

# **HEALTH IMPACT DUE TO SUBSISTENCE USE OF POLLUTED WATER OF SHITALAKKHYA RIVER**

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Institute of Water and Flood Management

**BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY**

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# **HEALTH IMPACT DUE TO SUBSISTENCE USE OF POLLUTED WATER OF SHITALAKKHYA RIVER**

Submitted by  
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**POST GRADUATE DIPLOMA IN WATER RESOURCE DEVELOPMENT**

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## CERTIFICATION OF THE PROJECT

The project report titled “**Health Impact due to Subsistence Use of Polluted Water of Shitalakkhya River**” submitted by Khaleda Begum, Roll No: D1008281011F, Session: October 2008 has been accepted as satisfactory in partial fulfillment of the requirement for Post Graduate Diploma in Water Resource Development on May 5, 2010.

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## **CANDIDATE'S DECLARATION**

It is hereby declared that this report or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Khaleda Begum

## ABSTRACT

The Shitalakkhya River is one of the main rivers around Dhaka city. The pollution of this river resulting from discharge of industrial waste effluent, domestic wastewater and agrochemicals into this river has reached alarming levels. The industries release many types of pollutants including many toxic heavy metals. The industrial units include dyeing/printing factories, edible oil factories, paper and pulp mills, chemical industries, jute mills, textile mills, soap factories, power plants, etc. Many of the industrial units drain out effluents directly into the river Shitalakkhya. But still this river water has many subsistence uses such as drinking, cooking, bathing, washing, fishing, boating, livestock grooming, and vegetable cultivation.

The present study is aimed to observe existing pollution status of the river, document the use of river water and assess health impact due to use of this river water especially on women and children. For collection of data and information, the river has been divided into four reaches and then Focus Group Discussions (FGDs) were carried out at different reaches to identify subsistence uses of river water and the resulting health impacts.

The river has been divided into four reaches on the basis of observation of pollution status of the river. The reaches are- Rugganj, Tarabo, Demra, Shiddhirganj. The pollution intensity is different in the four reaches as the number and type of industry are different in different reaches. As the pollution intensity and socio economic condition is different, subsistence uses of river water are also different in different reaches. River water has different types of subsistence uses but the uses of water vary with season. Due to pollution of river water, people are suffering from acute shortage of pure water. As a result, negative impact on public health was observed in all the reaches. Besides, negative impacts on health also occur due to pollutants that are entering into human body either through direct consumption or through food chain. The common diseases that are found in the study area are skin diseases, diarrhea, jaundice, cholera and dysentery. Due to pollution of river water children are particularly vulnerable to health impacts.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Water is the most vital element among the natural resources, and is crucial for the survival of all living organisms. The environment, economic growth and development of Bangladesh are all highly influenced by water - its regional and seasonal availability, and the quality of surface and groundwater. Spatial and seasonal availability of surface and groundwater is highly responsive to the monsoon climate and physiography of the country.

In terms of quality, the surface water of the country is unprotected from untreated industrial effluents and municipal wastewater, agricultural runoff containing of chemical fertilizers and pesticides, and oil. Water quality also depends on effluent types and discharge quantity from different type of industries, types of agrochemicals used in agriculture, and seasonal water flow and assimilative capacity by the river system.

The concerns over water quality relate not just to the water itself, but also to the danger of diffusion of toxic substances into other ecosystems. The aquatic environment for living organisms can be affected and bioaccumulation of harmful substances in the water-dependent food chain can occur. A variation of inland surface water quality is noticed due to seasonal variation of river flow, operation of industrial units and use of agrochemicals.

The rivers around Dhaka city are severely polluted. The pollution problem of Shitalakkhya which is also known as Lakhya river is acute. There are many industries along Shitalakkhya river which are discharging their effluents directly into the river. The river water has many uses. Such uses of the polluted river water have severe health implications. So it is important to study the various uses of the polluted river water and how it may pose danger to health of the uses.

## **1.2 Objective of the study**

The objectives of the study are

- To observe existing pollution status of the Shitalakkhya river.
- To document the use of river water.
- To assess health impacts due to use of this river water, especially on women and children.

The study will help to understand the severity of pollution problem in Shitalakkhya River and its impact on health of users of the river water.

## **1.3 Rationale of the Study**

In recent times, river pollution problem has become one of the burning issues in different parts of Dhaka City particularly in industrial cluster areas. So there is a need for assessing the potential impacts on human health due to river water pollution and its causes and consequences.

## **1.4. Limitations of the study**

Due to resource constraints, no laboratory analysis of river water itself could be done.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Concentration of people in urban growth centers simultaneously increase the concentration of domestic and industrial activities that lead to pollution problem for urban and its surrounding areas. In the rural area, runoff of agrochemicals from agricultural fields deteriorates water quality. It has mostly affected the fisheries sector. However, pollution issues are most acute in urban areas.

Water Pollution is mostly concentrated in urban growth centers and industrial belts. Due to lack of adequate regulatory measures and institutional setup for proper monitoring and control, pollutants from municipal, industrial and agricultural waste enter into the inland water system. Major causes of pollution that aggravate water quality are industrial effluents, agrochemical, and spillage and low water flow in dry season.

Industrial pollution and deteriorating water quality is a growing environmental concern. Most of the industries in Bangladesh are located along the bank of the main rivers. The most significant industrial growth has been recorded after 1982 especially the development of garments, textile and dyeing industries. The industrial sector of Bangladesh can be categorized into 3 major categories based on its input: agro-based industries, non-renewable local resource based industry and imported resource based industries.

- Agro-based Industries: It includes jute, pulp and paper, match, sugar, shrimp salt etc. The main polluter from this category are sugar, pulp and paper and tanneries.
- Non- renewable local resource based industry: Includes industries based on mineral resources, hard rock, sands, glass, limestone and various types of clays. In this sector, the major polluters are cement and fertilizer factories.
- Imported resource based industries: This category includes textiles, pharmaceuticals, plastic, petroleum/ refineries, and metal works. Most of these are considered as highly pollutant.

## **2.2 Surface water pollution around Dhaka city**

Dhaka is surrounded by rivers and inter-connected with canals which have always formed a life-line for city residents. In the last twenty years, a convergence of unregulated industrial expansion, rural-to-city migration, encroachment of the rivers, overloaded infrastructure, confusion about institutional responsibility for the quality of Dhaka's water bodies, and very ineffective enforcement of environmental regulations have all taken their toll on surface water quality. There is only one sewage treatment plant at Pagla which is currently operating below capacity because of sewerage system failures, and few industries operate effluent treatment systems. Almost all the waste from humans, industry, and millions of farm animals, along with tones of pesticides and fertilizers, make their way into Dhaka's surface water untreated, and a percentage of these wastes infiltrate to the groundwater. As a result, pollutant levels in the groundwater are increasing, and many sections of the rivers and canals in the city and surrounding areas, especially the Buriganga and Shitalakkhya, are biologically dead during the dry season, spurring widespread public concern and prompting reaction at the highest political levels (WB, 2006).

The main industry clusters and effluent "hotspots" around Dhaka City include the tanneries at Hazaribagh which pollute the Buriganga River, the Tejgaon Industrial Area which drains to the Balu River, the Tongi Industrial Area which pollutes Tongi Khal, the Sayampur and Fatullah industrial clusters in Dhaka South and Narayanganj which discharge to the Buriganga River, and the developing heavy industry strip along the Shitalakkhya River (WB, 2006).

Dhaka surface water is in very poor condition, especially in the dry season. For some six months of the year, the flow rate of the rivers is negligible, often with only a tidal pulse, but the volume of effluent entering the canal and river system remains about the same as during the wet season. Consequently, dilution of contaminants is drastically reduced in the dry season. As the most polluted areas are the Buriganga and Shitalakkhya Rivers, Tongi Khal, and the canal system in Dhaka East, where very low oxygen levels reflect the breakdown of organic waste, principally domestic sewage and chemical residues from

industry. The high levels of oxygen demand in the Shitalakkhya Rivers, in particular, reflect the high density of industries discharging untreated waste into the rivers. Some tidal backflow of relatively clean water from the Meghna and Dhaleswari Rivers results in dilution of contaminants in the southern reaches of the Shitalakkhya Rivers, but the extent of this positive effect is limited (WB, 2006).

### **2.3 Pollution load from industries**

Industrial pollution is an area of growing environmental concern in Bangladesh. There are increasing efforts to develop the industrial sector of the country by both stimulating the local industries and attracting foreign investors. As Bangladesh attempts to attain economic development by replacing its agricultural base with industrial and rural enterprise with urban centers, pollution and other environmental impacts of industries are becoming critical in development planning (Bhattacharya et.al.1995).

Unplanned growth of industries and lack of treatment facilities of industrial waste water is the primary cause of water pollution in Bangladesh. Water pollution disturbs the normal uses of water for irrigation, agriculture, industry, public water supply and aquatic life. Prevention of water pollution is not only important from the view point of public health, but also from the view point of aesthetics, conservation and preservation of natural resources. In Bangladesh, pollution of surface water bodies from industrial effluents is a major concern. Here majority of the industrial wastes is discharged into surface water bodies without any kind of treatment. According to the study (BKH, 1995), an estimated 32 million kilogram of BOD are discharged into the environment annually, most of which end up in the surface water bodies around the industrial locations. While this figure is quite alarming it must be recognized that the number of industrial units and industrial production have increased significantly since these estimates were made; and the present estimates of wastewater flow and waste load are expected to be significantly higher.

The increasing urbanization and industrialization of Bangladesh have negative implications for water quality. The pollution from industrial and urban waste effluents and from agrochemicals in some water bodies and rivers has reached alarming levels. The

long-term effects of this water contamination by organic and inorganic substances, many of them toxic, are incalculable. The marine and aquatic ecosystems are affected, and the chemicals that enter the food chain have public health implications (DoE, 1999).

Table 2.1 states the top polluters. These industries emit both organic and inorganic pollutants. The biodegradable organic pollutants reduce the dissolve oxygen of water and hamper the aquatic ecosystem of water and non-biodegradable organic component persist in the environment for a prolonged period and pass into the food chain. Inorganic pollutants are mostly metallic substance. They undergo different chemical reaction in the river system and thus seriously deteriorate the water quality (ADB, 2004).

**Table 2.1: Top five polluters that causes water pollution (ADB, 2004).**

Rank	Industrial sector	% Contribution
1	Pulp and Paper	47.4%
2	Pharmaceuticals	15.9%
3	Metal	14.0%
4	Food Industry	12.1%
5	Fertilizer/Pesticides	6.6%

Percentage contribution of industrial water polluters is shown in the following pie chart.

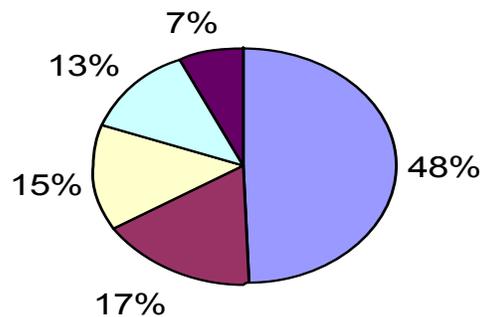


Figure 2.1: Annual water pollution by industrial sector (Source of data in Table 2.1).

There are different types of industries in our country and their contribution to national pollution is different. Contribution of national pollution load to water by some selected sectors in terms of total metal, BOD and total particulate are given in Table 2.2.

**Table 2.2: Contribution of national pollution load by selected sectors and their pollutants.**

Type of industry	Toxic metal to water(mg/l)	BOD (mg/l)
Textiles	8.20	10.72
Non-ferous metal	6.10	11.41
Iron and steel	53.55	0.07
Sugar and refineries	0.00	41.34
Chemicals	8.09	3.08
Cement	0.00	0.00
Tanneries	1.56	1.90
Fertilizers/pesticides	2.09	0.36
Vegetable oils	0.06	2.19
Chemical products	6.31	0.06
Tobacco	0.0	0.08
Drug/Medicines	0.58	0.64
<b>Total</b>	<b>86.55</b>	<b>71.84</b>

Source: Banglapedia (2006)

Different types of industry discharge different types of wastes and the characteristics of these wastes also vary from one another. Important characteristics of waste water from major industries are given in Table 2.3.

**Table 2.3: Important characteristics of waste water from major industries.**

Industries	Important characteristics
Acid manufacture	Low pH
Beet sugar	High BOD
Coal washery and FeSO <sub>4</sub> Present	Low pH, high suspended solids, H <sub>2</sub> SO <sub>4</sub>
Coke manufacture phenol and oils	High suspended solids, NH <sub>3</sub> , H <sub>2</sub> S
Distillery	High BOD, with brown color and dischargeable dour, high dissolved and suspended solids.

Electroplating	Low pH, high COD; also contains heavy metals and toxic substances.
Paint manufacture	High BOD; contains synthetic resins, solvents, pigments and heavy metals such as Al, Cr and Pb.
Petroleum refining	High COD/BOD ratio; also contains hydrocarbons, alcohols, aldehydes, phenols, oils, metals etc.
Plastic manufacture	Acids, formaldehyde and phenols.
Pulp and paper industry	Lintense brown colored with characteristic odor, board industry alkaline; highly dissolved and suspended solids.
Steel industry	Low pH, phenols suspended solids and metals present.
Tannery	High BOD and COD; contains highly dissolved and suspended solids, oil and grease and heavy metals like Cr.
Textile processing	High BOD; suspended and dissolved solids, phenolic substances, acids, chlorine dues and Cr present.

**Source:** Kumar & Kakrani (2000)

The industries also release many types of pollutants; among these pollutants most of the industries release many toxic heavy metals. These heavy metals make the water quality very poor. Some major sources of heavy metals given in the Table 2.4.

**Table 2.4: Industrial sources of heavy metal.**

Source	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Mining and ore processing	*	*	*		*	*		*
Metallurgical	*	*	*	*	*	*	*	*
Chemical industry	*	*	*	*	*	*		*
Alloys					*			
Paint		*	*		*			*
Glass	*				*	*		
Pulp and paper			*	*	*	*	*	
Leather	*		*		*	*		*
Textile	*		*	*	*	*	*	*
Fertilizers	*	*	*	*	*	*	*	*
Chlor-alkali production	*	*	*		*	*		*
Petroleum refining	*	*	*	*	*	*		*
Coal burning	*	*	*	*	*	*	*	

**Source:** Mishra (1990)

## 2.4 Pollution in Shitalakkhya River

Many industrial units are increasingly polluting Narayanganj, the industrial and river-port town near the capital city. People there feel that the condition in and around the town is gradually becoming intolerable. Other than the town, there are industrial units at Rupganj, Demra, Tarabo, Kachpur, Modanpur, Shiddhirganj, Adamji, Godnile, Nabiganj, Khanpur, Kalirbazar and Kerosin Ghat.

Moreover, there are industrial units along the Dhaka- Chittagong highway. The industrial units include dyeing/printing factories, edible oil factories, paper and pulp mills, chemical industries, jute mills, textile mills, soap factories etc. Many of the industrial units drain out effluents directly into the river Shitalakkhya.

### 2.4.1 Pollution sources in Shitalakkhya River

There are mainly two types sources of pollution, these are:

1. Point sources of pollution of the Lakhya river,
2. Non-point sources of pollution of Lakhya river.

**Point sources of pollution of the Lakhya River:** The point sources of pollution of Lakhya River are as shown in Table 2.5.

**Table 2.5: The point sources of pollution of Lakhya River.**

Source	Description
Majheepara khal, Killarpul Khal, Kalibazar Khal, Tanbazar Khal, B.K. Road Khal	Carry untreated wastewater originating from domestic and industrial sources in Narayanganj City.
DND Khal	DND Khal carries domestic and industrial wastewaters from the DND project area.

Source: Magumder, 2005.

### Non-point sources of pollution of Lakhya River:

There are numerous indistinct sources, which discharge pollutants in the Lakhya river. They are either of domestic origin or of industrial origin. Some are combined wastes from domestic and industrial sources.

**Table 2.6: Nonpoint source of pollution into Lakhya River.**

Source	Description
Narayanganj City	Wastewater discharge from domestic and industrial activities.

Source: Magumder (2005).

Most of the polluted industries are situated around the bank of the Shitalakkhya river. Alam (2006) identified different sources of pollution of Shitalakkhya river. Category of pollutant sources, pollutants of Shitalakkhya river are given in the Table 2.7.

**Table 2.7. Category of pollutant sources and pollutants of Sitalakhya River.**

Categories of pollutant sources	Pollutants	Pollution source
Urea Fertilizer Plant	$\text{NO}_3^-$ , $\text{NH}_4^+$	PS
Lime stone & stone grinding Plant & Cement industry	$\text{Fe}$ , $\text{Ca}^{+2}$ , $\text{HCO}_3^-$	NPS & PS
Agricultural Land	$\text{B}$ , $\text{Na}^+$ , $\text{PO}_4^{+2}$ , $\text{SO}_4^{-2}$ , $\text{NO}_3^-$ , $\text{NH}_4^+$ , $\text{Fe}$	NPS
Oil Industry & Refinery	$\text{Pb}$ , $\text{Cd}$ , $\text{Cl}^-$ , $\text{Fe}$	PS
Sewerage & Public Toilet	Pathogens & Other microbes	NPS & PS
Metal & Waste dumping place	$\text{Fe}$ , $\text{Zn}$ , $\text{Pb}$ , $\text{Mn}$ , $\text{Al}^{+3}$ , $\text{Mg}^{+2}$	NPS & PS
Boat & Ship dock yard	$\text{Cl}^-$ , $\text{Fe}$ , $\text{Mn}$ , $\text{Pb}$ , $\text{Zn}$ , $\text{Ca}^{+2}$	PS
Soap factory	$\text{Ca}^{+2}$ , $\text{HCO}_3^-$ , $\text{Pb}$	PS
Dye factory, Textile & Tannery	$\text{Ca}^{+2}$ , $\text{Pb}$ , $\text{Cr}$ , $\text{Co}$ , $\text{Zn}$ , $\text{Cl}^-$	NPS & PS
Rice processing industry	$\text{Na}^+$ , $\text{PO}_4^{+2}$ , $\text{SO}_4^{-2}$ , $\text{NO}_3^-$ , $\text{NH}_4^+$ , $\text{Fe}$	NPS
Power plant & station	$\text{Pb}$ , $\text{Cr}$ , $\text{Zn}$ , $\text{Fe}$	PS
Jute mill & Store house	$\text{Na}^+$ , $\text{PO}_4^{+2}$ , $\text{SO}_4^{-2}$ , $\text{NO}_3^-$ , $\text{NH}_4^+$	NPS & PS
Electroplating Industry	$\text{Fe}$ , $\text{Zn}$ , $\text{Cd}$ , $\text{Al}^{+3}$	PS
Market place (Meat & Vegetable)	Pathogens & Other microbes	NPS
High way & Rail station	$\text{Pb}$ , $\text{Fe}$ , $\text{Cr}$ , $\text{Zn}$ , $\text{Al}^{+3}$	NPS & PS

Source: Alam (2006).

NPS = Non Point Pollution Sources; PS = Point Pollution Sources

Alam (2006) also made a classification of pollution sources of Shitalakkhya river. In terms of pollution the most polluting sector in the Shitalakkhya River is:

- Food industry, where the sugar mills and oil/fat factories cause most of the pollution.
- Pulp and paper industry is the worst water polluter.
- Metal industries (ferrous and nonferrous) rank first in terms of toxic metals emission.
- The largest amounts of toxic chemicals are released by the tanneries and leather industries (raw and processed). These industries are large in size or are located in large clusters (tanneries), thus can be identified and managed as point sources of pollution.

#### 2.4.2 Pollution loads discharged into the Lakhya River

Islam (2008) estimated the total amount of pollution load from fertilizer factories into the Lakhya River are shown in Table 2.8.

**Table 2.8: Pollution load from fertilizer factory in Lakhya River.**

<b>Pollutants</b>	<b>Quantity(Kg/day)</b>
BOD <sub>5</sub>	2665-3369
COD	4714-5221
Total Ammonia (NH <sub>3</sub> -N)	7850.68
Total solids	7449-10380
Total suspended solids (TSS)	1513-3375
Total Dissolved Solids (TDS)	5467-7004

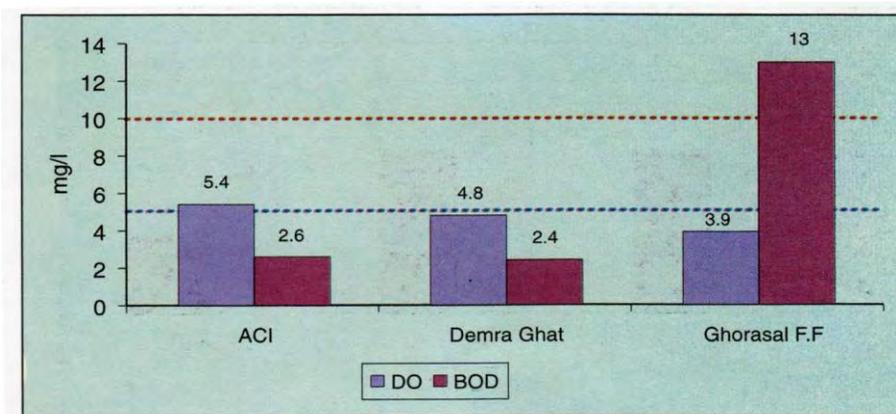
Source: Islam (2008).

He also observed that the fertilizer factories are the major sources of total ammonia load discharged into the Lakhya River in the study area. The amount of total ammonia load in down stream is greater than the load of total ammonia in the upstream. This increment occurred due to the ammonia load discharged from fertilizer factories. So the ammonia load discharged from fertilizer factories has a large impact on the Lakhya river water

quality. Highest amount of BOD<sub>5</sub>, COD and NH<sub>3</sub>-N was found at the discharging point of waste into the Lakhya and was found decreasing with distance at the down streams. The concentration of most of the water quality parameters in down stream is greater than the concentration in upstream.

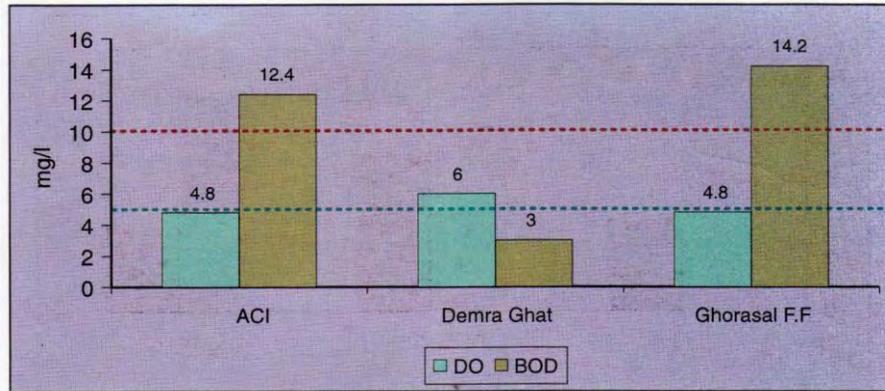
## 2.5 Water quality of Shitalakkhya River

Ambient water quality of the Shitalakkhya River presented by the monitoring data of DoE (DoE, 2006) during the reference period 2002-2006 at three points, viz. those at ACI Ltd., Demra Ghat and Ghorashal Fertilizer Factory shows the water quality of the river. The water quality corresponding to the parameter DO is slightly lower during the leanflow (April-May) period than the acceptable minimum at ACI Ltd and Ghorashal Fertilizer Factory (Figure 2.2). DO levels is slightly better at Demra Ghat, where DO is higher than the acceptable minimum and at Ghorashal Fertilizer Factory, a slightly improved picture still remaining during the highflow (July-August) periods (Figure 2.3). On the other hand BOD levels are well below than the maximum acceptable limit at ACI Ltd. and Demra Ghat but quite higher at Ghorashal Fertilizer Factory during the leanflow period (Figure 2.2). During the highflow period BOD level is on the higher side at ACI Ltd (12.5 mg/l) and at Ghorashal Fertilizer Factory (14.2 mg/l) whereas, at Demra Ghat, still at the lower side (3 mg/l) against the maximum acceptable limit (Figure 2.3).



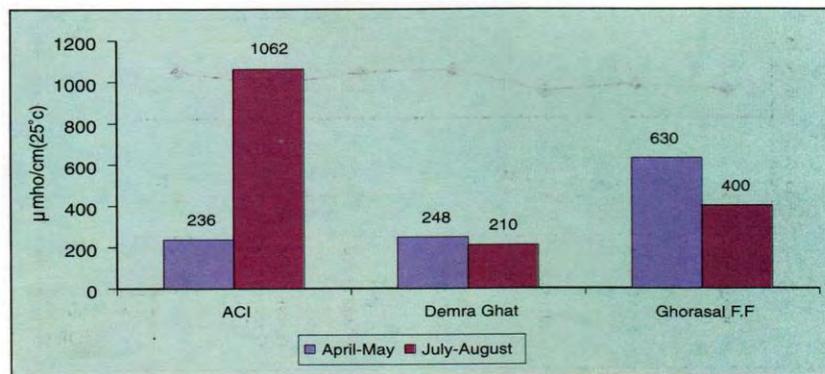
Source: DoE (2006)

Figure 2.2: Ambient surface water quality (DO & BOD) of river Shitalakkhya, 2006 (April-May)



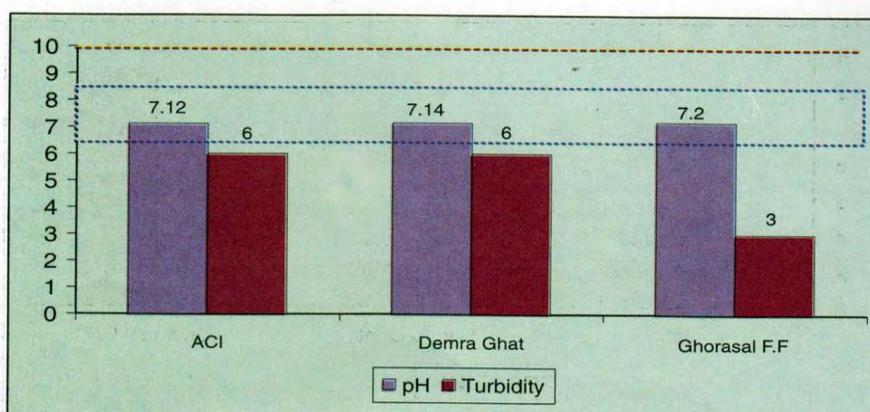
Source: DoE (2006)

Figure 2.3: Ambient surface water quality (DO & BOD) of river Shitalakkhya, 2006 (July-August)



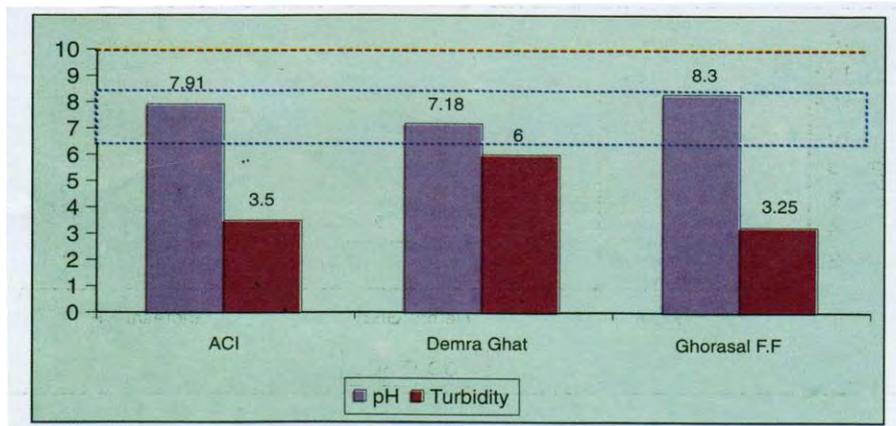
Source: DoE (2006)

Figure 2.4: Ambient surface water quality (EC) of river Shitalakkhya, 2006 .



Source: DoE (2006)

Figure 2.5: Ambient surface water quality (pH & Turbidity) of river Shitalakkhya, 2006 (April-May)



Source: DoE (2006)

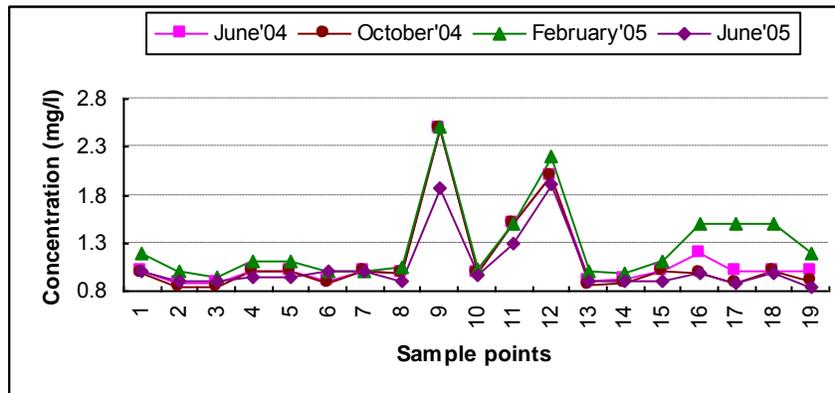
Figure 2.6: Ambient surface water quality (pH & Turbidity) of river Shitalakkhya, 2006 (July-August).

The EC of the river water (Figure 2.4) at Ghorashal Fertilizer Factory is higher in the leanflow period and quite higher at ACI Ghat in highflow period than the other two points. The pH of the river water is within acceptable limit in both period at all the points (Figure 2.5 & 2.6).

Alam (2006) assessed water quality assessment of Shitalakkhya River. For this assessment he selected 19 sampling point from upstream to down stream of Shitalakkhya River. The sampling points included different areas of Narayanganj district such as Rupganj, Kaetpara oil plant, Vulta oil plant, Demra, Tarabo, Kachpur, Modanpur, Shiddhirganj, Adamji, Godnile, Nabiganj, Khanpur, Kalirbazar, Kerosin Ghat etc. The analytical result of the study indicated specified problems as well as pollutant concentration of Shitalakkhya River. The concentrations of different polluting agents were found higher in dry season and low in wet season. It was also found that the concentration of pollutants decreased from the source to a distance because of their dilution.

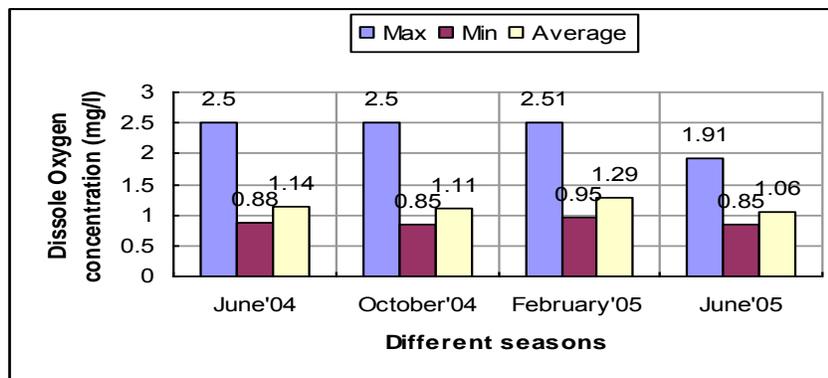
The average DO concentration of a water cycle in Lakhya river is very low. The highest average DO concentration was found during the month of February 2005 (1.29 mgL<sup>-1</sup>) in

dry season (Figure 2.8). The DO concentration is highest (2.5 mg/l) in sampling point 9 (Madanpur) among all the sampling points which is also quite low (Figure 2.7).



Source: Alam (2006)

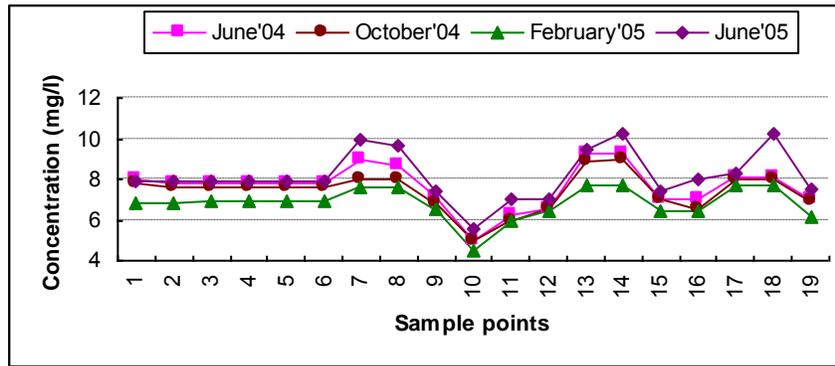
Figure 2.7: Dissolve Oxygen conc. of Shitalakkhya River at different seasons.



Source: Alam (2006)

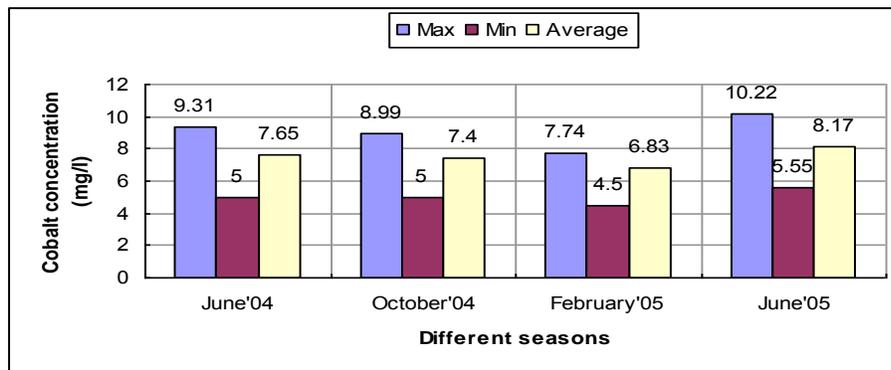
Figure 2.8: Maximum, minimum DO conc. ranges and averages in Shitalakkhya River at different seasons.

The BOD concentration in Lakhya river of a water cycle is quite high. The highest average BOD concentration was found during the month of June 2005 (8.17 mgL) in wet season and maximum BOD concentration is also high during the month of June 2005 which is 10.22 mgL (Figure 2.10). BOD concentration is lowest in sampling point 10 (Shiddirganj power plant) among all the sampling points (Figure 2.9).



Source: Alam (2006)

Figure 2.9: Biochemical Oxygen Demand conc. of Shitalakkhya River at different seasons.



Source: Alam (2006)

Figure 2.10: Maximum, minimum BOD conc. ranges and averages in mg/L of Shitalakkhya River at different seasons.

The concentration of different water quality parameters in water cycle at Demra are given in Table 2.9.

**Table 2.9: Reported values of different water quality parameter at Demra.**

<b>Chemicals(mg/L)</b>	<b>June' 04</b>	<b>October'04</b>	<b>February'05</b>	<b>June'05</b>
pH	7.0	6.5	6.2	5.0
TDS (mg/l)	24	50	330	100
SS (mg/l)	3	12	20	18
EC ( $\mu$ S)	15	75	600	210
DO (mg/l)	0.9	0.9	0.12	0.10
BOD (mg/l)	8.0	8.0	6.5	7.9
COD (mg/l)	19	18	17	19.5
Chloride (mg/l)	14.5	54.5	73	124
Bicarbonate (mg/l)	100	200	400	700
Sodium (mg/l)	5	11	22	60
Potassium (mg/l)	1	1.8	3.1	10
Ammonia (mg/l)	40	50	100	300
Nitrate (mg/l)	0.8	1.3	2.0	6.1
Calcium (mg/l)	50	100	110	440
Magnesium (mg/l)	30	100	120	350
Phosphate (mg/l)	1	3	7	12
Manganese (mg/l)	1.1	1.4	1.6	1.7
Sulphate (mg/l)	1	3	6	12.5
Boron (mg/l)	0.95	0.10	0.115	0.11
Iron (mg/l)	0.1	0.25	0.5	1.05
Copper (mg/l)	6.0	6.1	8.1	8.0
Cobalt (mg/l)	1.4	1.5	1.55	1.6
Zinc (mg/l)	12.8	15.5	18.8	19.8
Lead (mg/l)	3.7	5.7	5.8	5.9

Source: Alam (2006).

The standard value of these water quality parameters for recreational and fishing are given below:

**Table 2.10. EQS of some relevant water quality parameters (DOE, 1991).**

<b>Parameters</b>	<b>Recreational</b>	<b>Fishing</b>
Total Alkalinity, mg/l	NYS	70-100
Ammonia (NH <sub>3</sub> )	2	0.025
Ammoniacal Nitrogen (as N), mg/l	NYS	1.2
BOD (ultimate), mg/l	3	6
Chloride (as Cl), mg/l	600	600
COD, mg/l	4	NYS
Chromium, , mg/l	NYS	0.05
Coliform (total), Nos/100 ml	NYS	NYS
DO,mg/l	4-5	4-6
Nitrate (as N), , mg/l	NYS	NYS
pH	6-9.5	6.5-8.5
SS, , mg/l	20	25

If we compare the standard value (Table 2.10) and reported value (Table 2.9), we can see that most of the values in different time of a water cycle period exceed the standard limit which indicates that the river water is no more suitable for the use of fishing and recreational purposes.

**Table 2.11: Year to year changes of water quality.**

Station	Year Dry season	Turbidity mg/l	Temp °C	DO mg/l	BOD <sub>5</sub> mg/l	pH	EC	Total Alkalinity
Ghorashal F.F.	2002	8	22	6.5	2.5	7.21	155	48
	2003	5	23	6.2	3.1	7.1	240	100
	2006	7.2		3.9	13	7.2	630	
ACI	2002	10	24	7.2	3	6.95	136	90
	2003	5	23	5.8	2.7	7.15	160	120
	2006	6		5.4	2.6	7.12	236	

Source: DoE (2006) and Magumder (2005).

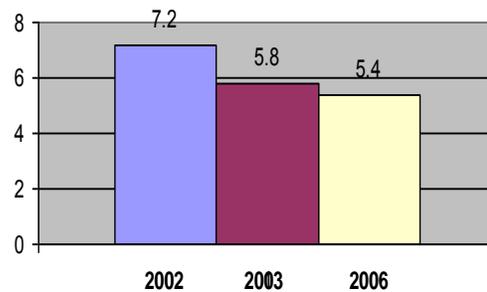
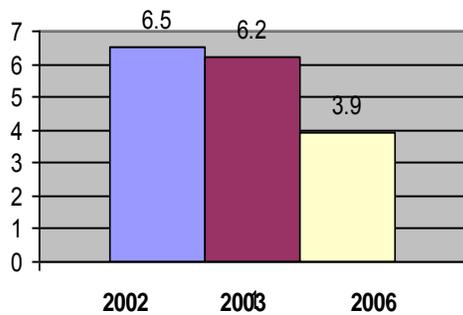


Figure 2.11: DO concentration at Ghorashal F.F. Figure 2.12: DO concentration at ACI.

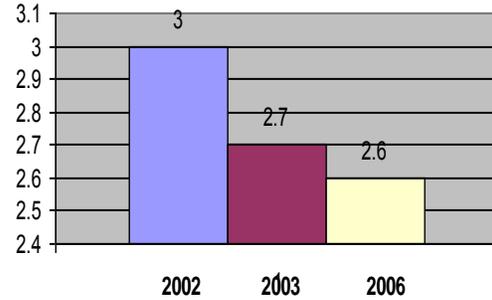
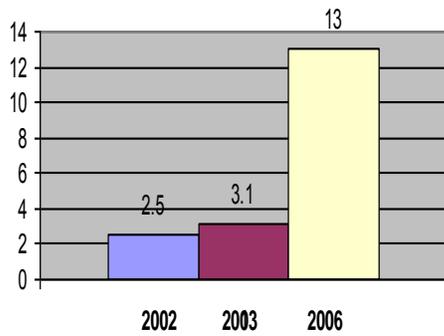


Figure 2.13: BOD concentration at Ghorashal F.F. Figure 2.14: BOD concentration at ACI.

In Table 2.11, the reported values of year 2002 & 2003 (Magumder, 2005) and year 2006 (DOE,2006) are compared. From these three years data we can see that concentration of DO is decreasing day by day in both points (Figure 2.11 and 2.12). The concentration of BOD is increasing at the first point (Figure 2.13) and decreasing at the second point (Figure 2.14). The value of pH and EC are increasing day by day at both points. This scenario indicates that pollution intensity is increasing day by day.

## 2.6 Health Impact

The total burden of disease in Bangladesh is comparable to other low income Asian countries, the share attributable to respiratory infections and diarrhoeal disease is significantly higher. Both are associated with poor environmental conditions. The environmental factors account for as much as 22% of the national burden of disease, principally in the form of respiratory infections and diarrhoeal disease. Achievable goals for reduced exposure to environmental health risks could result in economic savings equivalent to as much as 3.5% of GDP (WB, 2006).

Environmental health risks in Bangladesh are dominated by those contributing to the high rates of diarrhoeal disease. Globally, it is estimated that 90% of the diarrhoeal disease burden is related to poor sanitation and lack of access to clean water and safe food, with

more than 90% of this burden being borne by children. The most significant health risk for 6-23 month age group is diarrhoea. The second most significant set of environmental health risks are those contributing to respiratory infections and disease, either through exposure to smoke from cooking in the home or air pollution in urban areas. These sources contribute to acute respiratory infections in children and chronic lung disease in adults, estimated to account for 36%-60% of all respiratory infections and disease in Bangladesh. The third environmental health risk identified is exposure to high levels of toxic chemicals, which can lead to an increased risk of certain cancers, particularly those related to renal and gastric functions, as well as those of the skin and blood. It is a well-known fact that clean water is absolutely essential for healthy living. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people worldwide are deprived of this (WB, 2006).

Environmental degradation in the river water from untreated domestic and industrial effluent has reached such an alarming level that it poses a significant threat to public health, ecosystem and economic growth of surrounding areas. The water is so polluted that no aquatic life can survive during the six-month dry season, which has drastically changed the socio-economic structure of the localities adjacent to the river.

World Health Organization (WHO) published (WHO, 2010) name of some given water related diseases are:

- Anaemia
- Arsenicosis
- Ascariasis
- Campylobacteriosis
- Cholera
- Cyanobacterial Toxins
- Dengue and Dengue Haemorrhagic Fever
- Diarrhoea
- Drowning
- Fluorosis

- Guinea-Worm Disease (Dracunculiasis).
- Hepatitis.
- Japanese Encephalitis
- Lead Poisoning
- Leptospirosis
- Malaria
- Malnutrition
- Methaemoglobinemia
- Onchocerciasis (River Blindness)
- Scabies
- Schistosomiasis
- Spinal Injury
- Trachoma
- Typhoid and Paratyphoid Enteric

Virtually all types of water pollution are harmful to the health of humans and animals. Water pollution may not damage our health immediately but can be harmful after long term exposure. Different forms of pollutants affect the health of animals in different ways. Industrial waste often contains many toxic compounds that damage the health of aquatic animals and those who eat them. Some of the toxins in industrial waste may only have a mild effect whereas other can be fatal. They can cause immune suppression, reproductive failure or acute poisoning. Heavy metals from industrial processes can accumulate in nearby lakes and rivers. These are toxic to marine life such as fish and shellfish, and subsequently to the humans who eat them. Heavy metals can slow development; result in birth defects and some are carcinogenic (Fewtrell and Kay, 2008).

Bangladesh Center for Advance Study (BCAS, 2006) has conducted a study in Kaliakoir to investigate effect of human health and industrial pollution. The research undertaken with the community and health workers in Kaliakoir provides evidence that local communities are suffering from a variety of health problems that could be a direct or indirect result of the activities of local factories. These problems include skin diseases, diarrhea, dysentery, respiratory illnesses, anaemia and complications in childbirth.

In this study researchers have seen that many community members believe that these problems are result of an increase in the number of industrial units in the area. It is their opinion that effluent entering the surface water bodies in the area, including khal and beel, is reducing the quality of water and as a result they are unable to use it for the purposes for which it was used in the past, such as bathing and washing cattle. When they do use it, they and their livestock suffer direct health impacts such as skin rashes and sores.

Not only do community members feel that industrial pollution is affecting their health directly but also that it is impacting on the productivity of the beel and land, which is in turn affecting their health.

Whilst no direct linkages have been proven between industrial pollution and ill health in the area there is evidence to suggest that they may be related. Skin problems may for example be related to the high pH of the water. Gastric ulcers and other similar gastric problems may be related to diet and the impacts of the pollution on crops and fish consumed by people living around Mokesh Beel. The problems of diarrhea and dysentery are to be caused directly by the industrial effluent, as they are usually the result of microbial contamination.

## CHAPTER 3

### METHODOLOGY

#### 3.1 Selection of Study Area

Strategically, Shitalakkhya is the most important river for Dhaka dwellers in terms of its use in domestic life. The Shitalakkhya has been considered as relatively unpolluted compared to other water bodies and hence targeted as a potential major source of drinking water for the ever-expanding population of the city. The river water is also being used for many purposes such as for agricultural production, fish production and also for domestic uses. Poor people have no alternatives but using the river water so they are more affected by the polluted water of this river. Residents nearby have no choice but to do their washing in the pitch black malodorous water. But the pattern of subsistence use of river water is changing day by day due to pollution of the river. Therefore it is very important to study the impact of pollution of river water on subsistence uses and its consequences on human health.

#### 3.2 Collection of Data/Information

In this study there are two types of data- primary data and secondary data. Secondary data was collected through literature review and from many relevant organizations. Primary data was collected through field visits, interviews and Focus Group Discussions. Four field visits were conducted, first field visit was carried out to understand the problem through transact walk, second field visit was to divide the river reaches and to conduct interviews with local people and following two field visits were to conduct Focus Group Discussions.

- i. **Literature Review:** Significant amount of information has been collected through literature review. Review of relevant literature had been conducted for obtaining a thorough understanding of the problem. Special attention was given to Shitalakkhya pollution in this study with data from secondary sources. Relevant materials have been collected from various organizations such as Department of

Environment (DoE), Bangladesh Bureau of Statistics (BBS). Besides, the internet was explored to obtain relevant information about Shitalakkhya River pollution and its impact on subsistence uses and health impact.

- ii. Transect boating:** In order to familiarize with the field condition. This helped to obtain preliminary information about river water use, river network and to understand the problem of the study area. During the visit photographs were taken to keep a record of severity of the problem in the area. During transect walk several tea stall meetings were made with the local people. After understanding the problem, a transect boating was made to divide the river into several reaches based on observation of pollution status.
- iii. Preparation, Pre-Testing and Finalization of Participatory Rapid Appraisal (PRA) format for Collecting Primary Data and Information:** Focus Group Discussion (FGD) is one of tools of PRA which was adopted to collect data and information relating to causes of river pollution, its impacts on subsistence uses and human health and peoples perceptions about the problems. An FGD format, which had embodied the guidelines of questions addressing the different aspects of river pollution in line with the objectives, was developed for conducting PRA. The draft PRA format was tested and verified from the field to see how far the questions asked were appropriate for the PRA surveys. The pre-tested PRA format was then modified and finalized.
- iv. Focus Group Discussion:** A total of 8 FGDs has been conducted at 4 locations - Rupganj, Tarabo, Demra, Shiddhirganj. In each area 2 FGDs were conducted, one with male and another with female group but there were not significant difference in the opinion of male and female group. Total number of participants was around 90, at each FGD 8 to 12 participants were present. During FGD, sources of pollution, its causes and impact on subsistence uses and finally consequences on health were identified. There was no significant difference in responses between male and female FGDs.



Photo 3.1: FGD with male group at Demra.

Photo 3.2: FGD with female group at Shiddirganj.

- v. **Key Informant Interview:** Two key informant interviews were also conducted in the study area one with local representative and another with local physician.

### 3.3 Data Analysis and Interpretation

Collected data and information were compiled and analysed. The interpreted data were then generated in tabular form and important ones were presented in graphs and figures.

## **CHAPTER 4**

### **DESCRIPTION OF THE STUDY AREA**

#### **4.1 Shitalakhya River**

##### **4.1.1 Geography of Shitalakkhya River**

Shitalakkhya River is also known as Lakhya River. The river flows through Ghazipur forming its border with Narsingdi for some distance and then through Narayanganj. A portion of its upper course is known as Banar River. It flows in a southwest direction and then east of the city of Narayanganj in central Bangladesh until it merges with the Dhaleswari near Kalagachhiya. The river is about 110 km long and at its widest, near Narayanganj, it is 300 meters in width. The river reaches the Lakhya River at 20600 meters. The river's maximum depth is 70 feet (21 m) and average depth is 33 feet (10 m). This river is connected with Balu River and Saydabad Water Treatment Plant (SWTP) intake canal (Figure 4.1). Dhaka city wastes fall into the Lakhya River through Balu River.

##### **4.1.2 Hydrology of Shitalakkhya River**

Its highest discharge has been measured at 2,600 cusec at Demra. It remains navigable year round. The river flow remains very low in dry season and high in monsoon. The water level in the river system varies from 1m PWD to 1.50m PWD having average level 1.35m PWD during dry period. The river system gets virtually no fresh water inflows from upstream except some wastewaters and agricultural returned water in the dry season. Average channel widths at level of 1.5 m PWD is 260 m. Storage volume and open area of the river system at 1.25 m PWD level (an average water level in dry season) are 75 million m<sup>3</sup> and 32 million m<sup>2</sup> respectively. Tidal influence is very much apparent in this river. During tidal period pollution intensity remains low (Magumdar, 2005).



Figure 4.1: Shitalakkhya river and its connection with other rivers and canals.

## **4.2 Narayanganj District**

Narayanganj District is a district in central Bangladesh, part of the Dhaka Division. The main city of the district is also called Narayanganj; it is near the capital city of Dhaka. The river port of Narayanganj is one of the oldest in Bangladesh. It is also a center of business and industry, especially the jute trade and processing plants, and the textile sector of the country. It is nicknamed the Dundee of Bangladesh due to the presence of many jute mills.

### **4.2.1 Geography**

Narayanganj District is bounded by Gazipur and Narsingdi Districts on the north, Brahmanbaria and Comilla Districts on the east, Munshiganj District on the south, and Dhaka District on the west. Geologically, the area lies on the edge of the Madhupur Tract and Holocene floodplain deposits form the aquifer. The total area of the district is 759.57 km<sup>2</sup>, of which 48.56 km<sup>2</sup> is riverine and 0.60 km<sup>2</sup> is under forest. The district lies between 23°33' and 23°57' north latitude and between 90°26' and 90°45' east longitude.

The city of Narayanganj is located some twenty kilometres southeast of Dhaka, the national capital, on the flat Ganges Delta and alluvial plain. The Shitalakshya River divides the town into two parts, the Narayanganj Municipal Area and Kadam Rasul Municipal Area. This area is crossed by many small artificial canals fed by monsoon rain. Average annual rainfall is 2550 mm, 80 to 90% of which occurs between May and October.

### **4.2.2 Administrative Area**

Narayanganj Zila consists of five upazilas, 47 unions and 827 mauzas. Out of the five upazilas Rupganj is the largest with an area of 247.97 km<sup>2</sup>, which is 32.65% of the total area of the zila. Bandar is the smallest with an area of 55.84 km<sup>2</sup>. All the upazilas have more or less similar characteristics.

### **4.2.3 Population**

The total population according to 2001 census in the Narayanganj district is 2173948, the total number of male is 1161971 and female is 1011977 (BBS 2007). Here we can see that number of male is higher than number of female as it is an industrial area.

### **4.2.4 Literacy rate and educational institutions**

The average literacy rate Narayanganj district is 39.84%; the percentage of male literacy rate is 46.23% and the percentage of female literacy rate is 32.24%. Total number high school in Narayanganj district is 129, total number of primary school is 423. The noted educational institutions are Narayanganj High School (1885), Tolaram College (1937) and Sonargaon J R institute (1900). Some other educational institutions in this district are Art College 1, physical education institute 1, marine technology centre 1.

### **4.2.5 Main occupations**

People in this district are engaged in different types of occupations. The percentage of people engaged in agriculture is 13.37. Some people do not have own agricultural land, they act as agricultural laborer on other land and the percentage of this type of people is 8.61. Some people act as wage labourer and their percentage is 4.07, commerce people are 19.9%, service holder is 23.36%. The percentages of some other occupational people are weaving 5.49%, transport 4.09%, fishing 1.21%, industries 2.74%, construction 1.48%, others 15.68%.

### **4.2.6 Manufacturing**

Narayanganj district is converting an industrial area and we know this district is known as the Dundee of Bangladesh. Different types of industries are situated in this district such as Adamjee Jute Mills (closed in 2002), Chittaranjan Cotton Mills, Lakshmi Narayan Cotton Mills, Dhakeshwari Mills, Star Particle Board Mills, Dhaka Vegetable Oil Mills, Husain Paper Mills, Moula Textile, RM Steel Mill, Haripur Electricity Centre, Hosiery Industries, Dying Mill, Aluminum Factory. Besides, Kachpur has become as an industrial town.

#### 4.2.7 Cottage industries

Different types of cottage industry are also situated in this district. Weaving is traditionally the most important cottage industry. Rupashi and Kazipara are famous for Jamdani sari production. Narayanganj is also famous for hosiery products.

#### 4.2.8 Health centers

Numbers of health centers are less against total number of people. There is one District Hospital, one Health Division in this district. There is four private hospitals and four Thana health complex (BBS 2007).

### 4.3 Socio economic characteristics of the study area

Rupganj union, Tarabo union, Shiddirganj union (Narayanganj district) and Demra union (Dhaka district) belong to study area. Administrative information that is area, households, number of population and literacy rate about these four unions are given in the following Table 4.1.

**Table 4.1: Area, number of households, number of population and literacy rate of four unions.**

Union	Area in Sq.km	Households	Population				Literacy rate (7+ years)		
			Total	Density (Per sq.km)	Male	Female	Total	Male	Female
Shddirganj	11.79	22282	96222	8161.32	53723	42499	61.22	65.76	55.40
Rupganj	29.19	8791	44013	1507.81	22703	21310	46.76	50.71	42.55
Tarabo	21.95	19731	91131	4151.75	52459	38672	54.40	60.53	45.77
Demra	14.37	4561	23374	1626.58	12567	10807	54.21	58.83	48.79

Source: BBS (2006) and BBS(2007).

In the above Table, we can see that number of households is highest in Shiddirganj and number of population also highest in also highest in Shiddirganj. This may be Shiddirganj is more developed union than other three unions and there may be also more working opportunity as there is higher agricultural activities and large number of industries are

present there. Literacy rate is also highest in Shiddiragnj. In all these unions number of male is higher than number of female as all these are industrial areas.

The main activities of these four unions are shown in the Table 4.2. Percentage of not-working people is highest at Shiddirganj and then at Demra. Agricultural activities are higher in Rupganj and industrial activity is higher in Tarabo.

**Table 4.2: Population 10 years and over by main activities (%).**

Union	Total	Not working	Looking for work	Household work	Agriculture	Industry	Business	Service	Other
Shddirganj	75234	34.08	3.06	22.02	6.74	4.17	8.25	0.56	15.27
Rupganj	32758	25.14	1.96	34.39	19.53	2.05	8.38	0.43	6.31
Tarabo	71804	24.56	2.41	22.89	3.79	9.86	6.57	0.33	26.16
Demra	17940	31.36	2.56	29.46	9.14	1.86	9.52	0.78	11.70

Source: BBS (2006)

There are mainly four sources of drinking water in these unions, these are-tap, tubewell, well, pond and other sources. In the Table 4.4 it is seen that highest percentage of household use tubewell water at Rupganj followed by Tarabo, Demra and then at Shiddirganj.

**Table 4.3: Sources of drinking water.**

Union	Total household	Sources of drinking water (%)				
		Tap	Tube-well	Well	Pond	Other
Shddirganj	21158	15.9	75.76	5.11	0.45	2.27
Rupganj	8743	0.42	98.29	0.35	0.02	0.90
Tarabo	17540	3.04	92.54	1.28	0.18	2.95
Demra	4521	1.19	88.98	2.59	1.0	6.24

Source: BBS (2006)

#### **4.4 Industries around Shitalakkhya River**

Numbers of industries are present in the study area and most of the industries are playing considerable role in river pollution. Major types of industry are chemical industry, textile and dyeing industry, paper mills, cement industry, oil industry, power plants, glass industry etc. The approximate location of these industries along the Shitalakkhya river are shown in Figure 4.2.

Name of some industries that are situated in the study area are-Navana pharmaceuticals, Hima food, Momin Uddin Textile, Mir Cement Factory, Lina paper mills, Sinha dying industry, Fatullah dying mill, Shonali paper mill, Mahbub dying mill., J.M.S.Glass Industries Limited, Pusti Soyabin Oil, Scan Cement, Haripur power station and Shiddirganj power station

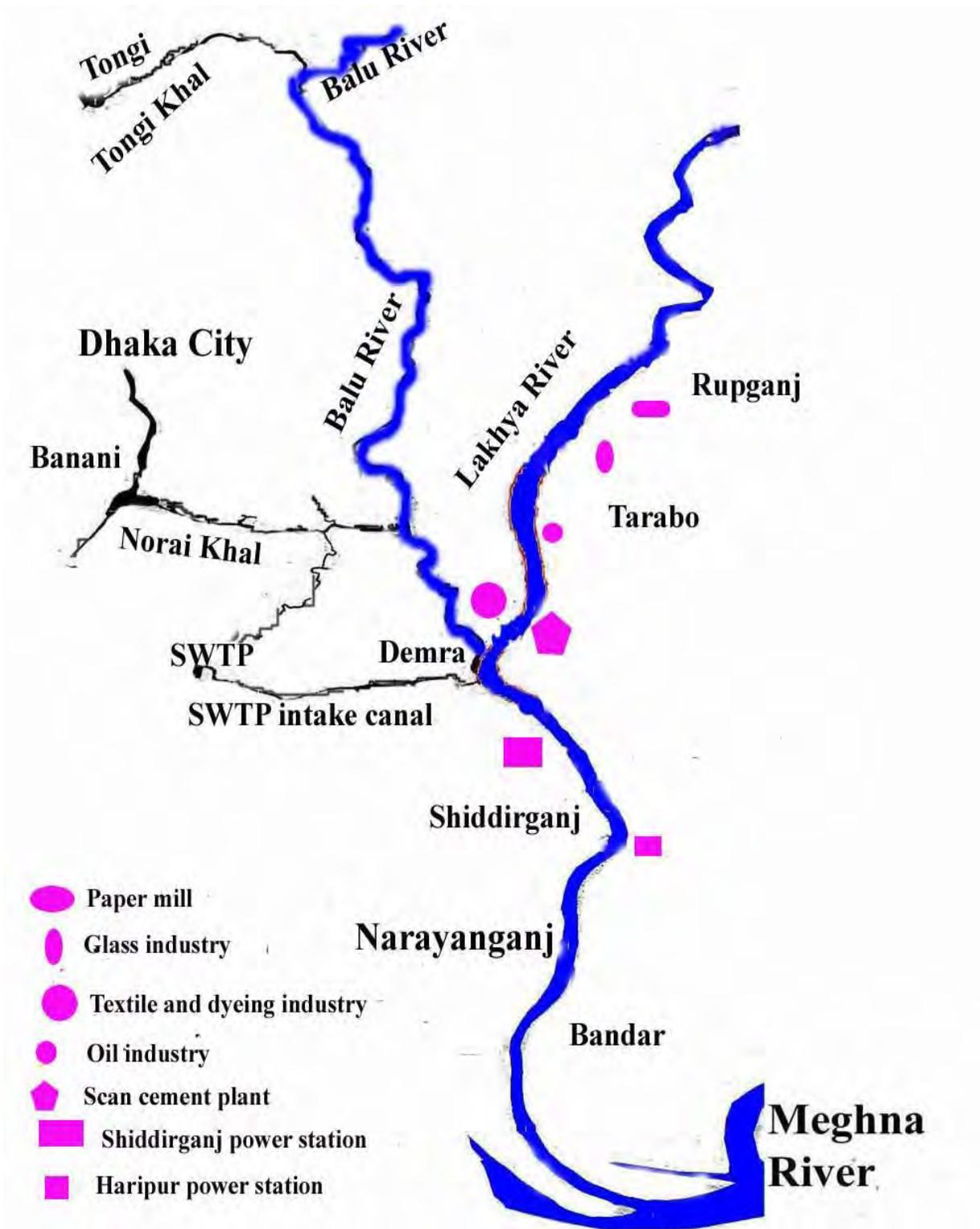


Figure 4.2: Approximate location of major industries around Shitalakhya River.

## **CHAPTER 5**

### **RESULTS AND DISCUSSION**

#### **5.1 Division of river reaches**

The river has been divided into four reaches on the basis of observation of pollution status (mainly colour and smell) of the river. The reaches are shown in Figure 5.1. The names of four reaches are:

1. Rupganj ( Approx.  $23^{\circ}44'8''\text{N}$  to  $23^{\circ}45'8''\text{N}$ )
2. Tarabo (Approx.  $23^{\circ}43'8''$  to  $23^{\circ}44'8''\text{N}$ )
3. Demra (Approx.  $23^{\circ}42'8''$  to  $23^{\circ}43'8''\text{N}$ )
4. Shiddirganj (Approx.  $23^{\circ}39'8''$  to  $23^{\circ}41'8''\text{N}$ ).

Information was collected mainly from the respondents who live along the river side and the focused area was Chanpara slum under Rupganj union, Sharulia under Demra union, Shailo road, Shardar Bazar under Shiddirganj and from Tarabo. The pollution intensity is different in the four reaches as the number and type of industry are different in different reaches. As the pollution intensity and socio economic condition is different, subsistence uses of river water are also different in different reaches.

##### **5.1.1 Rupganj**

Rupganj is situated at the upstream of the Shitalakkhya River. Number of industries is less in this area compared to other areas. Through discussion with local people it is known that there are some dyeing industries and jute mill in Rupganj. In this area, there is a local market which is known as Rupgonj Bazar. The shop keepers of this market are highly dependent on Shitalakkhya river. Most of the local people in this reach depend on the Shitalakkhya river for their domestic purposes.

##### **5.1.2 Tarabo**

This is the region in which Balu River is connected which is the main outfall of discharge of Dhaka city waste into the Shitalakkhya River. As a result, pollution intensity is more in this reaches than Rupganj. In this area, glass industry, textile industries and paper mills are located.

### **5.1.3 Demra**

It is a highly industrial area and the main reason of pollution in this reach is industrial wastes. Some big industries such as Pusti Soybean oil, Scan Cement industry are situated here. Other types of industries such as chemical industry, textile and dyeing industry are also situated here. Because of industrial pollutant, pollution intensity is very high here.

### **5.1.4 Shiddirganj**

This reach is situated in the down stream of the river. This is also a highly industrial area. In this area two power plants are situated of the country namely Shiddirganj Power station and Haripur Power station are situated here. Because of the wideness of the river in this reach pollution intensity is lower than Demra to some extent.

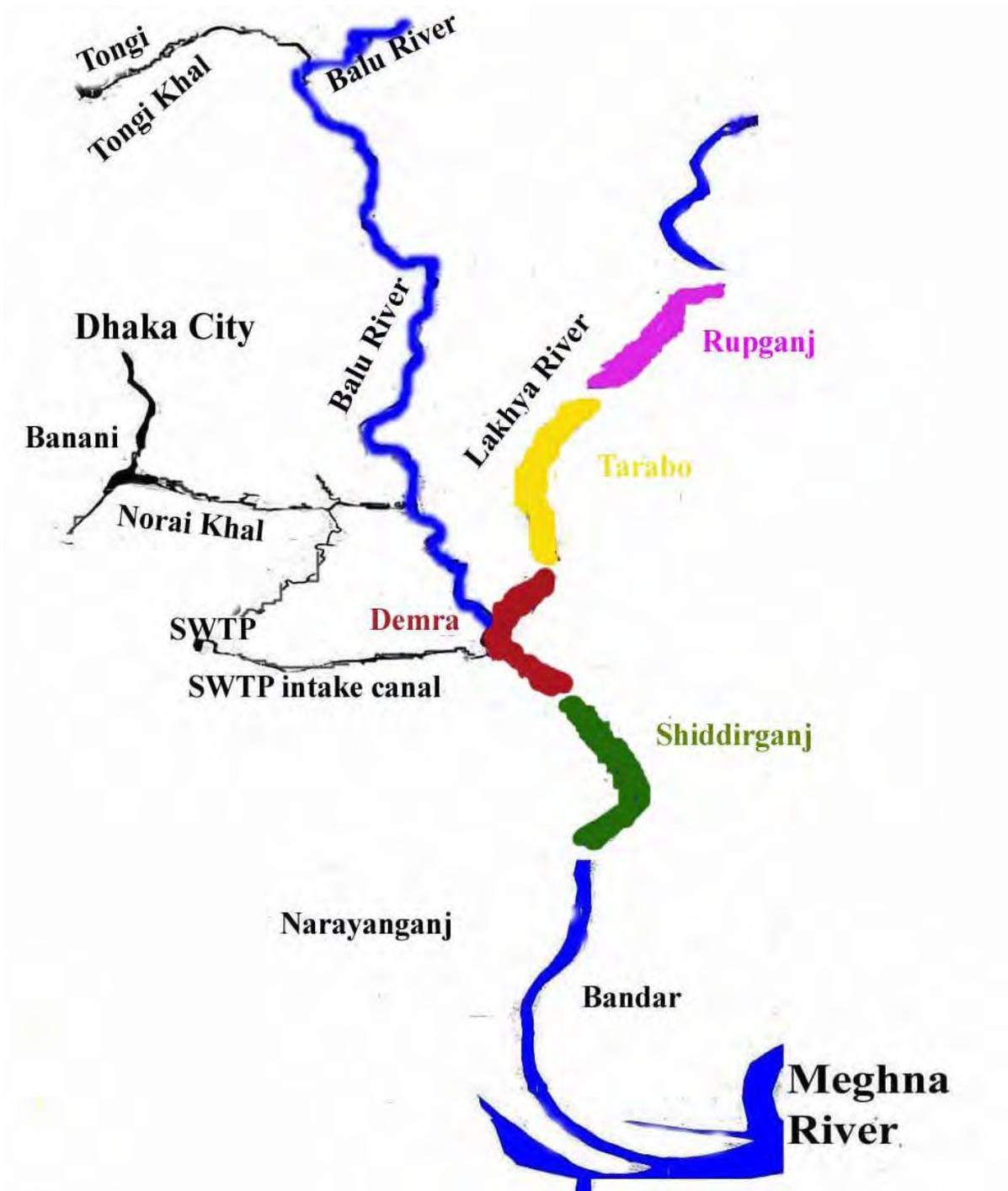


Figure 5.1: Approximate division of river reaches.

## 5.2. Pollution Intensity

At present, the water of Shitalakkhya River is significantly polluted that is the river is no more suitable for subsistence uses. The pollution intensity varies with season. The river becomes highly polluted in dry season and in wet season pollution intensity is low because of dilution with rainwater/upstream flow. From the field visits some observations of physical parameters of the Shitalakkhya river water are given in the Table 5.1.

**Table 5.1: Pollution status of Shitalakkhya river on the basis of observation of physical parameter.**

Parameter	Site							
	Rupanj		Tarabo		Demra		Shiddirganj	
	Dry Season	Wet season	Dry Season	Wet season	Dry Season	Wet season	Dry Season	Wet season
Colour	Black	Normal	Black	Normal	Pitch black	Light black	Black	Normal
Smell	Bad	Not noticeable	Very bad	Not noticeable	Very bad	Not noticeable	Bad	Not noticeable
Temperature	Normal	Normal	Normal	Normal	Normal	Normal	Warm	Warm

### 5.2.1 Rupganj

The color of the river water varies in different reaches. The color of river water is black but less dark than other three reaches because in this reach, number of industries is less and offtake of Balu is far away from this reach. For the same reason, severity of bad smell is not so high but local people said that they get bad smell only for Dhaka city waste not for industrial wastes.

### 5.2.2 Tarabo

Pollution intensity in Tarabo is higher than Rupganj, because in this area number of industries is higher than Rupganj and the outfall of Dhaka city waste is near Tarabo that is, connection of Balu river is close to the Tarabo. Therefore, color of river water black here and darker than Rupganj. The same reason is responsible for very bad smell in this area.

### 5.2.3 Demra

The quality of river water is very poor in Demra. The colour of river water in this reach is pitch black and smell is very bad. Because the outfall of Balu river is situated on Demra and considerable city wastes discharge into the Shitalakkhya river through this Balu river. A large number of industries are also situated in Demra and these industries also discharge considerable amount of wastes into the Shitalakkhya River.

### 5.2.4 Shiddirganj

In Shiddirganj, river water is warm because two large power plants are situated here and power plant discharge warm water directly into the river. Other types of industries are also situated here and impact of city wastes is also present. But pollution intensity is not as high considering number of industries here because of the wideness of the river. As the river is wide at the down stream, pollutants become diluted. The local people said that from three or four years the river is getting worse. The local people understood that the river water has polluted after getting bad smell from the river water and seeing the black color of the water.



Photo 5.1: Local wastes discharged at Demra.



Photo 5.2: Polluted water at Shiddirganj near power plant.



Photo 5.3: Pitch black river water observed at Demra.

(Note: Use of pitch black river water for washing.)

### 5.3. Pollution Type

Narayanganj is a highly industrial area and a large number of industries are situated on the bank of Shitalakhya river. From field observation and FGD, three main sources of pollution are identified in all the four reaches, which are:

- Dhaka city domestic wastewater
- Industrial waste
- Local waste

Industry of pollutants has been assessed qualitatively based on type of industries. Typical effluents from such industries have been discussed in chapter 2 (Literature Review) e.g. Table 2.2, 2.3, 2.4.

**Table 5.2: Intensity of different pollutants in Shitalakhya river.**

Parameter	Site			
	Rupganj	Tarabo	Demra	Shiddirganj
BOD	Moderate	Moderate	High	High
Suspended solids	Moderate	Moderate	High	High
Nitrate, Phosphate	High	High	Moderate	Low
Sulphate	Moderate	Moderate	High	Moderate
Heavy Metal	Moderate	Moderate	High	High

### **5.3.1 BOD**

BOD load is high in Demra and Shiddirganj because in these two reaches number of textile and dyeing industry is higher than other two areas and these two industry release significant amount of BOD, therefore we can say that the BOD load is high in these areas. However it can be mentioned that worst effect of organic wastes is usually felt some distance of its discharge point.

### **5.3.2 Suspended solids**

The suspended solids is high in Demra as chemical industry, textile industry, jute mill, oil industry, paper industry are present and all these industries release suspended matter with wastes, high in Shiddirganj as textile industry is present here and high in Tarabo as paper mill, glass industry present here. All these industries release significant amount of suspended solids into the river.

### **5.3.3 Nitrate and phosphate**

Nitrate and phosphate is high in Rupganj and Tarabo as jute mills are present here and fertilizer factory are situated in the upstream and these industries release significant amount of nitrate and phosphate into the river.

### **5.3.4 Sulphate**

Sulphate is high in Demra as cement industry is present here that release high amount of Sulphate. Sulphate is moderate in Rupganj and Tarabo as jute mills are present.

### **5.3.5 Heavy metal**

Heavy metal is high in Demra as chemical industry, textile industries are present and these industries release significant amount of heavy metal into the river and also high in Shiddirganj as power station, textile industries are present here.



Photo 5.4: Waste water discharging from at Shiddirganj power plant.



Photo 5.5: Waste water discharging from textile industry at Shiddirganj.



Photo 5.6: Discharge of local waste into Shitalakkhya river at Demra.

#### **5.4. Subsistence uses of river Water**

River water has different types of subsistence uses but the uses of water vary with season that is in dry season and wet season. Different types of subsistence uses of the Shitalakkhya river water are presented in Table 5.3 and this Table is prepared on the basis of FGD.

**Table 5.3: Different types of subsistence uses of Shitalakkhya river water.**

Subsistence uses	Sampling Points							
	Rupganj (1)		Tarabo (2)		Demra (3)		Shiddhirganj (4)	
	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season
<b>Drinking</b>	No	No	No	Low	No	Low	No	Moderate
<b>Cooking</b>	Low	Moderate	No	Moderate	No	Low	Moderate	High
<b>Bathing</b>	Very High	Very High	Very High	Very High	High	Very High	Very High	Very High
<b>Washing</b>	Very High	Very High	High	Very High	High	Very High	Very High	Very High
<b>Fishing</b>	No	No	No	No	No	No	No	No
<b>Boating</b>	Moderate	Moderate	Moderate	Moderate	Low	Low	Low	Low
<b>Livestock grooming</b>	Low	Low	Low	Low	Low	Low	Moderate	Moderate
<b>Vegetable Cultivation</b>	Low	Low	Moderate	Moderate	Low	Low	High	High

Note: No use-No; Only few people use-Low; Some people use-Moderate; Use by most of the people-High; Use by all-Very High.

### 5.4.1 Drinking

The river water is not used for drinking purpose in any area in the dry season due to very bad smell and pitch black color of river water. But few people of Tarabo and Demra said that they use this water for drinking in wet season and they treat the water with alam (fitkery) then use it for drinking. The number of people who use the river water for drinking purpose in wet season is some what high in Shiddhirganj. After the river water become polluted, the sources of drinking water become difficult in all the four reaches. People who have tubewell use tubewell water for drinking but those who do not have tubewell they take water from those who have tubewell by giving some monthly charge. They also face some harassment to collect this tubewell water from tubewell owner especially in the dry season as the water become very scarce in this season. In the dry season, when ground water does not come through tubewell, drinking water becomes more difficult to the local people.

### **5.4.2 Cooking**

The use of water for cooking varies with the season. Local people of Rupganj and Tarabo said that they use the river water for cooking in wet season as the bad smell become less. In wet season they use water for cooking through boiling or by using fitkary. Those have tube well in their own house, they use tube well water for cooking but those don't have tube well they use river water for cooking in wet season. But in dry season, people cannot use river water for cooking as pollution of water in dry season is much higher than the wet season. But some people has no alternative but using this river water for cooking as they can collect very limited amount of tube well water which is not sufficient to meet their drinking demand. Use of river water for cooking in Shiddirganj is high in wet season and moderate in dry season because most of the people have no alternative source of water for cooking purpose. Their house owners give very limited amount of water for their drinking; therefore they are bound to use river water for cooking. In both seasons they treat the water with alum (fitkery) and then use it for cooking.

### **5.4.3. Bathing**

Most of the people use the river water for bathing in all the four reaches. They use the river water directly for bathing. About ninety percent people use the river water for taking their bath. Male, female and children take their bath directly into the river and to some extent old people also use the river water for their bathing. A few people having tube well take bath with tubewell water but some people are very unwilling to spend their valuable tube well water for bathing though they have tubewell in their houses. But others are bound to use the river water for bathing. In Shiddirganj, when water becomes much warm they cannot use the water for bathing because their skin is burnt. It can be said that Shitalakkhya river water is significantly used by local people for bathing.

### **5.4.4. Washing**

The people in all four reaches use this water for washing of all types of things such as clothes, utensils etc. Some people, who get very limited amount of tube well water, also wash vegetables with the river water. Most of the vegetable shopkeepers in Rupganj Bazar wash their vegetables by this river water and washing of all the things in this Bazar

is done by Shitalakkhya river water. In both seasons, local people of all the four areas use river water for all kinds of washing. In a word, we can say that the Shitalakkhya river water has significant use for washing purpose in both seasons.

#### **5.4.5 Fishing**

Local people of Rupganj and Tarabo said that they get very few fishes in this river in the wet season. But in the dry season, no fishes occur in any reaches from the river. They claim that this river water is not suitable for fish cultivation; therefore the fishermen shifted their profession from catching fish, now they work in different industries as worker. The local people in all the reaches also said that Ghorashal fertilizer factory discharge their waste two or three times in a year. At that time all the fishes die and local people catch those fishes and eat these fishes.

#### **5.4.6 Boating**

Though the river water is quite polluted for boating, but a good proportion of people still earn through boating. But they also said that their earning has drastically reduced after the river has become polluted. Previously, many people used the boats only for their recreational purpose. But now people are very unwilling to use the river path. When people are bound to use the river path only at that time they cross river through boat. In other words, we can say that recreational use of Shitalakkhya River has totally appeared; now people do not want to get on boat due to very bad smell of the river water. Therefore, the income level of the boatmen has highly reduced as a result, their living standard has also declined. Number of boatmen is moderate in Rupganj and Tarabo but they are very poor and their living standard is also very poor. Number of boatmen is few in Demra and Shiddirganj because these two are highly industrial area and most of the people work in industry in these two areas.

#### **5.4.7 Livestock grooming**

The river water is used for livestock bathing. They also use the river water for livestock drinking. This use is low compared to other uses but moderate in Shiddirganj because cultivation practice is more intensive in this area compared to other three areas.

### 5.4.8 Vegetable Cultivation

In Rupganj and Demra very few people grow vegetable in their yards but culture of vegetable cultivation is high in Shiddirganj. They cultivate different types of vegetable in river side by using river water directly.



Photo 5.7: Use of river water for boating at Rupganj.



Photo 5.8: Extensive use of river water for washing at Rupganj.



Photo 5.9: Taking river water for cooking at Tarabo.



Photo 5.10: Vegetable washing with polluted river water at Rupganj.



Photo 5.11: Bathing in river at Demra.



Photo 5.12: Live stock washing in the river at Shiddirganj.



Photo 5.13: River water used for vegetable cultivation at Shiddirganj.

## **5.5 Health hazards due to Shitalakkhya River pollution**

### **5.5.1 Observed health impact of local people**

Pure water is an essential component of healthy life but the people who live beside the Shitalakkhya River are now suffering from scarcity of pure water. Deficiency of pure drinking water during dry season is high as the river become highly polluted and people

also do not get water from the tube wells. As a result, negative impact on the health sector appeared in all the reaches. For the same reason, water born diseases also increased among the local people. Some common diseases identified in the four reaches based on interview and FGD are shown in the Table 5.4.

**Table 5.4: Common diseases of local people.**

Diseases	Site			
	Rupganj	Tarabo	Demra	Shiddirganj
<b>Skin Diseases</b>	Prevalent in most of the people			
<b>Diarrhea</b>	Very frequent suffering among children	Frequent suffering among children	Frequent suffering among children	Very frequent suffering among children
<b>Jaundice</b>	Less frequent, children& women are mainly affected	Less frequent, children& women are mainly affected	Less frequent, children& women are mainly affected	Frequent, children& women are mainly affected
<b>Cholera</b>	Less frequent, children& women are mainly affected			
<b>Dysentery</b>	Very frequent suffering among children	Very frequent suffering among children	Very frequent suffering among children	Very frequent suffering among children-

### **Skin Diseases**

In the Table 5.4 it is seen that in all the reaches most of the people are affected by skin diseases. Because in Table 5.3 we have seen that the use of river water is very high for bathing and washing purposes, as a result their skin are directly exposed to polluted water. Therefore skin diseases are highly prevalent in all the reaches.

### **Diarrhea**

In Table 5.4 it is seen that diarrhea occur very frequently in Shiddirganj because in Table 5.3 we have seen that moderate number of people in dry season and high number of people in wet season use river water for cooking purpose. Though they use water through alum (fitkery) but all the pollutants are not removed by alum (fitkery), as a result many

pollutants are entering into their body and diarrhea occurs frequently. People, who are taking polluted water, are more or less affected by diarrhea but children are the main victim because their body mechanism is not strong enough to resist the pollutant. For the same reason, diarrhea occurs very frequently in Rupgonj as large number of people depends on the river water.

### **Jaundice**

Jaundice occurs frequently in Shiddirganj because many pollutants and microorganisms can enter their body as they use water for cooking purpose. And women are more affected because they remain more in contact with water than male.

### **Dysentery**

Very frequently occur in all the reaches because people are directly exposed to the polluted water either through cooking or bathing or vegetable washing.

### **Cholera**

Cholera occurs in all the reaches but less frequently and children and women are mainly affected.

### **Bad smell**

Most of the respondent said that after taking bath by this polluted water they get bad smell from their body and after washing the cloth with this river water, they also get bad smell from their clothes.

### **Health hazards of children**

All most all the respondents reported about the health hazards of children due to pollution of the Shitalakkhya River because when they come to the river for bathing they spend long time with the contact of the polluted water. Children in these areas are mainly affected by diseases like skin diseases, diarrhoea, blood dysentery, cold and cough, typhoid, fever etc. The small children those are used to breast feeding are also affected through their mother as their mother use the polluted water. These children are mainly affected by skin diseases, diarrhea. But no cases of death due to the diseases have been

reported by them.



Photo 5.14: Skin Diseases of different ages of children due to use of polluted river water seen at Shiddirganj.

### **5.5.2 Potential Health Impacts**

We know polluted water has so many severe impacts on human health but through interviews and FGDs it has been seen that local people are not aware or do not know about all the health hazards that occur due to water pollution. Therefore, it is time to discuss the potential health hazards due to water pollution. At first we see the paths through which polluted water can affect human health.

To understand the linkage between water pollution and health impact I have interviewed a health specialist Mr. Mujibur Rahman in Narayanganj. He explained me the cause and effect diagram between water pollution and human health by the following way:

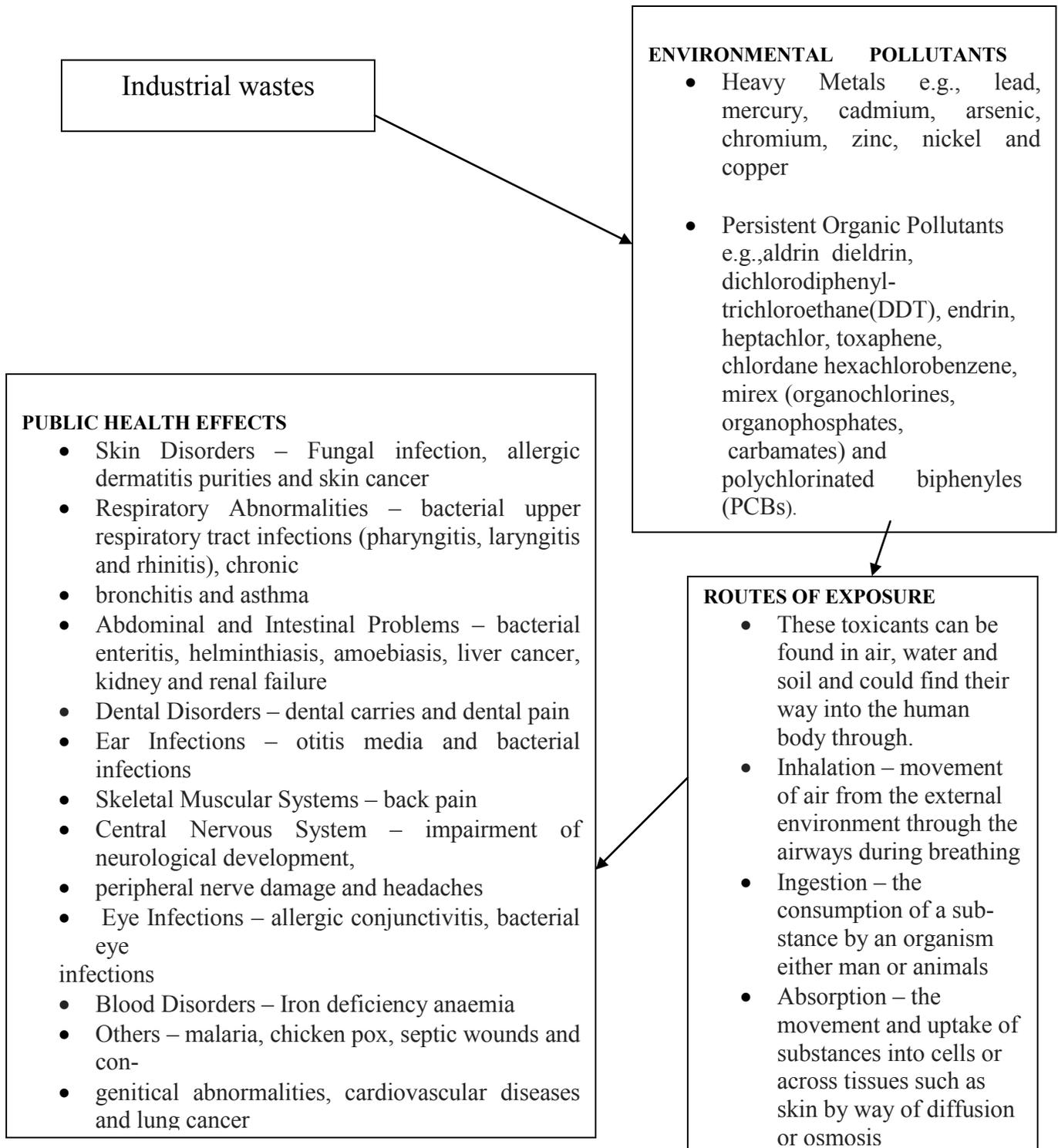


Figure 5.2: Cause and effect diagram by water pollution.

People who are bound to use river water do their cooking only through boiling or by using alum (fitkery), but through these two processes all the pollutants are not removed especially heavy metals are not removed. Besides this, when all fishes of the river die due to discharge of wastes from Ghorashal fertilizer factory, local people catch them and eat them. Pollutants are also entering into the food chain through vegetable cultivation and through livestock. The health impacts are described below.

**Lead.** Lead releases from chemical industry, glass industry, pulp and paper industry, textile industry, fertilizers industry. All these industries are present at Demra and glass industry, pulp and paper industry, textile industry are also located at Tarabo. Lead is hazardous to health as it accumulates in the body and affects the central nervous system. Children and pregnant women are most at risk (Fewtrell and Kay, 2008).

**Nitrates.** Nitrates are released from fertilizer industry and paper and pulp industry. Paper mill is present in Tarabo. Drinking water that gets contaminated with nitrates can prove fatal especially to infants that drink formula milk as it restricts the amount of oxygen that reaches the brain causing the „blue baby“ syndrome. It is also linked to digestive tract cancers. It causes algae to bloom resulting in eutrophication in surface water (Fewtrell and Kay, 2008).

**Arsenic.** Arsenic is released from chemical industry, glass industry, textile industry and fertilizer industry. Chemical industry, glass industry, textile industry are located on Demra. Arsenic poisoning through water can cause liver and nervous system damage, vascular diseases and also skin cancer (Fewtrell and Kay, 2008).

**Mercury.** Mercury is released from chemical industry, glass industry, pulp and paper industry, textile industry, fertilizers industry. Chemical industry, glass industry and textile industry are present in Demra; glass industry, textile industries and paper mills are present in Tarabo (Fewtrell and Kay, 2008).

Young children and fetuses are most at risk of mercury because their systems are still developing. Exposure to mercury in the womb can cause neurological problems,

including slower reflexes, learning deficits, delayed or incomplete mental development, autism, and brain damage. Mercury in adults is also a problem, causing:

- central nervous system effects like Parkinson's disease, multiple sclerosis, and Alzheimer's disease;
- heart disease;
- and, in severe cases, causing death or irreversibly damaging areas of the brain.

**Other heavy metals.** Heavy metals cause damage to the nervous system and the kidney, and other metabolic disruptions (Fewtrell and Kay, 2008).

**City wastes:**

Dhaka city wastes and local city wastes discharged into the Shitalakkhya River through Balu River and these wastes contain lots of bacteria, virus and protozoa. Therefore, the water of Shitalakkhya contains lots of bacteria, virus and protozoa. Different types of diseases that occur due to bacterial, viral and protozoa infection are given in the following table:

**Table 5.5: Causes of water borne diseases.**

<b>Causes</b>	<b>Water-borne diseases</b>
Bacterial infections	Typhoid, Cholera, Paratyphoid fever, Bacillary dysentery
Viral infections	Infectious Hepatitis (jaundice) Poliomyelitis
Protozoal infections	Amoebic dysentery

Virtually all types of water pollution are harmful to the health of humans and animals. Water pollution may not damage our health immediately but can be harmful after long term exposure.

## **CHAPTER 6**

### **CONCLUSION AND RECOMMENDATION**

#### **6.1 Conclusion**

The river has been divided into four reaches on the basis of observation of pollution status of the river. The reaches are Rupganj., Tarabo, Demra and Shiddhirganj. The pollution intensity is different in the four reaches as the number and type of industry are different in different reaches. In Rupganj some dyeing industries and jute mills are located. In Tarabo glass industry, textile industries and paper mills are located. In Demra some big industries such as Pusti Soybean oil, Scan Cement industry are situated here and other types of industries such as chemical industry, textile and dyeing industry are also situated here. In Shiddirganj two power plants Shiddhirganj Power station and Haripur Power station are situated.

The pollution intensity of Shitalakkhya river varies with season. The river becomes highly polluted in dry season and low in wet season because in monsoon pollutant of river is flushed by rain water. The pollution intensity has been determined in terms of some physical parameter such as color, smell and temperature on basis of field visits. The color of the river water is pitch black at Demra and smell is very bad at Tarabo and Demra. The river water is warm in Shiddirganj as two power plants discharge warm water directly into the river.

Three main sources of Shitalakkhya river pollution are Dhaka city waste, industrial wastes and local wastes. Pollution type is different in different reaches as industrial type is different. Pollution type has assessed in terms of intensity of some pollutants-BOD, suspended solids, nitrate, phosphate, sulphate and heavy metals. Discharge of BOD is high in Demra and Shiddirganj, suspended solid is also high in Demra and Shiddirganj. Nitrate and phosphate are high in Rupganj and Tarabo. Heavy metals are high in Demra and Shiddirganj.

Shitalakkhya river is polluted enough but still this river water has many subsistence uses. But subsistence uses vary with seasons and also vary with pollution intensity and socio economic condition of different reaches. Different types of subsistence uses are drinking, cooking, bathing, washing, fishing, boating, livestock, and vegetable cultivation. Some people of Tarabo and Shiddirganj use this river water for drinking purpose and also use for cooking purpose by treating the water with alum (fitkery) or through boiling. Some people of Shiddirganj also use this water for cooking in dry season because they have no alternative sources. The major subsistence use in all reaches are washing and bathing. Due to pollution of river, deficiency of pure drinking water during dry season is high and people also do not get water from the tube wells in dry season. As a result, negative impact on the health sector appeared in all the reaches as pollutants are entering human body either through direct consumption or through food chain. Some common health hazards in study areas are skin diseases, diarrhea, jaundice, cholera, dysentery. People also get bad smell from their body and their clothes after bathing and washing respectively. Children are mainly vulnerable to river pollution.

## **6.2 Recommendations**

- Due to time limitation it was not possible to determine how many or what percentages of people depend on river water for their subsistence uses in different river reaches. Therefore, it is necessary to quantify number of people who are dependent on river water for their subsistence uses.
- Pollution level of river water has reached alarming level; therefore reducing pollution is must for saving this river.
- It is right time to find out alternative sources of water because during dry season people do not get water from tubewell. Therefore at that time, all the people depend on polluted river water although pollution level remains very high during dry season. So it is recommended to provide deep tubewells to the affected villages.

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## APPENDIX A

### Name list of FGD participants

#### Name of female participants

Location	Participant (Female)
<b>Rupganj</b>	Haoa Begum Shapla Saleha Kolpona Taposhi Sharmin Shoma
<b>Demra</b>	Shumona Hosne Ara Anju Baby Oaleda Ambia Begum Shirin
<b>Tarabo</b>	Rahima Shimu Shompa Salma Shahida Ruma
<b>Shiddirganj</b>	Julekha Amena Taslina Shoma Mitu Nahida

	Kakoli Shumona
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### Name of male participants

<b>Location</b>	<b>Participant (Male)</b>
<b>Rupganj</b>	Ali Hossain Shah Alam Shahid Shukkur Ali Ali Ashraf Md. Zaman Shakhawat Hossain
<b>Demra</b>	Aolad Hossan Alomgir Abul Mia Md. Shafik Rangu Mia Rahim Mia Bazlu Mia
<b>Tarabo</b>	Rahim Mia Shumon Abdul Hai Salim Shahid Jahirul Ramjn
<b>Shiddirganj</b>	Amin Joinal Jamal

	<p>Sohel</p> <p>Mamun</p> <p>Nahid Ali</p> <p>Shamsul</p>
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**Name of key informants-**

1. Mr. Mujibur Rahman (Doctor) at Rupganj
2. Md. Zaman (Gram Sharkar) at Demra

**APPENDIX B**  
**(Summery of FGDs)**

<b>Perception about pollution status of river water by the local people</b>	
Sources of pollution	Industrial wastes, city wastes, household wastes.
Quality of river water five years ago	River water was not polluted severely like present condition. Boatman Bazlu Mia said that 15-20 years ago the water of Shitalakkhya river was the holy water for us. People came from long distance to take this river water because they believed that this water was the medicine of all diseases but now people cannot come near the river because of its bad smell.
Acceptance of present status of river pollution	Large number of people can not accept this poor condition of river water because they are highly dependent on river water.
Prediction about quality of river water after 5 years	River water will be very poor in quality if necessary action is not taken.
<b>Subsistence uses of Shitalakkhya River water</b>	
Drinking	River water is used for drinking purpose at Tarabo and Shiddirganj in wet season. Shakhawat Hossain, a resident in Tarabo said that the river water was not so polluted like now. Before this severe pollution of river water people used this water as drinking water by using simple Fitkari but now this water is totally impossible to use for drinking purpose.
Bathing	River water is used for bathing in all the four reaches.
Washing	River water is used for cloth, utensils washing. Rahima a housewife in Tarabo area said that in

	rainy season she use the river water for her all household works. But during dry season she cannot use the river water at all for household activities.
Cooking	River water is used for cooking in both dry and wet season at Shiddirganj and in wet season at Tarabo and Rupganj. Small uses of river water are occur at Demra in wet season.
Fishing	No fishes occur at any reaches in dry season and very small fishes occur in wet season. Rahim Mia, 55, a local people said that in his childhood he saw hundreds of fishermen catching fish and dolphins playing around in the Shitalakhya but now getting fish is difficult even in wet season.
Livestock grooming	Livestock washing and drinking at Shiddirganj.
Boating	A good percentage of people involved in boating at Rupganj and Tarabo and small percentage at Demra and Shiddirganj.
Vegetable cultivation	River water is heavily used for vegetable cultivation at Shiddirganj.
<b>Health impacts of local people</b>	
Common diseases of local people	Diarrhea, Jaundice, Cholera, Dysentery, Skin diseases are the most common diseases. "The pitch black malodorous water gives itching skin and rashes," says Ambia Begum, a resident of Shiddirganj who has to bathe in the river as there is no alternative water source for her and many others in the area.
Vulnerability to children and women	Children and women are highly vulnerable to polluted water at all the four reaches.
Seasonal variation of diseases	Seasonal variation in frequency of diseases exists at all the reaches. Severity of diseases is high in dry season.