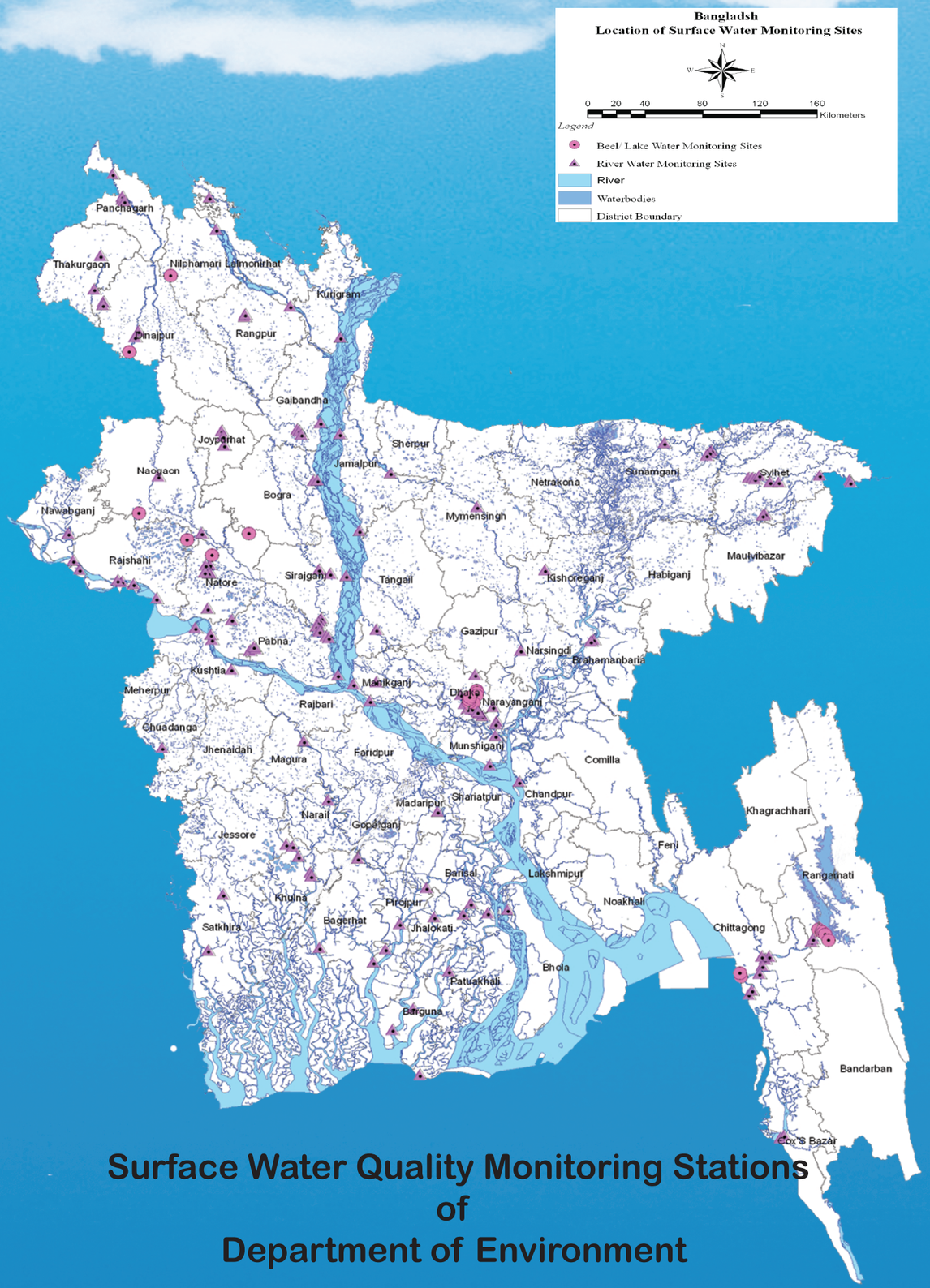
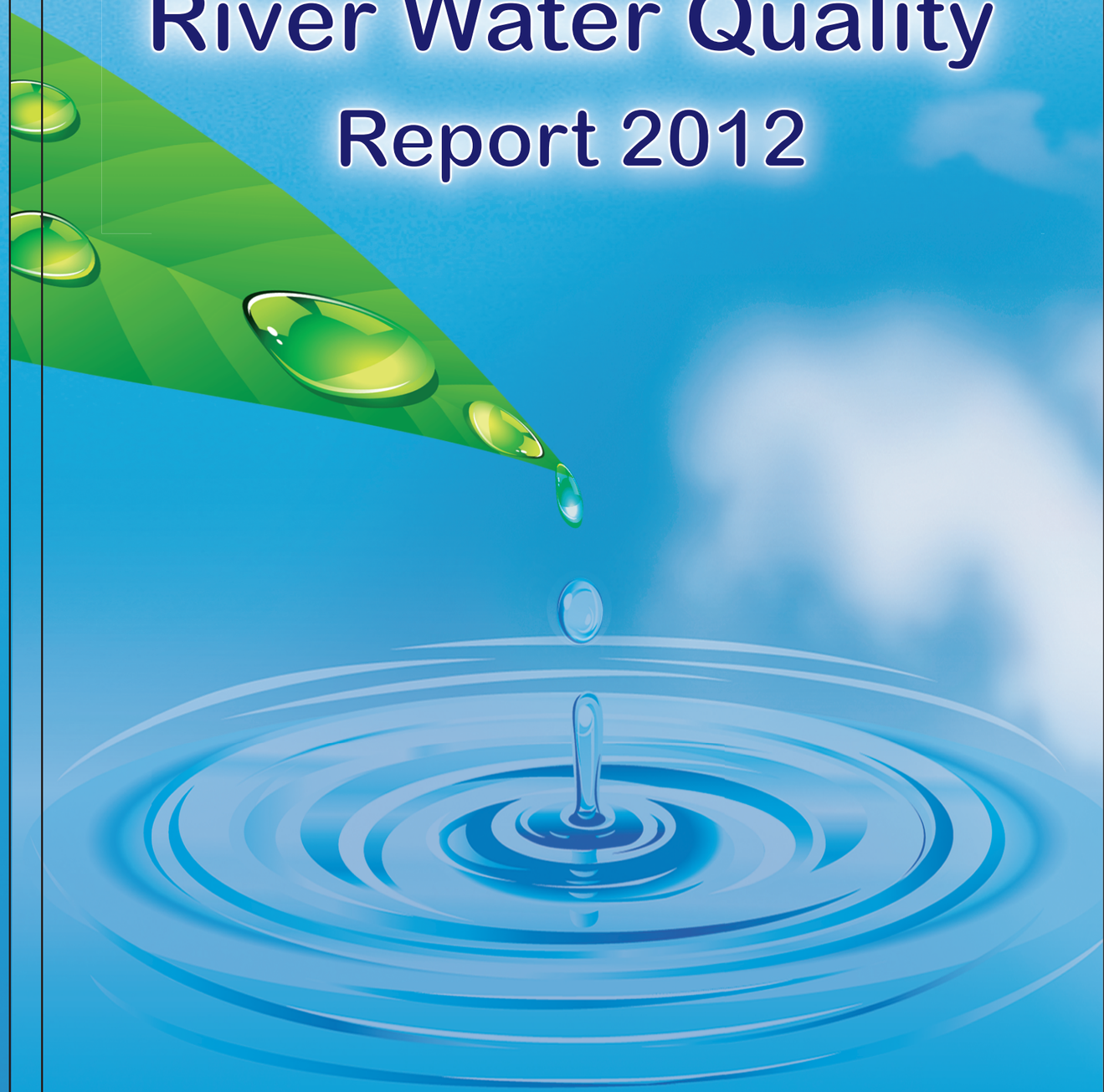


Surface Water Quality Monitoring Stations of Department of Environment

River Water Quality Report 2012



Department of Environment
Ministry of Environment and Forests
Government of the People's Republic of Bangladesh

River Water Quality Report 2012

Publisher
Natural Resource Management Section
Department of Environment
Ministry of Environment and Forests

Publishing Date
December 2013

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SPECTRUM
advertising limited

ISSN: 2226-1575

MESSAGE

The Department of Environment (DoE) has been monitoring surface water quality since its origin in 1973. DoE monitor surface water quality following its monitoring network that includes major rivers and lakes. It has successfully translated monitoring information into development of policy and legislative frame work for environmental protection.

Bangladesh is criss-crossed by hundreds of rivers, streams, canals and creeks with a total length of at least 24,000 km and an area of 4,600 sq.km. The combined total catchment area of the Ganges--the Brahmaputra-the Meghna (GBM) river systems is about 1.74 million sq. km of which seven percent lies within Bangladesh. In this riverine Bangladesh water greatly occupies most avenues of lives and livelihoods. Water is the central gem of all production activities where quantity and quality matters most.

“River Water Quality Report 2012” is the third of its kind that shed light on present status of river water quality in Bangladesh and also highlighted the necessary steps to be taken for sustainable management of aquatic ecosystems.

I express my sincere thanks to the Natural Resource Management and Research section, DoE for preparing this report.

I hope this document will be useful in the decision making process for conservation of degraded riverine ecosystems of Bangladesh.

Md. Golam Rabbani
Director General

FOREWORD

Being a country of rivers, Bangladesh needs to adopt adequate measures to halt further degradation of our precious water resources. The river water quality report 2012 contains statistical analyses of various water quality parameters of different rivers of the country for the period from January to December of 2012. It offers a clear view of present situation of water quality of some of our rivers and recommends ways and means for conservation and sustainable use of water.

Population pressure, release of untreated waste and effluent from urban areas and industrial units, and encroachment are the main causes for deterioration of water quality. Upstream withdrawal of water and salinity intrusion due to sea level rise are also responsible for degradation of river water quality. River water resources will always serve as the basis for securing lives and livelihoods for millions of people by providing different ecosystem services in this river-floodplains country.

The report suggests future programme of actions for conservation of river water resources. We have to implement these activities recommended in this report to pave the way of conservation and sustainable use of water resources at various levels of our development agenda.

Dr. Sultan Ahmed
Joint Secretary
Director (NRM and Research)

TECHNICAL NOTE

To track changes in water quality continuous monitoring is essential. Even though continual monitoring of surface water quality in spatio-temporal context and measurement of fewer parameters of water quality were done, this report would shed some light on water resource quality of the country. Water quality parameters like PH, DO, BOD, COD, Turbidity, TDS, SS, Total Alkalinity, EC and Chloride those presented in this report were measured more or less round the year of 2012. From the analyses, impact of seasons and industrialization on water quality surfaced up especially for the rivers surrounding Dhaka city. During the rainy season water quality of most rivers (under the monitoring programme) was good while comparing with the Environmental Quality Standard (EQS) set in the ECR, 1997. Water quality of rivers around Dhaka city and the environs, Chittagong and Khulna did not comply with EQS in the dry season indicating the most probable effect of dense industrialization in those areas followed by increased human pressure on rivers. The difference in pollution level among the sampling points along a single river was also evident. To get clearer picture on water quality, more intense and systematic monitoring is essential. However, current condition of surface water quality fingering to noncompliance of rules by the industries as well as intuitions responsible for domestic and other wastes management. Thus, need to escalate monitoring and enforcement activities as well as awareness building in all walks of life to achieve sustainable management of water resources.

Dr. Md. Sohrab Ali
Deputy Director (Water & Bio.)

ACKNOWLEDGEMENT

We would like to thank all divisional offices and Dhaka Lab of the Department of Environment, for providing with water quality data. We greatly acknowledge kind support and guidance of Md. Golam Rabbani, Director General, Department of Environment for preparation of this report. Also we are expressing our sincere thanks to the reviewers for their suggestions. Special thanks go to laboratory personnel for their kind contribution in terms of water quality data generation through sampling and laboratory analyses.

EXECUTIVE SUMMARY

Rivers are important features of Bangladesh's landscape where hundreds of rivers crisscrossed the landmass and playing role of artery and veins. Rivers are mainly used for irrigation, fisheries, drinking water, navigation and industrial purposes. Bangladesh's streams and rivers are also the home to a wide variety of aquatic flora and fauna. The volumes of water they carry vary widely depending on the season, heavy summer rainstorms, upstream diversion of water flow and dry winter months.

The Department of Environment (DoE) has been monitoring surface and ground water quality since 1973. The surface water quality-monitoring programme of DoE supposed to include 63 stations of the 27 rivers in Bangladesh. But divisional offices monitoring water quality only at 28 stations of 12 rivers at monthly interval. The monitoring involved making field measurements (only pH at some stations) and collecting water samples for laboratory analyses. Five divisional offices and Dhaka Lab measured 12 parameters (physical and chemical) of collected samples. Depending on continuity of measurements in the spatio-temporal context, we took ten parameters (e.g. pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solid (SS), Total Dissolved Solid (TDS), Electrical Conductivity (EC), Chloride, Turbidity and Total alkalinity for our analyses.

Based on the parameters mentioned above water quality of the major rivers e.g. Padma, Meghna, Jumuna, Dhaleshwari, Surma, Korotoa etc. was within the limit of Environmental Quality Standards (EQS) in 2012 while rivers around greater Dhaka were highly polluted spicially in the first five or four months of 2012 in terms of DO, BOD and COD value. No dissolved oxygen was found from January to May at different location of Buriganga, Shitalakhya and Turag River. High level of Chloride (133.96 mg/l), TDS (432 mg/l), BOD (48 mg/l) and COD (283 mg/l) were found in Buriganga river from January to December in 2012. In Meghna DO and BOD level was found within the EQS which varied from 5.2 to 7.2 mg/l and 0.3 to 3.4 mg/l respectively. In Jamuna DO and BOD level was found from 5.9 to 8.5 mg/l and 2.8 to 11.0 mg/l respectively.

High level of Chloride, TDS, Turbidity was found in Moyuri, Rupsha, Pashur and Kakshiali River. Highest level of Chloride (5451 mg/l) and TDS (11200 mg/l) were found in Pashur river. Heigh value of Turbidity (87.2 JTU) was found in Kakshiali river. More than 400 mg/l COD was found in Karnaphili river and Bakkhali river. All those indicated degradation of water quality in respective rivers.

Lack of continuous monitoring is one of the major problems for analysis river water quality data. Establishment of detail inland surface water standard and water quality index is essential to assess water quality of rivers.

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BOD	-	**Biochemical Oxygen Demand**
COD	-	**Chemical Oxygen Demand**
ECA	-	**Ecologically Critical Area**
ECR	-	**Environmental Conservation Rules**
DO	-	**Dissolved Oxygen**
DoE	-	**Department of Environment**
EQS	-	**Environmental Quality Standard**
GEMS	-	**Global Environment Monitoring System**
GPS	-	**Global Positioning System**
IWM	-	**Integrated Watershed Management**
NTU	-	**Nephelometric Turbidity Unit**
SoE	-	**State of the Environment**
TDS	-	**Total Dissolved Solid**
WQI	-	**Water Quality Index**
WCZ	-	**Water Control Zone**

CHAPTER 1: INTRODUCTION

1.1 Background

In Bangladesh, rivers, their tributaries and distributaries are the principal sources of fresh water for all forms of lives. To evaluate water quality for human consumption and other uses the Government has set specific standards for inland surface water in the Environmental Conservation Rules (ECR), 1997.

The flows in the rivers varies greatly depending on seasons, rainfall intensity and upstream diversion of trans-bound any rivers. Following fluctuation in flow river water quality varies significantly. A significant portion of the river's base flow in the country is abstracted for potable use. This together with dry winter and diversion upstream flow greatly reduce the river's flow volume, and its natural flushing and purification capacity. Dumping of industrial untreated waters, household and municipal wastes etc. into water courses further degrade surface water quality. Because of severe pollution,Government has already declared four rivers (Buriganga, Shitalakhya, Turag and Balu) as Ecologically Critical Area (ECA) to protect from further pollution.

To monitor surface water quality the Department of Environment (DoE) has setup a monitoring network. Following this network, DoE collect surface water samples for laboratory analyses. Samples are collected on monthly basis from selected sampling points of rivers under the monitoring network.

1.2 Major objectives of the report

i. To provide updated information on the rivers water quality to help information based decision-making process for sustainable development and management of water resources.
ii. Sensitization and Awareness building among the stakeholders.
iii. To provide information for research/study in the relevant field.
iv. Information sharing and preparation of State of the Environment (SoE) Report.
v. To provide water quality data to Global Environment Monitoring System (GEMS).

1.3 Limitation of the report

This report has been prepared based on primary data and information collected from divisional offices of DoE for the period of January to December 2012. The following are the limitations of the report:

- Data on all the parameters as per ECR 1997, for the entire period could not be furnished with this report due to lack of irregular sampling and laboratory analyses.
- This report lacks of information on microbiological parameters.
- Data on weather conditions of the sampling locations, at the time of sampling were unavailable.

1.4 River water quality monitoring

Monitoring surface water quality is one of the vital work of the Department of Environment (DoE). The information obtained from monitoring would constitute part of diagnosis of functionality of aquatic ecosystem. Also it would help evaluating effectiveness of the pollution control measures and would provide necessary input for development of water resource management plan.

Following countrywide monitoring network water samples have been collected for laboratory analyses. In 2012, the monitoring program covered 63 sampling locations in 27 rivers. About 50% of these locations were monitored on monthly basis.

CHAPTER 2: AN OVERVIEW OF BANGLADESH'S RIVERS

Rivers of Bangladesh

Rivers are the most important elements of physiographic features of Bangladesh. The Padma, the Jamuna and the lower Meghna are the widest rivers, with the latter expanding to around eight kilometers across in the wet season, and even more during the floods. The pride of Bangladesh is its rivers with one of the largest networks in the world with a total number of about 700 rivers including tributaries and distributaries having total length of about 24,140 km (Banglapedia, 2006). These all together cover about 7 percent of country's surface area. The watercourses of the country are unevenly distributed. They increase in numbers and size from the northwest to the southeastern region.

The river system of Bangladesh is extremely dynamic. The discharge carried by those rivers has a wide seasonal fluctuation peaking at the monsoon (July to September). Bangladesh has predominantly four major river systems.They are –

- **The Brahmaputra-Jamuna,**
- **The Ganges-Padma,**
- **The Surma-Meghna, and**
- **The Chittagong Region river system.**

The principal rivers of Bangladesh are the Padma, the Megna, the Jamuna, the Brahamaputra, the Dhaleswari and the Karnafuli. Besides those rivers, there are many small rivers like the Buriganga, the Sitalakhya, the Gumti, the Tista, the Atrai, the Kortoa, the Mohananda, the Madhumati and many others.

CHAPTER 3: MEASUREMENT OF RIVER WATER QUALITY

3.1 Water quality parameters

A comprehensive range of physico-chemical parameters like Temperature, Electrical Conductivity (EC), Dissolved Oxygen (DO), pH, Total alkalinity, Turbidity, Total Dissolved Solid (TDS), Suspended Solid (SS), Biochemical Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD) were set in the ECR'97 to assess the inland water quality in Bangladesh. But only a few of them commonly analyzed by the divisional offices. Azide Modification Method was used to analyze DO, Dilution Method for BOD_5, Closed Reflux Colorimetric Method for COD, Argentometric Methods for chloride and Gravimetric Methods for TDS.

3.2 Comparison with standards for inland surface water

River water quality was compared with the Environmental Quality Standard (EQS) set in the rules for inland surface water to get insight about the state of the river ecosystems in Bangladesh. This is essentially helpful for development planning and management of aquatic ecosystems.

CHAPTER 4: RIVER WATER QUALITY IN 2012

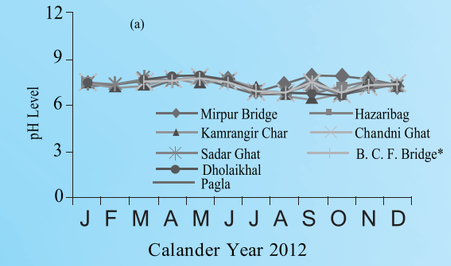
4.1 Buriganga river

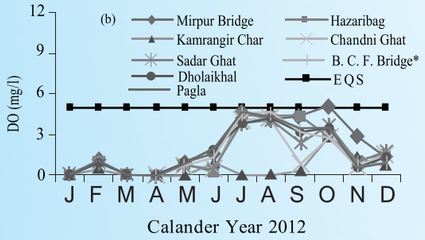
To monitor water quality of Buriganga river samples were collected from eight different locations viz. Mirpur Bridge, Hazaribag, Kamrangir Char, Chandni Char, Sadar ghat, Dholaikhal, Bangladesh China Friendship Bridge (BCFB) and Pagla along the river.

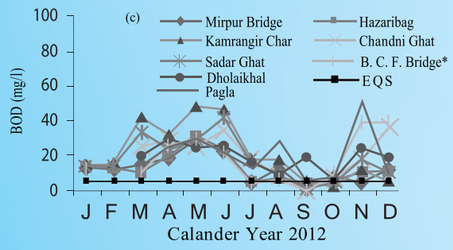
In 2012, pH among different locations varied from 6.4 to 7.9 (Fig.-1a) while standard pH range for inland surface water for fisheries is 6.5 to 8.5. In 2011, pH level varied from 6.2 to 7.88. Dissolved oxygen (DO) in Buriganga river water was very low in 2012. During the first four months, DO level was almost nil at all locations of the river (Fig.-1b). Direct discharge of untreated effluent from industries, domestic wastes, tannery wastes into the river dry weather and reduced flow of water are the proximate causes for depletion of DO in dry season. DO level was slightly increased in wet season (June to November) at all locations of the river. In 2011, DO level varied from 0.1 to 5.1.

In 2012, BOD of Buriganga river was higher than EQS (≤6 mg/l). At Kamrangir Char point BOD level was much higher than EQS for fisheries round the year (Fig.-1c). This was mainly because of discharge of untreated tannery wastewater into the river. The maximum BOD (48 mg/l) was found at kamrangir Char in May and the minimum (1.0 mg/l) was at hazaribag in September. In 2011, BOD range was 87-3.1 mg/l. In 2012, COD level was mostly below the EQS (200 mg/l) set for industrial wastewater after treatment. The maximum and the minimum COD concentration of Buriganga river was 283 mg/l at Hazaribag in December and 5 mg/l at same point in September (Fig.-1d). In 2011, COD varied from 226 mg/l to 28 mg/l.

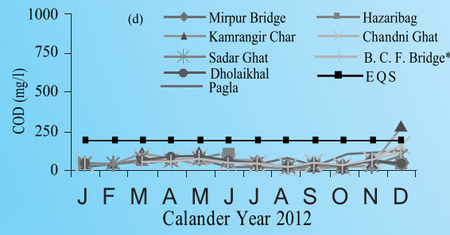
TDS of Buriganga river varied from 70 to 432 mg/l (Fig.-1e) against the EQS of 2100 mg/l for industrial wastewater after treatment. In 2011, TDS concentration varied from 120 to 1188 mg/l. Turbidity range was from 0.97 to 1.41 NTU and was within the EQS (10 NTU) (Fig.-1f). In 2011, Turbidity range varied from 6.0 to 16.6 NTU. Chloride concentration of the Buriganga river was below the EQS for industrial wastewater after treatment. The maximum and the minimum concentration was 3.5 and 133.96 mg/l respectively (Fig.1g). In 2011, Chloride concentration varied from 6.0 mg/l to 48 mg/l.

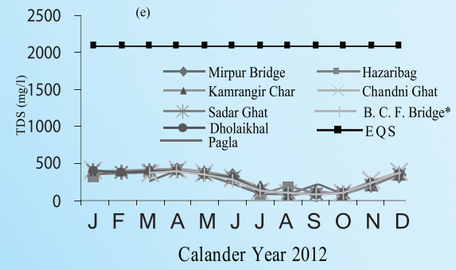


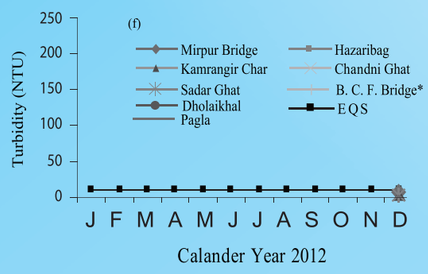




Note: Highest BOD was recorded 87 mg/l at Hazaribag in March 2011.







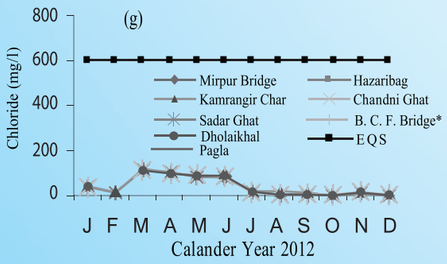


Fig.1.Graphical presentation of pH, DO, BOD, COD, TDS, Turbidity and Chloride of Buriganga River in 2012

Note: B.C.F.B=Bangladesh China Friendship Bridge, EQS = Environmental Quality Standard

Table-1. Level of Total alkalinity at different sampling locations of Buriganga river in 2012.

Sampling Locations of Buriganga River	Total alkalinity (mg/l)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mirpur Bridge	-	148	326	212	170	180	40	51	70	75	112	160
Hazaribag	-	160	358	218	160	170	50	44	55	90	120	165
Kamrangir Char	-	144	**410**	232	180	210	64	148	80	60	120	160
Chandni Ghat	-	142	371	216	150	139	50	48	65	90	170	190
Sadar Ghat	-	-	334	214	140	113	50	52	58	60	140	167
Dholaikhal	-	-	329	228	160	120	30	60	58	55	170	190
B.C.F. B*	-	-	350	218	130	139	40	75	65	60	160	178
Pagla	-	-	208	214	150	109	**30**	47	64	75	140	165
EQS for wastewater after treatment from industrial units 150 mg/l												

The maximum and the minimum Total alkalinity of Buriganga river was 410 mg/l at Kamrangir Char in March and 30 mg/l at Pagla in July (Table-1).

Table-2. Level of EC at different sampling locations of Buriganga river in 2012.

Sampling Locations of Buriganga River	EC (µmhoms/cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mirpur Bridge	710	731	786	720	680	686	246	147.3	165.6	183.3	390	629
Hazaribag	844	762	844	724	682	685	171.9	421	230	184.7	395	719
Kamrangir Char	812	780	**864**	812	684	593	380	164	294	178.9	398	731
Chandni Ghat	810	770	805	790	682	581	198.2	156	193.2	237	582	831
Sadar Ghat	710	737	718	794	688	545	159	251	183.8	184.3	437	710
Dholaikhal	644	210	730	810	690	552	161.8	209	177.4	185.6	522	714
B.C.F. B*	612	202	650	730	620	492	157.3	171	175.2	188.7	514	822
Pagla	510	212	547	728	670	392	160	**157**	473	203	454	706
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

Electrical Conductivity at different locations of Buriganga was below the EQS (1200 µmhoms/cm) for treated wastewater from indusial units (Table-2).The maximum and the minimum EC of Buriganga river was 864 mg/l at Kamrangir Char in March and 157 mg/l at Pagla in August.

Table-3. Level of SS at different sampling locations of Buriganga river in 2012.

Sampling Locations of Buriganga River	SS (mg/l)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mirpur Bridge	24	40	38	36	44	28	30	20	48	40	42	40
Hazaribag	38	48	30	38	42	30	26	36	54	42	50	38
Kamrangir Char	36	42	38	48	50	40	40	**12**	**60**	50	54	48
Chandni Ghat	34	40	34	40	48	36	36	20	50	40	48	42
Sadar Ghat	42	24	34	38	46	38	34	30	50	42	44	44
Dholaikhal	30	22	36	42	40	30	30	28	46	48	42	46
B.C.F. B*	26	20	32	36	44	32	32	22	48	44	40	44
Pagla	28	20	30	36	42	26	28	20	58	40	38	42
EQS for wastewater after treatment from industrial units 150 mg/l												

Suspended Solid (SS) of Buriganga river at different locations below the EQS (150 mg/l) limit for wastewater after treatment from industiial units. The maximum and the minimum SS was 60 mg/l in September and 12 mg/l in December at Kamrangir Char respectively (Table-3)

4.2 Shitalakhya River

Shitalakhya river is a distributary of the Brahmaputra river. It remains navigable round the year. For monitoring water quality samples were colleted from three different locations viz- Demra Ghat, Ghorasal Fertilizer Factory (GFF) and near ACI factory at Narayangonj.

In 2012, pH level of Shitalakhya river water was within the EQS (6.5-8.5) for inland surface water. The maximum pH was 8.64 in September at Damra Ghat and the minimum pH was 6.7 in November at near ACI (Fig.-2a). In 2011, pH varied from 6.42 to 7.96. No Dissolved Oxygen was found at Demra Ghat from January to March. DO level was good at all locations in July. The maximum DO (6.2 mg/l) was found at GFF in February and the minimum DO (0.6 mg/l) was found at Demra Ghat in September (Fig.-2b). In 2011, DO varied from 0.1 to 6.5 mg/l.

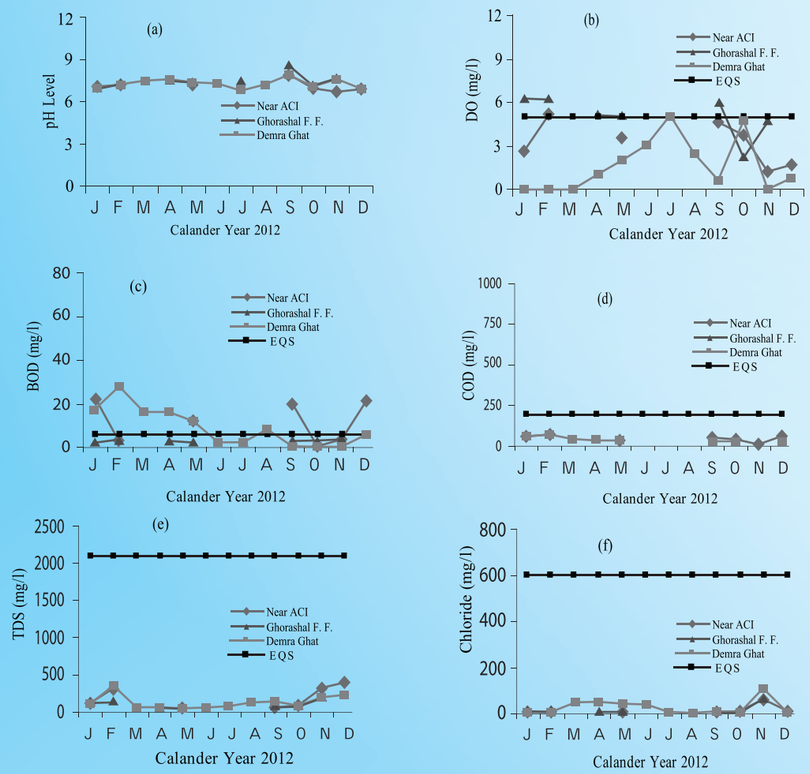


Fig.2. Graphical presentation of pH, DO, BOD, COD, TDS and Chloride of Shitalakhya River in 2012.

In 2012, BOD at Demra Ghat was very high during dry period. At Ghorasal BOD was within the EQS (≤6 mg/l) for fisheries throughout the year. Highest value of BOD (16 mg/l) was found at Demra Ghat in April and that of lowest (2.0 mg/l) was at Demra Ghat in June (Fig.-2c). BOD concentration was higher at Demra Ghat compare to other two locations. In 2011, BOD concentration varied from 2.3 mg/l to 48 mg/l. In 2012, COD level was within the EQS (200 mg/l) for wastewater after treatment from industrial units at all locations of Shitalakhya river. Among all the locations of the Shitalakhya river COD was lowest at ACI point (Fig.-2d). The maximum COD (73 mg/l) at ACI in February and the minimum COD (14 mg/l) was in November. In 2011, COD level varied from 22 mg/l to 84 mg/l.

TDS of Shitalakhya river varied from 52 to 392 mg/l against the EQS (2100 mg/l) for wastewater after treatment from industrial units. In dry season TDS (392 mg/l) limit was high at ACI sampling location (Fig.-2e). In 2011, TDS range was 80 to 430 mg/l. Chloride concentration of the Shitalakhya river in 2012 was below the EQS (600 mg/l) for wastewater after treatment from industrial units. The maximum Chloride (110 mg/l) was found at Demra Ghat in November and the minimum was 1.3 mg/l at Ghorasal F.F in October, 2012 (Fig.-2f). In 2011, Chloride concentration varied from 4.5 mg/l to 18 mg/l.

Table-4. Level of SS at different sampling locations of Shitalakhya river in 2012.

Sampling Locations of Shitalakhya River	SS (mg/l)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Narayangonj (Near ACI)	**20**	-	-	-	24	-	-	-	24	32	30	**408**
Demra Ghat	20	-	28	28	26	24	22	20	24	38	32	355
Ghorashal Fertilizer Factory (GFF)	20	20	-	20	22	-	20	-	22	26	28	-
EQS for wastewater after treatment from industrial units 150 mg/l												

SS of Shitalakhya river water at different locations was within the EQS (150 mg/l) except the month of December. Maximum SS concentration of Shitalakhya River was 408 mg/l in December and minimum 20 mg/l in January (Table-4)

Table-5. Level of EC at different sampling locations of Shitalakhya river in 2012.

Sampling Locations of Shitalakhya River	EC (µmhoms/cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Narayangonj (Near ACI)	254	628	-	-	124	-	-	-	147.7	198.6	668	803
Demra Ghat	184	-	124	116	102	**96.8**	148	263	294	139.6	**409**	505
Ghorashal Fertilizer Factory (GFF)	248	284	-	112	98	-	160	-	116.6	147.6	332	-
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

EC of Shitalakhya river at different locations was within the EQS (1200 µmhoms/cm) for treated wastewater from industrial units (Table-5). The maximum EC (409 µmhoms/cm) was at Demra Ghat in November and the minimum EC (96.8 µmho/cm) was at Damra Ghat in June.

Table-6. Level of Total alkalinity at different sampling locations of Shitalakhya river in 2012.

Sampling Locations of Shitalakhya River	Total alkalinity (mg/l)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Narayangonj (Near ACI)	88	92	-	-	72	-	-	-	**40**	70	130	**173**
Demra Ghat	84	-	72	72	68	64	72	66	66	60	120	140
Ghorashal Fertilizer Factory (GFF)	134	104	-	72	68	-	54	-	46	80	120	-
EQS for wastewater after treatment from industrial units 150 mg/l												

Maximum T. alkalinity (173 mg/l) was near ACI Factory in December and that of minimum (40 mg/l) was at ACI sampling point in September (Table-6).

4.3 Turag river

The Turag river is the upper tributary of the Buriganga. To monitor water quality in 2012, water samples were collected from near Fulpukuria Dyeing Ltd., near Hossain Dyeing Ltd., near Tongi Rail Bridge and Near Azmeri Composite Ltd.

The pH range (6.7- 8.4) (Fig.-3a) of Turag river was within EQS (6.5 -8.5). The maximum pH 8.4 (South side of Tongi Bridge) was found in February and the minimum pH 6.7 was found in February at Pagar, Tongi (near Hossain Dyeing Ltd.). In 2011, pH range was 7.18 to 8.24. DO concentration of Turag river was very low during dry season of 2012 and it was nil in March to June (Fig.-3b). In 2011, DO was varied 0.2 to 5.4. BOD of Turag river water was beyond the EQS (≤6 mg/l) for all locations. The maximum BOD was 38 mg/l in April at Pagar, Tongi and the minimum was 5.0 mg/l in November at north side of Tongi Bridge (Fig.-3c). In 2011, BOD varied from 1.4 mg/l to 36 mg/l. In 2012, COD at all locations of Turag river was below the EQS (200 mg/l) for wastewater after treatment from industrial units. The maximum and the minimum COD content of Turag river water was 290 mg/l in December and 9 mg/l in October (Fig.-3d). In 2011, COD range was from 18 mg/l to 102 mg/l. TDS was below the EQS (2100 mg/l) for wastewater after treatment from industrial units (Fig.-3e) at all the sampling points. The maximum TDS was 1020 mg/l in January while that of the minimum was 60 in July at Hossain Dyeing Ltd., Pagar, Tongi. In 2011, TDS varied from 66 mg/l to 924 mg/l. Chloride content of Turag river water was below the EQS (600 mg/l). The maximum Chloride was (133.96 mg/l) found in June and the minimum Chloride was (3.5 mg/l) in September at Tongi Bridge (Fig.-3f). In 2011, Chloride varied from 6.0 mg/l to 18.5 mg/l.

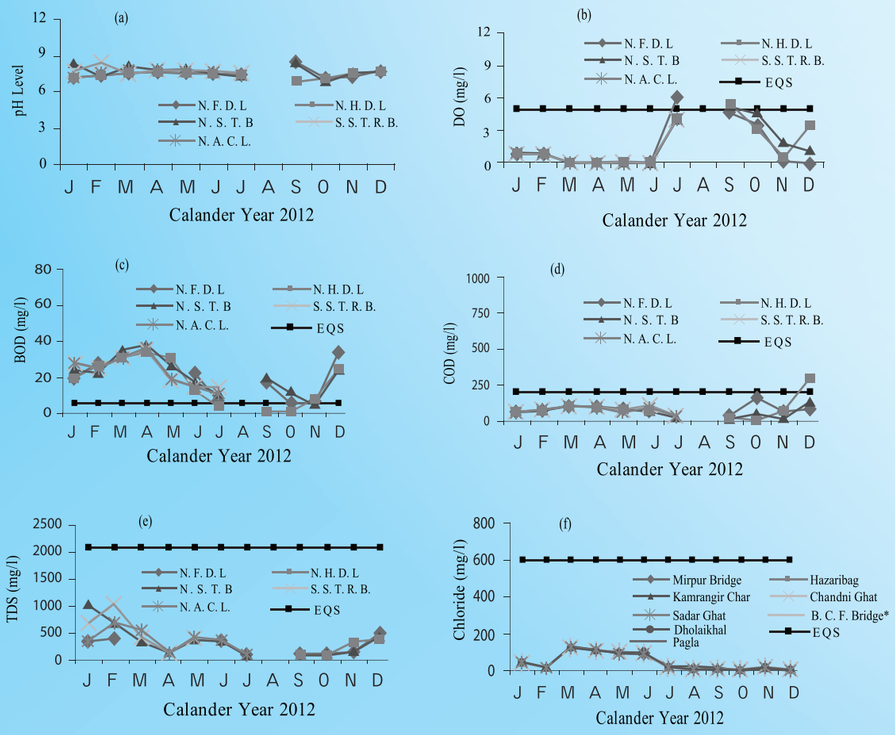


Fig.3. Graphical presentation of pH, DO, BOD, COD, TDS, Turbidity and Chloride of Turag River in 2012

Note: N.F.D.L = Near Fulpukuria Dyeing Ltd., N.H.D.L = Near Hossain Dyeing Ltd.,
N.S.T.R.B = North side of Tongi Rail Bridge, S.S. T.R.B = South side of Tongi Rail Bridge,
N.A.C.L = Near Azmeri Composite Ltd.

Table-7. Level of Total alkalinity at different sampling locations of Turag river in 2012.

Locations of Turag River	Total alkalinity (mg/l)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Near Fulpukuria Dyeing Ltd.	184	178	-	-	-	-	-	-	70	68	130	146
Near Hossain Dyeing Ltd.	192	-	**194**	122	164	160	114	-	**60**	70	133	169
North side of Tongi Rail Bridge	-	180	190	134	162	160	110	-	60	76	122	192
South side of Tongi Rail Bridge	-	176	192	128	144	-	118	-	-	-	-	-
Near Azmeri Composite Ltd. Dakshinkhan	-	188	196	120	148	-	112	-	-	-	-	-
EQS for wastewater after treatment from industrial units 150 mg/l												

T. alkalinity at different locations of Turag river was mostly above the EQS. The maximum T. alkalinity (194 mg/l) was near the Hossain Dyeing Ltd. Pagar, Tongi, in March and the minimum (60 mg/l) was in September near Hossain Dyeing Ltd. and Tongi bridge (Table-7).

Table-8. Level of EC at different sampling locations of Turag river in 2012.

Locations of Turag River	EC (µmhoms/cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Near Fulpukuria Dyeing Ltd.	636	760	-	-	-	-	-	-	186.7	203	281	995
Near Hossain Dyeing Ltd.	648	-	903	192	748	738	**112.8**	-	191.4	257	641	674
North side of Tongi Rail Bridge	**2040**	1325	606	284	720	715	140	-	154.4	183.4	322	847
South side of Tongi Rail Bridge	1343	2040	633	228	728	720	142	-	-	-	-	-
Near Azmeri Composite Ltd.	631	1343	1033	212	732	725	140	-	-	-	-	-
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

At different locations EC of Turag river water was within the EQS (1200 µmhoms/cm). The maximum EC (2040 µmhoms/cm) was in January at north side of Tongi Rail Bridge and the minimum (112.8 µmhoms/cm) was in July near Hossain Dyeing Ltd.,Pagar, Tongi (Table-8).

4.4 Dhaleshwari River

The Dhaleshwari river is a 160 km long distributary of the Jamuna river flowing through central part of Bangladesh. It starts off the Jamuna near the northwestern tip of Tangail. Then it branched into two: the north branch retains the name Dhaleshwari and the other branch flows as Kaliganga. The both branches merged at the southern part of Manikganj District. Finally the merged flow meets the Shitalakshya River near Narayanganj District. In 2012, water samples were collected from two locations namely Muktarpur Ghat, Munshigonj and Horindhora, Hemayetpur, Saver, Dhaka for analyses.

In 2012, pH of Dhaleshwari river water varied from 6.4 to 8.46 (Fig.-4a). In 2011, pH level varied from 6.2 to 7.4. In 2012, the maximum DO concentration (10.9 mg/l) was at Horindhora in February and the minimum (1.0 mg/l) at Muktarpur Ghat in November (Fig.-4b). In 2011, DO concentration varied from 4.8 to 6.8 mg/l. In 2012, BOD varied from 2.2 to 31 mg/l (Fig.-4c) while EQS for fisheries is ≤6 mg/l. In 2011, BOD varied from 2.2 to 3.8 mg/l. Level of SS of Dhaleshwari river water was within the EQS. The maximum SS of Dhaleshwari river water was (4023.1 mg/l) in December and the minimum was 18 mg/l in July (Fig.4d) against EQS (150 mg/l) for wastewater after treatment from industrial units. In 2011, SS varied from 16 to 34 mg/l. TDS concentration varied from 9.2 to 217 mg/l (Fig.-4e) while standard TDS level is 2100 mg/l for wastewater after treatment from industrial units. In 2011, TDS concentration varied from 60 to 240 mg/l. Chloride concentration ranged from 0.5 to 10.0 mg/l (Fig.-4f), which is far below the EQS (600 mg/l) for wastewater after treatment from industrial units. In 2011, Chloride concentration range of Dhaleshwari river water was from 3.5 to 9.0 mg/l.

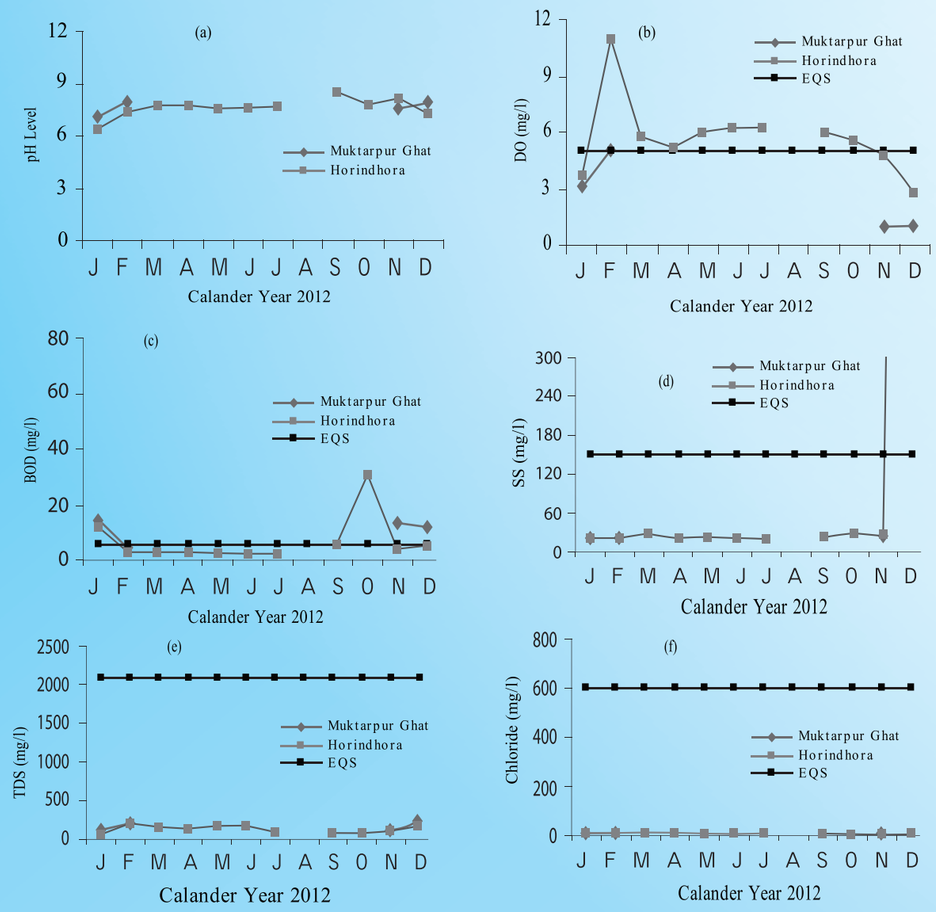


Fig.4. Graphical presentation of pH, DO,BOD, SS, TDS and Chloride of Dhaleshwari River in 2012.

Table-9. Level of T.alkalinity at different sampling locations of Dhaleshwari river in 2012.

Sampling Locations of Dhaleshwari River	Total alkalinity (mg/l)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Muktarpur Ghat, Munshigonj	78	96	-	-	64	-	-	-	80	-	-	-
Horindhora,Hemayetpur, Saver, Dhaka	54	**124**	64	58	-	50	**48**	-	-	70	93	100
EQS for wastewater after treatment from industrial units 150 mg/l												

The maximum T. alkalinity of Dhaleshwari river water was 124 mg/l in February and the minimum was 48 mg/l in July (Table-9) at Hemayetpur respectively.

Table-10. Level of EC at different sampling locations of Dhaleshwari river in 2012.

Sampling Locations of Dhaleshwari River	EC (µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Muktarpur Ghat, Munshigonj	246	414	-	-	**88**	-	-	-	170.5	-	-	**449**
Horindhora,Hemayetpur, Saver, Dhaka	128	390	288	282	-	256	180	-	-	172.8	222	367
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

Electrical Conductivity of Dhaleshwari river at different locations was within the EQS (1200 µmhoms/cm).The maximum and the minimum EC of Dhaleshwari river water was 449 µmhoms/cm in December and 88 µmho/cm in May at Muktarpur Ghat (Table-10).

4.5 Brahmaputra river

The Brahmaputra, a trans-boundary river that originates from Manossavovar near Mount Kailash in the Himalayas and flows via Tibbet, China, India and Bangladesh to Bay of Bengal. The total length it travels from Himalayans to the Bay is 2900 Km (Chowdhury, 2006).

In 2012, pH level of Brahmaputra river varied from 6.63 to 8.1 mg/l (Fig.5a), while standard range for fisheries is from 6.0 to 8.5. In 2011, pH level varied from 6.0 to 7.4. DO concentrations varied from 5.4 to 9.4 mg/l (Fig.5b). The highest and the lowest DO was found in February and April respectively, while EQS of DO for fisheries is ≥5 mg/l. In 2011, DO varied from 5.1 to 6.9 mg/l. BOD concentration varied from 2.0 to 4.2 mg/l (Fig.5c) while EQS for fisheries is ≤6 mg/l. In 2011, BOD varied from 2.0 to 3.6 mg/l. The maximum and the minimum SS of Bhramaputra river water was 22 mg/l in February and 18 mg/l in June (Fig.5d), where EQS for treated wastewater from industrial units is 150 mg/l. In 2011, SS varied from 16 to 30 mg/l. Chloride level varied from 2 to 8.5 mg/l (Fig.5e) and was less than EQS (600 mg/l) for treated wastewater from industrial units. In 2011, Chloride concentration varied from 3.5 to 9.0 mg/l. TDS level ranged from 71 to 163 mg/l (Fig.5f) and was much below the EQS (2100 mg/l). In 2011, TDS level varied from 60 to 138 mg/l.

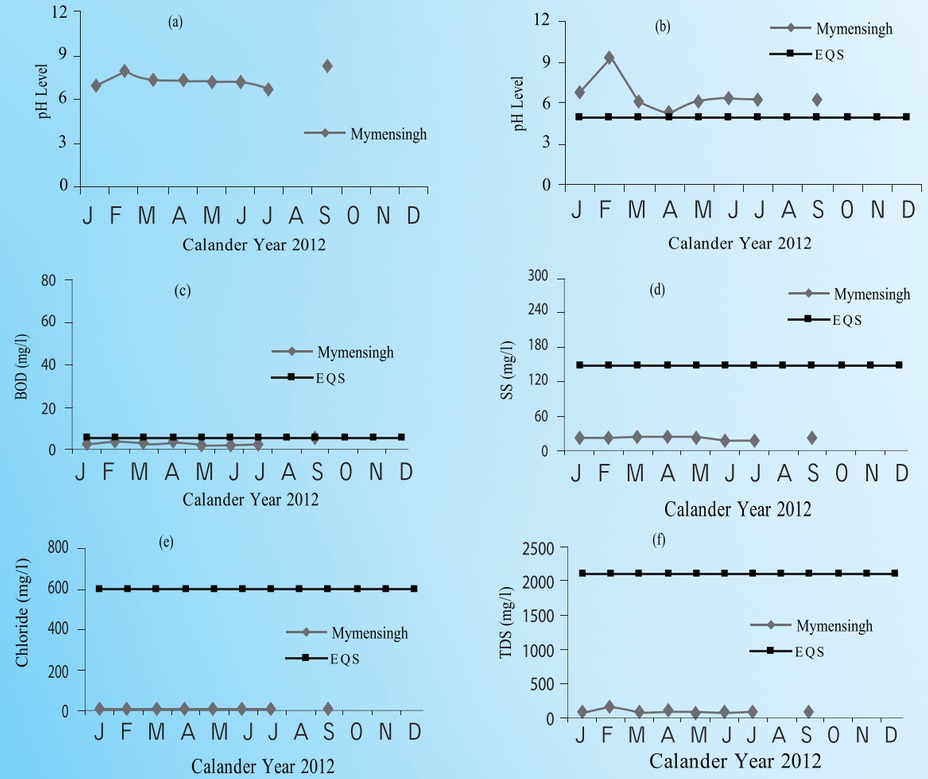


Fig.5. Graphical presentation of pH, DO, BOD, SS, Chloride, and TDS of Brahmaputra River in 2012.

Table-11. Level of Total alkalinity of Bhramaputra river in 2012.

Sampling Locations of Bhramaputra River	Total alkalinity (mg/l)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mymensingh	64	**84**	56	68	42	40	46	-	**38**	80	-	-
EQS for wastewater after treatment from industrial units 150 mg/l												

The maximum and the minimum T. alkalinity of Bhramaputra river water was (84 mg/l) in February and 38 mg/l in September (Table-11) respectively.

Table-12. Level of EC of Bhramaputra river in 2012.

Sampling Locations of Bhramaputra River	EC (µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mymensingh	**142**	**273**	182	172	164	160	169.6	-	152.4	155	-	-
EQS for wastewater after treatment from industrial units 1200 µmhos/cm												

Level of EC of Bhramaputra river water was within the EQS (1200 µmhoms/cm). The maximum and the minimum EC was (273 µmhoms/cm) in February and (142 µmhoms/cm) in January (Table-12).

4.6 Kaliganga river

The Kaliganga river flows by Manikganj district. Water samples were collected from one location (e.g. Manikganj) of the river for analysis of water quality.

pH of Kaliganga river varied from 6.9 to 7.4 (Fig.6a). The maximum and the minimum pH was found in January and September respectively. In 2011, pH level varied from 6.28 to 7.16. DO level varied from 5.5 to 14.5 mg/l (Fig.6b) and met the EQS for fisheries (≥5 mg/l). In 2011, DO varied from 5.0 to 6.6 mg/l. BOD varied from 2.2 to 5.0 mg/l (Fig.6c). BOD level was within the EQS limit for fisheries throughout the year. In 2011, BOD varied from 2.2 to 22 mg/l. COD range was 25 and 5 mg/l (Fig.6d). In 2011, COD range was 60 to 54 mg/l.

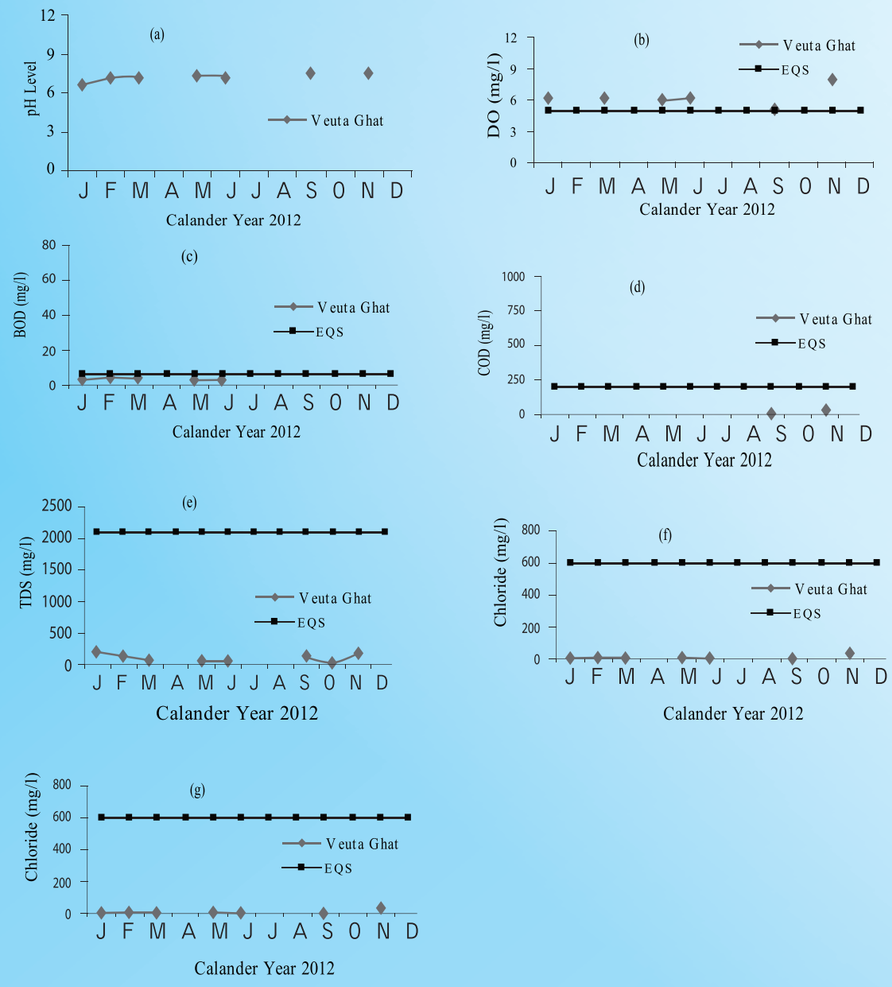


Fig.6. Graphical presentation of pH, DO, BOD, COD, TDS, Chloride and SS of Kaliganga River in 2012

In 2012, TDS concentration was very low compare to the EQS (2100 mg/l) for wastewater after treatment from industrial units. The maximum TDS was 178.3 mg/l in November and the minimum TDS was 41.4 mg/l in June (Fig.6e). In 2011, TDS concentration varied from 74 to 340 mg/l. Chloride level was lower than the EQS (600 mg/l). Highest Chloride concentration (30.0 mg/l) was in November and the lowest Chloride level (0.5 mg/l) was in March (Fig.6f). In 2011, Chloride varied from 4.0 to 14 mg/l. SS of Kaligonga river was within the EQS (150 mg/l). The maximum and the minimum SS was 22 mg/l and 18 mg/l respectively (Fig.6g).). In 2011, SS varied from 18 to 34 mg/l.

Table-13. Level of T.alkalinity of Kaligonga river in 2012.

Locations of Kaligonga River	Total Alkalinity (mg/l)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Veuta Ghat, Manikgonj.	64	-	54	-	50	48	-	-	**40**	-	**129**	-
EQS for wastewater after treatment from industrial units 150 mg/l												

The maximum and the minimum T. alkalinity of Kaligonga river water was 129 mg/l in November and 40 mg/l in September (Table-13).

Table-14. Level of EC of Kaligonga river in 2012.

Locations of Kaligonga River	EC (µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Veuta Ghat, Manikgonj.	320	-	108	-	90	**82.8**	-	-	187.9	-	**370**	-
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

EC of Kaligonga river water was within the EQS (1200 µmhoms/cm). The maximum and the minimum EC was 370 µmhoms/cm in November and 82.8 µmhoms/cm in June (Table-14).

4.7 Jamuna River

The Jamuna river is one of the three main rivers of Bangladesh. It is the main distributary channel of the Brahmaputra river that flows out of India into Bangladesh. To monitor water quality, samples were collected only from two locations e.g. Bahadurabad Ghat (B. Ghat) and near Jamuna Fertilizer Factory (JFF) in 2012.

In 2012, the maximum pH (8.46) was found at Jamuna Fertilizer factory in September and the minimum (7.2) was found at Bahadurabad Ghat in January. pH level was within the EQS limits throughout the year (Fig.7a). In 2011, pH level varied 6.4 to 7.6. At JFF, DO varied from 5.9 to 8.5 mg/l (Fig.7b). DO level was higher than the EQS (≥5 mg/l) for fisheries. In 2011, DO concentration varied from 4.5 to 7.8 mg/l. In 2012, the maximum BOD level was 11. 0 mg/l and the minimum BOD level was 2.8 mg/l while the EQS (≤6 mg/l) for fisheries (Fig.7c). In 2011, BOD concentration varied from 2.0 to 3.8 mg/l. Level of SS of Jamuna river water was within the EQS (150 mg/l). The maximum and the minimum SS was 24 mg/l in October and 20 mg/l in January (Fig.7d) respectively. In 2011, SS concentration varied from 16 to 28 mg/l. TDS varied from 63.1 to 165.5 mg/l (Fig.7e), while EQS for TDS is 2100 mg/l. In 2011, TDS level varied from 60 to 160 mg/l. Chloride content varied from 1.5 to 8.5 mg/l (Fig.7f). The maximum chloride (8.5 mg/l) was found at JFF in February, and the minimum (1.5 mg/l) was found in September. In 2011, Chloride concentration varied from 3.0 to 16.0 mg/l.

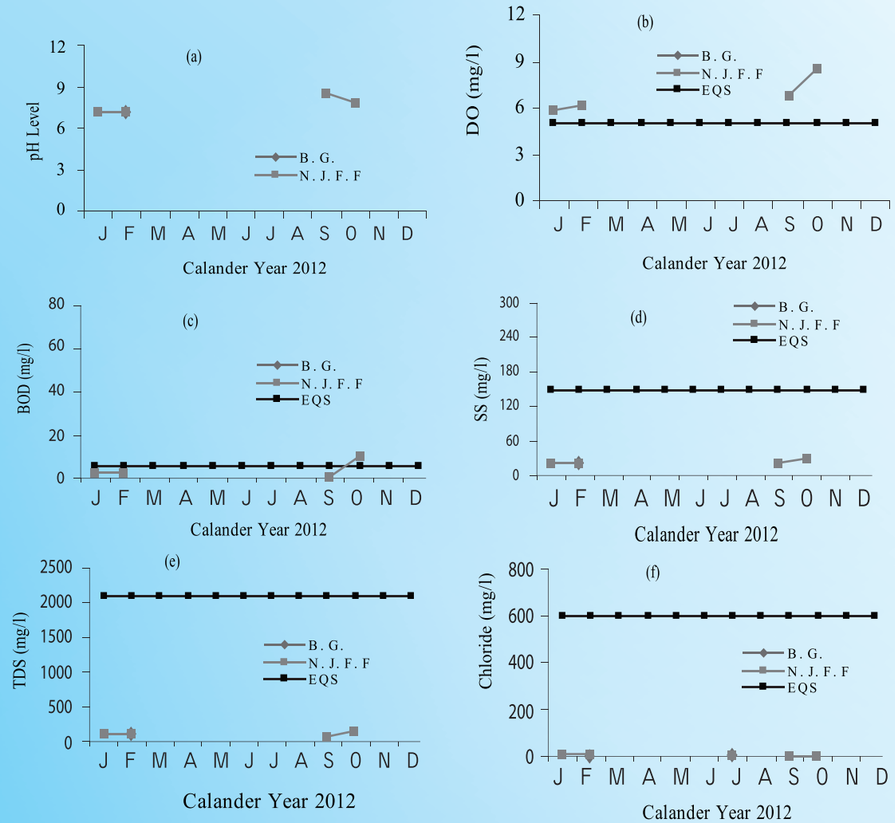


Fig.7. Graphical presentation of pH, DO, BOD, SS, TDS and Chloride of Jamuna River in 2012

Note : B.G = Bahadurabad Ghat, N.J.F.F = Near Jamuna Fertilizer Factory

Table-15. Level of Total alkalinity at different sampling locations of Jamuna river in 2012.

Sampling Locations of Jamuna River	Total alkalinity (mg/l)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bahadurabad Ghat (B.G)	-	84	-	-	-	-	-	-	-	-	-	-
Near Jamuna Fertilizer Factory (NJFF)	64	**138**	**-**	-	-	-	-	-	60	**58**	-	-
EQS for wastewater after treatment from industrial units 150 mg/l												

The maximum and the minimum T. alkalinity of Jamuna river water was 138 mg/l in February and 58 mg/l in October (Table-15) respectively.

Table-16. Level of EC at different sampling locations of Jamuna river in 2012.

Sampling Locations of Jamuna River	EC (µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bahadurabad Ghat (B.G)	-	212	-	-	-	-	-	-	-	-	-	-
Near Jamuna Fertilizer Factory (NJFF)	194	204	**-**	-	-	-	-	-	**132.6**	**344**	-	-
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

Level of EC of Jamuna river water at sampling locations was within the EQS (1200 µmhoms/cm). The maximum and the minimum EC of Jamuna river was 344 µmhoms/cm in October and 132.6 µmhos/cm in September (Table-16).

4.8 Meghna River

The Meghna is an important river in Bangladesh and one of the three that forms the Ganges Delta, the largest on earth fanning out to the Bay of Bengal. To monitor water quality, water samples were collected from Bhairab Bazar, Meghna Ghat, near Shahjalal Paper Mills, Chandpur (side), Chandpur (middle), Zia Fertilizer (up stream), Zia Fertilizer (down stream) AFCL (up stream) and AFCL (down stream) of the Meghna river.

Throughout the year pH level was within the standard limit for inland surface water. The maximum pH was 7.6 in November at Chandpur and the minimum pH was 6.24 in September near Bhairab Bazar (Fig.8a). In 2011, pH level varied from 6.24 to 7.6. DO level of Meghna river was above the EQS (≥5 mg/l) for fisheries althrough the year (Fig.8b). In 2011, DO level varied from 5.2 mg/l to 7.2 mg/l. At all locations of the river BOD level was below the EQS (≤6 mg/l) for fisheries round the year. The maximum and the minimum BOD load was 3.4 mg/l in October and 0.3 mg/l in July (Fig.8c). In 2011, BOD concentration varied from 0.3 to 3.4 mg/l. COD varied from 1.5 to 3.5 mg/l (Fig.8d). At all locations COD level was under the EQS (200 mg/l) for wastewater from industrial units round the year. In 2011, COD concentration varied from 2.0 to 3.0 mg/l. TDS of Meghna river was very low in 2012 and ranged from 45 to 150 mg/l (Fig.8e). In 2011, TDS concentration varied from 45 to 150 mg/l.

In 2012, Chloride concentration at all the locations was also under the EQS (600 mg/l) for wastewater after treatment from industrial units. The maximum chloride (11.0 mg/l) was found in April and the minimum (3.0 mg/l) was in October (Fig.8f). In 2011, Chloride concentration varied from 3.0 to 11 mg/l.

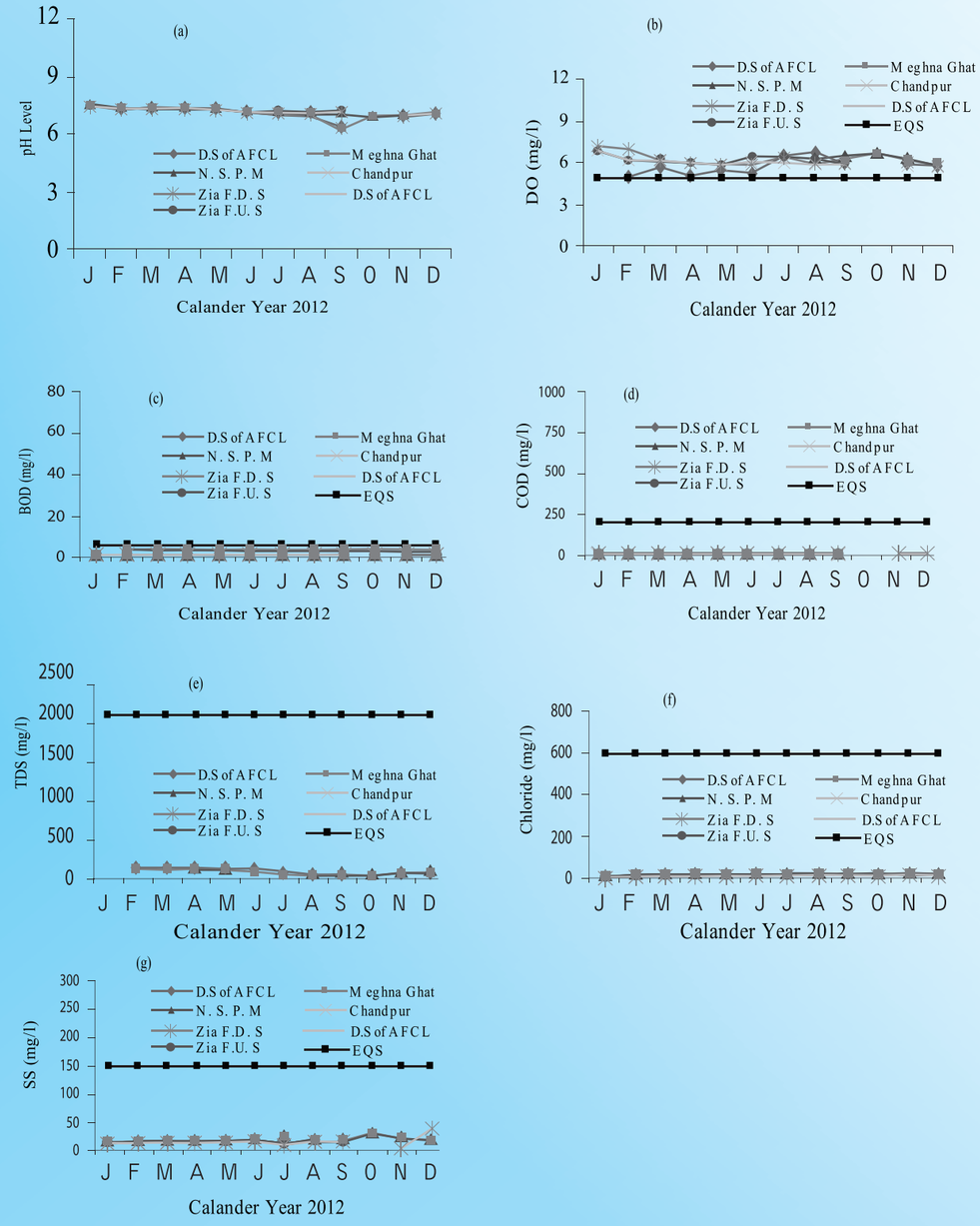


Fig.8. Graphical presentation of pH, DO, BOD, COD, TDS, Chloride and SS of Meghna River in 2012

Note: N.S.P.M = Near Shajalal Paper Mill, Zia F.D.S = Zia Fertilizer Factory Down Stream,
Zia F.U.S = Zia Fertilizer Factory Up Stream, AFCL U.S= AFCL up stream, AFCL D.S= AFCL Down Stream

Table-17. Level of EC at different locations of Meghna river in 2012.

Sampling Locations of Meghna River	EC (µmhoms/cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bhairob Bazar	-	-	-	94	88	-	-	-	617	54.4	-	-
Meghna Ghat	142	202	78	74	68	63.3	94	-	-	73.3	140.6	131.1
Near Shajalal Paper Mill	-	-	-	-	-	80	98	-	-	-	-	136.1
Chandpur (Side)	130		136	122	244	-	104	120	112	-	114	151
Chandpur (Mid)	134		132	116	226	-	100	108	110	-	110	125
Zia F. Up Stream	-	-	-	-	-	-	-	-	-	-	-	-
Zia F. (D.S)	-	-	-	-	-	-	-	-	-	-	-	-
AFCL (US)Ashugonj,	122	380	388	276	234	**61**	70	102	74	-	158	123
AFCL (DS)Ashugonj,	126	740	748	344	312	112	74	156	102	-	**2140**	543
EQS for wastewater after treatment from industrial units 1200 µmhos/cm												

EC of Meghna river water at different locations was within the EQS (µmhoms/cm). The maximum and the minimum EC of Meghna river was 2140 µmhos/cm in November at AFCL (Up Stream), Ashugonj and 61 µmhoms/cm in June at AFCL (Down Stream), Ashugonj (Table-17).

4.9 Padma river

The Padma is a major trans-boundary river of Bangladesh. Water samples were collected from three locations of the river namely Mawa Ghat, Pakshi Ghat (Bank and Middle) of Pabna, Iswardi and Baro Kuti Ghat (Bank and Middle) of Rajshahi.

In 2012, pH level of Padma river varied from 6.0 to 7.8 (Fig.9a) while standard pH for inland surface water is 6.5 to 8.5. The maximum pH was found at Baro Kuti Ghat bank in January and the minimum pH level was at Pakshi Ghat in October. In 2011, pH level varied from 6.4 to 8.3. DO level of Padma river was above EQS (≥5 mg/l) for fisheries at all the locations and it varied from 5.4 to 8.26 mg/l (Fig.9b). In 2011, DO concentration ranged from 5.0 to 10.5 mg/l. BOD load was within the EQS (≤6 mg/l) for fisheries at all locations. The maximum BOD was found 2.8 mg/l in July and that of the minimum was 1.15 mg/l in November (Fig.9c). In 2011, BOD load varied from 1.5 to 3.5 mg/l. TDS level of Padma river was within EQS throughout the year of 2012 and it varied from 90 to 370 mg/l (Fig.9d). In 2011, TDS concentration varied from 87 to 280 mg/l.

The maximum and the minimum EC of Padma river water was 699 µmhoms/cm in December and 138.3 µmhoms/cm in September (Fig.9e), while EQS is 1200 µmhoms/cm waste from industrial units. In 2011, EC varied from 64 to 461 mg/l. Level of SS was within the EQS (150 mg/l). The maximum and the minimum SS concentration of Padma river was 90 mg/l in December and 26 mg/l in January (Fig.9f). In 2011, SS concentration varied from 15 to 74 mg/l.

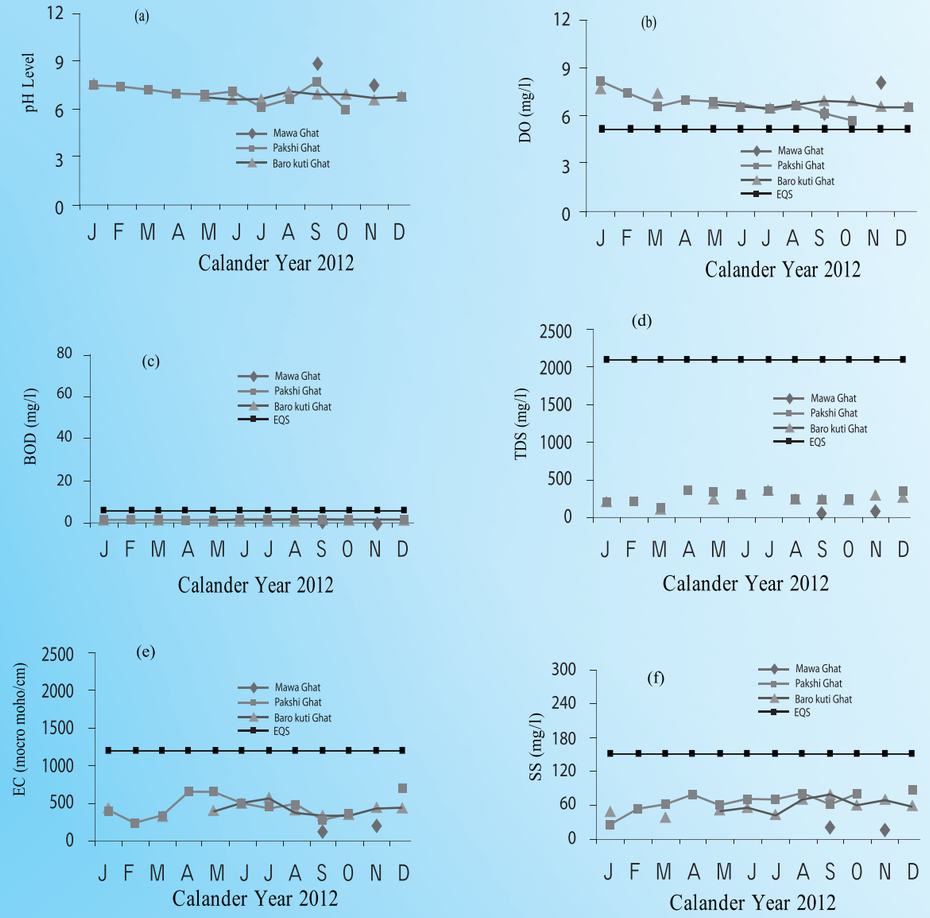


Fig.9. Graphical presentation of pH, DO, BOD, TDS, EC and SS of Padma River in 2012

Table-18. Level of Total alkalinity at different sampling locations of Padma river in 2012.

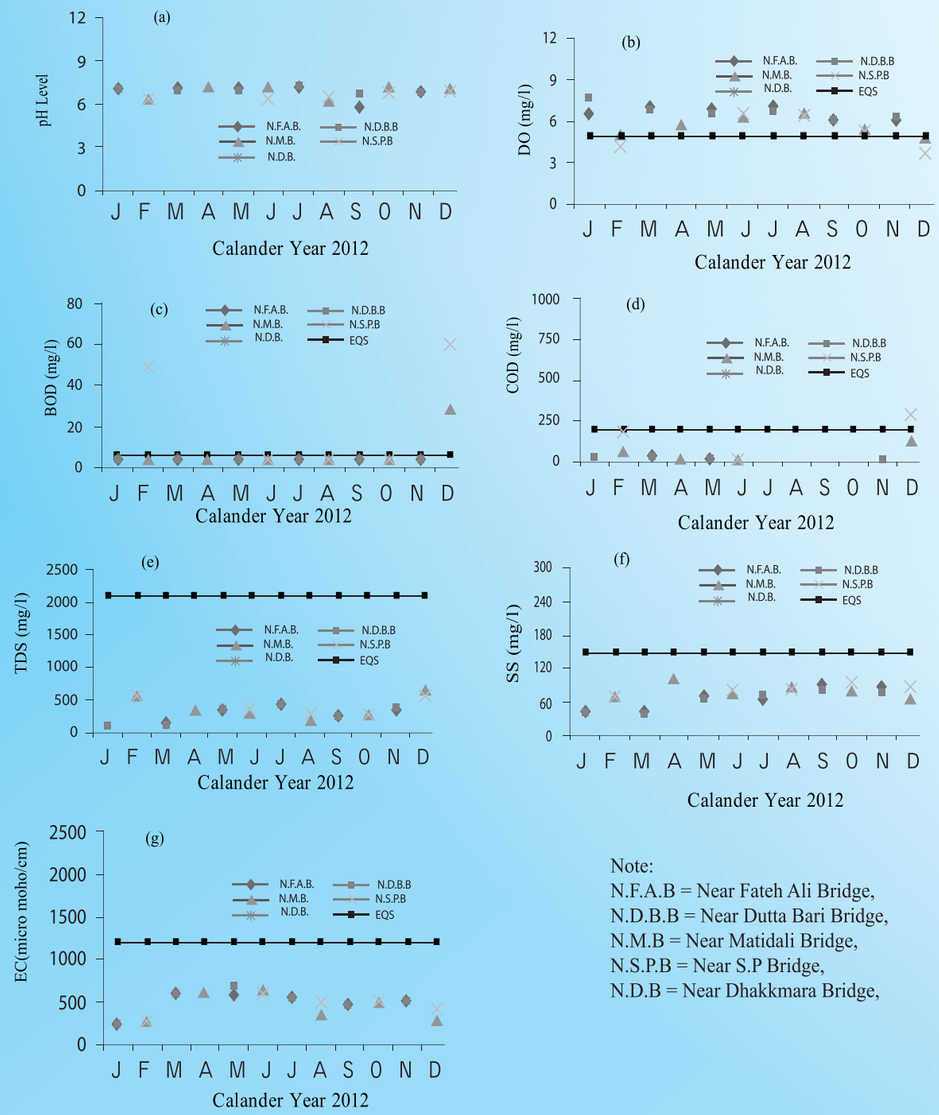
Sampling Locations of Padma River	Total alkalinity (mg/l)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mawa Ghat	58	-	-	-	62	-	-	-	60	-	**90**	-
Pakshi (B), Iswardi	52	48	55	46	46	45	42	38	33	34		37
Pakshi (M),Iswardi	56	44	56	46	48	43	43	37	31	36		38
Baro kuti (B), Raj.	54		40		38	36	42	32	**30**	39	34	34
Baro kuti (M), Raj.	46		42		37	34	40	30	31	33	36	37
EQS for wastewater after treatment from industrial units 150 mg/l												

The maximum and the minimum T. alkalinity of Padma river water was 90 mg/l in November and 30 mg/l in September (Table-18).

4.10 Korotoa river

To analyse water quality of Korotoa river in 2012, water samples were collected from five locations of the river e.g. near Fateh Ali Bridge, near Dutta Bari Bridge, near Matidali Bridge, near S.P Bridge, near Dhakkmara Bridge of the river.

pH level of Korotoa river water varied from 5.8 to 7.42 (Fig.10a) and was within EQS limit. In 2011, pH level varied from 6.0 to 8.38. DO level of was within the EQS (≥5 mg/l) for fisheries. DO varied from 3.0 to 8.0 mg/l (Fig.10b). In 2011, DO concentration varied from 2.2 to 8 mg/l.



Note:
N.F.A.B = Near Fateh Ali Bridge,
N.D.B.B = Near Dutta Bari Bridge,
N.M.B = Near Matidali Bridge,
N.S.P.B = Near S.P Bridge,
N.D.B = Near Dhakkmara Bridge,

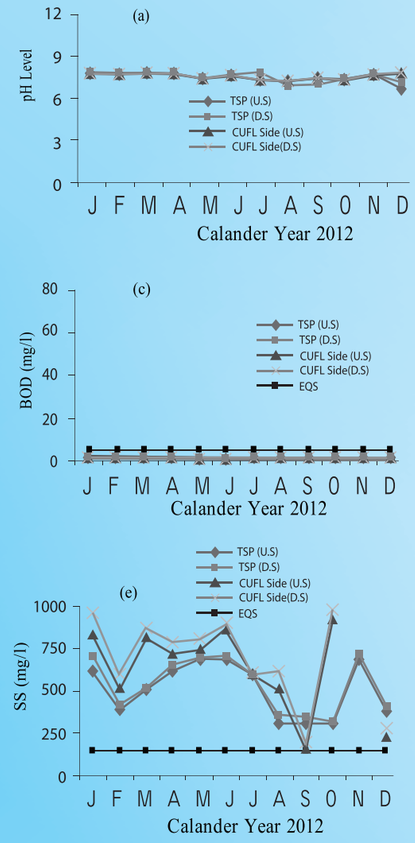
Fig.10. Graphical presentation of pH, DO, BOD, COD, TDS, SS and EC of Korotoa River in 2012

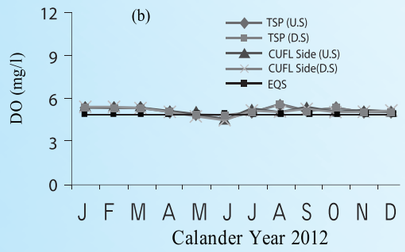
In 2012, BOD was also within the EQS (≤6 mg/l) limit for fisheries except in the month of December. BOD varied from 2.0 to 65 mg/l (Fig.10c). In 2011, BOD concentration varied from 2.1 to 74 mg/l. In 2012, COD level of Korotoa river was low compare to EQS (200 mg/l) for wastewater after treatment from industrial units. COD varied from 8.0 to 308 mg/l (Fig.10d). The maximum COD concentration was 308 mg/l in Korotoa river Down stream, Near S.P Bridge, Bogra. In 2011, COD concentration varied from 20 to 308 mg/l. TDS varied from 110 mg/l to 670 mg/l (Fig.10e). In 2011, TDS range was from 29 mg/l to 723 mg/l. Level of SS of Korotoa river at different locations was within the EQS. The maximum and the minimum SS was 110 mg/l in April and 30 mg/l in January (Fig.10f) respectively. In 2011, SS concentration varied from 26 mg/l to 90 mg/l. EC varied from 228 mg/l to 686.6 mg/l (Fig.10g) and was within the EQS limit. In 2011, EC concentration varied from 64 mg/l to 690.6 mg/l.

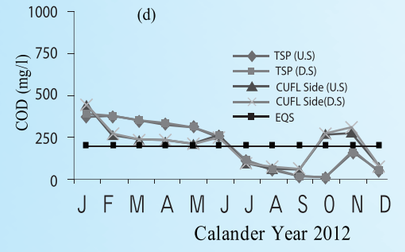
4.11 Karnaphuli river

Karnaphuli river is in the south-eastern part of Bangladesh that flows through Chittagong Hill Tracts and Chittangong into the Bay of Bengal. Water samples were collected from two locations comprising four points (e.g. Triple Super Phosphate (TSP) industry Upstream, TSP industry Downstream, Karnaphuli Urea Fertilizer Limited (CUFL) Upstream and CUFL Downstream of Karnaphuli river for analyses of water quality in 2012.

In 2012, pH level among the sampling points of the Karnaphuli river varied from 6.4 to 7.98 (Fig.11a), while standard pH for inland surface water is 6.5 to 8.5. In 2011, pH level varied from 6.8 to 8.0 mg/l. DO level of Karnaphuli river was high althrough the year of 2012 and met the standard of DO for fisheries (≥5 mg/l). DO varied from 4.4 to 5.5 mg/l (Fig.11b). In 2011, DO concentration varied from 5.2 to 6.8 mg/l. BOD level was below the EQS limit (≤6 mg/l) for fisheries throughout the year. It varied from 0.8 to 2.6 mg/l (Fig.11c). In 2011, BOD concentration varied from 1.0 to 2.4 mg/l. COD value varied from 4.0 to 441 mg/l (fig.11d), while EQS for wastewater after treatment from industrial units is 200 mg/l. COD value was high at CUFL upstream and downstream compare to TSP upstream and downstream. In 2011, COD value varied from 53 to 923 mg/l. Level of SS of Karnaphuli river water at different points was beyond the EQS (150 mg/l). The maximum and the minimum SS was 1207 mg/l in November and 161 mg/l in September (Fig.11e). In 2011, SS value varied from 219 to 953 mg/l. In 2012, Chloride concentration of Karnaphuli river was higher especially at CUFL upstream and downstream and varied from 54 to 12390 mg/l (Fig.12f) where standard for Chloride is 600 mg/l for wastewater after treatment from industrial units. The maximum (12390 mg/l) level was found at CUFL downstream in January and the minimum (54 mg/l) level at TSP upstream in April. In 2011, Chloride concentration varied from 130 to 10700 mg/l.







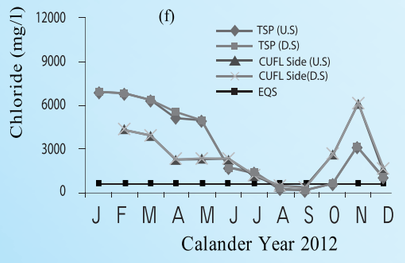


Fig.11. . Graphical presentation of pH, DO, BOD, COD, SS and Chloride of Karnaphuli River in 2012

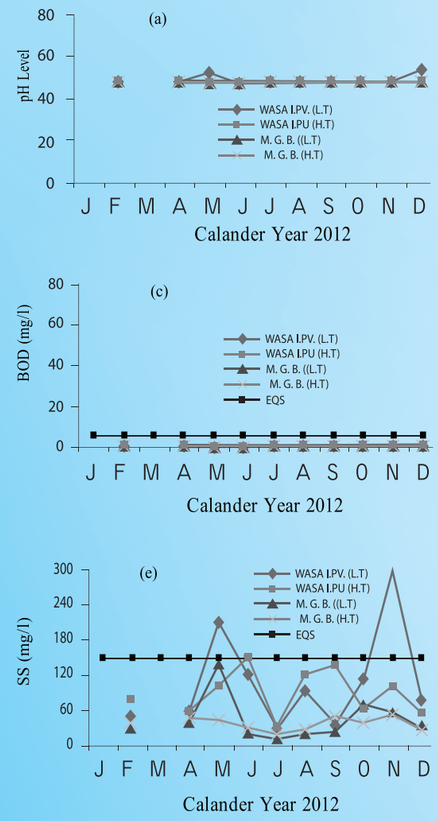
T.S.P = Triple Super Phosphate, C.U.F.L = Carnaphuli Urea Fertilizer Limited

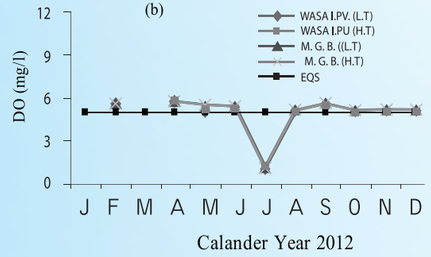
U.S= Up Stream, D.S= Down Stream

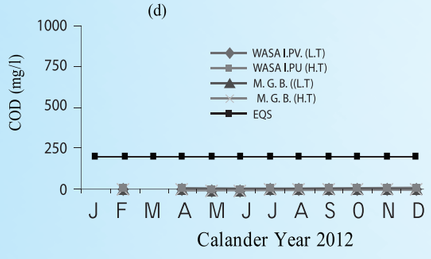
4.12 Halda River

Halda river passes through the South-Eastern part of Bangladesh. Water sampling points were WASA intake Point (upstream), WASA intake Point (downstream), Maduna Ghat (Bank) and Maduna Ghat (Middle) of Halda River. Samples were collected during high tide and low tide at all locations of the river. To simplify the analysis, only high tide and low tide variation for the sampling points were considered. Because no significant variation was found between upstream and downstream (WASA intake Point) and river bank- middle (Maduna Ghat).

pH of Halda river water was within EQS limit in 2012 and varied from 7 to 8 (Fig.12a). In 2011, pH level varied from 6.8 to 7.6. DO level of Halda river was well above the EQS limit throughout the monitoring period of 2012 and met the standard of DO level for fisheries (≥5 mg/l) at all locations of the river during high tide and low tide. DO varied from 1.0 to 5.65 mg/l (Fig.12b). In 2011, DO range was from 5.2 to 6.8 mg/l. The maximum and the minimum BOD was 1.8 and 0.3 mg/l respectively (fig.12c). In 2011, BOD concentration varied 1.0 and 2.4 mg/l.







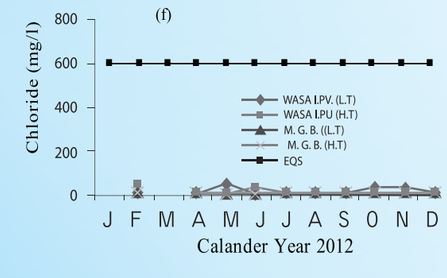


Fig.12. Graphical presentation of pH, DO, BOD, COD, SS and Chlorideof Halda River in 2012.

Note: WASA I.P (HT)= WASA Intake Point High Tide, WASE I.P (LT)= WASA Intake Point Low Tide

M.G.B (HT) = Maduna Ghat Bank High Tide, M.G.B (LT) = Maduna Ghat Bank Low Tide

In 2012, COD at the sampling locations of Halda river during high and low tide varied from 1.0 to 4.0 mg/l (Fig.12d). In 2011, COD varied from 53 to 923 mg/l. The maximum and the minimum SS content of Halda river water was 211 mg/l in May and 13 mg/l in July (Fig.-12e). In 2011, SS value varied from 219 to 953 mg/l. Chloride level of Halda River in 2012 was well below the EQS (600 mg/l) for treated wastewater from industrial units. Chloride varied from 8 to 47 mg/l (Fig-12f). Concentration was relatively higher during high tide compare to the low tide concentration of Chloride at all locations of the river. In 2011, Chloride concentration varied from 6 to 55 mg/l.

4.13 Bakkhali River

Bakkhali is the only river in Cox's Bazar district. It rises from the ranges that divided Chittagong from Arakan and flows north, then turn to the west and flow passes Ramu, Cox's Bazar towns and falls into the Maheshkhali channel. Water samples were collected from two locations e.g. Mazer Ghat and Fishery Ghat of Cox's Bazar of Bakkhali river in 2012.

In 2012, pH level varied from 6.8 to 8.45 (Fig.13a) and was within the standard limit (6.5-8.5) of inland surface water at all the locations during sampling period. In 2011, pH level varied from 7.2 to 7.9.

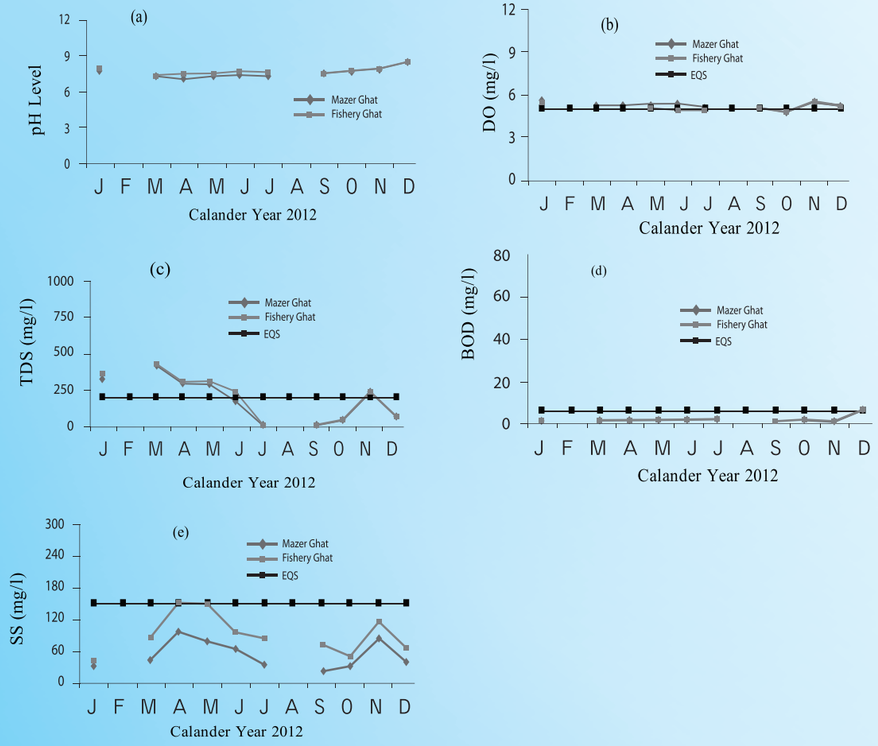


Fig.13. Graphical presentation of pH, DO, BOD, COD, SS and Chloride of Bakkhali River in 2012

In 2012, DO concentration varied from 4.8 to 5.9 mg/l (Fig.13b). DO at all the sampling points was above the EQS for fisheries (≥5 mg/l). In 2011, DO content varied from 5.4 to 6.4 mg/l. In 2012, BOD level of Bakkhali river water was below the EQS (≤6 mg/l) for fisheries throughout the sampling period. The maximum and the minimum BOD was 1.9 and 0.6 mg/l (Fig.13c) respectively. In 2011, BOD varied from 0.6 to 1.4 mg/l. COD level of Bakkhali river was much higher than the EQS (200 mg/l) for treated wastewater from industrial units. COD varied from 1.0 to 413 mg/l throughout the sampling period (Fig.13d). In 2011, COD level varied from 1 to 735 mg/l. In 2012, SS of Bakkhali river water at different locations was within the EQS. The maximum and the minimum SS concentration of Bakkhali river was 152 mg/l in April and 19 mg/l in September (Fig.13e). In 2011, SS value varied from 13 to 123 mg/l.

Table-19. Level of Chloride at different locations of Bakkhali river in 2012.

Sampling Locations of Bakkhali River	**Chloride (mg/l)**											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mazir Ghat at Cox's Bazar	6300		10500	7389	8100	1362	165		**45**	166		7166
Fishery Ghat at Cox's Bazar	10900		**14222**	11945	12200	2110	546		176	188		7500
EQS for wastewater after treatment from industrial units 600 mg/l												

Chloride concentration varied from 45 to 14222 mg/l (Table-19) against the EQS (600 mg/l) for treated wastewater from industrial units. In 2012, Chloride concentration varied from 342 to 9100 mg/l.

4.14 Moyuri river

For monitoring water quality of Moyuri River in 2012, water samples were collected from one location named Gallamari Bridge comprising Bank, Middle and Opposite Bank of the river.

In 2012, pH level of Moyuri river water varied from 6.35 to 7.73 (Fig.14a) and was within the EQS limit. In 2011, pH level varied from 6.93 to 7.72. DO content of Moyuri river water was below the EQS (≥5 mg/l) for fisheries. DO level varied from 0.4 to 2.0 mg/l (Fig.14b). No dissolved oxygen was found from April to June. In 2011, DO concentration varied from 0.2 to 4.8 mg/l. BOD level of the Moyuri river water varied from 6.0 to 20 mg/l while EQS for fisheries is ≤6 mg/l (Fig.14c). In 2011, BOD level varied from 1.8 to 36 mg/l. TDS range was from 547 to 1015 mg/l (Fig.14d) while EQS is 2100 mg/l. Highest TDS value was found in from February to June and lowest was found from July to December. In 2011, TDS concentration varied from 190 to 10300 mg/l. Chloride level was much higher (March-June) compare to rest of the period and varied from 680 to135.65 mg/l (Fig.14e).

In 2011, Chloride level varied from 21 to 6483 mg/l. Turbidity level of Moyuri river at all points was very high. It varied from 40.1 to 79.6 NTU while Turbidity for drinking water is 10 NTU (Fig.14f). In 2012, Turbidity level varied from 44.6 to 166.8 NTU.

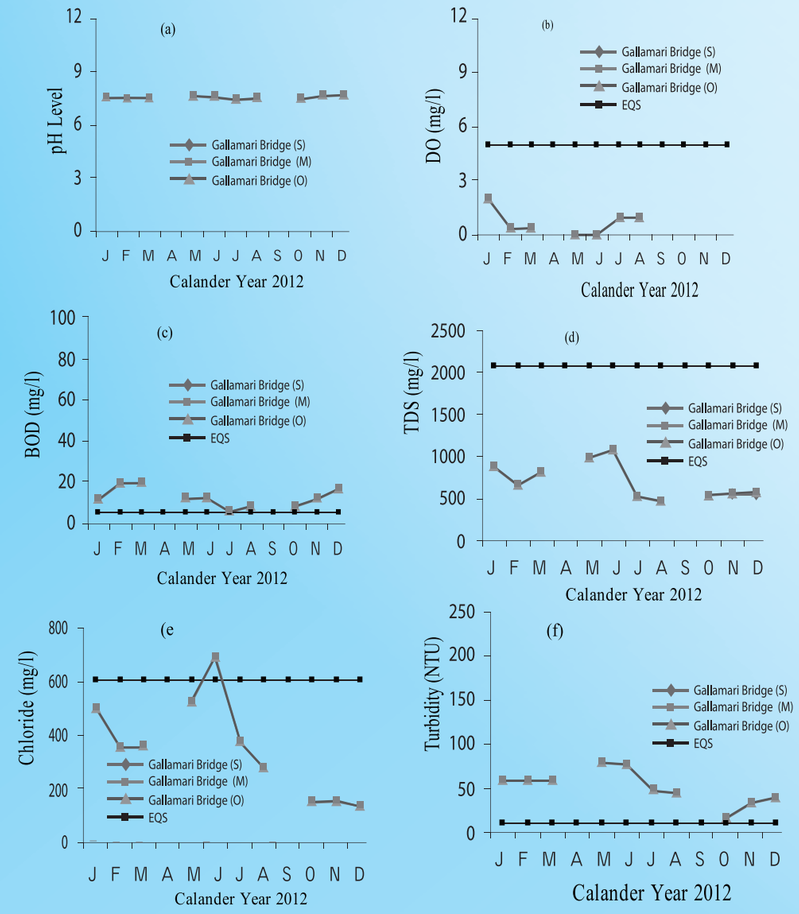


Fig.14. Graphical presentation of pH, DO, BOD, COD, TDS, Chloride, Turbidity of Moyuri River in 2012

Note: S=Side, M= Middle, O= Other side

Table-20. Level of EC at different sampling points of Moyuri river in 2012.

Sampling Locations of Moyuri River	EC (µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gallamari Bridge (Side point)	1773	1338	1661	**2280**	2030	2200	1091	998	930	1103	1123	**544**
Gallamari Bridge, (Middle point)	1773	1338	1661	2280	2030	2200	1091	998	930	1103	1123	544
Gallamari Bridge, (Opposite point)	1773	1338	1661	2280	2030	2200	1091	998	930	1103	1123	544
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

EC varied from 544 µmhoms/cm to 2280 µmhoms/cm. The maximum and the minimum concentration was 2280 µmhoms/cm in April and 544 µmhoms/cm (Table-20) in December respectively while standard for treated wastewater from industrial unit EC is 1200 µmhoms/cm.

Table-21. Level of Salinity at different sampling points of Moyuri river in 2012.

Sampling Locations of Moyuri River	Salinity (ppt)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gallamari Bridge, (Side point)	0.9	0.6	0.8	**1.1**	1.0	1.1	0.5	0.5	0.4	0.5	0.5	**0.1**
Gallamari Bridge, (Middle point)	0.9	0.6	0.8	1.1	1.0	1.1	0.5	0.5	0.4	0.5	0.5	0.1
Gallamari Bridge, (Opposite point)	0.9	0.6	0.8	1.1	1.0	1.1	0.5	0.5	0.4	0.5	0.5	0.1
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity level varied from 0.1 ppt to 1.1 ppt. The maximum and the minimum salinity was 1.1 and 0.1 mg/l respectively while standard salinity is 400 ppt for treated wastewater from industry (Table-21). In 2011, salinity varied from 0.6 ppt to 11.8 ppt.

4.15 Bhairab River

Bhairab river flows in the south of Bangladesh. The river is approximately 62 K.m long and 100 m wide. Its average depth is 1.22 to 1.53 m and with minimal water flow with plenty of silt. Water samples were collected from three locations comprising nine different points (e.g. Noapara Ghat Bank, Middle and Opposite, Fultala Ghat Side, Middle and Opposite and Charerhat Ghat Side Middle and Opposite) of Bhairab River for analyses water quality in 2012. To simplify data analysis only middle point of all locations was considered. Because, no significant variation was found between side, middle and opposite point of a location of the river.

In 2012, pH at different locations of the Bhairab river varied from 7.42 to 7.87 (Fig.15a) while standard pH for inland surface water is 6.5 to 8.5. In 2011, pH level varied from 7.11 to 7.78. BOD level of Bhairab river water was below the EQS (≤6 mg/l) for fisheries round the year of 2012. BOD varied from 0.5 to 0.8 mg/l (Fig.15b). In 2011, BOD level varied from 0.5 to 1.1 mg/l. COD was relatively low in 2012. The maximum and the minimum COD was 22 and 20 mg/l (Fig.15c) respectively while EQS for COD is 200 mg/l. In 2011, COD varied from 20 to 22 mg/l. DO was below the EQS ((≥5 mg/l) for fisheries. In 2012, the maximum and the minimum DO was 5.3 to 7.8 mg/l (Fig.15d) respectively. In 2011, DO varied from 6.4 and 4.4 mg/l. In 2012, TDS level of Bhairab river was also very high during February to June at all locations. The maximum and the minimum was 116 to 2180 mg/l (Fig.15e) respectively while EQS is 2100 mg/l. TDS was high from March to June. In 2011, TDS varied from 130 mg/l to 15000 mg/l.

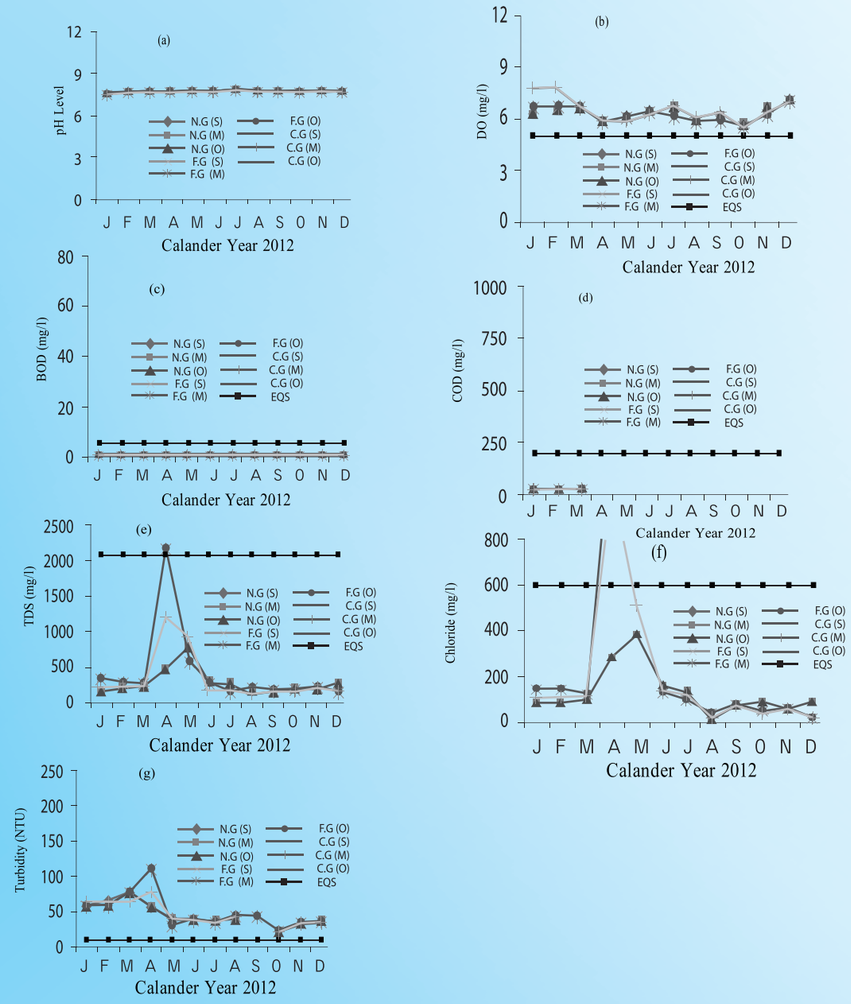


Fig.15. Graphical presentation of pH,DO,BOD,COD,TDS,Chloride and Turbidityof Bhairab River in 2012.

N.G = Noapara Ghat, F.G = Fultala Ghat, C.G = Charerhat Ghat

S = Side, M = Middle, O = Other Side

High level of Chloride was found from March to June in Bhairab river water. It varied from 16.78 to 1290 mg/l (Fig.15f) while EQS for Chloride is 600 mg/l. Highest Chloride (1290 mg/l) was found in April and lowest was 16.78 mg/l in December. In 2011, Chloride level varied from 9.6 to 9340 mg/l. Turbidity of Bhairab river water at all locations was very high in 2012. It varied from 20.7 to 108 NTU while the EQS for drinking water is 10 NTU (Fig.15g). The prime reason may be of carrying huge silt by the river throughout the year. In 2011, Turbidity level varied from 38.4 to 188.8 NTU.

Table-22. Level of Salinity at different locations of Bhairab river in 2012.

Sampling Locations of Bhairab River	Salinity (ppt)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Noapara Ghat (Side)	0.2	0.2	0.2	0.5	0.7	0.2	0.2	0.0	0.0	0.1	0.1	0.1
Noapara Ghat (Middle)	0.2	0.2	0.2	0.5	0.7	0.2	0.2	0.0	0.0	0.1	0.1	0.1
Noapara Ghat (Opposite)	0.2	0.2	0.2	0.5	0.7	0.2	0.2	0.0	0.0	0.1	0.1	0.1
Fultala Ghat (Side)	0.3	0.3	0.2	**2.3**	0.5	0.2	0.1	**0.0**	0.1	0.1	0.2	0.1
Fultala Ghat (Middle)	0.3	0.3	0.2	2.3	0.5	0.2	0.1	0.0	0.1	0.1	0.2	0.1
Fultala Ghat (Opposite)	0.3	0.3	0.2	2.3	0.5	0.2	0.1	0.0	0.1	0.1	0.2	0.1
Charerhat Ghat (Side)	0.2	0.2	0.1	1.2	0.9	0.2	0.1	0.0	0.1	0.1	0.2	0.1
Charerhat Ghat(Middle)	0.2	0.2	0.1	1.2	0.9	0.2	0.1	0.0	0.1	0.1	0.2	0.1
Charerhat Ghat (Opposite)	0.2	0.2	0.1	1.2	0.9	0.2	0.1	0.0	0.1	0.1	0.2	0.1
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity varied from 0.0 ppt to 2.3 ppt. The maximum and the minimum salinity was 2.3 ppt in April and 0.0 ppm in August respectively (Table-22).

4.16 Rupsha River

Rupsha is one of the most famous and important river of Bangladesh that flows by the port city Khulna, and falls to the Bay of Bengal through Poshur River at Mongla channel. Water samples were collected from two different locations comprising six points (e.g. Rupsha Ghat Bank, Middle and Opposite and Labanchara Ghat Bank, Middle and Opposite) of Rupsha River for monitoring water quality in 2012. To facilitate analysis, only the middle point value of two locations were considered. Because, no significant variation was found between bank and middle points of both locations.

In 2012, pH varied from 7.44 to 7.88 (Fig.16a) while in 2011, pH level varied from 7.13 to 7.73. It has been observed that DO level was lower than EQS (≥5 mg/l) for fisheries during February to June. The maximum and the minimum DO content was 6.8 and 5.7 mg/l respectively (Fig.16b). In 2011, DO level varied from 6.8 and 4.5 mg/l. In 2012, the maximum and the minimum BOD was 8.0 and 0.4 mg/l respectively (Fig.16c). In 2011, BOD varied from 0.6 to 8.0 mg/l. The maximum and the minimum COD was 22 and 20 mg/l respectively (Fig.16d) while the EQS is 200 mg/l. In 2011, COD concentration varied from 22 and 225 mg/l. Chloride level was much higher in April than the EQS (600 mg/l) for treated wastewater from industrial units. Chloride content varied from 16 to 2609 mg/l (Fig.16e). In 2011, Chloride varied from 15.6 to 9720mg/l. In 2012, Turbidity level was relatively higher throughout the year and varied from 10.22 to 89.20 NTU (Fig.16f) while EQS for drinking water is 10 NTU. In 2011, Turbidity varied from 52.2 to 210.6 NTU.

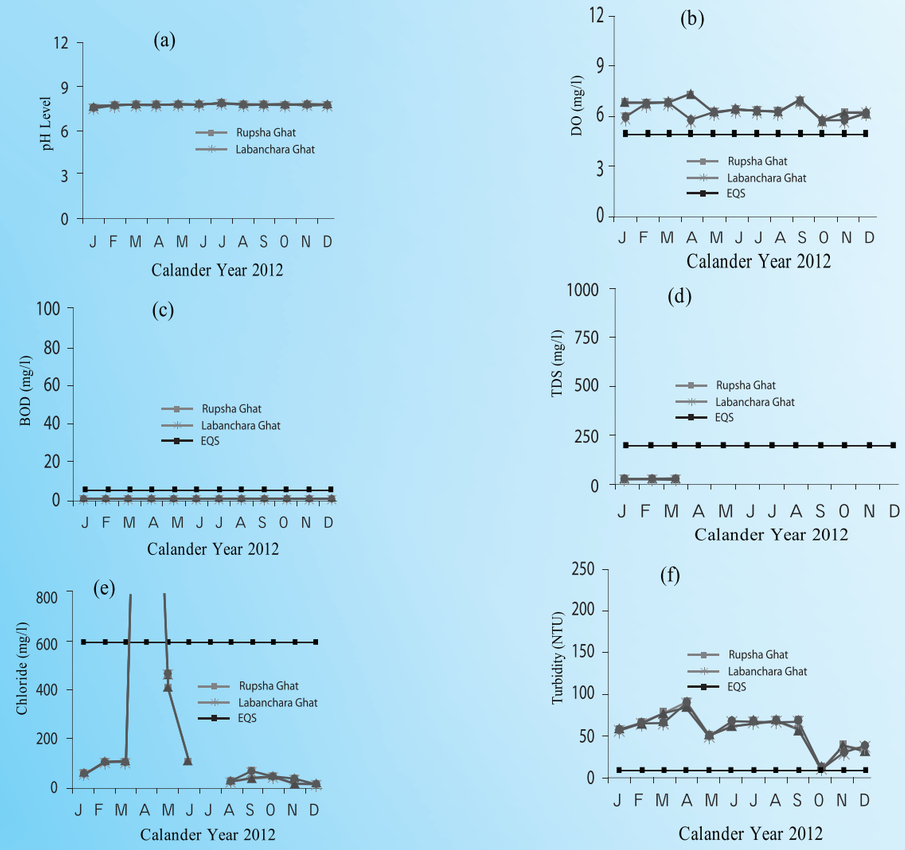


Fig.16. Graphical presentation of pH, DO, BOD, COD, Chloride and Turbidity of Rupsha River in 2012.

Table-23. Level of TDS at different sampling locations of Rupsha river in 2012.

Sampling Locations of Rupsha River	TDS (mg/l)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rupsha Ghat (Side)	204	214	244	417	820	203	147	136	**125**	160	165	160
Rupsha Ghat (Middle)	324	214	244	417	820	203	147	136	125	160	165	160
Rupsha Ghat (Opposite)	204	214	244	417	820	203	147	136	125	160	165	160
Labanchara Ghat (Side)	203	204	1800	**5140**	920	206	140	140	169	165	160	170
Labanchara Ghat (Middle)	203	204	1800	5140	920	206	140	140	169	165	160	170
Labanchara Ghat (Other)	203	204	1800	5140	920	206	140	140	169	165	160	170
EQS for wastewater after treatment from industrial units 2100 mg/l												

TDS was high during April in 2012 at Labanchara Ghat. TDS level varied from 125 to 5140 mg/l (Table-23) while standard for treated wastewater from industrial units Turbidity is 2100 mg/l.

Table-24. Level of Salinity at different sampling locations of Rupsha river in 2012.

Sampling Locations of Rupsha River	TDS (mg/l)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rupsha Ghat (Side)	0.2	0.2	0.1	4.6	0.8	0.2	0.1	0.0	0.0	0.1	0.1	0.1
Rupsha Ghat (Middle)	0.2	0.2	0.1	4.6	0.8	0.2	0.1	0.0	0.0	0.1	0.1	0.1
Rupsha Ghat (Opposite)	0.2	0.2	0.1	4.6	0.8	0.2	0.1	0.0	0.0	0.1	0.1	0.1
Labanchara Ghat (Side)	0.2	0.2	1.9	**5.8**	0.8	0.2	0.1	**0.0**	0.1	0.1	0.1	0.1
Labanchara Ghat (Middle)	0.2	0.2	1.9	5.8	0.8	0.2	0.1	0.0	0.1	0.1	0.1	0.1
Labanchara Ghat (Other)	0.2	0.2	1.9	5.8	0.8	0.2	0.1	0.0	0.1	0.1	0.1	0.1
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity level varied 0.0 ppt to 5.8 ppt. The maximum and the minimum salinity was 5.8 ppt in April and 0.0 ppt August respectively (Table-24). In 2011, salinity varied from 0.2 ppt to 17.7 ppt.

4.17 Mathavanga river

For analysis of water quality of Mathavanga river, water samples were collected from a single location comprising three diffeent points, Pipeghat, Pipeghat 200 m upstream and Pipeghat 200 m downstream of Darshana, Chuadanga.

In 2012, pH varied from 6.9 to 7.91 (Fig.17a) while in 2011, pH range was from 7.19 to 7.71. In 2012, DO level was high at upstream of pipeghat but no dissolved oxygen was found at Pipeghate in April (Fig.17b). DO varied from 4.4 to 7.8 mg/l while standard DO for fisheries is ≥5 mg/l. In 2011, DO level varied from 0 to 7.2 mg/l. In 2012, BOD level varied from 0.5 to 143 mg/l (Fig.17c). In 2011, BOD range was from 0.5 to 187 mg/l. In 2011, COD varied from 20 to 5460 mg/l while EQS for treated wastewater from industrial units is 200 mg/l. TDS was below the EQS (2100 mg/l) at all the locations in 2012. High level of TDS was found at Pipeghat compare to other points of the river. It varied from 115 to 410 mg/l (Fig.18d). In 2011, TDS varied from 105 to 555 mg/l. Chloride of Mathavanga river water varied from 11.0 to 16.8 mg/l (Fig.18e) while EQS for Chloride is 600 mg/l. In 2011, Chloride content varied from 6.9 to 121.8 mg/l. Turbidity level was above the EQS (10 NTU) for drinking water and varied from 20.0 to 78.6 NTU (Fig.18f). In 2011, Turbidity level varied from 20.2 to 210.7 NTU.

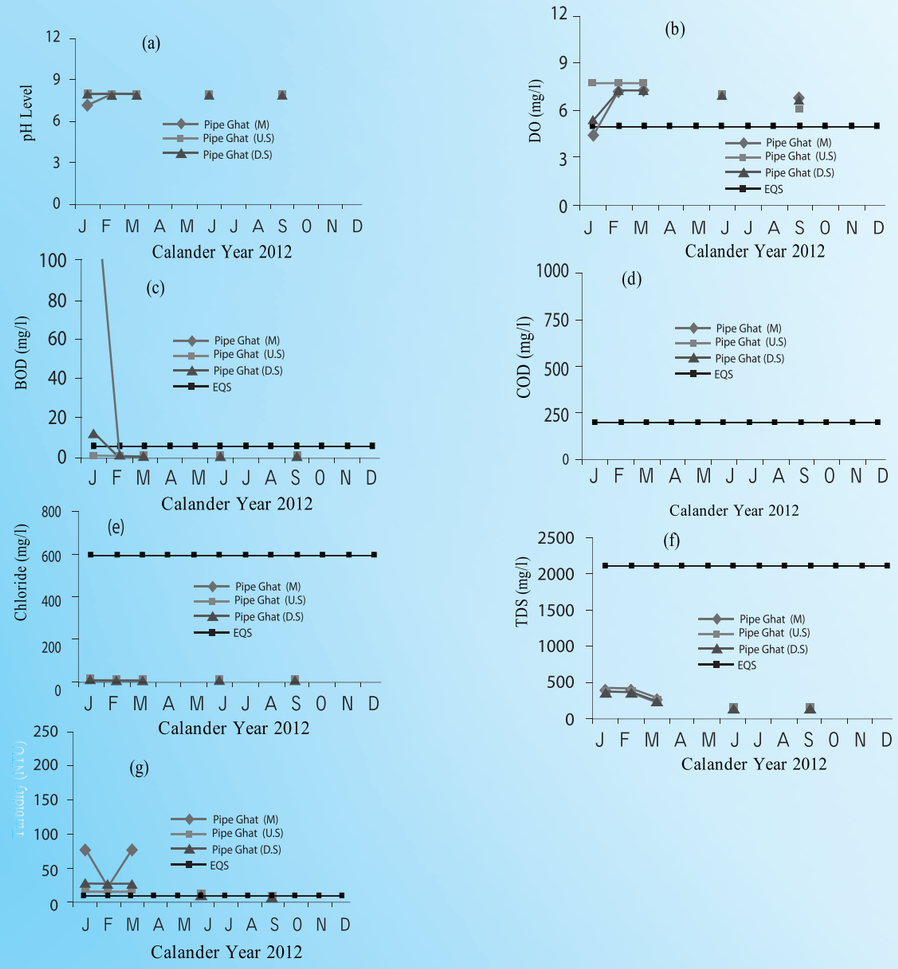


Fig.17.Graphical presentation of pH, DO, BOD, COD, TDS, Chloride, Turbidity of Mathavanga River in 2012

4.18 Pashur river

For analysis of water quality, water samples were collected from one location of Pashur river comprising three different points e.g. Monglaport Bank, Middle and Opposite bank.

In 2012, pH level varied from 7.71 to 7.88 (Fig.18a) and was within the EQS (6.5 to 8.5). In 2011, pH level varied from 6.5 to 8.5. DO level was above the EQS (≥5 mg/l) for fisheries all over the year. The maximum and the minimum concentration of DO was 6.8 and 4.8 mg/l respectively (Fig/18b). In 2011, DO varied from 6.8 and 4.6 mg/l. In 2012, BOD level was within the EQS (≤6 mg/l) for fisheries during the sampling period. The maximum and the minimum value of BOD was 0.9 and 0.5 mg/l respectively (Fig.18c). In 2011, BOD level varied from 1.2 and 0.8 mg/l. High level of TDS was found at Pipeghat compare to other points of the river. TDS varied from 151 to 11200 mg/l (Fig.18d). In 2011, TDS level varied from 205 to 17750 mg/l. Chloride level of Pashur river water varied from 30 to 5451 mg/l. Chloride concentration was higher at all points during January to July compare to rest of the period (Fig.18e). In 2011, Chloride level varied from 76 to 11390 mg/l.

Turbidity level varied from 22.4 to 110 NTU (Fig.18f) against the EQS for drinking water (10 NTU). Turbidity concentration was very high all over the year. In 2011, Turbidity level varied from 58.7 to 178.6 NTU.

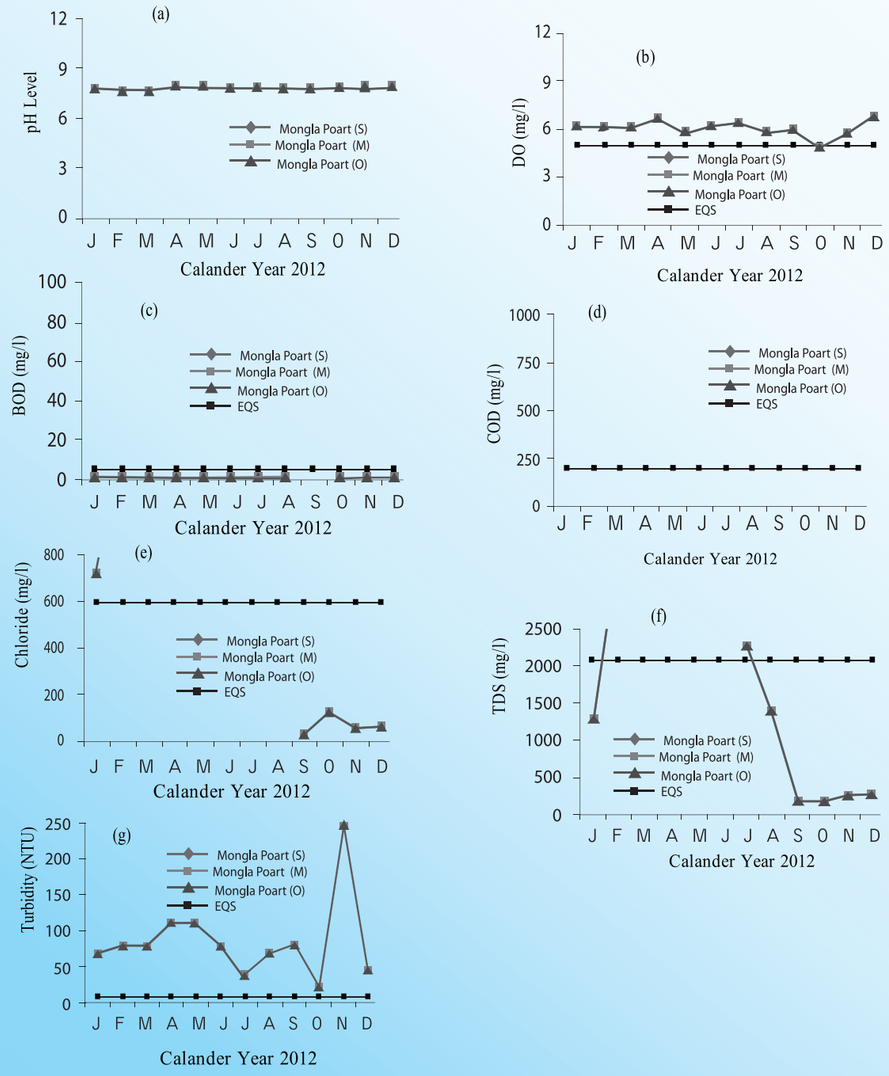


Fig.18. Graphical presentation of pH, DO, BOD, COD, TDS, Chloride, Turbidity of Pashur River in 2012

Table-25. Level of Salinity at different sampling locations of Pashur river in 2012.

Sampling Locations of Pashur River	Salinity (ppt)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mongla Poart (Side)	1.3	4.1	4.9	9.7	**13.4**	2.5	2.2	1.4	**0.2**	0.2	0.2	0.2
Mongla Poart (Middle)	1.3	4.1	4.9	9.7	13.4	2.5	2.2	1.4	0.2	0.2	0.2	0.2
Mongla Poart(Opposite)	1.3	4.1	4.9	9.7	13.4	2.5	2.2	1.4	0.2	0.2	0.2	0.2
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity varied from 0.2 ppt to 13.4 ppt. The maximum and the minimum salinity was 13.4 ppt in May and 0.2 ppt in September to December respectively while EQS for Salinity is 400 ppt (Table-25).

4.19 Kakshiali River

To monitor water quality of Kakshiali river, water samples were collected from three different points e.g. Kaliganj Bank, Middle and Opposite bank at Shatkhira location in 2012.

In 2012, pH level was within the EQS (6.5-8.5) for inland surface water and was varied from 7.65 to 7.79 (Fig.19a). In 2011, pH varied from 7.11 to 7.74. DO level varied from 5.1 to 5.9 mg/l (Fig.19b) throughout the year while EQS for fisheries is ≥5 mg/l. In 2011, DO level varied from 4.6 to 5.8 mg/l. BOD was far below the EQS (≤6 mg/l) for fisheries. It varied from 0.5 to 0.8 mg/l (Fig.19c). In 2011, BOD level varied from 0.4 to 1.0 mg/l. TDS level was very high all over the year of 2012. It varied from 3910 to 15,200 mg/l (Fig.19d). In 2011, TDS level varied from 212 to 18,200 mg/l.

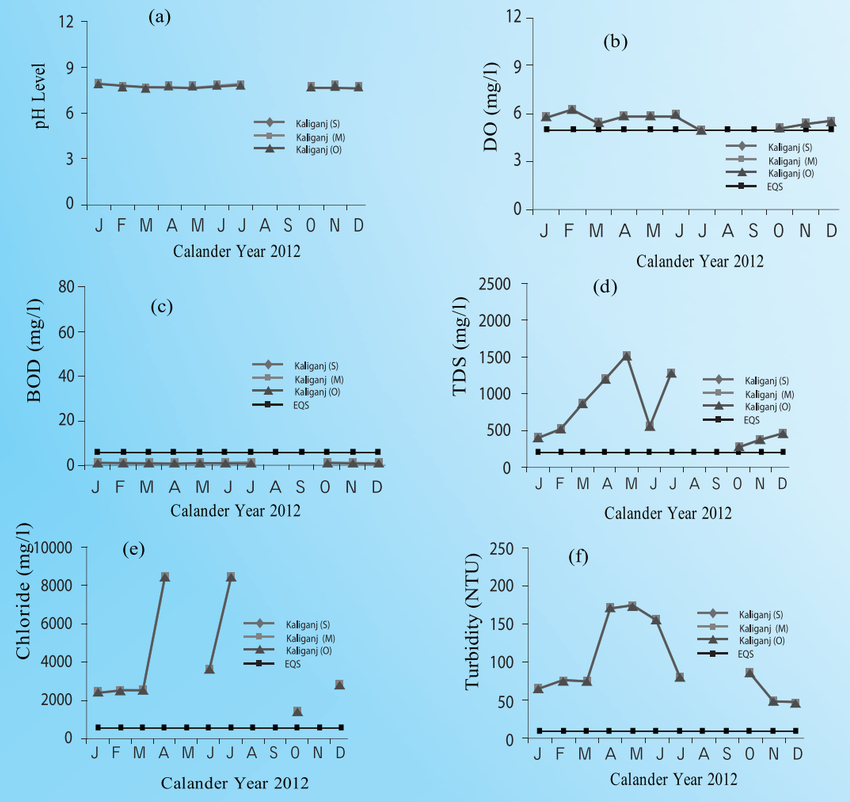


Fig.19. Graphical presentation of pH, DO, BOD, COD, TDS, Chloride, Turbidity of Kakshiali River in 2012

Note : S = Side, M = Middle, O = Opposite

In 2012, Chloride concentration was very high during January to June and varied from 1439 to 8440 mg/l (Fig.19e) while standard for treated wastewater from industrial units Chloride is 600 mg/l. The highest Chloride was found in July and the lowest value was in October. In 2011, Chloride level varied from 72.4 to 9811 mg/l. Turbidity level was above the EQS (10 NTU) limit for drinking all over the year that varied from 46.1 to 87.2 NTU (Fig.19f). In 2011, Turbidity level varied from 46.8 to 187.5 NTU.

Table-26. Level of Salinity at different sampling locations of Kakshiali river in 2012.

Sampling Locations of Kakshiali River	Salinity (ppt)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Kaliganj (Side)	4.4	5.5	10.3	15	**18.8**	6.8	15.7	-	-	**2.9**	4.3	5.2
Kaliganj (Middle)	4.4	5.5	10.3	15	18.8	6.8	15.7	-	-	2.9	4.3	5.2
Kaliganj(Opposite)	4.4	5.5	10.3	15	18.8	6.8	15.7	-	-	2.9	4.3	5.2
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity varied 2.9 ppt to 18.8 ppt. The maximum and the minimum salinity was 18.8 ppt in May and 2.9 ppt in October (Table-26) respectively while EQS for Salinity is 400 ppt. In 2011, Salinity varied from 0.2 ppt to 20.8 ppt. In 2011, salinity varied from 0.2 ppt to 20.8 ppt.

4.20 Gorai River

Water samples were collected from two locations viz. Kamarkhali ghat, Magura and G K ghat, Kustia comprising three points each. Only middle point of both locations was considered for analyses because there was no significant difference between bank, middle and opposite bank of both locations.

In 2012, pH of Gorai river water was varied from 7.28 to 7.88 (Fig.20a) and was within the EQS (6.5-8.5) for inland surface water. In 2011, pH level varied from 7.22 to 7.81. In 2012, DO was above the EQS (≥5 mg/l) limit for fisheries at both location. Level of DO varied from 5.8 to 7.2 mg/l (Fig.20b). In 2011, DO level varied from 5.7 to 6.8 mg/l. In 2012, BOD level was far below the EQS (≤6 mg/l) for fisheries. It varied from 0.3 to 0.6 mg/l (Fig.20c). In 2011, BOD level varied from 0.4 to 0.6 mg/l. TDS level of Gorai river water was very low throughout the year while comparing to the EQS (2100 mg/l) for treated wastewater from industrial units. It varied from 63.7 to 210 mg/l (Fig.20d). In 2011, TDS level varied from 85 to 220 mg/l. Chloride level was also within the EQS (600 mg/l) for treated wastewater from industrial units. The maximum and the minimum chloride value was 22.5and 8.1 mg/l (Fig.20e). In 2011, Chloride level varied from 6.5 to 35.5 mg/l. Turbidity level was relatively higher throughout the year than the EQS (10 NTU) for drinking water. It varied from 10.1 to 21.6 NTU (Fig.20f). In 2011, Turbidity level varied from 17.6 to 22.6 NTU.

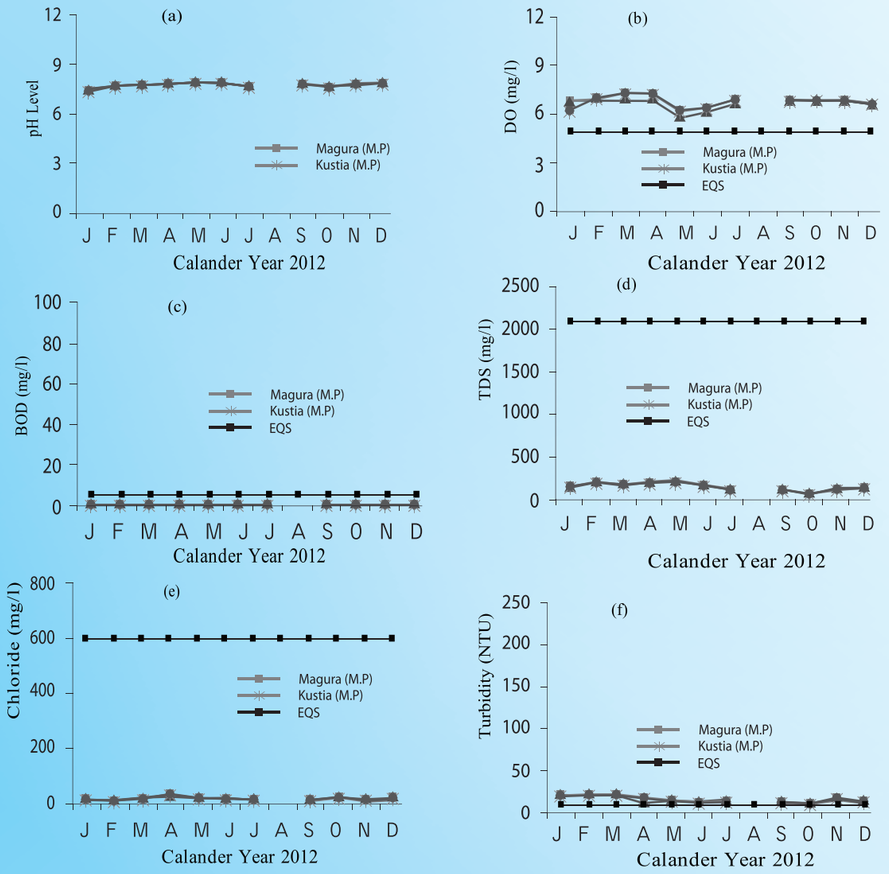


Fig.20. Graphical presentation of pH, DO BOD, COD, TDS, Chloride, Turbidity of Gorai River in 2012.

4. 21 Modhumoti river

To monitor water quality of Modhumoti river in 2012, samples were collected from one location comprising three different points (Mollarhat side, middle and opposite) of Bagerhat.

In 2012, pH level of Modhumoti river was within the EQS and varied from 6.88 to 7.88 (Fig.21a). In 2011, pH level varied from 6.88 to 7.79. DO was varied from 5.8 to 6.8mg/l while EQS is (≥5 mg/l) for fisheries (Fig.21b). In 2011, DO level was varied from 5.4 to 6.2 mg/l. BOD was below the EQS (≤6 mg/l) for fisheries. BOD varied from 0.4 to 0.6 mg/l (Fig.21c). In 2011, BOD varied from 0.4 to 0.8 mg/l. TDS of Modhumoti river water was within EQS (2100 mg/l). The maximum and the minimum value was 183 mg/l and 113.0 mg/l respectively (Fig.21d). In 2011, TDS level varied from 94.0 to 1315 mg/l. In 2012, Chloride level varied from 8.13 to 45.6 mg/l while EQS for treated wastewater from industrial units is 600 mg/l. The maximum value was found during March to December and the minimum was in April respectively (Fig.21e). In 2011, Chloride level varied from 6.2 to 274.5 mg/l. Turbidity varied from 10.8 to 12.8 NTU (Fig.21f) and was higher than EQS (10 NTU) for dirking water throughout the year. In 2011, Turbidity varied from 18.5 to 22.8 NTU.

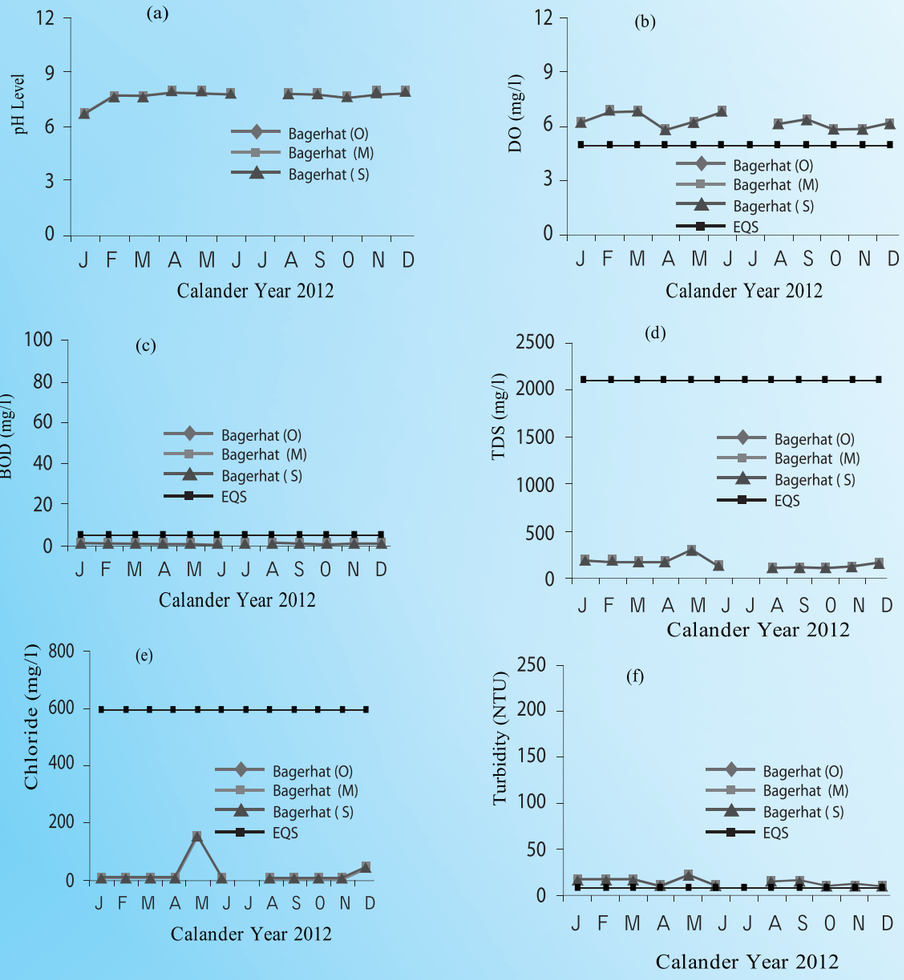


Fig.21. Graphical presentation of pH, DO, BOD COD, TDS, Chloride, Turbidity of Modhumoti River in 2012

4.22 Beel Dakatia River

To monitor water quality of Beel Dakatia river in 2012, samples were collected from one location at Khulna comprising two points (bank and middle).

In 2012, pH level was within the EQS and varied from 7.72 to 7.48 (Fig.22a). In 2011, pH level varied from 7.16 to 7.69. DO varied from 3.2 to 6.1mg/l (Fig.22b) and was closer to the EQS for fisheries (≥5 mg/l). In 2011, DO level varied from 3.2 to 5.6 mg/l. In 2012, BOD was below the EQS (≤6 mg/l) for fisheries that varied from 0.5 to 2 mg/l (Fig.22c). In 2011, BOD level varied from 0.8 to 2.0 mg/l. TDS of Beel Dakatia river water was within the EQS (2100 mg/l) except in the month May. The maximum and the minimum TDS was 2880 and 135 mg/l respectively (Fig.22d). In 2011, TDS level varied from 130 to 5600 mg/l. In 2012, Chloride level varied from 29.6 mg/l to 845 mg/l while EQS for treated wastewater from industrial units is 600 mg/l. The maximum value was found in July and the minimum was in August (Fig.22e). In 2011, Chloride level varied from 12.9 to 3640 mg/l. Turbidity varied from 12.25 to 68.40 NTU (Fig.22f) and was higher than EQS (10 NTU) for dirking water. In 2011, Turbidity level varied from 21.8 to 166.2 NTU.

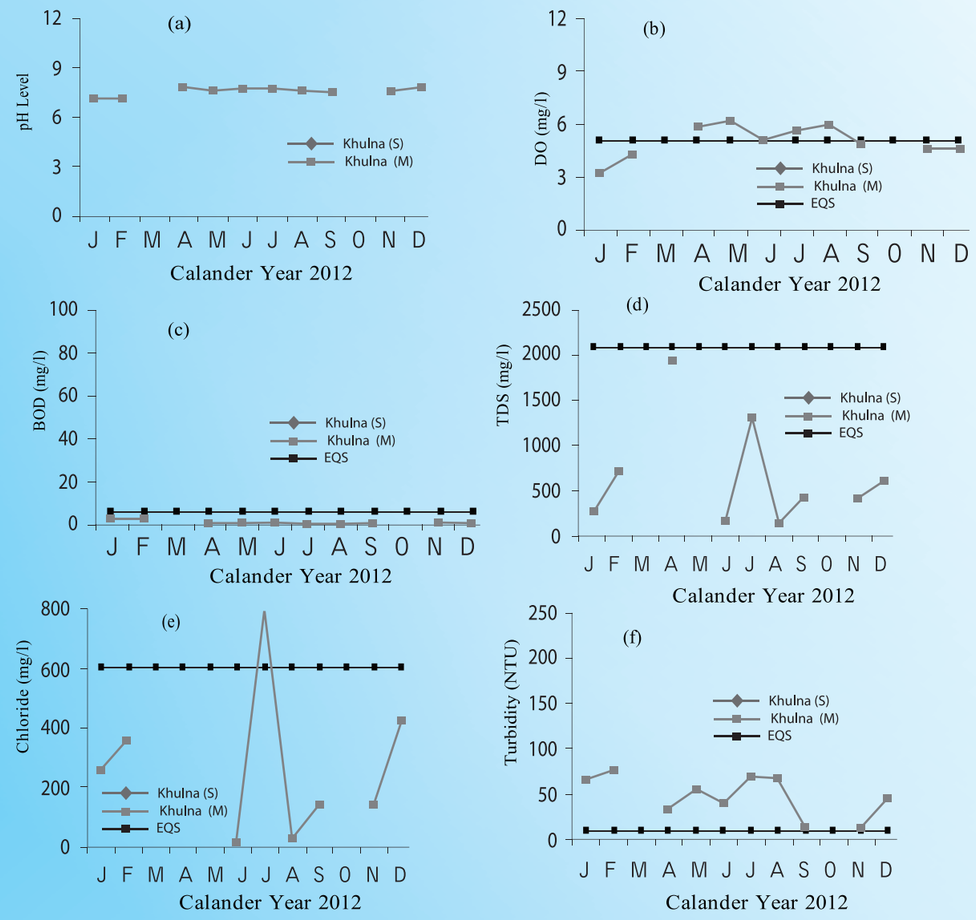


Fig.22.Graphical presentation of pH, DO, BOD, COD, TDS, Turbidity of Beel Dakatia River in 2012

Note : S = Side/bank, M = Middle

Table-27. Level of Salinity of Beel Dakatia river water in 2012.

Locations of Beel Dakatia River	Salinity (ppt)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beel Dakatia (Side)	-	-	-	1.5	**3.1**	0.1	0.8	**0.0**	0.6	0.4	0.6	0.8
Beel Dakatia (Middle)	-	-	-	1.5	3.1	0.1	0.8	0.0	0.6	0.4	0.6	0.8
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity varied 0.0 ppt to 3.1 ppt. The maximum and the minimum salinity was 3.1 ppt in May and 0.0 ppt in August respectively while standard for Salinity is 400 ppt (Table-27).

4.23 Kirtankhola River

Kirtankhola river starts from Sayeshtabad in Barisal and ends into the Gajalia near Gabkhan khal (Canal). This old river is now known as the Barisal river. The total length of the river is about 160 km (Murshed, 2006). For monitoring purpose water samples were colleted from three different locations of the river e.g. Lanch ghat (bank and middle) of Barisal, KDC Ghat and Dapdapia ghat (DG). Samples were collected during low tide (January-April and November) and high tide (June-September). Water sample was not collected in July.

In 2012, pH level of Kirtankhola river water varied from 6.0 to 8.2 (Fig.23a) and was within the EQS. In 2011, pH level varied from 6.2 to 7.8. DO level of Kirtankhola rive was above the EQS (≥5 mg/l) for fisheries at both locations of the river. DO varied from 5.7 mg/l to 7.3 mg/l (Fig.23b). In 2011, DO level varied from 4.6 mg/l to 9.7 mg/l. In 2012, BOD was low round the year. The maximum and the minimum BOD was 2.5 mg/l and 1.1 mg/l respectively (Fig.23c). In 2011, BOD level varied from 0.5 to 5.4 mg/l. In 2012, COD level varied from 36 mg/l to 52 mg/l (Fig.23d) but data was not available from march to December. In 2011, COD level was above the EQS (200 mg/l) for waste from industrial units at launch ghat & KDC ghat, in February, March and April. It varied from 18 mg/l to 377 mg/l.

In 2012, TDS of Kirtankhola rive water was also within the EQS (2100 mg/l) throughout the year while it ranged from 20 to 75.8 mg/l (Fig.23e). In 2011, TDS level varied from 24.4 to 114.5 mg/l. Chloride content of the Kirtankhola river water varied from 13 to 45 mg/l (Fig.23f). In 2011, Chloride level varied from 15 to 150 mg/l. SS of Kirtankhola river water was within EQS. The maximum and the minimum SS of Kirtankhola river water was 30.3 mg/l in March and 6.72 mg/l in July (Fig.23g). In 2011, the maximum and the minimum SS was14.63 mg/l in January and 9.59 mg/l in May.

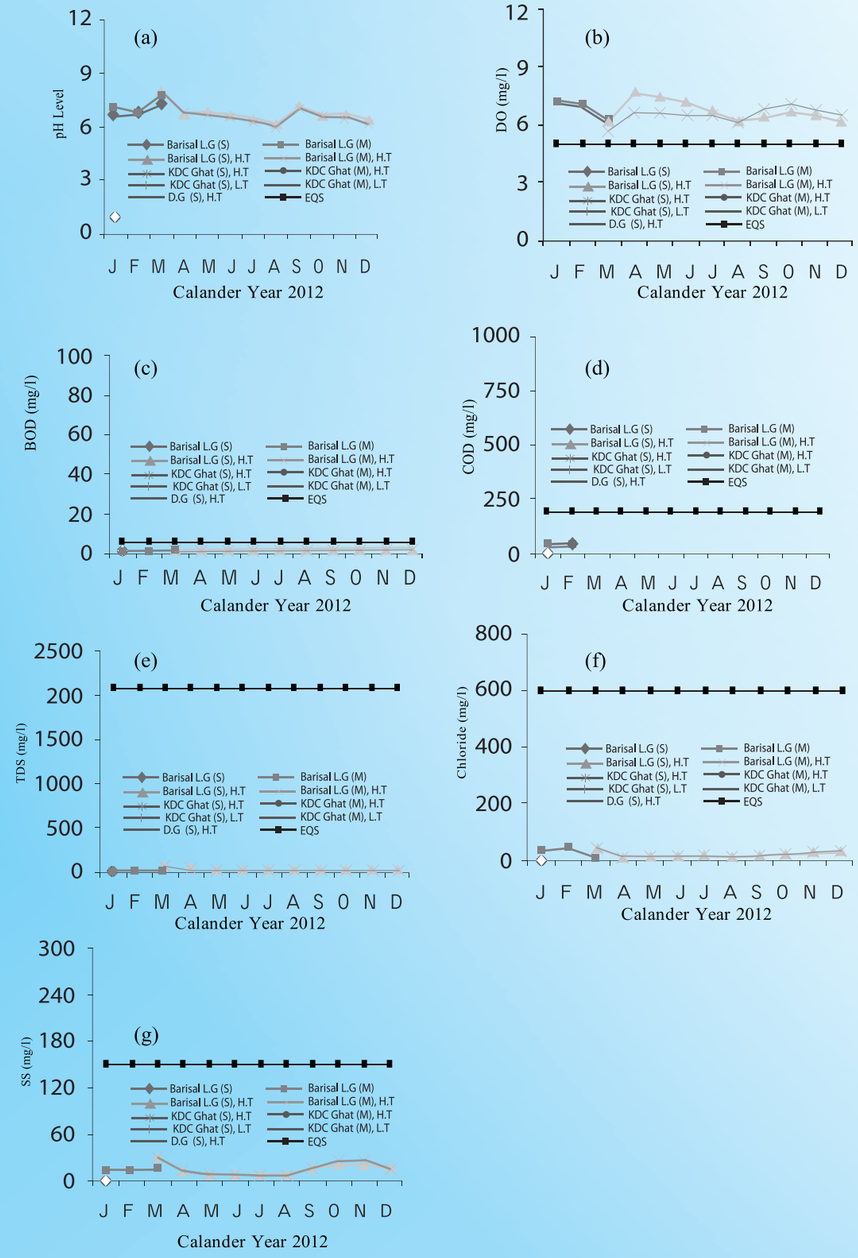


Fig.23.Graphical presentation of pH, DO, BOD, COD, TDS, Chloride, SS,EC of Kirtankhola River in 2012

L.G = Barisal Lanch Ghat, L.T=low Tide, H.T= High Tide, M=Middle, S=Side

Table-28. Level of Salinity at different sampling locations of Kirtankhola river in 2012.

Sampling locations of Kirtankhola River	Salinity (ppt)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Lanch Ghat (S),L.T	2.8	3.8	0.9	-	-	-	-	-	-	-	-	-
Lanch Ghat (M), L.T	3.6	4.2	**0.6**	-	-	-	-	-	-	-	-	-
Lanch Ghat (S), H.T	-	-	-	11.0	1.4	1.4	1.3	1.3	2.3	3.1	2.4	2.7
Lanch Ghat (M), H.T	-	-	-	**15.8**	1.3	1.3	1.1	1.1	2.5	2.8	3.0	4.1
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity concentration varied 0.6 ppt to 15.8 ppt. The maximum and the minimum salinity was 15.8 ppt in April at Lanch Ghat (Middle), high tide, Barisal and 0.6 ppt in March at Lanch Ghat (Middle),low tide, Barisal while salinity standard for treated wastewater from industrial units is 400 ppt (Table-28).

Table-29. Level of EC at different sampling locations of Kirtankhola river in 2012.

Sampling locations of Kirtankhola River	EC(µmhoms/cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Lanch Ghat (S),L.T	75.9	75.3	**81.1**	-	-	-	-	-	-	-	-	-
Lanch Ghat (M), L.T	73.3	75.4	81.0	-	-	-	-	-	-	-	-	-
Lanch Ghat (S), H.T	-	-	-	65.1	41.2	42.2	44.2	47.4	50.4	55.3	62.4	61.1
Lanch Ghat (M), H.T	-	-	-	65.9	**40.5**	40.5	43.5	45.7	50.7	57.9	61.7	60.5
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

EC level of the Kirtankhola river water varied from 40.5 to 81.1µmhoms/cm against the EQS for treated wastewater from industrial units is 1200 µmhoms/cm (Table-29).
(Note: L.T = Low Tide, H.T= High Tide)

4.24 Tetulia River

For analysis of water quality of Tetulia river water samples was colleted from Vedhoria Feri Ghat location (bank and middle point). Samples collected during High Tide.

In 2012, pH level of the Tetulia river water ranged from 6.2 to 6.9mg/l (Fig. 24a) while in 2011, it varied from 7.2 to 7.6. DO varied from 5.85 to 7.6 mg/l (Fig. 24b) while standard limit for fisheries is ≥5 mg/l. In 2012, DO level varied from 6.7 to 7.9 mg/l. BOD level of the Tetulia river varied from 1.2 to 2.6 mg/l (Fig. 24c) against corresponding EQS (≤6 mg/l) for fisheries. In 2011, BOD level varied from 0.2 to 2.2 mg/l. In 2012, COD level was from 41 to 43 mg/l (Fig. 24d). In 2011, COD level varied from 36 to 52 mg/l (Fig. 25d). TDS range was from 20 to 38 mg/l (Fig. 24e). In 2011, TDS level varied from 129.0 to 109.3 mg/l. Chloride level varied from 11 to 51 mg/l (Fig. 24f) while EQS for treated wastewater from industrial units is 600 mg/l. In 2011, Chloride level varied from 62 to 74 mg/l. SS level varied from 5 to 15.24 mg/l (Fig.24g) and was below the EQS (150 mg/l). In 2011,SS level varied from 11.60 to 44 mg/l.

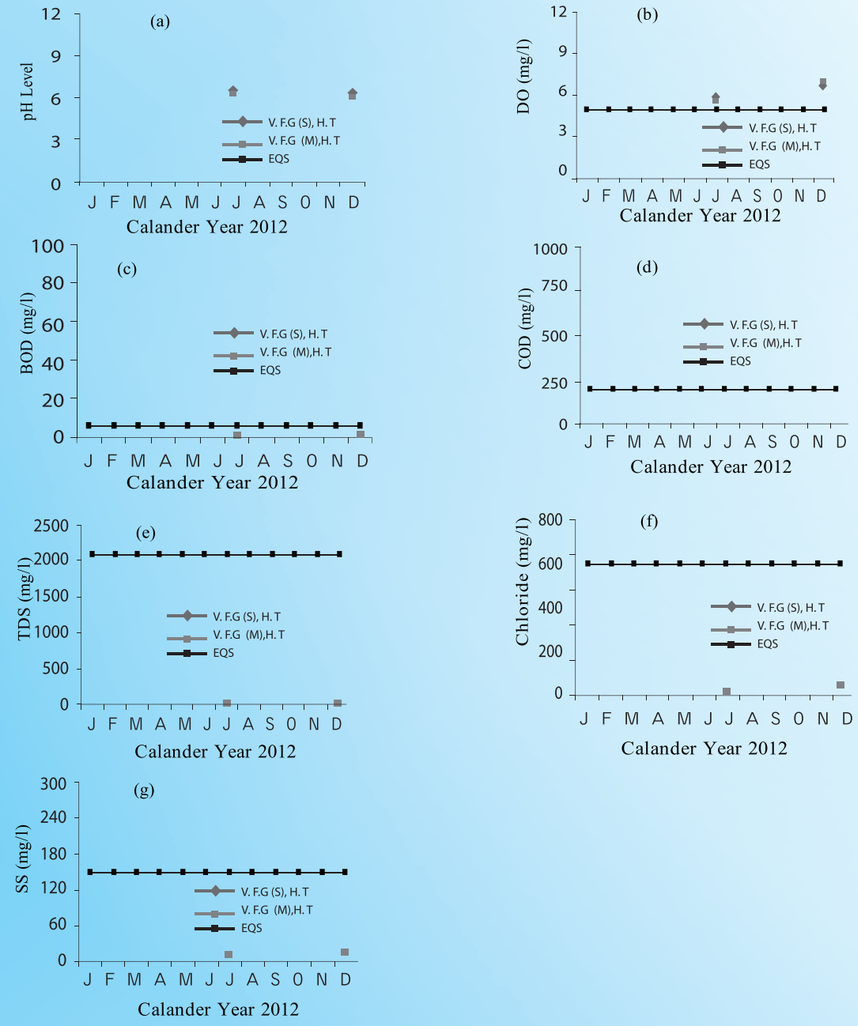


Fig.24.Graphical presentation of pH, DO, BOD, COD, TDS, Chloride and SS of Tatulia River in 2012

Note: V.F.G= Vedhoria Feri Ghat, S=Side, M=Middle, H.T= High Tide

Table-30. Level of EC at different sampling locations of Tetulia river in 2012.

Sampling Points of Tetulia River	EC(µmhoms/cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Vedhoria Feri Ghat (Side),	**-**	76.2	148.3	**-**	-	-	**38.3**	-	159.4	-	**-**	57.3
Vedhoria Feri Ghat (Middle),	-	74.7	151.6	-	-	-	40.4	-	**160.7**	-	-	58.1
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

EC level of the Tetulia river varied from 38.3 to 160.7 µmhoms/cm against the EQS for treated wastewater from industrial units is 1200 µmhoms/cm (Table-30).

4.25 Lohalia River

To monitor water quality of Lohalia River water samples was colleted for analysis from Lanch Ghat, Patuakhali (e.g. Side and middle high tide) of the river.

In 2012, pH level of the Lohalia river water varied from 7.4 to 8.2 (Fig. 25a) while EQS for fisheries is 6.5 to 8.5. In 2011, pH level varied from 7.2 to 7.8. In 2012, DO level varied from 5.7 to 7.9 mg/l (Fig. 25b) and was above the EQS (≥5 mg/l) for fisheries. In 2011, DO level varied from 7.8 to 8.9 mg/l. In 2012, BOD range was from 1.5 to 2.7 mg/l (Fig. 25c) while EQS for fisheries is ≤6 mg/l. In 2011, BOD level varied from 1.3 to 2.9 mg/l. In 2012, TDS level of the Lohalia river varied from 73.3 to 79.5 mg/l (Fig.25d) while EQS for treated wastewater from industrial units is 2100 mg/l. In 2011, TDS level varied from 3.3 to 79.0 mg/l. Chloride level of the Lohalia river was from 45 to 156 mg/l (Fig. 25e) while corresponding EQS is 600 mg/l for treated wastewater from industrial units. In 2011, Chloride level varied from 66 to 156 mg/l. SS level of the Lohalia river varied from 29.7 to 35.4 mg/l (Fig. 25f) against EQS (150 mg/l) for treated wastewater from industrial units. In 2011,SS level varied from 13.39 to 31.6 mg/l.

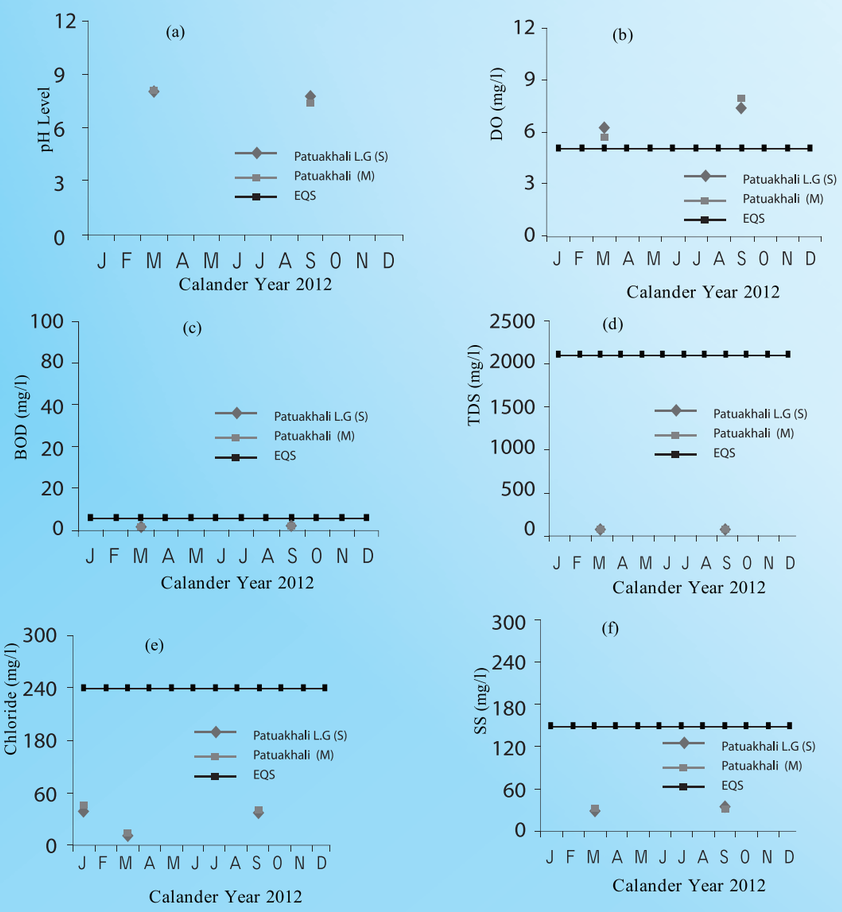


Fig.25. Graphical presentation of pH, DO, BOD, COD, TDS, Chloride and SS of Lohalia River in 2012

Note : LG = Lanch Ghat, S = Side, M = Middle

Table-31. Level of Salinity at different sampling points of Lohalia river in 2012.

Sampling Locations of Lohalia River	Salinity (ppt)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lanch Ghat (Side),	-	-	**3.8**	-	-	-	-	-	11.3	-	-	-
Lanch Ghat (Middle),	-	-	4.5	-	-	-	-	-	**12.1**	-	-	-
EQS for wastewater after treatment from industrial units 400 ppt												

Salinity level of the Lohalia river water varied from 3.8 ppt to 12.1 ppt (Table-31).

Table-32. Level of EC at different sampling points of Lohalia river in 2012.

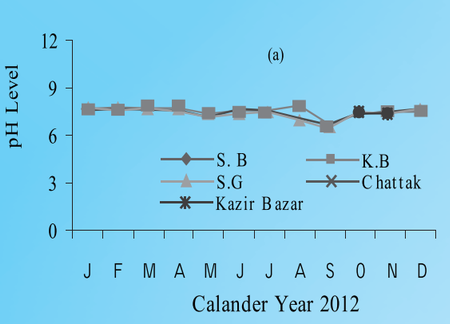
Sampling Locations of Lohalia River	EC(µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lanch Ghat (Side),	-	-	**148.3**	-	-	-	-	-	159.4	-	-	-
Lanch Ghat (Middle),	-	-	151.6	-	-	-	-	-	**160.7**	-	-	-
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

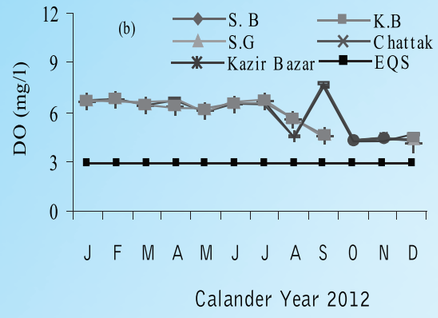
EC level of the Lohalia river varied from 148.3 to 160.7 µmhoms/cm against the EQS for waste from industrial units is 1200 µmhoms/cm (Table-32).

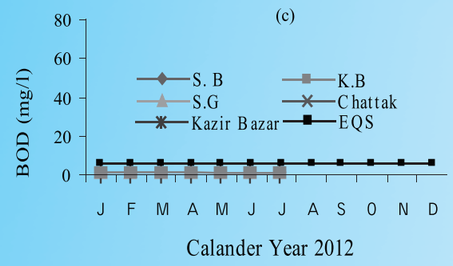
4.26 Surma river

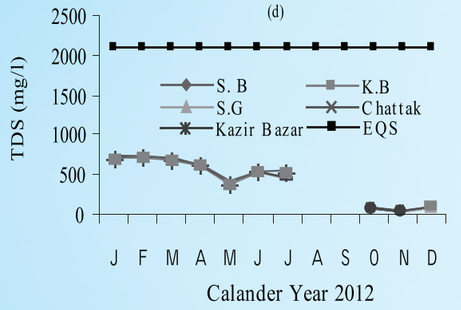
The Surma river is a part of the Surma-Meghna river System. The average depth of this river is 86m and maximum depth is 170m. For monitoring purpose water samples were collected from six different locations of the river namely Mehendipaka Bridge, Knee Bridge, Kazi bazaar, Chattak, Shajalal Bridge and Shak Ghat. In October water sample was not collected.

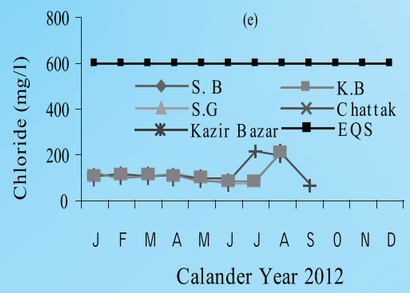
In 2012, pH level of the Surma river varied from 6.5 to 7.79 (Fig. 26a). In 2011, pH level varied from 7.3 to 7.9. In 2012, DO content of Surma river water was mostly above the EQS (≥5 mg/l) for fisheries except July at Chattak point. It varied from 4.2 to 6.8 mg/l (Fig. 26b). In 2011, DO level varied from 6.3 to 7.9 mg/l. BOD value was also within the EQS at all locations. The maximum and the minimum BOD was 1.3 and 1.0 mg/l respectively (Fig. 26c). In 2011, BOD level varied from 1.0 to 1.9 mg/l. TDS level was varied from 57.5 to 750 mg/l (Fig. 26d) where EQS for TDS is 2100 mg/l for treated wastewater from industrial units. In 2011, TDS level was varied from 60 to 880 mg/l. In 2012, Chloride content of Surma river water was within the EQS (600 mg/l) and varied from 70 to 220 mg/l (Fig. 26e). In 2011, Chloride level varied from 70 to 280 mg/l. SS level of Surma river was within the EQS the limit for treated wastewater from industrial units. It varied from 100 to 120 mg/l (Fig. 26f). In 2011, SS level varied from 70 to 140 mg/l.











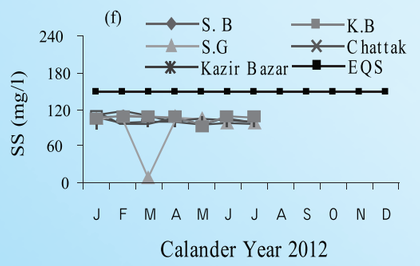


Fig.26. Graphical presentation of pH, DO, BOD, TDS, Chloride and SS of Surma River in 2012

Note : KB= Knee Bridge, SB= Shajalal Bridge, SG= Shak Ghat

Table-33. Level of EC at different sampling locations of Surma river in 2012.

Sampling Locations of Surma River	E.C (µmhoms/cm /cm)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Shajalal Bridge (S)	310	320	320	310	300	-	620	280	-	182	**107.1**	-
Shajalal Bridge (M)	310	310	310	320	300	-	**625**	270	-	182	107.2	-
Shajalal Bridge (O)	300	310	310	320	290		625	272		182	106.9	-
Keen Bridge (S)	-	-	-	-	-	-	-	-	-	190.1	110	182
Keen Bridge (M)	-	-	-	-	-	-	-	-	-	109.2	109	182
Keen Bridge (O)	-	-	-	-	-	-	-	-	-	190.2	108	182
Shak Ghat (S)	330	320	310	320	310	-	580	185	-	-	108.5	-
Shak Ghat (M)	330	330	300	320	310	-	585	185	-	-	107.5	-
Shak Ghat (O)	320	340	310	320	300	-	587	185.5	-	-	108.1	-
Chattak (S)	-	-	-	-	-	-	240	-	-	-	-	182.2
Chattak (M)	-	-	-	-	-	-	242	-	-	-	-	181.5
Chattak (O)	-	-	-	-	-	-	242	-	-	-	-	182.2
EQS for wastewater after treatment from industrial units 1200 µmohoms/cm												

Note: S=Side/Bank, M=Middle, O = Opposite/Bank

EC level of Surma river was within the EQS limit. It varied from 107.1 to 625 µmhoms/cm(Table-33).

4.27 Kushiara river

Kushiara river is one of the Trans-boundary rivers of Bangladesh. The total length of the Kushiara is about 161 km. The average width of the river is 250m and in the rainy season the mean depth of the Kushiyara reaches upto 10m (Ahmed, 2006). Water samples were collected from two locations (e.g. Jokigonj and Fenchugonj Fertilizer Industry) of the river in 2012 for analysis water quality. Samples were collected first seven month of 2012.

In 2012, pH level of Kushiara river was within EQS (6.5-8.5) for inland surface water. It varied from 7 to 7.9 (Fig. 27a). In 2011, pH level varied from 7.4 to 7.8. DO was above the EQS (≥5 mg/l) for fisheries and varied from 4.2 to 6.8 mg/l (Fig. 27b). In 2011, DO level varied from 6.7 to 7.7 mg/l. BOD level was from 1 to 1.3 mg/l while EQS for fisheries is ≤6 mg/l (Fig. 27c). In 2011, BOD level varied from 1.0 to 1.4 mg/l. In 2012, TDS level of Kushiara river water was below the EQS for treated wastewater from industrial units and varied from 41.6 to 720 mg/l (Fig. 27d). In 2011, TDS level varied from 400 to 900 mg/l. SS level of Kushiara River was within the EQS limit for treated waste-water from industrial units. It varied from 100 to 120 mg/l (Fig. 27e). In 2011, SS level varied from 80 to 120mg/l. Chloride was also within the EQS (600 mg/l) limit for drinking water. The maximum Chloride was found at Jokigonj (290 mg/l) in June and the minimum concentration (70 mg/l) was in September at Fenchugonj (Fig. 27f). In 2011, Chloride concentration varied from 120 to 290 mg/l.

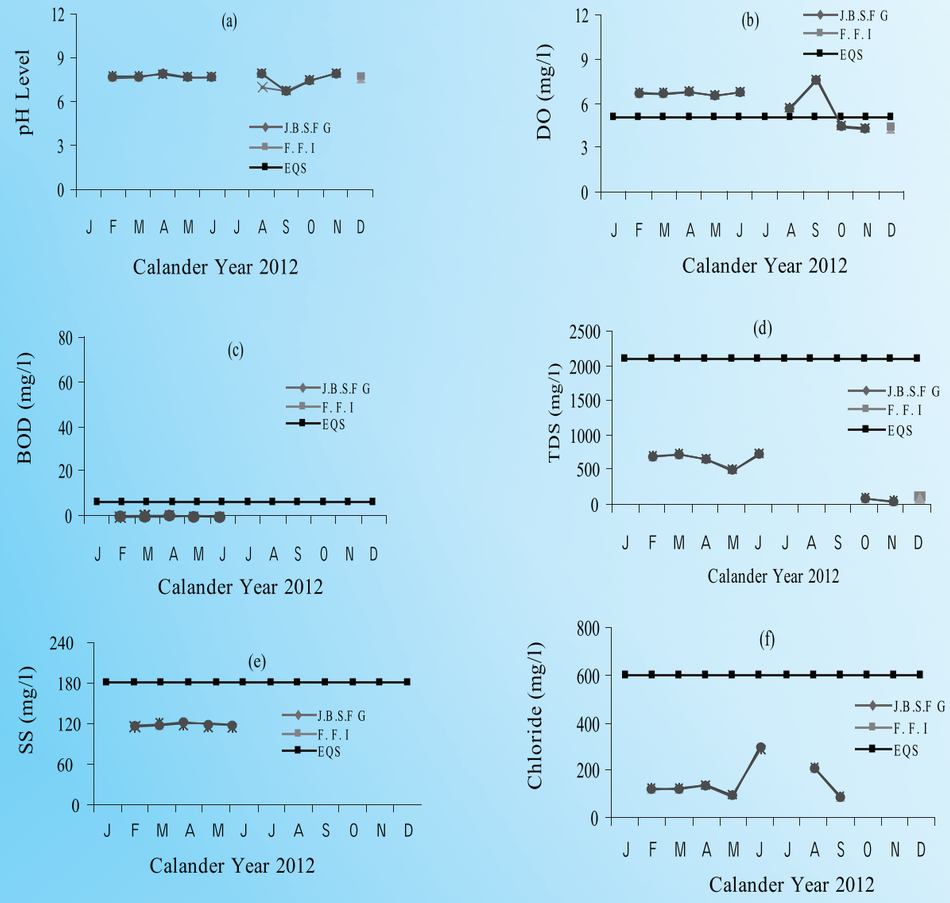


Fig 27. Graphical presentation of pH, DO, BOD, TDS, SS and Chloride of Kushiara River in 2012

Note : J.B.S.F Ghat = Jokigong B.S.F Ghat, F.FI = Fenchugonj Fertilizer Industry.

Table-36. Level of EC at different sampling locations of Kushiara River in 2012.

Sampling locations of Kushiara River	EC (µmhoms/cm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jokigong B.S.F Ghat(S)	-	-	-	-	-	-	-	-	-	-	-	180.2
Jokigong B.S.F Ghat(M)	-	-	-	-	-	-	-	-	-	-	-	181.2
Jokigong B.S.F Ghat(O)	-	-	-	-	-	-	-	-	-	-	-	181.2
Fenchugonj Fertilizer (S)	-	**340**	320	320	290	-	-	260	-	180.2	**81.2**	-
Fenchugonj Fertilizer (M)	-	330	310	330	295	-	-	275	-	181	81.6	-
Fenchugonj Fertilizer (O)	-	330	320	340	295	-	-	270	-	180.2	81.8	-
EQS for wastewater after treatment from industrial units 1200 µmhoms/cm												

EC level of Kushiara river was within the EQS for treated wastewater from industrial units. It varied from 81.2 to 340 µmhoms/cm (Table-36).

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Despite discontinuity of monitoring data in some cases, this report would shed some light on overall surface water quality status of Bangladesh and provide food for thought of how to plan for proper monitoring. Because water quality monitoring information shall provide the basis for water resource development plan.

5.2 Recommendations

To provide with concrete useful information for policy feedback a continuous monitoring of a comprehensive set of parameters is essential. The following actions are recommended to get comprehensive data set through better monitoring and analyses of the rivers water of Bangladesh.

- Judicious selection of sampling locations.
- Collection of water samples and analyses must be in a consistent way and on regular basis for assessment of water quality.
- Increase skilled manpower at all level of water quality analysis including sample collection.
- Microbial test (Fecal Coliform, E-Coli etc) of river water is essential for analyses of water quality of rivers.
- Use Global Positioning System (GPS) to represent monitoring results in global context.
- Establish Water Quality Index (WQI) to assess water quality analysis.
- Undertake capacity building programme of the laboratory (both human and logistics capacity).
- Review and update surface water monitoring network.
- Need to collect supporting weather information while sampling.
- Need to collect data on river flow.
- Strengthening regional cooperation for the sustainable management of trans-boundary rivers, Integrated Watershed Management (IWM) approach can be implemented in this regard.
- For each river, sampling must be done from more than one location.

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