

**EFFECTS OF LAND USE CHANGE ON DRAINAGE AND  
RETENTION PONDS IN THE WESTERN PART OF DHAKA CITY**

By

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**MASTER OF URBAN AND REGIONAL PLANNING**

DEPARTMENT OF URBAN AND REGIONAL PLANNING  
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

JUNE 2010

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**A thesis submitted to the Department of Urban and Regional Planning in  
partial fulfillment for the degree of Master of Urban and Regional Planning**

DEPARTMENT OF URBAN AND REGIONAL PLANNING  
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

JUNE 2010

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the Western part of Dhaka City

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## **Candidate's Declaration**

I hereby declare that this thesis has been prepared in partial fulfillment of the requirement for the degree of Master of Urban and Regional Planning at the Bangladesh University of Engineering and Technology, Dhaka and has not been submitted anywhere else for any other degree.

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*Dedicated to*  
*My Respected Teacher*  
*A.S.M Mahbub-un-Nabi*  
*Professor, URP, BUET*  
*Thank you for your love and inspiration*

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**Bivash Das**  
**June, 2010**

## Abstract

Urban flooding in Dhaka city is a common phenomenon which reflects the poor management & development planning regarding wet land preservation. Dhaka has experienced major floods in 1954, 1955, 1970, 1974, 1980, 1987, 1988, 1998 and 2004. About 77% areas of Dhaka City were submerged and about 60% of the city dwellers were directly affected by the terrible flood of 1988. Several studies carried out in 1988-89 to develop a comprehensive flood policy and Program for Bangladesh, including Dhaka City. Based on the study results, Flood Action Plan (FAP) was formulated. In support of Government's flood action program, Dhaka Town Protection component, FAP-8 was formulated which consist of two parts FAP-8A & FAP-8B. FAP-8B is covered with 136.5 sq. km of western part and FAP-8A is covered with 128.5 sq. km of eastern part of Dhaka City.

This research has encompassed mainly the western part of Dhaka City. This study has attempted to explore the land use changes and also the cause and effects of land use changes on FAP-8B proposal in the western part. Land use changes have been analyzed through Satellite Image Interpretation and physical feature data analysis. The study area is the main built-up area of the Dhaka City. Major land use in the western part is residential about 51% and it consists of 73.6 % population of DCC area. Most of the study areas are affected by water logging and flood. Unplanned physical intervention of the natural drainage system is the main reasons for flooding. The socio economic condition and development pattern or trend of the infrastructure development pattern has imposed significant impact on the land use changes.

During 1989 to 2007, wetland areas have been decreased nearly 22% to 12%. From the year 1989, on an average 2.5% wetlands have been decreased. FAP-8B proposed about 4.5% area of total land for retention pond in the western part but now exist only 1.79%. About 6.71% of the Kallayanpur retention ponds areas are now using as water body. Out of 14 khals, 13 khals within the western part are encroached significantly and the encroachment is about 34% of its total area. The result reveals the rapid rate of wet land degradation and unplanned infrastructure development.

Three pump stations of FAP-8B proposal in mention location have constructed during different time period but not properly maintained. These pump stations are closely related with the prevention of seasonal flooding or urban flooding of western part. This research has also compared the operation and management strategies followed in the three pumping station areas. Analysis reveals that Goranchatbari Pump Station is well-functioned and well managed (using for fisheries and agricultural purpose) than other two pump stations. Considering the operation and management strategies BWDB has shown better performance than DWASA although 2 pump stations are operated by DWASA. Reservoir area of Goranchatbari shows best performance considering its land use control and economic contribution.

Spontaneous development, lack of management work and coordination, lack of proper policy guidelines & implementing authorities are main reasons for decreasing of retention ponds and natural drainage channels. Therefore, the concerned authorities need to take appropriate measures immediately like development control to save retention ponds, improve natural drainage system and water bodies, develop Community Based Waste Management System Development, Drainage Capacity Adjustment, Comprehensive Drainage Development Plan, Multipurpose use of retention pond areas etc. to overcome the situation.

Finally, with some relevant recommendations regarding wet land preservation, this research has been ended as a strong basis for further analysis for the researchers as well as policymakers.

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## List of Acronyms

ADB	Asian Development Bank
BIWTA	Bangladesh Inland Water Transport Authority
BNHA	Bangladesh National Housing Authority
BUET	Bangladesh University of Engineering & Technology
BWDB	Bangladesh Water Development Board
CBD	Central Business District
DAP	Detailed Area Plan
DC	Deputy Commissioner
DCC	Dhaka City Corporation
DIFPP	Dhaka Integrated Flood Protection Project
DIT	Dacca Improvement Trust
DMAIUDP	Dhaka Metropolitan Area Integrated Urban Development Plan
DMDP	Dhaka Metropolitan Development Plan
DND	Dhaka Narayanganj Demra
DOE	Department of Environment
DPHE	Department of Public Health and Engineering
DPZ	Detailed Planning Zone
DSMA	Dhaka Statistical Metropolitan Area
DWASA	Dhaka Water and Sewerage Authority
FAP	Flood Action Plan
HSD	Housing and Settlement Directorate
JICA	Japanese International Cooperation Agency
KPI	Key Point Installations
LGED	Local Government Engineering Department
MHPW	Ministry of Housing and Public Works
NGO	Non Government Organization
NHA	National Housing Authority
RAJUK	Rajdhani Unnayan Kartripakkha
REHAB	Real Estate and Housing Association of Bangladesh
RS	Revenue Survey
SP	Structure Plan
SPZ	Special Planning Zones
UAP	Urban Area Plan
UNCHS	United Nations Conference for Human Settlement
UNDP	United Nation Development Plan
ZIA	Zia International Airport

## **Chapter One: Introduction**

### **1.1 Background of the study**

One of the major natural disasters in Bangladesh is flood. It occurs almost every year threatening rural and urban inhabitants. Even in a normal flooding event, the death and the amount of economic loss is very significant leaving heavy burden on national budget which depends on international support. Because of Bangladesh's low elevation, between 30 and 70 percent of urbanized and agricultural areas are generally inundated during part of the monsoon season. Dhaka has experienced major floods in 1954, 1955, 1970, 1974, 1980, 1987, 1988, and 1998 due to the over flow of surrounding rivers (Huq and Alam, 2003). During 1988 flood, about 77 percent areas of Dhaka City (total area 260 sq. km) were submerged to depth ranging 0.3 to over 4.5 meter and also about 60 percent of the city population was directly affected by the flood. Elimination of water storage areas by land filling is one of the major causes of rainfall flooding and drainage congestion in many locations in the western part of Dhaka City. This is also another reason (Chowdhury et al., 1998).

Several studies have been carried out in 1988-89 to develop a comprehensive flood policy and program for Bangladesh, including Dhaka City. Based on the study results, Flood Action Plan (FAP) was formulated under the coordination of the World Bank in November 1989. In support of government's flood action program, both the government of Japan and the Asian Development Bank were agreed to provide assistance for Dhaka Town Protection component, FAP-8. This is a two part coordinated action plan namely FAP-8A & FAP-8B. The project "FAP-8B" is covered 136.5 sq. km of western part and "FAP-8A" is covered by 128.5 sq. km of eastern part area for continuing development by phase-I and phase-II respectively over 10 to 15 years (JICA, 1991).

Under the project "Phase-I (western area)" was completed in 1997. The FAP-8B proposed for rehabilitation and upgrading of 21 major khals with total length 78.6 km. Improvement through rehabilitation of internal drainage khal and construction of storm drainage were important activities under the plan. Construction of Pump Station No. 3, at Goranchatbari for west part was also prioritized. In addition, the Urban Area Plan under the Dhaka Metropolitan Development Plan for the period 1995-2015 specifies (12% retention pond areas) requirement for retention of storm run-off in the storm water

management area. The retention pond area either should be: (i) a lake situated adjacent to the embankment/pumping station at the lowest location, (ii) a network of connected widened khals that meet retention requirements, or (iii) a combination of the above alternatives (DMDP, 1995-2015).

The Master Plan for Dhaka City flood protection recommends a compartmentalization concept to prevent river flooding. West part of the Dhaka City is divided into 2 compartments (JICA, 1991). Internal rainfall runoff of the compartments is drained to the river by pump stations at the outfall of the main drainage channels. During the disastrous flood of 1998, Dhaka Western part showed successful mitigation measure than any other affected part of the city areas but failed to take its full strength protective measure. In 1998 flood, water entered into the protected part of the city through hydraulic leakage such as buried sewerage pipes, breached and incomplete floodwalls, un-gated culverts and inoperative regulators. The drainage network and retention ponds of the city were found to be in poor conditions and capacities of the pumping stations were found inadequate (Faisal et al., 2003).

In order to improve water logging problem, 21 khals have been developed and 50 km of storm sewer have been rehabilitated or constructed in different parts of the city. Permanent storm water pump stations have been constructed at the out fall of Dholai khal, Kallayanpur khal and at Goranchatbari on Digun khal with capacity of 22m<sup>3</sup>/sec, 10m<sup>3</sup>/sec and 22m<sup>3</sup>/sec respectively. Due to inadequate internal drainage system, performances of the Dholai khal and Kallayanpur pumping stations have become unsatisfied. On the other hand, Goranchatbari pump station is well managed and more effective. This research has been conducted focusing the existing situation of the retention pond areas and its connected natural drainage/canals. This study has tried to find out causes of land use changes and its effects on FAP-8B proposal within the Dhaka western area. In addition, it has also attempted to make a rational comparison among three pump stations which is intermingled with the urban flooding problem.

## **1.2 Objectives**

The research has been conducted to fulfil the following objectives:

1. To investigate causes and effects of land-use changes on FAP- 8B proposal
2. To compare operation and management strategies followed in the three pumping station areas



### **1.3 Rationale of the study**

Dhaka is an unplanned and one of the most populated cities in the world. It has been many years that the city dwellers suffer immensely from water logging during rainy season and even after a moderate rainfall in other seasons. Rainwater cannot easily percolate down the ground in absence of open space. The rainwater is drained out only through underground and open drainage systems. Due to land filling activities, many drainage channels cannot carry rainwater to big canals or rivers. The surface drains, storm sewerage and canals, through which rainwater is supposed to flow to the retention ponds, are clogged with household or industrial wastes or blocked by encroachers.

Dhaka was established in 1610. In 1917, Sir Patrick Geddes, a British town planner designed Dhaka. Then, Dhaka Master Plan of 1959 and Dhaka Integrated Plan of 1981 were prepared which proved themselves effective from water management point of view, by Shankland Cox. Recently, Flood Action Plan (FAP, 1992) 8A & 8B and DMDP (1995-2015) have been also formulated considering this context. In all these plans, the waterways, water bodies and flooding are the crucial aspects which play a vital role to maintain the ecological balance. But most of the plans had never been approved or implemented.

This study has attempted to assess the success and short comings of FAP- 8B regarding land use change after its implementation period which reveals the existing condition of retention pond and natural drainage channel in western part of Dhaka. For this, development pattern and its effects on retention pond and natural drainage system of the study area have also been analyzed. At last, the study has demonstrated the strength and weakness of the pumping stations which explores operational procedures and its overall management.

This research will facilitate in formulating policy guide lines for proper development considering flood protective actions in greater Dhaka City. It can be considered as an effective basis for the concerned authorities to review existing policies and strategies related with flood control. Finally, the recommendations and suggestions based on the existing situation will ensure the protection of retention areas and drainage channel to safeguard the city from water logging and environmental degradation to some extent.

## **1.4 Scope and Limitations of the study**

Some limitations have been encountered during the study period to conduct the research work according to the selected objectives. These limitations are described below:

- Very few studies were conducted related to land use change on drainage and retention ponds of Dhaka City. As a result, there is lack of literatures to enrich the analysis of this study by reviewing their study findings.
- The study fully depends on spatial data. The study has failed to accumulate all relevant maps. Maximum maps are indicative. Moreover accuracy levels of the maps are very low. On the other hand the management authorities have failed to provide correct information due lack of knowledge and storage of data and maps.
- There is lack of secondary data on natural drainage system (khals) and retention ponds in terms of width, length, depth, capacity, pick flow rate, drainage coefficient etc. and their layout. Therefore, it is not possible to accomplish hundred percent accuracy of the data analysis.
- During the FGD, some participants are reluctant to make any comments against the responsible development authorities but they know the lack of efficiency of those authorities, because they think that any negative comments would be harmful for them in near future.
- Encroachment issue is very sensitive, during the field investigation little cooperation carried out by the local stakeholder.

## **1.5 Literature review**

Land use change of drainage and retention ponds in the Dhaka City is a common and continuous practice. But few studies have been conducted in this context and on its related issues like water logging, urbanization, drainage system etc. Some relevant studies which have been already conducted are described below:

According to the project report of “Rehabilitation of Dholai Khal” project, before 1947, storm water of Dhaka City drained out through different natural canals but after that, the spontaneous development of the city without any Master Plan causing depletion of natural drains. In 1964, Dholai khal was filled for carrying out development works without considering logging which turned out as a major problem (DWASA, 2000).

Huq and Alam (2003) described that after implementation of the flood control project in the western part of Dhaka, unplanned and uncontrolled expansion of urban area stretched rapidly towards the low-lying areas adjacent to the flood protection embankment. These are deeply flooded floodplain areas near the river. The residents in these lowlands suffer from inundation due to accumulation of rainwater after heavy rainfall. Land development through land filling process in these 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 which is adversely affecting the residents in those areas.

Bari and Hasan (2001) investigated the impact of land use changes due to urbanization on storm runoff characteristics in the eastern part of Dhaka City. It has been found that peak rate run-off volume increases with growth in urbanization. Most of the low lying lands, which once acted as retention basin, have been filled up. As a consequence, runoff volume is increasing with increase in built-up area in Dhaka City.

Chowdhury, J. U. et al. (July, 1998) shown from the analysis of rainfall data that the spatial variability is quite large. The areal reduction factor is likely to be substantially lower than that used in the storm water drainage master plan for Dhaka City. Analysis of storm rainfall and runoff data indicates that the initial loss is much higher than those expected in cities in developing countries. The runoff ratio and runoff coefficient are found substantially smaller than those used in the storm water Drainage Master Plan for Dhaka City. There are domestic wastewater discharges in the storm sewers and the relative magnitude was highest in the unplanned high-density residential area. Deposition of solid materials and rubbish is larger in the surface drains than that in the underground sewers.

In Dhaka, around 49 housing projects have been identified without approval within flood plain zones and sub-flood plain zones earmarked in the DMDP covering around 9,241 acres of land (The Daily Star, Feb 18, 2007). In Dhaka, yearly rate of loss of wetland during 1989-1999 periods was 1.23 percent whereas during 1999-2003 periods the rate was 5.67 percent. Dhaka is still left with 19.3 percent of wetland. If the current rate of loss of wet land continues, by the year 2037 all temporary wetlands of Dhaka will disappear (The Daily Star, May 19, 2006).

Different countries are applying different policies, laws to save this valuable resource. Many states declare in the constitutions that all waters within their boundaries are the property of state. The state may then allocate the water rights through an administrative system. In USA, for example, a person who wants to use water submits an application to the appropriate agency, stating the source, method of diversion and intended use of water. The actual water right is not vested until the water is diverted to a beneficial use (say, irrigation). The water quantity and quality depends on given purpose and on priority date (the date of first beneficial use or the date of application). In dry season, some owners may get no water at all due to have older water rights to take water first. According to Spanish water law, No one shall use water or deteriorate natural water resources for own private benefit which is against the interests of the community or obstruct any stream of importance (Sterner, 2003).

## **1.6 Operational Definition**

- CS Map : Cadastral Survey (CS) map prepared for all over Bangladesh based on the survey from 1912 to 1915. People use these maps to find location and actual area of land in the field.
- DMDP : Dhaka Metropolitan Development Plan, a Package of Structure Plan, Urban Area Plan and Detailed Area Plan were prepared to develop Dhaka City in a planned way for 20 years (1995-2015). The project was one of UNDP's aided projects implemented in cooperation with UNCHS/HABITAT in Dhaka.
- Drainage System : Channels, either constructed or natural, passes through surface or underground or both that are usually used to drain out the flood or rain water.
- Kutchha : A term locally used for earthen infrastructure or structures made with mud, bamboo and thatch.
- Khals : 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. Begunbari khal, Dholai khal, Shegunbagicha khal etc. are some major khals in Dhaka City.

- RAJUK** : Rajdhani Unnayan Kartripakkha (Capital Development Authority) is the planning and development management authority of Dhaka Mega City. It was first established in 1955 as DIT and bestowed with the responsibility of implementing Dhaka's first Master Plan. As present implementing the DMDP-a twenty years plan consisting of different components for the development and growth of Dhaka- is RAJUK's major responsibility. RAJUK's geographical area now covers 1528 sq. km.
- Retention Area** : Natural or man-made depression usually reserved in urban area to retain the flood or rain water.
- RS Map** : Revenue Survey (RS) map prepared for different part of Bangladesh based on the survey from 1966 to 1975 to collect revenue by the Government.
- Reservoirs** : Large tanks and ponds, Dighis, lakes etc. serve as immediate detention areas for storm water. These are man-made and also natural; and these may be privately owned or government owned or khas land. These structures function as drainage relief and source for water for emergency use, fisheries, environment and nature preservation.
- Water logging** : Flooding in built up areas caused by rainfall, where water remains stagnant for long time due to lack of proper drainage system and creates many adverse impact on daily life.

## **1.7 Outline of the Methodology**

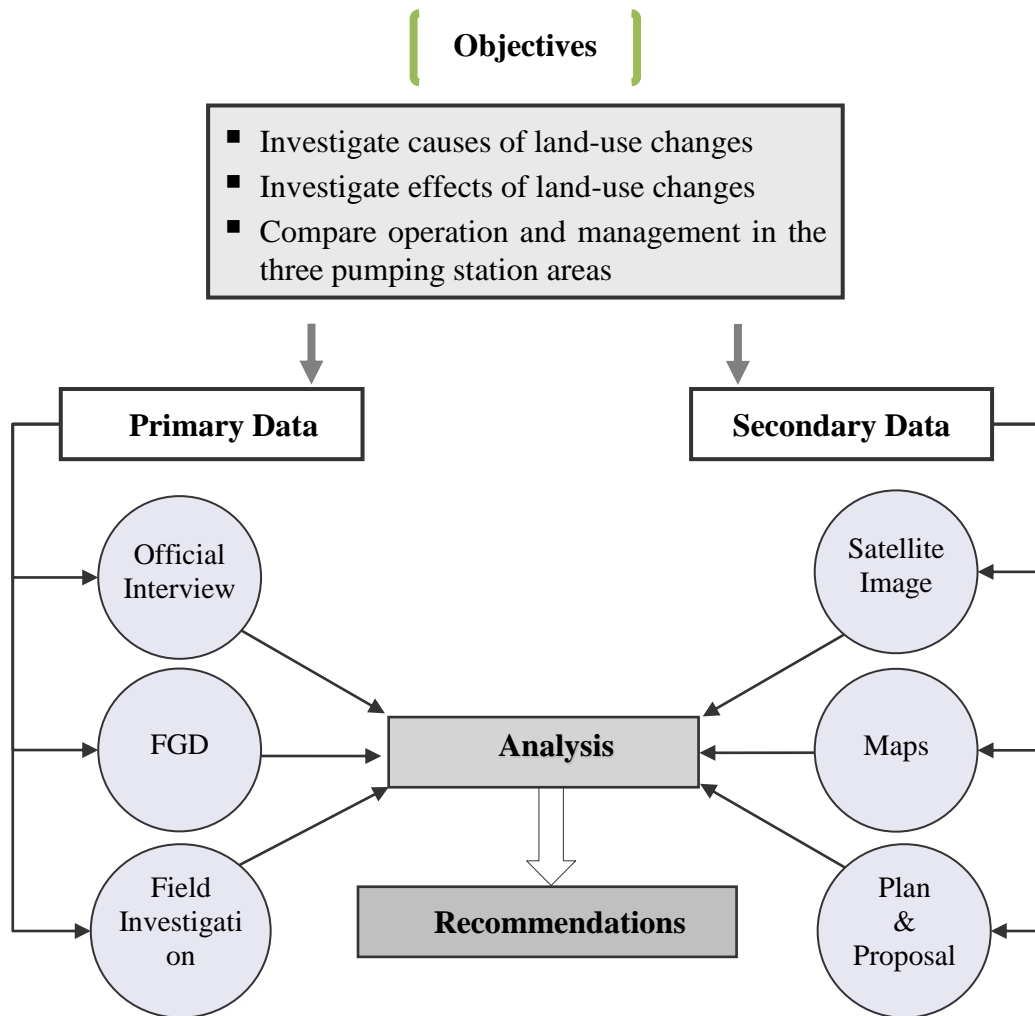
Methodology is the systematic and logical study of the principles guiding scientific investigation. This study has maintained a systematically well arranged methodology for the achievement and successful accomplishment of the research work. The research methodology has followed in this study is self explanatory. The following methodology has adopted to fulfill the desired above objectives.

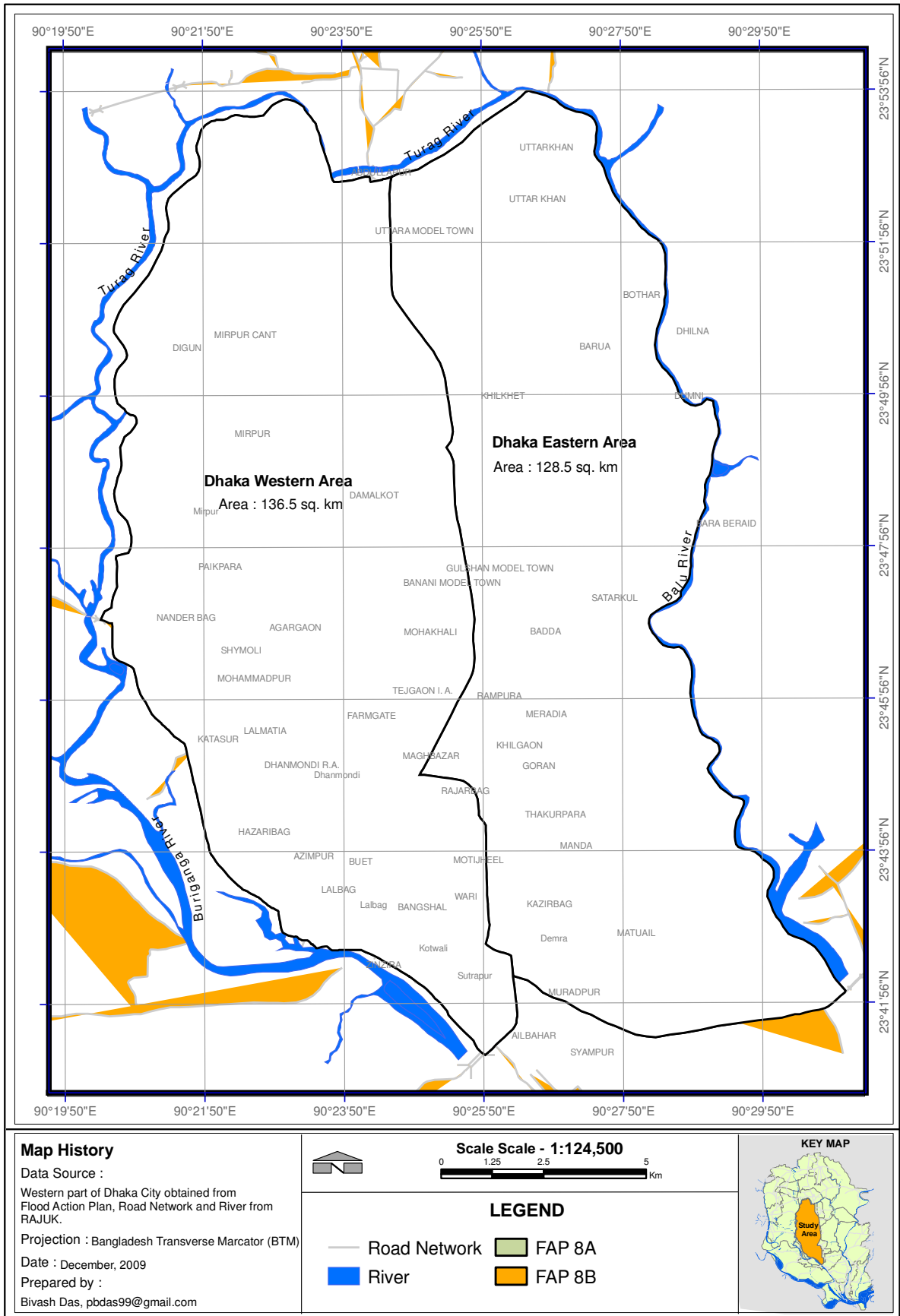
### **1.7.1 Selection of study area**

The study area is surrounded by Progati Sarani on the east, Turag River on the west and north and Buriganga River on the south, covering about 136.5 sq. km (Map 1.1). The study area is under the jurisdiction of the Dhaka City Corporation (DCC). Within 90 wards of DCC the study area comprised of 73 wards (29,246 acres) where two wards namely 22 and 58 are partially included. The study area is also recognized as FAP-8B west area.

The western part of Dhaka City has been selected for this research where significant land use change is quite apparent due to frequent intervention of different actor's namely different departments of government, individuals, private housing societies and developers. After construction of embankment around the western perimeter, this area has been rapidly urbanized. Existing three pumping stations of Dhaka City namely Goranchatbari, Kallyanpur and Dholai khal pump stations are located in the western area which is also the main concern of this study. So, this context is quite suitable to conduct this study and fulfill the objectives of the study. Therefore, an in-depth study has allowed discerning the land conversation process in the FAP-8B area and the significant impact on land use change of FAP-8B proposals.

**Figure 1.1: Flowchart of the thesis Methodology**





**Map 1.1: Location of the Western Part of Dhaka City**



### **1.7.2 Data collection**

The study requires a large amount spatial data and other relevant aspatial data. Most of the spatial data has been collected from secondary sources (from government offices, organizations, reports etc). To understand existing scenario and impact of development, an interview and focus group discussion have been conducted through systematic procedure. For data collection two steps have been considered e.g. i) Primary data collection (focus group discussion and field observation) ii) Secondary data collection (maps, images, photographs and relevant documents).

#### **1.7.2.1 Primary data collection**

As evident from the objectives stated in section 1.2 this study is also based on data collected from primary level of investigation. Under this research, brief discussion have been conducted among the officials of relevant departments who are involved in planning and management of FAP-8B project e.g. Bangladesh Water Development Board (BWDB), Dhaka Water and Sewerage Authority (DWASA), Rajdhani Unnayan Katripakha (RAJUK), Dhaka City Corporation (DCC) and others development organizations. In addition, focus group discussion has been conducted among local inhabitants. The questionnaires for different organizations are shown in Appendix: A.

#### **Focus group discussion**

Three FGD have been conducted to explore the causes and effects of land use changes. The group discussions with the inhabitants of Goranchatbari (FGD-1, No. of respondents: 11), Kallayanpur (FGD-2, No. of respondents: 17) and Dholai khal at Sutrapur (FGD-3, No. of respondents: 10) have been conducted between June-December, 2009. Total 38 respondents took part in these discussion sessions. The focus groups consisted of participants from different social groups namely the household's owner, elites of the locality, service holder, businessmen, students, officials of the pump station and others. Discussion has been conducted on study related issues like natural drainage, land use change, water logging of the study area etc.

#### **1.7.2.2 Secondary data collection**

The secondary data includes Flood Action Plan, Detailed Area Plan, Maps, Remote Sensing (RS) Image and other relevant literature those are collected from concerned

authorities and different offices. The RS Images were acquired during different time period e.g. TM of 28 Feb., 1989, ETM 28 Feb., 1989 and IKONOS of 8 Aug., 2004 and 10 Oct., 2007. The maps include FAP-8B proposed map, topographic map, land use map and physical feature map. Relevant literatures like published and unpublished thesis, books, newspapers, ordinance/policy etc. are also reviewed. Land use changes of retention pond and khal areas have been examined from map and image analysis.

### **1.7.3 Data Analysis and Report Preparation**

Different computer software have been used in data processing and analysis e.g. SPSS (Statistical Package for Social Sciences) version-11, Microsoft Excel (Version - Office XP) and Crystal Report. Spatial data analysis conducted with GIS softer like PC Arc Info 3.5.1, Arc View 3.2a and Arc GIS 9.0. The attribute data and maps have been developed through an integrated database concept.

## **1.8 Organization of the Study**

The thesis is organized in 7 chapters. The first chapter contains the background, rational, scope and limitation, literature review and the method to carry out the study. Statements of the problems pertinent to this study are explained in background. Necessity of the study is clearly highlighted and also specified short comings of the study. In Chapter-2, the history of Dhaka City and relevant development plan and policies on flood control are presented thoroughly. Chapter-3 represents necessary information on the study area or study area profile relevant to the thesis work. In chapter-4, the detail information on land uses changes based on analysis of satellite images of Dhaka City. Chapter-5 describes causes of land use changes and consequences on FAP-8B proposal have been stated which is the first objective. To fulfill the second objective Chapter-6 incorporates the operational and management procedures of the pump stations which reflect the effectiveness and weakness of these pump stations. At last, Chapter-7 includes the conclusion with necessary recommendations to improve the existing situation of retention pond areas and natural drainage pattern of the city and the summary of the whole research.

## Chapter Two: Dhaka City and Development Policies on Flood Control

### 2.1 Introduction

This chapter contains a brief discussion on development policies for Dhaka City in the last 50 years. The history of policies is classified according to the different ruling periods; development areas and population. This chapter also includes a brief description of the plans and policies related to flood control in the western part of Dhaka City and intends to explain the statements and recommendations of previous plans and policies relevant to the study.

### 2.2 Historical background of the city

Dhaka City has developed over a long span of time. During the early Mughal rule, the city covered an area of about 2.20 sq. km and was confined within the small continuous zone of the present old city. During the rule of the Mughals, Dhaka City grew in north-western direction. At that time, the city extended from the Buriganga River in the south to Tongi Bridge in the north, a distance of about 25 km and from Jafrabad (Sarai Jafrabad) in the west to Postagola in the east, a distance of about 15 km and the city had a population over a million (Travernnier, 1925). In 1867, the urban area expanded with a total area of 10 sq. km and a total population of 51,635. The urbanized area started to expand towards the north on the Pleistocene terrace which was high lands, mainly used for residential and recreational purposes. (Asaduzzaman, 1997)

**Table 2.1: Population and Area of Dhaka City (1700-2001)**

Year	Periods	Population	Area (sq. km)
1608	Pre-mughal	30,000	2
1700	Mughal period	900,000	40
1800	British period	200,000	4.5
1867	British period	51,636	10
1901	British period	104,385	20
1931	British period	161,922	20
1951	Pakistan period	411,279	85
1961*	Pakistan period	718,766	125

<b>Year</b>	<b>Periods</b>	<b>Population</b>	<b>Area (sq. km)</b>
1974	Bangladesh period	2,068,353	336
1981*	Bangladesh Period	3,440,147	510
1991*	Bangladesh period	6,887,459	1353
2001*	Bangladesh period	10,712,206	1530
1981**	Bangladesh Period	2,475,710	50 sq. mile
1991**	Bangladesh Period	3,839,000	54.5 sq. mile
2001**	Bangladesh Period	5,399,880	225 sq. mile

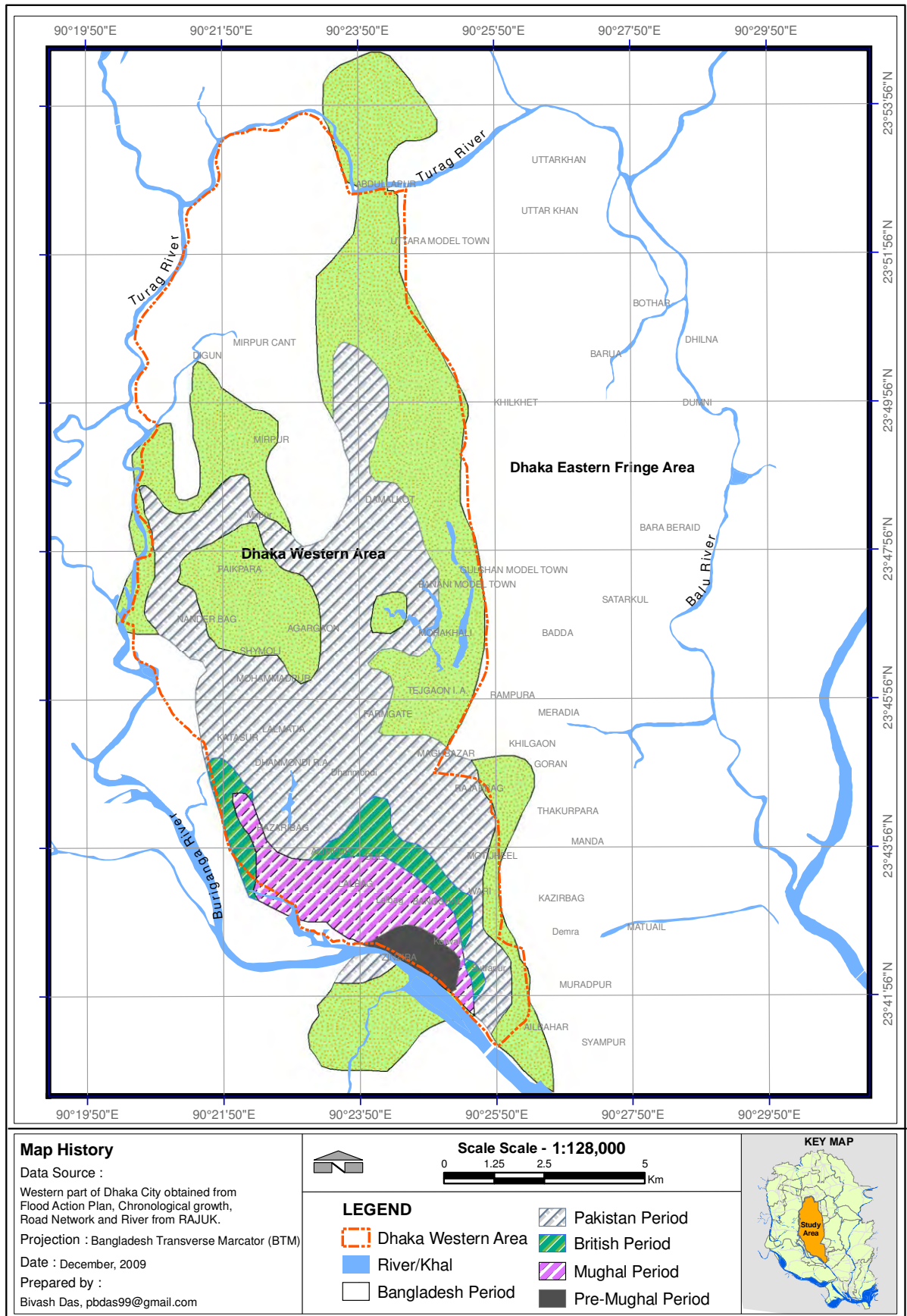
(Source: J. Taylor, 1840; BBS, 1977, 1991, 2001; Urban Area Report, 1997)

\* DSMA: Dhaka Statistical Metropolitan Area, \*\* DCC: Dhaka City Corporation

In 1941, the population of Dhaka was more than 200,000 and in 1947, it exceeded 250,000. The growth of Dhaka City gained momentum again after 1947. During this period, DIT was established in 1955 (which was later transformed into RAJUK in 1987) for supervision of the overall planning and development control of the city. Beside different urban development projects, DIT developed a number of residential areas to meet the housing needs of the city dwellers. CBD was also developed to meet the demand for space required for increasing commercial and government administrative activities. Initially, official, educational, residential and administrative spaces were fulfilled by the expansion of the city from Purana Paltan to Naya Paltan, Eskaton to Mogh Bazar, Siddiheswari, Kakrail to Kamlapur through Razar Bagh and Shantinagar. Segun Bagicha, Azimpur, Mirpur, Mohammadpur, Shre-e-Bangla Nagar, Tejgaon, Gulshan Model Town and other areas were developed between 1950 and 1960. Banani and Gulshan areas were also acquired by the government in early sixties under the 1959-Master Plan of Dhaka City. During 1959 Master Plan preparation period, the city area and population was 320 sq. miles and 1 million respectively. Later in 1995, the Dhaka Metropolitan Development Plan (DMDP) area was 590 sq. miles with population of 6.8 million.

Dhaka has also experienced the largest increase in population in the country during the last few decades. The city had 28.68 percent of the total urban population of the country in 1991. The growth rate of population of the city during the last few decades has been quite spectacular. Map 2.1 represents the growth of Dhaka City in between 1600 and 2001 (Hafiz, Jahan and Khan, 1997).

In case of Dhaka, it has never been possible for Government to keep balance between growing demand and supply. So, Government has failed to provide adequate housing facilities and job opportunities for city residents. As a result, large areas of unplanned housing and squatter settlements have been emerged in the northern part of the city. Private housing is also being developed in low lying areas to the east and west. In this way, a large part of the low lying areas, canals and water bodies are rapidly being disappeared due to these unplanned activities (Hafiz, Jahan and Khan, 1997). Therefore, all Low lying areas and natural water bodies demarcated as retention ponds for flood water or identified as flood flow zones are being filled up by land developers which cause increased vulnerability against floods.



**Map 2.1: Chronological growth of Dhaka at different time period**

## **2.3 Development plan and policies**

From the beginning of the history of Dhaka to the present day, the attempt to restrict the city development in a planned way had been taken in several times. This endeavor resulted some development plan and policies for the city. Some of the related issues regarding this study are depicted below:

### **2.3.1 The Dhaka Master Plan 1959**

The Master Plan for Dacca, 1959 was prepared on behalf of the DIT. The plan was basically a land use control document (Map 2.2). The plan covered roughly 220 sq. miles (later extended to 320 sq. miles) which was bounded by the rivers Dhaleswari, Turag, Balu and Lakhya in south , west, and east respectively and in north by Tongi khal with a population nearly exceeding 1 million. This plan gave priorities on rivers and khals to enhance the transport route as because water transport is the cheapest transport. At that time, Dacca (Dhaka) was the centre of a most extensive country boat trade which plies along the Buriganga River and numerous interconnecting waterways and khals (38.7% of total land area) which flow into it. Though, no retention area was demarcated in this plan but for river and khals, the plan recommended the followings:

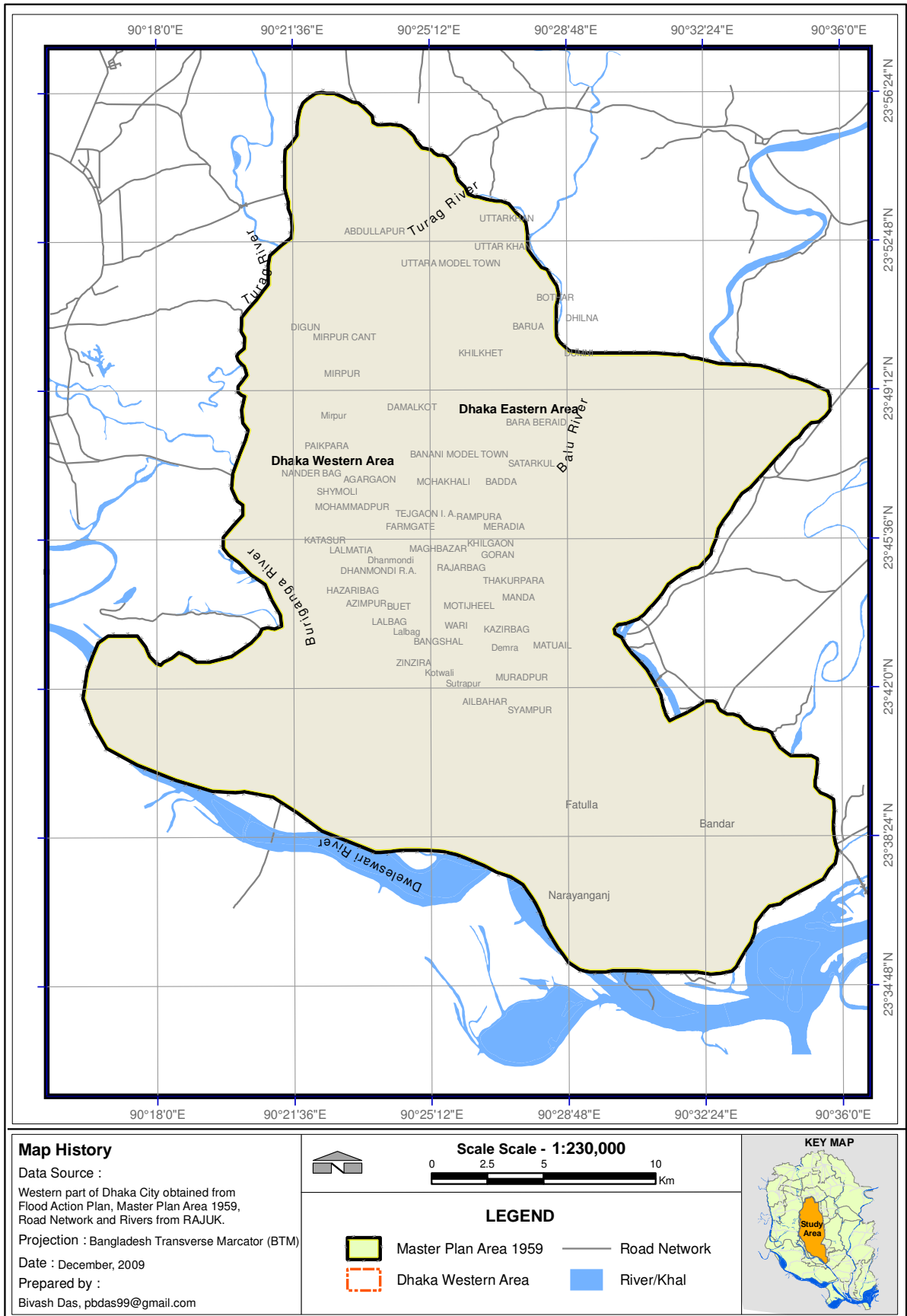
- Residing of steamer station on a spacious site lower down the river at Postogola
- Dredging of all weather channels for country boat to serve leather warehousing at Lalbagh, market and village at Nawabganj, the tannery area and proposed slaughterhouse at Hazaribagh
- Dredging of Grand khal and Behenali khal served old town and Tejgaon industrial estate respectively (convenient waterways to Dacca from the Balu River, in turns connected with the Lakhya (Sheetalakhya) River ) to provide all weather channels for boats
- Construction of the Demra khal following the route of Demra Road for giving direct access from Dacca to Lakhya River
- Continuous channels should be excavated along the natural lines of drainage and linked up, wherever possible with existing khals

### **Specification for Dholai Khal**

This was the ancient waterway that encircled the old town of Dacca, joining Buriganga by Mitford Hospital and Mill Barracks. Its eastern part followed the line of natural watercourse and drainage channel. At one time, it was a spacious waterway of commercial and amenity value. But recently, much of the khals were fallen in misuse through lack of maintenance. Extensive silting up of khals was taken place in western junction with Narinda khal and its width had been greatly reduced by encroachment of adjoining property owners.

As a consequence, except in the monsoon season, it is now little better than an open shower and due to rubbish resulted in unhygienic condition. So, it was recommended to retain only the eastern arm of Dholai Khal and where necessary deepened at its junction with Narinda khal which in turn connected with Grand khal and proposed Demra khal. Besides these, the remainder site of the khal should be filled to form an inner circular road encircling the old town and also for an amenity open space.





**Map 2.2: The Dacca (Dhaka) City Master Plan, 1959**

### **2.3.2 Dhaka Metropolitan Area Integrated Urban Development Plan (DMAIUDP) 1981**

The Dhaka Metropolitan Area Integrated Urban Development Plan was prepared in 1981, evolved from a series of Reports and Missions concerned with storm water drainage and flood protection. The study was funded by ADB which strongly recommended that further flood protection investment shall await the outcome of a broad multi-sectoral strategic study to evaluate metropolitan planning options. This plan also gave attention on the evaluation of metropolitan planning alternatives. The DMAIUDP study argues a coherent case for a strategy of long-term northern expansion, to accommodate an urbanized population of approximately 9 million by the year 2000.

#### **Flood Protection and Drainage**

At that time, there was no record of existing open channels, natural water courses or privately constructed drainage. From field observation, it had been observed that most of the drainage network was in old Dacca (Dhaka) and discharged through Dholai khal with pumping station at Narinda. But, local flooding was occurred due to rainfall and river water rise. So, it was recommended that only primary drain network will be provided, with reserves following natural drainage courses which will ensure a degree of channeled runoff without drain construction. This will accelerate flows and reduce effects of minor flooding but complete flood protection will be occurred in long term following incremental landfill program. The total area required for reserves was 91 acres. DPHE then constructed 50 miles drains in size varying 18" to 132" diameter (about 12% of built-up area –DPHE piped system). The Design process included:

- The point for discharging the storm water is either a natural water course or a low lying area
- The extent of drainage area, from which storm run off is likely to contribute flows into main drain, is determined and subdivided into drainage district
- The runoff and flow emanating from a drainage district is calculated with values of run-off coefficient (0.1 to 1) depending on land area and density of development

### **2.3.3 Dhaka Integrated Flood Protection**

After the devastating floods of 1988, the Government of Bangladesh (GoB) conceived the Flood Action Plan (FAP) to mitigate/control flood damages for the whole country. A component of the FAP studies, FAP-8, carried out a feasibility study for an integrated flood control measures to be considered to keep the Greater Dhaka flood free. In support of Government's flood action program, both the government of Japan and the Asian Development Bank were agreed to provide assistance for Dhaka Town Protection component, FAP-8. FAP 8 was split up in two sub-components, viz. FAP-8A and FAP-8B considering the at-a-time implementation cost for the whole project under FAP 8 (JICA, 1991).

#### **2.3.3.1 Flood Action Plan (FAP) – 8A**

JICA Master Plan study for Greater Dhaka, Tongi, Savar, Keraniganj and Narayanganj has the objective of developing Master Drainage and Flood control plan for Dhaka Metropolitan area of 850 sq. km, identifying priorities projects within this area and preparing feasibility studies for selected components. Three areas have been selected for feasibility study which constitutes a continuous zone along the eastern side. These are:

- 1) The Greater Dhaka East
- 2) The DND
- 3) Narayanganj West

For these three areas, individual Flood Protection Strategy has been outlined based on different context of urban development.

#### **1. The Greater Dhaka East**

The area covers 118.62 km<sup>2</sup> and bounded by Turag River, Balu River, Demra road and Dhaka-Mymensingh road, the DIT road, Biswa road on the north, east, south and west respectively. This area has only 6% water bodies and having proposal to preserve 17% water bodies of total area.

### ***Flood Protection Strategy***

- Study area will be divided into five drainage zones for the purpose of storm water drainage
- To provide protection from external sources of flood water, the area will be divided into four compartments defined by embankments
- Four Compartment include :
  - 2 retention pond areas (525 hectare) in Southern Compartment-2
  - Mainly Begunbari khal for drainage in Southern Compartment-1
  - 2 retention pond areas (263 hectare) in Northern Compartment
  - A retention pond area (263 hectare) in Central Compartment

### **2. The DND**

The area covers 56.79 km<sup>2</sup> and bounded by Demra road, Dhaka-Narayanganj highway, Demra-Narayanganj highway on the north, west, and east respectively. Last two joins together in the south which forms the triangular shape. This area has only 6% water bodies and having proposal to preserve 15% water bodies of total area.

### ***Flood Protection Strategy***

- Study area is already protected by the three roads and the concrete wall on top forming flood wall (need to be rehabilitated, certain parts have to be raised)
- DND area will be divided into 2 drainage zones, proposal of 3 retention pond area in northern drainage zone (266 hectare) and other 3 in southern zone (377.5 hectare)
- Proposal of 3 new canals to facilitate drainage
- 1 pump house (having limited capacity) already exists near Katchpur Bridge and proposal of new pump house further south

### **3. Narayanganj West**

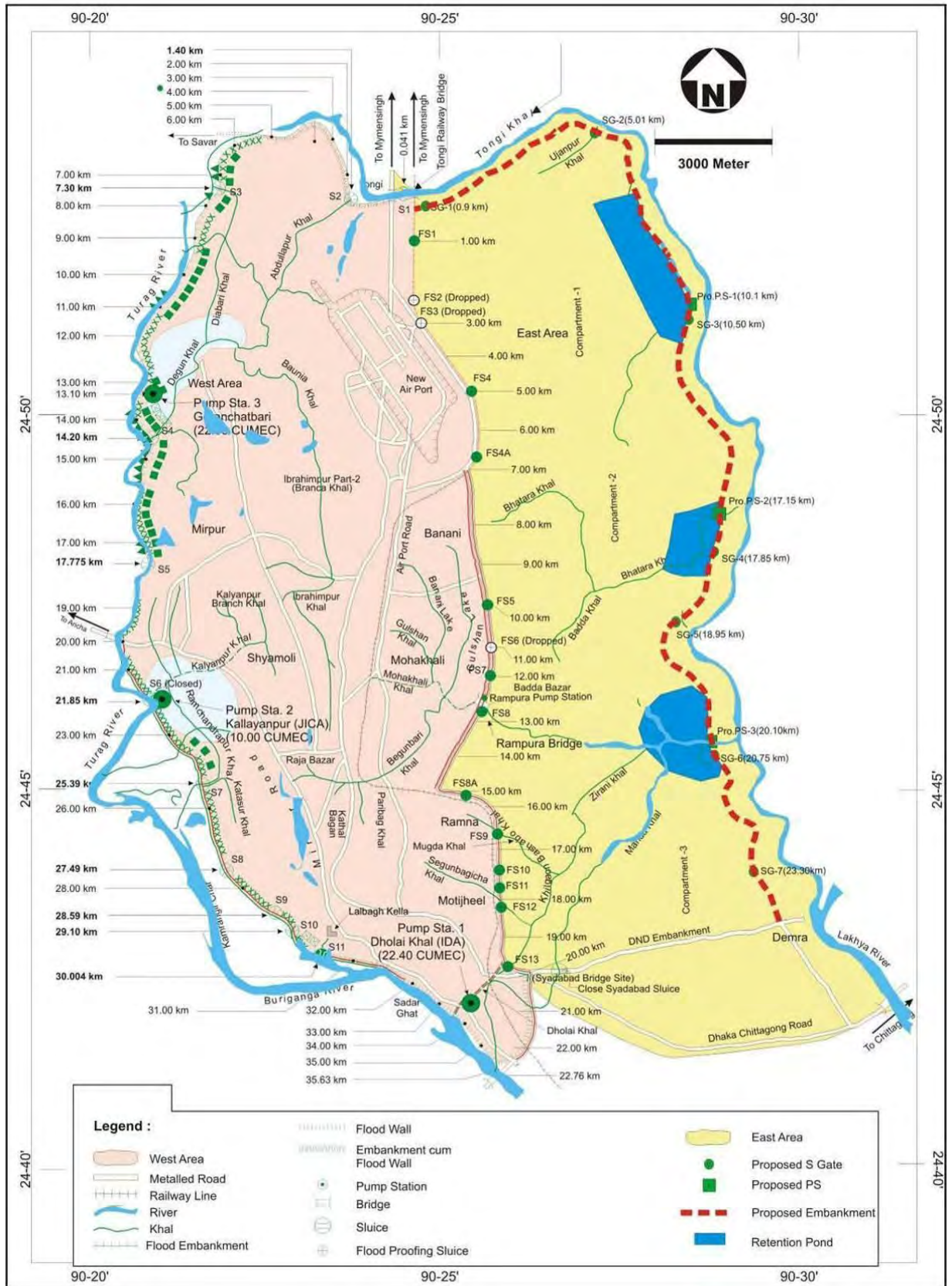
The area covers 18.63 km<sup>2</sup> and bounded by Dhaka-Mymensingh road, Lakhya River on the west, east respectively. The area extends up to Saiyedpur on the south and Dhaka-Narayanganj highway on the north. This area has only 5% water bodies and having proposal to preserve 7% water bodies of total area.

### ***Flood Protection Strategy***

- Study area will be protected by the embankments on the west, south and east (along Lakhya River)
- This area will be divided into 5 drainage zones
- 1st and 2nd zone include 3 retention pond area (84 hectare) and 2 pump stations, 3rd zone is relatively high so the gravity flow to Lakhya river is enough and 4th, 5th zones include 2 retention areas (26 hectare) and pump stations

### **2.3.3.2 Flood Action Plan (FAP) – 8B**

Dhaka Integrated Flood Protection Project (DIFPP) had the objective of identifying drainage, flood protection and complementary environmental improvement projects, and preparing feasibility studies for the immediate investment needs in the Dhaka City. FAP-8B proposed for rehabilitation and upgrading of 21 major khals with total length 78.6 km. Improvement through rehabilitation of internal drainage khal and construction of storm drainage were important activities under the plan. Construction of Pump Station No. 3 at Goranchatbari for west part was also prioritized (Louis Berger International, 1991). Detailing of FAP-8B proposals has been given and explained in chapter- 4.



**Map 2.3: Flood Action Plan (FAP-8B), 1992**

Source: BWDB

### **2.3.4 Dhaka Metropolitan Development Plan (DMDP, 1995-2015)**

The Dhaka Metropolitan Development Plan was a three tier Plan Package, viz. the Structure Plan (SP), the Urban Area Plan (UAP) and the Detailed Area Plan (DAP). The DMDP package contains the following components.

- The Structure Plan - 20 years time frame
- Urban Area Plan - 10 years time frame
- Detailed Area Plans - 5 years rolling
- Instruments for Implementation

Each component of the Dhaka Metropolitan Development Plan “package” is complementary but they need to be adopted and combined to address particular problems and planning needs of Dhaka (Map 2.4).

#### **2.3.4.1 The Structure Plan (1995-2015)**

The Structure Plan (SP) provides long-term strategies for the next 20 years for the development of the greater Dhaka sub-region (1528 sq. km.) and divided into 26 Special Planning Zones (SPZ), with a target population about 15 million. The Structure Plan described the features of spatial development strategy, how the city’s existing urban resources can be utilized by means of consolidation and accelerated development. It recommended planned new area development through infrastructure led development initiatives. The plan also suggested long-term planned new area development through flood protection and conventional development in dispersed flood free areas.

#### **Policies for Flood Control and Drainage**

The rivers, flood plains within the DMDP structure plan an important role in both ecology and economy of capital area. So, policies will be needed for hydraulic integrity of the flood plains and to protect rivers from urban pollution. Besides, following FAP-8 proposal, other Structure Plan policies of drainage sectors are:

##### ***Flood flow Zones***

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

### ***Main Flood flow Zones***

Land development for residential, commercial and industrial development, including raising the level of land via land filling, will be prohibited. Permitted uses are:

- Agriculture
- Dry season recreation facilities
- Ferry terminals and
- Excavation of mineral deposits

### ***Sub Flood flow Zones***

Development compatible with the rural nature of these mainly rice growing areas, will be permitted on the condition that the:

- Structures are built on stilts or on land raised above design flood water level
- Alignment of structures and raised land to be designed so as not to disturb flood flow

### ***Flood Retention Ponds***

Control will be maintained over the areas designated in the DMDP Structure Plan for flood protection retention ponds in order to ensure that they remain capable of fulfilling their primary function of water storage at times of flooding. The use of land within designated retention pond areas to be restricted with:

- Agriculture
- Fish cultivation
- Recreation

#### **2.3.4.2 Urban Area Plan (1995-2005)**

Urban Area Plan covers FAP- 8A and FAP-8B, additionally the outlying areas like, Tongi-Gazipur and Savar-Dhamsona are also put under consideration. It is prepared for 10 years time frame and specifies possible land use and development standards based on structure proposals in detail. Among the 26 Special Planning Zone (SPZ), the study area has covered SPZ 1, 2, 3, 4, 5, 6 & 7. Major issues, opportunities regarding Flood Protection and Drainage related to this research are given below:



**SPZ 1: (CBD South)*****Major Issues and Problems***

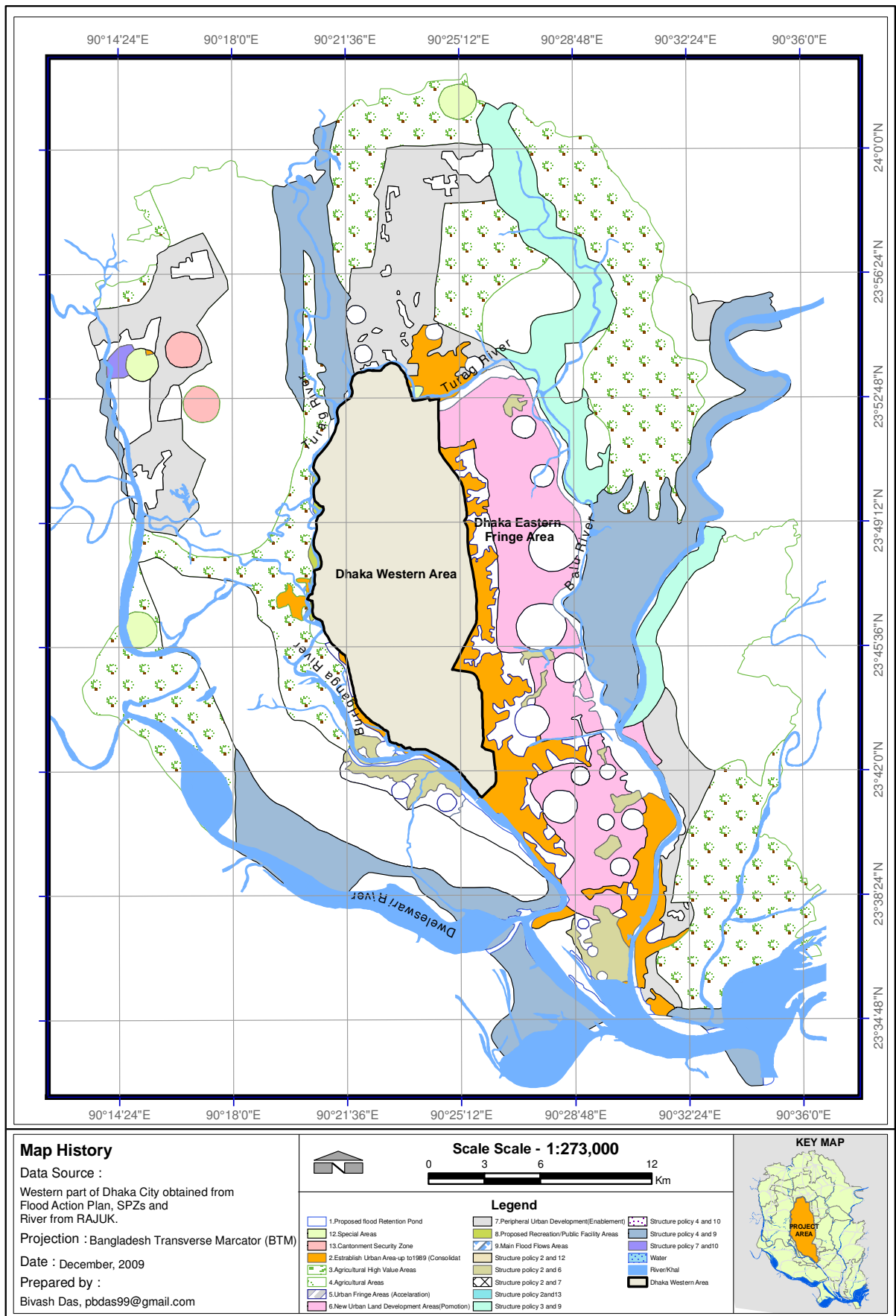
Occasional water logging occurs in the residential areas especially in the rainy season.

***Opportunities***

If FAP-8B proposals are fully implemented then the area will be free from outside flooding. As a result, water logging and drainage problems may be removed.

**SPZ 2: (CBD North)*****Major Issues and Problems***

- There are water logging problems in some areas of Kalabagan Triangle
- The gradual filling of the Begunhari Khal threatens the drainage function of this khal for the area on its west side.



**Map 2.4: Dhaka Metropolitan Development Plan (DMDP), 1995**

### *Opportunities*

Dhanmondi Lake provides a very important open space and recreation area. Begunbari khal should be developed in a similar way to prevent development encroachment and to increase the limited open space and recreation areas in the city.

### **SPZ 3: (Old city)**

#### *Major Issues and Problems*

Poor drainage, shortages of water, gas, and electricity are the characteristics of the whole area. Depletion of ground water will further deteriorate the situation.

### *Opportunities*

FAP-8B and Dholai Khal Improvement Projects, when will be completed which will reduce the drainage problems of the zone.

### **SPZ 4: (Western Suburbs)**

#### *Major Issues and Problems*

Development in the west to Shamoli Ring Road (Adabar) has encroached into the Kallyanpur retention pond area, which reduces the effectively of the pumping station and therefore may result in flooding elsewhere

### *Opportunities*

FAP-8B project will solve most of the drainage problems of the zone

### **SPZ 5: (Mirpur)**

#### *Major Issues and Problems*

A substantial part of the zone (northwest and east along side ZIA) is low lying. However, new urbanization pressures may endanger the area reserved for a retention pond which is vital for the functioning of the FAP-8B project recommendations.

### *Opportunities*

FAP-8B addresses the drainage requirements to a significant extent. There are many small water bodies within the spontaneous areas. These fulfill local requirements for open space and measures are required to secure their retention/drainage function.

## **SPZ 6: (Gulshan. Banani, Baridhara, Badda)**

### ***Major Issues and Problems***

Gulshan Lake is under constant pressure to be filled by RAJUK for creating new residential plots. If this is allowed to continue unhindered, it will not only destroy this wonderful open space but also the essential retention capacity for storm water from a vast area resulting local flooding and water logging.

"Eastern Housing" has planned a large scale development on the east of the area. This development may have substantial negative impacts on the water management regime of this area as the khal and retention pond areas may be compromised.

### ***Opportunities***

Adequate measures are required to prevent further filling and reduction in size of Gulshan Lake. So, to maintain effective retention functions and develop it as a centre of recreation, Gulshan Lake should also be integrated with Begunbari khal which can effectively control the development of Begunbari khal areas within this zone.

## **SPZ 7: (Eastern Suburbs)**

### ***Major Issues and Problems***

- The area is generally low lying and has been developed through land filling
- Lack of sanitation and drainage facilities cause environmental degradation

### ***Opportunities***

The proposed FAP-8A projects will greatly solve drainage problem, augment supply of flood free land and secure access from the east.

### **2.3.4.3 Detailed Area Plan (DAP)**

The Detailed Area Plan (DAP) provides more detailed planning proposals for specific sub areas of Dhaka. Initially, only priority areas are dealt. It describes the development strategies, critical planning issues, development plan proposals and implementation of the plans. It also includes the broad land use plans and policies for existing and new urban areas. For effective and efficient planning, the central area (study area) has been divided into 13 planning zones, which are called Detailed Planning Zone (DPZ). DAP has considered the safety and critical environmental issues like drainage, flood flow,

retention pond, geological fault lines etc. With the implementation of the enhancement activities to be included in the planning process, the condition of urban flooding/ drainage congestion of the city will be improved.

### ***Enhancement Activities***

- The drainage system of Dhaka city is inadequate. Expansion and rehabilitation of the existing drainage system is required
- Sewer lines should be separated from storm water drainage system
- In addition to the existing three storm water drainage pumps, two permanent pump stations are required at Maniknagar and Rampura
- If the eastern embankment is constructed then three pump stations at the off take of BoaliaKhal, ShahjadpurKhal and NoaraiKhal will be required
- All flood proofing structures would require proper maintenance and manned by adequate personnel for operations during monsoon under definite guidelines
- All drainage and flood control infrastructures should be handed over to Dhaka WASA for operation and maintenance
- The city flood and drainage management should be linked with weather and flood forecasting system for early warning and preparatory activities
- All the existing natural drainage routes should be freed from encroachment immediately
- Regular program should be undertaken for cleaning of the drains/ pipes/ khals before the advent of the monsoon. Adequate fund for these activities should be made available by December each year
- RAJUK should ensure that development of eastern Dhaka is carried out under a Detailed Area Plan which would integrate land use plan with that of utilities service like, storm water drainage, water supply and sewerage
- RAJUK should develop and implement building codes which would clearly give direction for preserving drainage facilities in city areas, most importantly, in low lying areas
- A central high-powered coordination committee should be created to coordinate activities of all agencies engaged in providing utility services to the city dwellers
- All drainage channels should be lined to protect and identify them

- To create public awareness regarding necessity for conserving and protection of the drainage system, man-made or natural
- Adequate lands would be required for retention ponds; the government should immediately acquire these lands before take over in the hands of land developers

## **2.4 Conclusion**

This chapter has been attempted to represent the growth pattern of Dhaka City and all the related development plans and policies regarding flood protection and drainage. This research is oriented with flooding and natural drainage of Dhaka City so all relevant issues in these plans and policies mainly represented here. This chapter has critically evaluated the Dhaka Master Plan 1959, Dhaka Metropolitan Area Integrated Urban Development Plan (DMAIUDP) 1981, Flood Action Plan under Dhaka Flood Protection Project and three tires Dhaka Metropolitan Development Plan (DMDP, 1995-2015). It has been observed that in different periods of Bangladesh different plans had been initiated by the government with international support.

## **Chapter Three: Profile of western part of Dhaka City: The Study Area**

### **3.1 Introduction**

This chapter contains detailed description of the western part of Dhaka City considering as study area. Physical, Topographical, Socio-Economic and other relevant information have been included thoroughly in this chapter. This chapter has also paying attention on the trend of development pattern of the western part of Dhaka City.

### **3.2 Briefly discussed about FAP-8B western area**

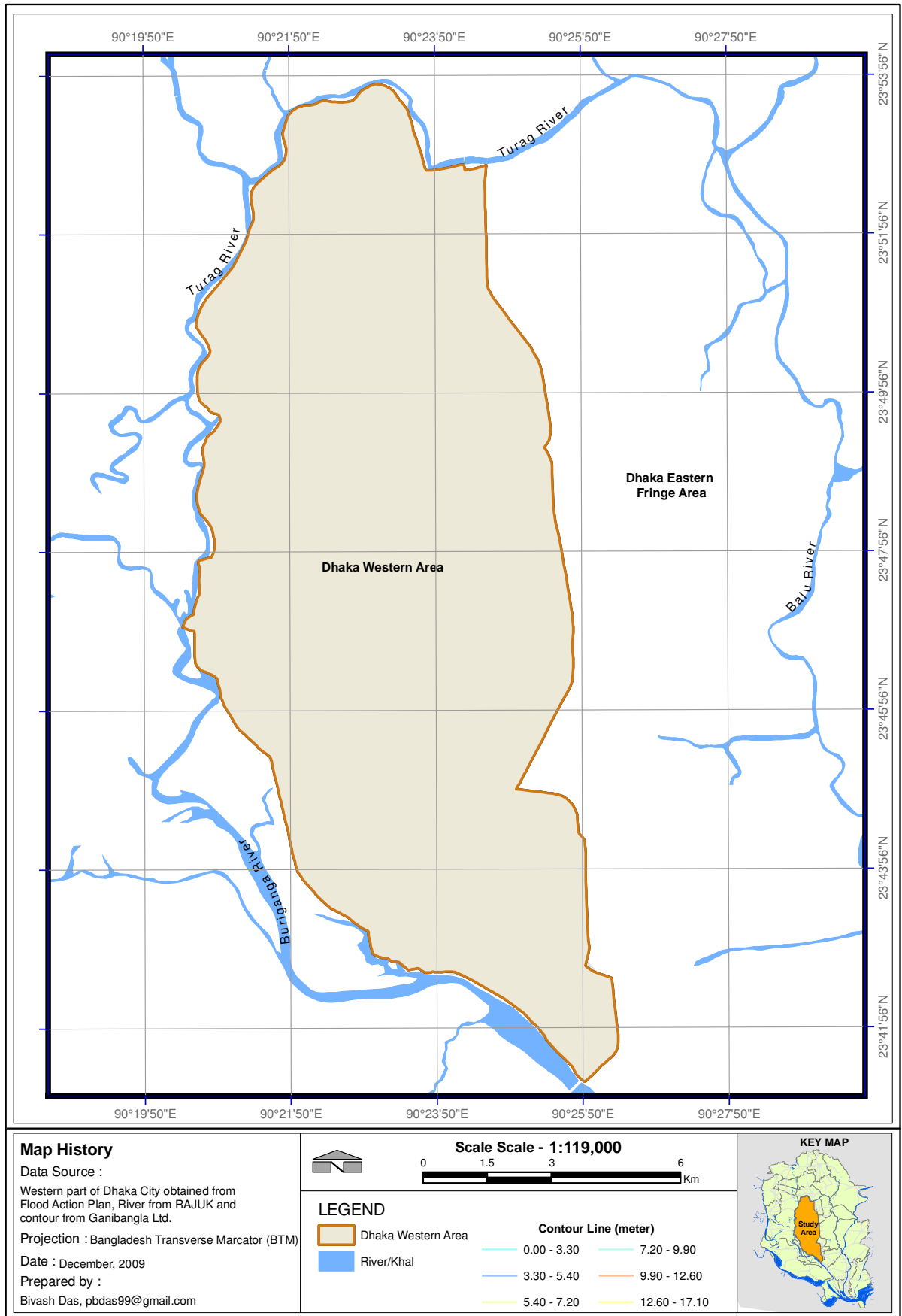
The natural drainage pattern and network of khals is destroying day by day due to the rapid unplanned physical expansion. So, for better understanding of the existing situation and to promote guidelines for future development, this aspect has to be taken under special consideration in this research.

#### **3.2.1 Geographic Location**

The western part of Dhaka City is located approximately in between longitude 90°19' E to 90°25' E and latitude 23°40' N to 23°53' N. The area is surrounded by Progati Sarani on the east, Turag River on the west and north and Buriganga River on the south. It covers most of the built-up areas of the city. It includes the restricted areas of KPI (Key Point Installations) like Zia International Airport, Dhaka Cantonment etc. Most of the areas of the western part are under the jurisdiction of Dhaka City Corporation (DCC) and consist of SPZ 1, 2, 3, 4, 5, 6 and 7 of DMDP. Total area of the Dhaka western part is 136.5 sq. kilometres (13,650 hectare or 33,730 acre).

#### **3.2.2 Topography**

The highest point of elevation is pointed in Mirpur area in the western part. Maximum elevation is 17 meter in Pallabi area at Mirpur. Besides, the lowest point is also situated at Mirpur, Kallyanpur Jheel and western part of the airport, which are considered as low-lying area. Average elevation of the western part is 6.93 meter from the mean sea level (DAP, 2009). The elevation of the study area is represented by contour lines in Map 3.1.



**Map 3.1: General Contour in the Western Part of Dhaka City**



### 3.2.3 Climate

The Maximum rainfall recorded in study area is 2,633 mm, the minimum is 1,197 mm. and the average is 1,863 mm annually. During the dry season, (from November to March) the total rainfall is 133 mm (source: BWDB, 2009).

### 3.2.4 Geology

Dhaka City and its surrounding areas are covered with Pleistocene Madhupur Clay and Holocene sediments belonging to the Ganges-Brahmaputra flood plain. The western part of the investigated area lies in the Madhupur Tract having highly oxidized Pleistocene sediments.

### 3.2.5 River, Drainage and Water Bodies

Dhaka City is comprised of several water retention areas and khals, which are drained to the surrounding rivers. The City's storm water is accumulated in the retention areas and discharged to the surrounding rivers through khals. In previous time, the storm water used to drain out through the existing khals, namely Dholai Khal, Arambag khal, Zirani khal, Dhanmondi khal (lake), Mohakhali khal, Banani lake, Gulshan lake, Begunbari khal etc. All these khals and lakes had outlets to the surrounding rivers namely Buriganga, Turag, Balu Rivers and low lying areas. The whole network of natural drainage and water bodies in western part of Dhaka City is represented graphically in Map 3.2.

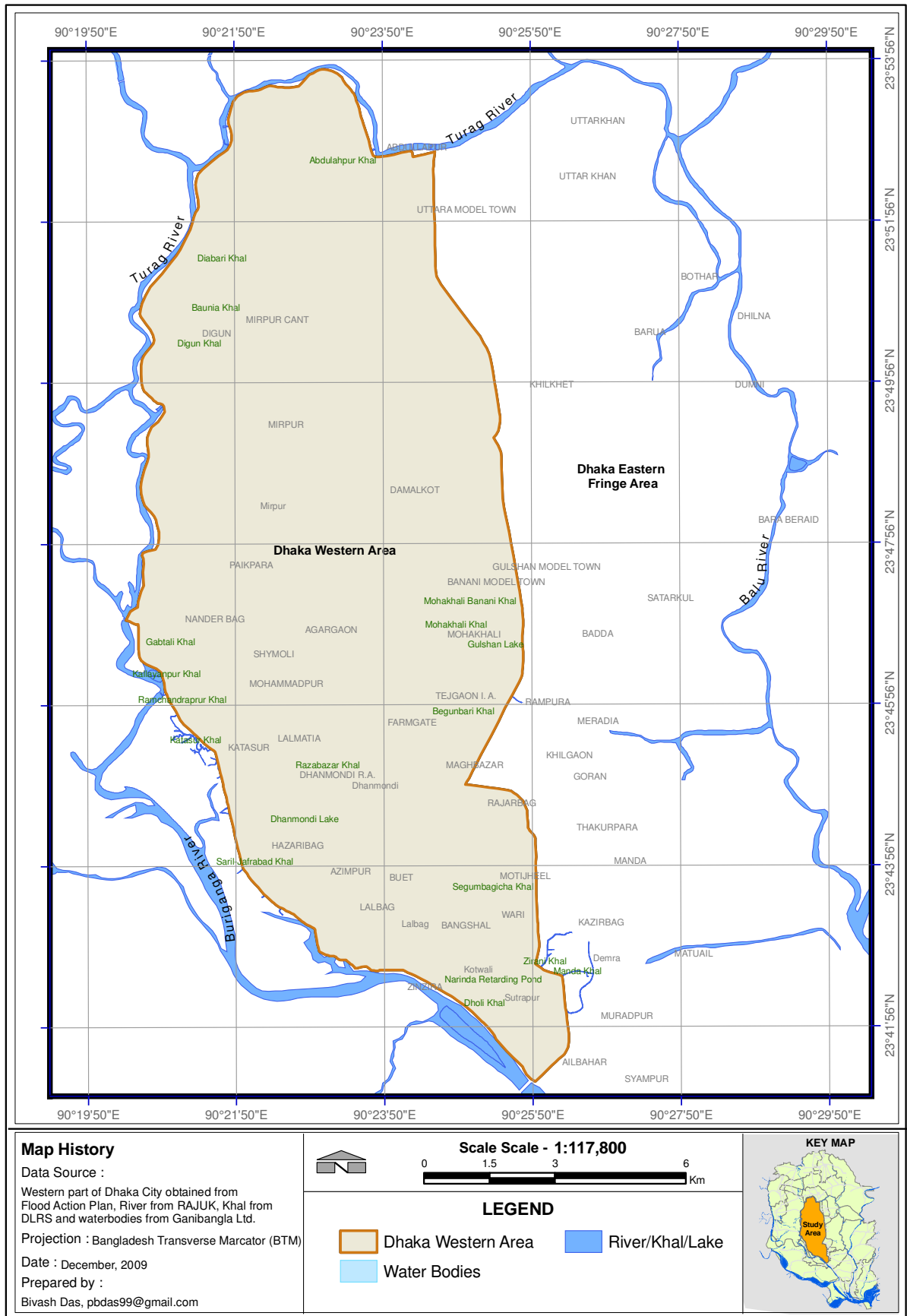
#### Rivers

The study area is bounded by two rivers namely Buriganga and Turag River. Originating from Bangshi and the old Brahmaputra rivers, the Turag has total length of 78 km, 23 km of which flow around the city. The characteristics of the rivers are shown in Table 3.1:

**Table 3.1: River Buriganga and Turag**

Name of the River	Length	Ave. depth	Ave. width
Buriganga River – Sadarghat to Mirpur Bridge	16.00km 13.50 km	12 feet (3.66 meters) 8 feet (2.44 meters)	200 feet (60 meters) 120 feet (36.5 meters)
Mirpur Bridge to Ashulia			
Total	29.50 km	-	
Turag River passing on the west of the city.	78.00 km 23.00 Km	8 feet (2.44 meters)	120 feet (36.5 meters)

Source: BIWTA, 2005



**Map 3.2: River, Khal and water bodies in the western part of Dhaka City**

## Khals

Among 21 khals, there are 14 open drainage channels (khals) in the FAP-8B western areas. Some of the major khals have number of branches. The catchments areas of the channels vary from 6 to 40 sq. km. The characteristics of the major khals are given in Table 3.2:

**Table 3.2: Characteristics of major khals in the western part of Dhaka City**

Sl. No	Name of the khals	Location	Length (Km)	Width
1.	Abdullahpur Khal	Joint of the Digun and Diabari khal to Turag river via Bounia and abdullahpur mouza	5.63	30-35 ft
2.	Begunbari khal	Hotel Sundarban To Banasri Via Hatir Jill And Rampura	5	30-35 ft
3.	Bounia Khal	Chalk digun mouza to end of the Bounia mouza	4.83	60-70 ft
4.	Dholai khal	Buriganga river to Dayagnaj bazar via sutrapur, gendiria, wari	5.1	50-120 ft
		Buriganga river to Dholai khal (branch 1)	1.93	20-120 ft
5.	Diabari khal	Starting from Digun khal to middle of the Diabari Mouza via bounia mouza	2.82	45-50 ft
6.	Digun Khal	Solahati village to Goranchatbari pump station	4.44	21-50 ft
7.	Gulshan Khal	Gulshan R/A (known as Gulshan Lake)	4.83	200 ft
8.	Ibrahimpur Khal	Taltala to Kallayanpur bridge via Kafrul and Paikpara Mouza	0.92	30-60 ft
9.	Kallayanpur Khal	Kallayanpur bridge to embankment via Mirpur Technical	3.06	20-100 ft
10.	Katasur Khal	Ramchandrapur khal to Rayerbazar khal	2.57	50-200 ft
11.	Mohakhali khal	Begunbari khal at Gulshal to Dhaka – Moyenshingh road	3.22	25-40 ft
12.	Paribag khal	Shahabag to Mugbazar khal	0.42	50 ft
13.	Ramchandraur Khal	Turag river to Katasur mouza via mohamadpur housing	2.45	15-160 ft
14.	Segunbagicha khal	Segunbagicha mosque to Bijoyagar road	0.75	60 ft

Source: FAP Map and DC Office, 2009

## Lakes

There are many water storage areas such as lakes, ponds, and low lying lands. The characteristics of major lakes in the study area are shown in Table 3.3:

**Table 3.3: Characteristics of major lakes**

Name of the lakes	Length (m)	Ave. depth (m)
Dhanmondi lake	2400	2.5
Ramna lake	400	4.5
Gulshan lake	3800	2.5

Source: JICA, 1991

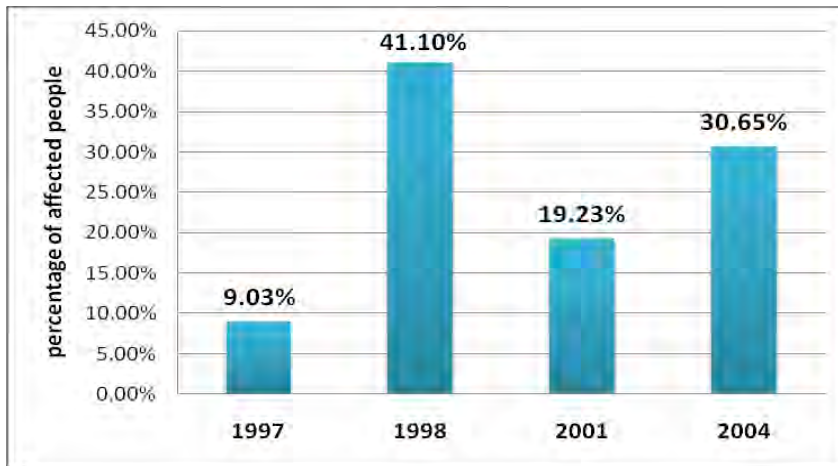
At present only 865,913 sq. meter of ditches, 4,131,795 sq. meter of marshy land and 667,136 sq. meter of pond are available in the study area (DAP, 2009).

### 3.2.6 Flood sensitivity

The western part of Dhaka City is the most flood sensitive area of Dhaka City. Statistics shows that about 65% of Dhaka's poorer inhabitants are presently subject to regular flooding residing in this part.

### Flooding and water logging

The study area is generally flooded by the ingress of flood water from north, west and south sides by the Bangsi, Dhaleswari, Tongi khal, Turag and Buriganga rivers. During the flood, the river water level become so high that flood water gradually overflows from lowland areas to higher lands. Then, it starts to enter in city areas and submerges roads and lower parts of buildings. Sometimes flood also occurs due to back water flow of these rivers in west Dhaka. In case of backwater flood flow, the ingress of flood starts from lower reaches to upper reaches of the rivers. In 1988, flood water over spilled the west area and engulfed also the east area from north-west to south-east. At that time, both areas were equally affected by this flood. But, in case of 1998 and 2004 flood, western part was safe because of the protective measures taken in between 1991 to 2000.



**Figure 3.1: Affected people by flood in different time period**

Source: Detailed Area Plan (Survey Report), 2009

Figure 3.1 represents the percentage of households affected by flood in different years in the study area. The major flooding years of Dhaka are 1997, 1998, 2001 and 2004. Over the last ten years, the flood of 1998 affected the study area significantly.

### 3.2.7 Drainage

Due to the unplanned physical intervention and development, the natural drainage system has been seriously hindered to flow. As a result, the catchments, flood flow zones and sub-flood zones have been divided and eventually the flow areas drastically reduced.

Storm water drainage within the flood embankment is maintained through the regulators and sluice gates in the city. When the surrounding rivers remain at low level & gravity flow permits, drainage is occurred through regulators and sluice gates. When the drainage loads become very high and regulators and sluice gates cannot accommodate sufficient flow and/or the outer rivers remain at high stages, drainage is occurred by pumping out city water to surrounding rivers. In western area of Dhaka, three main pump stations are located at Goranchatbari, Kallayanpur and Dholai khal.

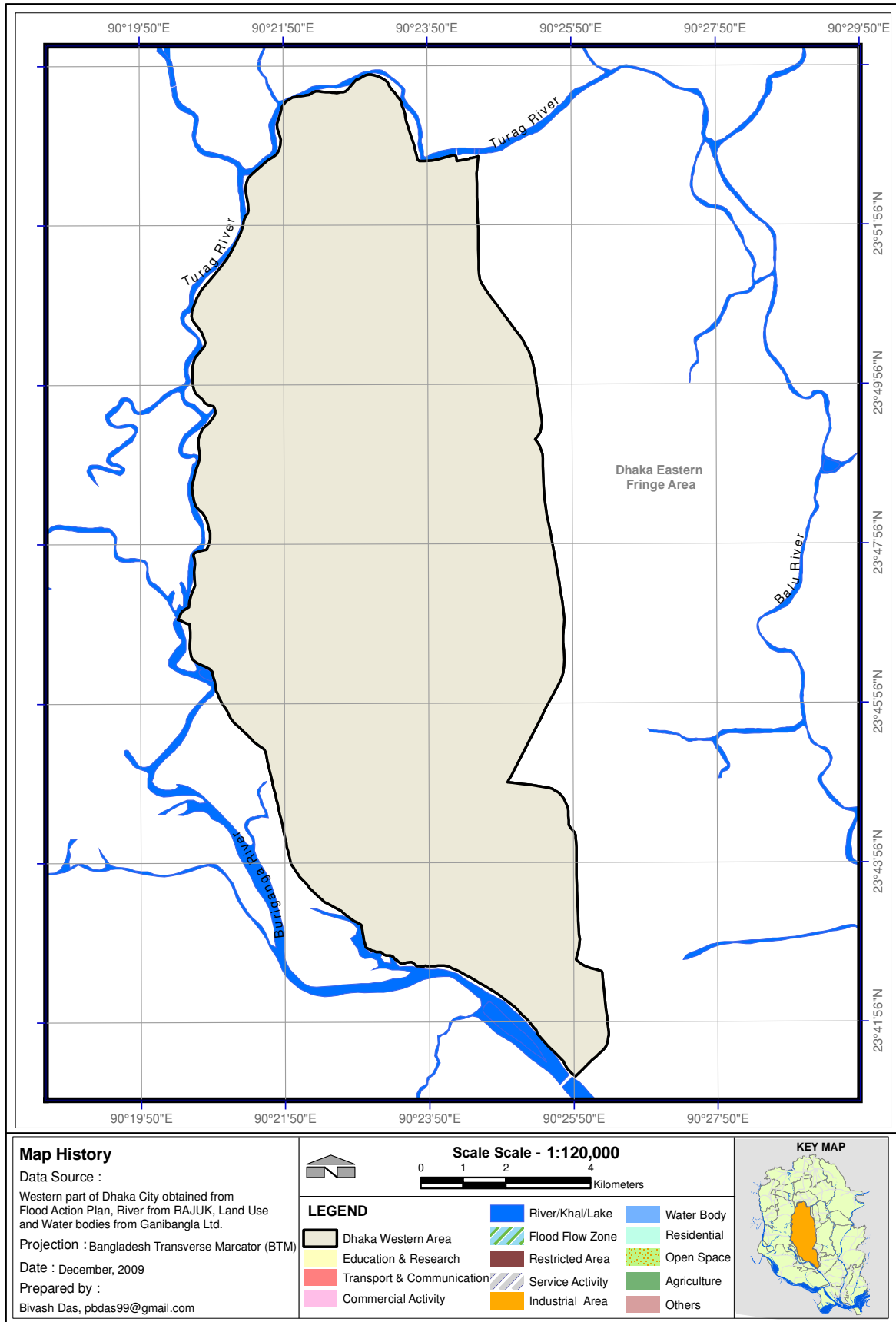
As rainfall in Dhaka is comparatively high, the drain density needs to be also high. Rainfall in Dhaka on an average 1,863 mm per annum and 70 percent of this rain comes from April to September. Within the city, Dhanmondi, Kalabagan, Mohammadpur, Mirpur areas have pucca drains. These drains are connected to natural khals of adjacent areas. Drainage of storm water from Segunbagicha, Ramna and Motijheel flows to the Segunbagicha khal, Arambag Jheel and Zirani khal. Old Dhaka City areas (Lalbag, Babu Bazar, Tantibazar, Shakhari Patti, Bangla Bazar, Fulbaria, Hazaribag, Bakshibazar etc.)

are connected to Dholai and Narinda Khal; Dhanmondi areas to Katasur Khal, Dhanmondi Lake and Hazaribagh khal; Kalabagan to Kalabagan low-lying area; Kathalbagan, Rajabazar to Begunbari Khal; Mohammadpur and Mirpur areas are connected to Ramchandrapur and Ibrahimpur Khals. Besides these, Shamoli, Aador, Kafrul, Pirerbag, Gabtali areas, Kallayanpur are connected to Kallayanpur khal. Kachukhet, Ibrahimpur, Baunia and further north area are connected to Abdullahpur, Digun, Baunia and Diabari Khals. Abdullahpur khal provides storm water drainage of New Airport, Faidabad and Abdullahpur areas. Finally, all these khals discharge mainly to Buriganga River. Besides, all discharges from Kallyanpur, Ibrahimpur, Baunia, Diabari and Digun khal fall in the Turag River.

On the other hand, WASA maintains 265 km pipelines, 16 km box culverts and 65 km canals to maintain the drainage network, while Dhaka City Corporation (DCC) maintains the primary drainage pipelines from households to WASA facilities (The New Nation, July 30, 2009).

### **3.2.8 Land use pattern**

The land use is categorized according to the functional activities such as residential, commercial, industrial, educational, recreational etc. Major land use in the study area is residential and it covers 51 percent of the total land area. Lands used for residential purpose cover 14.7% as planned area and 36.3% as unplanned area. The road network covers about 9.2% area. Significant portion (about 11%) of lands are mixed use (DAP, 2009). Land use pattern of the study area can be understood more clearly from Map 3.3.



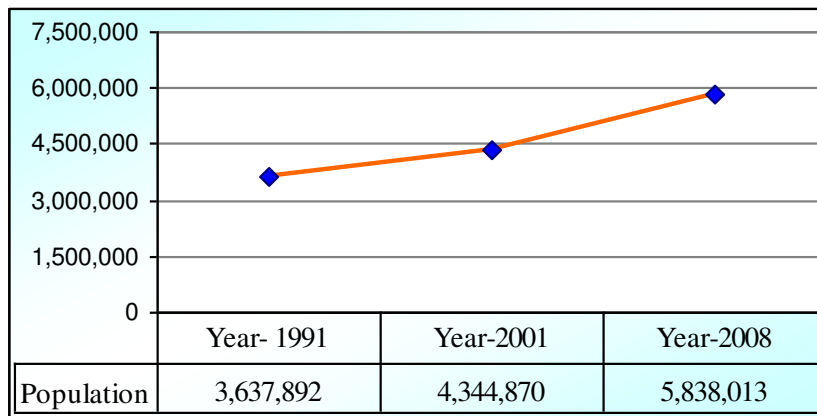
**Map 3.3: Land use pattern in the western part of Dhaka City**

### 3.3 Socio-Economic condition

The socio-economic status of the study area represents the understanding of demographic characteristics and occupational pattern of the inhabitants. From the secondary sources following analyses have been undertaken:

#### 3.3.1 Population

The study area is comprised of 73 wards of DCC jurisdiction. The total population of the western part of Dhaka City is approximately 4,344,870 which represent 73.6 % population of DCC area and 43.8% of Dhaka Metropolitan area. Changes of population over the years are represented in the figure: 3.2:

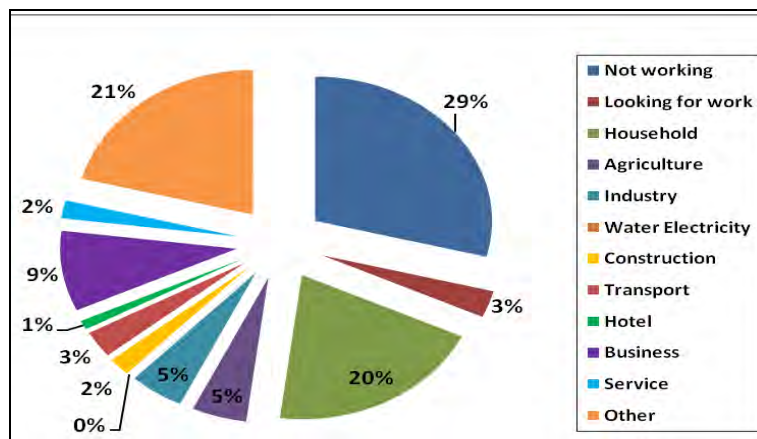


**Figure 3.2: Population changes in the FAP-8B western area**

Source: BBS, 1991, 2001 & DAP, 2009

#### 3.3.2 Occupational pattern

The occupational pattern of the project area is diversified and dynamic. Occupational pattern of the residents mainly reflects the majority urban based job and business.



**Figure 3.3: Occupational pattern of the Study Area**

Source: BBS, 2001



The chart represents that about 20% people are household worker and 29% are unemployed people. The major activity in the study area is business which involves 9% people and 21% people are involved in other activities. Besides these, 5% people are still engaged in agriculture based job, 5% in industrial works. The remaining 12% are comprised of other activities like industrial labours, skilled/unskilled professions etc. The occupational diversification represents that the study area is dominated by secondary occupation.

### 3.4 Development of Infrastructures

During last two decades, Dhaka has been spanned in both north and east direction by both haphazard and few planned way, triggering western part urban development by Government. The progress of urban development has occurred with enormous speed and dimension. The general city structure lies within the designated study area. This structure consists of city core area, industrial area, Urban Sprawl and Old Airport. Expansion of city structures can be observed more clearly from the graphical presentation (Map 3.4).

#### 3.4.1 Physical Infrastructure Development

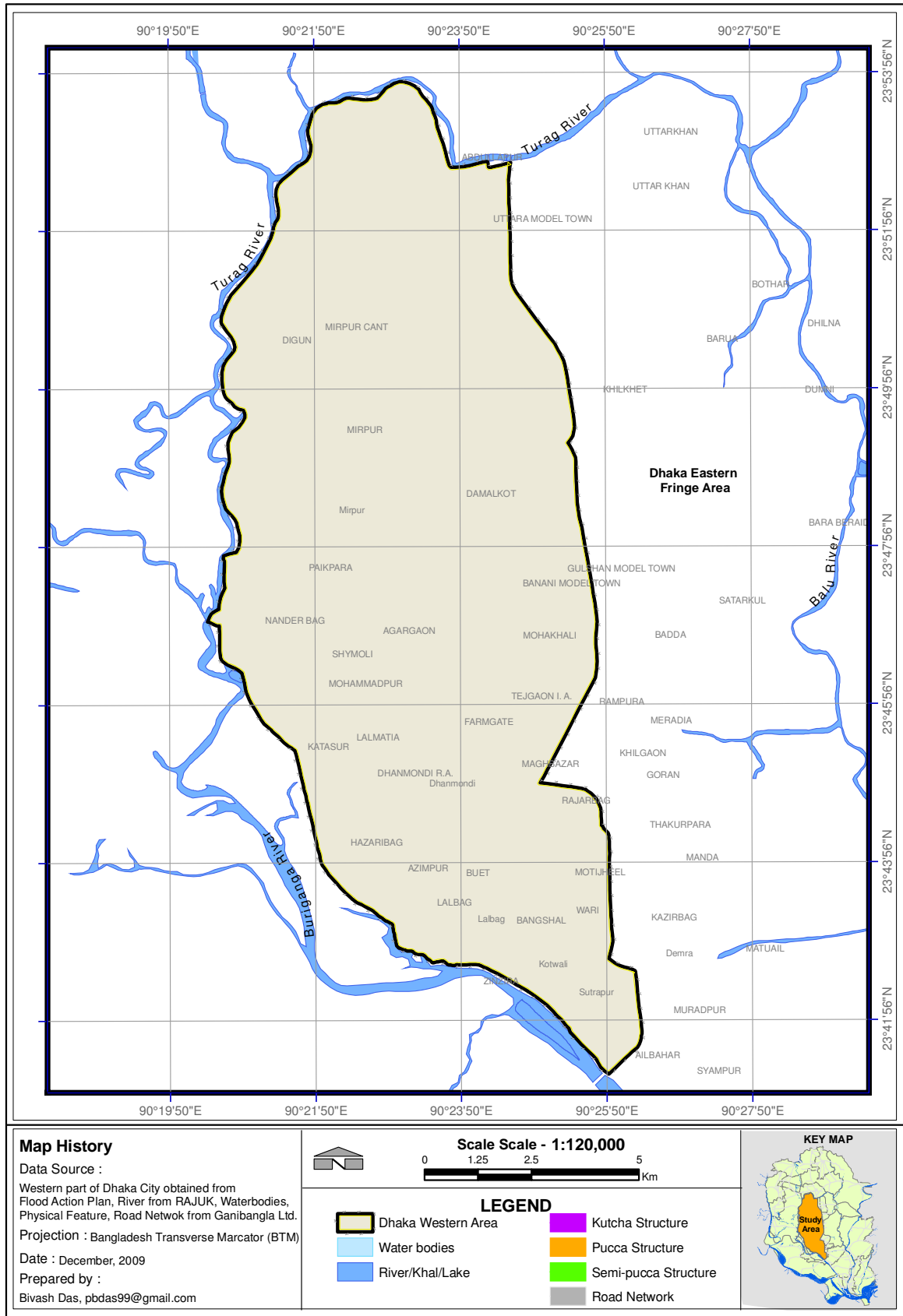
Dhaka is one of the most densely built-up cities of the world. On an average it has more than 8 buildings per acre. The study area has 260,429 buildings and including different residential, mixed and non-residential buildings. During last two decades, the construction of buildings has increased rapidly. Table 3.4 represents the existing number of buildings within the study area:

**Table 3.4: Existing building structures in the study area**

<b>Structure Type</b>	<b>Number of Structure</b>	<b>% of Structure</b>
Pucca	106200	40.78
Semi Pucca	102951	39.53
Tin shed	34075	13.08
Kutchra	17203	6.61
<b>Total</b>	<b>260429</b>	<b>100.00</b>

Source: Detailed Area Plan (Survey Report), 2009

Data represents that the southern edge of the city has got the highest number of buildings per acre and this varies from 20 to 29. On the other hand, number of buildings per acre is less than 5 in the central part of the city because the major open spaces of the city like Ramna Park, Soharwardi Park and National Eidgah etc. are situated in this area.



**Map 3.4: Physical Infrastructure Development in the Western part of Dhaka City**

The study area has about 1,495 km. of pucca (bituminous), 110 km. of semi-pucca and 144 km. of kutchra roads (DAP, 2009). The major roads are: Mirpur road (north-western); Begum Rokeya Sharani (northern); Airport road and Progati Sharani (northern); Dhaka-Naryanganj road (southern-eastern) and Dhaka-Mawa roads (southern), all of which are leading towards the main areas of the city centre.

In case of water supply, there is about 25% individual connection. Presently 83.70% of water is supplied from ground water source through DTW and 16.30% supplied from surface water source through water treatment plant. On the other hand, there are 881.02 km. of sewer lines, 50,671 sewer connection, 29 sewer lifting stations and 1 sewer treatment plant. There are 585 km. of drains of which 13.03 km are kutchra and the rest of them are pucca. All services are provided and maintained by DWASA. Approximately, 35 metric tons of solid waste per day is produced within the study area are responsible for serious health hazard (DAP, 2009).

### **3.4.2 Social Infrastructure Development**

Social infrastructures have been developing in Dhaka since its early period. These are used for different purposes, such as educational, recreational etc. The major higher educational institutions in the Dhaka City are namely Dhaka University, Mitford Medical College, Dhaka Medical college, Bangladesh University of Engineering and Technology, Bangabandhu Sheikh Mujib Medical University, Suhrawardy Medical college etc. There are also numerous government and privately sponsored universities, madrasa and educational institutions. The study area also includes different infrastructures providing recreational facilities such as art gallery, cinema hall, open space, parks, playgrounds, theater Hall etc. Besides these, there are 16 playgrounds and 17 parks in the study area. Among them Bahadur Shah Park, Balda Garden, Ramna Park, National Botanical Garden, Osmani Uddyan etc. are quite renowned.

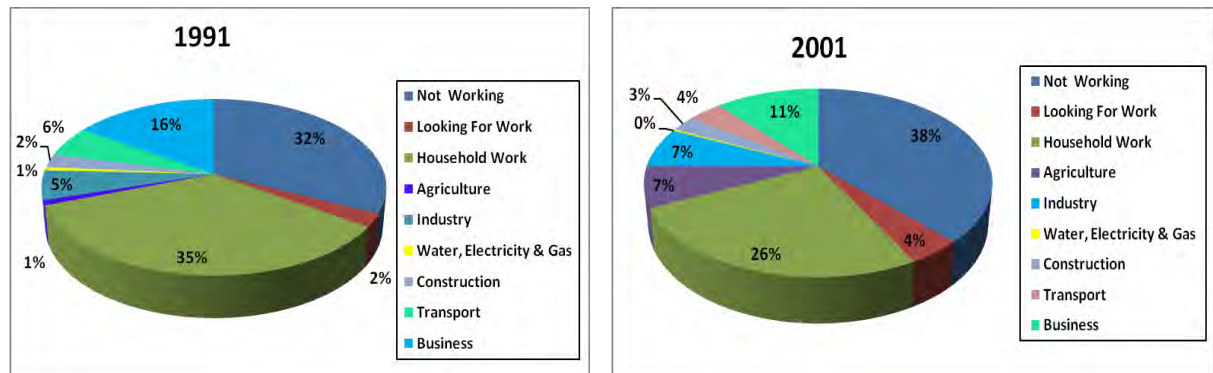
### **3.4.3 Housing program**

Under the Ministry of Housing and Public Works (MHPW), Bangladesh National Housing Authority (BNHA) provides housing among city people. The Housing and Settlement Directorate (HSD) has so far established 4 housing estates in the western part of Dhaka City with all civic and infrastructure facilities namely Lalmatia Housing Estate, Mohammadpur Housing Estate, Mirpur Housing Estate and Kallayanpur Housing Estate. These housing estates are consisted of residential and rehabilitation plots, flats, core

houses, shops, commercial, industrial and institutional plots, health centers, schools, mosques, parks, play grounds etc. All of these projects have been developed in the low laying areas. At present, 2 housing projects of plot development and flat construction are now under implementation phase in Mohammadpur, Lalmatia and Mirpur. Many housing estates/ societies (Government and Private) like Pisciculture Housing, Mohammadi Housing, Janata housing, etc have been built up in the study area.

### 3.4.4 Socio-economic Expansion

The population of Dhaka City has reached (areas under the jurisdiction of the DCC) at approximately 7.0 million. The population is growing by an estimated growth of 4.2% per annum, one of the highest rates amongst Asian cities. During 1991, total population of the study area was 87% of Dhaka. In 2001, it was about 74% of the total population under DCC jurisdiction. The involvement of local people in economic activities during 1991-2001 has shown in figure 2.2.



**Figure 3.4: Activities during 1991-2001 in the western part of Dhaka City**

Source: BBS, 1991 & 2001

The chart represents that from 1991 to 2001 extensive economical expansion has been occurred. It has been observed that in all sector of activities there is positive change or increasing indent except in sector of Water, Electricity and Gas. Major portion of population are involved in household work (35% in 1991, 26% in 2001) and in Business (16% in 1991, 11% in 2001). It is expected that the agriculture sector should have negative shift, but in reality it does not happen. It profs that city is not the only expanding in terms of population but also there is area of expansion. In addition, people living in the peripheral area of city are still linked with agriculture sector.

### **3.5 Conclusion**

This chapter has been concluded with all the related information to represent the study area profile. It is the main built-up area of the city with average elevation is of 6.93 meter. Major land use is residential (51%) where 36.3% is unplanned area. The study area consists of 73.6 % population of DCC area which is growing with at the rate of 4.2% per annum. 14 major khals, 865,913 sq. m. of ditches and 667,136s sq. m. of pond are available in the study area. This includes existing major issues like flood sensitivity, drainage of the study area. Most of the western areas are affected by water logging and flood. In addition, the socio-economic condition and the infrastructure development which have significant impact on the land use changes of the study area are also observed here.

## **Chapter Four: Land use changes in the Western part of Dhaka since 1992**

### **4.1 Introduction**

This chapter intends to explore the land use changes in the western part of Dhaka. Land use pattern and land conversion of Dhaka City during 1989, 1999, 2004 and 2007 are analyzed through Satellite Image Interpretation. Land use changes of retention pond and open drainage (khal) areas of the study area within FAP-8B proposals are discussed thoroughly in this chapter.

### **4.2 FAP – 8B proposals and specified land use**

The objective of the FAP-8B was to provide a relatively flood free and secured living environment within the framework of a long term flood protection program for Dhaka and to improve environmental conditions in Dhaka City for the promotion of a sustainable long term development. FAP-8B had four parts namely:

- a) Part-A: Flood Protection
- b) Part-B: Drainage
- c) Part-C: Environmental Improvement and
- d) Part-D: Implementation Assistance.

Part: A & B comprised of the proposals on drainage and Retention Ponds. Brief descriptions of the FAP – 8B proposals are as follows:

#### **a) Part-A: Flood Protection**

- Specialized remedial works and foundation stabilization of 7.80 km of the existing embankment.
- Erosion control and slope protection over 11.5 km of the existing embankment.
- Minor remedial works and slope protection over 24.2 km of the existing embankment.
- Repairing and stabilization of part of 5.3 km of the existing concrete flood wall.
- Construction of 1.6 km of the new flood wall/ embankment.
- Construction of 5 additional sluices on the existing embankment.
- Raising and flood proofing of the Central spine Road (from Tongi Railway Bridge to the Friendship Bridge).

- Construction of 22 cusec meter capacity pump stations (3 nos. Pumps) at Goranchatbari on the western embankment.

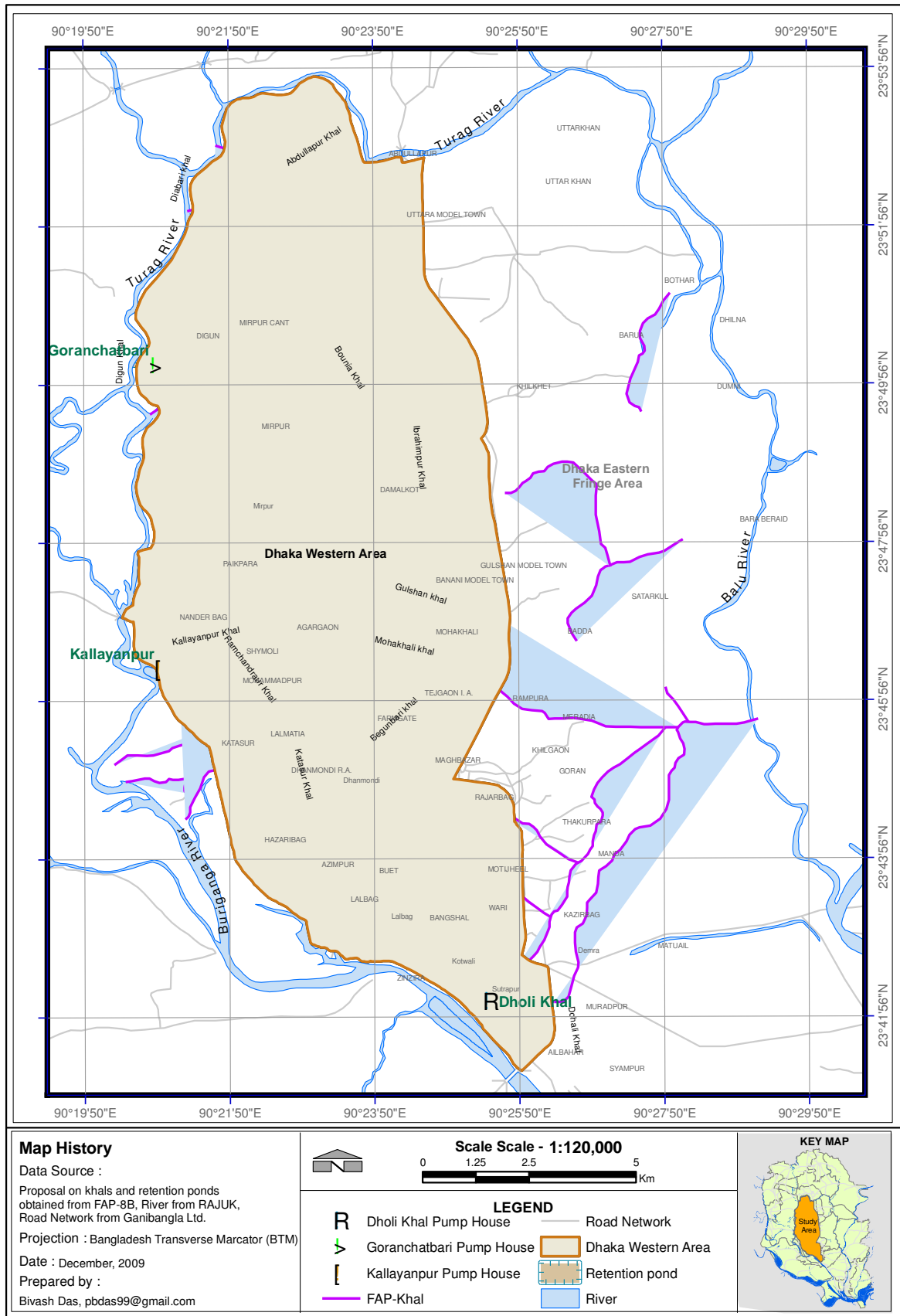
**b) Part-B: Drainage**

- Rehabilitation and upgrading of 21 Khals over a length of 78.6 km
- Rehabilitation and construction of 50.7 km of pipe drains
- Establishment of maintenance program and supply of maintenance equipment to safeguard the drainage improvement investment.

**c) Part-C: Environmental Improvement Program**

- Slum and squatter area improvement covering about 8725 beneficiary families.
- Solid waste management, including supply of 30 trucks and complementary waste handling equipment.
- Rehabilitation & extension of 131 km of minor local drains and supply of drain cleaning truck.
- Sanitation improvement including 30 public toilets, 5 mobile toilets, 5500 low cost sanitary latrines for low income residents and 2 septic tank de-sludging trucks.
- 1000 public water standpipes for low income communities

The primary focus of FAP-8B proposal was drainage improvement program for integrated drainage system within Dhaka urban area to eliminate/reduce the drainage congestion. Detailing of retention ponds and drainage channels have been explained in section 4.3. Pumping stations and its specification has been given in chapter- 6. FAP-8B proposals on drainage and retention ponds in the western part have shown in Map 4.1.



**Map 4.1: FAP-8B proposal on khals and retention ponds**

Source: FAP, BWDB



### 4.3 Pattern of land use change

Land use changes in the study area are examined from different sources of data. The analysis reveals that substantial growth of built-up areas in Dhaka City over the period resulted significant decrease in the area of water bodies, cultivated lands, vegetation and wetlands. Urban land expansion has been largely driven by elevation, population growth and economic development. Rapid urban expansion through infilling of low-lying areas and clearing of vegetation resulted in a wide range of environmental impacts, including habitat quality.

Land use changes have been observed in this study on the basis of Satellite Image Interpretation method. The changes are analyzed both statistically and graphically. These are depicted in detail in next section 4.3.1.

#### 4.3.1 Land use change in the western part of Dhaka City

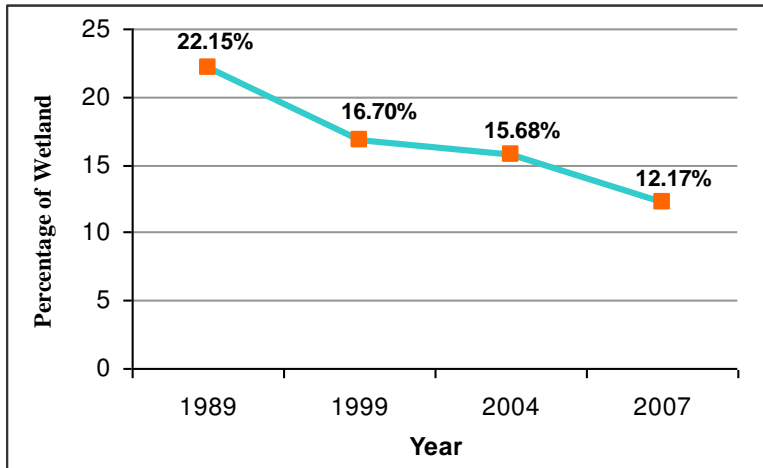
The land uses of the western part of Dhaka City are mainly Residential, Commercial, Educational, Mixed, Natural Water bodies/Low land, Restricted Area etc. An analysis of the satellite images of Dhaka of 1989, 1999, 2004 and 2007 have indicated that low lands are being reduced frequently including all water bodies and low-lying areas. As a whole, land use conversion during 1989 to 2007 in the western part is shown in Table: 4.1.

**Table 4.1: Trend of broad land use conversion in the western part during 1989-2007**

Land use	Year 1989		Year 1999		Year 2004		Year 2007	
	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area (ha)	%
Settlement/ built up areas	10,626	77.85	11,370	83.30	11,510	84.32	11,989	87.83
Water bodies/low land	3,024	22.15	2,280	16.70	2,140	15.68	1,661	12.17
Total Western Dhaka City	13,650	100.00	13,650	100.0	13,650	100.0	13,650	100.0

Source: Remote Sensing Image (TM 1989, ETM 1999, IKONOS 2004 & IKONOS 2007)

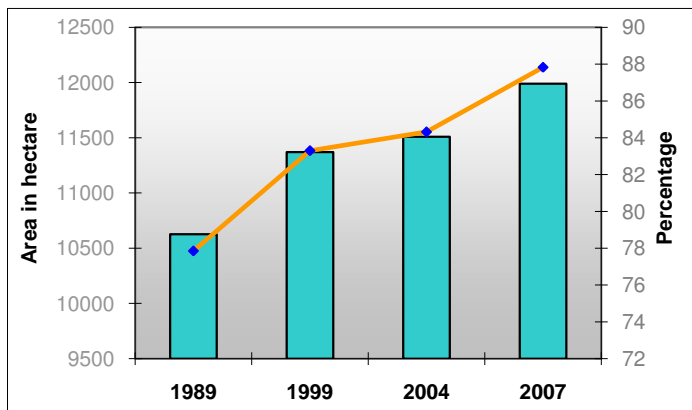
The information depicts the continuous increase of built-up areas and subsequent decrease of water bodies and wet lands in the study area over the decades. During 1989 to 2007, built-up area increases from about 78% to 88% in the study area. This context reveals the lack of proper control and law enforcement for wet land preservation by the government.



**Figure 4.1: Trend of wetland decrease in the western area of Dhaka City during 1989-2007**

Source: Remote Sensing Image Analysis, 2009

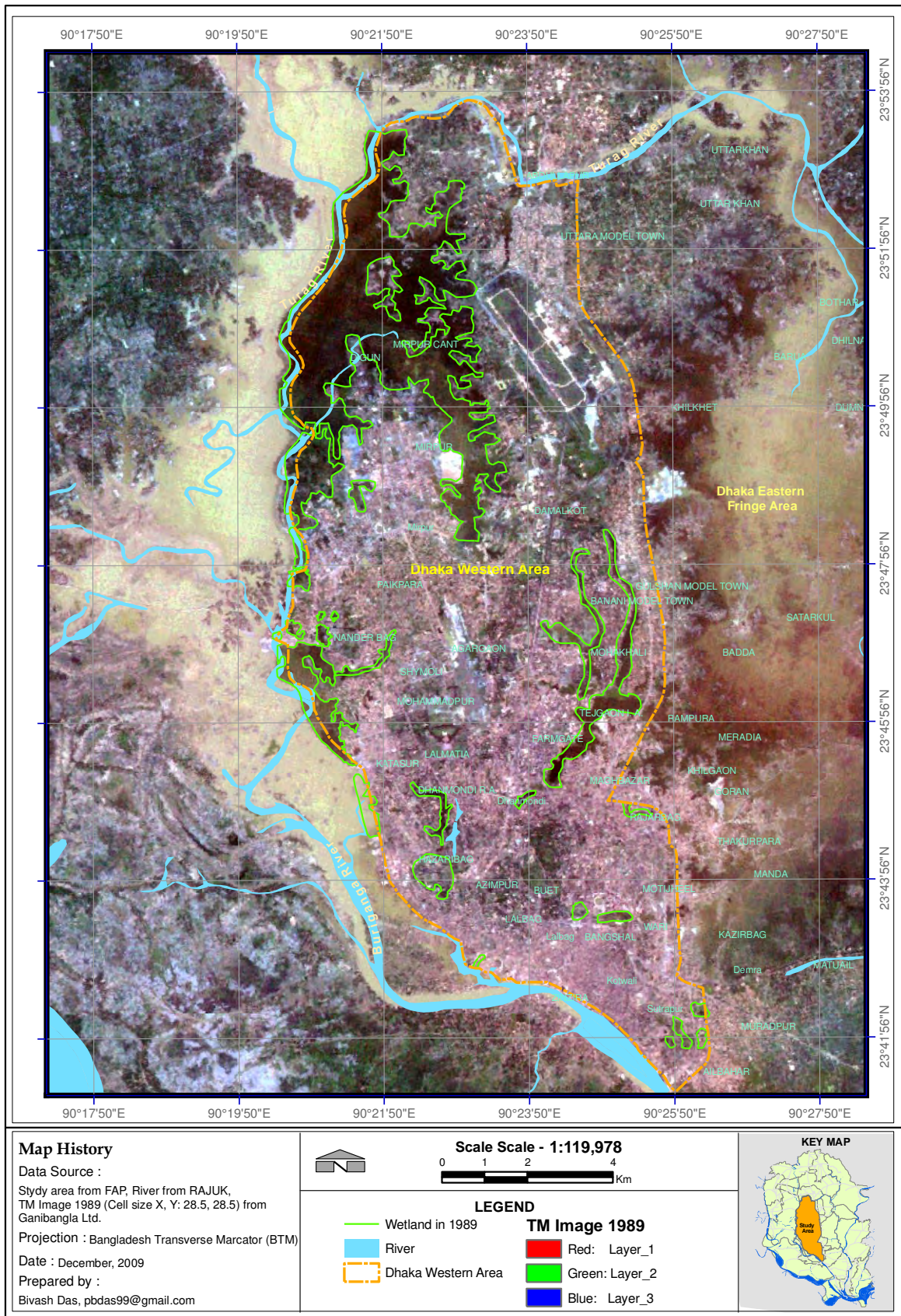
The chart depicts the decreasing trend of water bodies in the western area during 1989-2007. This trend reflects the gradual decrease of wetlands nearly 22% to 12% that means approximately 10% decrease of wetlands including water bodies. From the year 1989, on an average each year .55% wetlands have been decreased in the western part.



**Figure 4.2: Trend of built-up areas increase in the western area of Dhaka City during 1989-2007**

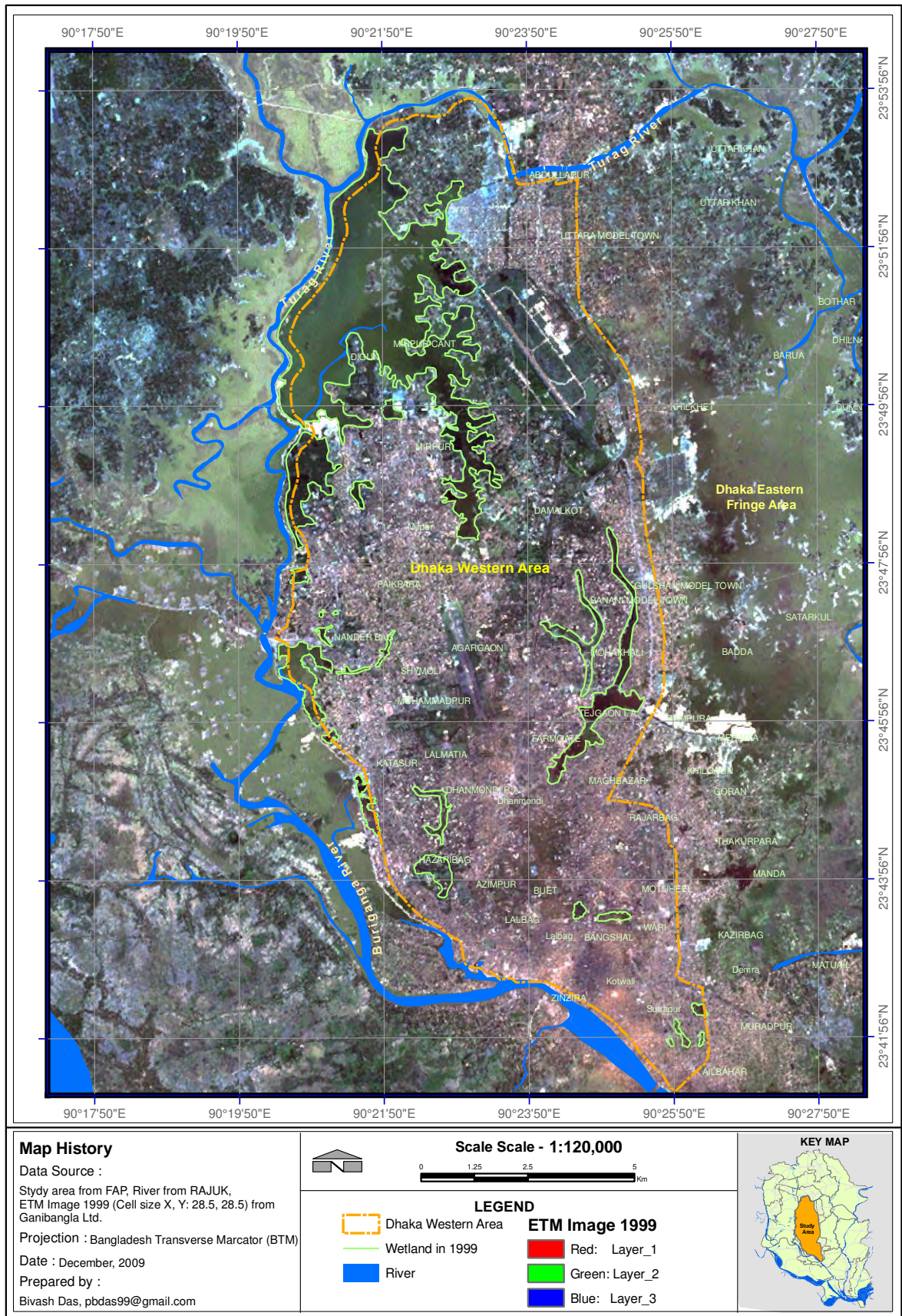
Source: Remote Sensing Image Analysis, 2009

On the other hand, it is observed that built-up area has been increased about 1500 hectare (10 %) in nearly 18 years from 1989-2007 in the west Dhaka. As a whole, it can be said that continuous increase and decrease of built up areas and water bodies respectively expose the violation of planning rules and accelerating environmental degradation. The gradual conversion of land uses of Dhaka City can be graphically interpreted or observed from the Map 4.2, 4.3, 4.4 and 4.5 representing data of 1989, 1998, 2004 and 2007. Finally Map 4.6 & 4.7 represents the over all wetland conversion in the western part of Dhaka City from given 4 year data analysis.



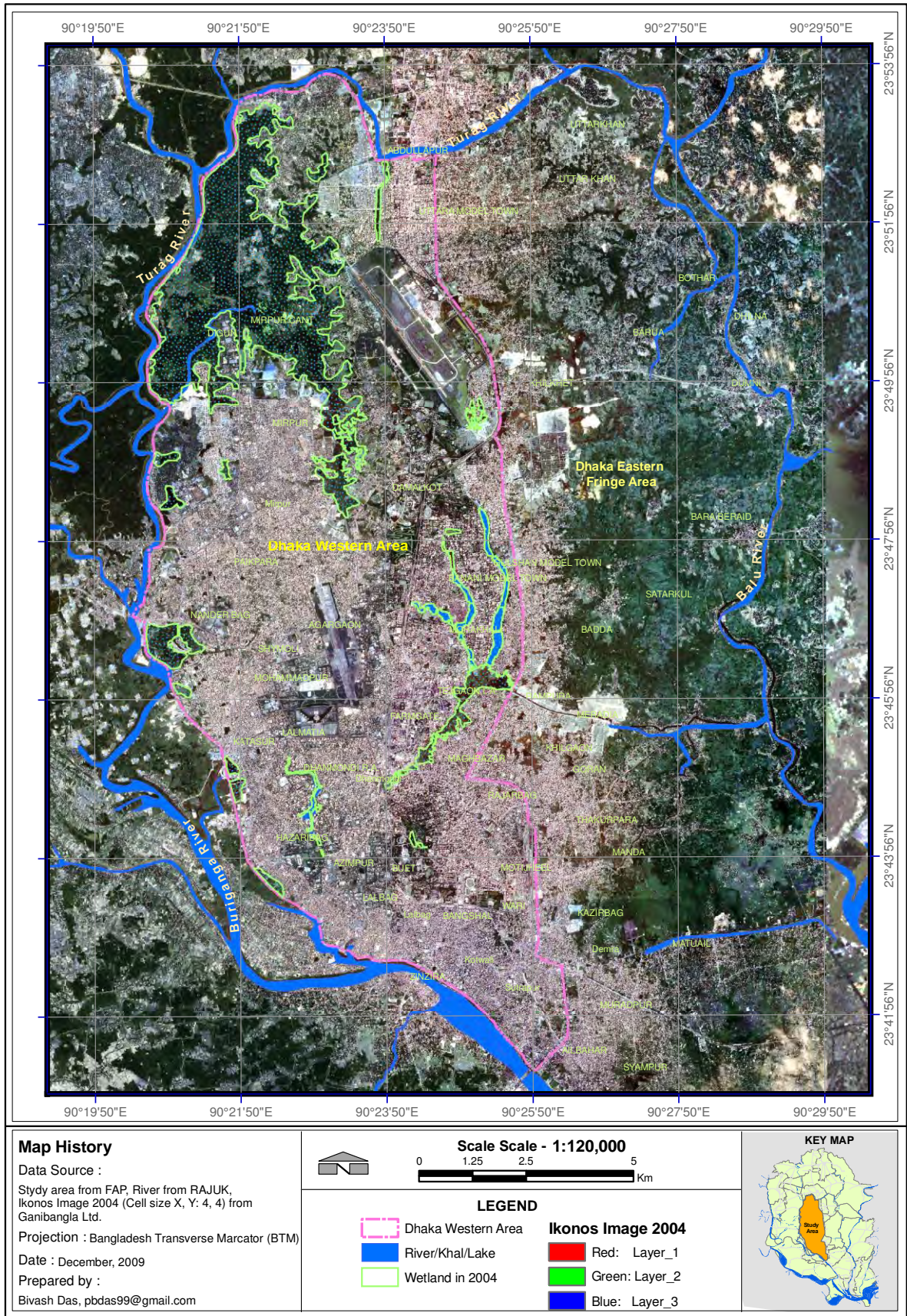
**Map 4.2: Land Use Pattern in the Western part of Dhaka City in the Year 1989**





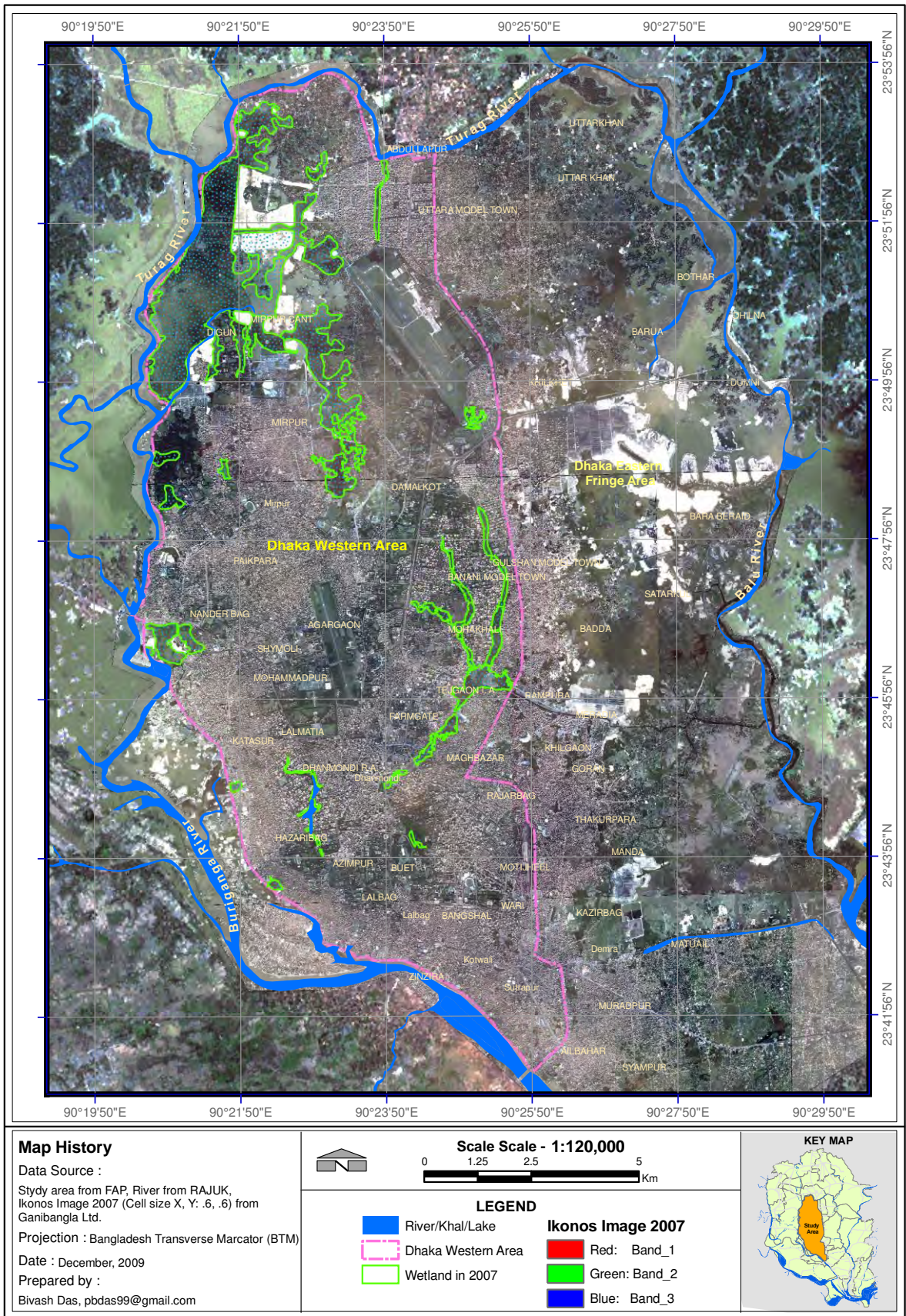
**Map 4.3: Land Use Pattern in the Western part of Dhaka City in the Year 1999**



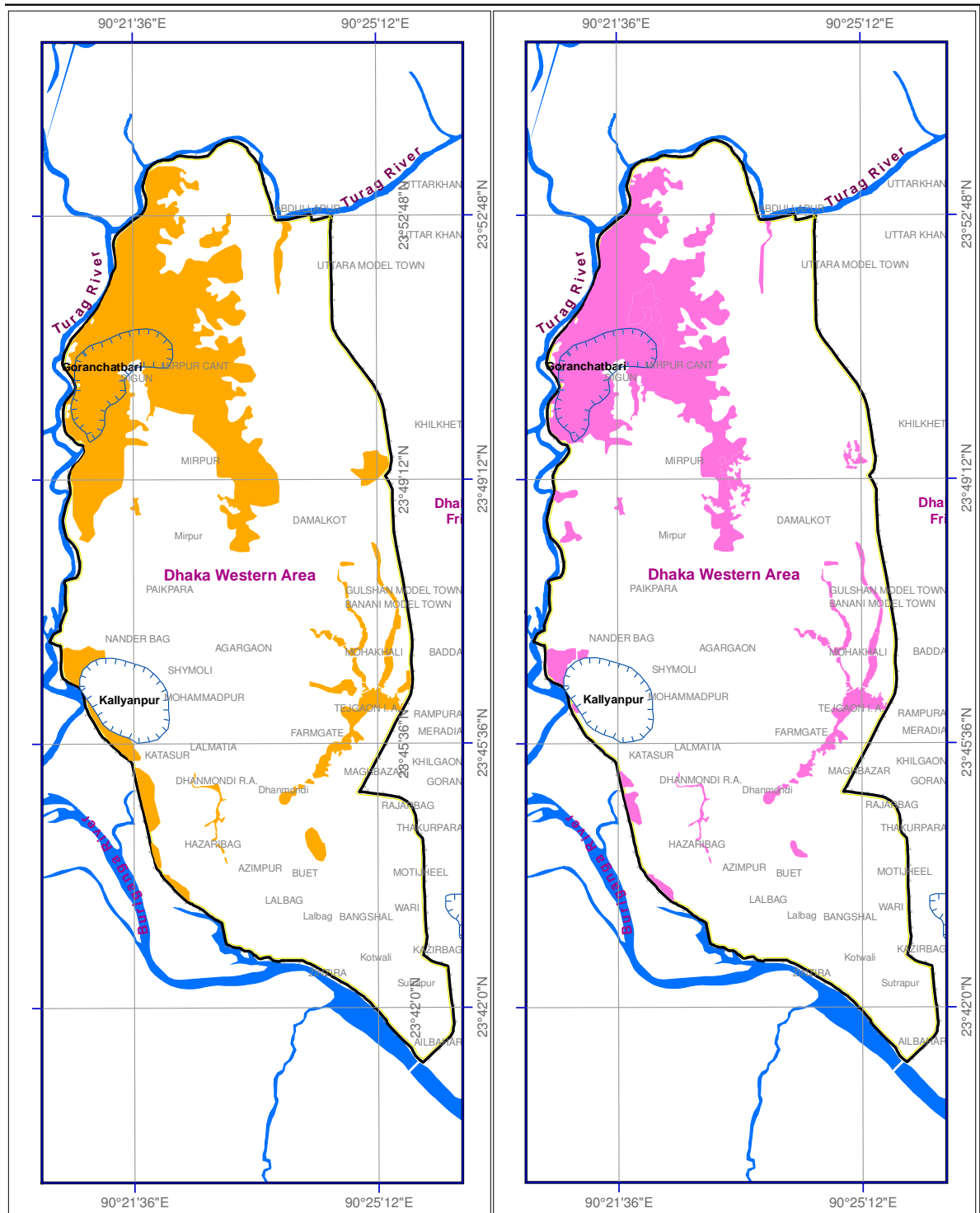


**Map 4.4: Land Use Pattern in the Western part of Dhaka City in the Year 2004**





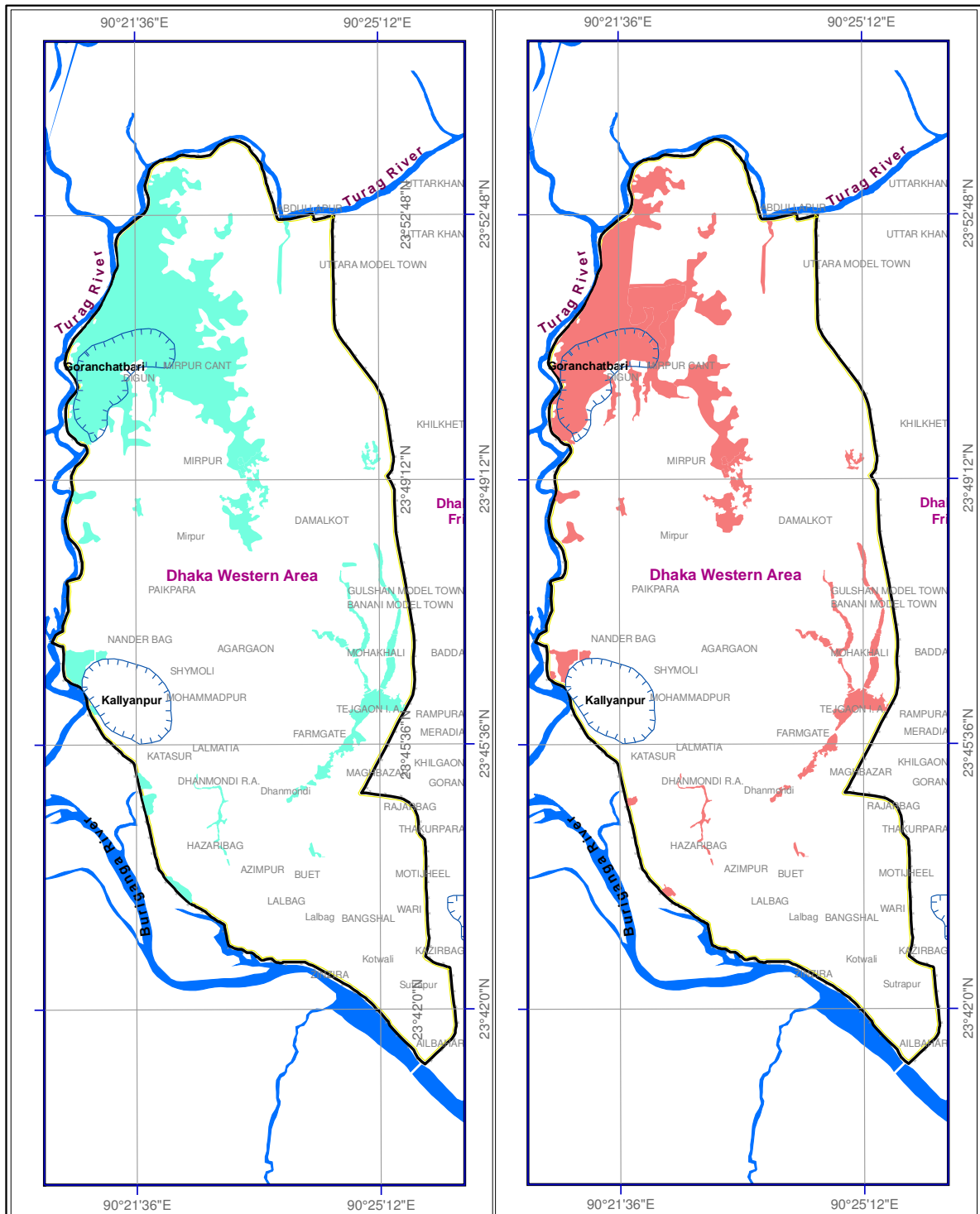
**Map 4.5: Land Use Pattern in the Western part of Dhaka City in the Year 2007**

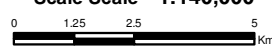



<p><b>Map History</b></p> <p>Data Source :          Study area from FAP, River from RAJUK,          Ikonos Image 2004 &amp; 2007 from Ganibangla Ltd.</p> <p>Projection : Bangladesh Transverse Mercator (BTM)</p> <p>Date : December, 2009</p> <p>Prepared by :          Bivash Das, pbdas99@gmail.com</p>	<p style="text-align: center;"><b>Scale Scale - 1:140,000</b></p> <p style="text-align: center;">0 1.25 2.5 5 Km</p> <p style="text-align: center;"><b>LEGEND</b></p> <table border="0"> <tr> <td><span style="display: inline-block; width: 15px; height: 10px; background-color: pink; border: 1px solid black;"></span> Wetland in 1999</td> <td><span style="display: inline-block; width: 15px; height: 10px; background-color: blue; border: 1px solid black;"></span> River</td> </tr> <tr> <td><span style="display: inline-block; width: 15px; height: 10px; background-color: orange; border: 1px solid black;"></span> Wetland in 1989</td> <td><span style="display: inline-block; width: 15px; height: 10px; border: 2px solid black;"></span> Dhaka Western Area</td> </tr> <tr> <td></td> <td><span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed black;"></span> Retainment pond</td> </tr> </table>	<span style="display: inline-block; width: 15px; height: 10px; background-color: pink; border: 1px solid black;"></span> Wetland in 1999	<span style="display: inline-block; width: 15px; height: 10px; background-color: blue; border: 1px solid black;"></span> River	<span style="display: inline-block; width: 15px; height: 10px; background-color: orange; border: 1px solid black;"></span> Wetland in 1989	<span style="display: inline-block; width: 15px; height: 10px; border: 2px solid black;"></span> Dhaka Western Area		<span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed black;"></span> Retainment pond	<p style="text-align: center;"><b>KEY MAP</b></p>
<span style="display: inline-block; width: 15px; height: 10px; background-color: pink; border: 1px solid black;"></span> Wetland in 1999	<span style="display: inline-block; width: 15px; height: 10px; background-color: blue; border: 1px solid black;"></span> River							
<span style="display: inline-block; width: 15px; height: 10px; background-color: orange; border: 1px solid black;"></span> Wetland in 1989	<span style="display: inline-block; width: 15px; height: 10px; border: 2px solid black;"></span> Dhaka Western Area							
	<span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed black;"></span> Retainment pond							

**Map 4.6: Wetland conversion of the year 1989 and 1999 in the western area**





<p><b>Map History</b></p> <p>Data Source :          Study area from FAP, River from RAJUK, Image ETM (1999) and TM (1989) from Ganibangla Ltd.</p> <p>Projection : Bangladesh Transverse Mercator (BTM)</p> <p>Date : December, 2009          Prepared by :          Bivash Das, pbdas99@gmail.com</p>	<p><b>Scale Scale - 1:140,000</b></p>  <p><b>LEGEND</b></p> <ul style="list-style-type: none"> <li><span style="color: red;">■</span> Wetland in 2007</li> <li><span style="color: cyan;">■</span> Wetland in 2004</li> <li><span style="color: blue;">■</span> River</li> <li><span style="border: 2px solid black; display: inline-block; width: 10px; height: 10px;"></span> Dhaka Western Area</li> <li><span style="border: 1px dashed blue; display: inline-block; width: 10px; height: 10px;"></span> Retainment pond</li> </ul>	<p><b>KEY MAP</b></p> 
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**Map 4.7: Wetland conversion of the year 2004 and 2007 in the western area**



### 4.3.2 Changes of the land use proposal in the FAP- 8B western area

First Phase of the flood protection works was commenced in early 1989, under priorities of the Govt., with aim to provide flood protection facilities to the western part representing the half of the Dhaka City (Rahman. and Islam, 1997). Under the project, “Phase-I” was completed in 1997. In the implementation stage, 1 pump station has constructed and 21 canals were developed in different parts of the city.

#### 4.3.2.1 Land use Changes in the retention pond areas

In FAP- 8B area, three pump stations are available at present. For Goranchatbari retention pond area, 686 hectares areas were proposed in the plan. But the base map represents 304.4 hectares land area and at present govt. become able to acquire 274 hectares which have been developed in the implementation stage. In case of Kallyanpur pumping station government become able to acquire about 3.2 hectare of land out of 200 hectare proposed land but yet not have been implemented. The base map represents 306.4 hectares pond area for the Kallyanpur pump station. Besides, the Old Narinda Pond as a reservoir for Dholai khal Pumping Station is not well managed and functioned. Here, Table 4.2 shows the detailing of retention pond areas in the study area:

**Table 4.2: Details of the proposed retention ponds areas in the western part**

Name of the pond area	Proposed area in FAP-8B map (ha)	Acquisition/Govt. khas land (ha)
Goranchatbari	304.4	274.0
Kallyanpur	306.4	3.2
Dholai khal - Narida Storage basin 2.4 ha Dayaganj-Jatrabari Storage basin 1.8 ha	-	4.2
Total	610.8	281.4

Source: Field Survey & Secondary Data Analysis, 2009

Dholai khal retention pond area was not specified in FAP-8B map. Besides, the area was khas land and now using as retention pond for the Dholai khal pump station.

**Table 4.3: Changes of retention pond areas during 1989-2007**

Retention pond area		Effective Retention Pond		Total
		Goranchatbari	Kallyanpur	
Year 1989	Area (ha)	294.90	134.05	428.95
	% of western area	2.16	0.98	3.14
Year 1999	Area (ha)	294.89	52.23	347.12
	% of western area	2.16	0.38	2.54
Year 2004	Area (ha)	294.07	37.32	331.39
	% of western area	2.15	0.27	2.43
Year 2007	Area (ha)	209.89	33.94	243.83
	% of western area	1.54	0.25	1.79

Source: Remote Sensing Image (TM 1989, ETM 1999, IKONOS 2004 & IKONOS 2007)

FAP-8B proposed about 4.5% land area of the western part (136.5 sq. km) for Goranchatbari (2.23%) and Kallyanpur (2.24%) retention pond area. Table 4.3 represents that during 1989 only 3.14% land area was effective as retention pond and in 2007 only 1.79%. As a whole, about 60% decrease of pond areas is observed from 1992 (based on proposed FAP map) to 2007 in the western area. Besides these, the observation also shows that during 1989-1999 per year pond area decrease was about 8 hectare, during 1999-2004 this rate was about 3 hectare and during 2004-2007 this was about 29 hectare. Among these three periods, 2004-2007 is quite significant. It is clear that Goranchatbari retention pond area is still now more or less effective but Kallyanpur retention pond area is going to be disappeared considering the proposed location of pond area.

#### **Land use changes in the Goranchatbari Retention Pond area**

In case of Goranchatbari pond area government's success in acquiring land area was 274 hectare while the required area (based on map) was 304.4 hectare. The existing land uses within proposed area are represented in Table 4.4 below:

**Table 4.4: Use of land within proposed retention pond area in Goranchatbari**

Land use	Area in ha	Percentage (%)
Open Space	2.19	0.72
Residential	93.25	30.64
Retention Pond (using as fisheries project)	190.35	62.53
Khal	18.61	6.12
Total	304.40	100.00

Source: Field Survey & Secondary Data Analysis, 2009

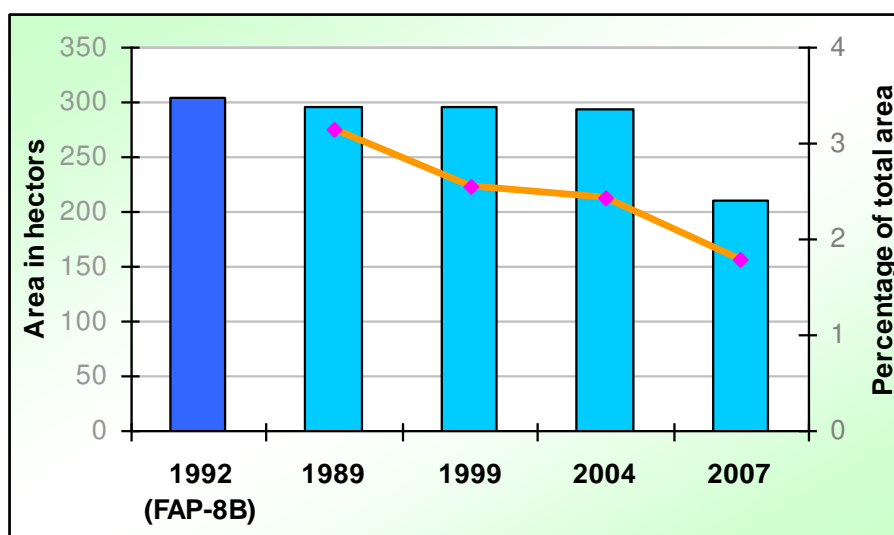
The proposed area (304.4 hectare) of Goranchatbari retention pond area is now used for different purposes. Here, the effective retention pond area is about 63% and another major land use category is residential which shares about 31%.

It has been observed from the Map 4.8 & 4.9 that FAP 8B proposed retention pond was 304.4 ha but 274.4 ha land areas were acquired for implementation. But a common area is identified between these areas which covers 213 ha (78% area of acquired land) of existing water body. Goranchatbari retention pond area is located within three mouza namely Baunia (J.L No. 13), Digun (J.L No. 20) and Goranchatbari (J.L No. 22). Table 4.5 represents the existing land uses of existing (acquired) Goranchatbari retention pond area:

**Table 4.5: Land use within acquired retention pond area in Goranchatbari**

Land use	Area in ha	Percentage (%)
Retention Pond area (alternative using as fisheries and agriculture)	272.63	99.35
Pump Area	1.37	0.65
Total Area	274.4	100.00

Source: Field Survey & Land use map of DAP, 2009



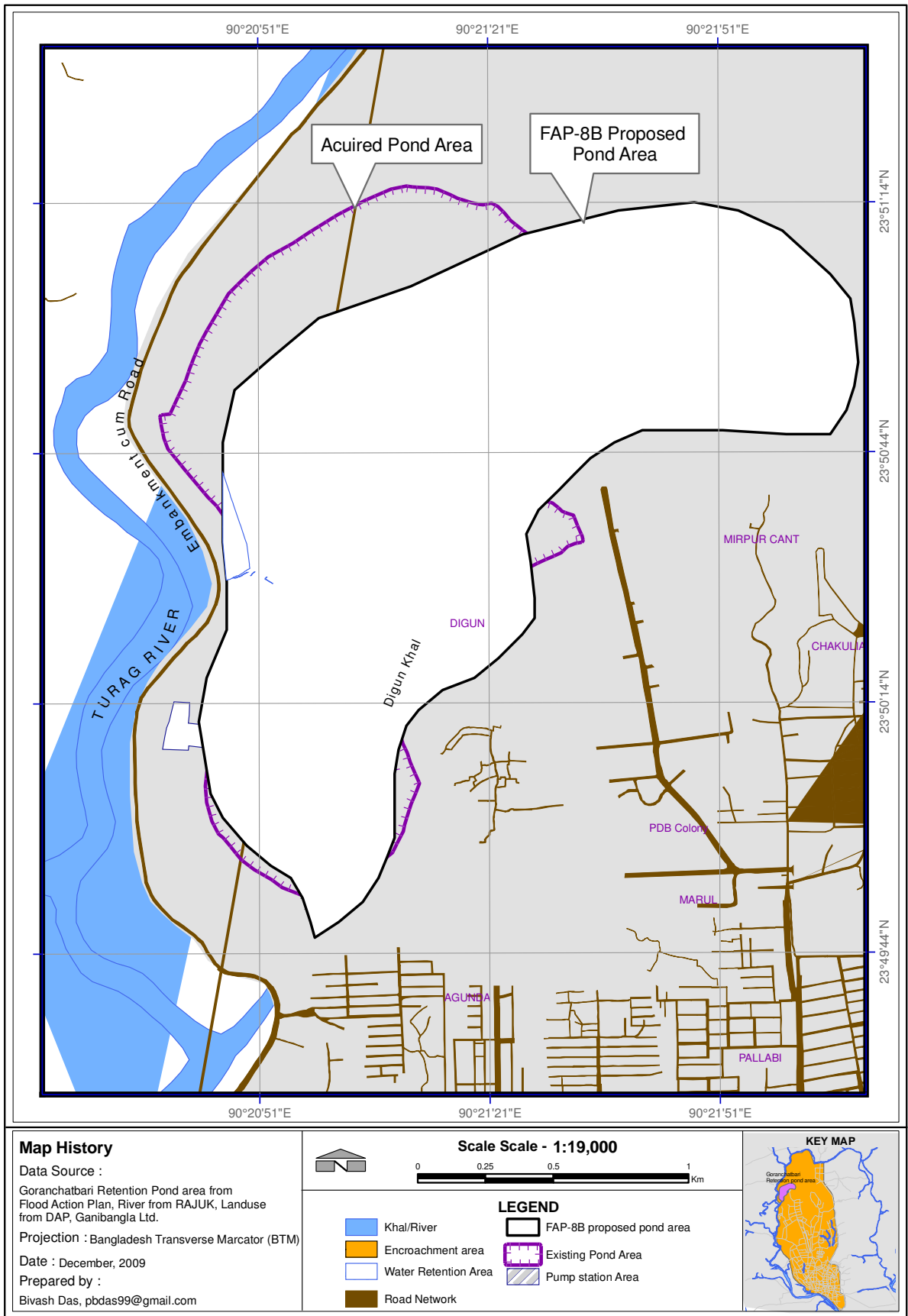
**Figure 4.3: Goranchatbari retention pond area during 1989-2007**

Source: Remote Sensing Image (TM 1989, ETM 1999, IKONOS 2004 & IKONOS 2007)

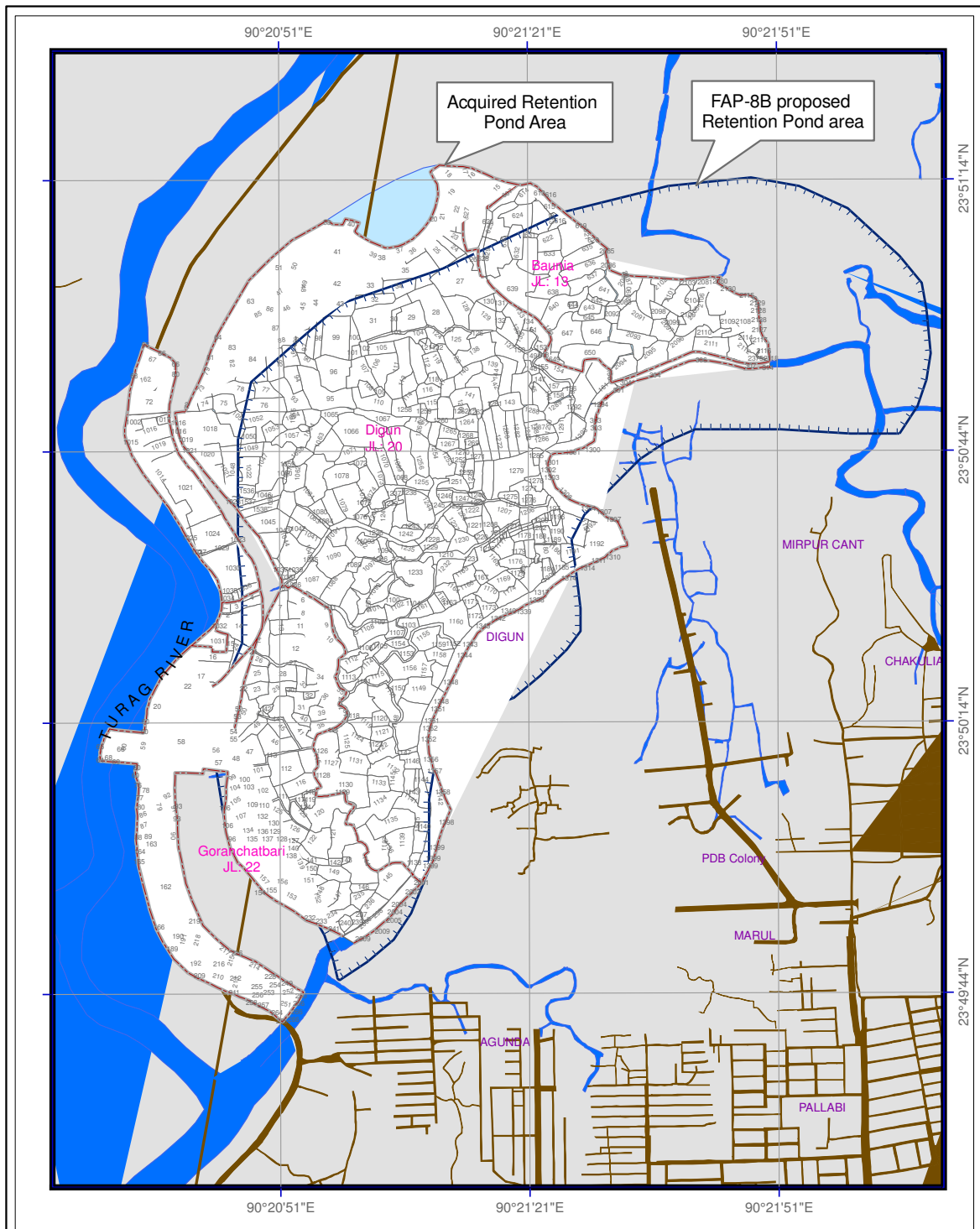
Figure 4.3 illustrates that during FAP-8B preparation period in 1991, Goranchatbari retention pond was proposed for 2.23% area (304.40 ha) of the total FAP-8B area. Satellite image analysis clearly states that during the year 1989, about 10 ha area had been already developed as built-up area within proposed Goranchatbari retention pond

area. Up to 2004, remaining proposed location was free from illegal encroachment activities but within 2007 about 210 ha (1.54% land of total western area) pond area was remain effective which indicates about 29% encroachment.

It is clear from analysis that during the plan preparation period, proposal for Groancharbari retention pond area was not properly assessed. On the other hand, after implementation of Groancharbari pump station with acquisition of 274 ha land for retention pond, over the remaining FAP-8B proposed area development control by the authority was absent. Besides, government had no policy for further acquisition or extension of pond area. As a result, out side of retention pond area has been become developed rapidly without any plan.



**Map 4.8: Land use within FAP-8B proposed retention pond area at Goranchatbari**



<p><b>Map History</b></p> <p>Data Source : Goranchatbari Retention Pond area from Flood Action Plan, River from RAJUK, Landuse from BWDB, Embankment from Ganibangla Ltd.</p> <p>Projection : Bangladesh Transverse Mercator (BTM)</p> <p>Date : December, 2009</p> <p>Prepared by : Bivash Das, pbdas99@gmail.com</p>	<p style="text-align: center;"><b>Scale Scale - 1:19,000</b></p> <p style="text-align: center;">0      0.25      0.5      1 Km</p> <p style="text-align: center;"><b>LEGEND</b></p> <table border="0"> <tr> <td> Mouza Boundary</td> <td> Embankment</td> </tr> <tr> <td> Plot Boundary</td> <td> Retention Pond Area</td> </tr> <tr> <td> Road</td> <td> Pump Operation Area</td> </tr> <tr> <td> River/Khal/Lake</td> <td> FAP-8B proposed pond</td> </tr> </table>	Mouza Boundary	Embankment	Plot Boundary	Retention Pond Area	Road	Pump Operation Area	River/Khal/Lake	FAP-8B proposed pond	<p style="text-align: center;"><b>KEY MAP</b></p>
Mouza Boundary	Embankment									
Plot Boundary	Retention Pond Area									
Road	Pump Operation Area									
River/Khal/Lake	FAP-8B proposed pond									

**Map 4.9: Land use within existing (acquired) Goranchatbari retention pond area**

### Land use changes in the Kallayanpur Retention Pond area

In case of Kallayanpur pond area government's success in acquiring land area was 3.2 ha only while the required proposed area was 306.6 ha (based on map). The acquired 3.2 ha is now being used as pump operation area. The existing land uses within proposed 306.6 hectare area (Map 4.10) are represented in Table: 4.6:

**Table 4.6: Land use within proposed retention pond area at Kallyanpur**

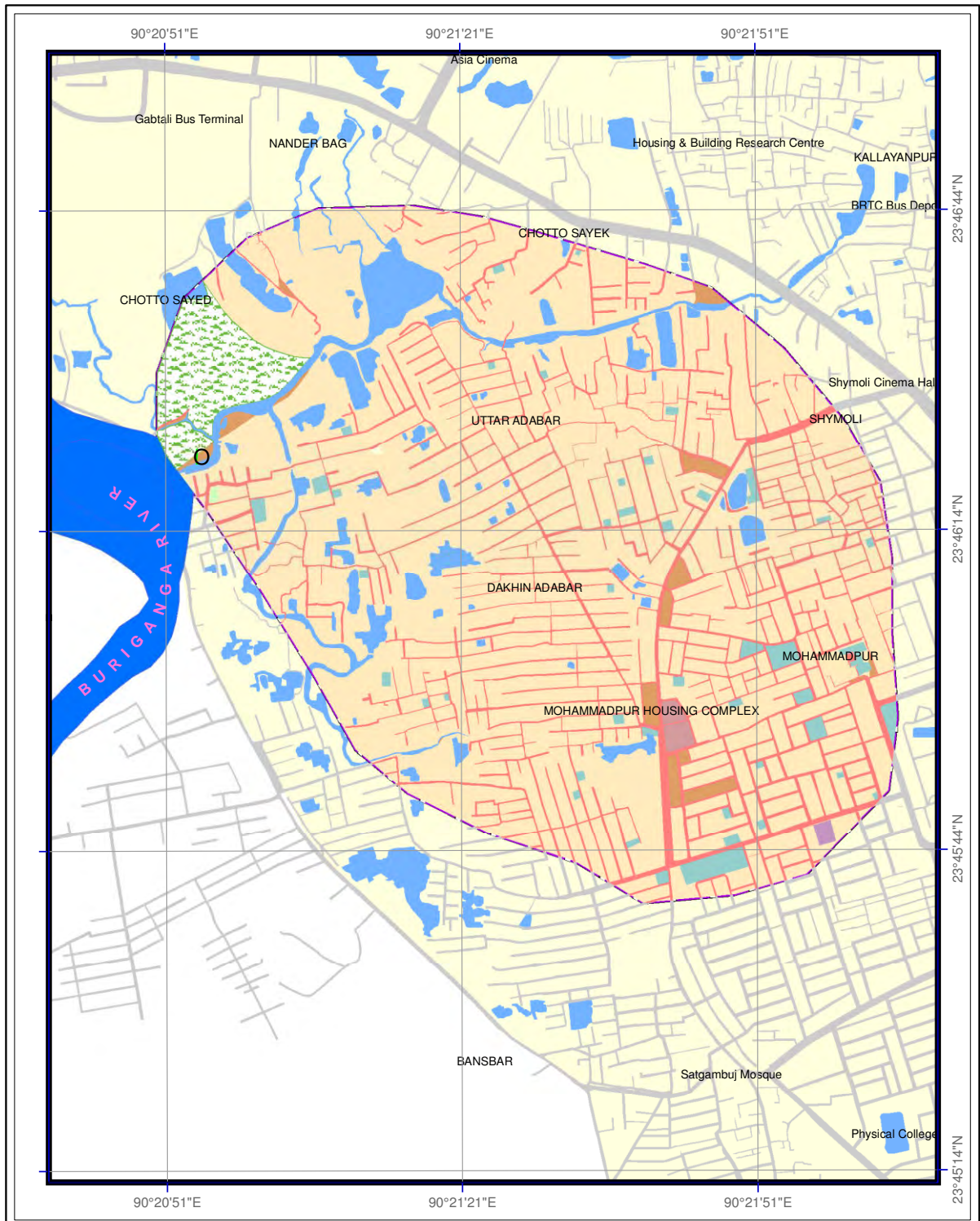
Land use	Area in hectare	Percentage (%)
Agriculture	10.76	3.51
Commercial Activity	0.94	0.31
Education & Research	6.13	2.00
Graveyard	0.33	0.11
Mixed Use	3.87	1.26
Open Space	0.09	0.03
Residential	233.09	76.08
Transport & Communication	30.62	9.99
Water Body	20.55	6.71
Total	306.38	100.00

Source: Field Survey & Land use map of DAP, 2009

It has been analyzed that most of the lands in proposed area are covered by residential land use (76.08%). While only 6.71% is covered by water body. This indicates significant encroachment by the built up areas and poor effectiveness of Kallayanpur retention pond area in the context of coverage area. The residential land use is mainly dominated by private and government housing scheme.

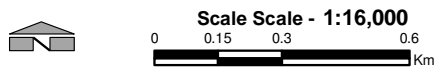
Among all housing schemes, about 2 public and 12 private housing schemes have been already identified within the proposed pond area at Kallyanpur (Map 4.11). Table 4.7 has been listed out the development of different housing schemes in the pond areas.





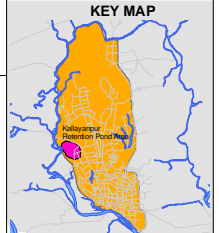
**Map History**

Data Source :  
 Kallayanpur Retention Pond area from Flood Action Plan, River from RAJUK, Landuse, Embankment from Ganibangla Ltd.  
 Projection : Bangladesh Transverse Mercator (BTM)  
 Date : December, 2009  
 Prepared by :  
 Bivash Das, pbdas99@gmail.com



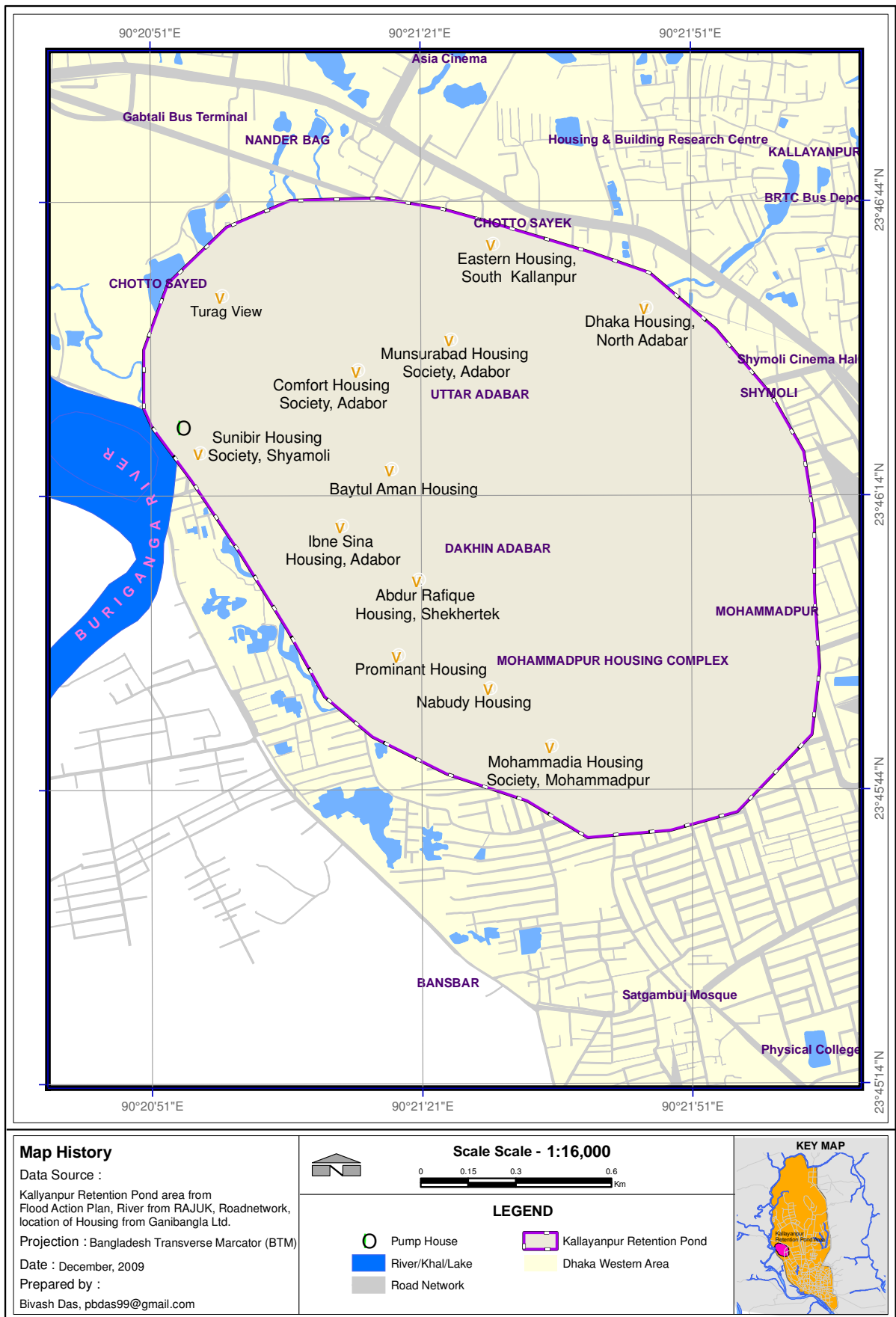
**LEGEND**

- Pump House
- Kallayanpur Retention Pond
- River/Khal/Lake
- Road Network
- Dhaka Western Area
- Agriculture
- Commercial Activity
- Education & Research
- Graveyard
- Mixed Use
- Open Space
- Residential
- Transport & Commun
- Water Body



**Map 4.10: Land use within designated Kallayanpur Retention Pond area**





**Map 4.11: Location of different housing within Kallyanpur retention pond area**

**Table 4.7: Housing Development within proposed retention pond area at Kallayanpur**

Sl. No	Name of the Housing	Locality	Ownership
1.	Munsurabad Housing Society	Adabor	Private
2.	Comfort Housing Society	Adabor	Private
3.	Eastern Housing	South Kallanpur	Private
4.	Dhaka Housing	North Adabar	Private
5.	Sunibir Housing Society	Shyamoli	Private
6.	Baitul Aman Housing	Mohammadpur	Government
7.	Ibne Sina Housing	Adabor	Private
8.	PC Culture Housing	Mohammadpur	Government
9.	Rafique Housing	Shakhertek	Private
10.	Mohammadia Housing Society	Mohammadpur	Private
11.	Extension Mohammadia Housing	Mohammadpur	Private
12.	Prominant Housing	Mohammadpur	Private
13.	Nabudy Housing	Mohammadpur	Private
14.	Turag View	Kallayanpur	Private

Source: Field Survey & Secondary Data Analysis, 2009

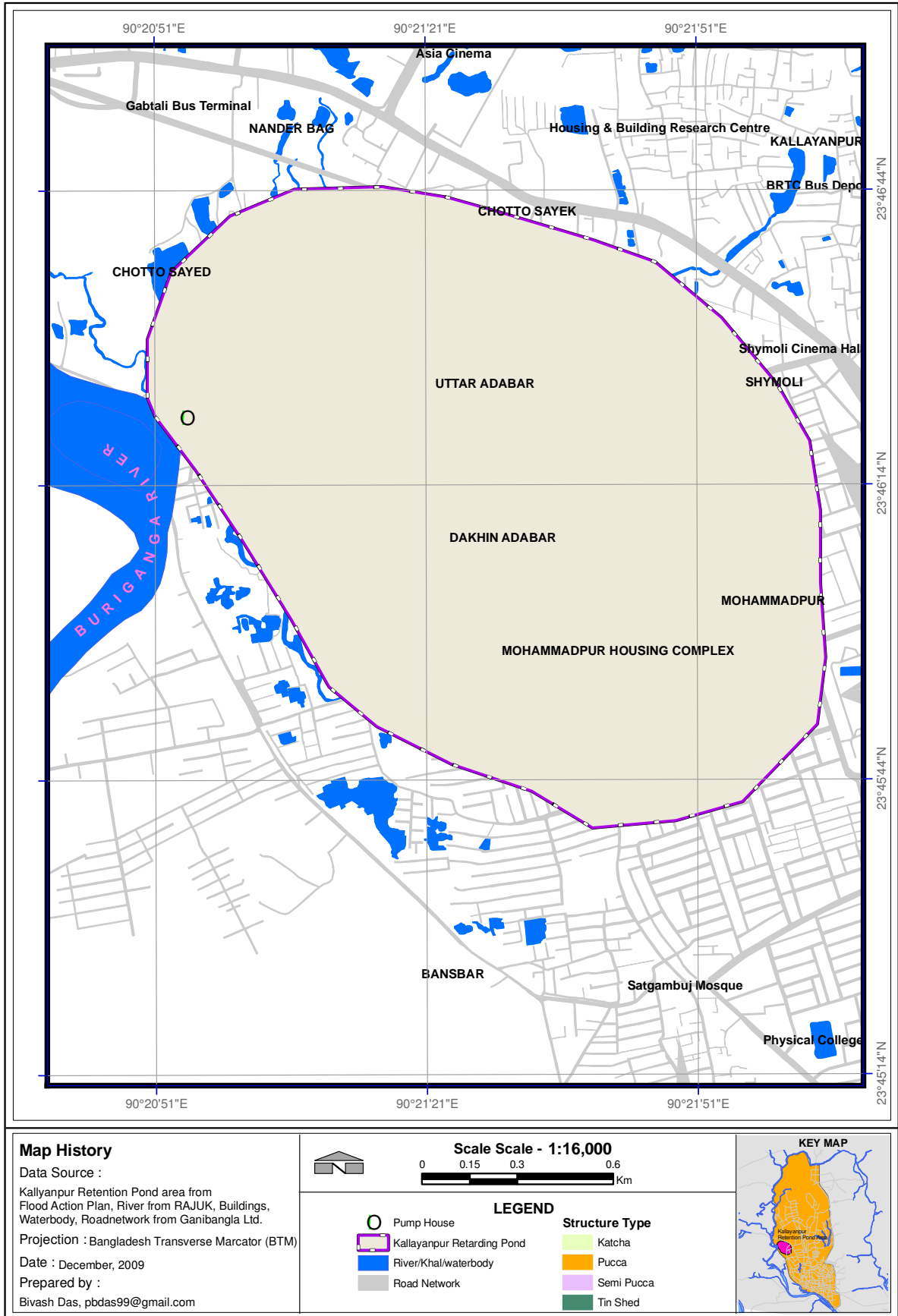
As a consequence of Housing development, during last two decades the construction of buildings has been increased rapidly. Table 4.11 represents the statistics of constructed buildings in the study area during 1990 to 2007.

**Table 4.8: Construction of Buildings in Kallayanpur retention pond area during 1990- 2007**

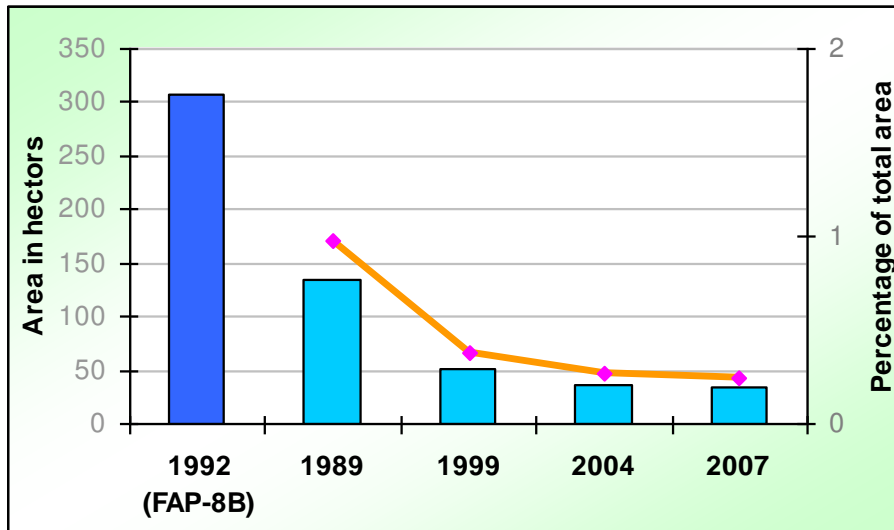
Year	Buildings					
	1-5 storied	% of total building	6-10 storied	% of total building	Total	% of total building
Before 1990	3285	34.39	84	0.88	3369	35.27
1991 - 1995	3316	34.72	223	2.33	3539	37.05
1996 - 2000	1662	17.40	216	2.26	1878	19.66
2001 - 2005	501	5.25	82	0.86	583	6.10
After 2006	142	1.49	40	0.42	182	1.91

Source: Physical Feature Map of DAP, 2009

It is clear that about 35 percent buildings were developed before 1990. Then next 35 percent was developed in between 1991-1995. This indicates that most of the building development has been occurred before and in nineties (Map 4.12). But FAP-8B has ignored the development which has been observed from proposal for retention pond (table 4.2).



**Map 4.12: Construction of buildings within Kallyanpur retention pond area**



**Figure 4.4: Kallyanpur retention pond area during 1989-2007**

Source: Remote Sensing Image (TM 1989, ETM 1999, IKONOS 2004 & IKONOS 2007)

Figure 4.4 illustrates that during 1992 (preparation period of FAP-8B), proposed Kallyanpur retention pond area was 2.24% (306.40 ha) of the total land area in the western part. From satellite image analysis, it is clear that alike Goranchatbari in FAP-8B plan proposed for Kallyanpur was not also properly assessed as about only 134 ha (.98% of total west part land area) area was effective during 1989. Kallyanpur retention pond area not only shares a small proportion of total pond area but also the subject of large encroachment activities. From 1989 to 2007, about 74% pond area had been encroached.

#### **4.3.2.2 Land use Changes in the open drainage (khal) areas**

FAP-8B emphasized on the cleaning and rehabilitation of 21 major open drainage khals totaling 78 km in length. But, minor initiatives have been undertaken by the authorities. Conversion of lands from khals to urban uses is common scenario in the western part. The present scenario of 14 khals out of 21 khals in the FAP-8B western area has been shown in table 4.9.

**Table 4.9: Present status of 14 khals of the FAP-8B proposal**

Sl. no.	Name of the khals	Present status
1.	Abdullahpur Khal	The Abdullahpur Khal is till now effective. About half of the khal area has been filled up and now is being used for residential purpose. The khal is now polluted by residential waste water.
2.	Begunbari khal	Filling up a large portion of Begunbari Khal in Tejgaon, Gulshan and Mohakhali areas.
3.	Baunia Khal	Baunia Khal is active now. Some portion are filled-up for residential development
4.	Diabari khal	Small portion of Diabari Khal has been filled up by developers.
5.	Digun Khal	Active as a channel for pumping station of Goranchatbari. Some branches have encroached by developers.
6.	Dholai Khal	Dholai Khal has been filled up and converted to box culvert. Small portion is used as an intake khal for pump station.
7.	Gulshan khal (lake)	Some portion of Gulshan lake has been filled up by Gulshan Residential area.
8.	Ibrahimpur Khal	Ibrahimpur khal is active now.
9.	Kallayanpur Khal	Major encroachment is identified on the Kalyanpur Khal within its six branches in Kallayanpur area.
10.	Katasur Khal	Encroachment is observed on Katasur Khal in Rayer Bazar and Mohammadpur area.
11.	Mohakhali khal	The khal is partially active. Some portion is encroached by the construction of building.
12.	Paribag Khal	Paribag Khal is filled up through development of road and buildings.
13.	Ramchandrapur Khal	Encroachment on Ramchandrapur Khal in Islambagh, Nawabganj and Hajaribagh area.
14.	Segunbagicha khal	Segunbagicha Khal is fully encroached by box culverts and construction of roads.

Source: Field investigation, 2009

From RS mouza maps and land use map analyses the existing use of all khal areas has been properly identified (Map 4.13). Table 4.10 represents the effectiveness of the major khals in the western area.

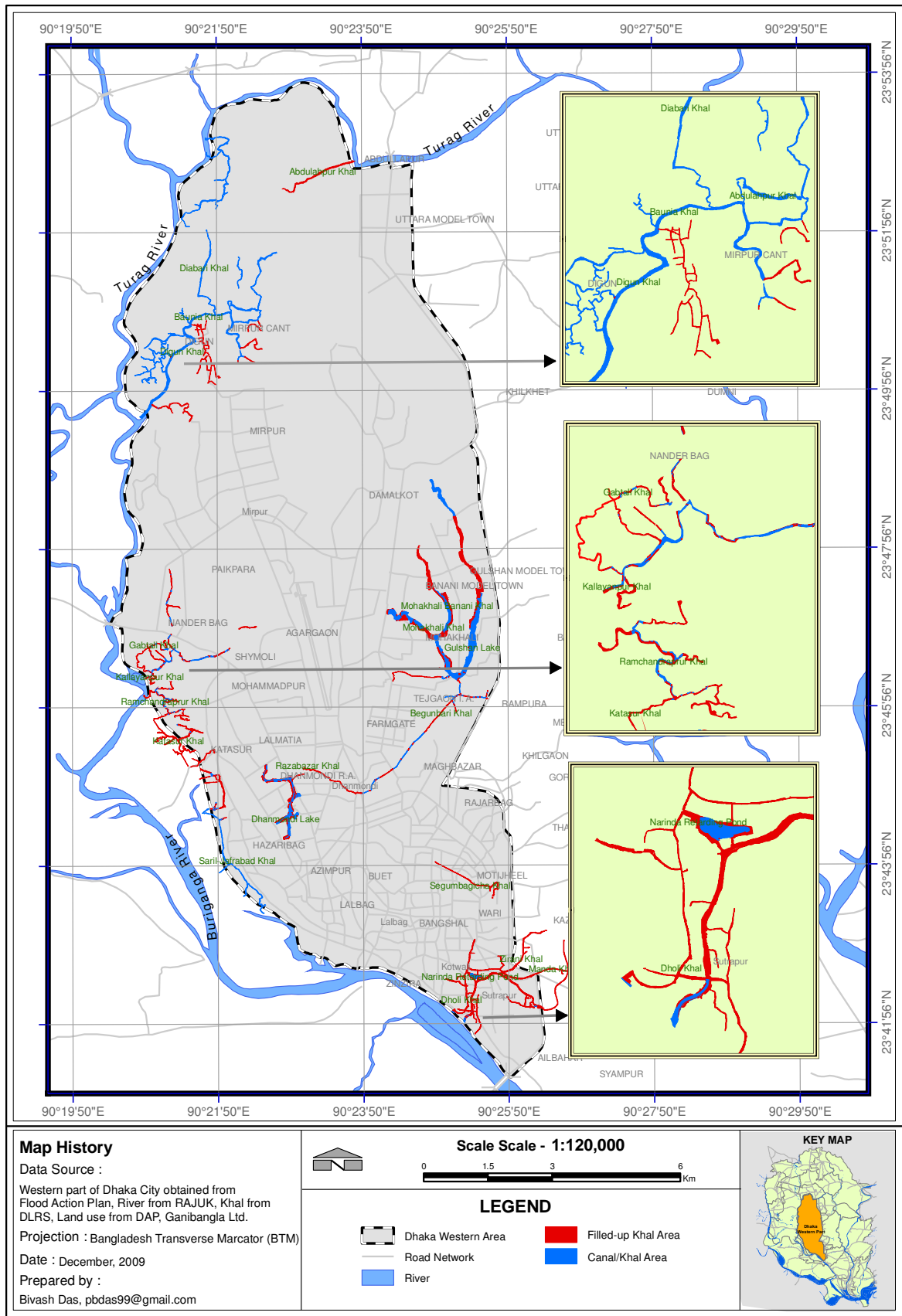
**Table 4.10: Existing Scenario of the major khals in the western part of Dhaka City**

Name of the khal	Existing use	Area in ha	Total Area (ha)	Effective area (ha)	Encroached area (ha)	% of Encroachment
Abdulahpur Khal	Residential	4.71	9.99	5.28	4.71	47.14
	Water body	5.28				
Baunia Khal	Residential	1.74	8.10	6.35	1.74	21.51
	Water body	6.35				
Begunbari Khal	Commercial	0.42	4.14	2.39	1.75	42.27
	Mixed Use	0.08				
	Residential	1.14				
	Transport & Communication	0.07				
	Vacant	0.04				
	Water body	2.39				
Dholai Khal	Mixed Use	3.43	9.74	1.26	8.48	87.08
	Residential	0.66				
	Transport & Communication	4.37				
	Vacant	0.02				
	Water body	1.26				
Diabari Khal	Residential	4.28	31.94	27.66	4.28	13.40
	Water body	27.66				
Digun Khal	Residential	4.28	21.93	17.65	4.28	19.52
	Water body	17.65				
Gulshan Khal (Lake)	Commercial	0.22	41.52	28.22	13.30	32.02
	Mixed Use	1.22				
	Residential	11.55				
	Vacant	0.31				
	Water body	28.22				
Kallayanpur Khal	Agriculture	0.02	6.71	3.56	3.15	46.87
	Education & Research	0.04				
	Mixed Use	0.22				

	Residential	1.84				
	Transport & Communication	1.02				
	Water body	3.56				
Segunbagicha Khal	Mixed Use	0.29	1.22	0	1.22	100
	Residential	0.30				
	Transport & Communication	0.61				
	Commercial	0.01				
Katasur Khal	Residential	4.34	6.89	2.56	4.34	62.97
	Water body	2.56				
Paribag khal	Residential	0.12	0.24	0.11	0.13	53.55
	Transport & Communication	0.01				
	Water body	0.11				
Mohakhali Khal	Commercial	0.32	28.15	19.11	9.04	32.12
	Mixed Use	0.54				
	Residential	5.89				
	Transport & Communication	0.34				
	Vacant	1.95				
	Water body	19.11				
Ramchandrapur Khal	Residential	1.51	2.37	0.63	1.74	73.41
	Transport & Communication	0.23				
	Water body	0.63				
<b>Total</b>		172.92	172.94	114.78	58.16	33.63

Source: Field investigation, 2009 & Secondary Data (RS map & Land use map of DAP) Analysis, 2009

It has been observed that 8 khals out of 14 khals of west Dhaka City have been encroached by nearly 50% to 100% range. Among them, Segunbagicha khal is encroached by 100% or completely. Others khals have been encroached by more than 10%. In case of land use violation, all the major khals are used at present for different purposes such as residential, transportation, commercial etc. It has been observed that nearly 25% areas are used for housing purpose and 4% for the requirement of transport need. An analysis shows that at Dholai khal about 45 percent area is now used for transport & communication purpose. About 13 percent area is now used as connecting khal for Dholai Khal pumping station.



**Map 4.13: Encroachment areas of the major khals in the western part of Dhaka City**



Analyses reveals that nearly 34 % khal areas are totally destroyed by the unplanned and illegal intervention of private developers, government as well as the city dwellers where as rest 66% area is now effective for run-off water circulation. Among the encroached areas, about 73% area is occupied by residential activities, 11% for transport & communication and 10% for mixed use. Due to lack of physical identification of khals area, the areas have been developed by local inhabitants in residential purpose. Development control and management authorities have no initiatives to safe the natural cannels. On the other hands road development schemes by the government are also important for the khal encroachment.



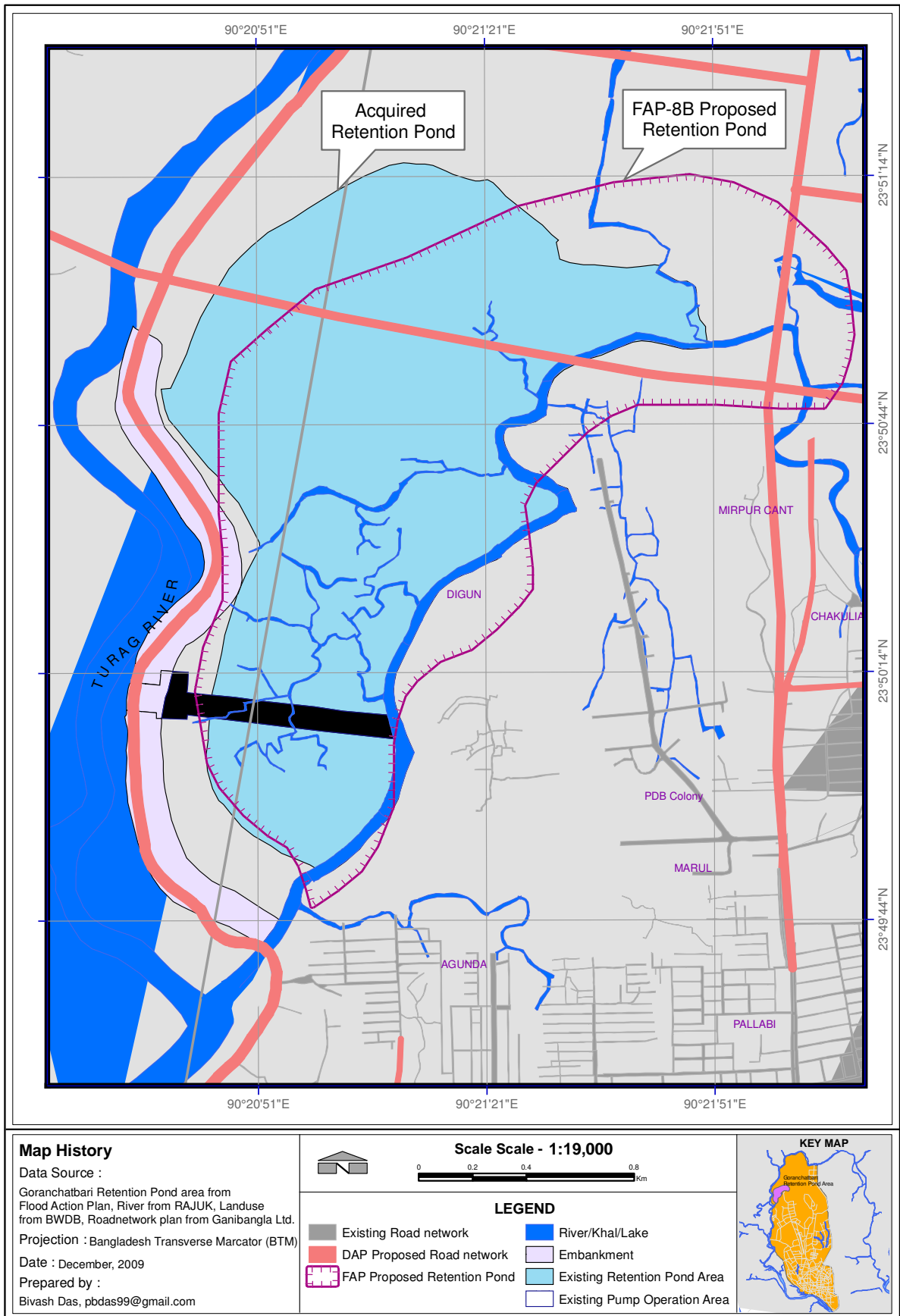
**Map 4.14: Part of Encroachment of Kallyanpur Khal**

Map 4.14 illustrates that Kallyanpur khal area has shrinking considering the khal area in RS map. Besides, numbers of one storied buildings and road have been constructed within khal area. Map and spot snap also represent that Kallyanpur khal in RS was 51 feet but now exist only 26 feet.

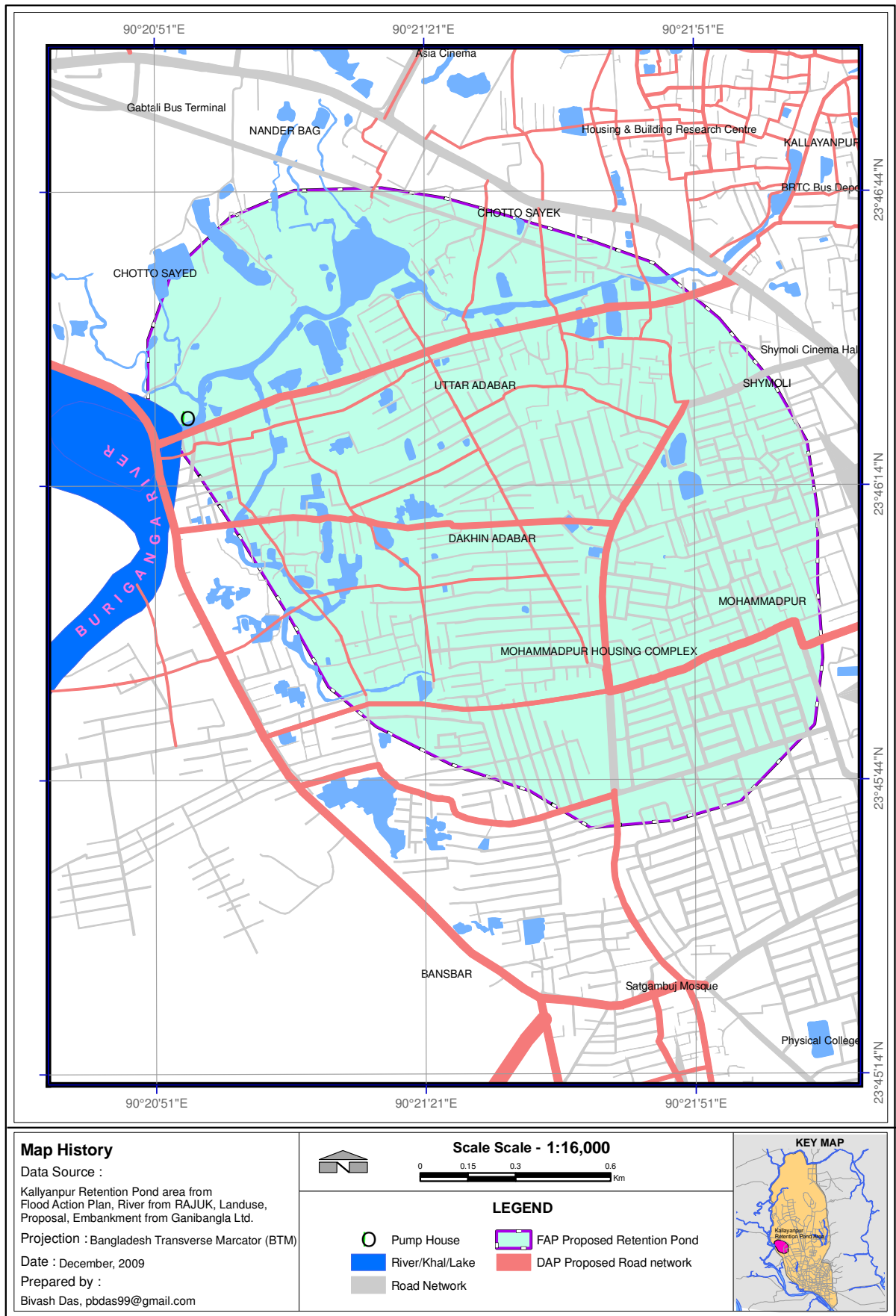
#### **4.4 FAP-8B Vs DAP Proposals: Land use deviation within retention pond areas in the western part of Dhaka City**

The Detailed Area Plan (DAP) has given precedence to remove water logging and drainage congestion in the Dhaka City. DMDP strongly highlighted to follow the Flood Action Plan (FAP). But DAP under DMDP has overlooked the FAP-8B plan and proposals. From land use map analyses it is clear that DAP has proposed numbers of development works within retention pond areas of FAP-8B.

Map 4.15 represents, that DAP has proposed 10.40 acres road within Goranchatbari retention pond area and 42.92 acres road (Map 4.16) within proposed Kallyanpur retention pond area. Land use proposal and development work of FAP-8B have been deviated by DAP proposal.



**Map 4.15: DAP's Road network proposal in Goranchatbari retention pond area**



**Map 4.16: DAP's Road network proposal in Kallyanpur retention pond area**

## **4.5 Conclusion**

Drainage and retention pond proposals of FAP-8B have been described under part - A & B. It has been observed that from 1989 to 2007 built-up area have increased about 78% to 88% and gradual decrease of wetlands nearly 22% to 12% in the western part. From the year 1989, on an average per year .55% wetlands have been decreased. In 1992, FAP-8B proposed about 4.5% land of the western part as retention pond area. During the year 2007, the effective area has been identified about 1.79%. Within proposed Kallyanpur proposed retention pond area only 6.71% is used as water body and 14 housing schemes have been already developed. Dhaka Detailed Area Plan (DAP) also proposed some development scheme within these pond areas. Major khals within western part area are encroached significantly (about 34%). It has been also observed that there is no connection between existing situation and the proposal. Development has ignored FAP-8B land use proposal and till now continuing. As a result, there is no effective planning implication in the preservation of wet land/low lying area in Dhaka city.

## Chapter Five: Causes of land use changes and its effect on FAP-8B proposals

### 5.1 Introduction

This chapter has focused on the first objective of this research to find out causes of land use change and its effects on FAP proposal within the study area. For this, three Focus Group Discussion and discussion with the authorities of concerned organizations, experts have been conducted. Causes of land filling on the retention ponds site and natural drainage in the western part have been identified from FGD and discussion.

### 5.2 Causes of land use changes

During the focus group discussion sessions, it has been strived to find out the main reasons for land use changes. The respondents pointed out major causes and also given weight on the causes. Figure 5.1 shows the opinions of the respondents about causes of land use changes. Using matrix method the ranking of causes of land use of the FGD were done and overall priorities ranking for the causes were also obtained. Comparisons were made between the rankings given by the three FGD. Priorities were measured based on the given ranking.

<b>Response</b>	<b>FGD - 1</b>	<b>FGD - 2</b>	<b>FGD - 3</b>	<b><i>Priority</i></b>
<b>Causes</b> Rapid urbanization	<b>1</b>	<b>1</b>	<b>1</b>	<b>1<sup>st</sup></b>
Unplanned and uncontrolled rapid physical expansion	<b>2</b>	<b>1</b>	<b>1</b>	<b>2<sup>nd</sup></b>
Unauthorized/illegal development	<b>3</b>	<b>1</b>	<b>1</b>	<b>3<sup>rd</sup></b>
Weakness of management authorities	<b>4</b>	<b>1</b>	<b>1</b>	<b>4<sup>th</sup></b>
Involvement of developer	<b>4</b>	<b>1</b>	<b>2</b>	<b>5<sup>th</sup></b>
Lack of coordination of development authorities	<b>3</b>	<b>3</b>	<b>3</b>	<b>6<sup>th</sup></b>
Lack of policy guidelines and its implementation	<b>5</b>	<b>2</b>	<b>3</b>	<b>7<sup>th</sup></b>
Lack of public awareness and education	<b>4</b>	<b>3</b>	<b>4</b>	<b>8<sup>th</sup></b>

*Priorities ranking: 1= high and 10 = low*

Source: FGD, 2009

**Figure 5.1: Matrix ranking for prioritizing the causes of land use changes**

Here, 3 FGD have been conducted for 3 pond areas which are Goranchatbari, Kallayanpur and Dholai khal pond areas. Figure 5.1 represents that the local people are more responsive (highest ranking) in FGD-2 that means Kallayanpur pond area is now in most vulnerable condition than Goranchatbari and Dholai khal pond areas. The figure represents that among all of the above reasons of land use changes, rapid urbanization, unplanned and uncontrolled rapid physical expansion and weakness of management authorities have been identified as the major causes. Here some of the parameters affecting the land use changes are analyzed and explained below:

### **5.2.1 Rapid urbanization**

During the last three decades, rapid population growth creates extra pressure on the lands of already overcrowded Dhaka City. The size of Dhaka City has grown from 1 sq. mile in 1600 to 590 sq. mile in 1997. In the mean time, the size of Dhaka Municipality, which has been upgraded to DCC, has grown from 6.1 sq. km. in 1906 to 360 sq. km. in 1997 having population from 276,033 in 1951 to 6,000,000 in 1997 (Islam, 1999; BBS, 1997). According to UNFPA, the present population is 12.3 million and will increase to 21.3 million and this continuous growth will lead Dhaka as 4<sup>th</sup> Mega City of the world by 2015. The study area is facing high population densities which cause substantial increase in built-up areas due to development of residential and commercial areas. These activities resulted in substantial increase of impervious areas, created obstruction to natural drainage pattern, and reduced detention basins, which have almost undoubtedly aggravated the land use change.

### **5.2.2 Unauthorized/ Illegal development**

According to the assumption of local people, unauthorized or illegal development is one of the main causes for land use changing. FGD reveals 3<sup>rd</sup> priorities in support of this cause. Illegal encroachment of natural drainage channel is a common and regular practice. Both influential and poor people encroaches the retention ponds and khal areas. As a result, most of the natural drainages of western part disappeared due to this illegal invasion. The illegal activities comprised of unauthorized construction, solid waste disposals and lack of effective regulations in preventing encroachments. Apart from the illegal development by the influential group, slums have also been emerged on the canals (Star weekend Magazine, 2009).

### **5.2.3 Unplanned and uncontrolled rapid physical expansion**

Planned development or planned physical expansion and development control is absent in the study area. Even, no development plan is fully executed. Rapid population increase requires a wide range of infrastructure development. In most of the cases the development has carried out by filling low-lying areas and water bodies in an unplanned way which acts as hindrance for natural drainage canals. It has been observed that major land use changes have been accelerated by numbers of Government development activities. In a project (prescribed and funded by World Bank, ADB and JICA), four major canals: Dholai Khal, Shegunbagicha Khal, Paribagh Khal and Dhanmondi Khal (now Panthopath) were converted to box culverts in the mid 1980s. But Drainage Department of DWASA is not well-equipped to clean quite longer box culverts and those canals have been virtually killed. (Star weekend Magazine, 2009).

In case of Goranchatbari people gave less ranking than Kallayanpur and Dholai khal in favor of this reason. The response has indicated that Goranchatbari area is relatively less affected by the reason.

### **5.2.4 Involvement of Developers**

Housing and apartment-owning is becoming a new trend among the city dwellers. Twenty years ago, in Bangladesh less than five companies were engaged in apartment-development while today there are more than 200 developers (Source: Ganibangla Ltd., 2009). In 1988, there were less than 20 such developers in Dhaka. At present there are 80 such developers working in Dhaka City who are members of REHAB. The Urban Area Plan of DMDP recommended some areas for retention ponds in and around the city to keep the city free from monsoon flood. The retention pond of Kallyanpur area has been filled up by numbers of housing and real estate developer. From FGD results it is clear that land use change of Kallayanpur area is seriously (given 1<sup>st</sup> ranking) occurred by the involvement of developers. According to the respondents of Kallayanpur area, 12-14 housing areas have been developed by developers, society and government involvement. Some of the mentioned areas are Munsurabad Housing, Dhaka Housing, Sunibir Housing, Baitul Aman Housing, PC Culture Housing, Mohammadia Housing, Nabudy Housing etc.



### **5.2.5 Weakness of management authorities**

Since 1959 no development plan has been implemented in Dhaka City. The development plans in Dhaka are always inappropriate and ineffective because of inefficiency of logistic support, co-ordination problem among concerned agencies, inadequate resources and manpower, government's reluctance, corruption and bureaucracy. 'Extension of time' is a common phenomenon in preparation and implementation of any plan. According to DWASA, some development activities have been carried out without management consideration. There is always a gap between regulatory framework and its enforcement. In addition, only paper based plan without implementation is the most conventional approach has collapsed the spatial planning system in Dhaka. FGD results shows that people are aware about this cause and land use changes in the Kallayanpur and Dholai khal area have its significant impacts. On the other hand, Goranchatbari area showed less rank regarding this reason.

### **5.2.6 Lack of coordination of development authorities**

Lack of institutional coordination and its legal procedure make serious problems in management or eviction of unauthorized structures. In the western part of Dhaka city, 19 canals are under the jurisdiction of DWASA, 5 canals are under the jurisdiction of NHA and DCC is the authority of 2 canals. 17 canals of the eastern part of the city are still under the jurisdiction of Deputy Commissioner's Office. The 11 canals of the DND area are under the jurisdiction of BWDB (Star weekend Magazine, 2009). It has been found during open discussion with the management authorities that Goranchatbari Pumping Station is under the jurisdiction of BWDB and other two Kallayanpur and Dholai khal Pumping Stations are under the jurisdiction of DWASA. All development activities and land uses are controlled by RAJUK and development activities are maintained by DCC. DOE is concerned with environmental aspects. As a whole, it is very difficult to co-ordinate all responsible authorities for taking any appropriate and effective development measures. People are equally worried all of those areas for the failure of government to control the land use changes.

### **5.2.7 Lack of public awareness and education**

In general, major portion of people of Bangladesh are poor and illiterate. Lack of public awareness "about the necessity of natural drainage" makes it difficult for general people to understand the effect of drainage blocking and filling of khals, low lands, wetlands

etc. Therefore, people don't hesitate to throw solid waste on to the roads and drains and their poverty encourage them to fill the natural water bodies. According to the respondents of FGD, through public awareness and education programs, it is possible to improve the maintenance of the drainage systems.

### 5.2.8 Lack of policy guidelines and its implementation

The laws and regulations for planning and development of Dhaka city are very old and in most cases outdated in terms of present development, control and needs (Islam, 2001). Most of the experts have blamed to concerned authorities that are unable to enforce the regulation for development control and illegal activities. For example, The Dhaka Master Plan has clearly marked and reserved 12 percent of areas for flood retention. According to the Wetland Conservation Act, 2000, no one has the right to develop wetlands, flood flow zones or catchments. But the developers and land owners have occupied and filled the areas. This indicates not only the lack of policy guidelines but also the negligence of government to implement and enforce the existing rules and regulation are responsible for land use changes.

### 5.3 Effects of land use Changes

Numbers of negative effects are found in the western part of Dhaka city due to land use changes of different plan and proposals. Environmental hazards are common scenery in the study area which is one of the major effects of land use changes of retention pond and natural khals area. During the focus group discussion sessions, it has been attempted to evaluate the effects of land use changes within the localities. The respondents have underscored the impacts which are represented here in Figure 5.2.

Effects \ Response	FGD - 1	FGD - 2	FGD - 3
Water logging	1	1	1
Flooding	2	1	1
Impedance of natural flood flow	4	1	1
Environmental degradation	3	2	2
Losses of agricultural land	5	1	3
Reducing the capacity of drainage	6	1	4
Changes of livelihood pattern	7	3	2

*Priorities ranking: 1= high and 10 = low*

**Figure 5.2: Matrix ranking for effects of land use changes**

Public Opinion Survey reveals the concern of the people about the plan and proposals to remove the fear from flood related disasters. But due to lack of land use control these plans and proposals have failed to disseminate the fruitful outcome. However, there are significant concerns for the drainage congestion and water logging created by the rapid expansion of built-up area. A few numbers of respondents do not consider that the plan and proposals are more helpful to support the acceptable solution. Public response regarding the importance of the FAP-8B was positive. All respondent in the study area agreed that FAP-8B proposals are important to helpful for remove drainage congestion; improve water logging situation and environment friendly.

Most of the people are concerned with the FAP-8B proposal in reducing drainage congestion, water logging and to enhance the environmental friendly outcome. Table shows that people are giving importance for implementation of FAP in the Goranchatbari, Kallayanpur and Dholai khal area. Impacts of the land use changes are analyzed and explained in next section:

### **5.3.1 Water logging and flooding,**

Water logging in the study area is a common phenomenon and the frequency is increasing gradually. The city has been experiencing water logging for the last 20 years. Increasing urban development without sufficient drainage facility results in water logging leaving parts of Dhaka city inundated for several days. This causes large infrastructural problems for the city. Urban runoff causes severe problems when a constructed drainage system fails. In addition, when the natural watercourses are destroyed, natural retention of runoff by plants and soil is removed and creation of impervious surfaces increases, the volume of runoff increases. Therefore, it becomes a burden for the inhabitants, leading to water logging and creating social, physical, economical as well as environmental impacts.

### **Areas vulnerable for Water Logging**

During the focus group discussion, it has been also attempted to specify the locality name of the annual water logging areas in the western part of Dhaka city. The discussion reveals that the problem of storm water drainage becomes acute in old Dhaka city areas Palton, Santinagar, and Motijheel commercial areas and also new Dhaka city area like: Mogbazar, Kalabagun, Dhanmondi, Mohammadpur, Mirpur, Banani, Gulshan suffer from drainage congestion during and after heavy rainfall. Old Airport road, Bijoy Sarani, Gabtali road and Tajmahal road submerge of water due to high rainfall. Most of the participants stated that in a year they suffer from water logging 1-3 times (FGD, 2009).



**Photo 5.1: Water logging and flooding in the western part of Dhaka City**

### **Impacts of water logging**

Water logging causes unbearable sufferings for the people by creating difficult situation for traffic movement as well as unhygienic environment that has long lasting consequences. During heavy rain falls the situation become more critical, all types of road become inundated for long times, which create unprecedented problems for the dwellers. In response of impact identifying, comparisons were made between the rankings given by the three FGD. Priorities were measured based on the given ranking has show in figure 5.3:

Response	FGD - 1	FGD - 2	FGD - 3	Priority
Damage to water supply, sewerage, drainage facilities and other utilities	1	1	1	1 <sup>st</sup>
Damage to city roads	2	1	1	2 <sup>nd</sup>
Outbreak of water borne diseases	3	1	2	3 <sup>rd</sup>
Damage to dwelling houses	4	1	2	4 <sup>th</sup>
Health and sanitation problem	4	2	2	5 <sup>th</sup>
Huge loss to economic activities	5	2	2	6 <sup>th</sup>
Disruption of business & commercial activities	6	2	2	7 <sup>th</sup>
Damage to small and medium industries	5	3	3	8 <sup>th</sup>
Loss of livelihood of poor people	6	3	3	9 <sup>th</sup>

Priorities ranking: 1= high and 10 = low

Source: FGD, 2009

**Figure 5.3: Matrix ranking for prioritizes of impact of water logging**

Figure 5.3 represents that most of the impacts are quite significant to peoples' life. The local people are more responsive (height ranking) in FGD-2 that means Kallayanpur pond area is now in most affected area. The figure represents that among the above impacts city municipal services are seriously affected. On the other hand, health problems and economic losses are also prioritized.

#### **Time Line Analysis of flood in study area**

During the focus group discussion, it is asked to the elderly person about the history of the water logging and flooding in the study area. Also it is wanted to know about the major damages during the period of occurrence. The local people sketched a clear time line about the incidence which is represented in Figure 5.4:

- 1985 ❑ Water logging in the minor area
- 1987 ❑ Flooded about thirty percent area
- 1988 ❑ Disastrous flood and covered more than eighty percent area
- 1995 ❑ Water logging some built up area and entered water from Buriganga and Turag River
- 1998 ❑ High flood founded all over the Dhaka city but less affected and improved water logging situation in the western part
- 2000 ❑ Water logging are found few areas besides within embankment
- 2004 ❑ Long lasting and high level flood and water logging; submerged large portion in the west part but comparatively better than east part
- 2007 ❑ Water logging are found few low land areas within western part

**Figure 5.4: Time Line of flooding and water logging in the western part**

The resemblance has been found between respondents' information and demarcated level in a reference house in each FGD location. It is clear that flood in 1988 was more dangerous than 2004 and lastly 1998. It is clear from the time line that 1998 flood level was high over the entire Dhaka city but the flooding was properly controlled in the western part. The respondents pointed out that after completion of western embankment and rehabilitation of major khals, the localities were less affected during the flood 1998 but its intensity was very high in the eastern part. They also pointed out that due to continuous landfill and encroachment of the rehabilitated khals and water bodies' western part was seriously affected by water logging during the year 2004.

### **5.3.2 Environmental degradation**

#### **Disappearing wetland**

Wetlands, fauna and flora are very much important because these play a vital role for biodiversity conservation. But these are disappearing gradually. Individual land owner, private developer and government are responsible for the deterioration of retention pond area and drainage channel as well as wetland. The reducing areas are mainly Kallayanpur, Mirpur and Mohamadpur area.

#### **Water pollution**

All the khals received domestic wastewater and discharged into water bodies including lakes, rivers and retention areas. According to the most of the local inhabitants, decreasing of khals and drainage channels cause pollution to the storm water of the study area as it is mixed with solid waste, clinical waste, silt, contaminants, domestic waste water and other human activities, which contaminated ground water. Storm water in Dhaka City is getting polluted in several ways. One of the major concerns is the contribution of domestic wastewater to the storm flows, and subsequent addition of pollutant loads to the receiving water bodies. Other causes of relatively high level of pollution are dumping of wastes beside the roads, near the receiving water bodies and open surface drains. A study shows that in Dhaka City 1,448 tones of solid waste are dumped into drains, rivers, canals, other water bodies, open spaces and low-lying areas in a day (The Daily Star, August 9, 2009). During the open discussion session, the Kallayanpur pump management authority blamed that numbers of sewerage out fall are connected with Kallayanpur khal and retention pond area.

### **5.3.3 Losses of agricultural land**

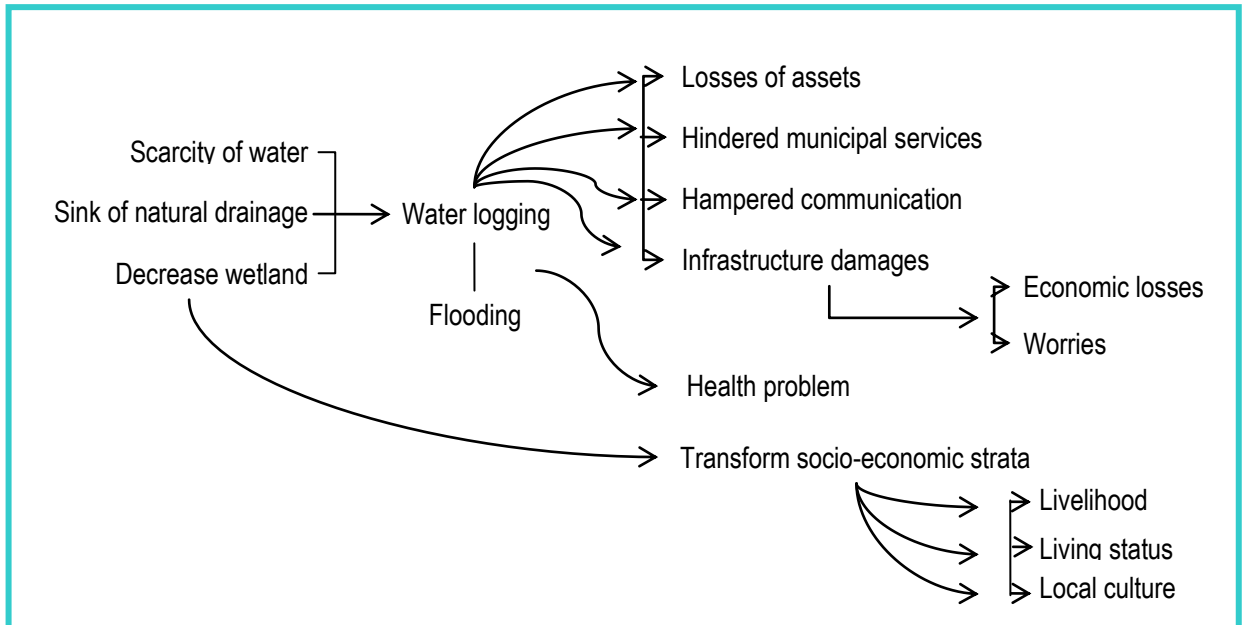
According to the respondents, some portion of the proposed retention pond areas (Goranchatbai and Kallayanpur) and its surrounding were dominated by agricultural lands. The local farmers grew seasonal vegetables from the land. The cultivable lands have been decreased due to urban area extension. The retention ponds or low lands were cultivated in lean (dry) season.

### **5.3.4 Reducing the capacity of drainage**

Most of the local people of the study area alleged that waste droppings are the main cause of reduction of drainage capacity, second illegal encroachment and rest of them replied for no regular drain maintenance. The drainage system of the study area is not sufficient in terms of width, depth and capacity or well managed for the disposal of storm or rain water. It is observed that most of the drains in the study area are very narrow. As a result, existing condition of drains and overflow from drains cause water logging which also reduces the road capacity. In FGD, maximum response is resulted in support of this effect from land use change.

### **5.3.5 Socio-Economic effects**

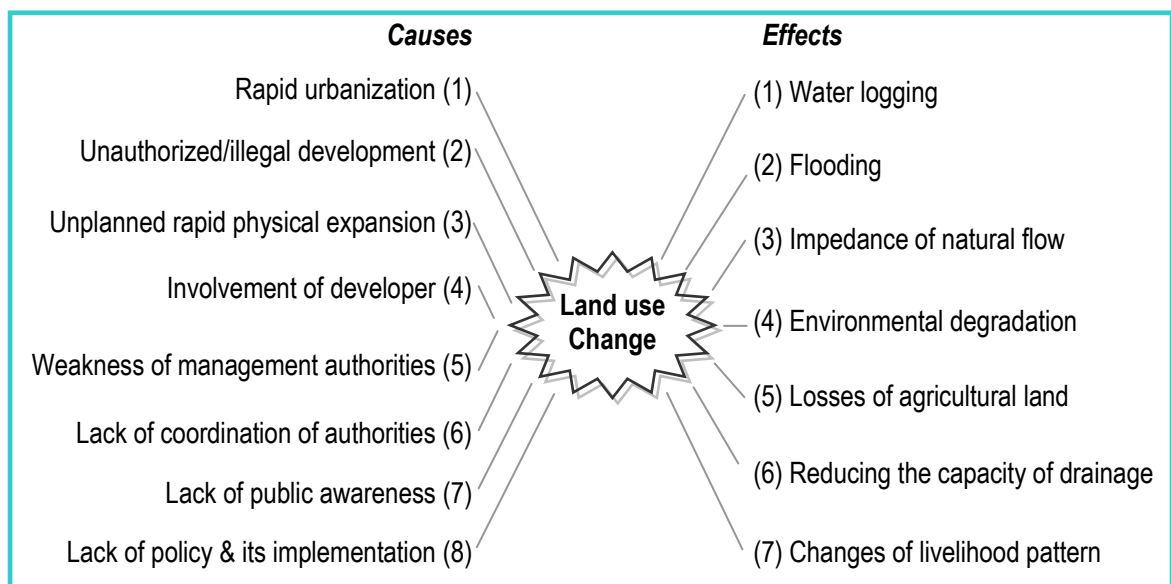
Due to the land use changes major changes have come in human living as well as livelihood pattern. According to the local inhabitants, three decades ago main activity was agriculture, fishing or small business but now activities are fully urban based. Most of the land owners are displaced and now dominated by migrant people. With land use change local culture has also been changed. Relatively affluent live in these areas. Besides these, economic activities have been expanded rapidly. As a whole, the effects of land use changes can be interpreted by the Impact Diagram (Figure: 5.5):



**Figure 5.5: Impact Diagram: Effects of Land use Changes**

#### 5.4 Cause-effect relationship

Cause effect diagram has been used for the study and the analysis of the problems of a wide range of areas. The main application of a cause effect diagram is to identify the causes and effects of a problem or phenomenon. It is also used to plan interventions to resolve some problems. The identification of the causes of a problem actually helps in arriving at the possible solutions (Kumar, 2002). In this study the Cause and Effect Diagram has been prepared to explore the land use change issue. Cause and Effect Diagram of land use change issue is depicted in Figure 5.6.



**Figure 5.6: Cause Effect Diagram of Land use Changes**



## **5.5 Conclusion**

This chapter explores the causes and effects of land use changes on FAP-8B proposal. Nine causes were identified for land use changes. In the priority list rapid urbanization; unplanned and uncontrolled rapid physical expansion; and Unauthorized/ Illegal development have shown 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> priorities respectively. Involvement of developers in the Kallayanpur area is remarkable. Weaknesses of management authorities are seriously found in the Kallayanpur and Dholai khal area and also identified the main reasons for land use change. Lack of coordination among DWASA, BWDB, DCC and RAJUK also highlighted. Water logging and flooding are the main effects of the land use changes. Due to massive land use changes adverse effects are found in the Kallyanpur and Dholai khal area where as Goranchatbari area is relatively more benefited regarding this context.

## **Chapter Six: Operation and Management Strategies for Drainage and Flood Control**

### **6.1 Introduction**

This chapter has tried to achieve the second objective of this research through a comparison of the three pumping station areas. Field observation, FGD and brief discussion with the official have given a clear view on pump station and its surroundings. This includes detail operation and management strategies of drainage and pumping station management for flood control in the western part of Dhaka City. In exploring these, proposals in FAP-8B pertaining with drainage and pump stations and the present management practice of the development agencies, management tools and operational procedure have also been explained here. In addition, this chapter analyzes the functional and operational drawbacks of the three pumping stations. Finally, the effectiveness of the pump stations is compared or summarized here.

### **6.2 Proposals on Natural Drainage, Retention Pond and Pump Stations**

Complete proposals on Natural Drainage, Retention Pond and Pumping Stations were shown for the western part of Dhaka City. The plans and proposals gave emphasis on rehabilitation of khals, reservation retention ponds area and construction of pumping stations. FAP-8B highlighted that effective Flood Control and Drainage Programs are one of the main priority items for improving the security and health of Dhaka residents.

#### **6.2.1 Proposal on Natural Drainage and Retention Pond**

The proposal on drainage and retention pond was important component of the FAP-8B. The primary focus was creating an integrated drainage system within Dhaka urban area to eliminate/reduce the drainage congestion and regular local flooding which prevails during the monsoon seasons. The Proposal on Drainage work included:

- Cleaning and rehabilitation of 21 major open drainage khals totaling 78 km in length. The rehabilitation work will consist of dredging and re-profiling to restore the khals to their design capacity

- Implementation of rigorous operations and maintenance program for the drainage work over the implementation period

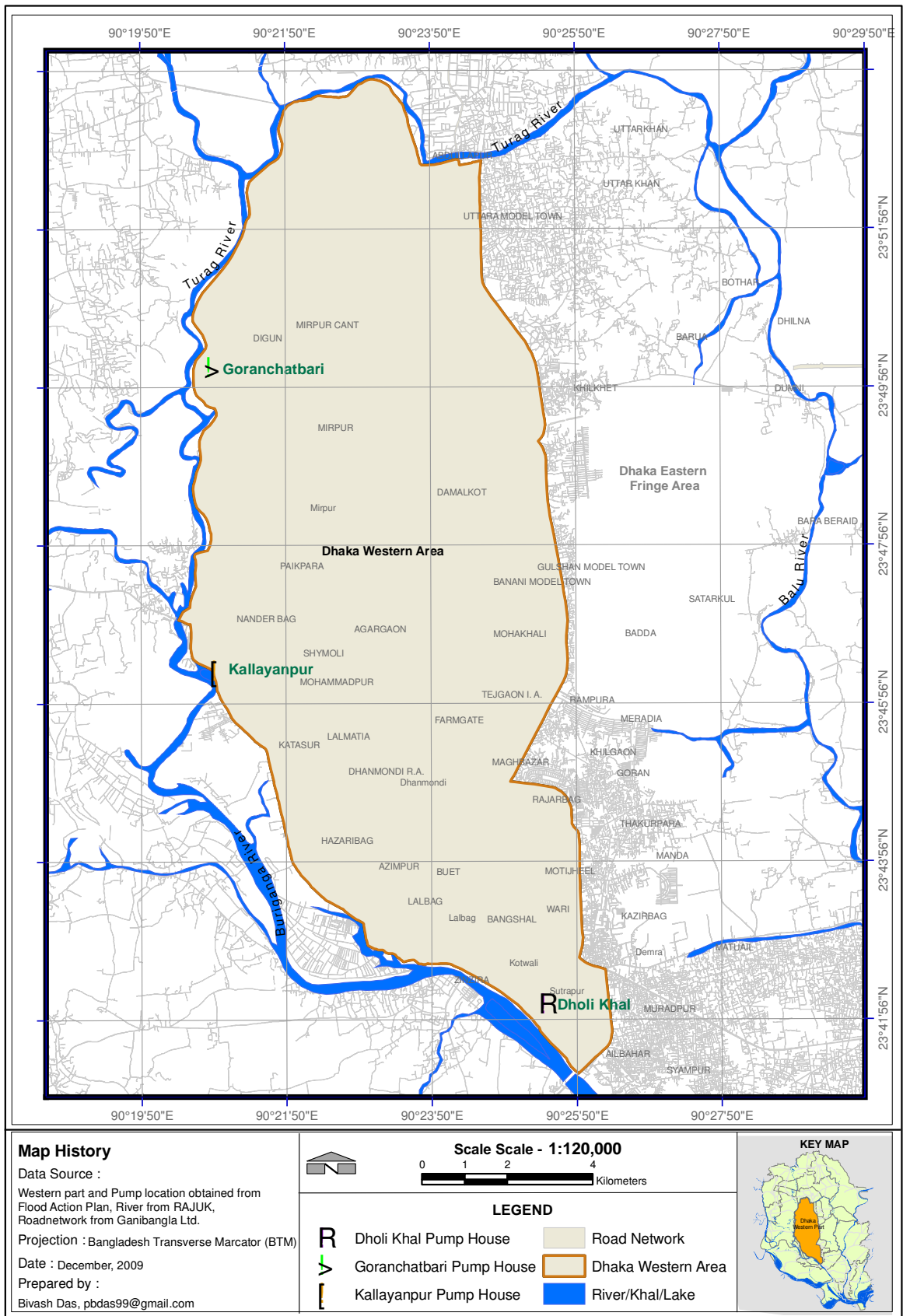
The Proposal on retention pond included:

- Reserving 686 hectares retention pond for Goranchatbari Pump Station with full capacity of 65.2 cubic meter per second
- FAP-8B also considered two important retention pond areas for Kallayanpur and Dholai khal Pumping Station. The proposed retention pond areas had 200 and 4.8 hectares area respectively.

### **6.2.2 Proposal on Pump Stations Management**

Construction of Pump Station No. 3 at Goranchatbari for west part is prioritized in FAP-8B. At the first stage of construction, it is required that the Pump Station must be established with the capacity of 22 cubic meter per second ( $\text{m}^3/\text{s}$ ) to provide about one third of the ultimate design capacity required to remove two days consecutive rainfall with 5 year recurrence frequency. The retention pond requires full capacity of 65.2 cubic meters per second ( $\text{m}^3/\text{s}$ ) for 686 hectares. It was considered that the pumping capacity provided by this first stage will significantly reduce the accumulated rainfall runoff within the tributary drainage area during the monsoon season, and will have very favorable impact upon the higher lands within the influence of the pump station. As lower lands become urbanized, the capacity of the pump station can be increased to accommodate those needs, and to reduce the corresponding retention pond areas. FAP-8B also mentioned that general layout and pumping procedures of Goranchatbari will be similar to those established for the adjacent Mirpur area which will be served by the pump station at Kallyanpur, now being constructed (JICA, 1991).

Three pumping stations namely Kallayanpur and Dholai khal have also been specified in FAP-8B. Location of three pump stations is presented in Map 6.1.



**Map 6.1: Location of Pumping Stations in the Western part of Dhaka City**

### **6.3 Specifications of the Pumps in the western part of Dhaka**

To remove water logging in Dhaka City and to improve the environment by providing better drainage facilities in study area three pump stations are constructed in three different periods considering some common criteria with different requirements which have been specified below:

#### **6.3.1 Goranchatbari Pump Station**

The pumping station at Goranchatbari was designed for 18 Sq. km covering areas, reservoir area of 274 hectare and three pumps each have capacity 7.3 m<sup>3</sup>/s for the draining of storm and waste water to the Turag River. Operating period of these pumps are designed from July to October. The intake khal of Goranchatbari pump station is Digun khal. For this station 3 new pumps have been proposed of each 7.3 m<sup>3</sup>/sec capacity.

#### **6.3.2 Kallayanpur Pump Station**

This pumping station is located at Kallyanpur close to the embankment of flood control project. The pumping station is designed and constructed by JICA in 1996. The pumping station at Kallayanpur was designed for 17.6 Sq. km covering areas, reservoir area of 200 hectare and three pumps each have capacity 3.3 m<sup>3</sup>/s for the draining of storm and waste water to the Buriganga River. Operating period of these pumps are designed from July to October. For this station, 2 new pumps have been added during 2007 with 5 m<sup>3</sup>/s capacity of each pump. At this moment the total capacity of this pump is 20 m<sup>3</sup>/s.

#### **6.3.3 Dholai khal Pump Station**

The pumping station is designed and constructed for draining of storm and sewage water during high flood level. This pumping station is constructed in 1998 by the Dhaka City Corporation. The pumping station at Dholai khal was designed for 18 Sq. km covering areas, reservoir area of 4.2 hectare and three pumps each have capacity 7.3 m<sup>3</sup>/sec for draining to the Buriganga River. Operating period of these pumps are from July to October. In Dholai khal Pumping Station, old Narinda Pond works as reservoir for storage of water. Intake khal and its branch khals also acts as storage khal.

The design of the pumps covers required drainage, pump capacity, reservoir level, discharge level, number and size of pump, pumping duration etc. Detail design specifications of the each pump station are shown in tabular form in Table 6.1:

**Table 6.1: Comparison of design specification of the three pump stations**

Design specifications		Name of the Pump station		
		Goranchatbari	Kallayanpur	Dholai khal
Date of construction	:	1999	1996	1998
Funded by	:	JICA	JICA	DCC
No. of Pumps	Built up	3	3	3
	Proposed/Added later	3 (proposed)	2 (new)	
Capacity	Built up	7.3 m <sup>3</sup> /sec	3.3 m <sup>3</sup> /sec	7.3 m <sup>3</sup> /sec
	Proposed/Added later	7.3 m <sup>3</sup> /sec (proposed)	5 m <sup>3</sup> /sec (added)	
Total capacity	:	22 m <sup>3</sup> /sec	20 m <sup>3</sup> /sec	22 m <sup>3</sup> /sec
Catchments area	:	18 sq. km	17.6 sq. km	18 sq. km
Pumping period	:	July - October	July - October	July - October
Diameter of Pump	:	1800 mm	1800 mm	1800 mm
Outfall	:	Turag River	Buriganga River	Buriganga River
Retention area	:	274 ha	200 ha	4.2 ha
Management authority	:	BWDB	DWASA	DWASA
Intake khal	:	Digun khal	Kallayanpur khal	Dholai khal

Source: DWASA & BWDB, 2009

#### 6.4 Performance Evaluation of three selected Pump Stations

From the field investigation and Focus Group Discussion (FGD) it has been observed that during 1998, 2004, 2007 floods the above pump stations performed different mitigation measure. During the flood 1998, Goranchatbari pump station was not completed and performance of the station was not possible to ascertain. But during floods in 2004 and 2007, the performance of Goranchatbari pump station was very well and pumping was started quite early to avoid any mishap. On the other hand, Kallayanpur and Dholai Khal pump station showed performance during all the three major floods but can not show the same efficiency as Goranchatbari. The difference of water level was always below the flooding level of that area. The performance of the Pump Stations was discussed in FGD has shown below:

**Table 6.2: Performance of Pump Stations in the study area**

Name of the pump station	Performance of Flood Mitigation measure		
	Flood 1998	Flood 2004	Flood 2007
Goranchatbari	Under construction	1	1
Kallayanpur	1	2	3
Dholai Khal	1	3	3

[Satisfactory = 1, Fairly = 2, Unsatisfactory = 3]

Source: FGD, 2009

Table 6.2 represents comparison among the performance of three pump stations during three flood periods 1998, 2004 and 2007. It shows that Goranchatbari executes always a satisfactory performance during flood period except in 1998 when it was under construction. On the other hand, the Kallyanpur and Dholai khal pump stations served well during 1998 flood but after that the scenario is totally different. In case of Kallayanpur, the performance has been gradually deteriorating due to the continuous encroachment activities and Dholai khal represents the unsatisfactory performance as because it is not well managed. However, Goranchatbari is still a well functioning, managed pumping station. Comparison on various features of 3 pump station management has shown below:

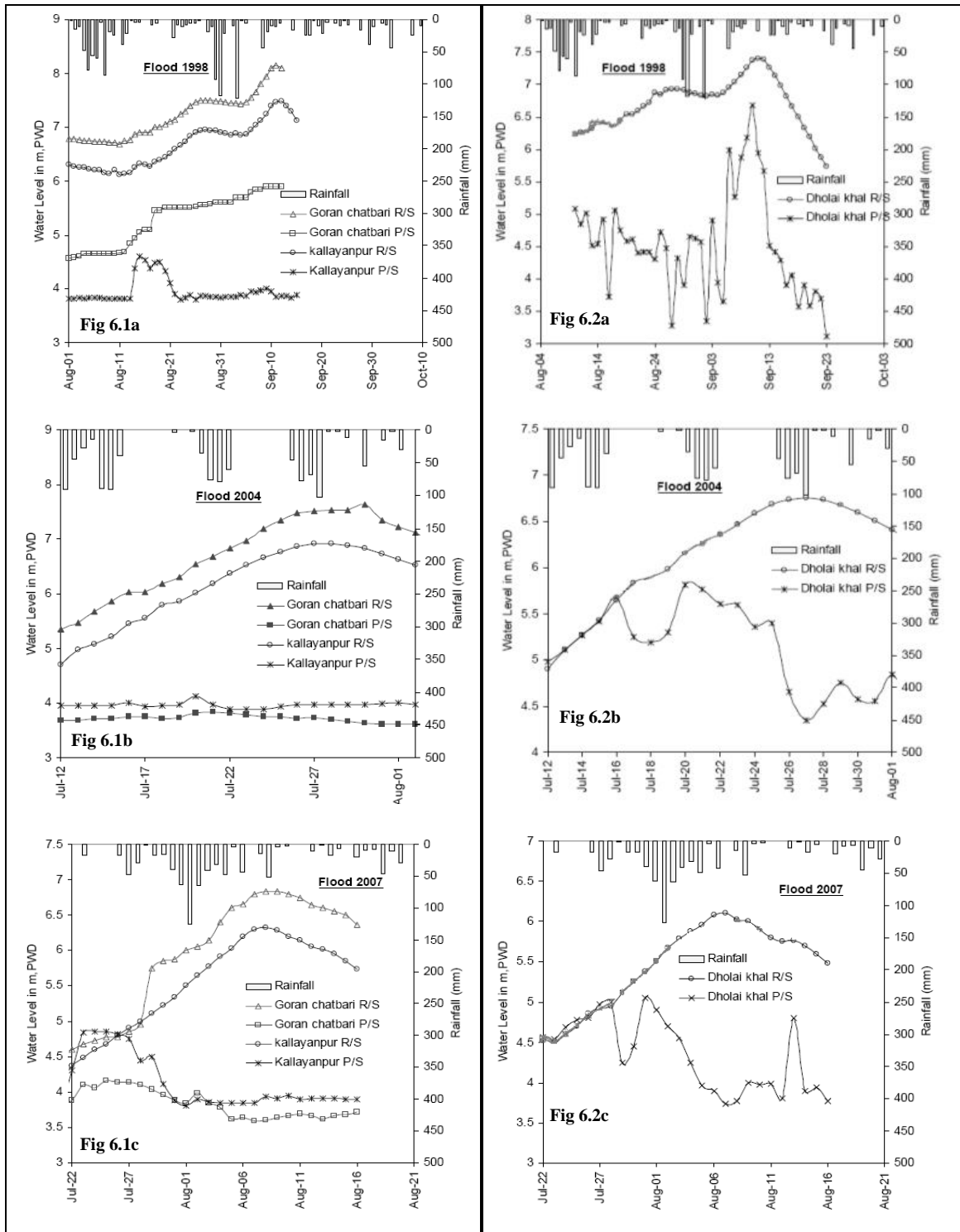
**Table 6.3: Comparison on various features of 3 pump stations management**

Description	Pump stations		
	Goranchatbari	Kallayanpur	Dholai Khal
Business use of retention pond	Fisheries & Agriculture	Residential, Commercial & Fallow land	No use
Land ownership of retention pond	Public	Private	Public
Manpower engaged for pump operation	16	6	8
Pump management authority	WDB	WASA	WASA
Physical demarcation of retention pond	Yes	No	Yes

Source: Field Observation, 2009

It has been observed the significant difference of riverside and protected side water level during floods in 1998, 2004 and 2007 of the three permanent pump stations located at Dholai Khal, at Kallayanpur and at Goranchatbari. Figure 6.1a to 6.1c shows the water level of river side and protected side of the Turag river at Goranchatbari and at Kallayanpur pump stations during floods 1998, 2004, 2007 respectively. Figure 6.2a to

6.2c also shows water levels in both country side and protected side of Dholai Khal pump stations during floods in 1998, 2004 and 2007 respectively (Islam et al., 2008).



**Figure 6.1: Performance of Goranchatbari & Kallyanpur pump stations during floods in 1998, 2004 & 2007**

**Figure 6.2: Performance of Dholai khal pump station during floods in 1998, 2004 & 2007**

(Source: IWF, BUET, 2008)



## 6.5 Effectiveness of intake khals of the Pump stations

Most of the drainage canals have been encroached and with little showers, the area turns into a lake. During the day of heavy rain the channels have failed to carry smooth flow of run off water. During Focus Group Discussion Meeting, the respondents seem that inadequate and faulty drainage network, filling up of drainage canals and lack of proper cleaning of drains are the main reasons behind water logging in the capital. The drainage system was not upgraded keeping pace with the rapid urbanization while around 50 per cent canals in the city dried up or have been illegally filled up and occupied over the last two decades. The FGD was conducted involving local people on the effectiveness of some surrounding khals and requested respondents to give their opinion. The responses are represented in Table 6.4 below:

**Table 6.4: Effectiveness of khals during three flood period in the study area**

Name of the Khal	Effectiveness		
	Flood 1998	Flood 2004	Flood 2007
Abdulahpur Khal	2	1	1
Baunia Khal	1	1	2
Begunbari Khal	2	2	1
Dhanmondi Lake	1	2	2
Digun Khal	1	1	1
Gabtali Khal	1	2	1
Gulshan Lake	1	2	2
Kallayanpur Khal	1	2	2
Ramchandrapur Khal	1	1	2



Source: FGD, 2009

1 = Satisfactory

2 = Unsatisfactory

Although 21 khals were rehabilitated under Phase-I of the Dhaka Integrated Flood Protection Project (DIFPP) but could not continue further. Maximum numbers of connecting khals are now being the subject of encroachment and filled up by sediment or solid waste. During the field visit in the three pumping station site, it was observed that the connecting Digun Khal of Goranchatbari was well managed besides the connecting Kallayanpur khal of Kallayanpur and connecting Dholai Khal of Dholai khal were not equally managed. The following photographs show the effectiveness of those connecting khal in the Dhaka western part.

**Table 6.5: Comparison of Effectiveness among the Intake Khals**

Existing condition	Recent Scenario of the Intake Khals for Pump Station
<p><i>The intake Digun khal is clean and well managed and able to provide effective service in quite good extent</i></p>	 <p><b>Photo 6.1: Digun khal for the Goranchatbari pump station</b></p>
<p><i>The intake Kallayanpur khal is filled up by residential, commercial waste and water-hyacinth which requires immediate rehabilitation</i></p>	 <p><b>Photo 6.2: Kallayanpur khal for the Kallayanpur pump</b></p>
<p><i>The intake Dholai khal is filled up by residential, commercial and industrial waste. This khal neither effective nor suitable for treatment</i></p>	 <p><b>Photo 6.3: Dholai khal for the Dholai khal pump station</b></p>

Source: Field Survey, 2009

## 6.6 Present management practice of the retention pond areas

Three retention ponds area within the study area have diverse management procedure. Based on the practice the ponds areas have shown different performance. From field investigation the following management techniques have been identified and showed below:

**Table 6.6: Comparison of three retention pond management strategy:**

Retention pond	Pond area management strategy
<i>Goranchatbari</i>	272.63 hectare lands are used as pond area in Groanchatbari. Most of the low lying areas are used for fisheries project and other comparatively high elevation lands are used for agriculture purpose. BWDB has completed the land acquisition and already compensated all land owners. The land owners use their land as a fisheries project without paying any charge to the authority. BWDB only do enforce the land use control or restrict any development. To get maximum benefit from these activities, land owners do this either individually or through co-operative way. Without any illegal invasion, the retention pond areas become well managed.
<i>Kallayanpur</i>	No land acquisition is occurred for Kallyanpur retention pond area. DWASA use the private land as a retention pond. As a result, without legal land ownership the authority has failed to control the land use as well as development. Existing low laying retention pond areas are fallow land and day by day converted to housing areas.
<i>Dholai khal</i>	Dholai khal retention pond is known as old Narinda Pond. Due to pollution created by residents, industries etc. there is no scope to use the pond for any other purpose. The pond area (khas land) is used only for temporary reservoir and connected to pump station through box culvert. It reveals that government development activity destroy the natural flow of this khal.

## 6.7 Effectiveness of retention pond areas for the pump stations

Required retention pond area for the Goranchatbari pump station was 686 hectares. During the implementation stage 274 hectares retention pond area was developed. Besides, required retention pond area for the Kallayanpur pump station was 200 hectares but any initiative was not undertaken for permanent development. On the other hand, required retention pond for the Dholai khal pump station was 4.2 hectares which was not sufficient for the designed pump station. It has been found from the field visit that about 273 ha, 10 ha and 3.5 ha water storage area exist in Goranchatbari, Kallayanpur and Dholai khal retention ponds area respectively. Among these Kallayanpur and Dholai khal water storage area are reducing day by day by illegal encroachments.

During field investigation in the three pumping station site, it was observed that Goranchatbari is well managed and provide satisfactory performance during the flood 2004 and 2007. Moreover, the pond areas are used as fisheries



**Photo 6.4: The retention pond area of Goranchatbari**

Source: Field Investigation, 2009

projects in off season which not only generate numbers of employments but also facilitate the maintenance of retention pond area.

On the other hand the Kallayanpur retention areas is gradually filled up by number of developers. In addition, lack of regular excavations of silt causes the rising of pond bed. As a result, capacity of the pond areas is very inadequate as per the pump station required.



**Photo 6.5: The retention pond area of Kallayanpur**

Source: Field Investigation, 2009

At present, govt. has planned to acquire 100 hectares of land.



The retention pond areas of Dholai khal khal are small and subject to continuous encroachment. Moreover, the existing retention pond areas are not well managed. In fact, Residential, Commercial and Industrial wastes are thrown into the pond. This context is enforcing people, life, and locality in vulnerable condition.



**Photo 6.6: The retention pond area of Dholai khal**

Source: Field Investigation, 2009

## **6.8 Operational strategies of the pump stations**

Goranchatbari, Kallayanpur and Dholai Khal pumps are operated during the month July, September and October. Due to heavy rainfall when the water levels +4.00 m GTS then all those pumps are usually started. The officials of the Goranchatbari pump station stated that considering the worse situation the pumps are started when the water level of the pond area over +3.5 m GTS. According to the three pump station authority, all of those pumps are not serviced regularly but quick initiative is taken if these become unworkable. According to the officials of Goranchatbari pump station yearly maintenance cost of the pump station is about taka 150 million and 16 persons are engaged in pump operation and management. On the other hand, in case of Kallyanpur and Dholai khal pump station not more than 14 persons are engaged for both pump stations.

## **6.9 Present status of Flood Protection works of FAP-8B**

Under Dhaka Integrated Flood Protection Project (1992-2000), the Drainage Improvement works have been completed by DWASA during the years and the Flood Control works have been completed by BWDB. In order to improve the water logging problem, 21 canals have been developed and 50 km of storm sewer was rehabilitated or constructed in different parts of the city. Under Phase-I of the DIFPP, construction of the Dhaka Western embankment was completed in 1997. The storm water pump stations have been constructed at the out fall of Dholai Khal, and Kallayanpur Khal. Another pump house has been constructed at Goranchatbari on Digun Khal. The Dholai khal and

Kallyanpur pump station are operated by DWASA and Goranchatbari drainage pump station is operated by BWDB.

## **6.10 Conclusion**

This part of this report tried to make an effective comparison among the existing condition of the three pump station regarding operation and management. Three pump stations of FAP-8B proposal have constructed during different time period but not properly maintained. Considering the operation and management strategy the BWDB has shown better performance than DWASA although 2 pump stations are operated by DWASA. Existing reservoir area of Goranchatbari, Kallyanpur and Dholai khal are 274, 10 and 3.5 hectares respectively. Reservoir area of Goranchatbari shows best performance considering its land use control and economic contribution. This explores the poor condition of the pump stations and ineffectiveness of management authority mainly in case of Kallyanpur and Dholai khal pump station. The existing situation requires the intense attention of government and policy makers to ensure the sustainability of the retention pond areas.

## **Chapter Seven: Recommendation and Conclusion**

### **7.1 Introduction**

Spontaneous development, management weakness, lack of coordination, lack of proper policy guidelines & implementing authorities are the main causes for decreasing of retention pond and natural drainage. Therefore, the concerned authorities need to take appropriate measures immediately to overcome the situation. Following measures can be a strong basis for the concerned authorities in assisting them to provide the comprehensive management of storm water and minimize the suffering of the city dwellers from physical, social, economical and environmental point of view.

#### **7.1.1 Development Control to save Retention ponds, Natural Drainage System and Water Bodies**

The concerned authorities like RAJUK, DCC, DWASA, BWDB etc. should take the appropriate measures immediately to protect retention ponds, wetlands, low lands, natural canals, khals, water bodies and rivers in and around the city area for its survival.

- First of all, RAJUK will have to stop construction of buildings on khals, proposed retention pond area, low lands and wetlands
- There should be a clear demarcation of the retention pond areas, khals, water bodies in maps and plans
- Many khals and lakes which are still being retained, strict measures need to be taken to keep them usable for regular drainage as natural drainage system
- The authority should apply existing laws and regulations and take immediate legal action against the violators of the planning rules and regulations

#### **7.1.2 Development of Waste Management System**

The Dhaka City Corporation is the responsible authority to manage the solid waste disposal. The following actions are recommended for Waste Management System:

- Convenient local collection points and more efficient removal services should be provided
- Different waste disposal system like incineration should be introduced instead of covering wetland and encroachment of water bodies as disposal areas

- As the capacity of landfill area is coming to a saturation point in the near future, the materials should be separated for recycling, thereby relieving the pressure on the landfill
- DCC should concentrate on formulating policies for overall solid waste management
- Coordination and cooperation among different divisions of DCC involved with the waste management should be improved

### **7.1.3 Drainage Capacity Adjustment**

The amount of adjustment in the carrying capacity of natural streams following urbanization depends on the degree of run off. Due to increase in the amount of impervious surface it is essential to increase or adjust the drainage capacity by dredging or deepening of existing retention pond. The following actions are recommended for adjustment of drainage capacity:

- Dredging of existing Goranchatbari and Dholai khal retention pond areas
- Demarcation of appropriate (water bodies) retention pond areas for Kallyanpur pump station and immediate need of land acquisition by the pump management authority
- Existing rest and large water bodies in the western part must be declared as retention pond area and also immediate need of land acquisition
- All encroached khals in the western part must be excavated to improve drainage network

### **7.1.4 Comprehensive Drainage Development Plan**

The existing storm water drainage is not sufficient for western Dhaka City to drain out the excessive rainfall during the monsoon in the region. On the other hand, storm sewers also receive domestic wastewater which causes unwanted overflow and deterioration of the storm water discharges. Therefore, there should be a comprehensive storm water drainage improvement plan. DCC should execute the comprehensive drainage improvement project as implementing agency. The proposed comprehensive drainage improvement plan should be exchanged with other utility organization to avoid overlapping and duplication.



### **7.1.5 Establish “Right-of Way”**

The natural drainage system of the city is losing their actual width and existence due to encroachment and reducing the water carrying capacity day by day. Therefore, to get rid of the water logging and flooding problem, the original width and alignment of the lakes, khals and rivers has to be re-established in proper shape and ensuring easy drainage flow through these natural channels.

- The concerned authority like DCC, RAJUK, BWDB and BIWTA will have to earmarked “right-of way” right over the natural drainage system
- On the basis of the Drainage Development Plan, in all areas where existing main drains are located or will be required in future will have to be identified and enforced existing legislation to prevent unauthorized development
- Proposed channel geometry will have to be ensured by the authority to keep waterway free from all unwanted intrusion, encroachment etc.

### **7.1.6 Improvement of Drainage Management System**

Adequate management of drainage system is essential to ensure the natural and smooth flow of storm water. The management system will be the composition of operation, maintenance, rehabilitation and replacement.

➤ *Operation:* related to drains involved in carrying out activities in the field of conservancy, collection and disposal of solid wastes from drains and retention ponds

➤ *Maintenance:* related to maintenance of drains and retention ponds as well as equipment

➤ *Rehabilitation and replacement:* related to provision of rehabilitation drainage work and replacement of equipment

The responsible authority should develop a routine preventative maintenance program for the drainage systems so that the structural improvements will provide a lasting benefit. It is, therefore, recommended that management authority should develop a comprehensive conservancy program for maintenance of drainage system. To make the conservancy program effective,

- Adequate funds in all annual budgets for carrying out routine maintenance program should be provided

- Institutional set up for effective operation and maintenance of drains and retention ponds should be strengthening
- The concerned authority should ensure regular and careful maintenance of all the interconnected secondary and tertiary drains through proper monitoring program
- Inspection at regular interval should be made on storage of construction materials and any sort of illegal affairs causing blockage of drains
- There should be a high degree of collaboration and co-ordination among different urban authorities responsible for operating and maintaining the various components of the drainage network
- The inhabitants should be motivated in cooperation of maintenance of drainage system

#### **7.1.7 Multipurpose use of pump stations and retention pond areas**

Western part of Dhaka City plays a key role in the national economy context. Scarcity of land is a main problem for any kind of new development in the study area and existing water bodies and khals are frequently threatened. Although reservation of retention ponds and khals are vital to protect Dhaka City but no rules and regulation are effective. It is very difficult for the management authority to reserve the water bodies or low lands without acquisition. On the other hand, every day new development projects like water treatment plant, water park etc. have been initiated by both private and Government. The following initiatives (development device) will be rewarding for preserving the pond areas with development work:

##### ***Goranchatbari pump station Vs surface water treatment plant***

According to the recommendations of the officials of the Goranchatbari pump authority, at first the existing pond area should be deeper and free from outside pollution. A surface water treatment plant could be established in this area. The connecting khals will collect runoff water from its catchments areas. During the peak rainy season the existing pumps will be used for both purposes. Without extracting any underground water the areas and treatment plants could serve at least 6 months (June-November) half of the City People. The activities will save huge money and contribute more on environmental up gradation. During summer and rainy season the area will earn huge revenue from successful fisheries project and relatively high land could be used as cultivation, these are already in practice.

### ***Kallyanpur and Dholai khal retention pond Vs Fisheries project***

Kallyanpur retention pond area is not demarcated properly in terms of existing situation and is the subject of extensive mismanagement. So, at first retention pond area must be properly delineated with the adjacent water bodies and wetlands which require immediate land acquisition. Considering the better experience and practice of Goranchatbari retention pond area the Kallyanpur retention pond should be developed as same model. Besides Dholai khal retention pond area should be developed for fisheries project.

#### **7.1.8 Awareness rising against closing of Khal/drain**

Most of the people in Dhaka city are ignored and even don't know the subsequent effect of the filling of natural drainage and water bodies. Therefore, the concerned development authority should take necessary steps for awareness generation about the importance of existence of natural canals through media campaign, leaflet, rally, cultural program etc.

## **7.2 Conclusion**

The devastating impact of the downpour can paralyze western Dhaka is a crucial reminder of the severity of the problem and the necessity for the government to take appropriate measures on a priority basis. Dhaka City could hurtle towards an ecological disaster if destruction of the natural drainage and water bodies isn't stopped and an effective management of urban drainage system isn't established. This study has tried to explore the existing condition of the natural drainage, retention pond areas of Dhaka city and also analyze the causes and effects behind the land use changes of FAP-8B area. In addition, the operational and management strategies of the three important pump stations namely Goranchatbari, Kallyanpur, Dholai khal are also observed. Finally, based on these analyses some relevant recommendations are given to ensure the effectiveness of these khals and as a whole the natural drainage system of the city. This research can be a quite better option for the policy makers before taking decision in near future and can be a basis for further analysis pertaining with wet land preservation.

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**EFFECTS OF LAND USE CHANGE ON DRAINAGE AND RETENTION PONDS  
IN THE WESTERN PART OF DHAKA CITY**

**Questionnaire for officials of relevant departments**

Name of the organization:

Name & designation of the respondent:

**A1: Questionnaire**

1. How much Developer Involve in the western part of Dhaka City in different time period?
2. How much housing and building construction project developed in the western part of Dhaka City in different time period?

\*Name of the housing project:

- a) ..... b) ..... c)  
.....
- d) ..... e) ..... f)  
.....

3. How much roads are constructed last 10 years within western areas?
4. How much others infrastructure are developed last 10 years within western areas?
5. Is the western area affected by flood?  
 Yes       No       No comments  
If yes, numbers of flood occurred in this area?  
.....

What were the affect of the flood?

6. Is the western area affected by water logging?  
 Yes                     No                     No comments

If yes, what are the affect of the water logging?

7. Have the development considered the Flood Action Plan?  
 Yes                     No                     No comments

If no, why?

.....  
.....

8. How much private development violated the Flood Action Plan?

9. Did any enforcement measures for the development control?  
 Yes                     No                     No comments

10. Is the FAP - 8B implemented?  
 Yes                     No                     No comments

If yes, what are the works have been completed?



**EFFECTS OF LAND USE CHANGE ON DRAINAGE AND RETENTION PONDS  
IN THE WESTERN PART OF DHAKA CITY**

**Questionnaire for Pump Management Authority**

Name of the Pump Station:

Name & designation of the respondent:

**A1: Questionnaire**

1. How long time do you engage the pump management? ..... Years
2. What is the basic information of the pump equipments?

Information on pump equipments	Description
Type of Pump	
Number of Pump	
Capacity of pump	
Pipe's diameter	
Design head	
Using equipments & it's functions	
Source of power supply & requirements	
Structure descriptions	
Discharge level	
Others specify	

3. How much professional staffs engage in pump operation? .....

4. Give the following information about pump operation area?

Information	Answer
Pump Construction year	
Pump station areas in sq. meter	
Water storage areas/ Retaining Pond Area	
Plot number of the Retaining Pond Area	
Catchments areas	
Drainage area (length, width & depth)	
Level of retaining pond & catchments areas	

5. Give the detail of the storage areas/ Retaining Pond Area?

RS Name	Mouza	Plot Number	Use	Owner

6. Give the following information about pump area management?

Information	Answer
Maintain period of pump area	
Numbers of time become unfit for work of the pump	
Number of responsible staffs for pump area maintain	
Maintain cost per year	

7. Give the following information about retention pond area and its management?

Information	Answer
Use of water storage areas during different season	
Numbers of person are responsible for storage areas management	
Who are involve for storage areas management	
Storage areas management cost per year	
Maintain period	
Using equipments	
Economic return from the areas	

8. Give the following information about the drainage channel/khal?

Information	Answer
Within time become unfit for properly work	
Types of particle for drainage/khal area fill up	
Number of staffs responsible for channel maintain	
Maintain equipments	
Maintain cost per year	
Drainage maintains authority	
Maintain techniques	

**EFFECTS OF LAND USE CHANGE ON DRAINAGE AND RETENTION PONDS  
IN THE WESTERN PART OF DHAKA CITY**

**Questionnaire for Focus Group Discussion**

**Group No. :** ..... **Locality Name:** .....

1. Name of the Group Members:

Sl. No	Name of the Group Member	Profession	Age
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

2. Is your locality affected by flood?

Yes                       No                       No comments

If yes, numbers of flood occurred in this area during last 10 years?.....

What were the affect of the flood?

3. Is your locality affected by water logging?

Yes                       No                       No comments

If yes, what are the affect of the water logging?

6. According to you, what are the main reasons for such flood and water logging in your locality?

7. What type of problems you used to face during the period of flood and water logging?
  
8. Do you think the water logging problem in your area can be solved?
  - i) If yes, how?
  
9. How much retention pond areas have in this area?
  
10. Do you think the existing retention pond area has linkage to water logging in this area?
  
11. Do you know about Flood Action Plan (FAP)?
  - i) If yes; is it implemented properly in this area?
  
12. What's the main obstacle of the implementation?
  
13. Give your recommendation to improve the situation



BIVASH DAS  
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