Air Quality Monthly Report

January, 2019

Department of Environment
Ministry of Environment, Forest and Climate Change
Bangladesh

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1. Introduction

Air quality management plans based on knowledge of sources, appropriate air quality standards, accurate air quality data, and effective incentives; and enforcement policies is therefore needed to be adopted.

At this backdrop, real-time measurements of ambient level pollutants were made at 8 major cities (Namely, Dhaka, Narayangonj, Gazipur, Chittagong, Rajshahi, Khulna, Barisal and Sylhet) of Bangladesh. The data generated will be used to define the nature and severity of pollution in the cities; identify pollution trends in the country; and develop air models and emission inventories.

The program encompasses operation of the sampling and monitoring network, and quality assurance activities to ensure the quality of the data collected and disseminated by the CASE project.

CASE project monitors the criteria pollutants such as carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, PM10 and PM2.5. Monitoring is performed to demonstrate attainment or non-attainment of national ambient air quality standards to assess the trends of air pollution levels.

The main purpose of this report is to present, analyze and make available of these data to the general public, stakeholders, researchers and policy makers to develop effective air pollution abatement strategies. This report summarizes the air quality data collected at the different CAMS in operation under the Department of Environment (DoE) air quality monitoring network.

The basis for discussion of air quality has been the data collected from the Air Quality monitoring Network stations under DoE. The data have been quality controlled and the air pollution levels have been compared to the Bangladesh Ambient Air Quality Standard as adopted in 2005. Table 1 represents the current and approved air quality standards for Bangladesh.

Table 1: National Ambient Air Quality Standards for Bangladesh

Pollutant	Objective	Average
CO	10 mg/m^3 (9 ppm)	8 hours(a)
	40 mg/m^3 (35 ppm)	1 hour(a)
Pb	0.5 µg/m^3	Annual
NO_x	100 µg/m^3 (0.053 ppm)	Annual
PM10	50 µg/m^3	Annual (b)
	150 µg/m^3	24 hours (c)
PM2.5	15 µg/m^3	Annual
	65 µg/m^3	24 hours
O_3	235 µg/m^3 (0.12 ppm)	1 hour (d)
	157 µg/m^3 (0.08 ppm)	8 hours
SO_2	80 µg/m^3 (0.03 ppm)	Annual
	365 µg/m^3 (0.14 ppm)	24 hours (a)

Notes:
(a) Not to be exceeded more than once per year
(b) The objective is attained when the annual arithmetic mean is less than or equal to 50 ug/m^3
(c) The objective is attained when the expected number of days per calendar year with a 24-hour average of 150 µg/m^3 is equal to or less than 1
(d) The objective is attained when the expected number of days per calendar year with the maximum hourly average of 0.12 ppm is equal to or less than 1 (Source: AQMP, DOE).

2. Monitoring Network

The main objective of the Bangladesh AQM network is to provide reliable information to the authorities and to the public about the air quality in most populous cities of Bangladesh.

As a part of the air quality monitoring strategy, several objectives can be achieved, including:

- Establish source/receptor relationships;
- Identify which are the pollutants of concern and their current status;
- Show how widespread air pollution problems are and indicate the general extent of the public exposure;
- Provide benchmarks against which trends in overall air quality can be compared and devise performance indicators for assessing the impact of an air quality management plan or strategy;
- Provide a data base for evaluation of effects; of urban, land use management, and transportation planning; of development and evaluation of abatement strategies; and of development and validation of atmospheric processes and models.

Another objective in the monitoring and management programme is to provide input data for modeling. These data will serve as a background for performing air quality planning and abatement studies. Model results August also serve as input to other studies such as health related investigations and exposure assessments.

The ambient air quality monitoring network Bangladesh consists of eleven (11) fixed Continuous Air Monitoring Stations (CAMS). The locations of the 11 CAMS are shown in Figure 1. Brief description of the monitoring stations and the list of measured parameters recorded at each station are provided inTable 2.

Table 2: Description of Monitoring Network:

City	ID	Location	Lat/Lon	Monitoring capacity
Dhaka	CAMS-1	SangshadBhaban, Sher-e-Bangla Nagar	23.76N 90.39E	PM10, PM2.5, CO, SO2, NOX, O3, and HC concentrations with meteorological parameters.
	CAMS-2	Firmgate	23.76N 90.39E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters.
	CAMS-3	Darus-Salam	23.78N 90.36E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Gazipur	CAMS-4	Gazipur	23.99N 90.42E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Narayangonj	CAMS-5	Narayangonj	23.63N 90.51E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Chittagong	CAMS-6	TV station, Khulshi	22.36N 91.80E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters.
	CAMS-7	Agrabad	22.32N 91.81E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Khulna	CAMS-8	Baira	22.48N 89.53E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological parameters
Rajshahi	CAMS-9	Sopura	24.38N 88.61E	PM10, PM2.5, CO, SO2, NOX, O3, and HC with meteorological

City	ID	Location	Lat/Lon	Monitoring capacity
				parameters.
Sylhet	CAMS-10	Red Crecent Campus	24.89N 91.87E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.
Barisal	CAMS-11	DFO office campus	22.71N 90.36E	PM10, PM2.5, CO, SO2, NOX and O3 with meteorological parameters.

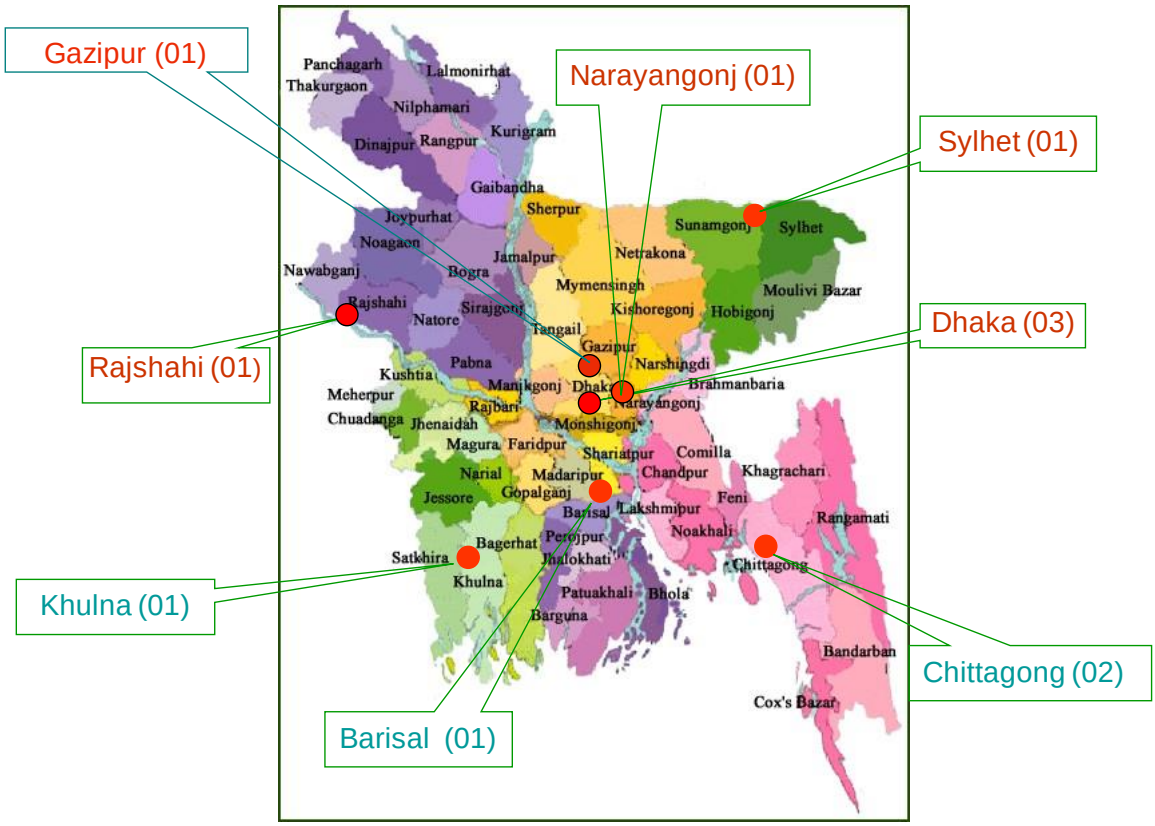


Figure 1: CAMS Location in Bangladesh

Monitoring data from network stations are transferred to a central data centre at the Department of Environment office in Dhaka and simultaneously transferred to Air Quality Management System based on NILU AIRQUIS system established under BAPMAN project. The data are stored in AIRQUIS database for quality check, control, evaluation, validation, statistical analysis. Quality controlled data are then stored in the final database for further analysis, reporting, presentations and future use.

3. Monthly Air Quality

The data presented in this report are based on monitoring results of air quality parameters during the month of January, 2019 from 11 CAMS operated by CASE-DoE monitoring network. Table-3 summarizes the basic statistics of the data along with the data capture rate and the number of days for which specific pollutant exceeded the Bangladesh National Ambient Air Quality Standard (BNAAQS). Since NOx have only annual standard, so for this pollutant daily 24-hours average concentration levels were compared with the annual average. During data quality control some data, which are outliers (beyond 3rd and 97th percentile) and inconsistent data, were flagged as invalid and those were not included in the analysis. Time series plots based on the data generated in the CAMS are also given in Annexes.

In general the data capture rate found little bit low compare to the previous month except few parameters in some CAMS in operation. During the reporting month several analyzers were not functional for some days due to routine preventive/corrective maintenance.

Inspection of the available data shows that there were occurrences of non-compliance for PM10& PM2.5 levels at all monitoring stations during the month of January, 2019. It is observed that the 24 hr average concentration level of PM2.5 exceeded BNAAQS for 25-31 days in CDA Chittagong CAMS, Sangsad CAMS, BARC CAMS, Gazipur CAMS, Narayonganj CAMS and Barishal CAMS and 13-23 days in Darussalam CAMS, Khulna CAMS, TV Station Chittagong CAMS, Rajshahi CAMS and Sylhet CAMS. On the other hand, 24 hr average concentration level of PM10 from the BNAAQS exceeded for 27-31 days in Darussalam, BARC, Gazipur, Rajshahi, & Barishal CAMS, 12-16 days in Narayanganj, Sylhet CAMS and in Khulna CAMS. The range of monthly average concentration of PM2.5 and PM10 measured at different CAMS were 87-229 µg/m3 and 104-401 µg/m^3 respectively during the monitoring month of January, 2019. From BNAAQS point of view, concentrations of PM cross their standards most of the days (Fig-3). 24-hours average PM levels in all cities demonstrate increasing trends compared to December 2018 due to decrease the precipitation. It is also observed that gaseous pollutants measured at different CAMS did not exceed the BNAAQS during the month of January, 2019.

In general PM pollution levels in the cities monitored during the reporting month found higher compared to previous month in respect of public health. Usually in the dry seasons the pollution level reached highest peak compare to the wet season, which is reflected in the data monitored in all CAMS during the month of January, 2019.

Daily air quality index (AQI) values were calculated based on the available air quality data and summary of the AQI by categories are presented in annex Figure 5. Summary data shows that AQI values were Extremely Unhealthy to Very Unhealthy along with few Unhealthy in couple of CAMS.

4. Summary and conclusion

Data obtained from CAMS operated under DoE air quality monitoring network during January, 2019 have been analyzed and reported. Data availability was 60-90% for all the criteria pollutants monitored at different CAMS with few exceptions. Air quality data for few pollutants were not reported because either the analyzer was not functional or the data capture rate was too low. From the analysis of the data following conclusion can be drawn:

- PM_{10} and $PM_{2,5}$ are the most critical pollutants. From BNAAQS point of view, 24-hour average for both PM10 and PM2.5 concentrations were found higher than the month of December, 2018 with few exceptions. It is observed that the average concentration level of PM2.5 and PM10 measured at different CAMS were 87-229 µg/m3 and 104-401 µg/m^3 respectively during the monitoring month of January, 2019.
- The gaseous pollutants measured at different CAMS did not exceed limit values of the BNAAQS.
- As a month of winter during January, 2019, the pollution concentration level was higher than the previous month although there was no remarkable variation of average wind speed.
- Monthly summary of calculated AQI values based on data from different CAMS showed that during this month most of day's air quality was in all categories with the majority of Extremely Unhealthy to Very Unhealthy along with few Unhealthy in couple of CAMS and in most of the cases responsible pollutant was PM2.5.

During the reporting month, some of the analyzers especially gaseous analyzers of some CAMS did not produce data because of their repair and maintenance activities.

ANNEX

Table 3: Summary Air Quality and Meteorological data measured during January, 2019 at different CAMS operated under DoE

Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
SO_2 -24 hr	ppb	140	Average	6.32	2.64	16.8	4.96	18.7	DNA	DNA	1.33	DNA	9.24	DNA
			Max	9.17	3.79	35.9	12.8	49.4	DNA	DNA	2.88	DNA	21.9	DNA
			Min	4.85	1.00	7.12	0.89	2.62	DNA	DNA	0.32	DNA	2.96	DNA
			Excedance(Days)	0	0	0	0	0	DNA	DNA	0	DNA	0	DNA
			Data capture(%)	95	97	99	94	99	DNA	DNA	71	DNA	88	DNA
NO_2 -24 hr	ppb	53 (Annual)	Average	63.3	141	93.2	63.7	105	18.0	41.0	48.2	51.7	57.5	28.7
			Max	191	217	151	104	140	24.3	52.0	125	140	110	143
			Min	25.4	80.4	21.9	12.7	77.0	13.2	29.8	19.6	28.7	13.3	7.94
			Excedance(Days)	0	0	0	0	0	0	0	0	0	0	0
			Data capture(%)	95	98	95	76	59	44	98	75	89	94	93
CO- 1 hr	ppm	35	Average	3.37	0.66	DNA	2.50	1.86	1.53	DNA	1.38	1.25	1.28	1.89
			Max	5.99	1.66	DNA	6.22	5.20	10.1	DNA	8.28	4.90	6.16	5.10
			Min	1.45	0.11	DNA	0.70	0.76	0.05	DNA	0.20	0.06	0.06	0.25
			Excedance(Hour)	0	0	DNA	0	0	0	DNA	0	0	0	0
			Data capture(%)	95	99	DNA	95	99	36	DNA	74	72	86	90
CO-8hr	ppm	9	Average	3.38	0.65	DNA	2.51	1.84	1.61	DNA	1.38	1.25	1.29	1.88
			Max	5.88	1.11	DNA	5.17	3.57	3.84	DNA	5.13	4.03	4.44	3.63
			Min	1.67	0.32	DNA	0.93	0.95	0.20	DNA	0.40	0.35	0.22	0.55
			Excedance(Hour)	0	0	DNA	0	0	0	DNA	0	0	0	0
			Data capture(%)	89	98	DNA	92	99	32	DNA	68	69	83	87
O_3-1hr	ppb	120	Average	DNA	4.41	6.72	23.8	5.11	DNA	17.4	9.80	12.8	12.0	18.3
			Max	DNA	30.7	41.1	72.7	30.5	DNA	52.2	35.8	40.0	38.7	62.9
			Min	DNA	1.32	0.12	2.15	0.71	DNA	3.65	0.22	0.05	0.16	0.29
			Excedance(Hour)	DNA	0	0	0	0	DNA	0	0	0	0	0
			Data capture(%)	DNA	97	92	60	99	DNA	40	23	63	94	84
O_3-8hr	ppb	80	Average	DNA	4.35	6.82	24.5	5.16	DNA	18.3	9.71	11.7	12.0	18.7
			Max	DNA	11.7	29.4	59.2	19.2	DNA	42.9	28.8	38.3	34.2	54.5
			Min	DNA	1.80	0.41	3.61	1.11	DNA	6.35	1.34	0.16	1.43	0.89
			Excedance(Hour)	DNA	0	0	0	0	DNA	0	0	0	0	0
			Data capture(%)	DNA	94	90	49	99	DNA	34	22	53	92	78

CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter, DNA= Data Not Available

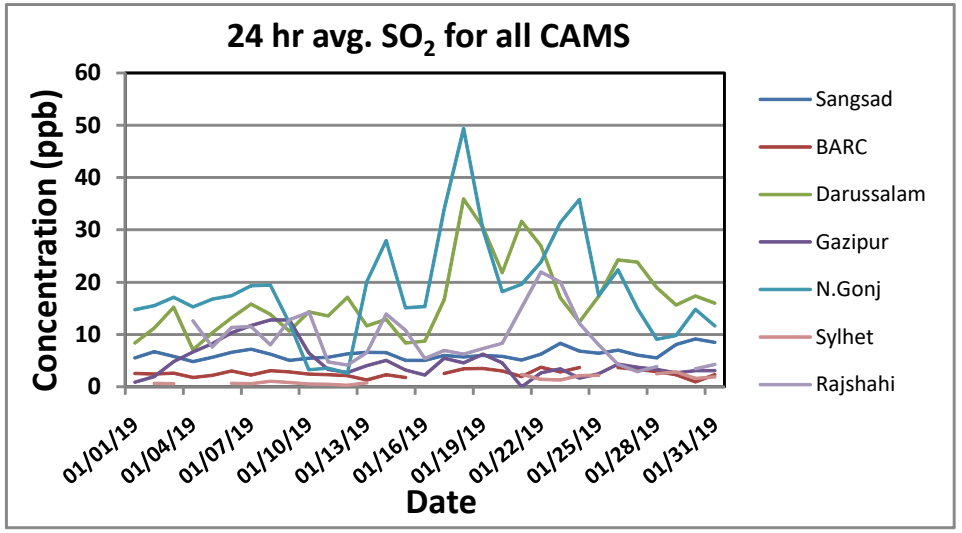
ANNEX

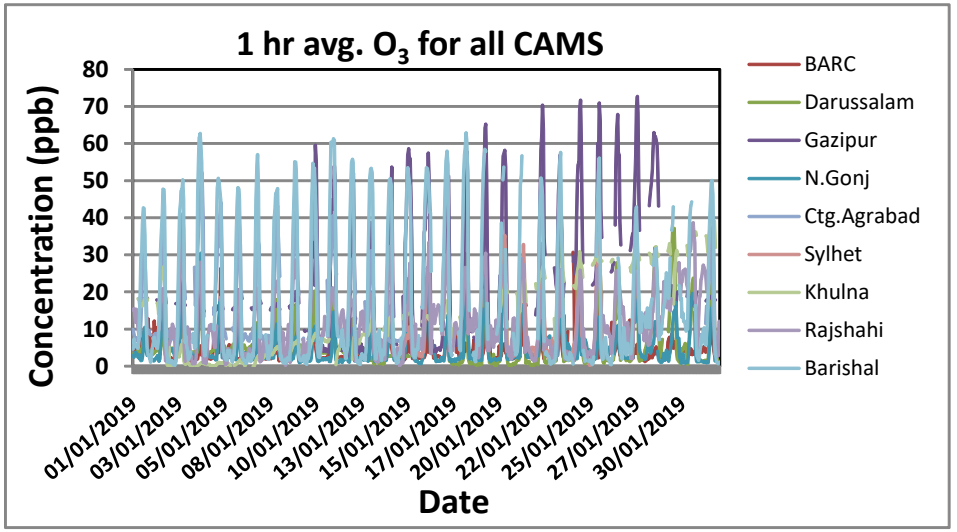
Table 3: Summary Air Quality and Meteorological data measured during January, 2019 at different CAMS operated under DoE (Cont'd)

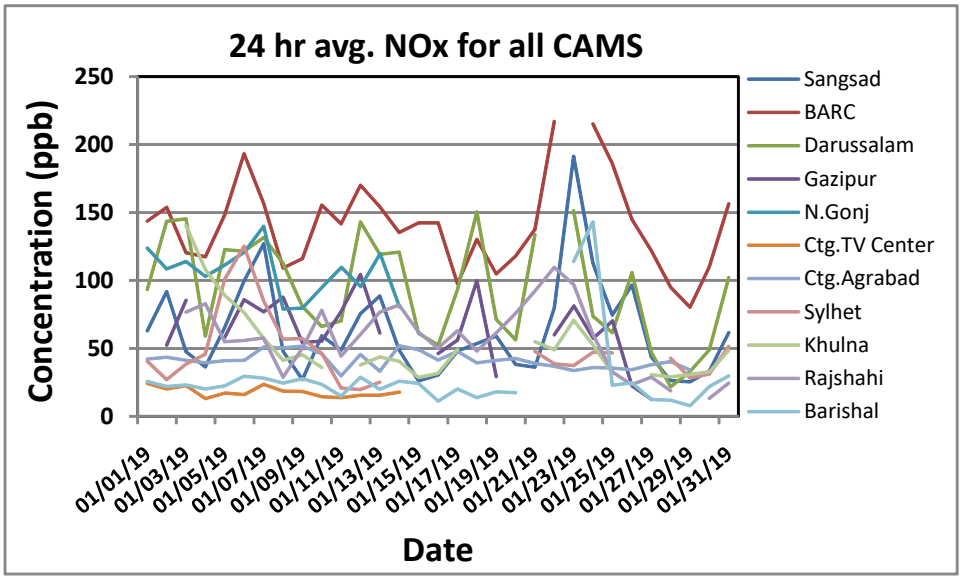
Parameter	unit	NAAQS	Summary	CAMS-1 (S-Bhaban)	CAMS-2 (BARC)[a]	CAMS-3 (D-salam)	CAMS-4 (Gazipur)	CAMS-5 (Narayonganj)	CAMS-6 TV-St (Chittagong)[a]	CAMS-7 Agrabad-(Chittagong)	CAMS-8 (Sylhet)	CAMS-9 (Khulna)[a]	CAMS-10 (Rajshahi)[a]	CAMS-11 (Barisal)
$PM_{2.5}$ -24hr	µg /m^3	65	Average	131	149	205	192	229	87.2	141	90.9	138	152	150
			Max	229	192	271	281	325	111	211	147	228	260	206
			Min	53.4	114	151	102	111	64.5	69.2	49.8	71.9	81.1	93.3
			Excedance(Days)	28	31	21	25	27	13	31	18	22	23	31
			Data capture(%)	91	99	73	85	90	44	99	72	83	85	89
PM_{10} -24hr	µg /m^3	150	Average	DNA	212	302	319	401	104	DNA	160	153	277	225
			Max	DNA	295	402	454	476	144	DNA	220	268	441	310
			Min	DNA	159	211	191	305	64.3	DNA	111	66.8	149	148
			Excedance(Days)	DNA	31	29	27	12	0	DNA	16	15	27	30
			Data capture(%)	DNA	99	96	85	36	40	DNA	74	84	94	93
Solar rad. 1hr	watt/m^2	NA	Average	112	DNA	DNA	DNA	DNA	DNA	144	165	425	153	147
			Max	504	DNA	DNA	DNA	DNA	DNA	620	661	954	540	640
			Min	5.07	DNA	DNA	DNA	DNA	DNA	6.74	7.46	318	0.25	7.87
			Data capture(%)	95	DNA	DNA	DNA	DNA	DNA	100	78	84	30	95
Relative Humidity 1hr	(%)	NA	Average	61.1	52.8	DNA	DNA	58.3	72.2	61.5	68.4	89.9	DNA	70.2
			Max	90.9	72.5	DNA	DNA	86.4	81.8	92.7	95.5	99.1	DNA	97.3
			Min	28.3	42.9	DNA	DNA	26.4	64.9	23.1	31.7	64.5	DNA	28.9
			Data capture(%)	95	99	DNA	DNA	99	44	99	78	88	DNA	95
Ambient Temp. 1hr	(°c)	NA	Average	17.3	23.0	20.2	DNA	22.3	22.5	22.6	20.3	17.0	19.7	21.1
			Max	27.1	32.7	25.1	DNA	32.1	31.4	26.5	29.6	21.3	29.3	32.6
			Min	9.92	16.6	11.3	DNA	15.4	15.7	19.8	13.8	13.6	11.1	13.0
			Data capture(%)	95	99	99	DNA	99	44	100	78	84	67	95
Rainfall 1hr	(m.m.)	NA	Average	0.96	0.16	7.97	1.68	0.35	DNA	DNA	DNA	DNA	DNA	DNA
			Max	6.24	7.70	15.3	3.40	1.83	DNA	DNA	DNA	DNA	DNA	DNA
			Min	0.02	0.02	0.47	0.09	0.02	DNA	DNA	DNA	DNA	DNA	DNA
			Data capture(%)	94	66	99	95	97	DNA	DNA	DNA	DNA	DNA	DNA

CAMS= Continuous Air Monitoring Station, NAAQS=National Ambient Air Quality Standard, a=Refurbisment CAMS, PM= Particulate Matter, DNA= Data Not Available

FIGURE 2: TIME SERIES OF ALL PARAMETERS (SO_2, NOx AND O_3) MEASURED IN ALL CAMS DURING JANUARY, 2019







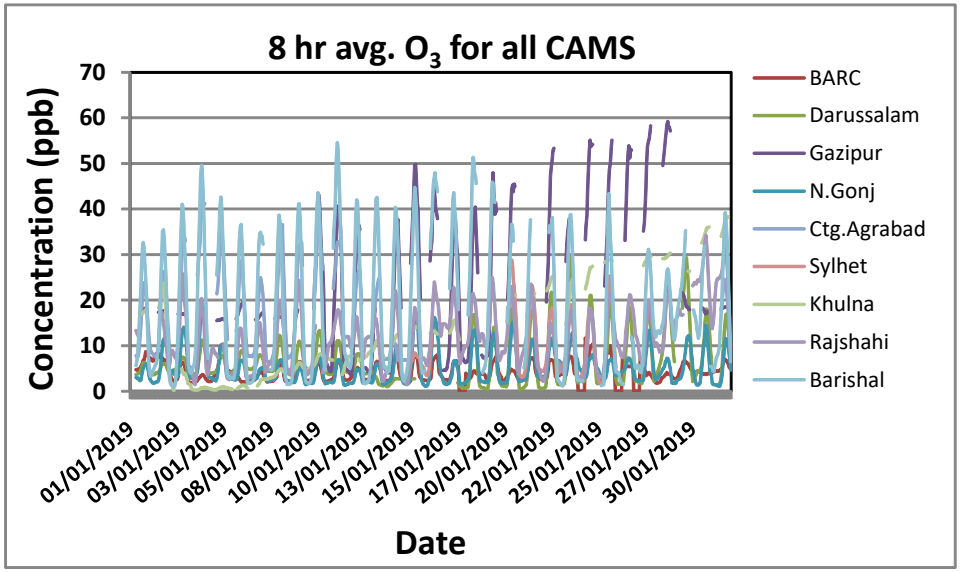
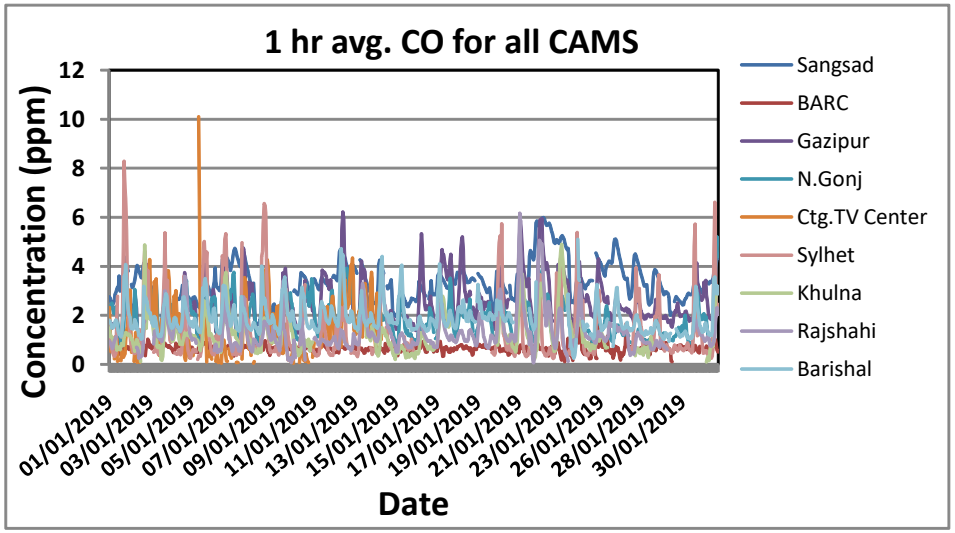
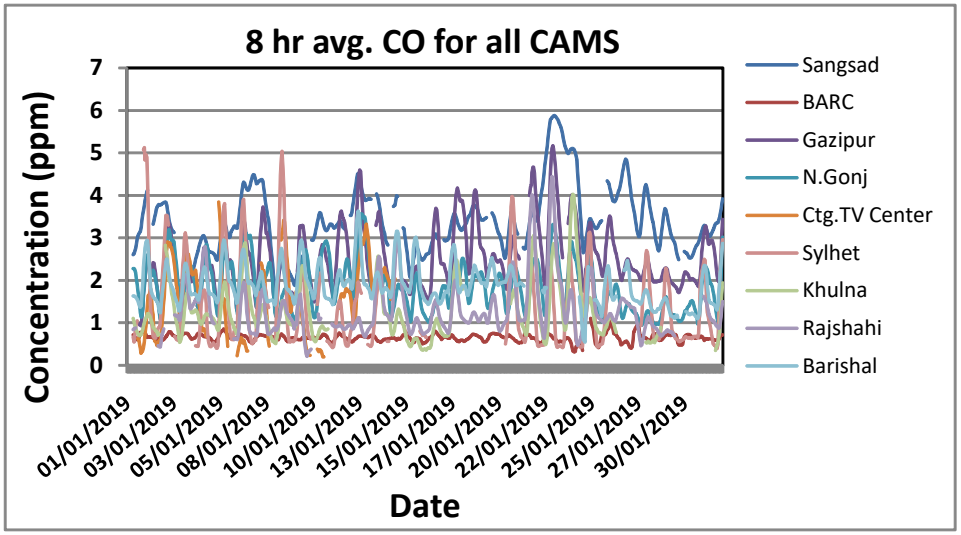
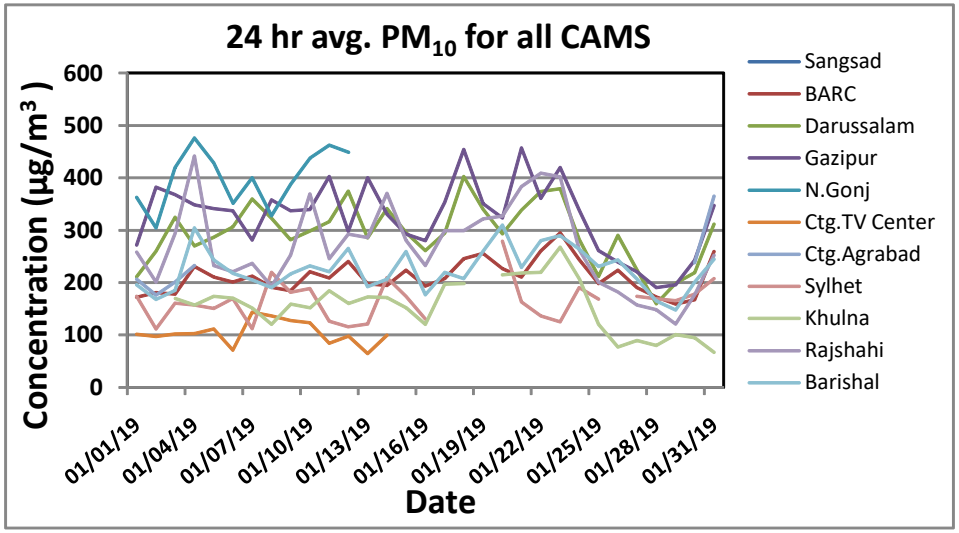


FIGURE 3: TIME SERIES OF ALL PARAMETERS (CO,PM10 AND PM2.5) MEASURED IN CAMS DURING JANUARY, 2019







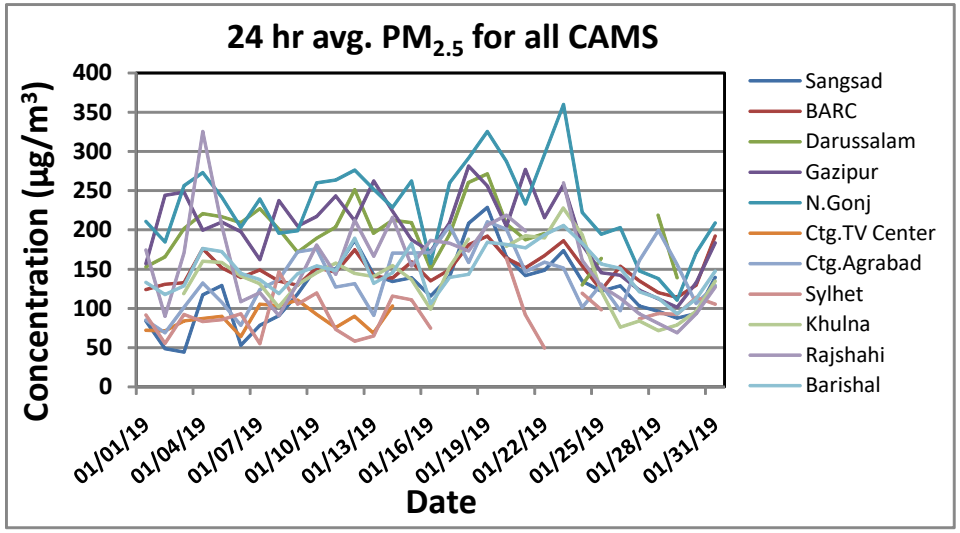
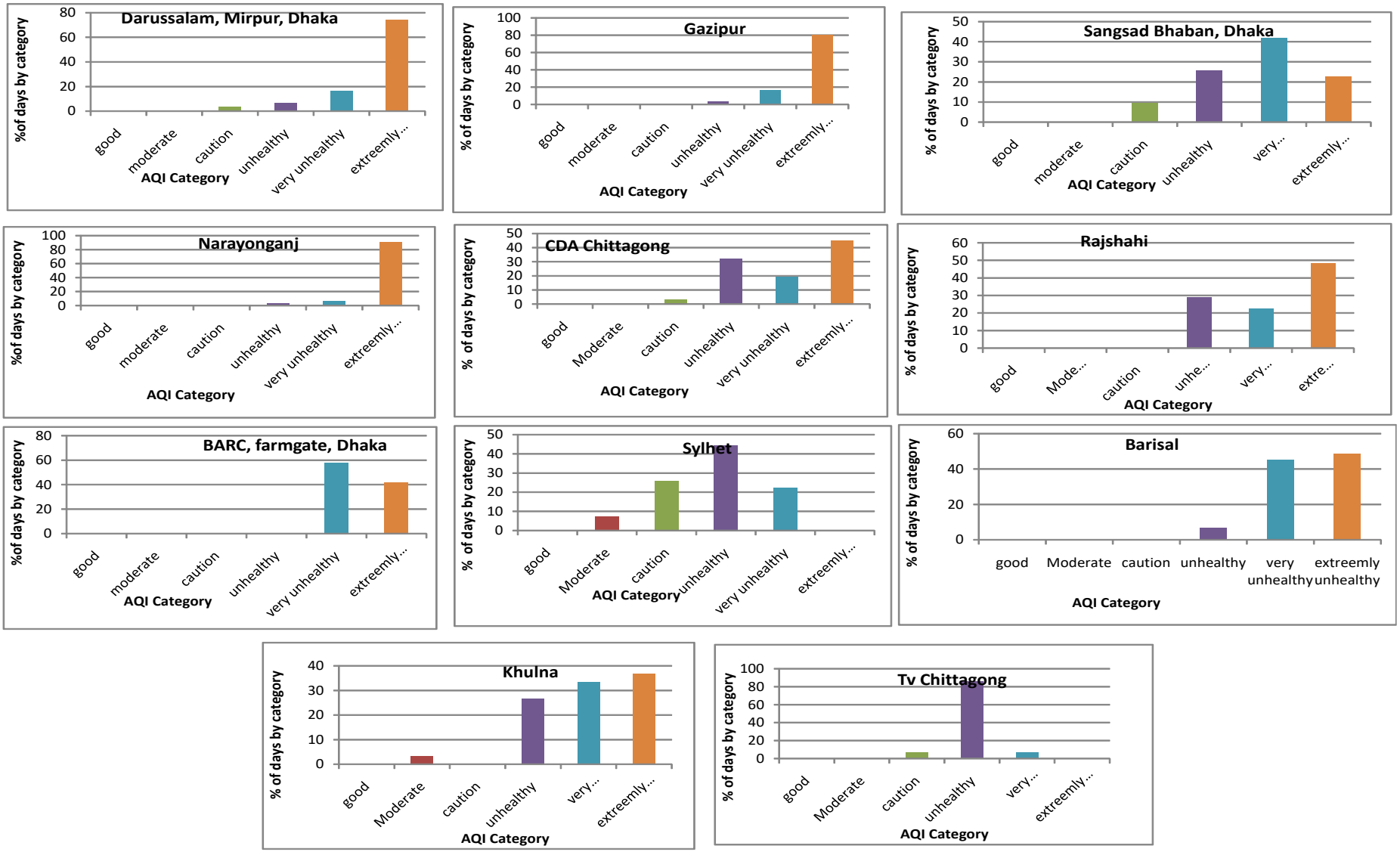



Figure 4: Monthly Summary of AQI for month of JANUARY, 2019