

Carbon dioxide and Suspended PM Variation in Barrackpore Cantonment Area during 2019-2020: Effect of Lockdown

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Abstract

Barrackpore cantonment, the oldest cantonment of India is very green indeed and have number of trees with low population density. In this study I had measured the amount of carbon dioxide and particulate matters namely PM 2.5 and PM 10 present in air throughout the years 2019 and 2020. From the experimental results it is evident that lockdown for pandemic and rainfall made a profound effect in air quality for at least seven months of 2020. Particulate matters are serious air pollutants and carcinogenic.

Keywords: Barrackpore Cantonment; Carbon dioxide; Lockdown.

Introduction

Barrackpore cantonment area (Location 22.78° N, 88.48° E) is situated within barrackpore subdivision, north 24 pargana district of West Bengal, India. Barrackpore cantonment is the oldest cantonment of India.¹ The cantonment area is surrounded by Barrackpore municipal area on the east and south, North Barrackpore municipal area on the north, Hooghly river on the west.^{2,3} According to Census of India data 2011, the total population was 17,380 within barrackpore cantonment area. The only road connections are there and one army air base is situated within this area. Number of Schools and only one college having two campuses are situated within this area. The main source of air pollutions are human activity and automobile exhaust. According to Indian standard, moderate level of carbon dioxide, particulate matter 2.5 (PM 2.5) and particulate matter 10 (PM 10) in air are 900 ppm, 100µg/m³, and 60 µg/m³ respectively.

Sampling and Instrument

Sampling were done in different locations of barrackpore cantonment area at least twenty days in every month. The instrument used is a portable low volume sampler made by Airveda TM Model No PM2510CTH (India Made).

The instrument measure PM by light scattering sensor and carbondioxide by nondispersive infrared sensor. The instrument was purchased by Barrackpore Rastraguru Surendranath College under UGC CPE fund.

Results

Table 1: Monthly average carbondioxide, PM 2.5, PM 10 and humidity data of barrackpore cantonment area during January 2019 to December 2019.

Month	Carbon Dioxide (ppm)	PM 2.5 (µg/m ³)	PM10 (µg/m ³)	Humidity (%)
January 2019	610.60	148.70	243.40	48.70
February 2019	582.00	113.50	210.16	51.50
March 2019	599.30	71.60	146.40	49.00
April 2019	594.57	50.14	95.57	56.00
May 2019	654.00	70.00	106.83	56.83
June 2019	745.00	47.40	85.80	57.20
July 2019	729.60	46.00	96.30	66.40
August 2019	688.80	27.50	50.50	65.30
September 2019	727.50	28.00	71.83	67.83
October 2019	823.00	41.50	69.00	64.50
November 2019	734.50	77.50	179.25	60.80
December 2019	653.60	129.30	225.60	51.30

Table 2: Monthly average carbon dioxide, PM 2.5, PM 10 and humidity data of barrackpore cantonment area during January 2020 to December 2020.

Month	Carbon Dioxide (ppm)	PM 2.5 (µg/m ³)	PM10 (µg/m ³)	Humidity (%)
January 2020	738.25	138.00	216.00	55.50
February 2020	660.30	81.50	133.40	45.10
March 2020	678.75	80.50	133.50	61.50
April 2020	469.00	44.00	202.00	70.00
May 2020	656.00	38.75	62.00	74.00
June 2020	672.75	39.50	57.50	68.75
July 2020	672.80	32.00	42.80	72.00
August 2020	684.60	09.60	15.60	71.50
September 2020	725.60	32.50	40.00	72.25
October 2020	826.00	41.00	61.00	52.00
November 2020	768.00	22.00	61.00	46.00
December 2020	744.28	153.28	246.57	53.57

Table 3: Monthly average temperature and number of rain day data of barrackpore cantonment area.

Month	Temp High/Low(°C)	Rain
January	26°/13°	1 day
February	29°/16°	1 day
March	34°/21°	2 days
April	36°/24°	3 days
May	36°/25°	7 days
June	34°/26°	14 days
July	33°/26°	18 days
August	33°/26°	18 days
September	33°/26°	14 days
October	32°/24°	7 days
November	30°/19°	1 day
December	27°/14°	0 day

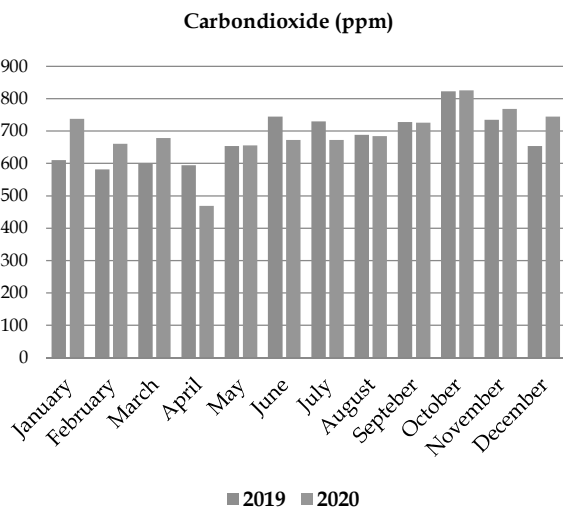


Fig. 1: Comparison of average Carbon dioxide values.

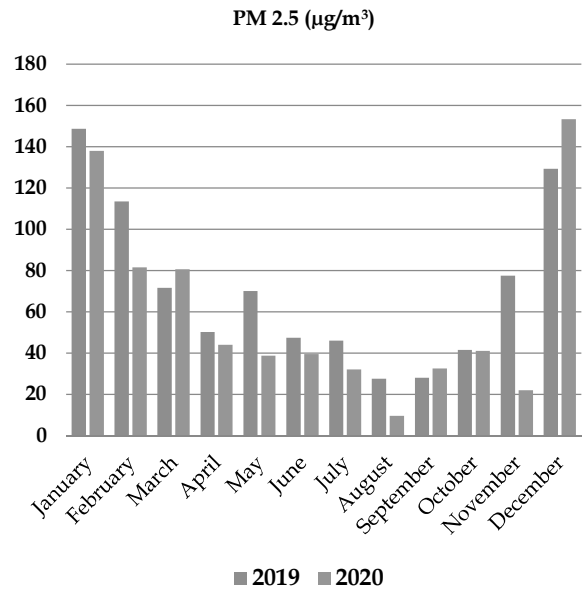


Fig. 2: Comparison of average PM 2.5 values.

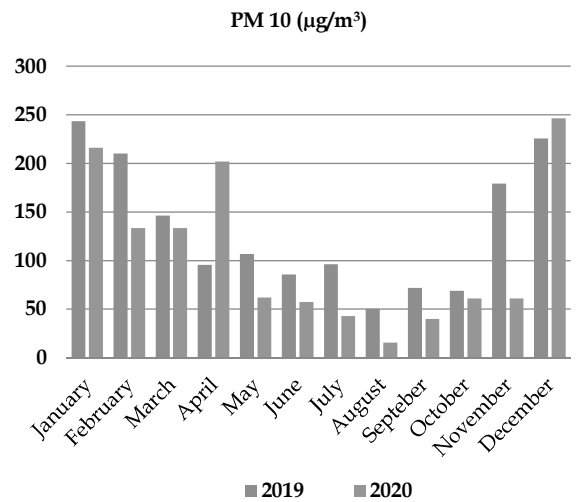


Fig. 3: Comparison of average PM 10 values.

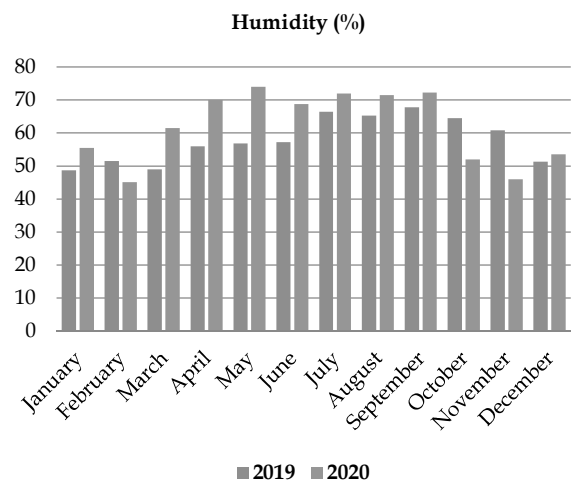


Fig. 4: Comparison of average humidity values.

Discussion

According to Indian standard air containing carbon dioxide above 1100 ppm is poor, around 900 ppm moderate and below 750 ppm is satisfactory. Carbon dioxide concentrations are comparable for the months August to November for both the year (Fig. 1). Carbon dioxide concentration majorly remain more than 600 ppm throughout the year with some exceptions (Fig. 1). The concentration of carbon dioxide is higher relatively during winter of 2019 (Table 1.) and also for 2020. Lowest carbon dioxide concentration is found during April 2020 (Table 2). According to Indian standard air containing PM 2.5 above 90 $\mu\text{g}/\text{m}^3$ is poor, around 60 $\mu\text{g}/\text{m}^3$ moderate and below 30 $\mu\text{g}/\text{m}^3$ is satisfactory. PM 2.5 remain higher than 80 $\mu\text{g}/\text{m}^3$ during winter (Fig. 2.) but gradually decreases with the number of rain days in a month. Rainfall removes particulates from air. The PM 2.5 value remain below 50 $\mu\text{g}/\text{m}^3$ during eight months (April 2020 to November 2020) (Table 2) whereas during 2019 for only five months (June 2019 to October 2019). The value of PM 2.5 stands below 100 $\mu\text{g}/\text{m}^3$ for nine months during 2019 and ten months during 2020. According to Indian standard air containing PM 10 above 250 $\mu\text{g}/\text{m}^3$ is poor, around 100 $\mu\text{g}/\text{m}^3$ moderate and below 50 $\mu\text{g}/\text{m}^3$ is satisfactory. Average PM 10 value were found higher than 100 $\mu\text{g}/\text{m}^3$ during winter (November, December, January, February and March) but gradually decreases with the number of rain days in a month (Fig. 3). Rainfall removes PM 10 from air. The PM 10 value remain below 100 $\mu\text{g}/\text{m}^3$ during six months during 2019 (April, June, July, August, September and October 2019) whereas, during 2020 it remains below 100 $\mu\text{g}/\text{m}^3$ for seven months (May 2020 to November 2020) (Table 2). The minimum value of PM 10 was found $\mu\text{g}/\text{m}^3$ for 15.60 for August 2020. Humidity is maximum in rainy season and minimum during winter (Figure 4).

Conclusion

Due to the effect of strict lockdown carbon dioxide concentration was low during April 2020 and the average value is lower than average April 2019 value by an amount of 21.12%. It may be concluded from data that with respect to carbon dioxide air quality of barrackpore cantonment area is "moderate". The air quality of barrackpore cantonment are poor during January, February, December 2019 and January & December 2020 with respect to PM 2.5. The barrackpore cantonment air quality with respect to PM 2.5 found "satisfactory" during August, September 2019 and July to November 2020. Within barrackpore cantonment area air quality is "satisfactory" with reference to PM 10 for August to October 2019 and May to November 2020. The extra four months PM 10 low data for the year 2020 can be attributed to lockdown due to pandemic. High PM 10 data are found for January, February, March, November, December 2019 and January, February, March, April & December 2020.

Particulate matter arises from soil dust, road dust, burning of fossil fuel in vehicles, industry exhausts, power plants etc. In barrackpore cantonment area

particulate matter in air arises only from soil dust, road dust, burning of fossil fuel in vehicles and human activity only. Though there are no industry within barrackpore cantonment area still there are many industries within barrackpore subdivision. Particulate matter deposits on the leaf of plants, may clog the stomatal mouth and interfere with the photosynthesis activity of plant.⁴ It is established fact that particulate matters are most powerful and harmful air pollutant as well as carcinogen. In the year 2016, throughout the world, 4.1 million deaths were reported on exposure to PM 2.5 through heart disease and stroke, lung cancer, chronic lung disease and lung disease.⁵ Fine particulate matter PM 2.5 reach to alveolus of human lung. In present days due to COVID 19 pandemic most people are using face masks which prevent entry of PM 2.5 and PM 10 within human lung. Even when the pandemic will be over use of face mask is essential during winter (December, January and February) to keep safe from air pollutant particulates as during winter PM 2.5 and PM 10 remain higher than Indian standard and WHO standard. As a result of lockdown PM 10 values found lower than expected during the period May 2020 to November 2020 and it is evident from the comparison data of 2019 for the same period (May to November). It is clearly evident that air pollutants specially particulates found relatively low during 2020 for post lockdown period with an effect for seven months, but again became similar to earlier (before lockdown) during December 2020. Final conclusion can be made that May 2020 to November 2020 overall air quality of barrackpore cantonment area was highly satisfactory whereas in 2019 overall air quality was highly satisfactory for June to October only.

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