Effect of Land Use Change on Geometric Characteristics of The Buriganga River

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March, 2006

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Institute of Water and Flood Management

The thesis titled "**Effect of land use change on geometric characteristics of the Buriganga River**" submitted by Rumana Binte Habib, Roll No: DF0328024, Session: April 2003 has been accepted as satisfactory in partial fulfillment of the requirement for Post Graduate Diploma in Water Resources Development in 22 March 2006.

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Roll No: DF0328024

Dedicated
To
My Beloved Parents

Md. Habibur Rahman
&
Mrs. Farida Begum

For Leading Their Children Into Intellectual Pursuits

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Abbreviation

BAPA	: Bangladesh Poribesh Aandolon
BIWTA	: Bangladesh Inland Water Transport Authority
BTM	: Bangladesh Transvers Marcator
BUET	: Bangladesh University of Engineering and Technology
BWDB	: Bangladesh Water Development Board
CEGIS	: Center for Environmental and Geographic Information Services
DOE	: Department of Environment
FGD	: Focus Group Discussion
GIS	: Geographic Information System
IWM	: Institute of Water Modeling
JICA	: Japan International Cooperation Agency
LGED	: Local Government Engineering Department
LGRD	: Local Government and Rural Development
NGO	: Non Government Organization
SOB	: Survey of Bangladesh
SPARRSO	: Bangladesh Space Research and Remote Sensing Organization
WASA	: Water Supply and Sewerage Authority

Glossary

Aman	:	Rice produced during the Kharif-II season.
Aspatial	:	Non spatial Data which has a attribute data table.
Aus	:	Rice produced during the Kharif-I season.
Cropping		
Kharif-I	:	Early Summer (March through June)
Kharif-II	:	Late Summer (July through October)
Low land (L)	:	Land which normally is flooded up to between 180 cm and 300 cm during the monsoon season.
Monsoon	:	Period of rains starting in June and ending in October.
Pattern	:	Sequence and arrangement of crops (including crop varities) on a plot of land over an annual cycle (or Sometimes more than one year if one crop or a complete cropping cycle occupies the plot for more than one year).
Perimeter	:	The weighted perimeter of the river
Rabi	:	Winter Season (November through February)
Spatial	:	Regional or Territorial data.
Watershed	:	The region or area drained by a river stream or The ridge or crest line dividing two drainage areas.

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Rumana Binte Habib

.....

Author

Abstract

Dhaka the capital city of Bangladesh, was established on the bank of the river Buriganga in early 17 th century. The heart of the city is the river Buriganga where the study is conducted to find the effect of land use change on geometric characteristics of the river. The study included analysis of geometric data for the different years 1973-74,1985-86,1995-96,2001-2002 and land use map of the years 1859,1984,1996 and 2001.

The river geometry during the period 1984 and 2001 has effected by the land use change (Location: Keranigonj, Pagla, Jinjira, Kamrangir char and Pachandana) and the other part of the study area (Location: Jajera –Dharmagonj , Mirerbag –Faridabad and Kalmarchar-Dawlia, near the village of Basila) has effected by the human intervention such as unplanned dredging. Land use pattern has suggested on the basis of social, economic, and environmental point of view.

Chapter one

Introduction

Chapter One

Introduction

বাংলাদেশ প্রকৌশল বিশ্ববিদ্যালয়
নং .....
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1.1 General

The history of civilization is closely related to some major rivers of the world. Many of the ancient civilization prospered in the fertile valleys of these rivers routs. During the ancient time, trade and commerce flourished using mostly river. While mankind benefits from rivers, they also cause lots of sufferings through causing flood, land erosion, siltation etc. Therefore, engineers need to plan, design, operate and maintain projects for regulation, flood mitigation, water supply, navigation and irrigation. Hence they require adequate knowledge of river behavior.

Bangladesh is a reverine deltaic country. Almost all the rivers that flow through Bangladesh are alluvial in nature. All alluvial rivers generally change its position and shape continually as a consequence of hydraulic force acting on its bed and banks and these changed to the geometric characteristics of the river. These changes may be slow or rapid and may result from natural environmental changes or from changes caused by man's activities. When a river channel is modified locally, the change frequently causes changes in channel's character both upstream and downstream.

In Bangladesh most of the river studies are related to the behavior and characteristics of only the major rivers. Apart from the three major rivers (The Padma, Meghna & Jamuna), there are numerous regional rivers that are interlaced throughout the country. Therefore, it is also important to understand the behavior and characteristics of these regional rivers.

The Buriganga is an important river in our country. It branches off from Dhaleswari short after Savar, and comes through the western and southern sides of the city, then curves rightward to meet again the Dhaleswari beyond Fatullah. In fact, Buriganga forms the southern and western boundary of the city (Ahmed M. F. *et al.* 2002).

1.2 The Glorious History of The Study Area

Dhaka is an ancient and historical city but Buriganga is too much ancient. The identity of the Buriganga is known in the "Kalika Puran" published two thousand years ago. There the writer identifies the Buriganga such as "Brithaganga". During the period of Muslims, we have known about Dhaka and Buriganga by different records.

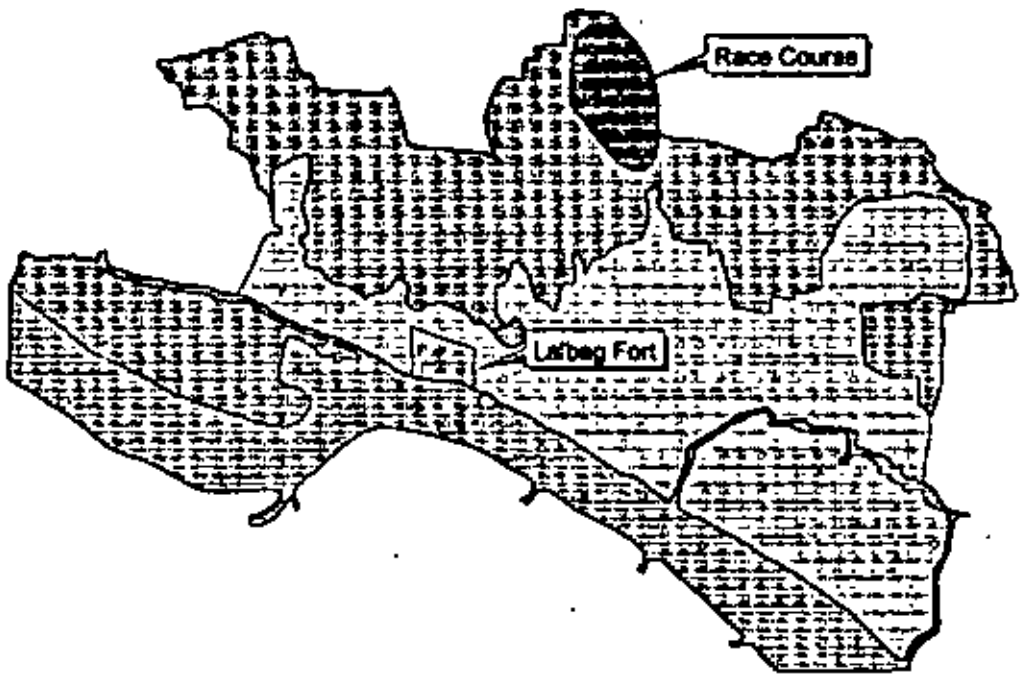
Buriganga witnessed the rise and fall of many empires and dynastics and arrival of Moghul Subedars Mir Jumla, Islam khan, Shayesta khan and records itineraries of world travelers.

During the period of Sultan Fakruddin the Arab travelers Ibne Batuta came and visited Dhaka. In 1348 he traveled Buriganga and disembarked from a Bajra to the Lalbag fort. To protect the Dhaka city from the attack of the Afghan rebels, Mogh, Arakan and Portuguese pirates the great Moghuls built Lalbag fort over the Buriganga. Mirjumla, Shayesta khan and many other Subedars had their great contribution to build Dhaka an ideal headquarter of the Moghuls

For the period of Subedar Islam Khan (1610) there were Shahi Bajras (large pleasure boat) and thousands of flotillas were all along the Lalbag on the bank of Buriganga. At that time the bank of the Buriganga was the only recreational place for all. Because of its transparent water, natural environment and advantage of communication, minister and Subeder wanted to build their residential house and recreational center there. Chhoto Katara, BoroKatara. Hossaini Dalan was made over the bank of the river. Moulvibazar, Begumbazar, Chawkbazar were named after the names of prominent Muslims and Babubazar, Tantibazar Singtola, Sutanagor etc were named after the names of professional Hindu craftsmen. In 1859, the city area was from northern part of the Buriganga to Race Course (Figure 1.1)

In 1835 Nawab Khwaja Abdul Ghani's father Khwakja Alimulla purchased Ahsan Manzil from a French businessman. At present where there is Ahsan Manzil there was a factory of the French people.

Area of Dhaka City



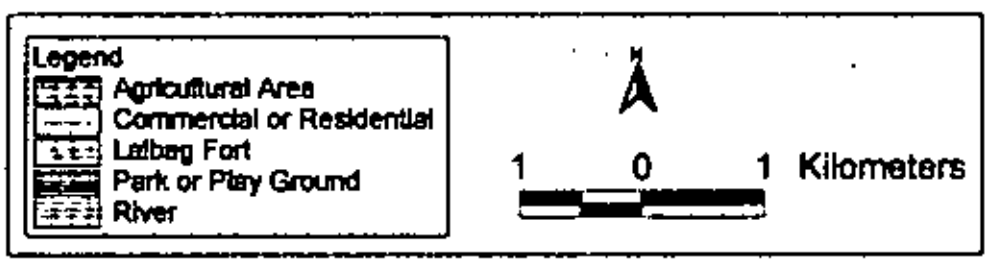


Figure 1.1: Area of Dhaka City in 1859

Source: Survey of Bangladesh (Year : 1859)

They lived in Farashganj. At That time "Ahsan Manzil" was the only architectural art in the city area (Photo 1.1).

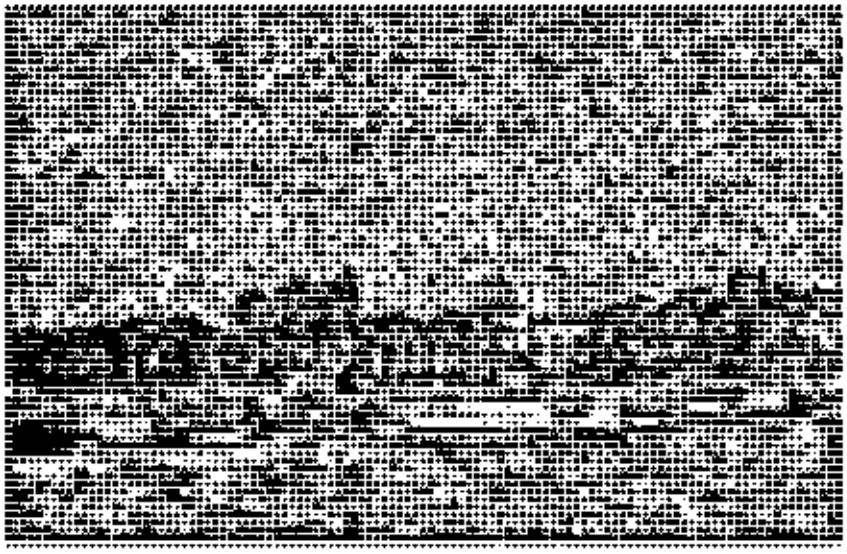


Photo 1.1: "Aahsan Manzil" the only architectural art in Dhaka city in eighteenth century.

Buriganga surrounded by a peripheral river system comprising Buriganga, Balu, Turag, Tongi Khal, and Lakhya. It had a number of water channels (Locally known as khal, such as: Jinjeera khal, Panea khal, Dholai khal, Narinda khal etc) which crossed through and around the city in the past and were of hydrographic importance linking, the peripheral rivers mainly with Buriganga. The majority of these khal does not exit any more as they have been filled in due to unplanned land use practice and environmental degradation.

There were much water in the Buriganga and sometimes it overflowed. On the bank a four-mile dam was made in 1735. But it was not strong enough. In 1857 after the end of Sepoy Mutiny Mr. C T Bakland Built Backland Bund and extended it from Farashganj to Babubazar. The dam is now the sprawling frontier and a bustling pavement of the Sadarghat full of urinals and cesspools.

Before two hundred years ago, there were much width and depth in the Buriganga River. At that time different types of big ship came to Buriganga River for business and others purpose.

1.3 The Present Situation of The Study Area

Not long ago, the Buriganga was beauty of a river. Its clean and transparent flow was a soothing sight. Its catches were special delicacies to fish lovers. Sailing on the river was a prime leisure of the Nawabs and aristocrats of the colonial Dhaka. Gone are those days of beauty and pride.

The capital city of Dhaka and Buriganga are related to each other. So that in 1959 a master plan was made to improve the river and urban beauty. In this master plan 291 acres of land was allotted for playground and park and a land of twenty-three acre was kept free along the river. But in reality, the land use is changing due to increase the population for the purpose of the business and for building of houses, especially after the independence. According to a survey of the NGO, 8 or 9 lack people are living besides the Buriganga River from Kamrangir char embankment of Hazaribag to Pagla. In 1998 a survey was conducted by The Department of Environment and they found that, the amount of dispossessed land was 50 acre (The Daily Ittefaq, 2003). That's why the width of Buriganga is shrinking fast and its other geometric characteristics are changing. For this reason, Buriganga struggles to survive.

Otherwise, many factories, market and other establishment have come up along the river and far from the river. The pontoons and others metal structures along the riverbank are occupying the major portion of the moving water of the bank. Due to occupying the riverbank, Buriganga have changed its behavior. Now a day's steamer can hardly enter Badamtoli that was once a busy station of steamers. Tanneries of Hazaribag, chemical industries of Tajgaon and many other factories poisonous wastes are falling down in the river without any treatment. Every day 98 metric ton hard waste and half of eight million liquids are falling down from 270 tanneries, 90% percent of them are situated at Hazaribag (The Daily Ittefaq, 2004). Not only from the tanneries, waste matter from thousands of latrines on both sides of the river has been connected with the flow. From the Launches and Engine vessels in Sadarghat and dockyard areas, there are discharges of kerosene and mobile oil. There are floating residential hotels on the river. Human excreta's and others waste from the floating vessels are spilled. These wastes contaminate the river water affecting its aquatic life and ecological health. Analysis of long-term data from some of the major rivers in Bangladesh shows that Buriganga is more polluted than any other river in the country (DOE, 1993). All the hard waste has been gathering in the

riverbed. For this reason, 25cm of polithin layer have been gathering in the riverbed of Buriganga and it is decreasing the river depth. According to BIWTA, huge volume of polythin layer has been found in the riverbed of Buriganga from Sadarghat to Narayangonj (4 Kilometer). Also, a large number of polythin has found from Sadarghat , Nawabgonj, and Showarighat area of the Buriganga (Poribesh posthro,2001) (Photo 1.2).

Photo 1.2 : Polythin layer along the Buriganga River.

An offshoot of Jamuna and Dhaleswari River, Buriganga runs through Saver, Amin bazaar, and Basila. Presently the off take of the river is dead but it receives flow from the Turag River. It is divided in Keranigonj point. In Kamrangir Char one branch has died (Figure 1.2). The other is flowing through Sadarghat and falling in Dhaleswari. Buriganga has its tradition. Historical monuments have been set up in Lalbagh, Keranigonj and Buckland Bund. But with the rise of population and unplanned urbanization in the city, it lost its heritage.

At Postogola Bangladesh-China Friendship Bridge and second Bridge of Buriganga have been constructed and communications with the remote areas has been extended in southern direction (Photo 1.3). As a result, several developers are developing housing projects on the right bank of Buriganga River. Once upon a time, that region was a vacant and agricultural area (The Daily Ittefaq, 2004).

Photo 1.3: Second Buriganga Bridge.

Buriganga is extremely important for the city of Dhaka. Many people live here for their employment opportunities and others facilities. It provides drainage for its internal waters; it is a potential source of water for domestic and drinking purposes, a place of recreation, and a number of other human activities. But will there be the image of Buriganga left in future? In the rush of construction and occupation of waterways will the flow of the Buriganga stop? If the wave of occupation of the banks and waters goes on uninterrupted and no dredging is conducted, may be there will be no Buriganga in the future. The river will turn into a canal and a draining reservoir of polluted water and a passage of carrying sewage.

1.4 Objectives of the Study

The objectives of the present study are as follows:

- To study the land use change along the bank of the Buriganga River.
- To study the impact of land use change on geometric characteristics of the river.

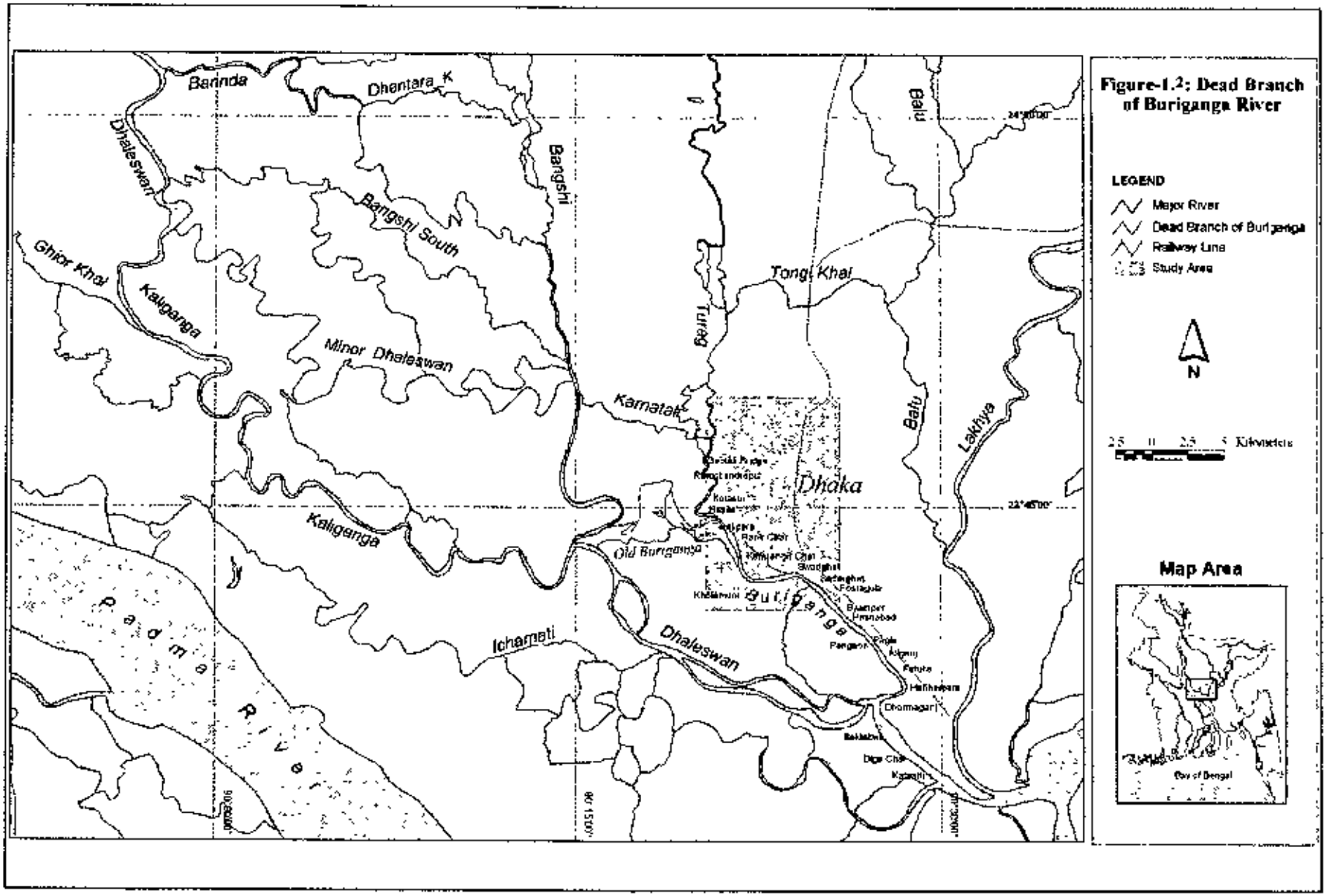


Figure-1.2: Dead Branch of Buriganga River

1.5 Rational of The Study

The Buriganga River & the land use along the riverside have been selected to study the land use change and its effect on geometric characteristics of the river. The experience of the Buriganga River can be applied in the future to any other river management programme of Bangladesh that has similar nature. So, the geometric characteristics of the Buriganga River and, the land use practice of the study area needs to be extensively studied. It is needed to find out the drawbacks of the present land use practice and suggest optimal land use.

1.6 Limitations

Sincere attempts have been made to achieve the objectives set for the present study. But the researcher faced some constraints to complete the whole study which are given as follows:

- Absence of cross-section data in 1973, in some particular locations.
- Absence of proper satellite image & land use map in 1973.

Chapter Two

Methodology

Chapter Two
Methodology

2.1 Methodology

The study was conducted on the basis of:

- Primary data and information obtained from,
  - Field observation
  - Focus Group Discussion (FGD)
- Secondary data, map and information obtained from BWDB, SPARRSO, CEGIS & SOB.
- Besides, reports and journals were collected from different organizations.

2.1.1 Field Observation

For this study, field observation was needed to know about the existing physical and environmental condition of the study area. During the study, the researcher visited the study area two times.

2.1.2 Focus Group Discussion (FGD)

Focus group discussions were needed for making use of the experience of local people. Opinion of local people regarding optimal land use and river situation were sought out through FGD. To complete the study, FGD was conducted at different locations of the study area. Every FGD comprised on average 12 to 15 numbers of people comprising various

professionals. People suggestions were colleted for the cause of land use change and river conditions. Dates of FGD and locations are given in Table 2.1 & Figure 2.1.

Table 2.1: FGD dates and locations.

Date	Location
February 14,2004	Fatulah
February 14,2004	Pangaon
February 14,2004	Faridabad
March 15,2004	Jinjira
March 15,2004	Kamrangirchar
March 16,2004	Basila

2.1.3 Estimation of Cross-Sectional Area & Perimeter

For estimation of cross-section area, four year average water level were used. Different average water levels for different cross-section numbers were taken. Standard procedure were applied to calculate the cross-sectional area and wetted perimeter.

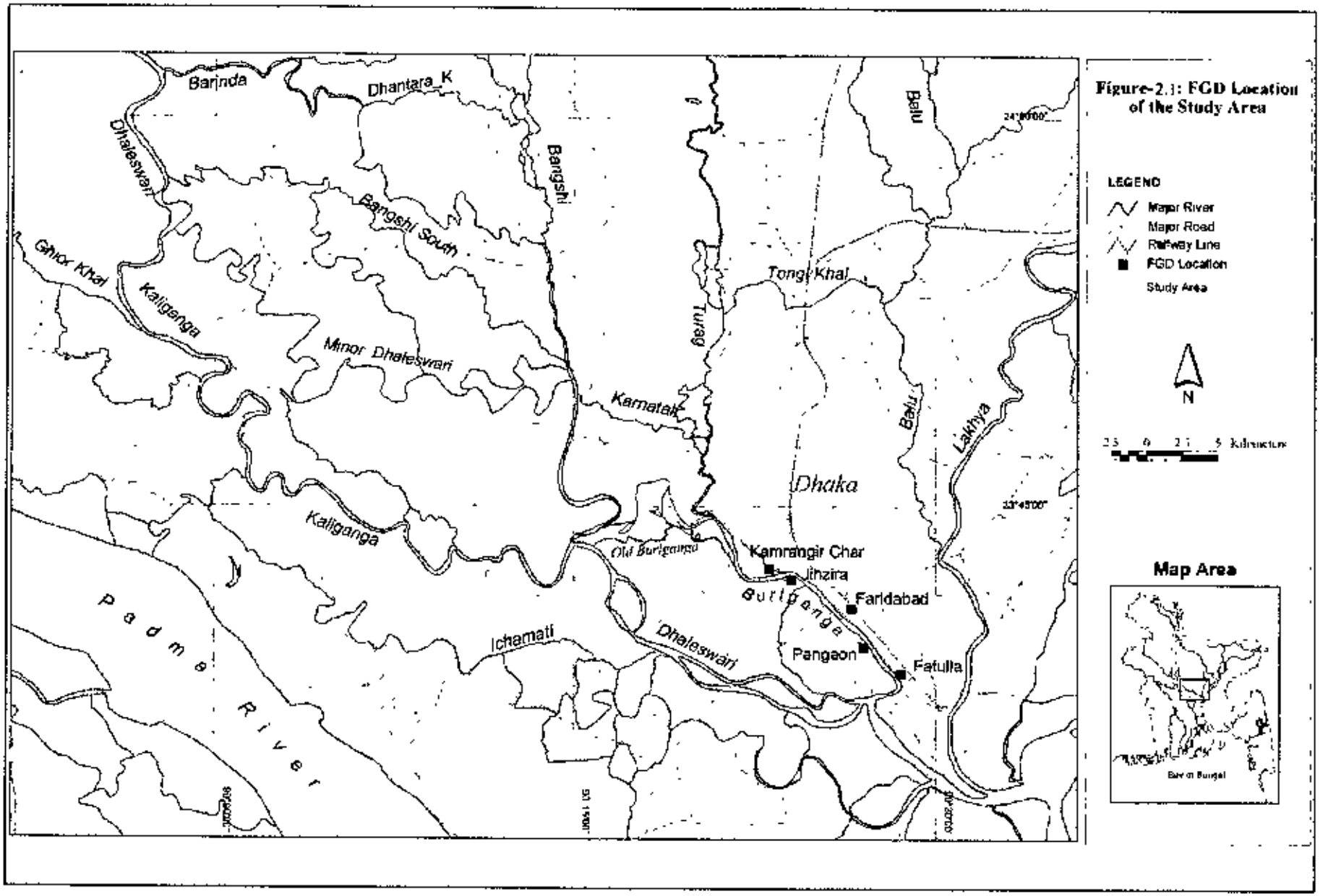


Figure-2.1: FGD Location of the Study Area

2.1.4 Estimation of Discharge

There is no discharge & velocity measuring station on the Buriganga River. So, the discharge was computed by Manning's formula.

2.1.5 Estimation of Slope

Surface slope data was collected from the previous study (Siddique, 1998), which are given below: -

The slope used for the determination of the discharge were calculated based on

100 – year flood level at Mirpur	= 9.035 m
100 – year flood level at Mill Barrack	= 7.969 m
100 – year flood level at Hariharpara	= 7.159 m
Distance between Mirpur and Mill Barrack	= 16.10 km
Distance between Mill Barrack and Hariharpara	= 9.66km

Water surface slope between Mirpure and Mill Barrack $= \frac{9.035 - 7.969}{16.10 \times 1000} = 0.0000662$ m/m

Slope between Mill Barrack and Hariharpara $= \frac{7.969 - 7.969}{9.66 \times 1000} = 0.0000839$ m/m

It appears that the slope between Mill Barrack and Hariharpara is steeper than the slope between Mirpur and Mill Barrack.

For the calculation 8 sections were used and slope was calculated according to Table 2.2.below

Table 2.2: High water surface slope

Serial No.	Number of cross-section		Slope per meter
	Form	To	
1	1	5	0.0000839
2	6	8	0.0000662

2.1.6 Maximum Depth & Width

Maximum depth and width data were collected from the graph of cross-sectional area for the year 1973-74, 1985-86, 1995-96, and 2001-02.

2.1.7 Estimation of Land Uses Percentage From Map or Satellite Image

In the present study, Remote sensing and GIS tools were used Dry-season satellite imagery for the year1996 and land use map of Dhaka city for the year 1859, 1984, and 2001 were used to study the land use change. Unfortunately all the maps were not for the same area. This imagery was read into Image Analysis Extension processing system, rectified to geographic coordinates and fixed to the Bangladesh Transverse Mercator (BTM) projection. Using GIS, the different land use area were digitized and run on error free techniques for preparing polygons. ARCVIEW software was used for counting the land use percentage and better re-presentation of the respective features. The land use map of 1996 has come from image and land use area map of 1859 was different from other maps. So, here the land use changes from 1984 to 2001 were compared because these two maps were collected as land use maps.

2.1.8 Data Analyses

All the available data and information recorded in above steps were complied and analyzed. Changing conditions of the land use and geometric characteristics were estimated. On the basis of the analyses of the data and information, conclusions were drawn and recommendations are made. Detail methodology of the study is shown in Figure 2.2.

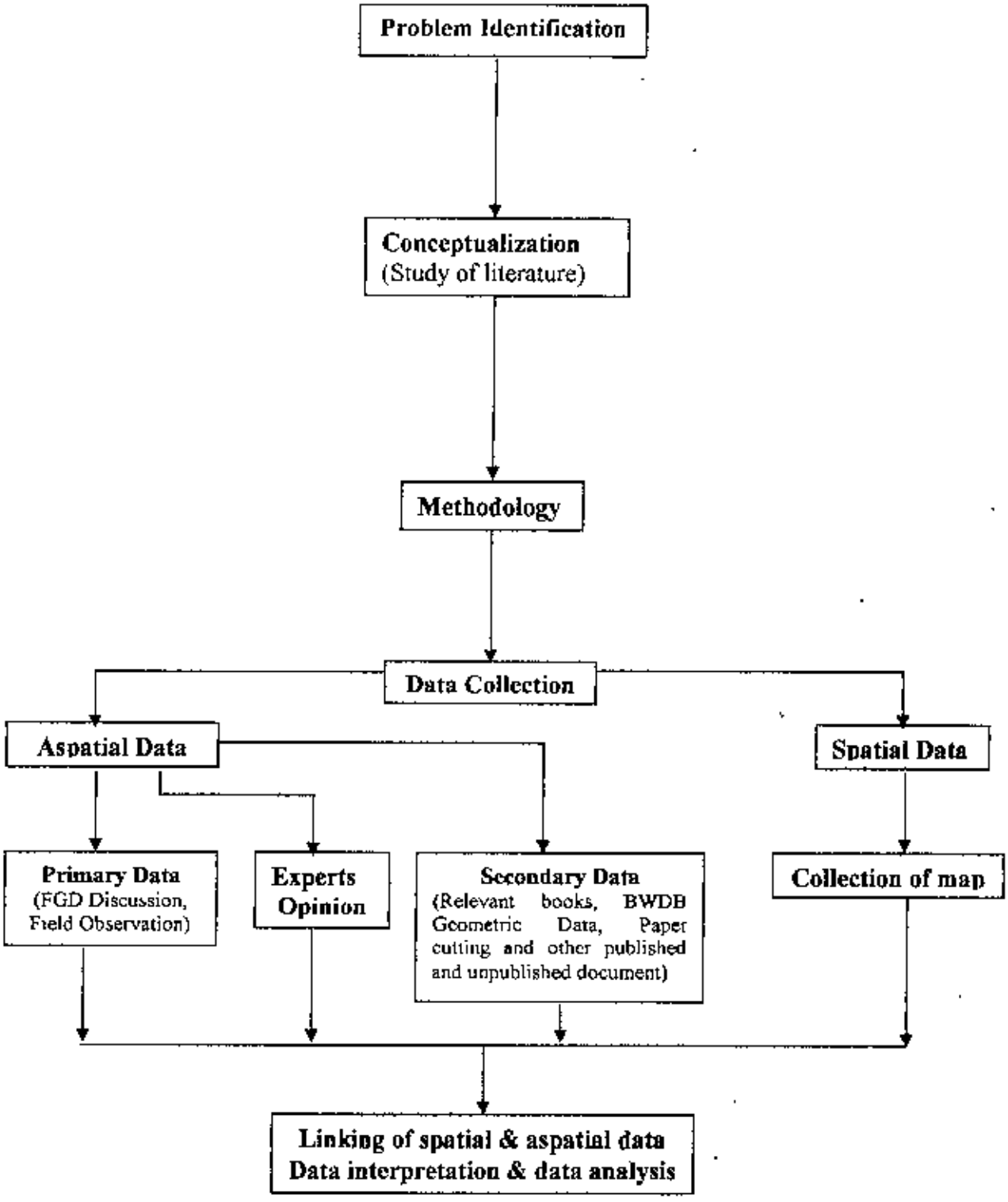


Figure 2.2: Schematic diagram showing the approach of the study.

Chapter Three

Review of literature

Chapter Three

Review of Literature

3.1 Introduction

Rivers vary greatly in size from tickles running through gullies to mighty channels suitable for ocean going vessels. Rivers also differ from one another in their physical characteristics and general behaviors Factors that have produced the present channel features, channel behavior and will affect the response of the channel to engineering works include source and supply of sediments, basin materials and vegetation, catastrophic events, earth movements, landslides and major floods, changes in land use and development, and past interferences including structures, dredging and diking.

3.2 Review of Previous Studies

Recent literature survey indicates that very few water resource development project, construction project or related studies were undertaken on the river Buriganga & Dhaka. Bangladesh Water Development Board collects hydrological data and they publish it in different reports. Moreover, the hydrological yearbook of Bangladesh Water Development Board contains hydrological data including rainfall and evaporation. Otherwise, SPARRSO, SOB collect various types of land use data, satellite image of Dhaka and publish it.

3.2.1 Buriganga River Water Quality Under Alternative Scenarios

Rahmau, and Rana (1995) had studied the management of Buriganga River water quality under alternative scenarios. They found that either a treatment plant at Hazaribag or shifting of tannery units to Savar would provide considerable opportunity to properly mange the Buriganga river water quality.

3.2.2 The Brief Overview of The Environment Quality Along The Buriganga River

Environmental Engineering Division (BUET, 1995) had studied about the brief overview of the environment quality along the Buriganga River. They found that the water quality of the dry season deteriorates exceedingly because of low flow conditions. The dissolved oxygen levels near Chandnighat, Sadarghat and Hazaribagh reduces to zero rendering, it unfit for survival of any aquatic habitat. Disposal of solid and hazardous wastes from the water vessels into the river is deteriorating the water quality at an alarming rate. During dry season the problem becomes acute.

3.2.3 Cross-Sectional Data Analysis of Buriganga River

Bhuiyan (1997) studied cross-sectional data of Buriganga River. He found that the cross-sectional area at stations BGA-2, 5, 7 and 8 have not been changed considerably and observed a large variation in cross-sectional area at section BGA-1.

3.2.4 Discharge And Sediment Data of The River of Buriganga

Siddique (1998) studied about the discharge and sediment data of the river of Buriganga. He found that the mean annual water discharge obtained from semi-log plotting was 2872 cumec and sediment discharge was 4600 kg/s using (Hossain formula) and 1900 kg/s using (Engelund-Hansen Formula).

3.2.5 The Valuing Cleanup of The Buriganga River

Alam (2001) had studied about the valuing cleanup of the Buriganga River. The major findings of this investigation reveal that not only a significant proportion of the respondents are willing to pay for environmental improvements, but also they are willing to contribute in terms of time. It is estimated to be about 60.55 percent of the total WTP (Willingness- to-pay) value. The development and restoration benefits of cleanup of the Buriganga River were estimated to be about US$ 7 million in a year. It was concluded that failure to consider such

benefits in the decision-making calculations could lead to gross under-estimation of the role that general public can play in such environmental improvement activities.

2.2.6 Dhaka Nogor Unnayn Porikalpona Protibedon, 1917

Patrick Geddes (2001) made a plan for the development of Dhaka in 1917. But very few people knew about the plan and paid attention to it. This plan has published recently in a book (Dhaka Nogor Unnayn Porikalpona Protibedon) by Dhaka Granthomala. In that plan, he gave some right direction about the future land use of Dhaka city. He said that the water net work of Dhaka to cover with old Dholai Khal, the part of north, east and west of city. Here he apprehends that this water network will be fill up. He also mentioned the people will be benefited by cleaning and increase the depth of this network. In 1859, Survey Of Pakistan (Land use map 1859) published a map of then Dacca, which gives the concept about the land use of that time. Different institutions also published land use map and other maps. But, there is no comparative study about this.

As mentioned earlier, no such study has been under taken that have direct relevance with the present study.

Chapter Four

Profile of the Study Area

Chapter Four

Profile of the Study Area

4.1 Location of The Study Area

Buriganga, which has been selected as study area is situated in the Dhaka district and it is the branch of the Dhaleswari river (Figure 4.1). It is surrounded by a peripheral river system comprising Buriganga, Balu, Turag, Tongi Khal and Lakhya. Dhaka city is situated on the left bank of the Buriganga River. The study area is located mostly in the northern part of the Buriganga River.

4.2 Physiography of Study Area

The study area belongs to the playstosin Sopan area. More especially this area is part of Modupur and Vaoul track.

4.2.1 Climate And Hydrology

The study area contains a typical monsoon climate with a warm and dry season from March to May followed by a rainy season from May to October and a cool period from November to February.

Table 4.1: Probable Storm Rainfall (in mm)

Duration	Rain Station	Return Period (Year)					
		2	5	10	20	50	100
1 day	Dhaka (B.M.D.)	137	184	215	244	283	311
2 day	Dhaka (B.M.D.)	184	239	276	311	357	391
5 day	Dhaka (B.M.D.)	251	324	372	418	478	523
1 month	Dhaka (B.M.D.)	514	636	176	793	892	967

Source : JICA, 1991.

The area being a midal zone is prone to flood that occurs either shortly prior to or soon after the monsoon period. Annual rainfall in Dhaka is approximately 2000 mm. More than 80% of the annual rainfall occurs during monsoon and July to August are the months of heavy rainfall Probable one day storm rainfall of 2, 5, 10, and 100 years return period are 137mm,184 mm., 215 mm and 311 mm respectively in Dhaka (Table 4.1).

Table 4.2 : Climatic condition in Dhaka City

Parameters	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Average Rain Fall (mm)	6.5	20.2	52 3	124.0	283.0	398 2	391	328.0	264.0	160	25.3	7.4
Days of Rainfall	1.0	2.0	4 0	8.0	14.0	19.0	22.0	22.0	16 0	9 0	2.0	1.0
Temperature (0°)												
High (extreme)	34.2	36.6	40.6	42 3	40 6	38.4	35 2	35.9	35.3	38.8	33.3	31.2
Low (extreme)	5 8	4 5	10.4	15.6	18 4	20.4	21.7	21 0	22 0	10.4	10.6	6.7
Average	18 8	21.5	26.1	28.7	28.9	28.7	28.7	28 7	28.7	23 6	23.6	19 8
Relative Humidity (%)	70.0	66.0	63.0	71 0	79.0	86.0	87.0	86 0	86.0	75.0	75 0	74.0
Evaporation (mm)	104	79 0	81.0	77 0	78.0	83.0	87 0	130 0	118.0	75.0	75.0	105 0
Wind Velocities Knot (1 Knot 1852 km./hr)	2.0	2.0	3.0	5 0	5.0	4 0	4.0	4.0	3.0	1.0	1.0	1.0

Source: JICA, 1991.

Average temperature varies from about 20°C in December and January to about 30°C in April to September. Maximum temperature sometimes exceeds 40°C in March and April. Monthly average evaporation varies from 80 to 130 mm. It is lowest in November and highest in August. The climatic conditions as reported in the flood control and drainage master plan are shown the Table 4.2.

4.2.2 Soil

The study area belongs to the old alluvial soil (Hasan M. *et.al.*, 1995).

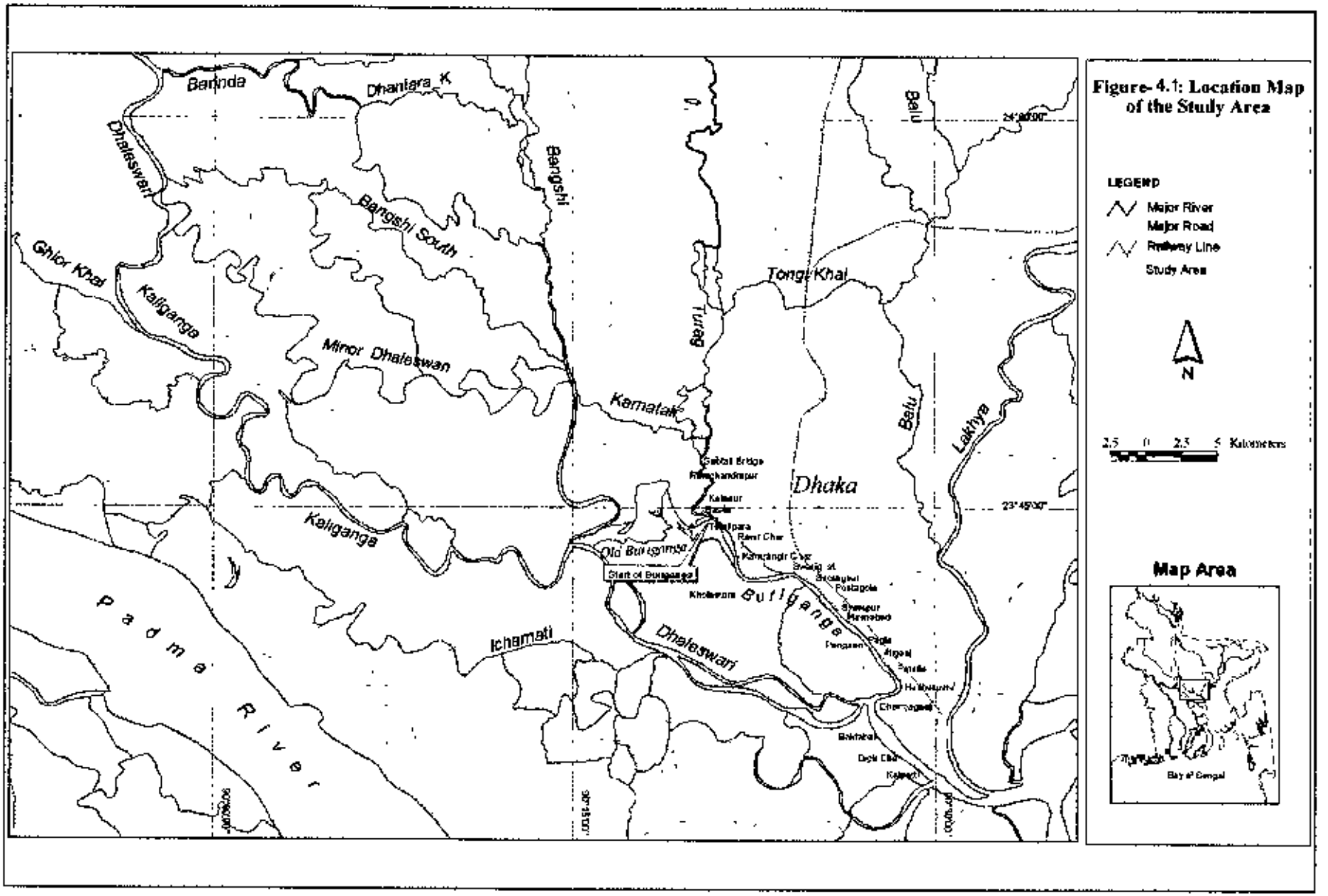


Figure- 4.1: Location Map of the Study Area

4.2.3 River system

Bangladesh is a country of river There are many big and small rivers. Most of the river in our country is not an isolated river. They are hydraulically connected with one another. Buriganga river also connected with other rivers. The description of the Buriganga river system is given below:

- The Jamuna
- The Dhaleswari
- The Buriganga

4.2.3.1 The Jamuna River

The Brahmaputra river originates in a great glacier mass in the kailas range of the Himalayas (Lake Manos) of south of Lake Gunkyud in south-east Tibet (eleveation 5400 m) and flows a total distance of 2800km before emptying into the Bay of Bengal through a joint channel with the Ganges. The Brahmaputra river after entering Bangladesh becomes a braided river.

The major flow of the Brahmaputra river (about 90%) is distributed to the Jamuna river near Bahadurabad of the Jamalpur District. The Rennel's Map of 1769 shows that the Brahmaputra River main flow was through old Brahmaputra river course towards the haors of the Meghna Basin. It is the great earthquake of 1787's that changed the course of the Brahmaputra river towards the Jamuna river.

The Jamuna river on its way southward meets with one major Tributary named the Hurasagar river. This river falls near Bera of Pabna on its right bank. The Jamuna river has three distributaries from its left bank named the Fatikjani river, the Pungli river and the Dhaleswari river. These distributors branch off from its left bank near Gopalpur, Bhuapur and at Elashin of the Tangail District. The total length of the Brahmaputra-Jamuna river from Noonkhawa of Kurigram District to Aricha of Manikganj District is about 220 km. The Jamuna river is non-tidal all along its way. Its width varies from 8 to 21 km with an average width of 14 km (BWDB,2002).

4.2.3.2 The Dhaleswari River

The Dhaleswari river is a distributary of the Jamuna river from the left bank. Its offtake has two mouths, one at the downstream of Jamuna Bridge and the other at Elashin. On its way to the southeast it meet with the Bangshi, the Kaliganga, the Buriganga, the Ichamoti and the Sitalakhya rivers and falls in the Meghna river. Presently the Dhaleswari river is flowing through a diversion from its right bank near Ghior and falling in the Kaliganga river. Thus the middle portion of the river is now dead. The total length of Dhaleswari is about 168 km and average width is 3.11 km (BWDB,2002).

4.2.3.3 The Buriganga River

The Buriganga river had its offtake from the Dhaleswari river near Hemayetpur of Dhaka district and outfall into the same river near Fatulla of Narayangonj District. Presently the off take of the river is dead but it receives flow from the Turag river. The length of the river is about 45 km. The average width is 0.76 km (BWDB,2002).

Hydraulically, the Buriganga is not an isolated river. Many other rivers are hydraulically connected with the Buriganga and influence the flow of the Buriganga. It is hydraulically connected with the Balu, the Dhaleswari, the Kaliganga, the Karnatali, the Lakhya, the Tongi khal and the Turag. The network of the river system hydraulically connected with the river is given in Figure 4.2.Upstream end of the Buriganga is at 11 km down from the Mirpur Bridge and down stream end at Hariharpara

Generally, the flow of the Buriganga is non tidal during wet season and tidal during dry season. If backwater effect is strong and upstream flow is small, then some times the wet season flow in the Buriganga becomes tidal. Tidal range of the river is not high. Maximum range at Millbarak in 1993 was about 0.75 metre. This range varies year to year but variation is small. Tidal influence propagates far upstream of the Mirpur Bridge (Rahman and Rana, 1995).

3.3 Growth Pattern of The Study Area

The study area is the part of Dhaka district. It is a dynamic area, which changes with the span of time. In the ancient period people has been made their settlement along the Buriganga River because of various facilities. That time vary few settlement had stablisted along the riverside and most of the land belongs to the agriculture. The land use pattern in the study area have undergone extensive changes over time, in response to accelerated economic growth, population pressure. In the present time, the land use has been extended to the Tongikhal.

The map (Figure 4.3) shows that in year 1600 – 1850, the settlement area is not large. But in the next 100 years from 1850-1950, the settlement area has been extended to the north side of the Buriganga. After the year of 1950, the rate of enlargement has been increased on both sides of the river.

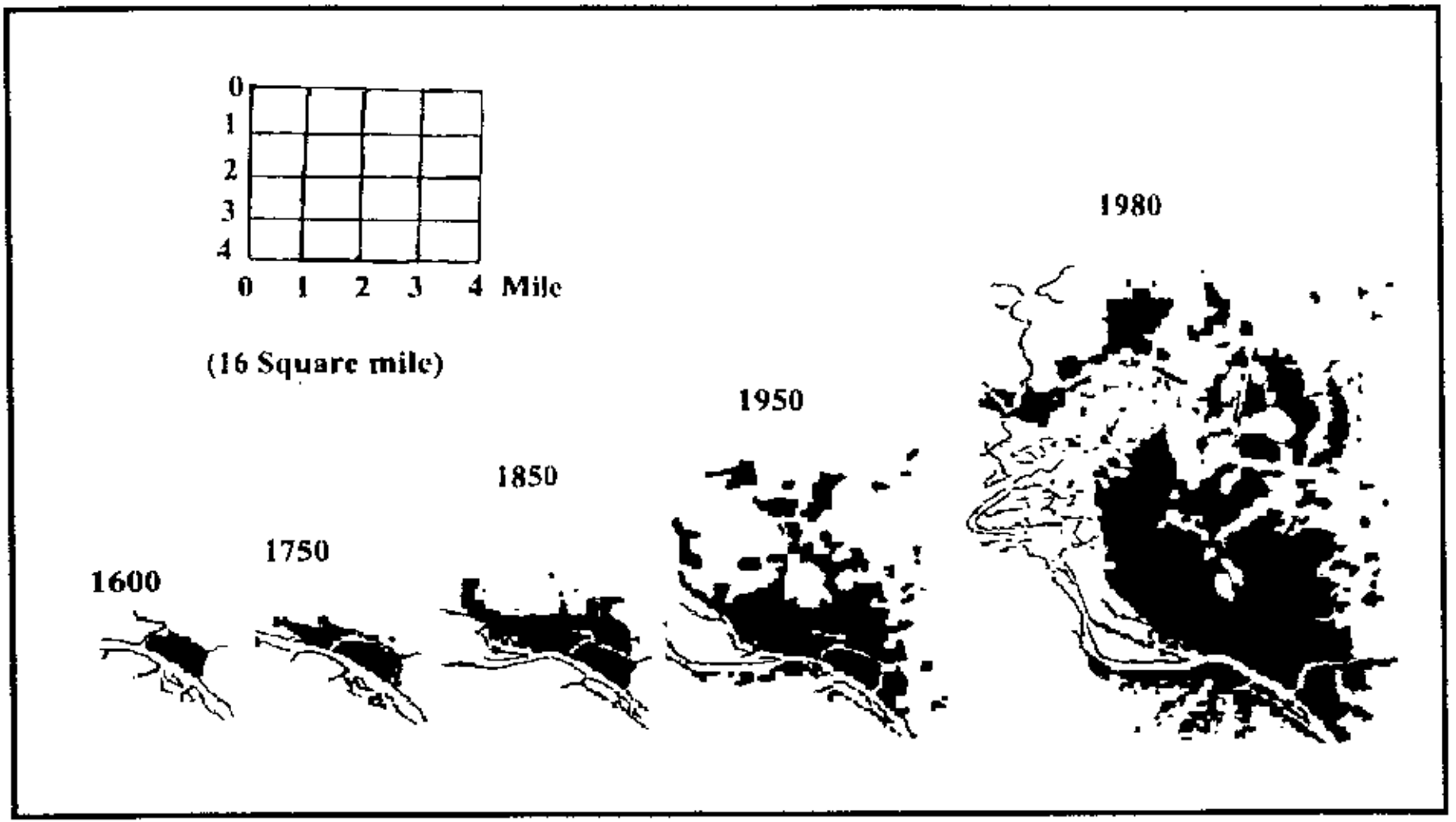


Figure 4.3: Comparison growth pattern of the study area.
[Source: Dhaka Nagor Unnaon Porikalpona (Report on Dhaka city planning, 1917) Patrik Geddas.]

4.4 Population In The Study Area

The study area is important, because of its geographical and economical advantages. That's why people have made their settlement here from ancient period. Now a days the population has been increasing day by day due to economic growth and other benefit. The growth pattern of population of the study area is given below: -

Table 4.3 : Population (Thousand) in Dhaka city of Bangladesh in census year.

Year	1901	1911	1921	1931	1941	1951	1961	1974	1981	1991	2001
Population (In thousand)	2617	2929	3172	3449	4224	4073	5096	7611	10014	13232	17200

Note: Figure may differ due to rounding

Source. Population Census 2001

Preliminary report, Bangladesh Bureau of Statistics.

Statistics Division, Ministry of planning, Gov. of the People's Republic of Bangladesh. Parishankhan Bhaban, Agargaon, Shere-Bangla Nagar, Dhaka. August-2001 (page 29)

4.5 Ecological Resources

JICA (1992) in its feasibility study carried out an inventory of ecological resources of Dhaka east, DND and Narayanganj west. The total number of identified floral species and fauna species is 112 and 117 respectively. The surveyed fauna species is limited to that of wild origin. The respective productive ecological elements are agricultural crops and aquaculture species. The water bodies of potential aquaculture during flood season become agricultural lands during dry season. The area is quite rich in community forest. Most low lands and floodplains of single cropped agriculture are the potential open water capture fishery areas of rainy/flood season.

4.6 Drainage System

The overall drainage patterns of all the rivers in the North central region follow south and southeasterly direction. But the drainage pattern in the study area follows differently depending on the local topography and depressions. The western part of the Greater Dhaka West drains towards west and south-west, where as the eastern part and the Greater Dhaka East drains towards and south-east. There are some major drainage khals in the study area. In the western part, the Kallyanpur khal, Baunia khal and the Dugun khal drain towards the Turag on the west. The Begunbari khal and Badda khal drains the central and eastern areas towards the Balu River on the east. The southern area drains through Segunbagicha khal, Gerani khal, Manda khal and Dholai khal towards the Buriganga on the south. The study area was divided into 12 drainage zones on the basis of topographic conditions, Khal system and outfall to the surrounding rivers shown in Figure 4.4 (JICA, 1991). The drainage system for the Greater Dhaka West has already been developed through construction of pump stations, sluices etc. Similar infrastructure would also be developed for proper drainage of the Greater Dhaka East under the BWDB's proposed project for construction flood protection embankment along the Balu river .

4.7 Embankment / Flood wall

Dhaka Town Protection Embankment (DTPE) was constructed under Dhaka Integrated Flood Protection project of Bangladesh Water Development Board (BWDB) during 1991-1998. The length of the DTPE is 36 km including floodwall. The embankment is constructed along the western edge of the capital city Dhaka from Tongi. Railway Bridge to Bangladesh-china Friendship Bridge constructed over the river Buriganga at Postogola-Hasnabad as shown in Figure 4.4. The embankment was constructed with the objective to protect Dhaka city from flood. At present the embankment under Dhaka Integrated Flood Protection Project keeps 136km^2 area of the capital city Dhaka flood area. The construction cost of the embankment was taka 8230 million (The Daily Janakantha, February, 2004). The embankment serves the dual purposes of road-cum-flood protection embankment.

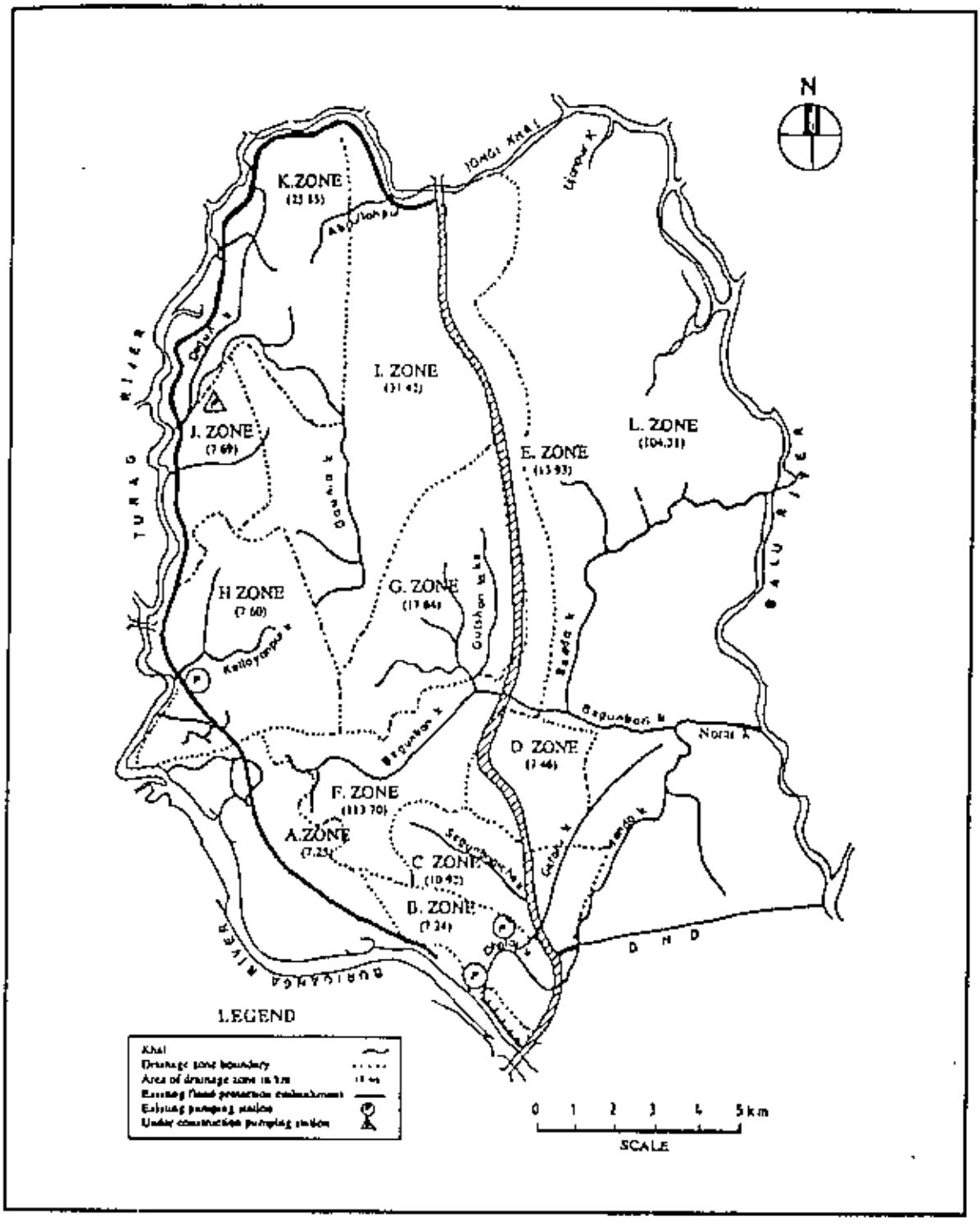


Figure 4.4: Major khals and drainage zones in Dhaka city (JICA,1991)

Chapter five

Analysis, Result & Discussion

Chapter Five

Analysis, Results and discussion

5.1 Introduction

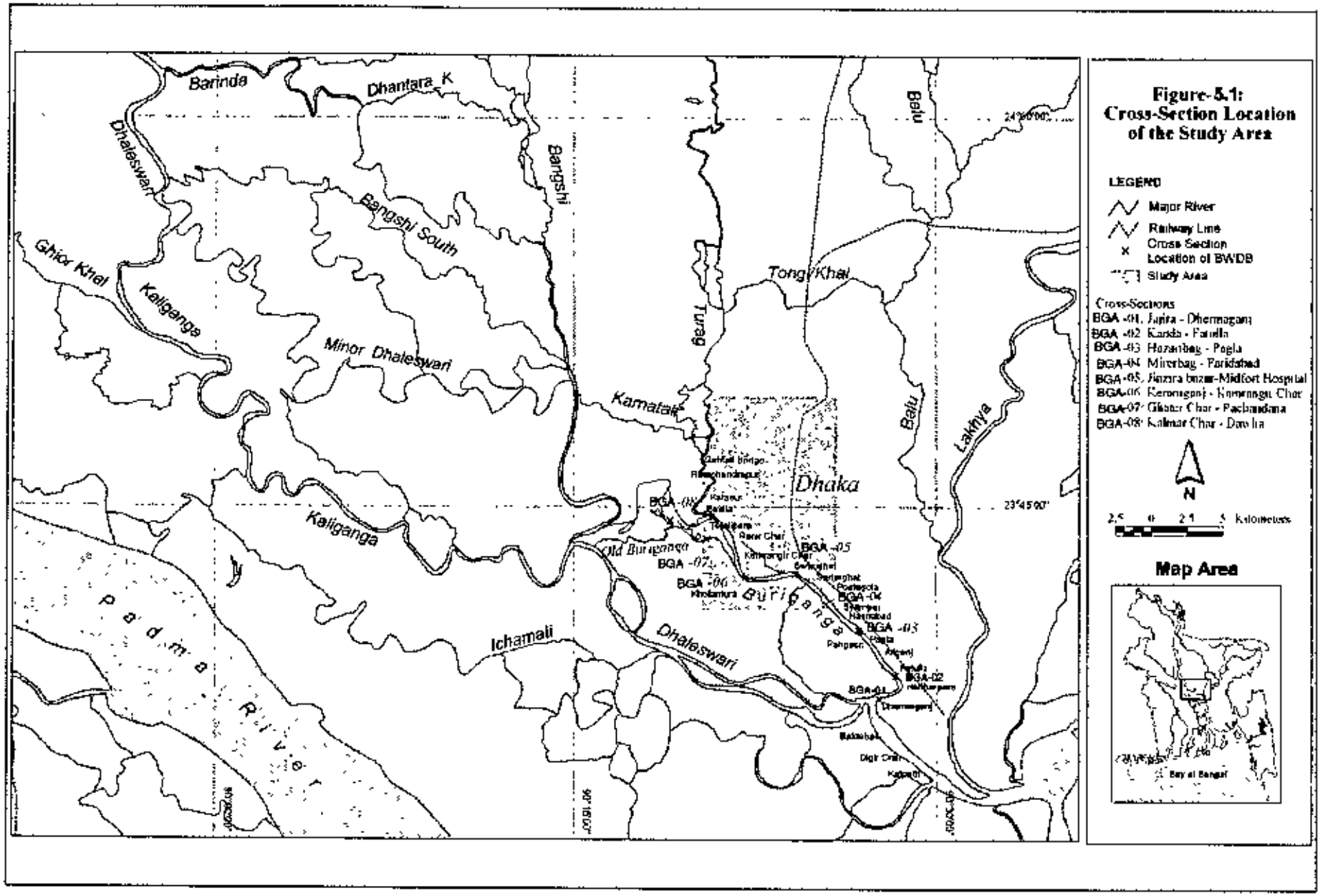
The aim of the present study is to have some idea about the variation of cross-section, cross-sectional area, the bed level change, discharge, average velocity, maximum depth, and width for 8 selected sections during the period 1973-74,1985-86, 1995-96 and 2001-02 and the change of land use for the period 1859,1984, 1996,2001. Here another aim is to find out the effect of land use change on geometric characteristics of Buriganga River. Geometric parameters and change of land use pattern have been used for this purpose. For the analysis of the plan form change, it is necessary to have long-term plan form data. But Buriganga has no long-term plan form data. Due to this, to study the change of plan form for the Burigaanga river was not possible.

5.2 Geometric Characteristics

The selected cross-sections of the river Buriganga at eight location (Figure 5.1) e.g. BGA-01 (Location : Jajera-Dhermagonj),BGA-02, (Location: Pangaon-Fatullah), BGA-03 (Location: Hazaribag-Dhaka Match Factory), BGA-04 (Location: Mirerbag-Faridabad), BGA-05 (Location: Jinjira Bazar-Midfort Hospital), BGA-06 (Location: Keranigonj-kamrangir Char), BGA-07 (Location: Ghatar Char-Pachandana) & BGA-08 (Location: Kalmar char- Dawlia) for the years 1973-74, 1985-86, 1995-96, and 2001-02 were plotted to visualize and analyze the variations of cross-sectional area, water width, maximum depth, discharge, and its movement throughout the 28 years period.

5.2.1 Variation of Cross-section

From Figure 5.2 and Table 5.1, it is seen that the sectioo BGA-01 (Location : Jajera-Dhermagonj), the cross-sectional area is about 2390m^2 for 1973-74 and 8704 m^2 for 2001-2002, which indicate that the cross-sectional area has increased day by day because of dredging by the local people in this section from many years. Here, there is no natural reason.


Barinda
Dhantara K
Dhaleswari
Bangshi
Bangshi South
Ghior Khal
Kaliganga
Minor Dhaleswari
Turag
Tongi Khal
Balu
Lakhya
Kamatak
Dhaka
Kaliganga
Old Buriganga
Buriganga
Dhaleswari
Ichamali
Padma River
BGA -01
BGA -02
BGA -03
BGA -04
BGA -05
BGA -06
BGA -07
BGA -08
Figure-5.1:
Cross-Section Location
of the Study Area
LEGEND
Major River
Railway Line
Cross Section
Location of BWDB
Study Area
Cross-Sections
BGA -01, Jatira - Dhemagani
BGA -02 Kanda - Fatulla
BGA -03 Hazaribag - Pagla
BGA-04 Mirerbag - Faridabad
BGA -05, Jinjira bazar-Midfort Hospital
BGA-06 Keronganj - Kumargaon Chor
BGA-07 Gilatar Char - Pachbaidana
BGA-08 Kalimar Char - Daulia
N
2.5 0 2.5 5 Kilometers
Map Area
Bay of Bengal

From Figure 5.3, 5.4, 5.6, 5.7, & 5.8 and Table 5.1 it is observed at section BGA-02, (Location: Pangaon-Fatullah), BGA-03 (Location: Hazaribag-Dhaka Match Factory), BGA-05 (Location: Jinjira Bazar-Midfort Hospital), BGA-06 (Location: Keranigonj-Kamrangir char) & BGA-07 (Location: Ghatar char-Pachandana) the cross-sectional area of 2001-2002 in comparison to 1973-74 have decreased. The reason is basically accumulations of sediment, sewage waste associated with a very low river velocity.

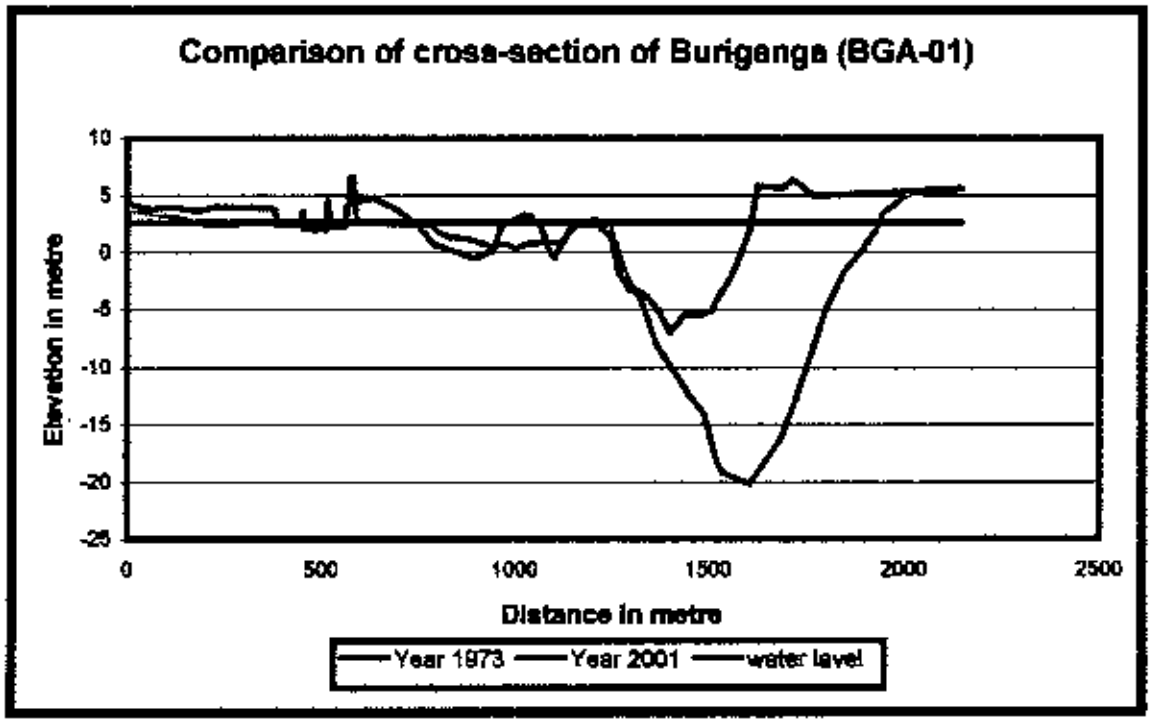


Figure 5.2: Comparison of cross-section (BGA-01) between year 1973 & 2001 of Buriganga River.

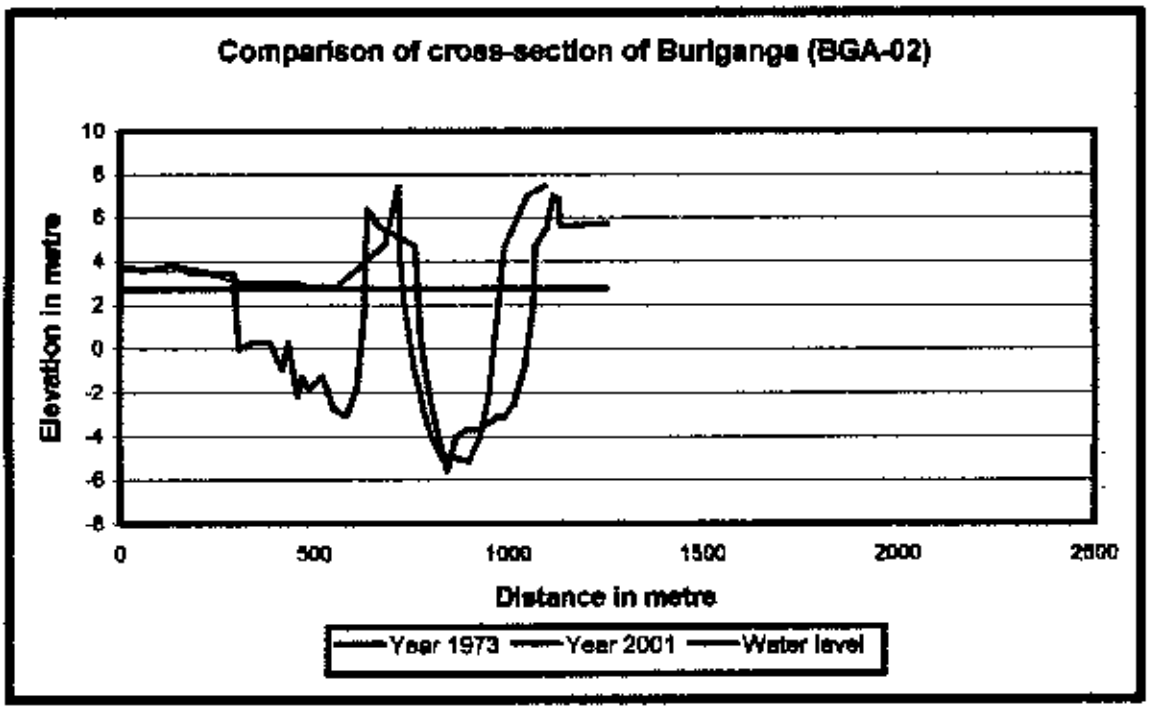


Figure 5.3: Comparison of cross-section (BGA-02) between year 1973 & 2001 of Buriganga River.

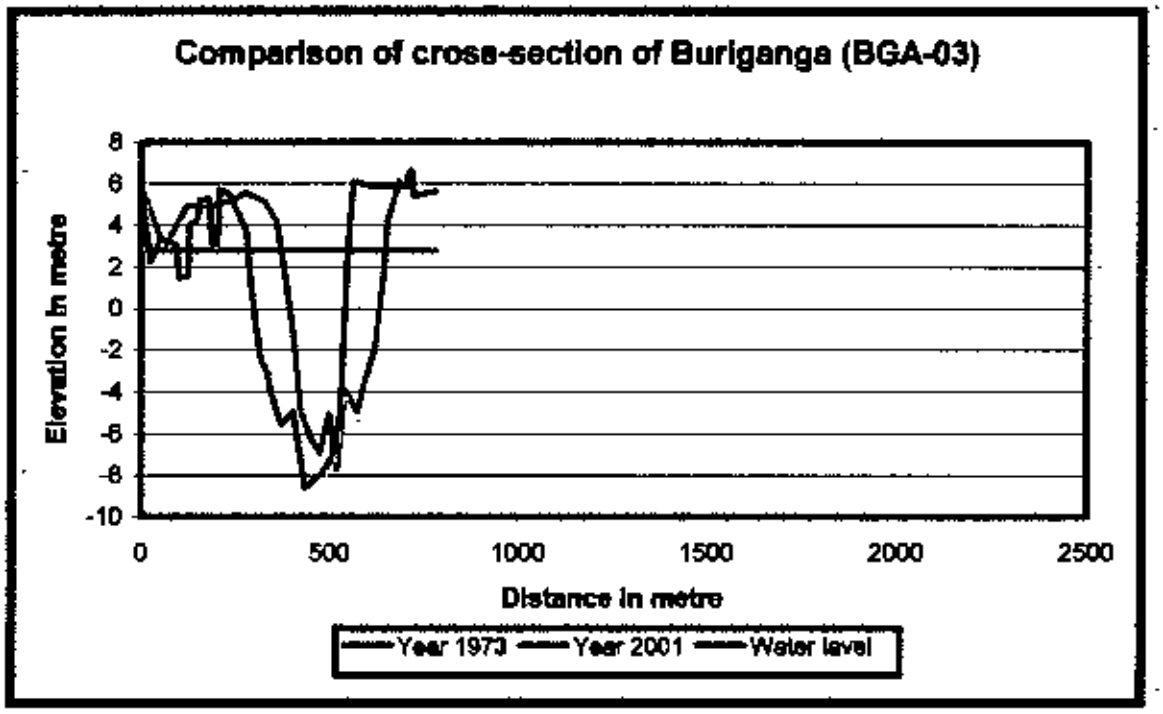


Figure 5.4: Comparison of cross-section (BGA-03) between year 1973 & 2001 of Buriganga River.

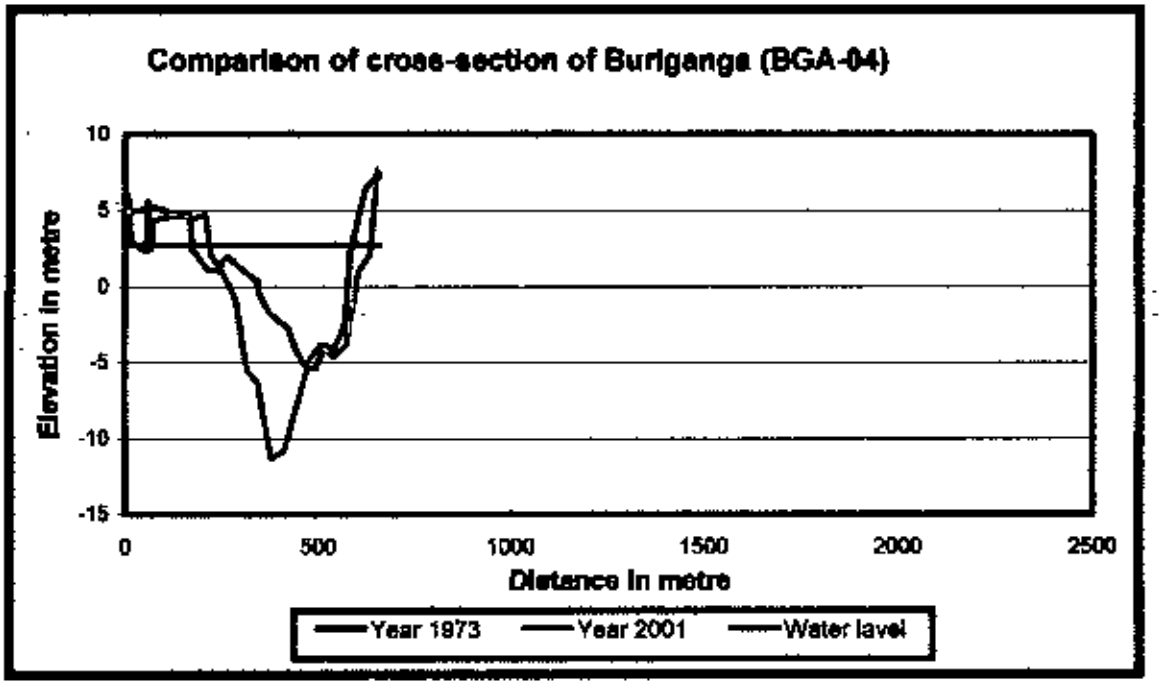


Figure 5.5: Comparison of cross-section (BGA-04) between year 1973 & 2001 of Buriganga River.

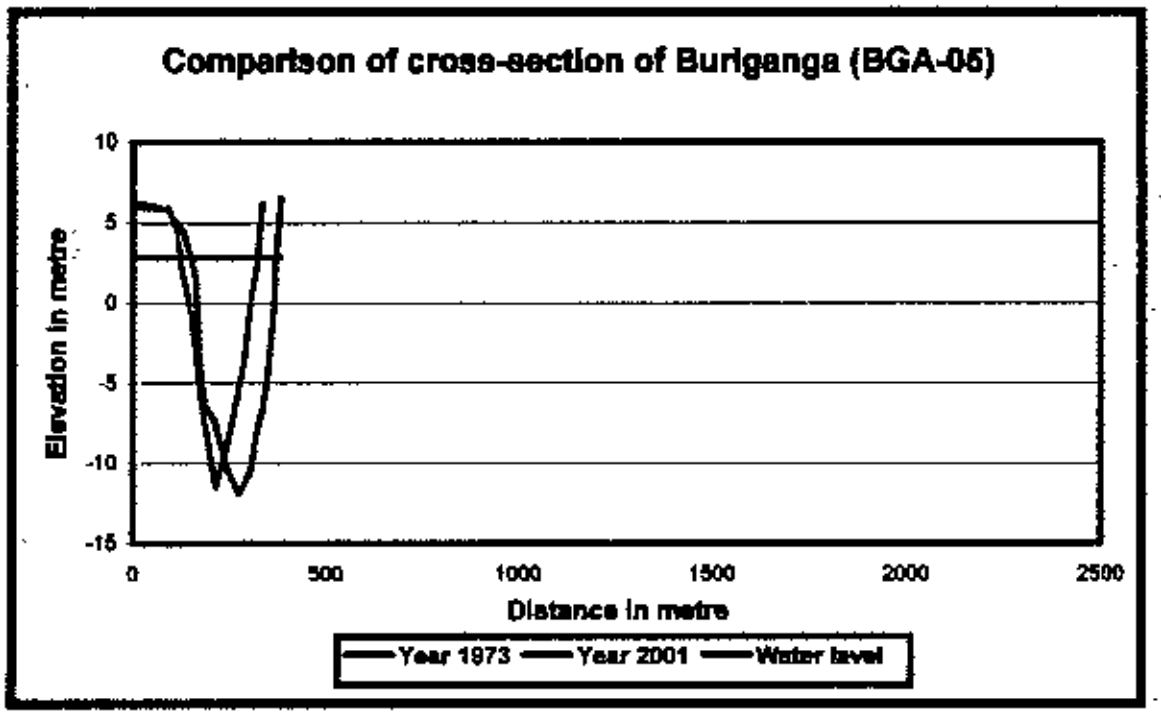


Figure 5.6: Comparison of cross-section (BGA-05) between year 1973 & 2001 of Buriganga River.

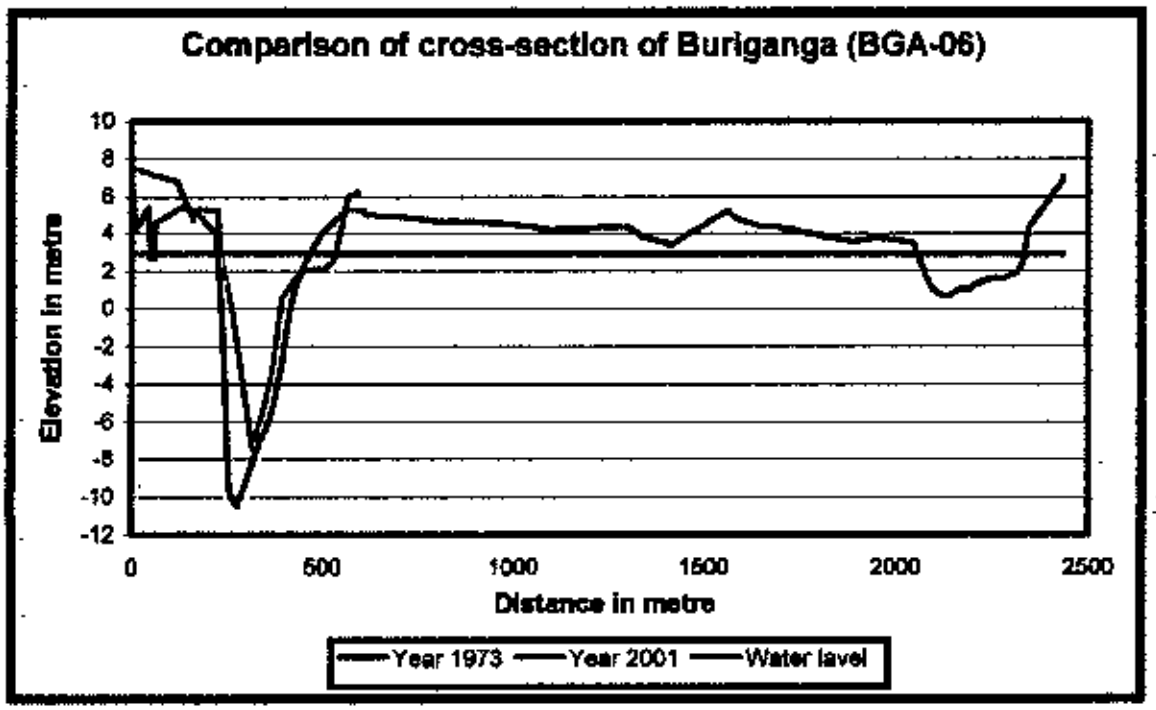


Figure 5.7: Comparison of cross-section (BGA-06) between year 1973 & 2001 of Buriganga River.

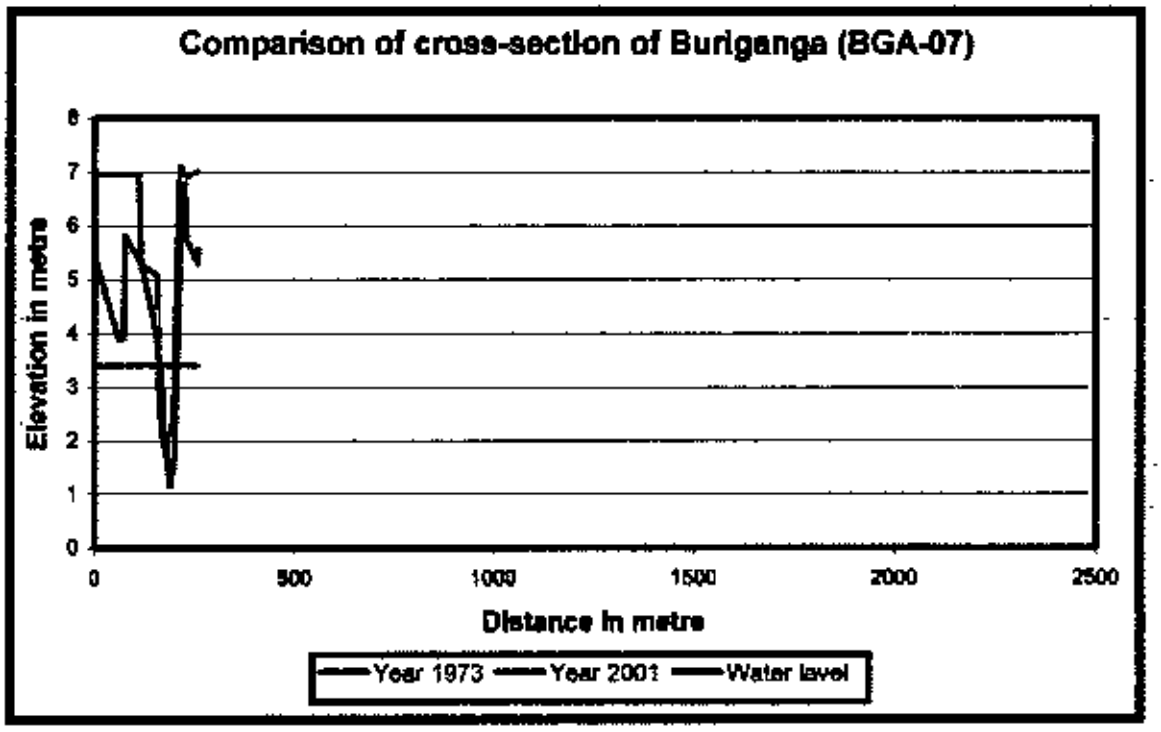


Figure 5.8: Comparison of cross-section (BGA-07) between year 1973 & 2001 of Buriganga River.

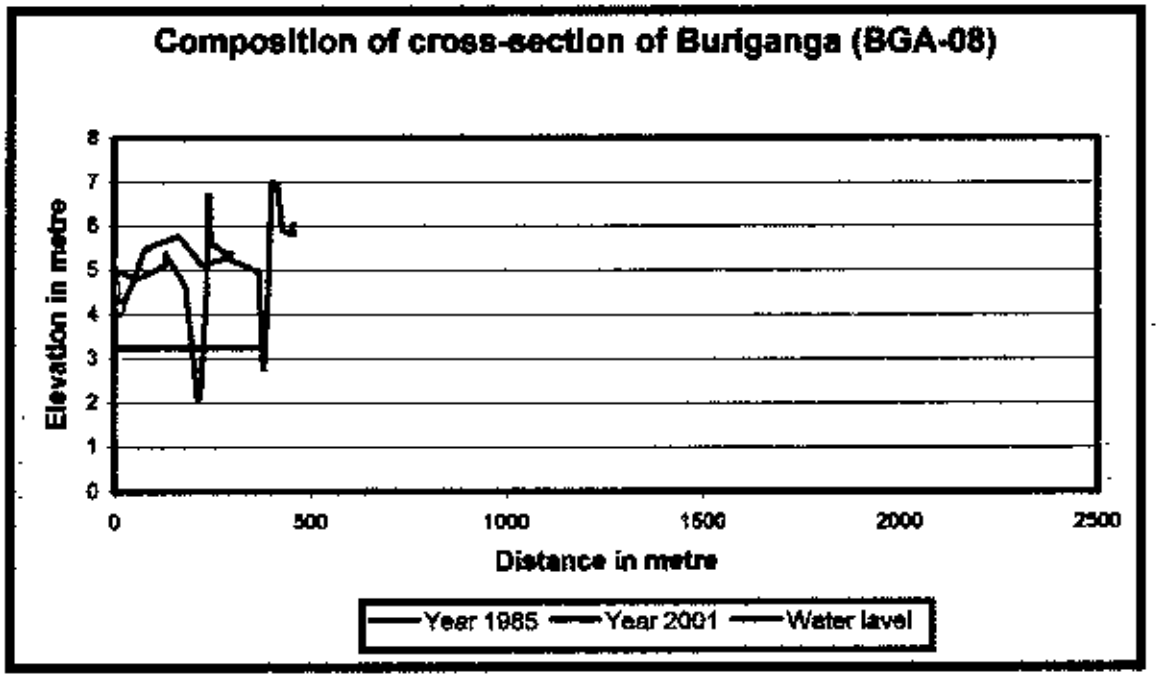


Figure 5.9: Comparison of cross-section (BGA-08) between year 1985 & 2001 of Buriganga River.

5.2.2 Comparison of Discharge

There is no discharge measuring station on the Buriganga River. So, the discharge of the Buriganga River was computed by Manning's Formula. From Table 5.2 and Figure. 5.10, it is seen that the section BGA-01,the discharge for the year 1973-74 is about 4176 m^3/s and for 2001-2002 is about 9488 m^3/s, which indicate the discharge has been increased in this section. Because of the cross-section area (Table 5.1) has been increased in this particular section.

Table 5.2: Comparison discharge data of Buriganga River for different year.

Year →	1973-74	1985-86	1995-96	2001-02
Cross-section No. ↓	Discharge (Q) m^3/s			
BGA-01	4176	2127	6790	9488
BGA-02	1946	1509	1066	702
BGA-03	1760	992	1382	1414
BGA-04	1347	2260	1765	3086
BGA-05	3147	2124	2379	1734
BGA-06	754	1241	712	677
BGA-07	9	32	15	8
BGA-08	×	0.08	4	1

From Table 5.2 and Figure 5.10, it is observed that the section BGA-04, the discharge for the year 1973-74 is about 1347 m^3/s and for 2001-2002 is about 3086 m^3/s, which indicate the discharge has increased in this section because of the area and conveyance has been increased. Otherwise, it is seen that in the sections BGA-02, BGA-03, BGA-05, BGA-06, BGA-07 and BGA-08, discharges have been decreased over the period 1973-74 to 2001-2002.

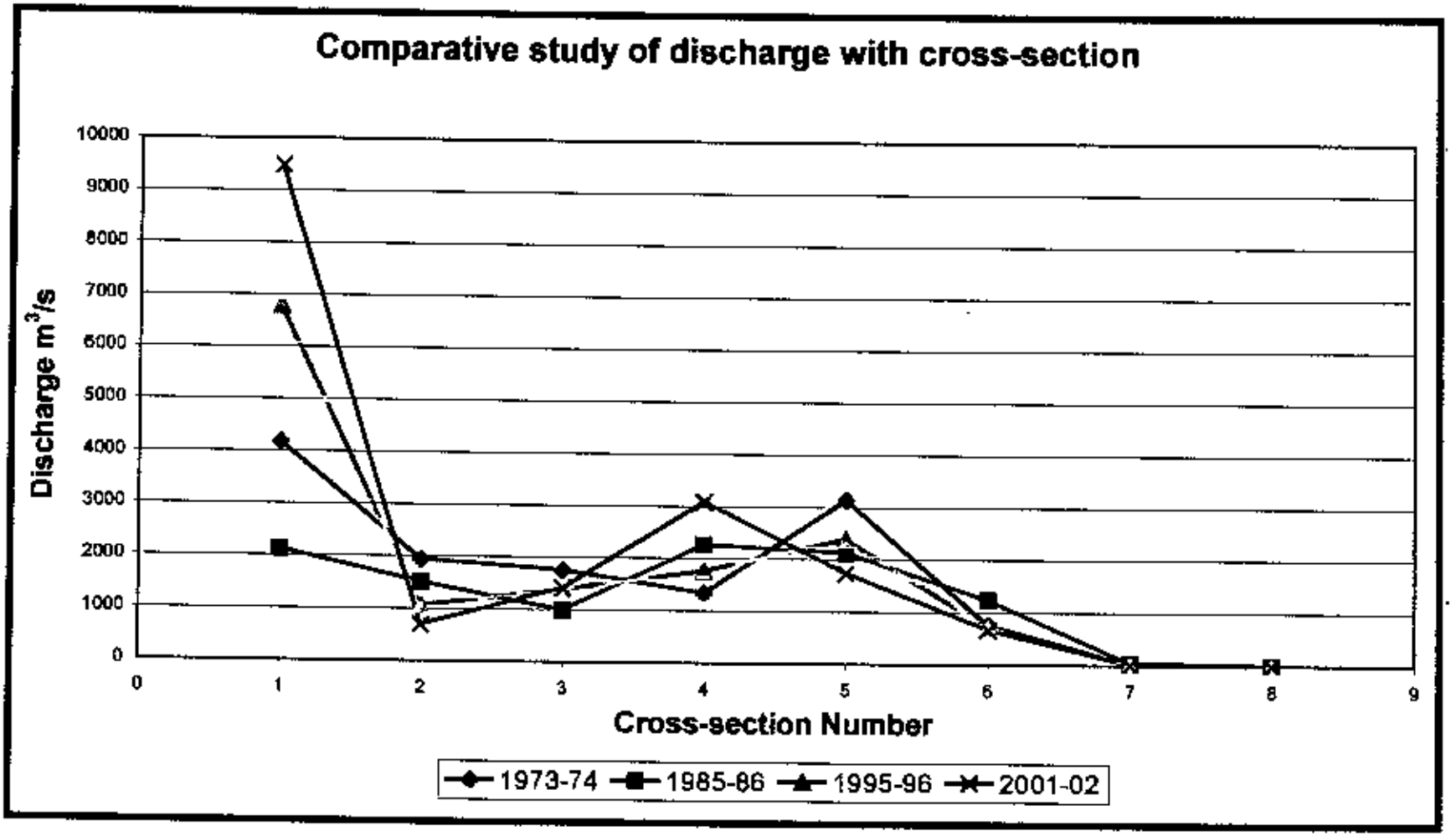


Figure 5.10: Comparative study of discharge with cross-section of Buriganga river for different year.

5.2.3 Comparison of Maximum Depth

Table 5.3: Comparison of maximum depth data of Buriganga River for the different year.

Year →	1973-74	1985-86	1995-96	2001-02
Cross-section No. ↓	Maximum depth (m)			
BGA-01	9.61	8.5	16.08	22.82
BGA-02	8.31	7.89	7.99	7.89
BGA-03	11.38	9.34	11.76	10.53
BGA-04	8.1	9.14	9.18	14.09
BGA-05	14.66	12.16	17.91	14.31
BGA-06	13.42	10.69	10.84	10.35
BGA-07	2.26	4.08	3.03	1.59
BGA-08	×	0.49	1.39	1.21

From Table 5 3 and Fig 5.11, it is observed that the biggest change in depth in the section of BGA-01 for the year 1973-74 is about 9.6 (m) and for the year 2001-2002 is about 22.82 (m), The cause of increasing the maximum depth in this particular section is dredging.

Again at section BGA-04, it is seen that the maximum depth has increased over the period from 1973-74 to 2001-2002, Because of dredging some people (land sailor) has been dredging the riverbed for filling the lowland. Another location (BGA-08: Kalmar char-Dawlia) has been increased owing to the same reason Otherwise, at section BGA-02, BGA-03, BGA-06, BGA-07, it is observed that the maximum depth has decreased. The reason may be man made.

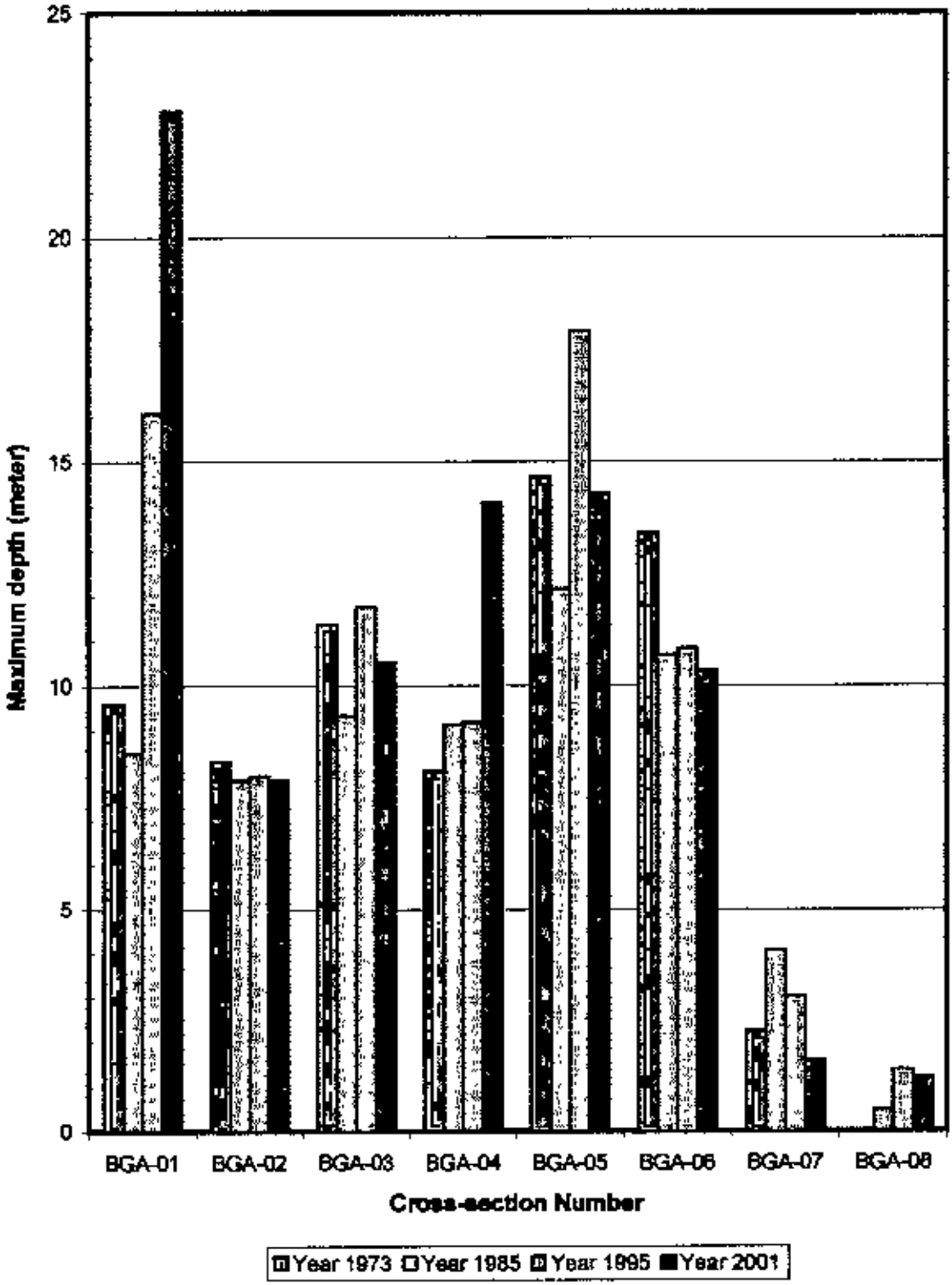


Figure 5. 11: Comparative study of maximum depth with cross-section of Buriganga River for different year.

5.2.4 Comparison of Water width

Table 5.4: Comparison of water width of Buriganga River.

Year →	1973-74	1985-86	1995-96	2001-02
Cross-section No. ↓	Water width (m)			
BGA-01	1059	1144	1461	1214
BGA-02	632	675	663	268
BGA-03	308	425	302	268
BGA-04	442	452	424	420
BGA-05	217	221	208	202
BGA-06	486	309	316	296
BGA-07	41	46	36	37
BGA-08	×	9.15	29	28

From Fig.5.12 and Table 5.4, it is observed that the water width of BGA-01 has been increased in the year 2001-2002 in comparison of 1973-74 in account of human intervention like unplanned dredging and erosion of riverbank

Otherwise, the effective charges have been occurred at BGA-02 and BGA-06. The water width of BGA-02 for the year 1973-1974 and 2001-2002 is 632 m and 268m respectively. Again at section BGA-06, it is seen that the water width has decreased over the period 1973-1974 (486m) to 2001-02 (296 m). Due to the commercial increment of land values, vested quarters both from government as well as the privet sectors are in unleashing attitude to grab the riverside land in a systemic and continuous way to create new plots. Only the section BGA-08, it is observed that the water width has been increased due to riverbank erosion.

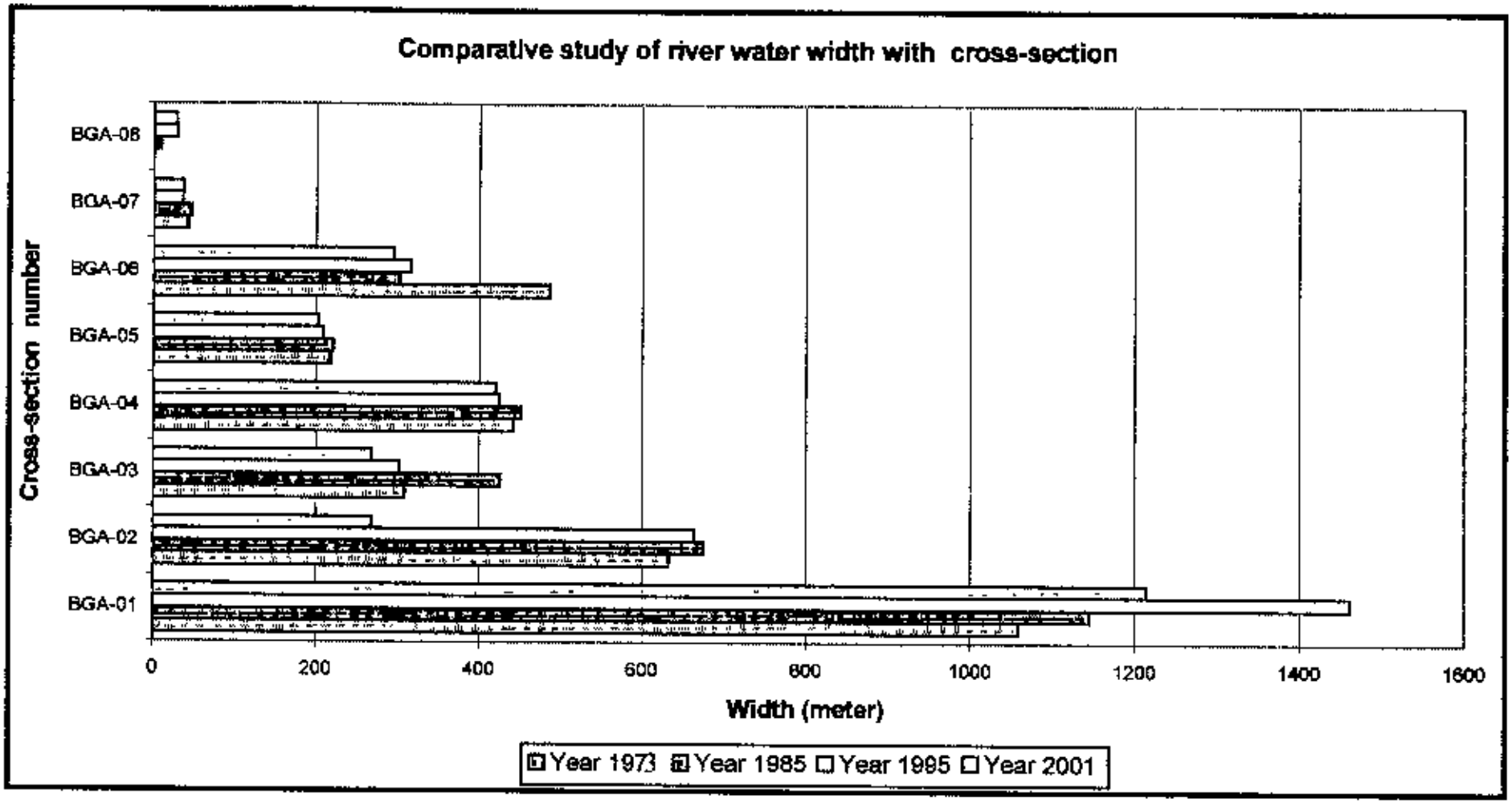


Fig. 5.12: Comparative study of river water width with different year of cross-section of Buriganga River.

5.3 Land use change of the study area

To identify the land use change of the study area, maps of different years were selected. Land characteristics & area were counted to visualize the variation of land use change. Here the land use maps of 1859 & 1996 are different from other maps. The land use area of 1859 is not comparable with other maps. The land use percentage of 1996 has been counted from image, which is not appropriate. So for comparism of the change of land use patterns, maps from the years 1984 and 2001 were considered **(Table 5.5, 5.6, 5.7 & Figure 5.13)**.

- ***Land use of 1859:***

In 1859 the major part of the study area was used as agricultural land. The area of the city was from Buriganga to Race Course There were very small residential & commercial areas at that time.

- ***Land use of 1984***

From Table 5.7, it is observed that, the highest amount of land was used as a residential purpose (44%). Huge area was used to agricultural purpose. At that time Industrial area was almost 2%. The most important characteristics of the land use of 1984 was the vacant area (10%) and swamp (10 28%) area (Figure 5.14 & Table 5.7).

- ***Land use of 1996***

Satellite image was used to identity the land use pattern for the year 1996. It is not possible to identify the appropriate land use from the image. It is observed from Table 5.6 that the amounts of residential and commercial area were the highest in the study area. It showed that the dwelling house and the population density were increased (Figure 5.15).

- ***Land use of 2001***

It is observed from Table 5.5 that 57.23% areas of study are roofed as residential and commercial area. To extend the city area, some area has manifestation as under development (9.28%) area. In 2001, the industrial area has diffused (2.26%). The lowland has decreased (9.14%). To augment with economical growth, the industrial area has expanded (Figure 5.16).

Table 5.5: Land use percentage of the year 2001.

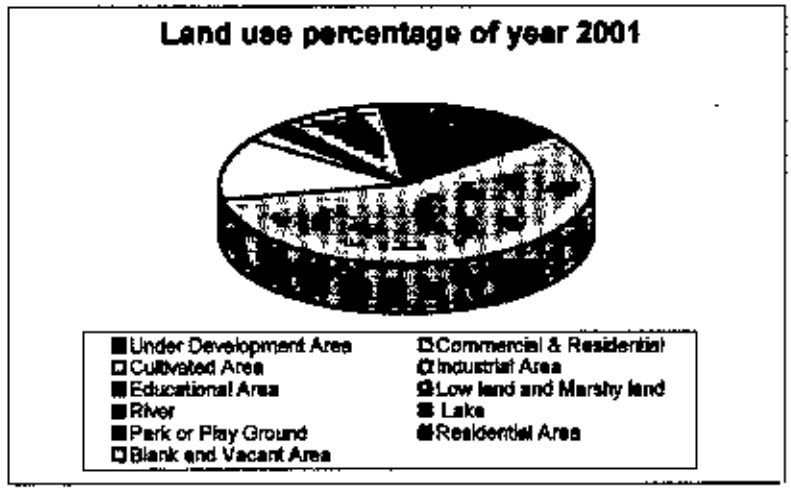
Type of Land use	Total Area (Hector)	Land use percentage (Year 2001)
Under Development Area	1312.66	9.28
Commercial and Residential Area	8099.43	57 23
Cultivated Area	1759.31	12.43
Industrial Area	320.04	2.26
Educational Area	268.00	1.89
Low land and Marshy land	1292 99	9.14
River	549.84	3.89
Lake	170.39	1.20
Park and Play Ground	378.51	2.67
Residential Area	×	×
Blank and Vacant Area	×	×
Total	14151.2	100

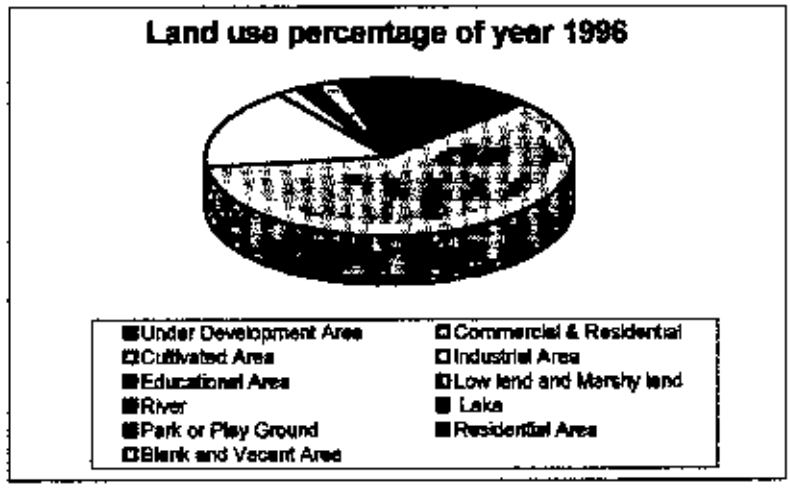
Table 5.6: Land use percentage of the year 1996.

Type of Land use	Total Area (Hector)	Land use percentage (Year 1996)
Under Development Area	1460.07	10.32
Commercial and Residential Area	8477.78	59.91
Cultivated Area	2349.93	16.60
Industrial Area	302.71	2.14
Educational Area	208 25	1.47
Low land and Marshy land	335.53	2.37
River	403.41	2.85
Lake	128.06	0 90
Park and Playground	485.48	3.43
Residential Area	×	×
Blank and Vacant Area	×	×
Total	14151.22	100

Table 5.7: Land use percentage of the year 1984.

Type of Land use	Total Area (Hector)	Land use percentage (Year 1984)
Under Development Area	×	×
Commercial and Residential Area	1207.07	8.53
Cultivated Area	3402.09	24.04
Industrial Area	278.67	1.97
Educational Area	219.84	1.55
Low land and Marshy land	1455.38	10.28
River	428.25	3.03
Lake	146.97	1.04
Park and Play Ground	457.72	3.23
Residential Area	5153.75	36.41
Blank and Vacant Area	1410.34	9.97
Total	14151.16	100





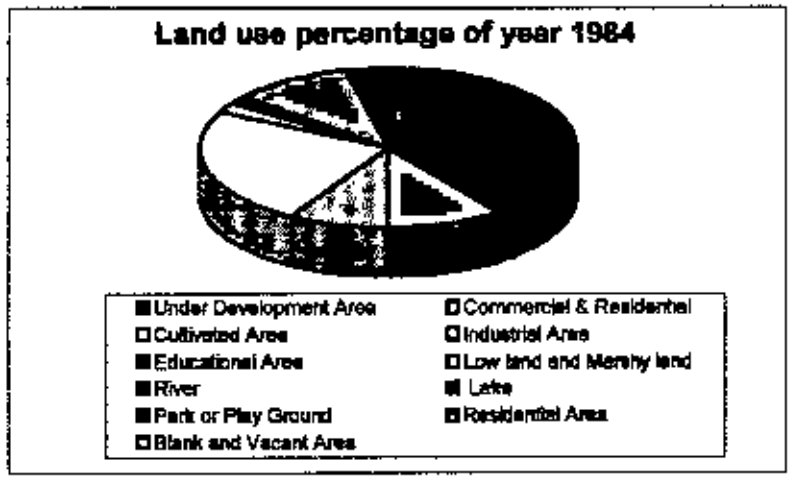
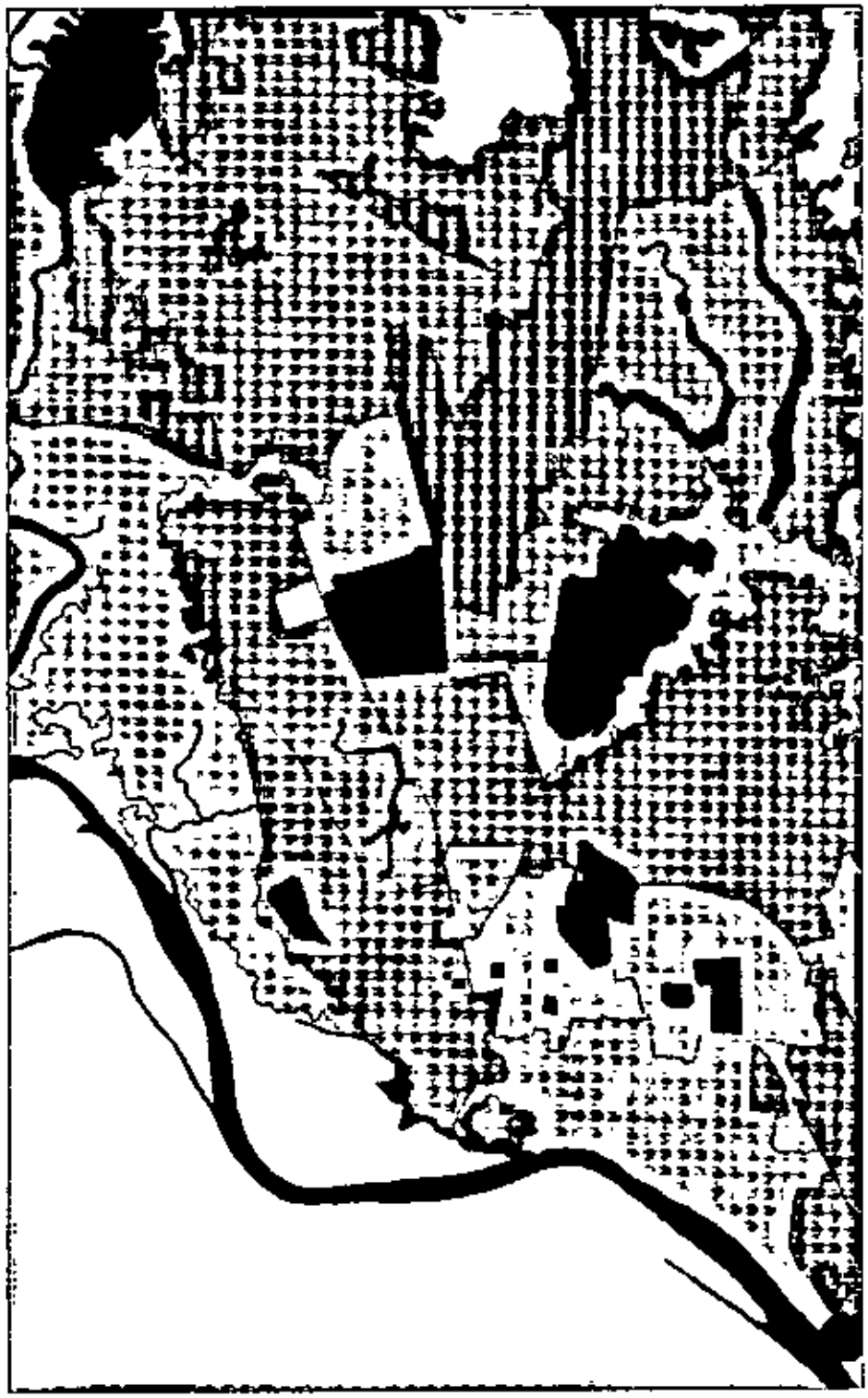


Fig. 5.13: Comparative study of land use change between 2001, 1997 & 1986.



Legend
Bank or Vacant Area
Commercial & Residential Area
Cultivated Area
Educational Area
Industrial Area
Low land or Marshy land
Park or Play Ground
Residential Area
River or Lack

1 0 1 Kilometers

Figure 5.14: Land use pattern of the year 1984

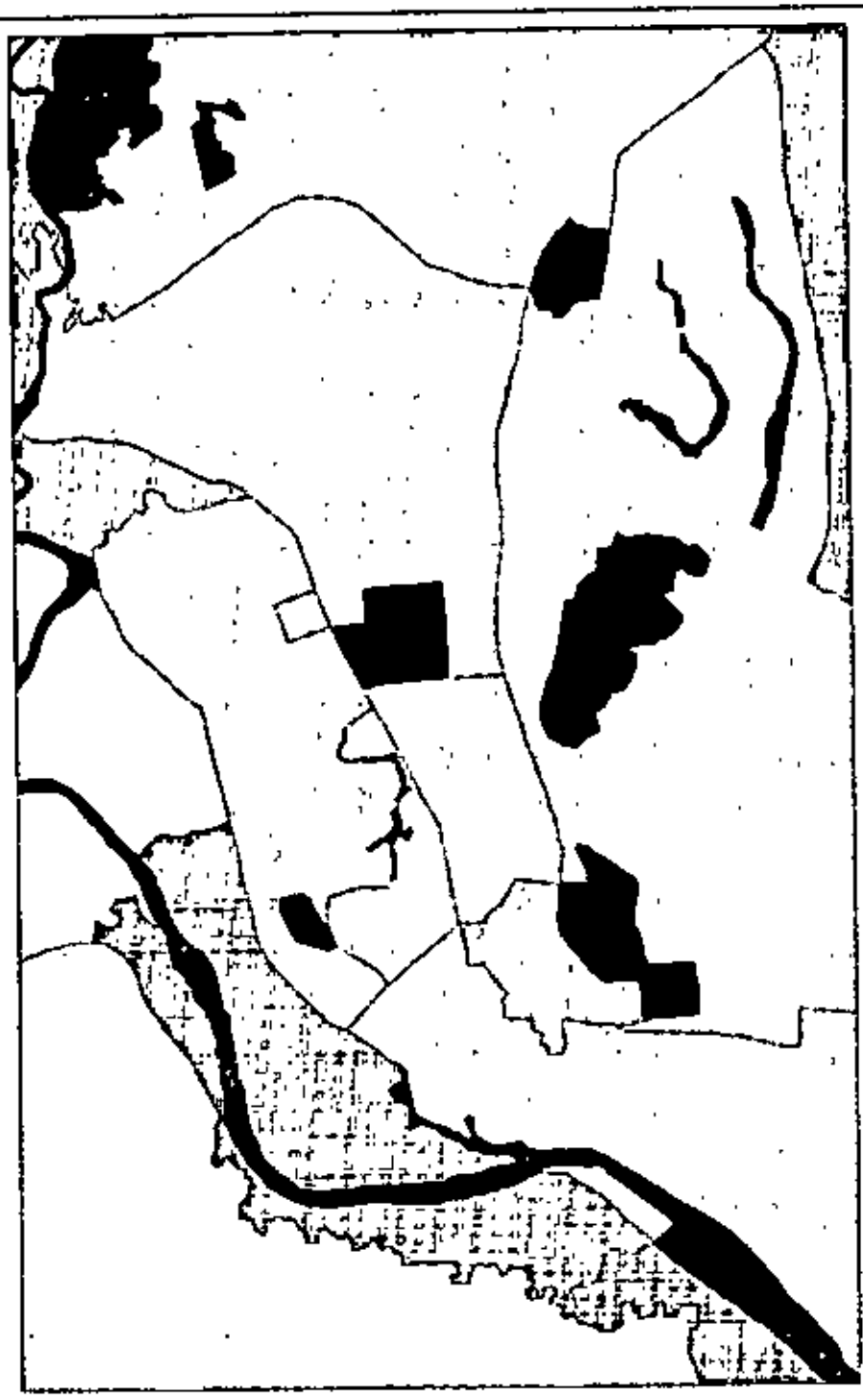


Figure 5.15: Land use pattern of the year 1996

Figure 5.16 : Land use pattern of the year 2001

5.3.1 Comparative study of land use change in 1984 &2001

Table 5.8: Comparative land use change of year 1984 and 2001.

Year 1984		Year 2001	
Land use Type	Land use (%)	Land use Type	Land use (%)
Commercial and residential	8 53	Commercial and residential	57.23
Cultivated area	24.04	Cultivated area	12.43
Industrial area	1.94	Industrial area	2.26
Educational area	1.55	Educational area	1.89
Low and marshy land	10.28	Low land	9.14
River	3.03	River	3.89
Lake	1.04	lake	1.20
Park and play ground	3.23	Park and play ground	2.67
Residential area	36.41	Underdevelopment area	9.28
Vacant area	9.97	Vacant area	0.00

It is observed from Table 5.8 that the land use has been changed mostly from 1984 to 2001. In 1984 the land use showed that many part of the study area was included as residential area (36.41%) & cultivated land was (24.04%). The table shows that 9.97% of the study area was vacant and the amount of industrial area was 1.97%. The real river area was 3.03%. In 1984 the amount of the low land and swamp was 10.28 %.

On the other hand, it is observed that in 2001 some unplanned area has build up along the riverside cultivated area, because of increase in population, which affect the river very much. The industry has comparatively increased (2.26%). The cultivated land has decreased from 24.04% to12.43%. The area of river comparatively increased because of unplanned dredging and river erosion such as Basila village (location BGA-08) and Jarjera-Dharmakonj village (BGA-01). To augment the people the low land has filled. As a result low land has been decreased from 10.28% to 9.18%, which has affected the natural sewage system (Figure 5.17).

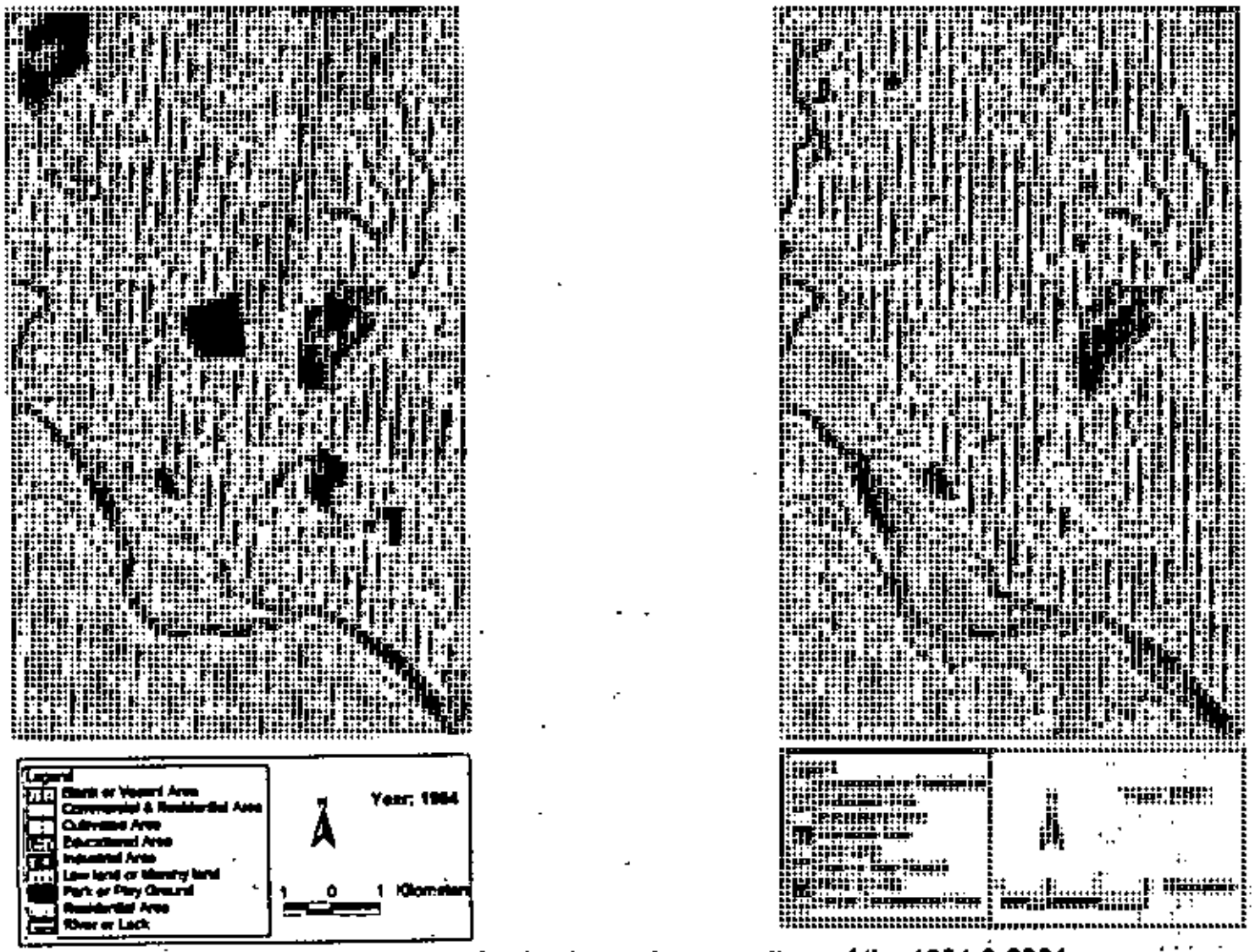


Figure 5.17: Comparetive land use change pattern of the 1984 & 2001.

5.4 Relationship between geometric characteristics and land use change

5.4.1 Focus Group discussion

People's opinion about cropping pattern

It is known from the field survey that many years ago there was cultivated land along the riverside. Many crops such as Aman, Irri, wheat, Dal, Nut, Til etc were grown in Kharif and Rabi season. But at present factory, commercial & residential area, etc. have been building because of population pressure. According to local people's view, cropping season has changed.

In the Kharif-I season, no crop is cultivated at present. But 20 year ago, Aush Dhan and chili were cultivated.

For the Rabi season, Eri, Wheat, Dal, Nut etc were cultivated before. Now a days the maximum land remains fallow and a little bit of wheat are grown in the right side (Pagla, Keranigonj) of the river.

Table 5. 9 Changing pattern of crop for land use change

Crop season	FGD opinion			Cause of crop season change
	0-10 Year*	10-20 Year**	20+	
Kharif-I	×	×	Aman	Land use change causes environmental degradation. Cutting of the top layer of the soil for brickfield, smoke of Brickfield, housing Business, water & Air pollution.
Kharif-II	×	×	Aman	
Rabi Season	Vacant-land, Wheat	Irri, Mustard seed	Irri, Wheat, Dal, Til	

Source: FGD.
* 0-10 Year Behind 10 year of the year 2004.
** 10-20 Year . Behind 10 year of the year 1994

Changing pattern of land use

The local people said that the maximum land of the riverside was agricultural land and other was basically settlement. At present, there is little vacant land and other lands are used for factory, godown, and settlement purpose. River is also used for settlement & Factory purpose. There are many brickfields in the riverbank. Government has already taken the decision to remove the brickfield from the riverside to prevent the air pollution. The smoke of brickfield destroys the growth & production of crop.

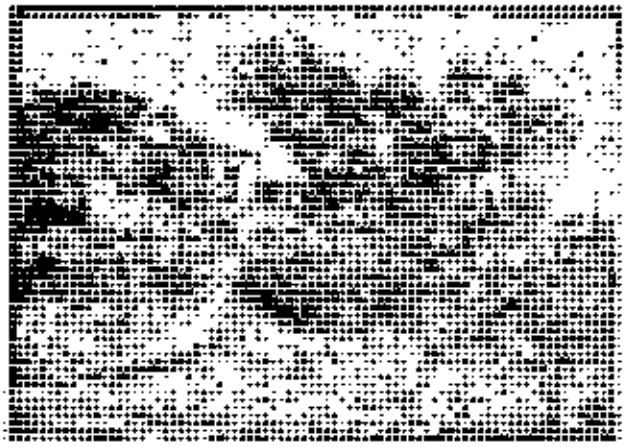


Photo 5.2 Developing area along the Buriganga river.

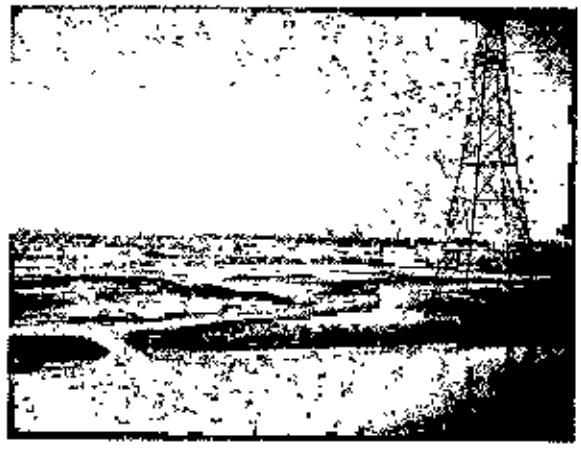


Photo 5.3 Real state company has encroached river side land which is now covered with Buriganga sand.

Some real-estate companies have bought the riverside land which is presently used as a developing area (Photo 5.2). As a result, local people have obliged to displace and farmers have changed their occupation because of pollution of water (Photo 5.3).

Changing pattern of the ecological resource

During the dry season, in the section of BGA-06, BGA-07 and BGA-08 there is no fish due to pollution of river water.

Changing pattern of the river geometry

BGA-01 (location: Jajera-Dharmagonj)

In the section BGA-01, people said that the depth of the river has increased, because of unplanned dredging

BGA-02 (location: Pangaon-Fatullah)

The depth has been decreased due to sedimentation, sewage disposal and other solid waste. Brickfield & enchroachment is another cause to decrease the depth, width.

BGA-03 (location: Hazaribag- Dhaka Match Factory)

People said that the riverbank has been eroded because of unplanned dredging

BGA-04 (location: Mirarbag-Faridabad)

The depth has been increased because of dredging In this section, people have been dredging the riverbed to fill up the low land along the riverside.

BGA-05 (location: Jinkira Bazer-Midfort Hospital)

The maximum depth and water with remains same to this section. This area has fixed up before long time.

BGA-06 (location: Brahman kitta-kamrangirchar)

The major change has occurred in this section. Local people said that Government has not

Photo 5.4: Picture of Lalbag fort along the Buriganga river (Year 1816).

Photo 5.5: "Presently Lalbag fort is situated Buriganga river (Year 1816) far from half kilometer from the bank of the Buriganga (Year2004).

taken any protection of the river in this section; the thana of Lalbag and Kamrangirchar will be joined in the future (Photo 5.4 & 5.5). Enchroachment is higher in this location compared to other section (Photo 5.6).

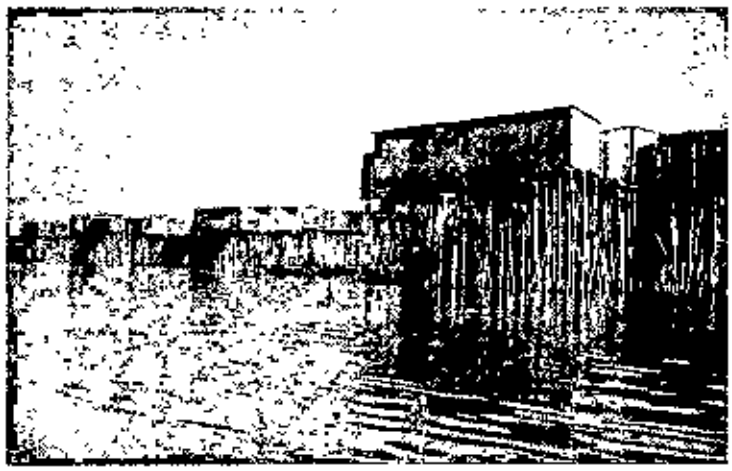


Photo 5.6: Enchroachment of the Buriganga River at Khamrangir char.

BGA-07 (location: Ghatarchar-Pachandana)

The depth of the river has decreased. People said that the riverbed is filled by the polythen and other solid & liquid waste.

BGA-08 (location: Kalmarchar- Dawlia)

In this section the riverbank has eroded due to unplanned dredging. Example: Basila village.

A fisherman's experience

Shaheb Ali (Age: 70) who is a boatman of village Aaintha in Kamrangirchar thana. He said that, a char is situated in front of Dhaleswari at the entrance of Jamuna River. That's why flow of the Buriganga is low. He also said the river bed has been field up by sedimentation during the flood season (Fig. 5.18).

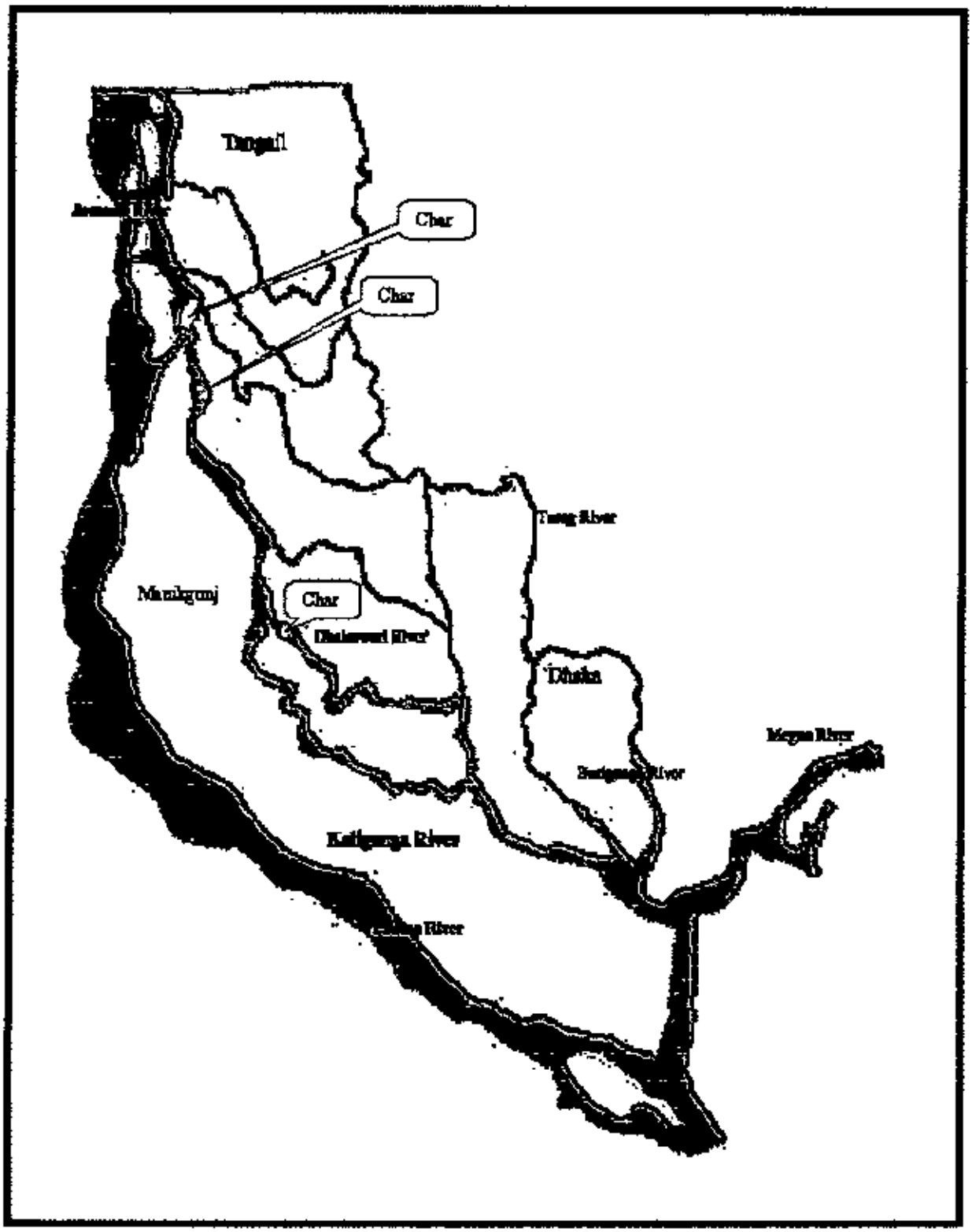


Figure 5.18: The char at the mouth of Dhaleswari to obstruct the flow of Buriganga River.
(Source: Graphoman's New Atlas, 1995)

5.4.2 Changes in Land use pattern

It has been observed that in 1984 agricultural activities were concentrated in a large area along the riverside. In comparisn to the commercial area the extent of residential area was also larger. The extent of industrial area was not significant. The land type along the riverside was basically low laying land.

The land use pattern of 2001 has shown a significant increase of unplanned development of industrial area along the riverside and the trend continues to date. The liquid & hard wastes of residential, commercial & industrial area are falling down in the Buriganga River through the Dholai Khal. Development of commercial and industrial area along the riverside is directly linked with the gradual decrease of cross-sectional area the only exception is that the cross-section area of BGA-01 & BGA-04 has increased Human intervention like dredging and natural cause like bank erosion is responsible for this. River pollution has also been increased because of the change of land use The unplanned urbanization is liable for decreased the water width of the Buriganga River.

5.4.3 Suggested Land Use Pattern

Land use pattern is suggested on the basis of social, economic and environmental point of view

Social consideration:

A land use pattern needs to be socially acceptable. Local people suggested avoiding the housing business. Because it makes the local people to shift to another place and it has been changing the occupation of the farmers. To remove the enchroachment, it is necessary to monitor the shoreline of the river regularly and apply the environmental & social rules and regulations where applicable.

Economic consideration

The pattern of land use needs to be economically attractive. People suggested that it is necessary to fix up the bank of the river, need plantation and others facilities such as public toilet, walking place, foods shop, fish catches place etc. Industry also should be shifted far from the river. It might help the river bank from enchroachment It is also necessary to improve the water quality to make the river as a tourist site. Re-excavation of the link canals will lessen the magnitude of flood. Changing the pattern of land use in this direction will increase the economic value of the land along the riverside.

Environmental consideration

Buriganga needs a proper environmental management program. Hazaribag tannery and the Dholai Khal out fall are the two major sources of pollution of the Buriganga river

Photo 5.7: Dholai khal out fall contains sewage and polluted water.

Water (Photo 5.7). Government has already taken the decision to remove the Tannery in the industrial complex under construction in Savar. The complex has also the provision of a plant for proper treatment of the effluents. DOE should monitor and ensure early removal of the tannery. As the other source of Dholai Khal outfall contains sewage, the outfall should be closed and the wastes be diverted by existing pumping system to the Pagla sewage treatment plant through construction of required pipelines. It would also improve living health and reduce water borne diseases. Tree plantation should be along the riverside and roadside to improve environmental condition.

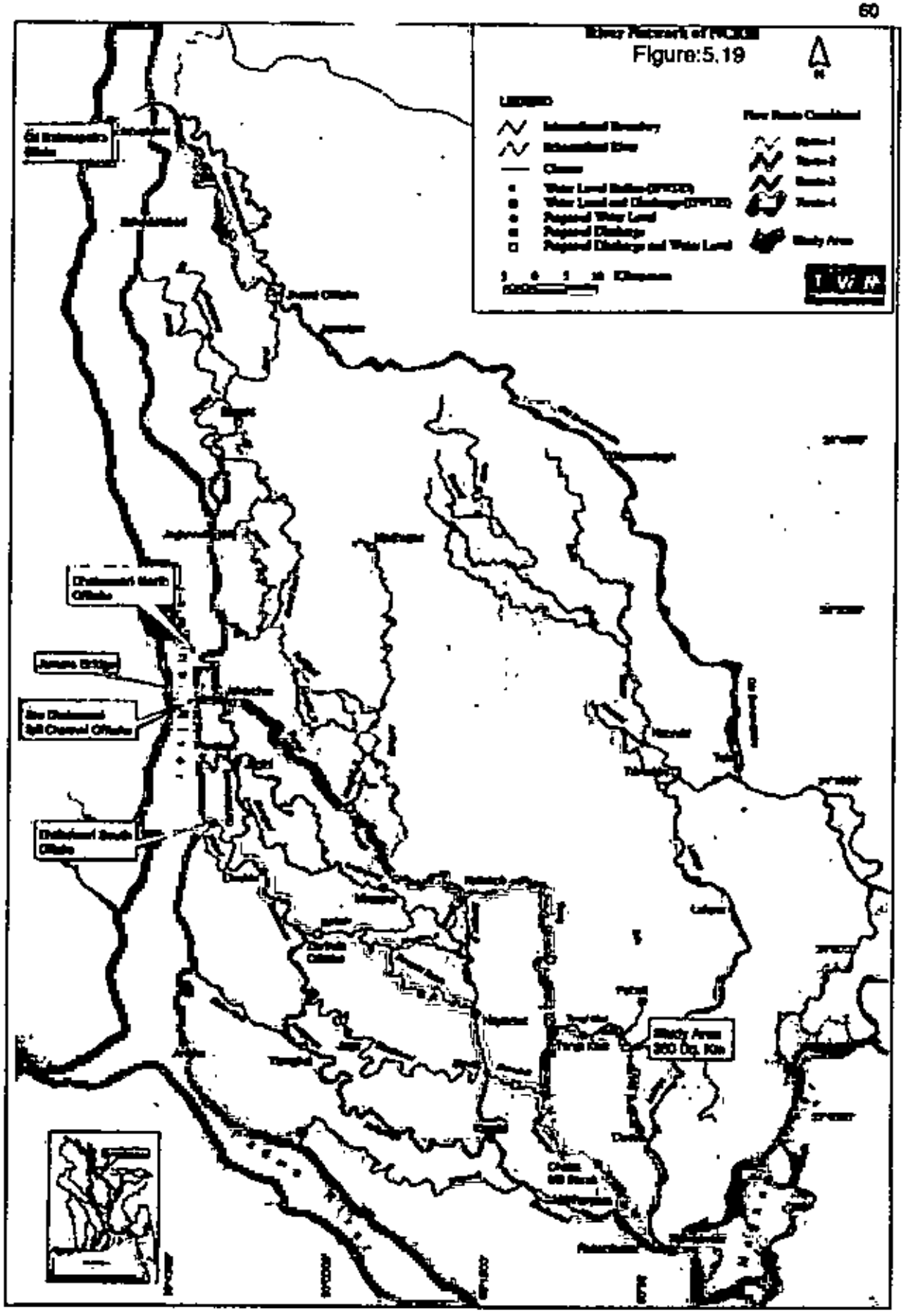


Figure:5.19
Study Area
360 Sq. Km

Finally IWM has selected New Dhaleswari offtake of Pungli-Bangshi-Turag-Buriganga route (Figure 5.20). This route will be 163 kilometer long and 610-core taka will be necessary for execution of this project. It requires a dredging of approximately one and half billion cubic feet of soils to complete this project. (The Daily Ittefaq, 2006)

5.6 Taking care of Buriganga

" Taking care of" the Buriganga River may require river Stewardship, River management, River restoration, waste management plan, or a combination of all four. These four terms-stewardship, River management, River restoration, and waste management plan are related but not interchangeable (Habib and Zahir, 2002)

5.6.1 River Stewardship: An Attitude

River stewardship really is an attitude It is the first important step in protecting a river. Stewardship reflects an understanding that what we do on land and in the water affects the river.

Stewardship centers on thoughtful consideration of the intricate river ecosystem and the interdependence between the river and its surrounding watershed. It takes into account the need to better balance our lives and lifestyles with the needs of our river.

It short, it is the recognition that rivers are vulnerable that in order to make thrive we both individually and collectively, must assume responsibility for this care.

5.6.2 River Management: A process

River management is a process and the second major step in river protection. It reflects a willingness to study a river to assess its status and its needs and to determine how best to maximize its potential as a thriving ecusystem.

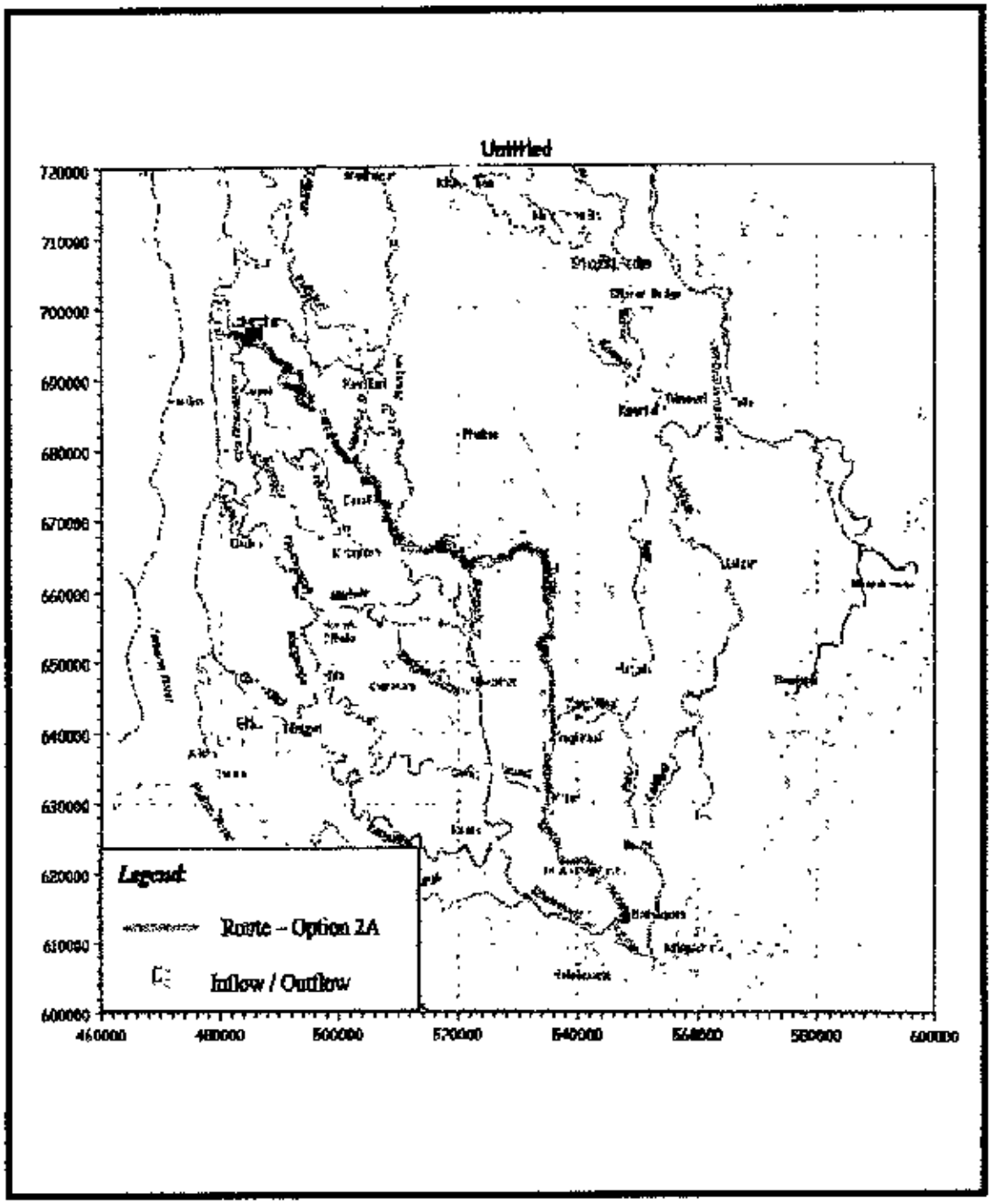


Figure 5.20: The selected option route of the river system of model.

River management can be as simple as encouraging the practices of stewardship among river home owners and other interested individuals (Drainage system, sewage Disposal, sanitation, solid & liquid waste of industry and residential) or it can include taking an active role in altering certain ecological relationships with in the river Buriganga and its watershed to make the river healthy and keep it healthy. River management can also include protecting the healthy of a river ecosystem through a plan of preventive action.

River Management, to be effective, requires the coordinated efforts of a group of individuals in the form of a river association, conservation club (BAPA, Geographical society etc.) or some other organization.

Two Philosophies of River Management:

River management approaches can be divided into two categories. One is the " quick-fix" approach. The other is long-term environmental management.

The " Quick-Fix" Approach

The "quick-fix" in river management is a short-term "solution" such as the application of aquatic herbicides to quietly kill unwanted algae Such chemical applications can go on year after year, becoming increasingly less effective if the underlying causes of the algal growth are ignored.

The " quick fix" treats the biological symptoms of a river problem, but plant and fish productivity are directly dependent on the chemical and physical processes going on in and around the river as well. These underlying factors must be the principle consideration in any plan to change the biology of a river. The quick fix approach need planned dredging for every year for Buriganga.

Long-term river management

Long-term river management considers all of the environmental, cultural, and biological factors affecting the river and sets a higher priority on finding lasting solutions than on

pursuing quick, cosmetic treatment of symptoms, Buriganga needs a high quality, financially efficient environmental project that takes time and begins with long range planning. Immediate in river rehabilitation techniques are necessary for Buriganga. The community will need to be sure that such immediate rehabilitation efforts are followed by appropriate long term management techniques. Such as Buriganga River augmentation, Sewage & industrial waste management.

Otherwise, preventive action should be the first priority of Buriganga River because Buriganga River is a valuable economical and recreational asset, so the primary objective should be to prevent further deterioration. Buriganga river deterioration can be prevented by managing the watershed and by protecting the shoreline.

5.6.3 River Restoration: Corrective Action

River restoration is an action directed toward a river to "make it better". It is one example of a river management technique. The complexity and expense of this activity requires an organization with some authority over the river and its watershed.

- ***River Restoration: What can be done?***

River restoration includes both "In river treatment techniques" and "Watershed Techniques" for the purpose of "restoring" a river. It is critical to remember, through that the watershed is usually the key to helping river recover its long-range vitality.

From analysis it is observed that, Buriganga River needs both " In river treatment techniques" and " watershed Techniques".

"In river treatment techniques"

- All illegal allocation, filling activity and enchroachment activity should be ceased and monitoring with immediate effect in the light of the directions given by the honorable Prime Minister on 19.06.2002.

- Continuity and connectivity of the remaining city Khal to the Buriganga River should be ensured as crucial goal for a sustainable development program.

Watershed Techniques

- Ensuring public participation at study of Buriganga-Lakya-Turag-Balu river system, design, implementation & maintenance stage as to corroborate sustainable Buriganga protection and development program. It helps to protect the watershed of Buriganga.

- To restoration the Buriganga River another watershed technique is "community base restoration and awareness the local people". For this purpose, Buriganga needs under the supervision of Environment/ public works/ LGRD Ministry, concerned government ministries (ie. WASA, BWDB, BIWTA etc) and the " civic Foram" should be associated in such program as to achieve a comprehensive planning & implementation for the watershed of Buriganga through "Watershed of Buriganga associations".

- To protect the Buriganga watershed flow and depth of Buriganga. It is necessary to dredging or cut the char that is situated at the mouth/ entrance point of Dhaleswari from Jamuna River. These type of program helps to improve the flow of the Dhaleswari-Buriganga-SitoLakhya-Turag-Balu river system. It also helps to stem the flow of nutrients and the fish culture of the river of Buriganga.

Chapter Six

Conclusion & Recommendation

Chapter Six

Conclusions & Recommendations

6.1 Conclusion

Average water level data at different sections over the years 1973-74 and 2001-2002 show that cross-sectional area at Jajera –Dharmagonj , Mirerbag –Faridabad and Kalmarchar-Dawlia (near the village of Basila) of the river Buriganga has increased for the year 2001-2002 in comparison to 1973-1974 period as a result of dredging. While cross-sectional area at Keranigonj- kamrangir char, Hazaribag-Pagla, Jingira bazaar-Midfort Hoapital and Ghatar char- Pachandana has decreased for the year 2001-2002 in comparison to that of 1973-1974 due to gradual sedimentation and disposal of sewage, solid and liquid wastes in Buriganga river. Discharge data shows that discharge in location Jajera-Dhermagonj, Mererbag-Faridabad part of the river Buriganga in the year 2001-2002 has decreased than that of the year 1973-1974, while maximum depth in the cross-section of the same area has increased significantly as a result of dredging. On the other hand, water width of river section at various section during the same period shows that it has increased in 2001-2002 at Jajera-Bhermgonj and Kalmar char-Dawlia section of the river caused by river bank erosion than that of 1973-1974.The maximum depth, water width and discharge at the location of Kalmar char - Dawlia has increased because of unplanned dredging, other human intervention and river erosion.

The land use has been changed mostly from 1984 to 2002. In 1984 agricultural activities were concentrated in a large area along the riverside. The extent of industrial area was not significant. The land type along the riverside was basically low land. The land use pattern of 2001 has shown a significant increase of unplanned development of industrial area along the riverside and the trend continues to date. Every kind of wastes of residential, commercial & industrial areas are falling down in the Buriganga River through the Dholai Khal which is directly linked with the gradual decrease of cross-sectional area and maximum depth. The only exception is that at the sections of Jajera-Dhermagonj, Mererbag-Faridabad &

Kalmar char – Dawlia, that have increased due to dredging and natural cause like bank erosion. The unplanned urbanization is liable for the decreased water width of the Buriganga River.

6.2 Recommendation

Based on the above findings of the study the following recommendations are made.

- To improve the environmental and the socio-economic conditions of the people of the study area re-excavating the khals and canals should be initiated.
- Although Government of Bangladesh has banned use of polythene, it has been found during the field visit that thousands of polythene bags were gathered in the bed of the river. Restriction on the use of polythene should be forced properly.
- All illegal houses along the riverside should be removed, following the rules and regulations, which were established by the "Bangladesh environment conservation law".
- Effective urban planning and land use regulation is required to maintain the river.
- Proper waste treatment plant should be established for the industries and effective Industrial zoning and land use control should be adopted to mitigate the water pollution in the Buriganga River.
- For the pollution of the Buriganga rive, fishing area as well as fish production are decreasing in the region. So, to fulfill the fish demand in the locality and for the country as a whole, unused canal, which is connected to the river of the study area region are snggested to be re-excavated and reformed where fish culture is suggested to be carried out.
- To ensure sustainable development of the study area, people, participation should be ensured during any kind of design, implementation and maintenance study.

- To restore the Buriganga river, community based restoration and awareness of the local people is necessary.
- Shoreline protection and management program is necessary for river restoration.
- To augment the Buriganga River, Government should take necessary attempt.
- Augmentation of Buriganga is important for the river geometry. The proposed augmentation project of BWDB should be supportable immediately.

6.3 Recommendation For The Future Study

The study dealt with the effect of land use change on geometric characteristics of the Buriganga river with a view to identify the possible mitigation measures. Although, a methodology for assessing impact has been adopted in this study, there is still ample opportunity to develop it further. In the present study only some selected sections were considered which was not enough to visualize clearly the geometric changes. In future studies larger number of sections should be considered. Industrial development zone, waste management program, mapping of important khal and canal areas etc. can be incorporated in future research.

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SPARRSO (1984), Land use map of 1984.

SOB(2001), land use map 2001

The Daily Ittefaq, (2003), 30th September

The Daily Ittefaq, (2004), 9th January

The Daily Ittefaq, (2004), 01st March

Appendix-A

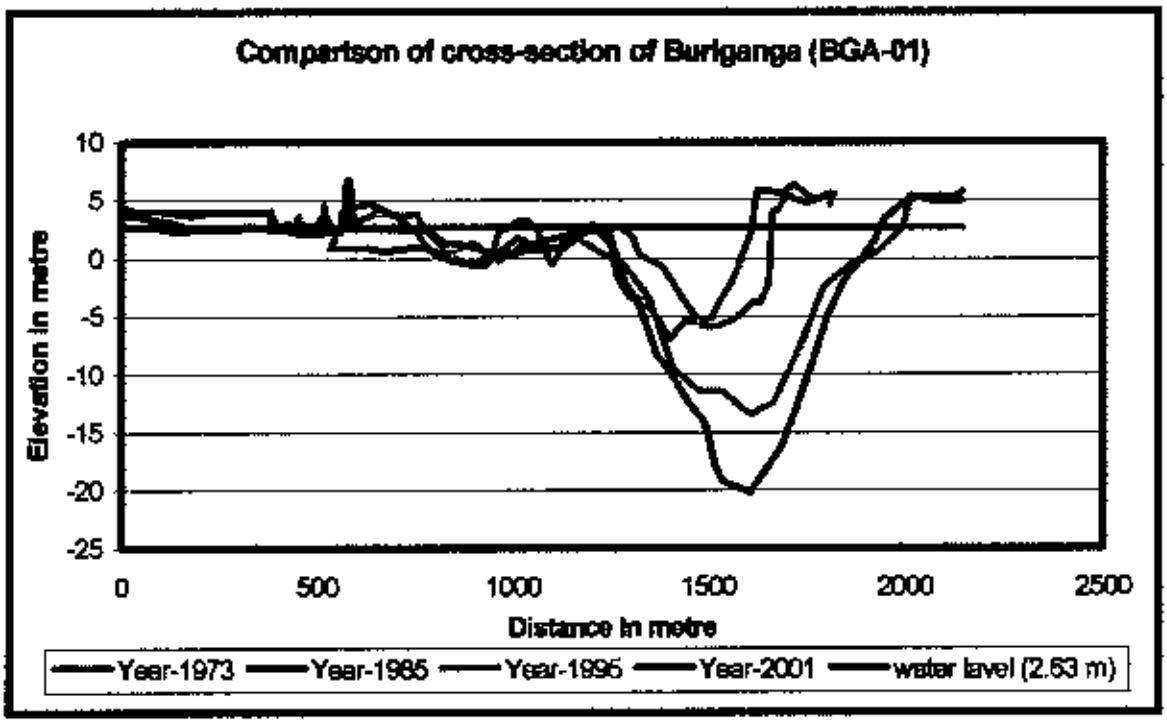

Fig. A.1: Comparison of cross-section (BGA-01) of river Buriganga for different year.

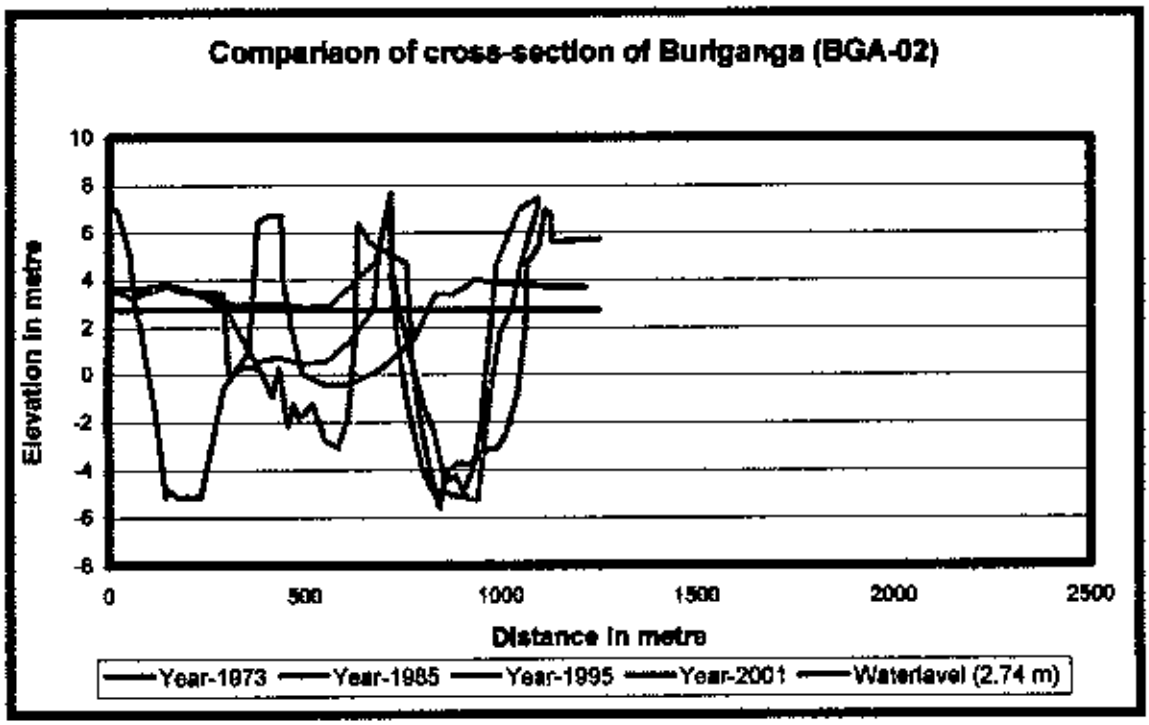

Fig. A.2: Compariaon of cross-section (BGA-02) of river Buriganga for different year.

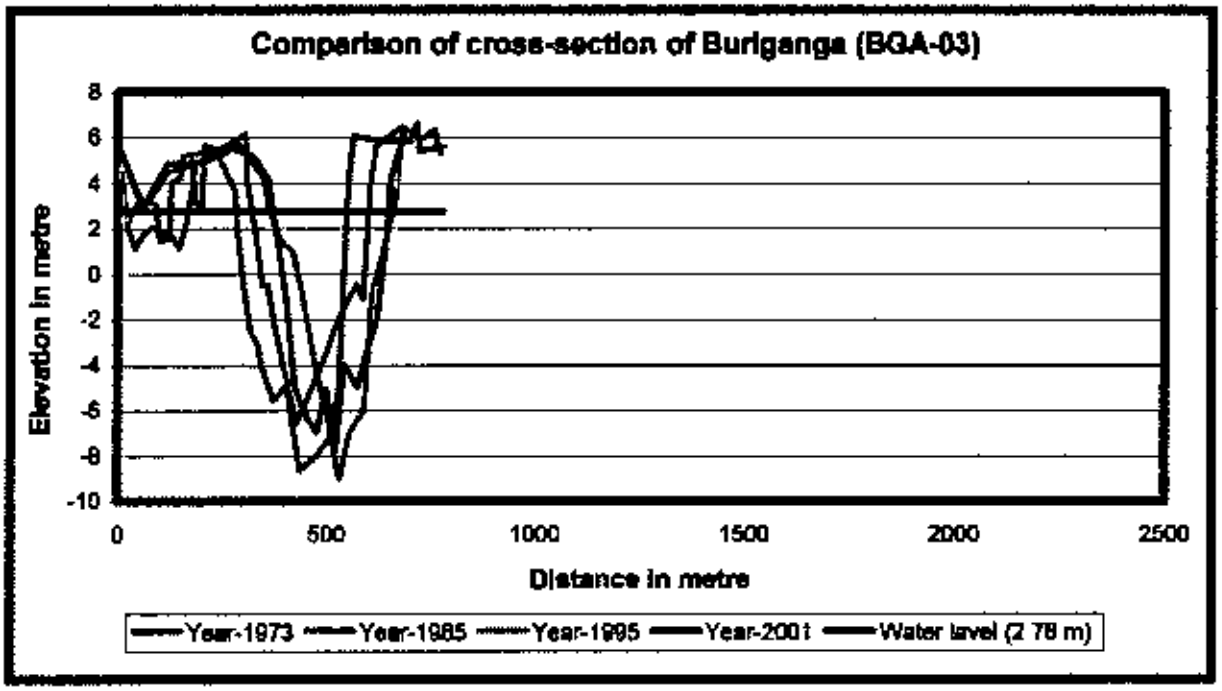

Fig. A.3: Comparison of cross-section (BGA-03) of river Buriganga for different year.

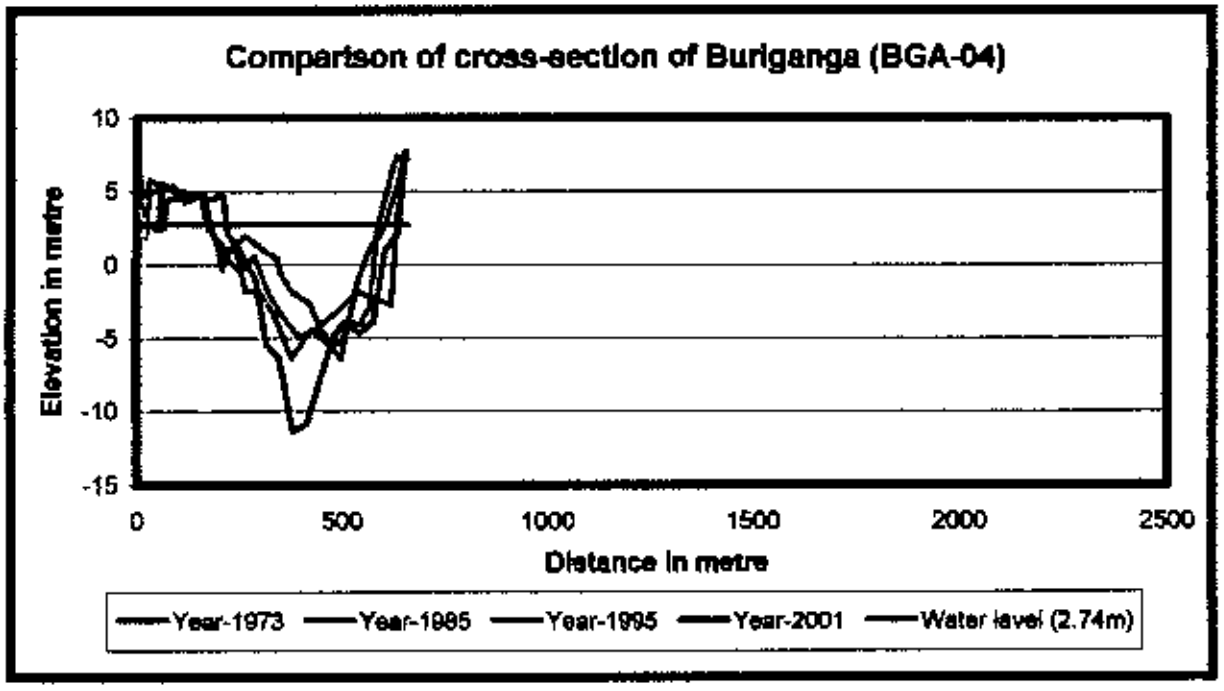

Fig. A.4: Comparison of cross-section (BGA-04) of river Buriganga for different year.

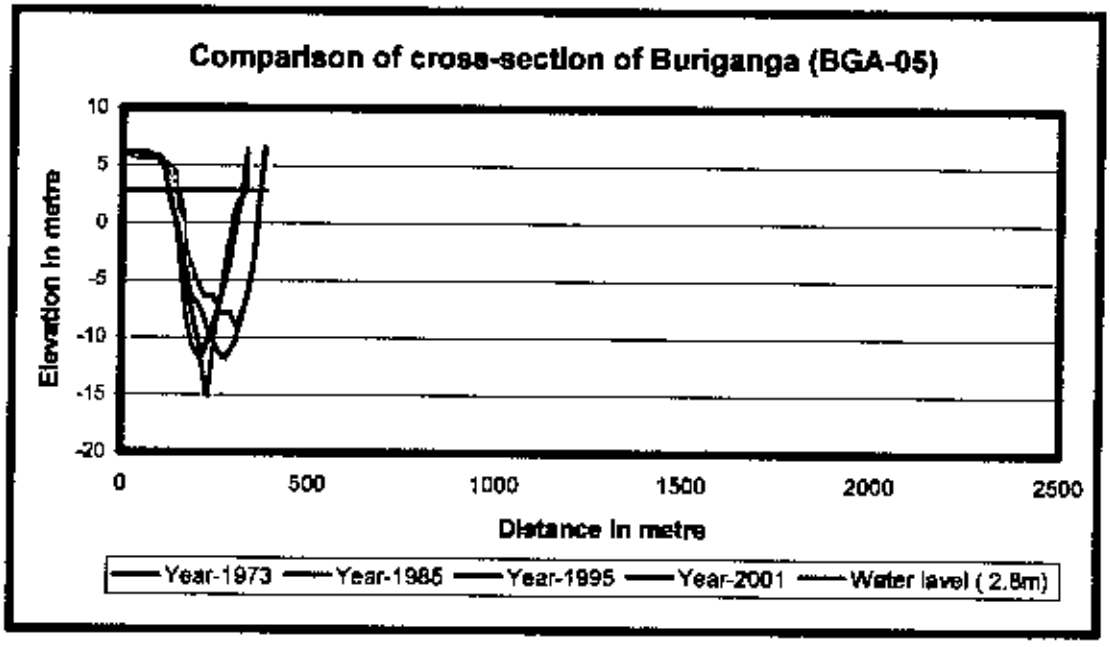

Fig. A.5: Comparison of cross-section (BGA-05) of river Buriganga for different year.

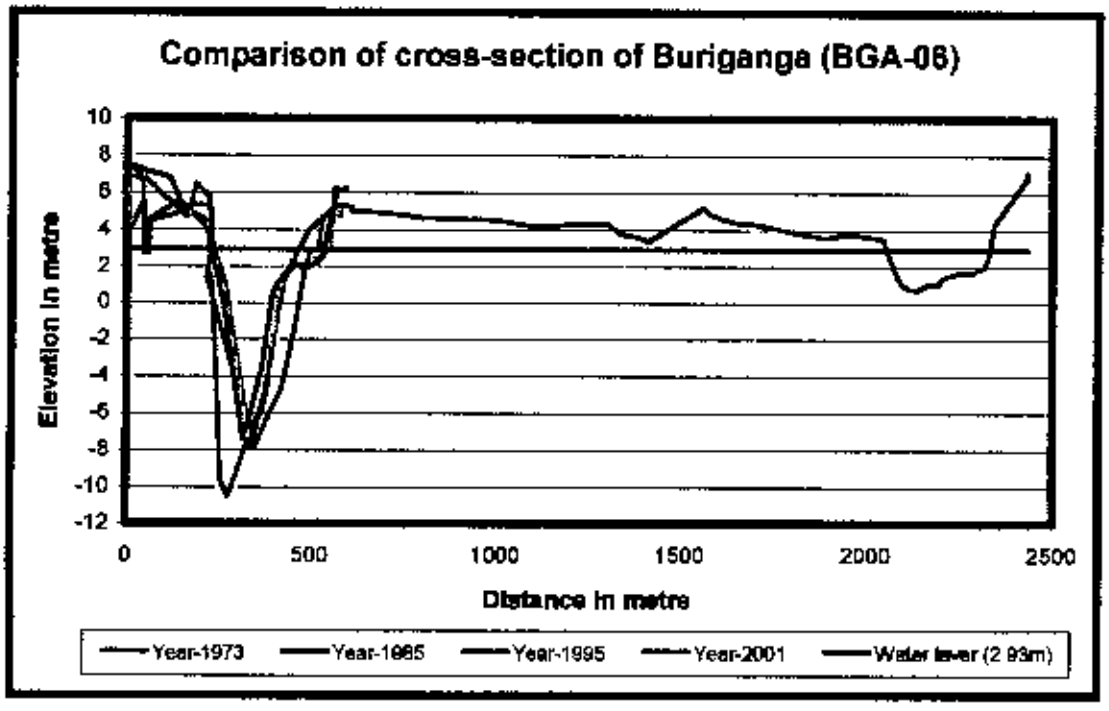

Fig. A.6: Comparison of cross-section (BGA-06) of river Buriganga for different year.

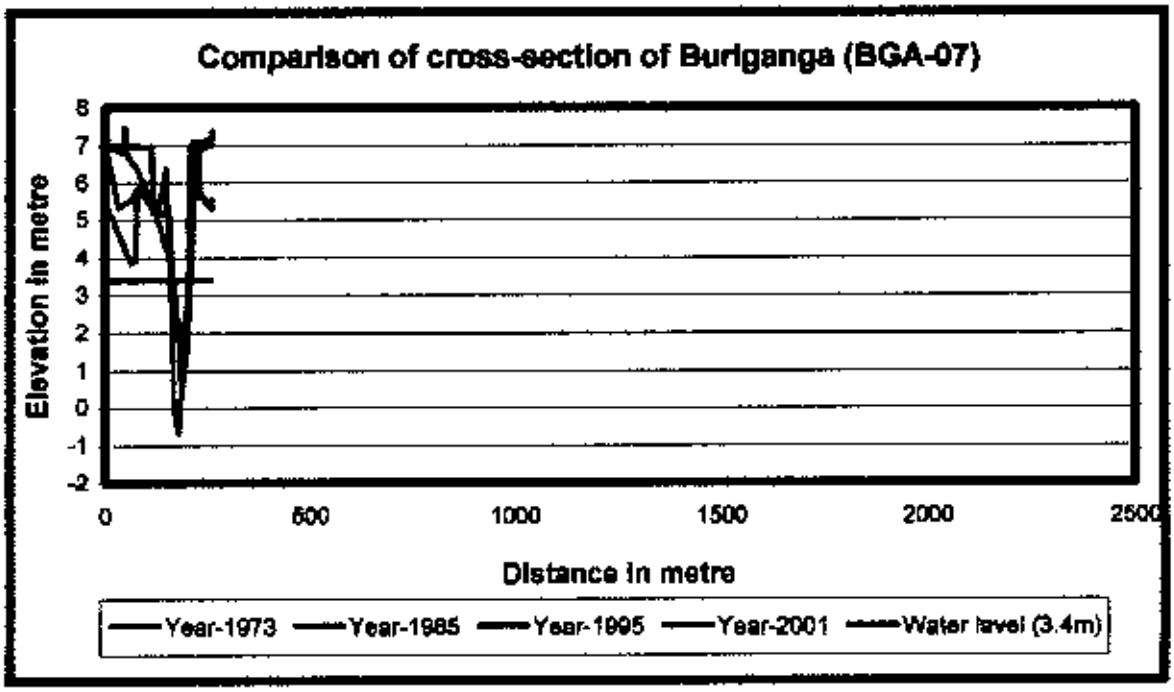

Fig. A.7: Comparison of cross-section (BGA-07) of river Boriganga for different year.

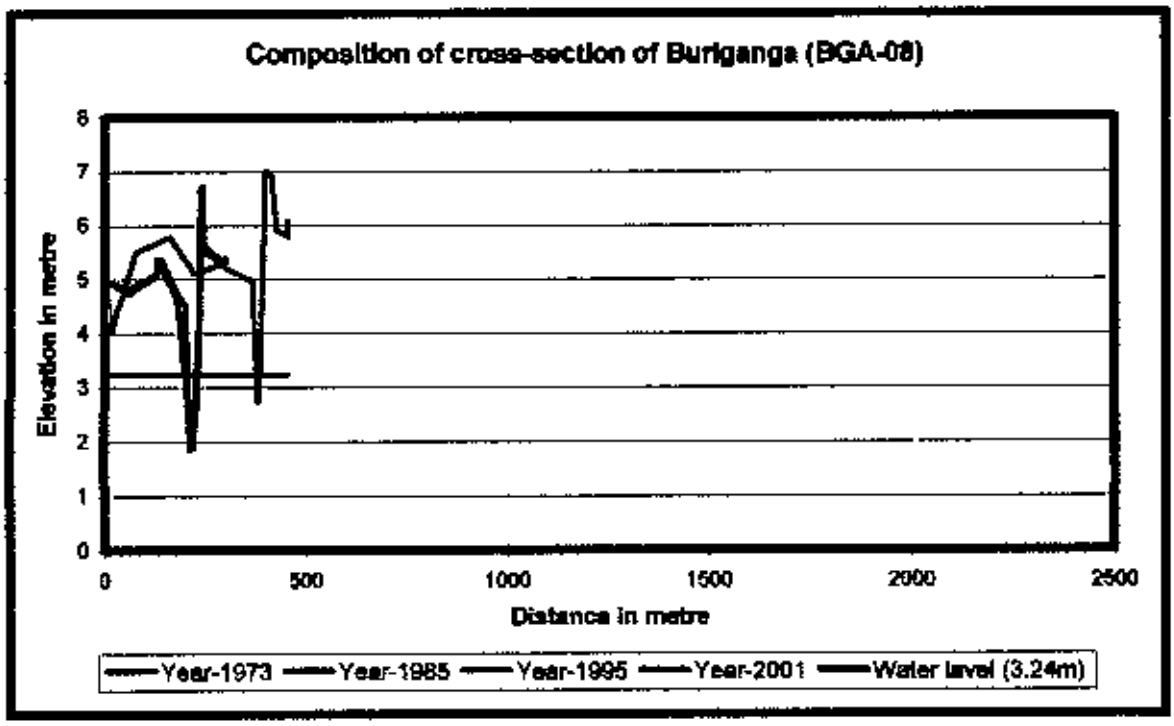

Fig. A.8: Comparison of cross-section (BGA-08) of river Buriganga for different year.

Appendix-B

১৮ কিলোমিটার তীরভূমি অবৈধ দখলে বুড়িগঙ্গা নদী সংকুচিত হচ্ছে

সামছুল ইসলাম ॥ বুড়িগঙ্গা নদী ক্রমান্বয়ে সংকুচিত হচ্ছে। একশ্রেণীর টাউট-বাটপার ও অসাধু ব্যবসায়ী চর দখলের ন্যায় বুড়িগঙ্গার প্রায় ১৮ কিলোমিটার তীরভূমি (ফুরন্যুর) অবৈধভাবে দখল করে নিয়ে রাতারাতি গজিয়ে উঠেছে নদীর উভয় তীরে নানা ধরনের স্থাপনা। নদী থেকে অবৈধ দখলদারদের উচ্ছেদ এবং পানির দূষণ মুক্ত করার লক্ষ্যে সরকার দু'বছর আগে 'বুড়িগঙ্গা বাঁচাও' কর্মসূচী হাতে নেয়। বুড়িগঙ্গা বাঁচাও কর্মসূচীর মুখ থুবড়ে পড়েছে। নদীর পানি দিন দিন দূষিত হচ্ছে। দূষিত পানি ব্যবহার করে অসংখ্য নারী-পুরুষ ও শিশু নানা ধরনের জটিল রোগে আক্রান্ত হয়েছে। নদীর নাব্যতা ক্রমেই হ্রাস পাচ্ছে। নৌযান দুর্ঘটনা বাড়ছে।

বিগত ১০ বছর যাবত বুড়িগঙ্গায় ড্রেজিং-এর মাধ্যমে মাটি খনন করা হয়নি। নদী থেকে অবৈধ দখলদারদের উচ্ছেদের লক্ষ্যে কার্যকরী কোন ব্যবস্থা নেয়া হচ্ছে না। এই অবস্থা চলতে থাকলে অচিরেই নৌযান চলাচলের ক্ষেত্রে মারাত্মক বিপর্যয় দেখা দিবে বলে অভিজ্ঞমহল মতামত ব্যক্ত করেছেন। ব্যস্ততম বুড়িগঙ্গা নদীর উভয় তীরে অবাধে একাধিক স-মিল, কাঠের দোকান, জাহাজ

শফিউদ্দিন বিটু ॥ চর দখলের ন্যায় বুড়িগঙ্গা নদী দখল হচ্ছে। নদীর গতিপথ হ্রাস পাচ্ছে। ছবিটি বুড়িগঙ্গার ফতুল্লা এলাকা থেকে নেয়া

১৮ কিলোমিটার তীরভূমি অবৈধ দখলে বুড়িগঙ্গা নদী সংকুচিত হচ্ছে

(প্রথম পৃষ্ঠার পর)

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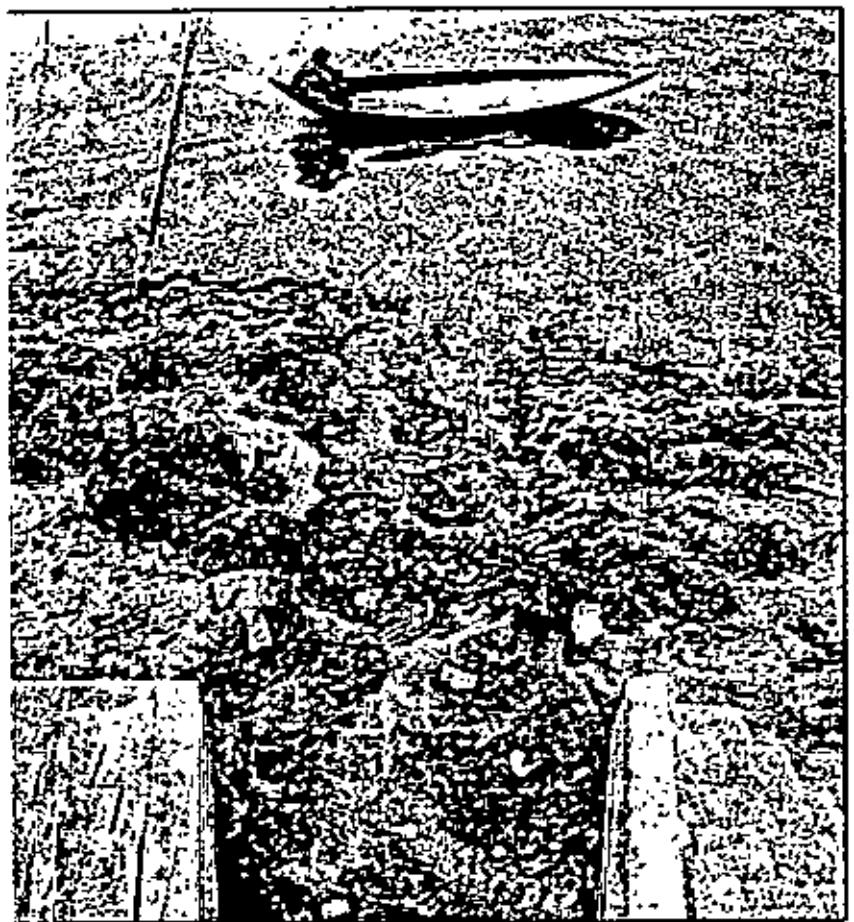

বর্জ্যে আবর্জনায় দূষিত বুড়িগঙ্গা

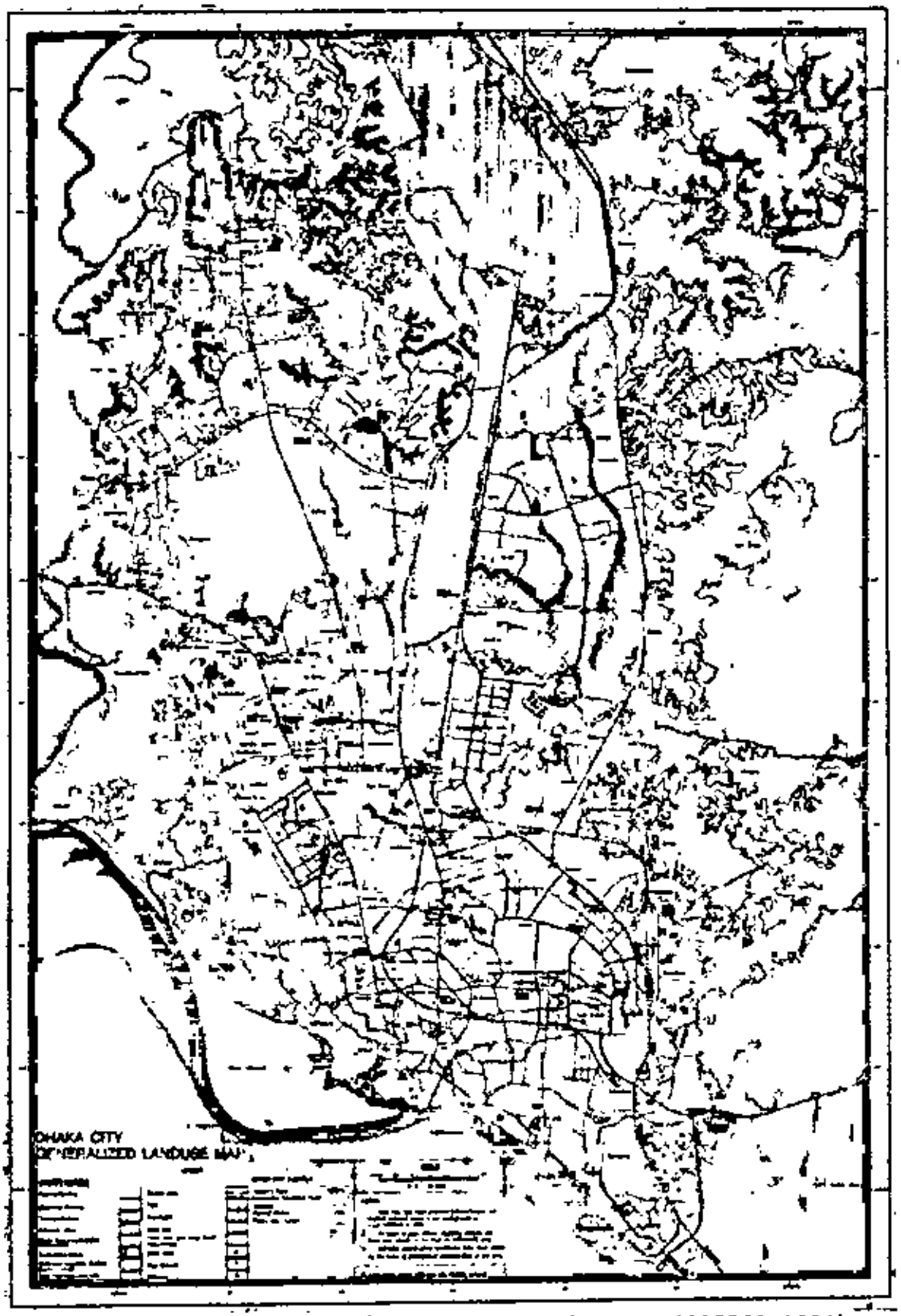

Figure: Land use map of the year 1984 (Source: SPARRSO, 1984)

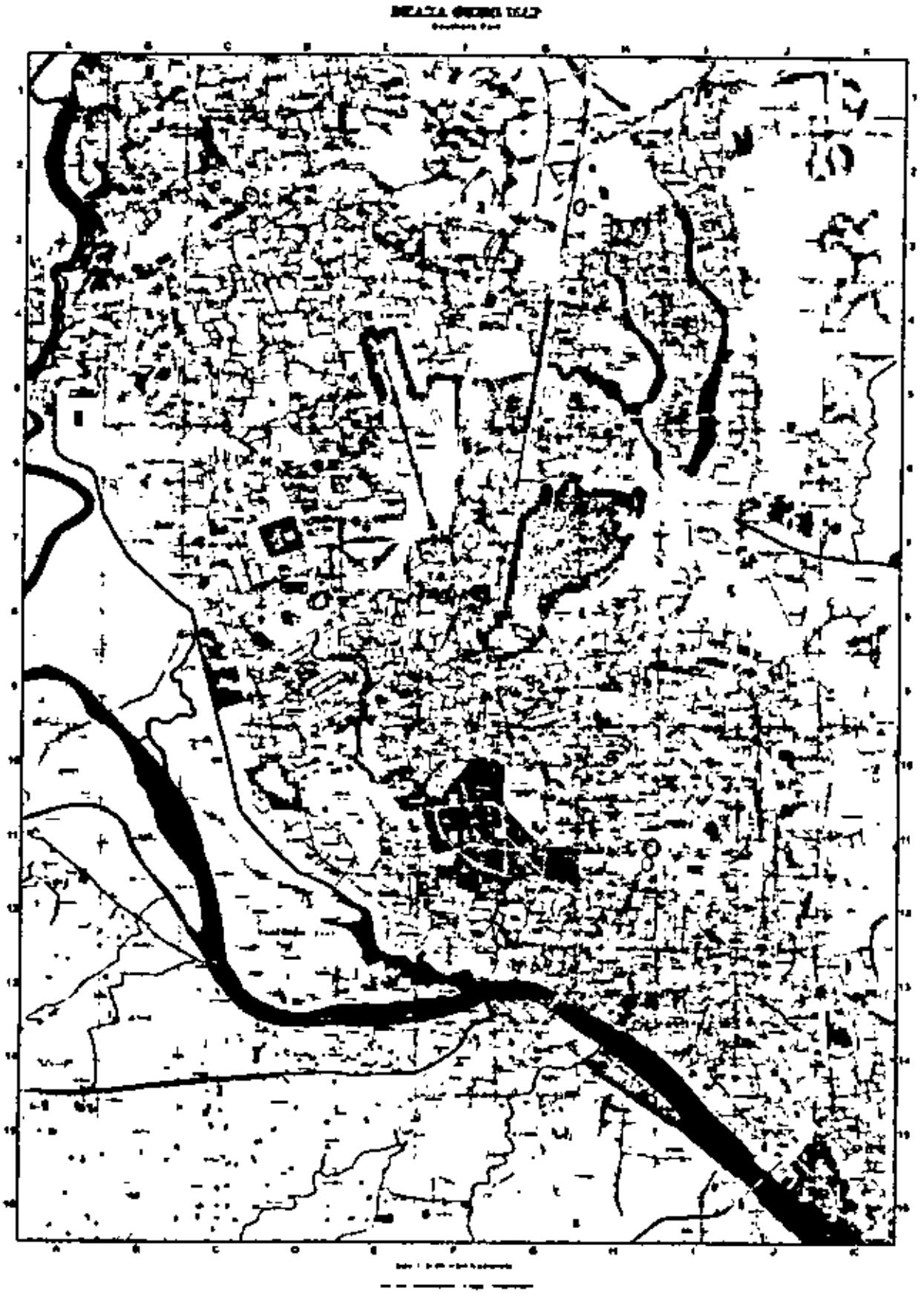

Figure: Land use map of 2001 (Source: SOB, 2001)