

Industrial pollution and its effect in the context of Bangladesh

Anindita Saha ¹, George R. Engelhardt ², Digby D. Macdonald ³ and Ruhul A. Khan ^{1,*}

¹ *Water Analysis Laboratory, Institute of Radiation and Polymer Technology, Bangladesh Atomic Energy Commission, Savar, Dhaka 1000, Bangladesh.*

² *OLI Systems, Morris Plains, New Jersey 07950-2443, USA.*

³ *Departments of Nuclear Engineering and Materials Science and Engineering, University of California at Berkeley, Berkeley, California 94720, USA.*

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Abstract

In recent times, Bangladesh has experienced increased environmental degradation in general, particularly industrial pollution. The effect of industrial pollution is huge and the country is affected badly in a socio-economic way. This article emphasizes the problem of industrial pollution with regard to the present status of the environment in Bangladesh. It contains a summary of the country's major environmental problems, a compilation of varied information on industrial pollution, and its effects. In the end, this article gives a silver lining on the magnitude of the problem and strategies for handling industrial waste management in an environment-friendly way.

Keywords: Industrial Pollution; Environment; Bangladesh; Wastewater; Waste management

1. Introduction

Industrialization started in Bangladesh during the 1950s with the establishment of jute, cotton, and sugar-based industries. In the late 1970s, industrialization increased rapidly driven primarily by the garments industry. Several government initiatives were also undertaken to promote industrial growth, including the establishment of industrial estates and export processing zones. By late 1990, around 60 industrial estates and two export processing zones were established. Growth was particularly marked in the garments sector. It was reported that huge growth in the garments industry sector happened after 1990 and reached more than four thousand enterprises in 2005. And now, Bangladesh's Economic growth improves as the industry sector employs a larger share of employment, providing for almost 21.32% of overall employment in 2019 [1-3].

Though the industrial sector has a huge contribution to economic development, unplanned rapid industrialization is bringing out adverse impacts on natural resources. Bangladesh loses 8000 ha. of farmland annually due to rapid urbanization, industrialization, unanticipated rural housing, and infrastructure development. Industrialization is one of the main reasons for environmental pollution and industrial pollution is wreaking havoc on the environment, destroying natural resources. Natural and anthropogenic practices are increasingly depleting resources, which is alarming [4-5]. Bangladesh spotted 1st position among the most polluted countries with a PM2.5 reading of 83.30 micrograms per cubic meter and Dhaka ranked 21st position among the most polluted cities in 2019 [6].

From a pollution point of view, dyeing, leather, sugar, pulp, and paper industries are the major contributors. Non-renewable local resource-based industries include industries based on mineral resources such as limestone, hard rock, gravel, glass, sand, and various types of clays. In this category, major polluters are the cement and fertilizer factories.

* Corresponding author: Ruhul A. Khan

Imported resource-based industries include textiles, pharmaceuticals, plastics, petroleum, and metal works. Many of these are found to be highly polluting.



Figure 1 Scenario of industrial pollution in Bangladesh

The EIA report on ship-breaking industries found a negative effect on abiotic and biotic factors which included soil quality, soil fertility, air quality, water quality, vegetation coverage, animal life, forest, and biodiversity. Limitations of resources, absence of interagency coordination, and lack of monitored regulation are determined as constraints of administration, resulting in continued pollution [7-10].

Above, this article focuses on the problem of industrial pollution in relation to the present environmental scenario in Bangladesh. It reviews the existing information on the issue in order to shed light on the magnitude of the problem and strategies for handling the crisis including their limitations. The discussion is opened by presenting a summary of the country’s major environmental problems. It also briefly analyzes industrial approaches to combat industrial pollution in Bangladesh. Finally, we look at some heartening recent strategies to encounter environmental problems, especially industrial pollution and furnish some suggestions.

2. Types of Industries in Bangladesh

Industrialization is an essential prerequisite for the rapid economic growth of a developing country like Bangladesh. There are various industries in Bangladesh including garments, chemical, pharmaceutical, leather, fertilizer, cement, tannery, and food. The growth rate of industries is on average 6- 10%. Chemical and pharmaceutical, power, food and allied industries have a major share in numbers as shown in figure.2.

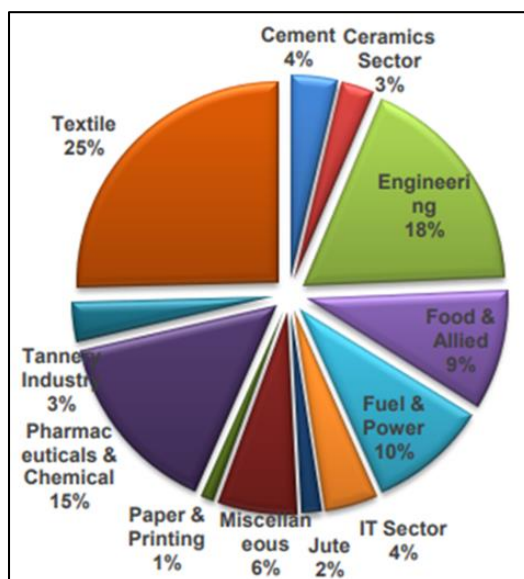


Figure 2 Percentage of Industrial sectors in Bangladesh. (Source: Bangladesh National accounts Blue Book 2016)

Industrialization is a better solution to economic development for a highly populated country like Bangladesh. So, the economic policy has been changing from agriculture to industrial sectors in the last few years [11-13]. The growth rate of the industry in the different sectors is quite satisfactory. Bangladesh aims to become a middle-income country by 2021 for its rapid economic growth in recent times. The textile sector has contributed 82% of the country’s total export revenue [1].

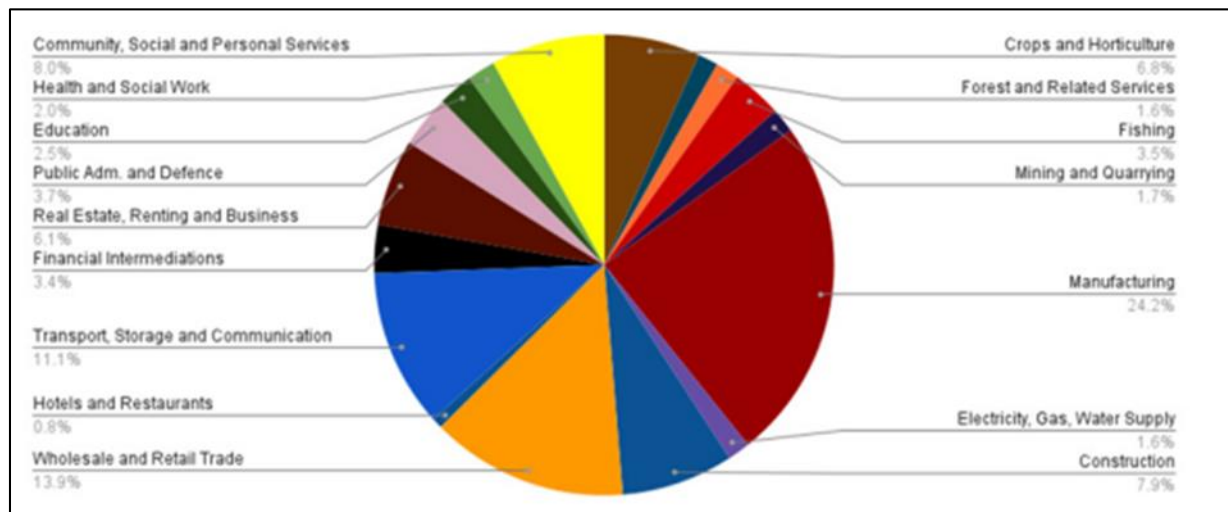


Figure 3 Sectoral contribution to GDP (Source: RUBA et al., Current World Environment, Vol. 16-2:348-361, 2021)

2.1. Pollution Caused by the Industrial Wastes

Though industrialization plays a significant role in the development of Bangladesh, it has also brought with it a range of problems. The industries tend to be clustered together and are highly polluting. As a consequence of their rapid and largely unregulated development, many aquatic ecosystems are now under threat, and with them the livelihood systems of local people [14,15]. Some major pollution caused by industrial sectors in Bangladesh are discussed below:

2.2. Water Pollution

Water is the most vital element among natural resources and is crucial for the survival of all living organisms including humans, for food production and economic development. Water quality depends on effluent types and discharge quantity from different types of industries, types of agrochemicals used in agriculture, and seasonal water flow and dilution capability by the river system [16,17].

The water quality of rivers has been seriously affected by the dumping of municipal solid waste, the direct connection of sewerage lines, and toxic industrial discharge [18].

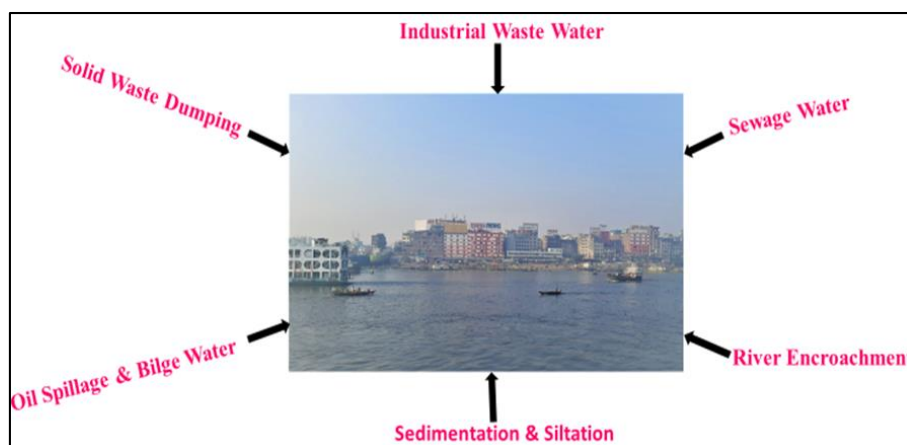


Figure 4 Major sources of water pollution

Major sources of water pollution are shown in figure 4. For example, Water pollution in the Buriganga river is at its highest level now. The most significant source of pollution appears to be an industrial and urban waste. In the dry season, the dissolved oxygen level becomes very low and the river water becomes toxic. Most importantly, the quality of the Buriganga river water has continuously been deteriorating. Due to severe water pollution problems, Buriganga is under threat of becoming a dead river in the future. Therefore, immediately necessary measures should take to save the life of the river Buriganga [19-21]. In figure 5, the scenario of water pollution in the Buriganga river is shown.



Figure 5 Water pollution in Buriganga river, Dhaka, Bangladesh

Industrialization coupled with urbanization has caused an excess release of wastewater, putting aquatic lives in immense harm. Heavy metals, pesticides, hydrocarbons, organic waste, pathogens, fertilizers, and new pollutants are polluting freshwater resources. More than 80% of wastewater in the world is dumped into the environment untreated. **Figure 6.** summarizes the water pollution load of ten major water-polluting industries. It shows that the water pollution load from the textile industry is approximately one-third of that of the food processing industry [22].

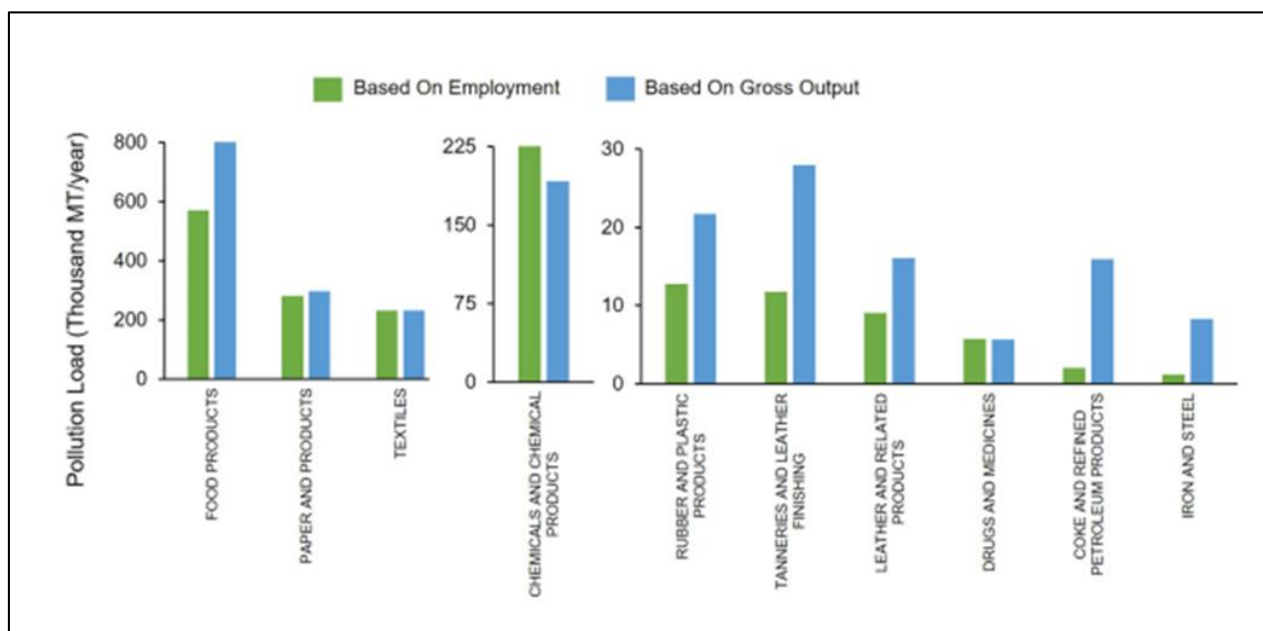


Figure 6 Establishing the accuracy of pollution load of major water-polluting industries

Water is presently contaminated by heavy metals from dyeing industries and oil spills from ship braking industries and ongoing vessels [10]. Rapid industrialization dramatically impacts emerging nations, resulting in huge economic and health losses due to toxicological effects on persons and the environment from air, water, and soil pollution. Around 70% of the wastewater that high-income nations produce is treated, compared to 38% in middle-income countries and 28% in lower-middle-income countries. Wastewater is mostly generated in the urban and industrial sectors, with additional sources including urban runoff, agricultural runoff, mining operations, landfill leachate, municipal, and energy generation. Hazardous organic components in wastewater include persistent organic contaminants, hydrocarbons, chlorinated solvents, PCBs, and volatile organic compounds [23-25].

2.3. Air Pollution

Ambient air pollution puts everyone at risk, from a child to the elderly. From 2018 to 2021, Dhaka was ranked as the second most polluted city in the world. In 2019, air pollution was the second largest cause of deaths and disability in Bangladesh and cost about 3.9 to 4.4% of the country's GDP," said the acting World Bank Country Director for Bangladesh and Bhutan, Dandan Chen [26].

Industrial exposures were identified as the major cause of air pollution in Bangladesh. The brick kiln industry, cement, steel, rice mill, and glass factory are regarded as major influential contributors to air pollution [27-29]. The relative contribution in the percentage of air pollution into the environment is presented in **Figure 7**. It can be seen that the top three air-polluting industries (brick industry, cement, lime, and plaster industry, and iron and steel industry) are responsible for almost 82–89% of the total air pollution in Bangladesh [22].

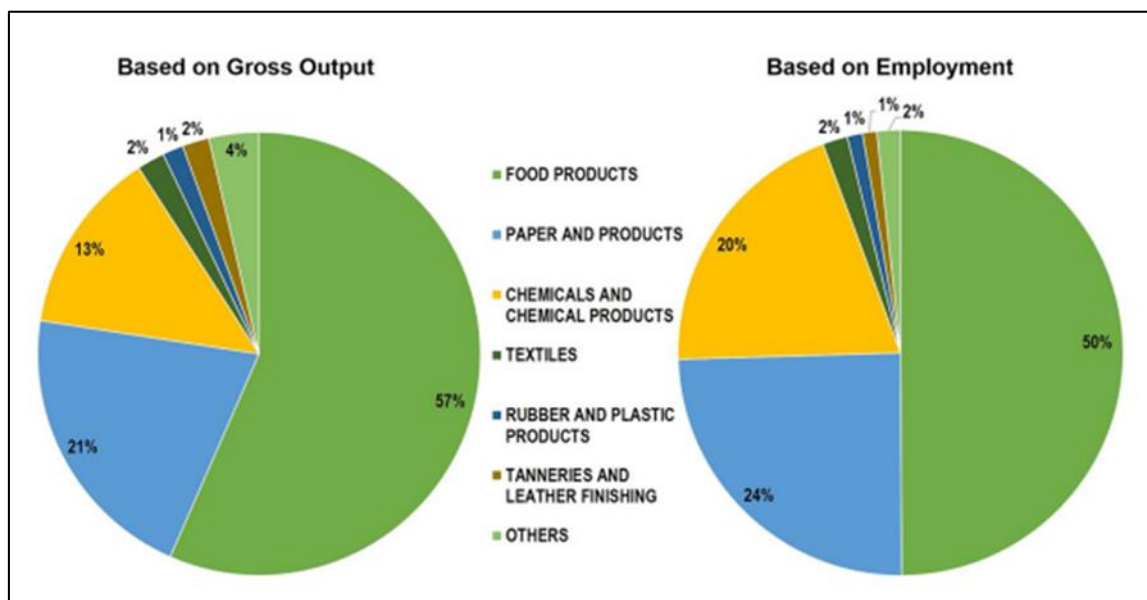


Figure 7 Relative contribution of different industries to air pollution

Industrial development is another major source of air pollution. Most of the industries in Bangladesh are situated in major urban areas. The food industry emits the maximum number of pollutants followed by cement, pulp and paper industry, and textile. In the food industry, most of the pollutants come from sugar mills. Pollution of air, water, and land is caused mainly by pulp and paper, food, tannery, and leather industry where the food industry caused greater air pollution, and sugar, mill, and oil factories contributed to pollutant emissions in the air. Hence, 81% of hazardous chemical emissions would end up in the air [30,31].

2.4. Soil pollution

Industrial development has outpaced agricultural growth, and it generates heavy metalloids and solid waste, and environmental deterioration. Heavy metals released into the soil by factories pose a significant danger to the atmosphere, as soil toxicity and pollution result from rapid industrial activity. Heavy metal deposition in farm soils is closely related to industrial wastewater used for irrigation. Although the readymade garments industry contributed significantly to the growth of nearby areas, the inadequate amenities and facilities exacerbated the problem [32-34]. The ascendant order of metallic concentration ($Fe > Zn > Ni > Cr > Pb > Cu > Cd$) was found in arable soil where Cd content in soil surpassed the allowable limit around industrial localities [35]. In agricultural soil near DEPZ, a great proportion of As, Fe, Hg, Mn, and Zn was observed in the dry season, and As, Fe, Mn, Zn, and Hg were determined in the wet season. N, P, and K were observed to be lower on rice plants that were planted on contaminated soil, indicating a significant negative effect on soil and plant growth. Heavy metalloids are responsible for entering into the ecosystem and deteriorating human health, the wild, and the bio environment [36].

3. Effects on the Environment & Human Health

The availability of heavy metals in river water directly affects fish physiology and consumption ultimately affects human health. The presence of heavy metals in the aquatic environment is of major concern because of their heavy toxicity, and bio-accumulating tendency in the biota. Pollution by heavy metals is a threat to human life and the entire environment as well as the wetland ecosystem [37-39].

Contaminated water is not suitable for household uses and possibly hazardous to many aquatic animals and human health. *Salmonella* spp. concentrations found in water and soil samples exceed the standard level both in water and soil which indicates contaminated water is unsuitable for drinking or for even washing without appropriate water treatment for humans [40]. In figure 8, the percentage of environmental health risks caused by different types of industrial pollution is shown.

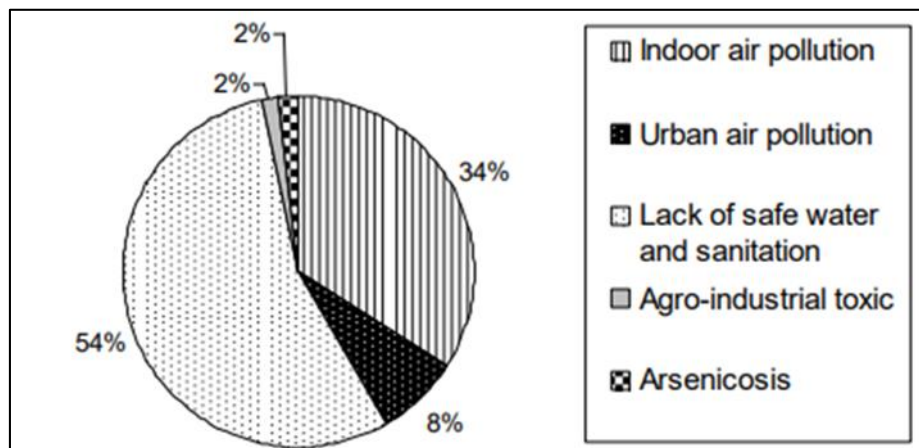


Figure 8 Percentage of environmental health risks

Escherichia coli and *Staphylococcus* causes abdominal cramping, and water-borne diseases like diarrhea, fever, nausea, and vomiting [41]. Long-term consumption of fish may have a negative impact on human health [42]. The toxic chemical pollutants like Hg, Pb, Cd, COC, and DO were found higher than the EQS value which is dangerous for the entire aquatic ecosystem and public health. Excessive discharge of nitrogen, sulfur, and phosphorus compounds in the water system can cause eutrophication. The presence of NO₃ - in natural water is associated with ecological and health hazards, excess NO₃ - in human food and animal feed has adverse impacts, and in human health, it causes methemoglobinemia cancer (child cancer), and respiratory illness. Excess NO₃ - pollute water causing eutrophication [43,44].

Syed Nazmul Ahsan, 2019 stated that a qualitative assessment found three major types of diseases appeared to be highly correlated with industrial water pollution. These are skin diseases, diarrhea, and dysentery. Also, 20 types of illness were identified due to industrial pollution. It affirmed that these types of illnesses have been increasing in the last 10 years [45]. Abu Naser Zafar Ullah et al. (Human Health and Industrial Pollution in Bangladesh, Kaliakoir, Gazipur) reported that skin problems, allergic conditions, itching, and other skin lesions are contact-type diseases. Research has shown that the Khal and beel are generally alkalies, which is likely to be attributable to the extensive use of the alkalis soda ash and caustic soda in the textile dyeing industry. This alkalinity is likely to be a key factor in the skin irritations reported by local communities as they reported that the symptoms manifest themselves when their skin has come into physical contact with beel water or sediment. The pollutants from industries are responsible for it. Pollutants from industries enter in the River through the Khal and beel and end up here [46].

Both short and long-term exposure to high levels of air pollution increases the risk of respiratory infection, heart disease, and lung cancer. Children, the elderly, the already ill, and poor people are more susceptible. Long-time exposure to ambient particulate matter accounts for 62% of all pollution-attributable deaths and 55% of Disability Adjusted Life Years. Air pollution causes the third-highest risk of premature death in the South East Asian region, including Bangladesh. Another report stated that in Bangladesh, 123,000 deaths were related to household and ambient air pollution in 2017 and 173,500 in 2019. Five diseases, namely lung cancer 13%, lower respiratory tract infection 7%, chronic obstructive pulmonary diseases 7%, ischemic heart disease 6%, and stroke 5% are attributable to air pollution among the top 10 diseases of death in Bangladesh. Eco-Social Development Organization, an action-research

conservation NGO in Bangladesh, reported in 2019, at least 200,000 people in Bangladesh might have died because of long-term exposure to polluted air [47-51].

4. Future Development

Bangladesh has achieved several milestones in the environmental sector despite the hardship of poverty, resource scarcity, overpopulation, corruption, and natural calamities. Achievements ranged from the incorporation of environmental concerns in sectoral policy formulation to benchmarking success at the field level. Like any other country, achieving environmentally sound development has emerged as the greatest challenge for Bangladesh. Integration of environmental issues and concerns into development processes should be a prime concern for Bangladesh. The growth of the country must be based on the principle of sustainable development. Economic growth and environmental sustainability should be treated as mutually interdependent aspects to improve the well-being of the nation.

In order to improve the situation, interventions both at the national and local levels are required. The implementation of legislation on safety precautions, and banning toxic chemicals and pollutant concentrations in industrial discharges into water sources are all required. Currently, most dyeing units across Bangladesh are in breach of the Environmental Conservation Act. However, the Department of Environmental due to financial, human, and political reasons does not act. An Information, Education, and Communication campaign would be beneficial in providing an understanding in the community about risks and possible ways to minimize them and to inform the people of Bangladesh public of the problems. It should be mandatory for all textile and dyeing industries to adopt more efficient production options. It also should be mandatory that industries construct and then regularly and efficiently operate their Effluent Treatment Plants (ETPs) and monitor their effluents to keep them within the standards set by law [52-54]

A policy brief of the MACH (Management of Aquatic Ecosystems through Community Husbandry) project titled Industrial Pollution and its Threat to Wetlands in Bangladesh reported that Textile industries increased 8-fold in 3 years in the Turag-Bangshi catchment. Few are functioning ETPs that they are required to have by law. It also suggested that flow segregation and optimization of chemical dosing can reduce the operating cost of ETP.

Then continuous monitoring is necessary to evaluate air quality and for the development plan to mitigate the health risk from air pollution. DoE has set up 4 monitoring stations at four divisional towns namely, Dhaka, Khulna, Chittagong, and Bogra. More stringent enforcement to reduce air pollution is required. Industrial waste management should include monitoring carbon exposure, market-based reward governance, recycling, and green technology adaptation [55,56].

In protecting the environment and controlling industrial pollution, the following measures may be suggested: introduction of greener technologies and waste energy recovery systems, provision of incentives for retrofitting, reduction of industrial processes responsible for 'greenhouse' gas emission, relocation of obnoxious industries like tanneries which are located in densely populated areas, identification and design of environmental norms, setting up quality standards and enforcement of those to regulate industrial emissions [31].

Increased awareness among industrialists about the pollution problem and their legal and social responsibility is necessary to prevent industrial pollution. Moreover, International buyers have a key role in influencing the industry, they need to be influenced to adopt environmental codes of conduct and then enforce them on their supplying industries. Most importantly, Bangladesh trade bodies should change their role and set environmental conditions for membership, for example, they could cancel the membership of companies that fail to install and operate properly ETPs. Finally, Government departments especially the Department of Environment (DOE), industrial associations and chambers, research institutions, international buyers, non-governmental organizations, and legal experts need to work together to develop a framework and modalities of implementation for improved environmental governance [57-59].

5. Conclusion

Among a series of alarming environmental problems, industrial pollution has been identified to be one of the most notorious and fatal environmental hazards for Bangladesh. Though the industrial sector now makes a significant contribution toward the Gross Domestic Product (GDP) of the country, we cannot ignore the pollution that occurred in our industry sector. Bangladesh will face the imminent risk of an environmental catastrophe if the rate and magnitude of industrial pollution cannot be controlled properly. In conclusion, this article has attempted to offer an overview of the problem of industrial pollution and how it affects the environment and socio-economic life of Bangladesh. This review also addresses the strategies and recommendations to minimize the problem.

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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