ANALYSIS OF THE HISTORICAL TREND OF ENVIRONMENTAL FINES FOR CURBING POLLUTION IN BANGLADESH

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(B.Sc in Civil Engg, MIST)

A THESIS SUBMITTED
FOR THE DEGREE OF MSc IN ENVIRONMENTAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING
MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

2021

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I hereby declare that this thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information that have been used in the thesis.

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25 February 2021

ABSTRACT

Various industrial sectors of Bangladesh are growing rapidly and contributing to the economic development in recent years. Effluents and emissions of these factories pollute the surrounding environment repeatedly even though the Department of Environment (DoE) monitor the pollution standards and enforce strict compliance of the pollution control measures. An exploratory analysis was carried out on water pollution of Bangladesh focusing on the geographical representation of environmental fines, the difference of fines for the textile sector from fines of other sectors, the similarity of violations, and measures for repeat offenders. This study evaluated whether punitive measures were causing any changes in polluters' behavior to comply with existing regulations and concluded that the environmental fines imposed by DoE were arbitrary. However, the data was sampled from newspaper-reported sources and may not represent the holistic nature of the problem. It is imperative to evaluate the enforcement measures, the number of fines of offenders, and the distribution of fines by analyzing authentic historical data from DoE for a significant period. The objectives of this empirical study are to analyze the current and historical trend of pollution fines, assess the deterrence created by fines, and determine the effectiveness of the Polluters Pay Principle (PPP) in Bangladesh. Data on fines from 2010 to 2018 was collected from the DoE. SPSS, a standard statistical software package, was used to prepare the database for conducting analysis. Standard descriptive statistics (mean, median, percentiles, and quartiles) were used to characterize the environmental fine data. t-tests were applied to assess the differences in fines between different groups (sectors, type of violation, etc). Analysis of means and variances for different groups were carried out to determine the disparities in levied fines. The historical trends of fines were assessed using time-series analysis. After performing the relevant statistical tests, analysis of the test

results was carried out and presented in graphical and tabular form. Critical analysis and comparison with standards were carried out to provide policy guidelines. Data of fines vary significantly. A large difference was observed between mean and median, minimum and maximum fines along with their standard deviations indicating the arbitrariness of imposing fines. Industries like Textile and fabrics, Real estate and construction, Brick Kiln and Other Private organizations were fined maximum times (i.e. 78%). Industries of Dhaka Division have experienced the maximum cases of violations (79%) and therefore needs a separate enforcement strategy. Textile and non-textile factories were fined differently, but effective enforcement could not be achieved. Time series analysis for the type of factories and violation across the observation period projects an irregular pattern. Violations in subsequent years do not portray the effectiveness of the enforcement measures. There was no difference in fines for all types of repeat offenders. Therefore, deterrence could not be achieved. Modification of the traditional enforcement system or adoption of alternative regulatory strategies is needed. PPP is partially implemented in Bangladesh. Revision of traditional monitoring, enforcement systems and alternative regulatory strategies may be adopted. Frequent monitoring and enforcement strategy for Textile factories should be continued by DOE. Textiles industries must have functional ETPs. Repeat offenders should be penalized differently to achieve deterrence. PPP should be effectively applied in Bangladesh like other countries. Revision of policy guidelines and strengthening with required manpower will enable DoE to implement PPP effectively.

ACKNOWLEDGEMENT

All praises to Almighty Allah. At the outset, I would like to express my sincere gratitude to my thesis Supervisor Professor Dr Tanvir Ahmed for the continuous guidance. He has been supervising throughout the research period with thoughtful guidance with his scholarly knowledge and keen attention. I am grateful to my parents and my spouse, who have provided moral and emotional support. I express my gratitude to my Co-Supervisor Professor Dr Md Tauhid Ur Rahman for his valuable guidance during the research.

I thank the Director General, DoE for providing the data on pollution fines and Mr Qumrul Hasan, a Student of BUET for his support to prepare the data and statistical analysis. I also like to thank Lieutenant Colonel Mohammad Russedul Islam, PhD, and Major Chowdhury Mohammad Toufiq Amin of MIST for the necessary coordination and support during the research.

Mohammad Osman Sarwar

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ABBREVIATIONS

AQMS	Air Quality Monitoring Stations
BEISP	Bangladesh Environmental Institutional Strengthening Project
BOD	Biochemical Oxygen demand
CEMS	Continuous Emission Monitoring System
CPCB	Central Pollution Control Board
CI	Confidence Interval
DF	Degree of Freedom
DO	Dissolved Oxygen
DoE	Department of Environment
ECA	Environmental Conservation Act
ECR	Environmental Conservation Rules
EIA	Environmental Impact Assessment
EPB	Environmental Protection Bureaus
ETP	Effluent Treatment Plant
ITLOS	International Tribunal on Law of the Sea
MLSS	Mixed Liquor Suspended Solids
MOU	Memorandum of Understanding
MRT	Mobile Rugged Tablets
NCC	National Coordinating Committee
NEP	National Environmental Policy
NEMAP	National Environmental Management Plan
OECD	Organization of Environmental Cooperation and Development
PEPA	Pakistan Environmental Protection Act
PPP	Polluter Pays Principle
SPCB	State Pollution Control Board
UOI	Union of India
WHO	World Health Organization
WTO	World Trade Organization

CHAPTER 1
INTRODUCTION

1.1 Background

Maintaining a sustained economic growth led by industrialization, Bangladesh aspires to become an upper-middle-income country in near future. Many industries and structures associated with unplanned urbanization have been built in past years. The rapid industrial growth and urbanization have a high environmental impact that is increasingly harming the prospect of overall economic growth and healthy living [1]. According to the Environmental Performance Index 2020, the position of Bangladesh is 162 out of 180 countries, indicating the alarming condition of the environment [2]. Presently, the DO level of the Buriganga River is less than 3 mg/l (Wet season) where the standard level should be 4-5 mg/l; BOD level is 12-55 mg/l and the standard level is 3-6 mg/l [2]. The annual $PM_{2.5}$ concentration of Dhaka is estimated at 83.3µg/m^3 for 2019 and Bangladesh had the worst air quality in the world in 2019 [3]. Disease caused by pollution was responsible for 28% of all deaths in Bangladesh in 2015 which was the highest in South Asia [1]. If this pollution continues, the population will become unhealthy and the progressive economy will be seriously hampered. Hence, prevention of pollution should be a priority if Bangladesh desires to continue industrialization and urbanization with required economic growth.

According to the Polluter Pays Principle (PPP), the polluter bears the costs of pollution and control measures, which are decided by the public authorities. Since 1972, the principle is being followed in many countries of the world [2]. It is adopted and implemented in different countries, such as China, India, Pakistan, etc [4,5]. Bangladesh has also incorporated the PPP and implemented it through various enforcement measures [6]. Bangladesh's policy and regulatory framework to control environmental pollution have

been improving gradually. The 1992 National Environmental Policy was the first environmental policy in Bangladesh and it was updated in 2018. In 1995, Environmental Conservation Act 1995 (ECA 1995), the first environmental law of Bangladesh and in 1997 Environmental Conservation Rules 1997 (ECR 1997) were enacted to strengthen the regulatory framework. From the beginning, 25 acts, policies, guidelines, and regulations have been prepared to ensure effective control of environmental pollution [1]. But the policy and regulatory framework could not effectively govern the environmental performance in Bangladesh.

Act, policy, and regulations will never be complete without proper implementation. Department of Environment (DoE) is the regulatory authority in Bangladesh and is mandated to implement the policies, rules, and regulations that are based on the Environmental Conservation Act 1995 (ECA 1995) and Environmental Conservation Rules 1997 (ECR 1997). Inspectors of DoE implement the rules and regulations related to enforcement through inspections and fining the factories (Article 4A, ECA 1995). But the manpower of DoE is not enough compared to the enormous task of its responsibility throughout the country; it needs 2000 manpower to monitor and enforce the rules but they have only 600 [7]. Their capacity is limited to carry out the required inspections to monitor the pollution and enforce the rules in the country. However, the policies and rules for enforcement may be evaluated for its effectiveness over a period, which may bring fruitful findings to prevent pollution with the existing scenario of DoE and rapidly growing industrialization.

As a tool of enforcement, DoE levies fines to the polluting factories during the inspection. It is difficult to keep the record and organize the data due to the shortage of manpower in DoE. There are researches on enforcement that were carried out on the data collected from print and electronic media. In this study, data of fines for various factories

around the country from 2010 to 2018 was collected from DoE. Fines levied for the violations is analyzed to find the trend of fines and effectiveness of the implementation of environmental rules and regulations.

The factories cause various types of violations that are responsible for pollution. DoE also penalizes the factories for these violations. Usually, the absence of Effluent Treatment Plant (ETP), faulty ETP or non-functional ETP are the major violations for factories causing water pollution. It is important to determine the effectiveness of the monitoring and enforcement activities of DoE to gradually reduce these violations. Factories causing violations may be grouped into different categories to identify the maximum violation and the effectiveness of monitoring and enforcement. In the rapidly growing economy, textile factories are generally causing maximum water pollution and brick kilns are responsible for air pollution. It is imperative to assess the effectiveness of policies and regulatory frameworks in the enforcement of pollution control in these factories.

DoE inspectors determine the fines for violations of the particular factory following a guideline, but sometimes the fines are levied arbitrarily. Analysis of fines for various factories and different violations during a considerable period will determine the arbitrariness of fines.

Fines levied for any violation is a measure to stop the violation. When levied fines are not effective the factories tend to repeat the violation. Repetition of violation is indicative of the in-effectiveness of the measure. Even if the factory is fined twice a year, for an average of BDT 10,00,000 (approx. US$120,000), it would be more economical to pay the fine rather than run a wastewater treatment plant[1]. Analysis of repetition of

violations in several years will indicate the ineffectiveness of the regulatory framework and policy.

Considering the important knowledge gap in enforcement effectiveness, a study was conducted on the structure of pollution fines based on the historical data from the period 2010-2018, which was collected from DoE's official database on fines.

1.2 Research Objectives

The objectives addressed in the study are as follows:

a. To analyze the current and historical trend of fines levied for environmental pollution across different industrial sectors, types of violations, and over different geographic locations using descriptive statistics.
b. To assess whether imposing fines acted as a deterrent for repeat offenders.
c. To determine the effectiveness of the application of the polluter pays principle in the context of Bangladesh.

1.3 Structure of the Thesis

The outcome of the study may help the policy-makers to set guidelines for enforcement measures and enforcing agencies to determine the adequacy of punitive actions against environmental pollution. It can also help enforcers to determine whether the current methodology for estimating fines is adequately safeguarding the environment or revision of the methods is warranted. The structure of the thesis is enumerated below:

a. Chapter 1 contains the introduction of the thesis which provides background of the study, objectives, scopes and structure of the thesis.
b. Chapter 2 contains the literature review which demonstrates how the research and methodology follow on from an impartial assessment of other learned work.

c. Chapter 3 explains in details the methodology and the key issues in implementation of the study.
d. Chapter 4 provides outcomes and observations of the significance of the tests and analysis.
e. Chapter 5 contains the conclusions and recommendations which provides an insight into the relative contributions of the work to the field of study.

CHAPTER 2

LITERATURE REVIEW

To curb pollution, fines are imposed by the Regulating Authority on polluting industries. The rules of imposing fines are mandated by the National Laws which are mostly enacted under the umbrella of internationally accepted principle; the Polluter Pays Principle (PPP). As the fine is one of the tools of enforcement, the effectiveness of the application of fines to control pollution is very important. Like other countries, Bangladesh has also adopted measures and set policies to curb pollution. The review on international practice, the effectiveness of enforcement by other countries, and the assessment of measures adopted by Bangladesh will provide significant background knowledge to achieve the objectives of the study. The monitoring of environmental pollution and enforcement of penalties in Bangladesh are also reviewed.

2.1 The Polluter Pays Principle

2.1.1 Historical Background

The Polluter Pays Principle (PPP) is an economic principle that makes the polluter liable to bear the costs and control measures of pollution. It was first mentioned in the recommendation of the Organization of Environmental Cooperation and Development (OECD) Conference on 26th May 1972 and reaffirmed in the recommendation on 14th November 1974. In 1992, PPP was laid down as Principle 16 of the UN Declaration on Environment and Development in Reo de Janeiro. The European Community took up the OECD recommendation in its first Environmental Action Program (1973-1976) and then included the recommendation on 3 March 1975 regarding cost allocation and action by public authorities on environmental matters. Since 1987 the principle has also been

preserved in the Treaty of the European Communities and numerous national legislation worldwide [8].

2.1.2 Functions

A polluter has to bear the costs of the administrative arrangements taken by the public authority to control and monitor the emission of pollutants. The damage caused by pollution should also be borne by the polluters. If the residual damage is found to cause damage to the environment, though the polluter has taken all measures to control and monitor the pollution, the polluter has to bear the cost of damage. In 1988, it was decided that the polluter should bear the cost of control for any accidental pollution also [9]. As a main function of the principle, the OECD recommendations specify the allocation "*of costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment*." The polluter should bear the expense of carrying out the measures "*decided by public authorities to ensure that the environment is in an acceptable state*" [9].

2.1.3 Impact

The application of PPP increases the cost of the goods which are produced by the factories polluting the environment. The clean-up cost increases the cost of production. Factory causing more pollution has to pay more. So the owners of the factories will try to reduce pollution. This cost internalization is part of international environmental law. It was recognized in Principle 16 of the 1992 United Nations Rio Declaration which said *"National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment"* [10].

2.1.4 PPP in International and National Laws

PPP is included in international and national laws; Helsinki Conventions for the protection of the Baltic Sea, WTO law, International Tribunal on Law of the Sea (ITLOS), etc. Referring to Article 38 of the Statute of the International Court of Justice, most of the nations have incorporated PPP in national legal orders for its increased acceptance [8].

2.1.5 Instruments to Implement PPP

Some of the instruments of PPP may be categorized as below: [11]

a. Command and Control Law
    (1) Licensing Procedure
    (2) Prohibitions
    (3) Emission Limit Values
    (4) Administrative Orders and Sanctions
b. Market-based Instruments
    (1) Subsidies/Feed-in Tariffs
    (2) Certificates
    (3) Tax Alleviations
    (4) Liability Rules
c. Soft Law
    (1) Voluntary Agreements
    (2) Environmental Management Systems (ISO 14001)
    (3) Labeling

2.1.6 Implementation of PPP in Different Countries

2.1.6.1 Implementation in China

PPP was adopted in 2013 and implemented in 2014 as Environmental Protection Law in China. Pollutant Discharge Fee was charged to enterprises and other liable entities through the law according to PPP. Under this law, an enterprise must purchase a 'Pollutant Emission License'; a discharge fee by polluters. This law was again modified in 2016 as Environmental Protection Tax Law; an Environmental Taxation System to include all responsible polluters to pay tax. The new system converts the volume of pollutants discharged by a polluter into 'Pollution Equivalent Number'. A conversion formula will convert the number into an indicator that will determine the tax according to the degree of pollution [4].

China has undergone five stages to materialize the policies for environmental protection. The fourth stage was 'From Point Source Treatment to Catchments and Regional Treatments: 1996- Present'. Point Source pollution is any single identifiable pollution including industrial pollution. The Government addressed 12 major pollutants by adopting PPP against the sources responsible for the pollution. Gradually, The Government shifted the focus on key catchments and regions and achieved the protection of the environment [12], [13].

2.1.6.2 Implementation of PPP in India

PPP has been developed gradually in India from the rule of 'absolute liability' where the court had directed polluters to pay a pollution fine which would be used to restore the living conditions and local environment of the affected place. Under Section 3 and Section 5 of The Environment (Protection) act 1986, the Court had the power to take measures according to PPP. However, PPP was not mentioned in any legislation until in the case of

'Vellore Citizens Welfare Forum v. Union of India (UOI) and Ors, where the PPP is governed under Article 48-(A) and Article 51-A(g) of the Constitution [5].

The Courts of India have applied PPP to make the polluter pay the damage caused by their actions in 2005 [14]. The objective was not only to punish the polluters but also to restore the damage to environment. In some cases, the Court had been firm on applying PPP even though the polluters were within the limit of the pollution. For the lack of enforcement by the Executives the pollution could not be controlled as per expectation and it appeared differently as 'Pay and pollute'. The situation demanded the need for criminal proceedings against the polluters. Pollution Control Board has imposed fines on offenders however they have been reluctant in taking action [5].

2.1.6.3 Implementation of PPP in Pakistan

The Government of Pakistan enacted The Pakistan Environmental Protection Act (PEPA) in 1997. Though PPP is not explicitly mentioned in PEPA, it included discharge standards, provision of discharge licenses, enforcements for polluters, etc which otherwise supports PPP. But Pakistan Environmental Protection Agency (Pak-EPA) could not implement the charges on polluters towards the end of the 1990s/2000s. But National Environmental Policy in 2005 did not include pollution charges as it could not resolve the ambiguity between finance charges and pollution abatement. The failure to implement PPP in Pakistan failed to effectively implement ETP in different industries [14].

2.1.6.4 Implementation of PPP in Bangladesh

Bangladesh is a signatory to the Rio declaration which enunciates the importance of PPP [6]. Bangladesh has also incorporated the PPP as the principle of international environmental law. The Bangladesh Environment Conservation Act, 1995 (ECA 1995) provides that the Director General of DoE can oblige a person to pay where such person is

responsible directly or indirectly for the injury to the ecosystem or person or group of persons. Section 9 of the said Act includes the power to ensure payment by any person responsible for the excessive discharge of pollutants [15]. In articles 6 and 7 of ECA 1995, it is mentioned restrictions on vehicles emitting gas and the manufacture of polythene bags which are harmful to the environment. The penalties for polluters are mentioned in Article 15. (ECA, 1995) and Environmental Conservation Rules 1997 (ECR 1997).

2.2 Environmental Enforcement Measure

2.2.1 Environmental Enforcement

Many countries enacted Environmental Laws basing on PPP and other international environmental guidelines. The Governments of these countries have evolved different monitoring and enforcement measures for the implementation of environmental laws. Environmental enforcement measures play a vital role to achieve the desired standard of the environment. Environmental Enforcement may be defined as; *the range of procedures and actions employed by a state, its competent authorities, and agencies to ensure that organizations or persons, potentially failing to comply with environmental laws or regulations, can be brought or returned into compliance and/or punished through civil, administrative or criminal action* [11].

2.2.2 Different Types of Enforcement Measures

Different types of enforcement measures are adopted in different countries. Some of the measures are enumerated below;

Every Country has an institutional structure to govern the laws of the environment. Administrative Enforcement may be described as the set of actions taken by the regulatory institutions to ensure compliance with the environmental requirements. Certain types of

sanctions, non-judicial in nature, may be included in the administrative power. Administrative Enforcement includes many different administrative aspects like issuance of permits or consideration of EIA reports. Officials of Institutional authority are empowered to impose a penalty or punish (non-judicial measure). However, environmental decisions are reviewable after they have fulfilled the requirement [11].

Civil Enforcement implies a set of actions that can help governmental and non-governmental stakeholders and individuals to use civil law of alternate remedies to assist in ensuring compliance with the environmental requirements. To use civil enforcement measures, both potential civil litigants and judicial officials must have a proper understanding of required procedures [11].

Criminal Enforcement includes investigation and prosecution to enforce environmental law by authority. Over the years, it has been proved that it is not as effective as expected. So countries are considering innovative ways of imposing sanctions. The institutional settings of criminal enforcement are likely to be similar to the settings of civil enforcement [11].

In response to the socio-economic and ecological factors, countries reformulate the enforcement measures like Joint Enforcement Action, Calculation and Compensation of Environmental Damage, and Measuring Enforcement Action. Different traditional enforcement measures are integrated to implement environmental laws. Joint Inspections may be conducted by different agencies to identify violations by the polluters. Police Forces, public prosecutors, and other related agencies execute inspection jointly to identify violations. Public engagement is becoming an integrated feature of compliance and enforcement. Public engagement and information disclosure facilitate the identification of violations and the adoption of remedial measures. To encourage and enhance

environmental compliance, many countries have promoted the rewarding of good compliance and arranged penalty to the polluters [16].

2.2.3 Effectiveness and Challenges of Enforcement Measures

Administrative Enforcement is the primary form of enforcement that is prevailing in maximum countries. There are Government agencies that directly regulate environmental pollution through appropriate laws. Other Ministries are also directly or indirectly involved in environmental pollution regulation. In many countries, there is a lack of coordination between the ministries, agencies, and other related organizations to achieve the common objective of environmental enforcement. So Coordination between the agencies and organizations must be improved to achieve the objective of environmental enforcement [11].

Effective enforcement of environmental law demands the proper sharing of information and knowledge management. Many countries experience insufficient sharing of information. The ministries, environmental agencies, related organizations, etc are often not on the same platform or properly coordinated to make adequate intelligence available. Where possible, the information should be preserved for future use and be available publicly [11].

Monitoring is important to effectively enforce environmental law. Technological advancement of many countries has facilitated the monitoring through the smart use of tools and equipment. The monitoring and inspection teams are better equipped with better tools to check compliance, report the violations, record the data, and apply the data [11].

Administrative Enforcement is very effective as it includes inspection and monitoring. It provides an effective way to detect violations of laws. In some countries, self-regulation programs are practiced by the regulated community, and self-reporting of

violations are also observed. But monitoring is important to confirm the compliance of the laws by all users. It is often observed that the violations are not prosecuted in due time. The authorities are alleged to be slow to take appropriate actions against the polluters [11].

Civil enforcement measures have been proved to be effective. Civil enforcements facilitate the enforcement mechanism of administrative enforcement and criminal enforcement. Civil society, the authority, and individuals are required to aware of the measures available to them to ensure significant enforcement. Institutional memory and sharing of the information are also essential to effectively implement civil enforcement [11].

Due to a lack of coordination between relevant institutions, lack of an appreciation of environmental crime, lack of expertise, and financial or technical resources, these sanctions are not always as effective as they might be [11].

Countries have incorporated different approaches and mechanisms to enhance the traditional enforcement. Economic incentives, coordination among relevant Government organizations, Public consultation mechanism, Compliance assistance program, Empowerment of NGOs, Integrated law enforcement, etc are introduced with the traditional enforcement by different countries. Integrated Permitting is a useful means to ensure compliance by the polluters to all relevant pollutions; air, water, land, use of energy, water, and raw materials. The regulator permits the user with necessary conditions to ensure the standard of the environment [16].

Joint Inspection is an important step to effective enforcement. Inspection by the Technical person of the environment department, Police Forces, and Public Prosecutors proved more effective to enforce environmental law. Increasing collaboration among the environmental authorities maximizes the effort by enforcing penalties for any violation of environmental laws [16].

Public Engagement plays a critical role to implement environmental law. Information sharing on environmental authorities and the private sector to enforce and comply may be ensured by the proper information sharing by the public involvement [16].

2.2.4 Enforcement Measures Taken by Different Countries (Asian and others)

Administrative enforcement has been adopted in many countries. In Thailand, a Memorandum of Understanding (MOU) has been agreed upon among relevant coordinating agencies to enforce laws. In Cambodia, there is a National Coordinating Committee (NCC) to work on international conventions. This committee also helps to enforce laws. In Indonesia, there is national, provincial, and municipal level coordination, with a specific and clear designation of functions at different levels. There is a hotline between federal and local governments to ensure up to date sharing of information. In China, the Federal government provides direction for cooperation with selected provinces. Later in 2008, the Ministry of Environmental Protection was established to regulate the environmental laws. There is a popular national hotline, managed by the Ministry of Environmental Protection, on which people can report any instances of environmental pollution. The hotline ('12369') was introduced in 2009 and has been very successful in 2013; almost 2000 complaints were received, 26% more than in 2012 [11].

Administrative enforcement has been facilitated by technological advancement which improved tools and equipment for enforcement activities. Environmental profiling is done using Google Earth or similar services to monitor the impact of environmental pollution. The Pollution Control Officers are trained to build the capacity to utilize the technology in favour of enforcement activities. Malaysia is using Mobile Rugged Tablets (MRT) for GIS applications to conduct verification and mapping of industrial sources. This

system is further linked to online enforcement reports and the Department of Environment application system. Malaysia is also applying technology to identify any violations without applying chemical analysis. The Philippines has installed CCTVs in strategic areas to observe discharging any untreated water. In Thailand, a mobile phone application has been developed that allows to check current air quality in a bigger city [11].

Different countries have adopted different measures to ensure inspection and monitoring. The local Government Police of China conducts daily inspections of hotspots for pollution. It is not a common practice but appears to be effective in Kunming city, Yunnan Province. Cambodia, The Philippines, and Tanzania have developed Electronic enforcement systems, such as the Continuous Emission Monitoring System (CEMS) which provides real-time data for emission. The Department of Environment has its online application system to record and track down the compliance history of industries based on inspections and reports. In Malaysia, there is a self-regulating program for the industry to monitor biological treatment systems providing daily monitoring for pH, dissolved oxygen (DO), and mixed liquor suspended solids (MLSS) as an indicator. Nearly 25 years ago, 56 Automatic Air Quality Monitoring Stations (AQMS) were installed throughout the country in Malaysia. The air quality data is transmitted hourly and then published through various media as an air quality index. This is a good practice contributing to awareness and civil society engagement [11].

Many countries have introduced integrated permitting to facilitate pollution control as well as smooth progress of industrial projects. In November 2016, China's State Council issued the plan for the implementation of the pollution control permit system. The plan provides guidelines for the authority to design the permitting system. In India, all industries/agencies are legally required to obtain permits from a State Pollution Control Board (SPCB). According to the notifications in 2006, by the Ministry of Environment and

Forest, certain new industrial projects should have a permit from the Central Pollution Control Board (CPCB) [16].

Joint Inspections by Environmental Inspectors, Police Force, and Prosecutors have been proved effective in many countries. In China, almost every year, the Ministry of Environmental Protection initiates nation-wide campaigns to address specific environmental problems, in collaboration with the National People's Congress (The Parliament in China), the National Development and Reform Commission, the Ministry of Public Security, the Ministry of Justice and the State Business Administration. The Campaigns often result in "Shutting down, suspending production, merging and converting production" for non-compliant enterprises. On 18 January 2017, and Environmental, Food and Drug, and Tourism Protection Police Corps was established formally under Beijing Public Security Bureau. The Corps is known as the Environmental Police and is comprised of more than 150 policemen responsible for the detection and investigation of environmental enforcement. In Indonesia, a multi-instrument monitoring system has been implemented, with its starting point being that there should be both impromptu and regular monitoring. To support monitoring and enforcement efforts, Gujarat has introduced a third-party Environmental Audit Scheme aiming at ascertaining the performance of the environmental management system in various industries in the state. One objective of the program is to arm the Gujarat PCB and the association of industries with necessary performance information to support compliance monitoring [16].

Information disclosure and public complaint have also been useful for effective enforcement of environmental law. In China, Environmental Protection Law (2014) includes a special chapter on information disclosure and Public Participation. To implement the law, the Beijing local Environmental Protection Bureau adopted regulations on the

award to whistle-blowers for reporting environmental illegal actions in 2014. The Institute of Public and Environmental Affairs runs real-time water and air pollution maps that use publicly available data to expose factories that are breaching pollution limits. The institute's pollution maps have also been transferred into a smartphone app called 'Blue Sky Map'. This app allows users to monitor in real-time a company's emission data for air and wastewater. India has also experimented with environmental information disclosure and performance rating schemes to exert public pressure on non-complying industries. The Green Rating Project for the Pulp and paper industry was launched in 1999 by the Centre for Science and Environment with support from the Confederation of Indian Industries. Citizen complaints to the PCB are an important mechanism for triggering compliance monitoring and enforcement response. In Maharashtra, for example, between April 2004 and March 2005, citizens filed 761 complaints concerning air (306), water (292), solid waste (31), and noise pollution (132). SPCB adopted different approaches to respond effectively to citizen complaints. For example, the Andhra Pradesh Pollution Control Board created a Task Force Cell to respond to public complaints, conduct surprise inspections, and require corrective action. In West Bengal, the people can complain by approaching the Board Office directly or by submitting complain in the Board's website [16].

2.2.5 Environmental Enforcement in Bangladesh

The Environmental Pollution Control Ordinance, 1977, Ordinance No. XIII of 1977 is promulgated for the control, prevention, and abatement of pollution and superseded the Water Pollution Control Ordinance, 1970. The 1977 Ordinance reconstituted the Environmental Pollution Control Board. In 1992, the National Environmental Policy (NEP) was prepared to aim for the protection and sustainable management of the environment. The National Environmental Management Plan (NEMAP) was developed in 1995 as the

framework of programs and interventions aimed at implementing NEP. Bangladesh Environmental Conservation Act (ECA) 1995 and Bangladesh Environmental Conservation Rules (ECR) 1997 have been enacted focusing on pollution control comprehensively. The Act authorized the establishment of the Department of Environment (DoE) which is responsible for implementing the objectives of the Act. The ECR 1997 provides additional guidance for specific components [17].

DoE officials have been engaged in implementing the provisions of law and rules as provided by the ECA 1995 and ECR 1997. To make the enforcement activities more effective DoE prepared an 'Inspection and Enforcement Manual' by the Joint effort of DoE and Bangladesh Environmental Institutional Strengthening Project (BEISP). Detail guidelines on Inspections, Pre-inspection activities, On-site Inspection activities, Post Inspection activities, etc are mentioned in the manual. However, the inspection activities should be weighed against the effective implementation of penalties mentioned in ECA 1995.

2.3 Calculation Methodology

India has the Central Pollution Control Board (CPCB) to enact National policy and control on pollution and the State Pollution Control Board (SPCB) or Pollution Control Committee (PCC) to adopt subsidiary regulations and control of pollution on states. CPCB in coordination with the concerned SPCB monitor the compliance and enforce penalties according to the different laws. CPCB co-ordinates the activities of the SPCB/PCC by providing technical assistance and guidance and also resolves disputes among them. CPCB is the apex organization in the country in the field of pollution control. The maximum penalty prescribed under The Water (Prevention and Control of Pollution) Cess Act, 1977 for violations is only Rs.1000, while the same under the Water (Prevention and Control of Pollution) Act, 1974 is Rs. 10,000. The maximum penalty under the Environment

(Protection) Act, 1986 is Rs. One Lakh. The calculation of the penalties is determined presumably in an arbitrary method [18].

An important pillar of China's pollution regulatory system is a pollution levy implemented nationally in 1982. Article 18 of the EPL specifies that: "In cases where the discharge of pollutants exceeds the limit set by the state, a compensation fee shall be charged according to the quantities and concentration of the pollutants released".

The levy system formally requires that a fee be paid by any enterprise only on the quantity of effluent discharge that exceeds the legal standard. Furthermore, the pollution levy is paid only on the pollutant that exceeds its standard by the greatest amount, and not on all the pollutants that exceed the standard. National regulations thus stipulate that a pollution levy L_{jm} be paid by a factory j emitting N pollutants where:

$$L_{jm} = \text{Max}\,[L_{j1}, L_{j2,} \ldots\ldots\ldots\ldots L_{jN}] \quad (1)$$

$$Ljt = \rho t \left[\frac{\eta jt - \eta t*}{\eta t*}\right] Wj; \quad i = 1 \ldots\ldots N \quad (2)$$

Where Ljt is the estimated levy to be paid by plant j on pollutant i (i=1,….N): ρt is the national levy rate for pollutant i; the pollution levy is further a function of the firm's industrial sector of activity; ηjt is the discharge concentration of pollutant i by firm j; ηt is the national legal discharge of pollutant i; W_j is the wastewater discharge volume by plant j. In China, Environmental Protection Bureaus (EPB) have been created at all levels of local governments; provinces, and counties. Effective implementation of the pollution levy at the provincial level to be a function of provincial income and education: the higher the level of income and education, the higher the effective levy [19].

In Singapore, any person discharging toxic substances to inland water first time may be charged not exceeding $50,000 or to imprisonment for a term not exceeding 12 months or both. For the second time or subsequent, imprisonment not less than one month and not more than 12 months and a fine not exceeding $ 100,000 are awarded [18].

In Bangladesh, ECA 1995 mentioned penalties on pollution of industrial water. As per ECA 1995, for first time pollution of water, imprisonment for one to two years or a penalty of Taka Fifty Thousand to Taka Two Hundred Thousand or both may be imposed. ECR 1997 set the allowable standards of elements of solid waste that may be disposed of to various water bodies. Bangladesh Water Act 2013 mentioned rules about the conservation of water bodies. As per the guideline of ECA 1995 (Revised in 2002), DoE published an Office Order on 01 July 2010 and it incorporates rates of penalties for pollution of the environment and ecosystem:

Table 2-1: Rates of Penalty for Pollution of Environment and Ecosystem. [21]

Serial	Subject	Unit	Amount of Penalty (Taka)
1.	Battery Manufacture	Cum (liquid waste)	20 to 50
2.	Paper /Board Mill	Do	16 (Recycled waste paper) 32 (Wood as raw material)
3.	Tannery	Do	50
4.	Consumer Oil Factory	Do	16
5.	Washing Plant	Do	16 to 32
6.	Rerolling	Cum (Gaseous waste)	20
7.	Steel Mill	Do	30 to 40
8.	Cement Factory	Cum (liquid waste)	28
9.	Ready-mix Factory	Do	28
10.	Glass Factory	Do	20 to 40
11.	Printing	Cum (Liquid waste)	20 to 40
12.	Solid waste	Cum (Solid waste)	100 to 1000
13.	Hospital Waste	Cum/ per kg (liquid & solid waste)	50 to 100 and 50,000 to 100,000
14.	Dockyard	Sft (soil, water, and air pollution)	5000 to 10000
15.	Ceramic Items & Tiles	Cum	20
16.	Salt Factory	Kg	20
17.	Sugar Mill and Sugar Refined Mill	Cum	30 and 20
18.	Medicine and raw materials factory	Cum	16 and 40
19.	Alkali Plant	Cum	16

On 02 July 2019, the Office Order is reviewed and the following Order is published by DoE:

Table 2-2: Revised Rate of Penalty for pollution of Environment and Ecosystem. [21]

Serial	Type of Factory	Type of Penalty	Index of Penalty	Quantity of Land	Rate of Penalty (Taka)	Remarks
1.	Orange -A	Without Environmental Clearance	Land area/ state of pollution	Up to one acre	200,000 (Two Lac)	
				1 to 3 acres	500,000 (Five Lac)	
				3 to 6 acres	10,00,000 (Ten Lac)	
				6 to 10 acres	20,00,000 (Twenty Lac)	
				Above 10 acres	50,00,000 (Fifty Lac)	
		Without Renewal of Environmental Clearance	Considering the land area	Up to one acre	200,000 (Two Lac)	
				1 to 3 acres	500,000 (Five Lac)	
				3 to 6 acres	10,00,000 (Ten Lac)	
				6 to 10 acres	20,00,000 (Twenty Lac)	
				Above 10 acres	50,00,000 (Fifty Lac)	
		Violation of Environmental Clearance/ Renewal	Maximum 05 Violation	Maximum 50,000 (Fifty Thousand)		
			More than 05 Violation	Maximum 100,000 (One Lac)		
02	Orange B	Without Environmental Clearance	Land area considered	Up to one acre	200,000 (Two Lac)	
				1 to 3 acres	500,000 (Five Lac)	
				3 to 6 acres	10,00,000 (Ten lac)	
				6 to 10 acres	20,00,000 (Twenty lac) maximum	
				More than 10 acres	50,00,000 (Fifty lac)	
		Without the renewal of	Land area considered	Up to one acre	200,000 (Two lac)	

		Environmental clearance		1 to 3 acres	500,000 (Five lac)	
				3 to 6 acres	10,00,000 (Ten lac)	
				6 to 10 acres	20,00,000 (Twenty lac)	
				More than 10 acres	50,00,000 (Fifty lac)	
		Environmental Clearance/ Renewal Condition violation	Maximum 5 violation	Maximum 200,000 (Two Lac)		
			More than 5 violation	Maximum 500,000 (Five Lac)		
03	Red	Without Environmental Clearance	Land area considered	Up to one acre	200,000 (Two Lac)	
				1 to 3 acres	500,000 (Five Lac)	
				3 to 6 acres	10,00,000 (Ten lac)	
				6 to 10 acres	20,00,000 (Twenty lac) maximum	
				More than 10 acres	50,00,000 (Fifty lac)	
		Without the renewal of Environmental clearance	Land area considered	Up to one acre	200,000 (Two lac)	
				1 to 3 acres	500,000 (Five lac)	
				3 to 6 acres	10,00,000 (Ten lac)	
				6 to 10 acres	20,00,000 (Twenty lac)	
				More than 10 acres	50,00,000 (Fifty lac)	
		Environmental clearance/Renewal Condition Violation	Maximum 05 Condition violation	Maximum 500,000 (Five Lac)		
			More than 05 Condition Violation	Maximum 1500,000 (Fifteen Lac)		

The penalties are determined as per the above-mentioned guideline by the DoE Inspection Team. The figures for fines levied are arbitrary, and no basis of setting fines have been mentioned [22].

2.4 Recent Study on Enforcement

An exploratory analysis of fines for water pollution in Bangladesh was performed recently. The study is claimed to be the first of its kind for Bangladesh. The paper mostly focused on the geographical representation of environmental fines, the difference of fines for the textile sector from fines of other sectors, common violations, and measures for repeat offenders [23].

The empirical study was based on data collected from different print/electronic media. It was also revealed that the fines mentioned in the reports were not fully collected for the political/bureaucratic appeal process. For example, during the years 2010-2013, 1371 industrial units were fined for environmental violations Taka 1,278,365,000. Out of this, the authority could collect Taka 880,993,000, which is 69% of the levied fine.

The study concluded that the arbitrariness of the fines was not effective to create deterrence and it should be replaced by a progressive fine which will discourage becoming repeat offenders. It has been estimated that the average cost of wastewater treatment for the textile dyeing factory was around 32 Taka per cubic meter, which could translate into an annual cost of Tk. 1,33,50,000 for a small factory. Even the factory is fined twice a year an average of Tk.10,00,000, it would be more economical to pay the fine rather than running a wastewater treatment plant. So restructuring the penalties basing on the abatement costs is necessary for effective compliance with environmental regulations and standards.

The paper evaluated whether enforcement was affecting any changes in polluters' behavior to comply with existing regulations and standards. Though newspaper reports for

five years and the sampling method is the key limitation of the paper, it could illustrate the situation of environmental enforcement in Bangladesh qualitatively:

- The arbitrary nature of the environmental fine is evident from the analysis and it should serve as a basis for developing a progressive penalty structure.
- Repeat offenders are not penalized heavily, thereby giving the wrong incentives to polluters.
- DoE should review mechanisms and penalties for non-compliance to pollution regulations and create more stringent sanctions and more effective mechanisms for penalizing non-compliant parties.

The paper left the following likely scope of research in the future:

- ❖ The dataset can be expanded using the identifier variable of the factory name and finding the annual turnover rate of the factory to test whether firm size has any influence on the size of the fine.
- ❖ If the violations can be ranked objectively, it will also be possible to run a regression analysis to see how much the fine will increase with an increase in the ordinal violation group.
- ❖ More statistical tools need to be employed to find out how much fines are charged for repeat offenders.
- ❖ If this dataset can be used to find the expected value of pollution fine, which is the product of the probability of inspection rates and mean/median nominal penalty, it can be compared with abatement costs to assess options for polluters which will be to comply or violate.

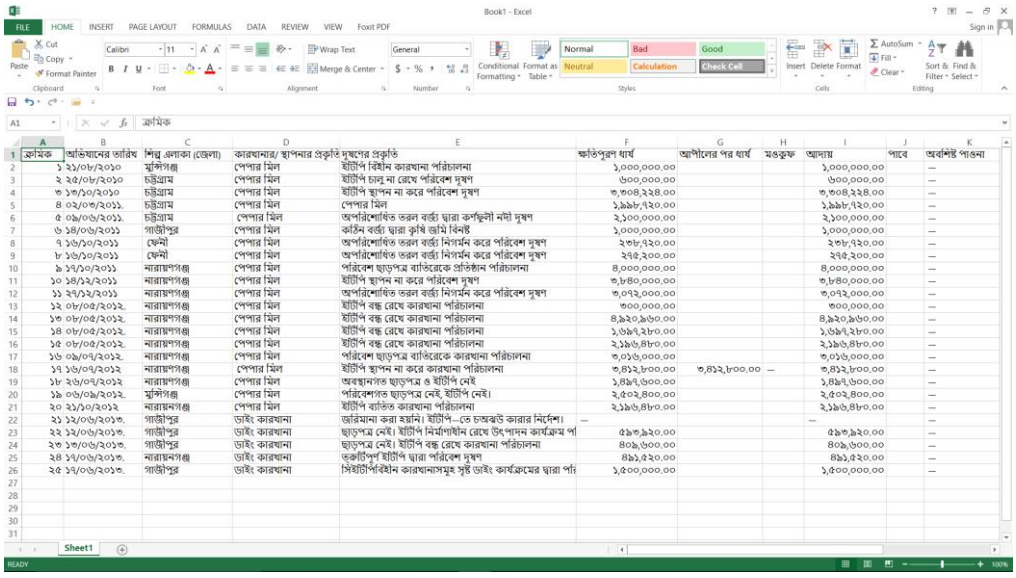
- Finding an optimal expected fine will also be useful since theoretically full compliance can be achieved by setting this expected fine at an arbitrarily high level by manipulating either inspection rates or nominal penalties or both [23].

CHAPTER 3

METHODOLOGY

Since the growing industry of Bangladesh are creating more opportunities for the economy, it is imperative to take necessary measures for curbing pollution. The trend of polluters in pollution should be analyzed so that DoE may amend the policy guideline for better pollution control. The study aims to evaluate the existing structure of pollution fines based on historical records. Data on fines from 2010 to 2018 was collected from the DoE. SPSS, a standard statistical software package, was used to prepare the database and necessary analysis. To avoid sampling error, the data containing incomplete information was excluded from the analysis.

Data for 9 years (2010 to 2018) could be collected and arranged for necessary analysis. A typical data sheet is shown in Figure 3.1.



ক্রমিক	অভিযানের তারিখ	শিল্প এলাকা (জেলা)	কারখানার/ স্থাপনার প্রকৃতি দূষণের প্রকৃতি		ক্ষতিপূরণ ধার্য	আপীলের পর ধার্য	মওকুফ	আদায়	পাবে	অবশিষ্ট পাওনা
১	২১/০৮/২০১০	মুন্সিগঞ্জ	পেপার মিল	ইটিপি বিহীন কারখানা পরিচালনা	১,০০০,০০০.০০			১,০০০,০০০.০০		–
২	২৪/০৮/২০১০	চট্টগ্রাম	পেপার মিল	ইটিপি চালু না রেখে পরিবেশ দূষণ	৬০০,০০০.০০			৬০০,০০০.০০		–
৩	১৩/১০/২০১০	চট্টগ্রাম	পেপার মিল	ইটিপি স্থাপন না করে পরিবেশ দূষণ	৩,৩০৪,২২৪.০০			৩,৩০৪,২২৪.০০		–
৪	০২/০৩/২০১১	চট্টগ্রাম	পেপার মিল	পেপার মিল	১,৯৯৮,৭২০.০০			১,৯৯৮,৭২০.০০		–
৫	০৯/০৬/২০১১	চট্টগ্রাম	পেপার মিল	অপরিশোধিত তরল বর্জ্য দ্বারা কর্ণফুলী নদী দূষণ	২,১০০,০০০.০০			২,১০০,০০০.০০		–
৬	১৪/০৬/২০১১	গাজীপুর	পেপার মিল	কঠিন বর্জ্য দ্বারা কৃষি জমি বিনষ্ট	১,০০০,০০০.০০			১,০০০,০০০.০০		–
৭	১৬/১০/২০১১	ফেনী	পেপার মিল	অপরিশোধিত তরল বর্জ্য নিগর্মন করে পরিবেশ দূষণ	২৩৮,৭২০.০০			২৩৮,৭২০.০০		–
৮	১৬/১০/২০১১	ফেনী	পেপার মিল	অপরিশোধিত তরল বর্জ্য নিগর্মন করে পরিবেশ দূষণ	২৭৫,২০০.০০			২৭৫,২০০.০০		–
৯	১৭/১০/২০১১	নারায়ণগঞ্জ	পেপার মিল	পরিবেশ ছাড়পত্র বাতিরেকে প্রতিষ্ঠান পরিচালনা	৪,০০০,০০০.০০			৪,০০০,০০০.০০		–
১০	১৪/১২/২০১১	নারায়ণগঞ্জ	পেপার মিল	ইটিপি স্থাপন না করে পরিবেশ দূষণ	৩,৮৪০,০০০.০০			৩,৮৪০,০০০.০০		–
১১	২৭/১২/২০১১	নারায়ণগঞ্জ	পেপার মিল	অপরিশোধিত তরল বর্জ্য নিগর্মন করে পরিবেশ দূষণ	৩,০৭২,০০০.০০			৩,০৭২,০০০.০০		–
১২	০৮/০৫/২০১২	নারায়ণগঞ্জ	পেপার মিল	ইটিপি বন্ধ রেখে কারখানা পরিচালনা	৩০০,০০০.০০			৩০০,০০০.০০		–
১৩	০৮/০৫/২০১২	নারায়ণগঞ্জ	পেপার মিল	ইটিপি বন্ধ রেখে কারখানা পরিচালনা	৪,৯২০,৯৬০.০০			৪,৯২০,৯৬০.০০		–
১৪	০৮/০৫/২০১২	নারায়ণগঞ্জ	পেপার মিল	ইটিপি বন্ধ রেখে কারখানা পরিচালনা	১,৬৯৭,২৮০.০০			১,৬৯৭,২৮০.০০		–
১৫	০৮/০৫/২০১২	নারায়ণগঞ্জ	পেপার মিল	ইটিপি বন্ধ রেখে কারখানা পরিচালনা	২,১৯৬,৪৮০.০০			২,১৯৬,৪৮০.০০		–
১৬	০৯/০৭/২০১২	নারায়ণগঞ্জ	পেপার মিল	পরিবেশ ছাড়পত্র ব্যতিরেকে কারখানা পরিচালনা	৩,০১৬,০০০.০০			৩,০১৬,০০০.০০		–
১৭	১৬/০৭/২০১২	নারায়ণগঞ্জ	পেপার মিল	ইটিপি স্থাপন না করে কারখানা পরিচালনা	৩,৪১২,৮০০.০০	৩,৪১২,৮০০.০০	–	৩,৪১২,৮০০.০০		–
১৮	২৬/০৭/২০১২	নারায়ণগঞ্জ	পেপার মিল	অবস্থানগত ছাড়পত্র ও ইটিপি নেই	১,৪৯৭,৬০০.০০			১,৪৯৭,৬০০.০০		–
১৯	০৬/০৯/২০১২	মুন্সিগঞ্জ	পেপার মিল	পরিবেশগত ছাড়পত্র নেই, ইটিপি নেই।	২,৫০২,৪০০.০০			২,৫০২,৪০০.০০		–
২০	২১/১০/২০১২	নারায়ণগঞ্জ	পেপার মিল	ইটিপি ব্যতিত কারখানা পরিচালনা	২,১৯৬,৪৮০.০০			২,১৯৬,৪৮০.০০		–
২১	১২/০৬/২০১৩	গাজীপুর	ডাইং কারখানা	ডারিমানা করা হয়নি। ইটিপি –তে চলমবুট কারার নির্দেশ।	–			–		–
২২	১২/০৬/২০১৩	গাজীপুর	ডাইং কারখানা	ছাড়পত্র নেই। ইটিপি নির্মাণাধীন রেখে উৎপাদন কার্যক্রম প	৫৯৩,৯২০.০০			৫৯৩,৯২০.০০		–
২৩	১৩/০৬/২০১৩	গাজীপুর	ডাইং কারখানা	ছাড়পত্র নেই। ইটিপি বন্ধ রেখে কারখানা পরিচালনা	৪০৯,৬০০.০০			৪০৯,৬০০.০০		–
২৪	১৭/০৬/২০১৩	নারায়ণগঞ্জ	ডাইং কারখানা	তরুটিপূর্ণ ইটিপি দ্বারা পরিবেশ দূষণ	৪৯১,৫২০.০০			৪৯১,৫২০.০০		–
২৫	১৭/০৬/২০১৩	গাজীপুর	ডাইং কারখানা	সিইটিপিবিহীন কারখানাসমূহ সৃষ্ট ডাইং কার্যক্রমের দ্বারা পরি	১,৫০০,০০০.০০			১,৫০০,০০০.০০		–

Figure- 3.1. Typical Data Sheet Collected from DoE

The data collected from DoE were arranged for type of factories, type of violations and quantity of fines. The incomplete, missing and irrelevant data are discarded. It was also

difficult to arrange the data as the record sheets were not standard. Initially about 2800 data-points were collected for 2010 to 2018 period. Finally, 2622 data were taken discarding the incomplete or irrelevant data.

Flow Chart

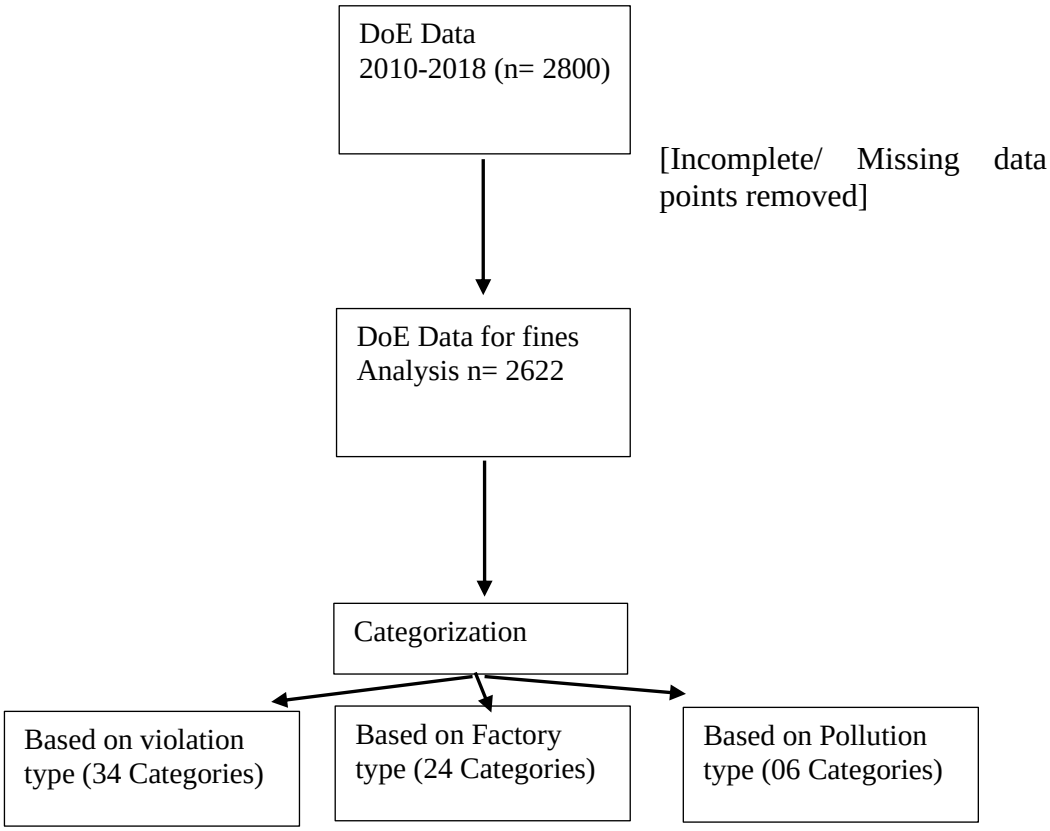


Figure- 3.2. Flow Chart of Categorization

There are various types of factories which have different numbers of violation. It would not be meaningful to analyze the data with existing type of factories. For the convenience of analysis and achievement of objectives, these factories are categorized as 24 types as shown in Table 3-1.

Table 3-1: Grouping according to Type of Factory and Abbreviations

Abbreviation	Type of Factory	Abbreviation	Type of Factory
TEX	Textile and Fabrics	PAR	Rice Parboiling
TAN	Tannery and Leather	PAI	Paint
PAP	Paper printing Mill	HCF	Healthcare Facilities
PHA	Pharmaceuticals	RCL	Real Estate, Construction and Land Developer
SHI	Shipyard and other Dockyard	BRI	Brick Kiln and Ceramics
CHE	Chemical Industries	STE	Steel Mill
POW	Power plant	FER	Fertilizer
FBE	Food, Beverage and Edible oil	SHO	Shops and Restaurants
TOB	Tobacco	FOU	Foundry and Metal
ELE	Electronics, spare parts, Workshop	FUE	Fuel Oil and Filling Station
PRI	Other Private Industries, Companies	PUB	Other Public Entities
POU	Poultry, Fish and Other Farming	CEM	Cement

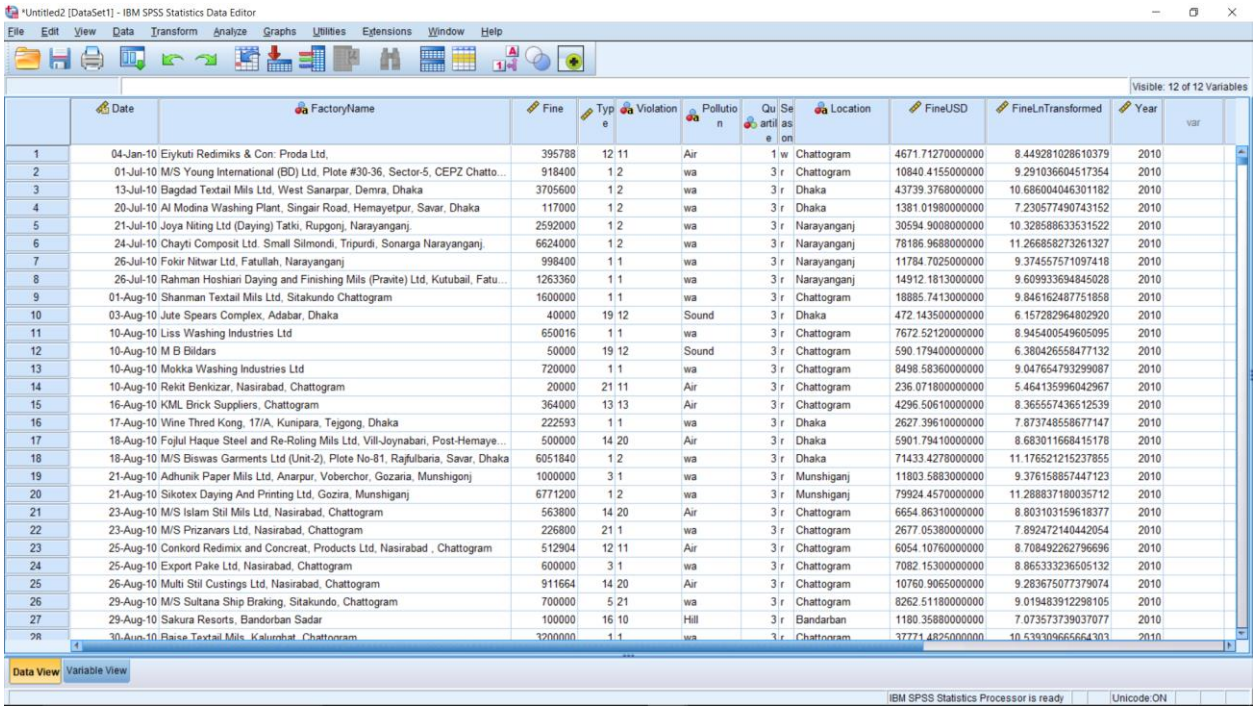
In the current and historical record, various types of violations by the factories were found. For the convenience of the analysis, the violations are also grouped into 34 types in Table 3-2. Water and air pollution caused by the factories around the country is considered in this study. There are other types of pollution causing environmental degradation and hazards.

Table 3-2: Grouping of Violations in Different Sectors.

Type	Environmental Sector	Violation
1	Water	Untreated Effluent, no ETP
2	Water	Untreated Effluent, non-functional ETP
3	Water	Untreated Effluent, Defective ETP
4	Others	No Site/ Environmental Clearance
5	Others	Invalid/Environmental Clearance expired
6	Water	Untreated Effluent, by-pass line
7	Water	Pollution by solid waste
8	Wetland	Encroachment of water bodies and illegal landfilling

Type	Environmental Sector	Violation
9	Others	No site clearance, factory in residential, prohibited areas and ECA's
10	Hill	Unauthorized Hill Cutting
11	Air	Air Pollution by dust, black smoke, no pollution control system
12	Sound	Sound Pollution
13	Air	Illegal Brick Kilns
14	Air	Burning wood and using agricultural land/topsoil in brick kilns
15	Water	Supplying contaminated drinking water
16	Others	Making Poultry feed from tannery waste
17	Others	Improper Medical Waste Management
18	Others	Illegal Shrimp Farming
19	Air	No air quality monitoring in industry
20	Air	Violation of air emission/ambient air quality standard
21	Others	Improper risk management in construction and industries
22	Others	Manufacturing, use and distribution of Polythene
23	Wetland	Unauthorized sand extraction
24	Wetland	Encroachment water bodies, illegal landfilling and unauthorized sand extraction
25	Air	Invalid/Environmental clearance expired, burning wood and using agricultural land top soil in brick kilns
26	Water	No site/ Environmental clearance, Untreated effluent, No ETP
27	Water	Invalid/ Environmental clearance expired, Untreated effluent, Defective ETP
28	Water	No site/ Environmental clearance, Untreated effluent, Defective ETP
29	Water	Invalid/ Environmental clearance, Untreated effluent, non-functional ETP
30	Water	No site/ Environmental clearance, Untreated effluent, non-functional ETP
31	Water	Invalid Environmental clearance, Untreated effluent, No ETP
32	Water	No site/ Environmental clearance, Untreated effluent, by-pass line
33	Water	Untreated effluent, Defective ETP, by pass line
34	Water	Untreated effluent, non-functional ETP, by pass line

Here, the study is limited to water and air pollution as industrial pollution is mostly related to it. The objectives of the study are to analyze current and historical trend of fines, effect on repeat offenders and effectiveness of PPP in country.



	Date	FactoryName	Fine	Type	Violation	Pollution	Quartile	Season	Location	FineUSD	FineLnTransformed	Year	var
1	04-Jan-10	Eiykuti Redimiks & Con: Proda Ltd,	395788	12	11	Air	1	w	Chattogram	4671.71270000000	8.449281028610379	2010	
2	01-Jul-10	M/S Young International (BD) Ltd, Plote #30-36, Sector-5, CEPZ Chatto...	918400	1	2	wa	3	r	Chattogram	10840.4155000000	9.291036604517354	2010	
3	13-Jul-10	Bagdad Textail Mils Ltd, West Sanarpar, Demra, Dhaka	3705600	1	2	wa	3	r	Dhaka	43739.3768000000	10.686004046301182	2010	
4	20-Jul-10	Al Modina Washing Plant, Singair Road, Hemayetpur, Savar, Dhaka	117000	1	2	wa	3	r	Dhaka	1381.01980000000	7.230577490743152	2010	
5	21-Jul-10	Joya Niting Ltd (Daying) Tatki, Rupgonj, Narayanganj.	2592000	1	2	wa	3	r	Narayanganj	30594.9008000000	10.328588633531522	2010	
6	24-Jul-10	Chayti Composit Ltd. Small Silmondi, Tripurdi, Sonarga Narayanganj.	6624000	1	2	wa	3	r	Narayanganj	78186.9688000000	11.266858273261327	2010	
7	26-Jul-10	Fokir Nitwar Ltd, Fatullah, Narayanganj	998400	1	1	wa	3	r	Narayanganj	11784.7025000000	9.374557571097418	2010	
8	26-Jul-10	Rahman Hoshiari Daying and Finishing Mils (Pravite) Ltd, Kutubail, Fatu...	1263360	1	1	wa	3	r	Narayanganj	14912.1813000000	9.609933694845028	2010	
9	01-Aug-10	Shanman Textail Mils Ltd, Sitakundo Chattogram	1600000	1	1	wa	3	r	Chattogram	18885.7413000000	9.846162487751858	2010	
10	03-Aug-10	Jute Spears Complex, Adabar, Dhaka	40000	19	12	Sound	3	r	Dhaka	472.143500000000	6.157282964802920	2010	
11	10-Aug-10	Liss Washing Industries Ltd	650016	1	1	wa	3	r	Chattogram	7672.52120000000	8.945400549605095	2010	
12	10-Aug-10	M B Bildars	50000	19	12	Sound	3	r	Chattogram	590.179400000000	6.380426558477132	2010	
13	10-Aug-10	Mokka Washing Industries Ltd	720000	1	1	wa	3	r	Chattogram	8498.58360000000	9.047654793299087	2010	
14	10-Aug-10	Rekit Benkizar, Nasirabad, Chattogram	20000	21	11	Air	3	r	Chattogram	236.071800000000	5.464135996042967	2010	
15	16-Aug-10	KML Brick Suppliers, Chattogram	364000	13	13	Air	3	r	Chattogram	4296.50610000000	8.365557436512539	2010	
16	17-Aug-10	Wine Thred Kong, 17/A, Kunipara, Tejgong, Dhaka	222593	1	1	wa	3	r	Dhaka	2627.39610000000	7.873748558677147	2010	
17	18-Aug-10	Fojlul Haque Steel and Re-Roling Mils Ltd, Vill-Joynabari, Post-Hemaye...	500000	14	20	Air	3	r	Dhaka	5901.79410000000	8.683011668415178	2010	
18	18-Aug-10	M/S Biswas Garments Ltd (Unit-2), Plote No-81, Rajfulbaria, Savar, Dhaka	6051840	1	2	wa	3	r	Dhaka	71433.4278000000	11.176521215237855	2010	
19	21-Aug-10	Adhunik Paper Mils Ltd, Anarpur, Voberchor, Gozaria, Munshigonj	1000000	3	1	wa	3	r	Munshiganj	11803.5883000000	9.376158857447123	2010	
20	21-Aug-10	Sikotex Daying And Printing Ltd, Gozira, Munshiganj	6771200	1	2	wa	3	r	Munshiganj	79924.4570000000	11.288837180035712	2010	
21	23-Aug-10	M/S Islam Stil Mils Ltd, Nasirabad, Chattogram	563800	14	20	Air	3	r	Chattogram	6654.86310000000	8.803103159618377	2010	
22	23-Aug-10	M/S Prizarvars Ltd, Nasirabad, Chattogram	226800	21	1	wa	3	r	Chattogram	2677.05380000000	7.892472140442054	2010	
23	25-Aug-10	Conkord Redimix and Concreat, Products Ltd, Nasirabad , Chattogram	512904	12	11	Air	3	r	Chattogram	6054.10760000000	8.708492262796696	2010	
24	25-Aug-10	Export Pake Ltd, Nasirabad, Chattogram	600000	3	1	wa	3	r	Chattogram	7082.15300000000	8.865333236505132	2010	
25	26-Aug-10	Multi Stil Custings Ltd, Nasirabad, Chattogram	911664	14	20	Air	3	r	Chattogram	10760.9065000000	9.283675077379074	2010	
26	29-Aug-10	M/S Sultana Ship Braking, Sitakundo, Chattogram	700000	5	21	wa	3	r	Chattogram	8262.51180000000	9.019483912298105	2010	
27	29-Aug-10	Sakura Resorts, Bandorban Sadar	100000	16	10	Hill	3	r	Bandarban	1180.35880000000	7.073573739037077	2010	
28	30-Aug-10	Baise Textail Mils, Kalurghat, Chattogram	3200000	1	1	wa	3	r	Chattogram	37771.4825000000	10.539309665664303	2010	

Figure-3.3. Use of SPSS for analysis

Standard descriptive statistics (mean, median, percentiles and quartiles) was used to characterize the environmental fine data. t-tests were used to assess the differences of fines between different groups (sectors, type of violation etc). Analysis of means and variances for different groups were carried out to determine the disparities in levied fines. The historical trends of fines were assessed using time-series analysis. After performing the relevant statistical tests, analysis of the test results were carried out and presented in graphical and tabular form. Critical analysis and comparison with standards were carried out to provide policy guidelines.

CHAPTER 4

RESULTS AND DISCUSSIONS

This Chapter presents the discussions on the results of the statistical tests and analysis from the graphical and tabular representations. The current and historical fines are discussed for the insights of related contributions. Results of repeat offenders are discussed for deterrence and modifications in policy guideline are suggested and PPP is discussed for the effective application in the context of Bangladesh.

4.1 Current and Historical Trend of Pollution Fines

Table-4.1 presents the descriptive statistics of fines for all records. TEX (Textile and fabrics factories) has 1234 violations. Though mean is 15686 USD, median is 5902 USD. There are outliers which have high amount of fines than the mean. Here the standard deviation is 28344 USD which implies the presence of outliers in data. In figure 4.1, it is also shown that the data are not normally distributed. Similar results are found in other types of factories too. RCL (Real Estate, Construction, and Land Developer factories) has 164 violations. The mean is 10972 USD and the median is 3742 USD. The standard deviation is 29233 USD. BRI (Brick kiln and ceramics factories) has 445 violations. The mean is 4310 USD, the median is 3541 USD and the standard deviation is 6565 USD. PRI (Other Private Industries factories) has 208 violations. The mean is 4837 USD and the median is 2361 USD. The standard deviation is 9733 USD. Though TEX has more numbers (1234) of fines as compared to other types, the standard deviation is not less than others as it has more outliers. Out of 2622 data, it is found that the minimum fine is 6 USD whereas the maximum fine is 354297 USD; the maximum fine is 59000 times the minimum fine. Enforcement measures are equally applied from small factories to large factories. The large difference in fines and the presence of outliers substantiates the arbitrariness of the fines.

Table-4.1: Basic Characteristics of Fines against the Type of Factories.

Type of Factory	Count of Fine (N)	Mean (USD)	Median (USD)	Sum (USD)	Minimum (USD)	Maximum (USD)	Std. Deviation (USD)
TEX	1234	15686	5902	19356510	13	354297	28344
TAN	12	22963	9821	275561	236	82473	26980
PAP	97	16361	9428	1587027	87	136487	19365
PHA	34	4987	1007	169548	6	59018	11005
SHI	21	4769	2361	100146	35	29499	6519
CHE	30	3529	2561	105858	45	9065	2400
POW	16	7319	3181	117106	354	59018	14215
FBE	53	10515	3331	557321	118	144476	21681
PAR	57	1067	590	60815	215	12984	1738
PAI	1	6445	6445	6445	6445	6445	-
HCF	37	2605	2361	96393	236	11922	2553
RCL	164	10972	3742	1799468	295	340368	29233
BRI	445	4310	3541	1917763	177	118036	6565
STE	60	10251	6642	615073	803	47495	10746
FER	1	236	236	236	236	236	-
SHO	32	4177	885	133676	59	47214	9387
TOB	3	9620	2892	28860	2361	23607	12116
FOU	25	6738	2361	168460	118	35354	9113
ELE	45	3018	1180	135795	49	35411	5694
FUE	8	4057	2361	32460	590	11804	3698
PRI	208	4837	2361	1006017	55	118036	9733
PUB	3	7161	4958	21483	4721	11804	4022
POU	20	12666	5902	253328	295	63002	17683
CEM	16	15130	15167	242084	1180	47214	12873
Total	2622	10979	3996	28787430	6	354297	22650

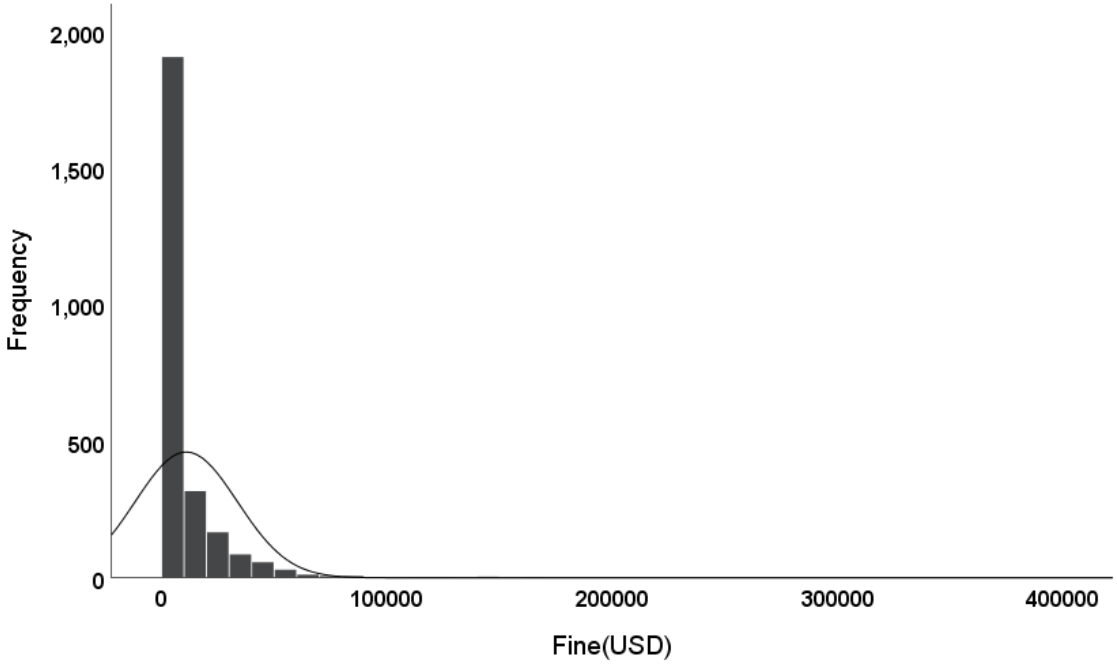


Figure- 4.1. Histogram of fined amount

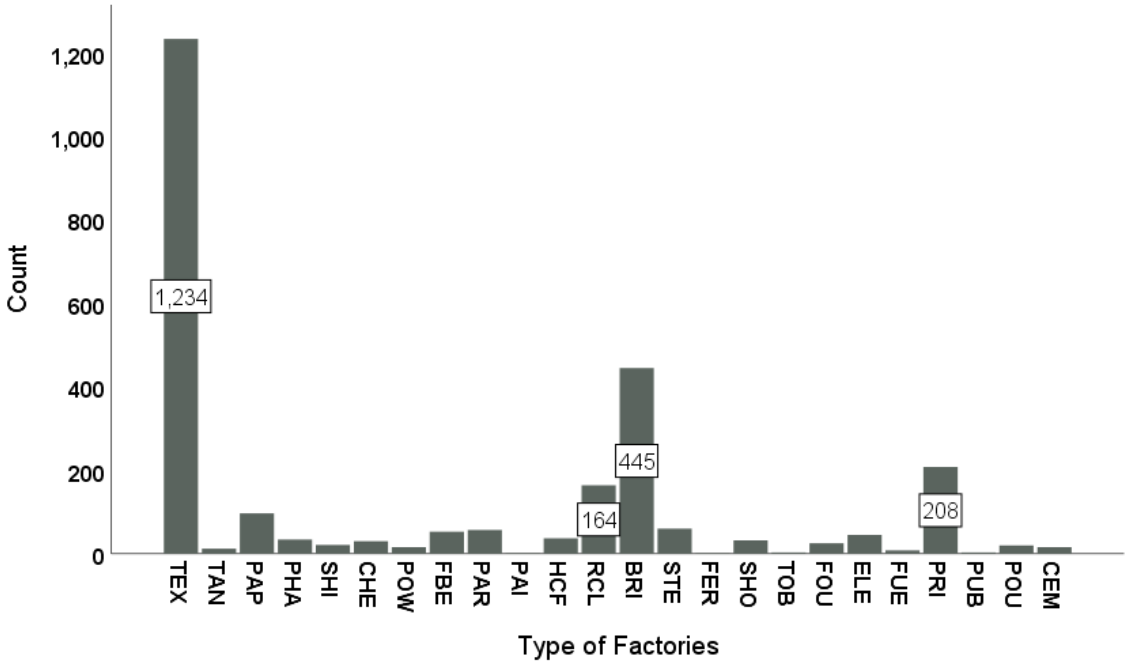


Figure- 4.2. Fine counts for different types of factories

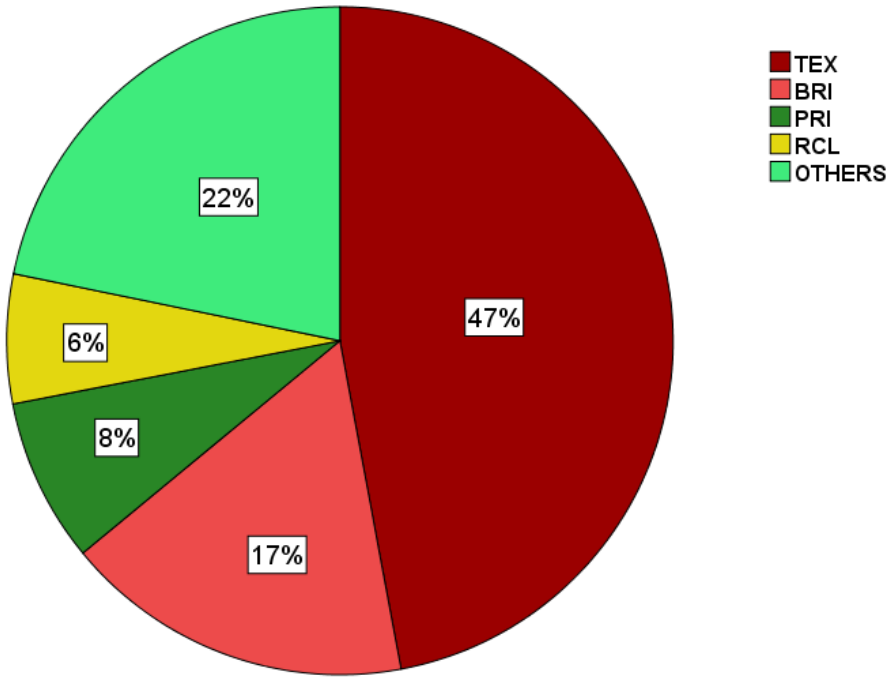


Figure-4.3. Predominant factories contributing pollution

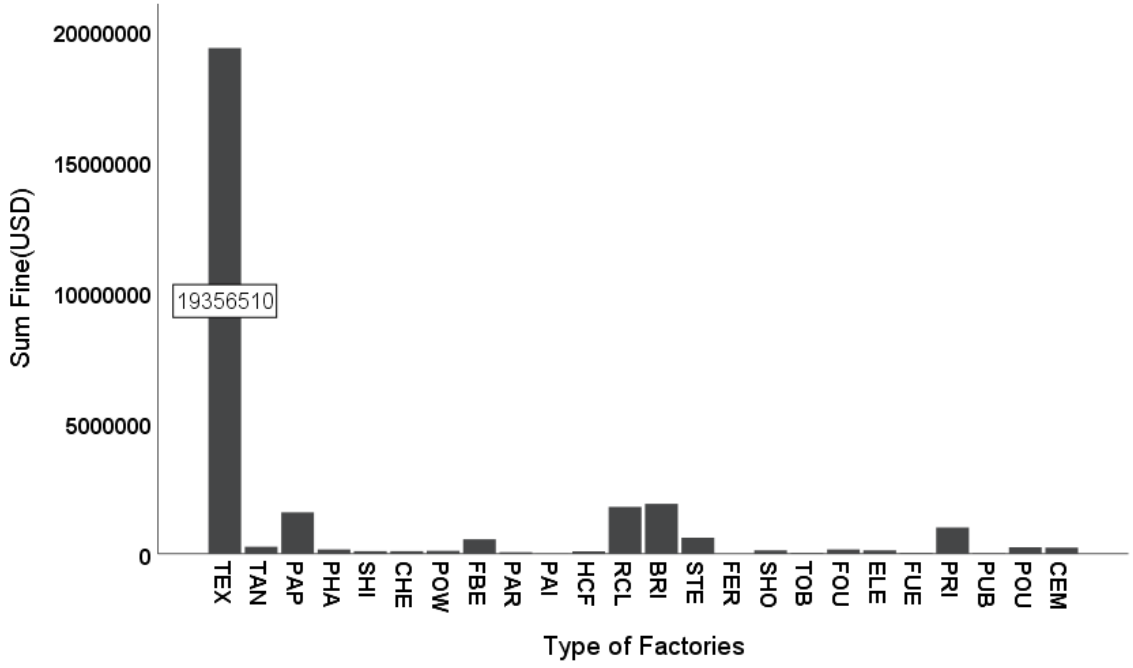


Figure- 4.4: Sum of fines against Types of Factories

Fig-4.2 shows the number of fines against each type of factory. As already discussed, TEX (Textile and Fabrics), RCL (Real Estate, Construction and Developer), BRI (Brick Kiln

and Ceramics), and PRI (Other Private Industries and Companies) have more violations than other types of factories. 78% of total fines were levied for these 4 types of factories. Fig-4.3 shows the major factories contributing to pollution. The Textile and Fabrics sector has a dominant role in Bangladesh's economy. As textile sector in Bangladesh is rapidly growing, it is obvious that the number of factories and violations in the textile sector is also increasing. The textile sector has contributed 82% of the country's total export revenue—about 28 billion USD per year [24]. In this study, Textile and Fabrics factories have maximum fine counts of 1234 out of total 2622 fine counts; 47% of total fine counts. For a similar reason, the Real Estate and Construction, Brick Kiln, and Other Private Organizations are also growing rapidly and contributing to pollution more. Fig-4.4 shows the comparison of the sum of fines against the type of factories. It clearly shows the significant dominance of textile sectors over other types of factories. Various types of violations are observed in the factories. To analyze the trend of violations, fines are categorized into 34 major violations as shown in Table 4.2. Violation 1,2,3,4, 9, and 26 are significantly more than other types:

1. Untreated effluent, no ETP. (Violation No. 1)
2. Untreated effluent, non-functional ETP. (Violation No.2)
3. Untreated effluent, defective ETP. (Violation No.3)
4. No site/Environmental clearance. (Violation No.4)
5. No site clearance, factory in residential, prohibited areas, and ECAs. (Violation No.9)
6. Invalid/Environmental clearance expired, untreated effluent, defective ETP. (Violation No.26)

Fine counts of 34 types of violations are shown in histogram of Fig-4.5. Violation 1,2,3,4, 9, and 26 have been found more than other types of violation.

Table 4.2: Fines Levied as per Violation

Violation	Count of Fines (N)	Mean (USD)	Median (USD)	Sum (USD)	Minimum (USD)	Maximum (USD)	Std. Deviation (USD)
1	179	17965	10198	3215745	45	354297	29917
2	323	21617	12374	6982439	118	265156	29595
3	446	12261	5892	5468248	6	179127	19434
4	346	9164	2361	3170761	13	320544	23436
5	70	9359	3541	655159	590	161053	20846
6	16	23070	18148	369116	1142	63637	18677
7	1	11804	11804	11804	11804	11804	-
8	38	12564	6128	477421	295	59018	14509
9	219	6111	2951	1338375	236	306893	24854
10	66	12782	4223	843634	59	340368	43825
11	107	3735	2361	399623	177	46627	6641
12	85	2977	2361	253070	215	10926	2559
13	81	4556	3541	369046	472	23607	3188
14	62	5989	3541	371341	1180	118036	14566
15	6	246	236	1475	59	590	184
16	2	15298	15298	30597	1180	29416	19966
17	2	2361	2361	4721	2361	2361	0
18	3	8833	7082	26499	6197	13220	3825
19	2	17705	17705	35411	17705	17705	0
20	59	8753	5902	516433	236	63002	9912
21	31	2389	1180	74052	236	15624	3171
22	25	1195	1180	29863	59	3541	1044
23	13	478	472	6220	295	956	180
24	12	3375	2951	40497	113	11804	2863
25	4	1180	1180	4721	1180	1180	0
26	348	9217	2794	3207377	12	160591	17766
27	2	14633	14633	29265	5892	23373	12361
28	2	12302	12302	24605	5892	18712	9065
29	4	11296	7661	45186	402	29462	13652
30	32	10984	4408	351476	118	120869	22689
31	30	11631	5787	348939	118	89092	17757
32	3	11589	5892	34766	590	28283	14699
33	1	42425	42425	42425	42425	42425	-
34	2	3559	3559	7118	77	7041	4924
Total	2622	10979	3996	28787430	6	354297	22650

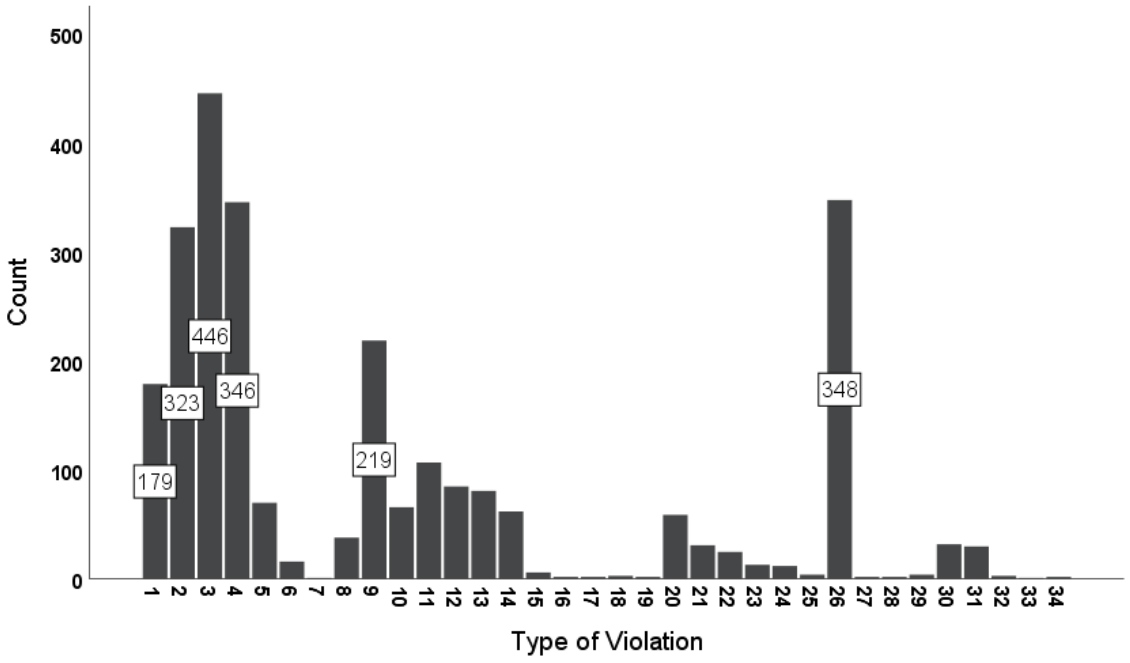


Figure- 4.5: Fine Count against Type of Violation

Mostly absence of ETP, non-functional ETP, and defective ETP are the primary types of violations. It is found that water pollution covers 36% of total pollution and it is mostly related to Textile and Fabrics. DoE being aware of the absence, non-functionality, or defective ETP, failed to enforce the effective use of ETP [24]. The absence of ETP may be attributed to the high cost of installation and lack of monitoring. Large factories may not face difficulties to install ETP, but small factories face difficulty in the installation of ETP. Here, assistance from the government as a subsidy may be effective. Like Tamilnadu, India Central ETP (CETP) may be established for a group of small factories; 25% of the cost was contributed by each of the central government and state government, 20% came from beneficiaries, and the rest was covered by bank loans [24]. The Non-functionality of ETP is found due to high operational cost and infrequent inspection. The major barrier for ETP running is high operational cost and high engineering cost. The factories know when the inspection would take place and it takes place twice or thrice a year. It is also found even if a factory is fined an average of 1,000,000 BDT twice each year, it would still be more

economical to pay the fine rather than running a wastewater treatment plant [24]. To ensure the functionality of ETP, frequent monitoring and levying fines must be ensured.

In Fig-4.6, the count of fines is shown against the different administrative divisions of Bangladesh as the spatial distribution of fines. Most of the fines incurred (2083 counts during 2010-2018) in the Dhaka division (79% of total fine) compared to the others because of the high density of industries in this division. Chattogram division has the 2nd highest counts of fines, however, it is almost 1/10th of the total counts of fines in the Dhaka division. It is not confirmed that DoE could reach all parts of the country equally. DoE needs 2000 manpower whereas it has only 600 manpower to conduct necessary monitoring, inspection, and enforcement [7]. Due to lack of manpower the authority is unable to inspect all divisions and the deduction about the geographical pollution is not comprehensive.

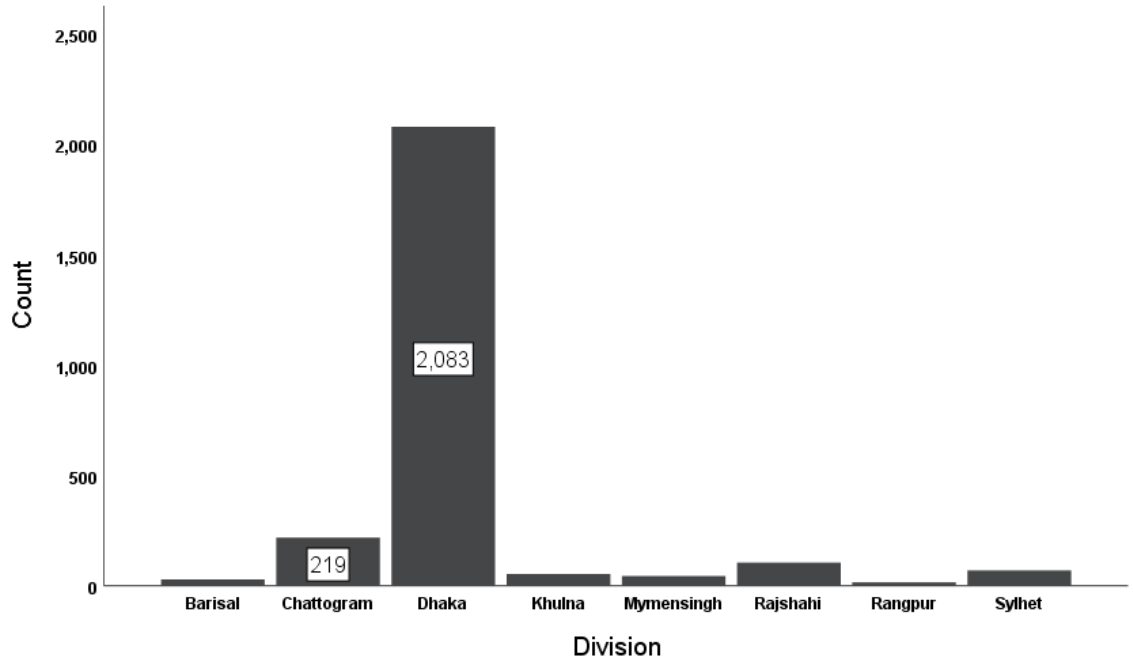


Figure- 4.6. Fine count for the Administrative Divisions

Table-4.3: Year-wise Fine statistics from 2010 to 2018.

Year	Fine Count (N)	Mean (USD)	Median (USD)	Sum (USD)	Minimum (USD)	Maximum (USD)	Std. Deviation (USD)
2010	146	10440	5607	1524286	118	82473	14850
2011	282	17671	5902	4983129	113	354297	41776
2012	375	11886	5902	4457380	354	88508	13725
2013	341	8791	3535	2997674	59	179127	16880
2014	419	13509	3541	5660111	590	320544	28313
2015	288	11595	4903	3339490	59	161053	20017
2016	232	10495	3541	2434902	6	160591	19771
2017	229	6409	3343	1467717	35	64400	9777
2018	310	6202	2656	1922742	15	167347	14331
Total	2622	10979	3996	28787430	6	354297	22650

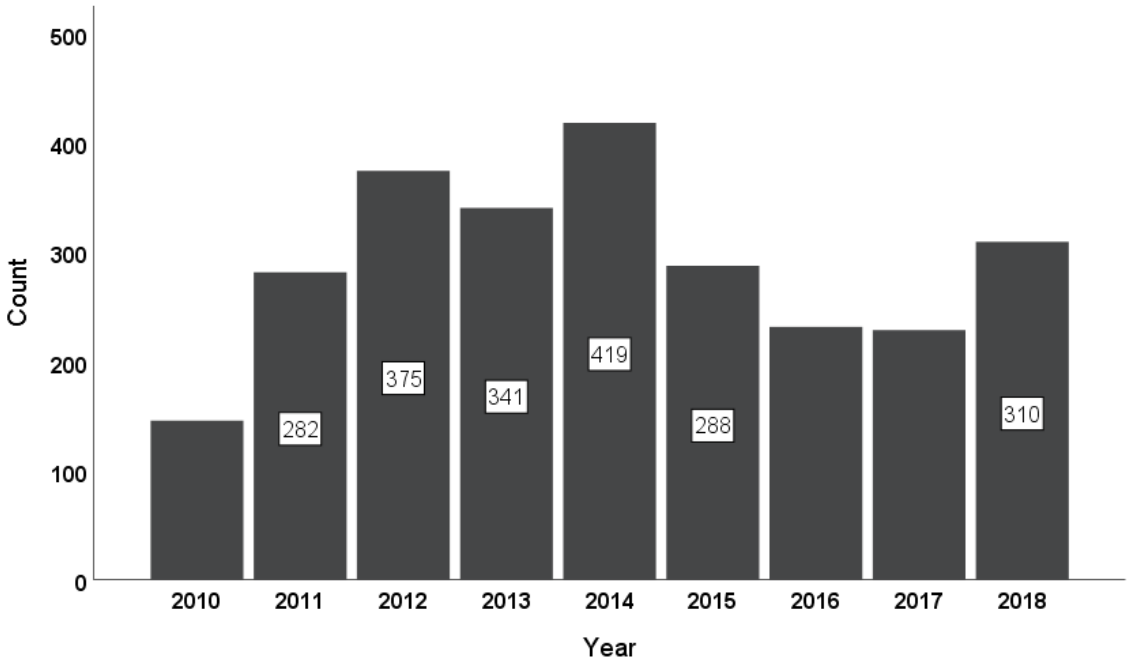


Figure-4.7: Fine Count against Years from 2010 to 2018

Fine statistics from 2010 to 2018 are shown in Table-4.3 and the comparative count of fines for each year is shown in Fig-4.7. In 2014, maximum fine counts (419) were found and maximum mean fine (13509 USD) was collected. In 2012, 2013, and 2014, there is an

average increasing trend in fine counts and collection. After 2014, both accounts decreased, though there was an increase in 2018.

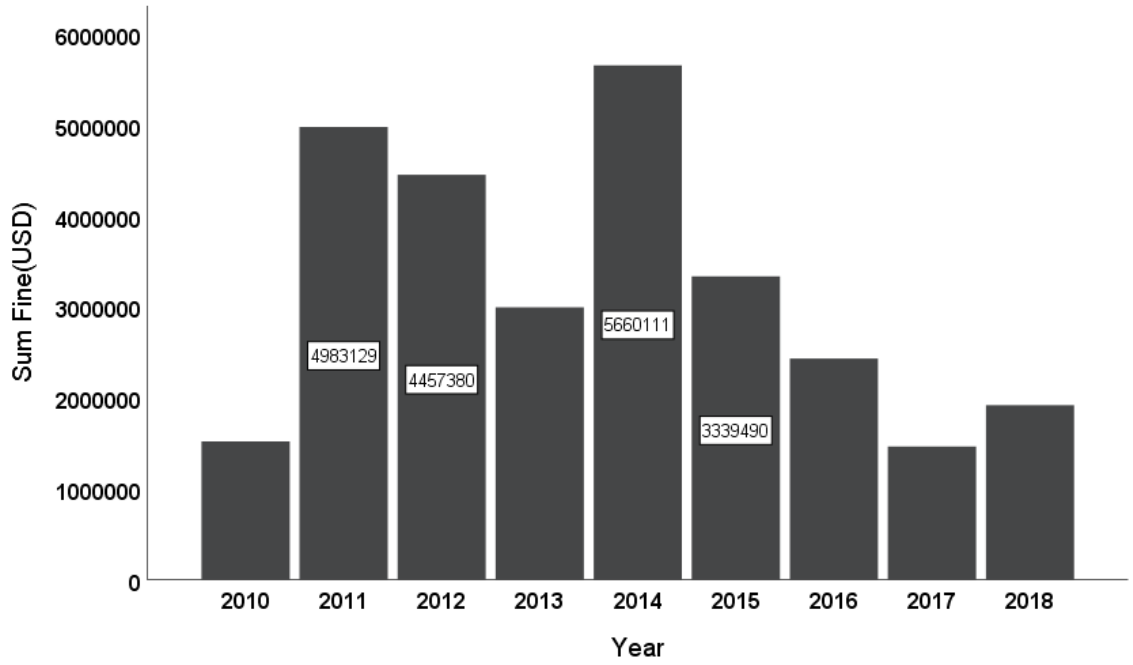


Figure- 4.8. Sum of fines in years from 2010 to 2018

In Fig.4.8 the sum of fines in each year is shown. Most fines were collected in 2011, 2012, and 2014. Later, the collection reduced gradually. The trend of levying fines was more in 2011, 2012, and 2014. Later levying fines was reduced gradually. The reason for most fines in these years is not known. However, it is presumed that DoE was more active in these years with available manpower. The gradual decrease of fines after 2014 may indicate either overall pollution standard improved or enforcement measure was not conducted properly.

Table-4.4: Fine Characteristics in Different Environmental Sectors

Pollution	Count of fines (N)	Mean (USD)	Median (USD)	Sum (USD)	Minimum (USD)	Maximum (USD)	Std. Deviation (USD)
Air	616	4774	3541	2940621	177	118036	7210
Water	1442	15243	6102	21979769	6	354297	26121
Others	347	6687	2361	2320400	35	306893	19576
Hill	66	12782	4223	843634	59	340368	43825
Wetland	60	7222	2951	433325	113	59018	11778
Sound	91	2964	2361	269682	215	10926	2544
Total	2622	10979	3996	28787430	6	354297	22650

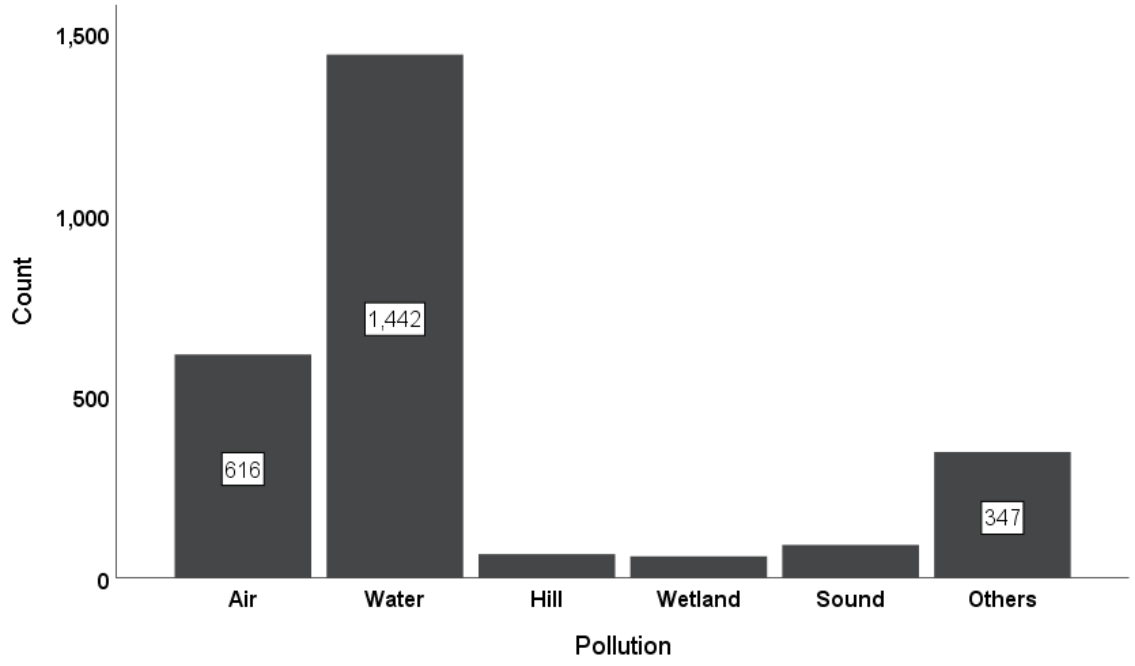


Figure- 4.9. Fine Count against Different Environmental Sectors

From Fig.4.9 it is found that air pollution (n=616) and water pollution (n=1442) were attributed to most counts in fines.

4.2 The Trend of Fines for Violations

While analyzing the fines as per the type of factories, it is found that TEX (textile and fabrics), RCL (real estate), BRI (brick kiln), and PRI (other private factories) are fined maximum. Again, analyzing the fines as per violations it is found water pollution-related violations are more than others. To investigate further, pollution fines are analyzed for major violations.

Table-4.5: Fines for Violation-3 (Untreated Effluent, Defective ETP)

Type	Count of fines (N)	Mean(USD)	Median(USD)	Std. Deviation
TEX	319	14961	7071	21962
PAP	25	11808	9386	11086
PHA	20	1425	599	2079
SHI	1	2361	2361	-
CHE	8	3485	2756	2814
POW	1	3010	3010	-
FBE	20	3416	1556	3998
PAI	1	6445	6445	-
HCF	1	8442	8442	-
BRI	6	7555	5123	8616
STE	6	1914	1440	1244
FOU	6	10861	6598	10001
ELE	12	3751	2042	4140
PRI	16	4539	4438	3973
CEM	4	3954	3093	2546
Total	446	12261	5892	19434

For Untreated Effluent and Defective ETP (violation-3), TEX (Textile and fabrics) was fined maximum (n=319). The mean is 14961 USD. Considering the mean value of fines, TEX and PAP are also fined maximum. In Fig- 4.10 (a) and Table 4.5, it is shown that for violation-3(Untreated effluent and defective ETP) also, TEX and PAP are more fined than other factories. TEX and PAP have pollutions related to water pollution which causes maximum pollution.

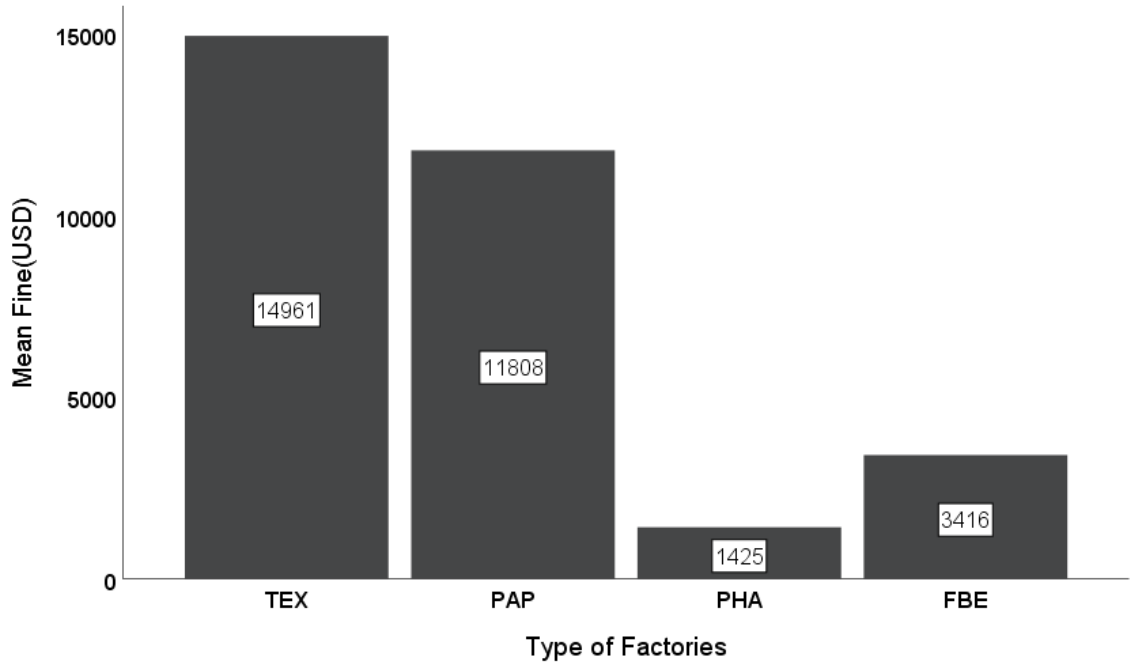


Figure-4.10(a). Mean fines for untreated effluent and defective ETP

Table-4.6: Fines for Violation-4 (No site/ Environmental clearance)

Type	Count of Fines (N)	Mean(USD)	Median(USD)	Std. Deviation
TEX	79	14064	4131	40222
TAN	2	4131	4131	2504
PAP	16	10730	2361	15027
PHA	4	16391	3244	28458
SHI	13	2550	1180	2430
CHE	8	2796	2361	2274
POW	1	6197	6197	-C
FBE	9	18558	590	47407
PAR	7	3204	1180	4348
HCF	22	1772	1180	1852
RCL	76	11491	4977	16315
BRI	9	13066	5902	15038
STE	9	10516	3541	13678
SHO	6	14656	6492	18590
TOB	2	12984	12984	15024
FOU	11	2726	1180	3579
ELE	13	4765	2361	9345
FUE	2	1771	1771	835
PRI	45	2388	1771	2306
POU	10	7329	1180	15010
CEM	2	24197	24197	32551
Total	346	9164	2361	23436

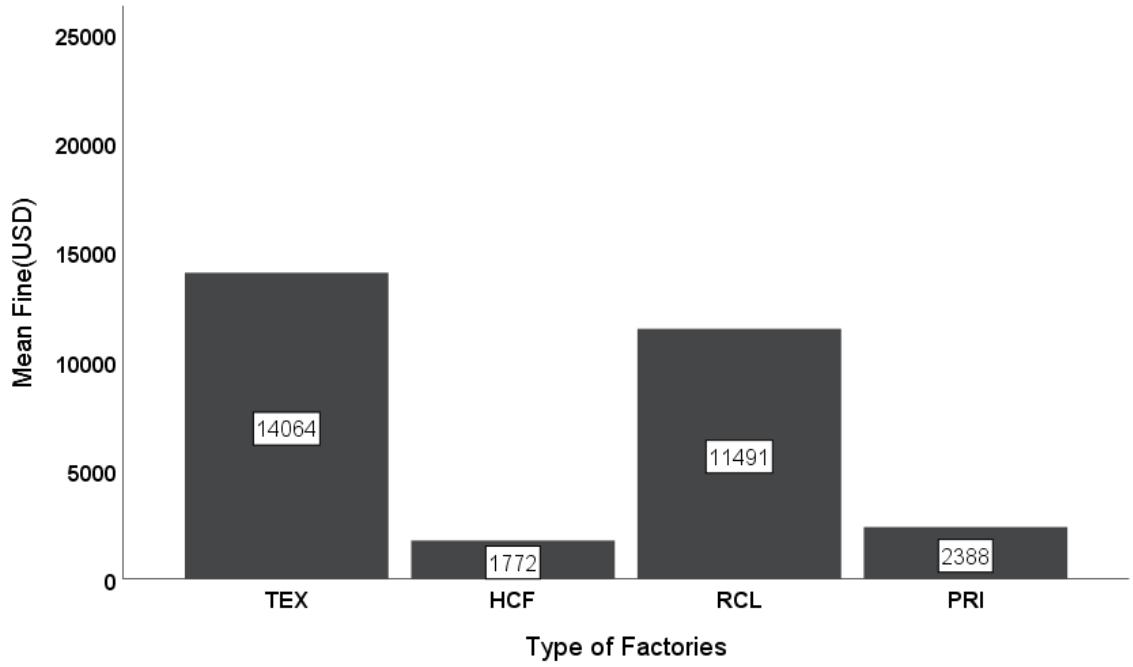


Figure-4.10(b): Mean fines for 'No site/Environmental Clearance'.

In Fig. 4.10 (b) and Table 4.6, it is shown that TEX and RCL are significant in the count of fine for violation-4 (No site/Environmental Clearance). For both the violations, Textile and Fabrics factories are fined maximum times.

4.3 Comparison- Fines for Textile Sector Vs Fines for Non-Textile Sector

Textile and Fabric factories are rapidly growing in the last few decades. It is found that Textile and Fabrics factories were fined more than any other factories. Moreover, violations related to Textile and Fabrics factories have been observed more than in other factories. There may be special consideration for levying fines to Textile and Fabric factories or the fines are levied arbitrarily. To investigate this, fines for Textile and Non-textile factories are tested. Welch's two-sample t-test is carried out.

Table-4.7: Characteristics of Fines for Textile Vs Non-Textile Factories

Type	Fine Count (N)	Mean (USD)	Median (USD)	Sum (USD)	Minimum (USD)	Maximum (USD)	Std. Deviation (USD)	Variance
Textile	1234	15686	5902	19356510	13	354297	28344	803367469
Non-Textile	1388	6795	2951	9430921	6	340368	14767	218060446
Total	2622	10979	3996	28787430	6	354297	22650	513027376

In Table 4.7, the count of fines for Textile factories (1234) is less than that of non-textile factories (1388). But the standard deviation of textile factories is higher than that of non-textile factories. Textile factories are fined more arbitrarily.

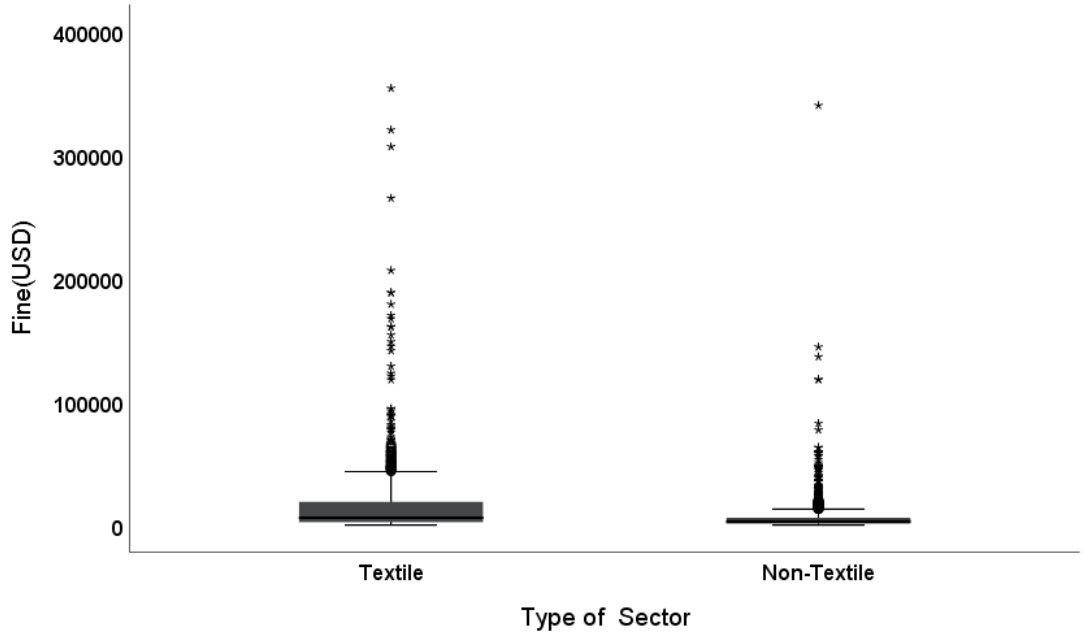


Figure-4.11: Fines for Textile vs non-textile Box Plot

In Fig.4.11, the box-plot shows the presence of outliers in the fines for textile, which mainly caused the variances in the data. It is also shown in Fig-4.1 that the data of fines are not normally distributed. Use of statistical tools are difficult when the fines are not normally distributed. Therefore, the fines are transformed by taking natural log for analysis. Here, t-tests are done for both actual and transformed data.

In t-test for Textile sector Vs Non-textile sector, the null hypothesis (Ho); the mean fine (μTex) for Textile is equal to the mean fine (μNon-Tex) of non-textile, μTex=μNon-Tex. The alternative hypothesis, (Ha); the mean fine for Textile is not equal to the mean fine of non-textile. Since the estimated t-test value (10.23) does not lie in between the range of critical values (-1.96, 1.96); we may reject the null hypothesis. It implies that there exists a significant difference between the mean fine for textile (μTex) and the mean fine for non-textile (μNon-Tex). Since the calculated p-value is hugely less than the level of significance (α=0.05); we may reject the null hypothesis. The 95% Confidence Interval (CI) for the difference between μTex and μNon-Tex is (7187, 10596); which does not contain the null value of '0', therefore we may reject the null hypothesis. So, the mean fine for Textile and Fabrics is not equal to the mean fine for non-textile factories. Similar results are obtained for the transformed data. While analyzing the fines for a few specific violations, it is found that Textile and Fabrics factories are fined maximum times. But t-test result reveals that the mean fine for Textile and Fabrics is not equal to the mean fine for non-textile factories. It may be deduced that DoE has been fining Textile and Fabrics factories with different rate. It contradicts with the finding of Haque (2017) which found mean fines were equal.

In Fig. 4.12, for Textile and Fabrics factories, the number of fines in 2010 was 53 and it increased in subsequent years. It became 244 in 2014 and gradually decreased again. For Brick Kiln and Ceramics, the number of fines is 12 in 2010 and it increased to 123 in 2012. It reduced gradually and was the lowest in 2015. Again it gradually increased and reached up to 63 in 2018. But the number of Brick Kiln and Ceramics factories was never reduced and the number of factories was increasing keeping pace with the growing economy. For other Private Industries and Companies, the statistics are fluctuating. The count is 16 in 2010, 44 in 2011, and 23 in 2012. The irregular pattern of the count of fines

4.4 Time Series Analysis for Predominant Factories

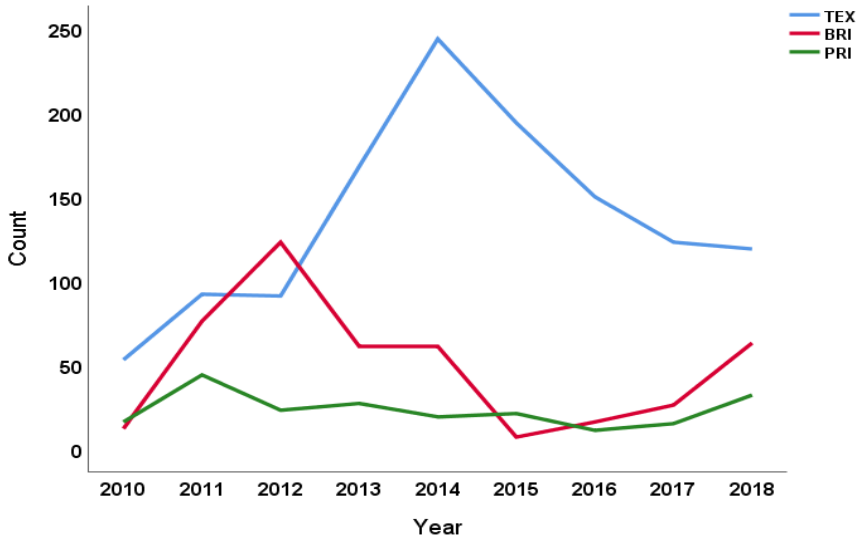


Figure-4.12. Year-wise fine for Textile and Fabrics, Brick Kiln and Other Private Factories

in subsequent years doesn't show the progress of effective pollution control. It indicates the demand for revision of enforcement measures.

For Untreated Effluent and Defective ETP (Fig-4.13), the trend of pollution fines over the observation period has gradually increased. As more pollution occurred for Textile and Fabrics factories, the trend of pollution related to these factories has also increased.

A similar trend is also observed for the violation of 'No Site/Environmental Clearance' for the same rationale (Fig-4.13). For Invalid/ Expired clearance, Untreated Effluent, and Defective ETP, the trend was upward up to 2015 and it was downward after 2015. As it was downward after 2015, it is presumed that the enforcement measure became effective after 2015, or the required enforcement measure was not conducted during the period.

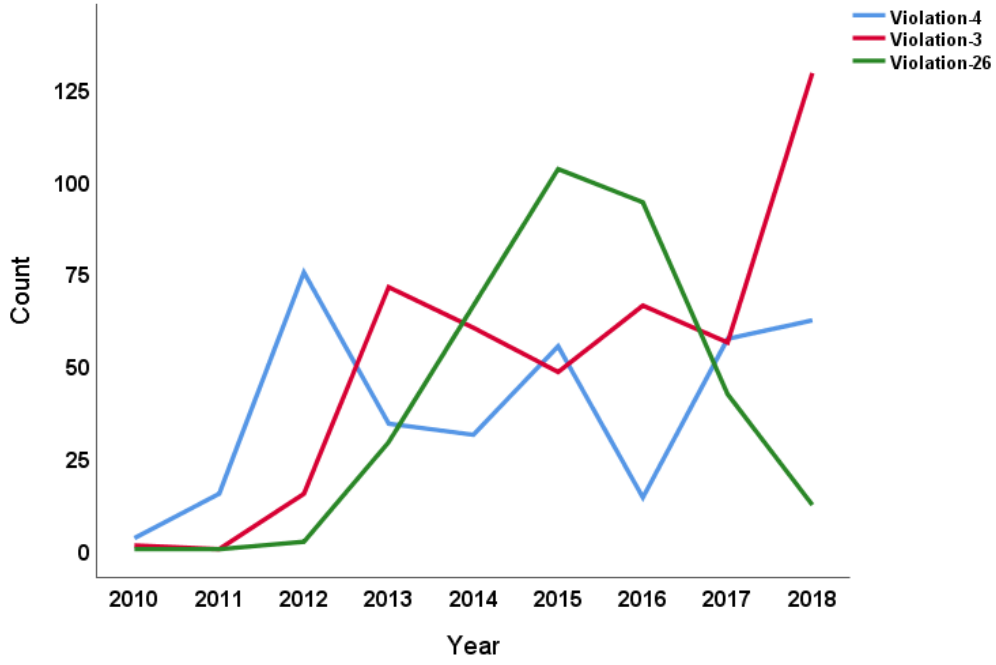


Figure-4.13. Year-wise fines for Violation 3, 4 and 26

In Fig 4.14 (a), fines for water pollution gradually increased from 2012 and it was maximum in 2014. Later it gradually decreased in the following years [2]. The authority from 2012-2014 might be more concerned about the violations of regulations and levied fines extensively. It may be mentioned that the catastrophic Rana Plaza, Savar was collapsed in 2013. It might influence the authority to be more strict and concerned during that period. It may be presumed that the pollution state has been improved gradually after 2014. Over the observation period (2010 to 2018) the fine counts do not give a clear impression about the progress of pollution control. When the fine count is decreased the pollution standard must be improved. But, later, it is found that the fine count is increased again.

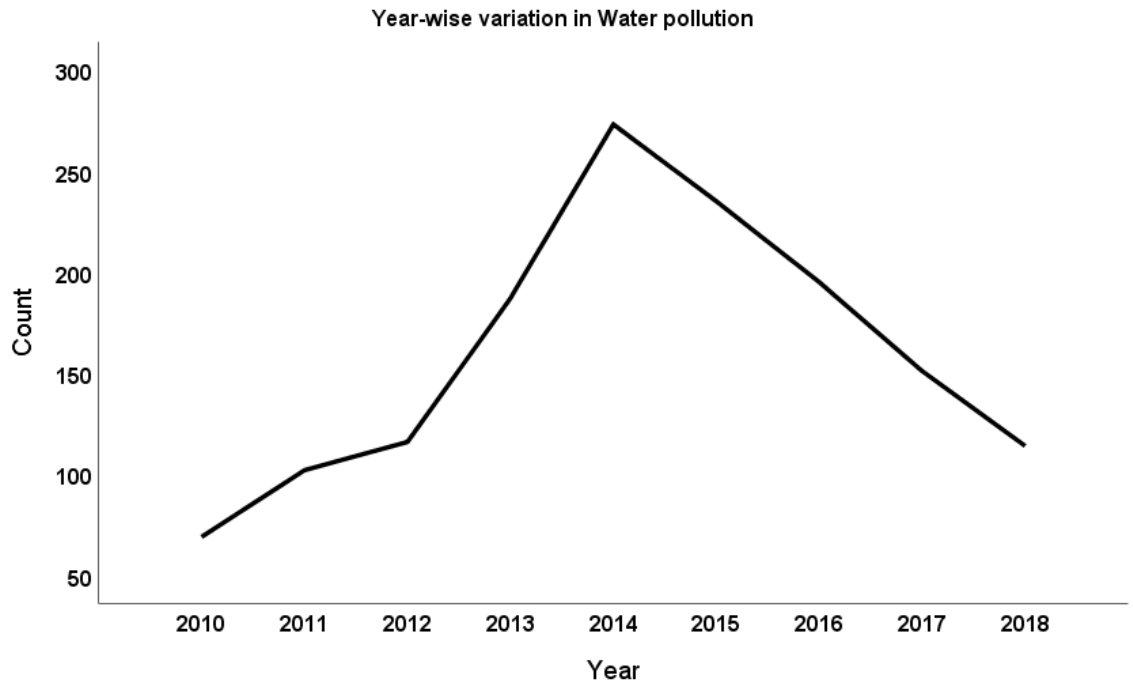


Figure 4.14(a): Year-wise fines for water pollution

The summary statistics in the figure and graphs demonstrate substantial variance in environmental monitoring and enforcement. It indicates that monitoring and enforcement were not executed properly and it must be reviewed for progressive control of pollution. In Fig 4.14 (b), the DO of the Buriganga River was less than 3 mg/L on average even after 2014 [2]. The statistics of pollution fines and corresponding DO level is quite misleading. It may be deduced that the state of pollution did not improved and the required pollution fines were not levied properly by DoE.

In Fig. 4.15 (a), year-wise fines for air pollution trend over the period is shown and it also does not project any impression about the effectiveness. But the air quality index shown in Fig.4.15 (b) shows the 'Very unhealthy to Extremely Unhealthy' state of air quality. It indicates the enforcement measures could not improve the air quality in this period.

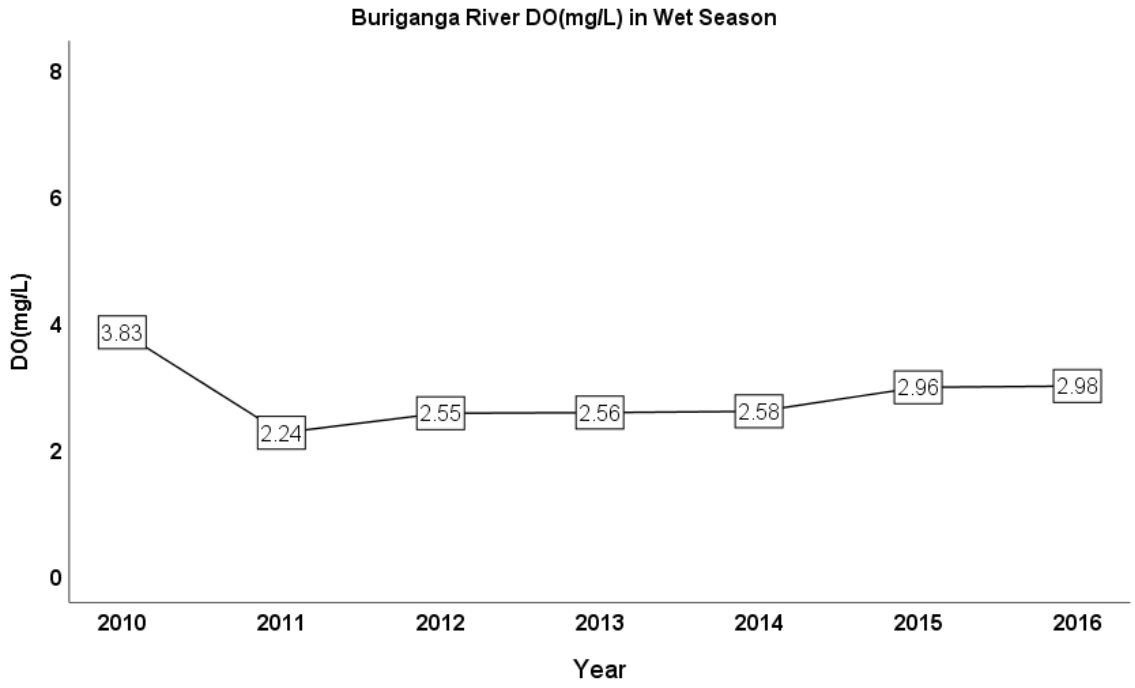


Figure 4.14 (b). Year-wise DO of Buriganga River

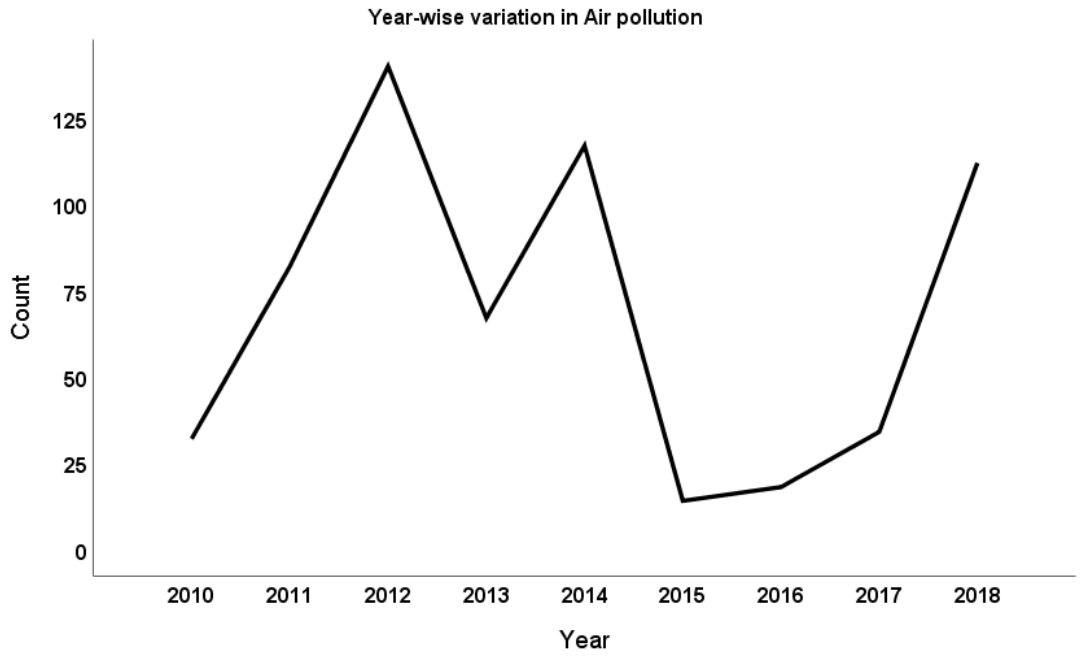


Figure-4.15(a). Year-wise fines for air pollution

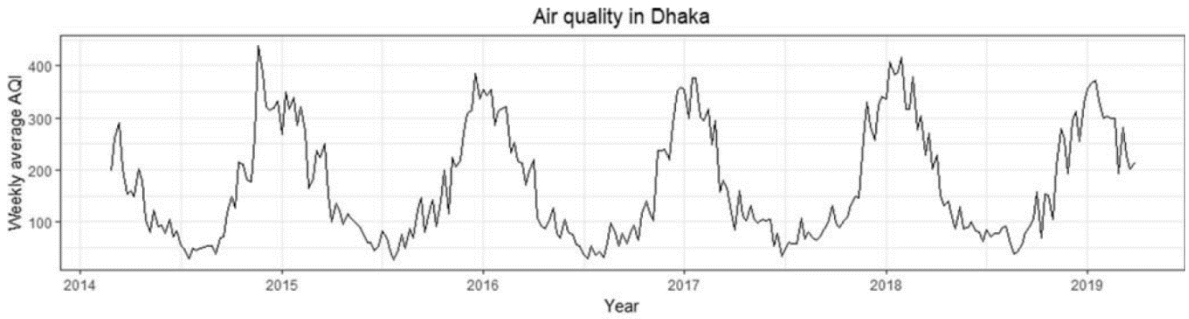


Figure-4.15 (b): Year-wise Air Quality Index of Dhaka city [25]

Table-4.8. Air Quality Standards

Moderate	51-100
Caution	101-150
Unhealthy	151-200
Very Unhealthy	201-300
Extremely Unhealthy	301-500

4.5 Repeat Offenders

Table-4.9: Repeat Offenders state from 2010-2018

Serial	Repeat Number	Number of Factories (n)
1	2 times	201
2	3 times	32
3	4 times	8
4	5 times	2
5	6 times	1

Strict monitoring and effective enforcement generate deterrence which improves the compliance status of the polluting factories and prevents the repetition of violations. The presence of Repeat Offenders indicates the failure to achieve deterrence among the polluters. In this empirical study, 201 factories were found repeating the violation 2nd time

and 32 factories were found repeating 3rd time. Most of the repeat offenders are Textile and Fabrics factories and located at Dhaka division. But the levied fine could not generate the required deterrence among the polluting factories. If the pollution fine is less than the abatement cost, it will not be able to achieve deterrence. It is necessary to investigate the difference between the fine amount of 1st time and 2nd-time offence.

Fig-4.16 shows the box plot of mean fines of 1st and 2nd-time instances of offences. The mean values are almost equal. It is required to conduct t-test to find the difference between mean fines of 1st and 2nd time. In the t-test for 2nd time offender, the null hypothesis, H_o: no difference of fines between 1st and 2nd-time offences and alternative hypothesis, H_A: Difference exists between mean fines of 1st and 2nd-time offences. Since the calculated p-value (0.529) is greater than the level of significance (α=0.05) and it contains the null value of '0' (-3305 to 6422), we may accept the null hypothesis. It means there is no difference between the mean fines of 1st and 2nd-time offence.

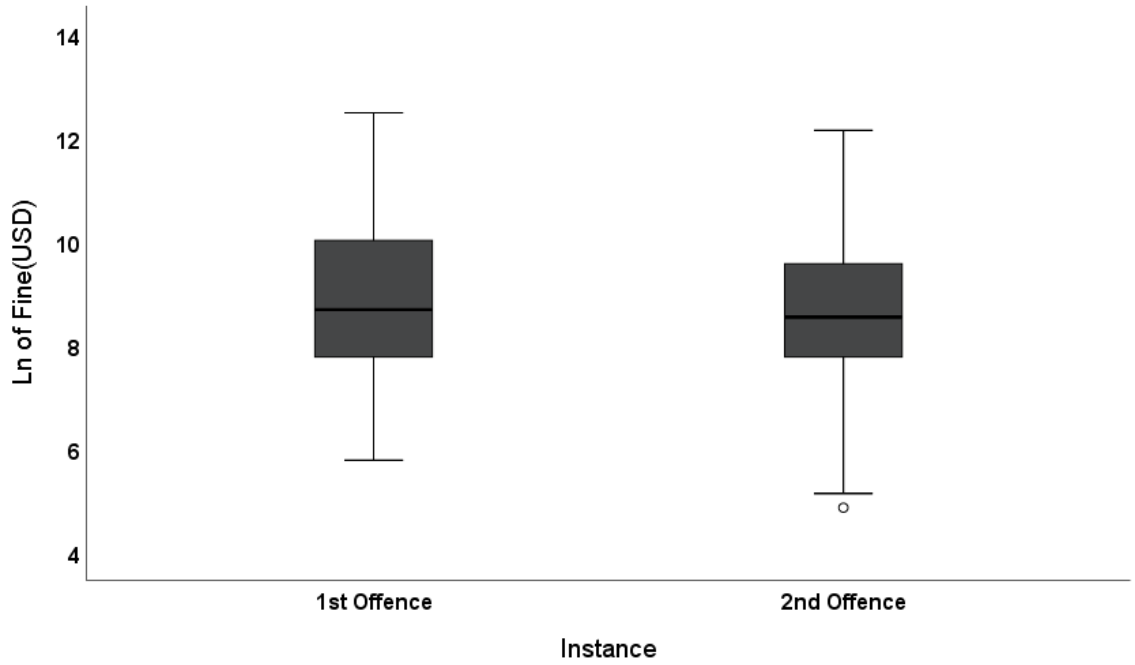


Figure-4.16: Difference of fine between 1st and 2nd Time Offender

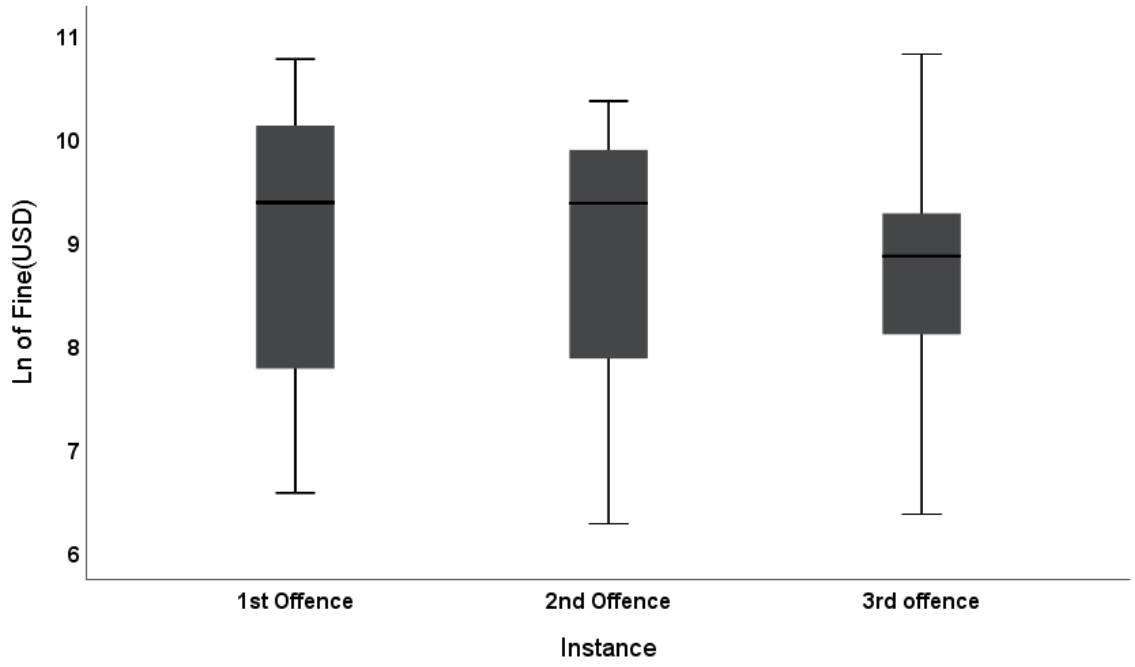


Figure-4.17: Mean fines of 1st, 2nd, and 3rd Time Offender

In Fig.17, the mean fines of 1st, 2nd, and 3rd-time offenders are shown. Polluting factories are fined repeatedly after 1st time fine. If the fine amount is the same or less than the 1st time fine, it may not create any deterrence. Analysis of Variance (ANOVA) may be tested to find the difference among the 1st, 2nd, and 3rd-time offenders. Here, the Null Hypothesis, Ho: No difference among mean fines of 1st, 2nd, and 3rd-time violation and the alternative hypothesis, Ha: Difference exists. Since the calculated p-value (0.192) is greater than the level of significance (α=0.05) and the difference is insignificant; the null hypothesis is accepted. It means there is no difference among mean fines of 1st, 2nd, and 3rd-time offenders. So every year fines are levied and it could not stop pollution creating deterrence among factories. Repeat offenders or frequent violators may have higher compliance and abatement cost. It is less likely to respond to compliance activities if it exceeds the fines levied for violation [26]. More research is needed to find the root causes of the repeat offences and take appropriate enforcement measures.

4.6 Application of the Polluter Pays Principle (PPP) in Bangladesh

Bangladesh incorporated PPP through the enactment of ECA 1995 and ECR 1997. DoE formulated a regulatory framework and policies for enforcement measures. Accordingly, DoE conducts inspections and fines are levied against the polluting factories. Fines levied across the observed years for different factories could not reduce the pollution level. It is found that fines were levied arbitrarily. The calculation of fine may not include the cost of pollution as mentioned in PPP. Therefore, the amount of fine is less than the abatement cost and the factory is more comfortable to pay the fine rather complying with the regulations of DoE. Violations of all factories do not appear to be reduced over the observation period. According to PPP, polluters should pay for the pollution. Here it is not followed properly.

According to PPP, polluter has to bear the cost of administrative arrangement required for controlling the pollution. Policy guidelines for fines might have included the cost of the administrative arrangement. Fines levied arbitrarily without effective deterrence cannot claim that the required cost as per the guideline of PPP was ensured. Moreover, Polluter has to bear the cost for any residual pollution as per PPP. But the fine structure mentioned in the Office Order of DoE does not make an impression that the cost of pollution control is included in fine. Necessary deterrence could not be achieved, after levying fines on factories. As the overall pollution standard is not improving by the present enforcement measure, the fine structure should be revised following conditions of PPP.

There are various tools for implementation of PPP; Command and Control Law, Market-based Instruments, and Soft Law. In Bangladesh, DoE implements the enforcement of rules through the administrative arrangements of the department and law enforcing

agencies. Police and courts are also integrated with the system to effectively implement the regulations. So, Command and Control Law is implemented partly in Bangladesh.

PPP is an internationally recognized way to control pollution. It is partly followed in Bangladesh. Through effective enforcement measures and proper use of laws and policies, PPP can be implemented in Bangladesh.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

Even though the industrial sector is significantly contributing to the economic development of Bangladesh, it is important to evaluate the pollution control of the factories for sustainable progress. DOE has been monitoring and enforcing pollution control with policies using its inadequate manpower. To evaluate the pollution control measure, fines for nine years were analyzed by using SPSS. Large differences of mean fine and difference of standard deviation indicated the arbitrariness of fines. Among all the factories, Textile and Fabric, Real Estate and construction, Brick Kiln and other Private Organization were found to contribute the most pollution. DoE levied maximum fines against textile and fabric factories. While investigating the violations, it was found that textile and fabrics have more violations than others. Therefore, textile and fabrics were tested against non-textile factories for the amount of fine. It was found that DoE levied different amounts of the fine against textile factories, however it was not effective at all. While investigating with different geographical locations, it was found that Dhaka division had experienced maximum violations. A Separate strategy for applying enforcement of pollution control for Dhaka division needs to be adopted.

Different factories were found repeating the violations during the observation period. By testing it was also found that fines for 1st, 2nd and 3rd time offence were equal. It reveals that fines could not make any significant deterrence. Provision of fines should be revised aiming to achieve deterrence.

Polluter has to bear the cost of pollution control as per PPP. The fine should include the administrative arrangement for pollution control also. The fine structure of DoE, as mentioned in the Office Orders, does not apparently make an impression that the amount

of fine includes the cost of pollution control. As Such, the fine is less than the abatement cost of any pollution. It needs further research to estimate the amount of fines which includes the cost of pollution control. PPP is partially implemented in Bangladesh.

Following conclusions are drawn from this study:

- Data of fines vary significantly. A large difference was observed between mean and median, minimum and maximum fines along with their standard deviations. The maximum fine was found as 59000 times than that of the minimum fine. It indicates the arbitrariness of imposing fines.
- Industries like Textile and fabrics, Real estate and construction, Brick Kiln and Other Private organizations were observed to enforce fines maximum times (i.e. 78%).
- Textile and Fabrics factories predominantly make violations in water pollution (i.e. 36%) whereas Brick kilns contribute mostly to air pollution.
- Industries of Dhaka Division have experienced the maximum cases of violations (79%) and therefore needs a separate enforcement strategy.
- Enforcement of fines for Textile and non-textile factories should be treated differently. Effective enforcement should be ensured.
- Time series analysis for the type of factories and violation across the observation period demonstrate an irregular pattern.
- Violations in subsequent years do not portray the effectiveness of the enforcement measures. Therefore, the enforcement measure should be restructured for the gradual reduction of pollution.

- There was no difference in fines for all types of repeated offenders and therefore targets of pollution prevention could not be achieved. It needs a modification of the traditional enforcement system or adoption of alternative regulatory strategy.
- PPP has been partially implemented in Bangladesh. Policy guidelines should be reviewed and manpower organogram should be reformed to implement PPP effectively.

Recommendations

Following recommendations are proposed:

- Current Enforcement measures in pollution control are completely arbitrary in nature. This is not sufficient enough to control pollution. The fines should be revised and restructured based on actual pollution impact so that it deters polluters. Revision of traditional monitoring, enforcement system and alternative regulatory strategies may be adopted.
- Monitoring of Textile factories frequently may be more emphasized in monitoring and enforcement strategy. Textiles industries must have functional ETPs. Further study may be conducted to find root causes of factories having no ETP or non-functional ETP.
- Repeat offenders should be penalized differently to achieve deterrence. Further study is required to find the causes of repeat offences in Bangladesh context. The turn- over and the abatement cost should be considered while imposing fines on the polluting factories.

- PPP should be effectively applied in Bangladesh like other countries. Revision of policy guidelines and strengthening with required manpower will enable DoE to implement PPP effectively.

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