

GREENHOUSE GASES (GHGs) MEASUREMENT IN CORRIDOR AREA FOR SOUTHERN BANGLADESH: STUDY CONDUCTED IN COASTAL BHANDARIA UPAZIAL OF PIROJPUR DISTRICT

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ABSTRACT

Air quality monitoring program was conducted for three years in transit of South Bangladesh called Bhandaria Upazila (Location: Nadmulla area) under Pirojpur district. The research was continued in the years 2019, 2020 & 2021. The air quality was measured in respect of CO, SO₂, NO_x and PM concentration in that particular area using Gas Analyzers (model: Handheld 3016). The wind direction of those sites was also monitored during monitoring the greenhouse gases emission. Finally, the analyzed data was combined, presented as a table and to add in the manuscript. The analytical results on concentration of GHGs (CO, SO₂, NO_x, PM₁₀ and PM_{2.5}) explored that the CO concentrations gradually decreased within the study period. The estimated AQI values of CO were below 50, which confirmed the green condition in respect of ambient air quality standards for Bangladesh, WHO guideline and US standard. The NO_x concentrations were within the limit of 19-45.00 µg/m³ which also confirmed the green state. The conc. of SO₂ was similar (<10.00 µg/m³) within the study period, which proved the pertaining the minimum sources for SO₂ emission in the study area. The concentrations of PM₁₀ has exceeded the green level and reached 85.00µg/m³, though the concentration of PM_{2.5} is being decreased but still the AQI values also exceeded the green level.

Key words: Greenhouse gases, measurements, coastal area, Pirojpur district.

Introduction

Rising atmospheric concentrations of greenhouse gases (GHGs), in particular carbon dioxide (CO₂), threaten have serious impacts on food production, natural ecosystems and human health across the next 100 years. Industrialized and rapidly industrializing countries are the most important sources of greenhouse gases. However, the biggest impacts will be felt by people in developing countries, especially those in low-lying coastal areas and marginal agricultural areas. Air pollution has emerged as humanity's most critical problem in recent decades. Globally, most urban areas face serious air quality problems due to over-increasing populations, combined with land use change and increased car traffic. Vehicle exhaust is estimated to contribute more than 45-55% of total pollution from all sources. Now, this complex pollution problem is not only limited to big cities, but it remains a problem in Himalayan tourist places and urban places all year round which can cause health problems for many people (Singh *et al.*, 2007). Human activities since the beginning of the Industrial Revolution (around 1750) have led to a 45% increase in atmospheric carbon dioxide concentration, from 280 ppm in 1750 to 415 ppm in 2019. This increase has occurred despite the fact that more than half of the emissions have been absorbed of various natural "sinks" involved in the carbon cycle (ESRL, 2008). During the industrial era, human activities added greenhouse gases to the atmosphere, primarily through the combustion of fossil fuels and deforestation (IPCC AR4 WG1, 2007). Global warming is the direct consequences of GHs. Climate change due to global warming and its negative consequence on environment and agro ecosystem is a serious concern of global community of recent age. It is considered as one of the most serious threats to the environment with its potential negative impacts on food security, agriculture, fisheries, human health, biodiversity, water and other natural resources. In Bangladesh, we have evidences of increased frequency of floods, changing rainfall patterns, more frequent droughts and salinity intrusion. An increasing number of evidence in recent years has clearly established the fact that anthropogenic climate change is a reality (SRDI, 2010). The coastal region is the habitat for 40 million people and they are very much vulnerable to the natural disaster along with an area of about 720 km coastline. They cannot lead a happy and peaceful life since frequent natural disasters tend to

sweep away their means of living and other properties (Akter, 2009). So Government has taken comprehensive program including constructions works to ensure the secured life. Those interventions accelerate the emission of GHGs. Indeed we have scarcity for the information's of GHGs emission except some imitative studies were being performed by Islam (2019, 2020) etc. Sustainable development is quite difficult ignoring the scenario of GHGs emission in our country. So, an environmental monitoring campaigning was been undertaken regard to control the quality of the environment and build a green and peaceful environment throughout Bangladesh.

Materials and Methods

Bhandaria Upazila (pirojpur district) area 163.56 sq km, located in between 22°22' and 23°33' north latitudes and in between 89°54' and 90°08' east longitudes. It is bounded by Rajapur and Kawkhali (Pirojpur) upazilas on the north, Mathbaria upazila on the south, Kanthalia (Jhalokati) and Rajapur upazilas on the east, Pirojpur Sadar upazila on the west. Communication facilities are pucca road 46 km, semi-pucca road 33 km, mud road 350 km; waterways 39 nautical miles. As a coastal region this upazila was affected by tidal bore and cyclone for many times. Besides, the cyclones of 1941, 1961, 1970, 1977, 1986, 1988 and 1998 caused huge loss of life and damage to settlements, crops, livestock and other properties of the upazila. The natural disaster is the direct consequences for GHGs emission/global warming. So a study regarding air quality monitoring program was conducted for three years in transit of South Bangladesh called Bhandaria Upazila (Location: Nadmulla area) under Pirojpur district. The research was continued in the years 2019, 2020 & 2021. The air quality was measured in respect of CO, SO₂, NO_x and PM concentration in that particular area using Gas Analyzers (model: Handheld 3016). The wind direction of those sites was also monitored during monitoring the greenhouse gases emission. Finally, the analyzed data was combined, presented as a table and to add in the manuscript.

Results and Discussion

The concentration of greenhouse gases (CO, SO₂, NO_x, PM₁₀ and PM_{2.5}) was measured during 2019, 2020 and 2021 in the corridor zone for southern Bangladesh (coastal Bhandaria upazila of Pirojpur district) and the values are illustrated in Tables 1-3. The CO concentrations gradually decreased within the study period (Fig. 1), indeed it is the green signal for the sound environment. It was mainly due to lockdown situations over Bangladesh and some brick kilns not operating in the Nadmulla area of Bhandaria upazila under Pirojpur district. The estimated AQI values were below 50, confirming the green status with respect to Bangladesh air quality standards, the WHO guideline and the US standard (Tables 4-5). The NO_x concentrations were within the limit of 19-45.00 µg/m³, which also confirmed the green state (Tables 4-5). But what is worrying is that the concentrations of NO_x are gradually being increased. Now is a good time to lower NO_x levels over Bangladesh. Transportation fuels are estimated to cause 54% of human-caused NO_x. A major cause of NO_x production from nitrogenous fuels such as certain coal and petroleum is the conversion of nitrogen bound to the fuel during combustion to NO_x. NO_x reacts with ammonia, moisture and other compounds to form nitric acid vapor and associated particles (Islam, 2019). SO₂ concentrations were comparable (<10.00 µg/m³) within the study period, demonstrating the relevant minimum SO₂ emission sources in the study area. The concentrations of PM₁₀ have exceeded the green level and reached 85.00 µg/m³.

Table 1. Air quality monitoring in coastal Bhandaria upazila of Pirojpur district during 2019

Air quality parameters	Concentrations	AQI values	AQI rating	Remarks
Carbon Monoxide (CO)	4.60 mg/m ³	46	Good	The AQI values for coarse Particulates (PM _{2.5}) have exceeded the green level and CO concentration is being decreased.
Nitrogen Oxide (NO _x)	19.00 µg/m ³	19	Good	
Sulphur Oxide (SO ₂)	<10.00 µg/m ³	3	Good	
Coarse Particulates (PM ₁₀)	39.00 µg/m ³	26	Good	
Coarse Particulates (PM _{2.5})	41.00 µg/m ³	63	Moderate	

Table 2. Air quality monitoring in coastal Bhandaria upazila of Pirojpur district during 2020

Air quality parameters	Concentrations	AQI values	AQI rating	Remarks
Carbon Monoxide (CO)	1.67 mg/m ³	17	Good	The AQI values for coarse Particulates (PM _{2.5}) have exceeded the green level and CO concentration is being decreased.
Nitrogen Oxide (NO _x)	43.00 µg/m ³	43	Good	
Sulphur Oxide (SO ₂)	<10.00 µg/m ³	3	Good	
Coarse Particulates (PM ₁₀)	49.00 µg/m ³	33	Good	
Coarse Particulates (PM _{2.5})	39.00 µg/m ³	60	Moderate	

Table 3. Air quality monitoring in coastal Bhandaria upazila of Pirojpur district during 2021

Air quality parameters	Concentrations	AQI values	AQI rating	Remarks
Carbon Monoxide (CO)	<1.00 mg/m ³	10	Good	The AQI values for coarse Particulates (PM _{2.5} and PM ₁₀) have exceeded the green level and CO concentration is being decreased.
Nitrogen Oxide (NO _x)	45.00 µg/m ³	45	Good	
Sulphur Oxide (SO ₂)	<10.00 µg/m ³	3	Good	
Coarse Particulates (PM ₁₀)	85.00 µg/m ³	57	Moderate	
Coarse Particulates (PM _{2.5})	37.00 µg/m ³	57	Moderate	

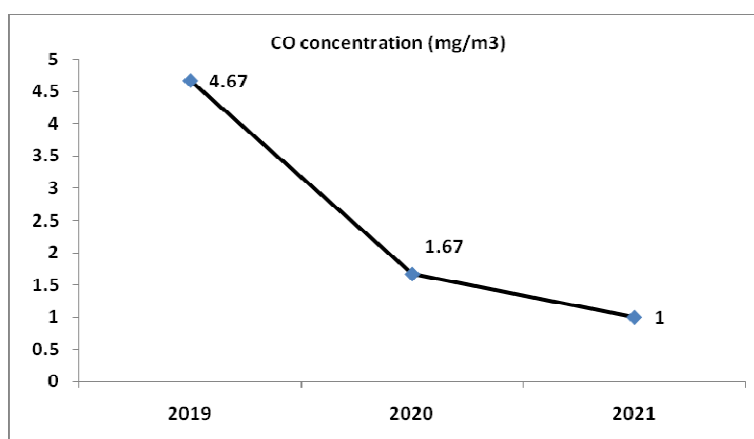


Fig. 1 Yearly variation of CO during 2019 to 2021 in coastal Bhandaria upazila of Pirojpur district

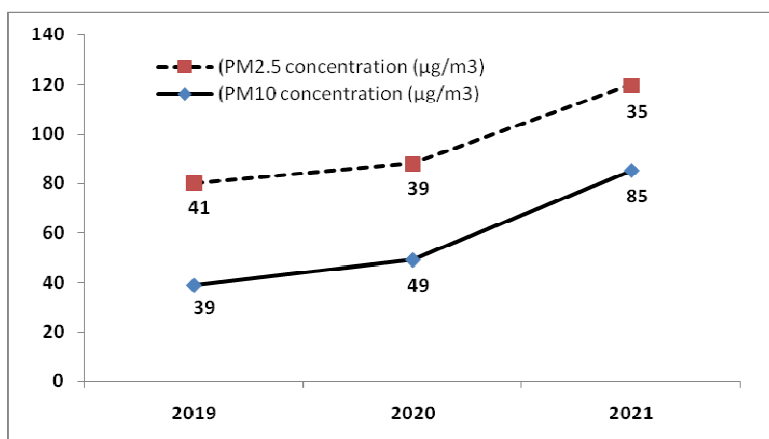


Fig. 2 Yearly variation of PM during 2019 to 2021 in coastal Bhandaria upazila of Pirojpur district

Table 4. Ambient air quality standards for Bangladesh, WHO guideline and US standard (Source: ADB 2006)

Pollutant	Averaging time	Bangladesh standard ($\mu\text{g}/\text{m}^3$)	WHO guideline ($\mu\text{g}/\text{m}^3$)	US standard ($\mu\text{g}/\text{m}^3$)
CO	8 hour	10 mg/m^3	10 mg/m^3	10 mg/m^3
NO _x	Annual	100	-	-
SO _x	24 hours	365	20	365
PM ₁₀	24 hours	150	50	150
PM _{2.5}	24 hours	65	35	35

Table 5. Approved Air Quality Index (AQI) for Bangladesh

Air quality index (AQI) Range	Category		Colour
	<i>In English</i>	<i>In Bangla</i>	
0-50	Good	Bhalo	Green
51-100	Moderate	-	Yellow Green
101-150	Caution	-	Yellow
151-200	Unhealthy	Ashasthykar	Orange
201-300	Very Unhealthy	Khub Ashasthykar	Red
301-500	Extremely Unhealthy	Ottanta Ashasthykar	Purple

Though the concentration of PM_{2.5} is being decreased but still the AQI values also exceeded the green level (Fig. 2). Indeed the air quality is being worsened rapidly around the world and not exception in Bangladesh. Again the higher concentrations of Particulate matter (PM) is observed in all over Bangladesh. So, this is the right time to take proper as well as comprehensive initiatives for reducing the emission of PM and other greenhouse gases for confirmation the secure planet.

Conclusion

Bangladesh is now a developing country. Construction is closely related to development. Vehicles are often in motion so greenhouse gas emissions are the normal phenomenon in coastal zones Bangladesh. Coastal Bhadaria Upazila of Piroipur is no exception. Thus, continuous environmental monitoring urgently needed to control the quality of the environment and build a green and peaceful environment throughout Bangladesh.

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