



An Analysis on Air Pollution in Selected Cities of West Bengal

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ABSTRACT

Air pollution constitutes a significant environmental and public health concern in rapidly urbanising India. This study examines air pollution in certain cities of West Bengal, focusing on the spatial and temporal variations of important air contaminants and their impacts on health and urban sustainability. Data on air quality from monitoring stations and secondary sources is utilised to assess significant pollutants such as particulate matter (PM_{2.5} and PM₁₀), sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), and ozone (O₃). The chosen cities, encompassing both industrial and residential areas, are significant urban centers where traffic emissions, industrial operations, construction, and household fuel combustion impair air quality. Seasonal trends in pollutant levels and national ambient air quality standards indicate that temperature inversion, less atmospheric dispersion, and heightened human activities exacerbate pollution during winter. Particulate matter, particularly PM_{2.5} and PM₁₀, is the primary pollutant surpassing thresholds in numerous cities. Industrial zones and densely populated urban areas exhibit elevated pollution levels, but wind speed, humidity, and precipitation influence the dispersion of pollutants. The research indicates that prolonged exposure to dirty air leads to respiratory diseases, cardiovascular conditions, and diminished quality of life among urban residents. The paper underscores the necessity for enhanced air quality monitoring, stricter enforcement of emission controls, more sustainable transportation and industrial technologies, and improved pollution mitigation expertise. The study elucidates urban environmental challenges and assists policymakers and environmental planners in enhancing air quality and public health through the comparison of air pollution in specific cities of West Bengal.

Keywords: *Emission, Metropolitan, Ecological Equilibrium, Degradation, Pollution.*

INTRODUCTION

The home of humans and other living things is the planet Earth. It is the place where people, along with the surrounding flora and animals, live, eat, breathe, grow, and spend many years. Due to his sixth sense, man holds a special place among all living things. Since the dawn of humankind's existence on Earth, nature has been at odds with humanity. The struggle of humanity with nature was gradual but unceasing. He fought nature relentlessly for ages, developing a complex personality in the process.

The fragile ecological equilibrium of the planet has been disturbed by unparalleled human intervention in the environment. Man has been continuously abusing the earth, especially its non-renewable resources. Examples of this include mining for metals and minerals, utilizing water indiscriminately from both surface and subsurface sources, altering waterways, upsetting landscapes, applying chemicals and other substances that cause disorder, and clearing vast tracts of forest land for development. These actions have resulted in serious ecological disasters, which have ultimately disrupted human life and the lives of many species. Man's rapacious industrialization and production of pollution of all kinds fueled the fire. The most significant threat to humanity in the new millennium is various forms of environmental degradation. In order to stop the current trend from continuing in its current direction and intensity and to begin the process of reversing it, man must limit his use of resources and refrain from degrading the land and atmosphere for a significant amount of time in the near future. For millions of years, natural resources were mostly unexplored in the universe, which increased Earth's capacity. Nonetheless, the massive industrial revolution occurred at unthinkable rates for a few hundred years.

Today, environmental contamination is a significant problem due to resource extraction and technical advancements made possible by highly productive capitalist enterprises. These activities have resulted in waste that is negatively impacting the quality of the air, water, and land. Millions of years pass before soil, water, and air pollution recover. The main sources of pollution are motor vehicle emissions and industry. Plastic, nitrates, and heavy metals are the poisons that cause pollution. The primary source of soil pollution is industrial waste, which depletes the soil of essential nutrients. Factories and businesses also discharge various gasses and pollutants into the atmosphere.

OBJECTIVES OF THE STUDY

1. To study the origin, development and pollution types with special focus to air.
2. To investigate the causes of air pollution in West Bengal.

RESEARCH METHODOLOGY

Descriptive statistics are used in the study "An Analysis on air pollution in selected cities of West Bengal" to summarize, organize, and present air quality data in a clear and meaningful way. The study focuses on major urban centres of West Bengal, including Kolkata, Howrah, Durgapur, Kalyani and Barrackpore.

Sample Size - 500 Respondents

DATA ANALYSIS

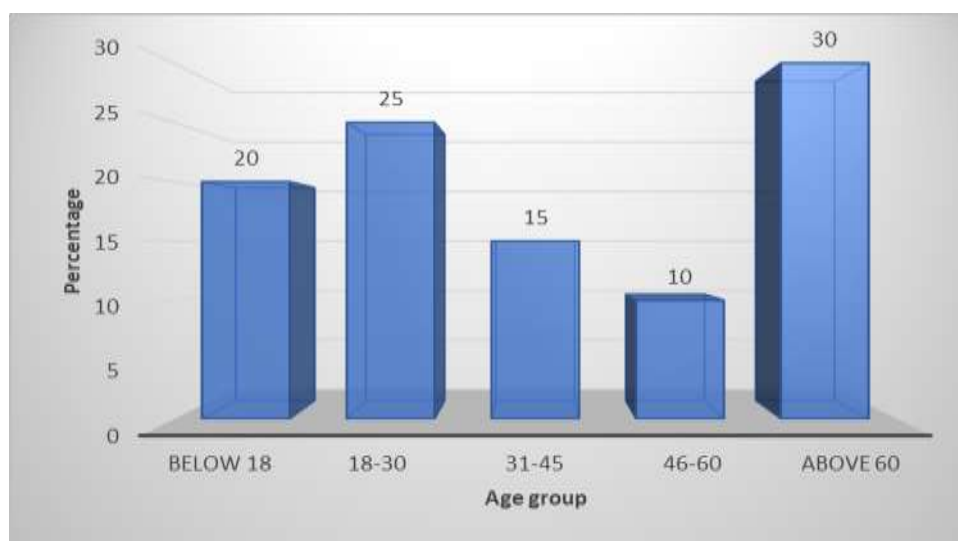
1. Age

The ages of the respondents were recorded and tabulated. The age range was 18 to 60 years, as the level of secondary school was the subject of the study.

Table 1.1: Age of the Respondents

City Name	Below 18	18-30	31-45	46-60	Above 60	Total
Kolkata	-	40	15	12	33	100
Howrah	30	25	20	8	17	100
Kalyani	20	15	15	15	35	100
Durgapur	30	20	15	10	25	100
Barrackpore	20	25	10	5	40	100
Total	100	125	75	50	150	500

Source: Primary Data

**Fig 1.1: Age of the Respondents**

The data shows that the majority of respondents, thirty per cent, were under 18, twenty-five per cent were between 18-30, fifteen per cent between 31-45, ten per cent between 46-60, and twenty per cent were above 60.

2. Gender

The gender of the respondents was taken and tabulated. The gender was taken only male and female for analysis.

Table 1.2: Gender of the Respondents

City Name	Male	Female	Total
Kolkata	60	40	100
Howrah	60	40	100
Kalyani	40	60	100
Durgapur	80	20	100
Barrackpore	60	40	100
Total	300 (60)	200 (40)	500 (100)

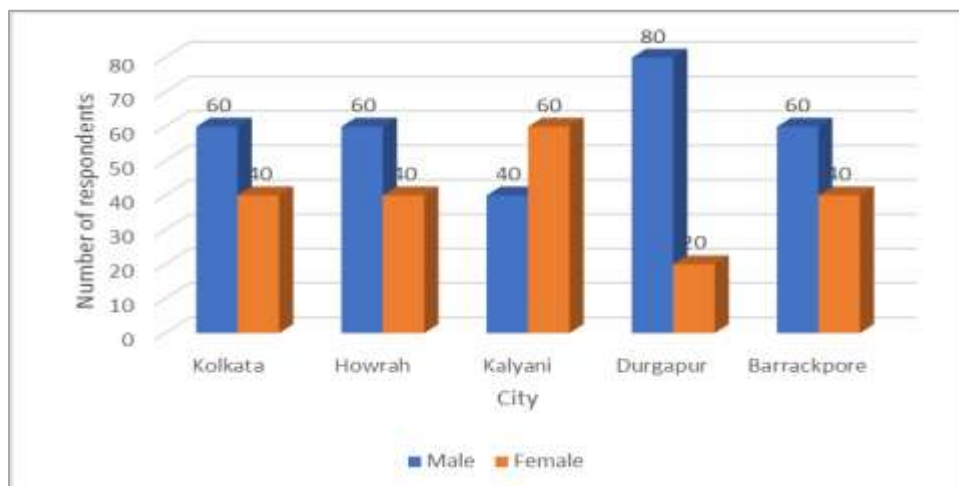


Fig 1.2: Gender of the Respondents

The data shows that 60 percent of the respondents are male and 40 percent of the respondents are female. The male respondents are slightly more than the female.

3. Educational Qualification

The data collected from respondents about their educational qualifications is presented in the following table:

Table 1.3: Educational Qualification of The Respondents

City Name	Primary	Secondary	Higher Secondary	Graduate	Postgraduate	Total
Kolkata	20	30	10	20	20	100
Howrah	30	15	20	10	25	100
Kalyani	15	12	18	25	30	100
Durgapur	25	35	10	10	20	100
Barrackpore	10	45	20	20	5	100
Total	100 (20%)	137 (27.4%)	78 (15.6%)	85 (17%)	100 (20%)	500 (100%)

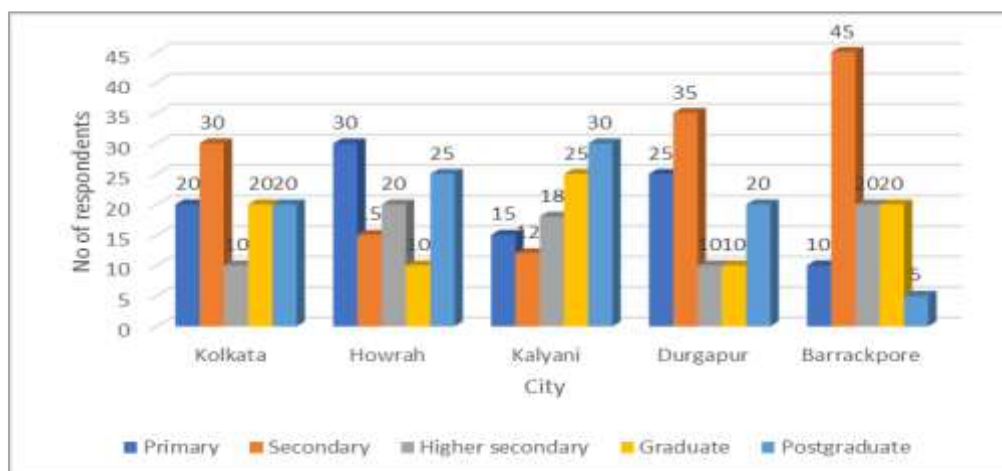


Fig 1.3: Educational Qualification of The Respondents

The data in table 1.3 shows that primary education is 20 percent among the respondents, secondary education is 27.4 percent, higher secondary is 15.6 percent among the respondents, 17 percent are graduate and 20 percent is post graduate. The majority are secondary as educational qualification.

4. Occupation

Breathing unhealthy air at work is dangerous. Exposure to air pollution varies depending on the job; moreover, occupation is a significant economic factor because it determines income flow used to meet family expenses. The occupation details of the sample respondents are listed in Table - 1.4.

Table 1.4: Occupation of the Respondents

City Names	Daily Wages	Weekly Wages	Private Employee	Government Employee	Total
Kolkata	34	38	18	10	100
Howrah	40	36	20	4	100
Kalyani	42	28	14	16	100
Durgapur	48	34	10	8	100
Barrackpore	34	40	14	12	100
Total	198 (39.60)	176 (35.20)	76 (15.20)	50 (10.00)	500 (100.00)

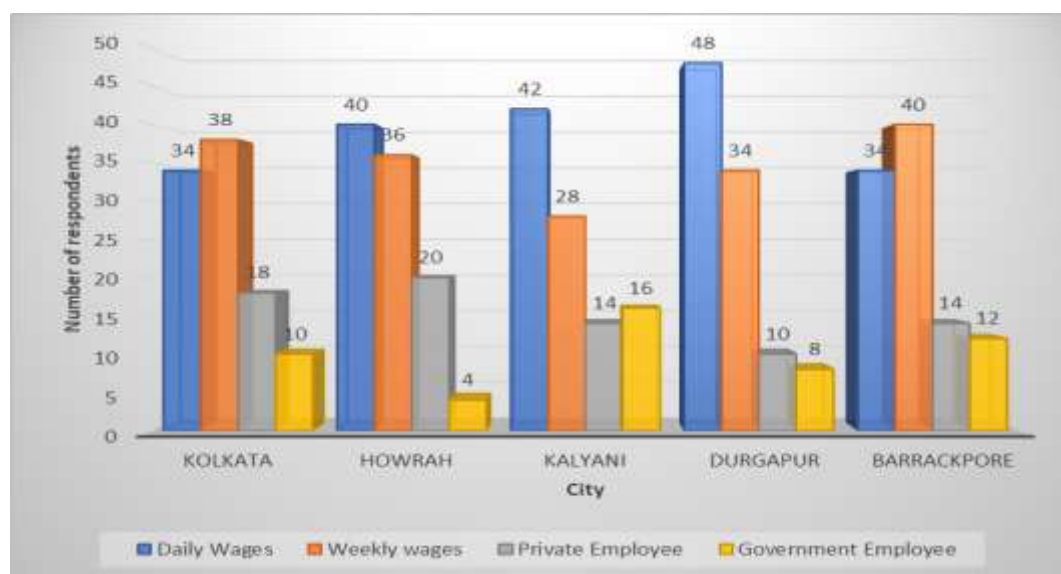


Fig 1.4: Occupation of the Respondents

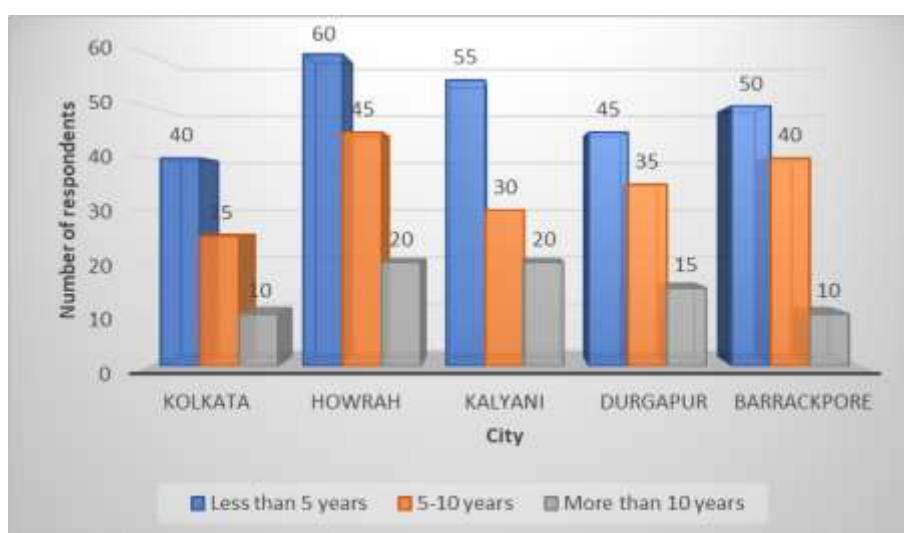
The data shows that 39.80 percent of the respondents have daily wages, 35.20 percent of them are having weekly wages, 15.20 percent of them have private employment and 10 percent have government employment.

5. Duration of Residence in The City

The duration of staying in the city was noted from them, and the data was tabulated as follows. The data depicts the number of respondents answering.

Table 1.5: Duration of Residence in The City

City Names	Less than 5 years	5-10 years	More than 10 years	Total
Kolkata	40	25	10	100
Howrah	60	45	20	100
Kalyani	55	30	20	100
Durgapur	45	35	15	100
Barrackpore	50	40	10	100
Total	250 (50)	175 (35)	75 (15)	500 (100)

**Fig 1.5: Bar Graph Showing Duration of Residence in The City**

6. Monthly Income

The cost of medical care for pollution-related illnesses burdened lower-income groups. Income is a key factor in determining social status and the standard of living. It greatly influences access to necessities. Therefore, the details are shown in Table – 1.6.

Table 1.6: Monthly Income of The Respondents

City Names	Lower Income	Middle Income	Above Middle	Higher Income	Total
Kolkata	46	18	20	16	100
Howrah	30	38	20	12	100
Kalyani	32	32	10	26	100
Durgapur	50	24	10	16	100
Barrackpore	38	32	12	18	100
Total	196 (39.2)	144 (28.8)	72 (14.4)	88 (17.6)	500 (100)

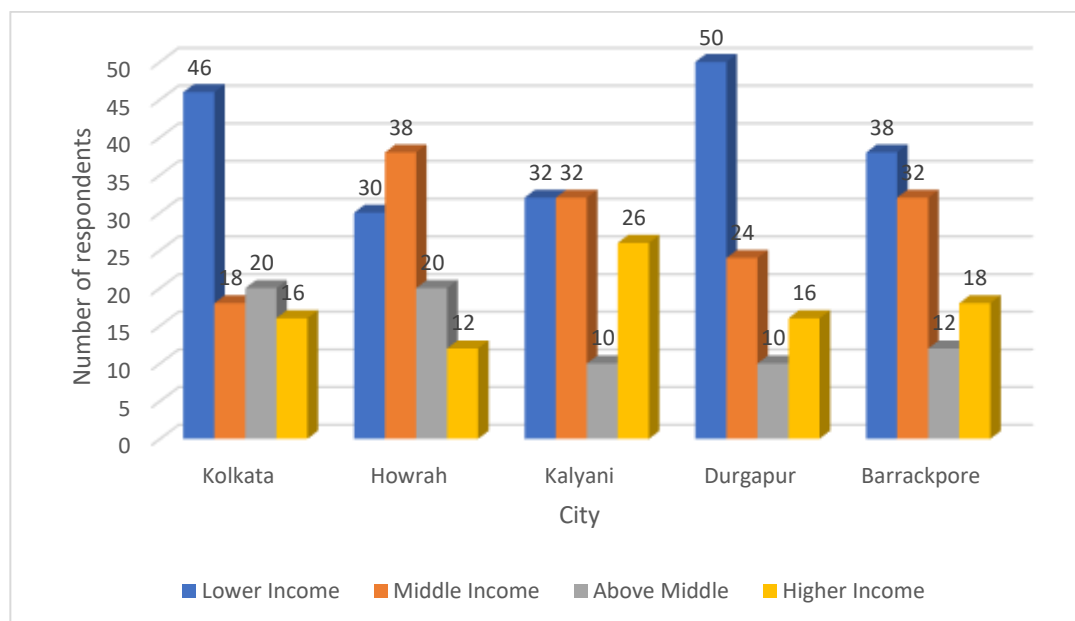


Fig 1.6: Bar Graph Showing Monthly Income of The Respondents

7. Family Size

The size of a family affects life quality. A large family cannot meet all of their necessities unless each member makes enough money. Presenting the family size is crucial since it has a significant impact on employment, income, air pollution, and associated costs. Hence, the details are shown in Table 1.7.

Table 1.7: Family Size Details of The Sample Respondents

City Names	Less than 4	4 to 6	More than 6	Total
Kolkata	36	54	10	100
Howrah	30	68	2	100
Kalyani	38	56	6	100
Durgapur	36	60	4	100
Barrackpore	32	54	14	100
Total	172 (34.40)	292 (58.40)	36 (7.20)	500 (100)

The data shows that 34.40 percent of the respondents have family member less than 4, 58.40 percent have family member between 4 to 6 and 7.20 percent of the respondents have more than 6. The majority of them have member between 4 to 6.

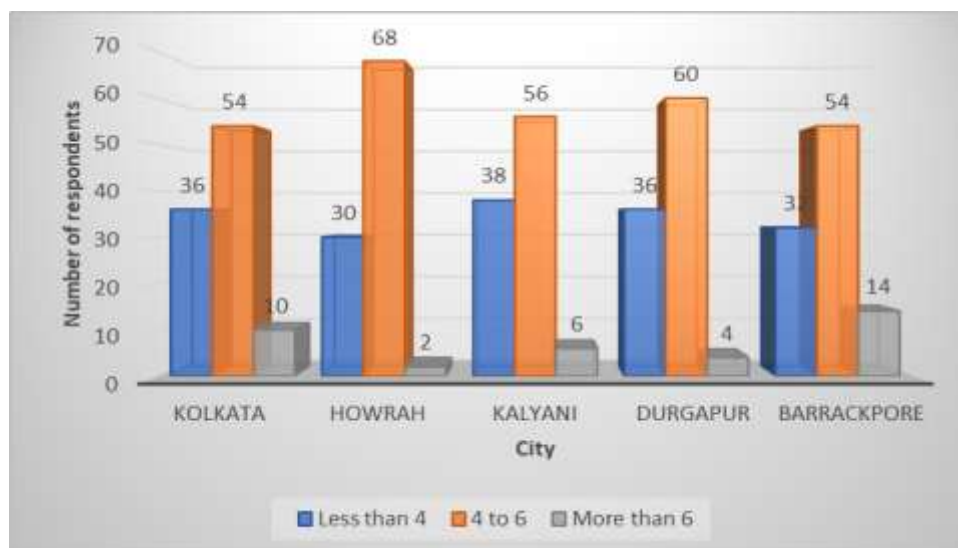


Fig 1.7: Bar Graph Showing Family Size Details of The Sample Respondents

8. Nature of Houses

A house significantly influences an individual's socio-economic status within society. Many urban residents face poor living conditions. The type of housing and roofing is crucial to this analysis because people spend most of their time inside, increasing their exposure to indoor pollution risks that can affect health.

Table 1.8: Nature of The Houses of The Sample Respondents

Type of Houses	Kolkata	Howrah	Kalyani	Durgapur	Barrackpore	Total
Thatched Roofing	2	6	8	6	10	32 (6.40)
Asbestos Roofing	34	14	16	16	14	94 (18.80)
Tiled Roofing	8	10	24	8	6	56 (11.20)
Concrete House	30	42	30	42	52	196 (39.20)
Independent House	8	12	14	18	14	66 (13.20)
Flat	4	10	8	6	2	30 (6.00)
Housing Board Flat	14	6	0	4	2	26 (5.20)
Total	100	100	100	100	100	500

The data shows that 6.40 percent of the respondents have thatched roof, 18.80 percent have asbestos roofing, 11.20 percent have tiled roofing, 39.20 percent concrete house, 13.20 percent have independent house, 6 percent have flat, 5.20 percent have housing board flat.

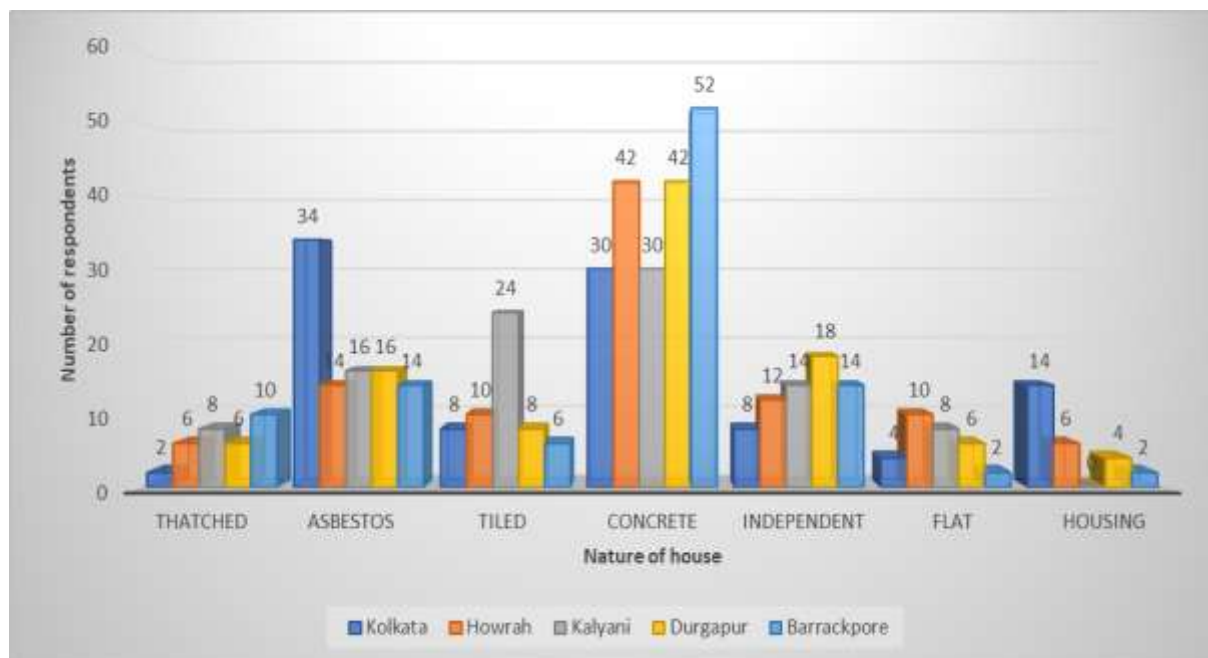


Fig 1.8: Nature of The Houses of The Sample Respondents

9. Ventilation

One of the key elements influencing indoor air quality is ventilation. The health of those who live in poorly ventilated homes can be impacted. Pollution levels and humidity can rise due to inadequate ventilation.

Table 1.9: Availability of Proper Ventilation in The Houses of The Sample Respondents

City Names	Available	Not Available	Total
Kolkata	62	38	100
Howrah	82	18	100
Kalyani	68	32	100
Durgapur	74	26	100
Barrackpore	74	26	100
Total	360 (72)	140 (28)	500 (100.00)

The data shows that 72 percent of the respondents have ventilation at homes but 28 percent of the respondents does not have ventilation. The majority of the respondents have ventilation at homes.

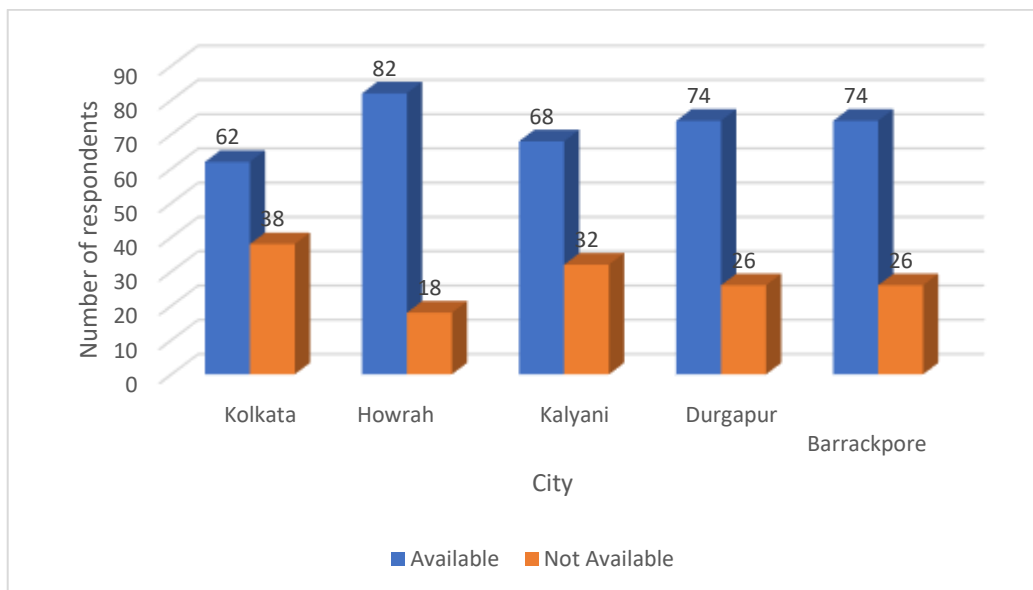


Fig. 1.9 Availability of Proper Ventilation in The Houses of The Sample Respondents

10. Weather Condition

The development and elimination of air pollution are significantly influenced by the weather. Temperature and wind have the most effects on this. Particularly in foggy conditions, air pollution is a major issue. The smoke or air pollution will fill the entire city and become stagnant when there is fog and light wind. Therefore, the relevant figures in Table – 4.10 gained entry in the study.

Table 1.10: Opinion on Weather Conditions in The City of The Sample Respondents

Type of Weather	Kolkata	Howrah	Kalyani	Durgapur	Barrackpore	Total
Hot & Humid	46	36	58	52	44	236 (47.2)
Hot & Dry	24	20	32	26	36	138 (27.6)
Cold & Humid	0	14	0	0	0	14 (2.8)
Cold & Dry	0	0	0	0	0	0 (0)
Hot & Cold	12	24	0	0	0	36 (7.2)
Cold	0	4	0	0	0	4 (8)
Hot	18	2	10	22	20	72 (14.4)
Total	100	100	100	100	100	500 (100)

The data shows that 47.2 percent reported hot & humid weather, 27.6 percent reported hot & dry, 2.8 percent reported cold & humid weather, 0 percent reported cold & dry, 7.2 percent reported hot & cold, 8 percent reported cold and 14.4 percent reported hot.

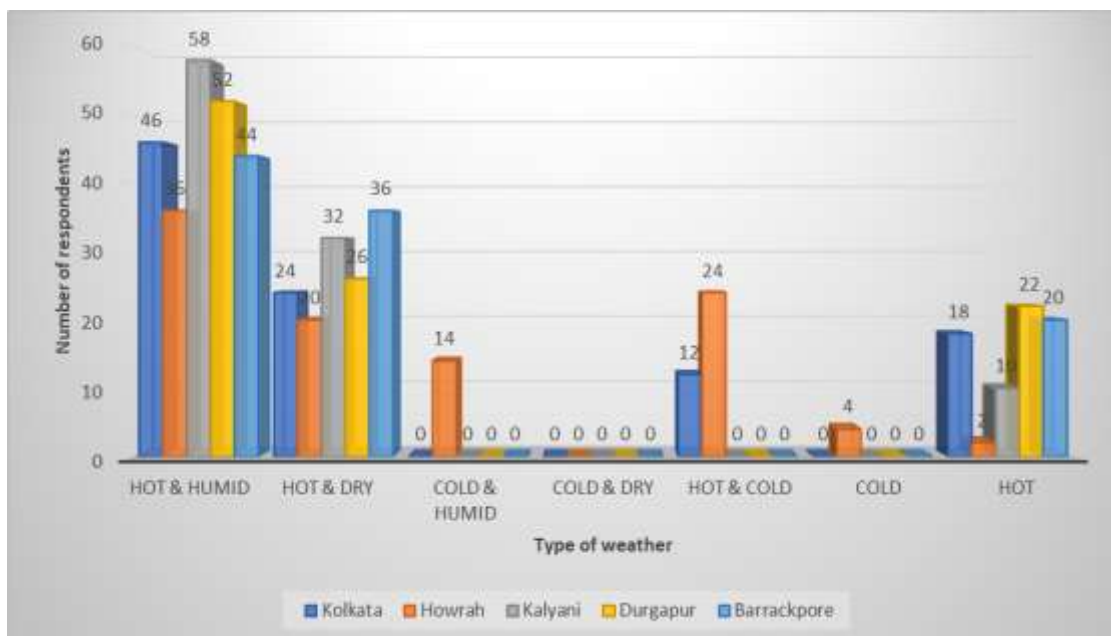


Fig 1.10: Bar Graph Showing Opinion on Weather Conditions in The City of The Sample Respondents

11. Level of Air Pollution

Living things' well-being and security depend on air quality. While all forms of life can survive for days without food and hours without water, they will die within minutes if deprived of air. Since air is vital for life, the focus of the study on air pollution levels aligns with their views, which are detailed in Table-4.11.

Table 1.11: Level of Air Pollution in The Cities of The Sample Respondents

City Names	Low	Medium	High	Extreme	Total
Kolkata	10	18	40	32	100
Howrah	12	24	52	12	100
Kalyani	16	20	40	24	100
Durgapur	18	34	30	18	100
Barrackpore	4	10	42	44	100
Total	60 (12.00)	106 (21.20)	204 (40.80)	130 (26.00)	500 (100.00)

The data shows that 12 percent of the respondents reported that the level of air pollution was low, 21.20 percent reported that it was medium, 40.80 percent reported it was high and 26 percent reported extreme level of air pollution.

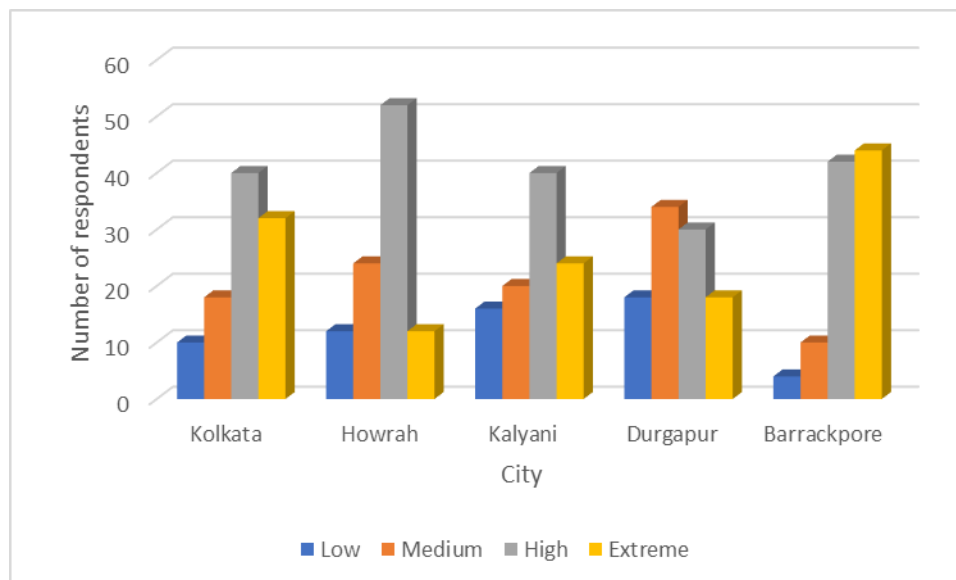


Table 1.11: Bar Graph Level of Air Pollution in The Cities of The Sample Respondents

12. Location of House

Different socioeconomic groups face varying levels of air pollution. Due to higher traffic densities or proximity to industrial pollution sources, residents of low-income neighborhoods may experience more exposure to harmful air pollution levels. Their living conditions and housing locations also increase their likelihood of indoor pollution exposure. The details are outlined in Table 4.12.

Table 1.12: Location of House

City Names	Market Area	Slum Area	Industrial Area	Residential Area	Outskirt	Total
Kolkata	20	24	22	34	0	100
Howrah	20	0	18	48	14	100
Kalyani	28	0	10	44	18	100
Durgapur	22	0	14	52	12	100
Barrackpore	16	16	18	46	4	100
Total	106 (21.20)	40 (8.00)	82 (16.40)	224 (44.80)	48 (9.60)	500 (100.00)

The data shows that 21.20 percent said they stay in the market area, 8 percent said they stay in the slum area, 44.80 percent live in residential areas, and 9.60 percent live in the outskirts area. The majority of the respondents stay in residential areas.

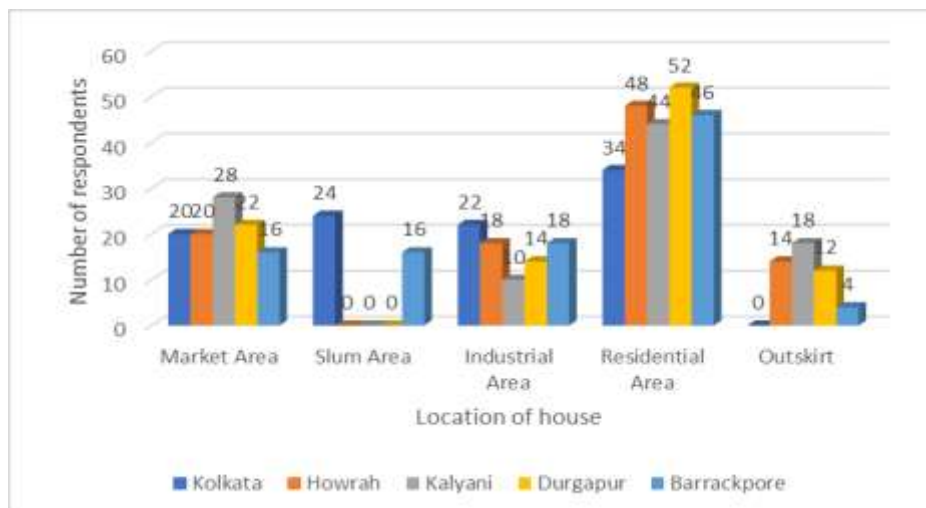


Fig. 1.12: Location of House

FINDINGS OF THE STUDY

- The majority of respondents, thirty per cent, were under 18, twenty-five per cent were between 18-30, fifteen per cent between 31-45, ten per cent between 46-60, and twenty per cent were above 60.
- 60 percent of the respondents are male and 40 percent of the respondents are female. The male respondents are slightly more than the female.
- The primary education is 20 percent among the respondents, secondary education is 27.4 percent, higher secondary is 15.6 percent among the respondents, 17 percent are graduate and 20 percent is post graduate. The majority are secondary as educational qualification.
- 39.80 percent of the respondents have daily wages, 35.20 percent of them are having weekly wages, 15.20 percent of them have private employment and 10 percent have government employment.
- The data shows that 34.40 percent of the respondents have family member less than 4, 58.40 percent have family member between 4 to 6 and 7.20 percent of the respondents have more than 6. The majority of them have member between 4 to 6.
- 72 percent of the respondents have ventilation at homes but 28 percent of the respondents does not have ventilation. The majority of the respondents have ventilation at homes.
- 47.2 percent reported hot & humid weather, 27.6 percent reported hot & dry, 2.8 percent reported cold & humid weather, 0 percent reported cold & dry, 7.2 percent reported hot & cold, 8 percent reported cold and 14.4 percent reported hot.
- 12 percent of the respondents reported that the level of air pollution was low, 21.20 percent reported that it was medium, 40.80 percent reported it was high and 26 percent reported extreme level of air pollution.
- 21.20 percent said they stay in the market area, 8 percent said they stay in the slum area, 44.80 percent live in residential areas, and 9.60 percent live in the outskirts area. The majority of the respondents stay in residential areas.

CONCLUSION

Deteriorating air quality has become a major environmental and public health concern, according to an assessment of air pollution in a few West Bengali cities. Rising pollution levels have been mostly caused by rapid urbanisation, population growth, industrial expansion, an increase in vehicle traffic, construction activity, and poor waste management. Particulate matter (PM_{2.5} and PM₁₀) concentrations are high in major urban areas like Kolkata, Howrah, Kalyani, Durgapur, and Barrackpore. These concentrations often above allowable limits and present major health concerns to locals.

The study shows that vehicular emissions remain a major source of pollution, especially in densely populated cities with severe traffic congestion. Industrial emissions, coal-based activities, brick kilns, and thermal power plants also greatly contribute to pollution in industrial areas like Kalyani and Durgapur. Additionally, construction dust, resuspended road dust, and open burning of waste further degrade air quality. Seasonal factors, particularly winter conditions and low wind speeds, increase pollution by trapping pollutants near the ground.

Poor air quality has many negative effects. Urban populations have seen an increase in respiratory diseases, asthma, allergies, cardiovascular problems, eye irritation, and a general reduction in well-being. Particularly at danger are vulnerable populations like children, the elderly, and people with underlying medical issues. In addition to its negative effects on health, air pollution affects quality of life, productivity, visibility, and urban ecosystems.

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