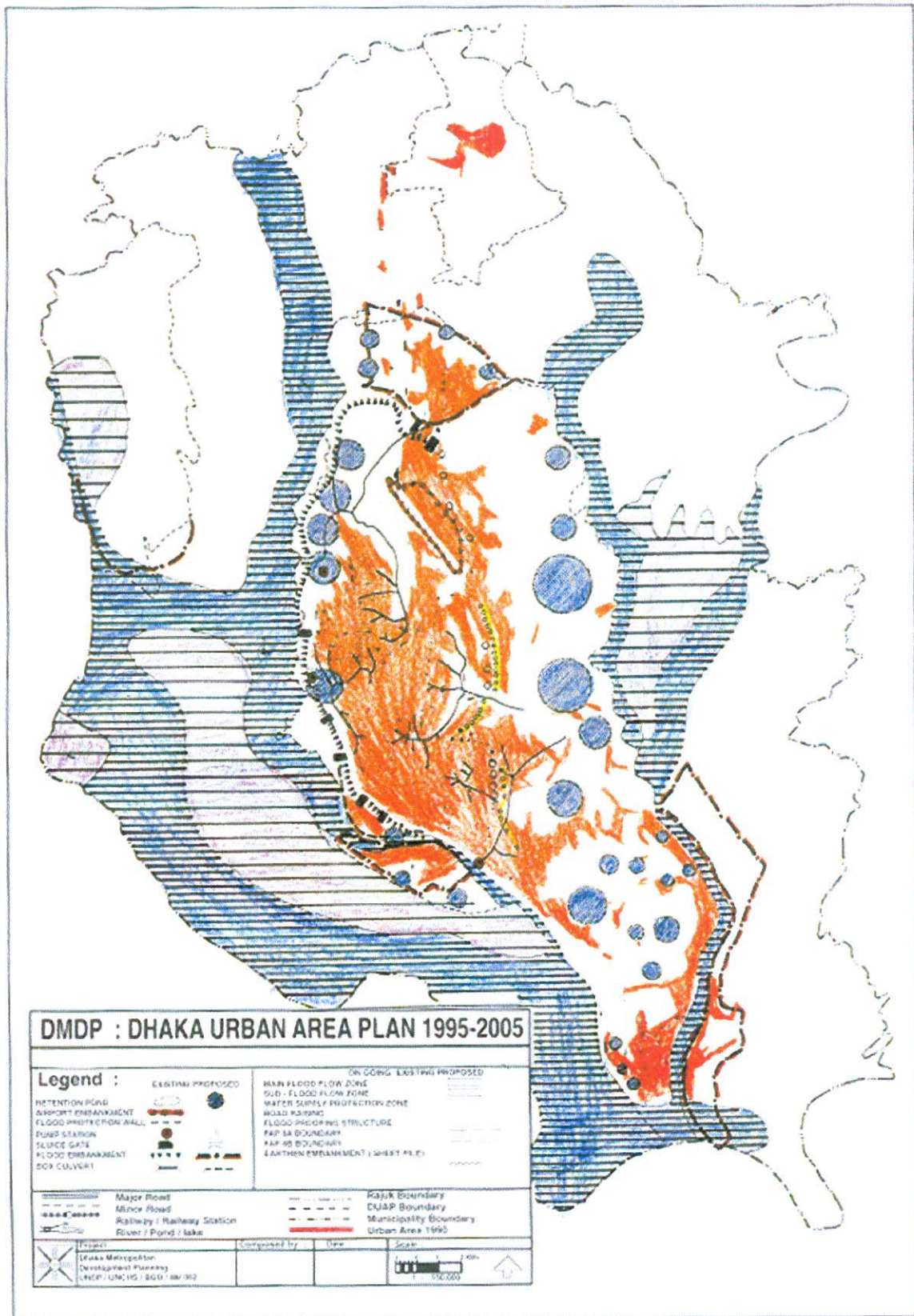


Figure 2.3 Development control for flood protection

Source: RAJUK, 1997

The UAP is intended to provide interim mid-term strategies for a 10-year period and were conceived as “nested” within the overall structure Plan. Unfortunately, although the UAP for Dhaka covers a smaller area and is drawn at a larger scale, its level of specificity is no different from the Structure Plan. Already this plan is lost its time and frame and can be considered invalid.

3. Detailed Area Plan

Detailed area Plan (DAP) provides more specific and detail planning proposal for specific sub-areas. DAP consists of reports and maps at 1: 3960 scale with supporting documents. The draft DAP is prepared but yet to final. Until a DAP is prepared for sub area, land use management function will be exercised through the policies, guidelines and rules found in the structure Plan and Urban Area Plan.

Rajdhani Unnayan Kartipakkha (RAJUK) is the custodian of the Detailed Area Plan. Duration has prescribed in the Structure Plan for the implementation of this Detailed Area Plan is up to the year 2015. RAJUK will guide the other authorities to implement their projects according to the Detailed Area Plan and all the physical development activities will follow the proposals prescribed in the Detailed Area plan. RAJUK may change (when necessary), amendment and alteration of this Detailed Area Plan as and when necessary.

Detailed objectives of the plan were to:

- a) Provide a detail analysis of the area in context of existing land use, land value, geological structure and socio-economic condition of the people.
- b) Preparation of engineering survey in context of physical components of the area.
- c) Preparation of topographical survey to know the land level of the area.
- d) Identification of highest floods level including average depth of the river and canal.
- e) Preparation of sub-soil investigation including load bearing capacity of the soil.
- f) Ground verification through Global Positioning System (GPS) of all major physical features in the area.
- g) Preparation of the report including all types of survey components and with the analysis of data and maps in view to the preparation of Detail Area Plan.

DAP has been conducted to fulfill the obligation of Dhaka Metropolitan Development Plan (DMDP). It is a legal document (SRO No. 184-law/97 dated 3rd August, 1997). It is not legal to violate DMDP. As the lowest tier of DMDP, DAP must conform to policies stated in DMDP Structure and Urban Area Plan.

2.2.4 Report of the Task Force on Bangladesh Development Strategies for the 1990s

The strategy proposed by the Task Force aimed to keep Dhaka's population within a quarter of national urban total. The Report of the Task Force proposed:

- Discouraging investments in new large industries within the Dhaka City Corporation limits.
- Dispersing population from the city, by the establishment of new satellite towns or accelerated growth of existing satellite towns.
- Improving the transport network with existing satellite towns and nearby secondary cities and small towns.

2.3 Flood Protection, Drainage Master Plan and Wetlands

2.3.1 Flood Action Plan (FAP) Studies

After the devastating flood of 1988, various studies were conducted by different agencies, countries and Government of Bangladesh. Several action plans were proposed. The World Bank coordinated the studies and framed a Flood Action Plan (FAP) with 26 components as the initial stage for the development of a long term comprehensive system of flood control and drainage works.

In response to the request of the Government of Bangladesh, the Government of Japan decided to conduct the study on Greater Dhaka Protection Project in the Dhaka Metropolitan Area of Bangladesh (FAP 8A) within the general framework of technical cooperation between Japan and Bangladesh.

The Greater Dhaka Protection Project (FAP 8A)

The Greater Dhaka Protection Project (FAP 8A), funded by JICA, formulated a framework for comprehensive flood control and storm water drainage in the Dhaka metropolitan area, covering an area of 850 km². The total area is divided into 12 drainage

zones. In order to identify an optimum drainage improvement plan, alternative studies for drainage system were conducted for three drainage zones: DB, DC and NA. Alternative plans were designed under the following conditions:

- The plans for the prevailing built-up areas of both the DB and DC zones shall incorporate previous JICA study recommendations
- Major drainage facilities, such as pumping station with retarding ponds, sluice gates and khals, for the future development areas shall be studied.

For DC and NA zones, more intensive studies were recommended at the feasibility stage. The study emphasized on the following four issues:

- Flood forecasting and warning system
- Flood evacuation system
- Land regulation
- Zoning of khals and retarding pond areas.

The project was aimed at protecting the future urban areas of 456 km² in the year 2010, from potential flood damage by means of structural measures of flood mitigation and storm water drainage improvement. Non-structural measures, such as flood plain management, are proposed for the remaining low-lying areas of 328 km², the area to be left undeveloped with no significant change in land use. The opportunity for planned urbanization with due flood mitigation and drainage improvement is a major advantage offered by this project.

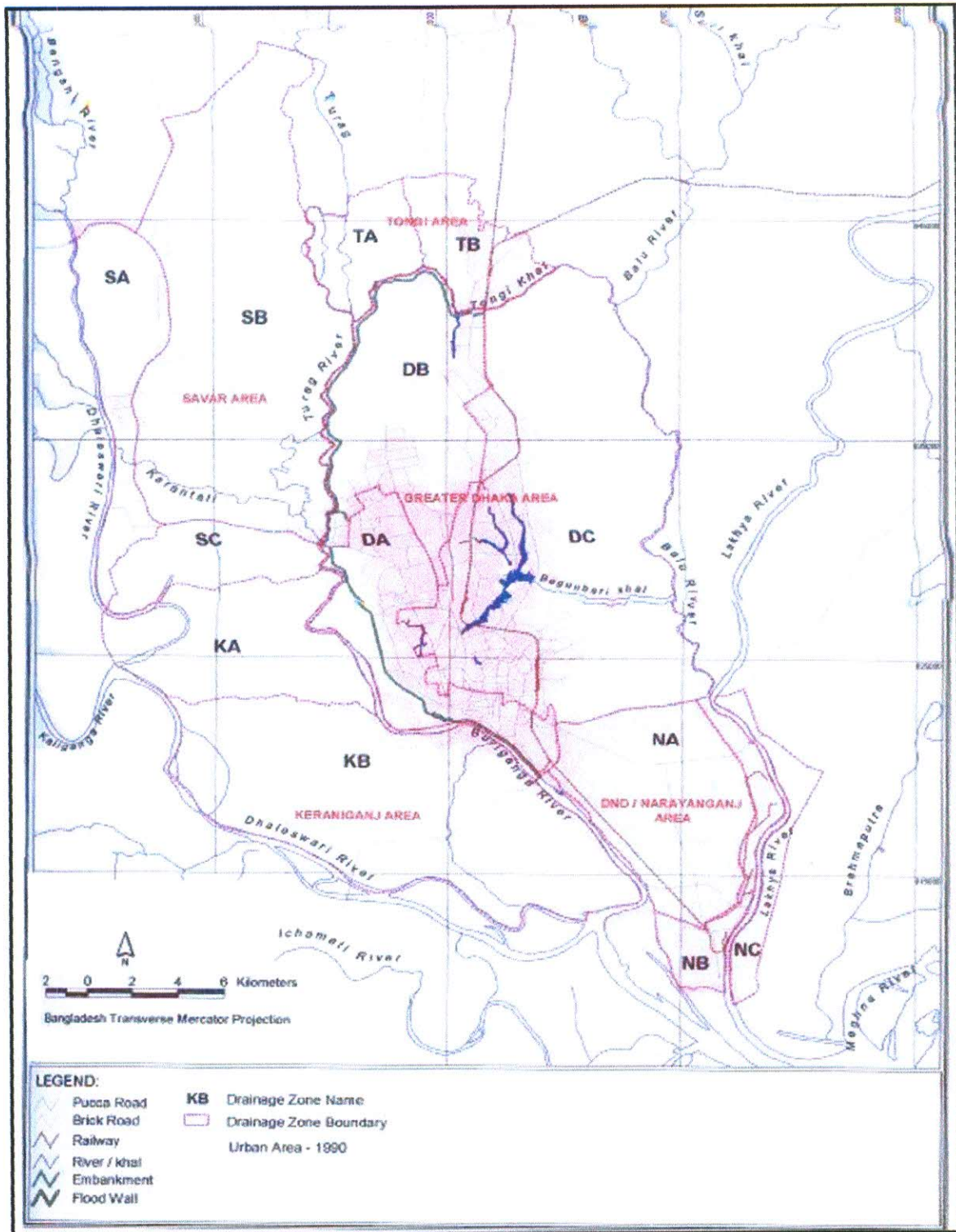


Figure 2.4 Drainage zones proposed in FAP 8A study cited in IWM, 2006

Source: IWM, 2006

The Dhaka Integrated Flood Protection Project (FAP-8B)

The Dhaka Integrated Flood Protection Project (FAP-8B) for the western part of greater Dhaka is under execution and funded by ADB. The project objective was to undertake an integrated urban development program consisting of:

- i) Flood control and drainage works
- ii) Complementary environmental improvement programs in low cost water supply and sanitation programs for the low income residents, solid waste management, and slum and squatter area development; and
- iii) Institutional support for improved efficiencies in urban management and revenue generation

In the final report of FAB-8B, it has been mentioned that due to high costs of providing full protection for all of Dhaka city and lack of available funding for the overall plan, consideration was given to phasing the project works to provide maximum early benefits at minimum costs. There are two parts in the phased programme: Part-A, flood protection and part-B, Drainage.

In part-A it was mentioned that there would be construction of gate control structures at each of the 13 drainage channel crossings, including Begunbari Khal. Moreover, there was provision of temporary pumping facilities along the easterly boundary for evacuation of internal rainfall during periods of high river stage combined with heavy rainfall. BWDB is responsible for the execution of part-A.

The project components concerning the flood protection are:

- Specialized remedial works and foundation stabilization on 7.8 km of the existing embankment;
- Erosion control and slope protection over 11.5 km;
- Minor remedial works and slope protection over 24.2 km;
- Repair and stabilization of parts of 5.3 km of existing concrete flood wall;
- Construction of 1.6 km of new flood wall / embankment;
- Construction of 5 additional sluices along the existing embankment;

- Raising and flood proofing of the central spine road;
- Construction of the first stage (22.5 cm³/s) of pump station No. 3 at Goranchatbari along the westerly embankment;
- Establishment of a maintenance program and supply of maintenance equipment to safeguard the flood protection investment.

Part-B, the proposed drainage works were a necessary complement to the flood protection works, and the primary focus of the drainage improvement programme was on creating an integrated drainage system within the Dhaka urban area to eliminate /reduce the drainage congestion and regular local flooding which prevails during the monsoon season. DWASA is responsible for the execution of part-B.

The project components concerning the drainage are:

- Rehabilitation and upgrading of 21 existing priority khals (including completion of the crash program initiated by the government), for a total length 78.6 km;
- Rehabilitation and construction of 50.7 km of pipe drains;
- Implementation of a rigorous operations and maintenance programme for the drainage works over the project implementation period as the project construction works are completed.

Under phase-1 of the DIFPP, construction of the Dhaka western embankment was completed in 1997. That is why the western part of the Dhaka city was flood free during the 1988 flood. After the flood, the Government of Bangladesh decided to construct the Dhaka eastern embankment presently.

2.3.2 Drainage System Improvement Projects, JICA, 1987

The study area was around 137 km², which was divided into 10 drainage zones. The drainage zones were further subdivided into 37 sub-zones, taking into account topography, flooding conditions, land use, prevailing drainage systems and requirements of flood protection and drainage improvement. Drainage zone boundaries of three priorities areas (B, C and F) were revised based on detailed studies on the topographic conditions, existing drainage system, ongoing drainage program, and proposed drainage

system. The study proposed drainage improvement plan along with alternative study of drainage improvement plan. A three-phased implementation program was proposed in the study. The study urged the immediate implementation of the highest priority program.

2.3.3 Updating Study on Storm Water Drainage System Improvement System, JICA, 1990

Dhaka city suffered very serious flood damage in 1988. To solve this problem, the Government of Bangladesh decided to implement the “ Greater Dhaka Flood Control and Drainage Scheme” proposed by the committee with the minister of planning as its chairman; also the Government of Japan was requested to undertake the Updating Study of the previous JICA study in consideration of the 1988 flood and the ongoing related projects. The scope of the work for the Updating Study was agreed upon between the ERD, the government of Bangladesh, and the Japan International Cooperation Agency (JICA) on June 1, 1989.

The objectives of the study were:

- To review and reassess the area under the phase-1 programme to be included in the first priority zone, taking into consideration the flood of 1988 and the ongoing related projects.
- To identify the urgent project to be included in the related phase-1 programme.
- To prepare the preliminary design for the urgent project mentioned above

The study area covered the phase-1 zone, of the 1988 JICA study and other related drainage zones as necessary, in consideration of the 1988 flood and other related ongoing projects. The study was conducted between July 1989 and January 1990.

Related ongoing projects during the study were:

- Dholai Khal Rehabilitation and Area Development Project (WB project)
- Greater Dhaka Flood Control and Drainage Project
- Khal Improvement Project

The report consists of two volumes: Main report and supporting report. The main report presents the summarized results of all studies. The supporting report includes the, 1988 flood, related ongoing project, updating the phased programme, urgent project, project cost and implementation schedule, project evaluation, topographic survey, soil survey and scope of work.

The phased programs of 1987 study were updated after 1988 flood as below:

- The total drainage area consisting of ten zones revised from 137.5 to 134.85 km².
- Construction of two new pump stations (total capacity 24.5m³/s and two regulating ponds with a total area of 242 ha with total storage capacity of 2.59 million m³) with new sluice gates.
- Extensive khal improvement of 25 existing khals.
- Drainage pipe improvement.

No revision of the 14 drainage pipe trunks was recommended, except for the installation of sluiced gates at their outlets to the Buriganga and Turag rivers.

Updating of priority zones was done: zones with highest priority – B, C, F and H (total area 49.46 km²), and second priority zones – A, D, E, G, I and J (total area 85.39 km²). Zone H was included as a high priority area due to its rapid urbanization and serious damage it suffered in the 1988 flood.

In addition to the capital construction involved in the project, non-structural measures were recommended such as, - to reserve swampy areas for the proposed pump regulating pond and to strictly enforce controls to prevent any reduction of the minimum cross sectional areas of the khals.

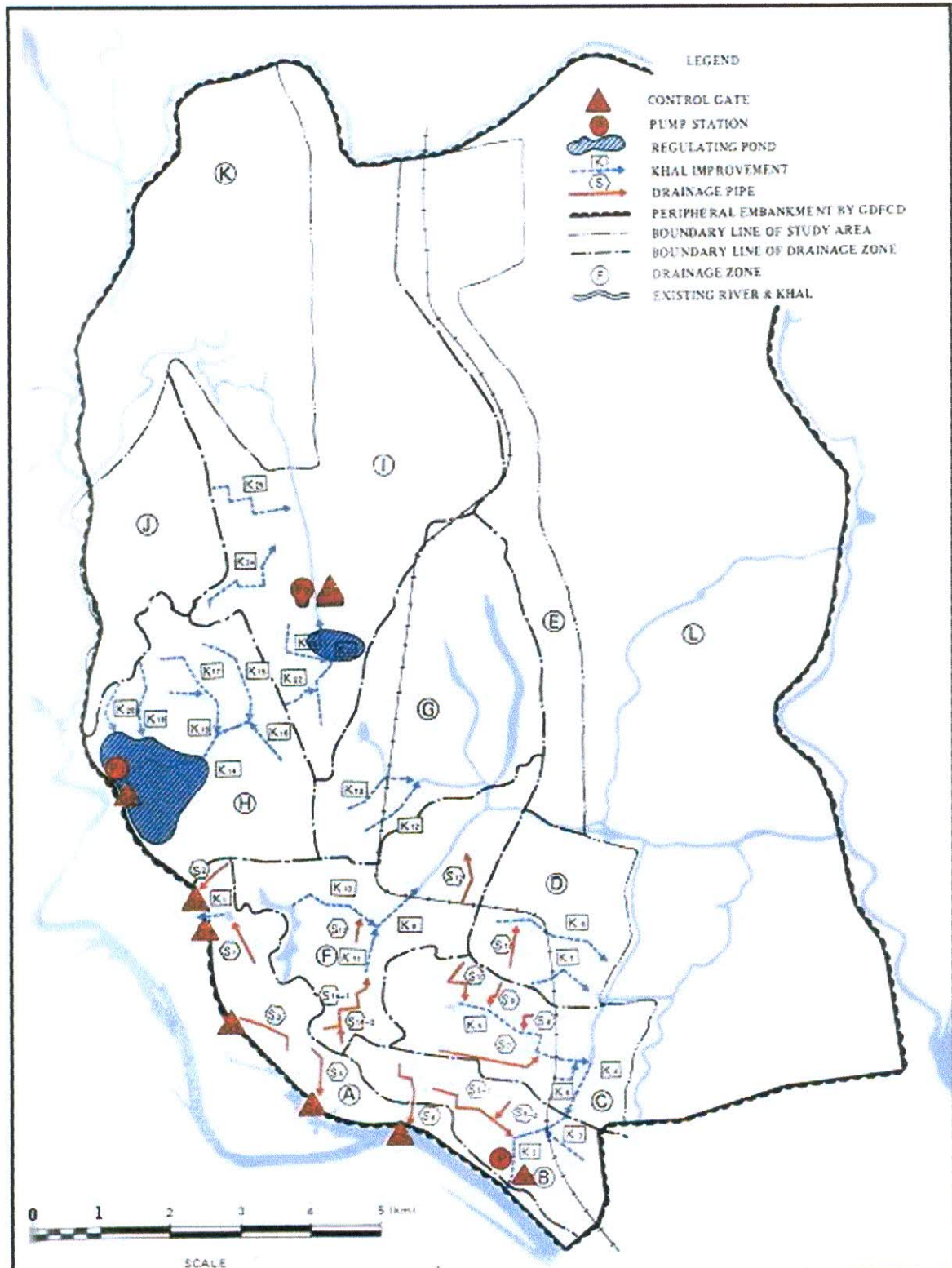


Figure 2.5 Proposed drainage facilities in JICA study 1990

Source: JICA, 1990

2.3.4 BETS Report, 2005

The Consultancy Services for Detail Engineering Design and Construction Supervision of the Removal of Water logging in Dhaka city awarded to Bangladesh Engineering and Technological Services Ltd. (BETS). The services were divided in two parts. First part was design phase and second part was implementation phase. The project prepared based on, the Feasibility Study conducted by JICA in 1989 and recommendation in the Master Plan on Drainage System of Dhaka, 1990. Existing canal improvement at Mohakhali, Ibrahimpur, Khilgaon, Bashaboo, Manda and other Khal including installation of pump stations at the outlet of the canals included in the scheme. Rehabilitation of storm sewer in the different parts of old Dhaka city has also been included in the scheme.

The objective of the project was:

- To remove water logging of the project area in Dhaka city and
- To improve the environment by providing better drainage facilities in the project area.

The major component of the project were as follows:

- Rehabilitation of 9.00km existing storm sewer line drains
- Construction of 88.70 km piped drainage facilities
- Construction of 10.00 km surface drains
- Re-sectioning/development of 16.50 km open channel
- Construction of 1.50 km box -culvert
- Installation of pump station at Rampura and on Segunbagicha khal.

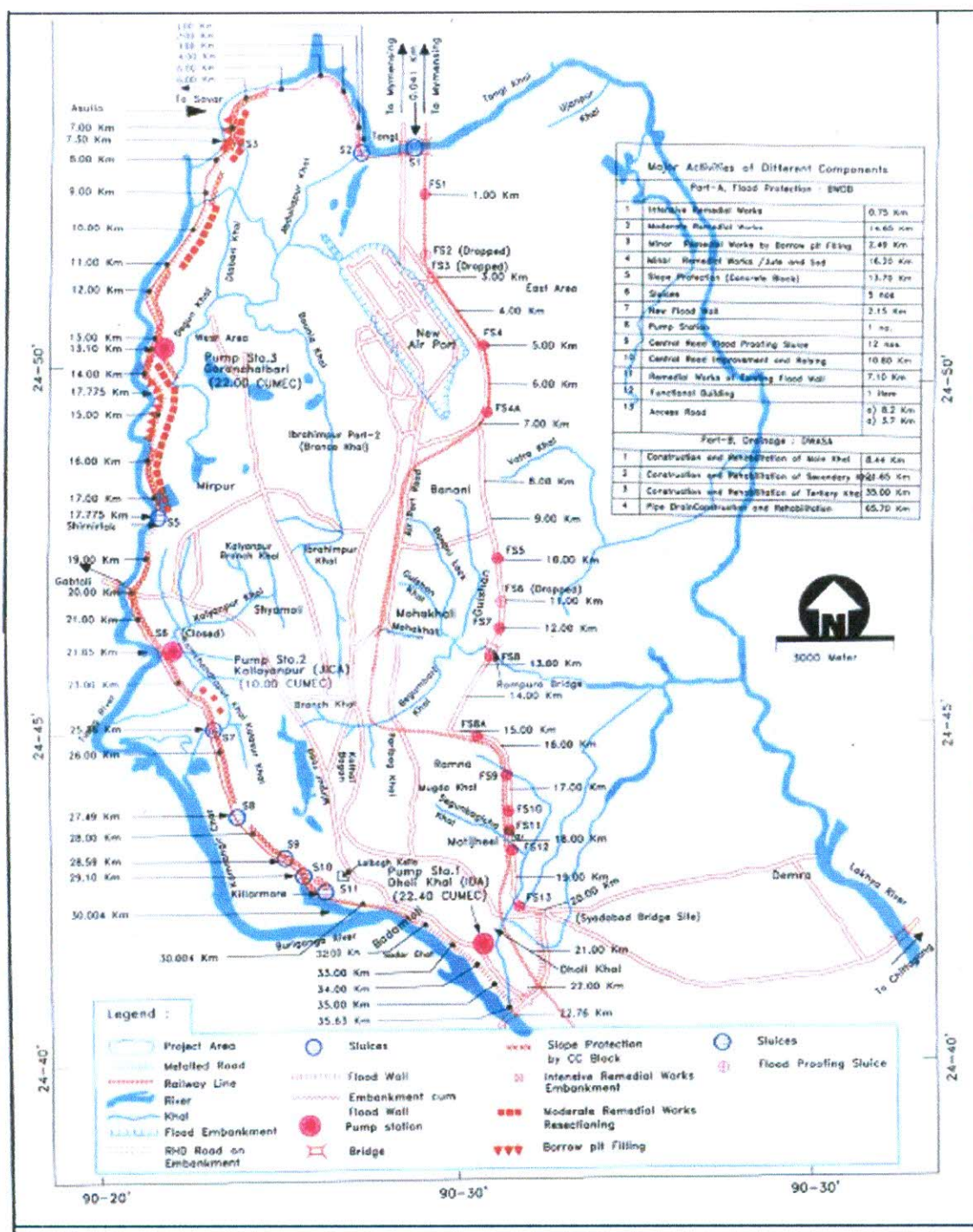


Figure 2.6 Project index map of Dhaka Integrated Flood Protection Project for removal of water logging in Dhaka city

Source: BETS, 2005

2.3.5 Study on Drainage Master Plan for Dhaka City and DND Area, 2006

In view of numerous shortcomings and problems, Dhaka Water Supply and Sewerage Authority (DWASA) intends to update the existing Master Plan of Dhaka City (developed by JICA) to improve the drainage situation. DWASA invited Institute of Water Modelling (IWM) to carry out a short study on Drainage Master Plan for Dhaka City. A contract was signed between DWASA and IWM in January 2005 to carry out the study.

The specific objectives of the study were:

- Collect, review and evaluate previous relevant studies
- Update the collected information through field visits and consultation with stakeholders
- Recommend various programmes for improvement of storm-water drainage system of Dhaka city.

The study had the following essential components:

- Review of different study report
- Collection of data/information/maps from secondary sources
- Development of an up-to-date drainage map
- Assessment of current drainage situation
- Assessment of institutional capacity of DWASA in handling drainage system
- Development of a drainage improvement plan with tentative costing.

This study put some recommendation for drainage improvement in western Dhaka, eastern Dhaka and DND area include a set of general recommendations and a number of specific recommendations. This study also recommended about institutional strengthening and capacity building. It was mention that the present set-up of DWASA found to be insufficient for operation and maintenance of the extensive drainage system of the city. The extent of drainage facilities is growing rapidly with the expansion of the city both spatially and as well as vertically. Therefore, the already inadequate staffing at the drainage circle needs immediate review and re-organization. It is envisaged that the jurisdiction of storm-water drainage management by DWASA would extend to eastern Dhaka and DND areas in various phases within the next 25 years.

A comparison of the JICA 1990 study and FAP 8A study was done by this study, which shown in Table 2.1.

Table 2.1 Comparison of the drainage zones of FAP 8A study and JICA study 1990

FAP 8A		JICA Study	
Zone Name	Area (km ²)	Zone Name	Area (km ²)
A. Greater Dhaka	262.42		
1. DA	34.33	H A B Total	17.60 7.25 7.24 32.09
2. DB	60.84	I J Total	31.42 7.69 39.11
3. DC1	45.86	E	7.00
4. DC2	30.65	E	6.93
5. DC3	90.74	C D F G Total	10.92 7.46 13.70 17.64 49.72
B. DND- Narayanganj Area	88.22 56.79 18.63 12.80		

Source: IWM, 2006

This study put some recommendation for drainage improvement in western Dhaka, eastern Dhaka and DND area include a set of general recommendations and a number of specific recommendations. This study also recommended about institutional strengthening and capacity building. It was mention that the present set-up of DWASA found to be insufficient for operation and maintenance of the extensive drainage system of the city. The extent of drainage facilities is growing rapidly with the expansion of the city both spatially and as well as vertically. Therefore, the already inadequate staffing at the drainage circle needs immediate review and re-organization. It is envisaged that the jurisdiction of storm-water drainage management by DWASA would extend to eastern Dhaka and DND areas in various phases within the next 25 years.

2.4 Land Management and Urban Wetland

Siddqui (1997) has identified in a book named “Land Management in South Asia A Comparative Study” how the land management runs in different parts of south Asia, delineated similarities and differences in land management practices, determined their reasons. He mentioned the major themes of land management in the South Asian context, which are:

- processes relating to changes in land titles, such as land records preparation and updating, land transfer registration, land mutation, etc.;
- land based disputes adjudication/resolution;
- management of state land and water resources consisting of distributable/leasable resources, such as agricultural land, non-agricultural land, water bodies, haats and bazars, minor minerals, etc. and non-distributable/non-leasable common property resources such as grazing land, forest land, pathways open water bodies, etc.;
- government intervention in land use through regulation, direct participation, taxation, consolidation and acquisition for development process;
- land revenue/tax and other sources of land-based revenues;
- land management organizational setup and its vertical and horizontal linkages; and
- people’s participation in land management, particularly through the involvement of NGOs, peasant associations, local government bodies, etc.

The author provided an analytical basis for shaping an appropriate land management policy in the three major South Asian countries, namely India, Pakistan and Bangladesh. For each of the three South Asian countries, delineated the present situation and changes since independence in respect of major land management practices in both urban and rural areas.

The author has not mentioned elaborately about the poor land management records, substantial encroachment of state land and its consequence impacts on the environment.

Siddiqui et al. (1988), discussed in a book named “ Land Reforms and Land Management in Bangladesh and West Bengal: A comparative Study” about a meaningful parallel between Bangladesh and West Bengal in respect of land reforms and land

management. The authors compared the issues were, Important land reform legislation since 1947, operation “Barga”, vesting and distribution of ceiling surplus land, Sairat Mahal management, Homestead land distribution, urban land reforms, Land revenue system, Land record system and Integrated Organizational setup for land reforms between West Bengal and Bangladesh.

The authors illustrated urban land ceiling system in West Bengal in comparison with Bangladesh. In West Bengal holding of urban land has been restricted through the Urban Land (Ceiling and Regulation) Act, 1976. According to this Act, a person can hold vacant land in urban areas up to five hundred square meters in category ‘B’, one thousand five hundred square meters in category ‘C’ and two thousand square meters in category ‘D’ urban areas. However for group housing sanctioned by competent authority, relaxation has been provided.

In Bangladesh, no such or any law for urban land ceiling exists. Although a proposal has been made a long time ago. On the contrary, government land on cities is being illegally occupied and used by the vested interest group. As yet, there is no clear cut policy for their distribution and utilization.

Islam and Akand (2004) have published an article entitled ‘Community and Institutional Responses to Wetland Management in Bangladesh: A Capsule of Suggestive Policy Recommendation’ in ‘Journal of Social Anthropology’. They have focused on causes of wetland loss and responsibility of the management of wetlands at community and institutional level. The authors pointed out that the wetlands in Bangladesh to date, has not received any special attention either by government and/or non-government organizations or by the natural and social scientists. Consequently, their vulnerability to both man-made and natural loss and degradation is alarming in our country. Wetlands are frequently and dimwittedly subjected to conversion into other uses rather than the actual usefulness of this unique productive ecosystem.

They prescribed some prescriptions regarding policy framework for wetland management in Bangladesh, such as:

- A national inventory should be conducted estimating the amount of wetlands and exploring their characteristics features;
- The GOs and NGOs should conduct baseline research on the wetlands for building a national database;
- The GOs and NGOs should encourage and provide the natural and social scientists with research equipments and financial support to conduct required intensive and extensive research on wetlands in Bangladesh;
- To government must enact required and effective regulations regarding wetland management up to mark. The administrative duties for maintaining the existing status of wetlands must be tightened with the desirable margin;
- The government and community people collaboratively should work together for the protection of representative examples of all types of wetland in both public and private ownership;
- The government should include wetland ecosystems as texts in the national curriculum from the primary to advanced educational levels;
- The GOs and NGOs should establish mitigation banking for the creation, restoration, and protection of an area of functioning wetland in advance of and to offset anticipated wetland impacts within the same ecoregion;
- There should be an association for the professionals who do research and related work on wetlands in Bangladesh;
- The government should promote public awareness first and encourage public participation in the planning and management of wetlands.

This paper is based fully on secondary data. The authors have not discussed about the wetland related laws to protect the wetlands.

Khan *et al.* (1994) discussed in an edited book named “Wetlands of Bangladesh” about history and heritage of wetlands, hydrological context, importance of wetlands of Bangladesh, socio-economic values and impacts of development activities. They cited that according to the laws of Bangladesh, wetlands are ‘lands’. The State Acquisition and Tenancy Act, 1950 defines it as land “ which is cultivated, uncultivated or covered with

water at anytime of year” (section 2/16). Therefore anything that is legitimate on a piece of land is also applicable to wetlands. The editors proposed some legislative framework for the protection of wetlands:

- a) Specific legislation for conservation of the wetlands which have been identified as being at critical level;
- b) Declaration of wildlife sanctuary and protected areas in accordance with and, if necessary, in addition to the Wildlife Preservation Order of 1973;
- c) Declaration of activities that lead to pollution of wetlands and taking part in activities which degrade the wetlands and cause loss of wetland functions and attributes as punishable offences under the Criminal Procedure Code.

They have omitted to discuss the consequences of changes of urban areas wetlands.

Alam (2007) has discussed in a research about the Sustainable Land Management: Policy Implication and Sectoral Achievement. In this research he has presented past and present situation of land management and gaps of policy implication. He also observed that though the world has only 2% wetland of its total area but it is very important and the wetland is now under threat. Because of the lack of proper management this wetland is decreasing and polluting in many ways. We should take the wetlands under sustainable land management to protect the rivers, canals, beels, haors, baors, ponds, marshy lands etc. otherwise environment and biodiversity will be affected abundantly.

But in his research there is no exhaustive discussion about urban land as well as urban wetland management.

Huq (2002) in a paper entitled “Optimum Landuse in the Lowlying Area Around Dhaka City: A Geological Perspective” pointed out that, urban development in a lowlying areas around Dhaka city is economically lucrative now. But in the long run, unplanned and indiscriminate development through lowland filling may threaten the very existence of the city. Following were the conclusion of that paper:

- Low-lying areas around Dhaka City are, the recharge source for its groundwater, and accommodation space for flood water that flow through the area.
- The maximum amount of recharge from these wetlands essential for maintaining the groundwater source; the volume of accommodation space required for regular

and extra- ordinary floods; maximum, minimum, temporal and spatial variations of water and sediment discharge during flood; the dimensions of present and potential flow paths and storage units of flood discharge; are largely unknown.

- Restriction on land use change, in the low-lying areas, imposed by RAJUK, cannot be lifted until a through study is conducted on relevant issues (e.g. ground water recharge, flood flow, regional impact etc.).
- More than 80%of the water supply of the city comes from groundwater. Unless a viable alternative to this source is found, the recharge areas (i.e. lowlands) must continue to have accommodation space for floodwaters for existing length of time at least.
- Artificial rejuvenation of all palaeochannels, excavation of present channels along with maintenance of efficient “excess water” flow paths adjacent to designated channels may be sufficient for safe and efficient passage of floodwater.
- Drainage congestion in the upstream part is unlikely to occur if maximum possible palaeochannels are rejuvenated.

UNEP (2001) identified five key environmental issues and relevant impacts in Bangladesh State of Environment Report; these are shown in (Table 2.2):

Table 2.2 Key environmental issues in Bangladesh and impacts

Potential Key Issues	Impacts
Land degradation	Ecology and quality of life
Water pollution and Scarcity	Ecology and quality of life
Air pollution	Environment and health
Biodiversity	Ecology, development and quality of life
Natural disasters	Environment, development and quality of life

Source: UNEP, 2001

It was mentioned in the report about land degradation that there were two major constraints in prevailing degradation. The first one is high population pressure on land and the second constraint is the absence of a comprehensive national land use policy. Poverty with rapid population growth, absence of a proper land use policy, and other driving forces compel people in Bangladesh to over- exploit natural resources like land, which form a major focus for human economic activities. In addition, urban sprawling

and infrastructure development have reduced the availability of land. There is a wide gap between awareness of land degradation problems and actions necessary to combat them. Land degradation in many areas goes unnoticed from generation to generation, and therefore the concept of land resource conservation fails to attract politicians and planners. In this report it was also pointed out that in order to combat land degradation and to attain sustainable land management and development, it is very urgent to build up institutional capacity to conduct field level research and apply the results through extension programs along with enabling policy makers to take necessary decision and to undertake appropriate mitigation measures.

Iqbal (1992) discussed in an article namely “Residential Land Price Inflation in the Dhaka Metropolitan Area: 1976-88” about the land price inflation, demand and supply factors which explain changes the residential land price. The factors were population increase, rise in income, private housing construction, the creation of vacant allotments and public and private investment on local infrastructure development. He mentioned that lack of firm control by the government over land traders have caused instability in the land markets of DMA and suggested that a fruitful and positive urban land management policy is required to market of the control the anomalies present in the property market of the DMA.

Choudhury (2001) depicted the actual characteristics of eastern part of Dhaka city along with the geomorphology, trend of land filling, its land use pattern and the environmental consequences of such land filling process in a paper namely “ Impact of Landuse Change and Urbanization on Geomorphologic Environment: A Case Study of Eastern Part of Dhaka Metropolitan Area”. The author mentioned that expansion of Dhaka city is engulfing the remaining lowlands, disregarding the impact of the change in the natural terrain configuration system. Such land filling would lead to disasters like decline in underground water level, waterlogging and scarcity of natural water retention areas. All the higher grounds that are visible today in the landscape are not tectonically uplifted terraces or deposited ridges; rather they are the result of land filling due to urban expansion. Such land filling is mainly occurring on wetlands. The author summarized the overall process of change within the natural environment due to urban expansion (Fig: 2.7).

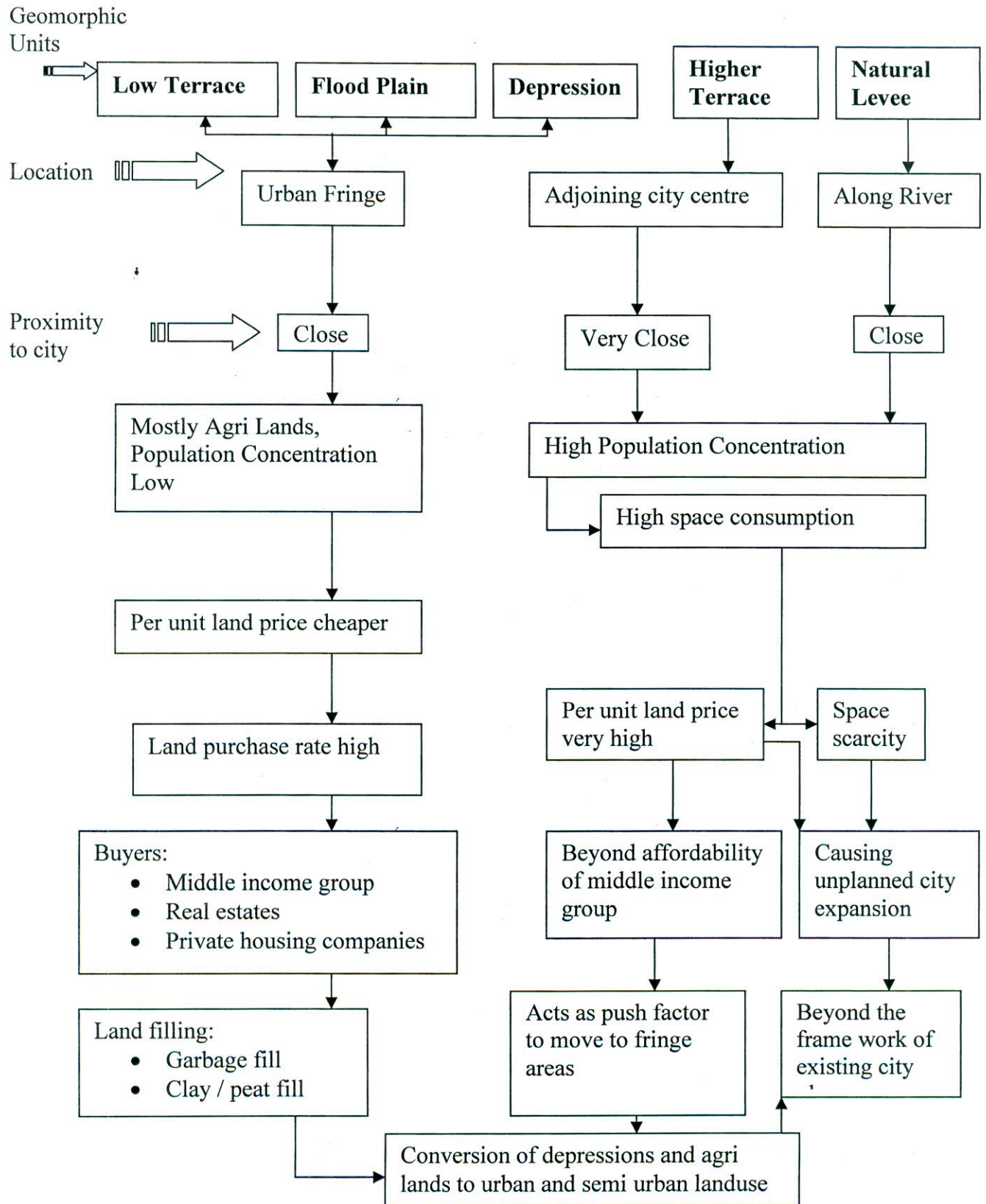


Figure 2.7 Changing Geomorphic Environment through Landuse

Source: Choudhury, 2001

2.5 Waterlogging in Dhaka City and Wetlands

Tawhid (2004) analyzed in a study that water logging becomes a burden for the inhabitant of Dhaka city and creating adverse social, physical, economical and environmental impacts. Disruption of traffic movement and normal life; damage of structure and infrastructure; destruction of vegetation and aquatic habitats; loss of income potentials are the encountered effects of water logging on city life. The author recommended some steps of measures for comprehensive management of storm water, which are:

- Saving natural drainage system and waterbodies through development control;
- Proper waste management system;
- Drainage capacity adjustment, comprehensive drainage development plan and improvement drainage management system;
- Awareness development against closing of drains and
- Legal instrument- consolidation of all environment laws in a single law and arrangement of all environmental activities under one umbrella.

Asaduzzaman, (1997) discussed in a research titled “ Geomorphological Controls Over Urbanization: A Case Study of Dhaka City” about the various geomorphological and physiological situation of Dhaka city. He mentioned that the main reason of waterlogging in the city is attributed to the drainage congestion due to unplanned structural growth. Most of the natural Khals are choked by encroachment, earth filling and deposition of city garbage. He pointed out that the total waterlogging area in the city is 3.51 sq. km. But the Buriganga river zone, Dholai Khal zone and Begunbari Khal zone are the worst affected zone, which comprise 0.41, 1.37 and 0.69 sq. km areas respectively. During a heavy rainfall in Dhaka city the depth, duration and frequency of waterlogging vary a great extent in place to place. The depth range from 0.31m to 0.61m and the average is 0.43m; duration of waterlogging range from 2.51 to 24.0 hours where average is 14.0 hours.

Table 2.3 Waterlogging/internal flood condition in Dhaka city

Drainage zone	Total area (sq.km.)	Urbanized area (sq.km.)	Flood Depth (meter)	Flood duration (hour)	Flood frequency (in one year)
Buriganga river zone	0.41	0.41	0.31 – 0.52 *0.35	2.5 -14 *7	5-19 *8
Dholai Khal zone	1.37	1.37	0.31-0.76 *0.46	3.5-102 *18	4-22 *12
Segunbagicha Khal	0.32	0.32	0.31-0.61 *0.48	2-17 *8	3-27 *8
Bashabo zone	0.16	0.16	0.40-0.55 *0.47	6-10 *8	7-13 *9
North East edge zone	-	-	-	-	-
Begunbari Khal zone	0.69	0.69	0.31-0.61 *0.43	2-22 *12	5-50 *10
Gulshan- Banani zone	0.12	0.12	0.31-0.46 *0.39	4-13 *10	3-14 *12
Kallyanpur zone	0.17	0.17	0.31-0.49 *0.39	6-24 *15	5-15 *8
North zone	0.26	0.26	0.31-0.41 *0.38	4-19 *15	6-8 *7
Turag river bank zone	-	-	-	-	-

* Average value

Source: Asaduzzaman, 1997

Jahan (2002) mentioned the performance of DND area in 1987, 1988 and 1998 flood. He classified the drainage problem of DND area into three types, such as river flooding induced drainage problem, rainfall induced drainage problem and human activities induced drainage problem. He also discussed the economic, environmental and social impact of water logging. He emphasized on the enhancement of pumping capacity and co-ordination of different discipline to face the water logging problem.

Huq and Alam (2003) done a study named “Flood Management and Vulnerability of Dhaka City” described that after implementation of the flood control project in the Dhaka West, unplanned and uncontrolled expansion of urban area stretched rapidly toward the low-lying areas adjacent to the flood protection embankment. These are deeply flooded

floodplain areas close to the river. The residents of the houses in these lowlands suffer from inundation due to accumulation of rainwater after heavy rainfall. Land development through land filling processes in the low-lying areas is causing a drastic reduction in water storage areas. Construction of embankments through low-lying areas without providing adequate drainage facilities has caused internal flooding adversely affecting the residents in those areas.

Khan (2001) in an article namely “ Assessment of Water logging Conditions Using Integrated GIS and Remote Sensing Techniques: A Study of Dhaka Mega City” described the water logging condition of Dhaka city, pre- urban natural drainage situation and the existing drainage condition, relationship between geomorphologic settings and present water logging conditions of Dhaka city. The author pointed out that the depth of water logging ranges 0.5 feet to 2.5 feet, the duration ranges from 1.5 hrs to 72 hrs and the frequency of occurrence per year ranges from 5 times to 20 times respectively (Table: 2.4).

Table 2.4 Water logging characteristics of Dhaka city based on storm events

Storm Event in minutes	Depth in feet	Duration in hrs	Frequency
< 30	0.5-1	1.5-24	10-15
30-60	0.5-2	2-48	15-20
>60	1.5-2.5	2-72	5-15

Source: Khan, 2001

She also described how the present trend of land encroachment of the Khal banks or narrowing of Khals is deteriorating water logging conditions. Listed identified problems due to encroachment process were:

- Solid waste and garbage disposal in them drastically reduces the flow capacity of the khals.
- Bank erosion due to the development of the slums and squatters; also obstruct the natural flow regime of the Khals.
- Some Khals partly or fully have already disappeared due to rapid and uncontrolled urbanization.
- Lack of landuse regulation to control land encroachment along the Khal banks.

The author mentioned that to cope with the water logging problem, there is immediate need for enactment of land use regulations and strict enforcement mechanisms, restrictions to the land encroachment on the bank of the Khals in the city and implementations of city's urban and drainage master plans. She also emphasized coordination between different agencies responsible for physical growth and planning of the city.

Rahman et al. (2005) in a study carried out on the investigation of hydrological aspects of Flood-2004, mentioned that destruction and encroachment of the khals in the western part has caused havoc with the city environment and increased in the western part has become more vulnerable to rainfall flood. External and internal floods also affected the Dhaka city. This report tried to investigate the hydrological characteristics of floods in 2004 and compare it with other historical floods and find out the causes and recent trend of floods and to evaluate the performance of flood control works around Dhaka west and get lessons for proposed flood around the Dhaka east.

In 2004 Dhaka west was not affected by external flood from the rivers whereas internal flooding became the main problem for the area. Addition of storm water and water logging problems worked as the stimulation of the internal flood. Again encroachment of storm water retention areas and drainage canals and blockage of drainage routes are among the main reasons behind insufficient storm water drainage in Dhaka west. From 2004 inundation of west part of Dhaka city in presence of plan flood controls works draws a lesson that not only the construction but also the proper maintenance of the flood control works should be continued. Unplanned urbanization, encroachment of the retention pond and drainage channel should be prohibited to get the proper efficiency of the flood control works while implementing the flood control plan for the east part of Dhaka city. These experiences will be a great lesson for the government.

Maathuis et al. (1999) published an article entitled 'Evaluating Urban Storm water Drainage Using GIS and RS Techniques—A Case Study in Dhaka, Bangladesh' in journal of '*Geocarto International*'. This study showed that a combination of an IRS-1C panchromatic satellite images with GIS spatial modeling and hydrologic data can be a

useful and accessible technology for a first screening and assessment of storm water drainage impacts of urbanization. They predicted the effect of urbanization upon runoff volumes and inundation area (Table 2.5):

Table 2.5 Predicted effects of urbanization upon runoff volumes and inundation area

Water level (meter)	Volume (m ³)		Reduction (m ³)	Area available for storage (hectares)		Reduction (hectares)
	Present	Future		Present	Future	
4	3501268	1466388	2034880	178.5	52.3	126.2
5	5684576	2016530	3668046			
4-5	2183308	550142	1633166	242.5	58.2	184.3

Source: Maathuis *et al.* 1999

They mentioned that one of the major environmental impacts of cities is caused by urban expansions onto flood plains and conversely, the intrusion and difficult evacuation of flood waters. The urbanization process also significantly increases the amount of impervious surface, shortening runoff travel times and increasing peak discharge rates. They pointed out that future urban planning should be through proper land use planning and storm drainage water management, providing regulations to keep sufficient area available for temporary storage of urban storm water runoff. Failure to provide sufficient storage capacity will aggravate water logging and inundation problems. Flooding heights and durations are both likely to increase. Even though the capital will be protected in the future from riverine floods by the Greater Dhaka Flood Protection project, however, during the monsoon season, large areas may still be susceptible to storm water flooding because the runoff resulting from the rainfall can not be disposed off properly.

Mark *et al.* (2001) performed a pilot study titled ‘A Mouse GIS Study of the Drainage in Dhaka City’. The main objectives of the study was to build a mathematical pilot model of a sub-catchments in Dhaka City and to test the applicability of the MOUSE modeling software for analyzing the Dhaka City drainage. The other sub-objectives and scope of the study were:

- to gain an understanding of the flood control and drainage processes of the greater Dhaka area,

- to test the applicability of urban drainage modeling system, MOUSE for Dhaka City,
- to develop an integrated preliminary mathematical model covering an area in the central part of Dhaka City,
- to assess the adequacy of the existing drainage system,
- to assess data availability for developing detailed model for real time Decision Support System (DSS) for drainage monitoring for optimum operation.

They selected the Segunbagicha Khal for their study, one of the major drainage channels in the city. The study showed the applicability of the ArcView based MOUSE GIS system to reproduce and visualize the flooding scenarios of the past in Dhaka City. Further, the modeling system used to evaluate alternative alleviation schemes for reduction of the flooding problems in Dhaka City. The conclusion of the study was that using the hydrodynamic MOUSE model together with MOUSE GIS would provide a cost effective and informative methodology towards a finding an optimum solution of the recurrent water logging in Dhaka City.

Chowdhury (1998) discussed in a dissertation titled ‘Three Essays on Flood Hazard Mitigation: The Case of Bangladesh’ about the flood hazard mitigation strategy and addressed the principal areas of investigation by three consecutive essays. The first essay examined the importance of an effective flood monitoring system from ground observation and remote-sensing perspectives, the second essay examined the single-purpose residential land use/cover change and identified prevailing factors affecting resident motivation and decision- making on suburban floods plain encroachment, while the third essay investigated the importance of environmental factor in hazard mitigation by considering both human use system and natural event system in the hazard zones.

The author pointed out that lack of coordination between the physical, environmental, societal and technological system in the hazard zone and the adoption of public actions without any regard for the attitude, perception and behavior of the people are among the important factors responsible for the failure of public policy. He observed that a set of devices employing a variety of devices like land use regulations, zoning ordinances and

building regulations reduce damage from flood. Flood hazard zoning should be a basis for the development of regulations and responsibility legislation- land use control, building methods for example. The author recommended alternative strategy for hazard mitigation, in the most acutely flooded areas by effective land use control policies, so that new development should be managed in such a way that flood problems do not increase.

2.6 Interruption of Wetlands of Dhaka City

Anwar and Sabuj (2001) has published an article ‘ Land –grabbers Stretch their Claws to the Capital Lakes’ in Bangladesh State of Environment Report 2000, about the encroachment and environmental degradation of the lakes of Dhaka city. They have discussed elaborately about the major two lakes –Dhanmondi Lake and Gulshan- Banani – Baridhara Lake. About Dhanmondi Lake they pointed out that the lake has been under the threat of land grabbers and acute environmental degradation. It is no more the same beautiful lake that it once was. Due to unabated occupation of its banks by encroachers and its multifarious use including bathing, washing clothes and dumping of wastes, the Dhanmondi lake, which was once a spot of attraction for people in this metropolis, has become a dying water body. About Gulshan- Banani – Baridhara Lake, they cited that the lake once used to serve as an environmental relief to the local citizens, has also been gradually shrinking with influential people grabbing the land of the lake. Garbage and unauthorized establishments – most of them slums- and new multi-stored structures and houses have besieged the lake in all sides. But the authors did not discussed about the other lakes and water bodies of the city.

Majed and Rahman (2002) stated that small-scale contamination of wetlands; those might simulate the condition of large rivers or other water bodies regarding some aspects. Physical condition and surrounding environment of five lakes situated at different important location of Dhaka city had analyzed and on the basis of the data collected from Department of Environment on the various physical parameters of lake water were examined by the authors. They put some recommendations from over all views to preserve the roadside wetland as follows:

- To maintain the tradition of the lake and prevent pollution, the ejection of all types of wastes should be stopped on an urgent basis;

- It has to confirmed that no water from underground sewer lines can enter into the lake;
- Necessary steps have to be taken to fulfill the objective of the notice holding the specification that no solid waste could be thrown into the lake water;
- Routine inspection should be ensured.

Alam and Rabbani (2007) in a paper titled “Vulnerabilities and responses to climate change for Dhaka” mentioned that Dhaka is prone to damaging and costly flooding, both from the rivers that bound it and from rainfall that generates runoff that is beyond capacity of the drains. In less than 20 years the city has faced three major floods, each causing huge damage and economic loss. He has also pointed out that, the relevant government agencies have taken the initiative several times to recover the many canals and canal banks that are illegally occupied by influential local people, most of them affiliated with local politics and the power structure. These recovery programmes have not been implemented fully in the past. These canals need to be recovered using any measures, to improve the city’s natural drainage system.

2.7 Ground Water and Wetlands of Dhaka City

Akter and Billah (2005) discussed in an article entitled “Ground Water Demand and Supply Ratio: A Case Study of Dhaka City” about the existing water demand and supply ratio of Dhaka metropolitan city area. They mentioned that the city water supply for domestic and public use is less than the demand. From 1963 to 2001 the yearly average water demand and supply ratio was 1.9 : 1.2. At present, the demands of water increases cumulatively and conversely natural supply of water as well as recharge also decrease cumulatively. The shortage was not as considerable as now and alternative sources of safe water were available viz., surrounding rivers and water bodies which were not polluted at that time. The dynamic characteristics of Dhaka city are reducing the rechargeable open space within and around the Dhaka city by concrete coverage. This retards greatly the vertical recharge. Consequently, ground water table is declining continuously which may precipitate some undesirable effects such as land subsidence, drying of recreation lakes,

deterioration of ground water quality etc. They suggested that to reduce the dependence on ground water, surface water treatment plant or a well field, surface water reservoir, in the adjoining areas, needs to be constructed to augment ground water.

Mafizuddin and Hossain (1990) pointed out in a paper titled “Spatio-Temporal Variation of Ground Water Level in Dhaka City” about the nature and trend of ground water level variations, environmental and social factors responsible for such variation. They observed that there is a more or less perfect relationship between time and groundwater level. With the increase of time the depth of ground water level are increasing and the ground water level fallen up to 30m during 1970-90 periods. The cause of variation may be attributed to the excessive withdrawal in different wells of groundwater in the city to meet the daily need. Some other physical factors, like run off condition geology and soil may contribute to some extent for such differential rate, of variation of time.

The authors also mentioned that if present rate of ground water level falling continues the peizometric surface level will fall up to 110m below the measuring point up to 2050 AD that the result in the subsidence of the land surface up to 5.8m.

2.8 Regulatory Instrument to Control Wetland Change

Farooque and Hasan (1996) compiled the text of environment related Acts, Orders, Ordinances, Rules, etc. including a list of all environment related international instruments to which Bangladesh is a party. The environment related laws have uniquely been presented under nineteen different sectors like pollution and conservation etc. Though no interpretation of the laws can be found in the book, it is a useful book for the present research as it provides a reader with the overall picture of environmental laws of Bangladesh.

Khan (2004) wrote this book titled “An Introduction to Environmental Law: Principle and Practice” contains the subjects of environmentalism and historical background, modern and current international environmental issues, main environmental issues in Bangladesh, environmental issues and laws, management of environment both in the

global and national level, legal responses in the global, regional and national perspectives, some recommendations and suggestions etc. The researcher has found the book as a basic textbook on environmental laws of Bangladesh.

Hasan et al. (2006) compiled leading environmental decisions of five South Asian Countries namely Bangladesh, India, Nepal, Pakistan and Srilanka in this book named “Judicial Decisions on Environment of South Asia: 2001-2004”. These publications are unique listing of landmark environmental decisions not only under heads of names of countries, but also under heads of “Evolution of Right to Life and Environment”, “*Locus Standi* in Public Interest Environmental Litigation (PIEL)”, “Pollution and Conservation”, “Water Management and Conservation of Wetlands”, “Waste Management”, “Protection of Public Health and Consumers” etc. These judgments would provide an opportunity to understand the judicial attitude of the judges of the apex court of South Asian countries towards the conservation of environment. The only limitation of these publications is that there appears no attempt to analyze those judicial decisions.

Chowdhury (2007) wrote this book namely “Essays on Environment”. The book addresses important environmental issues like conservation of forest and biodiversity, overview of Bangladesh GEF profile, environmental policy, laws, rules in Bangladesh as well international conventions, treaties and protocols on environment to which Bangladesh is a party. The significance of this book is that it points out the government initiatives to conserve the environment through various ways, but did not try to point out the failure stories of the government of Bangladesh in dealing with environmental issues.

Razzaque (2000) illustrated in this article namely “Access to environmental Justice: Role of Judiciary in Bangladesh”, about four main areas where the Judiciary is active in accommodating environmental protection. These areas are constitution and environmental protection, standing in the court, remedies to facilitate the environmental justice and national application of international environmental law. The article discussed only on the access to environmental justice to the Supreme Court of Bangladesh; and no elaborative research was undertaken on the role of entire judiciary of Bangladesh with regard to conducting environmental justice.

HUDA (2003), The Hyderabad Urban Development Authority (HUDA) in collaboration with the Pune based World Water Institute (WWI) and with support from the Royal Netherlands Embassy (RNE) hosted an international workshop on urban water bodies at Hyderabad, Andhra Pradesh, India from 16th to 18th June 2003. It was mentioned in the conclusion of the proceeding of the workshop that one of the major problems faced all over the world is rapid urbanization coupled with encroachment, leading to the loss of catchments of lakes. On the management front, observed that active participation of all stakeholders that include primarily the dwellers (e.g., resident welfare associations, fisherman) and tourists in and around the lake who derive benefits (mostly direct) from it, government departments under whose jurisdiction the lake and its catchments falls helps in managing it better. Below was the set of final recommendations of the workshop:

Global:

- Work towards the establishment of an international protocol for urban water bodies;
- Establish an international network of individuals and organizations exclusively devoted to issues of conservation, utilization and management of urban water bodies;
- Call for an international conference to debate and discuss experiences related to conservation and management of urban water bodies;
- Establish an international training center at Hyderabad for training in waste water treatment, pollution control and management of urban water bodies to build on the experiences of the lakes restoration in and around Hyderabad;
- Documentation of best practices in management of urban water bodies with relation to financial, technology, social and ecological sustainability;

National:

- Need for an overarching policy to address issues related to urban water bodies;
- Need for an appropriate legal framework to cover urban water bodies, especially making such areas, and their designated buffer zones, inalienable and enforcing principle of 'polluter pays'

State:

- Enact the Lake Conservation Act which calls for interdepartmental coordination and provides a legal framework with flexibility for implementation of appropriate local solutions including the involvement of civil society at the highest level.

Local:

- Establish local stakeholder forums to support the management of urban water bodies
- Integrated management of urban catchments;
- Social, economic and cultural impact assessment of the interventions at the local level;
- Introduction of lake conservation as part of school and college education.

National Wetland Policies, Uganda (1995): The Ministry of Natural Resources of Uganda, in consultation with all stakeholders prepared a National Policy for the Conservation and Management of Wetland Resources. The wetlands policy calls for:

- No drainage of wetlands unless more important environmental management requirements supersede
- Sustainable use to ensure that benefits of wetlands are maintained for the foreseeable future;
- Environmentally sound management of wetlands to ensure that other aspects of the environment are not adversely affected;
- Equitable distribution of wetland benefits;
- The application of environmental impact assessment procedures on all activities to be carried out in a wetland to ensure that wetland development is well planned and managed.

Three principles apply in pursuit of the goals of the policy:

- a) Wetland resources form an integral part of the environment and their management must be pursued in the context of an interaction between conservation and the national development strategies and activities.
- b) Wetland conservation can only be achieved through a coordinated and cooperative approach involving all the concerned people and organizations in the country including the local communities. (The Ramsar Convention, 1995).

2.9 Summary of the Literature Review

Literature review on urban management in general and wise management of wetland in particular suggest that various aspect such as policies, laws and regulations, political will, people awareness and institutional capabilities are related to conserve the wetlands of Dhaka city. The causes of wetland change are manifold. Unplanned urbanization, garbage disposal, earth filling, encroachment, slums and squatters, enforcement of proper laws and regulations, institutional capacity and land use planning are closely related factors in respect of wise management of urban wetlands. In Bangladesh urban environment management including urban wetland management is at an incipient stage. Till to date very little work has been done on the transformation of wetlands and its consequential effects. None of this works covered the Dhaka city and its surrounding areas and most of these works used satellite images up to the year 2001 or earlier. It is well agreed in all relevant literature that wetlands of Dhaka should be conserved considering its immense environmental and socioeconomic contributions. But there is no comprehensive study available to apprehend the extent of environmental degradation and social implications; the city is approaching with the change of wetlands. Thus it requires an updated and inclusive study regarding the changing pattern of wetlands and its consequential impacts.

Chapter 3

Sources of Data and Research Methodology

Chapter 3

Sources of Data and Research Methodology

This chapter describes the research design adopted and steps followed to achieve the objectives set for this study. Work methodology includes the procedure of selecting the study area and samples; method of data collection and the analytical framework will be used for this research.

3.1 Types of Research

This research conducted investigations at two levels: macro level and micro level. A macro level study to determine the overall trend and context of changes of wetlands in and around Dhaka city and a micro level study to understand the inherent causes of wetland changes and its impact on environment of Dhaka city. The research for this study includes both exploratory and evaluative type. Exploratory in the sense that the research intends to explore the causes and factors responsible for the change of wetland. This research also intends to assess the perception of the people regarding environmental impact of wetland loss, opinion regarding the existing management system of urban wetlands. On the other hand existing laws and regulations, programs/ policies along with their enforcement has evaluated and described by using the primary and secondary data.

3.2 Sources of Data

The Primary and secondary sources of data are the basis of the research. The primary data of this research have collected from field level and the secondary data of this research have collected from various government, semi government and non-government organizations as well as from web site.

3.2.1 Primary Sources

To collect the primary sources of data / information the researcher adopted following data collection technique;

- Observation
- Questionnaire survey
- Interviews
- Photographs

3.2.1.1 Observations

Observation is one of the oldest methods of scientific information collection and reporting. Technical information can be obtained well by observation than asking questions. Measurement of time and distance could be more reliable by observation. The danger of false information through observation remains low in comparison to questionnaire and interview method. Observation was conducted to collect the data on following issues:

- Present physical status of the wetlands
- Purpose of wetland encroaching/grabbing
- Category/social status of wetland encroacher/ grabber
- Types of wetland disruption
- Observation of other factors, which seemed to be related with causes of wetland change.

3.2.1.2 Questionnaire Survey

To find out inherent causes of loss of wetlands in Dhaka city and its associate impact on city life, a field survey as questionnaire survey has been conducted. Total 390 households were selected as samples from five purposively selected areas. The questionnaire was designed in such a way that it would track down the problem from the inception and the impact of the wetland loss in the locality. Data or information about perception of the people on environmental problems due to wetland loss, how the people are affected by the problems, how they mitigate these problems and their expectation to get relief from these problems, causes of wetland loss, ways of wetland change, potentiality and enforcement of laws and regulations, opinion in respect of pro-environmental organization and political attitude for conservation and sustainable management wetlands were procured by this method.

3.2.1.3 Interviews

Scheduled interviews were arranged to find out the opinion and suggestion of the official, professionals and experts of different government organization and development agencies and policy makers regarding land use, drainage system, urban planning and development and wetland management and conservation and success and failure of enforcement or applicability of pertinent laws.

3.2.1.4 Photographs

Lot of photographs was needed to illustrate the ways of wetland disruption, consequence of wetland change and its effect on urban life. Some of these photographs have been collected directly from field survey and some other from daily newspapers.

3.2.2 Secondary sources

3.2.2.1 Maps and Images

To analyze the change of Dhaka city wetlands, different maps and satellite images were needed. To derive the land cover map of 1960, 1988 and 2008, topographic map of 1960, Landsat TM 1988 and ALOS- VNIR 2008 were used respectively. Goggle earth image was used to generate the land use map of selective changed wetlands areas. Other relevant maps were used as ancillary data.

Table 3.1 Maps and images used in this study

Sl. No.	Types of data used	Scale/ resolution	Year
1.	Survey of Bangladesh toposheet (79 I/5 & 79 I/6)	1: 50,000	1960
2.	Landsat TM image	30 m	1988
3.	Advanced Land Observation System (VNIR-Visible, Near Infrared) image	10 m	2008
4.	Goggle earth image (Quick Bird)	-	2008
5.	Dhaka City Corporation map	1: 30,000	2004
6.	Dhaka city and surrounding area map	1: 65,500	2008
7.	Dhaka city guide map of SOB	1: 20,000	1987,1995
8.	General land use map of SPARRSO	1: 25000	1991

3.2.2.2 Other Secondary Data

Other secondary data involves official statistics and surveys carried out by the government and different research organizations. Secondary data also has been collected from relevant books, journals, reports and written documents. Different offices and organizations which were visited and consulted are mentioned below:

- Institute of Environmental Science, Rajshahi University: Wetland and environment related various documents have been taken from the seminar library of this institute
- Ministry of Land: Land management, land administration and land policy.

- Ministry of Environment and Forest (MoEF): Environment related project paper, policy, rules and regulations.
- Department of Environment (DOE): Publications on World Environment Day, reports on State of Environment, annual reports, and other related books and documents on environment.
- Department of Geography and Environmental Studies, Rajshahi University: Different journals, urban geography related books and documents.
- Department of Geography and Environment, Jahangirnagar University: Relevant Journals, books and unpublished thesis.
- Department of Geography and Environment, University of Dhaka: Different Journals, flood related reports on Dhaka city, urban environment related books.
- Dhaka University Science Library: Different publications and thesis.
- Institute of Water and Flood Management (IWFM), BUET: Drainage Master Plan, Flood Action plan, flood and drainage related other reports and documents.
- Department of Urban and Regional Planning, BUET: Development plans of Dhaka City, journals and unpublished thesis.
- Dhaka City Corporation (DCC): DCC map, waste management papers.
- Dhaka Water Supply and Sewerage Authority (DWASA): Dhaka city's water supply and drainage system related information.
- Rajdhani Unnayan Kartripakkha (RAJUK): Urban planning and development related documents (i.e. DIT Master Plan, DMDP).
- Bangladesh Centre for Advanced Studies (BCAS): Wetland conservation and management related books and journal and publications.
- Centre for Urban Studies (CUS): Various research report on urban environment and urban planning.
- Bangladesh Paribesh Andolon (BAPA): Wetland conservation related unpublished papers.
- Bangladesh Bureau of Statistics: Urban population and population growth related information.

3.3 Selection of the Study Area

Dhaka the political, administrative, commercial and cultural center of Bangladesh has witnessed a phenomenal growth in population and size during the last 38 years. The population of Dhaka increased more than thirty times and the size of the city expanded by 18 times during the last 50 years with only minimal strategic guidance for the growth of the city. Growth of Dhaka city is unabated by continued rural urban migration, natural increases and expansion of urban boundaries and eventually demand for increased urban settlement and other infrastructure.

The natural adjustment between the landform and land use is being disturbed particularly in the urban areas like Dhaka due to fast growing population, change in the economic condition and change in the technology. The two basic outcome of such disturbance are: wetlands getting filled in for urban expansion and unplanned encroachment of settlements on the wetlands. The effect of human interference over natural system results in a serious water logging problem throughout the Dhaka city in the monsoon season. Considering the magnitude of the problem of land use/land cover change, spatial change of wetlands; comparing the other cities of the country and recent coverage by the mass media and the movement of environmentalist, the Dhaka city is selected as the study area for this study.

3.4 Sample Size Determination and Selection of the Respondents

Sampling technique plays a vital role in research work. Sampling provides sufficient information about population. It plays role to select a portion of the population that displays all of the characteristics of the population. When we come to a decision about a population from sampling results, then those results to be as representative of the population as possible.

It has observed from the overlaid wetlands map of three years (1960,1988 and 2008) that wetlands have disappeared totally or in some areas partially within the study area. From these changed wetlands areas five areas were selected purposively. Then the households numbers of these areas were find out with consultation BBS Community Series, 2007.

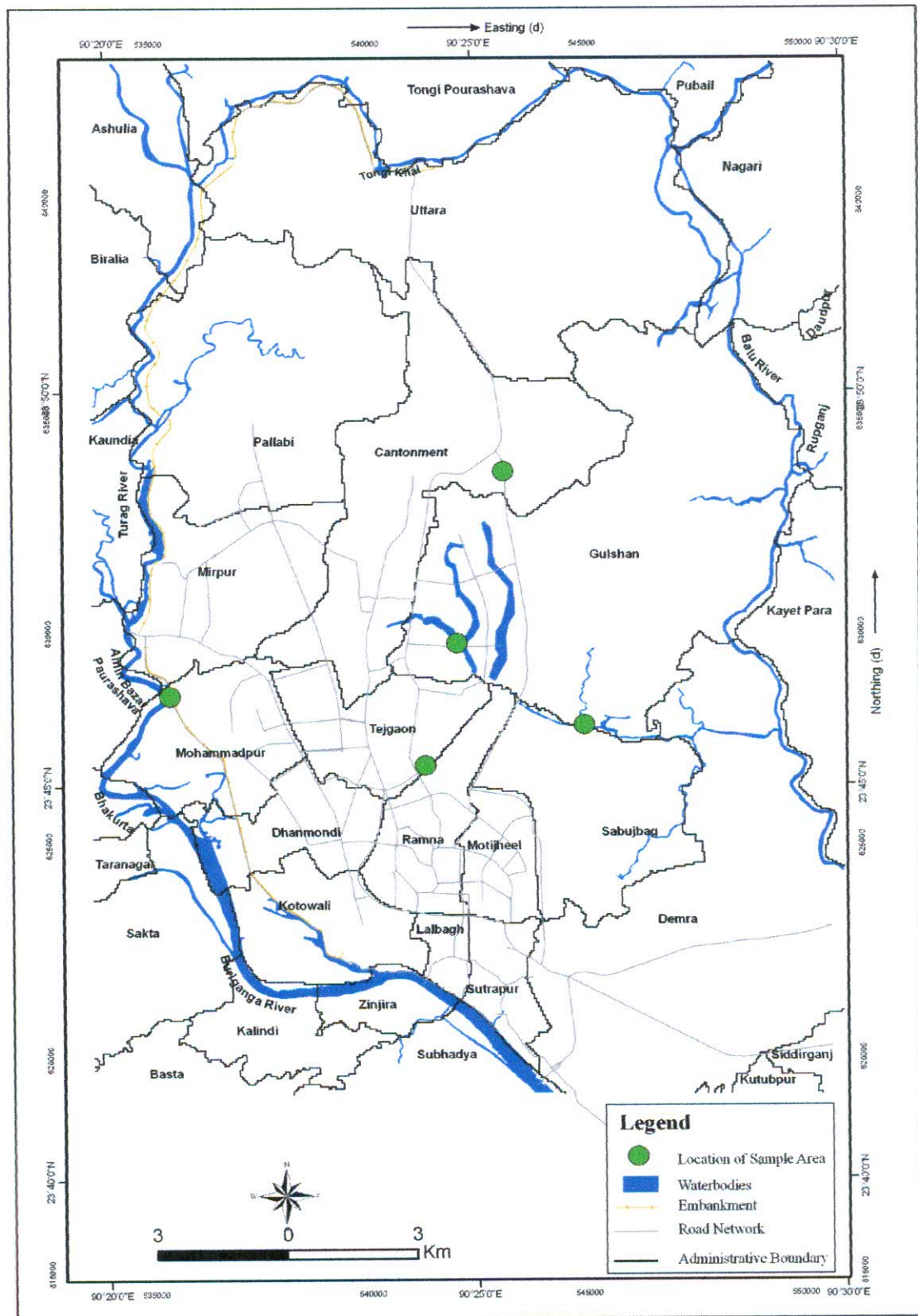


Figure 3.1 Sample areas for questionnaire survey

Table 3.2 Sample areas, corresponding wards/union parishad and household number

Serial No.	Name of the area	DCC ward number / Union Parishad	Household number
1	Part of Turag river (Aminbazar-Gabtolli area)	9 (part)	1935
		43 (part)	3982
		46(part)	3206
		Aminbazar Union (part)	213
2.	Upper part of Gulshan lake (Joarsahara, Kalachandpur area)	17(part)	2691
		18(part)	4545
3.	Lower left side of Gulshan lake(Mohakhali,Niketon Housing Project area)	20(part)	925
4.	Begunbari Khal part-1, commonly known as Hatirjheel (Begunbari, Kunipara, Noyatola, Madhubag, Mohanagar project, Ulan, Merul Badda area)	22(part)	2178
		37(part)	8532
		54(part)	4416
		55(part)	4769
5.	Begunbari Khal part-2 (Rampura bridge – Nasirabad Nandipara Khal; Aftabnagar, Banasree housing, Meradia area)	22(part)	1835
		26(part)	3272
		Satarkul Union (part)	544

Here the units vary in sizes (Table: 3.2). Under such circumstances, selection of units with unequal probabilities may provide more efficient estimators than equal probability sampling (Singh and Mangat, 1996). For this reason Probability Proportional to Size (PPS) sampling procedure was applied for this study and for drawing the PPS sample cumulative total method was used. With this method five sampling area were selected which contain the 1st, 6th, 8th, 11th and 12th serial number of the following table and corresponding total households numbers are (1935+4545+2178+4769+1835) 15262. Due to time and budget constraint it was not possible to cover 15262 households. For this reason Yamane's mathematical formula was used for determining the sample size.

Taro Yamane's (1970) formula:

$$n = N / 1 + Ne^2$$

Where, N = total household, n = sample size and e = level of confidence

Therefore the sample size, $n = 15262 / 1 + 15262 * (0.05)^2$

$$n = 389.78$$

$$n = 390$$

Table 3.3 Cumulative totals of household sizes and associated numbers

Sl. No. of ward / Union	Household size	Cumulative size	Numbers associated
1	1935	1935	1-1935
2	3982	5917	1936-5917
3	3206	9123	5918-9123
4	213	9336	9124-9336
5	2691	12027	9337-12027
6	4545	16572	12028-16572
7	925	17497	16573-17497
8	2178	19675	17498-19675
9	8532	28207	19676-28207
10	4416	32623	28208-32623
11	4769	37392	32624-37392
12	1835	39227	37393-39227
13	3272	42499	39228-42499
14	544	43043	42450-43043

Then a stratum with proportion allocation formula was used to divide the sample number proportionately in each of the five strata.

$$\text{Here, } n_i \propto N_i$$

$$\text{or, } n_i = K N_i$$

$$n_i = n/N * N_i$$

Where, i = 1, 2,3, 4,5; N = total household, n = sample size.

Therefore, $n_1 = 49$, $n_2 = 116$, $n_3 = 56$, $n_4 = 122$, $n_5 = 47$

$$n = \sum n_i$$

$$= n_1 + n_2 + n_3 + n_4 + n_5$$

$$= 49 + 116 + 56 + 122 + 47$$

$$= 390$$

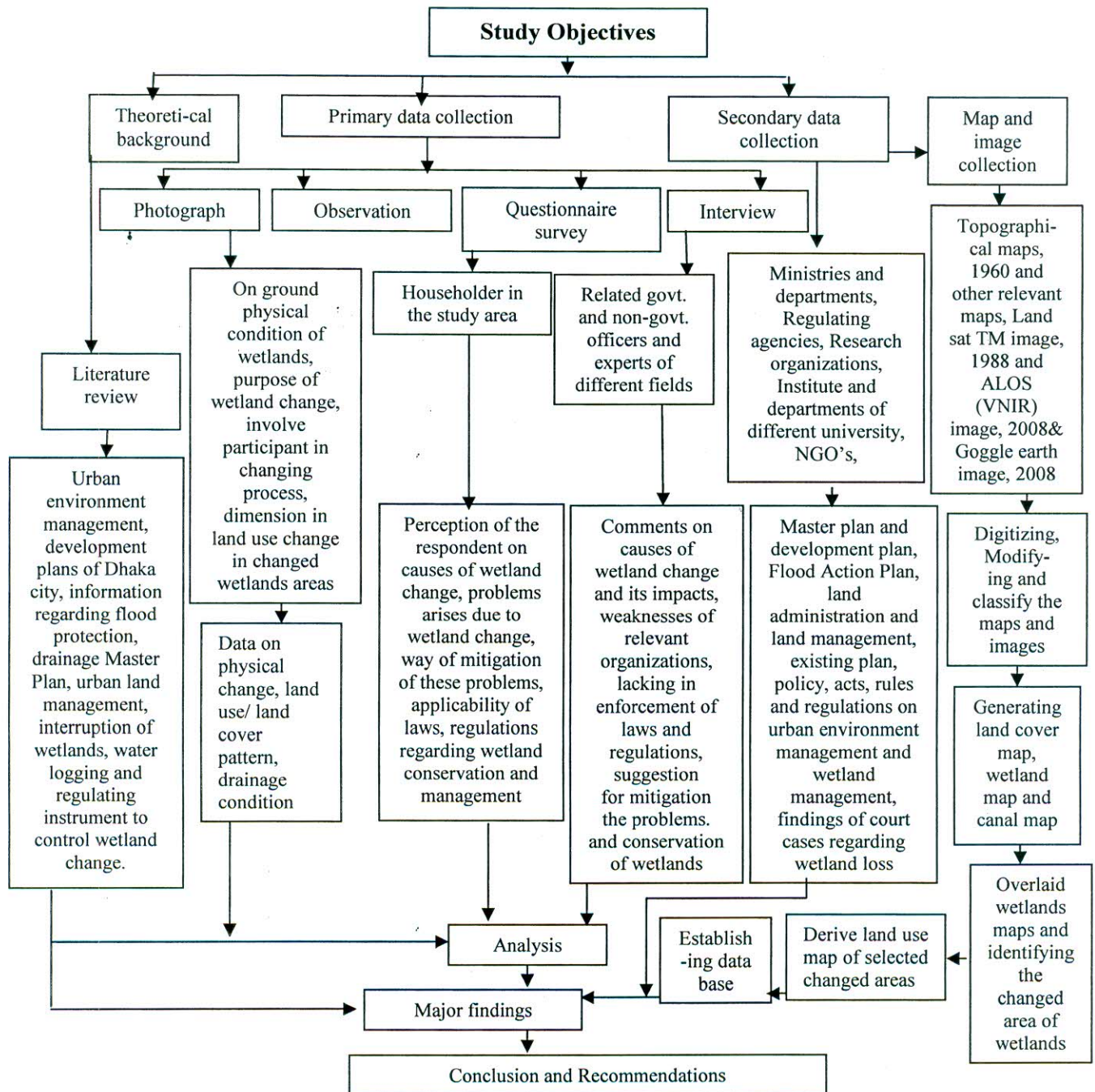
To select the respondent from the each of the above five strata simple random sampling was used. Purposive sampling method was followed to select the 50 respondents of officials and experts of different fields to know their view of causes of wetland change and its impact on environment, applicability of acts and rules and way to relief from this problem.

3.5 Methods of Data Processing and Analysis

After completion of primary data collection from the field level, the interviewed questionnaires were edited and edited data were doubly entered into SPSS Windows 15 version to minimize the processing error. Both SPSS (Statistical Package for the Social Scientist) and Microsoft Excel were used for data processing and statistical analysis. The secondary data used in this research was included after checking its acceptability carefully. With a view to describing data percentage and frequency were widely applied.

Both tabular and graphical representation was used for data presentation responding to the objective to the research. Relevant study maps and images were digitized, classified and modified according to the requirement using some Geographic Information system (GIS) like ArcGIS, Erdas Imagine etc.

3.6 Overall Research Methodology



Chapter 4

Growth of Dhaka City and Wetland Disruption

Chapter 4

Growth of Dhaka City and Wetland Disruption

4.1 Physical Feature of the Study Area

4.1.1 Geographical Location

Dhaka city is located in the central part of Bangladesh and situated on the northern bank of Buriganga. The Balu river in the east, Tongi khal in the north and Turag river in the west. The study area lies between $90^{\circ} 20'$ and $90^{\circ} 30'$ east longitude and $23^{\circ} 40'$ and $23^{\circ} 55'$ latitude. The study area is included in the survey of Bangladesh Toposheet No.s 79 I/5 and 79 I/6. Based on flood control infrastructures, the city is divided into two parts: Dhaka East and Dhaka West.

4.1.2 Area and Population

Dhaka city has mainly two connotations. First is Dhaka City Corporation (DCC) has a clear administrative boundary and its area can easily be measured. At present the DCC has area of 290 sq km (Islam, 2005) The population of DCC area is about 673774 (BBS, 2007a). Another one is Dhaka Metropolitan Area (DMA), the area defined by the metropolitan police administration for the maintenance of law and order. DMA is slightly larger than DCC.

Table 4.1 Population changes in Dhaka Metropolitan Area and Dhaka city Corporation area

Year	Population (DMA)	Growth rate (DMA)	Population (DCC)	Growth rate (DCC)
1974	1950252	-	-	-
1981	3458602	8.5	-	-
1991	73340000	7.8	4486421	-
2001	11162000	8.2	5378023	3.77
2016	15569000	8.33	8000000	1.02

Source: BBS, 2001 and RAJUK 1997

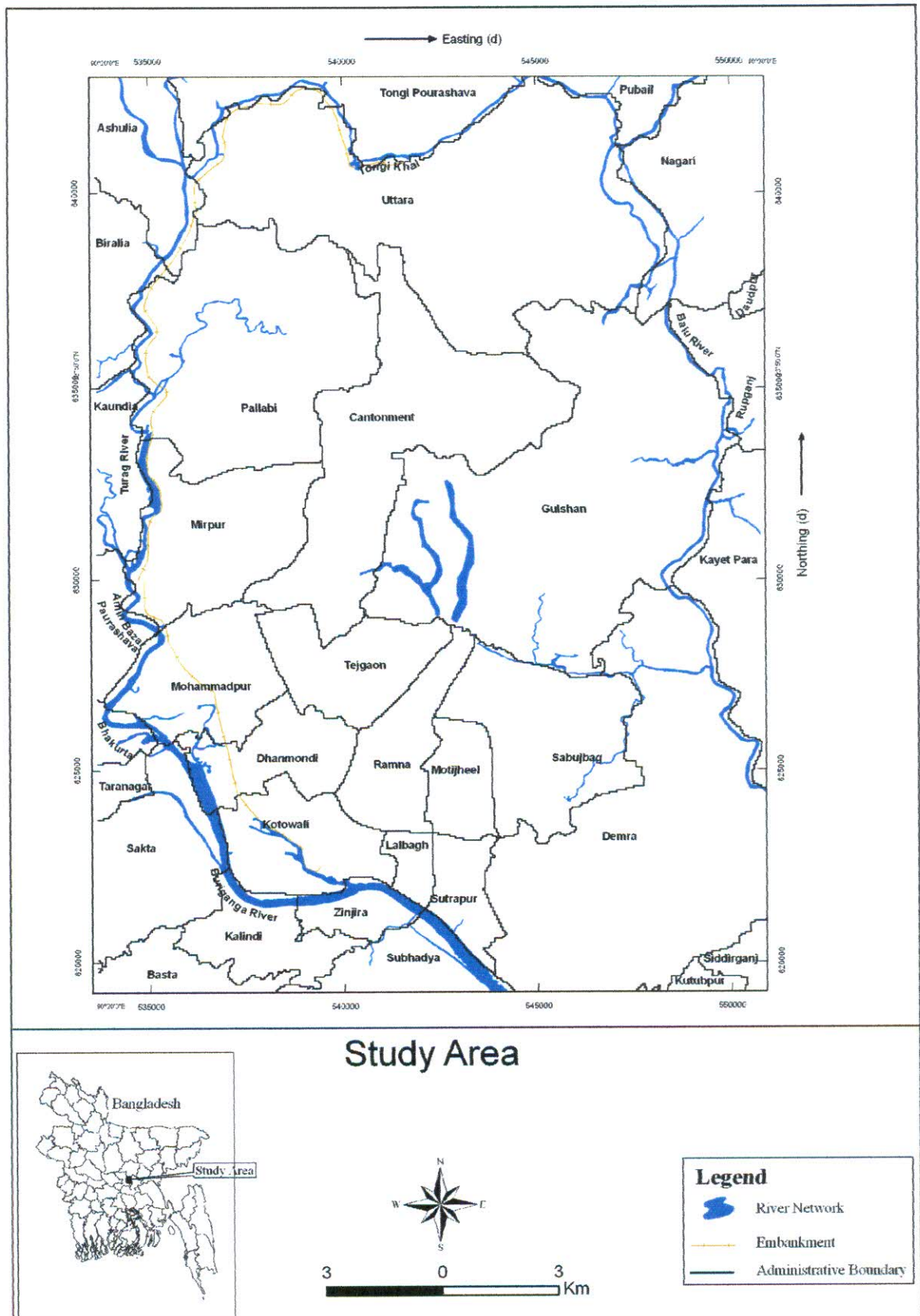


Figure 4.1 Location of the study area

4.1.3 Climate

The Dhaka city usually experiences characteristics of tropical monsoon climate. It is hot and humid during May to September while cool and dry during November to February. The monsoon is the rainy season ranging from the month of May to September (Nishat, *et al.*, 2000). Rainfall in Dhaka occurs from three main sources: the western depression of winter, the early summer thunderstorms known as Nor'westers and the summer monsoon. Average numbers of rainy days per month during June to August are 19 to 22. The average annual rainfall is about 2000 mm. Rainfall is rather scarce during the months from November to February. The lowest temperature during this period may drop down to about 5⁰ C. On the other hand, temperature, as high as 40⁰ C may occurs during the warm months of March and April. The average temperature of Dhaka city is 25⁰ C. Monthly evaporation varies from 80 to 130 mm. The climatic condition of Dhaka city are shown in the following table:

Table 4.2 Climatic condition in Dhaka city area

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. rainfall (mm)	6.5	20.2	52.3	124.0	283.0	398.0	391.4	328.0	264.0	160.0	25.3	7.4
Rainy days/m	1	2	4	8	14	19	22	22	16	9	2	1
Temperature ⁰ C												
High (extreme)	34.2	36.6	40.6	42.3	40.6	38.4	35.2	35.9	35.3	38.8	33.3	31.2
Low (extreme)	5.6	4.5	10.4	15.6	18.4	20.4	21.7	21.0	22.0	10.4	10.6	6.7
Avg.	18.8	21.5	26.1	28.7	28.9	28.7	28.7	28.7	28.7	27.4	23.6	19.8
Rel've Humidity	70.7	66.0	63.0	71.0	79.0	86.0	87.0	86.0	86.0	81.0	75.0	74.0
Evaporation	104.0	79.0	81.0	77.0	78.0	83.0	87.0	130.0	118.0	106.0	75.0	105.0

Source: JICA, 1991

4.1.4 Topography

Dhaka city represent mostly flat land area with slight undulation. It comprises of Madhupur tract and recent sediment. A large part of this city is covered by low-lying depression. The elevation of greater Dhaka lies between 2 to 13 above mean sea level

(msl). Most of the urbanized areas lie at elevation of 6 to 8 m above msl (Nishat, *et al.*, 2000). The area slopes towards southeast, east and west but general slope is from the north to south east where the ground surface merges gently with the flood plain of the Buriganga river (Sultana, 2005). The highest land of the city is located at Mirpur with an elevation of 13 m while the lowest is in the floodplain of Buriganga river in western part of Dhaka. The topography may be classified into the three topographic units: high land formation (6-13 m), medium land formation (5-6 m), and lower land formation (1.5- 5 m). The land area above 8 m msl covers about 20sq. km. The land ranging from 6 to 8 m msl covers 75 sq. km. while 170 sq km. of area is below 6 m (Nishat, *et al.*, 2000).

Table 4.3 Land elevation of Dhaka city (above mean sea level)

Land form area	Land elevation above mean sea level (meter)	Comments
1	Higher than 10.0	1 & 2 = these type of landforms considered as safe from annual flooding. 3 = this is marginally free from normal flooding. 4-6 = these type of landforms are under severe threat of flooding
2	8-10 meter	
3	6-8 meter	
	Average flood level 6.0	
4	4-6 meter	
5	2-4 meter	
6	Lower than 2 meter	

Source: JICA, 1992

4.2 Demographic Characteristics of the Respondents

This section captures the most important individual details of the respondent: their age, sex, occupation and level of education. Because of the nature of the questionnaire only individuals 20 years old or above were interviewed.

4.2.1 Sex Composition

Regarding the sex composition of total respondents, about 87% were males and around 13% were females. Most of the time women were not willing to talk with the interviewers. For this reason the proportion of the interviewed women is lower than the proportion of men.

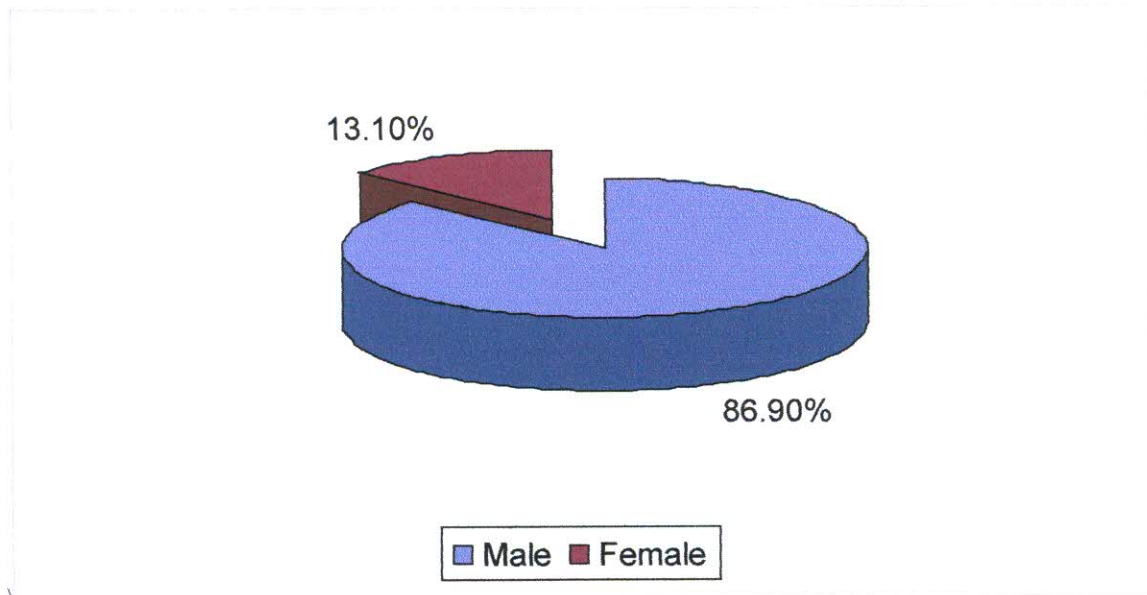


Figure 4.2 Percentage of respondents by sex

Source: Field Survey, 2009

4.2.2 Age Structure

Most of the respondents (42.6%) belonged to age group 40-49. The second major age group was 30-39 (27.7%). The lowest number of respondents (4.6%) belonged to age group 60+, while a slightly higher number of respondents belonged to the age group 20-29 (11.3%). The most junior respondent was 22 years old and the most senior respondent was 80 years old. The mean age of the respondent was about 35 years.

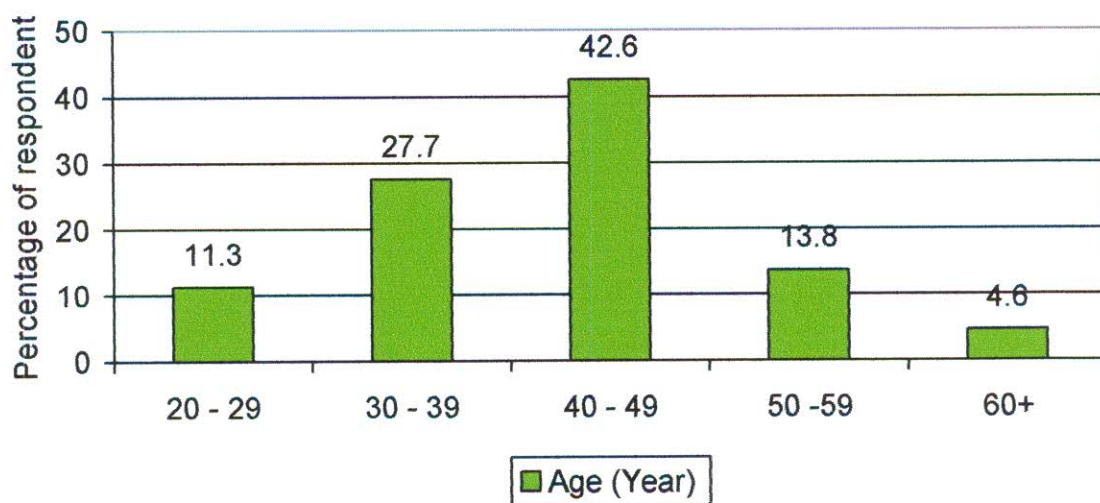


Figure 4.3 Age structure of the respondents

Source: Field Survey, 2009

4.2.3 Occupational Structure of the Respondents

Among the respondents majority were businessmen (54.1%). The second major occupation of the respondents was service (30.0%). The lowest percentage respondents were engaged in wage laborers (5.1%). Only 8.5% respondents were housewife and 2.3% respondent were unemployed.

Table 4.4 Occupation of the respondents

Occupation	Frequency	Percentage (%)
Business	211	54.1
Housewife	33	8.5
Wage Labourer	20	5.1
Service	117	30.0
Unemployed	9	2.3
Total	390	100

Source: Field Survey, 2009

4.2.4 Level of Education

Level of education is an important indicator of individual's quality of life. Out of the total respondents 17.2% respondents were secondary level, while 31.5% respondents were higher secondary level, 28.5% respondents were graduate level and around 13% respondent were post graduate level. Very few respondents were illiterate but 7.9% respondents were less than high school level. Only one respondent was more than postgraduate level.

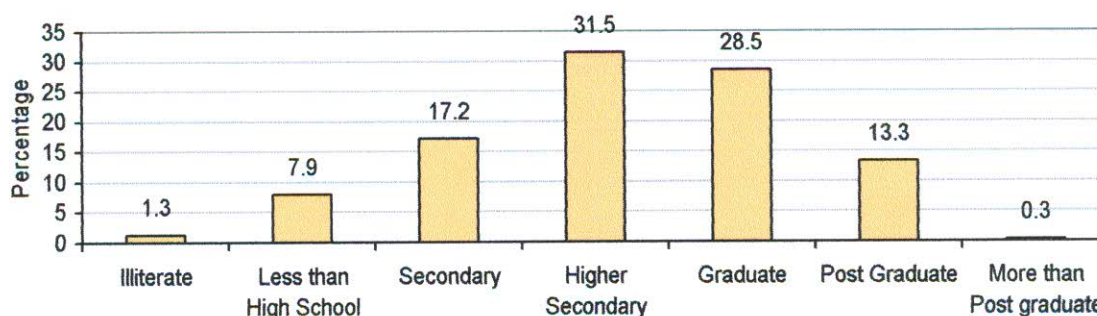


Figure 4.4 Education level of the respondents

Source: Field Survey, 2009

4.2.5 Ownership of the Land

During interview the respondent were asked about the ownership of land where they live.

Out of the total sample households 40% respondents have own house, while 59% live in rent house and only 1.3% live on khas land.

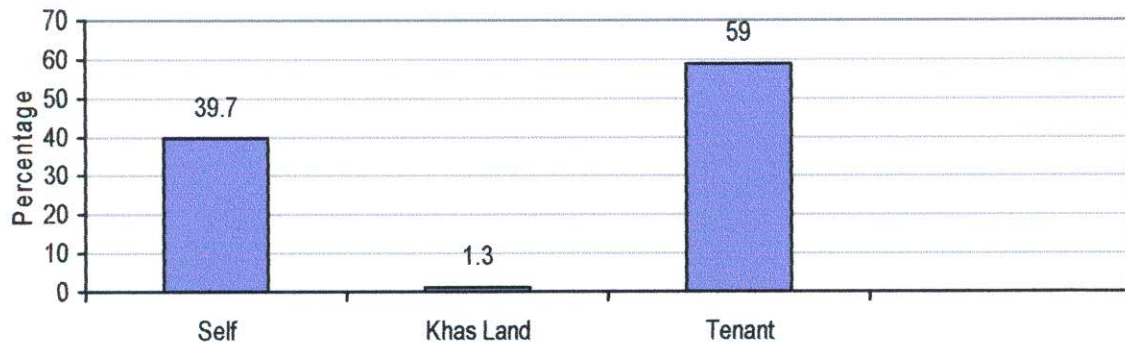


Figure 4.5 Ownership of the land where respondent live

Source: Field Survey, 2009

4.3 Physical and Demographic Development

The five major periods of growth and expansion of the city in the scale of time under are: Pre-Mughal (before 1604), Mughal (1604-1764), British (1764-1947), Pakistan (1947-1971) and Bangladesh (after 1971).

4.3.1 Pre-Mughal Period (before 1604)

The history of the present Dhaka city before the 16th century is obscure, but the available documents present that some parts of the greater Dhaka was ruled by the Buddhist then the Hindus till around the 13th century. However, Muslims arrived to colonize Dhaka and the nearby areas after 1275. The Turks and the Pathans ruled Dhaka till the arrival of the Mughals (Islam, 1999). The boundaries, size, and population of Dhaka city are also relatively undocumented and unclear before 1604. It is evident from the various writings on Dhaka that the areas to the east, northeast and southeast of Babur Bazar up to the Dulai River on the left bank (northern bank) of the Buriganga formed the old town. The Dulai River possibly formed the northeastern boundary of the old city, though it is difficult to determine the western limit of the pre-Mughal 'old city'. Considering testimony to the existence of a mosque at that time, however, it can be assumed the city limits went beyond Babur Bazar on the western side. It is quite likely that following the course of the

Buriganga settlements grew on the southern, western and north-western parts of the city. These, of course, were sporadic growths with the riverbank determining the basis for settlements. It could not be more than one square mile in area and was popularly known to have contained “fifty two bazaars and fifty three lanes” (Islam, 2005).

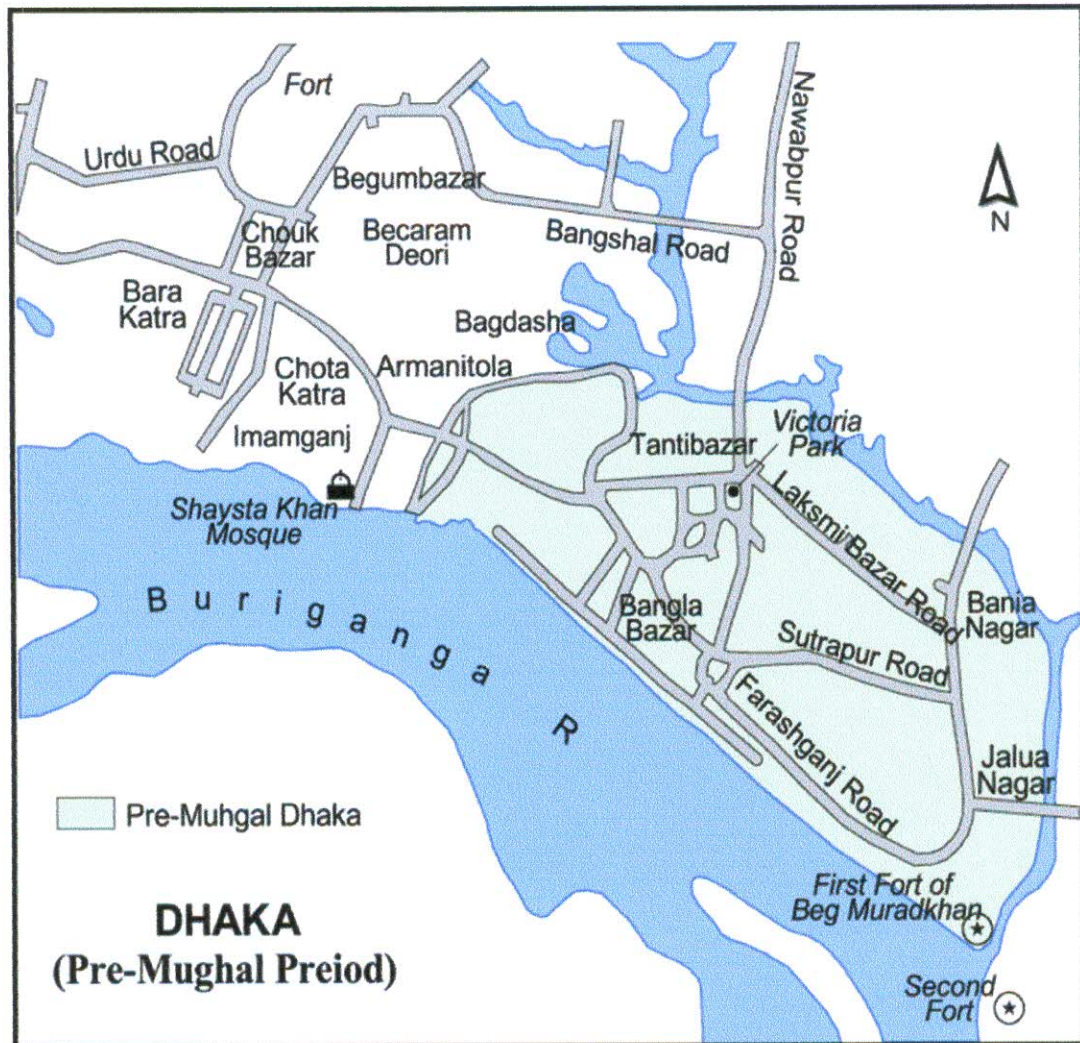


Figure 4.6 Dhaka city in Pre-Mughal period

Source: Banglapedia, 2004

4.3.2 Mughal Period (1604-1764)

Dacca (Dhaka) was renamed as Jahangirnagar and was made capital of Bengal by Islam Khan, the Moghal Viceroy of Bengal, in 1608. Large development took place during the period, 1608- 1706. Besides being a great military centre and administrative headquarters Dacca (Dhaka) became an important industrial town and a commercial centre of repute in and outside the country (Atiqullah and Khan, 1965).

According to documents and remnants of Muslim Mughal sculptures in the “old city”, Mughal Dhaka incorporated the “old Dhaka” within its boundaries. In this period the expansion to the west and the north was significant; with the fort in the centre the expansion to the west followed the riverbank and the city spread northward to Phulbaria on the fringe of the Ramna area. In this growth of Mughal Dhaka the general characteristics of a Mughal city were noticeable. The areas to the south and southwest of the fort up to the riverbank grew mainly as commercial areas while to the north and northeast residential areas sprouted.

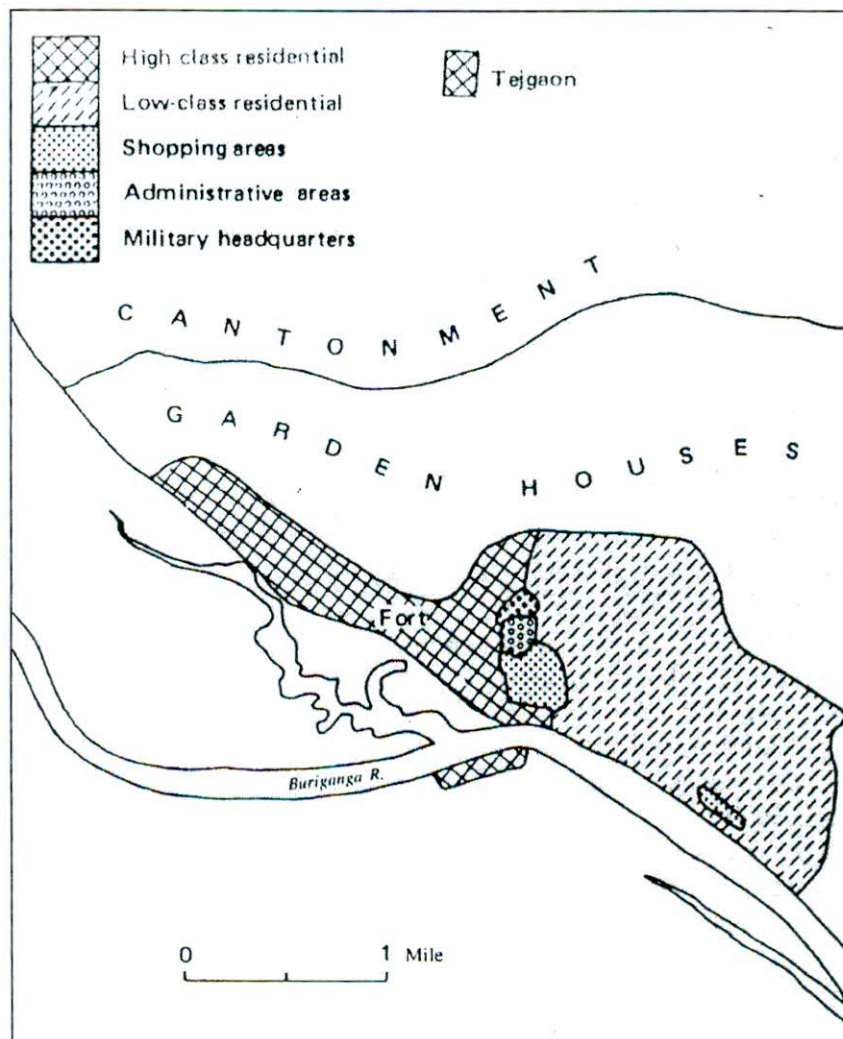


Figure 4.7 Dhaka city land use-1700

Source: Islam, 1996

The northern limit of the city extended to the gateway built by Mir Jumla (1660-63). Mir Jumla's name is also associated with the construction of two roads connecting Dhaka with a network of forts built for the defense of the capital city. A road headed north to a fort at

Tongi-Jamalpur and another toward the east connecting Dhaka with Fatullah, where two other defensive forts were constructed. These two roads influenced the growth of the city in these directions. In the available early records of the East India Company (1786 and 1800 A.D.) the boundary of the city is mentioned as: Buriganga in the south, Tongi in the north, Jafarabad-Mirpur in the west and Postogola in the east. The expansion of the city in the Mughal period was dictated by nature, particularly highlands. As provincial capital, Dhaka enjoyed a golden era, serving as the commercial headquarters and chief emporium for products of Eastern Bengal. Dutch, Portuguese, French, English, and Armenians were among those who established trading houses in the 17thC. The population of Dhaka city in the Mughal Period was 0.9 million living with its 50 square kilometer area (DCC, 2004).

4.3.3 British Period (1764-1947)

At the tail end of Mughal rule and the inception of British power around 1765, Dhaka begun to decline in importance and contract in size. The city experienced disastrous famines, floods and fires. Calcutta was growing in importance and it was difficult for Dhaka to compete with Calcutta, which as the Capital of British India enjoyed the patronage of the rules (Islam, 1996).

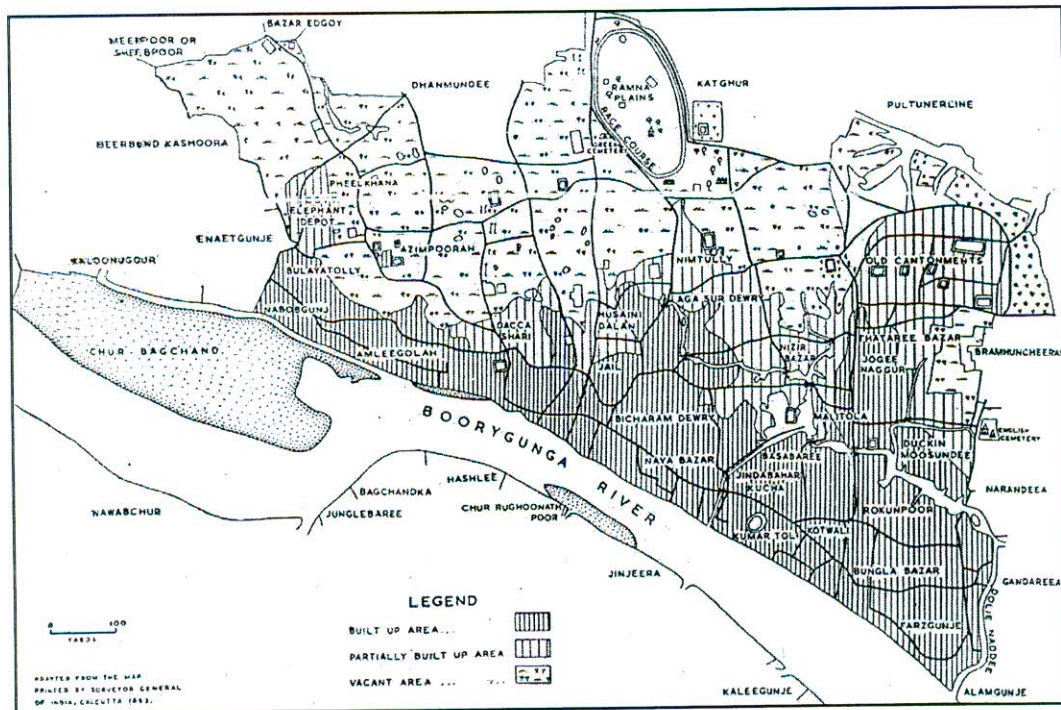


Figure 4.8 Dhaka city land use-1859

Source: Ahmad, 1963

By 1840, this decline had reached its nadir and most of the former Mughal city had been deserted or had fallen victim to the encroaching jungle (Ahmed, 1991). The decline affected Dhaka seriously and during this period Dhaka also suffered physical shrinkage to such an extent that the physical boundaries actually shrunk from 50 km to 8 km (Islam, 1974 cited in Tawhid, 2004) as did the population from 0.9 million to 0.2 million (Taylor, 1840).

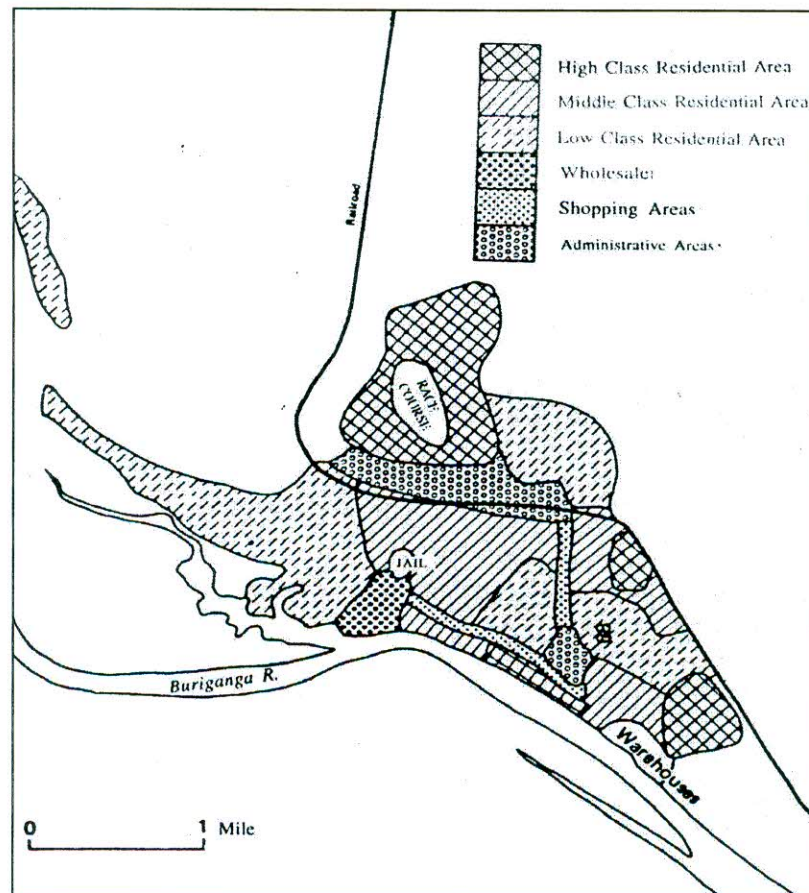


Figure 4.9 Dhaka city land use-1910

Source: Islam, 1996

However, the second half of the nineteenth century marked the beginning of the physical renewal of the city. In 1857, India came under the direct rule of the British crown and saw some development of utility services.

In 1905, Dhaka was made the capital of the new province of East Bengal and Assam, allowing further development of roads and proper drains, as well as fully planned residential areas like “Wari”, an upper-middle class area considered “the sanatorium of Dacca.” Thus the ‘new Dhaka’ of the present century had its birth at the hands of the British rulers.

The impetus for growth created by the 1905 partition of Bengal was seriously jolted by the annulment of the partition in 1911 when Dhaka reverted back to the status of a district town. However, the establishment of the University of Dhaka in 1921 helped to retain a semblance of prominence until 1947 when Dhaka again attained the status of the provincial capital of East Bengal, later named East Pakistan. From that time till 1947, Dhaka city functioned as a district headquarters, trade centre and university town. The main development took place in Ramna area. During the long period of over 180 years under the East India Company and the British Crown, the functional pattern of Dhaka city underwent marked changes (Islam, 1996).

4.3.4 Pakistan (1947-1971)

Pakistan was created on the 14th August 1947 and Dhaka was made the capital of the province of East Pakistan. Dhaka was suddenly called upon to shoulder many responsibilities (Islam, 1996). The real extent of Dhaka city in 1947 at the end of the British rule was not more than 65 sq. kms, with its built up limits extending from the northern bank of Buriganga River only up to Tejgaon. Its population was approximately 250,000 at that time (Islam, 2005). The needs of the officials engaged in administration, the business community and the residents grew out of the sudden onrush of people to Dhaka. This contributed to the growth of the city in its new role as the provincial capital. The Motijheel area, once desolate and lying on the fringe of marshes and swamps where the Nawabs had built a garden house was earmarked as the commercial area in 1954. Planning continued such that open areas of the city were devoted to recreation, residences, and more commerce. To cater to the ever-increasing residential needs of the new capital, the Dhanmondi area, adorned with paddy fields in the early 1950s, was developed as a residential area after 1955. The Mirpur Road formed an axis and the highlands on both sides of the road came to be occupied right up to Mohammadpur and Mirpur. In the mid-1960s these two areas were developed by the government mainly to accommodate the migrant Muslim population. The Tejgaon Airport and the Tejgaon Industrial area came under governmental schemes in the early 1950s. In the second half

of the 1960s the decision to have a capital for East Pakistan at Dhaka led to the development of the area to the west of Tejgaon farm and the Airport (now known as Sher-e-Bangla Nagar). With the creation of the Dhaka Improvement Trust (DIT) in 1956 (transformed into the Rajdhani Unnayan Karttripakkha in 1987) greater interest and care was undertaken in road construction and city planning. The DIT developed the Gulshan Model Town in 1961, Banani in 1964, Uttara in 1965 and Baridhara in 1972 (though first conceived in 1962). The Dilkusha Gardens adjacent to Motijheel came to be engulfed by the ever-growing commercial needs. In the mid-1960s the main railway line was shifted and directed eastward. The Dhaka Railway Station was moved from Phulbaria to Kamalapur. This eliminated the landmark that had long stood between the 'old Dhaka' of the Mughals and the 'new Dhaka' of the English. The rapid growth and development of the area between the old railway track and Kawranbazar necessitated this change. The influx of people caused the population to increase from 335,925 in 1951 to 556,712 in 1961 registering an increase of 65.7 percent (Islam, 1996).

4.3.5 Bangladesh (1971 onward)

Dhaka rearranged itself again as the capital city of Bangladesh after the liberation war in 1971. It accommodates all public and private factories and industries, and commercial establishments. The significant influx and natural growth of population after the liberation war made this one of the most populated cities in the world (DOE, *et al.*, 2006).

The growth outward, following the pattern set by the Mughal founders has been limited by the waterways surrounding the city. With increased population pressure the highlands spreading northward were occupied and built up. The intervening ditches, swamps and marshes were filled in, not in any planned manner, but as exigencies arose and private initiatives dominated the process. Development under the aegis of the DIT dictated nature rather than allowed nature to direct planned growth. In selecting the sites for the Model Towns of Gulshan, Banani, Baridhara and Uttara, the method of selecting the highlands on the main Dhaka -Tongi axis road is clearly discernible. No serious effort at reclaiming land under a well-planned scheme to give the city a homogenous and cohesive growth is visible.

Dhaka has grown on its own in a haphazard manner and the topography of the area dictated the terms and direction of the growth. Since Dhaka became the capital of an independent country the pressure on it has been enormous. The permanent inhabitants of the city have registered a steady growth. Along with it there was a very large floating population, the pressure of which has resulted in the growth of slums on any available vacant land. The recent phenomenon of high rise buildings, both in the commercial and residential sectors occupy the city's highlands and demonstrate ever-increasing pressure on Dhaka as it builds upwards, an inevitable and common phenomenon in all modern cities facing population growth. Since the 1990s, Dhaka has been on the verge of change in its urban character with vertical growth replacing horizontal expansion. Dhaka was a city of 2.8 million in 1981, which rapidly increased to 5.3 million in 2001 while expansion of city area was negligible (DOE, *et al.*, 2006).

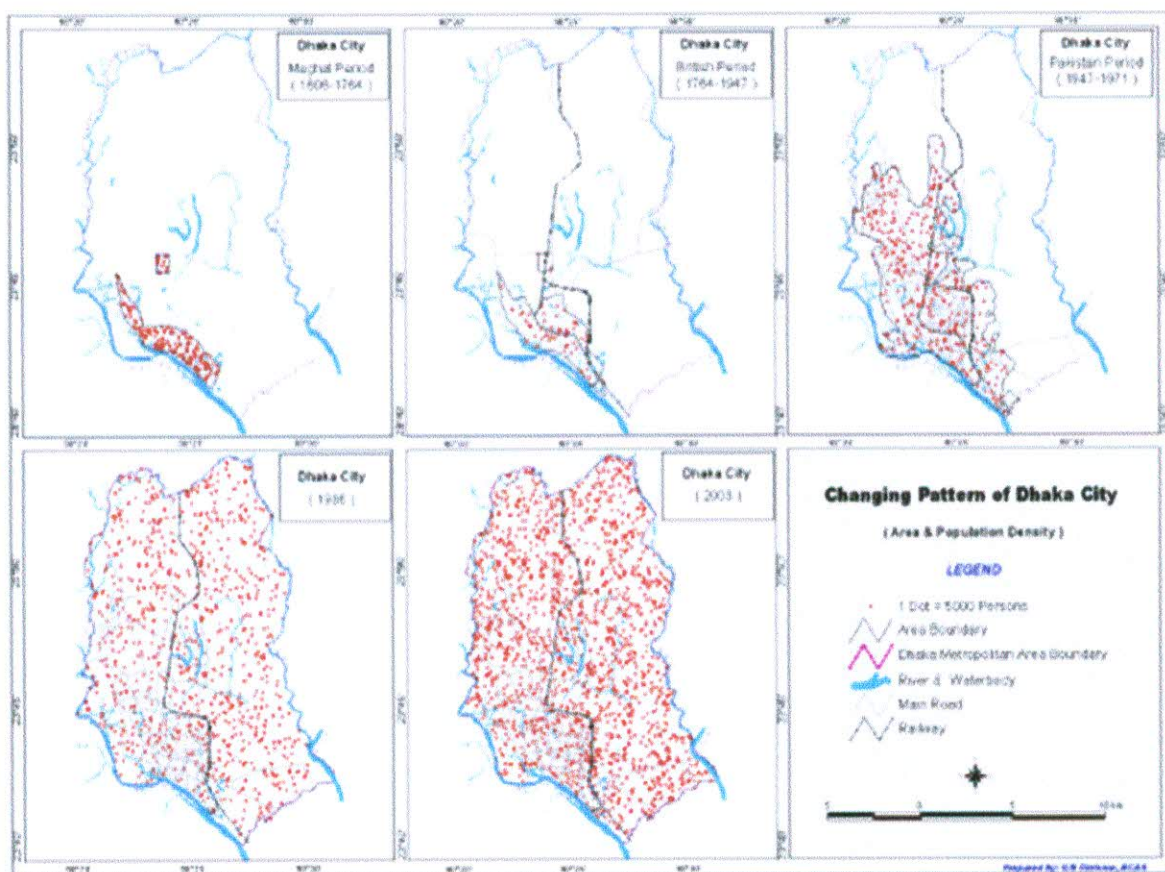


Figure 4.10 Changing of Dhaka city and its population

Source: DOE, *et al.*, 2006

Table 4.5 Area and population of Dhaka city, (1600 – 2001)

Year	Period	Area (Sq. mile)	Source	Population	Source
1600	Pre-Mughal Period	1	Islam, 1974	Unknown	
1700	Mughal Capital	50	Taylor, 1840	9,00,000	Taylor, 1840
1800	British Town	8	Islam, 1974	2,00,000	Taylor, 1840
1867	British Town	8	Islam, 1974	51,000	Census of Bengal, 1901
1911	British Town	--	--	1,25,733	Census of Bengal, 1911
1947	Capital of East Pakistan	12	Islam, 1974	2,50,000	Census of Pakistan, 1951
1951	Pakistan Period	--	--	3,35,928	Census of Pakistan, 1951
1961	Pakistan Period	28	Census of Pakistan, 1951	5,56,712	Census of Pakistan, 1951
1971	Capital of Bangladesh	40	Census of Bangladesh, 1974	15,00,000	Census of Bangladesh, 1974
1974	Capital of Bangladesh	40	Census of Bangladesh, 1974	16,00,000	Census of Bangladesh, 1974
1981	Dhaka Municipality	62.4	Census of Bangladesh, 1981	24,75,710	Census of Bangladesh, 1981
1991	Dhaka City Corporation Area	276	Census of Bangladesh, 1991	4,486,421	Census of Bangladesh, 1991
2001	Dhaka City Corporation Area	276	Census of Bangladesh, 2001	5,378,023	Census of Bangladesh, 2001
2005	Dhaka City Corporation Area	290	Islam, 2005	8,400,000	(DOE <i>et al.</i> , 2006).

Source: Islam, 1996; Tawhid, 2004; Islam, 2005 and DOE *et al.*, 2006

Physical expansion of the Dhaka city is governed by the number of factors. These are mentioned below:

- Capital of the country.
- High growth rate of population.
- All the ministries and high government offices, Embassies, and good institutions are located here.
- Rural-urban migration occurred because of better opportunities for jobs and accelerated rapid and uncontrolled growth of slums and squatter communities particularly in the low lying areas.
- Lack of decentralization process in National Development Programs.
- Good economic return from the land.
- Infrastructural development.

Rural urban migration is recognized as a major component of the aerial extent of the city in Bangladesh. The governing factors for this type of migration are rural population densities, rural landlessness, natural disasters, and less employment opportunities. Beside these factors, other important factors are the relatively more attractive opportunities for betterment of their present and future life.

4.4 Urbanization in Bangladesh and Dhaka City

Urbanization is a global phenomenon. The present century has witnessed great urban explosion. Since 1950 the number of people living in cities increased almost three times. In the developed countries, it nearly doubled and in the developing world quadrupled. So there is an inevitability about urbanization everywhere (Khan, 1994). Bangladesh is experienced one of the highest rates of urbanization in the last few decades. Urban population has grown at an annual rate of about 3.9 percent during 1960-1970, 4.0 percent during 1970-1980, 3.3 percent during 1980-1990 and 3.8 percent during 1990-2001, while rural population has grown at a rate of 1.04 percent during 1991-2001. Because of the large national population size, the absolute size of urban population is large at 28.8 million on of January 2001 (BBS, 2001), 32.4 million on July 2004, 33.5 million on July 2005 and 34.6 million on July 2006 (BBS, 2007a).

Table 4.6 Population of four Statistical Metropolitan Area and six City Corporations

SMA	2001	2006 (Estimated)	2007(Estimated)
Dhaka	9672763	11813728	12295728
Chittagong	2991723	3587692	3720437
Khulna	1172831	1323071	1355354
Rajshahi	651062	737336	756359
City Corporations			
Dhaka	5333571	6479751	6737774
Chittagong	2023489	2438403	2532421
Khulna	770498	830454	842995
Rajshahi	388811	447031	459682
Barisal	192810	205166	195955
Sylhet	263197	394119	445798

Source: BBS, 2007a

Dhaka the primate city and the other metropolitan areas of Chittagong, Khulna, Rajshahi, Sylhet and Barishal dominate the urban system in Bangladesh. Among the six cities Dhaka itself contains more than half and other five largest cities together account for less than half of the total urban population of the six cities (Table 4.6). Dhaka's population has growth at an annual rate of about 15.51 percent during 1961-1974, 14.89 percent during 1981-1991 and 8.6 percent during 1991-2001 (BBS, 2001).

Being a principal city contributes a greatly to the nation building process, but such role often leads to potential negative social and environmental impacts. Moreover Dhaka is growing in unplanned way. The present trend of city development is alarming and unacceptable. Absence of policy implementation has resulted sell-out of huger chunk of available lowlands to individuals and over ambitious developers. In Dhaka urbanization precedes because the planning procedure is extremely weak and slow (The Daily Star, 24 January, 2003).

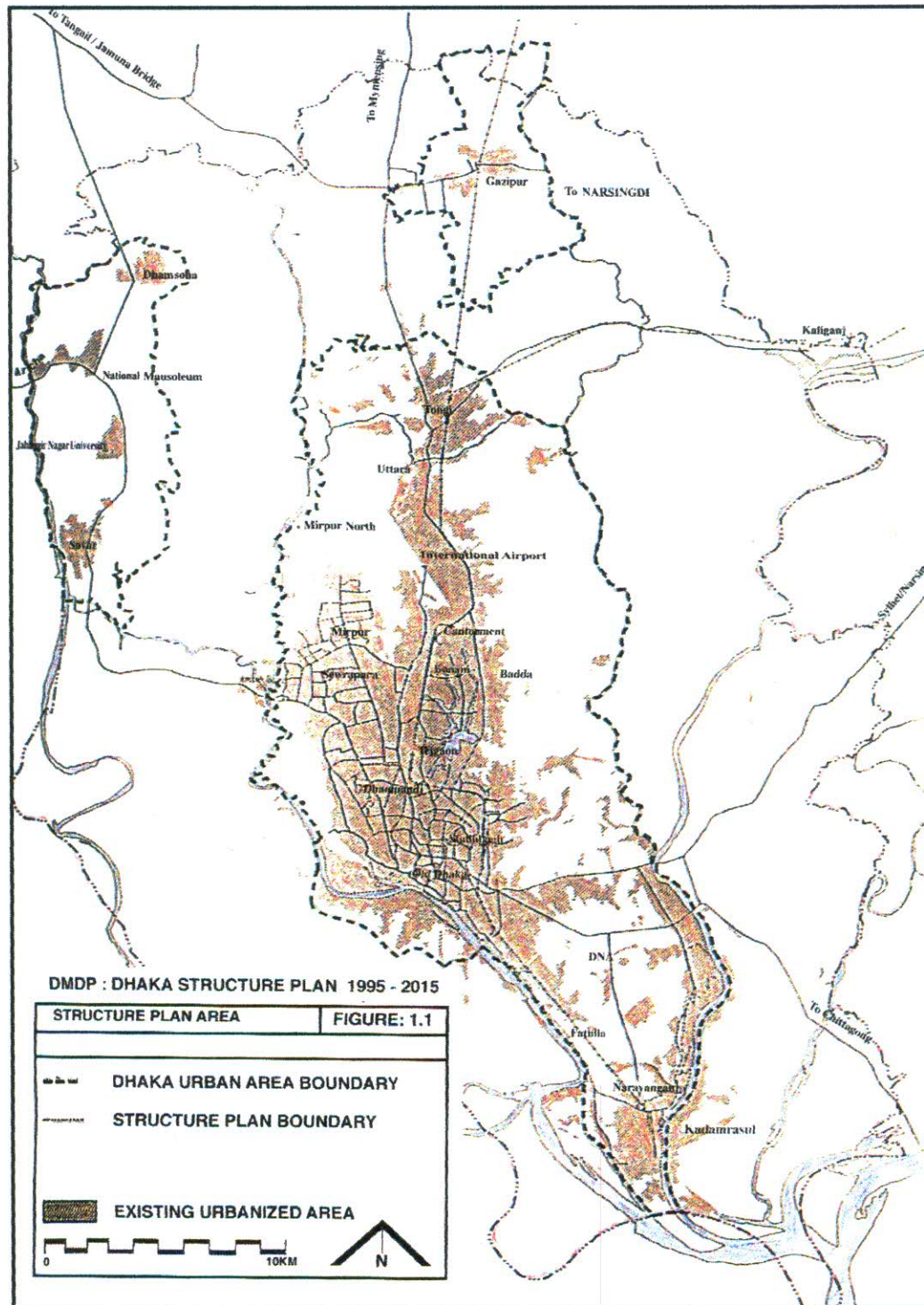


Figure 4.11 Existing urbanized area of greater Dhaka city

Source: RAJUK, 1997

Recently urban expansion is stretching into the lowland, back swamps and depressions. The following table depicts the relationship of urbanization process and geomorphological characteristics of Dhaka city from 1955 to 1996.

Table 4.7 Relationship between urbanization and geomorphology during 1955-1996

Geomorphic Unit	Year				
	1996	1989	1993	1975	1995
High, medium, low Madhupur terrace and natural levee	86%	91%	94%	94%	95%
Depression, abandoned channel, point bar	14%	9%	6%	6%	5%

Source: Khan, 1997

Above-mentioned table is giving a very clear indication of urban areas stretching into lower land over the time period. Because of the population growth/migration, urbanization is stretching along / towards the depression or back swamps (Khan, 1997). This process started from the mid eighties. These wetlands are very important for the ecological and environmental balance of the city.

4.5 Present Hydro-geographical Situation of Dhaka City

The surface water area of Dhaka city is about 10-15% of total land area (DOE *et al.*, 2006). The surface water of this city is closely dissected by a number of rivers, canals and lakes. The Buriganga, Turag, Tongi Khal and Balu River are the main streams that surround Dhaka city and these spillways help an efficient drainage in the city.

4.5.1 Surrounding Rivers of Dhaka City

The Buriganga

When Dhaka is fast expanding into a mega city, the Buriganga, which has contributed significantly to the origin and evolution of this city, is facing almost a destined extinction due to some obvious and unwise human interference into the hydrological settings of the river. The Buriganga an offshoot of the Dhaleswari, which is located centrally almost in the heart of Bangladesh, facilitated the origin of the small township of Dhaka during the Sultani rule of 'Sub-e-Bangla' in Pre-Mughal period (i.e. 1299-1608). Needless to say that during that period of the historical past the river was very much active with its profuse discharges of water and sufficient depth and extensive size and these essential fluvio-hydrological conditions of the channel of Buriganga helped it efficiently to maintain its easier connection with all the adjacent bigger rivers and neighboring areas of the town of Dhaka.

Only two three decades ago, the Buriganga provided the city dwellers with sufficient fish from its unpolluted water. However, by now, the river itself is about to die its channel is being choked up with siltation and clogged with the continuous accumulation of garbage into the river course. The length and width of the river have gradually shrunk.

The Turag River

The Turag flows through the north western part of Dhaka city. The river is now being flown into the Jamuna (Brahmaputra) system through a section of the Lowhajang river in Tangail. The Turag remains active throughout the year. However it maintains only a small flow in the dry season. The pattern of Turag is fully meandering. It always produces point bars and sand bars when the streams overflow their banks. It discharges the water into the Tongi Khal and the Buriganga river.

The Balu River

The Balu runs mainly through the extensive swamps and low lands in the east of Dhaka, joining with Lakshya near Demra. It has a narrow connection with the Tongi river (khal). In dry season, the main source of Balu's flow comes from the Turag river through the Tongi khal. The Balu drains the swamps of eastern boundary of the city.

Tongi khal

Tongi khal, a smaller stream of the city, marks the northern boundary of Dhaka city and flows on an east-west orientation. This khal drains the northern part of the city. Tongi Khal connects the Turag with Balu river.

Table 4.8 Characteristics of the Rivers surrounding greater Dhaka city

River	Length Around City (Km)	Mean Annual Max. Water Level(WL) and Adjacent Flood Plain Area Below		Mean Annual Mean Water Level(WL) and Adjacent Flood Plain Area Below		Mean Annual Min. Water Level(WL) and Adjacent Flood Plain Area Below	
		WL (m)	Area (Km2)	WL (m)	Area (Km2)	WL (m)	Area (Km2)
Buriganga	13	5.25	10	2.63	4	0.69	0
Turag	20	5.62	35	2.80	8	0.77	0
Tongi	6	5.58	0	2.59	0	0.44	0
Balu	22	5.67	105	2.83	26	0.81	0

Source: Khondaker and Chowdhury, 1992

4.5.2 Canals (Khals) of Dhaka city

It has been known from different government and non-government organization that there were more than 35 canals within Dhaka city area. These canals could have remarkable contribution in drainage service. The whole system is not functioning properly due to encroachment and improper management and overload of sewage. The conditions of some of the canals are very much critical at present and some of them are already vanished. However, all the canals flowing through different areas finally join the river system i.e, Segunbagicha – Jirani- Dholai khal joins with the Balu and Buriganga, Ibrahimpur- Kallayanpurkhal joins with the Turag, Dhanmondi- Gulshan-Banani- Mohakhali- Begunbari khal joins the Balu river. The following are the brief description of the canals of Dhaka city:

Shajadpur Khal: This canal starts at the point where Gulshan lakes meet progoti sarani and at the end of the Khal intersects with sutivola Khal. On both sides of this canal, there is open ground, paddy field etc. mainly on urbanized area. This Khal has been narrowed at the beginning that restricts free flow of water. This is a 2 km long open channel (DWASA, 2007). The canal is encroached in different place (C.S. plot no. 15,16; Mouza: Badda) by different encroacher. The total encroached area is about 13,500 sq ft (Siddique, 2004).

Imrahimpur Khal: This canal starts at the Taltola and passes through Kafrul and Paikpara Mouza and ends at Kalyanpur bridge. The total length of this Khal is 1.26 km. (DWASA, 2007); box culvert has been constructed at different location. The rest 88 m channel is in stream. Part of both embankments is encroached by unauthorized persons. The encroacher encroached the canal at least ten places on C.S. plot no. 2, 24, 27, 115, 251, 283, 285, 287 and encroached area is about 14200 sq.ft. (Siddique, 2004).

Khilgaon- Basabo Khal: This canal is about 2.54 km long going through some of the most densely populated area of Khilgaon and Bashabo and passes under the Khilgaon flyover. Box culvert exists about one fourth area of this canal in Bashabo after that is open channel. A tin-shed mosque, rickshaw garage and other small-unauthorized infrastructure remains there. The encroached area is about 1200 sq. ft. (Siddique, 2004).

Abdullahpur Khal: This Khal is about 3.00 km long in north western part of Dhaka. In Uttara residential areas it goes towards Baunia Mouza a depressed area. This canal is almost free from unauthorized encroachment and structures starting from the flood protection dam. The course of the canal starts from the connecting place of Digun Khal and Diabari Khal, passes through Baunia and Abdullahpur mouza and finally falls into Turag river. Rupayon Housing, Harirumpur Union Parishad and other individual encroacher illegally occupy about 2020 sq.ft area of this canal.

Sutivola khal: The course of the canal starts from the end point of Shajadpur canal and proceeds to Begunbari canal at Aftabnagar. The length of the canal is about 2.75 km. Residential developers have filled about 500 m length of the canal (DWASA, 2007). Other land use surrounding the canal is cultivated low paddy field.

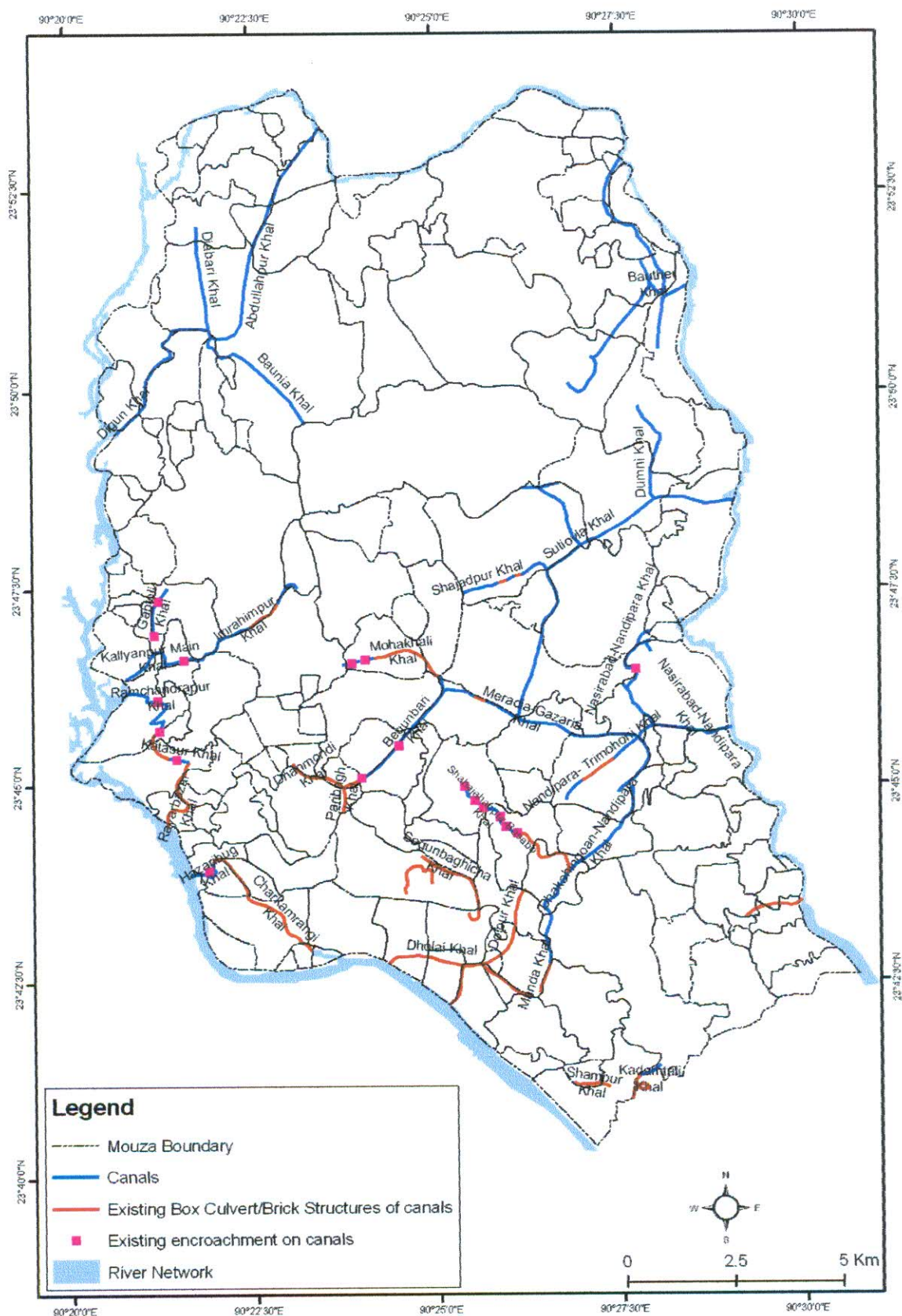


Figure 4.12 Canals of Dhaka city, 2008

Source: Prepared by author based on Siddique, 2004 and field observation, 2008

Katasur Khal: This is a 1.26 km long open channel in the western part of Dhaka, passing through densely populated urban area. This canal starts from Ramchandrapur canal and ends at Rayerbazar canal. A Portion of this channel has been converted to box culvert. At least ten places in the open channel part of the canal was encroached by individual encroacher and the total encroached area is about 12,200 sq.ft.

Ramchandrapur Khal: This is a 2.94 km long open channel in western Dhaka (DWASA, 2007). This Khal originated from the Turag river and passes through Mohammadpur housing and ends at embankment of katasur Mouza. Brothers Housing encroached about 10,700 sq ft area, Nobodoy Housing encroached about 4000 sq. ft area of the canal. On the other hand more than 4000 sq. ft area of the canal filled up for the Christian's graveyard and individual encroacher encroached about 11950 sq.ft area of the canal (Siddique, 2004).

Diabari Khal: The course of the canal starts from the connecting point of Digun khal and passes through Baunia Mouza and ends at the middle point of Diabari Mouza. The length of this canal is about 2.82 km (A.C.Land Office, Demra circle).

Baunia Khal: This canal originates from the east part of Digun Mouza and flows through east-west within the Baunia Mouza and ends at east border of Baunia Mouza. The length of this canal is 4.83km. RAJUK has acquisitioned this canal for renovation and using as lake.

Digun khal: This canal starts from the solahati village and flows up to Goranchatbari pump station. The length of the canal is 4.44 km (A.C. Land Office, Demra circle). The canal is connected with BWDB's pump station for water discharge and also connected with Turag river by sluize gate.

Gabtolli Khal: This canal starts from the slope of Mazar road and passes through Kandar Mouza and Paikpara Mouza and ends at Dhaka- Aricha road. The length of the khal is 4.44 km. The part of the canal is converted as road and rest of the part remains as clogged. This clogged part was encroached by different encroacher and encroached area is about 5850 sq ft (Siddique, 2004). This canal is also known as Kallayanpur Branch Khal (Kha).

Kallyanpur Main Khal: This is a 3.57 km. long open channel in the western part of Dhaka city, starts from Kallyanpur bridge and passes through Mirpur – Technical and ends at the sluice gate of the embankment. There are five branches of this canal. These are Kallyanpur branch canal- Ka, Kha, Gha, Uma and Cha. About 16550 sq ft area of the main canal was encroached by different encroachers. Five branch canals also illegally occupied at different point by different individual land grabber.

Hazaribug Khal: This is a C. S. recorded Khal. This canal starts from Hazaribagh and passes besides the Kallyanpur and Sultangonj Mouza and ends at the embankment near Kamrangir char. The length of the canal is 0.75 km. The Northern part of the canal is converted as road and southern part flows in a miserable situation.

Charkamrangi Khal: This is a 3.06 km. long open channel, originated from Buriganga river and ends at Kalunagar Mouza. During field visit it was observed that solid waste were dumping at the bank of the canal.

Begunbari Khal: This canal starts from hotel sundarban and passes besides the Sonargaon Hotel then passes under the Tongi diversion road to Hatirjheel- Rampura bridge and upto Bonosree. The length of the canal is about 4.4 km (Siddique, 2004). About 3240 sq ft area of the canal was encroached by individual encroacher and used as slums at Tongi diversion to Rampura bridge area. The influential people illegally occupied a big chunk area of Hatirjheel, another part of the canal, which extends from Hotel Sonargaon to Tongi diversion road.

Mohakhali Khal: This canal starts from the east part of Arong, Gulshan and the connecting point of Begunbari canal and crossed Dhaka- Mymensingh road and flows at the west side up to rail line. The total length of the canal is 3.22 km. Box culvert was built on the major part of the canal. The rest open part has encroached at different point (C.S plot no. 103, 104, 475, 478, 479 and 480 of Mohakhali mouza). The total encroached area is about 7800 sq. ft (Siddique, 2004).

Dumni Khal: This is a C.S recorded Khal. This canal starts from the northern corner of Dumni Mouza and passes towards southern corner of Kadaldia Mouza and flows towards east and finally falls into Balu river. The length of this canal is about 4.83 km.

Bauther Khal: This canal starts near the middle position of Barua Mouza and passes through Bautha and Delna Mouza towards north and ends at Balu river at south east side. The length of this canal is 2.02 km (Siddique, 2004). This is also a C.S recorded Khal.

Nasirabad- Nandipara Khal: This canal starts from the connecting point of Gazaria canal, at Nasirabad and passes through Nandipara Mouza upto Badda Mouza. The length of the canal is 0.57 km. (Siddique, 2004).

Meradia-Gazaria Khal: This canal starts from the western boundary of Meradia Mouza and passes through Aftabnagar and banasree project of Eastern Housing Ltd. and finally falls into the Balu river. The length of the canal is 5.44 km. About 1.06 acre area (on C.S. plot no. 45 and 301 of Meradia mouza) of this khal is illegally filled up by Eastern Housing Ltd. (A.C. land office, Demra circle).

Dhakhingoan - Nandipara Khal: This canal starts from the connecting place of Matuail-Manda khal and ends Gazaria khal at Nasirabad. The length of this canal is about 5.00 km (A.C. Land Office, Demra circle).

Nandipara Trimohoni Khal: This Khal has originated from Trimohoni and extends towards north and finally falls the beel area of Nandipara village. The total area of the canal is 0.73 km. An embankment was built with pipe culvert at the middle position of the canal. A major part of canal's bank has illegally occupied by unauthorized small shops and other infrastructures.

Manda Khal: This canal is joined with Dholpur khal and flows through Jatrabari, Jurain, Dhonia and up to Rajarbagh. The length of this canal is about 6.84 km. Some part of this canal is converted as Box culvert and road on pipeline, some part is filled with waste and garbage and rest of the part is as open channel. The bank of the open channel part is occupied by slums people and other individual encroacher at different point.

Shahajahanpur Khal: The course of the canal starts from the culvert No. 23 of Bangladesh Railway and falls into Khilgaon – Basabo Khal. The total length of this canal is 0.50 km. About 4140 sq. ft area of this canal was illegally occupied by land grabber.

Kadamtali Khal: This canal flows through the Kadamtali Mouza of Demra circle and Deulpara of Narayanganj district. The length of this canal is about 1.28 km (A.C. Land Office, Demra circle). The canal is filled with waste and garbage and most part of the bank is in encroached by local influential people.

Due to urbanization and some other human activities, some canals are disappeared totally or have no existence as open channel. These are mentioned below:

Dholai Khal: Historically, Dholai Khal was the most important Khal of Dhaka. The Dholai khal had played a great role in the foundation or formation of old Dhaka city. It had a triangular links with the river Buriganga, near Mitford Hospital and Mill Barracks; the Balu river in the eastern part and also connected with Begunbari Khal in Tejgaon, Dhanmondi and Gulshan (Islam, 2002). Now there remains box culvert that is used as road and unauthorized infrastructure was built in both side of that road.

Rayarbazar Khal: The canal originated from Katasur Khal and passed through Saraizafrabad and Sultanganj mouza and ended at the embankment near Rayerbazar. The length of the canal was 2.10 km (A.C. Land Office, Demra circle). The canal was filled up and DWASA built there brick sewerage line and road over that.

Dhanmondi Khal: The course of the canal was from Panthapath road via Kadalbagan and ended at Sonargaon road. The length of the canal was 1.65 km (Siddique, 2004). DWASA built box culvert on the canal.

Paribagh Khal: There is no existence of this canal as open channel because DWASA built brick sewerage line converting the canal and over the brick sewerage line it is used as road. The length of the canal was 0.42 km (A.C. Land Office, Demra circle).

Segunbaghicha Khal: The length of the first part of the canal was 1.39 km (Siddique, 2004). This part extends from Drainage Circle Office (DWASA), Segunbaghicha to Kamlapur road. Box culvert was built on this part and now used as road. The second part of this canal extends from Kamlapur road to Zirani Khal. The length of this part is about 2.80 km. About 4840 sq ft area of this part was encroached by the encroacher and they built different infrastructure.

Gopibagh Khal: This canal completely disappeared by land filling. Pucca road was built on this canal. The alignment of this canal was Gopibagh to Arambagh Khal and passed behind the Bangladesh Bank.

Dolpur Khal: The course of the canal was Saidabad bridge to Bashabo Khal near Rajarbagh mouza. The total length of the canal was 1.75 km. Saidabad to maniknagar pond part was covered by box culvert and road was made on the rest part of the canal.

Shampur Khal: This canal was situated in the border area of Shampur and Kadamtali mouza. Dhaka City Corporation built road on this canal. Physically there is no existence of this canal.

4.5.3 The Lakes of Dhaka City

The major lakes are Dhanmondi lake, Ramna lake, Gulshan lake and Crescent lake.

Dhanmondi Lake: In the early sixties Dhanmondi residential area was developed around the Dhanmondi lake which was a natural drainage line. To enhance the beauty of the area it was dug out and deepened in an area of 550 acres of land and trees were planted around the lake (Sultana and Huq, 2001). A walkway has built adjoining the bank of the lake which protects the bank of the lake from encroachment.

Gulshan Lake: The Gulshan-Baridhara-Banani Lake has been area of 210 acre. It was dug out from natural depression to provide environment friendly atmosphere to the residential area of Gulshan, Baridhara and Banani. But now garbage and unauthorized establishment-most of them slums-and new multistoried structures and houses have besieged the lake on all sides (UNEP, 2001).

The Crescent lake is relatively small. Its name has been derived from its crescent shape. It is a planned and dug out lake around the Parliament Building. Its banks are paved and the depth is shallower than the other lakes. The Ramna lake is situated within the Ramna park.

4.5.4 Low-lying Areas of Dhaka City

The low-lying areas of Dhaka city have been broadly identified in the DMDP. However the identification of low-lying areas on mouza map is not yet completed. In the DAP,s the natural water bodies, ponds, canals, flood flow and sub-flood zones and low-lying areas will be demarcated. The preparation of DAPs is in final stage.

However identification of low-lying areas in the city and restricted land use are most critical and debatable because some areas within the city go under water during the rainy season and water remains stagnant there for four to five months. In the lean season, these lands become dried up and can be brought under traditional land uses. The clauses of the natural water bodies, open space, park / playground protection Act, 2000 conflict with land classification (*vitta ,nalaa ,challa*) prepared by the Ministry of Land. Mentioning the above loophole in the law, landowners always try to keep aside their lands from being identifying as low-lying land.

4.6 Natural Drainage System of Dhaka City

Natural Drainage system is a balanced network of stream channels and adjacent land slopes, bounded by a drainage network and converging into a single channel at the outlet developed through natural process. Natural water bodies play an important role in the drainage system of any area. The water body performs together with the function of water reservoir and the discharge sites of artificial drains. The natural drainage system in the greater Dhaka city comprises of several retention areas and khals, which are linked to surrounding rivers.

4.6.1 Storage Area

There are many water storage areas such as lakes, ponds and low-lying lands in the study area. The city rainfall runoff accumulated in low-lying areas and lakes. It then flows through Khals and ultimately discharges into the adjacent rivers.

In the Dhaka Structure Plan of Dhaka Metropolitan Development Plan, has designated some retention ponds. The proposed retention ponds will be designed to reduce intensity of local flooding within the protected areas, and reduce pumping requirements at times of maximum surface water runoff. Their location should be the subject of detailed geological survey to ensure that the city's natural drainage system uncompromising and the effects of water logging are minimized.

4.6.2 Channels

Khals or canals passes through Dhaka city that are created naturally and used as drainage channel to drain out the flood as well as rain water of the city to the surrounded outfall rivers. The major channels (Khals) systems are:

- Degun-Ibrahimpur-Kallyanpur Khal system which drains to Turag river.
- Dhanmondi-Paribagh-Gulshan-Banani-Mohakhali- Begunbari Khal system which drains to Balu river.
- Segunbagicha-Gerani-Dholai Khal system which drains to Balu and Buriganga river.

4.6.3 Drainage Zones and Storm Sewer Network

The Dhaka city area is divided into 12 drainage zones (JICA, 1991) on the basis of topographic conditions, Khal systems and outfall to the surrounding river.

The present storm water drainage network under Dhaka WASA covers an area of approximately 140 sq. km. The important components of drainage network are mentioned below:

- i) 22 open canals having width of 10 to 30 m and total length of approximately 65 km.
- ii) 185 km. of underground pipes having diameter ranging between 450 to 3000 mm.

- iii) 6.5 km. of box culvert of sizes between 2.5 m * 3.4 m to 6 m * 4.1 m.
- iv) 2 storm water-pumping stations, of capacity of 9.6 m³/s and 10 m³/s at Narinda and Kallyanpur respectively.
- v) Recently DCC has constructed one storm-water pumping station, having capacity of 22 m³/s at the confluence of river Buriganga and Dholai khal. Dhaka WASA has taken over the operation and maintenance of the pumping station.

The responsibility of development, operation and maintenance of drainage system in Dhaka city lies with the Dhaka WASA. Moreover DCC and other several agencies are working for the development of the city drainage system. But there is little or no coordination among the concern organizations.

4.7 Process and Causes of Wetland Disruption

4.7.1 Process of Wetland Disruption

From the field observation, field survey and interview with the different concerns officials and environmentalist, the following types of wetland disruption were found:

4.7.1.1 Land Filling

Filling in a wetland occurs when earthen or other miscellaneous material is used to fill in the area of a wetland and to raise the final elevation of the site (Nakashima and Khan, 1994). Topographically Dhaka does not have continuous highland. This highland is already occupied by man's activities. Now the city expansion is stretching towards the low-lying areas, which is vulnerable to annual internal and external flooding. Due to the construction of embankment in the western part of the city the urbanization process has speed up in this low-lying areas using land filling methods. Frequently, this is done to provide new sites for buildings, infrastructure alignments, and for disposal of garbage and waste.

Table 4.9 Major depression storage in the floodplain during wet season

Depression	Area (Km2)	Average Depth (m)
South-West Buriganga Flood Plain	6	1.0
North-West Turag Flood Plain	20	1.5
North-East Balu Flood Plain	11	2.0
Central Balu Flood Plain	20	2.0
South- West Balu Flood Plain	40	2.0
Total	97	

Source: JICA, 1987

4.7.1.1.1 Land Filling by PLDCs

The Private Land Development Companies (PLDCs) implement housing projects in low lying areas with their own style ignoring the existing laws, restrictions and even they are not sincere and co-operative with government agencies. They are always looking for loopholes and default of laws and acts as well as weakness of authorities. The PLDCs flout laws and fill-up low-lying areas by carrying sand / earth from other areas using country boats and engine boats. The regulatory bodies in this context are not always eager to enforce law effectively. The PLDCs have filled up hectares of low- lying land on the city fringe areas flouting government directive and laws.



Photograph 4.1 Land filling besides the Balu River

Source: Field visit, 2007

Allegations run high that the PLDCs are motivated primarily in making high profits and are often involved in fraudulent land transaction. In this process of development, they almost ignored the master plan provision, existing policies and provisions of Town Improvement Act 1952 and Building Construction Act 1953. The PLDCs tendency is to start land collection and filling those first, and they create pressure to the authorities concerned from influential corners to obtain approval of the project.

The massive land filling activities in the low-lying areas have now become a deep concern to experts, professionals and environmentalists.

4.7.1.1.2 Land Filling by Public Sector Housing Projects

RAJUK plays key roles in implementing public sector housing projects. People are always attracted to buy RAJUK plots as the land price is reasonable, services are ensured, transfer of land is permissible, land can be transferred back to the RAJUK, deposits can be withdrawn etc. In contrast, private companies do not provide such facilities. But people are questioning why the RAJUK is implementing their housing project in wetland

There is another aspect of encroachment, which is done by PLDCs in the study area. A good number of land development companies are involved in land encroachment activities. Among them, some companies are big and powerful in terms of financial and political prowess. Each company maintains its tentative boundary adjacent to the project. These companies try to occupy all the lands including wetlands within their tentative boundary. If it is private owned land they try to purchase land applying the different technique, which are: attractive false offers to the land owners, make false case against land owners, and if it is public owned land (khas land) they try to fabricate the land records in collaboration with some dishonest officials of different public agencies and politicians who work for the illegal activities. Sometimes they encroach the khas land with the help of local muscleman.

4.7.2 Causes of Wetland Disruption

Out of the total respondents 387(99.2%) respondents viewed that the area of wetlands of Dhaka city is decreasing. It appears from the opinion of the respondents that Real estate housing companies, Government organizations, political leaders, influential people, local musclemen and slum people are main involved participant in wetland loss. 34.4% respondents support that Real estate housing companies are involved in wetland loss, 33.3% respondents support that Government organizations are involved in wetland loss, 7.0% respondents identify that political leaders are involved in wetland loss, 18.1% respondents identify that influential people are involved in wetland loss, 4.1% respondents opine that local musclemen are involved in wetland loss and 3.1% respondents support that slum people are involved in wetland loss. Survey results also reveal that unplanned urbanization, garbage disposal and earth filling are the main causes of wetland loss.

Table 4.10 Involved participants in wetland loss

Involved participant	Frequency	Percentage
Real estate housing companies	133	34.4
Government Organizations	129	33.3
Political Leaders	27	7.0
Influential People	70	18.1
Local musclemen	16	4.1
Slum people	12	3.1
Total	387	100.0

Source: Field survey, 2009

4.7.2.1 Rapid and Uncontrolled Urbanization

Dhaka is a major city in Asia and one of the fastest growing cities of the world. A principal reason of such a rapid growth is over concentration of maximum activities and development works in the city and little improvements in other cities, towns and villages in terms of infrastructures development and economic activities. Dhaka city has an enormous number of floating populations, which is the result of migration. People affected by the different kind of natural hazard i.e. riverbank erosion, cyclone, flood, etc. migrated towards Dhaka for their survival. Because of resource constraint and high land value it is very difficult for the government to accommodate those people. As a result illegal land encroachment has been accelerated along the bank of the wetlands.

Despite these facts, the city is not following any of the theoretical rules of urbanization or principles of urban growth. Rather an unplanned or haphazard situation of urban growth can be observed here. Within a very short period of time, especially since the independence of Bangladesh in 1971, the process of urbanization got momentum in Dhaka.

The urbanization activities have been achieving tremendous growth of the needs of the newly independent country's capital. The city began to expand in all directions including over the wetlands. Land development through filling of wetlands areas in the study area prompted urban expansion, establishment of infrastructures including road infrastructure, electricity gas and water supply etc. Urbanization enhances service facilities through establishment of residential, commercial, industrial, educational and administrative areas, in addition to that

motorized road network contributing to economic development and enhancing the quality of life. The demand for land within Dhaka has increased tremendously as the mobility of urban, sub-urban and regional commuter has increased. This has initiated the ongoing development of housing through land filling in the study area.

New areas of residential, administrative, business and commercial importance began to develop. At the same time numerous slums and unplanned low-income residential areas or squatters also grew up in different areas of the city. Keeping pace with the magnitudes of these urban growths, the new urbanized areas were being encroached in the wetland areas in the city. As a result the wetlands of the city started to disappear fast.

Present management practice of development agencies in the Dhaka city is not all systematic. Urban planning and development management in Dhaka is fragmented and uncoordinated. There are 42 agencies belonging to 22 ministries that guide and control Dhaka city. On one hand, RAJUK, the capital development authority has both urban planning and development responsibilities for Dhaka city. On the other hand, citizen services are provided and maintained by DCC. These arrangements have led to conflicts and misunderstandings among different government agencies. It appears from the opinion of the respondent that unplanned urbanization is the main cause of wetland loss. 36.4 percent respondent identified that unplanned urbanization is mainly responsible for wetland loss.

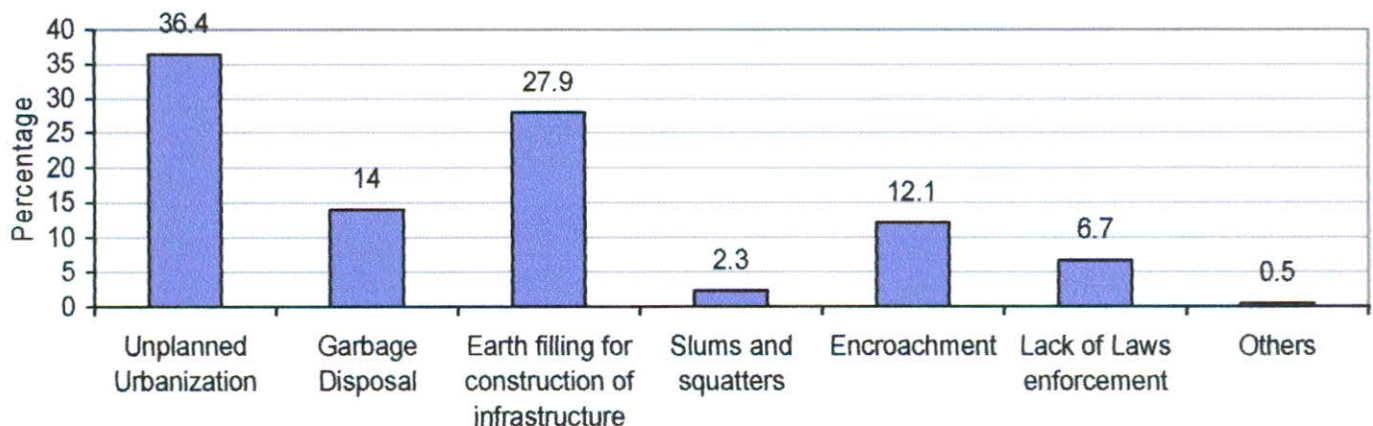


Figure 4.14 Opinion of the respondents on causes of wetland loss

Source: Field survey, 2009

4.7.2.2 Waste Management System

Dhaka City Corporation (DCC) is the responsible authority for solid waste management in the city. DCC divided its area into 10 zones for management of solid waste generation in the domestic, commercial, industrial and medical sectors.

Considering a composite generation of 0.5 kg per capita per day is approximately 5000 tones. With a collection of efficiently of less 50% more than 2500 tones of solid waste are left in the city uncollected (Shamsuzzoha, 2002).

Table 4.11 Sources and characteristics of urban waste in Dhaka

Types of Solid waste	Quantity (%)
Domestic	40-60
Commercial	5-2
Street Sweeping	20-30
Combustible	20-30
Non-combustible	30-40
Moisture	45-50

Source: Kazi, 2002

There are three distant phases of solid waste management as far as the technology concern, i.e.,

- Primary collection,
- Transportation
- Disposal/ treatment.

Out of all these three components of operation the primary collection is the most crucial issue in terms of physical works involved in achieving reasonable collection efficiency. The other components are within the management/control of executing authority.

Table 4.12 Composition of municipal solid waste

Components	Percent
Food and Vegetables	59.91
Plastic, rubber, wood and leather	17.67
Paper products	11.21
Garden wastes and etc.	8.67
Rock, dirt, debris and Misc.	2.3
Metals	0.15
Total	100

Source: Huda, 2002

The DCC authority suffers from a number of limitations as regards proper management of solid waste of Dhaka city. These are budget constraints, inadequate supervision of municipal waste collection and disposal, inefficient work force for waste collection, transportation and disposal, lack of logistic support, professional negligence, lack of transparency and accountability.

Many slums and squatters do not have access to solid waste management service from DCC or CBO's and NGO's. Due to lack of this utility service, large volumes of domestic waste of the slums and squatters remain uncontrolled. Maximum slum dwellers dispose their waste into low-lying lands, drains and canals. For a long time, it is common practice of the city corporation to dispose solid wastes to fill land in open low-lying areas in and around Dhaka city.

Table 4.13 Solid waste disposal sites

Classification of dumping sites	Sites
Abandon	Mirpur-Chalkbari, Mirpur- Gabtoli, Lalbag (Shoshan Ghat), Mugdapara, Jatrabari
Existing	Mirpur, Lalbag, Matuail
Proposed	Gazipur, Boliapur, Matuail extension.

Source: DCC, 2002

Besides thousand of tons solid and liquid industrial wastes are released from industrial everyday that are not properly measuring by DCC. Only domestic solid wastes are collected and dumped by DCC. But other industrial wastes are thrown into urban runoff of nearby drainage system (Bhuiyan, *et al.*, 2002).

There are four industrial zones located within the Dhaka city limits. These are: Hazaribag Tannery Industrial Area, Tejgaon, Tongi and Shaympur- Kadamtali. Besides these clustered industrial area there are many point and non point sources of individual wastes. The total discharge of waste effluent from these industrial zones is approximately 50,000 cu m /day (Shamsuzzoha, 2002). All these effluents are discharged in the surrounding rivers. Both solid waste and industrial effluent discharged into the water bodies in and around Dhaka city causing the following problems:

- Overflow and blockage the drainage system
- Surface water pollution is aggravated due to direct dumping from nearby slums and squatters
- Disappearance of number of small water bodies of city.

Survey results reveals that 14% respondents thinks that waste disposal into the wetlands is one of the main cause of wetland loss.

4.7.2.3 Lack of Public Awareness and Education

The classes of people of Dhaka city in term of social and economic position are heterogeneous. Behavioral pattern and attitude towards urban water bodies of different classes of people are then different. All most 30 percent population of Dhaka city lives in slums (Huda, 2002). They are deprived of access to any civic services and facilities. They do not them feel a sense of ownership on belongingness in the city. They are more concern for mere survival. A large number of people of Dhaka city still be unaware about the environment, how it gets polluted and why it should be protected. There is serious lacking of public awareness about the necessity of urban water bodies. People don't understand the effect of filling of wetlands. Therefore, they don't hesitate to throw solid waste on to the roads and drains and their poverty encourage them to fill the natural water bodies as well as destroy the ecological habitats. Not only the general people but also the Government authority sometimes occupies the wetlands, retention areas, khals etc. to save the cost of land acquisition for developments works like roads and so on. Thus, lack of public awareness and education contributing the wetland disruption in Dhaka city.

Chapter 5

Spatial Change of Wetlands and Land Use

Chapter 5

Spatial Change of Wetlands and Land Use

5.1 General Land Use/Cover Pattern

Land use is generally classified into five categories, i.e. cultivated, forest, and cultivable waste, current fallow and not available for cultivation. With the growing population and their expanding needs in various sectors, land use pattern have changed and “the area not available for cultivation” is increasing which includes land that is mainly urban, rural settlements and industrial land. On the other hand the net cropped land and forestland is shrinking.

Table 5.1 Bangladesh land area classification, 1990

Land use category	Million (ha)	Percent
Agriculture	9.25	64.2
State forest		
Classified	1.49	10.3
Unclassified	0.73	5.1
Private forest		
Village	0.27	1.9
Tea/ Rubber garden	0.07	0.5
Sub total (forest)	2.56	17.8
Urban	1.16	8.1
Water	0.94	6.5
Other	0.49	3.4
Sub-total	2.59	18.0
Total	14.40	100.0

Source: FMP, 1995

The major environmental issues relating to land resources span various sectors of the economy, because almost all areas including agriculture, water, forest, habitat, industry and horticulture compete for the use of land (UNEP, 2001).

The precarious land-man ratio has made land the most precious resource in Bangladesh, especially in the urban areas. The extremely rapid rise in the urban population in the recent decades, mainly through rural to urban migration, has made the urban land

situation more critical. The supply of urban land is highly limited and subject to many competing claims, such as for commercial, industrial, administrative, educational, recreational, military, roads, and most of all residential purposes. Indeed, land for shelter or housing development is increasingly becoming difficult to obtain. As a consequence of this the urban areas, particularly the large metropolitan cities, are experiencing problems of proliferation of slums and squatter settlements. While the urban population has increased at an abnormally high rate, the ability of urban local governments or development authorities has not improved and hence expansion of urban areas has taken place mostly in a haphazard manner. The most precious of our resources has been allowed to be used or misused in the most careless ways.

A large number of government agencies are involved in the management of urban land. In case of land policy and administration, the responsibilities of concerned agencies are not clearly defined. It is even difficult on the part of the agency concerned to apply their own policy, as there is no urban land use policy in Bangladesh.

Before 1953, there was no regulation to develop the urban areas of Bangladesh for its planned development. Town Improvement Act was promulgated in 1953. As per the Town Improvement Act 1953 (TI Act 1953) Rajdhani Unnayan Karttripakkha (RAJUK) is the legitimate authority to prepare land use plan and take care of plan implementation, control the development and manage the growth of Dhaka city. The main goal was ensuring a planned development; promoting healthy urban environment, reducing congestion and crowd, preventing development of conflicting-land use etc. above all, ensuring the sustainable development of Dhaka city. Other than there is no specific land use policy for the city.

However the present status of Dhaka city demonstrates that the development of the city did not succeed to fully meet the requirements of a mega city. Absence of adequate parks, open water bodies and drainage system has degraded the quality of living in the city in many ways.

Table 5.2 Land use distribution in DIT Master Plan

Land use	Occupied Area (Acres)	Occupied Area (%)
Housing and ancillary uses	5,848	20.1
Industry	906	3.4
Central business	246	0.9
Commerce	330	1.3
Warehousing and storage	388	1.5
Provincial Government center	100	0.4
Government areas	456	1.7
Education and institution zone	942	3.6
Main roads	790	3.1
Railways and Railway land	439	1.6
Steamer Station and Bus station	26	0.1
Open space	1,338	5.1
Cemeteries	113	0.4
Cantonments (part only)	971	3.7
Major reclamation (part only)	3,766	14.4
Water areas (rivers and land liable to flood)	9,389	38.7
Total	26,085	100

Source: DIT Master Plan, 1959

Table 5.3 Land use distribution in greater Dhaka city in the year 1990

Land use	% of total (area 275 sq. km.)
Residential area	22
Commercial	2
Industrial	1
Institutional	4
Roads	6
Other urban	6
Agriculture	46
Water	13

Source: *Source*: JICA, 1991, 1992.

There are two types of land ownership in Dhaka city. First, the privately owned land second, the government owned land. Ministry of Land (1982) has conducted a study on urban land ownership in Dhaka city in 1981. This study has observed that the distribution of land for use in various purposes is anomalous. Areas under private ownership are mainly uses for residential purposes.

Table 5.4 Use of privately owned land in Dhaka city

Type of use	Percentage of total privately owned holdings
Residence	87.64
Shop	4.91
Office	1.21
Factory	1.89
Vacant	1.19
Others	3.16

Source: MoL, 1982

Little studies have been conducted on the use of publicly owned vacant land in Dhaka city. A survey carried out by the Ministry of Land had figured out that there were about 500 acres of land, which had remained, vacant or unused for the purposes for which these land were initially acquired (Das, 1992). Most of these areas are now used as slums or for illegal and non-profitable purposes.

5.2 Maps and Images Interpretation

The topographic maps of 1960 (scale 1: 50,000) were used to generate 1960 land use/cover types. Landsat TM image of 1988 and ALOS (VNIR) of 2008 were employed in this study to produce land use / cover categories of 1988 and 2008 respectively. Both ArcGIS and Erdas Imagine software were used to device land use / cover classification in a multi-temporal approach.

A modified version of the Anderson Scheme Level I (Anderson, *et al.*, 1976) was adopted to study the land use/ cover change. This system proposed multilevel land use/cover types classification of which Level I classes can be mapped from Landsat data or from high altitude airphoto/imaging.

Six separable land use / cover types have been identified in this study as water bodies, lowlands, built-up, cultivated land, vegetation and bare soil. These are shown in the following table:

Table 5.5 Land use/cover classification scheme

Land use/cover types	Description
Water bodies	River, permanent open water, lakes canals, ponds and reservoirs
Lowlands	Low-lying areas, marshy land and swamp
Vegetation	Deciduous forest, mixed forest lands, palms, conifer, scrub and others
Cultivated land	Agriculture area, crop fields, fallow lands and vegetable lands
Bare soil/landfill	Exposed soils, landfill sites, and areas of active excavation
Built-up	Residential, commercial and services, industrial, transportation, roads, mixed urban and other urban

a) Features in 1960 Land Cover Map

From analysis of land cover map, 1960 (Fig: 5.1) it is observed that in 1960 the total area of water bodies were 2952.02, lowlands were 13527.58, vegetation were 6120.44, cultivated land were 13840.20, bare soil/landfill were 482.03 and built-up were 4641.73 hectares which was 7.10%, 32.55%, 14.74%, 33.30%, 1.17% and 11.18% of total area respectively. It is mentionable that, in 1960, wetlands areas were the highest land cover types (39.65%), the land fill areas were the lowest land cover types (1.17%) and built up areas were the second lowest land cover types.

b) Features in 1988 Land Cover Map

From the interpretation of land cover map 1988 (Fig: 5.2) the aerial extent of different features are observed. The areas of water bodies in 1988 were 2103.62, lowlands were 12717.73, vegetation were 5781.84, cultivated lands were 9037.10, bare soil/landfill were 1057.27 and built up areas were 10866.95 hectares which was 5.06%, 30.60%, 13.92%, 21.74%, 2.54% and 26.14% of total areas respectively. Here though wetlands areas were covered the highest land cover area, but both types of wetlands (water bodies and lowlands) area were decreased. The built up and land fill areas increased more than double and built up areas covered the second highest land cover types.

c) Features in 2008 land cover map

It is observed from the land cover map of 2008 (Fig: 5.3) that in the year 2008, 1990.71 hectares of area are under water bodies and 6414.57 hectares area are under lowlands, which are 4.79% and 15.43% of total area respectively. The vegetation areas are 3026.07, cultivated lands are 5266.80, bare soil/landfill are 2322.09 and built up areas are 22543.60 hectares, which are 7.28%, 12.67%, 5.59% and 54.24% of total area respectively. It is revealed that here built up areas cover the highest land cover type.

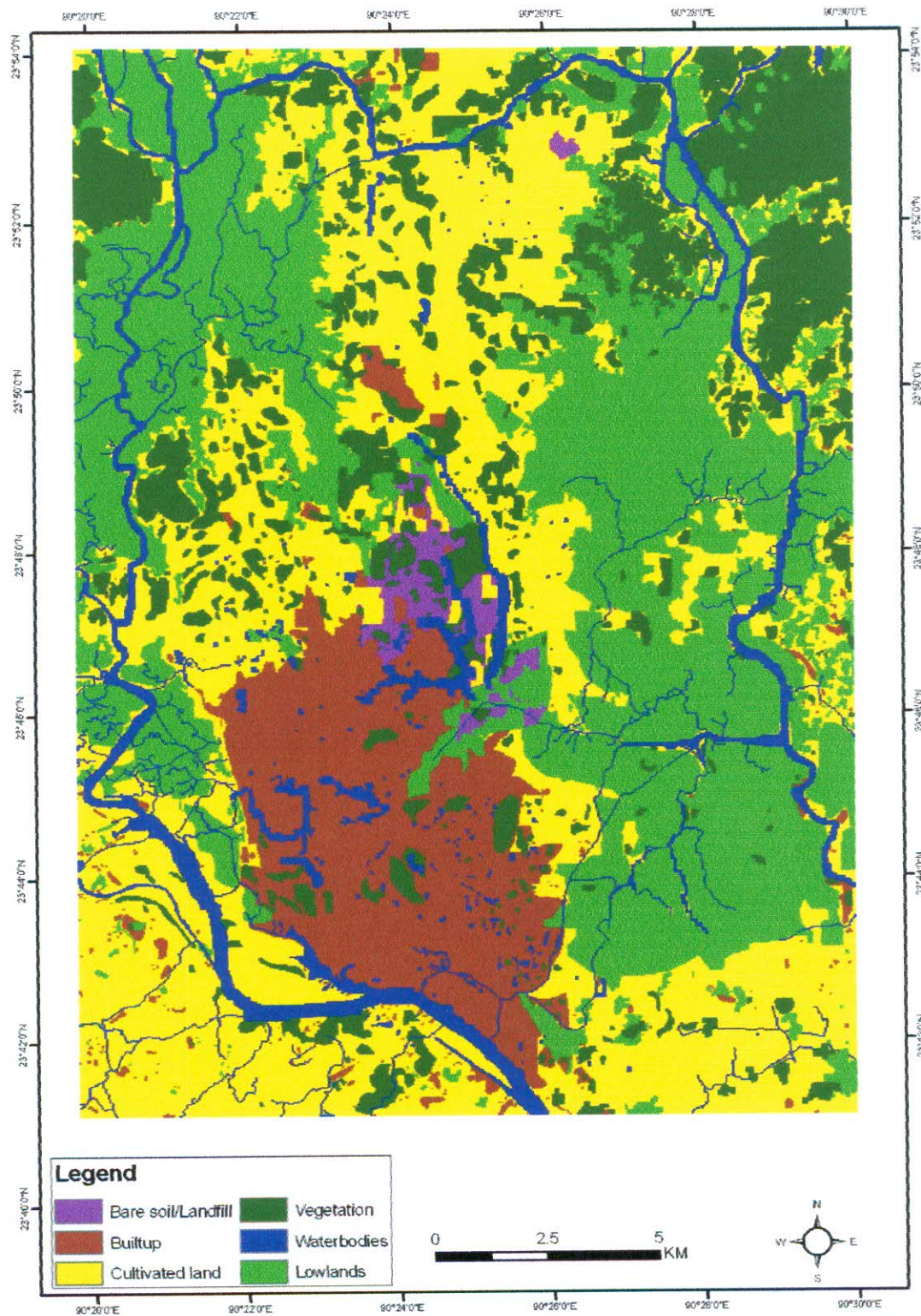


Figure 5.1 Land cover map of Dhaka city region, 1960

Source: Prepared by researcher based on topographic map 1960

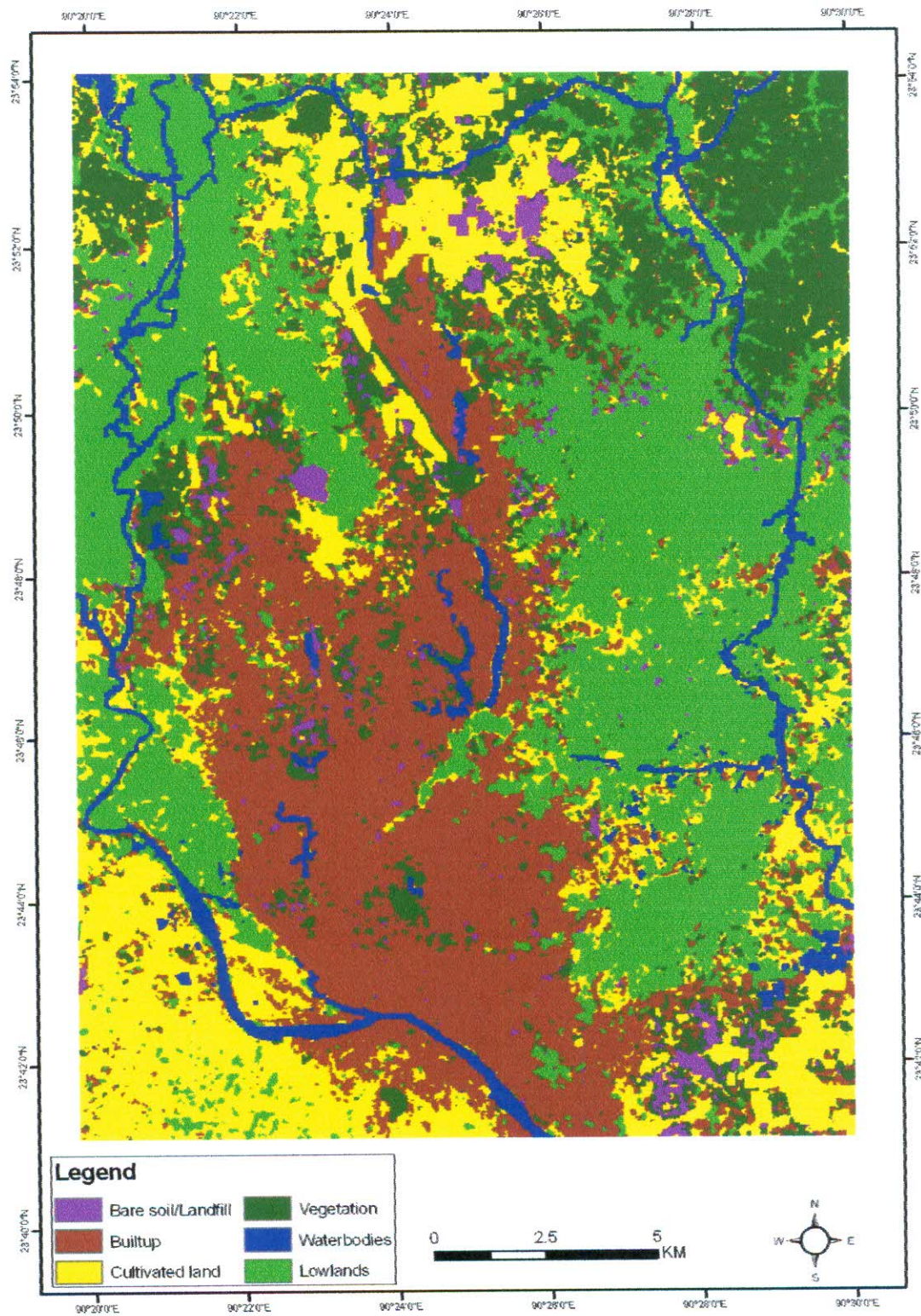


Figure 5.2 Land cover map of Dhaka city region, 1988

Source: Prepared by researcher based on Landsat TM image 1988

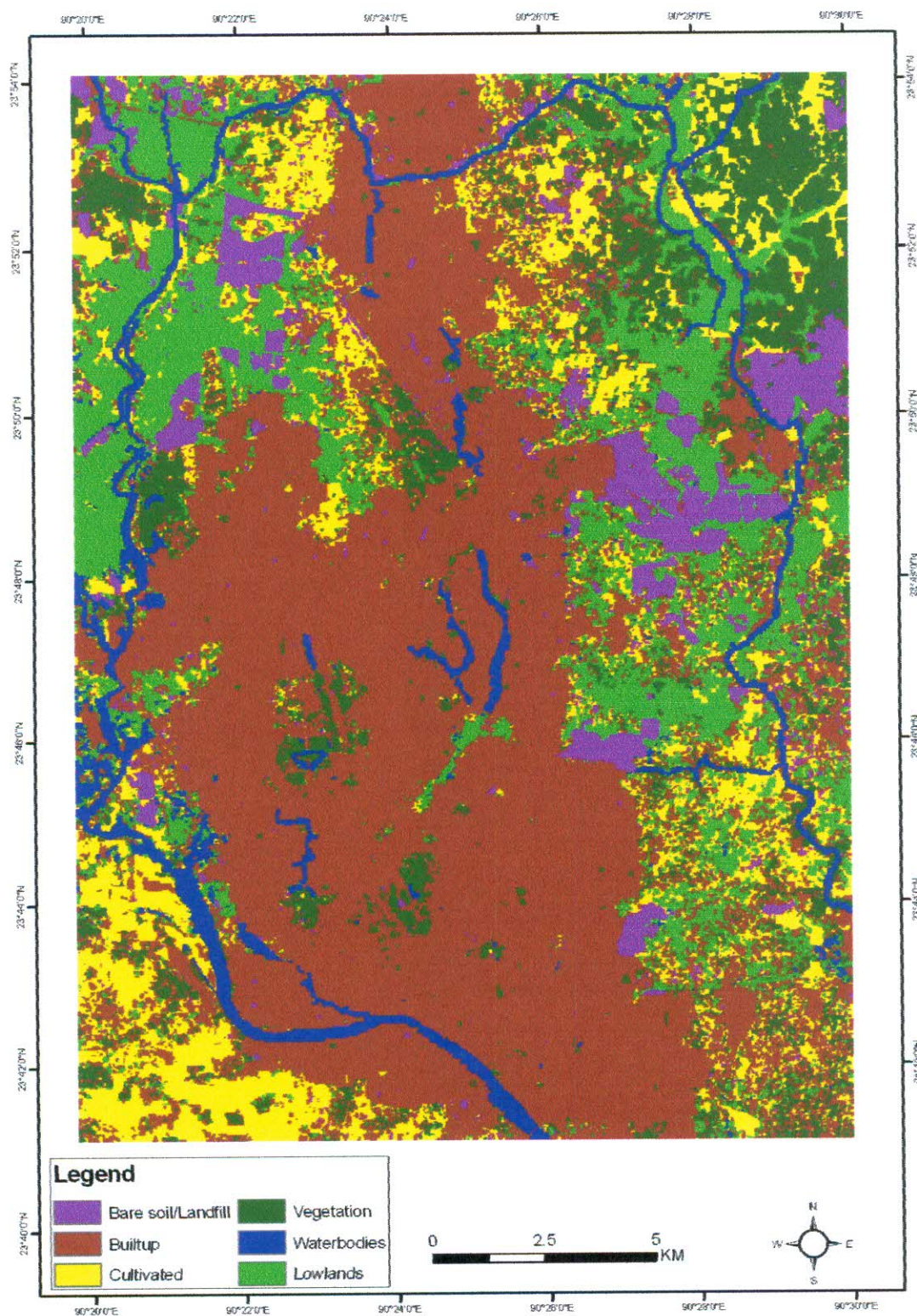


Figure 5.3 Land cover map of Dhaka city region, 2008

Source: Prepared by researcher based on ALOS image 2008

Land use / cover classification from 1960 to 2008 in Dhaka city are presented in the following table:

Table 5.6 Summary of land use/cover classifications statistics 1960-1988-2008

Land use/cover types	1960		1988		2008	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Water bodies	2952.02	7.10	2103.62	5.06	1990.71	4.79
Lowlands	13527.58	32.55	12717.73	30.60	6414.57	15.43
Vegetation	6120.44	14.74	5781.84	13.92	3026.07	7.28
Cultivated land	13840.20	33.30	9037.10	21.74	5266.80	12.67
Bare soil/landfill	482.03	1.17	1057.27	2.54	2322.09	5.59
Built-up	4641.73	11.18	10866.95	26.14	22543.60	54.24

Source: Prepared by researcher based on the land cover map of 1960, 1988 and 2008

Spatial patterns of land cover revealed that urban growth followed certain directions between 1960 and 1980s depending on the growth elevation. Historically, the direction of urban expansion of Dhaka has greatly been constrained by the low elevation of lands, surrounding rivers and risk of flooding. Thus major development was on the high and medium terraces usually not liable to inundation. The interpretation of the 2008 land cover maps, however indicates that Dhaka is being started to expand in all directions, specifically to north-east, south-east and southern trends by filling up wetlands. Poor coordination among the organizations and non- enforcement of laws are mainly accountable to the quick change of natural covers.

5.3 Change of Wetlands and Other Features

In general change means transformation in form in functional sense. Thus the conversion of a piece of agricultural land into settlement is a form of irreversible transformation. Again the conversion of the same piece of agricultural land into grazing or forest, land is also considered as transformation. But such type of transformation is not irreversible as the utility of the land may be reverted to agriculture again if owner desires to. Thus in this context wetland change may be considered as a change of form and utility of land which is supposed to have to water at or near the surface. When the wetlands are drained out and used for other purpose like settlement, it can be said that, the wetlands are changed into settlements.

From the maps and images interpretation of different years, it is observed that, the wetlands as well as other features are constantly changing. During the study period (1960-2008) as mentioned before, mainly six types of land use features were observed. The change of wetlands and other features are discussed as follows:

a) Water bodies

The total area of water bodies is declining progressively at a rapid pace. The percentage of water bodies of the study area was 7.10% in 1960. But the percentage decreased continuously, in 1988, the percentage was 5.06 and in 2008 it stands at 4.79%. The declining trend between the years 1960 and 1988 is relatively higher than that of the year between 1988 and 2008. The percentage of changed water bodies during the total study period (1960-2008) is 32.57%. The water bodies are converted to mainly built up areas.

b) Lowlands

Lowlands are shown mainly in the eastern and north- western part of the study area. From the land cover map of 1960, it revealed that total area of lowlands were 13527.58 hectares, which were about 32.55% of the total area. To meet up the growing demand of urban land, pressure exerts on lowlands cover between 1988-2008 that resulted 49.56% loss. The declining trend of lowland between the periods 1960-1988 is relatively low than that of the period 1988-2008. Though the water bodies are also decreasing, but the decreasing rate of water bodies is not high like lowlands. During the whole study period (1960-1988) the lowlands decreased by 52.58% where the water bodies decreased by 32.57%.

c) Vegetation

Table 5.6 demonstrates that the vegetation areas decreased mainly during the period 1988-2008. More than 2755 hectares of vegetation cover were decreased between this times, which is on average approximately 137 hectares per year. During the study period (1960-2008) 3094.37 hectares of vegetation area were disappeared.

d) Cultivated Land

This is another important land cover of the study area that has been gradually changed since 1960. The GIS analysis revealed that the area occupied by cultivated land decreased by 34.70% between 1960-1988 and by 41.72% between 1988-2008. It is also revealed that cultivated land is used for urban development and converted to built up areas and resulted 61.95% agricultural land loss during the study period 1960-2008.

Table 5.7 Showing the changed area of wetlands and other features in different years (1960-1988, 1988-2008 and 1960-2008)

Categories of land use/cover types	1960 area (ha)	1988 area (ha)	2008 area (ha)	1960-1988 area changed (ha)	% of changed area	1988-2008 area changed (ha)	% of changed area	1960-2008 area changed (ha)	% of changed area
Water bodies	2952.02	2103.62	1990.71	-848.40	28.74	-112.91	5.37	-961.31	32.57
Lowlands	13527.58	12717.73	6414.57	-809.85	5.99	-6303.16	49.56	-7113.01	52.58
Vegetation	6120.44	5781.84	3026.07	-338.60	5.53	-2755.77	47.66	-3094.37	50.56
Cultivated land	13840.20	9037.10	5266.80	-4803.10	34.70	-3770.33	41.72	-8573.40	61.95
Bare soil/landfill	482.03	1057.27	2322.09	575.24	119.33	1264.82	119.63	1840.06	381.73
Built-up	4641.73	10866.95	22543.6	6225.22	134.11	11676.65	107.45	17901.87	385.67

Source: Prepared by researcher based on table 5.6

e) Bare Soil/Landfill

Analysis of land cover changes in Dhaka city over time revealed a considerable increase in the bare soil / land fill areas over the study period. Major land fill activities occurred during the 1988-2008 period. Landfill areas increased by 1264.82 hectares between 1988-2008, which is an average more than 63.24 hectares per year. In 1960 the landfill areas were 1.17%, in 1988, 2.54% and in 2008, 5.59% of the total study area and increased rate of land fill areas observed 119.33% between 1960-1988 and 119.63% between 1988-2008. Analysis also revealed that bare soil/landfill areas increased to more than 382% in 2008 compared to 1960.

Land filling activities are occurring now mainly the eastern part of the study area. Some filled up areas are found around the previous land filled site and some new filled up lands are also found along the water bodies.

f) Built-up Area

Built-up area is mainly located at the central part of the study area. With increase of time built-up area has been changed. The nature of land cover changes revealed that the built-up categories have been increased significantly (Table 5.7)

In 1960, only 11.18% of the total area was built-up. But it increases up to 26.14% in 1988 and 54.24% in 2008. Built-up areas were 4641.63 hectares in 1960, which increased gradually to 10866.95 hectares in 1988 and 22543.60 hectares in 2008, indicating 134% growth within 28 years and 107% growth within 20 years. The GIS analysis also revealed that built-up areas increased 6225.22 hectares between 1960-1988, which is an average of more than 222 hectares per year. Similarly built-up areas increased in size by 11676.65 from 1988-2008, which is an average more than 583 hectares per year. Conversely water bodies decreased 30.30 hectares per year between 1960-1988, 5.65 hectares per year between 1988-2008 and lowlands decreased 28.92 hectares per year between 1960-1988, 315.16 hectares per year between 1988-2008. The decline of wetlands was clearly due to intensification of urban development in the Dhaka city.

Analysis also showed that built-up areas increased to about 385% in 2008 (Table 5.7) compared to 1960 and this is the highest percentage of land cover change among the above mentioned six types of land cover types.

Close examination of the change detection statistics revealed that 6225 hectares of the urbanized area (1960-1988) in study area were previously either cultivated lands or wetlands mainly. The newly urbanized 11676 hectares area (1988-2008) was previously mainly vegetation or wetlands and a few of cultivated lands.

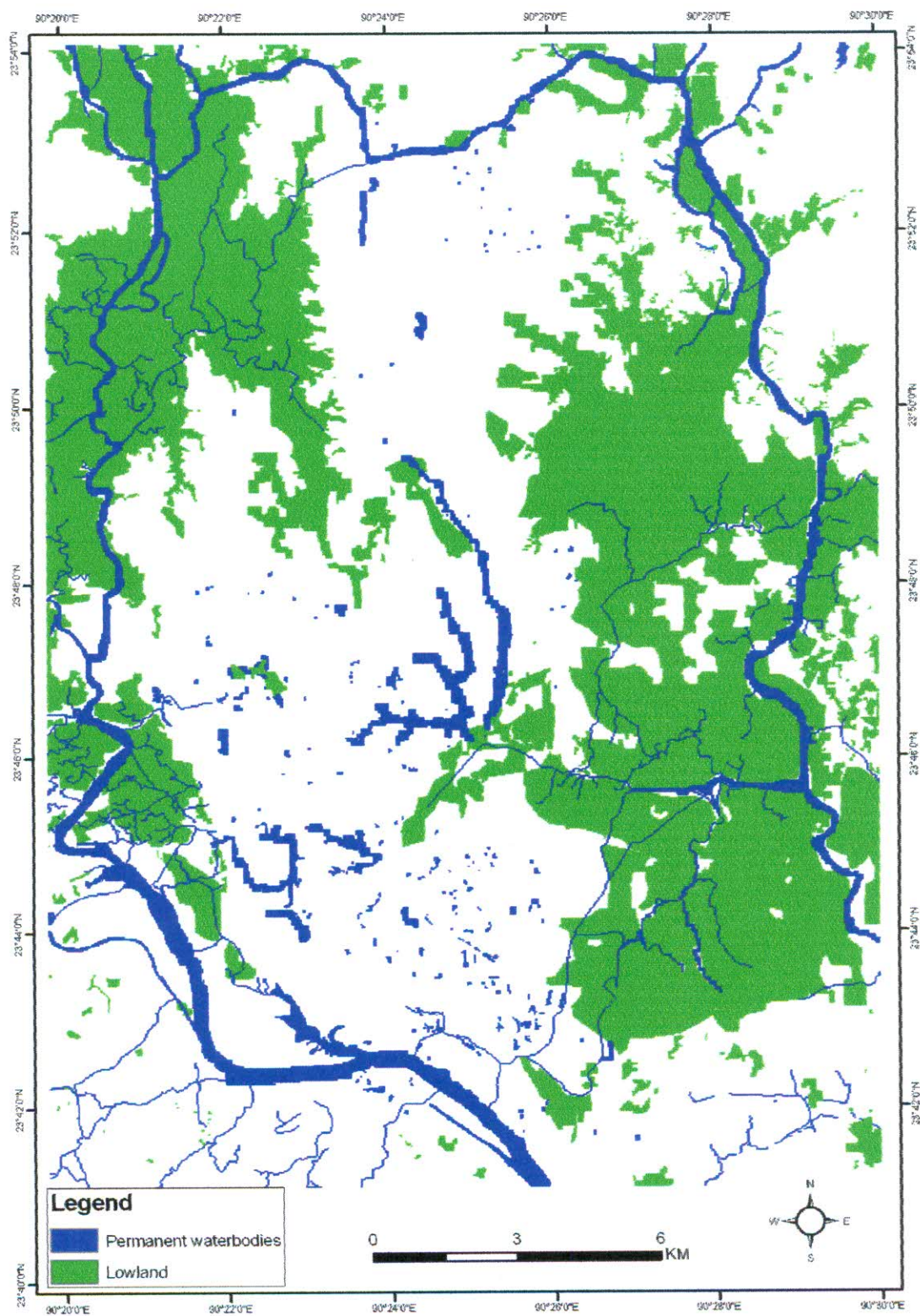


Figure 5.4 Different types of wetlands in the year 1960

Source: Prepared by researcher based on figure 5.1

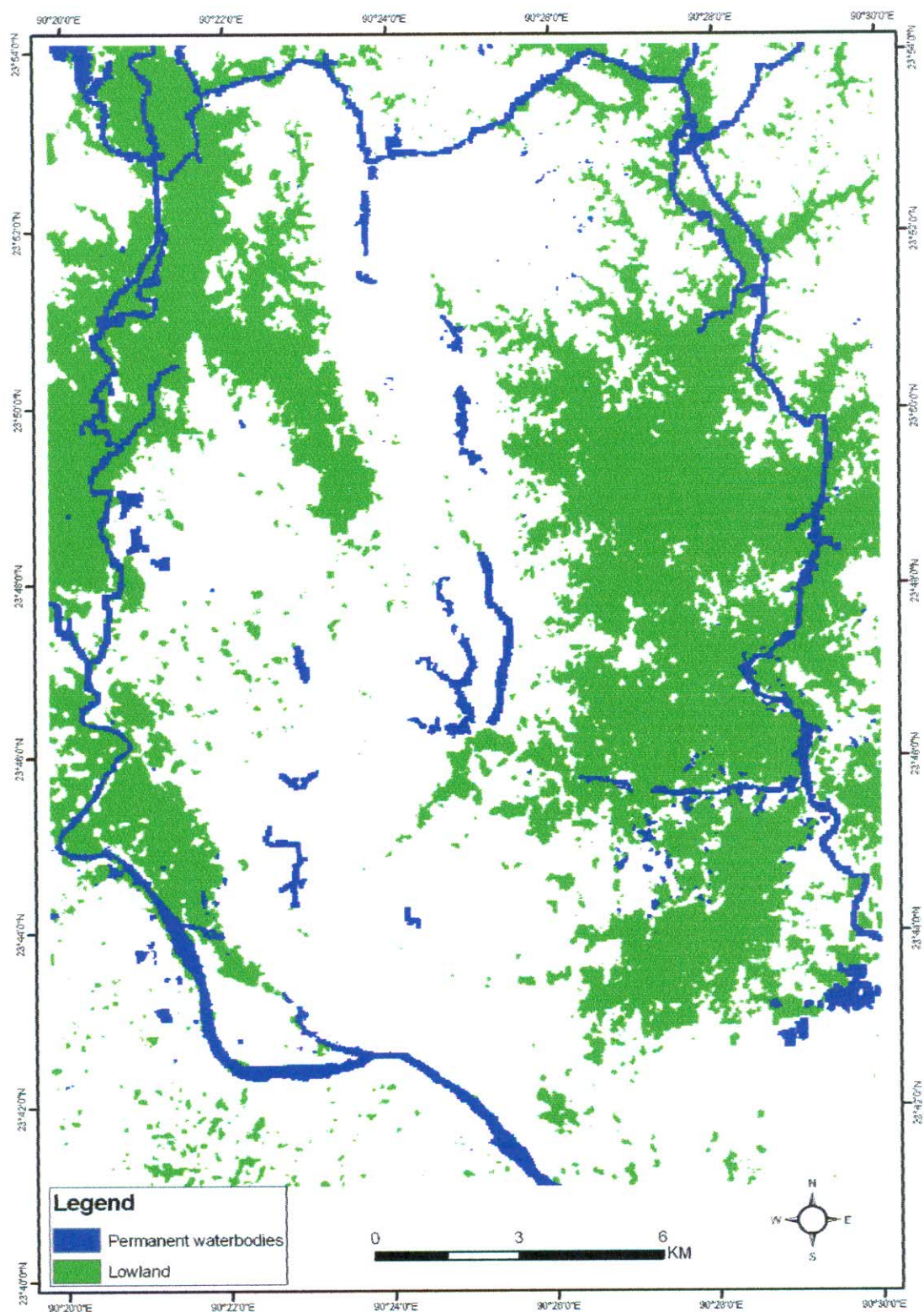


Figure 5.5 Different types of wetlands in the year 1988

Source: Prepared by researcher based on figure 5.2

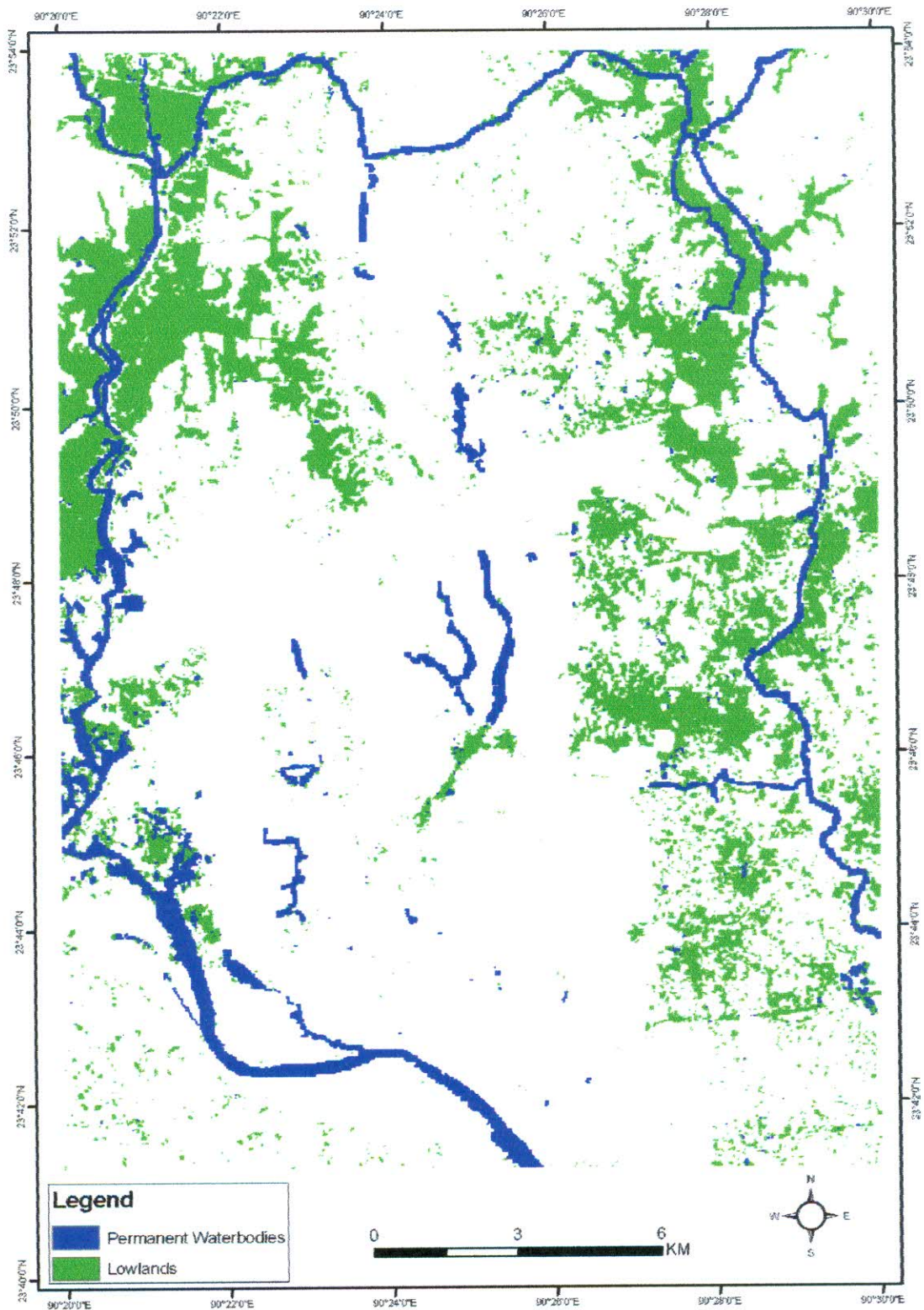


Figure 5.6 Different types of wetlands in the year 2008

Source: Prepared by researcher based on figure 5.3

5.4 Overlays of Wetlands Map and Change Detection

During the British period Dhaka had the status of only a district town (Khan and Islam, 1964). The city expanded along the river Buriganga to the south, Ramna to the north, Postagola to the east and Moneshwar to the west. In fact Dhaka is expanding through land filling activities from the very past, which probably dates back to 50's. In 1950 the Construction and Building Department of the Government of East Pakistan acquired 500 acres of low flood plains in Dhanmondi for the establishment of a residential area (Islam, 1996). At that time depression and low lands mostly covered the study area. By 60's study area started to experiences land filling for expansion of residential areas like Uttara, Gulshan, Banani etc.

The data layers, containing the areas of each category of wetlands of three years (1960, 1988, and 2008) were overlaid to reveal the change.

a) Changes in Lowlands

Dhaka city occupying the southern edge of Madhupur Tract and gradually extended towards the low-lying flood plain areas in different directions. The low-lying areas have been filled up by sand, soil, solid waste etc. and roads, houses, different infrastructures were built upon them. This process filled up a large number of lowlands.

From the overlaid map it is observed that the shape of lowlands are being changed day by day as filling activities became a regular phenomena for urbanization. Lowlands covered most of the eastern part and western edge of Dhaka city in the year 1960 (Fig: 5.7). In 1988 the lowlands of north-east part has reduced (Fig: 5.8). But in 2008 wetlands areas reduced in aerial extent drastically both in the eastern part and western edge of the city and became sporadic (Fig: 5.9). The reduction in the area of lowlands mostly occurred in Boro- Magbazar, Eskaton, Modhubag, Noyatola, East- Rampura, Matijheel and Jatrabari of the south-eastern part of the city. Lowlands in the north-eastern part mainly reduced in Badda, Satakul, Khilkhet, Askona, Dobadia and Dumni area.

The decreased in the area of lowlands mostly occurred in Aminbazar, Gabtoli, Adabor, Ramchandrapur, Katasur and Mohammadpur of the south-western part of the study area. In north-west corner area of lowlands decreased mostly in Diabari, Baunia, Dhaur, Kamarpara area. The reduction of wetlands in this area closely matches in landfilling in Dhaka.

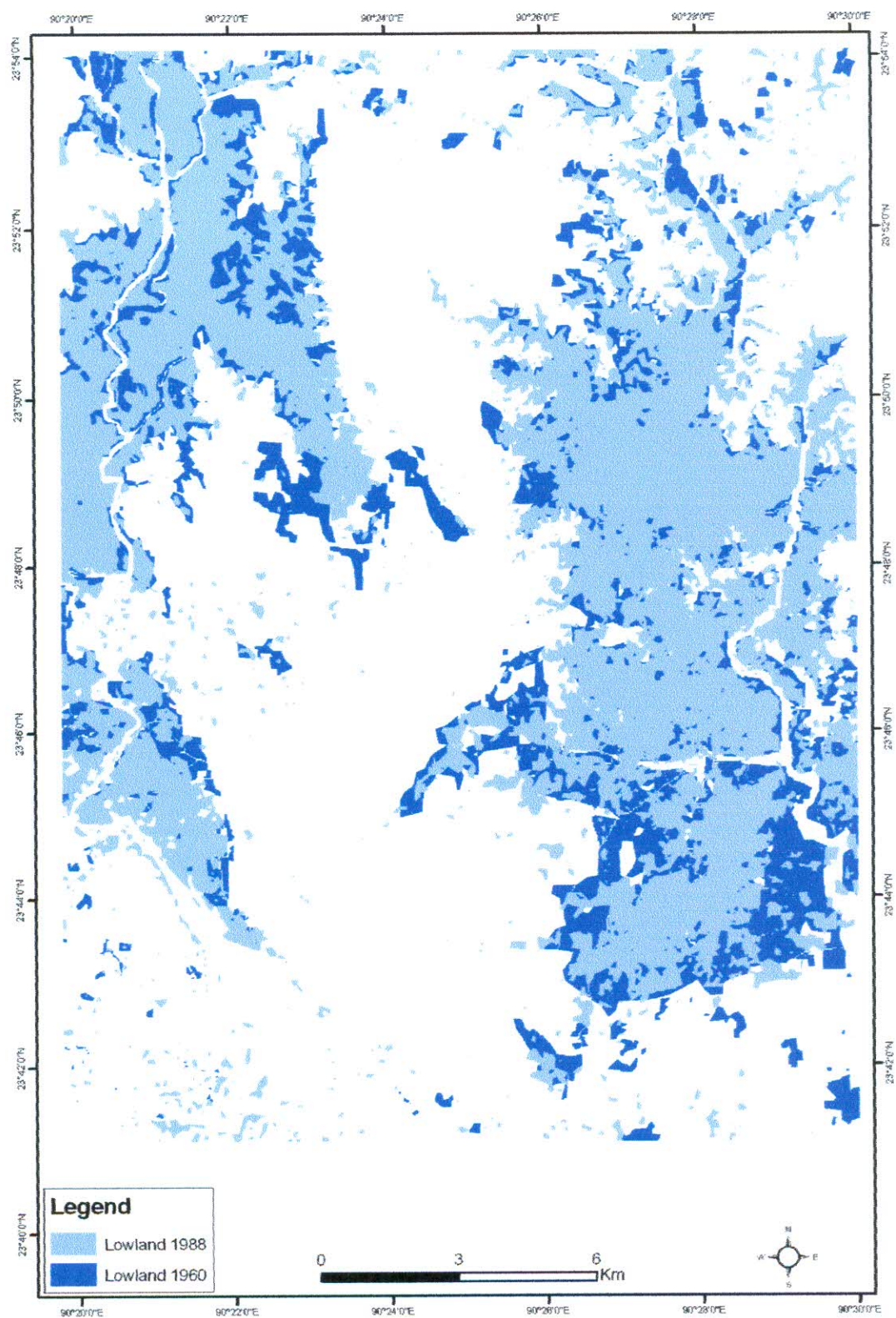


Figure 5.7 Overlay of lowlands of 1960 and 1988

Source: Prepared by researcher based on figure 5.4 and 5.5

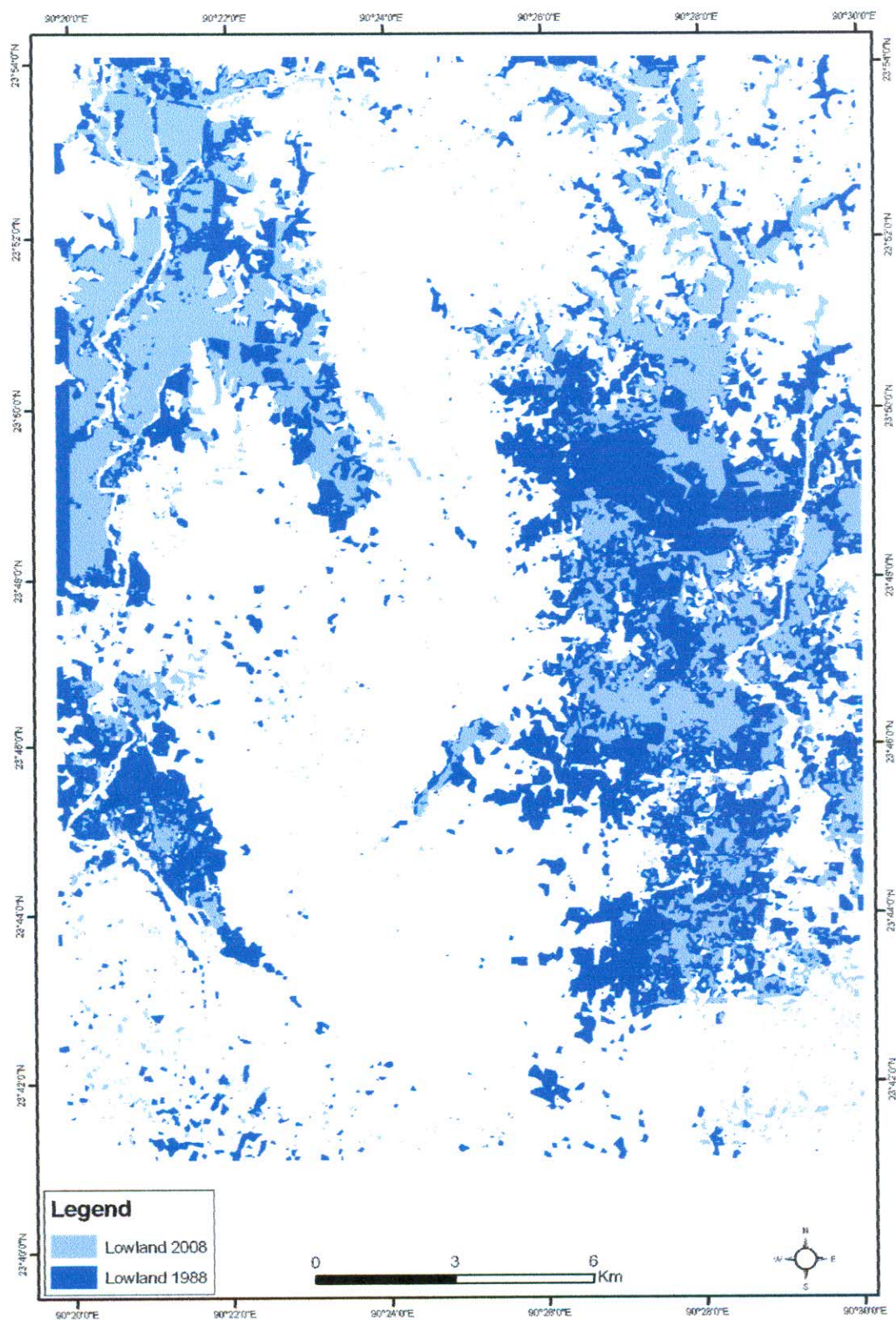


Figure 5.8 Overlay of lowlands of 1988 and 2008

Source: Prepared by researcher based on figure 5.5 and 5.6

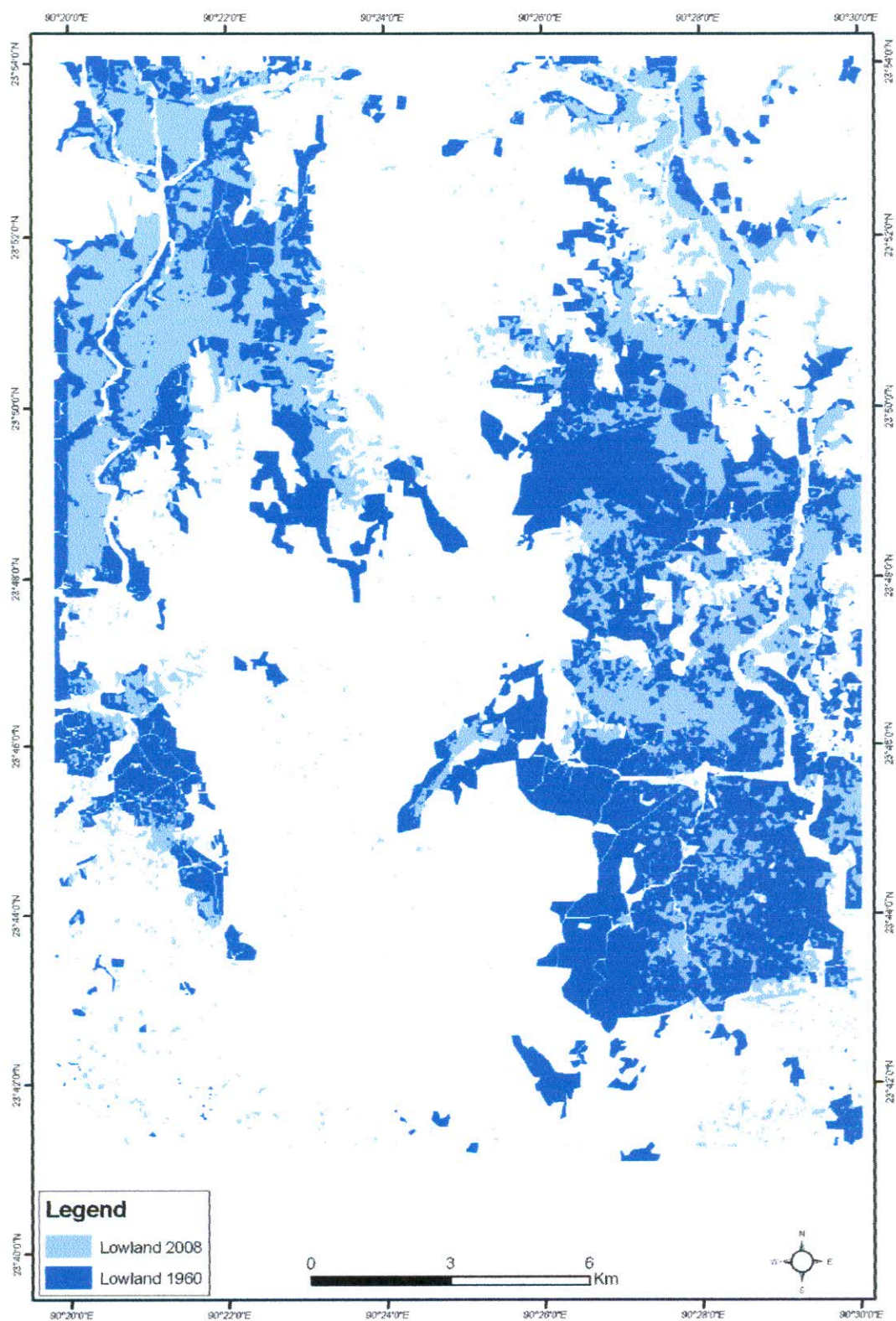


Figure 5.9 Overlay of Lowlands of 1960 and 2008

Source: Prepared by researcher based on figure 5.4 and 5.6

b) Change in Water bodies

Overlaid wetlands map of three periods, 1960-1988, 1988-2008 and 1960-2008 showed that, the area of water bodies is reduced or shrunk. The width of Gulshan – Baridara and Dhanmondi lake has reduced as they shrunk (Fig: 5.13). The upper part and lower left part of Gulshan – Baridhara lake totally disappeared in overlay map of 1960-2008 (Fig: 5.10), which was present in wetland map of 1960 (Fig: 5.4). Some of channels also disappeared or shrunken during the total study period. Surrounding four rivers, Buriganga, Turag, Tongi and Balu had shrunk more or less along all the areas of riverbank or foreshore (Fig: 5.10, 5.11, 5.12). The reduction in the areas of surroundings waterbodies mostly occurred in the Buriganga and Turag river. Overlay map of water bodies in 1960 and 2008 (Fig: 5.12) revealed that major changes occurred in Turag river from Aminbazar to connecting point of Buriganga river. Similarly during the same period major changes occurred in Buriganga river in the left side of the river in Kamrangirchar area and along the both side of the river in Bangladesh China Friendship Bridge to Lalbag area.

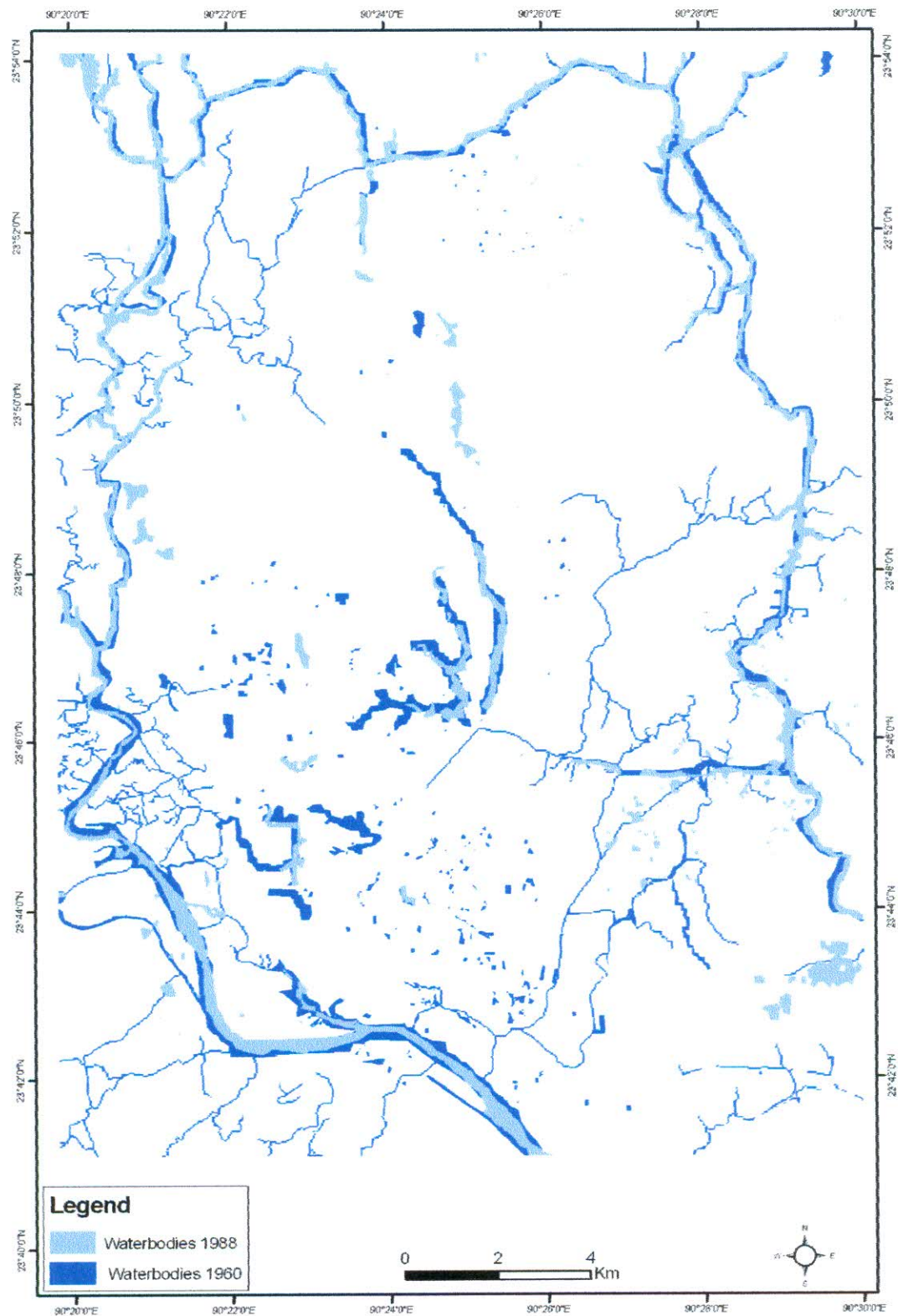


Figure 5.10 Overlay of water bodies of 1960 and 1988

Source: Prepared by researcher based on figure 5.4 and 5.5

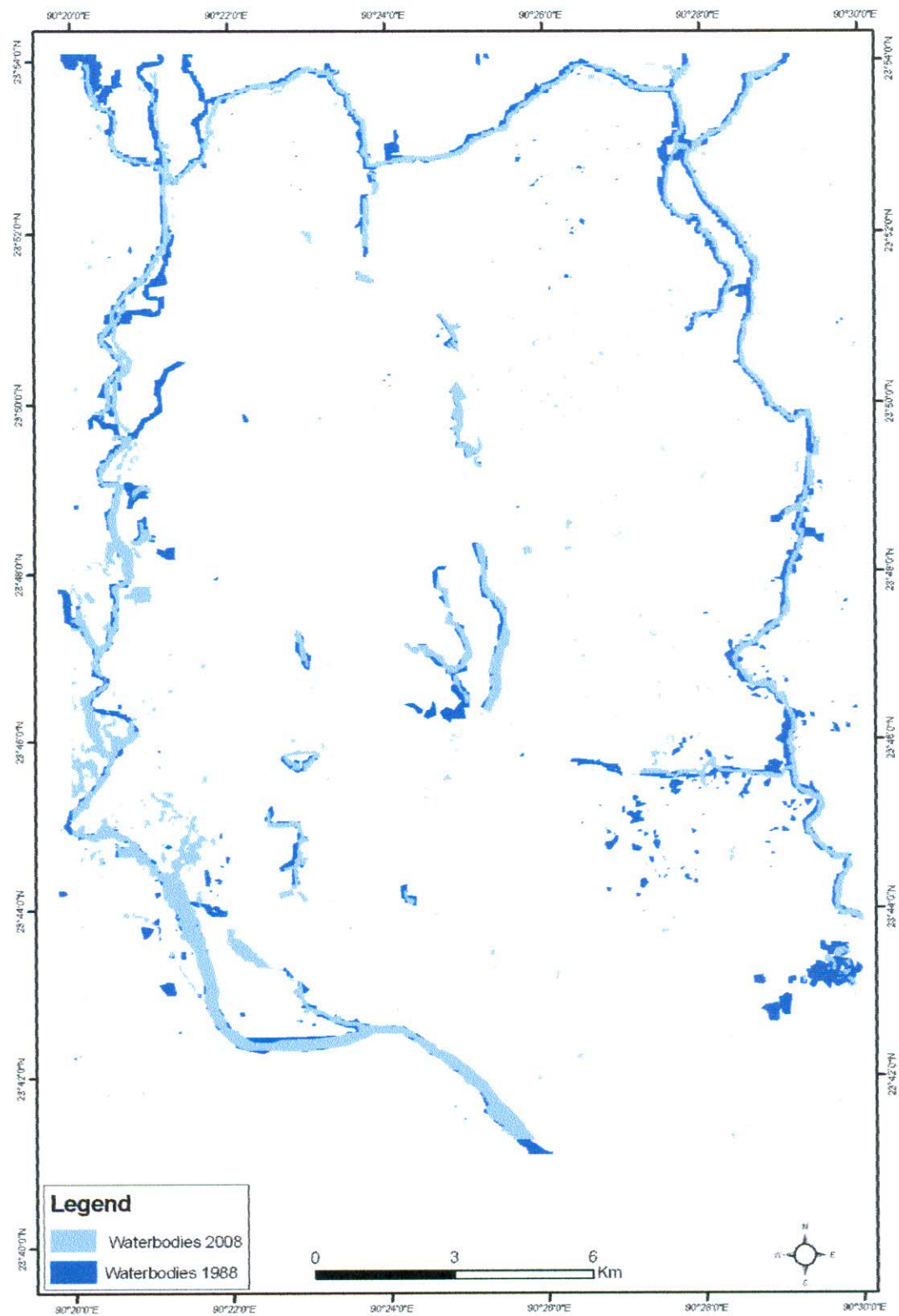


Figure 5.11 Overlay of water bodies of 1988 and 2008

Source: Prepared by researcher based on figure 5.5 and 5.6

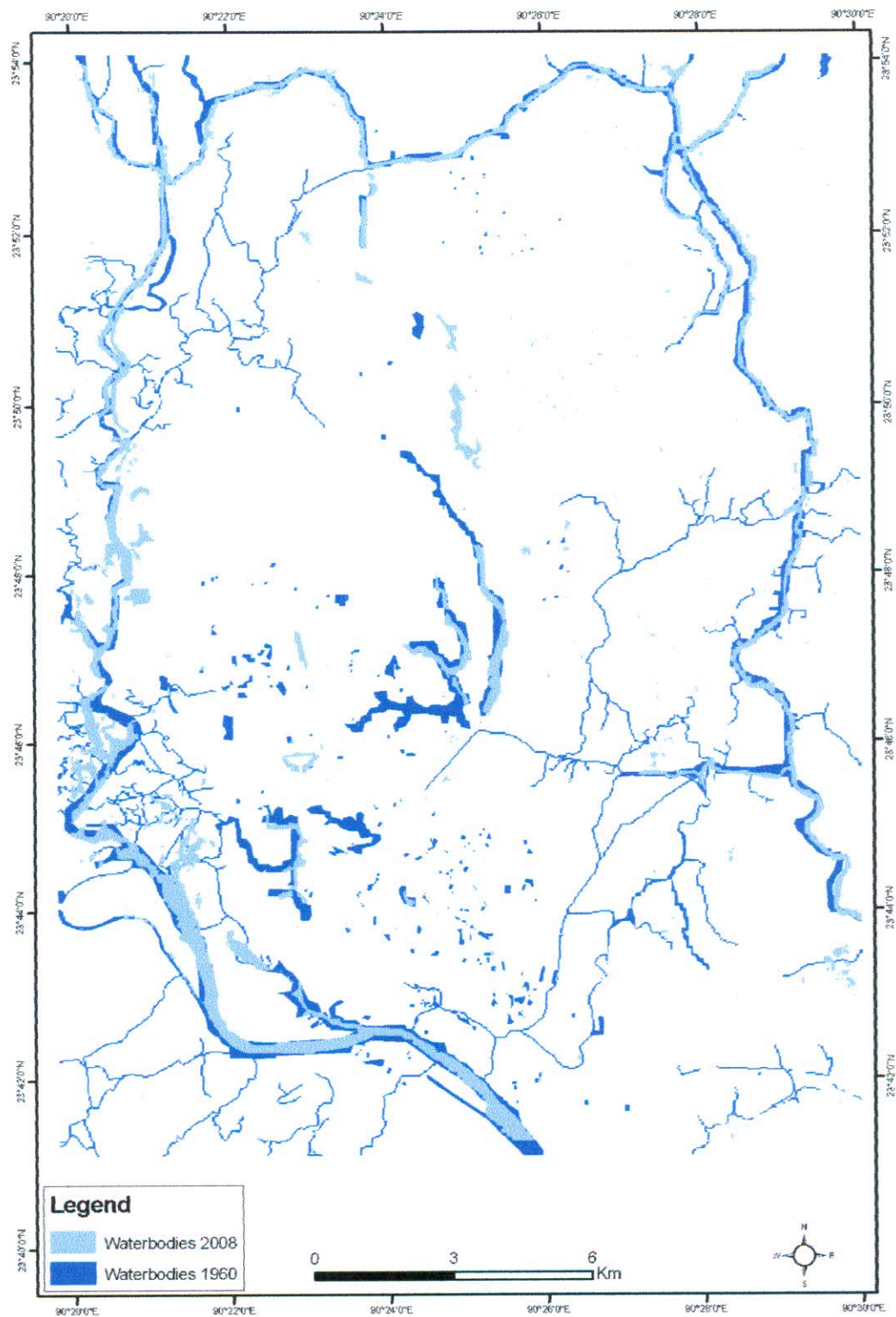


Figure 5.12 Overlay of water bodies of 1960 and 2008

Source: Prepared by researcher based on figure 5.4 and 5.6

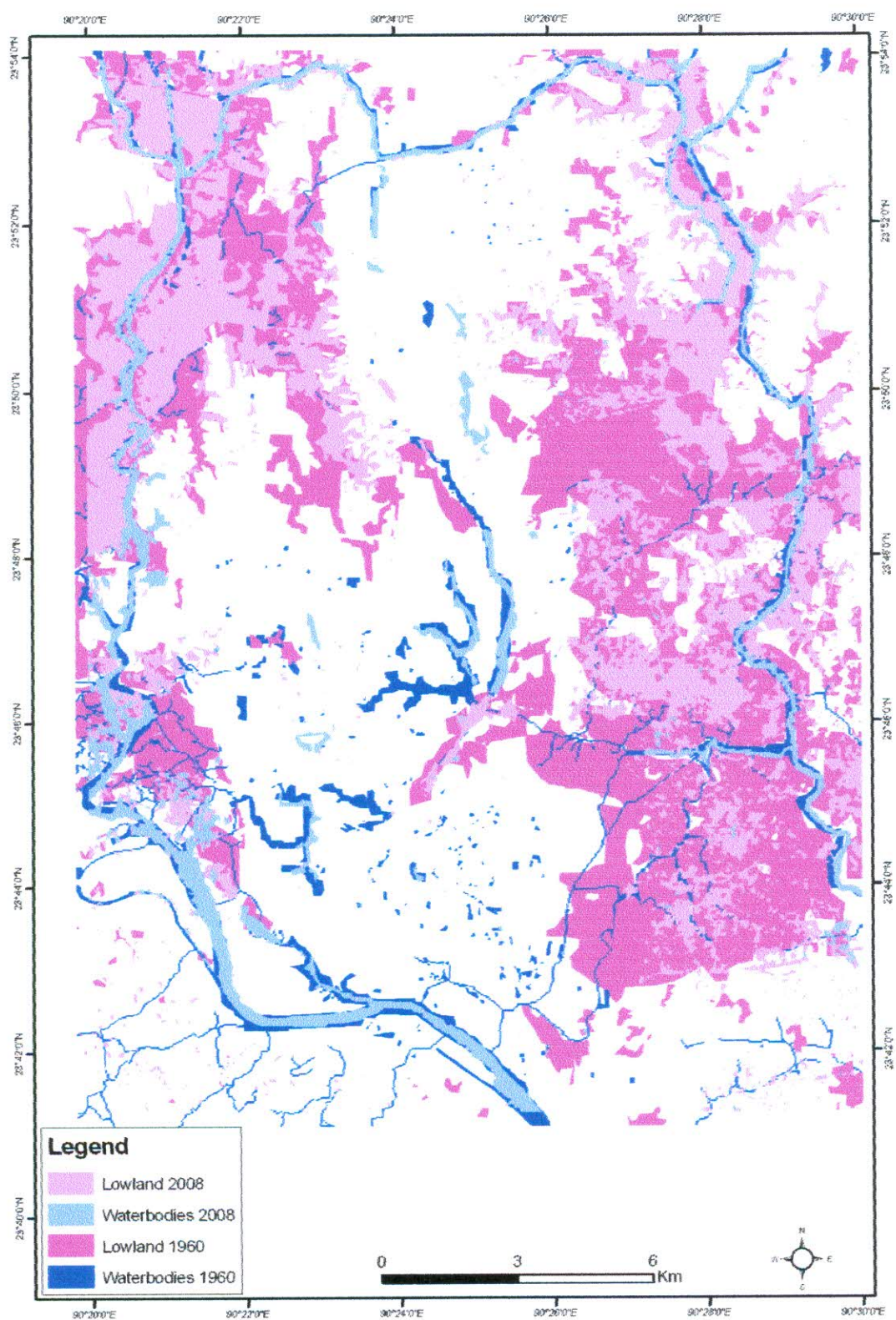


Figure 5.13 Lowlands and water bodies in Dhaka city in 1960 and 2008

Source: Prepared by researcher based on figure 5.4 and 5.6

5.5 Land use of Changed Wetland Areas

From the analysis of overlaid map of lowlands and water bodies, purposively and judgmentally five changed wetlands areas have selected to examine the dimension in the change in land use due to change in wetlands. Five changed areas have selected in such a way that covers almost all categories of wetlands in the study area like the river, lake, canal and lowlands. The five selected areas are: i) Begunbari canal (Hatirjheel) part-1; from backside area of Hotel Sonargaon to Rampura bridge. ii) Begunbari canal part-2; from Rampura bridge area to connecting place of Sutivola canal. iii) Along the both side of Turag river; Aminbazar to downwards up to Ramchandrapur area. iv) Upper part of Gulshan lake. v) Lower left part of Gulshan lake.

Begunbari canal (part-1 and part-2)

Begunbari canal and its adjacent lowlands are one of the selected areas in this research. Begunbari Khal is one of the important canals or water channels of the city. Historically this canal bears remarkable importance. Begunbari Khal was connected with Dhanmondi lake and Dhanmondi lake was with Turag River through Katashur canal. The other side of the canal was connected with Balu River and still it is connected.

The canal has a south-west to north- eastern alignment with Tongi industrial area. In the north-west, Moghbazar, Noyatola, Modhubagh, Mirertek and west Rampura residential area in the south east, Gulshan Model Town and Badda residential areas in the north. One third of the city's drain and rainwater is said to be discharged in the canal and into the Balu river. The basin serves as the largest retention pond of the city's rainwater and drain.

The lowlands areas of Begunbari Khal stretching from the eastern side of the Tongi diversion road up to the Rampura Bridge on the Progati Sarani serve very important hydrological functions of draining and detaining storm water from a large area of Dhaka city. These functions are particularly critical during monsoon. During dry season, storm water and illegally discharged domestic and industrial wastewater drain through this low land into the Balu river by gravity.

In the Master plan of 1959, Begunbari canal was placed at the center of a permanent water body connecting to Dhanmondi lake to the Balu River. The Begunbari basin area was marked as a collection chamber for the entire drainage of the adjoining areas. Based on 1959 Master Plan, all the land already developed has varied significantly from that proposed (Khan, 2003). Presently Begunbari canal of the city is under the threat of disappearance by indiscriminate land filling and illegal encroachment. Real estate housing companies, private land speculators, individuals, NGO office, Private university campus etc. already filled up a major low land area of Begunbari Khal.

During field visits, extensive land filling activities were observed in the lowlands between Tongi Diversion road and the rail line near the Sonargaon Hotel. A major land filling activity was done in the area adjacent to Sonargaon Hotel for the constructing BGMEA office located to the south of Panthapath. Another land filling was going on for construction of a CNG refilling station to the west of Tongi Diversion Road (Field visit, 2008).



Photograph 5.1 Encroachment of Begunbari Khal by slums

Source: Field visit, 2008

The study area Begunbari canal (part-1 and part-2) covers 8.85 sq km (Fig: 5.14). Table 5.8 shows the land cover use/ types of this study area. It is clear from the figure-14 and table 5.8 that in 1960 major land cover types of this area were wetlands (20.45%+60.45% = 80.90%). But in 2008 the situation is completely different, coverage of the wetlands (lowland and water bodies) is only 24.86% (6.78% + 18.08%), where as the built- up area and landfill area is (36.16+21.81) = 57.97%. From the above discussion it is evident that coverage of wetland in the Begunbari canal area are gradually decreasing and land fill and built-up area are increasing.

**Table 5.8 Land use/cover types statistics in the study area Begunbari canal
1960-1988-2008**

Land use/cover types	1960		1988		2008	
	Area (sq. km)	%	Area (sq. km)	%	Area (sq. km)	%
Built-up	1.10	12.43	1.26	14.24	3.20	36.16
Bare soil/landfill	0.03	0.34	0.46	5.20	1.93	21.81
Agriculture land	0.41	4.63	0.89	10.06	0.95	10.73
Vegetation	0.05	0.56	0.04	0.45	0.02	0.23
Water bodies	1.81	20.45	0.82	9.27	0.60	6.78
Lowlands	5.35	60.45	5.17	58.42	1.60	18.08
Transport and Communication	0.10	1.13	0.21	2.36	0.55	6.21
Others	-	-	-	-	-	-
Total	8.85		8.85		8.85	

Source: Prepared by researcher based on figure 5.14

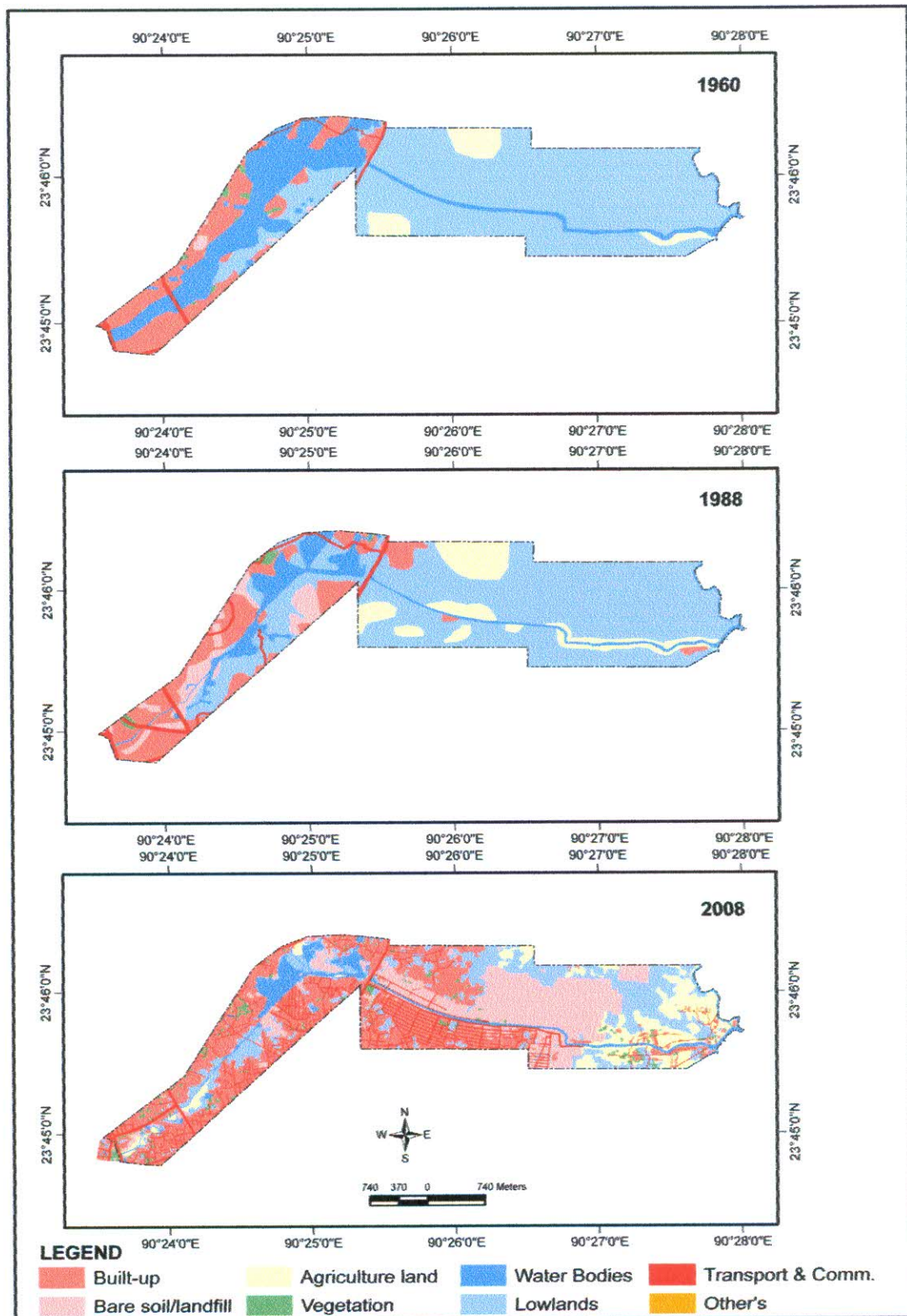


Figure 5.14 Landuse map of Begunbari Khal (part-land part-2) area showing change of wetland (1960-1988-2008)

Source: Prepared by researcher based on topographic map 1960, Landsat TM image 1988 and Goggle Earth image, 2008

Turag River Area (Part)

The study area Turag River (Part) covers 4.42 sq. km. (Fig: 5.15). In 1960, along the river of this area were mostly lowlands (76.24%), 1988 few built up area grew up near the Aminbazar-Gabtolli area replacing the lowland (Fig: 5.15). From the analysis of Goggle earth image, 2008 it is revealed that built-up area covers 14.03%, landfill area covers 16.97%, Water bodies covers 10.18 % and lowlands covers 48.64% (Table 5.9). Though the wetlands (water bodies and lowlands) are the dominant, if the present trend of land filling and built-up coverage continues, the wetlands coverage will be the minimum.

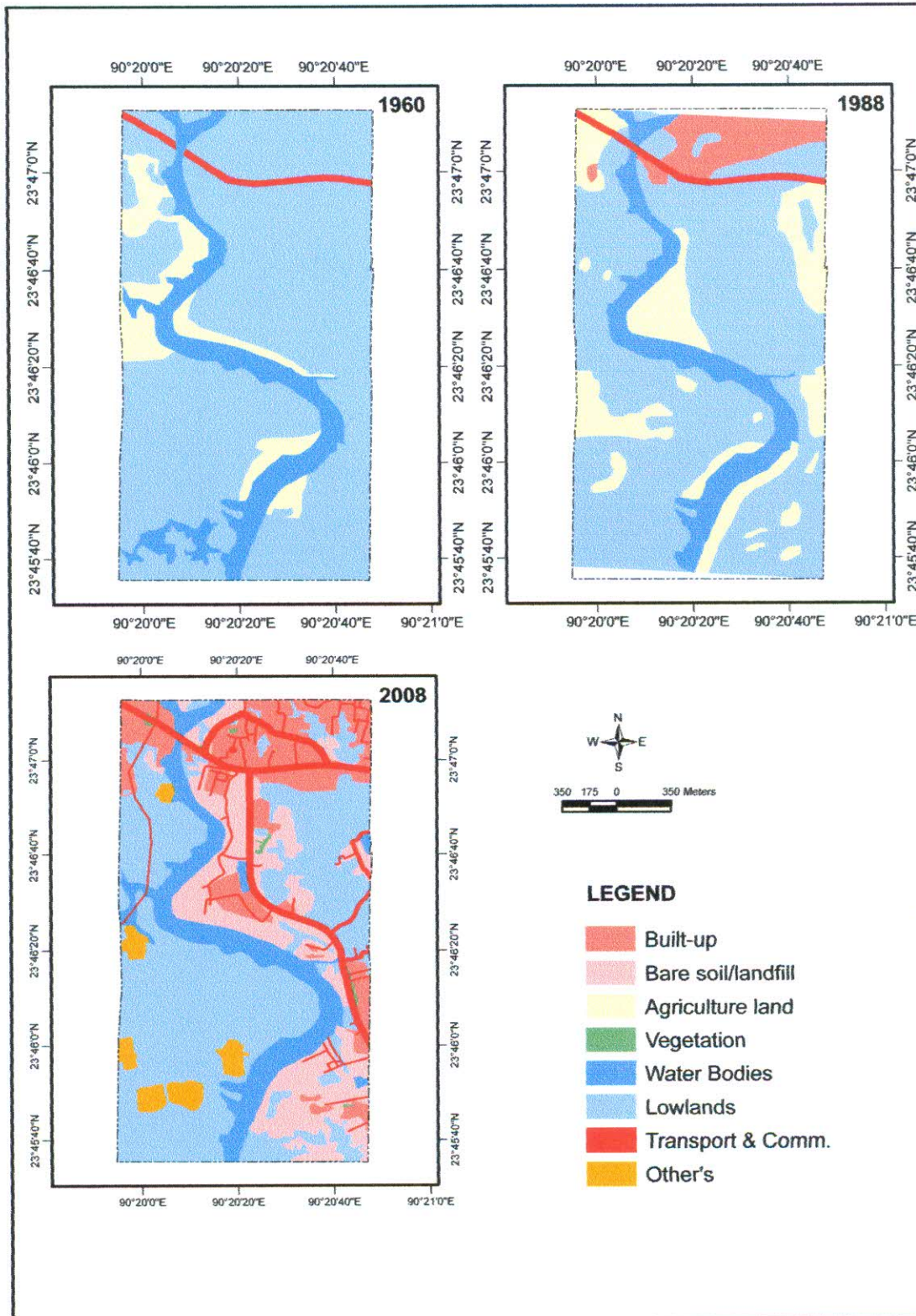


Figure 5.15 Land use map of part of Turag River showing change of wetland (1960-1988-2008)

Source: Prepared by researcher based on topographic map 1960, Landsat TM image 1988 and Goggle Earth image, 2008.

Table 5.9 Land use/cover types statistics in the study area Turag River part 1960-1988-2008

Land use/cover types	1960		1988		2008	
	Area (sq. km)	%	Area (sq. km)	%	Area (sq. km)	%
Built-up	-	-	0.28	6.34	0.62	14.03
Bare soil/landfill	-	-	-	-	0.75	16.97
Agriculture land	0.39	8.82	0.73	16.52	-	-
Vegetation	-	-	-	-	0.01	0.23
Water bodies	0.60	13.58	0.50	11.31	0.45	10.18
Lowlands	3.37	76.24	2.84	64.25	2.15	48.64
Transport and Communication	0.06	1.36	0.07	1.58	0.30	6.78
Others	-	-	-	-	0.14	3.17
Total	4.42		4.42		4.42	

Source: Prepared by researcher based on figure 5.15

Upper and lower left part of Gulshan lake

The study area upper part of Gulshan lake covers 2.03 sq. km. (Fig: 5.16) and lower left part of Gulshan lake covers 1.52 sq km (Fig: 5.17). From the overlaid map of water bodies during the period of 1960-2008 (Fig: 5.12), it is observed that a large portion of this lake in the upper part and lower left part has almost totally disappeared. In the wetland map of 1960, these two parts were prominently present (Fig: 5.4). But the major areas of these water bodies are now converted as built up area (Fig. 5.16 and Fig. 5.17). Table 5.10 shows that there were no built-up area in 1960 in the upper part of Gulshan lake study area but in 2008, 64.53 % of this area is covered by built up area and only their remains 6.89% (4.43%+2.46%) of wetlands.

Table 5.10 Land use/cover types statistics in the study area upper part of Gulshan lake 1960-1988-2008

Land use/cover types	1960		1988		2008	
	Area (sq. km)	%	Area (sq. km)	%	Area (sq. km)	%
Built-up ₁	-	-	0.82	40.40	1.31	64.53
Bare soil/landfill	0.11	5.42	0.06	2.96	0.03	1.49
Agriculture land	1.00	49.26	0.21	10.34	-	-
Vegetation	0.16	7.88	0.27	13.30	0.40	19.70
Water bodies	0.15	7.39	0.13	6.40	0.09	4.43
Lowlands	0.61	30.05	0.42	20.69	0.05	2.46
Transport and Communication	-	-	0.12	5.91	0.15	7.39
Others	-	-	-	-	-	-
Total	2.03		2.03		2.03	

Source: Prepared by researcher based on figure 5.16

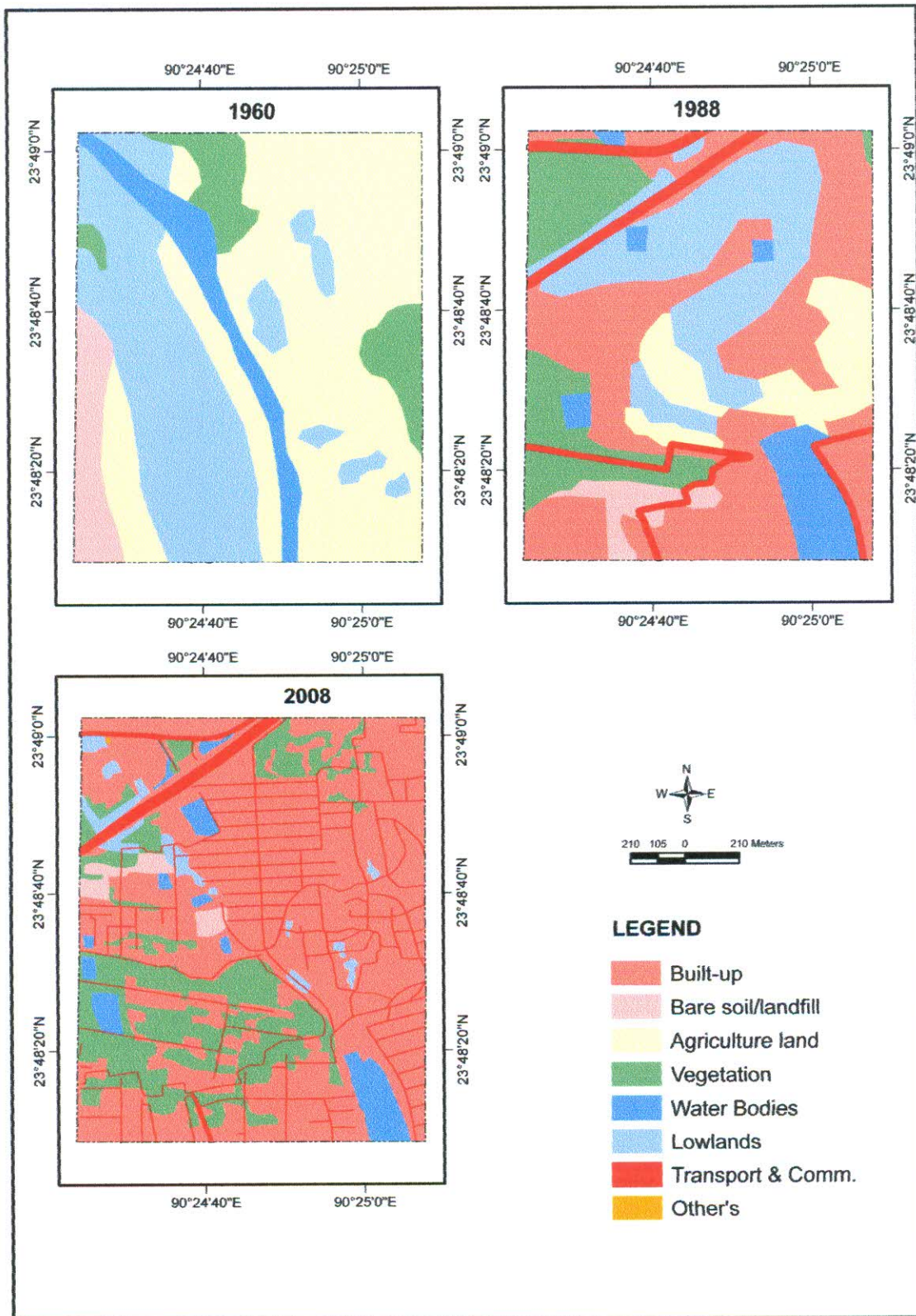


Figure 5.16 Land use map of upper part area of Gulshan lake showing change of wetlands (1960-1988-2008)

Source: Prepared by researcher based on topographic map 1960, Landsat TM image 1988 and Goggle Earth image, 2008

Table 5.11 shows that in 1960 the water bodies were 23.69% and lowlands were 9.21% in the lower left part of Gulshan lake study area. But in 2008 water bodies remains only 4.61% and the total lowland areas were changed. In 1960 built up area covered 58.55% where in 2008 it stands 75.66%. It is evident from the analysis of the figure 5.16 and 5.17 table 5.11 and 5.12 that the wetlands of these two study areas have been changed drastically into built-up categories.

Table 5.11 Land use/cover types statistics in the study area lower left part of Gulshan 1960-1988-2008

Land use/cover types	1960		1988		2008	
	Area (sq. km)	%	Area (sq. km)	%	Area (sq. km)	%
Built-up	0.89	58.55	1.14	75.00	1.15	75.66
Bare soil/landfill	0.08	5.26	-	-	0.04	2.63
Agriculture land	0.05	3.29	-	-	-	-
Vegetation	-	-	-	-	0.11	7.23
Water bodies	0.36	23.69	0.25	16.45	0.07	4.61
Lowlands	0.14	9.21	0.10	6.58	-	-
Transport and Communication	-	-	0.03	1.97	0.15	9.87
Others	-	-	-	-	-	-
Total	1.52		1.52		1.52	

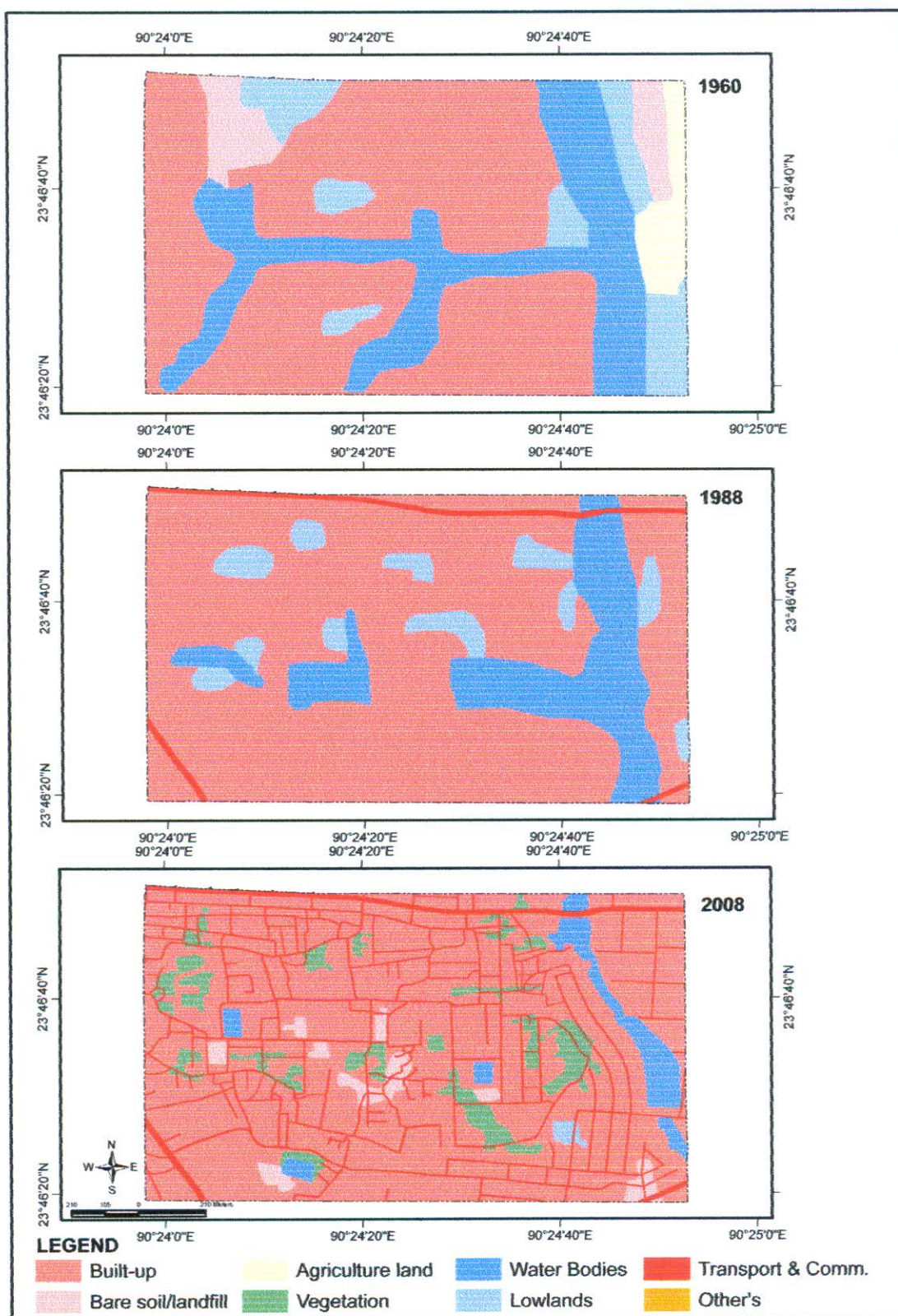


Figure 5.17 Land use map of lower left part area of Gulshan lake showing change of wetlands (1960-1988-2008)

Source: Prepared by researcher based on topographic map 1960, Landsat TM image 1988 and Goggle Earth image, 2008.

From the analysis of land use pattern of these above changed wetland areas (Turag River part area, Begunbari canal area and Gulshan lake area) it is revealed that the wetlands of Turag River part area are mainly converted to bare soil/landfill areas, the wetlands of Begunbari canal area are converted to bare soil/landfill, built up and agriculture land and the wetlands of Gulshan lake area mainly transformed to built up areas. From above result it can be concluded that the trend of changing pattern of wetland is – primarily wetlands are converted to landfill areas then it is used as any kind of informal purpose and finally converted to built up areas.

The Turag River part area is less urbanized than Begunbari canal and Gulshan lake area. Begunbari canal area is less urbanized than Gulshan lake area. Gulshan lake area is more urbanized than begunbari canal as well as Turag River part area. The built up area of Turag River part area, Begunbari canal area in 2008 were 14.03% and 36.13% respectively. The built up area of upper part of Gulshan lake area and lower left part of Gulshan lake area in 2008 were 64.53% and 75.66% respectively. So it is revealed from this analysis the rate of transformation of wetland is highly related with urban settlement.

Chapter 6

Transformation of Wetlands and Environmental Degradation

Chapter 6

Transformation of Wetlands and Environmental Degradation

The government organizations, the PLDCs and individual landowners are active to fill the wetland areas in a continuous process within the study area, resulting in the deterioration of wetland features. Field survey findings reflect that the rate of reduction of wetlands is high at along the built up areas. Reduction in wetlands can create a large number of environmental impacts. These impacts become problem when they reduce the ability of wetland to provide benefits. Respondent were asked to identify the impact of wetland loss, it appears from their responses that 59.4% respondent identified the drainage congestion and water logging, 30.8% respondent identified the reduce ground water recharge capacity, 5.9% identified reduction of water reservoirs.

Table 6.1 Impact of wetland loss as people perceives

Impact of wetland loss	Frequency	Percentage
Reduction of water reservoirs	23	5.9
Reduce ground water recharge capacity	119	30.8
Drainage congestion and water logging	230	59.4
Loss of vegetation	6	1.6
Increase Water borne disease	9	2.3
Total	387	100.0

Source: Field survey, 2009

6.1 Decline of Ground Water Level

The ground water exists under semi confined as well as unconfined, free water- table conditions. In general, Dhaka city can be divided into two parts based on static water level (Asaduzzaman *et al.*, 1992).

- In the northern part, the ground water depth is ranging from 1.0m to 5.0m during August and 2.0m to 7.0m during March, the wet and dry seasons respectively.
- In the southern part it ranging from 7.0m to 14.0m during August and 8m to 15m below the surface during March.

Two major and five minor depressions in the ground water table are locally developed. The major and two of the minor depressions are in the southern part of the city where dense residential and commercial areas are located. The other three depressions are located in the northern part of the city, which are less dense residential areas. The general direction of flow in the northern part of the city is towards the southeast and at the eastern side the groundwater flows is in northeast direction. It has been observed from the existing data that the fluctuation of the water table between dry and wet seasons ranges from 0.5- 2.5m (DWASA, 1991). The aquifer system under Dhaka is discharged by aquifer drainage to the rivers, direct evapotranspiration, and ground abstraction (DWASA, 1992).

Dhaka city's ground water level is depleting at an alarming rate. Ground water depletion is occurring more than 3m/year at most places of Dhaka city (Al-Mamun, 2006). Ground water table in the capital has dropped down to 61.18 meters below the surface, 35 meters in the last eleven years, due to lack of recharging which has put the sprawling metropolis at great risk.

Table 6.2 Ground water depletion situation in the capital

Year	Below the surface
1996	26.60 m
1997	28.15 m
1998	30.45 m
1999	31.86 m
2000	34.18 m
2001	37.78 m
2002	42.00 m
2003	46.24 m
2004	50.60 m
2005	57.42 m
2006	59.72 m
2007	61.18 m

Source: Islam, 2005 and The Daily Star, 26 March, 2008

In 1996 the ground water table was only 26.6 meter below the surface but it went 61.18 meter below in 2007. Expert says, “If water table continues to fall then a vacuum will be created in the aquifer which could cause a sudden collapse in the surface”.

There exist a seasonal fluctuation of ground water level characterized by rainfall and surface water recharge on the one hand and drainage to the rivers and direct evapotranspiration on the other hand. This rhythm governs the piezometric fluctuation over a large portion of the study area. Urbanization has made a major impact on the water balance of the Dhaka city (Nishat, *et al.*, 2000). The effects of urbanization on the water balance of Dhaka city are profound manifold. Urbanization causes dramatic changes to the water balance of many areas. This water balance can be identified as one of the major indication of human interference over the nature. Urbanization changes the hydrographic network of the city, which causes an imbalance in the local water circulation. The land conversion, construction of buildings, paved areas, and drainage and sewer system causes a decrease and even disappearance of natural watercourses and other open basins.

The Plio- Pleistocene aquifer of Dhaka city mainly depends for its recharge on the surface water system, which comprises of,

- Lateral inflow from the streams around the city.
- Infiltration due to local rainfall.
- Infiltration due to seepage from surface water system.
- Regional recharge in Dupi Tila formation from around the city.

Due to dense urbanization in the city there has been a decrease in the amount of recharge from the direct percolation due to decrease in the rechargeable area. On the other hand excess extraction of ground water to meet up the urban demand has disrupted the recharge-discharge equilibrium of the city (Choudhury, 2001).

Wetlands function like natural tubs or sponges, storing water and slowly release it. This process slows the water's momentum, erosive potential reduces flood height and allows for ground water recharge, which contributes to base flow to surface water system during dry periods. But most of the wetlands of Dhaka city are diminishing at an alarming rate.

6.1.1 Increase of Impervious Areas

Impervious area is defined in the study area as any man made object of impermeable natures that considerably diminishes the water storage capacity. 75 percent of the total urban areas are impervious in nature in Dhaka city. It contains 25 percent permeable surfaces that have not been engulfed by urbanization (Khan, 2001). Although percentage of impervious areas varies in different residential units (High, medium and low residential areas).

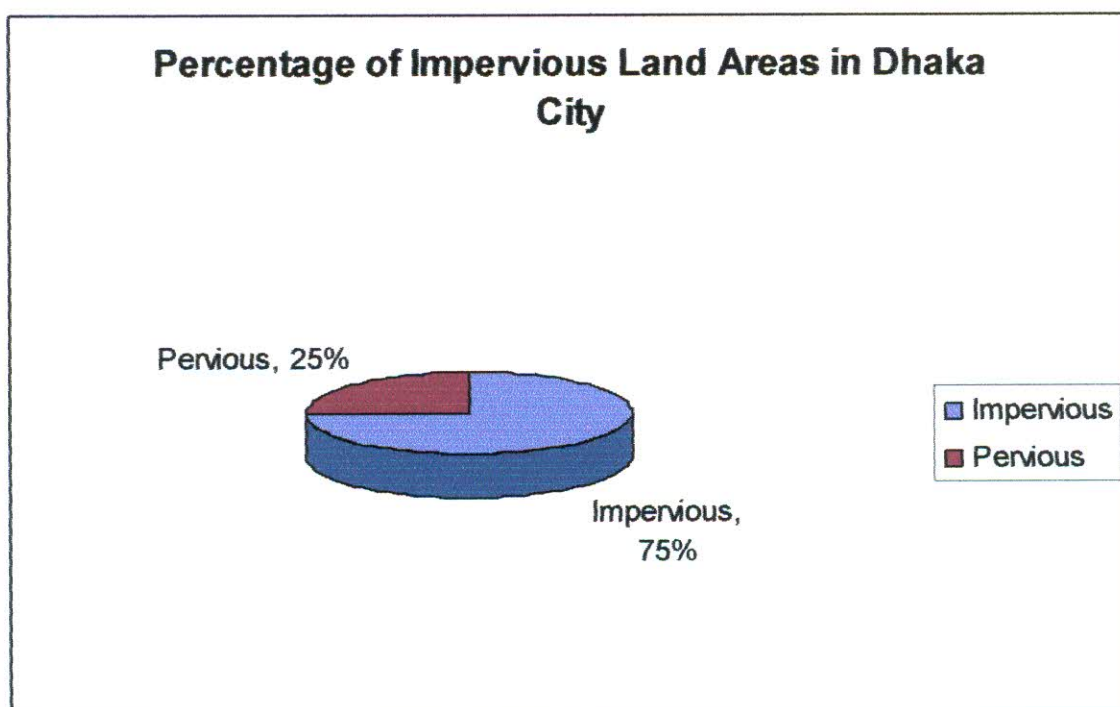


Figure 6.1 Percentage of impervious land areas in Dhaka city

Source: Khan, 2001

The impervious areas play a significant role to aggravate waterlogging problem. The effects of impervious are:

- Reduced infiltration/ subsurface flow
- Reduced ground water recharge
- Shortening the storm run off lag time consequently increase in the flood peak
- Change the flow regime of the khals
- Increase in surface runoff that puts pressure on existing drainage system and some cases causing failure in drainage performance.

Table 6.3 Imperviousness of land surface and runoff ratios for some areas in Dhaka city

Location	Land use	Sewer type	Impervious areas in percentage	Runoff ratio
New Elephant Road and adjoining area	Commercial cum residential	Under ground sewer	85	0.4-0.8
Dhanmondi and Shatmosjid Road	High class residential	Under ground sewer	65	0.4-0.7
Zigatala	Unplanned high density residential	Under ground sewer	90	0.3-0.6
Azimpur	Planned and unplanned residential	Surface drain	80	0.2-0.5
BUET	University campus	Surface and subsurface	55	0.1-0.3

Source: Chowdhury, *et al.*, 1998

6.1.2 Increase of Surface Runoff

In a natural watershed, part of the rainfall is intercepted by vegetation and the rainwater falls on the ground, some parts are stored in depressions and rest begins to penetrate the soils. When the vegetation and soils are saturated the excess rainfall produce surface and subsurface runoff. When the watershed is experiencing urbanization and a gradual increase of imperviousness occurs then the storage is diminishing and a larger volume is more rapidly available for surface runoff and attaining higher peaks. The immediate effect of encroachment into wetlands is increase in impervious areas, which leads to unbalanced surface runoff to be piped to the receiving watercourse instead of being evaporated, intercepted or otherwise attenuated or infiltrated into the ground. Water runs off more quickly from the relatively impermeable surfaces of streets and roofs and flows through drains and sewers more efficiently than across the natural surfaces. This reduces the time for surface run-off generation or “lag time”.

Table 6.4 Runoff coefficients used in the Storm Water Drainage Master Plan

Land use	Proposed runoff coefficient
Commercial area	0.65
Industrial area	0.55
High class residential area	0.30
Middle and low class residential area	0.50
Green zone and others	0.20
Water bodies	0.10

Source: JICA, 1991

Urban sprawling has been very rapid in the city, producing more impervious surfaces contributing to reduction in infiltration and accelerating runoff. As impervious surfaces increased significantly, water levels in the surrounding rivers were augmented to be above of the normal flood level for longer time (Dewan, *et al.*, 2008).

6.2 Scarcity of Natural Water Retention Areas

The water retention areas in the urbanized area play a significant role to reduce water logging. When urban expansion occurs in the wetlands, the next results are decrease in natural water retention areas. The process of land development through land filling buries a large number of natural channels. Flood alleviation measures through construction of embankment in the western and eastern part of city will speed up the urbanization in the low-lying area using land filling methods. Through these practices the “Natural Storage Function” is disrupted.

The retention areas under natural conditions play a role in retaining excess run off thus delay and lower the flood peak and slow down the average speed of the flood water, when wetland is started to be disappeared due to encroachment, the retention areas decreases and rainwater overflows the banks of water body.

As estimated by FAP-8A study JICA, 1992 that about 12.5 percent areas should be reserved as retention ponds. In order to realize such proposals, areas for retention ponds and east west polders should be reserved.

6.3 Drainage Congestion and Water logging

Dhaka city has experienced significant urban growth during the last 50 years. The land use has undergone radical changes since 1971 when Dhaka became the capital of the new sovereign state of Bangladesh. Change in land use alters the physical characteristics of an area, which in turns brings changes in hydrological regime. A study by JICA (1987) observed that many portion of the major drainage Khals were subject to encroachment due to earth filling, deposition of city garbage and construction of building and roads. As a result, water logging has become a common phenomenon during monsoon.

The private residential land development companies (PRLDCs) to implement housing project in wetland areas with their own style ignoring the existing laws, restrictions, and even they are not sincere and co-operative with government agencies. They are always looking for loopholes and defaults of law/acts as well as the weakness of authorities. It is apprehended that such development in the long run not only contradictory to the recommendations made in the DMDP, the massive land is going to aggravate flood situation of the city. The present trends of residential land development in and around the city have posed environmental threat to the areas. The areas have been considered as reservoir for a long time where storm water of the city run off through internal Khals. The developing activities damage natural landscaping and changing the character of the areas. The urban upstream cannot discharge storm water adequately in the natural reservoir. During field survey the respondent were asked about whether facing water logging in the area where he lives. Out of the 390 respondents 388 (99.49%) respondents reply that they face water logging problem.

Khan (2001) observed the relationship between geomorphological setting and present water logging problems. The medium and lower Madhupur terrace units are more vulnerable to the present water logging situation. This is an indication of adverse effect of human interference over the landscape.

Table 6.5 Distribution of water logging affected areas per geomorphic unit

Geomorphic unit	Number of waterlog affected areas
High Madhupur Terrace	15
High and Medium Madhupur Terrace	8
Medium Madhupur Terrace	60
Medium and Low Madhupur Terrace	3
Lower Madhupur Terrace	22
Abandoned Channel	10
Old Natural Levee	0
Depression	12
Sandbar	0
Point Bar	2
Khal/ River	0
Active Natural Levee	3
Natural Levee (lower part)	15
Total	150

Source: Khan, 2001

The city is experiencing severe problem of rainfall flooding for the last few years. Moderate rainfall causes serious problems for some areas of city, namely Malibag, Mauchak, Modubag, Shantinagar, Rajarbag, Fakirapul, Rampura , MotiJheel, Badda , Mohammadpur etc. Drainage congestion results in local floods with ankle to knee- deep water on the streets. This water logging problem is creating environmental and health hazard in the city (Nishat, *et al.*, 2000).

Table 6.6 Average depth of water logging

Depth of water logging	Frequency	Percentage
Less than 1 foot	123	31.70
Less than 2 feet	230	59.28
Less than 3 feet	33	8.50
More	2	0.52
Total	388	100

Source: Field survey, 2009

Flooding in Dhaka city is aggravating and is attributed to the rigorous changes of land covers, particularly remarkable increase of urban areas. In 1988 the total flooded area was 47.1%, in 1998 the area was 53.2% and during the flood of 2004 it was 43% (Dewan, *et al.*, 2008).

Table 6.7 Inundation area percentage (%) in 1988, 1998 and 2004 floods

15 October, 1988	Dry Season		
	Water	Non-water	Total
Water	3.9	44.8	48.7
Non-water	1.0	50.3	51.3
Total	4.9	95.1	100
25 August, 1998	Dry Season		
	Water	Non-water	Total
Water	4.0	50.6	54.6
Non-water	0.9	44.5	45.4
Total	4.9	95.1	100
24 July, 2004	Dry Season		
	Water	Non-water	Total
Water	3.7	41.7	45.4
Non-water	1.1	53.5	54.6
Total	4.8	95.2	100

Source: Dewan, *et al.*, 2008

Unwise closure of natural and old artificial drainage and navigational canals has aggravated the situation. Main streets now go under a meter of water after every heavy monsoon shower (Islam, 2005).

Flooding and drainage problem will continue to pose a serious problem for the city in future. The condition is apprehended to further worsen due to the unplanned and often illegal earth filling of wetlands in and around the city by unscrupulous real estate companies (Islam, 2005).



Photograph 6.1 Water logging situation at Motijheel area in Dhaka city

Source: The Daily Star, July 05, 2008

The water logging problem has been getting worse since the eighties. During this period, Dhaka has experienced high rate of urban expansion both in horizontal and vertical direction in an unplanned and unregulated manner. On the other hand, uncontrolled land development in the low lying areas without following the appropriate planning standards and land use controls result in water logging problem in the higher terrace due to the obstruction and closure of the natural flow and disruption of the hydrological link between major and minor channels. Filling up the eighty percent low lying areas, water bodies in the capital by encroachers in the city, since those used to be the major channels for draining out rain water. The rivers around the city were also encroached upon over the years worsening the situation (The Daily Star, July 05, 2008).



Photograph 6.2 Water logging situation at Shantinagar area in Dhaka city

Source: The Daily Star, June 22, 2007

6.3.1 Peoples Perception on Interruption of Normal Life and Loss Due to Water logging

Water logging seriously hamper the city life. Respondent were asked whether they affect due to water logging, out of 390 respondents 388 respondents reply that by anyhow they affect due to water logging. It has direct impact on the urban poor, because the poor people generally live in low-lying and flood prone areas and slums. The rich people have the option to move to less flood prone areas or any suitable alternatives. But the poor people have no other alternatives; they have to stay within the aquatic environment with a miserable situation.

6.3.1.1 Hamper of Daily Life

Respondent were asked about hampering of daily work due to water logging. Around 96% respondents reply positively. Those who reply positively, they were asked which type of interruption they face. There were four possible answers and others option for this question. It appears that 38.93% respondents identify that it is difficult to go work places,

30.93% respondents identify not possible to move on foot and 14.13% respondents identify movement of vehicle disrupted (Table: 6.8). It is observed during field visit due to water logging problem heavy traffic congestion occurred on the streets of Dhaka city. Normal traffic movement hampered during rainfall over 25 mm and people lose their valuable time.

Table 6.8 Interruption of daily work

Categories	Frequency	Percentage
Hampered daily work		
Yes	375	96.6
No	13	3.4
Total	388	100.0
Types of interruption of daily work		
Not possible to move on foot	116	30.93
Shops remain close	52	13.87
Difficulty to go work places	146	38.93
Movement of vehicles disrupted	53	14.13
Others	8	2.14
Total	375	100.0

Source: Field survey, 2009



Photograph 6.3 Boats are being used as transport on road during waterlogged situation

Source: Rahman, *et al.*, 2005

6.3.1.2 Children's Problem

Figure 6.2 shows that about 76% respondents mention that their children get problem due to water logging. Four answers were placed to the respondent for this question. 58.3% respondent opine that it is difficult for the children to go to school and 30.8% respondent mention that rickshaw fair is high during water logging time.

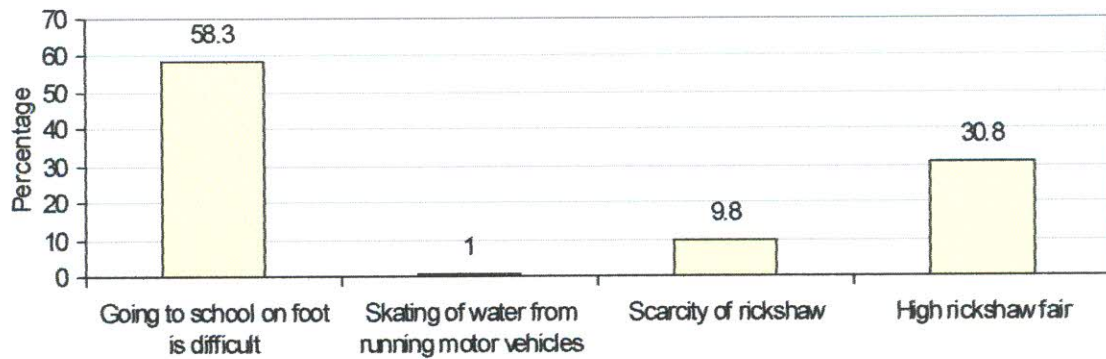


Figure 6.2 Children's problem due to water logging

Source: Field survey, 2009



Photograph 6.4 Showing the children's problem due to water logging

Source: The Daily Star, June 30, 2008

6.3.1.3 Disruption of Electricity

Sometimes electric poles become electrified due to water logging so that electric supply needs to disconnect for those areas. While any people coming in contact with the foundation of the electrified poles, accident occurs due to electric shock. Survey results reveals that 22.3% respondents experienced about the disruption of electricity. Out of them 72.4% respondents identify frequent power failure occur and 19.5% identify long time power failure as the types of disruption.

Table 6.9 Disruption of electricity due to water logging

Categories	Frequency	Percentage
Disruption of electricity during water logging		
Yes	87	22.3
No	303	77.7
Total	390	100.0
Types of disruption of electricity		
Frequent power failure	63	72.4
Long time power failure	17	19.5
Total disruption of power failure	7	8.0
Total	87	100.0

Source: Field survey, 2009



Photograph 6.5 Showing the waterlogged power grid

Source: Rahman *et al.*, 2005

6.3.1.4 Damage of Roads and Motor Running Problem

Water logging causes serious deterioration of road surface. Most of the city road surfaces are flexible bituminous. Logging of water over such roads reduce the adhesive quality of bitumen seriously and disintegrate the road cover. From field visit it has clearly seen that the quality of road surface deteriorated considerably after removal of water. Size of previous holes expanded, segregation of stone or brick, or break down of pavement at many places is seen. It needs a huge cost to replace these and increases the maintenance cost for the authority. Prolonged water logging damages the roads badly in the rainy season every year, which interrupts the movement and journey. Data show that maximum respondents (78.4%) support that water logging damage the roads. They were asked about the types of damage of road; of them 92.8% respondents opine that damage of carpeting occur, while around 6% opine to formation of galleys.

Respondents were also asked about the risk to run motor vehicles in water logging. Table 6.10 shows 85.82% respondents identify that it is dangerous to run motor vehicles in water logging, of them 207 respondents (62.2%) opine that ‘dropping in the manhole’ is the main risk to drive motor vehicle in water logging, while 18.6% mention stop engine due to water.

Table 6.10 Perception on damage of roads and motor running problem

Categories	Frequency	Percentage
Damage of roads due to water logging		
Yes	304	78.4
No	84	21.6
Total	388	100.0
Types of damage of roads		
Formation of galleys	18	5.9
Carpeting Damages	282	92.8
Others	4	1.3
Total	304	100.0
Whether it is dangerous to run motor vehicles in water logging		
Yes	333	85.82
No	55	14.18
Total	388	100
Types of risk to drive in water logging		
Stop engine due to water	62	18.6
Sits get wet	2	0.6
Struck in the galleys	62	18.6
Dropping into open manhole	207	62.2
Total	333	100.0

Source: Field survey, 2009



Photograph 6.6 Showing the motor running problem due to water logging

Source: The Daily Star, 29 July, 2008

6.3.1.5 Damage of Houses and Economical Loss

Water logging causes the damages of houses and other infrastructure. Sometimes water enters into the houses and the floor and wall remains wetted for a long period and it damages the household goods. The subsurface of the pucca houses in the low-lying areas remain underwater due to water logging. The brick foundations losses its longevity and being damping. In slums and low-income areas, most of the people are used to live in Katcha and vulnerable houses. These houses become badly damaged during period of water logging. Survey data reveals that 34% respondents claimed their house was damaged due to water logging. These respondents were asked about the amount of expenses for repair their damaged house. Of them 34.1% respondents claimed that they expend less than 2000 taka, while 32.6% reported 2001-4000 taka, 23.55% assert 4001-6000 taka and around 9% reply, they expend more than 6000 taka.

As a result of water logging lack of transportation, lower presence of workers disturb the industrial production system. Specially the small industries are the serious victim. As people movement reduced during waterlogged situation, transaction of trade and

commerce industries sharply reduce. Some market places also go under water and they cannot open their shops. Water logging hamper traffic movements therefore creates an obstacle for communication and timely supply of goods, which means the loss of time, reduced production and economic losses.

The respondents were also asked about any other losses they have to face due to water logging. Out of the 388 respondents, 92 respondents claimed that they faced other losses due to water logging. Of them 65.2% claimed that the amount of loss is 1500-3000 taka.

Table 6.11 Perception on damage of house and economical loss

Categories	Frequency	Percentage
Damage of house due to water logging		
Yes	132	34.0
No	256	66.0
Total	388	100.0
Amount of expenses for repair		
Up to 2000	45	34.1
2001 - 4000	43	32.6
4001 - 6000	31	23.5
6000 +	13	9.8
Total	132	100.0
Whether any other loss due to water logging		
Yes	92	23.7
No	296	76.3
Total	388	100.0
Amount of loss		
Up to 1500	14	15.2
1501 - 3000	60	65.2
3001 - 4500	6	6.5
4501 - 6000	8	8.7
6000 +	4	4.3
Total	92	100.0

Source: Field survey, 2009



Photograph 6.7 Ground floor of the house is waterlogged; caused damage and economical loss

Source: Rahman *et al.*, 2005

6.3.2 Health Related Problem Due to Water logging

6.3.2.1 Getting Drinking Water Problem

Contamination of drinking water supply is another problem caused by water logging. Though the water supply pipes of Dhaka WASA are sealed against any kind of contamination to enter, still through leaks and some underground storage tank water becomes contaminated in many places.

During field survey the respondent were asked about whether they face problem in getting drinking water. 59% respondent replies that they face drinking water problem during water logging. They were again asked about the types of problem they face, in reply of this question 69% respondent assert that 'supplied water is dirty', while 17% report 'water is not available when needed' and 14% identify that 'water becomes less'.

Table 6.12 Perception on getting drinking water problem

Categories	Frequency	Percentage
Whether the respondent face problem in getting drinking water		
Yes	229	59.0
No	159	41.0
Total	388	100.0
Types of problem faced collecting drinking water		
Water becomes less	32	14.0
Water is not available when needed	39	17.0
Supplied water (from WASA) is dirty	158	69.0
Total	229	100.0

Source: Field survey, 2009

6.3.2.2 Sanitation and Unhygienic Problem

Most of the sewer system i.e. one waterline collect both storm and domestic sewage. Due to excess storm water pressure, they try to overflow through manholes, where most of them have no cover at all. So the logged water around is actually nothing but highly polluted sewer and drain water. It is unthinkable about using this water; even walking through such water may cause skin diseases to people.

Where the water forms stagnant pools, it becomes a breeding site of for mosquitoes. Flooded septic tanks and leach pits also provide breeding sites for mosquitoes. Dhaka city is suffering a lot from tremendous increase of mosquitoes and its associated disease vectors, which is ultimate result of water logging. During field survey respondent were asked whether they face any sanitation problem due to water logging. Out of 388 respondents 122 (31.4%) identify that they face sanitation problem. About the types of sanitation problem, 67.2% of the above mentioned respondents opine that 'toilet overflowing' problem, while 7.45% assert 'toilet's waste floats on water' and 25.4% identify 'toilet sunk under logged water'. Respondent were also asked about the types of unhygienic situations that created during water logging time. Table 6.13 shows that 38.4% respondents identify that mosquito increases during this time, while 25.5% report spread odor, 1.5% mention kitchen waste floats on water and 34.5% identify waste of open drainage floats on water.

Table 6.13 Sanitation and Unhygienic Problems Due to water logging

Categories	Frequency	Percentage
Whether the respondent face any sanitation problem		
Yes	122	31.4
No	266	68.6
Total	388	100.0
Types of sanitation problem		
Toilet Overflowing	82	67.2
Toilet's waste floats on water	9	7.4
Toilet sunk under logged water	31	25.4
Total	122	100.0
Unhygienic situations that created by water logging		
Mosquito Increase	149	38.4
Spread odor	99	25.5
Kitchen waste floats on water	6	1.5
Waste of open drainage floats on water	134	34.5
Total	388	100.0

Source: Field survey, 2009

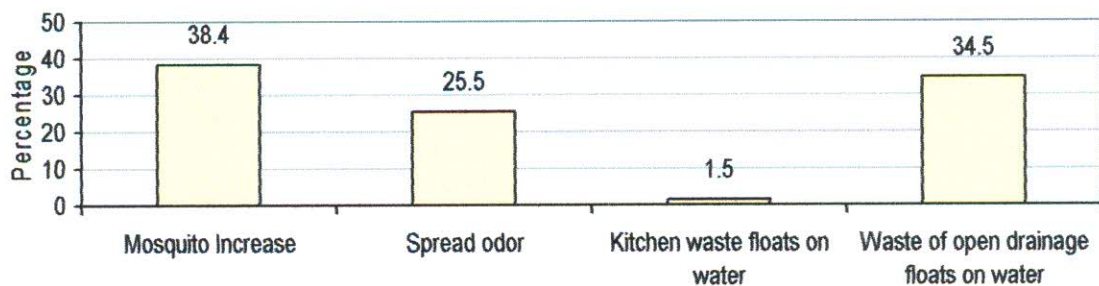


Figure 6.3 Unhygienic situations that created by water logging

Source: Field survey, 2009

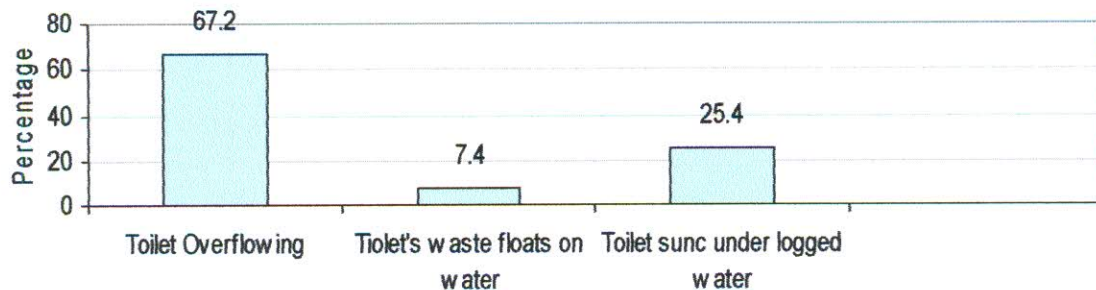


Figure 6.4 Types of sanitation problem caused by water logging

Source: Field survey, 2009

6.3.2.3 Suffering from Diseases Due to Water logging

Table 6.14 show that out of 388 respondents, 233 (60.1%) respondents identify that they suffer from disease due to water logging. It appears from their responses that 69.5%, 0.9%, 16.7%, 8.2%, and 3.9% respondents are suffer from Diarrhoea, Malaria, Skin Disease, Dysentery and Typhoid respectively (Figure: 6.5). Among their identification Diarrhoea and Skin Disease are in leading position. Diarrhoea stands first position.

Respondents were asked from where they received treatment. 65.2% respondents report that they receive treatment from doctor's chamber, 0.9% from clinic, 6.4% from hospital and 27.5% in home (Figure: 6.6). Respondents were also asked about the amount of money they expend for treatment. Survey results reveal that, 47.2% assert that they spend up to 500 taka, while 47.6% expend 501-1000 taka, 1.7% expend 1001-1500 taka, around 0.9% expend 1501-2000 taka and 2.6% expend more than 2000 taka.

Table 6.14 Perception about suffering from diseases

Categories	Frequency	Percentage
Whether suffered from diseases during water logging		
Yes	233	60.1
No	155	39.9
Total	388	100.0
Amount of money spend for treatment		
Up to 500	110	47.2
501 - 1000	111	47.6
1001 - 1500	4	1.7
1501 - 2000	2	.9
2000 +	6	2.6
Total	233	100.0

Source: Field survey, 2009

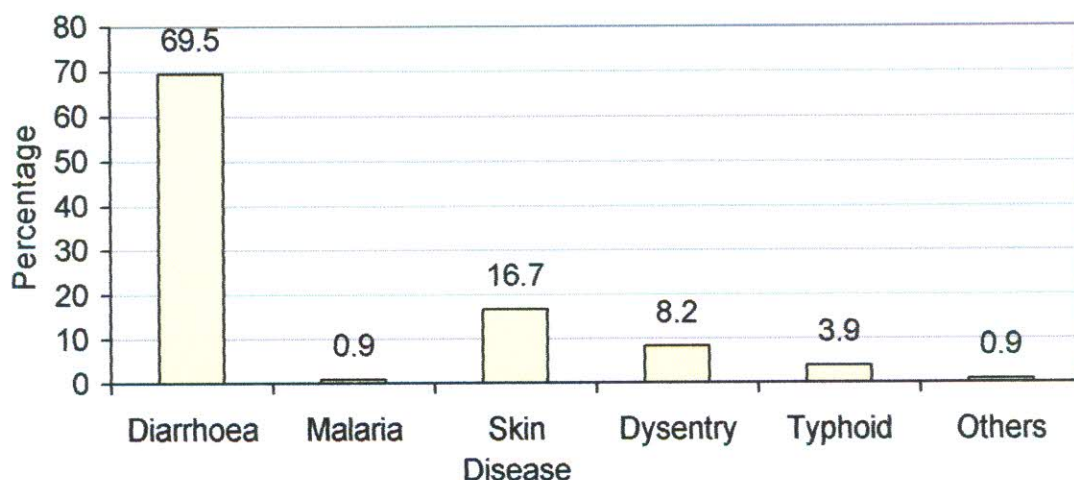


Figure 6.5 Types of diseases suffered during water logging

Source: Field Survey, 2009

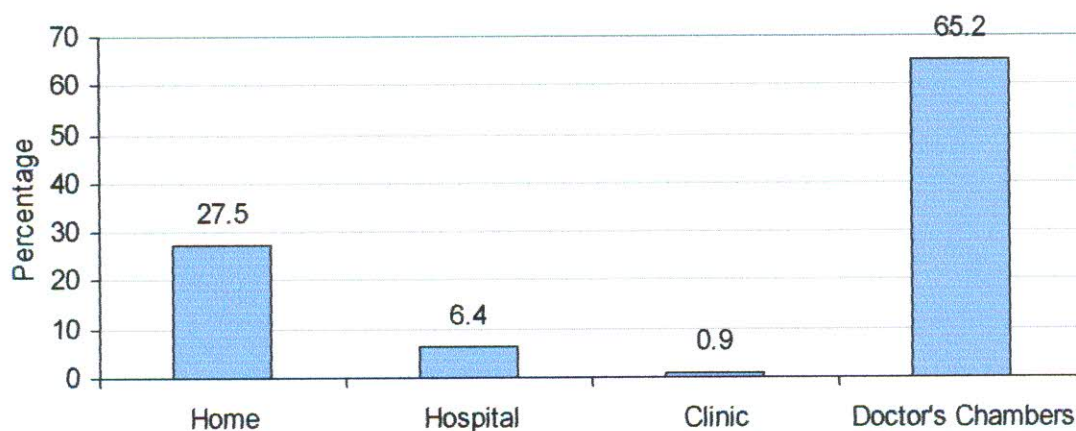


Figure 6.6 Place of treatment during suffering from diseases

Source: Field Survey, 2009

6.3.3 Perception Regarding Mitigation of the Problems

During field survey respondent were asked how they meet the problems during water logging time. Regarding drinking water problem, 76.5% respondents opine that they meet this problem with boiled water, while 14.2% reply they bring water from another area and 5.9% mention that they buy bottle water. In reply of the question whether the respondent take any help during water logging. Out of 388 respondent 122 respondent reply that they take help during water logging.

Table 6.15 Opinion of the respondents regarding mitigation of the problems

Categories	Frequency	Percentage
Meeting the drinking water problem		
Drink Boiled Water	297	76.5
Bring water from another area	55	14.2
Buy bottle water	23	5.9
Others	13	3.4
Total	388	100.0
Whether the respondent take help during water logging		
Yes	122	31.4
No	266	68.6
Total	388	100.0
Sources of help		
Govt. Organization	3	2.5
NGO	2	1.6
Relatives	5	4.1
Neighbour	110	90.2
Others	2	1.6
Total	122	100.0
Types of help		
Living	33	27.0
Food	76	62.3
Medicine	10	8.2
Above All	3	2.5
Total	122	100.0

Source: Field Survey, 2009

These respondents were also asked about the source and categories of help that they take during water logging time. 90.2% respondents opine that they take help from the neighbor (Table 6.15). About kind of help, 62.3% respondent reveal that they take only food as help, while 27% mention that they take living facility, 8.2% report that they need only medicine and 2.5% respondent opine that they take all of the above mentioned help.

6.3.4 Government Steps to Overcome the Water logging Problem

Respondent were asked whether government has taken any step to curb the water logging problem of Dhaka city. Out of 388 respondents only 80(20.6%) respondent viewed that government has taken step to curb the water logging problem. These respondents (20.6%)

were also asked about the types of steps taken by the Government. In reply, 23.7% respondents mentioned that number of sluice gates increased, 22.5% viewed that engaged pumps to drain out the logged water and 47.5% stated that re-excavated the encroached natural drainage channel.

Table 6.16 Steps taken and should be taken by the Government to overcome the water logging problem

Categories	Frequency	Percentage
Whether there is any step taken by the govt.		
Yes	80	20.6
No	308	79.4
Total	388	100.0
Steps taken by the govt.		
Number of sluice gates has been increased	19	23.7
Engaging pump to drain logged water out the logged water	18	22.5
Re-excavated the encroached natural drainage channel	38	47.5
Others	5	6.3
Total	80	100.0
Measures should be taken to overcome the water logging problem		
Give more attention on natural storm water drainage system	65	16.7
Remove all illegal structure from the water bodies	220	56.7
Prepare water retention pond	29	7.5
Control disposal of waste in natural drainage channels	69	17.8
Others	5	1.3
Total	388	100.0

Source: Field Survey, 2009

This was asked to the respondent what types of measures should be taken by the government to overcome the water logging problem. Maximum respondents (56.7%) opined to remove all illegal structure from the water bodies, 17.8% respondent viewed to control disposal of waste in natural drainage channels and 16.7% respondent cited to give more attention on natural storm water drainage system.

Chapter 7

Wetland Management and Government Policy

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Wetland Management and Government Policy

The present wetland management practices of the public agencies are not at all inclusive. The existing acts/laws of different agencies remain, as management tools, which are not exercised properly in the areas. Overlapping of functions among the agencies creates conflicts in management and controls. This chapter analyses this issue, the management drawbacks of public sector, loopholes of the government laws and acts and role of environmental groups in this regard. Coordination among the public agencies and their management system are ineffective because most agencies implement their programmes in their own way. The effective control in the city area is not possible due to lack of coordination among the city development agencies.

7.1 Land Rights/Land Ownership

Nothing perhaps is closer and more fundamental to the requirements of human survival than land. Expanding urbanization and conversion of agricultural land and wetland to non-agricultural purposes for social requirements have the effects of reducing the total area of agriculture and wetland. Traditional laws on land ownership have signally failed to cope with the ever-increasing requirements food and employment to the people.

Land reforms in any predominantly agriculture country like Bangladesh is a complex issue. Ownership of land determines the status of an individual in the society. The land rich people enjoy political power and exert considerable social influence. The urban elites also are in many cases land-rich people. They have very little relationship with productive processes and enjoy unearned income sitting in urban areas. Land reforms are, therefore, imperative for ensuring social justice and are largely dependent upon political will for their successful implementation (GOB, 1989).

The State Acquisition and Tenancy Act, 1950 imposed for the first time in the history of tenurial legislation in this country, a ceiling on the ownership of agricultural land. It did not however envisage a similar ceiling on the ownership of urban land. As a result of

rapid urbanization and migration of people from rural to urban areas, the demand for, and the value of, land in urban areas especially in the cities, have increased tremendously and are continually on the rise. The urban rich find it more profitable to invest in the land rather than in the commercial or industrial ventures. In order to ensure social justice, reduction in the income disparity and to discourage speculation in land and unearned income, the government has decided in principle to impose a ceiling on ownership of land in cities, municipal towns and other urban areas in the country.

Preparation of the record of rights is an important aspect of land right and land ownership. There are two parts in the preparation of the record of rights. The first part is to draw a revised mouza map showing changes in location area and characteristics of land. The second part is to prepare the Khatian (cadastre) indicating the ownership, area and character of land. These two parts together are called the record of rights. The phases followed in the survey and preparation of record of rights are traverse survey, plot to plot survey or Kistwar, demarcation of boundary, Khanapury (preliminary record writing), Bujharat (local explanation), attestation, draft publication, hearing of objections, appeal, final Junch (checking), printing and publication of Khatian. At present the landowner is heard individually when survey is conducted and records are prepared. There is as yet no scope for involvement if people's organizations/farmer's organizations/local government organizations and NGOs (Siddique, 1997). Various donor agencies like UNDP and ADB are now involved in the land records modernization efforts in Bangladesh but there is little initiative and innovation from within.

Land records are managed by both the Collectorate setup and the DLRS. Land records are prepared by the DLRS and then they are handed over to the Collector (DC) and Thana and union land offices for land management. These records are partially kept updated as a consequence of sale and transfer through the mutation process. If the land records could be fully updated by the Collectorate officials, there would be no requirement for revisional settlement. Efforts have been made to develop a linkage between the activities of the DLRS and the Collectorate setup at the Thana level, but with little results so far.

At present the common man does not have access to information on land records are maintained in the Union Land Office. Though they have different registers with different kinds of information, the common people are not allowed to look at these registers. However, on payment of a small fee, the common man gets a certified copy of the ROR and Mouza map. Although the laid down procedure for these is simple, in reality both time and “extra money” are needed to obtain these.

One fundamental aspect of land registration in Bangladesh is that it does not prove title. It is merely the record of an isolated transaction. It only shows that a particular transaction took place but it does not establish whether the parties are legally entitled to enter into such a transaction. It may not be consistent with a previously registered transaction. In other words registration takes place without any critical examination of relevant records (Siddique, 1997). As the Sub register’s offices are under the Ministry of Law, Justice and Parliamentary affairs and the AC (Land) works under the Ministry of Land, interchangeability between these two posts in terms of transfer and posting is not possible unless the two posts are brought under the ministry of Land. This would require the reorganization of the department of Registration.

There are instances of false registration in both urban and rural areas. The incidence of false registration is much higher in the urban areas. One plot of land is sold to different people and this leads to litigation. This happens particularly in places where the land value is high. False registration is also done for obtaining ex-parte decrees from the civil courts. When the deed is placed for registration, it should contain necessary information on ownership, location of plots, etc. authenticated by the AC (Land). This will reduce false registration. At present the common people do not have any access to information maintained by the Sub-Register’s Office. If they would like to have a copy of their registered land they have to spend a significant amount of money for that purpose.

There are two ways a mutation process can start, namely mutation according to the land transfer (LT) and mutation in response to application. The updating of records of rights is also done during the settlement operation. When there is no settlement operation, this is done by the AC (Land) under section 143 of the East Bengal State Acquisition and Tenancy Act, 1950 on receipt of an application from the tenants. The general public do

not have access to information on mutation. The people are generally illiterate, and revenue officials are also difficult to deal with. On payment of a prescribed fee, information on a particular parcel of land is supposed to be made available to them. However, in practice, 'extras' have to be spent. The land offices are noted for inefficiency and corruption. As the land records are not updated, there is scope for creating confusion, which leads to corrupt practices.

The existing legal provision particularly of the East Bengal State Acquisition and Tenancy Act, 1950 and the Land Acquisition Ordinance have to be amended to protect land from going over to speculative and unplanned uses and provisions regarding transfer of land and right of preemption have to rigidly enforced.

7.2 Organizations Involved in Wetland Management

Organizations Involved in Wetland Management in Bangladesh

Many institutions, both formal and informal, influence the wetland ecosystem of the country. They also impacts resource utilization, which ultimately influences the wetlands of the country (Huq, 1993). The following organizations are involved in the wetland management in Bangladesh.

Government Agencies

- Ministry of Environment and Forest
- Ministry of Land
- Bangladesh Water Development Board
- Space Research and Remote Sensing Organization
- Department of Environment
- Department of Forest
- Department of Fisheries
- Flood Plan Coordination Organization

Non- government Organizations

National NGOs

- Bangladesh Centre for Advanced Studies
- Nature Conservation Movement
- Centre for Natural Resource Studies

International NGOs

- Asian Wetland Bureau
- International Waterfowl and Wetland Research Bureau
- International Union for Conservation of Nature and Natural Resource

Organizations Involved in Wetland Management in Dhaka city

Wetland management in Dhaka city is cross-related with the functions of some ministries and departments. The ministries, which relate to urban wetland management in different ways, are Ministry of Land, Ministry of Environment and Forest, Local Government Division, Ministry of Water Resources and Ministry of Shipping.

The responsible department and/organization under the above mentioned ministries are Rajdhani Unnayan Kartripakkha (RAJUK), Dhaka Water Supply and Sewerage Authority (DWASA), Dhaka City Corporation (DCC), Bangladesh Inland Water Transport Authority (BIWTA) and Bangladesh Water Development Board (DWDB) and Deputy Commissioner Office, Dhaka. Among them RAJUK, DWASA, DOE and BIWTA are directly related to wetland management.

RAJUK: RAJUK used to be the paramount land development agency in the public sector. It started its journey as the Dhaka Improvement Trust (DIT) in 1956 as a regulatory and supervisory body in the planning and development of Dhaka and is still continuing with this role.

The growth of Dhaka was attempted to be brought under a Master Plan in 1959 covering an area of about 829 sq. km. However, its purpose and scope were rendered inadequate in the context of political and socio-economic changes since 1971 (Islam, 2005). Then to face the challenge of the mitigating the problem, a project was undertaken known as Dhaka Metropolitan Development Plan, DMDP (1995-2015). The plan was supposed to be presented as three components, namely (a) The Structure Plan, covering the entire planning region (b) The Urban Area Plan covering the present built up area and (c) The Detailed Area Plan (DAPs). The DAPs should have been complemented along with two other plans because without DAPs implementation of the Master Plan would not be possible. DAPs is now at final stage. Much physical expansion and urban development have taken place without planning. RAJUK has neither enough planners nor institutional

arrangements to promote a planned development of Dhaka. The existing organization setup in the RAJUK is weak in terms of plan preparation, development and development control. This organization is having poor technical manpower and logistic support. Specially the manpower, to oversee the in-filed development of the city. To carry put these tasks properly more professionals and planners are needed. The RAJUK deserves full technical supports like GIS and MIS labs; unfortunately which is unavailable at present. Now the RAJUK is trying to set up these modern equipments for proper planning. Most parts of Dhaka have been built informally by individuals without any planning guideline.

DWASA

Dhaka Water and Sewerage Authority (DWASA) was created in 1963. In 1989, the drainage circle of Bangladesh Public Engineering Department was handed over to DWASA with staff and resources. This authority is main concerned about to supply water, drainage and sewerage within city areas. This authority is also responsible for the management and preservation of canals to discharge storm water. The common operations for the preservation of canals by WASA are:

- Cleaning activities of the box culverts that are set up at the different place of the city.
- Cleaning activities of surface drains and storm sewerage lines.
- Demolish illegal structure in and around the canals.
- Conducting surveys to demarcate land of the canals and recover them from the grabbers to facilitate its natural flow during the rainy season.

Lack of funds had slowed down the implementation of DWASA projects to expand and improve drainage system of the city. DWASA often conducts surveys to demarcate land of the canals and recover them from the grabbers to facilitate its natural flow during the rainy season. But the grabbers again encroach the canal.

DOE

The mandate of the Department of Environment is, broadly, to ensure conservation of the environment, improvement of the environmental standards and control as well as mitigation of environmental pollution as has been provided for in the Bangladesh Environment Conservation Act, 1995. The mandate of the department has expanded over

time, evolving from an exclusive focus on pollution control to intensive action-oriented responsibilities of management of still broader environmental areas comprising the various ecosystems and natural resources. Given the mandate as embodied in the Environment Policy 1992, The Environment Conservation Act 1995, the Environment Conservation Rules 1997 DOE is being guided by following ten operating principles: (a) Sharing responsibility for environmental management with all Bangladeshis and other government agencies (b) Serving as a catalyst for environmental action (c) Leading by example (d) Focusing on result (e) Seeking cost effective solutions (f) Promoting locally developed technologies (g) Safeguarding Bangladesh's interests while collaborating in international forums (h) Honest, open and creative communication (i) Working collaboratively in teams while respecting the views, knowledge and skills of individuals; and (j) Creating opportunities for all staff, with gender equity, and ensuring all are equipped with the skills they need (DOE, 2006). The key word point to an active role of DOE in solving environmental problems with public involvement and support through enforcement of the environmental laws and regulations and their compliance. In reality DOE measures are inadequate to protect polluting activities and insufficient enforcement of relevant policies, acts and guidelines. The DOE is presently weak by technicalities like shortage technical manpower and equipments. The building capacity of DOE and financial strengthening are not up to the mark. Recently an amended table of organogram and equipment (TO&E) has placed by DOE, which is under process for approval.

7.2.1 Development Activities and Existing Management

Development agencies like the RAJUK, RHD, DWASA, DOE and DCC are responsible for regulating development activities. The existing wetlands are gradually being filled up as well as obstructed by road constructions; as a result the canal and channel networks are drying up. At the same time, the PLDCs are forcing drastic reduction in wetlands by unregulated land filling and encroachment activities without paying attention to their drainage network. Therefore, the scope becomes limited gradually to retain storm and flood water.

The public agencies involved in city development has short, medium and long term development programmes and they are implementing those programmes in phases ignoring the programmes of other agencies. In the development process, coordination is

very weak in the area of infrastructure development. Overlapping and conflicting activities among the agencies are the most common phenomenon.

From the management perspective, the DWASA associated with BWDB, DC Office, Dhaka, RAJUK and DOE are directly or indirectly responsible for making the area sustainable where canal and drainage must be active. Under these circumstances, some agencies feel their importance, but they don't take any coordinated action in this regard. RAJUK, DWASA, DC office and DOE are taking isolated measures against the illegal activities. Moreover most of these agencies have resource constraints and shortage of technicalities. As a matter of fact, the wetland management claims a comprehensive conservation and restoration of these water bodies in the past and current development and modification of wetlands has greatly reduced their former extent.

7.2.2 Overlapping and Conflicts Among Agencies

The present programmes and responsibilities of concern public agencies are not coordinated, rather isolated, and therefore widely criticized. The RAJUK is responsible for planning, development and development control of the city areas. At the same time, the DCC can design plan within its jurisdiction. There is a major overlapping in functions. The DWASA holds the mandate to provide water supply, drainage and sewerage and control of water logging or internal flooding. BWDB is liable to construction of embankment and control the external flooding in the city. The advantage and disadvantage of construction of embankment is debatable but conflicts arise among the control of internal and external flooding activities. The MoL, and D.C office, Dhaka are authorized maintaining the records of land ownership, *khas* land, acquisition of land for different organizations development work. These offices also hold the authority to lease out *khas* lands and exchange deed with public companies or individuals. They are not encouraged in updating land records due to shortage of manpower and absence of modern management system, which creates a lot of ambiguities in land records. It has been observed that as the number of these institutions grew, confusion over levels of authority, overlapping responsibilities and conflicts grew parallel. The overlapping and conflicts areas of major public agencies in the Dhaka city are shown in the following table:

Table 7.1 Overlapping among agencies and conflict in the study area

Agencies / Organizations	Overlapping/conflicting areas
Ministry of Land (MoL)	All land records of the study area including government <i>khas</i> land record is maintained and land acquisition is done by Deputy Commissioner office, Dhaka, in the study area. Ministry of land is here supervising authority. Confusion arises when RAJUK and other agencies issues clearance and development permission within the acquired land or <i>khas</i> land without consultation with the Deputy Commissioner office, Dhaka or Ministry of Land.
RAJUK	Wetlands are not yet earmarked on mouza map (scale: 1: 3960). On the other hand C.S; R.S and S.A map are maintained and updated by DGLR and Deputy Commissioner office, Dhaka. Due to the absence of clear identification of wetlands or government <i>khas</i> land, RAJUK faces difficulties to prepare DAPs and issuing planning permission.
DWASA	Canals (Khals) are maintained by DWASA for the operation of storm water drainage and remove waterlogging. On the other hand waste management is conducted by DCC. There is a conflict to clean the garbage from the canal in the study area. Sometimes permission for own departmental developmental works by the WASA creates conflicts with land use provision and infrastructure proposal of DMDP.
DCC	DCC has the provision to drawn up Master Plan of an area of the Dhaka city within its jurisdiction. At the same time RAJUK implements its development activities according to DMDP. DCC is within the DMDP, obviously their raised conflicts among the development plan of both agencies.
DOE	DOE is responsible for preparation of environmental plan, its implementation, monitoring, review of feedback. DOE is final authority to approve the EIA. The public agencies are doing their activities, such as, canal excavation / re- excavation, construction of embankment in their own departmental ways. In many cases these creates conflicts. On the other hand development activities of both private sector and public sector are not guided by environmental planning and there is no control of DOE in many cases.
BWDB	BWDB is responsible for preparation of embankment for flood protection in the study area. BWDB has constructed an embankment in the western part of Dhaka city and proposed another embankment in the eastern part of the city. Different question raised about the negative environmental impact of western part embankment. The questioned are raised because absence of coordination, harmony of land uses, proper drainage planning and lack of proper EIA.

Source: Prepared by researcher

7.3 Existing Policies, Laws and Regulations

The foundation of Bangladesh's environmental law can be traced back to that British laid legal system. Farooque and Hasan (1998) observe that the statutory laws prevailing in Bangladesh have about 185 laws deal with or have relevance to environmental issues. The statutory laws (laws enacted by the parliament) and by- laws (rules regulation etc, promulgated by the concerned authorities under the provision of the statutory laws) are the main source of environmental legislation. The statutory laws, which are bearing environment directly, indirectly and casually. These laws provide measures relevant for environment conservation, offer protection against various environmental offences and prescribing or prohibiting certain activities, lay down rights and duties. A great bulk of these environmental legislation were existent in the country right from the 19th century although they remained either uninformed to a large extent due to several factors. Law enforcement activities from the public sector and their performances are weak and ineffective. It is observed that each agency / organization carries their programmes within their institutional framework. In the process, implementation of some functions is overlapped among the agencies.

7.3.1 National Level Frameworks

Protection of right to life and personal liberty as a fundamental right to life is ensured by the constitution of Bangladesh (Article 31 and 32). But the fundamental rights, the preamble or the state policies in Bangladeshi Constitution do not expressly mention any right to healthy and clean environment. Most of the environmental cases are in the form of writ petitions covered by article 102 of the constitution and the court extended the meaning of "person aggrieved" in a way favorable to people not technically aggrieved (Razzaque, 2000). The Judiciary applied internationally recognized environmental concepts such as sustainable development, intergenerational equity and precautionary principle in the national court.

National Environment Management Action Plan, 1995

The National Environment Management Action Plan or NEMAP is a plan of the Government of Bangladesh prepared by the Ministry of Environment and Forest in consultation with people from all walks of life. An environmental concerns encompass all sectors of the economy multi- disciplinary approaches are therefore needed for the

formulation of policies and implementation of programmes related to environmental issues. NEMAP was prepared by the Government of Bangladesh to be the base for programmes and interventions aimed at promoting better resource management, making people aware of environmental problems and reversing the present trend toward environmental degradation. NEMAP constitutes a synthesis of the perception of the government and the people of Bangladesh regarding environmental issues and what needs to be done to deal with them (GOB, 1995).

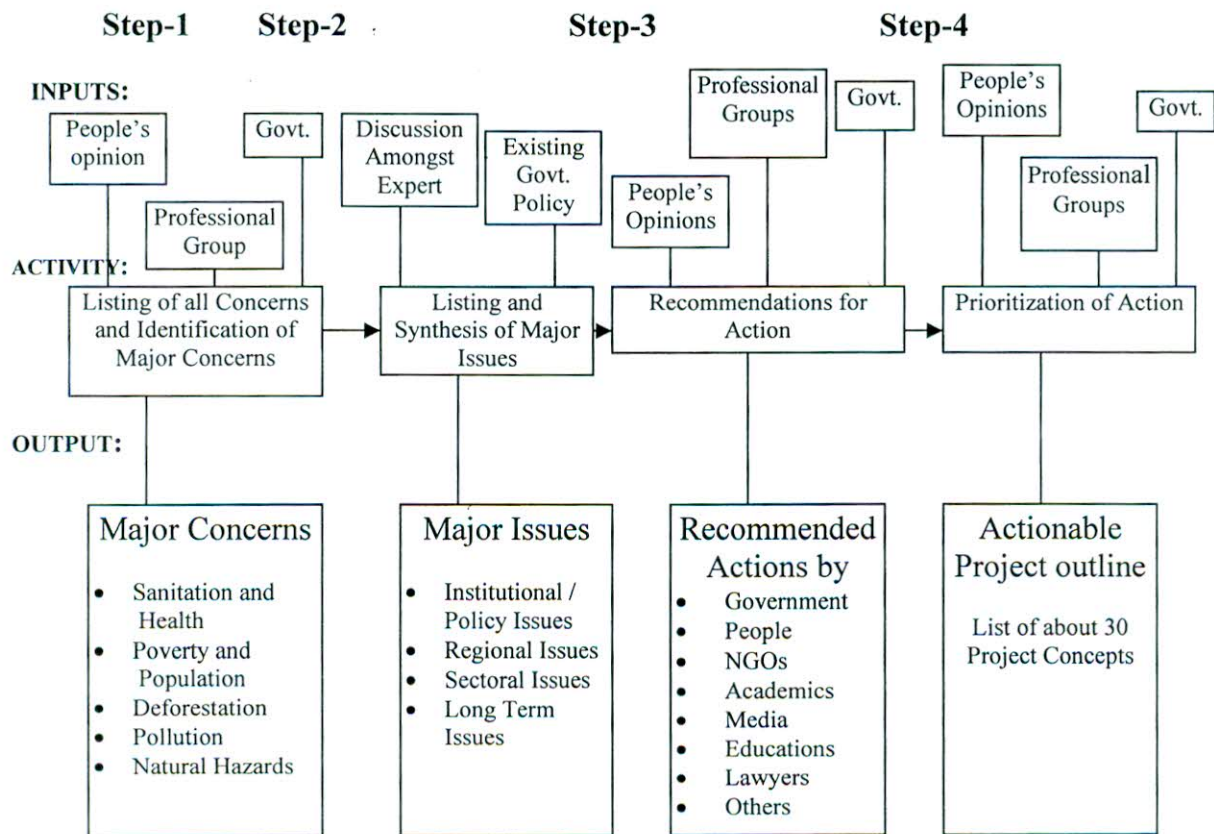


Figure 7.1 Steps of the preparation of action plan of NEMAP.

Source: GOB, 1995

NEMAP has grouped all the relevant necessary actions under four heads: institutional, sectoral, location- specific and long-term issues.

The institutional aspect reflects the need of inter-sectoral cooperation to tackle environmental problems that need new and appropriate institutional mechanisms at national and local levels. The sectoral aspects reflect the way of Ministries and agencies are organized and make it easier to identify the agency to carry out the recommended actions.

The location-specific aspect focuses on particularly acute environmental problems at local levels that need to be addressed on a priority basis. The long-term issues include environmental degradation of such degree that it might become more serious and threatening than they seem to be if their cognizance is not immediately taken (DOE, 2006).

In NEMAP wetland issues has illustrated as follows:

The reduction of wetland is one of the marked features of environmental degradation in Bangladesh. The reduction has been partly due to natural causes, partly due to human interference and partly to a combination of both (GOB, 1995).

Key issues:

- Reduction of wetland area
- Loss of wetland biodiversity
- Lack of integrated wetland management policy

Recommended actions:

- Wetland management plan incorporating
- Biodiversity conservation
- Development of comprehensive wetland policy

In practice, very few of the guidelines mentioned in the National Environment Management Action Plan have been implemented.

The National Environment Policy, 1992

The National Environment Policy sets the policy framework for environmental action in combination with a set of local sectoral guidelines. The objectives of The National Environment Policy, which are related to wetland management, are:

- Identification and control of all types of activities related to pollution and degradation of environment.
- Maintaining ecological balance and ensuring sustainable development of the country through protection and conservation of the environment.
- Environmentally sound development in all sectors.
- Sustainable long- term and environmentally congenial utilization of all natural resources.
- Maintaining active association, as far as possible, with all international initiatives related to environment.

The Policy details various specific policies and principle of their implementation for various sectors. It also provides for an environmental action plan toward ensuring its goals and objectives (DOE, 2006).

The Policy, which are directly or indirectly related to wetland management are:

- Keep the rivers, canals, ponds, lakes, *haors*, *baors* and all other water bodies and water resources free from pollution.
- Conduct Environmental Impact Assessment before undertaking projects for water resources development and management.
- Integrate environmental considerations into all housing and urban activities and research.
- Control housing and urban development schemes having adverse impact on the local and overall environment.
- Focus greater importance on the role of water bodies in enhancing beautification of the cities.

The National Water Policy, 1999

The government of Bangladesh has undertaken the water policy in order to manage the water resources of the country in a comprehensive, integrated, and equitable manner. The objectives of the water policy aim:

- (a) To address issues related to harness and develop all forms of surface water (more emphasis on wetland), and ground water and management of these resources in an efficient and equitable manner,
- (b) To ensure the availability of water to all elements of the society,
- (c) To accelerate the sustainable public and private water delivery systems with appropriate legal and financial measures and incentives,
- (d) To bring institutional changes that will help decentralize the management of water resources and enhance the role of woman in water management,
- (e) To develop a legal and regulatory environment for decentralization, sound environmental management, and improving the investment climate for the private sector in water development and management, and
- (f) To develop a state of knowledge and capability which will enable the country to design future water resources management plans with economic efficiency, gender

equity, social justice and environmental awareness to facilitate achievement of the water management objectives through active public participation (Ahmad, 2000).

With over 50 clauses of relevance to the environment, the 1999 National Water Policy forms a comprehensive framework for ensuring activities in the water resources sector are fully environment friendly. Compliance with the policy will ensure that the development and management of the nation water resource include protection, restoration, preservation of natural habitats and their dependent bio- diversity and water quality. Specific provision includes:

- Protection, restoration and enhancement of the water resources;
- Protection of water quality, including strengthening of the regulation concerning agrochemicals and industrial effluent monitoring;
- Facilitation of potable water and sanitation provision;
- Participation local communities are a requirement for all water sector development as a subject to an environmental assessment procedure and for the planning and management process (UNEP, 2001).

It is envisaged that, by the year 2025, Bangladesh's water sector management will incorporate the wetland related environmental goals, such as, (a) to restore and enhance Ramsar designated wetlands and other wetlands from degradation. (b) to protect river from encroachment. (c) to make sure that effluent treatment becomes an integral part of all industrial processes (Ahmad, 2000).

The National Housing Policy 1993 (Amended 1999)

The key strategies of the policy are

- The role of government in housing will primarily be to increase access to land, infrastructure, services and credit facilities for all especially to the low and middle income group;
- The private sector would be encouraged through policies and supply of more housing units in the market for all income groups and the public sector would take facilitator's role;
- Improvement of the existing housing stock, both in public and private sectors;
- Emphasis will be laid on affordability, personal savings, self-help and cost effectiveness etc.

Recently, the Bangladesh National Housing Authority has taken the initiative to revise the existing housing policy.

Draft Land Use Policy

The Ministry of Land has taken the initiative and prepared a draft land use policy for Bangladesh (UNEP, 2001). Salient features of the draft land use policy are as follows:

- Agriculture land should be used as per national agriculture policy. In case of unavailability of land for non-agricultural uses, less productive can be acquired.
- Extensive reforestation is needed to enhance the overall environmental condition of the country.
- Unplanned rural settlement should be addressed by introducing a comprehensive housing policy, incorporating city corporation and metropolitan areas. Land acquired by the Bangladesh Small and Cottage Industries Corporation (BSCIC) should be used properly and new industry should be discouraged within a range of 10 km.
- Highlights the importance of wetlands

Government land and administration concerning the ownership, tenure and transfer of lands defines and protects the private property right in land. Property taxation and land use regulation are therefore part of the framework for the operation of the private sector in urban land.

Government activities and involvement, together with private sector initiatives, create the urban land use pattern. These government activities are usually not directed or coordinated toward land use objectives because decisions come from different authorities and departments, each with their own outlook and interest. In many cases activities of different departments are inconsistent.

The key objectives of urban land policy are:

- To provide a basis to improve the operation of the government sector in the development and use of urban land.
- To improve the operation of the private sector in the development and use of urban land.

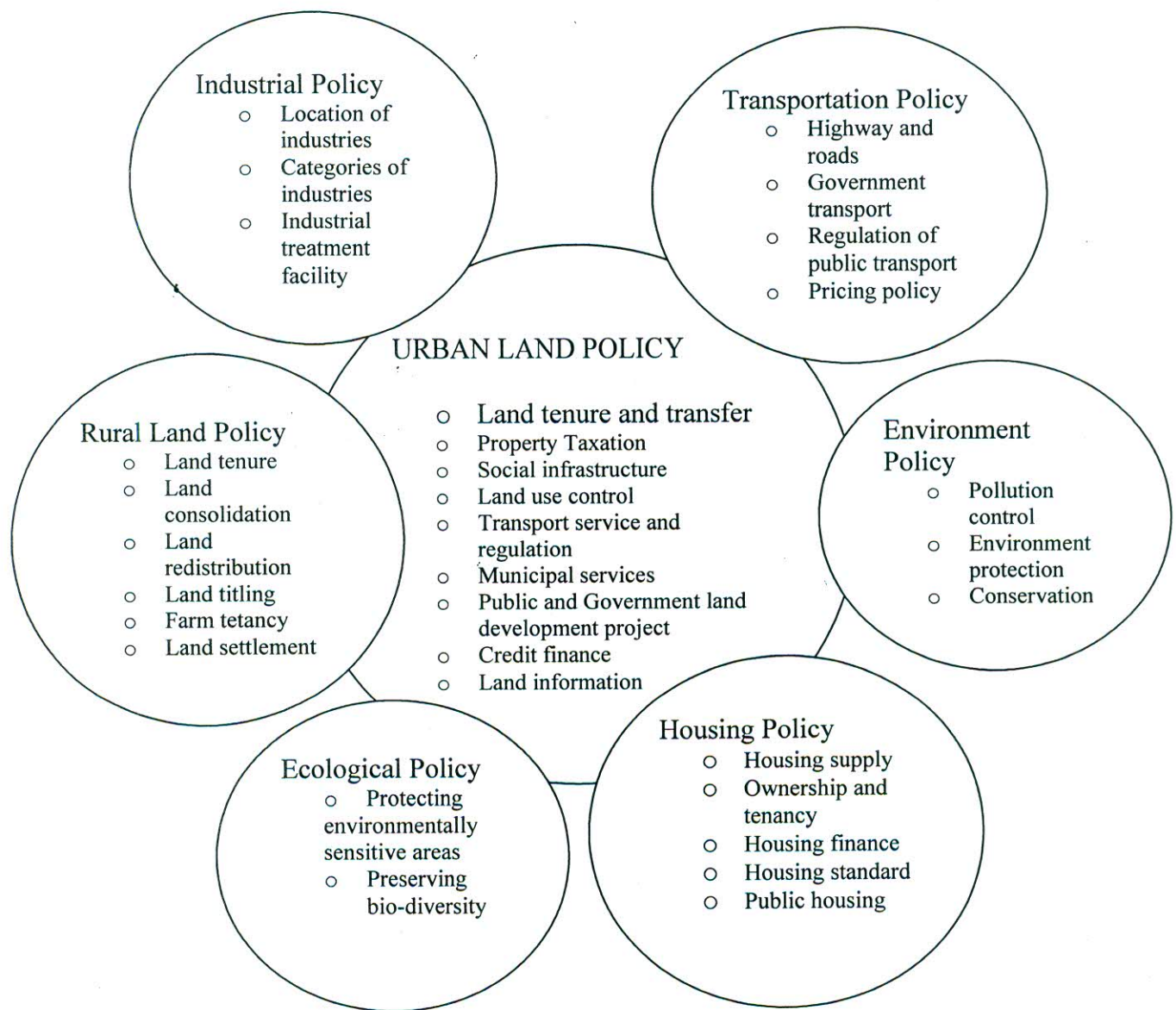


Figure 7.2 Urban land policy and related areas of government policy

Source: Islam, 2000

- To create coordination and consistency among different authorities and department, which directly or indirectly influence urban land use.
- To ensure ecological balance and environmental quality. Land use policy can protect and preserve environmentally sensitive areas, open spaces and water bodies.

Urban land policy stands alongside and overlaps transport policy, environmental policy, ecological issues, housing policy, employment policy, industrialization policy and rural land use policy.

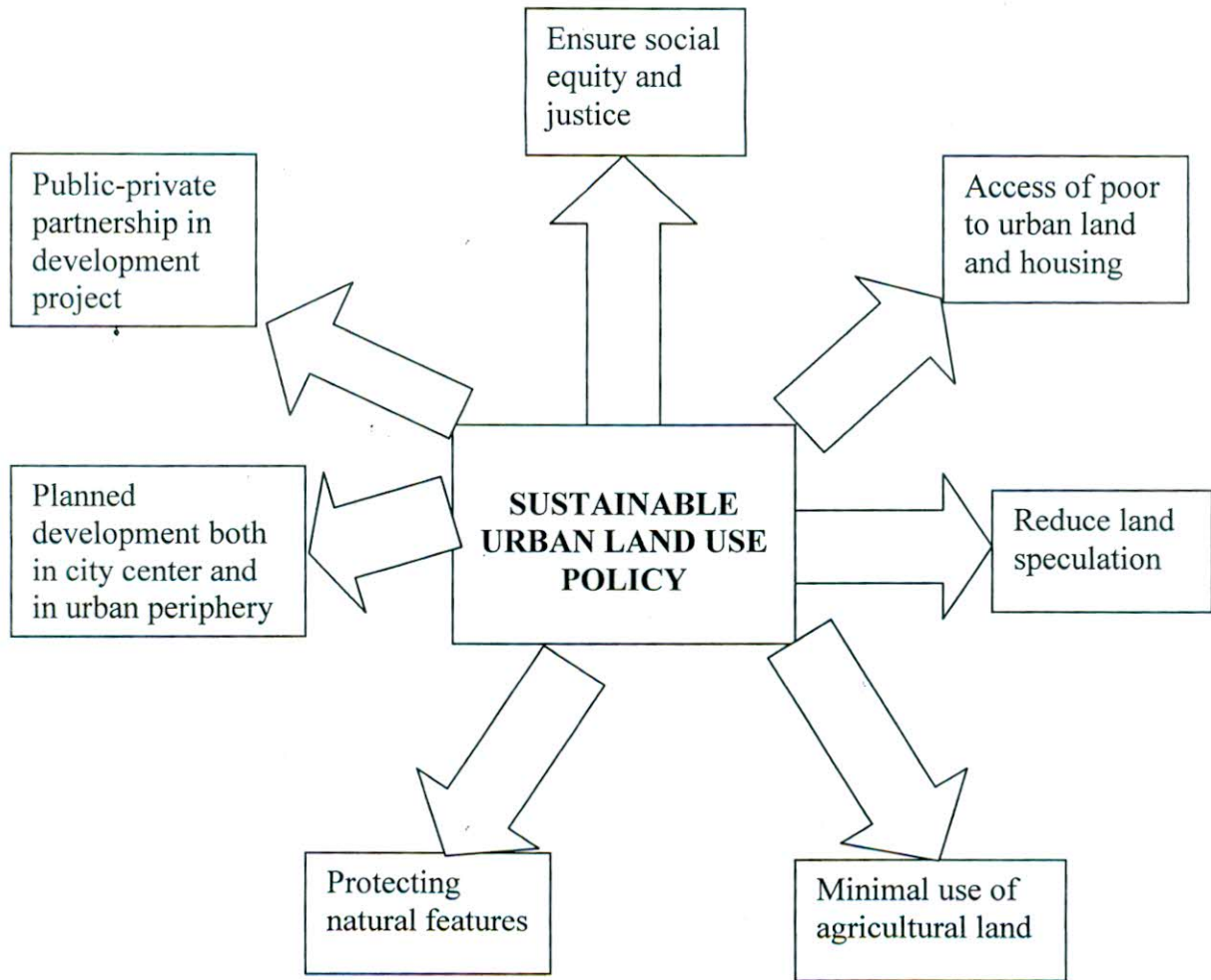


Figure 7.3 Goals of urban land use policy towards sustainable urban development

Source: Islam, 2000

The following features characterize urban land and its development in Bangladesh (Islam, 2000).

- Unplanned development both in city centers and in urban fringe areas.
- Slow rates of land supply.
- High price of land.
- Limited access of the poor to the land market.
- Complex tenure and transfer system.
- Land speculation and unused and under-used urban land
- Absence of well structured taxation measures.

The concept of “urban growth boundary” can be an effective tool to control unwanted, leapfrog development. An urban growth boundary identifies and separates potential lands for urban development from surrounding non-urban areas. The extent of the boundary

depends on the availability of services and utilities to support future development. The boundary is also established to protect valuable agricultural land and environmentally sensitive areas from uncontrolled growth.

Statutory rules control land use according to planning standards. It is based on land use policies including local plans, such as control of residential density, road standards, maintenance providing of infrastructure, and services. The acts and the master plans of the cities are the principal legal instruments, which force and exercise planning control and standards. The land use of metropolitan Dhaka ought to follow the provision of the City Master Plan. Housing, commercial, and industrial project buildings that need planning permission are generally practiced. It must be in conformity with the land use provision of the Master Plan.

The Fifth Five Year Plan (1997-2002)

The Fifth Five Year Plan of Bangladesh 1997 -2002 sets out several objectives of linking development activities with environment as stated below:

- Promoting protection of the environment and encouraging participatory community based management of environmental resources.
- Advancing activities in development interventions that are environment friendly.
- Preserving, protecting and developing the natural resource base.
- Strengthening the capabilities of both the public and the private sectors to address environmental concerns.
- Creating public awareness for participation in environment promoting activities.

7.3.2 Environmental Laws for Wetland Conservation and Protection

The Environment Conservation Act, 1995

In 1995, the Environment Conservation Act was enacted to repeal the Environment Pollution Control Act, 1977. This Act is for the conservation of environment, improvement of environmental standards and control and mitigation of environmental pollution.

Salient Features of Environment Conservation Act, 1995

Powers and Functions of Director General (Section-4)

Department of environment has been established under the provision of this act with a Director General as chief administrator. The Director General can undertake all activities, as he deems fit and necessary, for conservation and enhancing the quality of environment and control, abatement and migration of pollution.

Declaration of Ecologically Critical Area (Section -5)

In section 5 of this Act said about Declaration of Ecologically Critical Area, “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 area as ecologically critical area”(BCAS, 1999).

Government has declared Gulshan -Baridhara lake as Ecologically Critical Area, by the Gazette notification number MoEF-4/7/87/2001/839; dated: 26/11/2001(Farooque and Hasan, 1996).

Direct or Indirect Damage to Eco-system (Section-7)

The Director General, making a proper assessment of the harm caused to the ecology by certain activity, may direct the concerned person(s)/ agencies/ organizations to take corrective measures and make such person(s) / agencies/ organizations comply with such directives.

Information to the Director General Regarding Environmental Pollution or Degradation (Section-8)

To arrange public hearing on request from any person apprehending damage due to environmental pollution or degradation of environment.

Discharge of Excessive Environmental Pollutant (Section-9)

In case where emission or effluent caused by an accident or any other unforeseen activity or event exceeds the amount specified by rules, the person(s) / agencies/ organizations responsible for such an accident or unforeseen activity or event the person responsible or the person in charge of the place at which such discharge occurs shall be bound to control or mitigate such emission or effluent.

Environmental Clearance (Section-12)

Neither any industry shall be established nor shall any project be undertaken anywhere without obtaining environmental clearance.

Formulation of Environmental Guidelines (Section-13)

The Government may, from time to time, through notification in the official gazette, formulate and issue environmental guidelines in realization of the objectives of the act.

Penalty (Section-15)

Any person(s) violating the act shall be subject to a maximum of five years imprisonment or a penalty of a maximum of taka one hundred thousand or both.

The Environment Conservation Rules, 1997

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. Due to promulgation of Environment Conservation Rules some vital provisions of the Environment Conservation Act have now become fully operative. This rules provide for, *inter alia*, the following:

- The national Environmental Quality Standard (EQS) for ambient air, surface water, ground water, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of actual and anticipated pollution load;
- Procedure for obtaining and according environmental clearance;
- Requirement for undertaking Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) as well as formulating Environmental Management Plan (EMP). according to categories of industries/ development projects/activities;
- Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life (DOE, 2006).

In rule-3 of this rules illustrated about Declaration of Ecologically Critical Area and mentioned that 12 factors will be considered while declaring an area Ecologically Critical Area. Wetland is one of them (Rule- 3.1.h) (BCAS, 1999). “The Government

shall, in accordance with the standards referred to in rules 12 and 13, specify the activities or processes which can not be continued or initiated in an Ecologically Critical Area” (Rule- 3.2).

The Environmental Court Act, 2000

An Act to provide for the establishment of environmental courts and matters incidental thereto. The Environmental Court Act, 2000 provides for effective and expeditious disposal of law suites in respect of all types of sources of environmental pollution (DOE, 2006). Consisting of an all together of fourteen sections, in section-4 of this Act has provided the provision about Establishment of environment Courts. The Act provides for, *inter alia*, the following:

- Setting up a court in each administrative division and an Appellate court in Dhaka with the rules of business as laid down in the Criminal Procedure Code (CrPC) and Civil Procedure Code (CPC);
- Assigning an officer, by the Director General, to investigate, with the power of the officer in Charge of a police station, into the offences or related matters.

Notification of Ecological Critical Areas (1999)

In April 1999, the enactment of the clause on Ecologically Critical Areas was signed by the Ministry of Environment and Forest. In the notification, it is mentioned that the government is convinced to announce the endangered ecosystems as Ecologically Critical Areas due to unplanned human activities. Under these circumstances, in order to conserve nature and develop the ecosystem, establish the environmental pollution control and development, and sustainable environmental management, the following areas were declared as Ecologically Critical Areas. Seven locations of the countries (all wetlands) are included under this notification. These are: Sundabans, Cox’s Bazar- Teknaf Coastal beach, St. Martin’s Island, Sonadia Dip, Hakaluki haor, Tanguar haor and Marjat baor (Kabir and Amin, 2007).

In the study area Gulshan- Banani Lakes has declared as Ecologically Critical Area by the Gazette notification number MoEF-4 /7/87/2001/839; Dated: 26/11/2001.

The State Acquisition and Tenancy Act, 1950

This law has transferred ownership of wetlands and jalmahals from the zamindars to the government. However, The State Acquisition and Tenancy Act restricted private ownership over certain categories of property as absolutely “non-retainable”. According to this act a single person cannot own more than 60 bighas of land. According to the section 2/16 of this Act it is land “which is cultivated, uncultivated or covered with water at any time of the year”. Therefore anything that is legitimate on a piece of land is also applicable to wetlands (Khan, *et al.*, 1994).

The Embankment and Drainage Act, 1952

This Act is related to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and watercourses for the better drainage of lands and for their protection from floods, erosion or other damage by water. According to the section-4 (1) of this Act “Every embankment, water course and embanked tow path maintained by the government, and all land, earth, pathways, gates, beams and hedges belonging to or forming part of, or standing on, any such embankment or water-course shall vest in the Government”.

The Building Construction Act, 1952(amended 1987):

The East Bengal Building Construction Act, 1952, (amended 1987) is considered a legal document for development control. Rules, regulations, and ordinances of the City Authorities are also being exercised for this purpose. As per Acts, the definition of building is: ‘Building includes a house, hut, wall, and any other structure where of masonry bricks, corrugated iron sheet, metal tires wood, bamboo, mud, leaves, grass, thatch, or any other materials whatsoever.’

Every construction requires permission as per provision of ‘The East Bengal Building Construction Act 1952 (amended 1987) (EBBC Act 1952).’ The developing agencies are empowered for planning permission and approval of building plans and prevent illegal constructions in the metropolitan areas.

In section-3 (1) of this Act has the provision for restriction on construction of building and excavation of tank. “Notwithstanding anything contained in any other law for the time being in force, or in any agreement, no person shall, without the previous sanction of

an authorized officer, construct or reconstruct or make addition or alteration to any building or excavate or re-excavate any tank within the area to which this Act applies; and such sanction shall be subject to such terms and conditions as the authorized officer may think fit to impose” (section 3.1).

This act does not cover the landfill activities; therefore, RAJUK cannot exercise the power of the act to stop haphazard landfill activities in the wetland areas.

The Building Construction Rules, 1996

The East Bengal Building Construction Act-1952 (amended 1987) has empowered to initiate building rules under section 18, EBBC Act 1952 which has been updated, based on public interest, regularly since 1954, (in 1984 and 1996). It has been formulated through the Government of Bangladesh exercising the power of the Act. In rule-10 of The Building Construction Rules, 1996, has mentioned about the land use policy for building construction. The rule is “all kinds of construction of building shall be consistence with the directed land use plan within the Government approved town, cities and master plan of the cities” (Farooque and Hasan, 1996).

The Dhaka City Corporation Ordinance 1983(modified 1992):

Dhaka City Corporation (DCC) is empowered to prepare master plan under this act. Section 108 of this act illustrate about the master plan. The corporation may, and if so required by the government shall, draw up a master plan for the city which shall, among other matters provided for sub-section (c) restriction, regulation and prohibitions to be imposed with regard to the development of the sites, and the erection and re-erection of buildings within the city (Farooque and Hasan, 1996).

This is overlapping with the Town Improvement Act 1953(amended 1987) under section 73 and 74.

The Inland Water Transport Authority Ordinance, 1958 (amended, 1997)

According to the section 15(1) of this ordinance, the authority may draw up programmes of dredging requirements and priorities for efficient maintenance of existing navigable waterways, and for resuscitation of dead or dying river, channels, or canals, including development of new channels and canals for navigation (BIWTA, 2008).

The Natural Water body, Open Space, Park/ Playground Protection Law, 2000

The government has framed the Natural Water body, Open Space, Park/ Playground Protection Law, 2000 to protect natural water bodies, canals, rivers, depressed low-lying areas and open space within metropolitan areas. It provides power to the concern authorities to protect water bodies to face environmental hazards. According the provision of section -5 of this Act, “the area which are marked as play ground, open space, park and natural wetlands shall not be change the class of the area or these area cannot be used other purpose or cannot be provided lease or rent or cannot be transfer in any other way”. According the provision of section -5 of this Act, if anybody violates any provision of this Act, he will be punished for five years imprisonment or 50,000 taka or both (Islam, 2003). This law also indicates that the land use in the DMDP will be the documents for Dhaka Metropolitan Areas. The Broad land use has been shown in the Dhaka Structure Plan (1: 50000) and Urban Plan (1: 25000). But in the detailed level such land use (like water bodies, canals, rivers) are not yet been demarcated on mouza map (1: 3960).

The Private Land Development Housing Project Rules, 2004

The Private Land Development Housing Project Rules (PLDHPR), 2004 was framed with guidelines and instructions of private housing project. This rule clearly states that how the project will prepare, and how the project gets approval and how the project will monitor. The salient features of PLDHPR are registration, advice, application, layout plan, land use provision, checking and verification, approval procedures and implementation (Roy, 2007).

The enforcement, management parts is not properly indicated, in PLDHPR and therefore whole process of the implementation delayed and cumbersome.

The Town Improvement Act 1953

City area is changing continuously through development activities by different actors like government agencies, private developers, individuals, and others. Planned urban growth is mainly based on the development control measures. Land use control in urban areas of Bangladesh is initiated with the adoption of the Town Improvement Act 1953. But there is a loophole of this act. RAJUK is empowered to prepare master plan of Dhaka under

section 73 and 74 of this act including land uses. The provision of the act is that no compensation shall payable to any person owe the restricted use to which his land may be put under above sections. The enforcement for ensuring prescribed land use as per the master plan has become weak because of such land is privately owned.

Flood Zone Policy and Water Retention Pond Policy of DMDP

The DMDP has been earmarked certain areas as Main Flood Flow Zone. The intent of earmarking certain areas as Main Flood Flow Zone is to protect the safety, health and welfare of the general public, to reduce negative environmental impacts within waterways and to protect and preserve natural drainage system to ensure their continued and proper functioning.

Flood Zone Policy of DMDP

Land development, within the designated flood plain areas of the DMDP Structure Plan, will be controlled in order to avoid obstruction to flood flow, which might otherwise result in hydraulic effects, such as, the rise of flood water levels and change inflow direction.

DMDP Structure Plan proposed some water retention ponds to reduce the intensity of local flooding within the protected areas and also reduces pumping requirements at times of maximum surface run-off. On the policy map the identified areas for retention ponds are indicative.

Water Retention Pond Policy of DMDP

DMDP Structure Plan proposed some development restriction to protect the flood flow zones and water retention ponds. The proposed restrictions are mentioned in the following table:

Table 7.2 Proposed restriction for Flood Flow Zones and Water Retention Ponds in Structure Plan of DMDP

Name of the area	Permitted uses	Restriction
Main flood flow zone	○ Agricultural ○ Dry season recreation facilities ○ Ferry terminal ○ Excavation of mineral deposits. Provided that they cause no adverse hydraulic effect.	Land development for residential, commercial and industrial development including raising the level of land via land filling will strictly be prohibited.
Water retention pond	-	The use of the land within designated retention pond areas to be restricted to the activities - ○ Agriculture ○ Fish cultivation and ○ Recreation No land filling or permanent structures will be permitted within the designated retention pond areas.

Source: RAJUK, 1997

7.3.3 Weakness in the Acts/Laws/Plans

The legal system of Bangladesh is the legacy of British colonial era. Most of the laws formulated by the British rules were aimed at protecting their interest. Some laws have also become redundant since the situation under which they were enacted does not exist anymore. The regulatory programmes in Bangladesh have clear limitations for overall wetland protection and management. Although there are a good number of sectoral legislation to protect environmental damages, those need to be amended and updated.

For the proper development of Dhaka city and control of land filling on wetlands, encroachment of wetlands and its environmental consequences, several regulations and laws, such as environmental conservation act, 1995, environmental conservation rules, 1997, wetland conservation act, 2000, PLDPR, 2004 are initiated. Different agencies

enforce their laws according to the requirement and their own mode of action. In this process overlapping of functions among the agencies are found. Moreover, some conflicts occur due to overlapping of jurisdictions of different agencies. Above mentioned all laws/ regulations are not particularly effective in controlling unauthorized and illegal activities regarding wetlands, since there are numerous loopholes that allow much malpractices. However under this research, the relevant acts, rules, regulations and plans have been critically reviewed and their weakness and loopholes are mentioned below.

Table 7.3 Loopholes of acts, rules, regulations and plans

Name of the act/ rule/ regulation / plan	Weakness /loopholes
Dhaka Metropolitan Development Plan (1995-2015).	DMDP does not provide detail guidelines to the private sector or other developers. The general guideline has loopholes for the irrational land development activities, because DMDP did not prepare any land use map according to the C.S. mouza map (scale 1: 3960). When any individual or a PRLDHP seeks permission to develop an area, it is difficult to check individual C.S. plot. A broad land use has been shown in the Dhaka Metropolitan Structure Plan (1: 50000) and Urban Area Plan (1: 25000). But in the detailed level land use are yet been demarcated on mouza map. The overall development strategies and development guidelines of Dhaka city are formulated by the Structure Plan and Urban Area Plan as the first and second level of planning. On the third level these have to be elaborated and turned into an effective implementation tool through DAP. DAP is now at draft stage, but problems remain also in DAP. The proposals of DAP contradicts with the flood zone policies of DMDP. According to DMDP, there are two categories of Flood Flow Zones: (i) Main Flood Flow and (ii) Sub-Flood Flow Zone. But in the proposed DAP, there is no category as “sub-flood flow zone”. Most part of sub- flood flow zone has been designated as “urban residential zone” and “agriculture with rural homestead”. According to DMDP Structure Plan,” agriculture land” is classified into two categories: “high value agriculture land” and “agriculture land” but DAP proposed only one category of agriculture land,

Name of the act/ rule/ regulation / plan	Weakness /loopholes
	labeled as: “agriculture with rural homestead”. This change of land use is gross violation of DMDP. This change would create scope for the private land development companies and individual land developer to extend urban uses in the valuable agricultural land.
Natural Water body, Park / Playground Protection Law, 2000	There remains controversy on the delineation of wetlands. This controversy mainly lies on whether the flood flow zones which contain water only in wet season will be included in the definition of wetland or not, On the other hand declaration of natural water bodies, the low lying and retention area, <i>khal</i> , natural water body within DMDP are not demarked in <i>mouza</i> map. It provides a greater scope for the developer to fill it up and change the original characteristics of the land.
The Private Land Development Housing Projects Rules (PLDHPR), 2004	There is no penal section in this rule, which can apply to protect the growing unauthorized housing projects. Who will be responsible for the encroachment of PLDHPR, 2004, is not properly indicated in PLDHPR, 2004. Moreover PLDHPR is supported by the clearance of other agencies; those agencies are supported by own acts and laws.
The National Housing Policy 1993 (revised 1999)	According to the policy guidelines the private sector are adequately provided land, finance and services etc. Private land development policy yet approved as guidelines. Under the loopholes, the private companies, the developers implement their projects occupying wetland areas. There is a large gap between policy and reality.
The Dhaka City Corporation Ordinance 1983 (modified 1992)	According to the section 108 of this ordinance, Dhaka City Corporation (DCC) is empowered to prepare master plan. This is overlapping with the section 73 and 74 of The Town Improvement Acts 1953 (amended 1987).
The Building Construction Act 1952 (amended 1987)	This act does not cover the landfill activities; therefore, RAJUK cannot exercise the power of the act to stop haphazard landfill activities in the wetland areas.

Source: Prepared by researcher

7.4 International Conventions on Wetlands

In respect of the importance of wetlands and the environmental, social and economic consequences of wetland loss, an increasing number of countries have initiated national programs to address wetland conservation needs. Globally, there are a few conventions, which directly or indirectly relate to wetland management and conservation. Four of these international conventions are of special interest. They are: Ramsar convention, World Heritage Convention, Bonn Convention and the Biological Diversity Convention. Among the conventions, the most important is the Ramsar Convention, which is directly related to wetlands.

Ramsar Convention on Wetlands

The official name of the convention is “The Convention on Wetlands of International Importance Especially as Waterfowl Habitat”. It is the modern global intergovernmental treaty of this kind. It reflects its original emphasis on the conservation and wise use of wetlands primarily to provide a sound habitat for water birds. Over the years, the Convention has broadened its scope to cover all aspects of wetlands conservation and wise use of principles. It also recognized wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well being of human communities. In the city of Ramsar in Iran, the convention was adopted in February 1971, and it is popularly known as Ramsar Convention. The Convention entered into force in 1975. In 1992, there were 70 contracting parties to the convention. By the end of 2003 the number of contracting rose to 138, and more than 1310 wetlands were designated for inclusion in the list of “Wetlands of International Importance”, covering some 111 million hectares. In order to join the convention, the countries were required to designate suitable wetlands within their territories for inclusion in the special list. The broad objective of this convention is to stop the progressive encroachment and loss of wetlands, to recognize the fundamental ecological processes of wetlands and their economic, scientific and recreational value (Khan. *et al.* 1994; Islam 1996). UNESCO serves as depository for the convention. The administration has been entrusted to a secretariat known as the “Ramsar Bureau”, which is housed in the headquarters of IUCN – The World Conservation Union in Gland, Switzerland, under the authority of the Conference of the Parties and the Standing Committee of the Convention (Kabir and Amin, 2007).

To meet the objectives, the Convention provides for general obligations relating to the conservation of wetlands throughout the territory of the contracting parties and special obligation pertaining to those wetlands, which have been designated in a “List of Wetlands of Importance”. These are-

- Enlisted wetland of international importance.
- Designate at least one wetland when becoming a party.
- Formulate and implement for conservation of wetlands
- Establish nature reserves of wetlands whether listed or not and provide proper wardening.
- Additional nature reserves for waterfowl habitats in case of deleting/restricting listed wetland boundaries
- Undertake management plan to increase waterfowl population on wetlands. Exchange of information about ecological change in a listed wetland and general information.
- Contribute to the budget for next financial year as decided by the yearly conference of parties
- Report to the bureau regarding wetlands and changes made to it (DOE, 2008).

Bangladesh has demonstrated its concern for wetlands through the National Environmental Policy by convening a workshop on wetlands and become a signatory of Ramsar Convention in May 1992 (Khan, *et al.*, 1994). Membership of the Ramsar Convention means that it is obliged to manage its wetlands and wetland resources in a sustainable way. Since the government of Bangladesh is a designated member of Ramsar Convention, it is now obliged to follow certain key guidelines. One of the major guideline is to ensure the wise use of wetlands. According to Ramsar Bureau, wise-use is defined as the “sustainable utilization of wetlands for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem.

The principle actor in the domain of ICTPs in Bangladesh is Ministry of Environment and Forest, with the Department of Environment (DoE) and the Department of Forests (DoF) acting as the technical arm of MoEF for implementation of the ICTPs. Ramsar Convention is looked into by these institutions. These institutions have limited manpower

and financial resources back up in addressing the implementation issues of ICTPs. In the Department of Environment one small section has been created to look after all the ICTPs including Ramsar Convention.

7.5 Enforcement of Laws and Rules

During the interview, respondent were asked whether they know about the “Wetland Conservation Act, 2000”. Out of the total sample households, around 95% respondents reply they do not know and about 5% respondents opine that they know about the “Wetland Conservation Act, 2000” (Table 7.4). Attempts were made to know the views of the respondent about proper enforcement of wetland related laws and regulation. Table 7.4 shows that around 93% respondents think that wetland related laws and regulation are not enforced properly. Questions were asked to this 93% respondent about the causes of non-enforcement. Out of them 136 (37.4%) respondents identify negligence of the authority as the main cause, while 132 (36.3%) respondents assert corruption of the concerned department, 82 respondents (22.5%) opine lack of co-ordination among the concern agencies is the main cause and 14 respondents (3.8%) claim that complicated system is responsible for non-enforcement.

Table 7.4 Opinion on enforcement of laws and rules and cause of non-enforcement

Category	Frequency	Percentage
Whether know about “Wetland Conservation Act, 2000”		
Yes	19	4.9
No	369	95.1
Total	388	100.0
Proper enforcement of laws and rules		
Yes	24	6.2
No	364	93.8
Total	388	100.0
Causes of non-enforcement		
Lack of co-ordination among the concern agencies	82	22.5
Negligence of the authority	136	37.4
Corruption of the concerned department	132	36.3
Complicated system	14	3.8
Total	364	100.0

Source: Field Survey, 2009

7.5.1 A Case Study Regarding Non-enforcement of Wetland Conservation Act, 2000

Case Study: BGMEA Building

Bangladesh Garment Manufactures and Exporters Association (BGMEA) has built a fifteen storied building in the Begunbari Canal area without proper approval from Rajdhani Unnayan Karttripakkha (RAJUK) and in violation of Wetland Conservation Act, 2000. Construction work of this building was started in 2002.



Photograph 7.1 BGMEA building on Begunbari Khal

Source: Field visit, 2008

RAJUK issued a letter to BGMEA (on July 30, 2006) directing it to pay penalty for not complying with the submitted plan and demolish those portions of the building already constructed but not included in the plan. According to the official of RAJUK, they had earlier notified the BGMEA and asked them to stop the construction without approved plan but they did not pay attention. The BGMEA has also been asked to remove earth filling on the canal in between the building and main road and to build an approach road with a bridge over the canal as per the design of its own cost to facilitate water flow in the canal.

Bangladesh University of Engineering and Technology (BUET) carried out a survey on the entire Begunbari canal stretching up to Rampura for a development scheme drawn up by RAJUK. The scheme includes three components and facilitating beautification, protecting environment and sewerage flow. The environmental improvement plan in the BUET report says that the water body will have a hundred foot wide channel for water flow a sewage disposal, but the BGMEA building has blocked and filled the channel.

During the field visit in BGMEA building, it was clear that the official were not inclined to talk regarding the development permission issue. The BGMEA authority denied showing any legal documents making excuse of workload. About the RAJUK notice BGMEA authority claimed that they did not receive any such notice. They said it is too late now to raise questions in this regard. Foundation work and building construction took quite a long time ago. The RAJUK did not raise question in the beginning.

This is questionable, why RAJUK did not stop the construction work at the initial stage. This construction was completely violation of Wetland Conservation Act, 2000. The RAJUK authority did not lodge any case against BGMEA according to the provision of Wetland Conservation Act, 2000. This indicates the lack of proper monitoring, inefficiency and negligence of concern GOs.

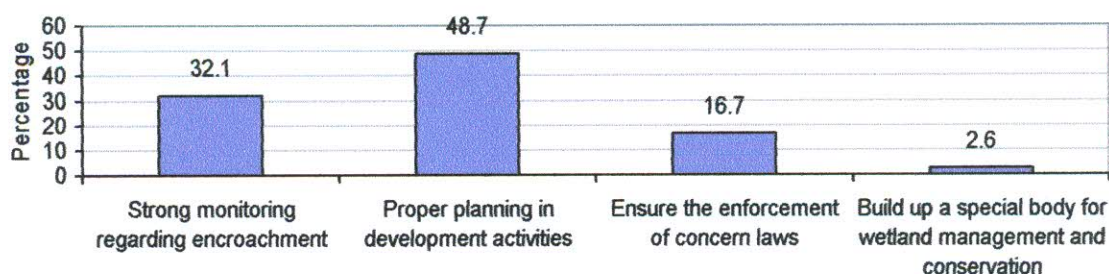
7.6 Government Initiatives for Wetland Conservation

Respondents were asked regarding the government initiatives to build awareness among the urban people for wetland conservation. Out of the total sample households, around 93% respondents opine that government has no initiatives to build awareness about this matter. Respondents were asked regarding the appropriate measures that should be adopt by the government to conserve the wetlands. Data show that about 49% respondents think proper planning in development activities is needed, while 32 % respondents believe that strong monitoring regarding encroachment is essential, around 17% respondent emphasize on ensuring enforcement of concern laws and 2.6% respondents stress on built up a special body for wetland management and conservation (Figure 7.4).

Table 7.5 Build awareness by the government for wetland conservation

Category	Frequency	Percentage
Whether there is any initiative to build awareness by the govt.		
Yes	26	6.7
No	362	93.3
Total	388	100.0

Source: Field Survey, 2009

**Figure 7.4 Measures should be taken by the government for wetland conservation**

Source: Field Survey, 2009

There are huge numbers of private residential project without having any legal status. Neither they are approved nor did they apply for registration. They are starting their business without any concern of RAJUK. Recently RAJUK has filed cases against the developers of all these projects (RAJUK identified), accusing them violating the Wetland Protection Act 2000, Private Housing Land Development Rules 2004, Town Improvement Act 1953 and Dhaka metropolitan development plan 1995-2015.

Table 7.6 List of cases against land development companies by RAJUK

Name of the project	Name of the company	GD No. and thana	Date of the GD
Green Model Town	Amin Mohammad Lands	GD No 54, Demra thana	20-03-2006
Jamuna Model Town	Jamuna Builders Ltd	Khilkhet thana	16-08-2005
Uttaran Project	Mission Energy and Properties Ltd.	GD No 779, Turag thana	22-06-2006
Tamanna River View Project	Baitul Aman Bahumukhi Samity Ltd.	GD No. 897, Shah Ali thana	-
Basumati Project	Hirajheel Properties Development	GD No. 143/06, Badda thana.	03-07-2006

Source: RAJUK office record, 2006

The total length of foreshore land of Dhaka river port is 41 km (82 km in both side). More than three thousands unauthorized structures including 20 religious institutions were identified into this foreshore land (BIWTA, 2009). According to the government instruction BIWTA started its eviction activities since 2001. With the cooperation of Office of the Deputy Commissioner and Dhaka Metropolitan Police (DMP) the BIWTA authority has evicted 2938 unauthorized structure up to June 2009 and the total amount of recovered land is 223.42 acres (Table 7.7). But the evictee again made unauthorized structure in the recovered land. To overcome this problem government should construct walkways and plant trees along the riverbanks within the short time after the eviction.

Table 7.7 Statistics of eviction during 2001 to 2009 at Dhaka river port area

Serial No.	Date of eviction	Number of listed unauthorized structure	Number of evicted unauthorized structure	Amount of recovered land (acres)
1	2001	596	443	72
2	2002	350	289	34.70
3	2003	491	576	46.00
4	2004	404	305	3.5
5	2005	509	500	2.22
6	2007	800	764	61
7	2009 (Up to 20-06-2009)	69	61	4.0
	Total	3219	2938	223.42

Source: BIWTA, office record, 2009

7.7 Activities of Different Environmental Groups Regarding Wetland Conservation

Recently, leaders of 20 environmental and social organizations called on the government to take effective steps to protect the city from floods and water logging and to evict illegal encroachers occupying water bodies. They also demanded immediate execution of the government's decision regarding the DMDP 1995-2015 and the Wetland Protection Act, 2000.

7.7.1 Activities of Bangladesh Poribesh Andolon (BAPA)

BAPA is a civil society organizations and groups of people who are concerned and sympathetic to environment. It was officially launched in July 2000 and since then it is working as a plat form of all pro-environment activities in Bangladesh mainly in Dhaka. To conduct the environmental movement BAPA took its strategy to form a number of Task Forces. These are formed with the specialist and activist who are interested and concerned about different issues and problems of environment. BAPA is playing vital role for sustainable improvement of urban environment through various environmental movements.

BAPA formed a human chain in front of RAJUK office in 2004 where hundreds of people gathered. Speaking at the gathering, the leaders said most city roads go under knee-deep water even after slight or moderate rain because of major area of wetlands in and around the capital has been filled up by land grabbers. They demanded recovery of such wetlands from illegal encroachers for the greater interest of the city.

7.7.2 Activities of Forum of Environmental Journalist of Bangladesh (FEJB)

FEJB is a pioneer of professional watchdog for environmental conservation. It is a kind of think-tank and research organization. Its activities include holding of seminars and workshops, training programs for journalist and arranging field trips, publishing books, reports news letters, documentary films and features. It arranges seminars/ workshops on environmental issues where relevant experts are invited. The views or comments of these meeting or discussed issues are published in the newspaper.

FEJB is a member-oriented organization. The journalist who are working in daily newspapers and interested in environmental issues can be its member. These members are trained up with environment related topics and are motivated to write on the issues like unplanned urban growth, sewerage, and on others environmental degradation.

FEJB is playing as vital role for creating people awareness regarding various issues of environmental degradation along with its impact on public health, which ultimately helps the government to take the strict action to protect urban environment.

7.7.3 Activities of Bangladesh Environmental Lawyers Association (BELA)

BELA is a non-governmental, non-profit and non-partisan organization. It is Dhaka base organization and runs its work with the help of foreign donation. It started its mission in 1991 as an advocacy group of young lawyers working out techniques and adopted various means to create awareness amongst major actors and common peoples and active the great bulk of environmental legislation. It is engaged in research, promotion of environmental awareness, education, training, advocacy and conflict resolution etc.

BELA's legal process and method of handling the environmental/ public issues are comprises of serving legal notice, mediation and court cases. In a number of instances the service of legal notice upon the violator of law could create enough pressure and the legal notice ended up through the process of mediation, not court cases, where the parties preferred to go for amicable solution.

7.7.4 Court Cases Regarding Wetland Conservation

Writ Petition No. 4098 / 1999

Bangladesh Environmental Lawyers Association (BELA)

----- Petitioners

Versus

Bangladesh and others

----- Respondent

The writ petition was filed by Bangladesh Environmental Lawyers Association (BELA) under Article 102 of the Constitution of the People's Republic of Bangladesh, due to the failure of the respondents to prevent illegal encroachment over the river Buriganga for residential and commercial purposes in contravention of Articles 13, 15, 21, 31, 32 and 40 of the Constitution of People's Republic of Bangladesh.

The petitioners mentioned that the existence of the Buriganga River is posed to serious threat as large number of unlawful encroachment over the River has severely affected its flow converting the same into a narrow canal at certain spots.

Such encroachment over the river Buriganga has already resulted in the shrinkage of the River affecting not only its navigability and has also posed a definite threat to its existence and if the same is allowed to continue any longer then perhaps very little time is

available before the River becomes a physically dead one. Most of the establishments over the River do not have any required legal sanction from Respondents Nos. 5, 8 and 9 (The Director General, Department of Environment, The Deputy Commissioner, Office of the Deputy Commissioner, Dhaka. The Deputy Commissioner, Office of the Deputy Commissioner, Narayanganj respectively) nor do they have any license from the Respondent No.7 and are operating in a manner threatening the existence of the ecosystem of the River and its resources.

For that reason the petitioner prayed appropriate order and direction from this Hon'ble Court to save the River Buriganga and its invaluable aquatic resource and thus protect the eco-system and environment of the City and neighborhood to uphold public interest, public health and for public duty under the law and the Constitution. Under this circumstances the petitioner prayed to the court to issue a Rule Nisi calling upon the respondents to show cause as to why they should not be directed to perform their legal duties in taking immediate appropriate measures for removing the illegal encroachment over the river Buriganga and for recovering the public property of the river Buriganga and protecting its environment and restoring the same in a manner best suited in the interest of the public.

The Hon'ble Court upon hearing the petitioner issued a Rule on 18 January 2000 in the following terms:

“Let a Rule Nisi issue calling upon the respondents to show cause as to why they should not be directed to perform their duties in taking immediate appropriate measures for removing the illegal encroachment over the river Buriganga as depicted in the report of the respondent Nos. 5 and 8 for recovering the public property of the river Buriganga and protecting its environment and restoring the same in a manner best suited in the interest of the public or as such other order or further order or orders passed as to this court may seem fit and proper.”

The Hon'ble Court further directed in the following terms:

“Pending hearing of the rule respondent Nos. 1, 2, 3, 6, 7, 8 and 9 are directed to prepare and submit before this court a report in the form of an action plan setting out a definite time frame and stating the measures to be undertaken for recovering the public

property of the river Buriganga and evict the illegal encroachers as listed in the reports of respondent nos. 5 and 8 within 2 (two) months. The rule is made returnable within 4 (four) weeks from date."

Having received no report from the said Respondents as directed by the said Order dated 18 January, 2000 of the Hon'ble Court, a further direction was issued upon the Respondents on 23 April, 2000 in the following terms:

"The court passed an order directing the respondent nos. 1, 2, 3, 6, 7, (Secretary, Ministry of Land, Secretary, Ministry of Home Affairs, Secretary, Ministry of Water Resources, Secretary, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, respectively) 8 and 9 to prepare and submit a report in the form of an action plan setting out a definite time frame and stating the measures to be undertaken for recovery of the public property of the river Buriganga and evict the illegal encroachers as listed in the reports of the respondent nos. 5 and 8.

Let a notice be served on those respondents and submit a report as directed by this court within 1(one) month."

On 19 July 2000 the Hon'ble Court was pleased to issue a further order and extended the time for submission of the report in the following terms:

"By order dated 23.04.2000 the Respondents No. 1, 2, 3, 6, 7, 8 and 9 were directed to prepare and submit a report in the form of action plan for setting out a definite time frame and stating the measures to be under taken for recovery of the public property of the river Buriganga and evict the illegal encroachers as listed in the reports of respondent nos. 5 and 8. This report has not been submitted.

The learned Deputy Attorney General has no instruction on the matter. We, therefore, give respondents further 1 (one) month time to comply with the order dated 23.04. 2000.

Let this matter come up in the list for order on 20.08. 2000."

The Hon'ble Court on 20 August, 2000 adjourned the matter till 15 October, 2000 upon the prayer of the learned Deputy Attorney General.

The petitioner put submission to the Hon'ble Court that the Respondents by not submitting the report as directed by the Hon'ble Court vide Orders dated 18 January, 2000, 23 April, 2000 and 19 July, 2000 have committed gross violation of the same for which a proceeding for Contempt of Court should be drawn against the Respondents to uphold public interest, rule of law and due honor and dignity of this Hon'ble Court.

For this reason the petitioner prayed to the Court to issue a notice upon the Respondent-Contemnors directing them to show cause as to why they should not be prosecuted for committing contempt of the Hon'ble Supreme Court, High Court Division in not submitting the report in compliance to the orders dated 18 January, 2000, 23 April, 2000 and 19 July, 2000 passed in Writ Petition No. 4098 of 1999 and take appropriate action to punish the Respondent-Contemnors according to law and/ or pass such other or further order or orders as your Lordships may deem fit and proper (BELA, 2008).

Writ Petition No. 3503/2009

Human Rights and Peace for Bangladesh represented by its Secretary and others
----- **Petitioners**

Versus
Bangladesh and others

----- **Respondent**

The writ petition was filed as Public Interest Litigation (PIL) by Human Rights and Peace for Bangladesh and four advocates of Bangladesh Supreme Court. The petitioners prayed for a direction to stop illegal encroachment, earth filling and to remove temporary and permanent structure built in the river Buriganga, Turag, Balu and Shitalakkha, violating the provisions of the Bangladesh Environmental Conservation Act 1995 (amended in 2000 and 2002) and Wetland Conservation Act 2000.

The petitioners stated that due to continuous encroachment, earth filling and structure building in the above mentioned rivers, day by day it is losing its width and affecting the life of the citizen. Due to the failure to ensure proper implementation of laws, encroachment, earth filling and temporary and permanent structure building is continuing and caused enough damage to the environment. The petitioners submitted that the respondents are public servants; they have failed to perform the duties and responsibility

as vested upon them. Under this circumstances the petitioner prayed to the court to issue a Rule Nisi upon the respondent 9, 10, 12 and 14 (The Chairman, BIWTA; The Director General, Land Records and Survey Directorates; The Deputy Commissioner, Dhaka; The Deputy Commissioner, Narayangonj and The Deputy Commissioner, Gazipur respectively) to demarcate the original territory and to remove all temporary and permanent structure illegally built in the said rivers.

The honorable High Court issued a Rule Nisi on 24.05.2009 to the respondents under the Article 102 of the constitution of the People's Republic of Bangladesh as follows:

“Let a Rule Nisi be issued calling upon the respondents to show cause as to why a direction should not be given upon the respondent nos. 9, 10, 12-14 to demarcate the original territories of the river Buriganga, Turag, Balu and Shitalakkha, through survey by a special team and restoring the said rivers to their original condition and why all the respondents should not be directed to protect rivers namely, Buriganga, Turag, Balu and Shitalakkha from illegal encroachments and earth fillings and /or such other or further order or orders passed as to this Court may seem fit and proper.”

“Let the respondents be directed to take immediate appropriate steps to stop further illegal earth filling encroachments, by different means and construction of temporary and permanent structures/ buildings in the rivers, namely, Buriganga, Turag, Balu and Shitalakkha, till disposal the Rule.”

The Court heard the both sides. During hearing the petitioner lawyer at an open court suggested that the High court bench ask the DCs of Dhaka, Narayangonj, Gazipur and Munsiganj to give their views on the matter. The judges accordingly asked the DCs, Chairman of WASA and Chief Executive Officer of DCC to meet them at the same court chamber. The High Court said non-implementation of 2001 verdict on saving rivers has caused the present pitiable situation. The court feels the situation is so critical that now it has to play a vital role in recovering the rivers from encroachers (The Daily Star, June 5, 2009). The DCs told the High Court bench that they would conduct a survey to demarcate the rivers and identify the encroachers (The Daily Star, June 9, 2009).

After hearing the both sides and concerned officials, the High Court issued a set of directives on 25 June, 2009, for the government to save the rivers around the Dhaka city from land filling, encroachment and pollution. The directives are:

- The Court directed the Deputy Commissioners (DCs) of Dhaka, Narayanganj, Gazipur and Munsiganj to demarcate the exact boundaries of Buriganga, Turag, Balu and Shitalakkha rivers by November 30, 2009.
- Directed to Secretary, Ministry of Environment and Forest to designate the four rivers as ‘Ecologically Critical Areas’ to facilitate the demarcation work.
- Directed to Secretary, Ministry of Establishment, not to transfer officials involved with river demarcation, till the tasks complete.
- The Court ruled that the government must ensure no influence is exerted on those involved in the job and done the demarcation without any discrimination.
- The High Court directed to Secretary, Ministry of Home; Inspector General of Police, Bangladesh; Police Commissioner, Dhaka Metropolitan Police, to provide sufficient security to officials during the work.
- The Court said once the demarcation is complete, the authorities must have the riverbanks lined with pillars by May 30, 2010.
- The authorities will have to remove the piles of garbage and deposits of sand and soil from the rivers by November 30, 2010.
- For the Dhaka City Corporation (DCC) and the Public Works Department (PWD), the directive is to construct walkways and plant trees along the riverbanks by May 31, 2011.
- The High Court ordered the Water Development Board to take measures to dredge the sources area of dying rivers within five years.
- The Court asked the DCs to continue the ongoing eviction drive
- The court ruled that the government officials concerned will be held responsible, if court directives are not followed duly.

In its judgment the High Court observed that the four rivers have become ‘biologically dead’ and steps should be taken to save them without delay, as they are the life line for over 1.20 crore Dhaka city dwellers (Bangladesh Supreme Court, 2009).

From the above two court cases it can be concluded that the hon'ble High Court Division has been issuing direction since 2000 to the relevant government organization for recovering the public property of the surrounding rivers and evict the illegal encroacher. But the government authorities did not enforce the acts and rules regarding urban land and water bodies. For example, it is prohibited in section 5 of Wetland Conservation Act, 2000, to change of the nature of any land that has been earmarked as a natural reservoir. As per section 8 of this act any person who acts in contravention of the act is liable to imprisonment not exceeding 5 years or a fine not exceeding taka 50,000 or both. But the natural reservoirs or wetlands are changing everyday. For the non-implementation of 2001 verdict of the hon'ble High Court Division on saving rivers has caused the present wretched situation. At last the hon'ble High Court Division directed the Deputy Commissioners (DCs) of Dhaka, Narayanganj, Gazipur and Munsiganj on 25 June, 2009 to demarcate the exact boundaries of Buriganga, Turag, Balu and Shitalakkha rivers by November 30, 2009. The DCs has submitted the demarcation report within the time. If the government authorities implement all the directions of the same date within the specific time it would be possible to protect the wetlands specifically the surrounding rivers of Dhaka city.

Chapter 8

Findings, Conclusion and Recommendations

Chapter 8

Findings, Conclusion and Recommendations

This chapter attempts to present a synopsis of facts and findings presented in the previous chapters regarding various aspect of change of wetlands in and around Dhaka city in line with the objectives of this research. On the basis of the major findings conclusions are drawn. Finally recommendations are made to save remaining wetlands of Dhaka.

8.1 Summary of findings

The findings are summarized under relevant headings on the basis of the discussions in the previous chapters.

8.1.1 Unplanned Growth of Dhaka City and Wetland Disruption

Dhaka has grown from a small settlement within the confines of the river Buriganga and Dholai Khal to to-days mega city. The Physical features, topography and demographic features of Dhaka city have always influenced its physical expansion.

Dhaka has grown on its own in a haphazard manner and the topography of the area dictated the terms and direction of the growth. Since Dhaka became the capital of an independent country the pressure on it has been enormous. Dhaka was a city of 2.8 million in 1981, which increased to 5.3 million in 2001 while expansion of city area was negligible. Rural urban migration is recognized as a major component of the aerial extent of the city. Dhaka itself contains more than half and other five largest cities together account for less than half of the total urban population of six cities. Because of the population growth/migration, urbanization is stretching along /towards the wetlands.

The Buriganga, Turag, Tongi Khal and Balu river are the main streams that surround Dhaka city and these spillways help an efficient drainage in the city. The natural drainage system in the greater Dhaka city comprises of several retention areas and Khals, which are linked to surrounding rivers. There were more than 35 canals within Dhaka city area. Some canals were filled up for the construction of road i.e. Dholpur Khal, Shampur-

Kadamtali Khal, Rayerbazar Khal and box culverts were made on some canals i.e. Dholai Khal, Dhanmondi Khal, Paribagh Khal and Rajarbagh Khal. These canals could have remarkable contribution in drainage service. The whole system is not functioning properly due to encroachment and improper management and overload of sewerage.

Field observation reveals that mainly land filling and encroachment process are involved for disruption of the wetlands of Dhaka city. Both PLDCs and public sector implement housing project in low-lying areas. RAJUK plays key role in implementing public sector housing projects.

According to the view of 99% respondent, the area of wetlands of Dhaka city is decreasing. It appears from the opinion of the respondents that real estate housing companies, GOs, political leaders, influential people and local musclemen are the main involved participant in wetland loss. Thirty four percent respondents support that mainly real estate housing companies are involved in wetland change and 33% respondents support that mainly government organizations are involved in wetland change.

8.1.2 Trend of Wetland Change and Change in Land Use Pattern Due to Change in Wetland

Analysis of land cover map of 1960, 1988 and 2008 shows that, in 1960 wetlands areas were the largest land cover types (40%), the land fill areas were the smallest land cover types (1%) and the built up areas were the second small land cover types (11%).

In 1988, though the wetlands areas were covered the highest land cover area (36%), but both types of wetlands (water bodies and lowlands) area were decreased. The built up and land fill areas increased more than double and built up areas covered the second highest land cover types. But in 2008, the situation is completely reverse, the built up areas became the highest land cover types (54%).

Three sectors namely public, private and individual householders are responsible for rapid land cover change in Dhaka. The declining trend of water bodies between the years 1960 and 1988 is relatively higher than that of the year between 1988 and 2008. The percentage

of changed water bodies during the total study period (1960-2008) is 33%. The declining trend of lowland between the periods 1960-1988 is relatively low than that of the period 1988-2008. During the study period the lowlands decreased by 53%.

The nature of land cover changes reveals that the landfill and built up categories have been increased significantly. The landfill areas increased in an average more than 63.24 hectares per year between 1988-2008 and increased to more than 382% in 2008 compared to 1960. The analysis also reveals that built-up areas increased 222 hectares per year between 1960-1988, indicating 134% growth within 28 years and from 1988-2008 increased 583 hectares per year indicating 107% growth within 20 years and built up areas increased to about 385% in 2008 compared 1960. Conversely water bodies decreased 30.30 hectares per year between 1960-1988, 5.65 hectares per year between 1988-2008 and lowlands decreased 28.92 hectares per year between 1960-1988, 315.16 hectares per year between 1988-2008. The decline of wetlands was clearly due to intensification of urban development in the Dhaka city.

Close examination of the change detection statistics revealed that 6225 hectares of the urbanized area (1960-1988) in study area were previously either cultivated lands or wetlands mainly. The newly urbanized 11676 hectares areas (1988-2008) were previously mainly vegetation or wetlands and a few of cultivated lands.

Overlaid map of three periods, 1960-1988, 1988-2008 and 1960-2008 shows that the shapes of wetlands are being changed and the areas are decreasing day by day as filling activities became a regular phenomena for urbanization. It is clearly observed from the analysis of change in land use dimension of five selected wetlands areas that wetlands are mainly converted to built-up areas.

8.1.3 Impact of Wetland Change on Environment

Disruption of wetlands can create a large number of environmental problems. It appears from the respondent responses that 59% respondent identified the drainage congestion and water logging, 31% respondent identified the reducing of ground water replacement capacity and 6% identified reduction of water reservoirs as the main impacts of wetland loss.

Urbanization changes the hydrographic network of the city, which causes an imbalance in the local water circulation. The land conversion, construction of buildings, paved areas, and drainage and sewer system causes a decrease and even disappearance of natural watercourses and other open basins. For this dense urbanization in the city there has been a decrease in the amount of recharge from the direct percolation due to decrease in the rechargeable area. On the other hand excess extraction of ground water to meet up the urban demand has disrupted the recharge-discharge equilibrium of the city. Dhaka city's ground water level is depleting at an alarming rate. Ground water depletion is occurring more than 3m/year at most places of Dhaka city. Ground water table in the capital has dropped down to 61.18 meters below the surface, 35 meters in the last eleven years, due to lack of recharging which has put the sprawling metropolis at great risk. Expert opined that if water table continues to fall then a vacuum will be created in the aquifer which could cause a sudden collapse in the surface.

The immediate effect of encroachment into wetlands is increase in impervious areas. In an average 75% of the total urban areas are impervious in nature and 25% areas are permeable in Dhaka city. The major effect of impervious are reduced infiltration, reduced ground water recharge, increase in surface run off. The impervious areas play a significant role to aggravate water logging problem.

The water retention areas in the urbanized area play a significant role to reduce water logging. The retention areas under natural condition play a role in retaining excess run off thus delay and lower the flood peak and slowdown the average speed of flood water. When urban expansion occurs in the wetlands, the next results are the decrease in natural water retention areas. Land filling, encroachment in wetland areas disrupts the "Natural Storage Function".

The present trends of residential land development in and around the city have posed environmental threat to the areas. The developing activities damage natural landscaping and changing the character of the areas. Survey result reveals that 99% respondent opined about facing water logging problem. Ninety seven percent respondents viewed that water logging hampers their daily work and out of them 38% respondent said that it is very difficult to go to work place during water logging time. About children's problem, 76% respondents mention that their children get problem due to water logging.

Analysis reveals that 22% respondents experienced about the disruption of electricity. Sometimes electric poles became electrified due to water logging, while any people coming in contact with the foundation of the electrified poles, accident occurs due to electric shock. Study data shows that maximum respondents (78%) opined water logging damaged the road and about the types of damage, among the above respondents 93% said water logging mainly damage the carpeting of roads. About the risk to run motor vehicle, in water logging, 84% respondents identified it is dangerous to run motor vehicles in water logging and out of them 62% opined that there is a risk of dropping into open manhole.

Survey data reveals that 34% respondents claim that water logging damaged their house and among them 34% respondents claimed that they expand less than 2000 taka, while 33% reported 2001-4000 taka, 24% assert 4001-6000 taka and around 9% reply, they expand more than 6000 taka to repair their house.

Contamination of drinking water supply is another problem during water logging time. Field survey result reveals that 59% respondents viewed that they face drinking water problem during water logging time and out of them 59% respondents assert that supplied water is dirty they cannot drink it.

During field survey it reveals that out of 388 respondents 122 (31%) respondents identify that they face sanitation problem due to water logging. About the types of sanitation problem, 67% of the above mentioned respondents opine that 'toilet overflowing', while 7% assert 'toilet's waste floats on water' and 25% identify 'toilet sunk under logged water'. About unhygienic situations that created during water logging time, 38% respondents identify that mosquito increases during this time, while 26% report spread odor, 2% mention kitchen waste floats on water and 35% identify waste of open drainage floats on water.

It is evident from the survey that 60% respondents suffer from diseases due to water logging and out of them about 70%, 1%, 17%, 8%, and 4% respondents are suffer from Diarrhoea, Malaria, Skin Disease, Dysentery and Typhoid respectively. Among their identification Diarrhoea and Skin Disease are in leading position. Diarrhoea stands first position. Survey results also reveal that the amount of money, the respondents expend for treatment are 47.2% expend up to 500 taka, while 48% expend 501-1000 taka.

Survey results reveal that maximum respondents (56%) opined government should remove all illegal structure from the water bodies, 18% respondent viewed to control disposal of waste in natural drainage channels and 17% respondent cited to give more attention on natural storm water drainage system to overcome the water logging problem.

8.1.4 Urban Wetland Management and Government Institutions and Laws

Wetland management in Dhaka city is cross-related with the functions of some ministries and departments. The ministries, which relate to urban wetland management in different ways, are Ministry of Land, Ministry of Environment and Forest, Local Government Division, Ministry of water Resources and Ministry of Shipping.

The responsible departments and / organizations under the above mentioned ministries are Rajdhani Unnayan Katripakka (RAJUK), Dhaka Water Supply and Sewerage Authority (DWASA), Dhaka City Corporation (DCC), Bangladesh Inland Water Transport Authority (BIWTA) and Bangladesh Water Development Board (DWDB) and Deputy Commissioner Office, Dhaka. Among them RAJUK, DWASA, DOE and BIWTA are directly related to wetland management.

The present wetland management practices of the public agencies are not at all systemic. The existing acts/laws of different agencies remain, as management tools, which are not exercised properly in the areas. Overlapping of functions among the agencies creates conflicts in management and controls. Coordination among the public agencies and their management system are ineffective because most agencies implement their programmes in their own way.

RAJUK is the regulatory and supervisory body in the planning and development of Dhaka. RAJUK has neither enough planners nor institutional arrangements to promote a planned development of Dhaka. The existing organization setup in the RAJUK is weak in terms of plan preparation, development and development control. This organization is having poor technical manpower and logistic support. Specially the manpower, to oversee the in-filed development of the city.

DWASA authority is mainly concerned about to supply water, drainage and sewerage within city areas. This authority is also responsible for the management and preservation of canals to discharge storm water. DWASA often conducts surveys to demarcate land of the canals and recover them from the grabbers to facilitate its natural flow during the rainy season. But the grabbers again encroach the canal.

The Department of Environment holds the responsibility of environmental management and control of water resources, specifically it concerns to protect land, water and air pollution. The DOE is presently weak by technicalities like shortage technical manpower and equipments. The building capacity of DOE and financial strengthening are not up to the mark.

The existing canals are gradually being filled up as well as obstructed by road constructions and building box culverts; as a result the canal and channel networks are drying up. At the same time, the PLDCs are forcing drastic reduction in wetlands by unregulated land filling and encroachment activities without paying attention to their drainage network.

The public agencies involved in city development has short, medium and long term development programmes and they are implementing those programmes in phases ignoring the programmes of other agencies. Law enforcement activities from the public sector and their performances are weak and ineffective. It is observed that each agency/organization carries their programmes within their institutional framework. In the process, implementation of some functions is overlapped among the agencies. Moreover, some conflicts occur due to overlapping of jurisdictions of different agencies. Above mentioned all laws/ regulations are not particularly effective in controlling unauthorized and illegal activities regarding wetlands, since there are numerous loopholes that allow much malpractices.

Ramsar Convention is the modern global intergovernmental treaty regarding wetlands. The principle actor in the domain of ICTPs in Bangladesh is Ministry of Environment and Forest, with the Department of Environment (DoE) and the Department of Forests (DoF) acting as the technical arm of MoEF for implementation of the ICTPs. Ramsar Convention is looked into by these institutions. These institutions have limited manpower

and financial resources back up in addressing the implementation issues of ICTPs. In the Department of Environment one small section has been created to look after all the ICTPs including Ramsar Convention.

Survey result clearly reveals that (93% respondents reflects this picture) think that wetland related laws and regulations are not enforced properly and out of them 37% respondents identify negligence of the authority as the main cause, while 36% respondents assert corruption of the concerned department, 23% respondents opine lack of co-ordination among the concern agencies is the main cause and 4% respondents claim that complicated system is responsible for non-enforcement.

Out of the total sample households, around 93% respondents opine that government has no initiatives to build awareness about this matter. Data show that around 49% respondents think proper planning in development activities is needed, while 32 % respondents believe that strong monitoring regarding encroachment is essential, around 17% respondent emphasize on ensuring enforcement of concern laws and 3 % respondents stress on built up a special body for wetland management and conservation.

8.2 Conclusion

Dhaka is one of the 10 mega cities in the world. Growing at a very fast rate, Dhaka urban is predicted to increase from 11.3 million today to 21.1 million by 2015 (World Bank, 2007). The city is expanding in an unplanned and uncontrolled manner. Among the six metropolitan cities Dhaka itself contains more than half and other five metropolitan cities together account for less than half of the total urban population of the six cities. A principal reason of such a rapid growth is over concentration of maximum activities and development works in the city and little improvements in other cities, towns and villages in terms of infrastructures development and economic activities. Rapid population growth creates extra pressure on the land of already over crowded Dhaka city. For this reason urbanization is stretching along/towards the wetlands.

Wetlands are the most important component of environment in the city and peripheral areas. There is serious lacking of public awareness about the necessity and importance of urban water bodies. Behavioral pattern and attitude towards urban water bodies of different classes of people are different because the classes of people of Dhaka city in

term of social and economic position are heterogeneous. The plight of wetlands in Dhaka city is alarming, as it is suffering neglect from adequate legislative, administrative and social management. This study intends to investigate how wetlands are being converted. Through this research it is found that the main causes of wetland loss are unplanned urbanization and earth filling for construction of infrastructures. Wetlands are randomly being filled up or encroached by mainly real estate housing companies, Government organization and influential people. The private land management companies legally and illegally occupy the wetlands and try to establish their rights and are developing the areas according to their will, flouting the policies stated in DMDP Structure Plan. It is evident from the satellite image of 2008 that a large portion of the wetland has already been lost. From the analysis of land cover map of three different years 1960, 1988 and 2008, it reveals that in 1960 wetlands areas were the highest land cover types, the land fill areas were the lowest land cover types and the built up areas were the second lowest land cover types. But in 2008 the situation is almost changed, the built-up areas became the highest land cover types. The landfill areas increased in an average about 382% and built-up areas increased more than 385% in 2008 compared to 1960. From 1960- 2008 Dhaka has already lost 32.57% of water bodies and 51.58% of lowlands. If wetland decreased in and around Dhaka city continues at the current rate Dhaka will be threatened as a city of living. The remaining wetlands are crucial for Dhaka to keep the ecological balance, especially to reduce the water logging impact.

The present trend of encroachment into wetlands in Dhaka city is a clear prohibition of planning norms. No rules/standards of planning will allow the present trend of uncontrolled land filling and encroachment into the wetlands.

It is revealed that from the analysis of land use pattern of the selected changed wetland areas (Turag River part area, Begunbari canal area and Gulshan lake area) the trend of changing pattern of wetland is – primarily wetlands are converted to landfill areas then it is used as any kind of informal purpose and finally converted to built up areas. It is also revealed from this analysis the rate of transformation of wetland is highly related with urban settlement.

So it is revealed from this analysis that the rate of transformation of wetland is highly related with urban settlement.

A large number of environmental degradation occurs due to reduction in wetlands. From the analysis of field survey results, it reveals that drainage congestion and water logging, declining ground water level and reduction of water reservoir are the main impact of wetland loss. Water logging in Dhaka city aggravating and is attributed to the rigorous changes of wetlands, particularly remarkable increase of urban areas. Severe water logging creates every year in the city during monsoon incurring huge loss in terms of adverse social, physical, economic and environmental loss. Analysis of people perception and field observation about impact of water logging in Dhaka city reveals that water logging hampers daily work, normal traffic movement and causes heavy traffic congestion on the street and people lose their valuable time. Water logging causes serious deterioration of road surface and it needs a huge cost to replace these and increases the maintenance cost for the authority. Prolonged water logging causes the damage of the house and other infrastructure. Contamination of drinking water supply and unhygienic situation also created during water logging time, as a results diarrhoea, skin disease and other diseases spread.

Analysis of survey results clearly reveals that (93% respondents views in the way) think that most of the national level plans, policies and laws on wetland management have not been enforced properly. From the analysis of opinion of the experts and peoples perception, it is also appears that the major reasons, which practically delay the implementation of the national laws, plans and policies, are lack of co-ordination among the concern agencies of the government, negligence of authority, corruption of the concerned development organizations, and abuse of laws by the influential elites. The responsible departments/organizations, which are mainly involved in wetland management, are RAJUK, DWASA, DCC, BIWTA, BWDB, DOE and Deputy Commissioner office Dhaka. These organizations are having poor technical manpower and logistic support. Overlapping of functions among the agencies creates conflicts in management and controls. Coordination among the public agencies and their management system are ineffective because most agencies implement their programmes in their own way. It is evident from the analysis of court cases that the concern government authorities are not serious to protect the wetland. The higher court directed several times to the concern government organization to protect the wetlands in and around Dhaka city. But the government authorities did not execute these directions. At last the hon'ble High

Court Division directed the Deputy Commissioners (DCs) of Dhaka, Narayanganj, Gazipur and Munsiganj on 25 June, 2009 to demarcate the exact boundaries of Buriganga, Turag, Balu and Shitalakkha rivers by November 30, 2009 and also directed to DCC and PWD to make walkways and plant trees along the river banks by May 31, 2011. The DCs have submitted the demarcation report within the time. If the government authorities implement all the directions of the same date within the specific time it would be possible to protect the wetlands of Dhaka city.

At the same time dishonest practices of real estate housing companies and other involved participant in wetland loss, with connivance of a section of government officials should be stopped immediately for the protection of remaining wetlands of Dhaka city.

As a result combined effort is necessary from the part of involved stakeholders, like local people, NGOs, local government body, central government and civic organization to implement the conservation strategies of wetlands. Political will and government commitment is also needed for this purpose. If government has the inclination to preserve the wetlands and if general people are also made conscious regarding the importance of wetlands, the present trend of land filling and encroachment will be stopped and it would be possible to protect the remaining wetlands of Dhaka city.

Despite the limitation, this study will help the decision makers as well as urban planners, researchers and other relevant organizations to formulate better planning and monitoring the measures related to management and protection of wetlands of Dhaka city.

8.3 Recommendations

This study reveals that wetlands of Dhaka are facing a very vulnerable situation now. All the preceding chapters give an alarming situation of loss of wetlands in and around Dhaka city. Rapid population growth and its growing demand for housing in Dhaka city are encouraging the real estate business and private developers to grab and encroach the wetlands for housing, roads and commercial activities. These unplanned development activities are grossly violating the Dhaka Metropolitan Development Plan (DMDP) and the Wetland Conservation Act, 2000. Due to Such activities, the natural drainage pattern and flood retention areas are destructed and if the trend of wetland changes goes on, it will create more environmental degradation. So it is very urgent to take necessary steps to

protect the remaining wetlands of Dhaka. The policy guidelines/ recommendations are formulated on the basis of findings of this study are outlined below:

- **Demarcation of Wetlands**

Demarcation of wetlands is now a widely raised issue. Due to demarcation problem it has become easy to legitimate the illegal encroachment. The structure plan of DMDP designated the retention pond in an around Dhaka city by a circle (Fig: -----). Retention ponds are not properly located in mouza maps. From the DMDP structure plan, it is not clearly understandable that in which mouza the proposed pond is located because the size of the pond covers more than one mouza in the map. To avoid this confusion the ponds should be shown to scale in the map so that specific areas can be preserved for the retention purpose according to the Master Plan. Detailed Area Plan (DAP) is an opportunity to bring Dhaka metropolitan areas under planning guidelines. it will provide more detailed planning proposals for the specific sub areas of Dhaka city. DAP is supposed to address the wetland issue with immense importance. Through DAP demarcation of wetland can be done. If the Detail Area Plan for the study area is prepared properly, there will be no confusion regarding the delineation of the wetlands. So RAJUK should complete the DAP as soon as possible which will ensure the proper enforcement of law and will help to protect the remaining wetlands of Dhaka.

- **Improve the Capabilities of Relevant GO's**

RAJUK is responsible to monitor the development work within the study area, but it is really impossible for RAJUK to monitor the whole area with its lack of manpower, lack of technical expertise. Moreover RAJUK does not have any field office to monitor the development work and enforce the laws properly. To improve the monitor of unplanned development and enforcement of laws RAJUK should set up its field office to monitor the development work.

In the existing set up of RAJUK, only 10 Urban Planners are working for 120 million populations in its jurisdiction area. They are working in plan preparation, implementation and development control. A particular ratio must be maintained in 'planner' and 'the people to serve'. At least 120 town planners should be in the RAJUK so that 1 planner can serve 1 lac people. Organogram of RAJUK should be reviewed and duties and

responsibilities should be reexamined. Right people with right qualification should work in the appropriate positions. So the institutional capacity of the planning department of RAJUK should be independently appraised, existing sanctioned posts should be filled on a priority basis and necessary additional planning positions, where required built into the organizational set up of the planning department.

RAJUK may continue to be the apex planning authority responsible for overall urban planning and regulate landuse development, implementation functions should be preferably taken up only by the sectoral agencies. In addition, the process of approval of building plans should be preferably divested to urban local bodies and the same should be monitored by RAJUK to assess adherence to proposed landuse and land development controls. As a result, multi-agency checks and balances would be built into the system.

Capacity of other relevant organizations involved in wetland management, like DWASA, DOE, DCC and BIWTA need to be enhanced in respect of manpower and equipments.

- **Protection of Lowlands (Wetlands)**

The amount of high land within the study area is limited. Due to the over population pressure, the city needs more houses and other infrastructures. As a result the city is expanding and lowlands are being filled up by different private and public organizations. So a comprehensive guideline and action plan needs to be prepared defining the extent of filling as also the areas which should be protected and defining the drainage channels that should be protected. This should be done in close consultation with stakeholders and after working out a rehabilitation package for land owners who stand to loose their lands for urbanization. Guidelines should preferably demarcate all these information on a map and this should be public information. The rehabilitation package should be attractive, such as, the land owner should be given plot to another place for construction of structure or he lives outside the lowlands area, should enjoy the benefit of tax exemption for some of the utilities and municipal taxes.

- **Protection of Permanent Water bodies (Wetlands)**

Encroachments of the permanent water bodies such as lake, canals and rivers by land developers as well as individuals for so called development, illegal structures have already affected city life in many ways. The natural drainage system of the city is losing

their actual width and existence due to such encroachment and reducing the water carrying capacity day by day with the results of water logging during monsoon period within the city area. So to solve this problem, the original width and alignment of the lakes, canals and rivers has to be re-established in proper shape and ensure easy drainage flow through these natural channels. The government should construct walkways and plant trees along the banks of these permanent waterbodies to protect the encroachment.

- **Proper Waste Management System**

Dhaka City Corporation (DCC) is the responsible authority for solid waste management in the city. There is no scientific and technological method for disposal of solid waste applied today. As a result large pieces of lowlands are used for solid waste disposal, which encroaching the natural water bodies and causing pressure as well as having a negative impact on the environment. DCC can solve the problem with cooperation of citizens, central government NGOs and private sectors. Community based waste management can be a better alternative solution. Moreover solid waste can be used to prepare manure which is doing by Waste Concern, a private organization. Government can encourage this type of programme by public-private partnership to save the waterbodies /lowlands.

- **Ensure Strict Development Regulation**

The present study revealed that Dhaka has only 4.79% waterbodies and 15.43% of lowlands. Experts opined that, a densely populated city like Dhaka requires 25% wetlands for ecological balance and sustainability of habitats. The remaining waterbodies and lowlands have been filled up or converted in the name of development by both private and government sector. Due to absence of coordination, development program such as, construction of box culvert, road, embankment by the government agency often accelerate the process of wetland conversion. So the concerned authorities like RAJUK, DCC, DWASA, BWDB and BIWTA should take the appropriate measures immediately to solve the unplanned development. It would be better to stop all kind of land development project through a government order before completion of DAP.

- **Ensure Enforcement of Laws to Protect Wetlands**

This study showed that negligence of the authority and corruption of the concerned department are the main causes for non-enforcement of laws. Government should take strong and strict initiatives regarding enforcement of wetland related laws. In this regard Government commitment as well as political will is needed. A few wetland monitoring team can form under the proposed wetland management cell. These team will act like as mobile court and will report to the wetland management cell.

- **Formation of Wetland Management Cell:**

The present programs and responsibilities of concern public agencies regarding wetland protection are not coordinated, rather isolated. The civic organizations are making significant contribution to save wetland with their limited resources. But they are not performing in a coordinated way with government agencies. So, for the strong coordinated effort regarding wetland protection a 'wetland management cell' can be develop under the ministry of Environment and Forest or Ministry of Land and this management cell will be monitored by Prime Minister's Office. This cell will be formed with the participant of experts and professionals both from GOs and NGOs and have the authority to assign responsibilities to different agencies including law enforcing agencies

- **Positive Role of Media**

Role of mass media can play a vital role regarding protection of wetland loss. Media can work as a watchdog. Government should encourage the media for their campaigning and reporting to draw attention to the encroachment on the wetlands. At the same time government can discuss with the media personnel about banning advertisement of illegal real estate project in all media and with understanding can issue a order about banning this advertisement.

- **Awareness Programme**

There is a serious lacking of public awareness about the necessity of urban wetlands. A large portion of people in the city do not understand the effect of filling of wetlands. The problem of wetland loss can be effectively solved with the mobilization of stackholder in

the city. Public awareness will also promote people's participation in the implementation of relevant rules and regulations. The public awareness can be best achieved in association with the civil society, environmental groups, NGOs and the media.

8.4 Future Research Direction

The present study focused on nature of loss of wetlands, associated causes and its impact, mainly the water logging problem in Dhaka. Changes of wetland in this research also have been viewed from prevailing policy planning perspective and institutional set up. All environmental problem of Dhaka city related to wetland disruption was not taken into consideration in this research. This research indicates that a significant amount of wetland is still available in and around Dhaka city. Finding of this study can be used as a baseline work. With this in mind some areas of further studies are recommended in the following heads:

- Study on loss of wetlands and its impact on biodiversity of surrounding areas.
- Study on assessing the function of wetlands to make economic valuation of wetlands.
- Future research can be designed to evaluate the feasibility of the recommended strategies of this study for the protection of remaining wetlands of Dhaka.

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Appendices

Appendices

Appendix-A Questionnaire for Field Survey

Research title: Changing Pattern of Wetlands and its Impact on Environment of Dhaka City

Researcher: A.K.M. Shahabuddin
Ph.D Fellow
IES, R.U.

Questionnaire No. ----- Dated: -----

A. Personal Information of Respondents

SL. No.	Questions	Categories	Answers
1	Name:		
2	Address:	Holding No. ----- Ward No. ----- Thana ----- Road No -----	
3	Gender:	Male -----1 Female-----2	☐
4	Age:	Complete Years	
5	Occupation:		
6	Education:	Illiterate -----0 Less than High School -----1 Secondary-----2 Higher Secondary-----3 Graduate-----4 Post Graduate-----5 Others (Specify)-----6	☐
7	How long years are you living in this area (Near the specific water body of the study area)?	Complete Years	☐
8	The house where you live, the land is owned by	Self -----1 Khas land -----2 Live as a tenant -----3	
9	What is the proximate distance of wetland from your residence?	----- Kilometers	

B. Respondent Perception about Causes of Wetland Change

SL. No.	Questions	Categories	Answers
10	Is the area of wetland is decreasing?	Yes-----1 No-----2	☐
11	If 'Yes' then what are the probable reasons for that?	Unplanned urbanization -----1 Garbage disposal-----2 Earth filling for construction of infrastructure-----3 Slums and squatters -----4 Encroachment-----5 Lack of laws enforcement -----6 Others -----7	☐
12	In your opinion, who are involved in decreasing wetland area?	Real estate housing companies-----1 Government organizations -----2 Political leader -----3 Influential people -----4 Local musclemen -----5 Slums people -----6	☐
13	What is the main impact of reduction of wetland?	Reduction of water reservoirs -----1 Reduce ground water recharge capacity -----2 Drainage congestion and water logging-----3 Loss of vegetation -----4 Increase water borne disease -----5 Others (Specify)-----6	☐
14	Do you face any water logging in your area of living?	Yes -----1 No-----2	☐
15	If 'Yes' when?	Period / season of the year	
16	How long the water remains stagnant in the catchments area?	Hour(s) ----- Day (s)----- Month(s) -----	
17	What is the average depth of water logging?	Less than 1 foot Less than 2 feet Less than 3 feet Others	

18	According to you, what are the main reasons for such water logging in your area?	Lack of drainage Facilities -----1 Lack of cleaning and maintenance operation of the natural canals -----2 Unauthorized structure on the natural channel-----3 Encroachment of wetland areas ----- 4 Other reasons----- 5	☐
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C. Perception about Physical Problem and Loss Due to Water logging

SL. No.	Questions	Categories	Answers
19	Were you affected due to the water logging before?	Yes-----1 No-----2	☐
20	Does water logging hamper your daily work?	Yes-----1 No-----2	☐
21	If your answer is Yes, then what type of interruption do you face?	Not possible to move on foot-----1 Shops remain close-----2 Difficult to go work places -----3 Movement of vehicles disrupted -----4 Others -----5	☐
22	Do your children get problem due to water logging?	Yes-----1 No-----2	☐
23	If yes, what sort of problem do they get?	Get affected due to waterborne disease -----1 Going to school on foot is difficult-----2 Skating of water from running motors-----3 Scarcity of rickshaw-----4	☐
24	Is there any disruption of electricity during water logging?	Yes-----1 No-----2	☐
25	If the response is yes, then what type of disruption do you experience?	Frequent power failure-----1 If once power fail, it continues for long time-----2 Total disruption of power supply for long time-----3	☐
26	Is there any damage to roads due to water logging?	Yes-----1 No-----2	☐

27	If the response is yes, then what type of damage occurs?	Formation of galleys -----1 Carpeting of the roads damages-----2 Others -----3	☐
28	Is it dangerous to run motors in the water logging?	Yes-----1 No-----2	☐
29	If the reply is yes, what type of risk?	Water enters into the engine -----1 Sits get water-----2 Motor struck in the galleys-----3 Accident occur for dropping into open manhole-----4	☐
30	Have your house damaged due to water logging? If yes, what was the total expenditure for repair?	Taka -----	
31	Do you get any other financial loss due to water logging?	Yes-----1 No-----2	☐
32	If the answer is yes, please give amount of loss.	-----Taka	

D. Respondents Perception on Health Problems

SL. No.	Questions	Categories	Answers
33	Do you face any problem in getting drinking water during water logging?	Yes-----1 No-----2	☐
34	If the answer is yes, then what type of problems do you face?	Water becomes less -----1 Water is not available when needed -----2 Supplied water (from WASA) is dirty -----3	☐
35	Did you suffer by any disease during water logging? If yes, which of the following disease results?	Diarrhoea -----1 Malaria-----2 Skin disease -----3 Dysentery -----4 Typhoid -----5 Others (please mention)-----6	☐
36	Describe the type of treatment received		
37	Where was the treatment received?	Home -----1 Hospital -----2 Clinic -----3 Doctor's chambers -----4 Others -----5	☐

38.	What was the approximate total cost of the treatment?	Taka-----	
39.	Which type sanitation system used in your residence?	Pit latrine -----1 Pit latrine (pucca)-----2 Septic tank-----3 Directly connected with sewer line -----4 Others -----5	☐
40.	Do you face any sanitation problem during water logging period?	Yes-----1 No-----2	☐
41.	If yes, please mention which type of problem arises	Over flow the toilets -----1 Toilets waste floats on water -----2 Toilets goes under water-----3 Others -----4	☐
42.	What unhygienic situation does water logging create?	Mosquito increase -----1 Spread odor-----2 Kitchen waste floats on water-----3 Waste of open drainage floats on water -----4 Damage of floor -----5	☐

E. Respondents Perception about Mitigation

SL. No.	Questions	Categories	Answers
43	How do you meet the drinking water problem during water logging?	Drink boiled water -----1 Taking pure water from another area -----2 Buy bottle water -----3 Others -----4	☐
44.	Did you leave your residence during water logging? If yes, where did you go?	Relative house-----1 Neighbor house -----2 Govt. provided shelter -----3 Others -----4	☐
45	From where mainly you get the help during water logging problem?	Govt. organization-----1 Non Government organization -----2 Relatives -----3 Neighbor -----4 Others -----5	☐

46.	Which kind of help did you get?	Living -----1 Food -----2 Medicine -----3 Above all -----4	☐
47.	How did you mitigate transport/communication problem?		
48.	How did you solve the sanitation problem?		

F. Wetland Conservation and Management

SL. No.	Questions	Categories	Answers
49	Was there any step from the government taken to get rid of water logging?	Yes-----1 No-----2	☐
50	If your answer is yes, what type of measures had been taken from the following?	Number of sluice gates has been increased-----1 Engaged pump to drain out the water-----2 Re-excavated the encroached natural drainage channel-----3 Others -----4	☐
51	What measures can be taken to overcome water logging problem	Give more attention on drainage division of DWASA -----1 Re-excavate all the grabbed or encroached water bodies-----2 Prepare water retention pond -----3 Control disposal of waste in natural drainage channels-----4 Others -----5	☐
52	Do you know about “Water body Conservation Act, 2000”?	Yes-----1 No-----2	☐
53	Do you have any idea about importance of conservation of wetlands?	Yes-----1 No-----2	☐
54	Do you think wetland conservation related laws and regulations are enforcing properly?	Yes-----1 No-----2	☐

55	If 'No' please identify the cause of non-enforcement of laws and regulation.	Lack of coordination among the concern agencies -----1 Negligence of the authority -----2 Corruption of the concerned department -----3 Complicated system -----4	☐
56	In your opinion, what measures should be taken to conserve the wetlands?	Strong monitoring regarding encroachment-----1 Proper planning in development activities -----2 Ensure the enforcement of concern laws -----3 Built up a special body for wetland management and conservation -----4 Others -----5	☐
57	Is there any initiative from government to generate awareness about wetland conservation in your area?	Yes-----1 No-----2	☐
58	Is there any activity of any NGO's regarding protesting wetland encroachment/grabbing?	Yes-----1 No-----2	☐
59	Do you think strong public support is needed for the protection of existing wetlands?	Yes-----1 No-----2	☐
60	Do you have any other comments or suggestion for better management and conservation of wetlands of Dhaka city?	Comment (if any)	

Appendix-B
Questionnaire for Concerned Officials of Different Organization

Research title: Changing Pattern of Wetlands and its Impact on Environment of Dhaka City

Researcher: A.K.M. Shahabuddin
Ph.D Fellow
IES, R.U.

Questionnaire No. ----- Dated: -----

1. Name
2. Designation of the respondent
3. Working place
4. What are the roles of your organization for the management of Dhaka city?
5. What are the main reasons for wetland loss in Dhaka city?
6. Which laws are being implemented by your organization with this issue?
7. What are the weaknesses of your organization for the management of wetlands?
8. In your opinion what capacities your organization needs?

9. Do you think Government budget is sufficient to run programs related to wetland protection / conservation? If not, what is your suggestion?
10. Which programs are taken in current PRSP / last Five Years Plan related with this issue?
11. What are the effects of wetland loss on city life?
12. Do you think political commitment is needed to solve the wetland related problems? If yes, please comment on this.
13. Can you please say about the attitude of different Government about this issue?
14. What type of measures / actions are needed to solve or reduce the wetland loss?
15. Do you think wetland conservation related laws and regulations are being enforced properly? If not, why? Please give your opinion.
16. Do you have any other comments or suggestion for sustainable management of the wetlands of Dhaka city?

Appendix-C

Questionnaire for Experts of Different Fields

Research title: Changing Pattern of Wetlands and its Impact on Environment of Dhaka City

Researcher: A.K.M. Shahabuddin
Ph.D Fellow
IES, R.U.

Questionnaire No. -----

Dated: -----

1. Name
2. Working place
3. Field of expert
4. How many wetlands are present currently?
5. What are the main reasons for wetland loss in Dhaka city?
6. How does your organization work with this issue?
7. What are the programs of your organization related to land use or environmental management?
8. What is the amount the budget of your organization to implement these programs?
9. How many employees are involved to implement these activities?

10. Does have any donor agency for financial support of your organization? If yes, please mention the name.
11. Which geographical area covers your organization?
12. Which aspect of social problem deals your organization?
13. How many years is your organization working with this issue?
14. Did you face any resistance from any corner to implement the programs? If yes, Please mention that.
15. How much response do you receive from the stakeholder?
16. Did you observed any conflict with other organization during implement your programs? If yes, Please describe that.
17. What are the effects of wetland loss on city life?
18. What is your assessment about the level of environmental degradation due to wetland loss?
19. Can you please say about the achieved results of your organization?

20. Do you think the government institutions, which deal with wetland, are performed efficiently?

☐Yes

☐No

If not, please mention what are the lapses?

21. What is your suggestion to enhance the management system of wetland related activities that can help reduce the wetland loss?

22. Do you think existing urban development planning and land management system is inconsistent for the protection of wetland? Please give your opinion.

23. Do you think wetland conservation related laws and regulations are being enforced properly? If not why? Please give your opinion.

24. Do you have any other comments or suggestion for sustainable management of the wetlands of Dhaka city?

Appendix-D
Paper Clipping on Wetland Issues

The Daily Star

29 July, 2009

Downpour halts life

Record rain in Dhaka inundates streets, hampers commuting, education, trade; 9 die in electrocution; bus, ferry services disrupted

STAFF CORRESPONDENT

Incessant rain overnight had much of the city knee-deep in water throughout the day yesterday, wreaking havoc on life and trade.

At least nine people were killed and many injured as they stepped on power cables that had shorted in the driving rain.

The met office said 290 millimetres of rain fell in six hours to 7:00am. It is a record six-hour rainfall for the capital in 60 years.

The country's highest rainfall in 24 hours to 7:00am was 333mm in Dhaka. The second highest was recorded in Mongla at 169mm.

Meteorologists said a low formed in the Bay joined forces with monsoon

clouds and created a unique condition that caused such extraordinary rainfall.

They forecast the intensity will come down today, but the rain spell might continue till tomorrow.

The torrential pouring started at around 10 on Monday night. It soon submerged the city streets and alleyways, leaving hundreds of commuters stranded on their way back home.

With high winds and thunder, it snapped power and phone lines and making roads and sidewalks even more dangerous for late-night commuters.

People in the shantytowns were the worst sufferers. They found their huts under knee-deep water by 3:00am and had to take shelter in nearby buildings.

Most of those living on ground floors had to spend a sleepless night as they saw

water reach for their beds.

Attendance at the government and private offices was very thin. Shopping malls and other businesses had few shoppers as people remained indoors.

Children in most areas could not go to schools.

Though it meant sufferings for the downscale urbanites, the rain ended long dry spells bordering on drought, much to the relief of the farmers.

Of those who contacted live power lines, seven including a woman and a baby girl were in the capital and the rest two in Nalitabari upazila of Sherpur.

Shafiqul Islam, 35, and six-year-old Bristi died in the city's Kafrul area, Abdul Kader, 28, in Fakirapul, Jannatul Mawa, 35, in Demra, Shahin in Mohammadpur.

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Downpour halts life

FROM PAGE 1

and Bahar Uddin, 22, in South Kamalapur and Delwar Hossain, 30, in Jatrabari.

News Agency UNB reports that the Nalitabari victims are Azizul Haque, 55, and Muktarunnesa, 65. The two hailed from Haluaghat upazila in Mymensingh district.

As it poured all night the spectre of the floods that devastated Dhaka in 1988 and 1998 haunted the city dwellers.

Many commuters had to spend the night outside home as their vehicles could not reach destinations.

"I spent the night at a garage," said a newspaper reporter who lives in Katashur.

"As the CNG taking me home got on Dhanmondi Road-27, water leapt up to the seats. Shortly afterwards the engine stopped forcing me to take refuge at the garage in a roadside building," he added.

Most of the main thoroughfares including Manik Mia Avenue, Bijoy Sarani, Darus Salam Road, Airport Road, Rokeya Sarani, Mirpur-1, Mirpur Road, Outer Circular Road, Bijoy Nagar and the road in front of the Prime Minister's Office reeled under knee-to-waist-deep water for hours.

Passengers of the CNG-run auto-rickshaws had a terrible time as the three-wheelers stopped running without notice.

The rickshaws and auto-rickshaws that braved rainwater in the morning charged many times the usual fares.

Saiful Islam, a private firm employee, said it cost him Tk 200 to come to his office at Karwan Bazar from Mouchak.

Liton Ali of Kazipara in Mirpur said rickshaw-pullers charged Tk 50 for a ride that usually takes around Tk 5.

The manholes or potholes added to the sufferings as vehicles and pedestrians stumbled on them and fell in water.

Flights Cancelled

Two international flights—one of Malaysian Airlines from Kuala Lumpur and the other of Dragon Airlines from Hong Kong—failed to land at Zia International Airport Monday

they normally take to cross the Padma.

Other Districts

Our correspondents from different districts including Barisal, Khulna, Bagerhat, Satkhira, Pabna, Sylhet, Chittagong, Manikganj and Noakhali dispatched similar stories.

They said many thatched and mud houses caved in and the flimsy ones got blown away. Many areas plunged into darkness as electricity went out due to heavy rains.

Our Chittagong correspondent reports: Life in the port city came to a halt due to ceaseless rain.

Loading and unloading of cargoes were suspended at the port.

According to the Met office, over 156mm rainfall was recorded in Chittagong city in 24 hours to 4:00pm yesterday.

Loading of bulk cargoes has remained suspended at different jetties and the outer anchorage in the port area for the last two days due to rain, said port officials.

Vessel operation on the port channel however continued, said Chittagong Port Secretary Syed Farhad Uddin Ahmad.

Reclaiming of some city canals by the Chittagong City Corporation seemed to have prevented situation getting worse in rains.

People in low-lying areas like Muradpur, Bahodderhat, Nasirabad, Badurtala, Agrabad CDA residential area, Agrabad Excess Road and Halishahar however still had to face waterlogging.

DND Embankment

The low-lying areas inside Dhaka-Narayanganj-Demra (DND) and Narayanganj-Narsinghdi embankments have been inundated due to incessant rain, paralysing the life of several thousand people.

Many schools inside DND remained closed and production at most of the 1,000 industrial units suspended.

The water level in Shitalakhya, Meghna, Brahmaputra and Dhaleswari rivers continued to rise. The district administration apprehended that if rain continues

International Airport Monday night because of rain.

"The Malaysian flight is scheduled to fly in again tonight," said an official from ZIA yesterday evening.

Other flights however left the airport and landed there on schedule, he added.

Bus and Ferry Services Disrupted

Hundreds of motorised vehicles, including CNG-run auto-rickshaws, taxicabs and private cars, were stranded on the waterlogged roads for hours as their engines went out of order.

Meanwhile, only a small number of buses, trucks and auto-rickshaws came out on the roads yesterday, causing sufferings to those venturing out.

Besides, buses running between the capital and Mymensingh, Sirajganj and Tangail had to opt for Gabtoli road instead of the inundated Airport Road.

Ferry services on many routes were also suspended, disrupting bus service on highways.

Operation of launches and speedboats along Mawa-Kawrakandi route remained suspended for inclement weather.

Besides, over 500 vehicles were stranded on both ghats, as ferries were taking three to four hours more than what

district administration apprehended that if rain continues for next two to three days, the water level would go past the danger mark.

At least 300 houses and 400 shops and go-downs in a market inside Narayanganj-Narsinghdi dyke in Rupganj have gone under water causing a loss of several crores of taka.

Joynal Abedin, a resident of the area, said construction of five culverts on the link road was scheduled to be completed by January. But that did not happen, leading to waterlogging inside DND area.

Integrated water management a must to address waterlogging

Speakers tell discussion

STAFF CORRESPONDENT

Speakers at a discussion yesterday stressed the need for setting up an integrated water management project to avert water-related hazards, including waterlogging problem.

Disintegrated water management projects have brought economic benefits to one section of the society, while those have caused economic hardships to another section, especially poor people due to lack of environmental and equity considerations, they added.

Titled 'Equity consideration in water management: A crying need for social justice in

Bangladesh,' the discussion was organised by Bangladesh Paribesh Andolon (Bapa) at BIP conference hall in the city.

The speakers placed a six-point demand, including giving importance to environmental preservation and the livelihood opportunities of vulnerable groups in water management project, appropriate regulations and guidelines to ensure social justice and ensuring public participation in decision-making.

Other demands include cancellation of leasing system of water bodies, ensuring proper waste management, eviction of grabbers from the river bank and compelling industry owners for setting up effluent treatment plant.

Prof Jahir Uddin Chowdhury of Institute of Water and Flood Management at Buet called on the government to increase dependency on local experts instead of foreign consultants to formulate a water management planning.

He also called for introducing social science or social expectation course in all engineers' institutions to make the planners understand of our socio-economic reality.

Water control structures are to be made multi-functional to smooth agriculture, open water fisheries, navigation and ecosystem, he added.

Former director general of Warpo engineer Enamul Hoque criticised the government not to

make the water act draft public, putting a question to the government that why it is going to hold the meeting at Gazipur instead of Warpo building at Dhaka? There must be another motive behind meeting.

He demanded steps to introduce licence system among the public to use the water bodies instead of leasing.

Presided over by Bapa Vice-President ASM Shahjahan, also former adviser to a caretaker government, the discussion was also addressed by Brotee CEO Sharmin Morshed, Kabodak Rakkha Andolon President Rashidur Rahman Rashid and hydro geologist of Netherlands Remi Kempers.

Encroachers filling up Gulshan-Banani lake

TAWFIQUE ALI

A group of influential people have started encroaching upon the Gulshan-Baridhara-Banani Lake just after this government assumed power, taking advantage of the slack stance of authorities concerned.

Filling of the lake at Shahjahanpur Jheelpar, between Mariam Tower-1 and Gulshan-Shahjahanpur link road, has been going on for last two months in violation of the Wetland Conservation Act, 2000.

FM Abdul Haq Bhuiyan and his mother-in-law Sofia Begum have been filling an eight-katha piece of land on the Gulshan-Banani Lake at Karail (T&T colony) point for a month.

"The lake is identified as a lake in the Dhaka Metropolitan Development Plan (DMDP) and the layout of the lake is in accordance with Wetland Conservation Act," said Rajdhani Unnayan Kartipakkha (Rajuk) Town Planner Abu Hasan Mortuza adding, "Filling of the lake is illegal."

He said it is identified as a lake as it is inundated during the monsoon season.

Abdul Haq said, "It is not a lake, it is just a lowland under several feet of water." He claimed he is the owner of a piece of land there and he purchased it in 1983.

Mortuza said project director (PD) of the lake development and conservation is primarily responsible for the protection of the lake.

But PD Zahid Hasan Faruqi said he had nothing to do with the filling of the lake.

Rajuk Chairman Shafiqul Islam said they regularly file cases against filling of wetlands. "If needed, I will ask the PD to take further actions," Shafiqul said.

As many as 20 people, including real estate developers, an High Court (HC) judge, retired government officials, brother of a local ward councillor and an army officer, claimed ownerships of land at Jheelpar.

Bhuiyan claimed, "We are not filling a wetland, we are just developing a low-lying land. It

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Gulshan-Banani

FROM PAGE 16

is not a lake, it is a sewer."

Justice Abu Tarik, an HC judge, also claimed himself as the owner of the land and said, "If it is a part of the lake, the government can take it through due process."

They said the site was a part of an acquired property under LA case-138 in 1961. The government de-requisitioned it in 1992 without any gazette notification.

Haider Hossain of Ayub Properties said he bought a 10-katha piece of land in 1986. He claimed he had a deed. On how he obtained ownership of the land when the property was an acquired land, Haider said, "It is too a difficult question to answer...how did the government authorities concerned approve such document?"

Former chairman of the then Bangladesh Telegraph and Telephone Board (BT&T) Fazlur Rahman and his wife Sharmim Rahman said they have a deed of the land, which was made in 1983.

Tarafdar Rabiul Islam, a former UN official, said he bought a 10-katha piece of land in 1990. One Azizur Rahman Molla claimed he owned a 5-katha piece of land since 1986.

Monir Hossain, brother of Dhaka City Corporation ward councillor Anwar Hossain, claimed he owned a 4-katha piece of land there.

All the claimants said they have registered deeds, mutation records and tax receipts.

HC lawyer Tanjib-ul-Alam of Dr Kamal Hossain and Associates, however, said deeds made before de-requisition of land have no legal validity at all. De-requisition too has to be

gazetted, he added.

The Supreme Court, earlier, in a judgment directed Rajuk to demarcate the lake, acquire required land for conservation and maintain a certified layout of the lake.

Rajuk under its Tk-327.15 crore lake project proposed Tk 297.42 crore for land acquisition.

The Planning Commission of the planning ministry a couple of months back agreed that government would provide half of the project cost and Rajuk would provide the rest.

Office of the Deputy Commissioner (DC) of Dhaka will settle the claims over land once acquisition proposal is finalised, said an official.

30 October, 2008

TASK FORCE REPORT SUBMITTED TO GOVT

'Save Buriganga for sake of next generation'

BSS, Dhaka

The task force on saving the Buriganga river submitted its report to the government yesterday.

Task force Chairman Enam Ahmed Choudhury handed the report to Agriculture and Water Resources Adviser CS Karim at his secretariat office.

The government formed the task force on June 8 this year.

CS Karim said the task force recommendations would contribute a lot to saving the river to mark the occasion of 400 years of Dhaka as the capital. The work will begin soon to implement the recommendations.

The Buriganga must be saved for the sake of the next generation through implementation of the task force report, he said.

Karim said it poses a challenge to free the city's river from encroachers, end dumping of toxic effluents and increase its flow.

He said task force recommendations suggested that the Buriganga has not yet died. The plan of action has already been made and it only awaits implementation.

The chairman of the 11-

member task force said so much efforts have never been made to save the Buriganga.

"Dhaka is completing its four hundred years. We must save the Buriganga at this time by managing its banks, freeing them from encroachments and keeping it free from pollution, maintaining its normal flow and taking long-term measures to develop its navigation," Choudhury said.

The recommendations include review of lease on the river banks and terminating new lease, preventing dumping of industrial and other wastes in the river to keep it pollution free and maintaining its flow normal by excavation of canals.

Choudhury said already 2500 illegal establishments have been removed, and the Sutikholia and Shuvaddya canals have been reopened. Opening more canals has also been suggested.

The task force has had nine meetings and visited the river banks to prepare their report, he told a reporter.

He said a social movement should be built to create public awareness with the help of the local people and police help should be sought to manage the river banks.

He said recommendations have

been made to bring new water to the river. The Wasa should work with Rajuk so that it does not dump its wastes in the river.

The task force also suggested that the lands should be surveyed immediately to record them as the government property.

Notice should be issued to declare the boundary of Dhaka river port from Ashulia to Buriganga entry point at Dharmaganj, re-fixation of the limit of the proposed Mirkadim-Munshiganj river port on one side at Buriganga point to Gopchar of Shitalakhyia and on other side from Betka to Munshiganj launchghat.

The recommendations include limiting Tongi river port from Demra to Ashulia, expansion of BIWTA Tongi port, setting up of river police outposts at different places around Dhaka city including Buriganga and along the river ways under the police stations of the city.

Besides, the recommendations have been made to widen the Water Development Board embankment road by at least 80 feet, expansion of the BIWTA project to improve the river ways around Dhaka from Ashulia to Tongi, removal of huts and bazars set up by local government bodies on the river banks,

removal of religious and educational institutions through discussions with the local parliament members within six months.

Other recommendations include short and medium term projects to implement them within three years so that Dhaka City Corporation and Wasa take measures not to dump wastes or sewers in the river.

The task force recommended removal of tanneries from Hazaribagh elsewhere and taking up projects for implementation within three years so that other industries do not dump their wastes in the river, restriction on dumping wastes in the Buriganga and making it compulsory to take clearance from BIWTA to set up any establishment within 50 metres of the river banks, banning brickfields within 200 metres and initiating 'save the river' campaign in the media.

Apart from these, some long-term measures have also been suggested to maintain river flow and keep navigation normal like dredging of the Dhaleswari, Karnali rivers and river ways to Buriganga round the year and keep the river flow on with water flowing from the Jamuna and restoration of the navigation.

27 July, 2008

Free Turag from encroachment Demands Bapa

STAFF CORRESPONDENT

Bangladesh Paribesh Andolon (Bapa) yesterday called on the government to take immediate steps to make the river Turag and Tongi canal free from encroachers and pollution.

A team of Bapa placed the demand during a demonstration on Kamarpara bridge at Ashulia.

Earlier, the team found out that the process of encroachment is going on in many points along the Turag river.

They also witnessed many incidents of river pollution while carrying out monitoring activities through a boat rally on the river.

The boat rally, which started from BIWTA landing station at Ashulia at around 10:30am, travelled from Kamarpara bridge to Trimohoni and the Tongi canal. Bapa Vice President Prof Kazi Madina led the team.

During the journey, the Bapa team noticed that the Turag river was filled up in four points in the adjacent areas of Taltala Ghat.

They also found out that many areas of the river from Kamarpara Bridge and Trimohoni are being encroached and that there are activities leading to pollution of the river.

They witnessed the process of encroachment on both sides of the river near Biswa Jitendra

ground, at East Abdullahpur and the adjacent areas of Tongi road and rail bridges.

The team also noticed that wastes from industrial units, houses, kitchen markets and hanging toilets along the banks of the river are continuously polluting the water.

Later, the team staged a demonstration on Kamarpara bridge to protest the encroachment.

Speaking on the occasion, the team members criticised the authorities for their indifferent attitude to encroachment and pollution activities.

Prof Kazi Madina, Dr Md Abdul Matin and Iqbal Habib spoke at the demonstration.

HC outlines steps to protect city lakes

Asks govt to evict encroachers, carry out survey on Gulshan-Baridhara-Banani lakes

STAFF CORRESPONDENT

The High Court yesterday issued a set of directives to the government for preserving and protecting Gulshan-Baridhara and Gulshan-Banani lakes in the capital from illegal encroachments and structures and to shield the environment.

The HC said surveys should be conducted to demarcate the lakes. It asked the government to identify and evict all illegal occupants and demolish temporary and permanent structures

on the lakes. The court ruled that the surveys and evictions must be done by January 31, 2010.

It, however, said, "If there are legal and authorised occupants, they should either be provided with plots or alternative rehabilitation along with compensation for their loss."

The HC bench of Justice ABM Khairul Haque and Justice Mohammad Momtazuddin Ahmed also directed the government to inform the court about the implementation of the directives by February 15, 2010.

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HC outlines

FROM PAGE 1

It ruled that the government and Rajdhani Unnayan Karttripakkha (Rajuk) would have the liberty to take legal actions against encroachers and illegal occupants by filing compensation suits against the perpetrators.

The court directed police and other law enforcement agencies to cooperate with Rajuk in completing this job.

The surveys will be done with the help of deputy commissioner of Dhaka and the director general of Department of Land Record, its a. J. The director general of the Department of Environment will ensure that environment laws are maintained during this job, the court said.

The court fixed February 22, 2010, for issuing possible further orders on the matter.

The HC directives came after Kazi M Mosharraf Hussain, executive secretary of Gulshan Society, a registered development organisation, filed a writ petition in this regard in May this year.

The bench in the order said the case would continue in the court until the directives are implemented. It said any parties concerned in this case could appear before the court any time for any necessary court order to protect the lakes.

The petitioner stated that land of Gulshan-Banani and

Gulshan-Baridhara lakes are being encroached upon at many places and some pieces of land have already been grabbed.

The banks of the lakes are being filled and buildings and temporary structures are being erected there. People are even filling the middle of lakes, the petition said, adding that the perpetrators are adopting various techniques to gulp the lakes.

It said the lakes are shrinking every day and the result of which would be devastating and dangerous for the environment of the area.

It stated that Rajuk failed to prevent criminals from encroaching upon the lakes, which was a blow to the preservation of city dwellers' interest.

Repeated violations of laws or non-implementation of laws by the authorities concerned undermine the rule of law and jeopardise people's fundamental rights to life guaranteed in the constitution, it added.

The petition sought from the HC directions for the authorities concerned for taking immediate steps to protect and preserve the lakes.

Barrister ABM Siddiqui Rahman Khan moved for the petitioner while Deputy Attorney General Mostafa Zaman Islam stood for the government.

Appendix-E
Photographs from Study Area Regarding Wetland Change



Photograph 1 Land filling in the Turag River



Photograph 2 A large lowland area is filled by a PLDC beside the Buriganga river



Photograph 3 Encroachment in Gulshan lake by unauthorized structure



Photograph 4 Unplanned urbanization in the study area



Photograph 5 Solid wastes are disposed in lowland area



Photograph 6 Solid wastes are disposed in the river Buriganga



Photograph 7 Unauthorized structures in the wetlands beside the river Turag



Photograph 8 Dredger are used to fill up the lowland

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