

Water Quality and Status of Aquatic Fauna of Dhaka Mega City, Bangladesh

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Abstract: This research focused of the effect of water pollution on aquatic fauna at Dhaka mega city, Bangladesh. Dhaka is an over populated capital city of Bangladesh. The rapid urban expansion, highly demographic growth, industrial development of this mega city have been including in a polluted city. The industrial and municipal waste material have polluted the wetlands basin of this city. Aquatic fauna of these wetlands basin are endanger for pollutant substances. The aquatic records and have been collected by field observation. The water quality of this mega city have been explored by sample collection and lab analysis. Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are less than standard level. As a result the water body fully toxic that condition is not free for living organism. On the other way, the availability of Total Dissolved Solids (TDS), Lead (Pb) and Cadmium (Cd) are catastrophically high from standard level. So the water quality fully polluted and it is not sustainable for aquatic fauna.

Keyword: *Urbanization, water pollution, biodiversity, ecosystem, aquatic health*

1. Introduction

Water is important element of environment. It is composited by chemical substance. These substance are most important agents of bio-geo chemical process of environment. The wetland function have been disrupted if one of those substance increased or decreased. Due to changes of substances of the water the largely ecosystem have been suffered. The surface water of a geographic area is depended on physical topography, hydro-morphometric structure, catchment area, climatic factors and anthropogenic influences (Carpenter. et al., 1998 & Jarvie. et al., 1998). Beside this consideration the water quality is depended on socio-economic status of these area (Hussain, 2017). Dhaka megacity, capital city of Bangladesh is surrounding the river (Brammer, 2012). Then city is located inside a large wetland basin. This wetland water is polluted by urban uses (Kabir & Parolin, 2011). During the monsoon season the Dhaka city looks like as island. Turag, Balu, Banar, Buriganga and Shitalaskha River have been flood and created as a single water body. During the growth of urban population the city have been increased in areal content. The expansion city have been created more sources of waste materials by increasing of industries, housing, transportation and others. The urban waste and industrial waste have been mixed with this water body and changed the physical, chemical and biological characters of inside and outside surface water of Dhaka city (DoE, 2010). The pollutant substance is more harmful for aquatic components.

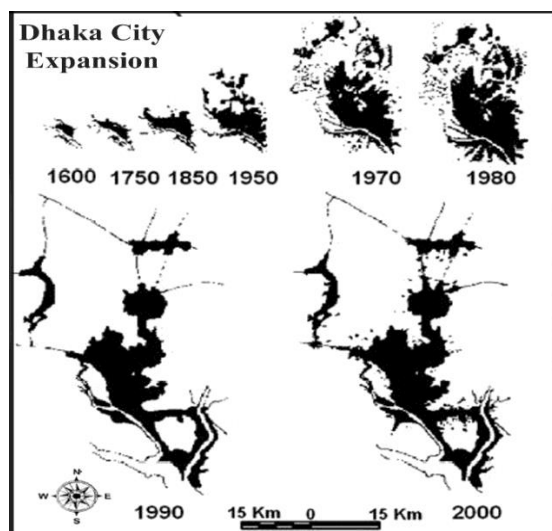
The aquatic fauna affected by this water pollution and all wetlands ecosystem have been including this disruption. The surface water quality of Dhaka city is not sustainable for aquatic fauna that also threaten for human health too (Beier, 2008). There are some fundamental research have been done to assessment of water quality of the Dhaka city. All of those research work focused on human health aspect but aquatic health is absence of those research. In this circumstances impact of surface water pollution on aquatic components is most significant and this research focused on the impact of surface water pollution on aquatic species of Dhaka megacity. The main aim of this research to describe the threat of water pollution on aquatic components of Dhaka mega city. To explore the main aim this research have been taken three objectives. These objectives have helped to obtain the purpose of the research. The objectives are; a) to estimate the aquatic species of this study area, b) to explore the water quality of the Dhaka city during several different season of the year, and c) to describe the threat of the pollutant substance on aquatic faun.

2. Study Area

Dhaka mega city, the capital of Bangladesh is situated between latitudes 23°42' and 23°54'N and longitudes 90°20' and 90°28'E on the Buriganga River in the middle of the Bengal delta, it is surrounding by Buriganga, Balu, Turag, Banar and Shitalaskha River (Google Earth, 2017). These rivers have dominated the

physiography and morphometric structure of Dhaka city area (Rashid, 1991). There are a large wetland basin in outside of metropolitan area and some canal

are inside of metropolitan area. It was originated due the availability of river navigation (World Bank, 2006).



Map 1. Dhaka City Expansion (DCC, 2004)



Map 2. Study are (Banglapedia, 2006)

The Madhupur high land is located north side of city. The rain fall of upper landform are stored on these river. The overflow of river water flooded the lower basin and heavy rainfall flooded the Dhaka city (Brammer, 2014). Up to near past (1990) Dhaka city flooded by monsoon rain by over flow of river water. From 1872 to 2011 during one and half century the population have been increased 69212 to 14 million (Bengal Census 1872 & BBS, 2011). The urban area have been expansion according to rapid population growth (Islam, 1996; Karim, 1986 & Chowdhury. et al., 1989).

Industry, productive factory and building have been increased due to growth population and urban expansion. All the measures are pollutant producer as well as the waste and pollution have been increased. All of waste matter mixed with the water body due to geographic structure of city

3. Methods

These research have been flowed gradually developed systematic approach to meet the purpose of study. The data have been collect from primary and secondary both sources. Present aquatic status has been collected by previous record and field observation. The water quality has been collect from existence area of interest. The multipole methods have been used in this research.

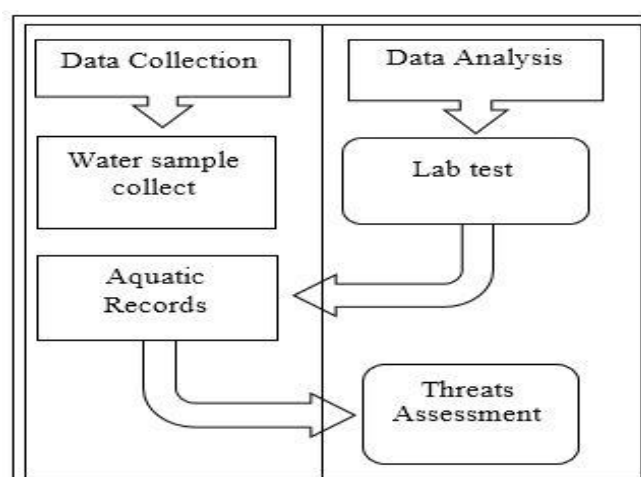


Figure 1. Methods and data analysis approach

3.1. Aquatic Status:

The aquatic record has been collected by field observation. The area of interest has been selected by satellite image analysis. The more water dominant permanent or most permanent location have been selected for data collection. The record of aquatic species has been collect by interview and group discussion of local fishermen and other people who are involved in various traditional occupation. They have experience more than ten years. Some published and unpublished documents have use to explore the aquatic status. Several interview have taken from expert zoologist to cross check of those aquatic record.

3.2. Water quality:

The water sample have been collected from several wetlands of Dhaka metropolitan area. The sample

point has been selected by satellite image analysis and collected water from five selected point in pre-monsoon (January - April), during monsoon (May - August) and post monsoon (September - December) at three different period of year. The water sample have been collected at February for pre-monsoon, June for monsoon, and November for post-monsoon.

Electrical Conductivity (EC), pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Lead (Pb), Cadmium (Cd), Chromium (Cr) and Copper (Cu) have analyzed in lab test. All water parameter and aquatic status have measured in three particular seasons; a) pre-monsoon, b) Monsoon, and c) post-monsoon or dry season to explore the seasonal variations. The water substance has compared with the standard of DoE (Department of Environment, GoB).

4. Result and Discussion

4.1 Aquatic Status of Dhaka mega city:

The aquatic fauna have been recorded by field observation and species identified. The study area is very rich of its biodiversity (Mustafa. et al., 2013) but 21 aquatic fauna have been recorded which have been found by field observation.

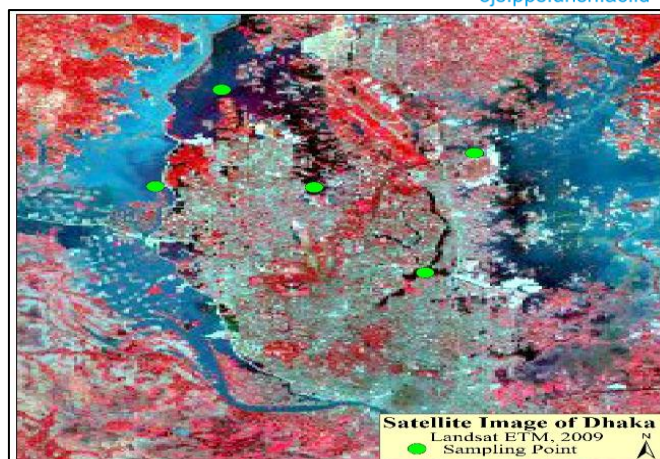


Figure 2. Satellite Image of Dhaka Mega city (Source: USGS, 2009)

The of aquatic species record collect by interview and group discussion of local fishermen and other people who are involved in various traditional occupation and they are non-educated by institution, perhaps they have strong occupational expense about aquatic bio-diversity because they are involve fishing or relevant profession during more than ten tears. They provided their realistic and experience gathered information about aquatic fauna. The aquatic record have been mention in table 1

Table 1. Aquatic record of Study area

Name	Class	Family	Species
Leeches	Clitellata	Erpobdellidae	<i>H. medicinalis</i>
Land Snail	Gastropoda	Hygromiidae	<i>M. vicinus</i>
Garden Snail	Gastropoda	Helicidae	<i>C. aspersum</i>
Burgundy Snail	Gastropoda	Helicidae	<i>H. Pomatia</i>
Asian Swamp Eel	Actinopterygii	Synbranchidae	<i>M. albus</i>
Mottled Eel	Actinopterygii	Anguillidae	<i>A. bengalensis</i>
Puntius	Actinopterygii	Cyprinidae	<i>P. chola</i>
Rohu	Actinopterygii	Cyprinidae	<i>L. rohita</i>
Spotted Snakehead	Actinopterygii	Channidae	<i>C. punctata</i>
Bullseye Snakehead	Actinopterygii	Channidae	<i>C. marulius</i>
Ceylon Snakehead	Actinopterygii	Channidae	<i>C. orientalis</i>
Bengal Monitor	Reptilia	Varanidae	<i>V. bengalensis</i>
Yellow Monitor	Reptilia	Varanidae	<i>V. flavescens</i>
Keeled Indian Mabuya	Reptilia	Scincidae	<i>E. carinata</i>
Olive Keelback	Reptilia	Colubridae	<i>A. schistosum</i>
The Indian Flapshell Turtle	Reptilia	Trionychidae	<i>L. punctata</i>
Checkered Keelback	Reptilia	Colubridae	<i>X. piscator</i>
Common Sand Boa	Reptilia	Boidae	<i>G. conicus</i>
Common Sunda Toad	Amphibia	Bufonidae	<i>D. melanostictus</i>
Asian Grass Frog	Amphibia	Dicroglossidae	<i>F. limnocharis</i>
Marbled Toad	Amphibia	Bufonidae	<i>B. stomaticus</i>

4.2 Water Quality of Dhaka mega city:

The water quality of Dhaka mega city explored by laboratory test. The average pH was 7.2, 7.38, and 7.6 in pre-monsoon, monsoon, and post-monsoon period respectively, where DoE (BD) standard is 7-9. The average Dissolved Oxygen was 1.6 (mg/l) in pre-monsoon period, 150.4 (mg/l) was in monsoon period, and post-monsoon it was 0.8 (mg/l), that extremely increased in monsoon season and decreased in post-monsoon period, where DoE (BD) standard 4.5-8 (mg/l). The average Biological Oxygen Demand (BOD) was 84.2 (mg/l) in pre-monsoon, and 50.2 (mg/l) was in post-monsoon period where DoE (BD) standard 50 (mg/l). Chemical Oxygen Demand (COD) was 218.4 (mg/l) pre-monsoon and was in 209.4 (mg/l) in post monsoon, that exceeded both of seasons from DoE (BD) standard 200 (mg/l). The average Total Dissolved Solids (TDS) was 1396.2 (mg/l), 0.019 (mg/l), and 1054.4 (mg/l) was in pre-monsoon, monsoon, and post-monsoon period respectively, where

DoE (BD) standard 150 (mg/l). The average Lead (Pb) was 0.76 (mg/l) pre-monsoon and 2.1 (mg/l) was in post monsoon, that exceeded both of seasons from DoE (BD) standard 0.1 (mg/l). The average Cadmium (Cd) was 0.4 (mg/l) pre-monsoon and 0.026 (mg/l) was in in post monsoon, that exceeded both of seasons from DoE (BD) standard 0.05 (mg/l). The average Chromium (Cr) was 0.3 (mg/l), 6.6 (mg/l), and 0.012 (mg/l) was in pre-monsoon, monsoon, and post-monsoon respectively where, DoE (BD) standard 0.05 (mg/l). The average Copper (Cu) was 0.14 (mg/l), 1.074 (mg/l), and 0.026 (mg/l) was in pre-monsoon, monsoon, and post-monsoon respectively where, DoE (BD) standard 0.05 (mg/l). The water quality of all seasons exceeded or decreased from the national (DoE) standard that is threaten for aquatic fauna (MoEK-GoEP, 1970; MoEF-GoB, 1994 and Mustafa. et al., 2013). The seasonal water quality of study area mention in table 2, 3 and 4. In table 4 represents the yearly average of water quality with national standard.

Table 2. Water quality of pre-monsoon period

Water Parameter	Unit	Point 1	Point 2	Point 3	Point 4	Point 5	Average
Electrical Conductivity(EC)	ds/m	3.2	2.9	3.1	3.3	3.5	3.2
pH		7.72	7.92	6.38	7.61	6.36	7.2
Dissolved Oxygen (DO)	mg/l	2.32	2	1.71	1	1	1.6
Biological Oxygen Demand (BOD)	mg/l	53	83	75	63	147	84.2
Chemical Oxygen Demand (COD)	mg/l	470	371	75	77	99	218.4
Total Dissolved Solids (TDS)	mg/l	1533	1138	1344	1223	1743	1396.2
Lead (Pb)	mg/l	0.66	0.67	0.72	0.86	0.89	0.76
Cadmium (Cd)	mg/l	0.33	0.42	0.52	0.32	0.38	0.4
Chromium (Cr)	mg/l	0.16	0.48	0.21	0.27	0.33	0.3
Copper (Cu)	mg/l	0.1	0.11	0.12	0.11	0.3	0.14

Table 3. Water quality of monsoon period

Water Parameter	Unit	Point 1	Point 2	Point 3	Point 4	Point 5	Average
pH		7.7	6.7	7.6	7.4	7.5	7.38
Dissolved Oxygen (DO)	mg/l	55	105	55	352	185	150.4
Total Dissolved Solids (TDS)	mg/l	0.04	0.03	0.01	0.009	0.006	0.019
Cadmium (Cd)	mg/l	117	801	439	480	755	518.4
Chromium (Cr)	mg/l	6	4	7	12	4	6.6
Copper (Cu)	mg/l	0.24	1.44	0.79	1.7	1.2	1.074

The water quality have slightly changed due to seasonal variation but the water is highly polluted at all season of the year. In monsoon period, the waste material have been washed out within rainwater and accumulated in water body. The water quality of pre-monsoon and post monsoon season are more polluted then monsoon period because the industrial wastewater come in water body as well as the rainfall is absence

during this period. As a result Total Dissolved Solids (TDS), Lead (Pb), Cadmium (Cd), Chromium (Cr), Copper (Cu) have been increasing on the other way Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) have been decreasing. The water quality of all seasons have exceed the national (DoE) standard (MoEF-GoB, 1994 & MoEK-GoEP, 1970)

Table 4. Water quality of post-monsoon period

Water Parameter	Unit	Point 1	Point 2	Point 3	Point 4	Point 5	Average
pH		8.2	7.7	7.8	6.9	7.4	7.6
Dissolved Oxygen (DO)	mg/l	0.55	1.57	0.57	0.54	0.75	0.8
Biological Oxygen Demand (BOD)	mg/l	45	76	34	74	22	50.2
Chemical Oxygen Demand (COD)	mg/l	298	199	162	221	167	209.4
Total Dissolved Solids (TDS)	mg/l	1366	631	1178	1130	967	1054.4
Lead (Pb)	mg/l	2.26	1.2	2.5	2.6	1.9	2.1
Cadmium (Cd)	mg/l	0.02	0.04	0.01	0.03	0.03	0.026
Chromium (Cr)	mg/l	0.01	0.02	0.01	0.01	0.01	0.012
Copper (Cu)	mg/l	0.03	0.04	0.03	0.02	0.01	0.026

Table 5. Yearly average water quality

Water Parameter	Unit	DoE (BD) Standard	Yearly Average
Electrical Conductivity (EC)	ds/m	1.2	2.12
pH		6-9	7.4
Dissolved Oxygen (DO)	mg/l	4.5-8	1.2
Biological Oxygen Demand (BOD)	mg/l	50	47
Chemical Oxygen Demand (COD)	mg/l	200	192.73
Total Dissolved Solids (TDS)	mg/l	150	989.7
Lead (Pb)	mg/l	0.1	0.76
Cadmium (Cd)	mg/l	0.05	0.21
Chromium (Cr)	mg/l	0.5	0.15
Copper (Cu)	mg/l	0.5	0.06

4.3. Sources of water:

The amount of water parameter Total Dissolved Solids (TDS), Lead (Pb), Cadmium (Cd), Chromium (Cr), Copper (Cu) have been increasing on the other way Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) are more than national (DoE) standard. This water have highly polluted by urban and industrial pollution. Liquid Organic wastes, Nutrient substances, Liquid Inorganic wastes Micro-organisms/germs, Synthetic compounds, Inorganic chemicals, Hot water, Silt and sediment, Industrial and Municipal waste, are main sources of pollution of wetlands on Dhaka mega city (Chakraborty. Etal., 2013 & Field observation, 2017). Most of the pollutant comes from industrial waste, there are a strong rule to operate Effluent Treatment Plant (ETP) for pollution protect. It is observed by field investigation, most of the industry have not run ETP a major number of industry have not ETP. On the other way the municipal authority have not maintain waste management. City dweller have not follow the municipal rule, they have thrown the homestead waste inside the road and canal.

4.4 Effect of water pollution of Aquatic fauna:

The polluted water have mixed with natural water body that is most harmful for aquatic species (Roy, et al., 2013). There is no require level of water pH for aquatic fauna but suddenly change of pH level is harm

for aquatic organization. The DO level is lowest than DoE slandered level. The DoE required is 4.5 to 8 (mg/l) but the yearly DO status is 1.2 (mg/l) as a result the water body become toxic (Hussain, 2017b). The toxic water is not sustainable for any biotic organ (Hussain, et al., 2017). Chromium and Copper are tolerable level of standard but Lead and Cadmium are very high from slandered. As a result the aquatic fauna can be effected very diseased. It also harmful for aquatic ecosystem. The TDS level is devastatingly high from tolerance level. The slandered of Total Dissolved Solids (TDS) is 150 mg/l but yearly average is 989.7 mg/l. As a result, solar energy cannot reach to the underwater flora and photosynthesis reaction is disrupted. So, plants cannot produce oxygen and it is very harmful for aquatic fauna.

5. Conclusion

All development activities have been performed by the costal of environment (Hussain, 2017). The environment have been polluted by the growth of population, urban expansion and industrial development (Hussain, et al., 2017). All of development project have produced the pollutant substances and degrade the environment. The wetlands of Dhaka mega city have been polluted by those development actives. The surface water quality of Dhaka mega city are not sustainable for aquatic fauna. The results of this study noticed the water quality and

signify impact of this water quality on aquatic fauna. The explored values of water properties were found to be highly vulnerable condition for all season of year comparing with the national standard values. This water is not detrimental for aquatic fauna. This polluted water have been disrupter the aquatic ecosystem (Roy, et al., 2014). It also have been broken the harmonious wetlands ecology of surrounding waterbed of Dhaka mega city. This affected condition not only threaten for aquatic organization but also in a broad function of ecosystem.

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