

Analysis Of The Causes And Impacts Of Water Pollution Of Buriganga River: A Critical Study

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Abstract: When water becomes contaminated by unexpected substances, it is considered as harmful for human and aquatic lives. This water is termed as polluted water. Various causes are responsible for polluting water. Some natural causes are mixture of biodegraded portion of animal and plants to pure water, siltation by erosion of river banks etc. Domestic wastes, industrial wastes, fertilizers etc. are man-made pollutants of water. The state of surface and ground water pollution in Bangladesh is alarming. Especially the Buriganga is largely polluted by Dhaka city. Necessity of water for each and every living beings needs no description. They intake water directly or indirectly for physiological activities. If this in taking water is polluted, it will do harm that is for sure. The worst part is, this bad impact transports to others through food chain. Therefore, we must be aware of the adverse influence polluted water may have on us. At present, we cannot prevent water being polluted cent percent, but minimization is very much needed. It is time we took some steps to start working on it.

Index Terms: Tannery, wastewater, water quality parameters, hazaribagh, Environment, Pollution, Human Health

1 INTRODUCTION

History of Buriganga:

In the distant past, a course of the Ganges river used to reach the Bay of Bengal through the Dhaleshwari river. When this course gradually shifted and ultimately lost its link with the main channel of the Ganges it was renamed the Buriganga. It is said that the water levels during high and very high tides in this river astonished the Mughals. In the 20th century the water table and river became polluted by polythenes and other hazardous substances from demolished buildings near the river banks. The course of the Padma, as the main course of the Ganges is known in Bangladesh, changed considerably during the period 1600 to 2000 AD. It is difficult to trace accurately the various channels through which it flowed, but the probability is that it flowed past Rampur Boalia, through Chalan Beel, the Dhaleshwari and Buriganga rivers, past Dhaka into the Meghna estuary. In the 18th century, the lower course of the river flowed further south. About the middle of the 19th century the main volume of the channel flowed through this southern channel, which came to be known as Kirtinasa. Gradually the Padma adopted its present course. [1]

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1.2 Objectives:

The objectives of the study are:

- To identify the causes of water pollution of Buriganga river
- To know the States of water pollution of Buriganga river
- To know impacts of water pollution of Buriganga river
- To identify the degree of pollution
- To find out a way to mitigate the water pollution of Buriganga river.

Review of Literature:

Many researches have been completed on water pollution. Dr. Z. Karim, Dr. Saleemul Haque, Md. Mahiuddin Ahmed, Masud Nabi Khan worked on water pollution. Their findings showed that polluted water may damage living beings partially or fully. They classified pollutants in four classes e.g. a) Pathogens b) Nutritious and biodegradable substances c) Organic agents and d) Toxic substances. Md. Anwarul Islam also worked on it. On the other hand Prof. Jasim Uddin Ahmed worked on arsenic pollution

2 CAUSES OF WATER POLLUTION

2.1 Buriganga Pollution

2.1.1 Natural and Man-made Causes of Buriganga River

There are various causes of water pollution of river. These causes can be divided broadly in two divisions, namely: a) Natural causes and b) Man-made causes.

a) Natural causes: The biodegraded portions of plants and animals mix with water and pollute it. Erosion of river banks caused siltation and this silt sometimes hamper aquatic lives. Many kinds of natural salts and other substances mix with rain water and finally fall in the rivers and ponds.

b) Man-made causes: The major portion of water pollution of Buriganga river occurred by man-made causes. Industrial wastes, agricultural wastes, domestic wastes, excess use of fertilizer, pesticides etc. are notable man-made pollutants. Water is seriously polluted by these pollutants. Water, polluted by such types of pollutants, is very harmful for both human and aquatic lives.

2.2.2 SOURCES OF POLLUTION

Untreated wastes of industries, solid wastes of urban and commercial area, wastes of sewerage in municipality, feces of animals, pesticides, fertilizers, radioactive wastes, erosion of lands river banks etc, are the main sources of water pollution. Even the hot water come out of die engine also pollute water. Because hot water help to removed the DO as gaseous oxygen. Oil from ships, industries also pollutes water of Buriganga.

The main pollutants:

The main water pollutants in Bangladesh are:

- Liquid Organic wastes
- Liquid Inorganic wastes
- Nutrient substances
- Synthetic compounds
- Inorganic chemicals
- Silt and sediment
- Hot water
- Industrial, Municipal and urban waste -

This are discussed below:



(a) Liquid Inorganic wastes:

Most of the inorganic liquid wastes come from industry, and their dilution in large river waters renders them harmless. Some inorganic toxic wastes can become concentrated up the food chain to fish. Many of the pollution incidents which have been resulted in largest number of deaths and serious injuries from water pollution have been arisen from human ingestion of fish, or crops contaminated with heavy metals or other inorganic compounds

• Liquid Organic Wastes:

Wastes when disposed of in water, bacteria and other micro-organisms combine with oxygen dissolved in water to break them down, can be termed as "oxygen demanding" wastes. Liquid organic wastes include sewage, many wastes from industries (especially industries producing agricultural and tannery products) and run-off from rains, floods and storms which picks up organic wastes from land, before flowing into streams, rivers, lakes or seas. As concentration of dissolved oxygen decreases, so fish and aquatic plant life suffer or die. According to Department of Environment, Government of Bangladesh (1988), Buriganga River near Dhaka shows BOD between 20-180 mg/l. A wide spread of fish deaths have occurred in these areas, and thousands of fishermen have lost their jobs. The industrial areas in Bangladesh are situated in the midst of densely populated regions. There are many hazardous and potentially dangerous polluting industries situated

in the cities of Bangladesh. In Dhaka at Tejgaon area, food processing industries are situated along with chemical and heavy metal processing industries. In Tongi a pharmaceutical industry is situated near a pesticide producing industry. Tannery industries of Hazaribagh also situated in a heavily populated residential area.

2.2 HAZARIBAGH LEATHER INDUSTRY AND SLUMS IN BANGLADESH

Buriganga River:

All industrial, municipal (700-1100 tonnes daily) and urban wastes of Dhaka city (population 1989 about 6.5 million and expected to grow in year 2000 to 11.1 million) are flushed into the Buriganga River. It is estimated that total organic waste load discharged into the river will be around 250 metric tonnes per day (Reazuddin, 1994). The following description of Hazaribagh leather industry explains the present status of industrial pollution in Bangladesh:

- pH , 4-10
- Total alkalinity as CaCO₃ , mg/l670-1850
- Electrical conductivity..... 670-2200 (Micro-mhos/cms)
- Chloride, mg/l1300-5000
- Chromium, mg/l3-36
- COD, mg/l3200-21000
- BOD,mg/l.....200-650
- DO,mg/l.....0.8-5
- Ammonia nitrogen, mg/l..... 12-1970



Fig 1. Tannery wastewater

Degree of Hazard to Public Health:

Highly toxic material via ingestion or inhalation. Corrosive to skin and mucous; potential carcinogenic. At present in Bangladesh the tanner's basic wet process technique is to treat the stock with increasing concentrations of process chemicals using water as the carrier. In order to ensure full penetration of the thickest hide or skin in the batch, these concentrations are in excess of what is needed and the unabsorbed chemicals are discharged in the effluent, where they are a waste and cause expensive treatment problems. While the Chemical companies in the Federal Republic of Germany, the United States, the United Kingdom, Switzerland, Spain and Italy provide short term training on the application of their chemicals, Whereas they do not provide any assistance how to treat toxic

effluents that increasingly contaminate surface and ground water. Consultants provide technological transfer and management either on arm's length fee paying basis on assignment or financed by the World Bank, UNIDO, ITC or other United Agencies. The small cottage tanners of Hazaribagh producing sandal leather out of cow heads are probably the only tanning group in the world using waste tanning liquor from the modern tanners as their process liquor. But after using these wastes are eventually discharged, as are all other tannery discharges in the Hazaribagh tanning effluents into the streets, gutters and sewers which ultimately enter surface and ground water. According to Dittfurth and Röhring (1987) about 250 different toxic chemicals and heavy metals like cadmium, chromium, arsenic, zinc etc. are used by the leather industry. When the local industry was basically a vegetable tanning complex, this effluent might have been high in BOD and unpleasant but particularly dangerous. There is, in addition, extremely hazardous air pollution occur in Hazaribagh which is not known in any other places of the world. The rest treated hides and skins are cooked in open air to obtain glue for the local market. They burn treated leather pieces instead of coal or wood as it is cheaper. The smog and the smell like a witch cooking pot and it is beyond author's capability to narrate. The most hazards occur when the poorer group uses poisonous treated leather pieces as an alternative fuel to cook regular meals. No body knows how much harm and potential carcinogen diseases will occur to the slum inhabitants. There is no warning from the Government or aid giving agencies or their representatives. This is the vicious circle that the poorest groups are the worst victims of the foreign currency earning schemes.

Buriganga turns into a toxic dump:

Severe pollution has reduced the river Buriganga into a 'dumping drain' of toxic refuse, threatening millions of people living on its banks with serious health hazards and a loss of their livelihoods. That the river is dying is clearly evident from its stench. The highly toxic waters release a 'gas' that starts irritating the nostrils and throat as soon as humans breathe it. Its foul odors can be smelled from as far away as half a kilometre. "Sometimes we are unable to sit in our office due to the unbearable stench from the river water," said an official at the Sadarghat river port. As the day rolls into the afternoon the heat of the sun turns the stench even fouler, making the 'pitch black' Buriganga water intolerable, he said. Soon after the floodwater receded and the river wore its lean period look, the pollution instantly increased due to a lack of dispersion. Millions of cubic metres of toxic waste from the Hazaribagh tanneries and thousands of other industries, topped with a huge volume of untreated sewage from the city, now remain almost stagnant within the river water. The situation is set to continue until a new flow of water rushes in from the upstream, beginning in perhaps another two months. In the meantime, people living along the river are the worst victims of the pollution, which they say is worse than anything they've seen in previous years. Thousands of water transport workers, working on the passenger and cargo vessels in Sadraghat, are forced to bring water from the river Meghna and Dhaleswari for washing. Unable to take a bath or wash clothes for days, many of them have even begun to suffer from various diseases. "We can not use the water of the Buriganga for bathing, washing or cooking," said Mohammad Uzzal, an employee of a launch. "For

cooking, we use the water collected from faraway places in our water tank," said Mohammad Jalil, a launch cook. Farid, a ticket collector of MV Mashiron Khan-1, said that even for washing the floor of the vessels they have to bring water from relatively less polluted rivers such as the Meghna near Chandpur. "Sometimes, when we require more water while anchored at the terminal, we are forced to buy tap water at a high price," said a launch operator. "If we wash the vessel with this water passengers complain of a bad smell," he said. At least two private companies supply 'pure water' to the launches in the Sadarghat, charging about Tk 150 for filling a 400-liter capacity water reservoir. upstream is almost totally cut off in the lean period," he said (Morshed Ali Khan and Rafiq Hasan , Daily Star, March 16, 2005). [2]

TABLE 1
Inter-linkage of pressures, state, impacts, and various responses related to water

Pressures	State	Impacts	Responses
<p>Pollution</p> <ul style="list-style-type: none"> • Industrial effluent • Agrochemical • Fecal Pollution • Ship breaking and lube oil discharge • Oil and lube spillage during normal refueling of ships at sea and river ports • Low water flow in the river system in dry season 	<ul style="list-style-type: none"> • Decreasing inland water quality in dry season • Decreasing coastal water quality • Salinity intrusion in surface and groundwater • Soil salinity increase • No primary or secondary measurement is available on discharge quantity 	<ul style="list-style-type: none"> • Pressure on urban water source • Fish fingerling mortality, migration and quality of fish • Degradation of fish habitat • Yield reduction (soil fertility loss) • Increase in risk from waterborne diseases • Affecting marine aquatic life 	<ul style="list-style-type: none"> • Environmental Conservation Act and Regulation • Setup environmental quality standard • Industrial EIA and effluent treatment plants to reduce pollutants load • Polluters pay principle • National Water Policy: EIA for water development projects and increase surface water flow in dry season
<p>Scarcity (dry season)</p> <ul style="list-style-type: none"> • Upstream withdrawal for consumptive and nonconsumptive use • Low rainfall • Gradual siltation in river bed and floodplain • Dry season irrigation • Flood 	<ul style="list-style-type: none"> • Decline river water level and discharge • Low water flow • Shrinking dry season water area • Decline/fluctuation of groundwater • Less access to safe drinking water 	<ul style="list-style-type: none"> • Decline in aquatic resources production • Navigation problem • Increase conflict among different users and sectors • Domestic uses • Increase pressure on groundwater • Quality of water decline 	<ul style="list-style-type: none"> • National Water Policy: Dredging and water harvesting, regional cooperation, augmentation of dry season flow and use of surface water for irrigation
Pressures	State	Impacts	Responses
<p>Abundance of Water (Monsoon season)</p> <ul style="list-style-type: none"> • Geographical location and setting (92 per cent runoff flows through Bangladesh, which is 7 percent of the catchment area) • Monsoon Climate (78 per cent rainfall occurs in the monsoon) 	<ul style="list-style-type: none"> • Increase flooding • Increase water related hazards • Increase river bank erosion • Increasing river bank shifting 	<ul style="list-style-type: none"> • Crop yield reduction and damage • Disruption of livelihood system • Damage of homestead and towns • Population displacement 	<ul style="list-style-type: none"> • National Water Policy: Structural and non-structural mitigation (early warning and flood proofing) • Planned development among different sectors need



Source: WAROP, 2000a

Region	No. of Establishments	Textiles, apparels & tanneries	Paper, paper products & printing	Chemicals, plastics & petroleum	Non-metallic minerals manufactures
North West	4,403	545	113	181	360
North Central	<u>12,133</u>	<u>4,093</u>	<u>207</u>	<u>1,242</u>	<u>733</u>
North East	<u>1,117</u>	<u>55</u>	<u>20</u>	<u>47</u>	<u>132</u>
South East	<u>2,518</u>	<u>346</u>	<u>68</u>	<u>83</u>	<u>549</u>
South West	<u>849</u>	<u>72</u>	<u>39</u>	<u>42</u>	<u>199</u>
South Central	<u>1,408</u>	<u>128</u>	<u>29</u>	<u>77</u>	<u>157</u>
South East	<u>2,506</u>	<u>475</u>	<u>102</u>	<u>231</u>	<u>229</u>

Oil and Lube Spillage

The river port of Dhaka, however, do not have facilities to receive and treat bilge and ballast water, and thus steamers launched Bode steamers Lunched Boat throw wastewater into the territorial waters of Buriganga. Oil and lube spillage also happens during refueling of vessels and cargo handling. In addition, there are innumerable mechanized trawlers and boats engaged in fishing in the river. The operators of these vessels dump waste, including burnt oil, into the water, because of their ignorance about its adverse effect on environment

Micro-organisms/Germs: With the feces of animals, wastes of sewerage, latrines etc. various kinds of bacteria, virus and other organisms spread out in the water bodies and pollute it. Poultry farms, tanneries and slaughter-houses always supply such kinds of micro-organisms to the water bodies

Nutrient substances: Domestic substances, excess fertilizers, minerals occurring nitrate are mixing with water. This nutrient substances caused fast growth of unexpected plants, Rotting this plants make water offensive taste and odor. Such kind of abnormal growth of aquatic plants is called "eutrophication

Synthetic compounds: Various cleaning agents, soaps, detergents pesticides and other chemical substances are belong to this group Industries also excrete such kind of compounds

Inorganic chemicals; many metals like lead, zinc, cadmium, mercury, arsenic and their compounds are inorganic pollutants. Many salts and ads are also in this group

Silt and sediment: Soil erosion gives rise silt and sediment in water bodies. Soil erosion enhanced 5 to 10 times as a result of agricultural and about 100 times due to construction activities.

Hot water: Thermal industries use huge amount of cold water to cool their engines from overheating. This hot water is thrown to the nearby water bodies and caused depletion of DO,

Oil : The river parts of Dhaka however, do not have facilities to received and treat bilge and ballast water and thus steamers, launches, throw waste water into the water of Buriganga river, oil and lube spillage also happen during refueling of vessels and cargo handling. In addition there is numerable mechanized trawlers and boats engaged in the river for various pur-

pose. The operator of these vessels dump waste, including burnt oil, into the water, because of their ignorance about its adverse effect on environment.

States of Water pollution of Buriganga

Measuring Parameter:

Various key parameters and indicators of water quality are monitored. These include physiochemical characteristics of water, like pH, DO, BOD, COD, TSS, SS, total coliforms, heavy metals, turbidity temperature etc.

State of river pollution:

Many rivers of Bangladesh are polluted. Among them the scenery of Buriganga.

Buriganga: In Bangladesh the worst polluted river is The Buriganga. The most significant source of pollution is appears to be from tanneries in the Hazaribag area. The wastes of tanneries contain hexavalent chromium which is very harmful. The permissible concentration of chromium is 0.1 mg/L but it is found 2.6 to 28.0 mg/L in the water of Buriganga. Table -2 shows this.

TABLE 2
Analysis of waste of Hazaribag tanneries

Parameters	Minimum Conc.(mg/L)	Maximum Cone. (mg/L)
pH	4	10
Calcium carbonate	185	647.5
Chlorides	175	1800
Chromium	2.6	17
COD	120	4200
Ammonia	12	19.7

In the dry season The DO level becomes very low and the river becomes very toxic. Table two shows DO and BOD of two spots Hazaribag and Chadnighat of Buriganga in dry season in 2012.

TABLE 3
Water quality of Buriganga

Month	Point	BOD (mg/L)	DO (mg/l)
January	Hazaribag	530	1.6
January	Chadnighat	680	1.8
February	Hazaribag	640	2.6
February	Chadnighat	650	2.5
March	Hazaribag	450	3
March	Chadnighat	420	4
December	Hazaribag	400	4
December	Chadnighat	380	4.1

The seasonal variation of quality in the Buriganga depends on seasonal variation of water flow and the operation of tanneries of arsenic. It is of a serious concern, according to WHO and National guideline cone, of arsenic is .01 and .05 mg/L respectively.

3 IMPACTS OF WATER POLLUTION

3.1 IMPACTS OF SHORTAGE OF DO:

A large amount of urea is used for cultivation. Only 40% of dissolved urea is absorbed by plants. Remaining is mixed with water. If caused quick growth of unexpected plants. For biodegrading of these plants oxygen is taken from water. As a result amount of dissolved oxygen (DO) is depleted. Industrial wastes also caused depletion of DO by occurring chemical reaction.

Impacts of pH on:

There is no normal pH that applies to all fishes. Because fish originate in ponds, rivers, lakes, oceans that have different pH levels. But sudden change of pH can be harmful or even fatal to fishes. Table -4 shows this

TABLE 4
The Importance of pH for fish

"Minimum pH	Maximum pH	Effects
3.8	10.0	Fish eggs could be hatched but deformed young's are often produced
4.0	10.1	Livable limit for the most resistant fish species
4.1	9.5	Range tolerated by trout
4,0	4.3	Crops die in 5 days
4.5	9.0	Trout's eggs and larvae develop normally
4.6	9.5	Limit for perch
-	5.0	limit for stickle
5.0	9.0	tolerable limit for most fishes
-	8.7	Upper limit for good fishing water
5.4	11.4	Fish avoid water beyond this limit
6.0	7.3	optimum (best) range for fish eggs

The most significant impact of pH involve "Synergistic" effect. It involves the combination of two more substances that produces effects greater than their sum. For example, 4 mg/L iron would not present a toxic effect at a pH of 4.8 but as little as 0.9 mg/L of iron at a pH of 5.5 can cause fish to die.

Impacts of trace elements/ions :

Arsenic, lead, mercury, cadmium, chromium, nitrates, nitrites etc. May mix with water directly may be produced from the pollutants. However exceeding limit of this trace elements or ions caused various harm for human and other living beings

TABLE 5
Hazards of trace elements or ions

Name of element/ion	Impacts
Arsenic (As)	Dermatitis, Muscular paralysis, Damage to liver and kidney, Loss of hair, Gangrene, Cancer
Cadmium (Cd)	Kidney damage, Cancer
Chromium (Cr)	Skin ulcer, Kidney inflammation, Cancer
Lead (Pb)	Neurotoxin, Blood system and brain damage
Mercury (Hg)	Nerve damage, Kidney damage
Nitrate (NO ₃)	Diseases of domestic animals (above 75 ppm), Harmful for baby (above 67 ppm)

Source: Environmental Chemistry, A. K. Be

Impacts of germs/micro-organisms:

The people who are living By the Buriganga which is polluted by various germs and micro-organisms are severely suffering from various diseases like cholera, diarrhoea, Disentry etc, often.

Impacts of silts:

Silt may cover the leaves of aquatic plants and increase the turbidity of water, as a result, sunlight can not reach to the leaves of the plants and photosynthesis reaction is hampered. So, plants can not produce oxygen and food for them. Consequently, ecosystem is hampered.

4 ANALYSIS OF DATA AND INFORMATION

The data and information presented here shows the causes, states and Impacts of water pollution of Bangladesh. Surface water of Bangladesh is polluted by industrial effluents, agro-chemicals, domestic and sewerage dirt, oil and lube spillage and sediment. Maximum industries excrete toxic substances to water. Some sources spread germs and caused diseases. Excess use of fertilizer caused water pollution by supplying nutrient for unexpected plants which finally causes depletion of DO through eutrofication. Again most of the nitrate of urea goes through the soil to the ground water. Silt and sedimentation refrains sun light from passing through water to the aquatic plants. As a result, photosynthesis can not take

place. DO is very much essential for aquatic animals. Biochemical Oxygen Demand (BOD) and chemical Oxygen Demand (COD) rising means substances which consume oxygen from water increases in water bodies. So, higher the BOD and COD mean lower the DO and more hazardous for aquatic animals. Components of pesticides, specially chlorinated pesticides are dangerous water pollutants. They affect human nerve accumulating through food chain.

4.1 RESEARCH FINDINGS

Analyzing the data and information presented in this term paper findings that I got are-

- # No water is found actually pure. Naturally some substances are mixed with water. Again some natural pollutants removed automatically.
- # Rivers are highly polluted by both natural and man-made sources like industries and agro chemicals.
- # Unconsciousness of people is also responsible for water pollution. Especially rural people should be taught that using excess fertilizers and pesticides do not give more crop-yield.
- # Polluted water can do harm to human and aquatic plants directly or indirectly. That is, water pollution affects the ecosystem.
- # Toxic substances directly affect living beings through drinking water. Some toxic substances accumulate in the body and then express its contamination.
- # Arsenic pollution is a burning issue in Bangladesh; Maximum people are drinking arsenic contaminated water even now.
- # Less water flow is one of the reasons for toxicity in water, Because of less amount of water flow the concentration of pollutants become high.

4.2 RECOMMENDATION

The recommendations in the light of this research work are given below

- # Industries should be located in separate area and code of establishing industries must follow properly.
- # Effluents of industries must be treated and monitored sincerely before throwing it to water body.
- # Modern wastes management methods should be applied. Private sectors may be encouraged for introducing modern recycling process.
- # Urban sewerage system should be developed and the wastes should be treated before dumping it to water body.
- # Farmer should be made aware not to use excess fertilizers and pesticides.
- # Carbonate pesticides are less harmful than chlorine pesticides. So, farmers should use chlorine pesticides.
- # Rural people should be aware of alternative uses of animal feces.
- # Foods, containing vitamins and nutrients should take for remedial of arsenic contamination.
- # Mass media should come forward in publicity of causes and impacts of water pollution

ACKNOWLEDGMENT

The authors would like to convey their gratitude and respect to Mr. Sirajul Houque, professor, Department of Soil, Water and Environment, University of Dhaka whose active guidance enabled the authors to complete it.

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