Coronavirus Pandemic and Environmental Pollution in Bangladesh

Dr. M. A. Quader

Abstract

Environmental Pollution and Coronavirus phenomenon in Bangladesh are studied and analyzed. Environmental Pollution in Bangladesh is much more severe than the Coronavirus. In almost all attributes environmental pollution is getting worsened. Fortunately, life expectancy is increasing and death rate is decreasing. A couple of statistical models developed. Like all other countries of the world, Coronavirus has created a havoc. Unfortunately, this is being overlooked. There is a link between Coronavirus and Environmental Pollution in Bangladesh. Evidences are there. More studies are underway.

Key words: environmental pollution, life expectancy, death rate, link between environmental pollution, coronavirus, model.

1 Research Purpose and Research Design

(a) Research Purpose

With the passage of days, more and more strong indication is emerging to link the relationship between air pollution and Coronavirus. The US government scientists say that places with high air pollution will inevitably be places with a lot of COVID-19 infections. They also estimate that scientists estimate that COVID-19 may kill between 100,000 to 240,000 Americans. The majority of the pre-existing conditions that increase the risk of death for COVID-19 are the same diseases that are affected by long-term exposure to air pollution [01].

Areas with poor air quality will ultimately reduce overall immunity of the people and make them more susceptible for any infection, such as COVID-19. “If you’re getting it, and you have been breathing polluted air, it’s really putting gasoline on the fire”, said Francesca Dominici, a Harvard biostatistics professor.

Bangladesh is a small country with a high population density. It may be interesting to see how the country is performing in coronavirus and environmental pollution both of which are extremely serious topics for Bangladesh.

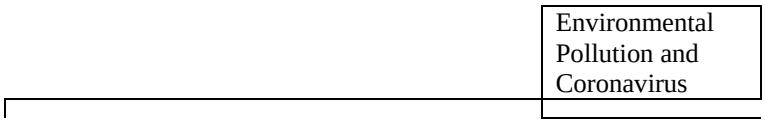
The objectives of the research study are as follows:

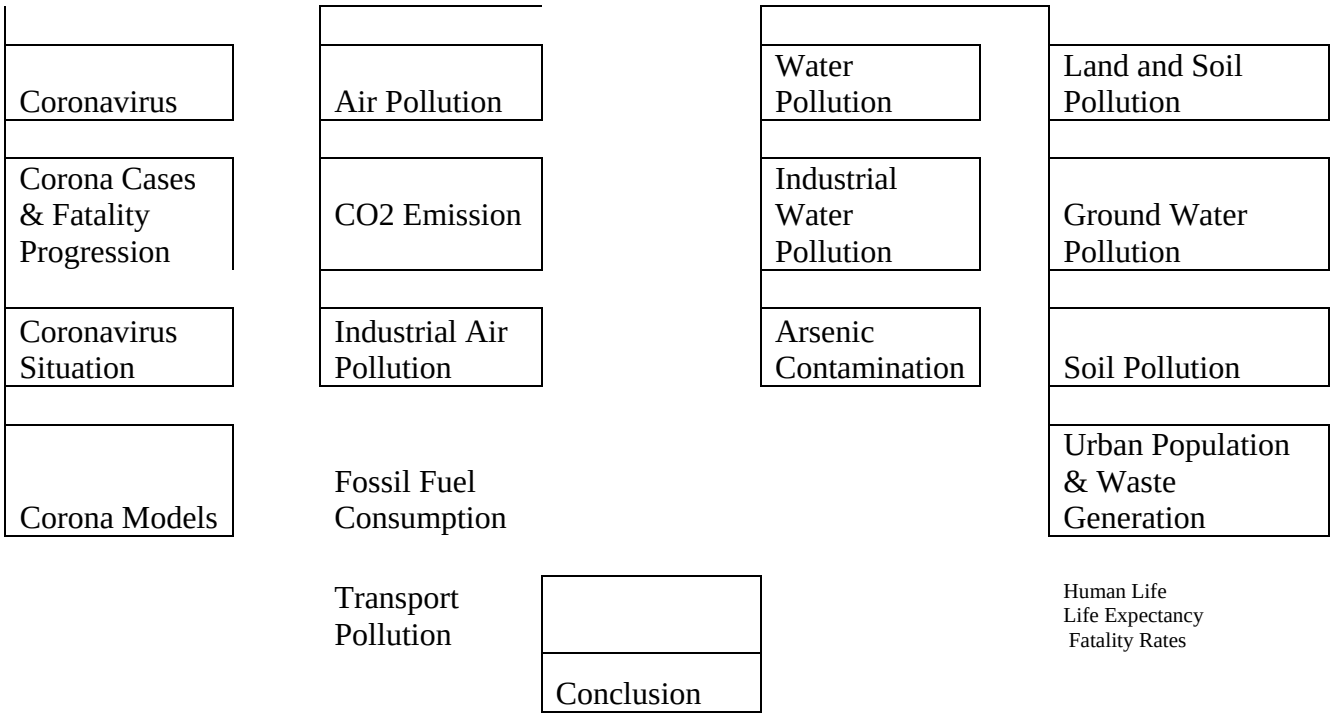
1) To study and analyze the Environmental pollution in Bangladesh.
2) To study and analyze the Coronavirus phenomenon in Bangladesh.
3) To explore the missing link between the two.

(b) Research Design

Research design in the form of a Study Diagram is shown hereafter.

Study Diagram





2 Literature Review

Here is a model.
Model: Fossil Fuel Consumption (% of total) = -2516.161572 +1.287035236 * year
R^2 = o.9926; F = 5639.12, df = 2,43; (1971 – 2014)

Fossil fuel consumption in Bangladesh during 1971 – 2014 is plotted in Fig 01. It is seen the consumption is consistently increasing. The rate of increase is 1.2870% per year. See the graph for CO2 emission. Data provided by some international organizations such as worldometer, WHO, EPAUS, ADB etc. were immense helpful. They professionally managed data. They are very fast as well. Author's publication on applied statistics by SPRINGER has been very useful in modelling. The Environment Departments and some research organizations such as Waste Concern very professionally prepared and made the data available.

3 Environmental Pollution

A new World Bank report shows that Bangladesh is among the countries that are most affected by pollution. WB estimated 28 percent of all deaths in Bangladesh are from diseases caused by pollution, compared to a 16 percent global average [02].

Environment pollution is due to the introduction of pollutants into the natural environment, and causes adverse effects. The main sources of global warming are the extraction and burning of fossil fuels. These are not only key drivers of climate change, but are also major sources of air pollutants in Bangladesh.

When we talk of the sectors of the environment affected by pollution, we need to classify the sectors. Classifying pollution by the sectors of the environment affected may be done differently. We shall follow the most commonly used method – air, water and soil & land.

(a) Air Pollution
(b) Water Pollution
(c) Soil and Land Pollution

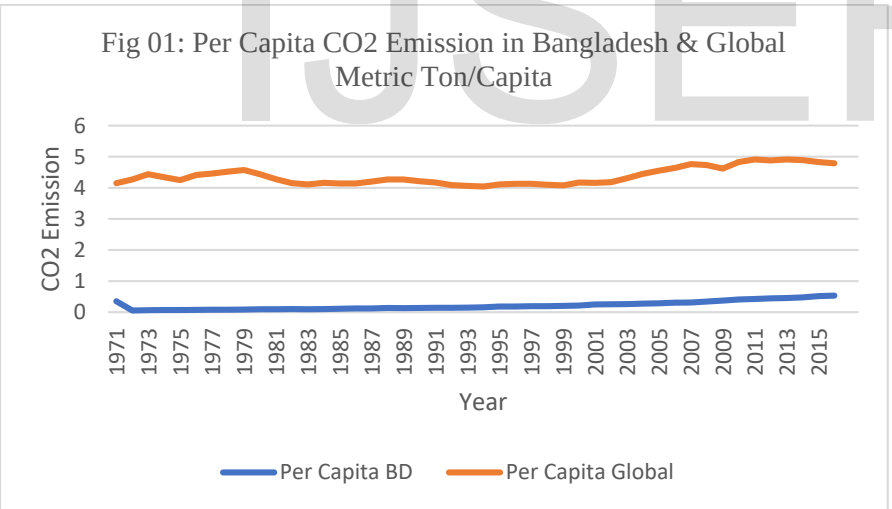
3.1 Air Pollution

(a) Atmospheric conditions both urban and rural areas are deteriorating due to air pollution.
(b) Uncontrolled emission from motor vehicles, dust, industrial waste product, construction dust, garbage, brick kilns, cooking stoves, burning of wood, coal and bio-mass are mainly responsible.
(c)Common pollutants: Dust, Carbon monoxide, Nitrogen oxide & Sulphur dioxide, respirable suspended particulates (RSP), Smoke etc.
(d) Effects on human health such as chronic bronchitis, acute respiratory infection in children, lung cancer, stroke & heart diseases, abnormality during birth.

3.1.1 CO2 Emission

The emission of CO2 in Bangladesh for several years is plotted (Fig 01). For comparison global figures are also plotted.

Fig 01: Per Capita CO2 Emission in Bangladesh & Global
Metric Ton/Capita



CO2 emission is a culprit in air pollution. Per Capita CO2 emission in Bangladesh and globally is shown in the figure. For the both the places, Bangladesh and global, CO2 emission is increasing consistently over time. However, as can be seen from the figure, there is a lot of difference between the two. For Bangladesh, per capita emission is much lower as compared to average world emission.

Bangladesh
Model: Per Capita CO2 Emission = -19.43 + 0.00985415 * Year
R^2 = 0.891913146; DF = 43, Sample size n = 45; F = 354.8282134

Model states increase of 0.00985415 metric ton per capita CO2 is emitted per year.

Global
Model: C02 Emission = -18.6632 + 0.011557 * year
R^2 = 0.313098; F = 20.05569; Sample size n = 46
Model states increase of 0.011557 metric ton per capita CO2 is emitted per year globally.

Per capita C02 emission in Bangladesh is less than 1 metric ton per year (1971 – 2016). That globally is between 4 and 5 metric tons per capita per year (1971 – 2016). The rate of increase per year in Bangladesh and globally is about the same at 0.01 metric ton per capita per year. Mainly, carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

The lower value (Bangladesh part) is due to, among others, low number of transports, low number of CO2 producing industries such as petrochemical industries.

Air pollution contributes to more deaths than many better-known risk factors such as malnutrition, alcohol use, and physical inactivity. CO2 is a real culprit. Air pollution is reducing global life expectancy by three years and killing 8.8 million people a year - MORE than malaria, HIV, war and smoking, scientists find" [03].

- Scientists led by Germany fear the world is facing an air pollution 'pandemic'
- They analyzed deaths attributable to breathing toxic air in every country
- Life expectancy has been cut by four years in East Asia, and two years in Europe
- Two-thirds of premature deaths are attributable to human-made emissions
- Air pollution predominantly killed by affecting the heart and blood vessels

3.1.2 Industrial Air Pollution Emission

The industrial air pollution emission in Bangladesh is summarized in the following table.

Table 01: Industrial Air Pollution Emission in Bangladesh

Rank	Industrial Sector	Emission (tons/year)	% Contribution
1	Food Industry	146,356.06	38.7
2	Cement/Clay	62,725.88	16.6
3	Pulp and Paper	51,963.92	13.7
4	Textile	39,831.01	10.5
5	Tobacco	16,992.20	4.5
6	Other Industries	60416.71	16.0
	Total	378,285.78	100.00

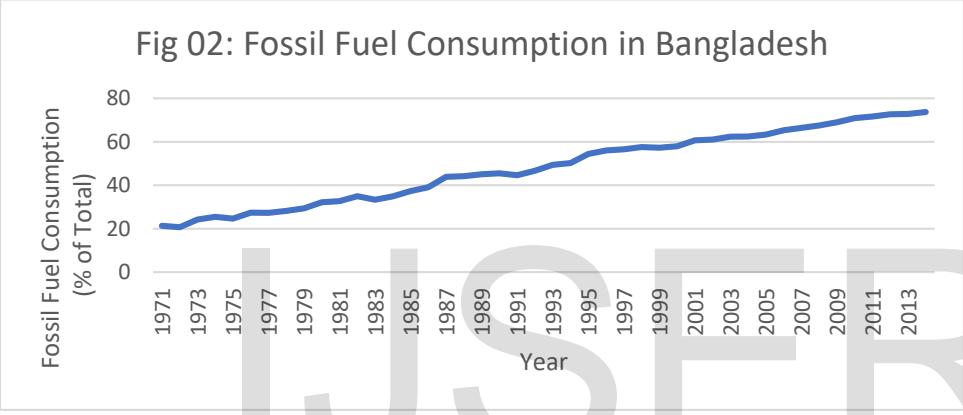
Source: Asian Development Bank, Country Environmental Analysis Bangladesh, July 2004

Food Industry is the highest CO2 emitting sector with 146,356 tons per year. This is at 38.7%. It may be noted that all the sectors have positive and very high growth rates. See Table 01.

3.1.3 Fossil Fuel Consumption

Definition: Fossil fuel comprises coal, oil, petroleum, and natural gas products.
Source: IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp), subject to https://www.iea.org/t&c/termsandconditions/

Fossil fuel consumptions from 1971 to 2014 in Bangladesh are plotted and placed here. The consumption of fossil fuel in Bangladesh has been consistently increasing. The consumption does not show any trend to decrease.



Source: IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp), subject to https://www.iea.org/t&c/termsandconditions/

Model: Fossil Fuel Consumption (% of total) = -2516.161572 +1.287035236 * year
R^2 = 0.9926; F = 5639.1; DF = 2,43
Model says rate of increase of fossil fuel consumption 1.2870% per year.

Although renewable energy is growing rapidly around the world, fossil fuels still make up a majority of the world's energy use. In 2017, 81 percent of the energy the world consumed was oil, coal and natural gas. These are fossil fuel.

3.1.4 Transport Pollution

Pollution by different types of vehicles is shown in the table. Trucks' contribution in pollution is the highest. It is alarming that the pollution contribution by all the vehicle types has been increasing. There is no trend to decrease. See the table (Table 02) and the figure (Fig 03).

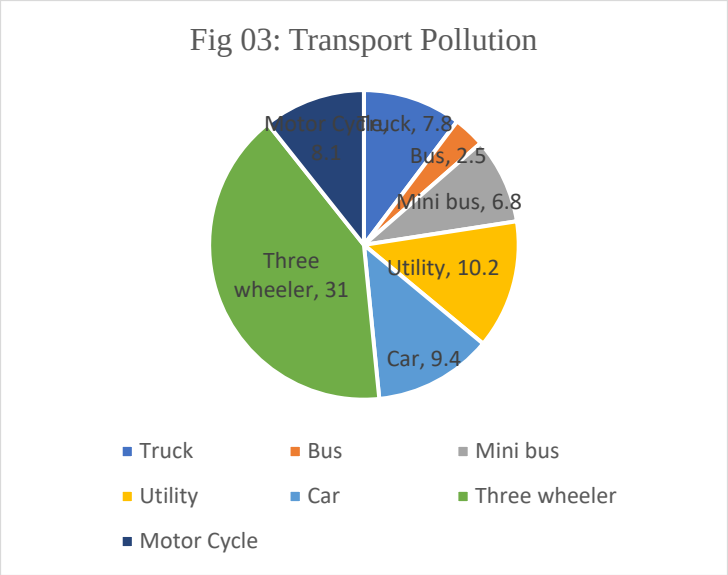


Table 02: Contribution of Air Pollution by Vehicle Type

Type of Vehicle	CO (%)	HC (%)	NOx (%)	PM (%)	Annual Growth
Truck	13.4	8.6	59.4	47.4	7.8
Bus	10.3	9.7	18.5	29.4	2.5
Mini bus	7.3	3.9	6.5	19.1	6.8
Utility	6.3	4.4	2.8	0.7	10.2
Car	38.1	18.2	6.5	1.2	9.4
Three wheeler	10.6	26.9	6	1.2	31
Motor Cycle	14	28.3	0.3	1	8.1
Total	100	100	100	100	

Source: Country Profile on Environment of Bangladesh by Japan International Cooperation Agency in the Year 1999.

3.2 Water Pollution

Water pollution is also important for Bangladesh. The Surface water system is under heavy contamination due to indiscriminate discharge of mainly industrial effluent (60%) and domestic waste water (40%). More than 60,000 cubic meter/day of toxic waste enters the Dhaka City canal and river system. Main polluters from the industries are textiles, dyeing, printing, washing and pharmaceuticals.

Like the rest of the third world countries, Bangladesh is one of the most densely populated countries. It is facing severe water pollution and scarcity. 8.5% of the total deaths in Bangladesh is caused by water, sanitation and hygiene-related issues [04].

3.2.1 Industrial Water Pollution

As may be seen from the table and figure, pulp and paper sector of the industries emit the highest quantity of emission in Bangladesh. It is 47.40% followed by pharmaceuticals at 15.90% (Table 03).

Table 03: Industrial Water Pollution in Bangladesh

Rank	Industrial Sector	Emission (tons/year)	% Contribution
1	Pulp and Paper	91,768.10	47.40
2	Pharmaceuticals	30,866.70	15.90
3	Metal	27,174.61	14.00
4	Food Industry	23,403.39	12.10
5	Fertilizer/Pesticides	12,715.00	6.60
6	Other Industries	7,706.06	4.00
	Total	193,633.86	100.00

Source: Asian Development Bank, Country Environmental Analysis Bangladesh, July 2004

3.2.2 Arsenic Contamination

In a study conducted in 2011 it was observed that 42,720 people were found to have excess deaths due to arsenic contamination in the country. This is 5.6% of all the deaths in Bangladesh in 2011. In the year total population of Bangladesh was 90,658,000 [05].

The highest concentration of arsenic detected in the tube well water was 4.7 mg/L. Another survey (2009) that sampled water from tube wells of 13,423 households throughout the country revealed that arsenic level in 12.6% of tested samples exceeded the Bangladesh Arsenic standard for drinking water. Nov 30, 2018

According to the report of the survey, it has been reported that, on daily basis, a male living in arsenic-contaminated areas on an average ingests 1.734 mg of arsenic through drinking water, while a female ingests 1.321 mg of arsenic; they also receive additional exposure through vegetable and grains that they consume. People living in contaminated areas, per capita daily average intake of arsenic was estimated to be 1017.9 µg, of which 54.3% was from rice and vegetables, and 45.7% was from drinking arsenic-contaminated water. Vegetables such as potato, pumpkin, amaranth leaf, and *kalmi* leaf from contaminated areas were found to contain a high concentration of arsenic; 27.9% arsenic in these vegetables was reported to be inorganic arsenic, while organic arsenic monomethyl arsenic acid and dimethyl arsenic acid was 21.5% and 50.6%, respectively. The exposure through vegetables and grains becomes more complicated when the food is cooked or processed with arsenic-contaminated water.

Arsenic in Bangladesh has attracted much attention since recognition in the 1990s of its wide occurrence in well-water in the country. Since this time, significant progress has since been made and the number of people exposed to arsenic exceeding the Bangladesh drinking-water quality standard has decreased by approximately 40%. Despite these efforts, it was estimated that in 2012 about 19 million and 39 million people in Bangladesh were still exposed to arsenic concentrations above the national standard of 50 μg/L and the WHO provisional guideline value of 10 μg/L respectively. In a highly affected area of Bangladesh, 21.4% of all deaths in the area were attributed to arsenic levels above 10 μg/L in drinking-water. A similar dose-response function has been found in other parts of Bangladesh, and these results have been combined with national survey data to estimate an annual death toll of nearly 43 000. The US National Research Council has noted that as many as 1 in 100 additional cancer deaths could be expected from a lifetime exposure to drinking-water containing 50 μg/L.

Bangladesh is the classic of hydrological mismanagement, as deep tube wells were drilled in the 1970s without adequate testing of water for arsenic contamination. Today, the most estimate of the exposed over 2 decades to water containing arsenic at concentration ranging from 10 to 2,300 microgram/l is 57 million over an areal extent of 150,000 km^2. The number of arsenicosis cases is estimated as 5 million.

3. Land Pollution

Land pollution refers to heavy metals and metalloids. The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Examples of heavy metals include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb).

The waters of Dhaka rivers were studied for contamination by heavy metals. The researchers concluded that the rivers of Dhaka metropolitan city contained acceptable amount of As, Zn, Pb, Cd where Mn exceeded the recommended limit for drinking water, public water irrigation water and for aquaculture. In that sense it is hazardous for health, crops and aquaculture. All the water of rivers of Dhaka city can safely be used for specific purpose after proper treatment. Routine research work with wide public awareness, government participation and government regulations can save the water of Dhaka metropolitan city and thus a safe and sound water environment can be made for future generations [07].

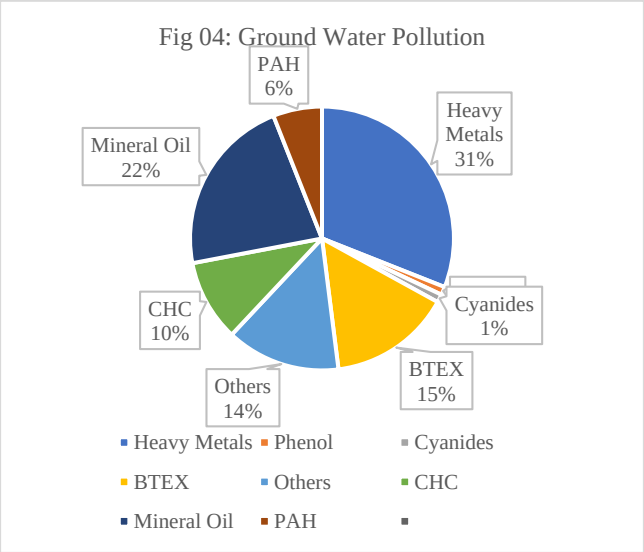
3.3.1 Soil Pollution

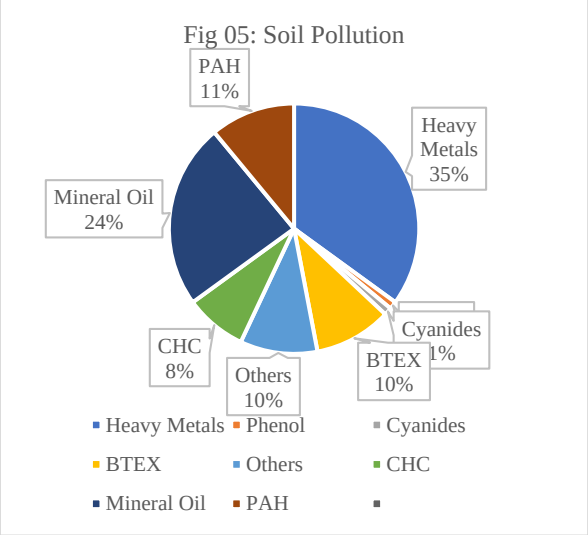
In a report of the European Commission, “Soil Contamination: Impacts on Human Health”, they noted “Over 200 years of industrialization have caused soil contamination to be a widespread problem in Europe. Decision makers, scientists, businesses and individual citizens generally accept and understand that air and water pollution can have negative impacts on human health, but the impacts of such soil pollution on our health have had a much lower profile, and are not so well understood”. See Fig 05.

In 2011 there were 42,720 deaths attributed to arsenic contamination. This is 5.6% of all the deaths in Bangladesh in 2011.

3.3.2 Ground Water Pollution

Distribution of ground water pollutants is shown in Fig 04. Heavy metals are the highest polluters like soil pollution both of which are over 30%.

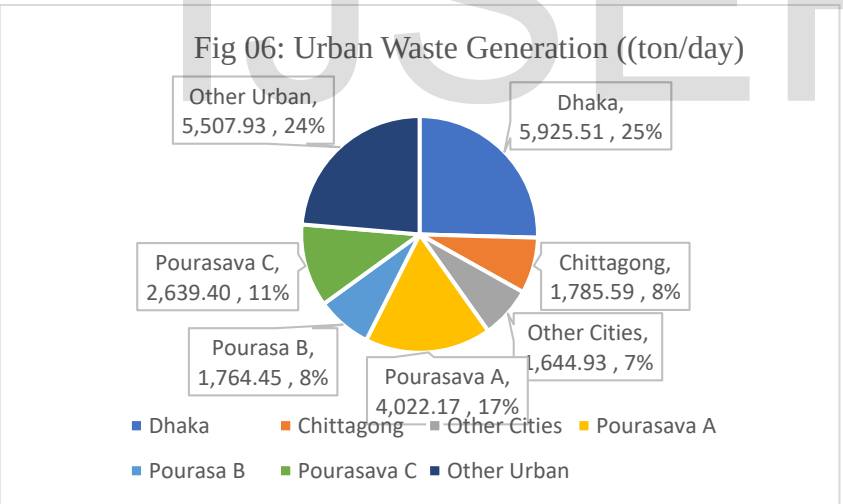




Source: Science Communication Unit, University of the West of England, Bristol (2013).

3.3.3 Waste Generation

The total urban population and the waste generation in Bangladesh are shown in the Fig 06.



Source: Waste Concern, Bangladesh Waste Database 2014

The total waste collection rate in major cities of Bangladesh such as Dhaka is only 37%. Total quantity is 23,289.98 tons/day. When waste is not properly collected, it is illegally disposed of and this poses serious environmental and health hazards to the Bangladeshis. This quantity is 63% of the total. This means illegally disposed of quantity is 14,673 tons/day[08]

Growth of generation of wastes are shown in Fig. 06 from 1990 to 2925 (estimated).

The total quantity of waste generated every day in Bangladesh has been increasing annually since 1991. Whereas in 1991 the urban areas of Bangladesh were generating approximately 6,493 tons per day of municipal solid waste, by 2005 that figure had more than doubled to reach 13,330 tons per day. In 2014, it is estimated that Bangladesh generated 23,688 tons per day in its urban areas. At the same time the total urban population of Bangladesh has been increasing, from 20.8 million in 1991 to 32.76 million in 2005 to 41.94 million in 2014 due to rapid urbanization. The total urban population is estimated to be as high as 78.44 million by 2025, and the total waste generation is expected to reach 47,000 tons per day in 2025. There is an obvious link between greater quantity of waste generated and a higher urban population. Interestingly, since 2005 the rate of change of total waste generated daily has exceeded the rate of change of the population growth, due to an increased average daily per capita waste generation rate.

3.3.4 Human Life

Life Expectancy

Life expectancy for several years in Bangladesh is shown in Fig. …

But one thing is good. The life expectancy is consistently increasing. See Fig 07 appearing hereafter. The life expectancy of 39.12 years in 1951 increased to 72.77 years in 2020 (over 70 years).

Fig 07: Life Expectancy in Bangladesh

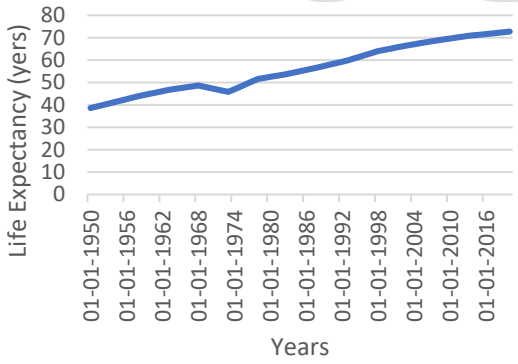
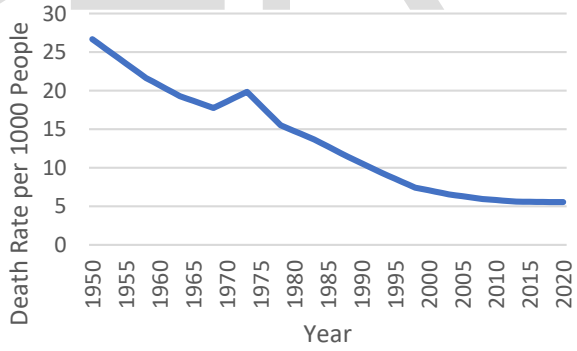


Fig 08: Historical Death Rate Bangladesh



Death Rate

The death rates are also decreasing consistently (Fig 08). In 1951, death rate was 26.04 persons per 1000 people. In 2020 it came down to 5.55 persons per 1000 people. This is remarkable.

4. Coronavirus in Bangladesh

The strangeness of coronavirus is that it has appeared throughout the world in a very short time covering all parts of the globe. The scientists are working very hard, but yet they could not identify the clinical part of the disease. No medicine could yet be discovered. None of the available medications including vaccine can be useful.

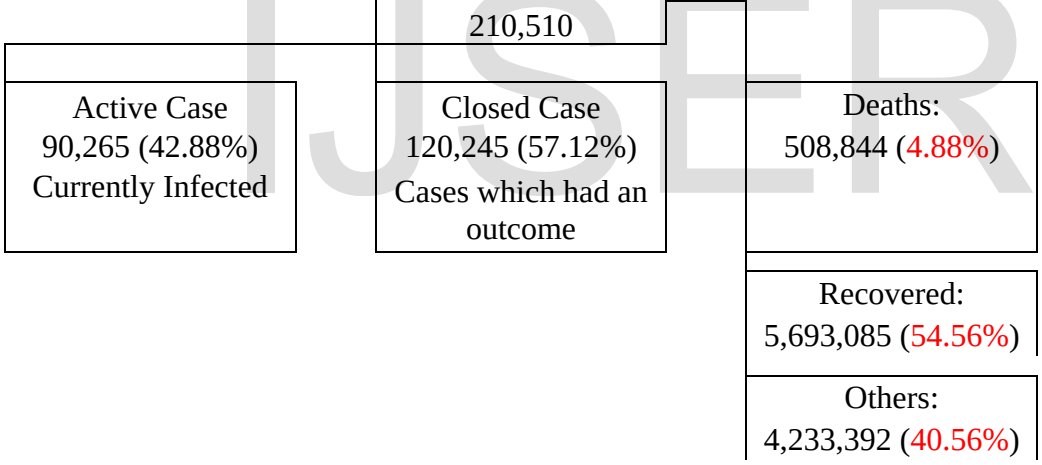
In the prevailing situation, the World Health Organization has adopted the following strategy. Strategic objectives for this response are to: (a) Limit human-to-human transmission including reducing secondary infections among close contacts and health care workers, preventing transmission amplification events, and preventing further international spread from China, (b) Identify, isolate and care for patients early, including providing optimized care for infected patients; (c) Identify and reduce transmission from the animal source; (d) Address crucial unknowns regarding clinical severity, extent of transmission and infection, treatment options.

4.1 Coronavirus Situation in Bangladesh

Coronavirus situation in Bangladesh is shown in the diagram in the Fig 06. The figure may slightly be changed when the readers read it since coronavirus infliction is changing every day.

(21.07.2020)

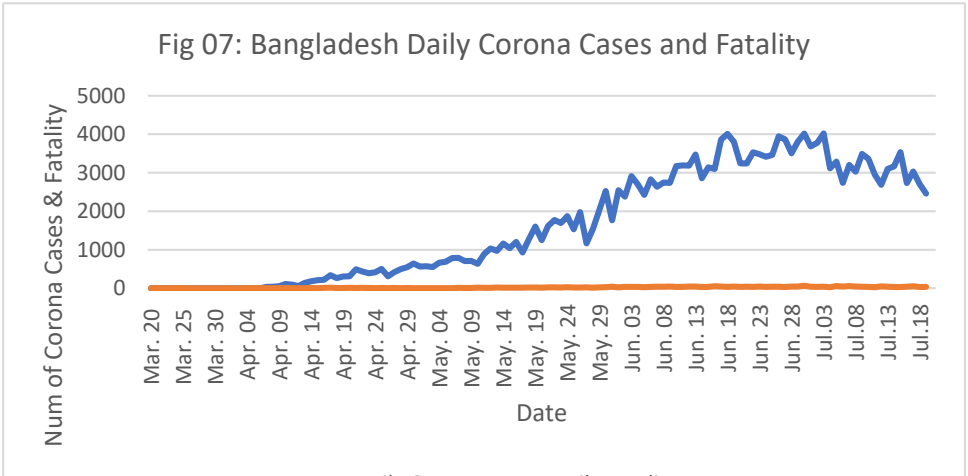
Fig 06: Coronavirus Cases



Source: Figures from worldometer; drawn by author

4.2 Coronavirus Cases Progression in Bangladesh

Coronavirus appeared around 23 January 2020. But it appeared in Bangladesh a little later (20 March 2020). Progression of deaths/fatality is following almost the same level. Cases are following very fast rate. There is a decreasing trend of the cases Fig 07.



Source: Basic figures from worldometer; drawn by author

4.3 Corona Models

The basic figures from worldometer; models developed, analyzed by author [08].

(a) Progression of Cases over Time

Model: Case = - 211.28 + 27.76 * day

R^2 = 0.71795; F = 9577; DF = 2, 116 sample size n = 119; count day 1 from Jan 23, 2020

Rate of increase is 27.75 per day. See also the table (Table 04).

(b) Progression of Fatality over Time

Model: Fatality = - 2.35527 + 0.3644 *day

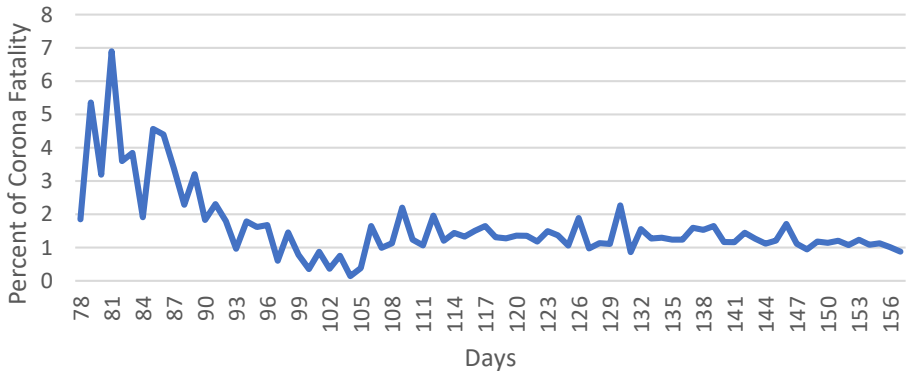
R^2 = 0.7409; DF = 2, 116, sample size n = 119

Rate of fatality is 0.36 per day. See also the table (Table 04).

(c) Proportion of Bangladesh and global in Corona Cases and Fatality

Plot of Bangladesh Corona Fatality as percentage of Corona cases is shown in Fig 08. Notice the decreasing trend in the proportion (percentage).

Fig 08: Percent of Fatality of Cases against Time



Source: Basic figures from worldometer [09]; drawn by author

Model: Percent of Fatality = 4.49282 – 0.02434 * day

R^2 = 0.2411; F = 46.19 ($F_{0.05, 2, 80}$ = 2.99)

Count day 1 from 23 January, 2020

Rate of decrease of percent fatality is 0.024.
Note with importance that the percent fatality is decreasing. This means that overall the intensity of fatality is decreasing.

(d) Combined Cases and Fatality

Please see Table 04 in which Bangladesh Coronavirus Cases and Fatality are plotted as percentage.

Table 04: Coronavirus Parameters in Bangladesh.

Sl. No.	Model	Bangladesh	Global
1	Rate of Progression of Corona Cases over Time; number/day	27.76	1069.15
2	Rate of Progression of Corona Fatality over Time; number/day	0.36	42.016
3	Decrease of percent of Proportion of Corona Fatality (percent)	0.02434	0.06336972
4	Rate of Increase of Per Capita CO2 Emission (metric ton/capita/year)	0.00985415	0.011557

5 The Missing Link

There was a confusion whether there is any link between environmental pollution and coronavirus. By now some studies have been made on the subject. One such study is done by Harvard University. The report says that even a small increase in air pollution can make the coronavirus more deadly, according to new research from Harvard University.

The report, which awaits peer review, looked at air pollution and COVID-19 deaths in 3,000 United States counties. The nationwide study concluded that just a single microgram per cubic meter increase in the common air pollutant PM2.5 can increase the death rate COVID-19 by 15%. Dario Caro, Environmental Scientist from the Aarhus University who said about how poor air quality can worsen the effects of the virus. He says, 'There is a link between air pollution in Italy and coronavirus death toll [10].

Dario Caro, Environmental Scientist from the Aarhus University who said about how poor air quality can worsen the effects of the virus. He says, 'There is a link between air pollution in Italy and coronavirus death toll'.

A new study on the update of 21 April 2020 further confirms the link between the mortality rate of COVID-19 and air pollution**.** Carried out by Yaron Ogen, a scientist from the Martin Luther University Halle-Wittenberg in Germany, it was just published in the journal Science of the Total Environment.

The study analyzed ESA satellite data on air pollution (NO2 levels) and air currents in Italy, France, Spain, and Germany with confirmed deaths related to COVID-19. There were 4,443 fatalities in these countries due to COVID-19 by March 19, 2020. Most fatalities (83%) occurred in regions where NO2 levels were high. 15.5% of the fatalities occurred where pollution was "mid-level" and only 1.5% where it was considered low.

They said, there is no question that air pollution is a major factor that needs to be taken into consideration. It is indisputable that chronic air pollution, with peaks of concentration of fine dust and other pollutants, is a worsening factor in cases of epidemics. Air pollution acts in two ways: as a vehicle that amplifies the spread of the virus and as a chronic stress factor that makes the population more vulnerable to an epidemic, even if it is not possible, as in the Italian case, to establish by how much. (Ref: Claude ..)

These are some of evidences of the link between the two. By now there are more evidences.

5.1 Deaths Scenario in Bangladesh

Impact, Economic Impact, Injustice, and Solutions Pollution in the air, water and soil was responsible for 26.6% of all deaths in Bangladesh.

981,203 total deaths in Bangladesh in 2015. This is 100%.

Environmental death of total deaths is 26.6%, means 261,000 number.

Total Corona Deaths is 2,618. This is 0.27% of all deaths.

Impact, Economic Impact, Injustice, and Solutions Pollution in the air, water and soil was responsible for 26.62% of all deaths in Bangladesh (Table 05).

Table 05: Deaths Scenario in Bangladesh

Item	Number	Percentage
Environmental Deaths	261,000	26.62
Water & Related Pollution Deaths	83,325	8.50
Arsenic Contamination Deaths	42,720	4.30
Corona Deaths	2,618	0.27
Other Deaths	590,631	60.25
Total	980,294	100.00

Source: author

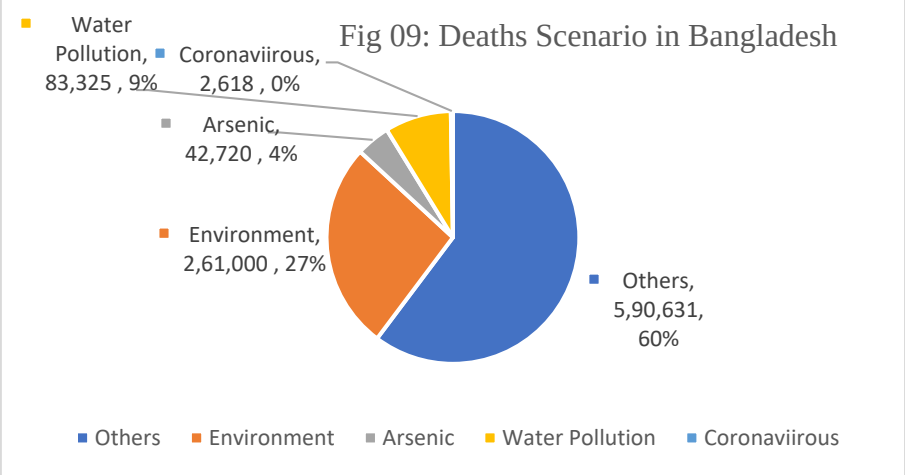


Fig 09: Deaths Scenario in Bangladesh

Source: drawn by author

6 Conclusions and Recommendations

Like other global countries, Bangladesh also created a pandemic over Coronavirus. As on July 21, a total of 210,510 persons were inflicted by Coronavirus in Bangladesh. Total fatality was 4.88%. A couple of statistical models regarding different aspects of Coronavirus have been developed. One model shows the percentage of fatality of all coronavirus cases is decreasing over the months.

All attributes of environmental pollutions in Bangladesh are deteriorating making the people increased vulnerable to pollution effects. Some of the items are fossil fuel consumption, CO2 emission, arsenic contamination, wastes disposal etc.

There is one good aspect. This is life expectancy. The life expectancy of the people of Bangladesh has been increasing consistently.

There is another very good aspect. The death rate of the people here. The historical death rates in Bangladesh for the last 70 years has been decreasing. See Fig, … appearing hereafter. The death rate was 26.04 persons per 1000 population in 1951. This rate decreased to 5.54 persons per 1000 people in 2020. This is a remarkable.

It is postulated that there is a connection between coronavirus and environmental pollution. Coronavirus develops and spreads out of environmental pollution. Places with poor environmental condition, are places for higher coronavirus development and spread.

Table 06: Summary Table

Sl No.	Items	World	Bangladesh	% (B/W)
1	Population (million)	7,800	161.4	2.07
2	Population Density (per km^2)	14.7	1,115.55	7588.78
3	Environmental Deaths (WHO) (persons/day)	34,588	1902	5.50
4	Corona Cases (persons/day)	113,387	1,596	1.41
5	Corona Cases Density (Cases/million)	1,788	1,216	68.03
6	Corona Deaths (persons/day)	4,819	20	0.42
7	Corona Deaths Density (no./million)	76	15	20.35
8	Overall Air Pollution Deaths (persons/day)	19,178	337	1.76

Source: author

The environmental deaths rate is 715 persons per day in Bangladesh. The coronavirus deaths rate is 7 persons per day. Please see Fig … The environmental death rate is 102 times the coronavirus death rate. This suggests drastic actions to control environmental pollution.

Bangladesh is for those who are living here. It should be the prime principle to protect their lives.

The efforts and energy already put in place to combat the coronavirus will continue. But there must be a jump on the control of the environmental pollution.

Death scenario in Bangladesh is depicted in table. …Highest percentage of deaths occurs due to environmental pollution at 26.62%.

Even a small increase in air pollution can make the coronavirus more deadly, according to new research from Harvard University.

The report, which awaits peer review, looked at air pollution and COVID-19 deaths in 3,000 United States counties. The nationwide study concluded that just a single microgram per cubic meter increase in the common air pollutant PM2.5 can increase the death rate COVID-19 by 15%.

References

[01] Brilliant & Company. Follow. Apr 17 · 4 min read, The Deadly Link Between COVID-19 and Air Pollution, medium.com,

[02] World Health Organization, Global Health Estimates (GHE), Health statistics and information systems.

[03] Brilliant & Company, The Deadly Link Between COVID-19 and Air Pollution

[04] UN – Water, 2013, Aug 2, 2019, Water pollution in Bangladesh and its impact on public health, www. ncbi.nlm.nih.gov › pmc › articles>PMC6684462).

[05] World Health Organization, Arsenic in tube well water in Bangladesh: health and economic impacts and implications for arsenic mitigation, Bulletin of the World Health Organization, Volume 90, Number 11, November 2012, 839-846.

[06] Scoop Health, Saturday, 18 April 2020, 7:52 am, Press Release: Earth Day, Study Links Air Pollution to Higher Coronavirus Death Rates

[07] Mokaddes, M. A. A., B. S. Nahar1and M.A. Baten, Status of Heavy Metal Contaminations of River Water of Dhaka Metropolitan City, 349J. Environ. Sci. & Natural Resources,5(2): 349-353, 2013.

[08] Miah, Md. Abdul Quader. Applied Statistics for Social and Management Sciences, Springer, Singapore, 2017

[09] Worldometer COVID-19 Data, WORLDOMETER, COVID-19 Coronavirus Pandemic, https://www.worldometers.info

[10] Dominici PhD, Department of Biostatistics, Harvard T.H. Chan School of Public Heath, Boston, MA, 02115, USA, Coronavirus: Study links air pollution to higher coronavirus death rates). April 10, 2020.

[10] Forthomme, Claude, Senior Editor, COVID-19: Link with Air Pollution? Italy's and China's Experience.

[11] Waste Concern, Bangladesh Waste Database 2014, Web: www.wasteconcern.org

[12] United States Environment Protection Agency, www.epa.gov>clean-air-act-overview> evolution-clean-air Clean Air Act of 1963

[13] Ahsan, Syed Nazmul, State of Water Pollution from Industrial Effluents in Bangladesh, Department of Environment, 05 May 2019, Dhaka

[14] Susan Marcott, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Arsenic Contamination in the World, 2012.)