IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Assessment Of Air Pollution Level In The City Of India (Delhi)

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Abstract

In this communication the air pollution assessment of Delhi, India is presented for the month of January 2023 and a particular day as 06 February 2023. The Central Pollution Control Board (CPCB), Ministry of Environment, Forests, and Climate Change provided open access internet data for the current study, which included PM2.5 (diameter 2.5 m), PM10 (diameter 10 m), NO_2, NH_3, SO_2, CO, ozone, and air quality index (AQI) concentrations in Delhi city from 06 January 2023 to 06 February 2023. The sub-indices for each pollutant at a monitoring station are created using the health breakpoint concentration range and the 24-hour average concentration value (8-hourly for CO and O_3). The average AQI, PM2.5 and PM10 are observed by 353.96, 176.72 and 298.83 respectively. Researchers in the field of pollution would benefit from the study, which offers a variety of crucial indicators to confirm environmental contamination in Delhi, India, at various sites and health risk issues.

Keyword: Pollution, AQI, PM2.5, PM10, CPCB Guidelines etc

1. Introduction

Numerous artificial and natural factors can contribute to outdoor air pollution. It is a concoction of concoctions, and the composition of outdoor air fluctuates greatly over time and distance, reflecting variations in its sources, the weather, climatic changes, and other things. The sources of outdoor air pollution in any one location are not just local, but also regionally, nationally, and even internationally. People are continually shifting from rural to urban regions, which is the primary source of the air quality issues [2]. Urban areas have greater air pollution levels as a result of a number of factors, including industrial operations, energy producing facilities, and household heating [3]. They can be distinguished by the toxicological consequences of prolonged inhalation exposure [4]. The primary pollutants are a result of human activity, particularly those from industrial and combustion processes.

The environmental elements were altered in metropolitan areas, which led to a rise in pollution. In actuality, the high capacitance of construction materials, the dense built environment, and paved roads altered the local micrometeorological conditions. Compared to rural regions, the urban environment has different air quality parameters, including temperature, humidity, and wind speed and direction. Additionally, customers experience significant levels of discomfort due to road traffic, household heating, industrial activity, and underperforming buildings' energy efficiency. Because of the poor ventilation and the presence of tall buildings, which reduces the dispersion of air masses, the individuals exposed to air pollution are even more obvious. Due to this, pollutants created below building height linger at street level and worsen health conditions, particularly during thermal inversion occurrences [5-20].

The Air Quality Index (AQI) shows daily air quality and its elevated levels are associated with public health risks [21]. Countries have many air quality indices based on various national quality standards and dose-response correlations of contaminants [22, 23]. A rise in AQI raises acute and chronic health concerns, particularly in the elderly and in young children [24, 25].

Paliwal [26] assessed the air pollution of Jaipur city for the year 2022 for three places and compared the pollution level between them.

In the present study, the Central Pollution Control Board (CPCB), Ministry of Environment, Forests, and Climate Change provided open access internet data from which the concentrations of various pollutants in the Delhi city from 06 January 2023 to 06 February 2023 have been presented which included Particulate Matter 2.5 (PM2.5) (diameter< 2.5 m), PM10 (diameter <10 m), NO_2, NH_3, SO_2, CO, ozone, and air quality index (AQI). The 24-hour average concentration value (8-hourly for CO and O_3) and health breakpoint concentration range are used to generate the sub-indices for each pollutant at a monitoring station. The study is provide the various important parameters to verify the environmental pollution in Delhi India at various locations and health risk problems and will be beneficial to the researchers in the field of pollution.

2. Material and Methods

2.1 Characteristics of the Study Area

A study based on 2016 numbers found that 13 of the 20 cities with the highest annual levels of air pollution were in India, where at least 140 million people are estimated to breathe air that is at least ten times the WHO permissible limit. Pollution is mostly caused by industrial activities (51%), followed by automobiles (27%), burning in agriculture (17%), and other factors (5%) [27, 28]. India's air pollution is a serious health danger; in 2019 the list of the 30 most polluted cities in the world included 21 Indian cities [29]. It will be put into practice in 102 cities where the ambient air quality is thought to be subpar [30]. It is observed that the Delhi city is the most polluted city in India from last many years. So the assessment of its pollution level is needed daily, monthly and yearly for studied and for planning to reduction and control the pollution level.

Delhi is the capital of India, which is officially known as the National Capital Territory (NCT) of Delhi. Delhi shares borders with the states of Uttar Pradesh in the east and with the state of Haryana in the remaining directions as it spans the Yamuna river, particularly on its western or right bank. The NCT is 1,484 square kilometres in size (573 sq mi). The NCT has a population of about 16.8 million people, compared to about 11 million people living in Delhi's city proper, as per the 2011 census [30].

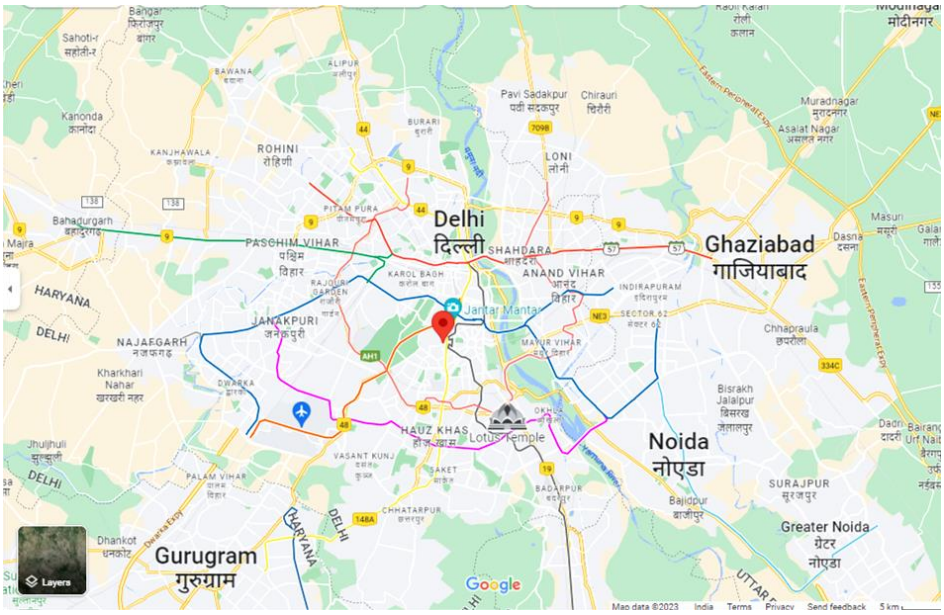

Figure 1: Map of Delhi, India [31]

2.2 Air Quality Parameters Level

The Indian National Air Quality Index takes into account eight pollutants which are PM10, PM2.5, NO_2, SO_2, NH_3, CO, O_3, and Pb with a 24-hour average period. Figure shows the pollution level (AQI) indicators as: good below 50 (AQI), satisfactory (AQI=51-100), moderately polluted (AQI=101-200), poor (AQI=201-300), very poor (AQI=301-400), severe (AQI=401-500 and above).

Good (0 - 50)	Satisfactory (51 - 100)	Moderately polluted (101 - 200)	Poor (201 - 300)	Very Poor (301 - 400)	Severe (401 - 500)

Figure 2: Air quality with AQI level

2.3 Pollutant Legislation

The Central Pollution Control Board, established pursuant to section 3 of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974), shall exercise and perform the powers and duties of the Central Pollution Control Board for the prevention and control of air pollution under this Act, without prejudice to the exercise and performance of such powers and duties under that Act. The state or quality of the air that surrounds us when we are outside is referred to as ambient air quality. The Central Pollution Control Board (CPCB) has established ambient air quality guidelines known as National Ambient Air Quality Standards that are applicable across the country. The 1981 Air (Prevention and Control of Pollution) Act grants the CPCB this authority. The Central Government passed the Air (Prevention and Control of Pollution) Act in 1981 in an effort to stop the decline in air quality. The Central Pollution Control Board's (CPCB) primary responsibilities are outlined in the following manner by the Air (Prevention and Control of Pollution) Act of 1981:

- To offer advice to the central government on any issue relating to bettering air quality and preventing, controlling, and reducing air pollution
- To organise and oversee the implementation of a national programme aimed at preventing, managing, and reducing air pollution.
- To offer the State Pollution Control Board advice and technical support.
- To conduct and support studies and research on the prevention, regulation, and reduction of air pollution

- To compile, publish, and gather technical and statistical information about air pollution; and to establish and repeal air quality standards

Table 1 shows the limits of standard air pollution parameters regulated by CPCB and WHO.

Table1. Directives 2009 CPCB standards of main Pollutants [32]

Pollutants	Concentrations in Ambient Air		Averaging Period	Guideline values prescribed by WHO
	Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area (notified by Central Government)		
PM2.5	40-60	40-60	Annual, 24 Hours	10-25
PM10	60-100	60-100	Annual, 24 Hours	20-50
SO_2	50-80	20-80	Annual, 24 Hours	20-500
NO_2	40-80	30-80	Annual, 24 Hours	40-200
CO	02-04	02-04	8 Hours, 1 Hour	04
O_3	100-180	100-180	8 Hours, 1 Hour	100
Pb	0.5-1.0	0.5-1.0	Annual, 24 Hours	0.5
NH_3	100-400	100-400	Annual, 24 Hours	54
Ni	20	20	Annual	25
As	6	60	Annual	6.6

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time, they may exceed the limits but not on two consecutive days of monitoring.

2.4 Monitoring Station Network

The air quality standard parameters of Delhi city at 118 locations are noted from website of CPCB. Table 2 shows the name of all 118 places of data collection.

Table 2: 118Locations for data collection in Delhi City

118Locations for Air Pollution Data Collection in Delhi, India					
1	ITI Shahdra	41	Karol Bagh	81	Diplomatic Enclave
2	Loni	42	Kalkaji	82	Bawana Industrial Area
3	Pooth Khurd	43	HT House	83	Gulmohar Park Block B
4	ITI Jahangirpuri	44	Okhla Phase II	84	Hauz Khas
5	Narela	45	Katwaria Sarai	85	I P Extension
6	Mother Dairy Plant	46	Ramesh Park	86	Niti Marg
7	Sonia Vihar Water Treatment Plant Djb	47	Chanakya Puri	87	Bali Nagar
8	Alipur	48	Rohini Sector 30	88	Sukhdev Vihar
9	Punjabi Bagh	49	Anand Parbat	89	Delhi Gymkhana Club
10	Sri Auribindo Margta	50	Kohat Enclave	90	Paschim Vihar
11	Shaheed Sukhdev College Of Business Studies	51	Greater Kailash II	91	Dwarka Sector 6
12	Delhi Institute Of Tool Engineering	52	Mori Gate	92	Saket
13	Jawaharlal Nehru Stadium	53	Shalimar Bagh	93	Dwarka Sector 23
14	Satyawati College	54	Panchsheel Vihar	94	Safdarjung Enclave
15	Mandir Marg	55	Mukherjee Nagar	95	Darya Ganj
16	Mundka	56	Rohini Sector 24	96	Deepali
17	RK Puram	57	Dwarka Sector 10	97	Dwarka Sector 12
18	Pusa	58	Model Town	98	Dwarka Sector 7
19	Anand Vihar	59	Ghazipur	99	Bhalswa Landfill
20	PGDAV College	60	Rohini Sector 15	100	Dwarka Sector 5
21	New Delhi Us Embassy	61	Ashok Vihar Phase 4	101	Dwarka Sector 18B

22	Major Dhyan Chand National Stadium	62	Janakpuri	102	Dwarka Sector 3
23	Lajpat Nagar	63	Shahdara	103	Mayur Vihar
24	Prashant Vihar	64	Wazirpur	104	Vasant Vihar
25	Saket Block C	65	Malviya Nagar	105	Sukhdev Vihar DDA Flats
26	Embassy of Belgium	66	Rajinder Nagar	106	Kashmiri Gate ISBT
27	LIC Colony	67	GTB Nagar	107	New Sarup Nagar
28	Sir Edmund Hillary Marg	68	Raghubir Nagar	108	Mustafabad
29	Shastri Nagar	69	Civil Lines	109	Siddhartha Enclave
30	Uttam Nagar	70	New Friends Colony	110	Hazrat Nizamuddin
31	Ashok Vihar Phase 1	71	Sheikh Sarai	111	Connaught Place
32	Rohini Sector 7	72	Naraina Industrial Area	112	East Patel Nagar
33	Hari Nagar	73	Inderlok	113	Saraswati Marg
34	Vasundhara Enclave	74	Jangpura	114	Loni Dehat
35	Golf Links	75	Vasant Kunj	115	Surya Nagar
36	Punjabi Bagh Block D	76	Dwarka Sector 11	116	Rohini Sector 10
37	Anand Lok	77	Greater Kailash	117	Rohini Sector 5
38	Ashok Vihar Phase 3	78	Ashok Vihar Phase 2	118	RK Puram North Block
39	Green Park	79	Hastsal	**Total 118 stations**	
40	Defence Colony	80	Delhi Cantt		

3. Result and Discussions

The daily average AQI of Delhi city is shown in figure 3 for one month from January 06 to February 07, 2023. It is observed that the average AQI was more than 350 on January 09 and 10 and lowest is found below 150 on January 24, The average AQI for the month was observed more or less 200, it is moderate and poor indicator but it was the lowest as compared to last few years.

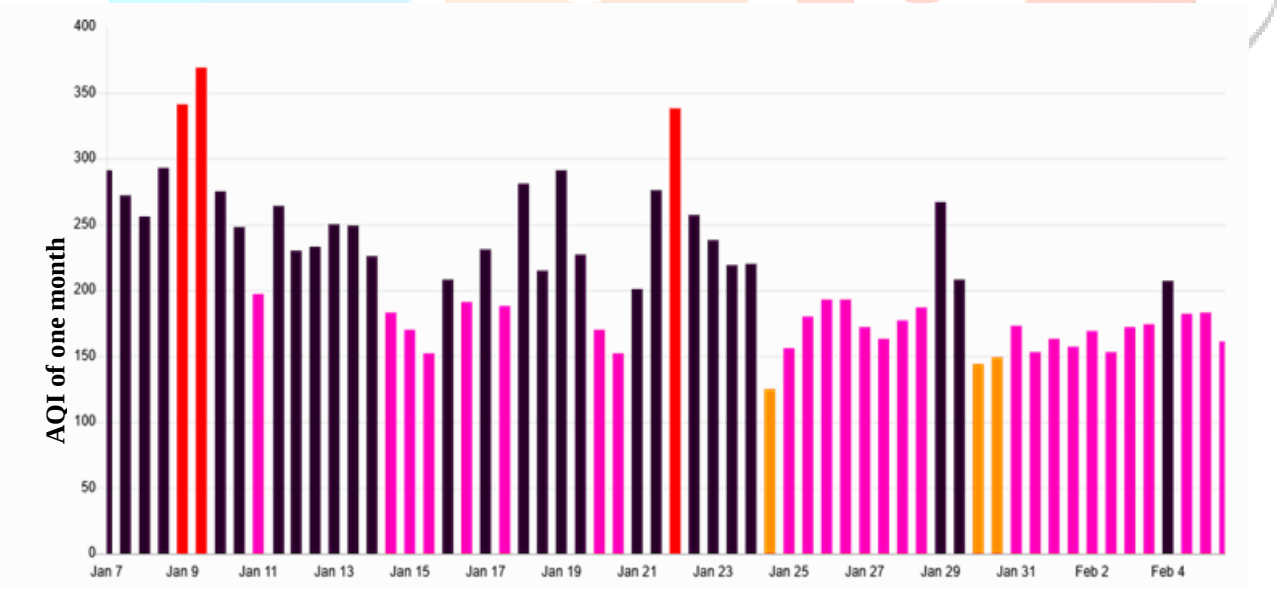

Figure 3: Daily average AQI-US for First month of 2023 in Delhi

The daily average PM2.5 of Delhi city is presented in figure 4 for one month from January 06 to February 07, 2023. It is observed that the average PM2.5 was more than 400 on January 10 and lowest is observed below 150 on January 24-25, the average PM2.5 for the month was observed below 250, it is poor indicator as indicated by the limit of PM2.5 in table 1.

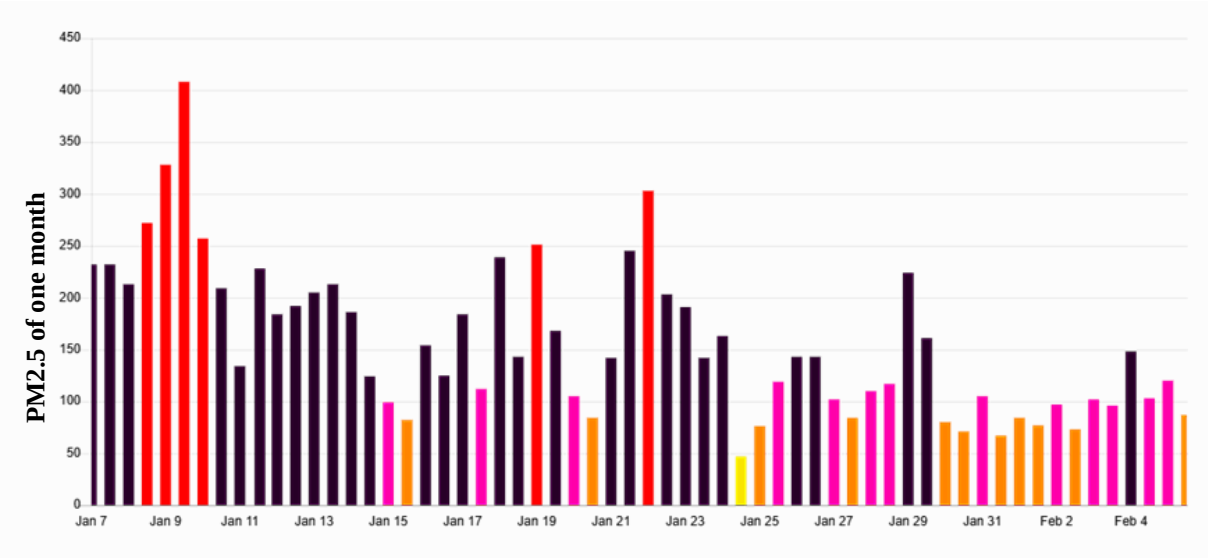

Figure 4: Daily Average PM2.5 for First month of 2023 in Delhi

The daily average PM10 of Delhi city is presented in figure 5 for one month from January 06 to February 07, 2023. It is observed that the average PM10 was more than 400 on January 10 and approximately equal to 400 on January 22 and lowest is observed below 150 on January 24-25, the average PM2.5 for the month was observed below 250, it is observed poor indicator as shown the limit of PM10 as per CPCB in table 1.

The daily average SO2 of Delhi city is shown in figure 6 for one month from January 06 to February 07, 2023. It is indexed or scaled as 1 is equal to 20 mg/m3. It is found that the average SO2 was more than 5.0 (More than The maximum limit of SO2) on January 19, 29, 30, 31 and Feb 2, lowest is observed below 2.0 on January 11,12, 14, 25, 26 and Feb 04. The average PM2.5 for the month was observed below 3.0 (approximately 60), it is observed poor indicator as shown the limit of SO2 as per CPCB in table 1.

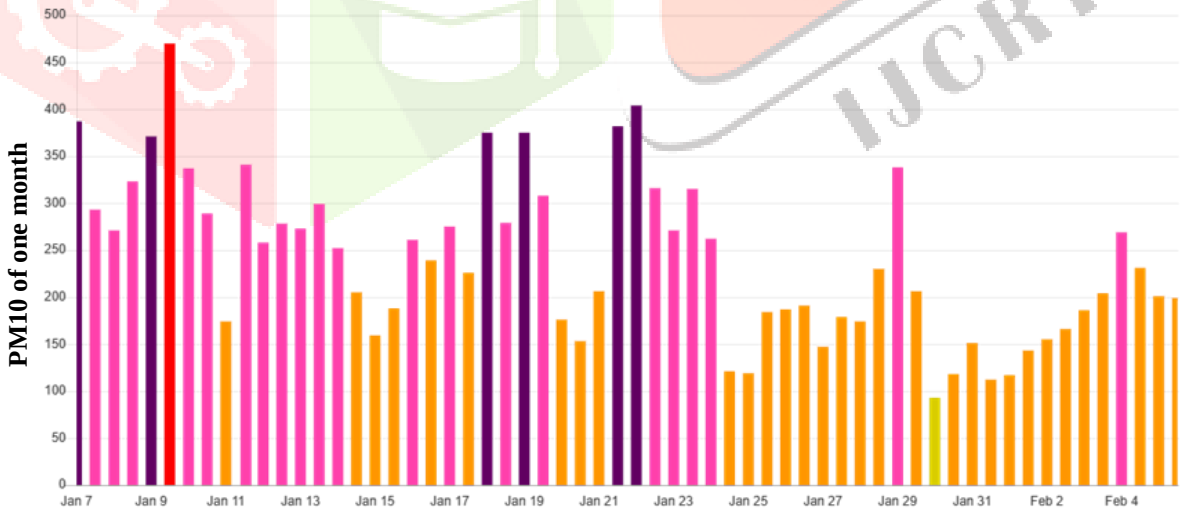

Figure 5: Daily Average PM10for First month of 2023 in Delhi

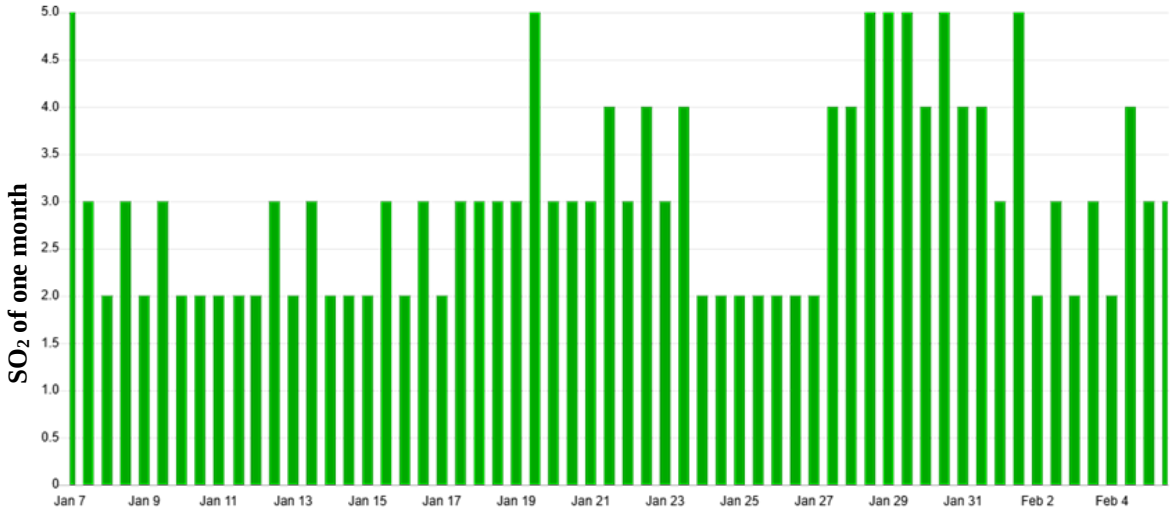

Figure 6: Daily Average SO_2 for First month of 2023 in Delhi

Daily average variation NO2 is presented in figure 7 for a month of January 2023 dated January 06 to February 07. The highest value more than 30 of NO2 is observed on January 19 and other two days 09 and 22 January also observed more than 29. The acceptable limit of NO2 as per CPCB is 40-80 and the value of observed is less than the limit values. The nO2 level is normal in Delhi in the month of January 2023.

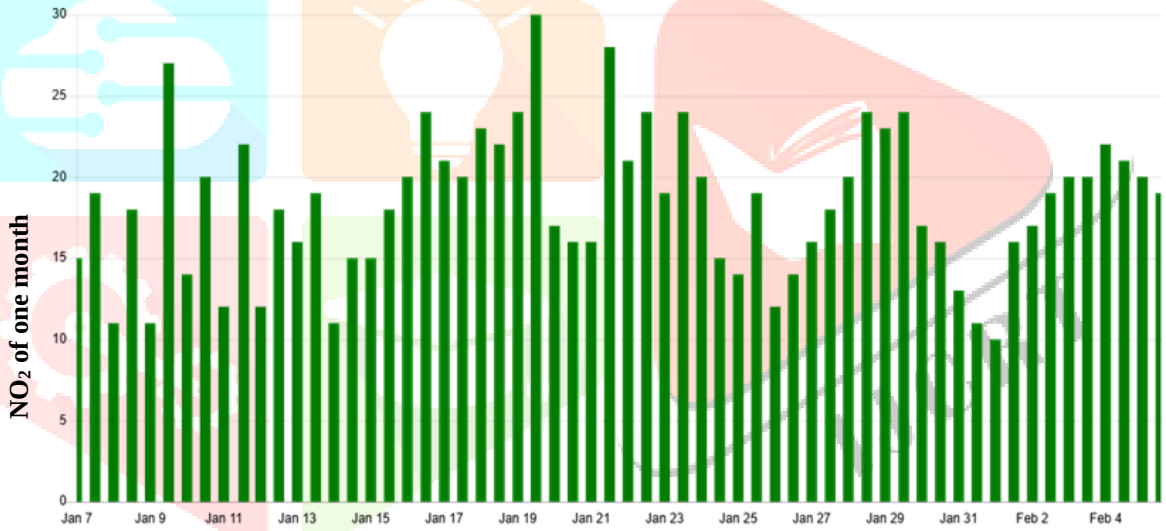

Figure 7: Daily Average NO_2 for First month of 2023 in Delhi

The average daily values of NOx are represented of Delhi city in figure 8. It is found that the highest value is more than and the lowest value is approximately 12. The Nox vale is in the range of acceptable limit in the month of January 2023.

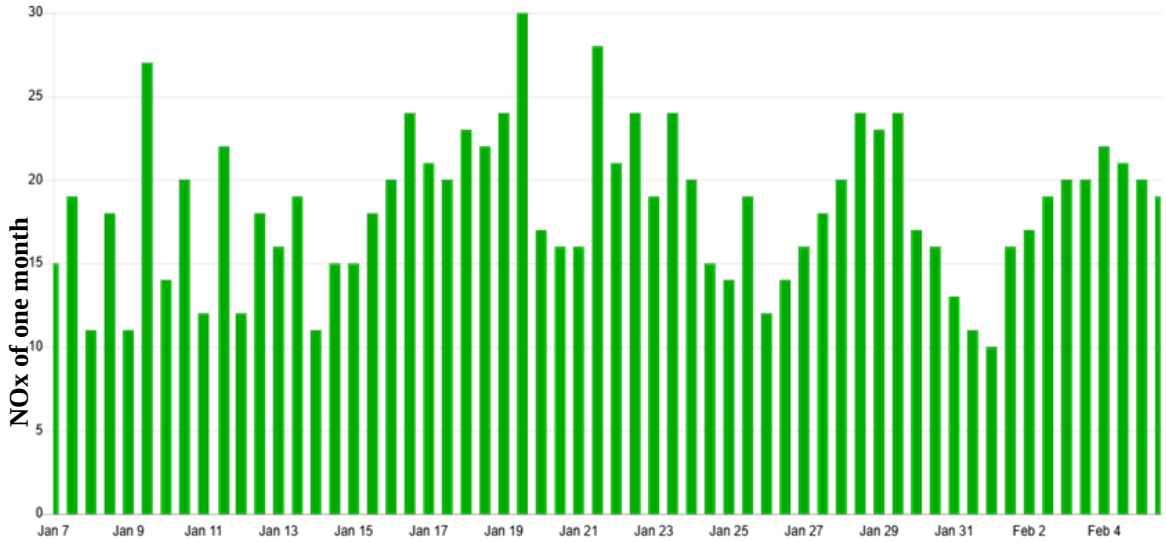

Figure 8: Daily Average NOx for First month of 2023 in Delhi

The daily average value of CO of January month is presented in figure 9 and found higher values on the days of January 9,19,22,and the lower values on January 8,12, 14 and Feb1.

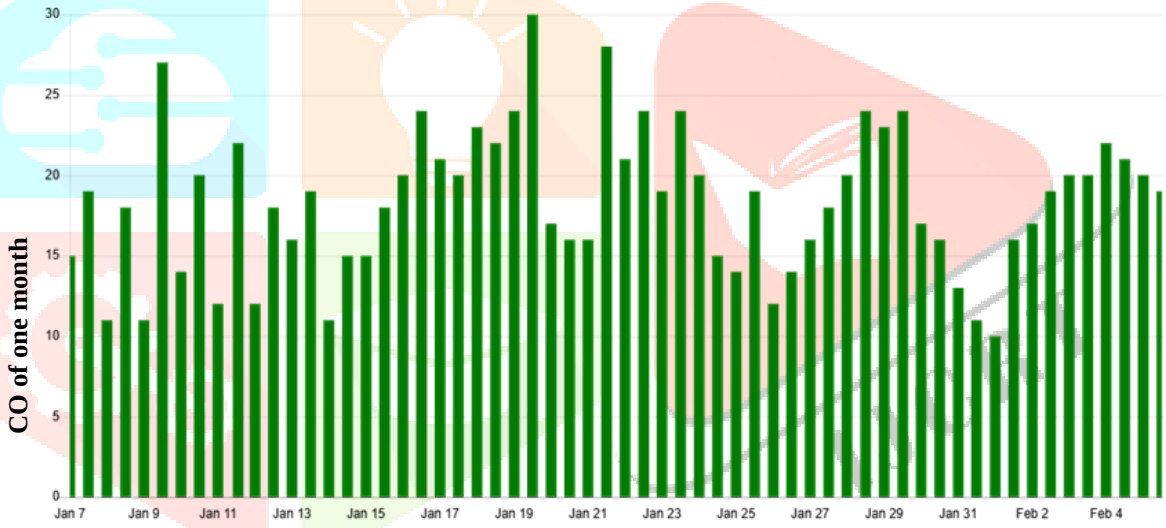

Figure 9: Daily Average CO for First month of 2023 in Delhi

The Ozone value of daily average is shown in figure 10 and it is observed that the higher ozone more than the scale value 30 on January 19 and 20 and the lowest values on January 8, 14, 26 and February 01. The values are in the range of acceptable limit.

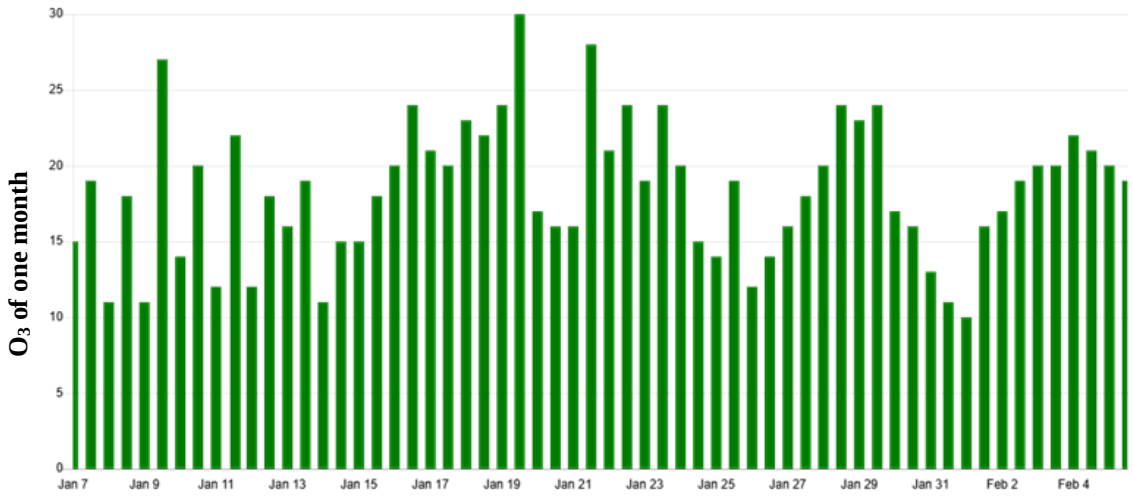

Figure 10: Daily Average O_3 for First month of 2023 in Delhi

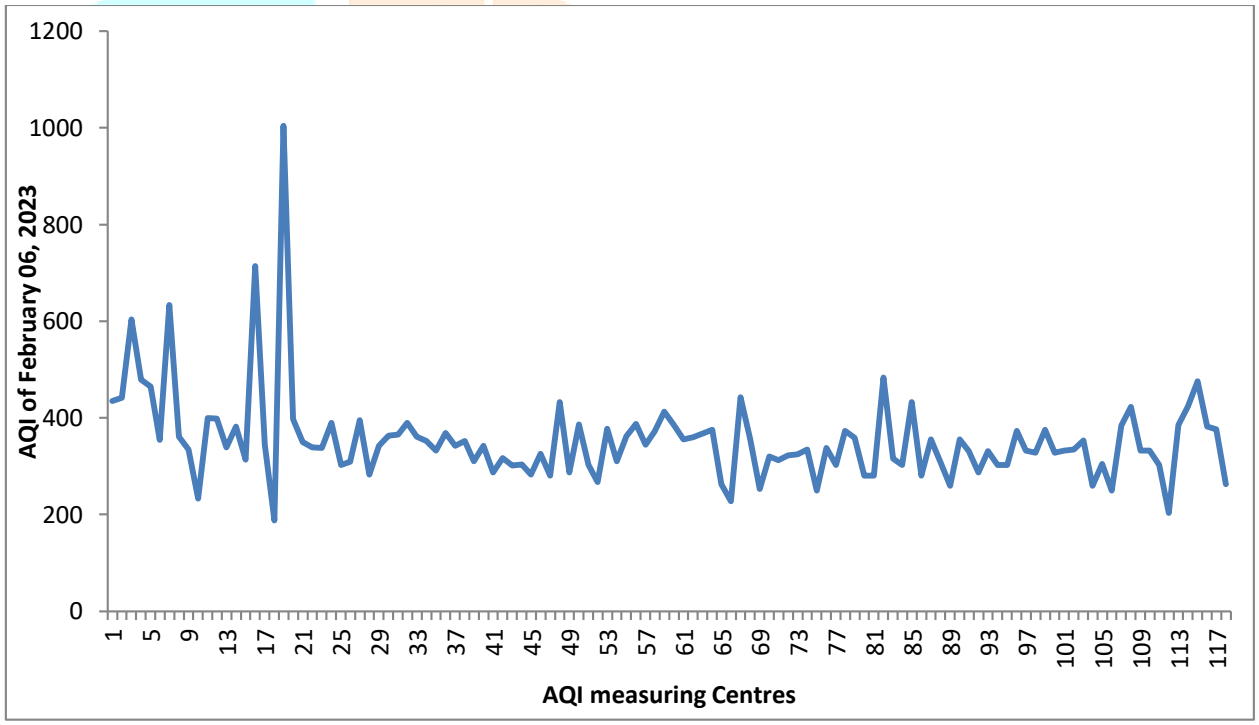

Figure 11: AQI of 06 Feb 2023 of 118 places in Delhi

A full day average AQI of 118 (List of 118 places is shown in table 2) places was observed on February 06 and presented in figure 11. It is observed that the lowest value of AQI established on February 05 as per the data available and the news of Times of India. The credit of reduction of pollution is gone to the Arvind Kejriwal (Chief Minister of Delhi Government). The lowest AQI is observed on 06 February at Kawaria Sarai and Saket approximately 280 and the highest value of AQI is observed at Anand Vihar by value 1004 and other higher values observed at Mundka (714) Sonia Vihar Water Treatment Plant Djb (633), and Pooth Khurd (604). The average AQI is 353 which is comes into the range of very poor. So it is found that the air quality in Delhi is very bad due to high AQI for whole the year.

Figure 12 represents the average variation of PM2.5 for all 118 centers or measuring places. It is observed that the highest value of PM2.5 found at Pooth Khurd by 313 and atLoni by 304 and the lowest values observed at East Patel Nagar by 91. The average value of PM2.5 of February 06, 2023 is observed by 176.72. Some of the places have their PM2.5 value very close to the average value, these are: Dwarka Sector 10, Defence colony, Anand Lok, Major Dhyan Chand National Stadium, RK Puram and Jawaharlal Nehru Stadium.

As per the CPCB limit of PM2.5 is very less than the observed average vale even the lowest value observed at East Patel Nagar by 91, it represents the higher value means the air is not safe for humans life and the sickness syndrome due to PM2.5have built in environment of Delhi. These are the headache, Asthma and disease related to lungs and hearts.

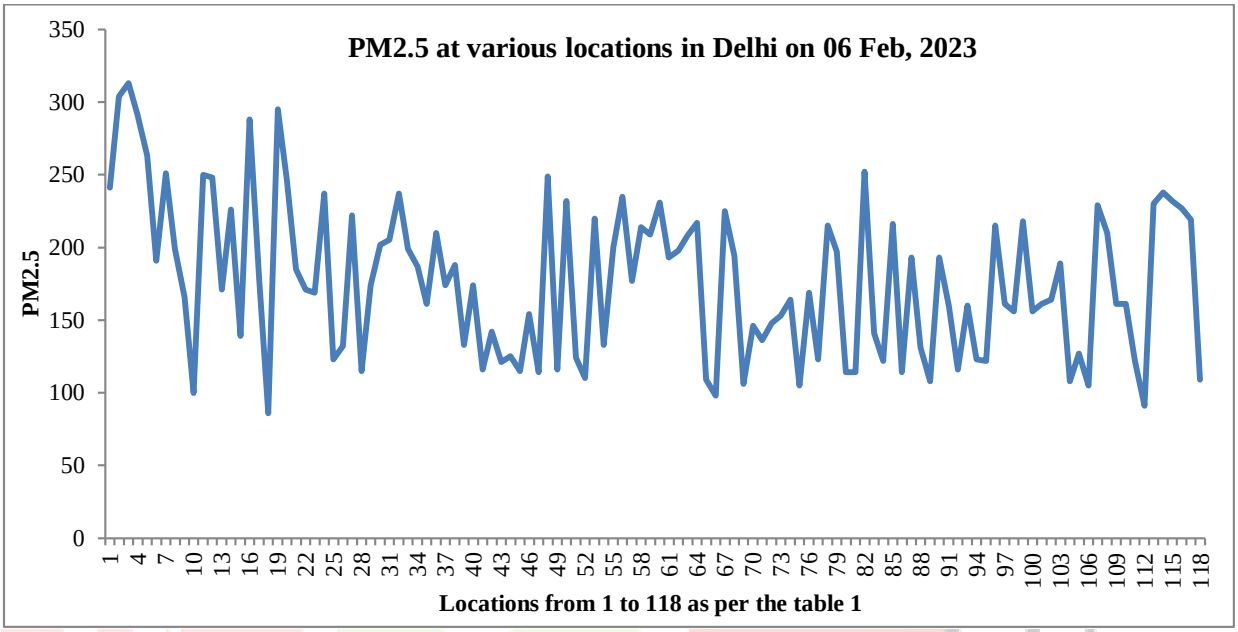

Figure 12: Average PM2.5 of 06 Feb 2023 of 118 places in Delhi

Figure 13 represents the average variation of PM10 for all 118 centers or measuring places. It is observed that the highest value of PM10 found at Anand Vihar by 913 and the lowest values observed at Civil Lines by 85. The average value of PM10 of February 06, 2023 is observed by 298.83. Some of the places have their PM10 value very close to the average value, these are: Siddharth Enclave, Dwarka Sector 1, Dwarka Sector 18B, Dwarka Sector 12, Defence Colony, Anand Lok and Ashok Vihar sector 3. The average value of PM10 is found more than the prescribe value of CPCB and WHO.

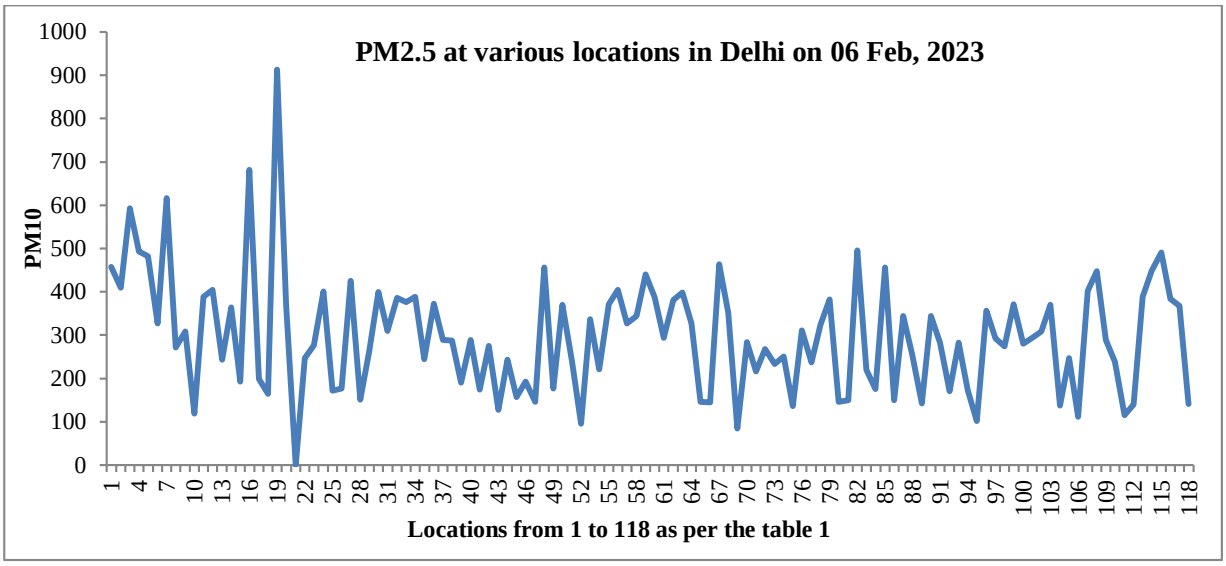

Figure 13: Average PM10 of 06 Feb 2023 of 118 places in Delhi

The PM2.5 and PM10 are observed very high in Delhi city in similar way all the pollutant elements are observed in the higher range of the CPCB and WHO prescribed values. The value of air pollution in Delhi is caused by the large number of vehicles on roads, biomass burning in Delhi and NCR regions, Crackers and Fumes in all festivals, low wind velocity due to high rise buildings and coal & petroleum product burning in small scale industries and for running the boilers. In continuous of that the application of air conditioners and refrigerators also creates the air pollution.

4. Conclusions

The major goal for reducing air pollution is to achieve an urban sustainable development by the use of appropriate mobility policies, i.e., to enhance traffic mobility conditions, to boost road safety, to lessen traffic caused by pollution, and to re-qualify urban areas. It comprises optimizing public space, protecting historical and architectural legacy, and ensuring the health and quality of life of citizens. Government of India should strictly follow the rules of environment pollution. BS-VI vehicles and Diesel Generator sets must be replacing the old vehicles in order to reduce the pollutants generated by heating systems in buildings.

The old technique boilers, heating equipments, R-11 & R-12 based refrigerators and air conditioners must be replaced by latest technological low polluting paraphernalia. In actuality, condensing boilers enable minimizing the use of combustion and, as a result, a drop in emission. Artificial rains may also reduce the AQI of daily.

Compliance with ethical standards

Acknowledgments

I acknowledge my thanks to the CPCB India who provided the online data.

Disclosure of conflict of interest

I would like to declare that no conflict of interest exits in this manuscript. The work described is original research and none of the material in this paper has been published or is under consideration for publication elsewhere.

Statement of ethical standard

All the ethical practices have been followed during writing.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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