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Impact of River Water Quality on Public Health in Perspective of Asian Rivers: A Case Study of Buriganga River, Bangladesh

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ABSTRACT

Water pollution is one of the current global problems. So many countries are suffering from this problem specifically most South Asian and Southeast Asian countries, and Bangladesh is one of those countries that are suffering from water pollution. Furthermore, the city of Bangladesh, Dhaka is one of the most densely populated cities in the world and overpopulation is showing a negative impact on the water quality now. Most of the rivers are very polluted around Dhaka city because of anthropogenic causes. This study focused on Buriganga river pollution and its impact on public health. This study intended to find out the major cause of Buriganga river pollution and the health status of the community living beside the Buriganga river. Also the study identified all the common diseases which people are suffering from around the Buriganga river area. Then the study compared the results with other southeast Asian countries so that it can make the relationship and can make it easier to understand the current situation of water pollution on public health in East Asia and Southeast Asia regions. During the research work, it was noticed that the Buriganga river is very polluted due to human activities. The transportation system, fishing, and waste canals from industries become the primary reasons behind Buriganga's current condition. Also irresponsibility of both the environmental department and civil society is the major factor in Buriganga river pollution. The hygienic level was also not in a good condition because so many wastes like plastic materials and other daily use materials were thrown out into the river. That's why public health conditions around the Buriganga river become vulnerable nowadays. So policies have to be implemented from the right perspective and the institutions have to be strong enough to handle all the issues regarding the Buriganga River.

Keywords: Buriganga; Water quality; River pollution; Public health; Dhaka city

1. Introduction

Bangladesh is situated in the southern part of Asia which is one of the low-lying riverine countries. There are more than 700 rivers in the country including tributes that flow through the country, the capital city of Bangladesh is one of the megacities in the world and it was established 400 years ago. This city was started in the northern part of the Buriganga River which was called at that time (the Ganges River) [1]. The capital city of Bangladesh is spread over an area of 1.5 to 1.7 kilometers square close to the connection of the Postogola and Buriganga Rivers) [2]. The capital of Bangladesh, Dhaka city has the Buriganga (Old Ganga) river beside it which is one of the main rivers flows [3] in the area. Buriganga is mainly a part of the greater Ganges which is a transboundary river it flows through the country of India and Bangladesh. Buriganga is only 18 km long whereas the greater Ganges is 2525 km long [4]. In Dhaka city, river water pollution is an extreme problem right now. All the rivers around Dhaka city are getting polluted day by day including the Buriganga river [5]. Bangladesh is still a third world and one of the most densely populated countries. Almost 97% of its total population has access to water but the quality of water is still questionable [6]. Water pollution is the contaminated state of water and it could be groundwater or river water [7]. Water pollution is one of the biggest problems in Dhaka city as well as in Bangladesh and there are many rivers, man-made wells, lakes, and streams polluted by human activities, especially rivers surrounding Dhaka cities like Buriganga, Turag, Balu, Shitalakkhya, Daleshwari, and Bangshi River are being polluted due to high population living sides of that rivers and also because of the number of industries are growing very fast [8]. So this study will focus on the Buriganga River which is one of the most polluted rivers in Bangladesh and flows past the southwest outskirt of Dhaka city, this river has an average depth of 7.6 metres (25 ft) and its maximum depth reaches 18 metres (58 ft) [9]. This river is one of the most polluted rivers in the country and struggling for its existence, the Buriganga River is afflicted by the noisome problems of pollution as the source of chemical wastes from industrial, medical wastes, household waste, sewage, plastics, dead animals and sometimes oils spilled by the boats and other river transportation system, furthermore, Dhaka city discharges into the Buriganga river more than 4,500 tons of solid wastes per day [10]. Different factors are affecting the quality of water in the Buriganga River and are also affecting its aquatic life forms. But the more concerning side is all the water parameters like pH, Biological Oxygen Demand (BOD), Dissolve Oxygen (DO), and chlorides hardly can satisfy the standard which is made by the Department of Environment, Bangladesh [11,3]. In the last years, the Buriganga River was going a very dangerous situation which led to being the most polluted river in Bangladesh, the main factors of this pollution are anthropogenic [12] and some other natural factors, many types of research said that main problem of the river is the rapid growth of Dhaka city, the industrial revolution, population density, and climate change, the combination of these factors caused Buriganga river to be more polluted than other rivers [4]. Many researchers proposed different sources but still, there is a variation in their findings, like the number of waste spilled into the river every day [13], percentages of each waste, the role of society in keeping the safety of the river, legislation of the river safety, management of the river, So, these different results caused frustrate to understand specific factors causing the adverse situation of the Buriganga River, also it's tough to present the health status of the people living surrounding area of the river, the water quality of the river may change from months to months, year to year due to amount of waste entering the river [1] so it is needed to be tested every time to assess the current status of the river, Like Bangladesh Water pollution also become a severe problem in Malaysia and Philippine. Specially Kualalampur and Manila, the capital city of Malaysia and Philippine respectively. In Malaysia, the Department of Environment (DOE) monitored 473 rivers in 2014. On the basis of water quality parameters (e.g. dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammoniacal nitrogen

(NH$_3$-N), suspended solids (SS) and pH) DOE found that 244 (52%) were clean, 186 (39%) were slightly contaminated, and 43 (9%) were infected [14]. In Philippine also 50 out of 421 rivers are considered biologically dead, meaning that the rivers do not contain any oxygen and are unable to support most species of life [15]. According to the Environmental Management Bureau (EMB) out of 127 freshwater bodies of the Philippines, only 47% retain good water quality [15]. The Marilao River, which runs through the capital city, Manila, is included in the list of the Top 19 Most Polluted Rivers in the World. On the other hand, Kumar et al. [16] analyzed the water quality of the Pasig-Marikina River, Philippines, based on three indicators for aquatic ecosystem health viz. Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Nitrate (NO$_3$) stated that the water quality of the respected river will rapidly deteriorate and will be not suitable for any aquatic life in terms of major water quality parameters. Due to its enormous economic and material advancement since the 1950s, Taiwan has made notable social and political gains. The nation has undergone extensive industrial development and is presently regarded as having a top-tier semiconductor industry. However, the risks associated with such rapid growth have led to a serious deterioration of the environment, especially its scarce water resources. As rivers from all Asian countries are facing the impact of rapid urban and economic growth, the study intended to show the overall scenario of these rivers.

2. Objectives

The study will discuss what were the findings during the research work elaborately by focusing on the objectives of **a.** Identification of major causes of Asian River pollution including the Buriganga river from Bangladesh and **b.** Assessment of health status of community living beside the Buriganga river.

3. Materials and methods

3.1 Study area

The research study has been completed in a specific area of Dhaka city (**Figure 1**) which is one of the most populated cities in the world, specifically the target area of the study was the Buriganga river at the point of Showari ghat area which is very close to two police stations of Chakbazar Ward-66 (part) and Kotwali Word-68 (part), The geographical position of Showari ghat is 23.7113° N, 90.3944° E [8]. For the Initial Survey, the study considered the whole Showari ghat area. The study area is under the jurisdiction of Dhaka north city Corporation (DSCC) (**Figure 1**). There is an embankment that was constructed in 1980 which is now known as the Shadarghat-Gabtoli road [17]. There is a significant amount of change that can be noticed in the sociocultural characteristics of the area, because of the unplanned population growth, new settlements are being constructed without following any proper planning and rules [18].

3.2 Data collection procedure

By asking the locals questions, this study utilised an indirect survey design and used qualitative research as part of the surveying process [19]. A questionnaire survey form was first developed to gather information, and then other researchers visited the study area with some locals to gather data by questioning them. It served as a translator because that is the simplest kind of communication [20]. Most of the questions were quantitative and were designed as optional questions [21]. It was very easy and possible for everyone to answer that's why the field study was successful and all the data have been collected previously.
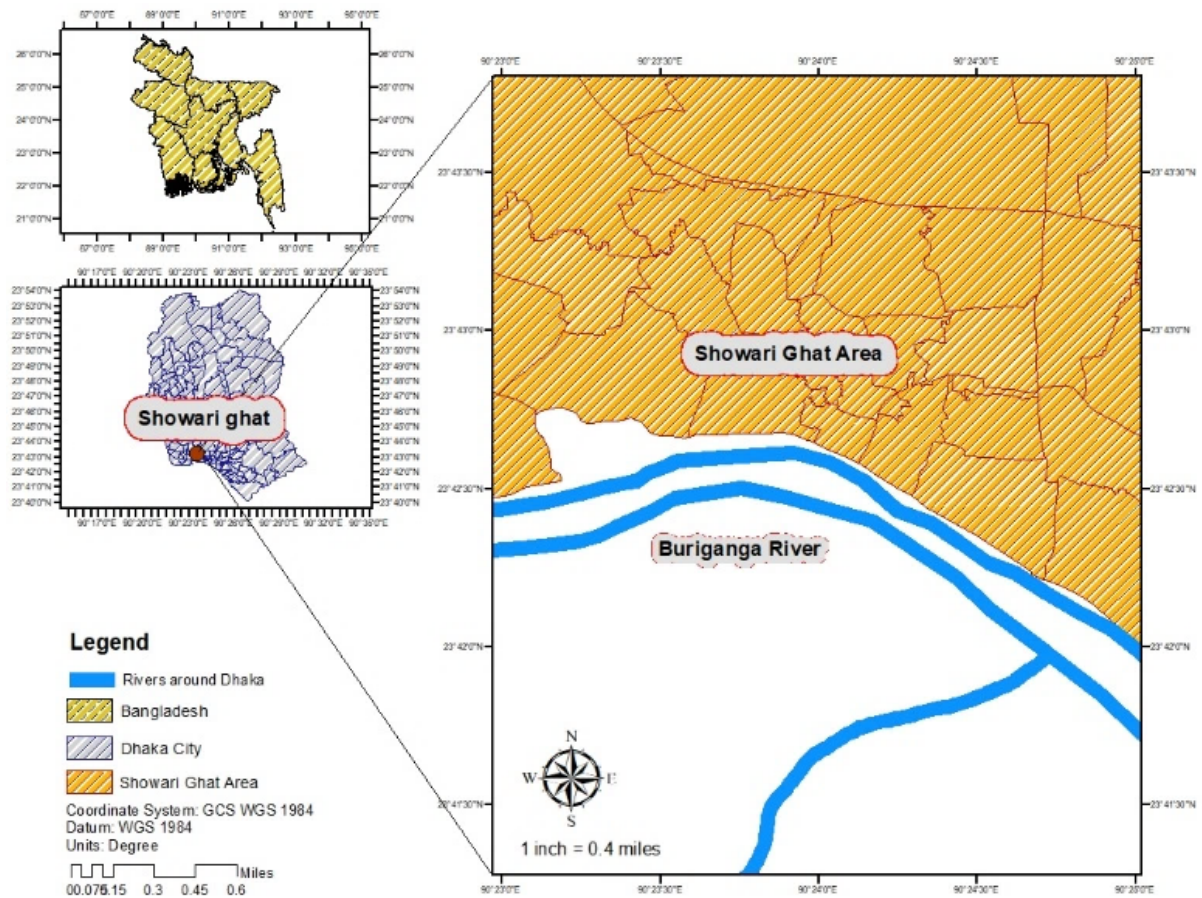
Figure 1. Study area.

3.3 Research population

The study of this research was conducted by the community living in the Buriganga river area. Both male and female, old and young people were a part of the study. The response was collected through random selection, so the study was successfully communicated to most of the community living in that area and they became a part of the study. 45 among society living there provided different responses. To determine the sample size of the study, the Slovene formula has been used.

n=N/1+N (e2)   n=?
n= Sample size   N=51
N= population size   e=5%=0.05
E= margin of errors, Therefore;
                      n=51/1+51*0.0025
                      n=45.2=45 respondent
                      Sample size = 45 respondent

3.4 Sampling technique

In this study, simple random sampling was applied [19]. The study has considered different selection criteria. Inclusion criteria were used to determine the accurate information from the targeted respondents (**Figure 2**). It prevents unwanted information to include in the survey [22]. Under this criterion, the study has also included the local community people for investigation so that the study can achieve a high level of accuracy during the survey (**Figure 2**). Exclusion criteria were also followed to prevent the unfavorable outcome. Under these criteria, the study carefully differentiates those who came for temporary visits [23].

3.5 Data analysis plan

Data were analyzed by using SPSS, version 20.0, the data was cleaned and checked any possible missed data before it was processed [24], the results
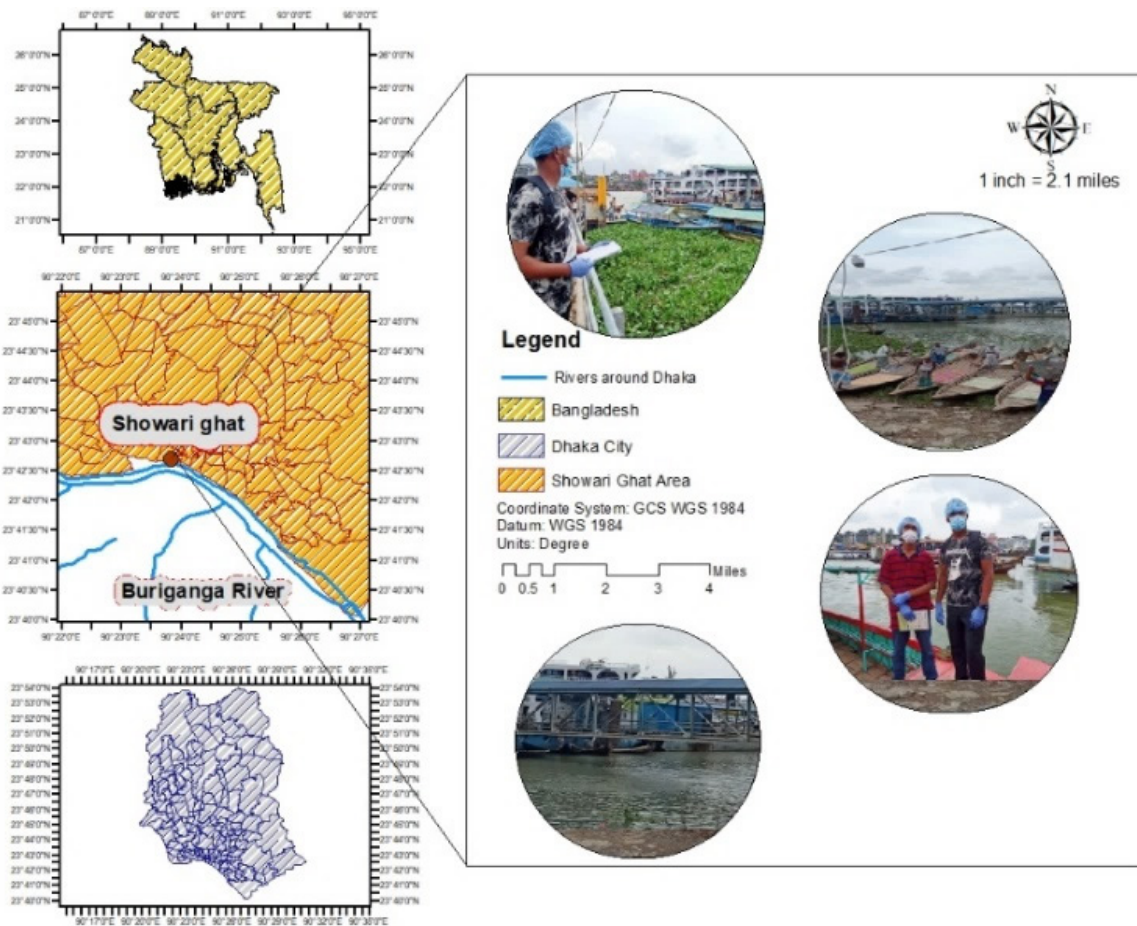
Figure 2. Sampling technique.

were entered in an open office spreadsheet (Excel) to obtain good and quality tables, bars, and pie charts, for a bivariate description of the statistics [25], and were transformed into Microsoft word. This chapter will present detailed information from the work and will decide the outcome of the research study. The study was analyzed through SPSS software and then interpreted understandably. Tables and all the charts of the research work will appear in this study. As the study is interpreted in this chapter that 45 persons participated in the research work, and all their responses are kept in this chapter elaborately.

4. Results and discussion

The study was conducted under the supervision of experts in this field. So, the study showed some spectacular results. In total 45 respondents participated in this study (**Table 1**). The study result showed diversity between participants. Different age groups and different professions of people have participated in the survey that's why the survey showed a diversified result on every question. The study also considered respondents' gender distribution and the occupation they are relying on (**Table 1**). Not only the basic category but also the study focused on the participants' family members and the amount of time they are related to the study area. During the survey, the study had more than 13 questions and asked every one of these 45 respondents to complete the survey, and the study found enough responses for the query. In **Table 1** the general information of the respondent of the survey has been shown where it can be observed that almost 40% of the respondent has completed the higher secondary education level and 22% has completed their primary and undergraduate education level (**Table 1**), which indicated that the survey respondents are capable enough to understand the objectives of the survey. It was also observed

that most of the respondent was male and only about 31% of the respondent were female. The survey also indicated that most of the participants are living in the river area for at least 5 years (**Table 1**).

4.1 Observation of people about Buriganga river and its environment

Table 2 is describing how people are concerned about environmental pollution or water pollution, and the study is showing 64.4% (29 people) of respondents are moderately concerned, 15.6% (7 people) are extremely concerned and 20% (9 people) are slightly concerned, which present those slightly concerned are more than for those extremely concerned and this is one of the factors causing water pollution in Buriganga river although those moderately concerned are higher than both others. **Table 2** is showing the current status of the Buriganga river 64.4% (29 people) of the respondent responded Buriganga river is very polluted, while 31.1% (14 people) responded Buriganga river is polluted and

4.4% (2 people) responded Buriganga river is clean and save, this study is making thing clear that Buriganga river is very polluted, which is difficult to be used for drinking, cooking, and washing. **Table 2** is stating the what are the major causes of Buriganga River pollution, after surveying we found 31.1% (14 people) are waste canals from industrial, 24.4% (11 people) are wasted, 17.8% (8 people) are household wastes, 11.1% (3 people) are rapid urbanization, 6.7% (5 people) are lack of awareness, 8.7% (4 people) are poor management, this study showed that human being is the major causes of Buriganga river pollution if we accumulate only the wastes will be around 73.3%. **Table 2** is presenting here the most common diseases in the Buriganga river area, 56.6% (25 people) of the respondents said Diarrhea, 31.1% (14 people) said skin diseases, 11.1% (5 people) said Cholera, and 2.2% (1 person) malaria, so this study will let us know the most common diseases in Buriganga river area are Diarrhea and Skin Diseases. **Table 2** is clarifying the existence of a water quali-

Table 1. Pilot survey information of primary respondents.

1.	**Education Level:**	This study was participated by 45 respondents who were living in the Buriganga river area, the education level of respondents varied from person to person, 22.2% (10 people) among them were graduated from primary school, 40% (18 people) graduated from Higher Secondary School, 22.2% (10 people) graduated undergraduate, and 15.6% (7 people) were none educated people. This study showed that higher secondary school level participants were among the most.
2.	**Age Distribution:**	In total 45 persons contributed to this research work, 21 among them (46.7%) were range between 15- 30 years old, while 24 among them (53.3%) were more than 30 years old, this will present us that most of the respondents were old or more than 30 years old.
3.	**Gender Distribution:**	Among 45 respondents, 68.9% (31 people) of the respondent are male while 31.1% (14 people) are female which will declare that most people living/working Buriganga river area are male.
4.	**Respondent's family members:**	Of the 45 respondents, 66.7% (30 people) of the respondents consist 0-5 family members, 31.1% (14 people) of the respondents consist of 5-10 members and 2.2% (1 person) consist of more than 10 members.
5.	**Respondent's occupation level:**	Among 45 people, 48.9% (22 people) of the respondents are employees, 44.4% (20 people) are a businessman and 6.7% (3 people) are students, so we can understand the higher number of respondents are employees, those are not more concern for the Environment and water pollution.
6.	**Respondent's living years in the Buriganga river area:**	This study will show us that 46.7% (21 people) of respondents were living in the Buriganga area for 1-5years, and 42.2% (19 people) of respondents were living for more than five years. 11.1% (5 people) of the respondent were living for less than 5 years.

Source: Survey Sept. 2020, Mustafe Said Nur.

Table 2. People's concerns about the environment.

Q1.	How concerned are you about water pollution?	Frequency	Percentage
	Slightly concerned	9	20%
	Moderately concerned	29	64.4%
	Extremely concerned	7	15.6%
	Total	45	100%
Q2.	What do you think current Status of the Buriganga river	Frequency	Percentage
	Safe And Clean	2	4.4%
	Polluted	14	31.1%
	Very polluted	29	64.4%
	Total:	45	100%
Q3.	What do you think are the major causes of Buriganga river pollution?	Frequency	Percentage
	Wastes	11	24.4%
	Rapid urbanization	3	11.1%
	Lack of social awareness	5	6.7%
	Poor management	4	8.7%
	Waste canals from industries	14	31.1 %
	Household waste	8	17.8%
	Total:	45	100%
Q4.	What are the most common diseases in the Buriganga river area?	Frequency	Percentage
	Diarrhea	25	56.6%
	Skin diseases	14	31.1%
	Cholera	5	11.1%
	Malaria	1	2.2%
	Total	45	100%
Q5.	Is there regular examining /testing water quality of the Buriganga river?	Frequency	Percentage
	Yes	10	22.2%
	No	35	77.8%
	Total:	45	100%
Q6.	Are there well-equipped centers for disease control and prevention to prevent newly out-breaking diseases?	Frequency	Percentage
	Yes	1	2.2%
	No	44	97.8%
	Total:	45	100%

Source: Survey Sept. 2020, Mustafe Said Nur.

ty testing center in the Buriganga river area, 77.8% (35 people) of the respondents told us that there is no water quality testing center in the Buriganga river area, while 22.8% (10 people) told us there is a center, according to major of respondent's this study will clear that there is no water quality testing center in Buriganga river area. **Table 2** is showing the availability of health centers in the Buriganga river area, 97.8% (44 people) of the respondent responded NO, there is no health centers in the Buriganga river area while only 2.2% (1 person) responded there is a center, according to this study it's tough to control and identify new diseases since there is lack of health center.

4.2 Administration of Buriganga river protection

Table 3 is stating the existence of strong admin-

istration in the Buriganga River area. According to the responses of interviewers 40% (18 people) of the respondents said disagree with the existence of strong administration in the Buriganga river area as well as that 40% (18 people) said strongly disagree, while only 11.1% (5 people) and 8.9% (4 people) agree, so this study declared that it is not a strong administration are Buriganga river area and this is one of the factors why Buriganga river is very polluted. **Table 3** is focusing on the government plan or how the government set plans for river protection according to respondent's responses there is a weakness in government preparation for river protection 46.7% (21 people) strongly agree that weakness and 28.9% (13 people) agreed but 11.1% (5 people) disagree also while only 13.3% (6 people) and strongly disagree that statements. **Table 3** is demonstrating the level of rule and regulation in the river protection 44.4% (22 people) of the respondents said there is no rule and regulation in Buriganga river protection and they chose strongly disagree furthermore 20% (9 people) chose to disagree while only 17.8 % (8 people) selected strongly agree and 17.8% (8 people) disagree so this table will clear us weaknesses of river protection. **Table 3** is focusing on the role of the community in Buriganga river protection and declared us there is a lack of community role and their missing are part of river pollution 57.8% (26 people) of the respondents selected strongly agree with the lack of community role and 20% (9 people) agreed that but 11.1% (5 people) disagreed also, while only 11.1% (5 people) strongly disagrees, so this will tell us community is missing in the river protection and they are part of the problem.

Table 3. Administration of Buriganga river protection.

Q1.	There is strong administration for Buriganga river protection?	Frequency	Percentage
	Agree	4	8.9%
	Disagree	18	40%
	Strongly agree	5	11.1%
	Strongly disagree	18	40%
	Total	45	100%
Q2.	Lack/weak of government plan are the part Buriganga river pollution	Frequency	Percentage
	Agree	13	28.9%
	Disagree	5	11.1%
	Strongly agree	21	46.7%
	Strongly disagree	6	13.3%
	Total	45	100%
Q3.	There is rule and regulation in the Buriganga river conservation	Frequency	Percentage
	Agree	8	17.8%
	Disagree	9	20 %
	Strongly agree	8	17.8%
	Strongly disagree	22	44.4%
	Total	45	100%
Q4.	The role of the community is missing in the Buriganga river protection	Frequency	Percentage
	Agree	9	20%
	Disagree	5	11.1 %
	Strongly agree	26	57.8%
	Strongly disagree	5	11.1%
	Total	45	100%

Source: Survey Sept. 2020, Mustafe Said Nur

4.3 Pearson correlation

To correlate with my question, the study was designed in four groups. Group 1 = Personal information of the respondents (Personal). Group 2: Measuring the level of the river (Measuring). Group 3: Rule and regulation of river protection (Regulations). Group 4: How are respondents aware of / concerned about river status (Aware)? After grouping and correlating I found these results (**Table 4**).

To determine the linkage between the research constructs, a bivariate analysis of correlation has been used to pre-evaluate [26]. To be specific, the Pearson correlation analysis has been used to calculate the strength of the linear relationship between the variables and a strong correlation coefficient has been reported by bivariate analysis (significant at the level of 0.01) (**Table 5**).

Table 4. Pearson correlation.

Correlations		personal	measuring	regulation	aware
personal	Pearson Correlation	1	0.057	−0.086	−0.207
	Sig. (2-tailed)		0.712	0.575	0.172
	N	45	45	45	45
measuring	Pearson Correlation	0.057	1	0.570**	−0.126
	Sig. (2-tailed)	0.712		0.000	0.410
	N	45	45	45	45
regulation	Pearson Correlation	−0.086	0.570**	1	−0.021
	Sig. (2-tailed)	0.575	0.000		0.889
	N	45	45	45	45
aware	Pearson Correlation	−0.207	−0.126	−0.021	1
	Sig. (2-tailed)	0.172	0.410	0.889	
	N	45	45	45	45

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5. Cross-tabulation correlation.

Case Processing Summary								
		Cases						
		Valid		Missing		Total		
		N	Percent	N	Percent	N	Percent	
What is your education level? * How concerned are you about -polluted water?		45	100.0%	0	0.0%	45	100.0%	

What is your education level? * How concerned are you about -polluted water? Cross tabulation					
Count					
		How concerned are you about the pollution of water?			Total
		Slightly concerned	moderately concerned	extremely concerned	
What is your education level?	primary school	2	7	1	10
	higher secondary school	3	12	3	18
	undergraduate	0	7	3	10
	non-educated	4	3	0	7
Total		9	29	7	45

Table 5 continued

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
How long have you been living in the Buriganga river area? * What do you think current status of the Buriganga river?	45	100.0%	0	0.0%	45	100.0%

How long have you been living in the Buriganga river area? * What do you think current status of the Buriganga river? Cross tabulation

Count					
		What do you think current status of the Buriganga river?			Total
		clean and safe	polluted	very polluted	
How long have you been living in the Buriganga river area?	less than one year	0	2	3	5
	1-5 years	0	10	11	21
	more than 5 years	2	2	15	19
Total		2	14	29	45

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
What do you think are the major causes of Buriganga river pollution? * Lack/weak government plan for river protection is part of the river pollution?	45	100.0%	0	0.0%	45	100.0%

What do you think are the major causes of Buriganga river pollution? * Lack/weak government plan for river protection is part of the river pollution? Cross tabulation

Count					
		Lack/weak of government plans for river protection are part of the river pollution?			Total
		agree	disagree	strongly agree	strongly disagree	
What do you think are the major causes of Buriganga river pollution?	Wastes	1	2	6	2	11
	rapid urbanization	1	0	2	0	3
	lack of social awareness	0	1	3	1	5
	poor management	2	0	1	1	4
	waste canals from industries	5	1	6	2	14
	Household wastes	4	1	3	0	8
Total		13	5	21	6	45

4.4 The main causes of Buriganga river pollution

Following the completion of the survey, the study discovered sufficient responses to the inquiry. During the survey, the study had more than 13 questions asked to each of these 45 respondents. One of the principal reasons for pollution is a lack of understanding and knowledge of the society that lives next to the river [3,27]. The respondent is informed that there is no ongoing or one-time awareness campaign for that society and that 20% of people are just mildly concerned about water contamination and the environment, compared to 60% who are not

particularly concerned. There aren't many educated people in that region; 40% of respondents only have a high school diploma, 22.2% have a primary school diploma, and 15.6% are uneducated. Only 22.2 respondents have completed an undergraduate degree program, and those who have aren't in the environmental sciences. Another significant source of pollution in this area is a lack of or inadequate government river protection plans [28]. 46.7% of the respondents responded strongly agree while 28.9% also responded agree this shows that weak government plans for river protection are part of Buriganga river pollution [3,27], these weak plans will lead to a lack of rules and regulations for river protection and this will enhance pollution possibility since there are no rules which can punish those did anti-environmental activities. Waste canals from industries and household waste also make river pollution. In this study, it was quite understandable that industrial waste is the major cause of Buriganga pollution [29,28] and there are some canals from industrial that directly involve the river and impact its quality [3,27], some other factors are also part of the Buriganga river pollution like after surveying we found 31.1% are waste canals from industrial, 24.4% are other wastes, 17.8% are household wastes, 11.1% are rapid urbanization, 6.7% are lack of awareness, 8.7% are poor management, this study has shown that human being is the major causes of Buriganga river pollution, if the study accumulates only the wastes it will be around 73.3%. The absence of a water quality testing center is also responsible for this condition water quality testing center contributes maintenance of water quality, if there is regular testing the possibility of pollution will be very rare [3] but unfortunately, the Buriganga river has no water quality center as 77.8% of the respondents said, and this is one of the factors causing Buriganga river pollution. Lack of community participation in river protection can play a key role in pollution [27]. The role of civil society is missing, no one is taking care of the river, no groups are protecting the river by their own decision, mostly they seem irresponsible in the case of river protection.

4.5 Health status community living beside the river

Buriganga River is very polluted, according to 64.4% of respondents, while 31.1% of respondents said the same. This study will make it clear that the river is very polluted, making it difficult to use it for drinking, cooking, or washing. As a result, the polluted water impacted the community living next to the river, and the researchers noted that the current situation is not good [30], furthermore, there is no health center in that area, where the community can control or identify newly out broke diseases, it's very difficult to identify breaking diseases within a short time, due to a lack of health centers.

4.6 Most common diseases in the Buriganga river area

Finally, during the research work, the study identified the most common diseases in the Buriganga river area [30]. And they become like the following,

- 56.6% of the respondents said diarrhea,
- 31.1% said skin diseases,
- 11.1% said cholera,
- 2.2% malaria.

So, this study indicated that the most common diseases in the Buriganga river area are Diarrhea and Skin Diseases.

4.7 River water pollution impacts health in Asian countries

In Asia, resources like clean water, clean air, and a fresh environment are becoming increasingly scarce. Growing human populations, increased industrialisation, and agricultural expansion have had a major impact on natural ecosystems and water quality during the past 50 years. These issues could be made worse by climate change in the area [31]. Asia's fast industrializing and the urbanizing economy will have an impact on local, regional, and global surroundings as a result of the trajectory of social and technological change [32]. Because of industrialization and overpopulation the water quality of Asian

rivers is degrading. For example, in a study based on the Buriganga river of Bangladesh, it was shown that the river water quality is degrading. The degradation of the water quality has several health impacts [33]. In **Table 6** the major rivers from different countries were considered to show how river pollution is impacting the health of the population where it can be observed that several countries from Asia have river pollution which is directly impacting the health of their population (**Table 6**).

Table 6. List of some major rivers, their sources of pollution, and their health impact on South-East Asian countries Malaysia and the Philippines.

Country	River Name	Source of Water pollution	Health Impact	References
Malaysia	Kuantan, Pahang	Manufacturing industries, chemical industry Agro-based Industries, Rubber Mills, Palm Oil Mill, Animal Pig, Sewage Treatment Plant, Food Services Establishment	The concentration of heavy metals in fish was found at a carcinogenic level which causes adverse effects on human life. Poor blood circulation, skin lesions, vomiting, and damage to the nervous system.	[34]
Malaysia, Kuala Lumpur	Jinjang River	Agricultural and development activities,	Extremely contaminated with fecal coliform bacteria (E. coli) create a health hazard.	[35]
Malaysia, Kualalampur	Jinjang River	Leachate Treatment Plant	Leachate may affect human health as leachate contains heavy metals such as lead, cadmium, aluminum, copper sulfate, nickel, and zinc	[36]
Philippine, Manila	Pasig-Marikina River,	Industrial and household contamination	Water quality is not suitable for any aquatic life.	[16]
Philippines, Manila, Bulacan	Marilao River	Organic pollution and heavy metal pollution. Heavy metal pollution mainly comes from jewelry smelting, tanneries, used lead-acid battery recycling, and other industries dealing with heavy metals	Health risk to close communities that surround the stream water for fish ponds, bathing, and swimming that causes some health issues	[37]
Jakarta. Indonesia	Ciliwung River	Human waste, industries such as metal plating, and textile. food-processing, pharmaceutical, electronics, paint, and paper. fertilizer. chemicals	A high level of BOD can affect the underwater organism, contaminated with Faecal coli.	[38]
Eastern Jakarta. Indonesia	Sunter River	Industrial waste and Human waste	A low amount of DO can affect water quality, High BOD and Faecal coli make water unsuitable for aquatic organisms	[39]
North Jakarta, Indonesia	Jakarta Bay	Land drainage, urban stormwater runoff, atmospheric deposition, and industrial waste from r the metal, battery, leather, and textile industries.	effects of the volatile components of oil on corals, oil residues, heavy metals, and organic micro-pollutants have potential human health impacts.	[40]
Thailand	ThaChin river	Aquaculture plays the most important role in nutrient pollution, contributing 62% and 54% of the total NET N and P load to the river system also RICE farming is also a very significant pollution source, PIG farming, households, and industries.	Critical Dissolve Oxygen (DO) level resulting in fish death. low oxygen and elevated ammonia and phosphorus levels. The high nutrient concentrations lead to eutrophication.	[41]
India	Sutlej river	Industrial waste, sewage, and agricultural runoff are contaminating the Sutlej river in the Indian Punjab.	Cd > Ni > Cr > As was the metal with the highest potential of causing cancer, and regions along transboundary lines had the highest risk.	[42]
India	Ganga river	Fe, Mn, Zn, Cr and Pb are the main pollutant. The river water has been found to be severely contaminated due to heavy metals	Target cancer risk assessment showed high carcinogenic risk from As, Cr, Ni and Pb as well as residues of DDT and HCHs.	[43] [44]

Table 6 continued

Country	River		
India	Ajay River basin	The degree of contamination in the sediments of the Dikrong river, for the metals Al, Fe, Ti, Mn, Zn, Cu, Cr, Ni and Pb, has been evaluated. the water is highly contaminated through numerous geogenic and anthropogenic sources.	High load of Cd, Pb and Fe in water body could harm the population.	[45]
Pakistan	Siran river	Due to agricultural activities, the direct dumping of solid waste into rivers, and the discharge of domestic waste water effluent, the pollution level in the Siran River is rising.	High value of TSS, COD and E. coli can create major health impact.	[46]
Pakistan	Kabul River	One of the main sources of pollution in the Kabul River is textile effluent.	The substantial decrease in fish and crop which ultimately harm human health.	[47]
China	Wei River	Heavy metals (Hg, Cd, Cr(VI), Pb, and As)	With the exception of As, the five heavy metals in the area posed tolerable health risks. But Arsenic (As) in food and drinking water can cause cancer and skin sores when consumed over an extended period of time.	[48]
China	Huaihe River	Various organic pollutants, including Polycyclic Aromatic Hydrocarbons (PAHs), Organochlorine Pesticides (OCPs) and some other Semi-Volatile Organic Compounds (SVOCs)	high level of health risk in the study area mainly cancer.	[49]
Sri Lanka	River Mahaweli	Cadmium (Cd), Cadmium, derived from contaminated phosphate fertilizer, in irrigation water finds its way into reservoirs	Chronic renal failure (CRF)	[50]

5. Conclusions

One of the most crucial water sources for Bangladesh's capital city of Dhaka is the Buriganga River. The Buriganga River serves as a key source of water for the city of Dhaka, however due to several shortcomings in the correct management system, it is unfortunately becoming increasingly polluted over time. Although the issue of water pollution is widely acknowledged and discussed, no appropriate steps have been made to address it. The study survey revealed how participants relate to the issue and how they accept accountability. Numerous issues have been found in the study as a result of the Buriganga river's water pollution, and those issues directly affect the general public's health in the area. So, the pollution rate of Buriganga reaches an alarming state where it can be a threat to the survival of Dhaka city. A proper step is mandatory to take immediately so that the pollution problem of the Buriganga river can be resolved.

Conflict of Interest

There is no conflict of interest.

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