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# GREENHOUSE GASES EMISSION IN THE RURAL AREAS OF COASTAL BARGUNA DISTRICT BANGLADESH

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## ABSTRACT

The study was conducted in 2019 to investigate the greenhouse gases (GHGs) concentrations in rural as well as coastal Patharghata upazila of Bangladesh. This study received equipment supports from Khulna University of Enginnering & Technology, Khulna. Air quality was monitored using Gas Analyzers (model: Handheld 3016) from various locations in Patharghata Upazila. Reading continued for 30 minutes (minimum time). The wind direction of those sites was also monitored. Finally, the analyzed data was combined, presented as a table and included in the manuscript. Five individual GHGs (CO, $NO_X$, $SO_X$, $PM_{10}$ and $PM_{2.5}$) were measured in this study. CO concentrations were measured at four selected locations and the concentrations lied within in the 1.0-1.4 mg/m$^3$ range. The measured $NO_X$ concentration (122 µg/m$^3$) exceeded the standard value (100 µg/m$^3$), hence there is the possibility of health risk. The AQI for $SO_X$ can be placed in good/green state. In case of PM ($PM_{10}$ and $PM_{2.5}$) the concentrations exceeded the international standards (WHO and US) but were within the limit set for Bangladesh.

**Key words:** Greenhouse gases, emission, rural area, coastal district, Pathatghata upazila.

## Introduction

Greenhouse gases (sometimes abbreviated as GHGs) are gases that absorb and emit radiant energy in the thermal infrared range. Greenhouse gases cause the greenhouse effect (IPCC, 2015). The major greenhouse gases in the Earth's atmosphere are water vapor ($H_2O$), carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and ozone ($O_3$). In the absence of greenhouse gases, the average temperature on the Earth's surface will be about -18°C (NASA GISS, 2016) instead of the current average of 15°C (Karl and Trenberth, 2003; NASA, 2010). Global warming can cause the Earth's surface temperature to exceed historical values by 2047, adversely affecting ecosystems, biodiversity, and human life. Current emissions rates can raise temperatures by as much as 2°C, which the UN IPCC has specified by 2036 as an upper limit to avoid "dangerous" levels (Mora, 2013).

Human activity since the beginning of the Industrial Revolution (in1750) has increased the atmospheric concentration of carbon dioxide by 45% from 280 ppm in 1750 to 415 ppm in 2019. This increase occurred despite the absorption of more than half of the emissions from various natural "sinks" involved in the carbon cycle (ESRL, 2008). The majority of anthropogenic carbon dioxide emissions are mainly from the burning of fossil fuels of coal, oil and natural gas, including deforestation, land-use change, soil erosion, and agriculture (IPCC, 2015). The major source of anthropogenic methane emissions is animal agriculture, followed by temporary emissions from gas, oil, coal and other industries, solid waste, waste water and rice production. However, the contribution of each gas to the greenhouse effect is determined by its properties, its quantity, and the indirect effects it causes. Schmidt *et al*. (2010) analyzed how individual components of the atmosphere contribute to the overall greenhouse effect. They estimated that water vapor accounts for about 50% of the Earth's greenhouse effect, 25% for clouds, 20% for carbon dioxide, and 5% for traces of greenhouse gases and aerosols. The direct radiative effect of the mass of methane is about 84 times stronger than the same mass of carbon dioxide over the 20-year timeframe, but it is present in much smaller concentrations so that its total direct radiative effect has so far been smaller, in part due to its shorter atmospheric lifetime in the absence of additional carbon sequestration. On the other hand, methane has a large indirect radiation effect because it contributes to the formation of ozone in addition to the direct radiation effect. Sindel *et al*. (2005) stated that the contribution of methane to climate change is at least

twice the previous estimate as a result of this effect. It is one of the pandemics for climatologists around the world that the increasing value of greenhouse gases not only concentrates in the industrial or urban areas of the world but also reaches remote and rural coastal areas of Bangladesh (Authors' own discovery). Bangladesh, however is one of the most climate-sensitive countries in the world and is expected to become even stronger as a result of climate change. Accordingly GoB (2001), Bangladesh is a disaster-prone country and the coastal area is more vulnerable than any other region of the country. Because coastal areas are destroyed every day and they mostly dependent on natural blessings (Islam *et al*., 2019). Therefore, the Southwestern coastal areas of Bangladesh are more critical. It is the matter of sorrow that in this country it does not have sufficient capacity to ensure that appropriate measures are taken to limit damage due to insufficient resources (Ahmad, 2010). In view of the above observations and facts, the current study was conducted in Barguna district with the aim of measuring the predominant greenhouse gas concentrations in the rural Patharghata upazila of Bangladesh.

## Materials and Methods

The study was conducted in 2019 to investigate the greenhouse gases (GHGs) concentrations in rural as well as coastal Patharghata upazila of Bangladesh. This study received equipment supports from Khulna University of Enginnering & Technology, Khulna. Patharghata is located at 22.0458°N 89.9689°E. It has 25,610 households and a total area of 387.36 km². As of the 1991 Bangladesh census, It has a population of 134635. Males constitute 50.56% of the population, and females 49.44%. This Upazila's eighteen up population is 68751. Patharghata has an average literacy rate of 66.4% (7+ years), and the national average of 32.4% literate (BBS, 2006). It is near Bay of Bengal. Local transportations, which use different types of fuel, are frequently moved in the area. Again, the conditions of the vehicles are not good, hence a little greenhouse gas is added to the atmosphere and the concentration of greenhouse gas is increasing. Air quality was monitored using Gas Analyzers (model: Handheld 3016) from various locations in Patharghata Upazila. Reading continued for 30 minutes (minimum time). The wind direction of those sites was also monitored. Finally, the analyzed data was combined, presented as a table and to add in the manuscript.

## Results and Discussion

The concentration of GHGs is increasing rapidly around the world, which is being also spreaded in the rural areas. It is not exception in the rural as well as coastal Patharghata upazila of Barguna district. This is one of a pilot and very proactive study for rural remote areas of Bangladesh. Therefore, as an initiative study, GHGs was measured at four different spots in Patharghata upazila. Five individual GHGs (CO, $NO_X$, $SO_X$, $PM_{10}$ and $PM_{2.5}$) were measured in this study (Table 1). The Ambient air quality standards of Bangladesh as well as WHO guideline and US standard are presented in Table 2. On the other hand Table 3 represented the Approved Air Quality Index (AQI) for Bangladesh. CO concentrations were measured at four selected locations and the concentrations lied within in the 1.0-1.4 mg/m$^3$ range. Observed values were compared with various national (Bangladesh) and international (WHO and US) standards and found no harmful effects of CO in the studied rural areas of Patharghata upazila. Accordingly the AQI values, the observed CO concentration may be fixed as a Good/green state. The NOX concentration (122 µg/m$^3$) exceeded the standard value (100 µg/m$^3$), hence there is the possibility of health risk. Accordingly AQI value the situation was categorized as caution/yellow state. This is a good time to reduce $NO_X$ levels in the study area. Nitric oxide is produced during a thunderstorm due to the extreme heating and cooling during a lightning strike. Fertilization by agriculture and the use of nitrogen-fixing plants also contribute to atmospheric $NO_X$ by promoting nitrogen fixation by microorganisms. Transport fuels are estimated to cause 54% of man-made $NO_X$. A major cause of $NO_X$ production from nitrogen-containing fuels such as certain coals and petroleum is the conversion of nitrogen bound to the fuel to $NO_X$ during combustion. $NO_X$ reacts with ammonia, moisture, and other compounds to form nitric acid vapor and associated particles. Small particles can penetrate deeply into sensitive lung tissue and damage it, leading to premature death in extreme cases. Inhalation of such particles causes or worsens respiratory diseases such as emphysema or bronchitis, and aggravates existing heart disease.

Table 1. Air quality monitoring in the different locations at coastal Patharghata upazila of Barguna district Bangladesh

| Locations | Measured concentrations | AQI values | AQI rating | Remarks |
|---|---|---|---|---|
| GHG: Carbon Monoxide, CO ($mg/m^3$) as 8 hours average | | | | |
| Location 1: Gahorpur | 1.4 | 14 | Good | Observed no health hazards regard to Carbon Monoxide |
| Location 2: Tafalbaria | 1.0 | 10 | Good | |
| Location 3: Koraila | 1.1 | 11 | Good | |
| Location 4: Hatimpur | 1.3 | 13 | Good | |
| Average | 1.2 | 12 | Good | |
| GHG: Nitrogen Oxide, $NO_X$ ($\mu g/m^3$) as an annual average | | | | |
| Location 1: Gahorpur | 135 | 135 | Caution | Have possibility for health risk |
| Location 2: Tafalbaria | 127 | 127 | Caution | |
| Location 3: Koraila | 110 | 110 | Caution | |
| Location 4: Hatimpur | 115 | 115 | Caution | |
| Average | 122 | 122 | Caution | |
| GHG: Sulphur Dioxide, $SO_X$ ($\mu g /m^3$) as 24 hours average | | | | |
| Location 1: Gahorpur | 17 | 5 | Good | The $SO_X$ did not show any negative impact on ambient air quality |
| Location 2: Tafalbaria | 20 | 5 | Good | |
| Location 3: Koraila | 31 | 8 | Good | |
| Location 4: Hatimpur | 15 | 5 | Good | |
| Average | 22 | 6 | Good | |
| GHG: Coarse Particulates, $PM_{10}$ ($\mu g /m^3$) as 24 hours average | | | | |
| Location 1: Gahorpur | 98 | 64 | Moderate | PM concentration did not assured the sound health condition |
| Location 2: Tafalbaria | 91 | 59 | Moderate | |
| Location 3: Koraila | 57 | 37 | Good | |
| Location 4: Hatimpur | 47 | 31 | Good | |
| Average | 73 | 48 | Good-Moderate | |
| GHG: Fine Particulates, $PM_{2.5}$ ($\mu g /m^3$) as 24 hours average | | | | |
| Location 1: Gahorpur | 63 | 96 | Moderate | According to current reading, adverse effects on ecosystems were marked |
| Location 2: Tafalbaria | 47 | 72 | Moderate | |
| Location 3: Koraila | 37 | 56 | Moderate | |
| Location 4: Hatimpur | 33 | 50 | Moderate | |
| Average | 45 | 69 | Moderate | |

Table 2. Ambient air quality standards for Bangladesh, WHO guideline and US standard (Source: ADB 2006)

| Pollutant | Averaging time | Bangladesh standard ($\mu g/m^3$) | WHO guideline ($\mu g/m^3$) | US standard ($\mu g/m^3$) |
|---|---|---|---|---|
| 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 3. Approved Air Quality Index (AQI) for Bangladesh

| Air quality index (AQI) Range | Category | | Colour |
|---|---|---|---|
| | *In English* | *In Bangla* | |
| 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 |

The direct impact of $NO_X$ emissions has a positive impact on the greenhouse effect. $NO_X$ also readily reacts with common organic chemicals and even ozone to form a variety of toxic products: nitroarenes, nitrosamines and also the nitrate radical some of which may cause DNA mutations (Wikipedia, 2019). The measured $SO_X$ were within the limit of Bangladesh and US standards, but slightly exceeded the WHO standard. The AQI for $SO_X$ can be placed in good/green state. In case of PM ($PM_{10}$ and $PM_{2.5}$) the concentrations exceeded the international standards (WHO and US) but were within in Bangladesh standard. As a whole based on PM concentrations the ambient air quality may be categorized as Moderate/yellow green state.

## Conclusion and Recommendation

The study examined the ambient air quality in respect of CO, $NO_X$, $SO_X$ and PM and observed the health risk from $NO_X$ as well as PM concentration. So, we have to consider this unwanted situation and seek the best options to be ensured the good air quality in the rural as well as coastal Bangladesh. Here maintenance of vehicle quality and smart agriculture are highly appreciated.

Since the study was conducted on a limited scale, more sites need to be incorporated and atmospheric conditions (temperature, RH, precipitation, and sunshine) monitored to draw final conclusions.

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