International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

An Overview of Air Pollution and Its Impact on Human Health in Kolkata

Arpita Dutta[1], Arnab Rao[2]

[1,2]Student, Geography, University of Calcutta

Abstract

This paper consists the overview of air pollution in the Kolkata Municipal area in between the time span of 2018 to 2022 to analyse the trend of air pollution in the area and its impact on human health. For this purpose some cartographic techniques have been used to analyse the data. Different calculations have been done with different data sets to analyse the trend.

Keywords: A.Q.I- Air quality index, P.M- Suspended particulate matters

Introduction

The air we breathe is an essential ingredient for our wellbeing and a healthy life. But unfortunately air has been polluted. There is no doubt that air pollution existed in ancient times, but it was much less severe and less widespread than today.

According to Mishra (2003) rapid growth in urban population, increasing industrialization, and rising demands for energy and motor vehicles are the worsening air pollution levels.

Air pollution effects human health as well as the climatic condition and indirectly effects the economic condition of the place. Meteorological factors, vehicle emission, industrialisation and many other natural and man-made causes increase the level of pollutants in air.

In India air quality is a very important issue now a days and Kolkata is one of the most polluted cities in India after Delhi (Kolkata news, 19.11.2020). For these reasons this topic is needed to be enlightened.

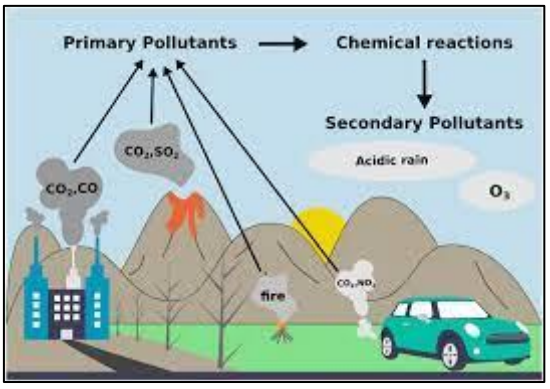


Figure 1.Types of Pollutants and Air Pollution

Types of air pollution

Pollutants that are emitted directly from identifiable sources, produced both by natural events (for example, dust storms and volcanic eruptions) and human activities (emission from vehicles, industries,

etc.) are referred to as primary pollutants. There are five primary pollutants that together contribute about 90 per cent of the global air pollution. These are carbon oxides, 5 nitrogen oxides, sulphur oxides, volatile organic compounds (mostly hydrocarbons) and suspended particulate matter.
Those substances that are not directly emitted into the atmosphere, but rather are formed by chemical reactions in the atmosphere are referred to as secondary pollutants. Acid rain is a form of secondary pollution because it results from processes occurring within the atmosphere after primary pollutants such as SO2 are emitted from exhaust stacks and other sources.

Literature review-

Several literatures have been studied to understand about the air pollution in Kolkata and its effect on health of citizen of Kolkata.

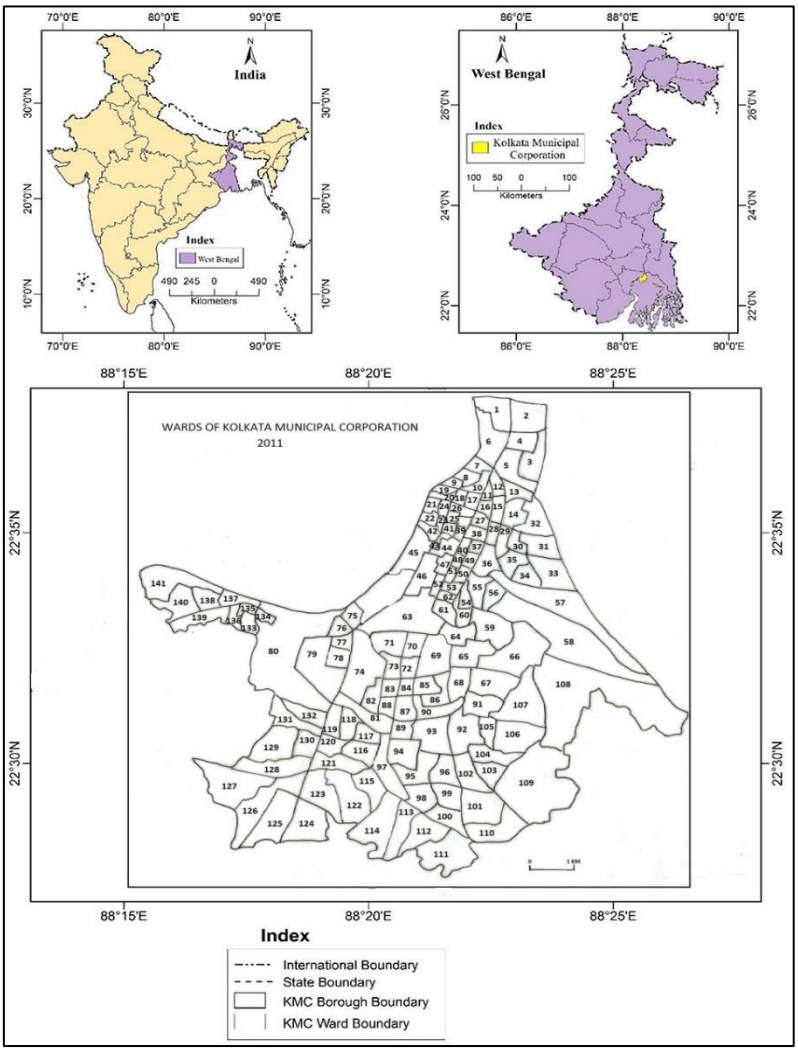
- According to Mishra (2003), poor environmental regulation, less efficient technology of production, congested roads, and age and poor maintenance of vehicles, also add to the problem. He further added that air pollution is caused of ill health and death by natural and man-made sources, major man-made sources of ambient air pollution include tobacco smoke, combustion of solid fuels for cooking, heating, home cleaning agents, insecticides industries, automobiles, power generation, poor environmental regulation, less efficient technology of production, congested roads, and age and poor maintenance of vehicles.
- WBPCB published annual report on air pollution of Kolkata and pointed out that the air pollution level in Kolkata is observed too high in industrial and residential area also.
- According to European Public Health Alliance, 2009, The natural sources of air pollution include incinerators and waste disposals, forest and agricultural fires.
- According to Prof. Masood Ahsan Siddiqui et al (2010), three factors account for the air pollution- (i) less human population, (ii) small consumption per person and (iii) very basic types of materials used.

Location of the study area-

The study has been conducted in Kolkata, the capital city of West Bengal and a metropolitan city in eastern India. It is located on the latitude 22deg34min03sec N and longitude of 88deg 22min 12sec E on the left bank of Hugli river. The total area of the city is 206.08sq.km.
The city of Kolkata has been dubbed as one of the most unplanned and polluted cities in the world. A study in comparison of air quality data among four metropolitan areas in India indicates a higher pollution level in Kolkata in comparison to Mumbai and Chennai, and is close to Delhi. It has also been termed as the dusty city.
For this project we selected 5 major places in Kolkata based on their location namely-

1.SHYAMBAZAR (ward-10), 2. BEHALA (ward-129), 3. TOLLYGAUNGE (ward-97), 4. MINTO PARK (ward-74), 5. PICNIC GAEDEN (ward-66). Thus, these different places of south, north, east, west and middle Kolkata has been selected and refers the air quality of Kolkata.

Figure 2, Ward Division Map Of Kolkata



(https://www.google.com/search?q=kolkata+municipal+corporation+ward+wise+map+from+research+paper&tbm=isch&ved=2ahUKEwjY7Y3z4vODAxUgbmwGHZKNAO0Q2-cCegQIABAA&oq=kolkata+municipal+corporation+ward+wise+map+from+research+paper&gs_lcp=CgNpbWcQAzoFCAAQgAQ6BAgAEB5Q3ANY3Spg0y1oAHAAeACAAc4JiAHaSZIBDzAuMS4yLjUuMS4zLjMuMpgBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=HdSvZZjrL6DcseMPkpuC6A4&bih=585&biw=1263&rlz=1C1YTUH_enIN1088IN1088&hl=en#imgrc=oras99CMYEm_hM
https://www.google.com/url?sa=i&url=https%3A%2F%2Facademic-accelerator.com%2Fencyclopedia%2Fkolkata-municipal-corporation&psig=AOvVaw35CslWxTREA5YT_ENonFAI&ust=1706109046377000&source=images&cd=vfe&opi=89978449&ved=0CBEQjRxqFwoTCLiT95Xl84MDFQAAAAAdAAAAABAD)

Objectives-

The objectives of the study resolves around the following goals, which successful achievement can provide fruitful solutions for the existing problem.

1. To identify the air pollution zones in Kolkata.
2. To find out the different sources of air pollution.
3. To assess the harmful effects of air on health.

4. To know the steps that should be taken to reduce air pollution.

Methodology-

The whole case study has been done with the help of secondary data. The data has been collected from West Bengal Pollution Control Board (WBPCB).

For case study 5 places have been selected according to their location namely Shyambazar, Behala, Tollygaunge, Minto Park, Picnic Garden. From 2018-2022 5 years have been selected for the study. To represent the status of air pollution in different parts of Kolkata various cartographic techniques have been used in the study to show the selected 4 pollutants which are PM2.5, P.M 10, NO2, SO2.

The AQI is calculated in the following process-

The data reading is devided by the national standard and multiplied by 100 to get the AQI for the pollutant.

Table 1, Among metropolitan cities, Central Pollution Control Board declares the standard value of different pollutants

POLLUTANTS	STANDARD VALUE
PM 10	60
PM 2.5	40
NO2	40
SO2	50

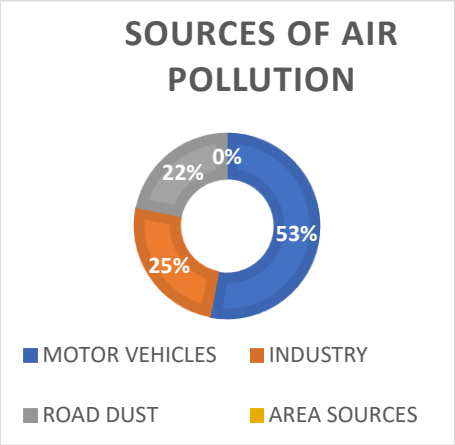
Sources of air pollution-

Table 2, Sources Of Air Pollution

	Emissions (Tonnes/Year)			**Totals**	**% RPM**	**% NOx**	**% SO_2**	**% Total**
	RPM	**NOx**	**SO_2**					
Motor Vehicles	16,115	95,452	0	**111,567**	7.4	44.0	0	**51.4**
Industry	6571	34,208	12,378	**53,157**	3.0	15.8	5.7	**24.5**
Road Dust	45,881	0	0	**45,881**	21.1	0	0	**21.1**
Area Sources	6573	0	0	**6573**	3.0	0	0	**3.0**
Grand Totals	**75,140**	**129,660**	**12,378**	**217,178**	**34.5**	**59.8**	**5.7**	**100.0**

Source: Compiled by Researcher from WBPCB, 2005.

Figure 3, Pie Diagram Of The Various Sources Of Air Pollution



Several factors cause air pollution in Kolkata and among them the main factor is transportation, where the abundance of poorly-maintained vehicles, use of petrol fuel, and poor controlling are making transportation the major air polluting sector. Additionally, there are three thermal power plants operating in and around Kolkata, and some small-scale industries which also affects the air quality. An analysis of different sources of air pollution in Kolkata has revealed that motor vehicles are the leading contributor to air pollution (53%) which is followed by industry (25%) and dust particles (22%), respectively.

Major findings-

- **Treand of each pollutants in each station 2018-2022-**

From the collected data from WBPCB 2018-2022, the level of 4 pollutants pm 10, pm 2.5, so2 and no2 are represented by simple bar diagram of each station.

In 2018, highest amount of pm 2.5 was in Shyambazar (71.92 unit) and lowest in Minto park (62.87unit), highest amount of no2, so2, pm 10 was also in Shyambazar (41.83 ug/qb.m, 6.12 and 134.08 respectively) and lowest in picnic garden (32unit, 3.3 and 94.83 unit respectively).

In 2019, the highest amount of pm 2.5, pm 10, no2 and so2 was observeb in Shyambazar (68.6, 125.2, 43.4 and 9.1 respectively) and the lowest amount of pm 2.5 and no2 was in Minto park(50.6, 37.6 respectively), lowest so2 was in Tollygaunge and picnic garden(7.5) and lowest pm 10 was in picnic garden(83.8).

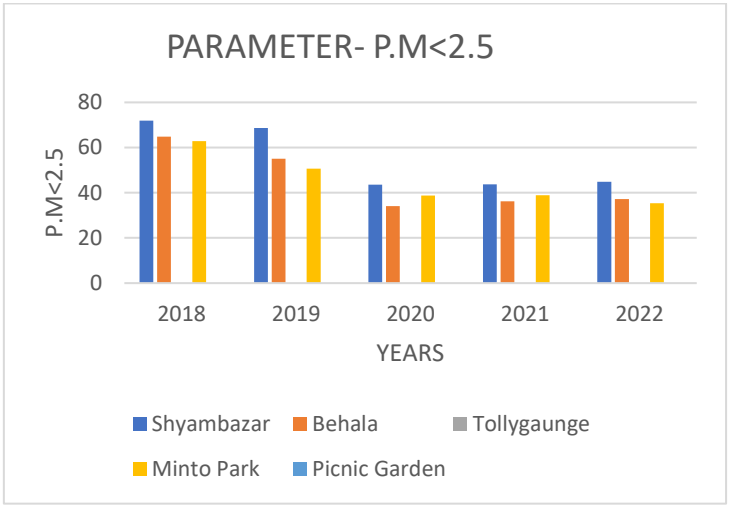
In 2020, Shyambazar obtained the highest amount of pm 2.5 and pm 10 (43.6 and 92.7) picnic garden and minto park obtained the highest amount of no2 and so2 respectively in the value of 49.3 and 6.67.

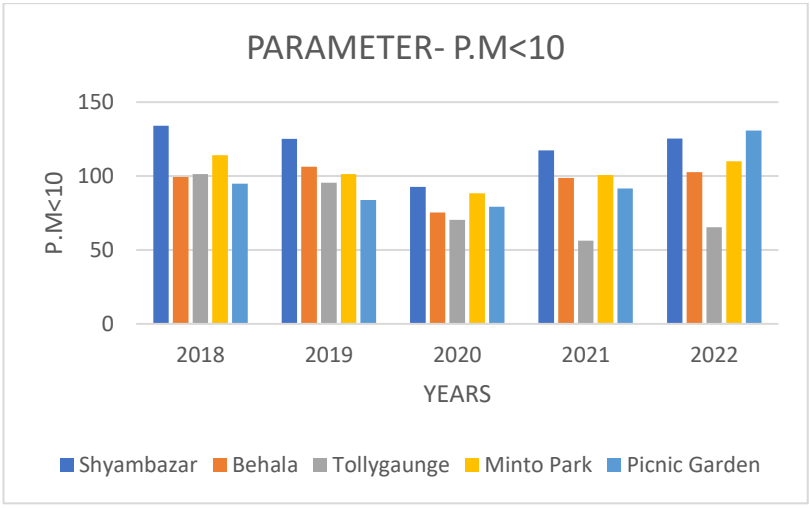
In 2021, Shyambazar obtained highest number of each pollutants (pm 10- 117.42, pm 2.5-43.79, no2-40.37 and so2 6.75) and behala was lowest in case of pm 2.5 (36.21), tollygaunge was lowest in case of no2, so2 and pm 10(34.23, 4.33, 56.31 respectively).

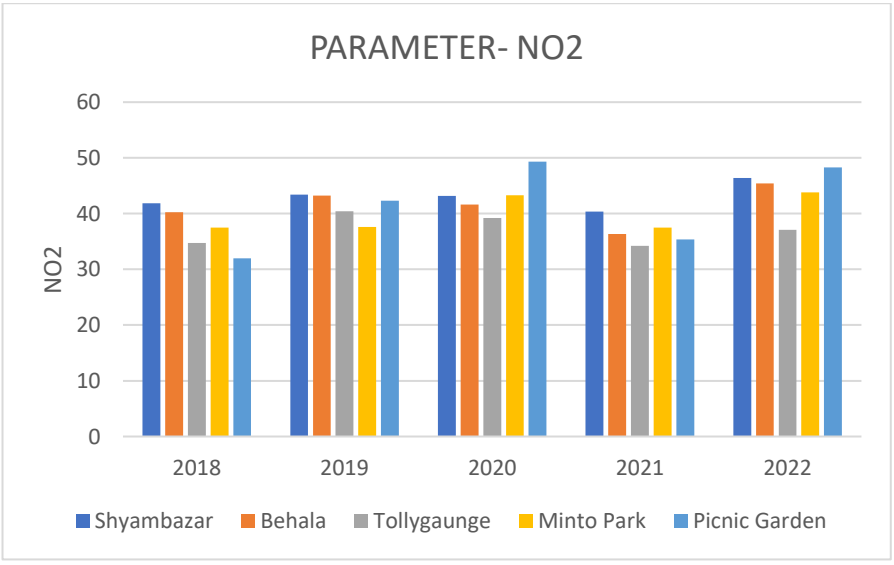
In 2022, shyambazar was highest for pm 2.5(44.8) and picnic garden was highest for no2, so2 and pm 10 with the value of 48.3, 9.5, 130.7 respectively. In minto park pm 2.5 was observed in the lowest condition with the value of 35.3 and tollygaunge was observed with lowest value in case of no2, so2 and pm 10 with the value of 37.1, 3.3 and 65.4 respectively.

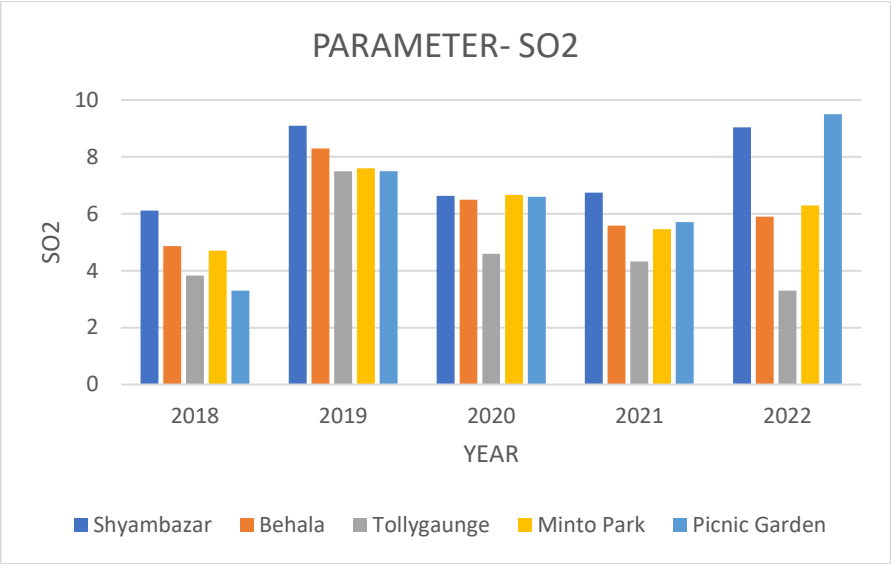
In case of Tollygaunge and picnic garden the value pf pm 2.5 was not observed.

Figure 4, Air Quality Status Of Samle Stations Of Kolkata (2018-2022)









Data source- West Bengal Pollution Control Board (2018-2022)

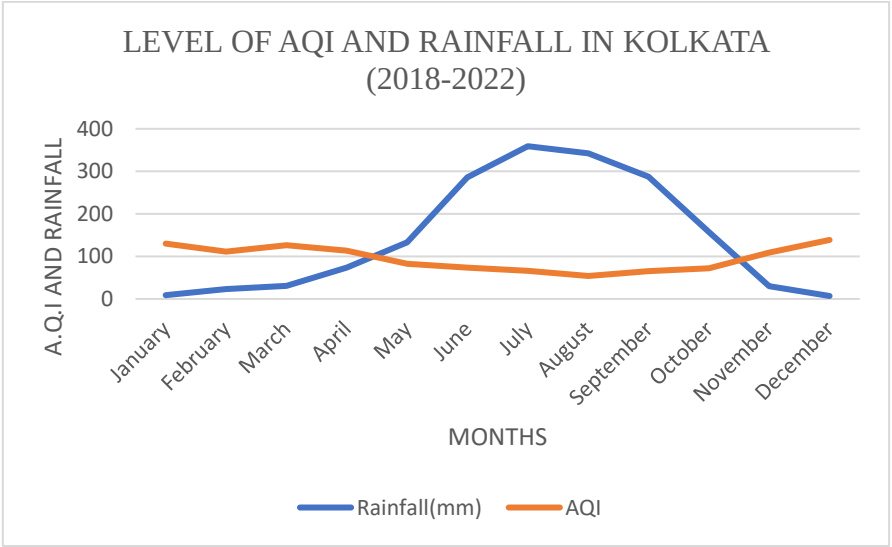
- **Meteorological factors and AQI of Kolkata-**

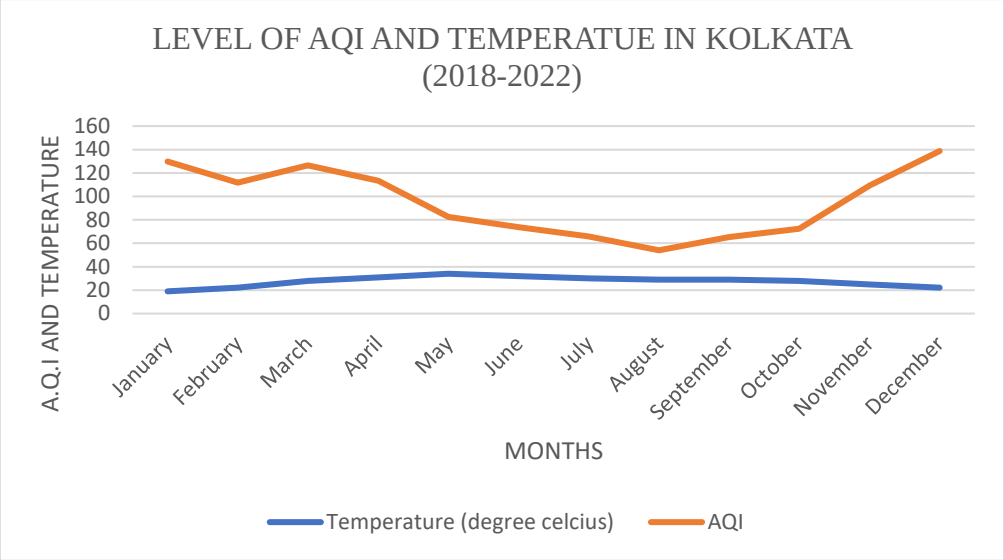
It is seen from the data collected from IMD and WBPCB that there is a direct relation of air quality with the meteorological factors like rainfall, temperature, humidity etc. For this analysis the average value of rainfall and temperature of 2018-2022 was taken and compared with the value of AQI of Kolkata of the same time period.

From the analysis of the data it is clearly seen that when the temperature is moderate and rainfall is very high, then the level of air pollution comes in a good state. In case of June- Sept the air quality become in a good condition and the value of AQI decreases (average 66.3) as the quantity of rainfall increases (287-359 mm) and temperature becomes moderate(28-30 deg Celsius).

When the quantity of rainfall starts decreasing the value of AQI increases and the air quality becomes poor. In case of Nov- feb as the rainfall decreased, the pollutants and dusts rises more and effects the air quality.

Figure 5, Level Of A.Q.I And Meteorological Factors In Kolkata (2018-2022)





Data source- Indian Meteorological Department and West Bengal Pollution Control Board

- **Corelation of AQI and monsoon-**

In this analysis, we calculate the trend of AQI with monsoon from2018 to 2020. The months are divided in 3 divisions as-

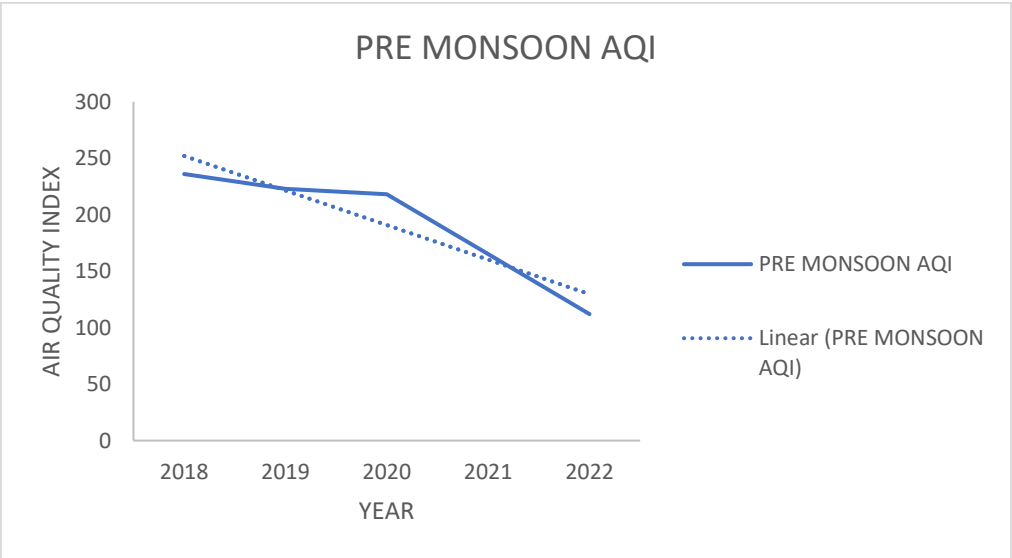
JAN-APR- Pre monsoon

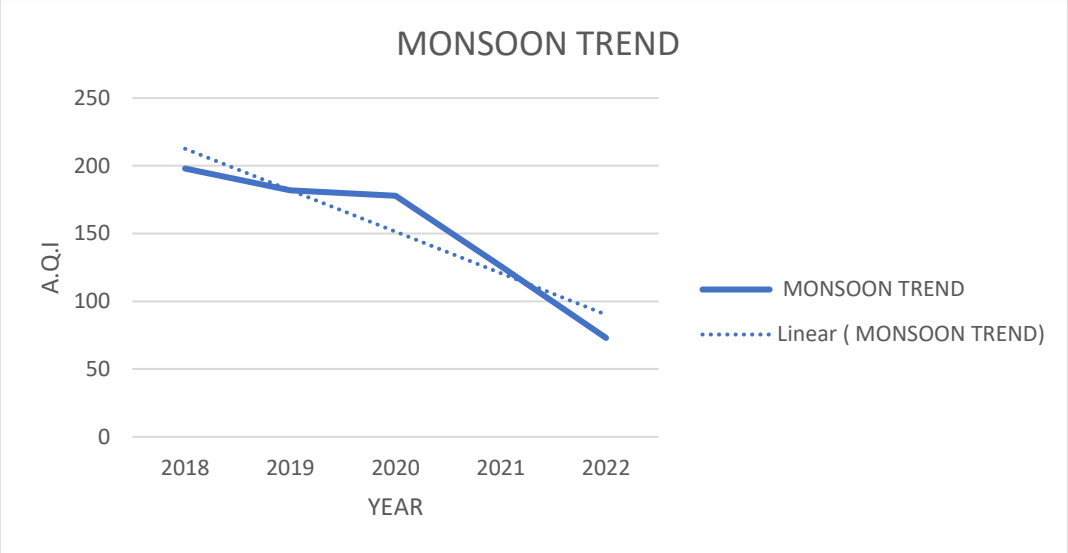
MAY- AUG- Monsoon

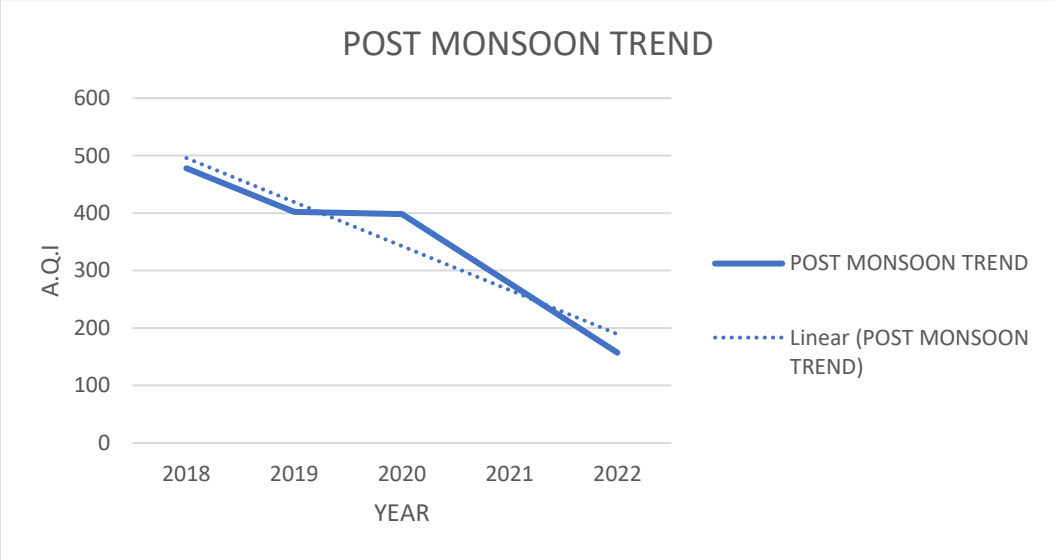
SEP- DEC- Post- monsoon

In case of monsoon the AQI becomes lowest than the other 2 seasons and in case of post monsoon the AQI rises the most. And in case of the trend of AQI in past 5 years, a downwards moderate slope trend line is seen.

Figure 6, Air Quality Trend During Pre Monsoon, Monsoon, Post Monsoon In Kolkata (2018-2022)



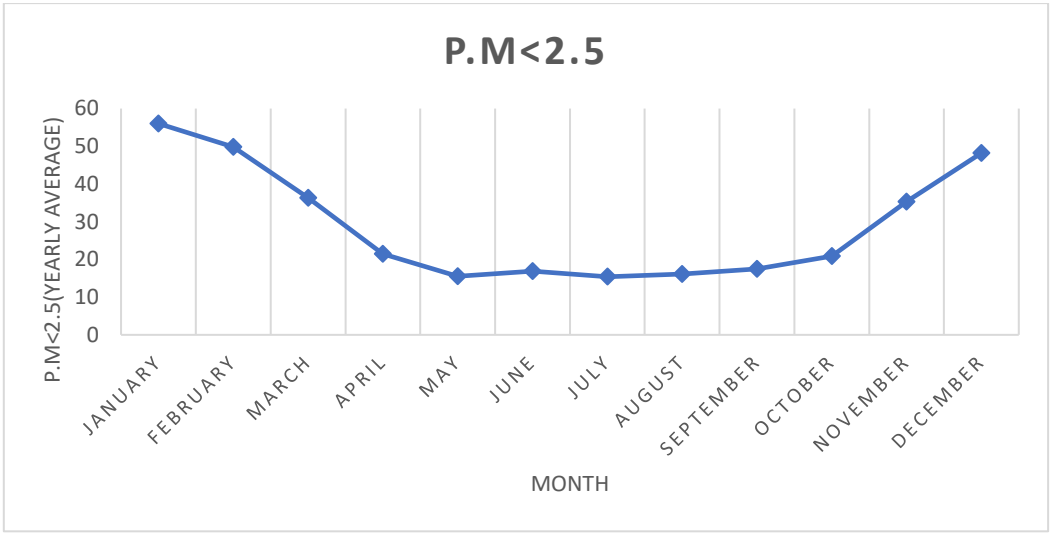


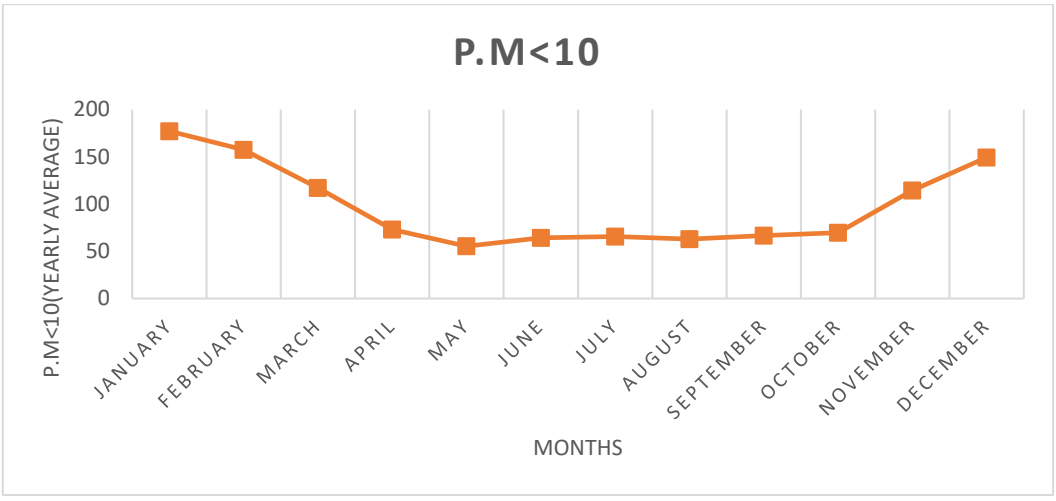


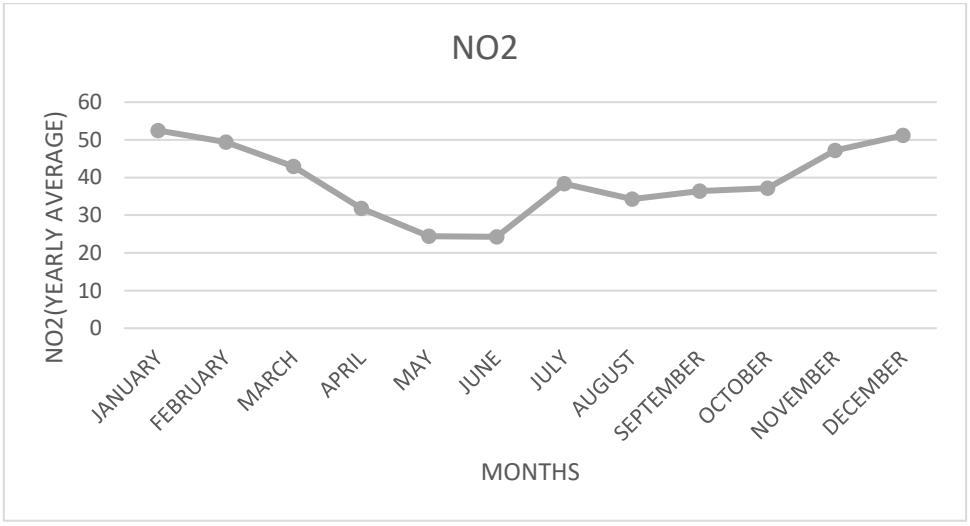
Data source- Indian Meteorological Department and West Bengal Pollution Control Board

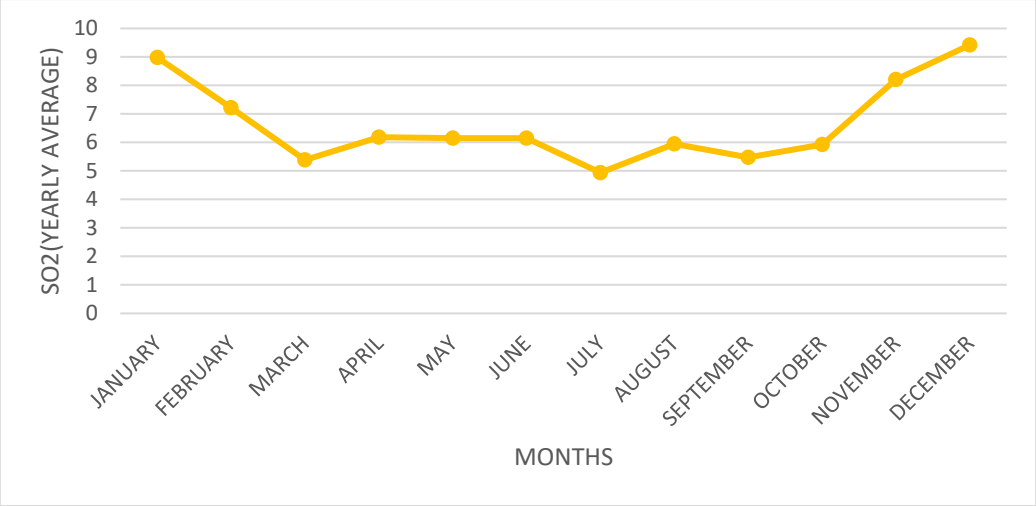
- **Air quality and festive season-**

In this analysis, we divided the months in 2 phases-
JAN- SEP- Non festive season
OCT-DEC- Festive season
In case of festive season the pollutants increases and pollutes the air. The trend of AQI with festive season is shown by a line diagram which shows, In 2018- 2022, all the pollutants increases in festive time specially in Dec- Jan and becomes lowest in non festive season specially in May-Jun.
Figure 7, Level Of Pollution In Festive Season (October- December) In Kolkata (2018- 2022)


P.M<2.5
P.M<2.5(YEARLY AVERAGE)
60
50
40
30
20
10
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MONTH


P.M<10
P.M<10(YEARLY AVERAGE)
200
150
100
50
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MONTHS

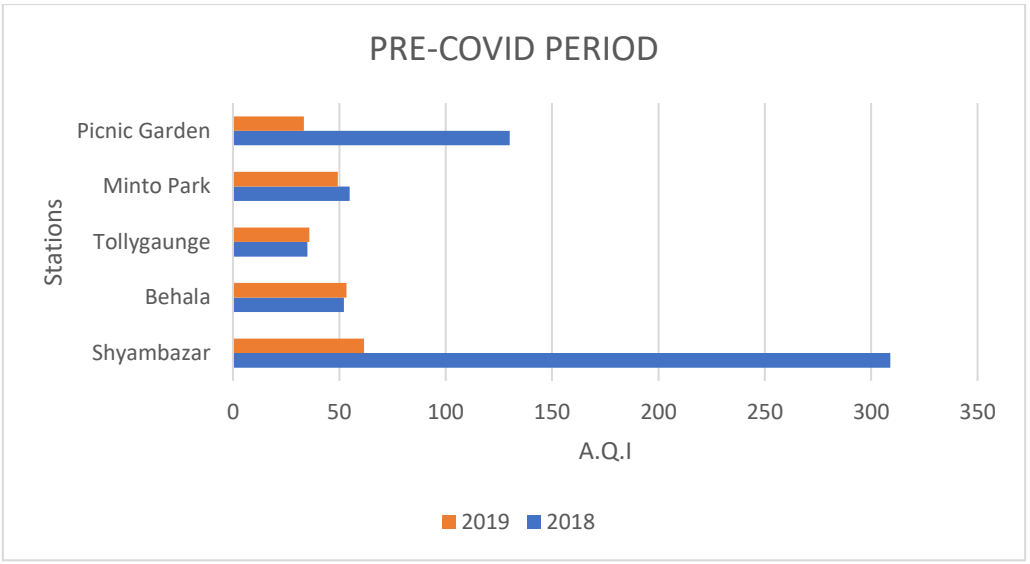

NO2
NO2(YEARLY AVERAGE)
60
50
40
30
20
10
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MONTHS

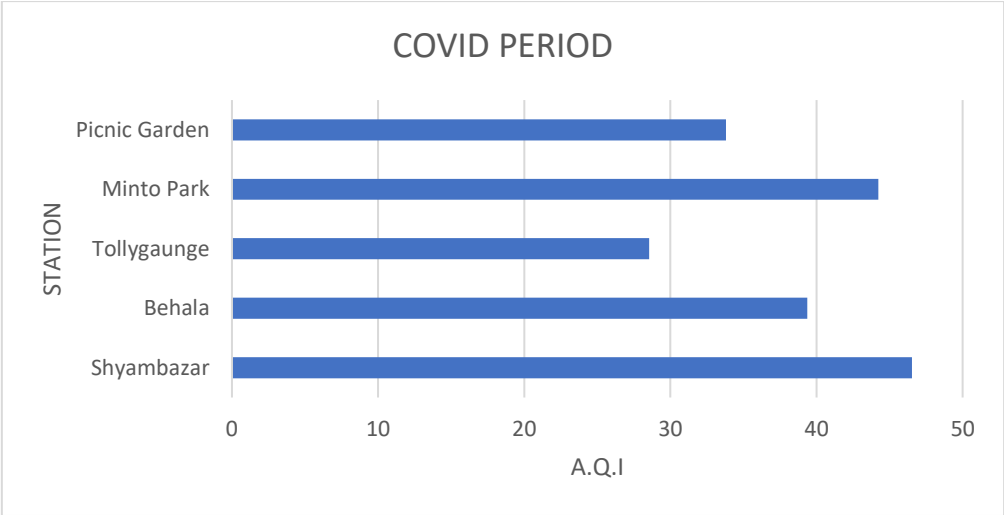


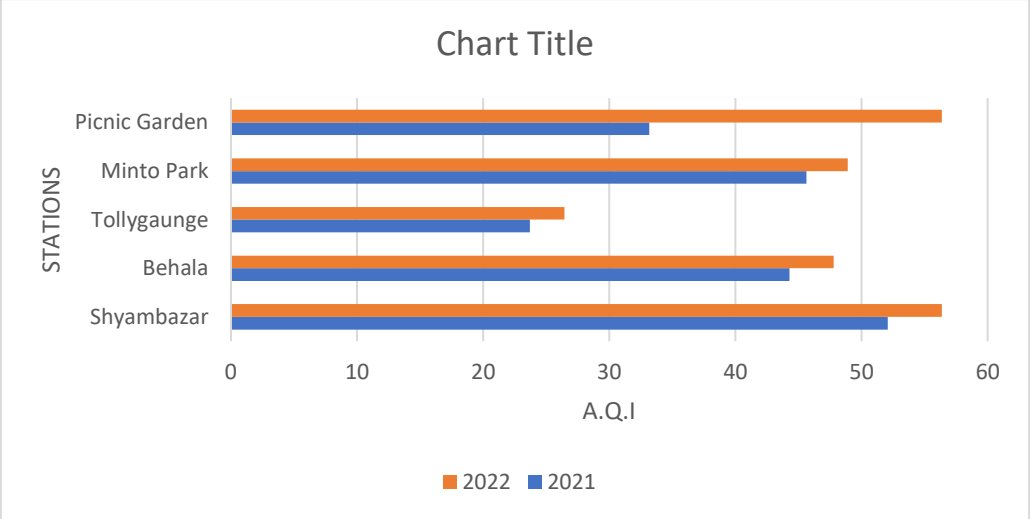
Data source- West Bengal Pollution Control Board (2018-2022)

- **Covid and A.Q.I-**

In this study, the 5 year span was divided in 3 periods-
PRE COVID- 2018-19
COVID-2020
POST COVID- 2021- 22
It is seen that in case of every station the amount of AQI was lowest in the covid period than the other two periods. In 2018-19 the value of AQI was highest among all the periods due to normal amount of vehicle emission and the normal amount of industrialization.
But in covid period, 2020, due to the lockdown, every thing was stopped, people were bounded in their home. For these reasons the number of pollutants became decrease.
In the post covid period, all things were started to get normal, people started their common outdoor activities. That's why the AQI increased but not as the post covid period, because of the presence of covid and the restrictions.







Data source- West Bengal Pollution Control Board.

Impact of air pollution on human health-

Fine particulate matter (PM 2.5) is 30 times thinner than a human hair and can be inhaled deeply into lung tissue. It accounts for most health effects due to air pollution. Air pollution can affect lung development and is associated with emphysema, asthma, and chronic obstructive pulmonary disease (COPD). PM 10 and nitrogen oxide have been linked to chronic bronchitis.

Cardiovascular disease –

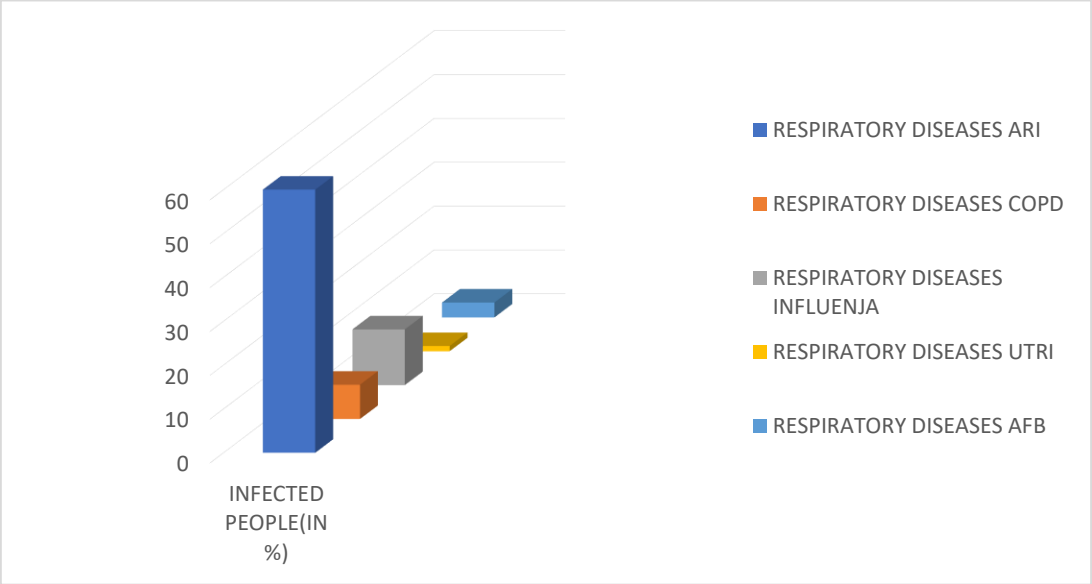
Air pollution can aggravate heart and cardiovascular system in many ways. PM 2.5 can impair blood vessel function and speed up calcification in arteries.

Cancer-

Many types of cancer are associated with air pollution.

- Researchers found that occupational exposure to benzene, an industrial chemical and component of gasoline, can cause leukaemia and is associated with non-Hodgkin's Lymphoma.
- A long-term study, 2000-2016, found an association between lung cancer incidence and increased reliance on coal for energy generation.

Figure 8, Health Effect Of Air Pollution



Data source- Primary survey, MDPI

According to WBPCB, different amount of AQI effects the human health in different ways. *Table3, AQI Level And Health Impact*

AQI	Remark	Color Code	Air Quality Index (AQI)	Sensible Health Impacts
0-50	Good			Minimal Impact
51-100	Satisfactory			Minor breathing discomfort to sensitive people
101-200	Moderate			Breathing discomfort to the people with lung, heart disease, children and older adults
201-300	Poor			Breathing discomfort to people on prolonged exposure
301-400	Very Poor			Respiratory illness to the people on prolonged exposure
>400	Severe			Respiratory effects even on healthy people

(Source-West Bengal Pollution Control Board)

Suggestive measures-

In Kolkata the following measures can be taken-

1. Use of low sulphur fuel instead of high sulphur fuel by electric utilities .
2. Reduce the amount of pollutants by the less production of cfcs and carbon.
3. Stop cutting the trees and plant more trees.
4. Use filter and scrubber in cars and factories chimney.
5. Reduce the use of fossil fuel.
6. Reduce the amount of unscientific works by human in case of living and industrialization.

Conclusions-

The study shows the different sources, effects, problems, suggestive measures to control air pollution in Kolkata. It has been found that vehicles, factories, road dust etc are the major sources of air pollution in Kolkata. Several health impacts such as COPD, emphysema, asthma etc has been occur in human health

that causes due to air pollution. In these circumstances the local administration, ngos and local public should take necessary steps to improve air quality.

Appendix-

Table 4, TABLE FOR AIR QUALITY STATUS OF SAMPLE STATIONS OF KOLKATA (2018-2022)

PM<2.5

Station	2018	2019	2020	2021	2022
Shyambazar	71.92	68.6	43.6	43.79	44.8
Behala	64.79	55.04	34.1	36.21	37.2
Tollygaunge	0	0	0	0	0
Minto Park	62.87	50.6	38.7	38.95	35.3
Picnic Garden	0	0	0	0	0

P.M<10

Station	2018	2019	2020	2021	2022
Shyambazar	134.08	125.2	92.7	117.42	125.29
Behala	99.38	106.3	75.3	98.62	102.7
Tollygaunge	101.38	95.5	70.38	56.31	65.4
Minto Park	114.12	101.3	88.25	100.67	110
Picnic Garden	94.83	83.8	79.3	91.62	130.7

NO2

STATION	2018	2019	2020	2021	2022
Shyambazar	41.83	43.4	43.2	40.37	46.42
Behala	40.25	43.25	41.6	36.33	45.4
Tollygaunge	34.75	40.4	39.2	34.23	37.1
Minto Park	37.5	37.6	43.3	37.5	43.8
Picnic Garden	32	42.3	49.3	35.37	48.3

SO2

STATION	2018	2019	2020	2021	2022
Shyambazar	6.12	9.1	6.63	6.75	9.04
Behala	4.87	8.3	6.5	5.58	5.9
Tollygaunge	3.83	7.5	4.6	4.33	3.3
Minto Park	4.71	7.6	6.67	5.46	6.3
Picnic Garden	3.3	7.5	6.6	5.71	9.5

(Source-West Bengal Pollution Control Board)

Table 5, Correlation Between Meteorological Factors And Air Quality(2018-2022)

MONTHS	Rainfall(mm)	AQI
January	9	129.8
February	23	111.6
March	31	126.4
April	74	113.5
May	133	82.6
June	286	73.8
July	359	65.8
August	342	54
September	287	65.4
October	157	72.5
November	30	109.2
December	7	138.7

MONTHS	Temperature (degree celcius)	AQI
January	19	129.8
February	22	111.6
March	28	126.4
April	31	113.5
May	34	82.6
June	32	73.8
July	30	65.8
August	29	54
September	29	65.4
October	28	72.5
November	25	109.2
December	22	138.7

Data source- Indian Meteorological Department and West Bengal Pollution Control Board

Table 6, Correlation Between Monsoon And AQI Of Kolkata

YEAR	PRE MONSOON AQI	MONSOON TREND	POST MONSOON TREND
2018	236	198	478
2019	223	182	402
2020	218	178	398
2021	165	126	278
2022	112	73	157

Data source- Indian Meteorological Department and West Bengal Pollution Control Board

Table 7, Air Quality Index In Festive Season (October- December) In Kolkata (2018-2022)

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
8.98	7.22	5.39	6.18	6.15	6.15
56.02	49.84	36.33	21.48	15.5	16.92
177.22	157.58	117.06	73.22	55.4	64.17
52.48	49.38	42.92	31.8	24.4	24.26
JULY	**AUGUST**	**SEPTEMBER**	**OCTOBER**	**NOVEMBER**	**DECEMBER**
4.94	5.95	5.48	5.93	8.21	9.42
15.4	16.11	17.48	20.84	35.3	48.22
65.66	62.95	66.52	69.81	114.48	149.19
38.38	34.26	36.38	37.12	47.22	51.18

(Source-West Bengal Pollution Control Board)

Table 8, Changes Of A.Q.I In Pre, Post And Covid Period

	Pre- Covid		Covid	Post- Covid	
Station	**2018**	**2019**	**2020**	**2021**	**2022**
Shyambazar	309.03	61.57	46.53	52.08	56.38
Behala	52.21	53.28	39.37	44.3	47.8
Tollygaunge	34.99	35.85	28.54	23.71	26.45
Minto Park	54.8	49.27	44.23	45.64	48.9
Picnic Garden	130.13	33.4	33.8	33.17	56.38

(Source-West Bengal Pollution Control Board)

Table 9, Impact Of Air Pollution On Health

	RESPIRATORY DISEASES				
Diseases	**ARI**	**COPD**	**INFLUENJA**	**UTRI**	**AFB**
INFECTED PEOPLE(IN %)	60	7.8	12.7	1.2	3.4

(Source- Primary survey. MDPI)

Acknowledgement-

I would like to show my regards to all of my teachers and friends who helped me in this research. Really obliged towards my parents. All the websites and other research papers also helped me a lot for the completion of this paper.

Biography-

I am Miss, Arpita Dutta, student of University of Calcutta, pursuing M.sc in Geography. I completed my graduation under University of Calcutta, Vidyasagar College. Passed H.S in 2020.

References-

1. Mishra, V. (2003) Effect of Indoor Air Pollution from Biomass Combustion on Prevalence of Asthma in the Elderly. Environmental Health Perspectives, 111, 71-78. Https://scirp.org/reference/referencespapers.aspx?Referenceid=1426199

2. M.S.Haque et al, 12.10.2017, Air Pollution and Human Health in Kolkata, India: A Case Study, Climate-MDPI, 5.77, 3-4 & 13-15. Https://www.researchgate.net/publication/322615960_Air_Pollution_and_Human_Health_in_Kolkata_India_A_Case_Study
3. Rahman et al , 12.12.2011, Air Pollution in Kolkata: An Analysis of Current Status and Interrelation between Different Factors. Versita, SEEU Review, 8, 185-186 Https://www.researchgate.net/publication/271381801_Air_Pollution_in_Kolkata_An_Analysis_of_Current_Status_and_Interrelation_between_Different_Factors
4. Sylvia Medina, Alain Le Tertre, Michael Saklad, 28.10.2009, The Apheis project: Air Pollution and Health—A European Information System, Air Quality, Atmosphere and Health- Springer, 2(4), 187. Https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2805804/
5. West Bengal Pollution Control Board: Annual report: 2018-2022.