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Reasons and consequences of river water pollution and their remediation: In context of Bangladesh

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Abstract

As the population grows and the uncontrolled industrialization, urbanization rises as well, it is high time we should give proper attention to the fact of river pollution in our country which is deploying harmful impacts both on human health and environmental, aquatic ecosystem. A plethora of studies have been done on different aspects of river water pollution. In this paper a thorough discussion regarding this fact has been presented compiling a number of important studies on it. Major causes behind this pollution have been mentioned widely, like improper management of industrial and sewage effluents. However, to detect this contamination in the major rivers of Bangladesh, various studies have been done to see the physicochemical properties of the water, such as p^H, turbidity, color, odor, DO, TOD, COD, TSS, EC, dissolved metal, and other chemical and bacteriological substances etc. The microorganisms within the water are the prime sources to cause different water borne diseases like Diarrhea, Cholera, Scabies and Asthma. To find out the remedies to this problem, urgent emphasis should be given on preventive measures and to take appropriate steps to halt and improve the existing pollution of the rivers. A lot of water treatment systems are being practiced throughout the world to restore the health of the rivers as well as to reuse the waste water. Though the systems are not much popular in Bangladesh, the government should facilitates the practice of them extensively and strengthen the laws against environmental pollution.

Keywords: Water Pollution; River of Bangladesh; Water-borne Diseases; Water Quality Parameter; Water Treatment.

1. Introduction

Water is another name of life and it is irrefutable that it is our one the most important natural resources comprising two third portion of the earth. Water is indispensable in our daily life for different uses ranging from domestic chores to divers industrial actions. Water pollution may be defined as alteration in the physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life (Report, 1965, restoring the quality of our environment, president science committee, Washington USA). A close observation into our river resources will unveil a dire picture. A huge misuse of water from lake, pond, river, and ocean is going on making them the pool of toxins by being invaded with garbage like floating plastic to chemical and metal substances. And this pollution is expanding day by day destroying the waterways. This low quality water and water scarcity is associated with the reality that this pollution decreases the water supply and increases the financial burden to make it useable [1].

So we should put more attention in preventing the pollution as it is the economically more astute method, because we may live without food for some days but not without water, as it is essential for the survival of all the organisms, lives

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on the planet for their food preparation and development. Sea water being approximately 98% of total water is unworthy to drink for its increased salt concentration keeping the rest 2% water fresh. Of this water 1.6% is stored as polar ice and glaciers and 0.36% water is confined within the underground wells and aquifers. Consequently, only 0.036% water remains attainable as the river or lake water for usage. So the surrounding habitat, urbanization and civilization are highly impacted by the local, seasonal accessibility and quality of the water sources of that catchment area. As rivers buildup the main sources for household, agronomical and technical water requirement and, therefore, indispensable for the advancement of human civilization, in this way the rivers become the most susceptible to be contaminated. And this contamination occurs because of rubbish and refuse water disposal. Bangladesh is the 8th most populated country of the world with a high population growth. This high population growth is contributing to the increased contamination of river system of Bangladesh along with unauthorized development of riversides, unrestricted expansion of the cities, and agricultural actions [2].

The foremost reason behind this pollution is toxic industrial effluent as well as unrefined waste water which is discharged in the process of it manufacturing functions from the industries like tanneries, steel plants, textile, and engineering. Moreover, sewage water and rainwater which pass through the dumping site of the solid waste also add to the contamination of river by pouring into it. The oil emitting from the ships, cargos, boats is other sources of hampering the physiochemical and biological characteristics of aquatic ecosystem river [3].

As a consequence, pollutants beyond the threshold level can exert potential risk for the lives and the environment surrounding these rivers. By using this polluted water, which is dissolved with toxic metal in the agricultural paddy field results in the presence of those substances within the crops and vegetables. Consequently, through the food web people around the area consume those tainted foods and develop the risk of having various water borne diseases like diarrhea, cholera, skin disease, gastrointestinal disease, and respiratory conditions which can be persistent for a long time when toxic substances accumulate in the body for a longer period. Furthermore, this harmful effects not only affect the people by being restricted within the surrounding area of the polluted river or industries, but also can transcend beyond the boundaries of cities through moving with the polluted crops, vegetables, and water [4].

To put a solution to this problem, we have to restrict the ways of polluting the river water through enforcing laws. Though The Environment Conservation Law (1995) is established in Bangladesh, it has been failed to be proved as fruitful in reducing pollution. According to this, some effluent treatment plan (ETP) can serve the purpose of making the waste material reusable and safely disposable by recycling it through multiple physical, chemical and biological processes. So by creating awareness among people, taking preventive measures, and installing water treatment plan this river pollution can be addressed [5].

There has been plethora of works on various issues regarding river pollution. As this a burning issue, so this paper is representing an overall picture of the causes of river pollution in Bangladesh, its impacts on human and their environment, and the possible measures to improving the scenario.

2. Rivers of Bangladesh

Bangladesh possesses one of the largest networks of river systems of the world with, in total, around 700 number of river including its tributaries. The countrywide network is total 24,140km long consisting of 4 river system: (a) the Brahmaputra-Jamuna, (b) the Ganges-Padma, (c) the Surma-Meghna, and (d) the Chittagong Region river system of which Brahmaputra is the 22nd longest and the Ganges is the 30th longest river in the world.

Numbers of the rivers are gradually increasing in the southern part than the northern part flowing downward to be united with the sea, Bay of Bengal, situated on the south to the country. All the civilization and development has been occurred centering the rivers, and as a result, all the big cities stand by the bank of the main rivers of the country [6].

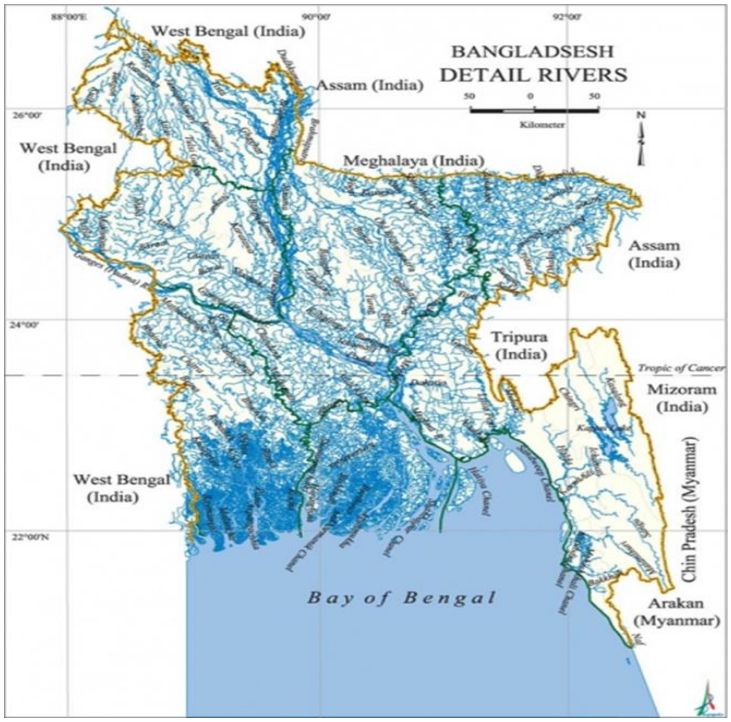

Figure 1 Main Rivers of Bangladesh

2.1. Parameters of Water Quality

To assess the level of pollution status of the river a number of physiochemical parameters are measured. They are (a) pH (b) Electric conductivity (c) Temperature (d) Total dissolved solid (TDS) (e) Total Solids (TS) (f) Total Alkalinity (g) Dissolved oxygen (DO) (h) Chemical oxygen demand (COD) (i) Biochemical oxygen demand (BOD), (j) Total Hardness and different dissolved metals and substances.

2.1.1. Different Water Quality Parameters and Their Recommended Levels

Water quality parameters	**Bangladesh Standards (mg/L)**	**WHO Guide Line**	**Water quality parameters**	**Bangladesh Standards (mg/L)**	**WHO Guide Line**
p^H		6.5-8.5	Chloride	150-600	
Electric conductivity	-us/cm		Chlorine	0.2	
Temperature	20-30C		Na	200	
TDS	1000		K	12	
Iodine	200-500		Color	15 Hazen	
Total Alkalinity			Iron	0.3-1.0	
DO	6		Lead	0.05	
COD	4		Ni	0.1	0.02
BOD	0.2		Phosphate	6	
Total Hardness	200-500		Zinc	5	
Mercury	0.001	0.001	Al	0.2	
Turbidity	10 NTU		Ammonia	0.5	
As	0.05	0.01	Silver	0.02	
Cd	0.005	0.003	Chloroform	0.09	0.2
Ca	75		Coli form	0 CFU (N/100ml)0.01	

Source: Department of Public Health engineering, Bangladesh [7].

2.2. Previous Research Works on Water Pollution Assessment:

Different study papers on the assessment of water quality have been published from time to time from which some have been studied for this review article. Those research findings are mentioned below.

Md. Humayun Kabir, Tanmoy Roy Tusher, Md. Saddam Hossain, Md. Sirajul Islam, Rifat Shahid Shammi, Tapos Kormoker, Ram Proshad & Maksudul Islam did a study on the ecologically and economically important river of Bangladesh, Shitalakkhya, to investigate the spatial-temporal variety of water quality and suitability besides its catalyzing factors and sources of pollution. They assessed 14 water quality parameters from five different sampling sites which were taken once in a month. The study result reveled that some parameters like temperature, TDS, TA, TH, NO2-, and NO3- went beyond highest threshold level and their variation was associated with pre monsoon (February–May), monsoon (June–September), and post monsoon (October–January) seasons which was statistically significant ($p<.05$). The water quality index (WQI) represented the river water to be inappropriate for drinking and aquatic ecosystem. Also the principal component analysis indicated that the variation of water quality was due to contamination from mainly point and nonpoint sources, such as, industrial effluents outflow, agricultural irrigation water mixed with inorganic fertilizers. They also conducted another study, cluster analysis, which alluded hydrological changes and sources of pollution to be responsible for this comparative spatial and seasonal change in water quality. The study overall represented the Shitalakhya river to be extremely polluted. Moreover, its use for human or any other purposes would be harmful, so Government should pay more attention to this important river [8].

Md. Aminul Ahsan, Md. Abu Bakar Siddique, Mahbuba Akhter Munni, Md. Ahedul Akbor, Shakila Akter, Md. Younus Mia Conducted a study on the Dhaleshwari, an economically vital river of the district Tangail, between March to May, 2016 regarding the physiochemical properties of water. The sample was collected from three different locations and analyzed for physicochemical parameters: color, odor, temperature, pH, DO, BOD, EC, TDS, anions: F-, Cl-, Br-, NO3-, NO2-, SO42- and PO43- and heavy metals: Pb, Cd, Cr, Hg and As to estimate the pollution status of the river. The analysis was done by using the standard methods of American Public Health Association. The result declared the color and odor of the water acceptable and other parameters statistically ranging from temperature- 29.3-32°C, pH- 6.78-8.12, DO- 4.11-7.31 mgL-1, BOD- 0.52-1.74 mgL-1, EC- 127-487 µScm-1 and TDS- 60-235 mgL-1. The anions concentration found as F- <0.5, Cl-- 1.08-6.8, Br-- <1.0, NO3-- 0.51-19.7, NO2- <1.0, SO42-- 3.34-9.37 and PO43-- 1.74-4.44 mgL-1. The concentration of major heavy metals found as Pb <0.01, Cd <0.001, Cr <0.005, Hg <0.001 and As- 0.002-0.015 mgL-1. Furthermore, there was positive correlation between temperature, EC, and TDS with each other and negative correlation between pH, DO, and BOD, the both group showed negative relation between themselves. The result along with anion pair analysis concluded saying the water useable and safe for domestic, fishing, and praedial activities. However, in case of human consumption, further treatment of the water is needed [9].

Another study by Md. Simul Bhuyan, Muhammad Abu Bakar, Aysha Akhtar, M. Belal Hossain, Mir Mohammad Ali, Md. Shafiqul Islam was done in the surface water and sediments of Meghna River regarding the globally significant ten metals, Zn, Al, Cd, Pb, Cu, Ni, Fe, Mn, Cr, Co. The study was conducted from September, 2015 to March, 2016 where two sampling points for three seasons were taken. Analyzing by Atomic Absorption Spectrophotometer, all the metals were found to be under the safe limit determined by WHO and EU except for Fe, Ni, and Al. Another principal component analysis and correlational matrix revealed anthropogenic trespasses of the metals in water and sediments. They saw potent correlation Fe vs Al (0.992), Mn vs Cu (0.948), Fe vs Mn (0.939), Zn vs Al (0.929), Fe vs Zn (0.920) in water. In sediment, very strong linear relationships were found in Cd vs Zn (0.999), Cd vs Cu (0.998), Zn vs Cu (0.996), Cd vs Ni (0.995), Ni vs Cu (0.994), Ni vs Zn (0.993) etc. at the 0.05 significance level which indicated its origin from industrial discharge with sewage and agronomical addition. So To conserve the river and the environment from risk factors, necessary steps should be taken [10].

Md. Sultanul Islam and Sharmin Zaman experimented the water of Buriganga River to assess the water quality and pollution level to address its hazardous impact on human as well as its environment. The study was carried out during monsoon, May to September, 2016. They took five sample from five different place and found a variety of physicochemical properties of water including temperature, pH, EC, DO, BOD, TDS and turbidity to be spatially and temporally varied from 27-34ºC, 6.02-7.79, 136-285 µS/cm, 0.6-2.4 mg/l, 6.7-20 mg/l, 68.2-145 mg/land 13.06-52 NTU respectively. The results indicate that the water is highly contaminated being malapropos for the aquatic organism and human use [11].

In a study conducted by R. M. Hafizur, H. M. Nuralam and I. M. Rumainul, the physicochemical properties of the river, Turag was evaluated to determine the pollution status of the water and the industrial discharge being dumped within the river. The author took the samples from a part of the river adjacent to Konabari industrial area, and two samples were taken during dry and wet season one for each consequently. The study analyses represented the surpassing of

maximum physicochemical properties of water more than the recommended range, set by Department of environment, Bangladesh. And the contamination was higher in dry season in comparison with that of wet season as the river remains more turbid in wet. Moreover, though the level dissolved metals were within the recommended level, but they were increased during dry season comparatively. Only the cadmium showed to be cross the approved level proving overall the water quality polluted and harmful for use [12].

Another significant study was experimented by Abu Reza Md Towfiqul Islam, H.M. Touhidul Islam, Md Uzzal Mia, Rahat Khan, Md Ahosan Habib, Md Bodrud-Doza, Md Abu Bakar Siddique, Ronghao Chu in which they assessed water from six main river basins of Bangaladesh: Meghna, Kartoya, Sitalakha, Teesta, Pashur and rupsha for 8 major trace elements. The statistical analyses they included were, the entropy water quality index (EWQI), sodium adsorption ratio (SAR), spatial autocorrelation index (SAI), hazard index (HI), and Monte-Carlo (MC) simulation, and found marked spatial differences in trace elements concentrations. Their average concentration went beyond the approved guideline except for Ni, As, Zn. The entropy theory mentioned Cr, Pb, and As as the main pollutants damaging the water quality. Moreover, regarding non-carcinogenic risk, their hazard index (HI) exceeded the permissible limit (>1) which is harmful for human health. The carcinogenic risk value of Cr was far more than As and Cd with the surpassing of recommended level by US EPA (>106 to 104). The result overall depicted the possible hostile health impacts of the people exposing to these water every day [13].

Md. Delwar Hossain1a, Md.Mostafizur Rahman1a, Joti Bikash Chandra1, Mashura Shammi1, and M. Khabir Uddin1 did a study on the Bangshi river water, Savar, Dhaka in 2011. Total 18 samples were taken of which 14 were from the main river and 2 samples took from a connection of the river with Dhalai Beel and another 2 samples from the connection with Karnapara canal. They assessed Temperature, pH, Total dissolved Solid (TDS), Electrical conductivity (EC), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD5) , Chemical oxygen demand (COD) by standard method and Some heavy metals such as Cu, Cd, Zn and Pb were also determined by Flame Atomic Absorption Method. It was seen that all the pH, DO, COD, and BOD value exceeded the recommended limit by Department of Environment among which COD and BOD was extremely high in concentration. The salinity, TDS, and EC values, on the other hand, demonstrated some variability expressing comparatively higher in industrial discharge dumping site. However, the dissolved metal values were found to be within the limit [14].

3. Causes of River Pollution

The source of river pollution can be categorized into two types, Point sources and Non-Point sources. Point sources are generally simple in nature, easy to identify, measure, and control. For example, discharge from industries and sewage treatment plants. On contrary to that, Non-point sources are diffused in nature which is difficult to screen and control, like waste water running over agricultural field, leakage of oil from boats. Some common examples are shown in the table below [1, 15].

3.1. Main Sources of Water Pollution in Bangladesh

3.1.1. Industrial Effluent

In Bangladesh indiscriminate growth of different industries have been found, of which majors are tanneries, dying and coloring industries, paper and metal mills, pharmaceuticals, textiles, washing etc. Their untreated wastes are being dumped into the river making it highly polluted. Around 200 rivers of Bangladesh are receiving these detrimental

mechanical wastes. Department of environment found on a survey that, approximately 1176 processing plants are polluting the water as well as environment throughout out the nation [1, 15].

3.1.2. Agricultural Reasons and Marinas

The fertilizers and pesticides, used in agricultural fields, are carried down into the river by the runoff water. River also gets contaminated by the oil discharged from the floating boats, ships, tanks during inland transportation, and recreational boat racing, sailing, washing water crafts. In fact, in our country, Bangladesh, this is the main reason behind the river water pollution [1, 15, 16].

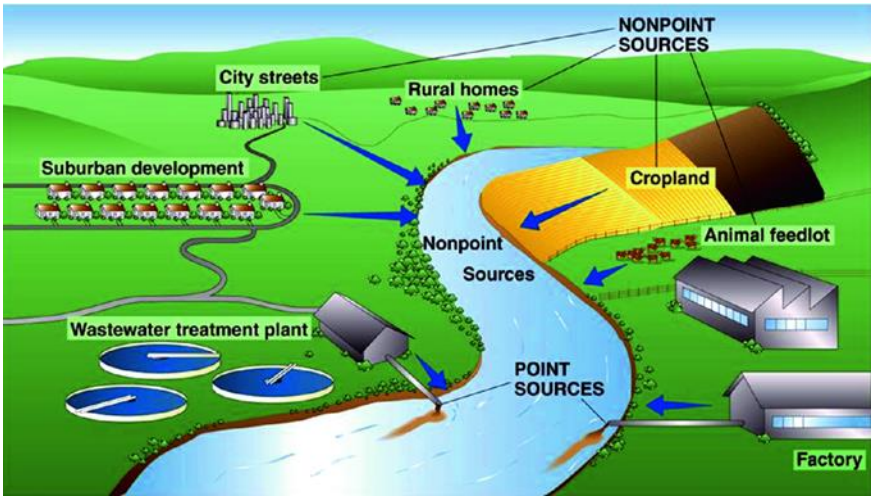

Figure 2 Sources of river pollution.

3.1.3. Encroachment and Land Grabbing

Disposal area on the bank of the river is narrowing the river gradually exerting potential risk for the survival of the river and its ecosystem. On top of that, encroachment of river sides is adding the increased junk piles and garbage loads filing the river beds [15].

3.1.4. Global Warming and Natural Calamities

As the temperature of environment and world is increasing gradually, the water would not out of its consequences. The rise of this water temperature will adversely affect the aquatic plants and organism resulting in decreased coral reef in water. On top of that, expansion of temperature will melt down the polar ice, therefore, increase water height causing flood and other natural calamities which will further pollute the water [1, 16].

3.1.5. Sewage Effluent

The Water Supply and Sewage Authority (WASA) collect the sewage, waste water and handle them. But this sewage system is old and not sufficient to cope up with the increased load of waste. For example, Dhaka WASA reported only 30% area of Dhaka city is cover by sewage system. In the area without the sewage facility, people connect their domestic sewers with the surface drains which directly carry the sewage effluents, waste water into the river along with its harmful, toxic dissolved substances which reduces the biological oxygen demand. Furthermore, without proper sanitation system, the risk of water contamination with the human excreta becomes increased implying serious human health risks as well as flora and fauna [1, 16].

3.1.6. Urbanization and Solid Waste Disposal

Due to rapid urbanization, installation of industries, constructions of roads, buildings, bridges have increased producing solid wastes which is dumped on bank of river. Also the storm water wipes away the respective sites draining the waste materials which consequently cover the city drainage and waterways. The local hospitals and healing centers also produces a huge number of solid wastes. Nearly 4,000 to 4,500 tons of solid wastes are produced every day of which 50% are discarded into River water [1, 17].

4. Impacts of River Pollution

The rivers are getting polluted in multiple ways and its contaminated water is inconsistently adding threat not only to the human health but also its environment. Some detrimental impacts are discussed below.

4.1. Impacts on Human health

River pollution deploy its detrimental effects mostly on human health. In developing countries, different enteric diseases are occurred due to water borne diseases among which Cholera is contributing to the highest share of total cases measuring 3-5 million cases and 100,000 - 130,000 deaths annually all together. In fact, Bangladesh is a red zone for cholera. In the year 2004, Bangladesh Demographic and Health Survey (BDHS) also published that 5.1% under five children deaths and 1.2% neonatal deaths were related to diarrhea [18].

By drinking the water which is contaminated with various microbiological organisms causes these enteric diseases, for example, Diarrhea, Cholera, Dysentery, Typhoid, Hepatitis B and A, Polio, Ascariasis, Cryptosporidiosis etc. They can also cause skin diseases like: scabies, dermatitis, respiratory diseases like: asthma, lung cancer, urinary tract infection, meningitis, septicemia etc. The water mixed with pesticides also causes nausea, vomiting, blurred vision, breathing difficulty, and coma. Furthermore, the dissolved heavy metals are responsible for kidney damage, cancer, abortion, even death [19].

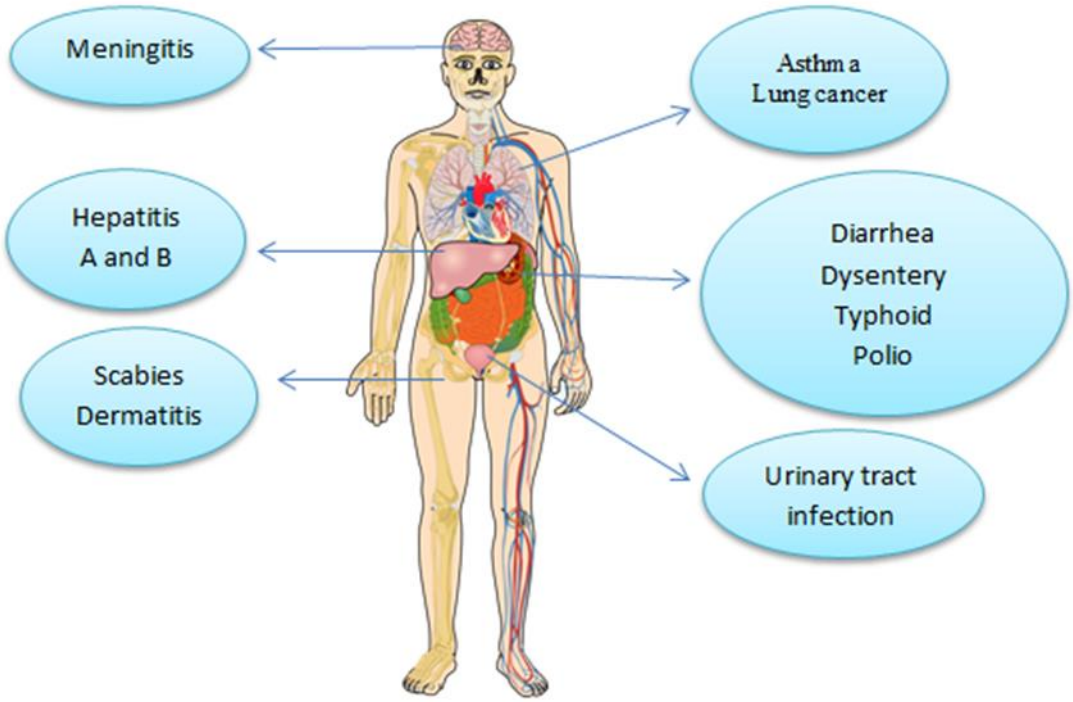

Figure 3 Human water borne diseases

4.2. Impacts on Aquatic Organisms and Plants

In polluted water, decomposer use up the dissolved oxygen which is obligatory for the aquatic plant and lives. So, reduced DO level caused the hamper of the eggs and larva to survive, reduction in growth as well as death of the adult and juvenile aquatic lives. Moreover, impaired physic-chemical properties of water, like attenuated BOD, COD level, salinity of water, increased TDS and CO2 facilitates the growth of pathogenic bacteria leaving the water inappropriate for aquatic fish, lives and environment hampering the biodiversity consequently [20].

4.3. Impacts on Agriculture and Soil

In most cases, the river water is used for agricultural purpose. So when the river water gets polluted, and therefore used for irrigation activities, it pollutes the soil as a consequence. Farmers themselves often opine that, if they would not have to use the contaminated water, the soil would not be damaged [21].

4.4. Impacts on Animals

By drinking the polluted water, cattle are also suffered from sore mouth, skin conditions. This can happen even if they are washed using this polluted water. In addition, these pollutants through the water enter the food web and become deleterious to the birds, fish, and mammals [22].

4.5. Impacts on Economy

This pollution of river hinders the development of river based tourism and recreational activities which could be a potential source of income and a strength for the economy [22].

5. Different Water Treatment Procedures

There is no fixed water treatment system. There are a number of substances and procedures to be adopted while preparing the water reusable. We have to take into consideration a multiple number of factors while choosing any procedure, such as, water quality, purpose of use, availability of manpower and resources, space, local and organizational acceptance, hygienic maintenance, impacts on health and environmental, system energy requirement, cost effectiveness, guidelines for recycling waste water etc. [23]. Some studies on variant water treatment procedures by different authors are presented below:

Khatun, A., Murshid, S. M., & Badruzzaman, A. B. M. did a study on different sources of greaywater in Dhaka, Bangladesh. Greywater refers to those we get from wash basin, sink, bath, washing machine, ablution in mosque etc. The authors selected the greywater from ablution in mosque as it was found to be less contaminated, therefore, more appropriate to reuse. They did a lab scale treatment and assessed the greywater prior to the treatment and afterwards. The physic-chemical parameter of raw greywater was pH- 6.83, turbidity- 10.5, 1.54, TS- 447 mg/l, TDS- 428 mg/l, TSS- 19 mg/l, BOD- 26 mg/l, COD- 50 mg/l, Nitrogen-Ammonia- 0.321 mg/l, Phosphate- 0.711 mg/l. But after the pretreatments, alum coagulation and chlorination, it was found to be improved being pH- 6.31, turbidity- 5.26, 1.34, TS- 431 mg/l, TDS- 416 mg/l, TSS- 15 mg/l, BOD- 12 mg/l, COD- 29 mg/l, nitrogen-ammonia- 0.282 mg/l, phosphate- 0.285 mg/l and pH- 6.24, turbidity- 4.83, 1.18, TS- 415 mg/l, TDS- 405 mg/l, TSS- 10 mg/l, BOD- 0 mg/l, COD- 24 mg/l, nitrogen-ammonia- 0.064 mg/l, phosphate- 0.237 mg/l respectively. This treated water met the standards for drinking water in Bangladesh. They suggested using this treatment system in low strength greywater and use it for non-potable activities [23].

Jia-yu Tian, Zhong-lin Chen, Yan-ling Yang, Heng Liang, Jun Nan, Gui-bai Li did another study named Consecutive chemical cleaning of fouled PVC membrane using NaOH and ethanol during ultrafiltration of Songhua River water. In the study, they experiment on the removal of fouling which was created in the PVC membrane by the raw river water during the ultrafiltration was done. By scanning electronic microscopy (SEM) and atomic force microscopy (AFM) analyses, they demonstrated that the NaOH and ethanol both removed the in-pore fouling including the surface. Moreover, they showed while single use of NaOH and ethanol removed 36.6% and 48.5% fouling respectively, the consecutive use of them both will show 85.1% efficacy in this treatment system [24].

Steven Walker, Roberto M. Narbaitz did another study on Ottawa River water where they compared different pretreatment efficacy. There are number of water pretreatment procedures, like coagulation, flocculation, sedimentation, floatation etc. The author took samples from the river water and analyzed them before and after pretreatments regarding the physic-chemical properties of water. The raw water possessed pH- 6.97, TOC- 6.78 ± 0.35 mg/l, DOC- 6.07 ± 0.05 mg/l, POC- 0.71 ± 0.10 mg/l, turbidity- 1.52 ± 0.10 NTU, alkalinity- 30.5 ± 1.7 mg as $CaCO_3$/l, total hardness- 34.3 ± 1.7 7 mg as $CaCO_3$/l. But after the alum sedimentation and alum floatation it was found pH- 6.56, TOC- 2.51 ± 0.10 mg/l, DOC- 2.45 ± 0.12 mg/l, POC- 0.06 ± 0.10 mg/l, turbidity- 0.88 ± 0.14 NTU, alkalinity- 1.4 ± 2.7 mg as $CaCO_3$/l, total hardness- 33.8 ± 5.1 mg as $CaCO_3$/l and pH- 6.46, TOC- 2.15 ± 0.11 mg/l, DOC- 2.07 ± 0.10 mg/l, POC- 0.08 ± 0.12 mg/l, turbidity- 0.37 ± 0.03 NTU, alkalinity- 5.6 ± 2.7 mg as $CaCO_3$/l, total hardness- 24.7 ± 1.4 mg as $CaCO_3$/l respectively. So the study revealed that the pretreatments significantly improved the water quality [25].

Hazrat Ali, Andreu Rico, Khondker Murshed-e-Jahan and Ben Belton, on the other hand, did a different type of study where they surveyed the exposure of various chemical and biological water treatment substances in the aquaculture sector of Bangladesh. These substances are used to maintain and improve the physic-chemical properties of the water. They performed a survey from November, 2011 to June, 2012 on nine different fish farms in Bangladesh using structured questionnaire. The results showed that 46 types of substances were being used to treat the water of the farm not only to maintain the quality of the water but also to improve the health and immunity of the fishes. The substances were classified in 7 categories like (a) water and soil treatment compounds, (b) fertilizers, (c) disinfectants, (d) antibiotics, (e) pesticides, (f) feed additives, and (g) probiotics [26].

Ahmed Khaled Abdella Ahmed, Taha F. Marhaba presented a paper on a water treatment process, river bank filtration (RBF), where they assessed a large number of studies by different authors depicting the efficacy of RBF. In this process, river water goes through a natural filter, made up of natural soil and aquifer sediments, which is placed at the river bank. The filtration process removes solids and both organic and inorganic matters from the river water, hence, it is called the natural filter. Here, a few treatment actions including, filtration, sorption, and biological degradation takes place. All the studies showed that, RBF improved the properties of water and decreased the microorganisms load. For example, the turbidity of Kalama River, Washington was found to be reduced from 1 and 5 NTU to 0.3 and 0.4 NTU. Again, another study proved that the DOC, TOC and DBP precursors of Ohio River, Wabash River, and Missouri River was decreased after RBF treatment. Another study on Langat River showed COD level fell from 53.0 mg/l in to 8–18 mg/l after RBF process. Another study in Netherland found that the RBF process could serve 4-log removal of viruses and 5- to 6-log removal of F-RNA phages. They also found decreased fecal indicator bacteria and Aeromonas and sometimes no bacteria at all in 1 l samples of RBF processed water [27].

Another study on removal of estrogenic and pharmaceutical compounds in sewage effluent was done by D.P. Grover, J.L. Zhou, P.E. Frickers, J.W. Readman. The authors performed the study between April 2006 and November 2008 in UK and took total 45 effluents samples seasonally by an automated pumping system at 4hourly interval. Then they treated the samples by an advanced technology, full scale granular activated carbon (GAC) plant. The result showed the reduction in the average concentrations from 3.2 ng L-1 to <0.6 ng L-1 (81% reduction) for estrone (E1), 3.8 ng L-1 to <1.2 ng L-1 (at least 68% reduction) for 17 estradiol (E2), and 0.8 to <0.4 ng L-1 (at least 50% reduction) for the synthetic 17-ethinylestradiol (EE2) in the sewage effluent, after the activation of the GAC plant [28].

6. Conclusion

From the above discussions, we can understand that rivers are an indispensable part of our lives and the pollution of these rivers add danger not only to the human being but also to the environment. Rivers are the main source of water for various purposes in life from household use to, agricultural use, washing industrial activities, and inland transportation. But this river water is getting constant pollution from different sources including human induced actions and natural catastrophes. As the environment conservation act is weakly practiced in our country, so unauthorized industrialization and uncontrolled chemical and pesticides usage in land has risen and, as a consequence, the physicochemical properties of water has surpassed the tolerable limit. Mainly the bacteriological and chemical tainting of water as well as the microorganisms contaminations are liable to cause different human water borne diseases. In our country, there has not been much research on human health impacts due to water pollution where we probe to understand it better. The adverse impacts of these pollutions are also destroying the aquatic ecosystem and hampering environmentally and economically as well. So addressing this issue has become obvious to restore the river, most specifically Buriganga, Meghna, Shitalakhya which are of the major rivers of the reverie Bangladesh.

The Environmental Protection Act in Bangladesh faces so many obstacles to come into execution like, lack of funding, skilled manpower, absence of inter-sectorial arrangement, lack of administrative capacity, hindrance of the environment laws, outdated environmental laws as well as people's ignorance, corruption and so on. So to ensure the prevention of river pollution, all these issues should be taken care of with equal importance. Besides, environmental education should be included into the school curriculum. This will help to generate awareness from the early life. Furthermore, in our country water recycling procedures are not much popular. More studies should be conducted on different water treatment systems and be installed and practiced regularly like other developed countries of the world to bring positive changes in aquatic environment.

7. Appendix

Al- Aluminum	BOD- Biochemical Oxygen Demand
As- Arsenic	CO_2- Carbon Dioxide
Br- Bromine	COD- Chemical Oxygen Demand
Ca- Calcium	DBP- Disinfection Byproduct
Cd- Cadmium	DO- Dissolved Oxygen
Cl- Chlorine	DOC- Dissolved Oxygen Carbon

Co- Cobalt	EC- Electrical Conductivity
Cr- Chromium	ETP- Effluent Treatment Plan
Cu- Copper	GAC- Granular Activated Carbon
F- Fluorine	NTU- Nephelometric Turbidity Unit
Fe- Iron	POC- Particulate Organic Carbon
Hg- Mercury	RBF- River Bank Filtration
K- Potassium	TA- Total Alkalinity
Mn- Manganese	TDS- Total Dissolved Solids
Na- Sodium	TOC- Total Organic Carbon
Ni- Nickel	TH- Total Hardness
NO_2- Nitrogen Dioxide	TS- Total Solids
NO_3- Nitrate	TSS- Total Suspended Solids
Pb- Led	US EPA- United States Environmental Protection Agency
PO_4- Phosphate	WQI- Water Quality Index
SO_4- Sulfate	
Zn- Zinc	

Compliance with ethical standards

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Disclosure of conflict of interest

All authors state that there is no conflict of interest.

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