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BANGLADESH DELTA PLAN 2100 FORMULATION PROJECT

Environmental Pollution

Baseline Report on Environmental
Pollution

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Executive Summary

Introduction

The environmental quality of Bangladesh is degrading severely with rapid economic growth of the country. Unsustainable development process, anthropogenic activities and the changing climate has created serious strain on the environmental quality. Severe degradation and pollution of air, water, and soil are not only threatening the ecosystem and public health, but also restraining economic growth. Hence, controlling air, water and soil pollution is increasingly getting priority in the development goals and plans of the country. Moreover, environmental pollution control for safeguarding the environmental quality is associated with the goal of Millennium Development of ensuring environmental sustainability.

Review of Existing Policy

Environmental pollution control is emphasized in several policies, acts, strategies and plans of Bangladesh. The National Environmental Policy, 2013 signifies the necessity of controlling air, water and industrial pollution. However, it does not mention anything about controlling soil pollution. Water pollution is discussed in National Water Policy and Bangladesh Water Act, 2013. National Land Use Policy, 2001 very briefly mentions the area of soil pollution. Instead of this, there is no other separate policy or act for controlling soil pollution. There is no separate law or policy for controlling air pollution too. However, controlling air pollution from brick kiln is mentioned in an act named "Preparing Brick and Establishing Brick Kilns (Control) Amendment. 2013." For conserving environment, developing environmental standards and controlling and abating pollution, The Bangladesh Environmental Conservation Act of 1995 was promulgated, which (and its amendments) is currently the main legislation in relation to environmental protection of the country. In order to address the waste management issues and reduce environmental, social and economic problem related to current waste management system, National 3R Strategies has been formulated. Moreover, Clean Dhaka Master Plan, 2005 and Action Plan for solid waste management in 19 towns of Bangladesh are some of the initiatives to address the waste management issues. Noise Pollution (Control) Amendment, 2004 was formulated to address the noise pollution issue of the country. Section 2 discusses these existing relevant policies, laws, plans and strategies and tries to find out the gap for improvisation.

Stakeholder Analysis

In this section relevant stakeholders with the theme of environmental pollution are identified and their roles are briefly discussed.

State of Environmental Pollution

The state of environmental pollution of Bangladesh is very severe. Bangladesh has fourth worst urban air quality among 91 countries according to WHO¹. From the analysis of the data of "Clean Air and Sustainable Development" (initiated by Ministry of Environment and Forest), it was found that the level of NO_x, PM_{2.5} and PM₁₀ was alarmingly high in the ambient air and the standard limit for these parameters were exceeded very frequently in different stations among the 11 continuous air monitoring stations. Additionally, from the analysis of the data, it was found that, the air quality of the dry seasons is much worse than the wet seasons.

¹ <http://www.thedailystar.net/bangladesh-4th-most-polluted-in-world-23348>

In case of water pollution also the scenario is very alarming. Pollution from industries, agricultural activities, sewerage, ships, transboundary sources are making the rivers more and more polluted day by day. For understanding the state of pollution of the river water, 13 rivers beside the major cities were selected and pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD₅) and, Chemical Oxygen Demand (COD) parameters of the selected rivers were analyzed. Almost all the selected rivers were found polluted to some extent in this analysis. DO and BOD were two major parameters which were not within limit in most of the selected rivers.

Though soil pollution is another major environmental concern, this issue is not recognized properly in different policy documents. Soil pollution is closely linked with water pollution. Improper disposal of solid waste is also responsible for soil pollution. Agricultural activities, ship breaking industries, industrial effluent etc are other major causes of soil pollution. Arsenic contamination is another major issue in this regard. However, more emphasize should be given on this sector.

Waste and Wastewater Management in Major Cities

Though solid waste management and sewerage treatment are daunting problems, especially of the urban areas of Bangladesh, these sectors are not properly noticed. Per capita waste generation rate of Bangladesh is not clearly known but according to estimation by waste concern, it was 0.41 kg/capita/day in 2005. However, in urban areas the rate was estimated 0.5 kg/capita/day in 2004. The rate of waste generation shows an increasing trend with time and economic development. It is also seen that the generation rate of waste is generally higher in high income group as their purchasing power is more than the other income groups. In the existing system of solid waste management of Bangladesh informal sector, community initiative and formal sector work together. However, the solid waste management system in Bangladesh is not sufficient and sustainable.

Ongoing National Scale Programs and Projects

Few national scale projects relevant to environmental pollution are identified. Some of the mentionable projects are "Clean Air and Sustainable Development", "Market Development Activities for Bondhu Chula", "Extension and Modernization of Divisional Laboratory of DoE", "Chittagong for enhancing capacity of monitoring and examining the impact of climate change", "CDM Using Municipal Organic Waste of Towns(City Corporation/Municipalities) in Bangladesh", "Implementation of 3R (Reduce, Reuse and Recycle) Pilot Initiative (Phase-1)", "Institutional Strengthening for the Phase-out of Ozone Depleting Substances (Phase-VI)", "Conversion from HCFC-141b to Cyclopentane technology in the manufacture of insulation foam in domestic refrigerators at Walton Hi-Tech Industries Ltd, Bangladesh", "Phase-out of CFC Consumption in the Manufacture of Metered Dose Inhalers (MDIs) in Bangladesh" etc.

Planning Contest

Bangladesh is facing some major issues and challenges in the field of retrieving environmental quality from the present degraded condition and future threats. Some of the major issues in the planning context of this field are growth of ship building and recycling industries in coastal and marine areas, restoration of polluted rivers, trans-boundary pollution, coal-based power generation, guiding landuse changes ensuring protection of natural landscape, bringing all waste and waste water in management process, cost recovery of waste water treatment plants and solid waste management plants, impact of channelization of major rivers on ecosystem and many more.

Interlinking with other Thematic Studies

Environmental pollution sector is interlinked with other thematic sectors of the Bangladesh Delta Plan, 2100. For instance, air pollution is closely connected with industrial activities, transportation system, land management system, agricultural practices, urbanizations, infrastructures, etc and water and soil pollution are related with other thematic studies such as water resources, river system management, climate change and disaster management, agriculture and food security, infrastructural development, industrial development, coastal polder issues, etc.

Knowledge Gaps

Significant knowledge gaps in the environmental pollution sector are encountered during planning process. Knowledge gap is more in the field of water and soil pollution sector than the air pollution sector. Lack of reliable data of water quality of major rivers, lack of data about soil quality, data gaps in the sector of air quality, absence of emergency response plan, inadequate knowledge on climate change related issues are identified as major sectors of knowledge gap in the context of planning.

Opportunities for Preparing Long-term Plan (BDP2100)

Preparation of long-term plan requires the incorporation of some strategic measures in the Bangladesh Delta Plan 2100 such as pollution monitoring, pollution prevention and control measures, emergency response plan development, treatment and management of waste water and solid waste, restoration of polluted environment, strategic change in other sectors interlinked with environmental pollution and financial mechanism development for pollution prevention, control and management.

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Acronyms

3R	Reduce, Re-use, Recycle
AQC	Air Quality Cell
AQI	Air Quality Index
AQM	Air Quality Monitoring
BBS	Bangladesh Bureau of Statistics
BCCTF	Bangladesh Climate Change Trust Fund
BOD	Biological Oxygen Demand
BRT	Bus Rapid Transit
BWDB	Bangladesh Water Development Board
CAMS	Continuous Air Monitoring Station
CASE	Clean Air and Sustainable Environment
CBO	Community Based Organization
CC	City Corporation
CDA	Chittagong Development Authority
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFC	Chloro Fluoro Carbon
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DoE	Department of Environment
DPHE	Department of Public Health and Engineering
ECA	Environment Conservation Act
EIA	Environmental Impact Assessment
EPZ	Export Processing Zone
EQS	Environmental Quality Standard
FAO	Food and Agricultural Organization
FOB	Foot Over Bridges
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für International Zusammenarbeit
HCFC	Hydro Chloro Fluoro Carbon
HFA	Hydrofluoroalkane
HPMP	HCFC Phase out Management Plan
JICA	Japan International Cooperation Agency
KCC	Khulna City Corporation

KDA	Khulna Development Authority
MDI	Metered Dose Inhalers
MLF	Multilateral Fund
MoEF	Ministry of Environment and Forest
NEMAP	National Environmental Management Action Plan
NEP	National Environmental Policy
NIPSOM	National Institute of Preventive and Social Medicine
NO₂	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NSDS	National Sustainable Development Strategy
NWMP	National Water Management Plan
NWRD	National Water Resource Database
O₃	Ozone
ODS	Ozone Depleting Substances
PDD	Project Design and Documents
PIN	Preparation of Project Idea Note
PM	Particulate Matter
RAJUK	Capital development authority
RDA	Rajshahi Development Authority
SEI	Sustainable Environmental Initiatives
SO₂	Sulfur Dioxide
SO_x	Oxides of Sulfur
SPM	Suspended Particulate Matter
SRDI	Soil Resource Development Institute
STP	Strategic Transport Plan
SUT	Sustainable Urban Transport
SWM	Solid Waste Management
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WARPO	Water Resources Planning Organization
WHO	World Health Organization

1. Introduction

Environmental pollution is closely related with the process of overall economic development. The restoration of polluted rivers, prevention and mitigation of environmental pollution, and safeguarding the environmental quality are the challenging issues in integrated development planning. Safeguarding the environmental quality by controlling environmental pollution is interlinked with the goal of ensuring environmental sustainability under the Millennium Development Goal for Bangladesh.

The state of environment of the country is under pressure of unsustainable development, anthropogenic activities, and the changing climate. Severe air, water, soil and noise pollution are threatening human health, ecosystems and economic growth of the country. Air pollution is caused due to population growth, burning fossil fuels, industrialization and associated motorization. The surface water of Bangladesh is polluted due to industrial discharge. The ground water in different parts of the country has been contaminated by arsenic. The soil quality is highly degraded by uncontrolled use of chemical fertilizer and polythene. The residents of major cities of Bangladesh are also exposed to high level of noise pollution. Poverty, over-population and lack of sufficient awareness regarding the issue are said to be the common causes behind this present state of environment.

The environmental pollution especially water pollution, air pollution and soil pollution are increasingly getting priority in country's development strategies and Plans. Environmental degradation is affecting country's economic growth. Lack of proper implementation and monitoring of environmental rules hinder the achievement of environmental goals. There is a good initiative of enforcing installation of effluent treatment plant in industries but are still faraway from the effective operation and monitoring of these ETPs. Only the mega cities like Dhaka, Chittagong, Khulna, Rajshahi, etc have limited waste management and waste water treatment facilities.

2. Review of Existing Relevant Strategies, Plans and Policies

2.1. National Environmental Policy, 2013 (NEP, 2013)

The NEP 2013 has been formulated revising and updating the NEP 1992 with the aim of integrating environment conservation and management in the mainstream of development. The NEP 2013 is based on 17 principal issues and 12 objectives. The NEP 2013 suggests 271 Action Plans for 23 sectors.

2.1.1. Principles:

The 17 principles of NEP, 2013 focus on population growth control, environmental protection, introducing scientific processes and considering environmental impacts and risks for acquiring, using and preserving natural resources and environment, valuation of natural resources and ecosystem services, considering the accessibility of local people and equity in case of using natural resources and eco-system services, decent and reasonable use of natural resources and reducing their wastage, sustainable use of renewable resources, poverty reduction and strengthening food security through biodiversity conservation, enforcing polluters pay principle, including the issue of preserving environment in all national level policy and ensuring their enforcement in public and private sectors, prioritizing preventive measures than curative measures in national level, including adaptive and mitigative strategies in all development plan and their implementation

related to combating impacts of climate change, considering climate change impacts and disaster management issues during the construction of any infrastructure in the country.

2.1.2. Objectives

Twelve objectives of NEP include provisioning natural balance and overall development through sustainable development and environmental conservation, reducing adverse impacts of climate change and decreasing the loss of natural disaster in the country, determining and controlling environment polluting and degrading activities, ensuring environment friendly development in all sectors, ensuring sustainable, long-term and environment friendly use of all national resources, emphasizing on mass awareness creation for conserving nature, establishing public-private partnership for improving environment, inaugurating and flourishing global and regional co-operation for improving global environment, mainstreaming environmental policies and strategies, creating competent population for combating against the challenges related to climate change and ecological sectors, assessing environmental impacts in all the necessary sectors, discouraging intrusion of alien and invasive species and taking decisions about them based on sufficient research.

2.1.3. Sectors

The action plans of the policies are elaborated under 23 different sectors such as (i) land (ii) water resources (iii) air (iv) food and potable water (v) agriculture (vi) health and health care provision (vii) accommodation, housing and urbanization (viii) education and mass awareness (ix) forest (x) biodiversity, ecosystem conservation and biosafety (xi) hilly ecosystem (xii) fisheries and animal resources (xiii) coastal and marine ecosystem (xiv) industry (xv) fuel and mineral resources (xvi) communication and transportation (xvii) ecotourism (xviii) population (xix) combating the impacts of climate change (xx) disaster management (xxi) science, research, information and communication technologies (xxii) other pollution control, and (xxiii) economic development. In this report, the action plans related to pollution and pollution prevention under the above mentioned sectors would be discussed.

2.1.4. Action Plans Relevant to BDP 2100 and Environmental Pollution

Though the first section, which discusses about land sector, emphasizes on sustainable land management, there is nothing about land/soil pollution.

In action plan seven and twenty three under the section water resources, it is mentioned that the water bodies and water resources should be kept free from pollution and illegal grabbing. This section emphasizes on protecting water resources. The policy requires necessary steps to restore and conserve the water bodies which have reached a delicate level due to continuous degradation. In necessary cases, the water bodies should be declared as protected area or ecologically critical area to accelerate the restoration process. The policy suggests about provisioning new industrial zoning for protecting the water bodies from possible pollution of industries. It also states that the water polluting industries have to have effluent treatment plant. Water monitoring system should be established for preventing pollution from different sources. Reevaluation of all types of development planning which are contradictory with the act of conserving river, water bodies and environment, is suggested in this section.

Management of air is discussed in the third section of environmental policy. Maintaining the air quality and keeping the pollutants within the limit is suggested in this section. It is also suggested to enforce law for maintaining the air quality and to upgrade the air quality standards if needed for improving the air quality. This policy restricts the importation of very old vehicles and makes it mandatory to obtain emission testing certificate before getting or renewing fitness certificate of the vehicles. It is also advised in this section to define quality standard of the fuels to be used in industries and vehicles and to strictly comply with that.

Moreover, the emission standard of specific industries and vehicles should also be set and maintained for improving the air quality. Emission tax should be fixed and collected for violating the defined standards.

Under the section four, the safety issues regarding food and potable water are mainly discussed. For preserving the water sources from pollution, it has been restricted to establish industries and/or dumping ground near the sources. All types of food which are adulterated, stale, contaminated, expired, polluted through radiation, mixed with artificial color and/or chemicals, genetically modified are prohibited to exportation, production, distribution, buying and selling.

Organic farming is encouraged in section five which discusses the environmental concerns related to agriculture. In order to reduce agricultural pollution it is encouraged to use organic fertilizer and organic pesticide. In the action plan 22 of this section it is advised to take proper measures to reduce the emission of methane from paddy field and to stop open burning of agricultural waste.

In the next section health and health care provision, it is mentioned that in all the activities in development sectors or other sectors should be prevented which can cause pollution, create imbalance in nature or threaten public health.

It is advised in the education and mass awareness section to encourage all the educational institutions to keep them pollution free and to take preventive measures for reducing the polluting activities. It is also suggested to provide incentive through honor to the best educational institution in terms of environmental development.

During conducting research in the field of genetic engineering to find out measures to reduce environmental pollution, it is instructed in biodiversity, ecosystem conservation and biosafety section to apply and follow all the rules related to biosafety.

For conserving the fish population and production in the Bay of Bengal it is instructed in section 12 to prevent all the harmful activities and measures should be taken to stop marine pollution. In section 13 also, it is suggested to take national and international level steps to control marine pollution.

Controlling industrial pollution is emphasized in this policy. In section 14, which talks about industries, it is briefed to take controlling measures to stop pollution from industries. The need of conducting EIA before establishing any new industry is also signified. It is instructed to prohibit the establishment of polluting industries and to gradually stop activities of already established industries which pollute the environment. Finding out alternatives to discourage the use of products from polluting industries is also suggested here. Introducing zero discharge/zero emission programs in the industries and implementing clean development mechanism (CDM) throughout the country is also suggested in this section. Mandatory measures to establish central effluent treatment plant in the industries should be taken according to the action plan 9 of this section. It is also advised to all the industrial units to ensure internal security and healthy environment.

Under the section fuel and mineral resources, it is discussed that the use of fuels which accelerates environmental pollution and climate change should be discouraged and the use of alternative and comparatively greener fuel should be encouraged. Harmful substances such as sulfur should be reduced to its minimum level in the fuel oil used in the country. Export of coal with excessive sulfur content is advised to reduce. In case of extracting fuels, the harmful impacts on environment and local people should be considered with importance and destructive extraction methods should be prohibited according to this policy.

Reduction of environmental pollution is also emphasized in communication and transportation section. It is instructed to ensure prohibition of all environment polluting activities in all road, rail, air and water

transportation sectors. Rail and water transportation is encouraged in this policy as these are fuel efficient sectors.

Strengthening the implementation of CDM such as carbon trading is encouraged in the section 19 which talks regarding combating the impacts of climate change. It is suggested in section 21 that environment pollution monitoring and controlling should be included in national science and technology policy. In section 22, it is instructed that other pollutions such as sound and vibration pollution, radiation pollution, thermal pollution, photo/lighting pollution, indoor pollution should be prevented.

In NEP, 2013 it is advised that the legal framework and laws should be upgraded and already established/upgraded laws and environmental court should be utilized and enforced to control the pollution and degradation of environment, ecosystem, and resources.

Table 1: Summary Table of NEP, 2013

Title	Year of Publication	Formulated By	Relevancy to BDP 2100 and Environmental Pollution
National Environmental Policy 2013	2013	Ministry of Environment and Forest	<ul style="list-style-type: none"> ▪ The NEP 2013 has been formulated revising and updating the NEP 1992 with the aim of integrating environment conservation and management in the mainstream of development. ▪ The NEP 2013 is based on 17 principal issues and 12 objectives relevant to sustainable development, valuation of ecosystem services, food safety, polluter's pay principle, and adaptation and mitigation to combat climate change ▪ The NEP 2013 suggests 271 Action Plans for 23 different sectors. ▪ Water and air pollution control and regulation are given importance ▪ Reduction of industrial pollution and pollution from communication and transportation sector is emphasized ▪ The action plans includes some new instrument or initiatives like Environmental Auditing, Air Quality Index, Emission Tax, Climate Change Resilience Agriculture, 3R, Land Zoning, EIA for housing and urban development projects, Core Zone and Buffer Zone of forest, Local and national Contingency for preventing Pollution from Sea/water traffic accident, ship waste collection and management plan at port, CDM, import and use of rehabilitation of climate displaced/migrants, EURO-5 and EURO V vehicle only, Low Carbon Growth, Waste Heat Recovery initiatives, Green Job, Economic Valuation of Ecosystem Services, etc.

2.2. National Water Policy

The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, equity in water supply, sustainable public and private water supply system including delineation of water rights and proper price signals of water, decentralization of water resource management system and revising the institutional framework for increasing the role of women in this sector, a legal and regulatory environment to promote the process of decentralization, sound environmental management and to attract private investment in this sector, capacity building and enhancement of knowledge with the participation of population for achieving the objective of present water policy and also to create a future water policy with economic efficiency, gender equity, social justice and environmental awareness.

2.2.1. Sectors

The national policy of water is explained in sixteen different sectors such as (i) river basin management, (ii) planning and management of water resources, (iii) water rights and allocation, (iv) public and private involvement, (v) public water investment (vi) water supply and sanitation (vii) water and agriculture (viii) water and industry (ix) water, fisheries and wildlife (x) water and navigation (xi) water for hydropower and recreation (xii) water for the environment (xiii) water for preservation of haors, baors and beels (xiv) economic and financial management (xv) research and information management.

2.2.2. Action Plans Relevant to BDP 2100 and Environmental Pollution

The issue of water pollution is discussed in several sections of this policy. In the first sector river basin management, the issue of transboundary pollution is mentioned and the necessity of agreements with the co-riparian countries is also stated to prevent chemical and biological pollution, created through anthropogenic activities.

Under section six, the scarcity of potable water due to pollution of surface water and contamination of arsenic in ground water is discussed. Drinking polluted and contaminated water poses serious threat to the public health. To address these issues, the government is to mandate relevant public water and sewerage institution which would provide necessary drainage and sanitation including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in interest of public health. Reduction in wastage and pollution of water due to human activities is also a concern of this section.

In the section Water and Agriculture, strengthening the regulatory system for non-point source pollution from agricultural chemical such as pesticides and fertilizers is suggested.

Water and Industry section suggests the establishment of zoning regulation for locating new industries with the consideration of fresh and safe water availability and effluent discharge possibilities. This section of the policy suggests that, the standard of effluent disposal into common waterways would be set up by WARPO in consultation with DoE. Effluent disposal from the industries would be monitored by the Government agencies to prevent pollution. Moreover, it is also stated in this section that, the industrial polluters would be required to pay for the cleanup process of the water body which was polluted by them.

The protection, restoration and enhancement measures of environment, which are consistent with National Environmental Management Action Plan (NEMAP) and National Water Management Plan (NWMP), should be given full consideration according to the suggestion of the action plan under section 12. Adopting polluter pay principle and educating industrial and farming communities are also two significant proposition of this section.

Introduction of financial incentives for water re-use and conservation, responsible use of groundwater, and for preventing over exploitation and pollution is proposed in the 14th section which discusses on economic and financial management side of the policy.

Table 2: Summary Table of National Water Policy

Title	Year of Publication	Formulated By	Relevancy to BDP 2100 and Environmental Pollution
National Water Policy	1999	Ministry of Water Resources	<p>The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. Some of the mentionable suggestions of the policy are:</p> <ul style="list-style-type: none"> ▪ Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities ▪ Effluent disposal will be monitored by relevant Government agencies to prevent water pollution; ▪ Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DOE; ▪ Industrial polluters will be required under law to pay for the cleanup of water- body polluted by them.

2.3. Bangladesh Water Act, 2013

The Bangladesh Water Act, 2013 is mainly based on the National Water Policy and it is designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. The law forms a National Water Resources Council with the prime minister as the head and 11 other ministers as the members of the council. The council also includes representatives from departments in concerns and nominated national experts to formulate relevant guidelines and policies in this regard. An executive committee under the ministry of water resources will work for implementing the decisions/policy/guidelines developed by the council.

The act declares all form of water within the territory of Bangladesh as the property of government. However, the surface water in private property can be used by the owner for all the needed purpose. The act requires permit/license for withdrawing large scale of surface or ground water; however, the maximum amount of water that can be withdrawn is not mentioned in the law.

Prevention of transboundary water pollution is also discoursed in the act. In this regard, combined survey, study and research on the international rivers and activities to prevent chemical and biological pollutant are suggested. According to this act, for regulating and controlling water pollution, the provisions of Bangladesh Environment Conservation Act, 1995 (the 1st law of 1995) would be applicable.

Non-compliance with the law would cause a maximum penalty of five years of imprisonment and/or BDT 10,000.

This law was one of the highly needed steps for protecting the water resources. It significantly recognizes the management aspects of natural flow of surface water and recharge of groundwater. However, one of the major drawbacks of this law is the requirement of written complaint from the director general of water resources planning organization or his/her appointee before filing a law suit under the provisions of this act.

Table 3: Summary Table of Bangladesh Water Act, 2013

Title	Year of Publication	Relevancy to BDP 2100 and Environmental Pollution
Bangladesh Water Act, 2013	2013	<p>The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. Some of the mentionable suggestions of the policy are:</p> <ul style="list-style-type: none"> ▪ Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities; ▪ Effluent disposal will be monitored by relevant Government agencies to prevent water pollution; ▪ Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DOE; ▪ Industrial polluters will be required under law to pay for the cleanup of water- body polluted by them.

2.4. National Land Use Policy, 2001

Realizing the pressure on the land of Bangladesh due to high density of population and viewing agriculture as one of the major economic activities, the National Land Use Policy, 2001 was formulated. The objectives of this policy focus on effective ways of using the lands which include land zoning system to regulate unplanned expansion of residential areas, establishment of industrial or commercial activities; balanced use of land harmonious with the environmental system, prevention of soil pollution etc.

The necessity of land zoning is emphasized in this policy as a way of regulating the unplanned use of the land resources. This policy also aims to declare a national zoning law under which the local governments would develop their own zoning map. It also suggests providing training to the relevant government officials and elected members of the city corporations, municipalities, district councils, upazila council for elucidating them with the idea of land zoning and for building their capacity.

The use of agricultural land, especially the irrigable ones, for other purposes is strictly discouraged in this policy. Moreover, due to rural-urban migration, the demand of land for housing is increasing and hence the pressure on agricultural land. The policy suggests undertaking specific coordinated policies regarding housing. It also states the importance about protecting the water bodies and increasing the fish production. Moreover, controlling and regulating industrial pollution for preventing soil pollution is also suggested here.

The importance of mass awareness for successful outcome of any policy matter is stated with significance. The policy reiterates the use of land in a harmonious way with the nature and environment.

Table 4: Summary Table of National Land Use Policy

Title	Year of Publication	Formulated By	Relevancy to BDP 2100 and Environmental Pollution
National Land Use Policy	2001	Ministry of Land	<ul style="list-style-type: none"> ▪ The Policy aims to control the present trend of conversion of agricultural land use to other use. ▪ The necessity of land zoning is emphasized in this policy as a way of regulating the unplanned use of the land resources and aims to declare a national zoning law ▪ One of the major objectives of the policy is to ensure safeguarding of environment in land use practices.

2.5. National 3R Strategy for Waste Management

"National 3R strategies" is developed to reduce the environmental, social and economic problems associated with the current disposal system of waste. 3Rs is the principle of reducing, reusing and recycling resources and products. The Strategy has been formulated in line with the National Goal of eliminating of waste disposal on open dumps, rivers and flood plain by 2015 and promoting recycling of waste through mandatory segregation of waste at source as well as creating a market for recycled products and providing incentives for recycling of waste

The inadequacy of national policy and support, absence of relevant strategies, lack of institutional capacity, lack of public cooperation, barriers in financing and cost recovery are recognized and discussed in the strategy report. The objectives of the National 3R Strategies are addressing the key issues and challenges of waste management which are acting as barriers in promotion of 3Rs, defining the roles of various actors to promote 3R and guiding the creation of enabling condition for successful implementation of 3R strategies. The priority sectors for 3R are identified as municipal solid waste, industrial waste, biomedical waste, institutional and commercial waste and agricultural waste.

The first core principle of the National 3R Strategies distinguishes waste as a resource. Realizing the importance of the source separation of waste, it is regarded as the second core principle of the strategies. Third and fourth principles state that technologies should be environment friendly, appropriate and affordable. Cleaner production is another core principle which is the continual effort to prevent pollution, reduce the use of energy, water and material resources and to minimize waste in the production process. Product life extension, industrial symbiosis and by-product exchange, polluters pay principle and take back provisions, green purchasing, establishing environmental management system, public-private partnership to secure improvements in the services, collaboration with scientific research bodies to promote 3R, correspondence between service received and payment made in the case of waste collection and disposal, supporting the informal sectors to achieve the objectives of 3R, gender sensitive approach and clear commitment to gender equity are also included as core principles of the strategies. Additionally another core principle of the strategies suggests undertaking separate laws for specific products, setting recycling

target, including 'design for environment considerations' concepts for reducing environmental impacts at all phases of product life cycle.

Table 5: Summary Table of National 3R Strategy for Waste Management

Title	Year of Publication	Formulated By	Relevancy to BDP 2100 and Environmental Pollution
National 3R Strategy for Waste Management	2010	Ministry of Environment and Forest	<ul style="list-style-type: none"> ▪ The priority sectors are: <ul style="list-style-type: none"> ○ Municipal solid waste ○ Industrial waste ○ Biomedical waste ○ Institutional and commercial waste ○ Agricultural waste ▪ One of the objectives of the strategy is to guide creation of enabling condition of successful implementation of 3R strategies. ▪ The strategy suggests a cost recovery mechanism based on levying a service charge for waste management that includes collection, transportation, separation, treatment, recycling and disposal.

2.6. The Bangladesh Environment Conservation Act, 1995

The Bangladesh Environment Conservation Act of 1995 (ECA '95) is currently the main legislation in relation to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The law aims to conserve and improve the environmental quality and to control and mitigate the pollution of the environment.

One of the main strategies of the act is the declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas. Restricting vehicles which emit smoke or gas that are injurious to public health or harmful for environment, is another provision of this act. Manufacture, sale etc of the articles which are harmful for environment or injurious to public health is restricted through this act. For repairing the damages of the ecosystem caused by a person or a group of people, the director general should determine the compensation for remedy of the injuries to the ecosystem. In case of discharge of excessive environment pollutant, the director general should take necessary remedial measures to control or mitigate environmental pollution and the cost of those remedial measures should be collected from the responsible person/people/group for the pollution. This act provides the authorization power of providing environmental clearance to the director general. Promulgating standards for quality of air, water, noise and soil for different areas and for limiting discharge and emitting waste, is also a concern of this act. Formulation and declaration of environmental guidelines is also another sphere of this act.

Table 6: Summary Table of Environmental Conservation Act, 1995

Title	Year of Publication	Formulated By	Relevancy to BDP 2100 and Environmental Pollution
Environmental Conservation Act, 1995	1995 and its Amendments up to 2013	Ministry of Environment and Forest	<p>The main objectives of ECA '95 are:</p> <ul style="list-style-type: none"> ▪ Conservation and improvement of the environment; and ▪ Control and mitigation of pollution of the environment. <p>The main strategies of the Act can be summarized as:</p> <ul style="list-style-type: none"> ▪ Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas; ▪ Regulations in respect of vehicles emitting smoke harmful for the environment; ▪ Environmental clearance; ▪ Regulation of the industries and other development activities' discharge permits; ▪ Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes; ▪ Promulgation of a standard limit for discharging and emitting waste; and ▪ Formulation and declaration of environmental guidelines

2.7. Acts for Regulating Pollution from Brick Kilns

The first act to regulate brick burning was formulated during 1989 which was named as Brick Burning (Control) Act, 1989. That act was emendated twice and the revised versions were published as Brick Burning (Control) (Emendation), 1992 and Brick Burning (Control) (Emendation), 2001. However, recently on November, 2013 a new law in this regard was formulated which is referred as Preparing Brick and Establishing Brick Kilns (Control) Amendment, 2013. This latest amendment is effective and followed at present.

This ordinance strictly bans the establishment of brick kilns in residential, business and reserved areas, agricultural land, government or private forests, orchard, sanctuary or wetland, and in ecologically critical area. It also restricts the collection of soil from agricultural land, mountains, and hillocks for manufacturing bricks. However, no one would be able to collect soil from haor-baor, ponds, canal, beel, river beds, char and fallow land for brick manufacturing purpose without the permission from appropriate authority. In order to reduce the use of soil, this act requires all the brick kilns with modern technology to prepare at least 50% hollow brick or compressed brick. This act prohibits burning fuel wood or any kind of wood for brick production/ burning. Moreover, it proscribes the use of coal which exceeds the standards of sulfur, mercury, ash contents or other similar substances. Violation of this law would cause someone a maximum of 5 years of jail and/or BDT 500,000. All the punishable crimes under this law would be incognizable and bailable.

Recommendation: However, except for restricting the use of coal, this ordinance does not talk about air pollution/air quality monitoring or control measures neither it has described any punishment for the person/owner who pollutes air. Though National Environmental Policy, 2013 suggests undertaking the measure of emission tax, this law does not implement this measure though this could have been a perfect sector of implementing this law.

Table 7: Summary Table of Preparing Brick and Establishing Brick Kilns (Control) Amendment, 2013

Title	Year of Publication	Relevancy to BDP 2100 and Environmental Pollution
Preparing Brick and Establishing Brick Kilns (Control) Amendment, 2013	2013	<ul style="list-style-type: none"> ▪ The act prohibits burning of fuel wood or any wood in brick making. ▪ The act bans the establishment of brick kilns in residential, business and reserved areas, agricultural land, government or private forests, orchard, sanctuary or wetland, and in ecologically critical area ▪ Restricts collection of soil for brick making from agricultural land, mountains, and hillocks for manufacturing bricks ▪ Collection of soil for brick manufacturing from haor-baor, ponds, canal, beel, river beds, char and fallow land without permission from appropriate authority ▪ Brick kilns with modern technology have to prepare at least 50% hollow brick or compressed brick

2.8. Noise Pollution (Control) Amendment, 2004:

As the noise level has increased sharply in recent years due to the use of microphones, loudspeaker, vehicles, horns, generator etc. and since mental and health impacts can be noticed among the exposed population, the noise pollution (control) amendment, 2004 was formulated. This act gives the authority to all the Paurasabhas, City Corporations, Capital development authority (RAJUK), Khulna Development Authority (KDA), Chittagong Development Authority (CDA), and Rajshahi Development Authority (RDA) to mark off the areas under their jurisdiction as silent, residential, mixed, commercial or industrial. They should also put sign to remark those areas. In case of union council, they should at least place signs or signboard at 100 meter distance of schools or hospitals. The act also describes the approved standard limit of sound in the added schedule 1 and 2. In the schedule 1, silent area means area up-to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishment identified/to be identified by the government. In the silent area it is prohibited to use any kind of horns of vehicles, audio signals and loudspeakers. In case of using amplifier, microphones or loudspeaker in residential area, mixed area, commercial area or industrial area, permission should be taken from appropriate authority which is mentioned in schedule-3 of the act. According to this act, daytime is counted from 6am to 9pm whereas nighttime is counted from 9pm to 6am. The details of the standards for sound in different types of areas are listed down in Table-1 according to the schedule-1 of the act.

Table 8: Standards for Sound

SL. No.	Category of Areas	Standards (in dBa)	
		Day	Night
1	Silent Zone	50	40
2	Residential Area	55	45
3	Mixed Area	60	50
4	Commercial Area	70	60
5	Industrial Area	75	70

According to noise pollution (control) amendment, 2004 use of pneumatic horn/hydraulic horn/multi-tuned horn in any kind of vehicle would be banned. The standard limit of the sound should be maintained if the selected spot is not designated for picnic. However, in designated picnic spot (selected by District Commissioner), loudspeakers can be used only from 8am to 7pm. However, it is banned to use loudspeaker during the journey, which is a very common practice in Bangladesh. It is also banned to use brick demolishing machine in residential area. Moreover, use of any kind of noise generating machine such as mixture machine is restricted to be used in residential area from 7pm to 7 am.

During election period it is permissible to use loudspeaker till 2 days before election from the period of announcing the schedule. However, this permission is not applicable for silent area. Only in residential and commercial areas, loudspeaker can be used from 8am to 8 pm.

This act also requires the people exposed to high noise in industries to wear personal protective equipments to reduce the impacts of noise pollution.

If someone uses sound amplifier, microphones or loudspeaker then s/he should take necessary measures so that the level of sound does not cross the standard limit in the neighboring area.

However, using loudspeaker for religious activities, warning people during natural disasters, celebrating national programs declared by government such as Independence Day, victory day, Bengali New Year etc., disseminating emergency information or notice or promotional activities of/by government or authorized organization, circulating news of death or loss etc are exempted from the restrictions of this act. Moreover use of siren/loudspeaker in ambulance, in vehicles of fire brigade, police or defense force is also exempted from this act.

Violation of the statute would cause someone a minimum penalization of BDT 5,000 and/or 2 months of jail and maximum penalization of BDT 10,000 and/or 6 months of jail.

Recommendation: This act only superficially talks and recommends about the noise pollution in roads. Considering the situation and road culture of Bangladesh, there should have been more clear acts for specific actions such as there should have been some measures to control the use of continuous and unnecessary horns in the road etc. Additionally, inclusion of rules and actions for controlling reckless use of microphones/loudspeaker by the vendors is a time demand.

Moreover, people generally misuse the freedom of using loudspeaker for religious purpose. There should be a time limit for religious activities too. Furthermore, the types of religious activities should also be defined here. Using loudspeaker continuously till midnight for religious activities such as milads, preaching (owaz), puja songs etc sometimes become very irritating and bothersome for the people. Moreover, using

loudspeaker in religious places has caused some very violent and racial incidents in recent years. Therefore the exemption of using microphones/loudspeaker should be revised carefully.

Similarly, more restrictions should be included in the act for controlling the use of loudspeaker during national events. Using loudspeaker in almost every street to celebrate national events causes immense suffering of the general people.

Most important of all, the enforcement of this law is very weak and this matter should be taken into serious consideration by the proper authority.

Table 9: Summary of the Noise Pollution Control Rule

Title	Year of Publication	Relevancy to BDP 2100 and Environmental Pollution
Noise Pollution (Control) Amendment, 2004	2004	<ul style="list-style-type: none"> Noise Pollution Control rules specifies the noise standards, defines different zones with respect to ambient noise limits. All the industrial activities, vehicle, etc should comply with the rules

2.9. Clean Dhaka Master Plan 2005

With the aim of developing capabilities and management skill of Dhaka City Corporation in operation of Solid Waste Management, the City Corporation Has prepared the Master Plan. With the technical and financial support from JICA, Dhaka City Corporation has developed this Master Plan for Solid Waste Management in Dhaka City. The Master Plan aims at improving solid waste management system of Dhaka City based on social acceptability and technical capability in order to achieve Clean Dhaka. 2015 is the target year. The Master Plan is to improve overall technical, institutional and financial capacity of solid waste management system. The plan identified numbers of programs and projects in line with the aim of clean Dhaka. The Master Plan brings hygiene, protection of surrounding water bodies, and sanitary land filling in solid waste management of Dhaka City. The Plan identified 25 priority projects and programs in the sector of:

- Primary Collection/Public Involvement
- Secondary Collection/Transport and Road/Drain Cleaning
- Final Disposal
- Legal Aspect
- Organizational Aspect
- Financial Aspect
- Privatization

2.10. Action Plan for solid waste management in 19 towns of Bangladesh Based on 3R Principle and Carbon Financing

In line with the National 3R Strategy for Waste Management, the Department of Public Health Engineering (DPHE) has formulated Action Plan for solid waste management in 19 town of Bangladesh. The Action Plans are based on the 3R principle and carbon financing. The General Strategy behind the Action Plan are:

- Raising Public Awareness Through Information, Education and Demonstration Projects

- Engaging an Affordable Mix of Appropriate Technical Options to Reduce, Reuse, Recycle Waste
- Building Partnership with NGOs and Civil Societies
- Private Sector Participation

The Action Plan considers investment from Public Funding, Donor Funding and Private funding through CDM. The plan adopts Cost Recovery through levying service fee for waste collection, transportation, separation, treatment, recycling and disposal.

2.11. National Sustainable Development Strategy (2010-2021)

The Planning Commission has prepared the National Sustainable Development Strategy (2010-2021) to meet the formidable environmental challenges that Bangladesh faces in the way to development. The DSDS has identified five Strategic Priority Areas along with three cross-cutting areas

Strategic Priority Areas:

- Sustained Economic Growth
- Development of Priority Sectors
- Social Security and Protection
- Urban Environment
- Environment, Natural Resources and Disaster Management

Cross Cutting Areas:

- Disaster Risk Reduction and Climate
- Good Governance
- Gender

The NSDS takes reducing the industrial water pollution and air pollution due to transport and managing solid waste as key challenge in managing urban environment. The NSDS takes the following strategy for urban pollution management:

- **Management of Water Pollution through:**
 - Enforcement of environmental rules and regulation
 - Industrial Zoning
 - Water Quality Monitoring
 - Ensure waste reception and facilities in ports,
 - Clean up and rehabilitate hot spot areas in Dhaka, Chittagong and Khulna,
 - Etc.
- **Managing Air Pollution**
 - Improved mass transport system
 - Replacement of traditional brick kilns to energy efficient brick kilns
 - Mandatory use of Dust Control Measures in construction works, etc

The strategy only consider pollution in urban area but does not address transboundary environmental pollution, pollution in major rivers, pollution in ECAs, Pollution in Coastal Areas, etc. Soil pollution is very alarming especially in urban fringe area where industries are discharging effluent directly into rivers and in coastal areas which has not been covered in the strategy.

2.12. Sixth Five year Plan

The Sixth Five Year recognizes mainstreaming the environmental issues in development process is highly required. The plan sets the following targets in the context of Vision 2021.

- Increase productive forest coverage by 2 percentage points.
- Improve air quality in Dhaka and other large cities
- and enacted Clean Air Act
- Treat all urban waste water by FY15 to clean river
- Waters
- Promote Zero discharge of industrial effluents.
- Urban wetlands are restored and protected in line with Wetland Conservation Act
- At least 10% of the wetland in peak dry season is protected as aquatic sanctuary
- Jolmahal leasing system phased out in favour of pro-poor community based management
- Risk Atlas for at least 7 cities/towns developed by
- 2015.
- 500 meter wide permanent green belt established and protected along the coast
- Eco-tourism promoted at least in 15 protected areas and ECAs
- Comprehensive Marine Resources Management Plan developed
- Land zoning for sustainable land/water use completed.
- Environmental, Climate Change and disaster risk reduction considerations are integrated into project design, budgetary allocations and implementation process.
- Canals and natural water flows of Dhaka and other major cities restored

In line with these set targets, the plant takes the following strategies for environmental stewardship to be executed by Department of Environment:

- Environment committees at Division, District and Upazila levels will be activated with the participation of all stakeholders.
- National Environment Council headed by the Prime Minister and executive committee of National Environment Council headed by the Minister for Environment and Forests would be activated.
- Drafting of EIA guidelines for all sectors under the Environment Conservation Act (ECA) 1995 will be formulated in order to ensure effective enforcement of EIA.
- Existing environmental laws and regulations will be amended to address new environmental issues
- Department of Environment will be strengthened in the light of existing Environment Policy, Environmental Act, Rules and Environment Management Action Plan in order to coordinate, monitor and implement these activities.
- Polluters Pay Principle' will be followed in order to ensure strict compliance of environment legislation.
- Sectoral legislations are to be reviewed and redrafted in light of Bangladesh's commitments
- expressed through signing and ratifying of a number of International Conventions and Protocols on environment.
- Incentives, in the form of tax-rebate, tax-holiday etc. will be provided and incremental cost incurred by the Environment-friendly entrepreneurs will be met in various forms/sources.
- Environmental Impact Assessment will be made while processing each development project requiring approval of the Government.
- 'National Environment Fund' will be established in order to provide assistance to the victims of environment degradation caused by the natural disasters and anthropogenic activities.

- Enhance national capacity to mainstream poverty-environment-climate nexus in the development project design, budgetary process, project implementation and monitoring process

The Plan also identifies several programs recognizing the interlinks of environmental issues with other thematic areas. The programs are prepared under the following major headings:

- Control of Air Pollution
- Controlling Industrial Pollution
- Conservation of Ecosystem
- Partnership Program for Environment Protection
- Conservation of Biological Diversities
- Protection of the Ozone Layer
- Measures toward Management of Wastes
- National Bio-Safety Framework
- Control of Noise Pollution
- Saving the River
- Generating electricity from waste
- Declaring Ecologically Critical Areas
- Reduction in the Production and Use of Black Polythene
- Poverty-Environment-Climate-Disaster Nexus Initiative in National Planning Process

The other development sector especially the transportation and urban transport sectors are considering improvement of environment as an objective of the programs identified in the plan.

3. Stakeholder Analysis

Attempts have been made to identify key stakeholders involved in the theme of environmental pollution. Policy makers, regulators, polluters, inhabitants, etc. are the major group in general. Different stakeholders and their roles are briefly discussed in the following table:

Table 10: Stakeholder Matrix

SI No	Name of the Stakeholder	Relevant Role	Strength and Weakness
1	Ministry of Environment and Forest (MoEF)	Nodal Agency for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programs	Strength: Environmental Acts, Rules and Policies Collaboration with Development Partners Weakness: Shortage of Man Power Lacks of Research Cell Lacks of Integrated Data Base
2	Department of Environment (DoE)	planning, promotion, co-ordination and overseeing the implementation of environmental programs	Strength: Environmental Acts, Rules and Policies Collaboration with Development Partners, Local People and NGOs Office establishment up to District Level Weakness: Lacks in Manpower, Laboratory Facilities (at district level) Lacks in Integrated Data Base Conventional Monitoring system for Water Quality Monitoring
3	Department of Public Health and Engineering (DPHE)	Provide drinking water supply and waste management facilities in cities and rural areas other than Dhaka city, Rajshahi City, Khulna City and Chittagong City	Strength: Good Laboratory Facilities Collaboration and Cooperation with Development Partners, Local Peoples, NGOs Relevant Plans on Water Supply and Sanitations Weakness: Lacks in manpower and laboratory facilities at District and Upazila Level Conventional Monitoring System of Drinking Water Quality
4	Dhaka City Corporation (North and	Provide solid waste management facilities in Dhaka city	Strength: Collaboration and Cooperation with Development Partners, Local Peoples,

SI No	Name of the Stakeholder	Relevant Role	Strength and Weakness
	South)		<p>NGOs</p> <p>Good Infrastructures</p> <p>Weakness</p> <p>No Long term Plan for further development of Waste Management In Dhaka City after expiration of Clean Dhaka Master Plan</p> <p>Land scarcity for waste disposal</p> <p>Lacks in skilled man power in waste management</p> <p>Limited equipments and resources for waste management</p>
5	Dhaka Water Supply and Sewerage Authority	Provide drinking water supply and waste water management facilities in Dhaka city	<p>Strength</p> <p>Upgraded system for providing water supply to the city inhabitants and its cost recovery.</p> <p>Digital Map of water supply, sewerage and drainage network</p> <p>Weakness</p> <p>Limited capacity of sewerage treatment</p>
4	Chittagong City Corporation	Provides solid waste management facilities	<p>Strength:</p> <ul style="list-style-type: none"> As a local government, CCC has great opportunities to work on the environmental as well as development sector of Chittagong city The role of CCC in the education and health care sector is noteworthy <p>Weakness:</p> <ul style="list-style-type: none"> Dependency on Central Government for Funding. Lack of inter-departmental coordination Failure to control the problem of drainage congestion and water logging especially during the

SI No	Name of the Stakeholder	Relevant Role	Strength and Weakness
			<p>rainy season</p> <ul style="list-style-type: none"> ▪ Lack of human resources and lack of functional accountability in the corporation's work. ▪ Lack of material and economic resources of CCC
5	Chittagong Water Supply and Sewerage Authority	Provides drinking water supply and waste water management facilities in Chittagong city	<p>Strength:</p> <ul style="list-style-type: none"> ▪ Improvement in capacity and reducing system loss ▪ Digital bill pay system. <p>Weakness:</p> <ul style="list-style-type: none"> ▪ Limited capacity to provide clean water to all city inhabitants ▪ Frequent increase of water price causes lack of satisfaction among the users.
6	Khulna City Corporation	Provides solid waste management facilities, takes initiatives to protect rivers surrounding the city (Mayur, Rupsha, etc) from pollution	<p>Strength</p> <p>One of the oldest city corporation/municipality in the country</p> <p>Master Plan</p> <p>Weakness</p> <p>Limited capacity in dealing with sewerage</p> <p>Clearance of DoE's of a new land fill site is in pending</p>
7	Khulna Water Supply and Sewerage Authority	Provides drinking water supply and waste water management facilities in Khulna city	<p>Strength</p> <p>Good Collaboration with development partners</p> <p>New Development plan for increasing capacity of water treatment</p> <p>Weakness</p> <p>Lacks in integrated planning with collaboration and cooperation of KDA, KCC, etc.</p> <p>Lack of skilled manpower in environmental sector</p> <p>Lack of capacity in treating waste water</p>
8	Rajshahi City	Provide drinking water supply and	Strength

SI No	Name of the Stakeholder	Relevant Role	Strength and Weakness
	Corporation	waste water management facilities in Rajshahi city	<p>New Development plan for increasing capacity of water treatment</p> <p>Weakness</p> <p>Lacks in integrated planning with collaboration and cooperation of RDA, RCC, etc.</p> <p>Lack of skilled manpower in environmental sector.</p> <p>Lack of capacity in treating waste water</p>
9	Bangladesh Export Processing Zone Authority	Regulatory authority of EPZs, also oversees the environmental protection programs in EPZs.	<p>Strength</p> <p>Strong establishment in terms of infrastructure, legal platform and participation of stakeholders</p> <p>Environmental outreach program to aware its stakeholders</p> <p>Weakness</p> <p>Lacks in law enforcement</p> <p>Lacks in cooperation with DoE</p> <p>Limited availability of Land and technology for setting up ETPs</p>
10	Department of Agriculture Extension	DAE is a service oriented govt. organization. Aware and train farmers about fertilizer use, pesticide use, advance technology for agriculture. Promote sustainable agricultural practices, Integrated Pest Management, etc.	<p>Strength</p> <p>Establishment up to Upazila level and communication network up to village level</p> <p>Participation of farmers in different planning process</p> <p>Weakness</p> <p>Lacks in manpower</p> <p>In sufficient establishment at union level</p> <p>No provision of environmental division to aware local farmers about environmental issues</p>
11	Dhaka Transport Co-ordination Authority	Advises the concerned agencies on an integrated and safe traffic and transportation system for Dhaka and to make necessary arrangements with that purpose Co-ordinates the traffic and transportation infrastructure development plan.	<p>Strength</p> <p>Special attention of GOB</p> <p>Has mandate to provide technical support to 32 government agency who are working in development sector</p> <p>Weakness</p> <p>Lack in manpower</p>

SI No	Name of the Stakeholder	Relevant Role	Strength and Weakness
12	Department of Inspection for Factories and Safety	Monitoring and ensuring compliance of labor laws, better working environment, workplace safety, and workers' welfare, health and safety.	Strength Industrial acts and rules Weakness Shortage of Manpower Shortage of Skilled Inspector in the field of Environment No collaboration with DoE
13	NGO Forum	A national level NGO works with water pollution issues	Strength A good network of NGOs and GOs working in the field of WATSAN Pioneer NGO in WATSAN sector Advance Laboratory facilities Weakness: Limited scope of research facilities Laboratory facilities at field level
14	Bangladesh Environmental Lawyers Association	an association of lawyers works with environmental justice and environmental regulatory issues.	Strength A good network of environmental activist A pool of environmental lawyers Acceptability and trust Weakness Limited research facilities

4. Existing Situation/State of Environmental Pollution

4.1. Priority Areas and Hotspot

In the context of the Delta Plant 2100, the baseline study have been carried out considering priority areas and hotspots to fasten the process and realizing the data gap. The priority areas/issues are listed below:

Priority Area	Hot Spot
Air Pollution	Major Cities i.e Dhaka, Gazipur, Narayanganj, Sylhet, Rajshahi, Barishal, and Chittagong
Water Pollution	Major Rivers i.e. Padma, Ganga, Jamuna and Meghna. And Rivers around the Major Cities: River around Dhaka and Narayanganj – Buriganga, Shitalakkhya, Turag River besides Chittagong City– Karnafuli, Halda River besides Barishal City- Kirtonkhola river River besides Sylhet City – Surma River Besides, Khulna – Moyuri , Rupsha River Across the Sundarbans and Mongla Port- Passur
Soil Pollution	Ship Breaking waste contaminated area – Chittagong Coast Industrial Polluted area – Dhaka, Gazipur
Waste Management	Major Cities: Dhaka, Chittagong, Khulna, Barisal, Gaziupur, Narayanganj, Sylhet
Noise	Major Cities:

4.2. Air Pollution

Bangladesh has ranked fourth among 91 countries with worst urban air quality according to the latest air pollution monitoring report of World Health Organization (WHO).² Moreover, three cities of Bangladesh are in the list of 25 cities with poorest air quality among 1600 cities of 91 countries.³ Air pollution can be very detrimental to public health and it can even cause premature death. In general, the pollutants in the air mainly affect the lung of human body and causes irritation and/or respiratory problems. It is assumed that around 20%-80% decrease in air pollution level of Bangladesh would save approximately 1,200-3,500 lives annually. Additionally, 80 to 230 millions cases of health problem would also decrease if the air pollution level can be dropped by the mentioned level.⁴ The world wide scenario of air pollution consequences is no less frightful. According to WHO, air pollution is associated with around 7 million premature death every

² <http://www.thedailystar.net/bangladesh-4th-most-polluted-in-world-23348>

³ *ibid*

⁴ http://www.case-moef.gov.bd/index.php?option=com_content&view=article&id=3&Itemid=18

year⁵. The matter of hope is that, the current national environmental policy of Bangladesh includes some new instruments or initiatives like Environmental Auditing, Air Quality Index, and Emission Tax etc.; which, if enforced properly, will definitely help in decreasing the air pollution level of Bangladesh.

4.2.1. State of Pollution

Air Quality Standard

Recently Ministry of Environment and Forest has revised the ambient air quality standard reviewing the similar standards of neighbouring countries, WHO standard and US standards. In the following table the revised standard has been compared with other international standards.

Table 11: Comparison of Bangladesh's ambient air quality standard with India, Nepal, USA and WHO

Pollutant	Averaging time	Bangladesh Standard	India Standard	Nepal Standard	US Standard	WHO Standard
CO (mg/m ³)	8 hr	10	2	10	10	10
	1 hr	40	4	100	40	30
Pb (µg/m ³)	Annual	0.5	-	-	0.15	0.5
SPM	8 hr	200	-	-	-	-
Coarse	Annual	50	60	-	-	20
PM ₁₀ (µg/m ³)	24 hour	150	100	120	150	50
PM _{2.5} (µg/m ³)	Annual	15	40	-	15	10
	24 hour	65	60	-	35	25
O ₃ (µg/m ³)	1 hour	235	100	-	235	-
	8 hour	157	180	-	157	100
NO _x (µg/m ³)	Annual	100	40	40	100	-
SO ₂ (µg/m ³)	Annual	80	50	50	78	-
	24 hour	365	80	70	365	20

Ambient Air Quality of the Country

Ministry of Environment and Forest has initiated a project named "Clean Air & Sustainable Environment" very recently with the aim of improving air quality of the state. Under this project, DoE has established 11 Continuous Air Monitoring Stations (CAMS) in 8 major cities of Bangladesh viz. Dhaka, Chittagong, Gazipur, Narayanganj, Sylhet, Barisal, Khulna and Rajshahi. Among the 11 fixed CAMS, 3 stations are in Dhaka and 2 stations are in Chittagong while the other cities have got 1 station each. The state of the ambient air quality as well as air pollution has been discussed with respect to the concentration of SO₂, NO₂, CO, PM_(10, 2.5), SPM and O₃ recorded in the abovementioned 11 monitoring stations.

Sulfur Dioxide (SO₂)

The one year recorded data of 11 CAMS shows that concentration of SO₂ in ambient air was within the standard limit (Figure 2). Among the 11 CAMS, highest SO₂ concentration, 30.6 ppb, was found at Khulna CAMS in the month of September. In general, it is vivid from the figure that SO₂ concentration remains higher in the months of November to March and remains lower in the months of April to August. The dry periods contained comparatively higher level of SO₂ in the air.

⁵www.who.int/mediacentre/news/releases/2014/air-pollution/en/

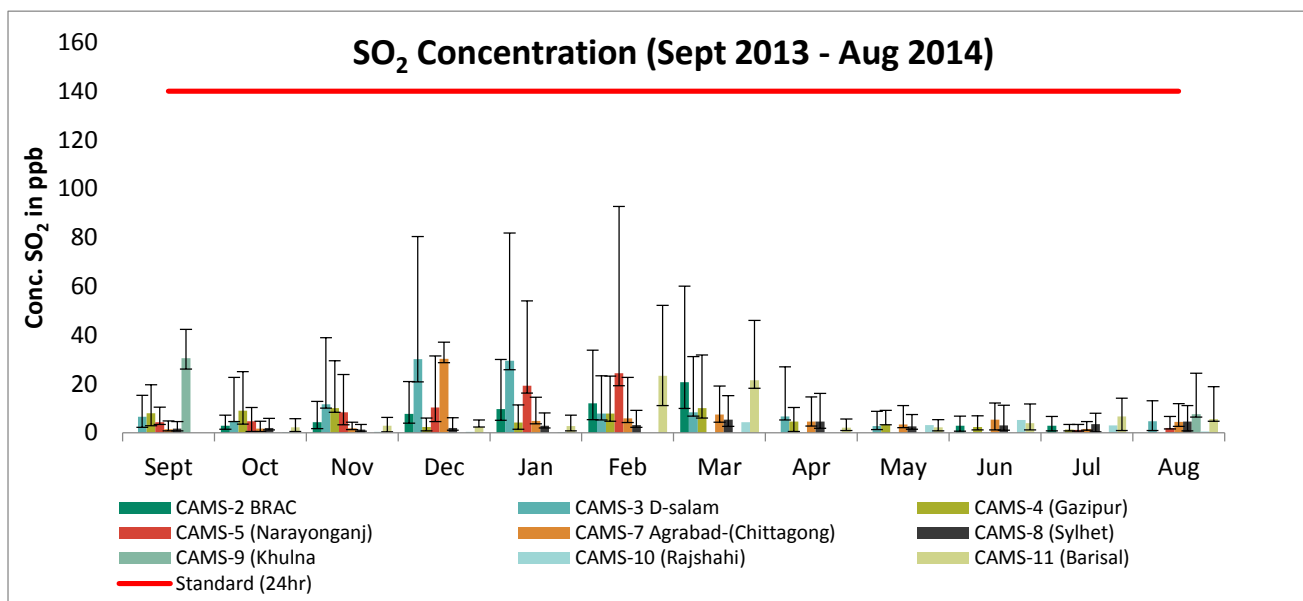


Figure 1: Concentration of SO₂ in major cities of Bangladesh (September, 2013- August, 2014)

Nitrogen Dioxide (NO₂)

The standard for NO₂ in Bangladesh is 53 ppb (annual) which was exceeded very frequently in almost all the major cities. Likewise SO₂ concentration, the concentration of NO₂ is higher from November to March, which are comparatively drier months of the country (Figure 3). The highest concentration of NO₂ was 191 ppb and found in Dhaka CAMS-2 BARC station during December, 2013. The number of days NO₂ exceeded the standard level is presented in Figure 4. From the analysis it was found that worst situation is in Rajshahi (CAMS 10) where the highest standard was exceeded for the highest number of day (139 day) in a year.

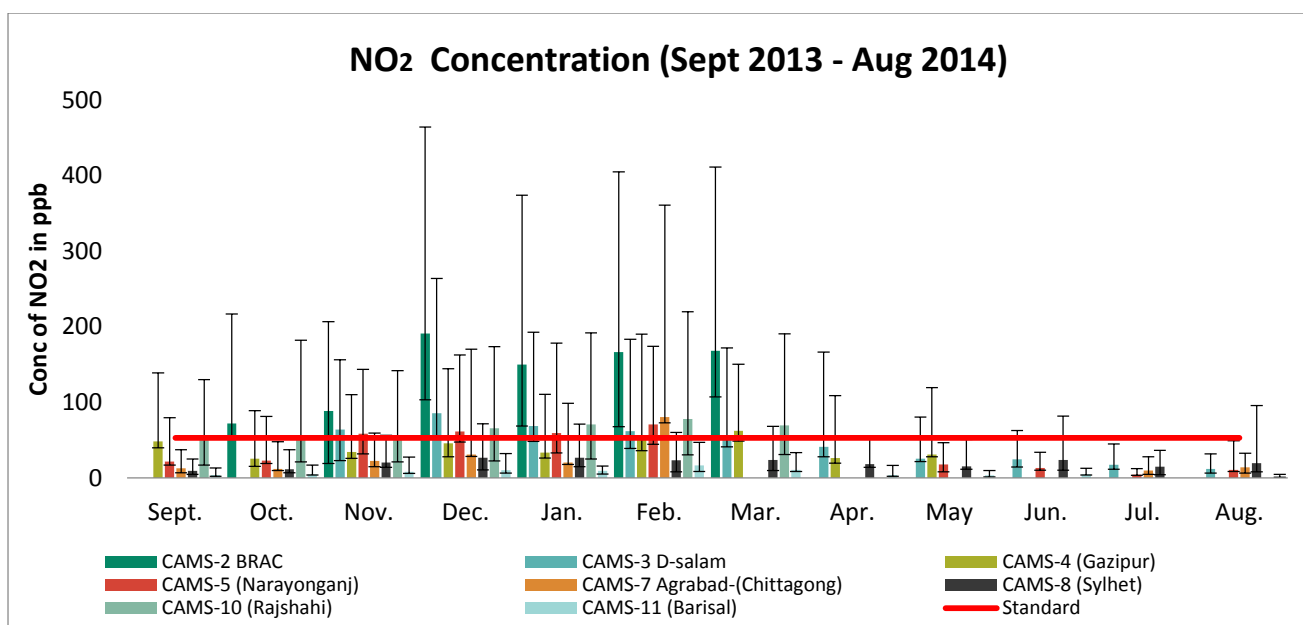


Figure 2: Concentration of NO₂ in major cities of Bangladesh (September, 2013- August, 2014)

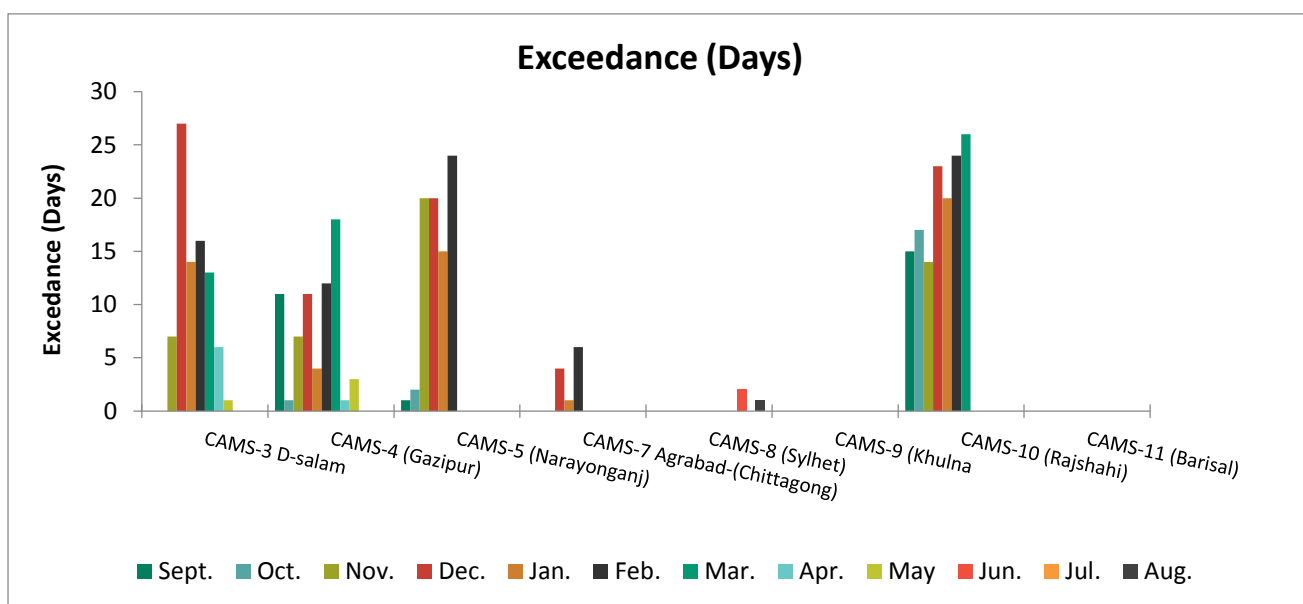


Figure 3: Number of Days-NO₂ exceeded the standard (September, 2013 – August, 2014)

Carbon Monoxide (CO)

Though the monthly averages of daily concentration are within the standard limit, the standard was found exceeding in several days in a month (Figure 5). The monthly maximum and minimum are shown by vertical bar (like error bar) in each column. The maximum occurrence of CO was recorded in CAMS-3 D-Salam Station in Dhaka in January, 2014 whereas the minimum concentration was recorded during July, 2014 in CAMS-5 Narayanganj.

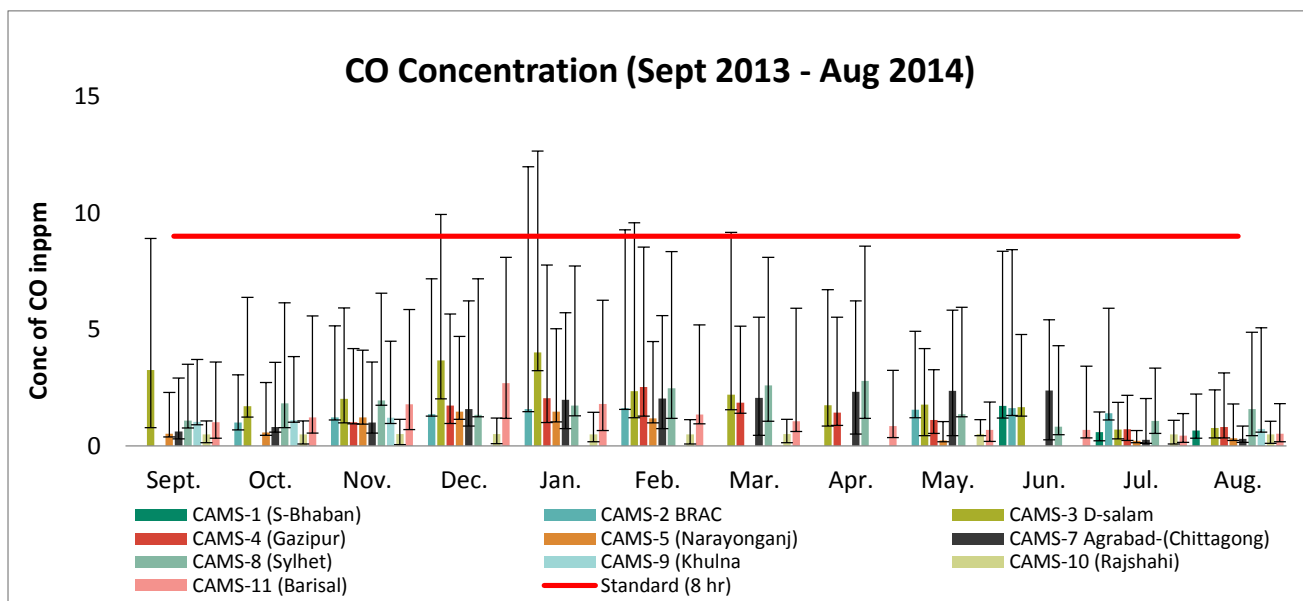


Figure 4: Concentration of CO in major cities of Bangladesh (September, 2013- August, 2014)

Ozone (O₃)

Similar to CO, the concentration of O₃ was also found below the standard limit (80 ppb, 8 hour) in all the stations except two exceptional days CAMS 3 (D-Salam) and CAMS-11 (Barisal). The maximum monthly average of daily concentration of O₃ was 25.1 ppb, recorded in CAMS-11-Barisal station during April, 2014 whereas the lowest was 1.38 ppb, found in CAMS-10-Rajshahi.

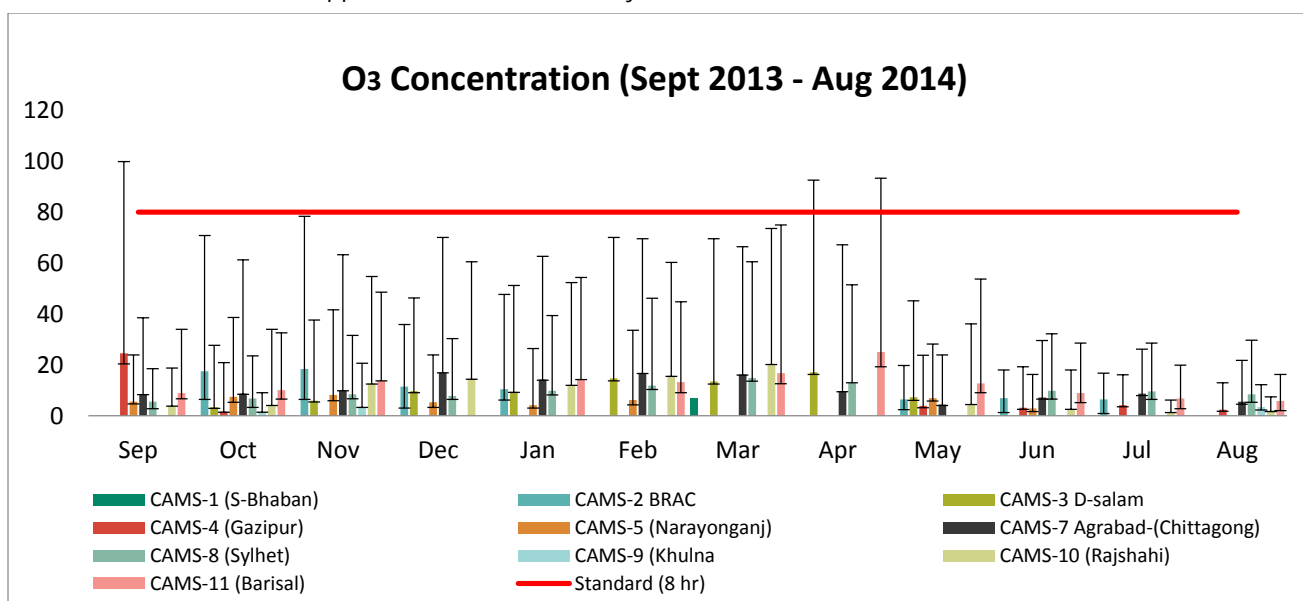


Figure 5: Concentration of O₃ in major cities of Bangladesh (September, 2013- August, 2014)

Particulate Matter (PM_{2.5} and PM₁₀)

Concentration of Particulate Matter in ambient air is highly alarming. The monthly average of daily concentration was found above the standard in the months of November to April. Dhaka, Narayanganj, Gazipur, Chittagong and Barisal are in worst condition. The tendency of exceeding the standard was seen in

all cities. However, the highest daily concentration of $PM_{2.5}$ ($325\mu g/m^3$) was recorded in CAMS-5-Narayanganj in January. In general, during the dry months of the year, the concentration of $PM_{2.5}$ reaches higher and during the wet periods the concentration becomes lower (Figure 7 and 8). It was found from the analysis that the highest number of exceedance of standard occurred in CAMS-4-Gazipur station where the standard was exceeded for 158 days in the months between September 2013 to August 2014.

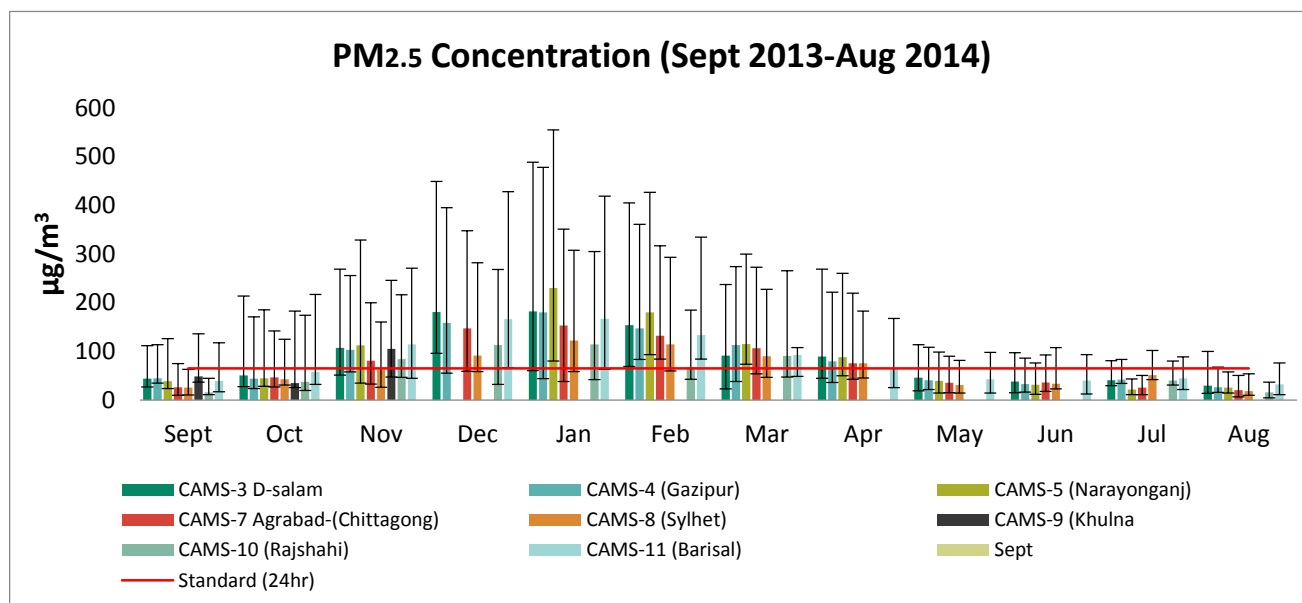


Figure 6: Concentration of $PM_{2.5}$ in major cities of Bangladesh (September, 2013- August, 2014)

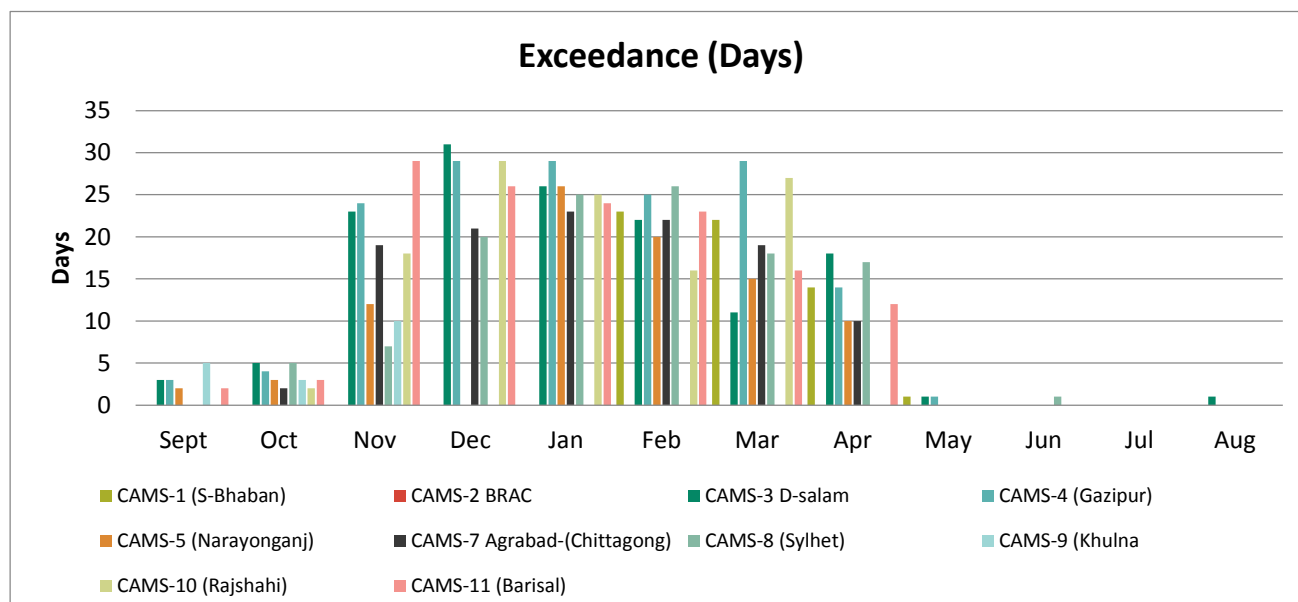


Figure 7: Number of Days- $PM_{2.5}$ exceeded the standard (September, 2013 – August, 2014)

The standard limit for PM_{10} is $150\mu g/m^3$ (8 hr) in Bangladesh which was also very frequently exceeded in different stations. The maximum concentration ($325\mu g/m^3$) was recorded in CAMS-5-Narayanganj stations

during January, 2014. Likewise $PM_{2.5}$, the seasonal variation of PM_{10} concentration can also be clearly seen from Figure 9 and Figure 10. The highest number of exceedance day was 158, which was found in CAMS-4-Gazipur station. However, during December, 2013 in CAMS-3 D-Salam station, the standard was exceeded for all the 31 days, which was the highest number of exceedance in a month for PM_{10} .

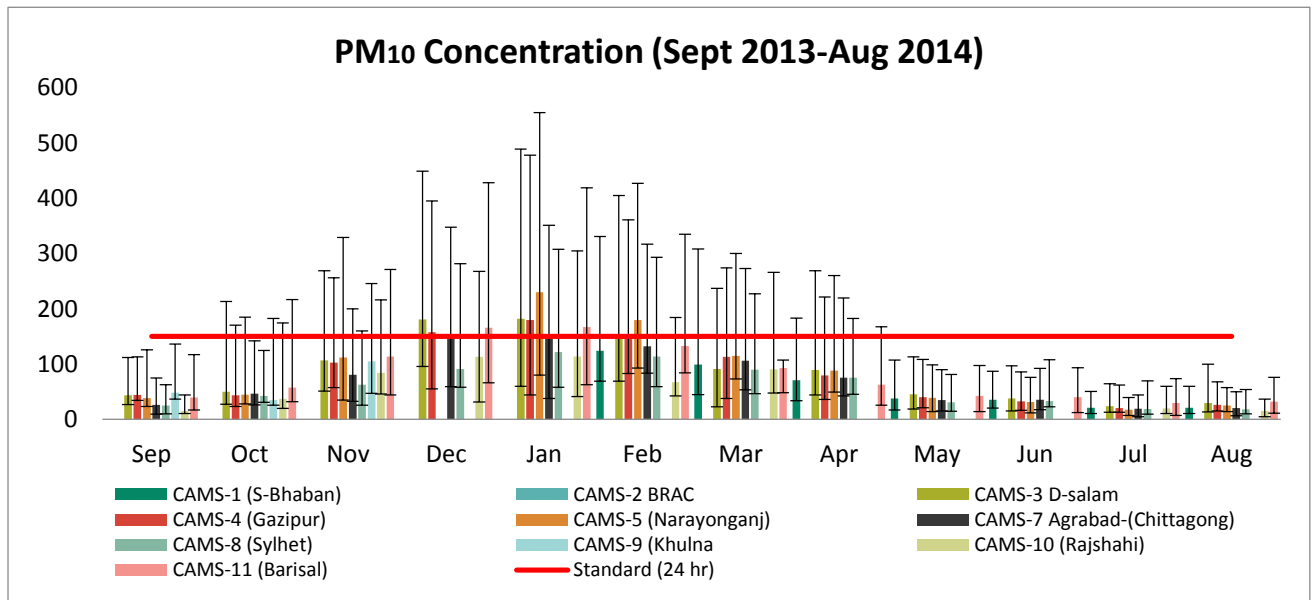


Figure 8: Concentration of PM_{10} in major cities of Bangladesh (September, 2013- August, 2014)

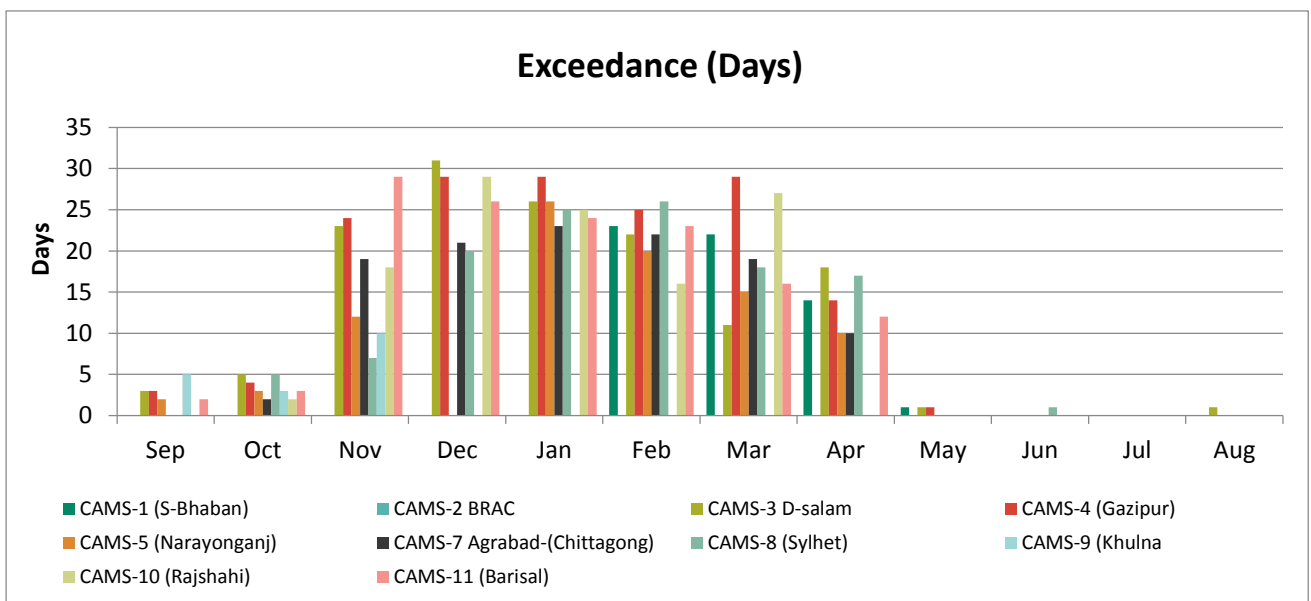


Figure 9: Number of Days- PM_{10} exceeded the standard (September, 2013 – August, 2014)

Air Quality Index

Bangladesh also has developed an Air Quality Index (AQI), which is basically a quick and effective mean to portray the ambient air quality relative to the national air quality standard. According to AQI system, the air quality is reported daily and then it depicts how polluted the ambient air quality is. Different countries

assign different colours and values for the same potential risk. The AQI system of Bangladesh is based on 5 different pollutants such as Particulate Matter (PM₁₀ and PM_{2.5}), NO₂, CO, SO₂ and O₃. Bangladesh has upgraded the AQI scheme very recently from a previous version as the previous one did not appropriately consider the values above long term standard concentration and did not clearly assert the impacts on sensitive groups, children and elderly people. For a better and comparative understanding both the previous scheme and present scheme of AQI indexes are presented in table 2 and table 3 respectively.

Table 12: Previous AQI scheme of Bangladesh

AQI Value	Level of Concern	Colors
0-100	Good	Green
101-150	Moderate	Yellow
151-200	Unhealthy	Orange
201-300	Very Unhealthy	Red
301-500	Extremely Unhealthy	Purple

Table 13: Present approved AQI scheme for Bangladesh

AQI Value	Level of Concern	Colors
0-50	Good	Green
51-100	Moderate	Yellow Green
101-150	Caution	Yellow
151-200	Unhealthy	Orange
201-300	Very Unhealthy	Red
301-500	Extremely Unhealthy	Purple

Based on the currently approved AQI scheme, the air quality status of Bangladesh from February 17, 2014 to March 31, 2014 May 2014 to August 2014 is presented in the figure 10 & 11. The AQI is worst in February to March and it improves in May to August. This AQI were calculated by CASE project of DoE. As per the AQI data, air quality in Gazipur is worst. In the months between February to May, AQI was unhealthy to extremely unhealthy for 100% days. In case of Dhaka for the same period, AQI was unhealthy for 95% days. In general, more than 70% days in the months from February to May, AQI was unhealthy to extremely unhealthy. In May to August, most of the days were of moderate and caution state. Among the 8 cities, situation in May to August, in Barisal is worst where 100% days were of moderate and caution state.

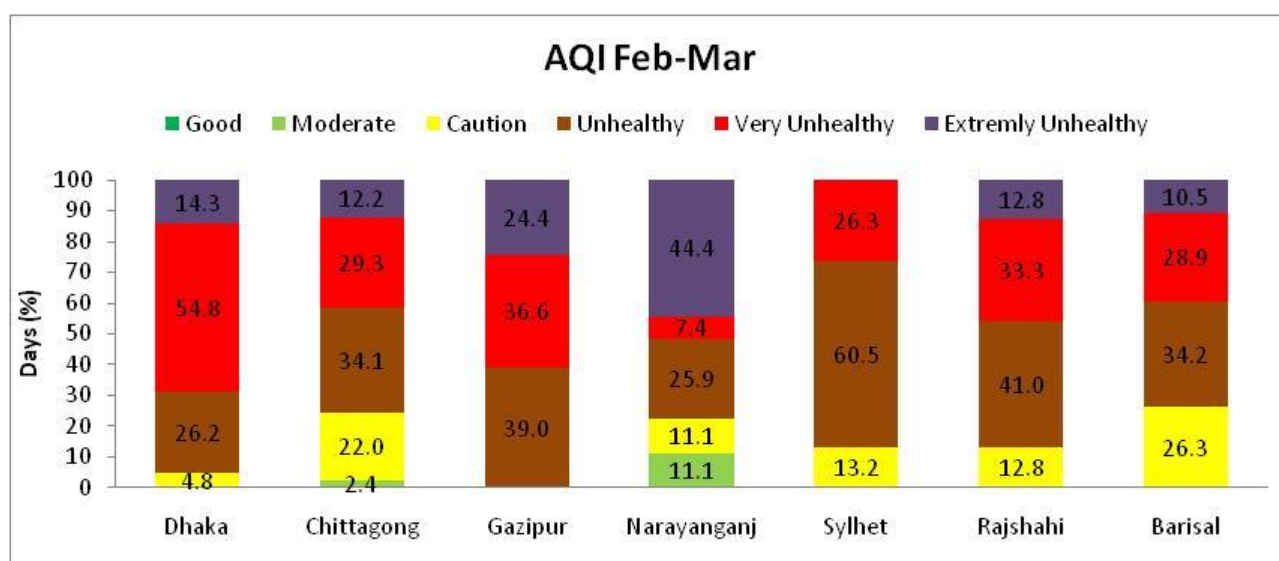


Figure 10 : Air quality status of Bangladesh (Feb 2014 – Mar 2014)

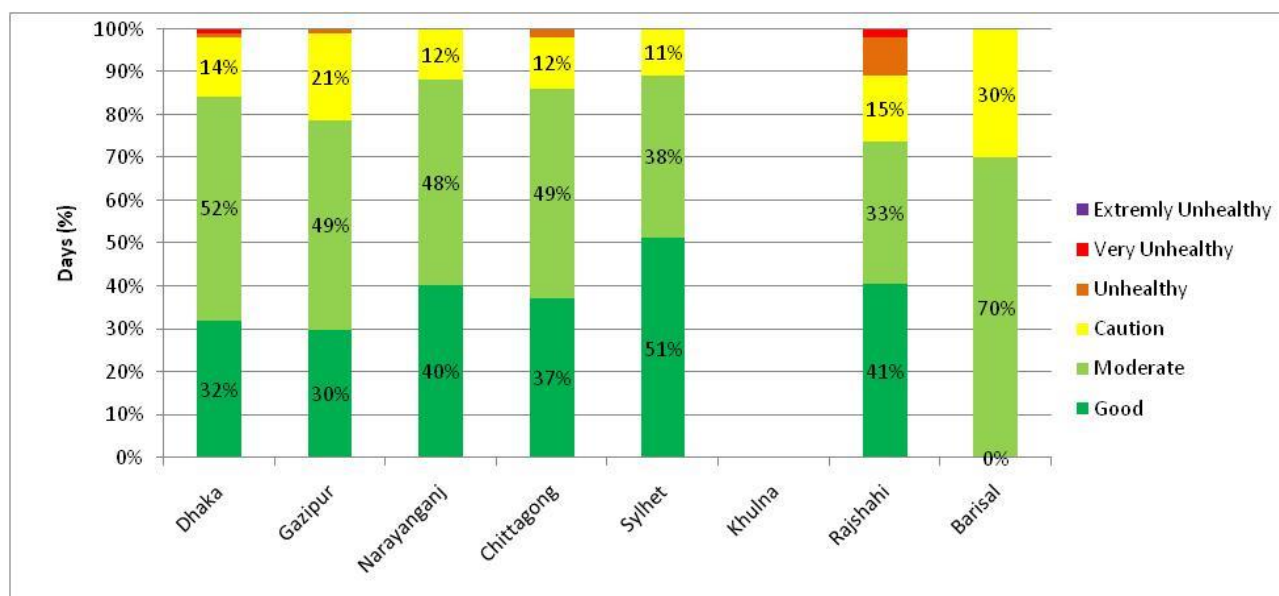


Figure 11: Air quality status of Bangladesh (May 2014 – August 2014)

4.2.2. Sources and Causes of Pollution

The sources of air pollution of Bangladesh can be divided into three major categories such as point, non-point and transboundary sources of air pollution.

Point Sources Different types of industries and factories which emit smoke can be considered as point sources of pollution such as brick kilns, pulp and paper mills, textile industries, steels re-rolling mills, power plant (natural gas, diesel and furnace oil based), fertilize (urea, TSP), cement, plastic, chemical industries/factories and many more. These sources can also be mentioned as stationary sources of air pollution.

Non-Point Sources The major non-point or mobile source of air pollution in Bangladesh is vehicle. Most of the vehicles, especially trucks and buses, which run in the roads of Bangladesh are generally old, overloaded and poorly maintained. A survey conducted by DoE reveals that approximately 90% of the vehicles in Dhaka are defective and emits high level of pollutants into the air. Though the total number of vehicle in Dhaka as well as in Bangladesh is less than the number of total population, use of impure fuel and lube oil, high sulphur diesel and lack of proper maintenance and traffic congestion, have made the transport sector as the main non-point source of air pollution.

Some of the human activities in our country such as open burning, disposal of solid waste in open places, brick/stone crushing, sand storage for construction activities etc are also non-point sources of air pollution in Bangladesh.

Transboundary Sources Though there is no mentionable government data available yet which states the transboundary air pollution issue of Bangladesh clearly, it is confirmed from some discreet scientific literature that the transboundary air pollution impacts the state of air of Bangladesh negatively. A trajectory analysis for identifying the transboundary air pollutants in Sathkhira Bangladesh affirms significant impact on air quality from transboundary sources (Saadat, Rahman, Hasan, & Alam, 2013). Another study asserts that PM concentration during winter is adversely impacted by transboundary movement of pollutants (Nasiruddin, Division, & Centre, 2009). However, both the study mentions the impact of wind direction and seasonal variation on the transboundary movement of the pollutants.

4.3. Water Pollution

Water pollution has been investigated through reviewing secondary data sources, which include information from the National Water Resources Database (NWRD) and Bangladesh Bureau of Statistics (BBS), several published journals and manuscripts, and the documents and reports of different national level studies carried out in different hydrological regions of Bangladesh. To develop an insight on the existing status of water pollution, the prominent sources and causes have firstly been identified through literature review.

The state of water pollution has been investigated afterwards, by evaluating the seasonal values of several significant water quality parameters. The state of water pollution has been discussed two-fold, considering an urban river context and major river systems context.

The urban river pollution has been assessed through the review of several existing literatures, which are confined within the perennial rivers in and around Dhaka City.

To draw the state of river water quality, the pH and DO have been considered. Ministry of Environment and Forest defined four parameters i.e. BOD, DO, pH and Total Coli form as regulatory parameter in the inland water quality standard. Out of the four, DO, BOD and pH data are available. The name of the rivers selected for this thematic baseline study is listed in the Table below:

Table 14: List of the selected Rivers and Water Quality Monitoring Stations of BWDB

SI No	Rivers	Adjacent Cities
1	Buriganga	Dhaka
2	Shitalakkhya	Dhaka, Narayanganj
3	Turag	Dhaka, Savar
4	Meghna	Chandpur, Barisal
5	Jamuna	Sirajganj
6	Padma	Faridpur, Rajshahi

7	Kirtonkhola	Barisal
8	Passhur	Mongla, Sundarbans
9	Rupsha	Khulna
10	Moyuri	Khulna
11	Karnaphuli	Chittagong
12	Halda	Chittagong
13	Surma	Sylhet

The obtained values of water quality were compared with the standard values set by the Department of Environment (Table 1.2) to assess their suitability in compliance with the country's major surface water uses (Irrigation and Fishing). Reports from a number of recently carried out national level feasibility studies have been reviewed to cluster supplementary information on water quality for different hydrological regions.

4.3.1. Water Quality Standard

Table 15: Water quality standards for Bangladesh

Water quality parameters	Standard value	Water use
pH	6.5 – 8.5	Irrigation
		Fishing
		Recreation
DO (mg/l)	5 or above	Fishing
		Irrigation
		Recreation
BOD	10 or less	Irrigation
	5 or less	Fishing
	3 or less	Recreation
Total Coliform	1000 or less	Irrigation
	---	Fishing
	200 or less	Recreation

Source: Environmental Conservation Rules 1997

4.3.2. State of Pollution

For having a comprehensive understanding about the state of pollution of the river of Bangladesh, the pollution level of the rivers is analyzed here. However, as there are more than 220 rivers in Bangladesh, it is difficult to consider all the rivers in the analysis and hence, this analysis is kept limited to the rivers beside the major cities of Bangladesh. A total of 13 rivers are considered in this case which are situated beside the major cities of Bangladesh such as Buriganga river (beside Dhaka), Shitalakhya river (beside Dhaka, Narayanganj, Ghorashal), Turagriver (beside Dhaka; upper tributary of Buriganga), Jamuna river (beside Rajshahi), Meghna river (beside Chadpur, Barisal,), Padma river (beside Rajshahi, Kushtia), Karnaphuli river (beside Chittagong), Halda river (beside Chittagong), Moyuri river (beside Khulna-Satkhira), Rupsha River (besides Khulna), Passhur river (beside Khulna and Sundarbans), Kirtonkhola river (beside Barisal), Surma river (beside Sylhet). The parameters which are considered in this study to understand the river pollution level are pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD5) and, Chemical Oxygen Demand

(COD). The analysis is based on river water quality data of 2012 and 2011 collected, analysed and published by Department on Environment (Department of Environment, 2012, 2013).

Buriganga River

Only pH level of Burigangariver is within the limit and it varies from 6.4 to 7.9, whereas, the standard level for inland surface water is within 6.5 to 8.5.

The standard level of BOD5 is ≤ 6 mg/l, whereas the maximum level of BOD5 in Buriganga river was 48 mg/l at Kamrangir Char in May and the minimum level was found 1.0 mg/l at Hazaribag in September. Analyzing the data of the whole year, it was found that the BOD level was lowest during the wet months (i.e. July, August, September, and October). However, all over the year, the level of BOD was found pretty much higher than the standard throughout the year.

However, the level of COD was found below the standard level (200 mg/l) almost throughout the year. The highest and lowest concentration of COD was recorded as 283 mg/l and 5 mg/l at Hazaribag point during December and September respectively.

According to Environmental Quality Standard (EQS) the minimum level of DO for fish should be 4-6 mg/l. Whereas, the DO level of Buriganga river, at almost all the points was found near to zero in the first four months of the year, and it increased only slightly during the wet season.

Furthermore, heavy metal concentration in Buriganga is much higher than the threshold limit (Mohiuddin et al., 2011), as seen in the following Table. Heavy metals were also found in the fish of Buriganga river (B. Ahmed, Rasel, & Miah, 2013).

Table 16: Concentration of Heavy Metal in Buriganga River

Seasons	Stations	Pb ($\mu\text{g/L}$)	Cd ($\mu\text{g/L}$)	Ni ($\mu\text{g/L}$)	Cu ($\mu\text{g/L}$)	Cr ($\mu\text{g/L}$)
Pre-monsoon	Balughat	62.34	9.21	10.05	145.03	645.26
	Sadarghat	71.09	8.45	8.52	132.18	605.87
	Foridabad	58.17	10.03	8.96	135.65	613.25
Monsoon	Balughat	64.05	8.19	7.62	107.38	586.27
	Sadarghat	62.36	7.08	9.05	201.29	557.16
	Foridabad	72.45	10.15	10.32	187.65	489.27
Post-monsoon	Balughat	70.19	9.05	9.13	175.27	605.13
	Sadarghat	65.28	12.33	7.15	193.82	578.25
	Foridabad	63.15	9.25	8.43	189.57	604.34
Average +/- SD		65.45 +/- 4.78	9.34 +/- 1.47	8.80 +/- 1.02	163.09 +/- 33.53	587.20 +/- 44.14

Source: (M. K. Ahmed, Islam, Rahman, Haque, & Islam, 2014)

The statuses of other water quality parameters are also alarming at some location of the Buriganga river. However, there are some issues of reliability in the river water quality data so far available in different published literatures and secondary sources.

Shitalakhya River

It is a distributary of Bramhaputra River. The minimum level of pH was found 6.7 in November near ACI point and the maximum level was found as 8.64 near DemraGhat during September.

In the first three months of the year no DO was found in this river near Demra Ghat. On the other hand the maximum recorded concentration of DO was 6.2 mg/l during February near Ghorashal Fertilizer Factory. The overall level of DO was found better during the month of July.

The concentration of BOD was found within the limit throughout the year at the point near Ghorashal Fertilizer Factory. The highest value of BOD was found 16 mg/l at DemraGhat in the month of April and the lowest value was found 2.0 mg/l at DemraGhat during July month.

COD level was found within the limit throughout the year at all the considered point of this river.

Turag River

TuragRiver is the upper tributary of BurigangaRiver. The pH level of this river varied from 6.7 to 8.4 which were within the suggested EQS limit. The DO level was found very low in this river and it was found nil from March to June. However, during the wet season the concentration of DO increased a bit though in most of the cases it was below the standard limit. The concentration of BOD varied from 5.0 mg/l to 38 mg/l in the year of 2012. The maximum concentration was recorded in April at Pagar, Tongi whereas the minimum concentration was recorded in November at north side of the Tongi Bridge. The maximum and minimum concentration of COD was recorded 290 mg/l and 9 mg/l in December and in October respectively.

Jamuna River

The level of pH varied from 7.2 to 8.46 which were within the EQS limit. The minimum pH was recorded in September at BahadurabadGhat and the maximum level was found at Jamuna Fertilizer Factory. DO was measured only at Jamuna Fertilizer Factory point and throughout the year the DO level was found higher than the minimum limit for fisheries. The concentration of DO varied from 5.9 mg/l to 8.5 mg/l.

The maximum level of BOD was found was recorded 11 mg/l and minimum level was recorded 2.8 mg/l. However, in case of Jamuna River, the data was not recorded continuously. Therefore, the seasonal variation of BOD could not be understood from the available data. No data is available for COD for Jamuna River.

Meghna River

Throughout the year the level of pH was within the EQS limit. The level of pH varied within 6.24 (in September near Bhairab Bazar) to 7.6 (in November at Chandpur).

The DO level was found higher than the minimum EQS level for fisheries throughout the year. Likewise, the concentration of BOD was also found within the EQS standard throughout the year. The maximum and minimum concentration of BOD was recorded 3.4 mg/l in October and 0.3 mg/l in July respectively.

The COD concentration in the Meghna River varied from 3.0 mg/l to 2.0 mg/l which were also within the EQS limit.

Padma River

Padma is a major transboundary river of Bangladesh. The level of pH varied from 6.0 to 7.8, whereas the standard limit for pH is within 6.5 to 8.5. The lowest level of pH was recorded at PakshiGhat in October which was a slightly more acidic than the standard limit. The maximum level of pH was recorded at BarokutiGhat Bank.

The concentration of DO was higher than the minimum EQS standard throughout the whole year and the concentration varied from 5.4 mg/l to 8.26 mg/l.

The BOD load varied between 1.15 mg/l to 2.8 mg/l. The maximum load of BOD was recorded in July and minimum load was recorded during November.

Karnaphuli River

Karnaphuli river flows beside the Chittagong City. The Largest sea port of the country is located at the bank of this river. The river has also ecological significance.

According to the published data of DoE, collected at four point in two locations, the river is polluted. Though the DO (ranges in between 4.4mg/L -5.5 mg/L) and BOD (0.8mg/L – 2.6mg/L) values were found close the EQS (≥ 5 mg/L for DO and ≤ 6 mg/L for BOD) round the year, the COD level was found exceeding the standard (200mg/L) in January to June and October to November. The COD value was found varying in between 4.0 mg/L – 923 mg/L in 2011-2012. The River receives industrial discharge, ship discharge, discharge of sewerage from city and fertilizer and pesticides washout from upstream agricultural lands.

Halda River

Originating from the Chittagong Hill Tract the Halda river flows beside the Chittagong city and falls in Karnaphuli river. The river is declared as ECA due its importance as natural fish spawning ground. According to the water quality data of 2012 and 2011 of DoE, the river water meets EQS. The pH, DO, BOD and COD values were found within the EQS. pH varies in between 6.8 – 7.6 (EQS is 7-8). DO levels were found varying 1.0 mg/L – 5.6 mg/L against the standard ≥ 5 mg/L (for fish). The lowest value was found in the month of June 2012 which was below the standard but in 2011 the values were 5.2 mg/L – 6.8 mg/L. The BOD were found varying 1.8 mg/L – 0.3 mg/L in 2012 and 1.0 mg/L – 2.4 mg/L in 2011. COD was found varying in between 1mg/L – 4mg/L in 2012 and 2 mg/L to 7 mg/L in 2011.

Moyuri River

Moyuri is one of the major polluted river flowing across the Khulna city. The river receives illegal sewerage discharge and industrial discharges as well. DO was found much below the EQS (for fish), varying 0 to 2.0 mg/L in 2012 and 0 – 4.8 mg/L in 2011. DO was found dropped to zero in the month of April to June in 2012 and March – April in 2011. BOD was also found above the EQS, varying in 6mg/L to 20 mg/L in 2012 and 1.8 mg/L to 36mg/L in 2011, while the EQS is only maximum 5mg/L (for fish). COD was found above the standard as well. COD was found in between 46 mg/L to 672 mg/L. in 2011 COD was found higher than the EQS in the months of January to June and December.

Rupsha River

The Rupsa River is a river in southwestern Bangladesh and a tributary of the Ganges. It forms from the union of the Bhairab and Atrai rivers, and flows into the Passur River. Its entire length is affected by tides.

pH level varies in between 7.13 and 7.88 in 2011 and 2012. DO level was lower than EQS (≥ 5 mg/l) for fisheries during February to June. The maximum DO level both in 2011 and 2012 was 6.8 mg/l but the minimum values were 5.7 mg/l and 4.5 mg/l. In 2012, the maximum and the minimum BOD was 8.0 and 0.4 mg/l respectively, while in 2011, these were 8.0 and 0.6 mg/l. The maximum and the minimum COD was 22 and 20 mg/l respectively while the EQS is 200 mg/l in 2012. In 2011, COD concentration varied from 22 and 225 mg/l.

Passur River

The Passur is one of the major rivers flowing through the Sundarbans. The Mongla Port is also situated at the left Bank of Passur river. A large scale industrial development is taking place along the bank of Passur from Chalna to Chandpai of Sundarbans triggered by the recent development of Port, possible construction of Padma bridge and construction of a mega coal based thermal power plant at the bank of Passur in Rampal.

The river water quality meets the EQS. pH level varies in between 7.71 and 7.88 which is within the EQS. The DO was found in between 6.8mg/L and 4.6 mg/L in 2012 and 2011. BOD was found varying in between 1.2 mg/L and 0.5mg/L in 2011 and 2012. COD value was also found within the EQS.

CEGIS is also carrying out a detail environmental monitoring study in Passurriver for the proposed Bangladesh-India Friendship Power Plant Company. As a part of the study, CEGIS collected and analysed water samples from 13 locations in Passurriver for round the year in 2014. CEGIS found BOD (1.9 mg/L – 5.0 mg/L) and COD (20 – 540 mg/L) little bit higher than the result of DoE but still within the EQS.

Kirtankhola River

The Barisal city is located at the bank of Kirtankhola river. The river plays an important role in navigation, trade, economy, livelihood, culture and environment of the Barisal region.

In 2012, pH level of Kirtankhola river water varied from 6.0 to 8.2 and was within the EQS. In 2011, pH level varied from 6.2 to 7.8. In 2012, DO level of Kirtankhola river varied from 5.7 mg/l to 7.3 mg/l which was above the EQS (≥ 5 mg/l) for fisheries. In 2011, DO level varied from 4.6 mg/l to 9.7 mg/l. BOD was low round the year in 2012, the max and min were 2.5 and 1.1 mg/l respectively. In 2011, BOD level varied from 0.5 to 5.4 mg/l. In 2012, COD level varied from 36 to 52 mg/l; but in 2011, it was above the EQS (200 mg/l) varying from 18 to 377 mg/l. The river is subject to pollution due to sewerage discharge, and discharge of industrial effluent.

Surma River

Surma river is flowing beside the Sylhet city. In 2012, pH level of the Surma river varied from 6.5 to 7.79, while in 2011 from 7.3 to 7.9. In 2012, DO content was mostly above the EQS (≥ 5 mg/l) for fisheries. In 2011, DO level varied from 6.3 to 7.9 mg/l. BOD value was also within the EQS. The max and the min BOD was 1.3 and 1.0 mg/l respectively in 2012, while in the previous year, it varied from 1.0 to 1.9 mg/l.

4.3.3. Sources and Causes of Pollution

Pollution from Industries

Untreated industrial effluent is the major source of pollution in common rivers of Bangladesh. Textile industries, chemical industries, fertilizer industries and power plant are commonly blamed for causing water pollution. It is recognized in most of the policy documents that industries are illegally discharging untreated waste water directly to the rivers or water bodies e.g. in National Water Management Plan (2001), National Sustainable Development Strategy (2010-2021), National Environmental Policy (2013), etc.

Industries produce waste containing toxic chemicals and pollutants (lead, mercury, sulphur, asbestos, nitrates etc.). Some industries do not have proper waste management system and drain waste water out into adjacent freshwater bodies and cause contamination. The toxic chemicals may change the colour of water, cause eutrophication, change water temperature and thus pose serious threats to several water dependent organisms. The National Water Management Plan listed industries situated in different hydrologic region to compare the pollution load in different hydrologic region (Table 17).

Table 17: Numbers of Industries in Different Hydrological Region

Region	No. of Establishments	Textiles, apparels & tanneries	Paper, paper products & printing	Chemicals, plastics & petroleum	Non-metallic minerals manufactures
North West	4,403	545	113	181	360
North Central	12,133	4,093	707	1,242	733
North East	1,117	55	20	47	132
South East	2,518	346	68	83	549
South West	849	72	39	42	199
South Central	1,408	128	29	77	157
South East	2,506	475	102	231	229
Total	24,934	5,714	1,078	1,903	2,359

Source: State of Environment 2001, (MoEF, 2001)

Pollution from Agricultural Activities

Excess use of fertilizer and pesticides ultimately pollute water bodies and rivers. Residue of fertilizers and pesticides ultimately reach to river with rainfall runoff. This is very common in rural area that results algal bloom and heavy metal contamination.

Pollution from Sewerage

This is becoming a major problem in urban areas and rural areas as well. None of our cities are completely covered by sewerage collection network and treatment facilities. Major portion of sewerage goes untreated and to the rivers. Even after treatment, the sewage water may carry harmful bacteria and chemicals (pathogens, microorganisms and other disease carrying contaminants) which pollute stream water. Most of the rivers near to the cities are polluted due to sewerage discharge. In rural area, indiscriminate discharge of sewerage is creating pollution problems in stagnant waterbodies, canals and rivers. In most cases, people discharge their household sewerage to adjacent water bodies or open field.

Transboundary Pollution

Ganges-Brahmaputra-Meghna Basin produces most of the major rivers of Bangladesh. 92% of the GBM Basin is located outside the Bangladesh. Therefore, the water quality that we are receiving is mostly contributed by the upstream activities in the transboundary watershed areas. There is no established system for monitoring water quality we are receiving from the transboundary sources.

Pollution from Ships

Pollution from ships are becoming very significant due to increasing trend of river and sea traffic. Ship pollution is easily seen in Buriganga, Passur and Karnaphuli rivers. Accident in river traffic is also increasing that cause significant damage to ecosystem. Sunken of oil tanker, klinker carrier, and other bulk carrier has increased recently in Passur river. The recent incident of sunken of Oil tanker (9 December 2014, in Shela river in Chandpai Range of Sundarbans) that resulted spill of around 350,000 litter of oil in Sundarbans. Earlier, in the same year two another klinker carrier sank in the Harbaria region of Sundarbans. Apart from

the accidental event, discharge of sewerage from ships, ballast water, bilge water, ship wash water, etc area causing pollution in navigation routes and marine areas of the country.

Table 18: Nature and Sources of Pollution in Major Rivers

Name of the River	Polluters	Pollutants
Karnaphuly	441 industries and 40-50 oil tankers	Heavy metals, degradable and persistent organic and inorganic compounds, oil, lubricants
Sangu	Fisherman	toxic chemicals
Bhairab	Khulna news print mills	Heavy metals
Mongla and Passur	Mechanical ships, oil tankers, marine vessels	Oil, grease and other lubricants
Rupsha	Mechanized vessels, Khulna city	Solid and liquid waste
Nabaganga	Sugar mills	Effluents
Mathavanga	Carew and Company, Darshana Sugar mills	Effluents
Kapotakkya	Jessore city	Solid and liquid waste
Shitalakkhya	Meghna Cement Factory, Ghorasal Fertilizer factory	NH ₃ , CaCl ₂ , NaOH, H ₂ SO ₄ and lubricants
Buriganga	Five main drains of Dhaka city, 277 tanneries, Passenger and merchant ships	Domestic and industrial waste, chemicals, oil, grease, lubricants
Turag	250 different industries	Heavy metals
Baloo	268 different industries	Heavy metals
Bongshee	Different industries	Effluents
Kaleeganga	Fabric industries	Effluents
Meghna	Ashuganj Fertilizer Factory	NH ₃ , other chemicals
Bramhaputra	Mymensingh city, industries and factories	Effluents
Jamuna	Sugar mills, Fertilizer factory	NH ₃ , CaCl ₂ , NaOH, H ₂ SO ₄ , lubricants
Hareedhoya, Kalagasia and Pahoria	2000 textiles mills and fabric industries	Effluents
Dhaleshwaree	Cement factory, other industries	Effluents
Chandana	Sugar mills	Effluents
Surma and Dhanu	Chhatak paper and pulp mill	NaOH, Cl, Hg, Ca, HCl
Kushiyara	Fenchuganj fertilizer factory	CO ₂ , NH ₃ , SO ₂ , oil, CaCl ₂ , NaOH, H ₂ SO ₄ , lubricants
Tulshiganga	Industries Naogaon municipal area	Solid and liquid waste, effluents

Name of the River	Polluters	Pollutants
NarrodNad	North Bengal Sugar Mills and Jamuna Distilleries	Effluents, Hot water
Padma	North Bengal Paper Mills	NaOH, Cl, Hg, Ca, HCl
Karatoa	Panchagar and Satabganj Sugar Mills, Zaz Distilleries	NH ₃ , CaCl ₂ , NaOH, H ₂ SO ₄ , lubricants, Hot water
Jamuneshwary	Shampur Sugar Mills, Rangpur Distilleries	NH ₃ , CaCl ₂ , NaOH, H ₂ SO ₄ , lubricants, Hot water
Kirtonkhola	Municipality and industries	Effluent and wastes

Source: BAPA (<http://www.cseindia.org/userfiles/Abdul%20Matin.pdf>)

4.4. Soil Pollution

4.4.1. State of Pollution

Soil pollution is another environmental pollution that threatens our ecosystem and human health but hardly recognized in our different policy documents. There was no authentic monitoring of state of soil pollution. Soil Resource Development Institute (SRDI) monitors soil quality with respect to soil fertility. Department of Environment regularly monitor air and water quality but does not have any program for soil pollution monitoring. However, different independent researcher, research institute and academic institute have conducted different research programs on soil pollution issues. In the following sections, attempts have been made to describe the state of soil pollution with reference to different research papers.

Soil pollution from Industrial Effluent

Bangladesh Bureau of Statistics recognizes evidence of soil pollution in the country in their book entitled 'Compendium of Environment Statistics of Bangladesh -2009'(Bangladesh Bureau of Statistics, 2010). With reference to a research of FAO, the BBS states arsenic contamination in soil in the irrigated paddy cultivation field. BBS also refers contamination of other heavy metal e.g. Selenium, Nickel and Zinc in soils of different region.

Table 19: Arsenic Contamination in Soil of Irrigated Paddy Field of different Region

SI No	Location	Arsenic concentration in Soil (mg/kg)
1	Gazipur	10.9 – 14.6
2	Bogra	4.9-15.5
3	Dinajpur	11.7
4	Naogaon	24.3-26.7
5	Nawabganj	15.7-20.9
6	Mymensingh	6.0-25.4
7	Rangpur	6.5-11.5
8	Rajshahi	7.8
9	Kachua, Hajiganj, Shaishabari	7.31-27.28
10	Chapai Nawabganj	5.8-17.7

Source : FAO, 2006 in (Bangladesh Bureau of Statistics, 2010)

In general, As concentration is higher in the soils of western part of Bangladesh (>30 mg/kg).

Table 20: Concentration of Se, Ni, and Zn in Soils of Different Region

Sl No.	Location	Selenium (mg/kg)	Nickel (mg/kg)	Zinc (mg/Kg)
1	Gazipur	0.37 – 0.27	7.16 – 1.69	17.49 – 3.94
2	Jessore	0.49 – 0.26	27.45 – 6.66	73.63 – 17.30
3	Faridpur	0.45 – 4.27	40.70 – 2.40	96.92 – 24.09

Source : FAO, 2006 in (Bangladesh Bureau of Statistics, 2010)

Soil Pollution from Ship breaking Industries

Ship breaking industries are growing in the coastal areas, especially at Chittagong coast. Pollution from ships is becoming a major threat near Port areas. Ocean going ships are causing pollution in Passur river and Karnafuli river and their adjacent coast. Ship wrecks, and sunken of bulk carrier are also threaten the ecosystem. The State of Environment, 2001 (MoEF, 2001) addressed that heavy metal concentrations are increasing in coastal and marine water due to port activities and ship breaking industries. A recent study on concentration of heavy metal in sea bed sediments in ship breaking region found concentration of Fe, Mn, Cr, Zn, Pb, Cu, Cd and Hg much higher than the safe limit (Siddique, Parween, Quddur, & Barua, 2009).

Table 21: Heavy Metal Concentration in Sea Bed Sediments near Ship Breaking Industries

	Fe	Mn	Cr	Ni	Zn	Pb	Cu	Cd	Hg
Location	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Salimpur	11932.61	2.64	68.35	23.12	83.78	36.78	21.05	0.57	0.015
Bhatiari	35216.35	8.25	86.72	35.12	102.05	122.03	39.85	0.83	0.02
Sonaichhari	41361.71	6.89	78.36	48.96	142.85	147.83	30.67	0.94	0.117
Kumira	20971.86	2.32	22.89	25.36	119.86	41.57	28.01	0.59	0.05
Sandwip (Control Site)	3393.37	1.8	19	3.98	22.22	8.82	2.05	0.19	0.02
Standard	27000 a	1.17 b	77.2 a	56.1 a	95.5 b	22.8 b	33.0 b	0.115 a, b	0.02 a

Source: (Siddique et al., 2009)

4.4.2. Sources and Causes of Pollution

Soil pollution is closely related with water pollution. In the Dhaka city adjoining areas like Gajipur, Kaliakoir, Tongi, etc. industrial effluent from different industries mostly dyeing, textile, pharmaceutical, ceramic, etc industries are polluting rivers and canals that ultimately pollute the soil of agricultural field. In coastal areas, soils near ship breaking industries are being polluted due to chemical spillage, oil spillage and dumping of hazardous waste from ship breaking, recycling and building activities. In port region, especially in Mongla Port region and Chittagong Port region, pollution from ships also pollutes the soils of the floodplain. Excess fertilizer, chemical pesticides and other chemical inputs of agricultural field also pollute the soil of the agricultural field.

Moreover, soils nearby the conventional solid waste disposal sites, soils are being polluted from the leachate from the waste.

4.5. Noise Pollution

Noise pollution can be defined as unwanted and/or excessive level of sound that may hamper the balance and regular activities of the biotic components of the environment. Along with the severity of air and water pollution, noise pollution is also emerging to be a serious problem especially in the urban centers of Bangladesh. Though there are rules and acts to control noise pollution, the absence of the implementation of the law has not improved the condition of noise pollution in the country. The situation is even getting

worse day by day with the increasing level of traffic on the roads and construction works all over the major cities. Though several health hazards and mental conditions are associated with noise pollution, the government of Bangladesh is indifferent towards this problem. No mentionable projects were undertaken by the government in broad scale to address this issue.

4.5.1. State of Pollution

An overview of the level of noise pollution of major four cities of Bangladesh is given in this section by reviewing existing literatures and available data on this issue. The data were collected from different secondary sources such as BBS and different published journals.

Dhaka:

Dhaka is one of the most densely populated cities of the world. Currently around 17 million people are living in Dhaka city. It is estimated that, by the year 2030 Dhaka will be the 6th most dense city of the world with a population of 27 million.⁶ Being the capital and largest city of Bangladesh, Dhaka faces the highest rush of migration and impacts of rapid urbanization. Increasing population and development activities have impacts on the acoustic environment of Dhaka. Noise level of some of the selected busy areas of Dhaka city shows a frightful scenario of noise pollution. Table 22 shows the noise level of some selected areas of Dhaka city.

Table 22 Noise level in different areas of Dhaka city

Location	Noise Level (dB)
Sayedabad Bus Terminal	106.0
Bangla Motor	106.0
Sonargaon Hotel	104.0
Farmgate	104.0
Mohakhali Crossing	103.0
Maghbazar	103.0
Mowchak	103.0
Gabtuli	102.0
Jatrabari	100.0
Tejgaon Industrial Area	97.0
Mirpur-1	97.0
Kakrail	92.0
Sapla Chattar Motijheel	89.0
Sadarghat	87.0
Mirpur-10	86.0
BIRDEM Hospital	81.0
Dhanmondi Residential Area	78.0
Gulshan Residential Area	70.0
Banani and Baridhara Residential Area	68.0

Source: Compendium of Environment Statistics of Bangladesh 2009

According to the BBS data, the noise level in the silent zone of Dhaka city is depicted in the table 23 below:

⁶ <http://www.thedailystar.net/rising-population-big-concern-for-dhaka-33081>

Table 23 Noise level in different silent zone of Dhaka city

Location	Noise Level (dB)		
	1999	2002	Standard
I.C.D.D.R.B Hospital	76.50	65.00	50.00
Dhaka Medial College Hospital	70.00	70.00	
Kakrail Mosque	70.00	70.00	
Bangabandhu Sheikh Mujibur Rahman Medical University	68.90	69.00	
Shaheen School	67.60	58.00	
Titumir College	66.80	66.80	
Temple and Church	65.50	85.30	
I.P.H Mosque	60.00	55.00	
Dhakeshwari Mandir (Bakshi Bazar)	53.00	53.00	
NIPSOM	50.00	57.00	

Source: Compendium of Environment Statistics of Bangladesh 2009

It can be seen from the table that, except NIPSOM during 1999, no other places meet the standard noise level of silent zone and the level of noise is very high in most of the places.

The noise level in different residential areas of the Dhaka city shows a similar trend of exceeding noise standard which is shown in table 24. Except Gulshan residential area during 2002, none of the selected residential areas meet the standard noise level.

Table 24 Noise level in different residential areas of Dhaka city

Location	Noise Level (dB)		
	1999	2002	Standard
Mirpur	79.40	63.00	55.00
Shakaripatti	75.50	75.60	
Dhaka Cantonment	74.40	73.00	
Dhanmondi	67.00	65.00	
Banani	61.40	61.40	
Mohammadpur	61.00	61.00	
Gulshan	56.60	55.00	

Source: Compendium of Environment Statistics of Bangladesh 2009

None of the selected mixed areas, commercial areas and industrial areas could meet the standard limit of noise set for the corresponding areas. The level of noise in the mixed areas, commercial areas and industrial areas are depicted in Table 25, Table 26 and Table 27 respectively.

Table 25 Noise level in different mixed areas of Dhaka city

Location	Noise Level (dB)		
	1999	2002	Standard
Mouchak Round	92.60	80.00	60.00

English Road	90.00	90.00
Dhaka Judge's Court	83.70	83.70
Chawk Bazar	77.80	79.00
Shakaripatti	77.50	75.50

Source: Compendium of Environment Statistics of Bangladesh 2009

Table 26 Noise level in different commercial areas of Dhaka city

Location	Noise Level (dB)		
	1999	2002	Standard
Farmgate	90.0	81.0	70.0
Rajuk Avenue	87.8	87.8	
New Market	86.4	86.3	
Gulshan	86.3	82.0	
Motijheel	82.0	83.0	

Source: Compendium of Environment Statistics of Bangladesh 2009

Table 27 Noise level in different industrial areas of Dhaka city

Location	Noise Level (dB)		
	1999	2002	Standard
Inside Nabisco, Tejgaon	89.0	85.0	75.0
Tejgaon	87.0	84.0	
Hazaribagh	80.8	80.0	

Source: Compendium of Environment Statistics of Bangladesh 2009

The average scenario of different zones of Dhaka is city is represented in table 28. None of the zones mentioned in the table meets the standard level of noise.

Table 28 Noise level of different zones of Dhaka city

Location	Noise Level (dB)		
	1999	2002	Standard
Silent Area	64.80	64.90	50.00
Residential Area	70.50	64.90	55.00
Mixed Area	84.30	81.60	60.00
Commercial Area	86.50	84.00	70.00
Industrial Area	85.60	83.00	75.00

Source: Compendium of Environment Statistics of Bangladesh 2009

Chittagong:

No intensive study on the overall noise pollution scenario was done by the government. However, from some discreet publications in the scientific journal a brief idea of the level of noise pollution can be inferred. Noise level at some selected locations of Chittagong city is given in the table 29.

Table 29 Noise level of different locations of Chittagong city

Location	Average Noise Level (dB)
Kaptai Rastar Matha	77.11
Bahaddarhat Circle	87.89
2. No Gate	90.01
GEC Circle	90.12
WASA Circle	81.19
Tiger-pass Circle	84.44
Agrabad Circle	87.67
Barek Building Circle	81.10
Bissho Road Matha	75.29
Boropol	76.00
A.K.Khan Circle	84.99
City Gate	82.09

Source: Muhit et. al., 2013⁷

Noise level in some sensitive areas of Chittagong city is shown in the table 30 below. It can be seen from the table that the level of noise in the sensitive institutions, which should have maintained the level of noise according to the guidance for silent zones, is very high. The minimum level of noise found in these areas was 59.73 dB and the maximum level was found 79.69 dB.

Table 30 Level of noise in some sensitive institutions of Chittagong city

Location	Noise Level (dB)	
	Max	Min
Pahartoli Eye Hospital	73.58	67.05
USTC Hospital	73.66	66.09
Ispahani Public School & College	65.84	59.73
Chittagong Government Women College	68.82	62.69
Chittagong Government College	75.44	67.93
Government Mohsin College	74.86	67.62
Chittagong Government High School	76.75	68.08
Chittagong Medical College Hospital	76.45	69.03
Aparnacharan Girls High School	73.59	64.45
Chittagong Municipal Model High School	79.69	67.23
Government City College	76.53	67.94
Chittagong City Corporation Matrishadan Hospital	70.14	65.52

Source: Chowdhury et. al., 2010⁸

⁷ Muhit, I. B., Chowdhury S. T. 2013. Magnitude and Impact Analysis of Road Traffic Noise Pollution at Port City Chittagong, Bangladesh. American Journal of Environmental Engineering. 3(3), 130-146.

Sylhet:

Noise level in the sensitive institutions of Sylhet city also exceeds the permissible noise standard. Whereas the level of noise should be within 50 dB, the minimum noise level found in the below mentioned areas (table 31) is 75.2 dB. The maximum recorded sound level was 97.3 dB.

Table 31 Noise level in some sensitive areas of Sylhet city

Location	Distance from Roadside	Traffic Noise Index (dBA)
City Poly Clinic and Mother Care Clinic	10	88.6
Royal Hospital, Zindabazar	20	75.2
Govt. Girls High School	5	97.3
Blue Bird High School	30	93.9
Darshan Deuri Primary School	5	86.5
Pathantula Jameya Islamiah Madrasha	5	81.7
Ananda Niketon School	10	88.3
Amberkhana Dargah Gate Primary School	5	93.8
Aziz Medical Center	5	85.5
Police Line High School	10	88.2
Sylhet Govt. Pilot High School	15	75.8

Source: Alam et. al., 2006⁹

The average noise level of Sylhet city at different time interval and different distance from roadside is given in table 32. Maximum sound level was 79.09 dB just beside the road side within 3pm-7pm whereas the minimum sound level was found 90 meters away from the roadside which was 48.2 dB during 11am-3pm.

Table 32 Average noise level (in dB) of Sylhet city at different time interval and different distance from road side

Time Interval	Distance from road side (m)						
	0	15	30	45	60	75	90
7am-11am	78.55	74.04	69.33	65.09	60.19	55.27	50.17
11am-3pm	77.24	72.54	67.91	63.19	58.05	63.24	48.2
3pm-7pm	79.09	74.38	69.65	65.00	59.71	54.94	49.78
7pm-11pm	77.45	72.99	68.05	63.18	58.36	53.41	48.33

Source: Alam et. al., 2006¹⁰

Khulna:

Noise level in some residential areas of Khulna city is depicted in table 33. The standard level of noise in the residential areas during day time (6am-9pm) is 55 dB which was met by only one residential area *Purbo*

⁸ Chowdhury, R. B., Dey, R., Alam M. S., Chakraborty, P. 2010. Extent of traffic induced noise in the noise sensitive institutions of Chittagong city, Bangladesh. *Noise & Vibration Worldwide* 41(1), 28-36.

⁹ Alam, J. B., Alam, M. J. B., Rahman, M. M., Dikshit, A. K., Khan, S. K. 2006. Study on traffic noise level of Sylhet by multiple regression analysis associated with health hazards. *Iran Journal of Environmental Health, Science and Engineering*. 3(2), 71-78.

¹⁰ *ibid*

Baniakhmar only during 12pm-4pm of working day. None of the other mentioned residential areas could meet the standard set for residential area.

Table 33 Noise level in different residential areas of Khulna city

Location	Noise Level (dB)					
	8am-12pm		12pm-4pm		4pm-8pm	
	Working Day	Holiday	Working Day	Holiday	Working Day	Holiday
Sonadanga RA	74.0	72.0	66.0	65.0	71.0	70.0
Khalispur RA	65.0	64.0	70.0	71.0	72.0	70.0
Sheikh Para	66.0	63.0	60.0	58.0	68.0	66.0
Mirja Pur	68.0	67.0	64.0	61.0	60.0	60.0
Toot Para	65.0	60.0	66.0	58.0	60.0	58.0
Purbo Baniakhmar	60.0	60.0	55.0	57.0	67.0	65.0
Paschim Baniakhmar	65.0	63.0	60.0	57.0	63.0	60.0
Ikbal Nagar	65.0	59.0	63.0	58.0	70.0	63.0
Nirali RA	69.0	60.0	65.0	60.0	75.0	66.0

Source: Compendium of Environment Statistics of Bangladesh 2009

The standard noise level for commercial area in Bangladesh is 70 dB. During working days none of the mentioned commercial areas of Khulna city could meet the standard level of noise. However, many of the areas during holidays could meet the set standard for noise. The minimum level of noise (58.0 dB) was found in New Market area on holiday between 12pm-4pm, whereas, the maximum level of noise (89.0 dB) was recorded in Sonadanga Bus Station area on working days between 4pm-8pm. The level of noise in some commercial areas of Khulna city is shown in table 34.

Table 34 Noise level in some commercial areas of Khulna city

Location	Noise Level (dB)					
	8am-12pm		12pm-4pm		4pm-8pm	
	Working Day	Holiday	Working Day	Holiday	Working Day	Holiday
Gollamari	77.0	68.0	75.0	60.0	78.0	68.0
Sonadanga Bus Station	85.0	78.0	78.0	80.0	89.0	76.0
Khalispur	81.0	71.0	78.0	67.0	85.0	70.0
Boyra	80.0	70.0	80.0	65.0	85.0	72.0
Daulatpur	85.0	71.0	83.0	60.0	88.0	75.0
New Market	80.0	65.0	76.0	58.0	80.0	60.0
Dakbangla	84.0	68.0	80.0	65.0	84.0	67.0
KCC Market	88.0	65.0	80.0	60.0	84.0	68.0
Rupsa	81.0	74.0	78.0	72.0	86.0	78.0
Moyla pota	86.0	80.0	80.0	78.0	85.0	70.0

Source: Compendium of Environment Statistics of Bangladesh 2009

During working days, the noise level beside the roads stay very high and the maximum level of noise was recorded 91.0 dB beside Khulna-Jessore Road during 8am-12pm. The minimum noise level (60.0 dB) was recorded during holiday in three different roads viz. Sher-e-Bangla Road, Klay Road, Ahsan Ahmed Road at

two different time periods. The noise level in some important roads of Khulna city is shown in the table 35 below.

Table 35 Noise level in some important roads of Khulna city

Name of the Roads	Noise Level (dB)					
	8am-12pm		12pm-4pm		4pm-8pm	
	Working Day	Holiday	Working Day	Holiday	Working Day	Holiday
Khan Jahan Ali Road	79.0	67.0	74.0	62.0	78.0	63.0
Sher-e-Bangla Road	76.0	71.0	72.0	60.0	81.0	70.0
Khulna-Mongla Road	81.0	75.0	78.0	68.0	79.0	75.0
Khulna-Jessore Road	91.0	75.0	75.0	70.0	89.0	78.0
Upper Jessore Road	85.0	70.0	79.0	76.0	87.0	68.0
KDA Avenue	83.0	73.0	80.0	64.0	80.0	76.0
Khulna-Satkhira Road	83.0	75.0	75.0	67.0	80.0	70.0
Sonadanga Road	84.0	74.0	68.0	65.0	88.0	72.0
Klay Road	85.0	65.0	78.0	60.0	80.0	67.0
Ahsan Ahmed Road	84.0	77.0	77.0	68.0	89.0	60.0
Rupsa Bridge	88.0	74.0	78.0	67.0	85.0	78.0

Source: Compendium of Environment Statistics of Bangladesh 2009

The level of noise in some of the hospitals of Khulna city, which fall under silent zone, is represented in the table 36. Though the level of noise should be within 50 dB according to the standard noise level of silent zones, the minimum level of noise recorded among the mentioned hospitals is 58.0 dB which also exceeds the standard limit.

Table 36 Noise level in different hospitals of Khulna city

Location	Noise Level (dB)	
	Max	Min
Khulna Medical College Hospital	68.0	59.0
Khulna Surgical & Medical Hospital Pvt. Ltd	70.0	64.0
Khulna General Hospital	68.0	58.0
Garb Newaz Clinic Duagnostic Ltd	68.0	63.0
Khulna Shishu Hospital	77.0	67.0
TB Hospital	72.0	64.0

Source: Compendium of Environment Statistics of Bangladesh 2009

4.5.2. Sources of Pollution

The sources of noise pollution can be divided into five main categories such as street traffic, aircraft, railroads, industry and construction according to the Compendium of Environment Statistics of Bangladesh, 2009.

Street Traffic Traffic induced noise can be said as the main sources of noise pollution in Bangladesh. Lack of law enforcement and awareness in this sector is making the situation worse. Excessive and unnecessary use of horns, lack of maintenance of the vehicle, absence of planning during construction of roads,

highways, flyovers etc, heavy traffic load on the roads, high density of population in the major cities etc issues are making the traffic induced noise level unbearable.

Aircraft Aircraft noise is another major source of noise pollution in Bangladesh which mainly disturbs the people living near airport areas.

Railroads The sound of engine, wheels, whistle of trains, warning signals at crossing create high level of noise. People living beside railroads mainly suffer from this noise.

Industry Product fabrication, product assembly, power generation, processing etc activities creates loud noise in the industry. As there is lack of awareness and law enforcement about noise pollution, the industries generally do not take any measures to control the noise.

Construction As Bangladesh is rapidly developing, construction activities are a very common thing here. Construction activities create loud sound, which is another major source of noise pollution in the country. Moreover, due to the absence of mitigative measures, the level of noise in most cases becomes intolerable.

Other Sources Other sources of noise pollution may include agricultural noise, use of excessive microphones, loud music, sirens, military noise etc.

4.6. Waste and Waste Water management in Major Cities

Solid Waste Management (SWM) and Sewerage Treatment are one of the major multidimensional problems faced by the urban world of the present time¹¹. The problem is much more severe in the developing countries especially of the ones with high population density like Bangladesh. Additional to high population density, Bangladesh is facing a rush of rural-urban migration as it is going through a phase of rapid urbanization. The problem is much more intensified as the urbanization process of Bangladesh is not occurring in a planned manner.

Poor management of solid waste and sewerage has severe consequences like failure in drainage system due to water clogging, deterioration of soil quality and soil pollution, air pollution, foul odour, surface water pollution, risk of ground water pollution through leachate percolation, spread of infectious and vector borne diseases, risk of explosion in landfill areas etc¹². Though SWM and sewerage treatment are daunting problems, they are still not considered as a major concern in Bangladesh. Open dumping, throwing waste here and there and also to water bodies etc are regular practice here. The relevant databases such as generation, composition, disposal of solid waste etc are not yet developed and the regulation system related to solid waste management is also very weak. Only very recently 'National 3R strategies for waste management' has been developed. However, no effective measures have still been taken to control the uncontrolled disposal and management system of solid waste. Even the city corporation regulated waste collection and disposal systems are not sanitary. However, this chapter tries to give an overview of the present situation of solid waste generation and management in the major cities of Bangladesh by reviewing existing literatures and analyzing secondary data.

4.6.1. Waste Generation

The per capita waste generation rate of whole Bangladesh is not clearly known yet. According to waste concern, the average per capita urban waste generation rate of Bangladesh in 2005 was estimated as 0.41

¹¹ Sujauddin et al., 2008

¹² Chowdhury et al., 2013

kg/capita/day¹³. The urban rate of waste generation and projected future waste generation rate in urban areas is depicted in the table below:

Table 37: Urban solid waste generation rate in Bangladesh

Year	Urban Population (million)	Waste Generation Rate (kg/Capita/day)	Total Waste Generation (Tonne/day)
1991	20.87	0.49	9873.5
2001	28.81	0.5	11695
2004	32.77	0.5	16382
2025	78.44	0.6	47064

Source: Waste Concern, 2004

As waste generation rate highly dependent on different social parameters and lifestyle, the generation rate differs from region to region and in different social class. The generation rate of waste of different city corporation areas is accumulated in this section from secondary sources.

Dhaka

Being the capital and largest city, Dhaka plays a role of economic and political hub of Bangladesh. Around 37% of the total urban population lives in Dhaka city and the pressure of rural-urban migration is highest on Dhaka¹⁴. It is one of the most densely populated cities of the whole world. According to a project entitled "Clean Dhaka Master Plan" (2005) conducted by JICA, the waste generation rate of Dhaka is presented in the table 21 below:

Table 38: Total solid-waste generation rate of Dhaka

Type	Amount (t/d)
Domestic waste	1950
Business waste	1050
Street waste	200

Source: (JICA, Pacific Consultant Internationals, & Co, 2005)

The per capita generation of domestic solid waste and seasonal variation of waste generation according to the income group is described in table 22. From the table it can be seen that on average the per capita generation of domestic solid waste in Dhaka city is approximately 0.340 kg/day. The highest amount of waste is generated by High Income Group (0.513 kg/person/day) whereas the lowest amount of domestic solid waste is generated by the lowest income group (0.260 kg/person/day). No significant variation or pattern is noticed between the waste generation rate in dry and wet season.

Table 39: Per capita domestic solid waste generation according to income group

Domestic Waste				
Income Group	Income Level (Tk/Month/Family)	Waste Generation Rate (Kg/person/day)		
		Dry Season	Wet Season	Average
Lowest Income Group	3000>	0.314	0.205	0.260

¹³ Waste Concern Waste Database, 2009

¹⁴ Rahman, H.Z. (2001). "Bangladesh Urban Transition: An Overview."

Low Income Group	5000>, ≥3000	0.326	0.345	0.336
Middle-Low Income Group	10000>, ≥5000	0.279	0.346	0.313
Middle Income Group	20000>, ≥10000	0.371	0.428	0.400
High Income Group	≥20000	0.588	0.438	0.513
Weighted Average				0.340

Source: (JICA et al., 2005)

The JICA study estimates that the average business waste generation rate is 1050 t/d. The breakdown of waste generation rate at different sources is depicted in Table 23. From the table it can be seen that on average restaurant (23.8 kg/place/day) and hotel (15.3 kg/place/day) generates the highest amount of waste place/day respectively. On the other hand, in market average per day waste generation rate is 1.1 kg per m². In case of business waste, it is seen that the amount of waste generation is slightly higher (5.7 kg/place/day) during wet season. In case of market waste generation also, the amount is marginally higher (0.4 kg/m²/day) during wet season.

Table 40: Solid waste generation rate in business sectors

Business Waste				
Sources	Waste Generation Rate			Unit
	Dry Season	Wet Season	Average	
Restaurant	24.0	23.6	23.8	kg/place/day
Shops	0.9	0.8	0.9	
Hotel	11.0	19.6	15.3	
Office	2.4	5.6	4.0	
Market	0.9	1.3	1.1	kg/m ² /day

Source: (JICA et al., 2005)

The country's average rate of street waste generation is 200 t/d (Table-21). On average 364.5 kg waste is generated in per km of the street of Dhaka city. In street, 40 kg/km more waste is generated during wet season than the dry season. The data on street waste generation is represented in table 24 below.

Table 41: Generation rate of street waste

Sources	Waste Generation Rate (kg/km)		
	Dry Season	Wet Season	Average
Street Waste	344.5	384.5	364.5

Source: (JICA et al., 2005)

Chittagong

The waste generation rate in Chittagong has increased 1302 ton/day within 10 years from 2000 to 2009. This rapid increase in waste generation rate can be associated with the rapid population growth and rapid urbanization process. The population of Chittagong city has increased 1.23 million within this time frame. Along with the population, the per capita waste generation rate has also increased from 0.26 kg/day in 2000 to 0.55 kg/day in 2009. This per capita increase in waste generation can be linked with the economic growth, improved living standard and increased buying capacity of the Chittagong dwellers. Though the increased waste generation gives a frightful scenario, the matter of hope is that in Chittagong, collection

coverage of the waste has also increased from 48% to 70% within these 10 years. Detailed of the waste generation and collection scenario from the year 2000 to 2009 is depicted in table 25.

Table 42: Municipal solid waste generation and collection in Chittagong (2000-2009)

Year	Population (million)	Waste Generation Rate (kg/capita/day)	Total Daily Waste Generation (ton/day)	Waste Collection (ton/day)	Collection Coverage (%)
2000	2.22	0.26	588	282	48
2001	2.29	0.28	637	312	49.0
2002	2.37	0.29	694	354	51
2003	2.45	0.31	758	409	54
2004	2.52	0.34	827	455	55
2005	2.60	0.38	984	551	56
2006	2.72	0.40	1075	634	59
2007	2.86	0.45	1285	784	61
2008	3.15	0.52	1650	1056	64
2009	3.45	0.55	1890	1323	70

Source: Chowdhury et al., 2013

The composition of municipal solid waste in the landfill is presented in the pie graph below in Figure 1. From the figure it can be seen that the highest amount of the waste is comprised of food waste. The compostable amount of waste in the landfill comprises 79% of the total waste.

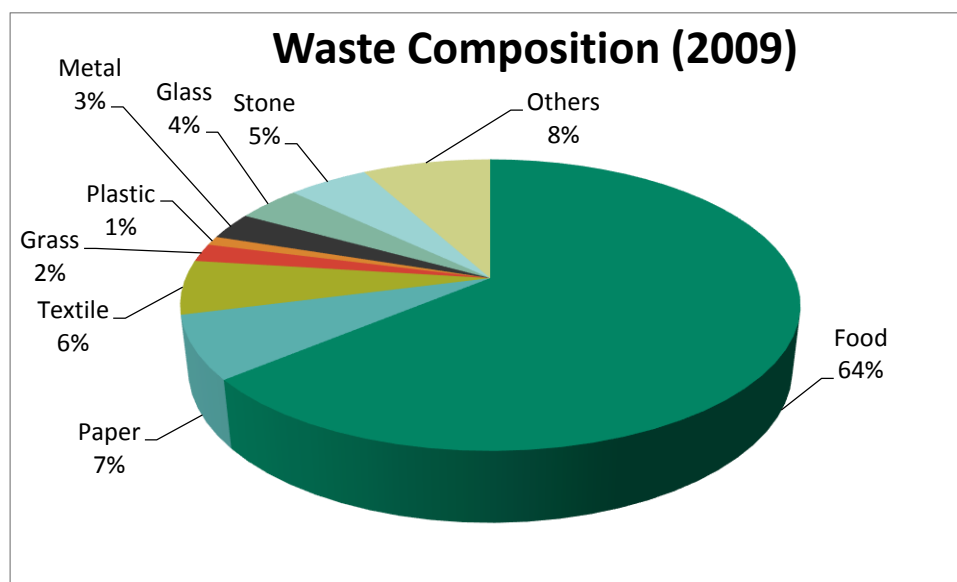


Figure 12: Waste composition in the landfill of Chittagong, 2009

(Source: Chowdhury et al., 2009)

Khulna

Khulna City Generates 300-380 tons of solid waste per day that includes 70% - 80% solid waste (Murtaza, 2002). Domestic, retail sale markets, slaughter house, hotels & restaurant, hospitals are the major sources waste. Khulna City Corporation is the responsible authority for management of these wastes. The KCC has only one landfilling site located in Rajbandh which is conventional. The site is equipped with a limited recycling facility, incineration facilities, and a conventional disposal area. Leachate from the waste disposal creates water pollution and nuisance to nearest society. The KCC has a plan of construction of asanitary landfilling area in Labanchora but the project is stuck due to public agitation related to land acquisition.

Other City Corporations

Average waste generation rates in Barisal, Gazipur, Narayanganj and Sylhet city corporations (CC) are 0.16, 0.20, 0.29 and 0.28 kg/capita/day (Table 26). From the comparison of the CC, it can be found that, after Dhaka and Chittagong, the highest amount of per capita waste is generated in Narayanganj and then Sylhet.

Table 43: Waste generation rate in four other city corporation areas

City Corporation	Income Class	Waste Generation Rate	
		kg/hh/day	kg/capita/day
Barisal	Low	0.74	0.17
	Lower middle	0.53	0.10
	Middle	0.86	0.17
	High	1.01	0.22
Weighted average		0.80	0.16
Gazipur	Low	0.39	0.07
	Lower middle	0.91	0.22
	Middle	0.87	0.18
	High	1.09	0.24
Weighted average		0.88	0.20
Narayanganj	Low	1.49	0.42
	Lower middle	1.37	0.29
	Middle	1.05	0.25
	High	1.43	0.32
Weighted average		1.29	0.29
Sylhet	Low	1.16	0.21
	Lower middle	1.22	0.25
	Middle	1.39	0.29
	High	1.44	0.30
Weighted average		1.36	0.28

Source: CEGIS Field Survey, 2012(CEGIS, 2013)

(Note: Here, income of Low income group= Up to BDT 4000; Lower Middle income group= BDT. 4001-8000; Middle income group= BDT 8001-30000; High income group= BDT above 30000)

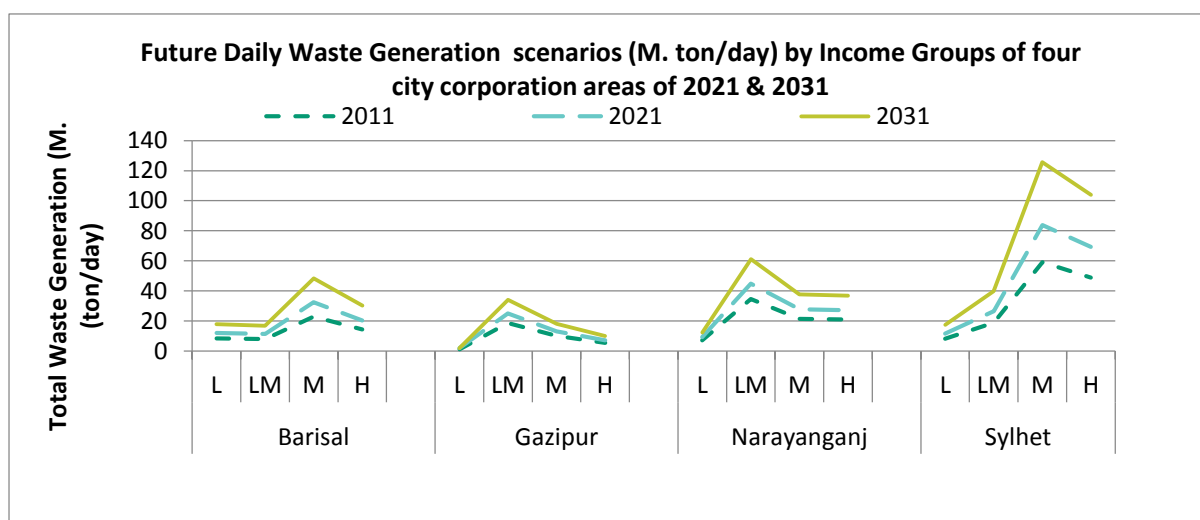
The collected waste generation (kg/capita/day) data were used to predict the future waste generation (metric ton/day) trend of waste in the four above mentioned city corporation. The projection has been done

mainly for the year 2021 and 2031. The predicted waste generation rate of the four city corporation areas are presented in table 29.

Table 44: Projected future population and waste of the years 2021 and 2031 of the four city corporation areas

City Corporation	2011		2021		2031	
	Population	Total waste (m. ton/day)	Population	Total Waste (m. ton/day)	Population	Total Waste (m. ton/day)
Barisal	3,28,278	53	4,66,155	76	6,94,571	113
Gazipur	1,79,037	35	2,38,119	47	3,30,986	65
Narayanganj	2,86,330	84	3,72,229	109	5,06,231	148
Sylhet	4,79,831	135	6,81,360	191	10,22,040	287

Source: CEGIS estimation from Field Survey data, 2012(CEGIS, 2013)



Here, Income class: L=Low; LM= Lower Middle; M=Middle; H=High

Figure 13: Projected waste generation status of the year 2021 and 2031 of four CC by different income groups

It is seen from the above figure that, Waste generation rate is highest in Sylhet among the four CCs. In general, Low-Middle and Middle income generating groups generate higher amount of waste. (Figure 13) In Gazipur and Narayanganaj, which are comparatively urban cities, Low-middle Income Group generates higher amount of waste. On the other hand, in Sylhet and Barisal, middle income group generates higher amount of waste.

4.6.2. Waste Management

Practicing Approach and Technologies

The existing solid waste management practice is not sufficient and environment friendly. In Bangladesh, generally three systems such as informal system, community initiative and formal system work side by side in waste management sector. The informal system of solid waste management includes huge informal labour forces who are involved in solid waste recycling trade chain. Community initiatives such as house to

house waste collection system were mainly started due to dissatisfaction of waste management system by formal sector. The community based initiatives are mainly conducted by the NGO's or Community Based Organizations (CBO's). CC/municipalities are responsible in the formal system of solid waste management in the urban areas. This formal system is based on conventional waste collection-transportation-disposal method which lacks the concept of sustainable and environment friendly processes¹⁵.

In the city corporation areas of Bangladesh, the waste management procedure is almost similar. The generalized process flow of the solid waste management system in the urban areas of Bangladesh is explained in the figure 3 below:

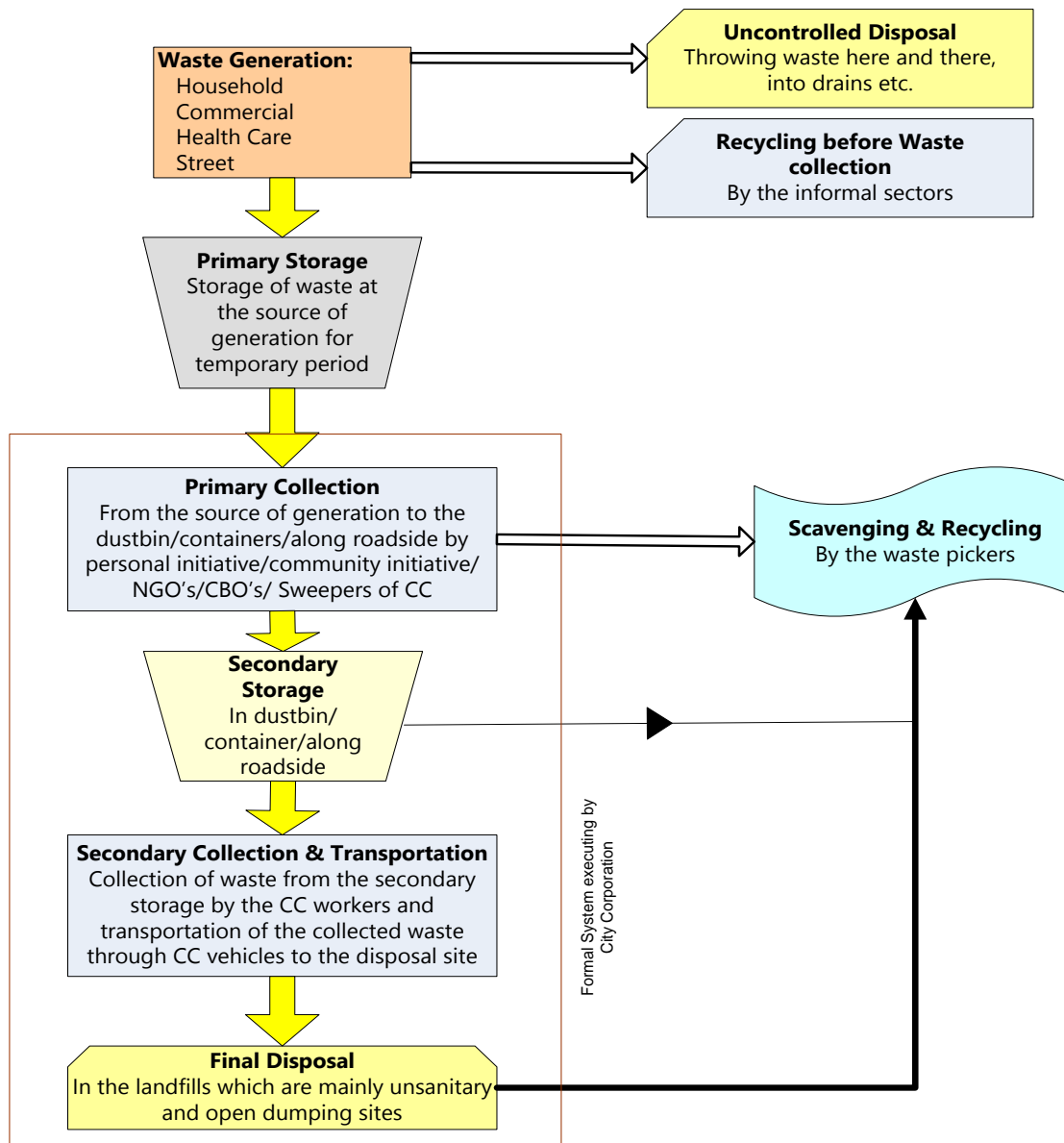


Figure 14: The generalized process flow of the solid waste management system in CC areas

Source: adapted from Waste Concern, 2004 and Chowdhury et al., 2013

¹⁵ Waste Concern, 2004

Cost Recovery

The cost of the solid waste management of a city corporation comes from revenue and house hold taxes. But the cost recovery is unclear as it is not mentioned in the house hold taxes. JICA studied the financial mechanism of Solid Waste Management of Dhaka city during preparation of Clean Dhaka Master Plan and identified the following constraints of cost recovery mechanism:

- Financial budget is department wise but not operation wise, that makes difficulties in assessing real cost of waste management.
- Overall SWM cost is unclear at all. So cost recovery measures are difficult to be taken quickly and properly. Unified SWM budget system composed by operation-wise cost should be introduced.
- Constraints in managing and operation of cost recovery mechanism
- Real cost incurred in the year is uncertain. Financial position is unclear. Current property value is not correct
- Low revenue of DCC
- Many appeals from taxpayers due to in-transparency of tax assessment system of DCC

4.7. E-Waste Management in Bangladesh

Not much is known about the extent of e-waste and hazardous waste generation and management system of Bangladesh as no inventory has been done yet on these issues. Though some initiatives were taken by some private sectors to know the generation rate of e-waste, in many cases the methodology of their study was not scientifically strong and clear.

As the world is experiencing an era of technological revolution, the use of electronic gadgets is increasing rapidly. In case of Bangladesh, the boom in the ICT sector is very noticeable. The mobile teledensity of Bangladesh is increasing at a very fast rate. While the number of active mobile subscriber was 58.36 million at the end of 2010¹⁶, the number became 97.18 million at the end of December 2012¹⁷. Approximately 230,000 computers and 65,000 laptops were sold inside Bangladesh only in 2009 alone¹⁸. The uses of other electronic gadgets are also increasing. Bangladesh has started producing EEE inside the country very recently. Moreover, it was found from the study that the lifespan of electrical and electronic equipments (EEE) are decreasing globally with the rapid development in this sector¹⁹. Though there is little information on the rate of usage of EEE in Bangladesh, no authentic information is available on the input or inflow of e-waste into the waste stream of Bangladesh and hence, it is impossible to get the real picture of this field.

A huge informal sector is related in the recycling process of e-waste. There are very less formal facilities related in the sector of e-waste recycling. No separate policy/rules/acts exist for guiding the management of e-waste. Only the National 3R Strategy for waste management mentions the issue of e-waste management and suggests starting the practice of extended producer responsibility (EPR) in the country.

¹⁶ Ahmed, F. R. S. 2011a. E-Waste Management Scenario in Bangladesh. Retrieved from <http://www.unep.org/ietc/Portals/136/Events/WEEE-E%20workshop%20July%202011/01.Bangladesh.pdf>

¹⁷ BTRC (Bangladesh Telecommunication Regulatory Commission). 2013. http://www.btrc.gov.bd/index.php?option=com_content&view=article&id=631:mobile-phone-subscribers-in-bangladesh-january-2012&catid=49:telco-news&Itemid=502

¹⁸ Sarkar P., Hasan M. 2010. Bangladesh. Retrieved from <http://www.giswatch.org/es/node/279>.

¹⁹ Lee J. C., Song H. T., Yoo J. M. 2007. Present status of the recycling of waste electrical and electronic equipment in Korea. *Resources, Conservation and Recycling*. 50: 380–397

4.8. Hazardous Waste Management

An inventory of hazardous waste management was published by Department of Environment, Bangladesh on 2010 where textile dying industries, hospitals and clinics, tannery, pesticides, fertilizers and oil refinery etc were enlisted as possible sources of hazardous waste in Bangladesh.²⁰ Only recently on 2011 a rule entitled "Hazardous Waste and Ship Breaking Waste Management Rules, 2011" was gazetted. However, there is no clear information on the generation and management of hazardous waste management in Bangladesh and the law enforcement is very weak in this regard. Consequently, the environment, specially the surface water of Bangladesh is severely degrading.

4.9. Environmental Pollution in Chittagong Hill Tract

Environmental pollution status in hill tract region is hardly addressed in research and planning documents. Scarcity of safe drinking water is highly scarce there. Ground water is highly rich in iron which has health impact. The stream water which is frequently used by the local and indigenous people is contaminated by faecal bacteria. Shifting cultivation has also impact on surface water quality. There is no recorded data on air quality. Solid waste management, waste water management, sewerage management are only limited to urban areas. As these hilly regions are located at upstream of the watershed areas, land use management in these areas are very important to know. Presently, shifting cultivation is very common. The farming practices, use of fertilizers and pesticides has direct impacts on stream water quality,

²⁰ DoE (Department of Environment). 2010a. Hazardous Waste Management in Bangladesh: A Country Inventory. Retrieved from http://www.wasteconcern.org/Publication/HazardousWaste_publication_short.pdf

5. Planning Context

5.1. Present Issues and Challenges

- **Growth of ship building and recycling industries in coastal and marine area recognized as ecologically sensitive area**

The ship building and recycling industries are growing in the coastal area, especially in Chittagong coast of Meghna Estuary. The Meghna estuary and the adjoining coast are also recognised as biodiversity hotspot. The environmental departments of the government are giving thrust in protecting these areas. On the other hand for the sake of the economic growth, other ministries like Ministry of Industries, Ministry of Shipping, Ministry of Power, Energy and Mineral Resources are promoting industrial development in coastal region.

- **Conflict between development activities and ecologically critical areas**

For example Government has a plan of building a deep sea port at Sonadia Island of Maheshkhali, Cox's Bazar which is a declared Ecological Critical Area and one of the country's biodiversity hotspot. Similarly, some coal based thermal power plant, ship building industries, and other heavy polluting industries are growing near Sundarbans and its Ecological Critical Area. The Mongla Port, the Mongla EPZ, several cements industries are already in the ecological critical area where any industrial activities are restricted.

- **Restoration of Polluted Rivers**

Restoration of the heavy polluted rivers like Buriganga, Sitalakkhya, Tongi, etc is one of the critical environmental issues. The so far identified plans and options for restoration are not beyond the criticism. The flow augmentation and restoring connectivity might spread pollution to other rivers. Again dredging and disposal as well might raise the problem of re-suspension of pollutants (especially heavy metals) absorbed in bottom sediments.

- **Trans-boundary Pollution**

Trans-boundary air pollution is one of the major causes of top dying disease of Sunduri Tree in Sundarbans Mangrove. A numbers of brick making industries developed in India along the border of south-western region of Bangladesh. Different researches find evidence of trans-boundary air pollution.

Bangladesh shares 57 crossing boundary rivers with India and Myanmar. The development and industrial activities happening in the upstream countries also have impacts on the river water quality of the downstream riparian countries. Water quality has not been discussed yet in our trans-boundary river treaties. But if we follow the trend of deterioration of water quality in our major rivers, then in future this will become one of the most important issue in trans-boundary water sharing.

- **Coal Based Power Generation**

With the aim of reducing high dependency on natural gas, government of Bangladesh is putting thrust on generating 20,000 MW (50% of total generation in 2030) electricity from coal based thermal power plants by 2030. Coal based thermal power plants are historically blamed for causing heavy pollution. Though, the

future plants will be of advance technologies and comparatively less pollution causing, these are still issues of environmental concerns.

- **Energy Development and production ensuring Environmental Safeguard**

The natural gas reserve is declining. We need to go for further exploration and mining. The potential gas and coal reserve areas are in places which are already in environmental concern. Socioeconomic issues, land acquisition, subsidence, ground water level drawdown, groundwater pollution, etc issues obstructed the further development of coal mining in North-western region which is one of the largest coal deposit region of the country. Once, the Bangladesh Petroleum Exploration and Production Company had keen interest on survey and exploration for gas & oil in Sundarbans. Government of Bangladesh has keen interest on exploration and production of gas and oil in Marine area. But the international historical records of severe environmental damage from such activities raise the issue of environmental risk. Energy development ensuring the environmental safeguard is always one of the hot issues. Some environmentalists always believe safeguarding environment in mining activities is always a myth that never happened.

- **Guiding Landuse Changes Ensuring Protection of Natural Landscape**

Conservation of natural landscape especially the wetlands, forests, hilly areas, flood plains, flood flow zones, etc is another pressing issue in the context of land use change due to urbanization and industrialization. The growing demand of settlements and industrial development restricts the conservation of natural landscape. The forest lands, wetlands, hilly areas, floodplains, inter-tidal areas are converted to other landuse for meeting the demand of housing, food, and economy as a whole. The legal instruments e.g. Landuse Policy 2001, ECR 1997, etc are not giving any promising results in controlling the unplanned landuse change. The issues related to enforcement of law, governances, transparency, political pressures and pressure of business men etc are also related to the issue of sustainable landuse change.

- **Implication of Economic Valuation of Ecosystem Services in Natural Resources Management**

The economic valuation of ecosystem services and its implication in natural resources management is considered effective to achieve the goal of environmental protection. But the ecosystem services are not always easily visible and people are not sometime willing to pay for enjoying the services. The complexity in economic mechanism of valuing the services and its implication, and the social readiness are the barrier for its adoption in natural resources management. However, the recently published National Environmental Policy (2013) recommends for consideration of value of ecosystem services along with the economic values of the ecosystem resources in national development planning.

- **Protection of Forest Resources, Sanctuaries, and Ecological Critical Areas**

Extraction of resources e.g. fuel wood, fisheries, woods, foods, roofing and thatching materials, medicinal ingredients, etc are prohibited or limited in forests and wetlands which are declared as sanctuaries and ecological critical areas. These embargos affect forest and wetlands dependent livelihoods. Government is now managing these protected areas through integrated and co-management approach. However, the dependent locals are still blaming the government for loss of their livelihoods.

- **Integration of different government department and private parties**

Integration of different government departments in environmental protection and management is realized by all and recommended in National Environmental Policy 2013 but the effectiveness is still faraway. How this integration can be done in effective way is still a debate and environmental governance issue.

- **Enforcement and Monitoring of law, rules and regulations**

Despite of having a good legislative platform, the effective enforcement and monitoring of law, rules and regulations are not achieved yet. The issue becomes complex due to its nature and its relation with environmental governance, transparency, public participation, private participation and integration of relevant government departments. The issue is commonly addressed in every policy and planning documents and none sees the solutions of it.

- **Pollution from Agricultural Field**

Pollution from agricultural field is commonly addressed issue. Excess use of fertilizer and pesticides reach to nearby the water bodies and ultimately find their way to river. One of the major sources of sediments in rivers and particulate matter in air is agricultural lands. Sustainable farming practices e.g. integrated pest management, use of natural fertilizers, optimum use of water for irrigation, etc. are commonly suggested by different policy and planning documents. However, low level of knowledge of our farmers, financial barrier, and other necessary technical supports obstruct sustainable farming practices.

- **Availability of land for large scale water and waste water treatment plant, waste management plant, land filling sites**

Land is one of the limiting resources. Land availability for different development activities are becoming very complex issue in cities, urban areas and even in rural area. The present state of environment and our socio-economic development urge for building of large scale water and waste water treatment plants, solid waste management plants and sanitary land filling sites in urban areas. Land availability will be one of the major issues that need to overcome before building new water and waste water treatment plants, waste management plants and land filling sites.

- **Issue of land availability and appropriate environmental management of dredged spoils**

Government is putting thrust on capital dredging of major rivers and navigational routes. The management of these dredged soils would be a major issue due to land availability and pollution risk from these dredged spoils.

- **Ensuring protection of ecosystem and habitats in channelization of major rivers**

Bangladesh Water Development Board is planning to channelize the Jammuna river with the aim of better management of the river for the purpose of navigation and ensuring safety from natural disasters. But the issue arises, how the other habitats e.g. charlands, shallow mudflats, submergible sand bars, shallow water areas, etc. will be protected and conserved. The diversified fish and aquatic biodiversity largely depends on these diversified habitats.

Table 45: Environmental Pollution Related Issues and Challenges

Sl no	Issue	Challenge
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1	Growth of ship building and recycling industries in coastal and marine area	<ul style="list-style-type: none"> • Safeguarding ECA and Cleaner Technology in Ship Breaking and Building
2	Restoration of Polluted Rivers	<ul style="list-style-type: none"> • Safe Disposal of Polluted Bed Soil dredged from River
3	Trans-boundary Pollution	<ul style="list-style-type: none"> • Bringing issue of Trans-boundary Pollution in Political Table
4	Coal Based Power Generation	<ul style="list-style-type: none"> • Adopting Cleaner Technology in Power Generation
5	Guiding Landuse Changes Ensuring Protection of Natural Landscape	<ul style="list-style-type: none"> • Implementing Landuse Policy, Landzoning
6	Bringing all waste and waste water in management process	<ul style="list-style-type: none"> • Availability of land for large scale water and waste water treatment plant, land filling sites
7	Cost recovery of wastewater treatment plants, solid waste management plants	<ul style="list-style-type: none"> • Increase of Waste Management Charge, Water Charge, etc • Enforcing Polluter Pay Principle
8	Impact of channelization of major rivers on ecosystem	<ul style="list-style-type: none"> • Ensuring protection of ecosystem & habitats in channelization of major rivers

5.2. Trends and Forecasts and Drivers of Change

A trend of increasing pollution in rivers and seas, air sheds and soil is clearly visible. Now most of the rivers passing through mega cities are polluted. In future, this pollution may spread further downstream. Due to increase of population, unplanned development of urban areas and industrial area, numbers of polluted rivers will be increasing. Now, air quality of the city areas are highly polluted in future same will be seen in the other urban areas like district town, upazila town, etc. as well. Government is taking different initiatives, but the concentration is on mega city areas. Unsustainable and unplanned development is continued in the other urban areas.

To identify long term and short term policy measures, attempts were made to identify and understand the drivers of change. The following drivers of changes are important, and should be targeted in the planning process:

- **Transportation** – In the air shed, NO_x concentration is increasing and already exceeded the EQS. The major source of NO_x is transportations. Improvement of transportation sector, reducing traffic congestions, introducing alternative fuel which is less polluting, improvement of public transports, etc would bring positive changes in improving air quality. Again shifting of major good transportation from road and rail to river would also reduce pollution as the water transportation is less polluting means of transportation.
- **Sewerage Treatment** – Rivers which are flowing through any city and beside an city are subject to sewerage pollution. In most cases, major portion of sewerage ultimately falls into rivers. Sewerage treatment is drive that has potential to make a change in river pollution status.
- **Construction Activities in Mega Cities**– In Dhaka and other mega city, PM_{2.5} and PM₁₀ are major pollutants that cause degradation of airsheds. The concentration of PM_{2.5} and PM₁₀ exceeds the standard limit very frequently. The major source of this PM_{2.5} and PM₁₀ is construction activities.

Efficient environmental management of construction activities to control dust and other pollution will significantly improve the air quality.

- **Central effluent Treatment Plant** – One of the major sources of river water pollution is industry. Legally, all the industries subject to effluent discharge should be equipped with effluent treatment plan. In practical, most of the industries do not have it or even if they have, do not operate it. Cost of treatment, lack of expertise, lack of available land, etc are the common excuses. However, a joint central effluent treatment plan built by several industries together may solve the issue of land availability, cost and knowledge. In industrial zone, a common central effluent treatment plant is also a good suitable solution.
- **Environmentally Safe Operation of Shipping and Transshipments** – Government is putting thrust on improving navigational system. Therefore, the river traffic is increasing in our inland rivers and ports. On the otherhand, ship pollution is becoming a major issue. For example, the river Buriganga, Passur, Karnaphuli, Kirtonkhola, navigational routes through Sundarbans, are polluted by Ships. Control of ship pollution and ship accident through safe operation would improve water quality of river used for navigations.
- **Science and Technological Innovation** – Technological innovation is very much essential in industrial sectors. New innovation of no polluting technology and their adoption in industries has great potential to improve the environmental quality.
- **Regional Cooperation** – Watershed and watershed do not follow political boundary. To prevent and control the transboundary boundary pollution, regional cooperation is a must.
- **Demography and Urbanization** - Pollution is strongly correlated with growth of population and urban areas. Bringing sustainability in urbanization and population growth would control the pollution and improve the environmental state.

5.3. Future Tipping Points

We can consider ambient environmental standards (e.g. Air Quality Standard, Water Quality Standard, Standards for metal/ heavy metal concentrations in Soils, etc (Figure xx) as the environmental tipping points. The state of environment has already reached the environmental tipping points. Water quality in most of the rivers surrounding the mega cities are heavily polluted, the air-sheds in major cities especially Dhaka, Narayanganj, Gazipur, Chittagong, Barishal and Rajshahi are already degraded, heavy metal pollution in soils is becoming another major concern. Therefore the environmental tipping point is already reached. However, for the purpose of the long term planning, the ambient environmental quality standard might be considered as threshold or tipping point.

6. Interlinking with other Thematic Studies

The Bangladesh Delta Plan 2100 aims at developing baseline report of 21 thematic sectors. These sector are interlinked with each other. One of the major objectives of the thematic study is to explore the interlinking of the thematic studies with the aim of proceeding in an integrated way. The interrelationship of environmental pollution with other thematic sectors is discussed in the following sections.

6.1. Air Pollution

Air Pollution is closely related with industrial activities, transportation system, land management system, agricultural practices, urbanizations, infrastructures, etc (Figure . Strategic intervention, technological shift and green initiatives in any of the interlinked thematic sector could bring significant change in the state of

air pollution. For example, conversion of petroleum based automobiles into CNG operated automobile significantly improved air quality of Dhaka city. Now, Ministry of Environment and Forest launched a project called 'Clean Air and Sustainable Environment' integrating transportation sector, brick making industries and environmental components. Delta Plan also aims at coming up with plans of similar integrated projects.

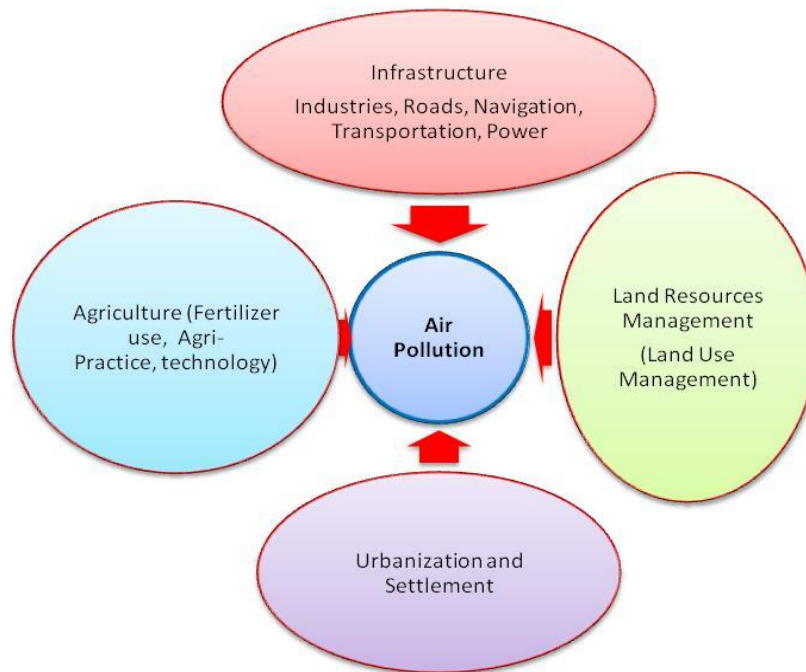


Figure 15: Interlinks of Air Pollution with Other Thematic Study

Therefore, the development plan to be prepared under different thematic study will consider its possible impacts on environmental pollution. Especially, the strategic plans and planning measures to be identified for the sector of infrastructures including roads, navigation, transportation and power, land resources and land use management, urbanization and settlement, agriculture and food security, public health, water supply and sanitation, forest and biodiversity, and ecological settings will consider the objective of improving air quality of the country.

6.2. Soil and Water Pollution

Soil and water pollution is also closely related with thematic studies on water resources, river system management, climate change and disaster management, agriculture and food security, infrastructural development, industrial development, coastal polder issues, etc. For example, lost of connectivity among flood plain, beels and other bodies, and river results lost of function of floodplain, beels and other waterbodies in purification of river water.

The floodplain, beels and tidal marshes act as Silica (Si) recycling. Biogenic and amorphous silica enter into floodplain, tidal marshes and beels and get transformed into biologically available Silica that again come back to river to favour growth of primary producers like Diatoms (Diatom represents 50% of total primary production in coastal and marine water (Struyf, Damme, Gribsholt, & Meire, 2005). This silica recycling function of tidal marshes, beels and flood will be lost due to separation of flood plan, tidal marshes and beels from river by poldering. Weathering of Silicate mineral is the major source of Silica in marine and river

water and there is no anthropogenic source of Silica (except a minor amount from washing powder). Therefore biological recycling of silica through tidal marshes, beels and floodplain is essential to favour continuation of the primary production in marine and river water.

The Tidal marshes and floodplain also play important role in removal of Nitrogen and Phosphorous from river water and ultimately prevent algal bloom. Thus coastal polder issues become very important for water pollution management planning.

Water quality of river has close interrelationship with landuse management in watershed area. Thus transboundary issues become integral part of the pollution management. The interlinking issues and linkage of water and soil pollution issues with other thematic sectors are depicted in Figure 16 below.

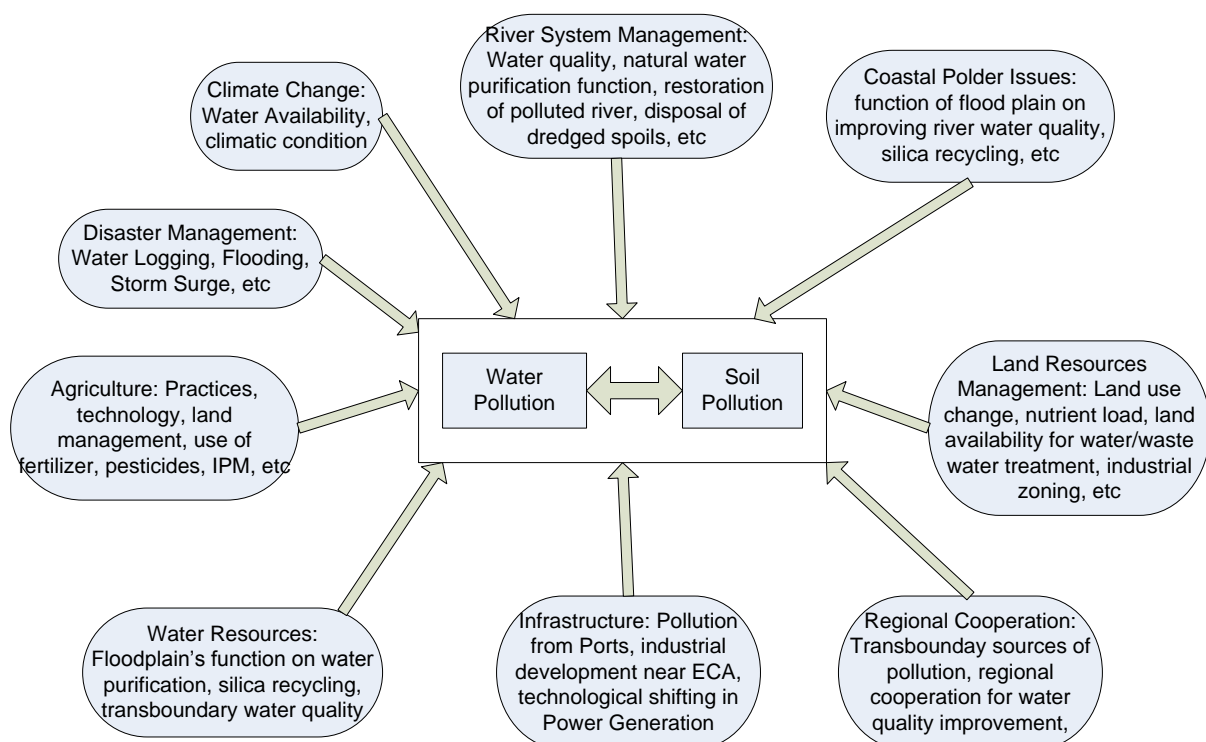


Figure 16: Interlinking of Water and Soil Pollution with other Thematic Sectors

7. Knowledge Gaps

Planning process (in line with the objectives of the Bangladesh Delta Plan 2100) encounters significant gaps in knowledge. The knowledge gap is very wider in water pollution and soil pollution sector in compare to air pollution sector. Department of Environment is Maintaining a good database of air quality of the major cities. On the other hand, data on soil pollution is very limited. DoE monthly collects water quality of the major rivers monthly. Unlike to air quality monitoring, there is no continuous monitoring station for monitoring water quality. However, important knowledge gaps revealed from the baseline study are discussed below:

- **Reliable Data of Water Quality of Major Rivers**

- ☐ Large Miss-matches among different published Water Quality Data
- ☐ Limited Capacity of DoE in regular collection and analysis of Water Quality Data
- ☐ Few parameters are tested monthly by DoE in major rivers (not beyond the issue of reliability and uncertainty)
- ☐ No Continuous Monitoring Locations
- ☐ Lac of Digital Database
- ☐ No data on quality of water coming from transboundary sources
- **Data of Soil Quality**
 - ☐ No data base on Soil Pollution (SRDI maintains soil fertility data base but not pollution)
- **Data Gaps in Air Quality**
 - ☐ Not all the continuous monitoring stations are working
 - ☐ No data on rural and sub-urban area

Emergency Response

- ☐ No available real time water quality monitoring setup
- ☐ No real time modeling system for monitoring accidental spill of chemical, oil, or any hazardous substances

Knowledge on Climate Change Related Issues

- ☐ Future Pollution Scenario (Water Quality, Air Quality, etc)
- ☐ Impact of Climate Change on State of Environment (Water quality, Air Quality, Soil Quality, etc)

8. Opportunities for Preparing Long-term Plan

From the analysis of policy documents, existing literature, suggestion and expectation of different stakeholders, and evaluation of current situation the following strategic measures have been foreseen to incorporate in the Bangladesh Delta Plan 2100 after further evaluation and assessment.

a) Pollution Prevention and Control

- Capacity Building of Department of Environment in enforcement of relevant environmental rules and regulations
- Land Zoning of Industries
- Promoting low/no polluting technology
- Introduce and promote different environmental improvement initiatives and green initiatives e.g. green building, energy efficient building, zero emission building, green city, etc.
- Introducing Environmental Audit, Energy Audit and Water Audit along with Financial Auditing

b) Pollution Monitoring

- Capacity building of Department of Environment in monitoring, investigating, and examining pollution
- Improvement, modernization and standardization of divisional laboratories of DoE
- Develop mechanism of regular monitoring, certification and standardization of different private laboratories
- Development of laboratories at district level office of DoE
- Installation of Continuous online monitoring system for water quality, air quality and soil quality

- Capacity building of DG Shipping, Bangladesh Inland Water Transport Authority, Chittagong Port Authority, Mongla Port Authority and Department of Environment for effective monitoring of ship pollution, inspection, certification and standardization of vessels

c) Emergency Response

- Develop and Institutionalize adaptive mechanism for emergency response to any accidental release/discharge/spill of any chemical substances (liquid and gaseous petroleum, oil, chemicals, etc) with
 - Institutional, legal and financial capacity
 - Knowledgebase:
 - real time monitoring system,
 - exposure modelling, real time risk modelling,
 - models for forecasting transport of hazardous chemical, oil, etc after accidental release/spill or discharge
 - Human Resources
 - Equipment and other facilities
- Capacity building of DG Shipping, Bangladesh Inland Water Transport Authority, Chittagong Port Authority, Mongla Port Authority and Department of Environment to administrate and execute emergency response activities

d) Treatment and Management

- Extend the sewerage network to cover 100% area of city area
- Bringing all sewerage in treatment plant
- Enforcing 'Zero Discharge of waste water' principle
- Planning and Implementing Industrial Zoning with central effluent treatment plan for each zone
- Construction of sewerage network and waste water treatment plan in every upazila town by 2100
- Enhancement of capacity of existing waste water treatment plan
- Initiate community based sewerage management system in rural areas
- Public Private Initiative in Water Treatment, Sewerage Treatment, Industrial Waste Water Treatment
- Creation of Buffer zone in flood plain area along the major river to allow natural removal of Nutrient Load (N and P) from river water, recycling of silica (especially in coastal region),
- Construction of Ship Waste and waste water treatment facilities at Mongla and Chittagong Port area with waste and waste water collection system from ships
- Revise the Port's Ordinance to stop miss conducts of ships e.g. oil spillage, discharge of ballast water, bilge water, other waste water
- Implement 3R principle

e) Restoration of Polluted Environment

- Improvement of Environmental/Ecological Health of Rivers flowing beside city and urban areas e.g. Buriganga, Sitalakkhya, Turag, Balu, Moyuri (in Khulna), Karnaphuli, Bongsee, etc.
- Hydrological restoration of major river network
- Improvement of Environmental/Ecological Health of different lakes/canals flowing through urban areas, major cities, town etc.

f) Strategic Change in other sectors interlinked with Environmental Pollution

- River transport is the least pollution option compare to road and rail transportation. Improvement of navigability of rivers to enable environment for becoming navigation as a major means of transportation would be an environmental improvement initiative
- Improvement of public transport- metro rail, Bus Rapid Transit, good rail network, good network of navigable rivers
- Introduce energy efficient technology and low polluting technology in power production. For example – ultra-supercritical boiler technology, clean coal technology, renewable energy based generation, etc.

g) Financial Mechanism of Pollution Prevention, Control and Management

- Enforce Polluter Pay Principle
- Provision of fiscal and other financial incentives for retro-fitting of for reduction of effluents from industries
- Tax incentives/exemption for importing advance low/no polluting machineries, adopting low/no emission technology in Industrial activities
- Cost Recovery through different instrument like sewerage tax, water tax, pollution tax, etc

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