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Assessment of Air Quality Parameters at Different Locations of Tangail Sadar Upazila, Tangail

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Abstract

The study was conducted to investigate the concentration of $PM_{2.5}$, PM_{10}, CH_4, CO_2, CO, SO_2 in the air of Tangail Sadar Upazila, Tangail. In the study area air quality data has been collected from eight sampling stations namely MBSTU campus, Baby stand, Nirala more, New bus stand, Rabna bypass, College gate, Old bus stand, Nogor jalfoi during dry season. The air quality data collected by using Aeroqual S 500 series. The concentrations of $PM_{2.5}$, PM_{10}, CH_4, CO_2, CO, SO_2 found in air were ranged from 0.03-0.06, 0.04-0.10, 12.3-36, 919-1238.2, 0.00- 2.61, 0.00-0.48 mg/m^3, respectively. The concentration of $PM_{2.5}$, PM_{10}, CO, SO_2 that have been found were higher than Bangladesh standard and WHO guideline. Their sources could be the motor vehicles, road dust, coal burning, road construction, open dumping of solid waste in Tangail Sadar Upazila. Appropriate engine design control strategies and maintenance services should be introduced for reducing emission. Efficient solid waste management system should be introduced to control emission from construction sources.

Key words: CO, $PM_{2.5}$, PM_{10}, SO_2

Introduction

Air pollution in recent time has become a grave concern all over the world. With the rapid growth in urbanization and industrialization, the air pollution situation is getting aggravated around the urban centers worldwide. About 80% people in urban areas are exposed to the air pollution exceeding the air quality standard value set by World Health Organization (WHO) and even 98% of cities in low-middle income countries and 56% in high income country do not meet the WHO guidelines (WHO, 2016). More than 4.2 million estimated people die worldwide every year due to exposure of ambient (outdoor) air pollution by cardiac arrest, brain stroke, cancer and different types of chronic respiratory diseases (Masum and Pal, 2020). Globally it is responsible for 9% of lung cancer deaths, 17% of chronic obstructive pulmonary disease deaths, more than 30% of ischemic heart disease and stroke deaths, and 9% of respiratory infection deaths (Mukta *et al.*, 2020).

In Bangladesh, air pollution is one of the most critical concerns among all environmental issues (Hoque *et al.*, 2020). The Environmental Performance Index (2020) shows the low environmental performance index for Bangladesh (rank: 162/180 countries), mainly resulted from the poor air quality index (Islam *et al.*, 2021). Air quality has deteriorated due to both human activities and natural phenomena such as windblown dust particles. The significant sources of air pollution in Bangladesh are brick kilns, burning in open air, vehicular emissions, sand fields along the banks of the rivers, coal and biomass burning and industrial emission etc. (Masum *et al.*, 2020). The pollutant species concerning transportation systems are carbon monoxide (CO), hydrocarbons (HC), photochemical oxidants, e.g., ozone (O_3), nitrogen oxides (NO_x), suspended particulate matter (SPM), sulfur dioxide (SO_2) and lead (Pb) (Mukta *et al.*, 2020). The level of pollution in urban cities of Bangladesh if remain upswing due to unplanned urbanization, industrialization and motorization there will be more loads of harmful pollutants and consequently incidences of air pollution related diseases like asthma, bronchial disease, pulmonary diseases and lung cancer will increase manifold which in a way will have profound public health implications in the foreseeable future (Hoque *et al.*, 2020). Tangail is the largest district of Dhaka division by area and second largest by population. At present the number of automobiles has amplified in Tangail city. Manifold combination of old and date expired vehicles has been intensified in the city area together with narrowing of road space, which finally contributing traffic congestion. The study was carried out: i) to measure the air quality parameters such as $PM_{2.5}$, PM_{10}, CH_4, CO_2, CO, SO_2 of Tangail sadar upazila, and ii) to compare the analyzed values with their standard levels to evaluate the current situation.

Materials and Methods

Study area

The study was conducted in eight areas of Tangail Sadar Upazila namely MBSTU campus, Baby stand, Nirala more, Old bus stand, New bus stand, Rabna bypass, Jalfoi bypass and College gate during dry season of 2021. All the areas are traffic places. Tangail Sadar Upazila is surrounded by Kalihathi Upazila on the north, Nagarpur and Delduar Upazila on the south, Kalihati and Basail Upazila on the east, and the Jamuna River on the west.

Data collection and analysis

Measurement of $PM_{2.5}$, PM_{10}, CH_4, CO_2, CO, SO_2 gases was done through Aeroqual S 500 sensor from the direct field observation of the study area at morning, noon and evening time during dry season, 2021. The Series 500 air quality sensor enables accurate real-time surveying of common outdoor air pollutants, all in an ultraportable handheld monitor. The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. The Microsoft Office Excel software was used to present and interpret the collected data.

Table 1. Locations of the study area

Locatio ns no.	Name of the	Latitude	Longitude
L-1	MBST U	24°14'1.83" N	89°53'24.24" E
L-2	Baby Stand	24°14'34.61" N	89°54'33.25" E
L-3	Nirala more	24°15'1.10" N	89°54'51.26" E
L-4	Old Bus stand	24°15'4.81" N	89°55'12.93" E
L-5	New Bus	24°16'3.23" N	89°55'31.35" E
L-6	Rabna Bypass	24°17'2.22" N	89°55'2.62" E
L-7	Jalfoi Bypass	24°14'33.65" N	89°56'25.09" E
L-8	College gate	24°15'25.14" N	89°55'18.83" E

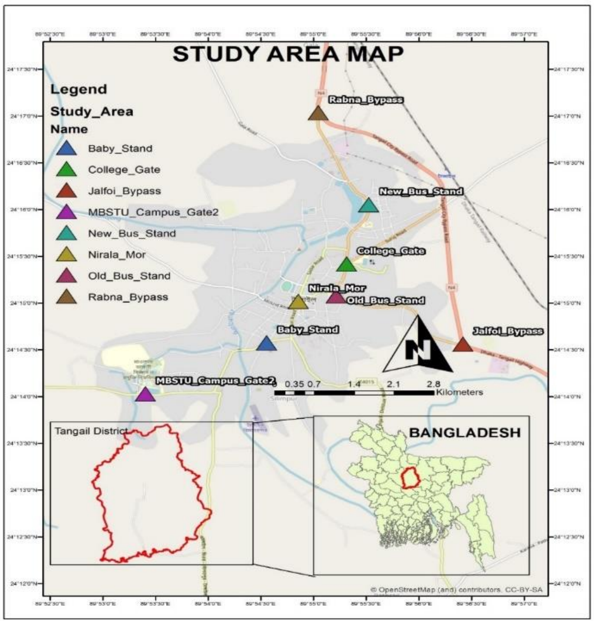

Fig. 1. Map showing the study area

Results and Discussion

The mean concentrations of $PM_{2.5}$ for studied locations were ranged from 0.026 to 0.056 mg/m^3 (Fig. 2). The maximum concentration of $PM_{2.5}$ (0.07 mg/m^3) was found at L-7 at evening and minimum concentration (0.01 mg/m^3) found at L-3 and L-6 at morning (Table 2). Highest concentration found in places where $PM_{2.5}$ comes primarily from combustion, fireplaces and car engines. The observed values of all locations exceeded the WHO guideline (Table 3). Masum and Pal (2020) studied that the mean concentration of $PM_{2.5}$ were 124.52 and 41.16 $\mu g/m^3$ during dry and wet season, respectively. Mukta *et al.* (2020) recorded the concentration of $PM_{2.5}$ 133, 115 and 37.5 $\mu g/m^3$ during post-monsoon, pre-monsoon and monsoon season, respectively. Islam *et al.* (2014) found the average 24 hours daily concentration of $PM_{2.5}$ ranged from 106 $\mu g/m^3$ to 299 $\mu g/m^3$. Hoque *et al.* (2020) reported the concentration of $PM_{2.5}$ ranging from 29.6 to 183.87 $\mu g/m^3$ in Dhaka city. These values are more or less similar with the present study.

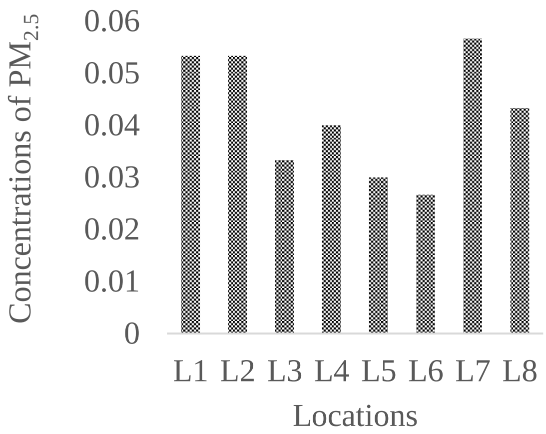

Fig. 2. $PM_{2.5}$ concentrations in different location of Tangail sadar upazila

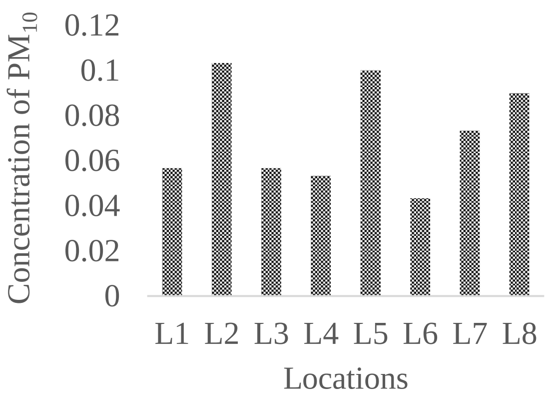

Fig. 3. PM_{10} concentrations in different location of Tangail sadar upazila

The mean concentrations of PM_{10} for studied locations were ranged from 0.04 to 0.10 mg/m^3 (Fig. 3). The maximum concentration of PM_{10} (0.18 mg/m^3) was found at L-2 at evening and minimum concentration (0.03 mg/m^3) found at L-3 and L-6 at morning and noon (Table 2). Highest concentrations of PM_{10} found near construction and landfill sites. The PM_{10} content of all the locations exceeded the standard limit except L-6 (Table 3). Masum and Pal (2020) studied that the mean concentration of PM_{10} were 212.33 and 85.10 µg/m^3 during dry and wet season, respectively. Islam *et al.* (2014) found the average 24 hours daily concentration of PM_{10} ranged from 132 µg/m^3 to 448 µg/m^3. Hoque *et al.* (2020) reported the concentration of PM_{10} ranging from 56.6 to 303 µg/m^3 in Dhaka city. Mukta *et al.* (2020) recorded the concentration of PM_{10} 169, 216 and 85.6 µg/m^3 during post-monsoon, pre-monsoon and monsoon season, respectively. These values are more or less similar with the present study.

Table 2. Concentration of gaseous pollutants in studied locations at morning (M), noon (N) and evening (E).

Parameters (mg/m^3)	Time	Locations							
		L-1	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**	**L-8**
$PM_{2.5}$	**M**	0.06	0.06	0.01	0.03	0.03	0.01	0.05	0.06
	N	0.04	0.04	0.05	0.05	0.03	0.02	0.05	0.04
	E	0.06	0.06	0.04	0.04	0.03	0.05	0.07	0.03
PM_{10}	**M**	0.06	0.08	0.03	0.04	0.12	0.03	0.07	0.11
	N	0.05	0.05	0.09	0.06	0.13	0.03	0.06	0.05
	E	0.06	0.18	0.05	0.06	0.05	0.07	0.09	0.11
CH_4	**M**	20	38	19	31	15	09	09	34
	N	17	37	24	34	13	28	14	26
	E	19	32	19	19	13	52	13	20
CO_2	**M**	969	1008	933	1195	902	904	895	1037
	N	926	922	980	1532	953	922	853	1023
	E	924	1068	964	987	1061	933	911	1018
SO_2	**M**	1.20	0.16	0.16	0.00	0.26	0.56	0.10	0.86
	N	0.10	0.10	0.06	0.00	0.36	0.16	0.02	0.30
	E	0.20	0.13	0.46	0.00	0.20	0.10	0.13	0.26
CO	**M**	0.40	0.00	0.00	3.44	0.00	0.00	0.00	0.00
	N	0.33	0.00	0.00	3.00	0.00	0.33	0.02	0.00
	E	0.63	0.01	2.40	1.40	1.23	0.00	0.00	0.01

Note: M: Morning, N: Noon and E: Evening

The mean concentrations of CH_4 found to vary from 12.3 to 36 mg/m^3 (Fig. 4). The maximum concentration of CH_4 (52 mg/m^3) was found in L-6 at evening and minimum concentration (13 mg/m^3) found in L-5 and L-7 at noon and evening (Table 2). Major sources of atmospheric methane are emission from anaerobic decomposition in natural wetlands, paddy rice fields, emission from livestock production systems (including intrinsic fermentation and animal waste), biomass burning (including forest fires, charcoal combustion, and firewood burning), anaerobic decomposition of organic waste in landfills and fossil methane emission during the exploration and transport of fossil fuels (Heilig, 1994). The sources of CH_4 found in present study could be stationary and mobile combustion and landfill.

The average concentration of CO_2 was ranged from 920 to 1238 mg/m^3 (Fig. 5). The maximum concentration of CO_2 (1532 mg/m^3) was found in L-4 at noon and minimum concentration (853 mg/m^3) found at L-7 at noon (Table 2). The major sources of CO_2 found in present study could be stationary and mobile combustion.

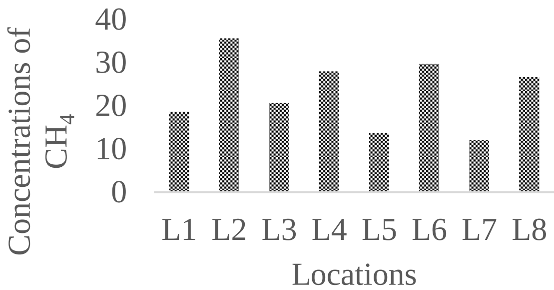

Fig. 4. CH_4 concentrations in different location of Tangail sadar upazila

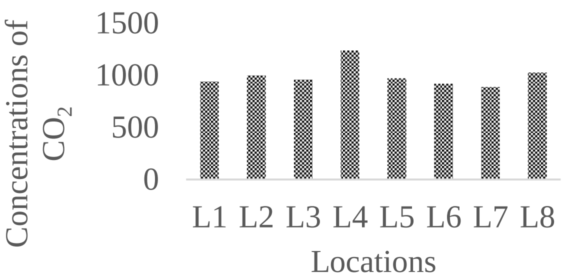

Fig. 5. CO_2 concentrations in different location of Tangail sadar upazila.

Table 3. Comparison of air quality pollutants concentrations with their standard levels.

Parameters (mg/m^3)	Locations								Avg.	WHO Guideline (2005)	Bangladesh Standard (DoE, 2005)
	L1	L2	L3	L4	L5	L6	L7	L8			
$PM_{2.5}$	0.05	0.05	0.04	0.04	0.03	0.03	0.06	0.04	0.04	0.01 (Annual) 0.025 (24-hr)	0.015(Annual) 0.065 (24-hr)
PM_{10}	0.06	0.10	0.06	0.05	0.10	0.04	0.07	0.09	0.07	0.02 (Annual) 0.05 (24-hr)	0.05 (Annual) 0.15 (24-hr)
CH_4	18.7	36	20.9	28.1	13.7	30.1	12.3	26.9	23.3	-	-
CO_2	940	1000	959	1238	972	920	920	1026	997	-	-
SO_2	0.46	0.13	0.41	0.00	0.28	0.27	0.08	0.48	0.26	0.02 (24-hr)	0.08 (Annual)
CO	0.45	0.03	0.80	2.61	0.41	0.11	0.06	0.03	0.55	0.01 (8-hr) 0.03 (1-hr)	0.01 (8-hr) 0.04 (1-hr)

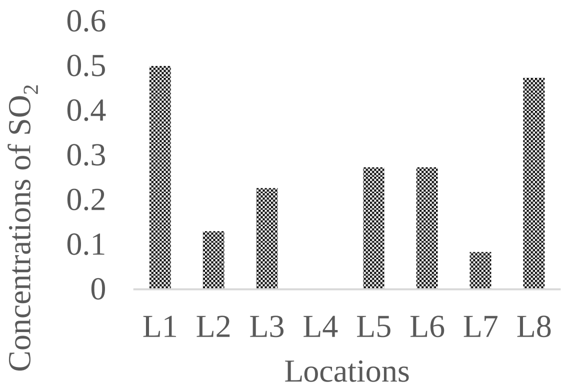

Fig. 6. SO_2 concentrations in different location of Tangail sadar upazila

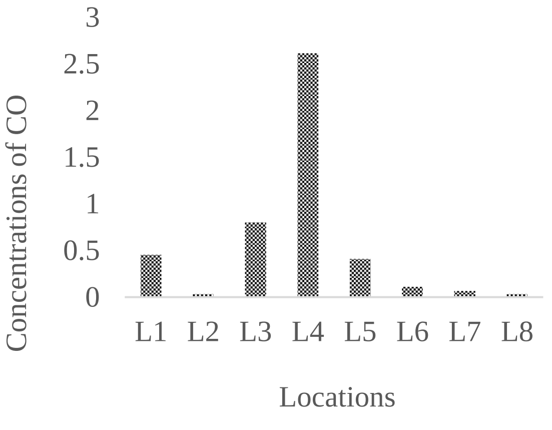

Fig. 7. CO concentrations in different location of Tangail sadar upazila

The mean concentrations of SO_2 for studied locations were ranged from 0.00 to 0.48 mg/m^3 (Fig. 6). The maximum concentration of SO_2 (1.20 mg/m^3) was found in L-1 at morning (Table 2). Fuel combustion and burning coal could be the major source of SO_2 emission in the study area. The SO_2 content of all the locations exceeded the standard limit except L-4 (Table 3). Masum and Pal (2020) studied that the mean concentration of SO_2 were 6.42 and 4.76 µg/l during dry and wet season, respectively. Haque *et al.* (2014) found trace amount of SO_2. Hoque *et al.* (2020) reported the concentration of SO_2 ranging from 1.2 to 37.1 µg/m^3 in Dhaka city, which is lower than the present study.

The mean concentrations of CO for studied locations were ranged from 0.00 to 2.61 mg/m^3 (Fig. 7). The maximum concentration of CO (3.44 mg/m^3) was found in L-4 at morning (Table 2). The major sources of CO are motor engines, burning coal, oil and wood, industrial activities, smokes (Ahmed and Rahman, 2020). The CO content of all the locations exceeded the standard limit (Table 3). Masum and Pal (2020) studied that the mean concentration of CO was 1.77 and 1.43 mg/l during dry and wet season, respectively. Islam *et al.* (2014) found the average 24 hours daily concentration of CO ranged from 2519 to 7730 µg/m^3. Mukta *et al.* (2020) recorded the concentration of CO 2.25, 1.75 and 0.84 mg/m^3 during post-monsoon, pre-monsoon and monsoon season, respectively. Hoque *et al.* (2020) reported the concentration of CO ranging from 0.85 to 6.00 mg/m^3 in Dhaka city. These values are more or less similar with the present study.

Conclusions

The rapid growth of industrialization and urbanization greatly disrupts the air quality. The present investigation revealed that the air of the Tangail sadar upazila was severely polluted. It could be due to the number of increased motor vehicles, road dust, coal burning, road construction, and landfill in Tangail sadar upazila. As the rainfall amount is low in dry season, concentrations of particulates were higher at that time. Also, SO_2 cannot outspread through the atmosphere and subsist in lower atmosphere during dry season, which also accelerated their high concentration in air. To exterminate vehicular emission, more electronic and hybrid vehicles should be instigated on the roads. Also, efficient solid waste management system and legal framework to control emission from construction sources needed to be taken immediately to remove health risk.

References

Ahmed, F. and Rahman, M.R. 2020. A review on air pollution status of Bangladesh and its effects on Human health. *Journal of Noakhali Science and Technology University*, 4(1&2): 27-38.

DoE (Department of Environment). 2005. Environmental quality standard for Bangladesh.

Environmental Performance Index. 2020. Yale Center for Environmental Law & Policy, New Haven.

Haque, H.A.; Huda, N.; Tanu, F.Z.; Sultana, N.; Hossain, M.S.A. and Rahman, M.H. 2017. Ambient air quality scenario in and around Dhaka city of Bangladesh. *Barisal University Journal*, 4(1):203-218.

Heilig, G.K. 1994. The Greenhouse Gas Methane (CH4): Sources and Sinks, the Impact of Population Growth, Possible Interventions. *Population and Environment,* 16(2): 109-137.

Hoque, M.M.M.; Ashraf, Z.; Kabir, M.H.; Sarker, M.E. and Nasrin, S. 2020. Meteorological Influences on Seasonal Variations of Air Pollutants (SO_2, NO_2, O_3, CO, $PM_{2.5}$, PM_{10}) in the Dhaka Megacity. *American Journal of Pure and Applied Biosciences*, 2(2): 15-23.

Islam, J.B.; Rahman, A.K.M.L.; Sarkar, M.; Ahmed, K.S. and Begum, B.A. 2014. Particulate matter and black carbon concentration in ambient air of an urban-traffic influenced site at farm gate, Dhaka, Bangladesh. *Jagannath University Journal of Science*, 3(1): 87-96.

Islam, M.S.; Rahman, M.; Tusher, T.R.; Roy, S. and Razi, M.A. 2021. Assessing the Relationship between COVID-19, Air Quality, and Meteorological Variables: A Case Study of Dhaka City in Bangladesh. *Aerosol and Air Quality Research*, 21(6).

Masum, M.H. and Pal, S.K. 2020. Statistical evaluation of selected air quality parameters influenced by COVID-19 lockdown. *Global Journal of Environmental Science and Management*, 6: 85-94.

Masum, M.H.; Rahman, S.M.R. and Pal, S.K. 2020. Ambient Air Quality in Major cities of Bangladesh. *Parana Journal of Science and Education*, 6(5): 61-67.

Mukta, T.A.; Hoque, M.M.M.; Sarker, M.E.; Hossain, M.N. and Biswas, G.K. 2020. Seasonal variations of gaseous air pollutants (SO_2, NO_2, O_3, CO) and particulates ($PM_{2.5}$, PM_{10}) in Gazipur: an industrial city in Bangladesh. *Advances in Environmental Technology*, 4: 195-209.

WHO (World Health Organization). 2005. Indoor Air Pollution and Health: Scope of the Problem, World Health Organization, Geneva.

WHO (World Health Organization). 2016. WHO global urban ambient air pollution database.