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Impact of Air Pollution on Human Health in Agra District

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Abstract:

A*ir pollution is the fifth leading cause of death in India after high blood pressure, indoor air pollution, tobacco smoking and poor nutrition with about 1.7 million Indians died due to air pollution in 2019 (lancet Planetary health). Close to half of the cities are reeling under severe particulate pollution while pollutants such as nitrogen oxides, ozone and air toxins are worsening the public challenge. According to an estimate of Centre of Study of Environment (CSE) half of the urban population breathes air laid with particulates that has exceeded the safety standards. As much as 1/3rd of urbanites is exposed to critical level of particulate pollution.* The present study impact of air pollution on human health in Agra district is base on the secondary source of data which is collected from government and private organizations where data are enumerated to show the rapidly increase of major cause of air pollution and its impact on human health. The inferences draw on the basis of data collected through the secondary source pertaining to the study to show the decreasing air quality of Agra due to various source of air pollution and cause of health problems due to lack of awareness about air pollution among residents of Agra district.

Keywords: Air Pollution, health.

Introduction

Air, which is mixture of gases, moisture, and some inert material, controls life on the earth. It is a reservoir of oxygen needed for mankind and other organisms.

Carbon dioxide is essential for plants. Any contamination in air may disturb the whole atmospheric system which is an insulation blanket around the earth. Without air there would be no cloud, no winds, no rain, no snow, and no fire on the earth. About 75 per cent of earth's atmosphere lies within 16 kilometres of height from the earth surface, and 99 per cent of it lies below on altitude of 30 kilometres (Saxena, 2000).

Air pollution has been defined in several ways H. Perkins (1974) has defined air pollution as, "The presence in the outdoor atmosphere of one or more contaminants such as dust, fumes, gas, mist, odour, smoke or vapour in quantities of characteristics and of duration such as to be injurious to human, plant, or animal life and to property or which unreasonably interferes with the comfortable enjoyment of life and property". According to World Health Organization (WHO), air pollution is defined as limited to situation in which the outdoor ambient atmosphere contains material in concentration, which are harmful to man and his surrounding environment. In simple words, air pollution may be defined as chemical imbalance in the quality of air so as to cause ill – effects. K.E. Maxwell (1973) noted that "our enormously accelerated abuse of the atmosphere has become a health hazard and a threat to life, damaging both plants and animals in areas polluted with poisonous fume, dust and smoke". The nature, dimension and magnitude of air pollution depend on a variety of factors such as residence time of pollutants in the atmosphere, sources of pollutants, nature of pollutants, number of pollutants etc. The residence time of pollutants in the atmosphere vary considerably depending upon the nature of pollutants itself upon the way emission has taken place, on meteorological factors (eg. Amount of moisture content in air, air temperature, nature of air circulation, cloudiness etc.) and on sink mechanisms.

Study Area

Agra (27.1767° N, 78.0081° E) is located in north central India, 200 km south east of Delhi. Two thirds of its marginal boundaries (SE, W and NW) are bounded by the Thar Desert of Rajasthan and is as a result a semi-arid area. Study sites fall in Indo-Gangetic plain where agriculture is the major activity. The soil type is a combination of sand and loam, containing surplus of salts. It has high exchangeable sodium percentage (ESP) values and moderate water retaining capacity. The major industrial activities are ferrous and non-ferrous metal casting, rubber processing, lime oxidation and pulverization, engineering works, chemicals and brick

kilns. Apart from the local sources, Mathura refinery and Firozabad glass industries are both situated at a distance of 40 km from Agra.

Meteorology of Agra is such that prevailing winds are mostly from the northwest so that Mathura lies upwind while Firozabad downwind**.** Agra which is about 169 meter above the mean sea level (MSL) has been reported as having semiarid climate with atmospheric temperature ranging from 11-48°C (max) and 0.7-30°C (min), relative humidity 25-95%, light intensity 0.7-5.6 oktas (cloudiness) and rainfall 650 mm per year.

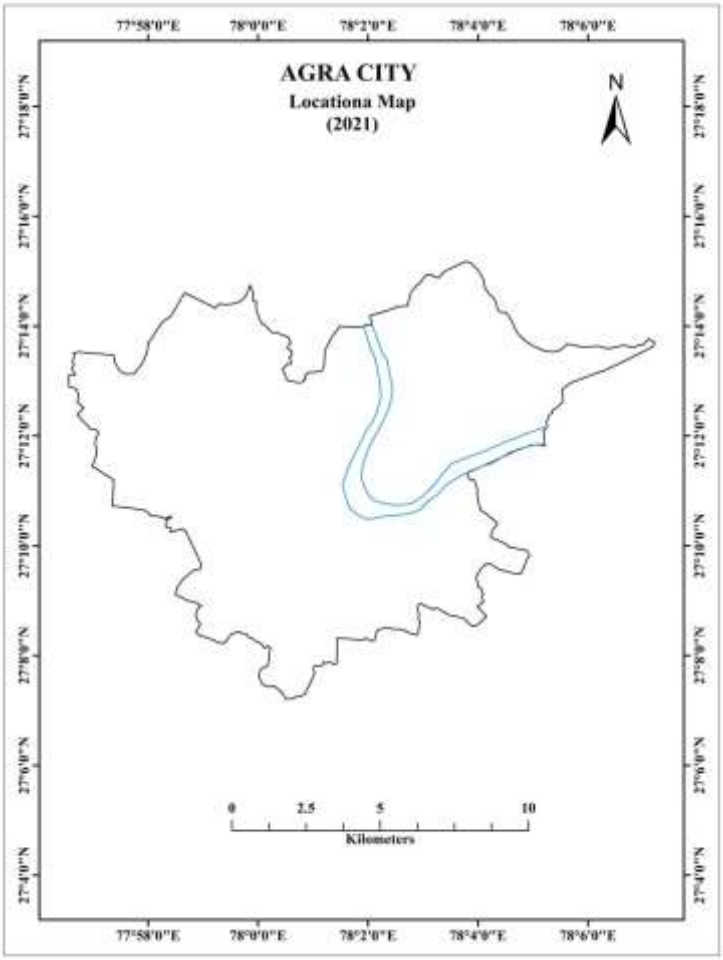

Fig. 1

The climate of Agra has been broadly divided into three seasons: winter (November to February), summer (March to June) and monsoon (July to October). The wind pattern at Agra projects that except in summer season the prevalence of calm conditions is higher with maximum frequency observed in post monsoon followed by winter. Calm conditions represent the wind velocity < 1 m s^{-1}. The wind speed in the Agra is mostly in the range of 1-2 m s^{-1}.

The prevailing direction follows two distinct patterns: during monsoon winds are from NE, SE quadrant while in the rest of the seasons these are from NW sector.

Increase in urbanization and industrialization and increase in the number of licensed industrial units has also resulted in an increase in population and vehicular traffic. Consequently, pollution problems have aggravated.

OBJECTIVES

1. To examination of different types of health problems.
2. To assess the quality of life among the residents of Agra District.
3. To promote an integrated approach to achieve sustainable and quality of Agra District Environment.

METHOD OF DATA COLLECTION

The study is primarily based on the secondary source of data which is collected by government organizations like, Central Pollution Control Board (CPCB), Uttar Pradesh Pollution Control Board (UPPCB), Data Dissemination Unit, Agra Development Authority (ADA), Agra Municipal Corporation (AMC), U.P. Jal Nigam, STP-Dhandhupura, Agra, DIC-Agra, Tourism Office- Agra, WHO Report, Chief Medical Officer (CMO), Agra, S.N. Medical College Agra, Lady Lyall Hospital and District Hospital Agra, RTO-Agra, NAAQS, Journals, BIS, MEF, UNEP Report etc.

A. Processing

After completion of data collection, the individual slip was processed and data were converted into the tabular form for categorization of data and preparing thematic maps.

B. Analysis

Processed data were statistically presented for logical analysis. Both quantitative and qualitative methods were used in the present study. M.S. Office and other computer-based techniques were used for mapping, analyses. The finding was obtained on the basis of analysis.

C. Problems Face During Data Collection

It is very difficult task to collect the data from government organizations. They always said this data has no access to third party. After many visits, they provide data.

DATA ANALYSIS AND FINDINGS

A. Growth of Automobiles and Air Pollution in Agra

Growth of the city has resulted enormous rise in number of vehicles and traffic flow. The city is well connected from the surroundings and a large number of heavy vehicles also enter into the city from all directions. The number of automobiles has increased from 68,515 vehicles in 1985 to 5,80,396 vehicles in 2011 (Table 2.5). If the same trend continues with increased number of registered automobiles, the city will face serious problem of traffic congestion and increase in emissions of air pollutants. The surface transport system of the city has not been able to keep pace with its physical expansion and development.

Table 2.5: Growth of Automobile (1985-2011)

Sl. No.	Vehicles	Years					
		1985	1990	1995	2002	2006	2011
1.	Two-Wheeler	47364	102669	157547	267272	387215	466981
2.	Cars, Motor cabs, Jeeps, Maxi Cabs,Three wheeler	4956	7272	13328	23584	39664	62051
3.	Buses, Omni Buses	1241	566	1081	1303	2542	2837
4.	Goods Carriages	4572	5410	4631	4796	7076	12736
5.	Tractors and Trailers	9051	14846	18207	23017	28046	34169
6.	Others	1331		2295	6007	11157	1622
Total		68515	133058	199801	326340	475700	580396

Source: *RTO Agra, 2011*

Residential areas have come up in the periphery of the city. On account of location of work place in the core of the city vehicular traffic has increased enormously on the major corridor of movement viz. Bhagwan Crossing, Rambagh, Sikandra crossing, Collectorate crossing, Water Works, etc. Consequently, these roads have intermixed with fast- and slow-moving traffic. The result is that the fast moving and slow-moving traffic fails to move with speed they are expected to move. During peak hours most of these roads are laden with uncontrolled heavy traffic. Narrow roads with little scope for development, illegal encroachments and lack of space are major problems in the older part of the city which causes congestion of traffic very often and increased emission of air pollutants. RTO records also reflect that there has been sharp increase in number of commercial vehicles.

Air Pollution in Agra

Studies revealed that all the metropolitan cities of India are facing environmental deterioration Agra is also a victim of this situation from the early days of its expansion. There is enough evidence to suggest that in recent year levels of SO_2, SPM, and Nox in most of metropolitan cities of India have been increasing. The major contributors of SO_2, SPM and Nox (as NO_2) in Agra are domestic fuel consumption, industries, railway shunting yard and thermal power plant.

Contribution of industrial sources like Mathura Refinery adds to the emissions from local sources. Besides, foundry, glass industries, refractory, etiquette, rubber industries, leather industries etc. are other industrial sources which emit air pollutants into environment (Government of India, 2006). The main sources of energy in the industries are coal and diesel. The majority of industries in Agra comprise of foundries. The vehicular traffic is one of the major sources of air pollution affecting the urban population in Agra. Unlike industrial emissions, vehicular pollutants are released at ground level and hence the impact on recipient population will be more. The vehicular growth in the city is quite high.

Road Traffic Flow and Auto Exhaust Gaseous Emissions:

Heavy traffic density causes emission of various types of air pollutants into ambient air causing increase in temperature and humidity of the area. Road crossings in densely populated areas have frequent traffic congestions resulting into higher emission of gaseous pollutants and dust particulates. Thus, it becomes pertinent to study the meteorological factors in the city. Primary data has been collected to assess the relation between number of vehicle and SPM, SPM and temperature, temperature and humidity at 18 major roads crossing of the city (Fig. 2.1). SPM, temperature and relative humidity have been monitored along with numbers of vehicles plying on the road at selected crossings. Bhagwan crossing has maximum traffic density (4,723 vehicle/hr.), while lowest traffic density is counted at crossing near to TajMahal such as Purani Mandi (1157 vehicle/hr.) and Kamala Nagar (1185 vehicle/hr.) residential area. Similarly SPM and temperature have also been observed on higher side at Bhagwan crossing (1165.35µg/m^3, 28.6^{0}C) as well as at Collectorate crossing (1152.35 µg/m^3, 27.8^{0}C) respectively. Teri Bagiya (305.65 µg/m3, 19.2^{0}C) and Nagar Nigam Chauraha (392.65µg/m^3, 20.88^{0}C) have low SPM concentration and temperature.

Table: 2.7: Traffic Density, SPM, Temperature and Relative Humidity at Major Road Crossing

Sl. No.	Locality	Road Crossing	Total Vehicle (No/hr)	SPM Level (µg/m^3)	Temp. (^{0}C)	Relative Humidity (%)
1.	Residential	Purani Mandi	1157	1023.47	26.3	43
2.		Bodla Crossing	2987	885.36	23.3	36
3.		Shah Ganj Chauraha	1575	503.60	21.2	38
4.		Kamala Nagar	1185	455.08	20.9	56
5.		Teri Bagiya	1454	305.65	19.2	36
6.	Commercial	Bhagwan Crossing	4723	1165.35	28.6	40
7.		Collectorate Crossing	4210	1152.35	27.8	52
8.		Sikandra	4538	1005.75	21.1	51
9.		Ghatia crossing	3234	987.09	22.7	42
10.		Loha Mandi	2001	980.50	18.6	41
11.		Khandari	4028	789.45	23.2	39
12.		Cantt. Railway Station	2065	703.80	21.4	49
13.		Rower House Crossing	2054	559.86	21.3	40
14.		Red Fort	2009	510.24	20.2	40
15.		Nagar Nigam	2334	392.63	20.8	57
16.	Industrial	Itmad-Ud-Daula	2726	1145.05	27.3	37
17.		Rambagh	4049	1042.60	26.3	42
18.	Silence	St. Johns crossing	2155	492.29	25.4	40

Source: Environmental Pollution and its effect on human health A geographical study of Agra city (2016)

Teri Bagiya is located in outer part of the city and because of this temperature is recorded on lower side. Relative humidity is found reversely related with SPM and temperature (Fig. 2.2 C). Volume or density of traffic also plays significant role in contributing emission of air pollutants at a particular point. Traffic composition varies from one place to another area of the city. The city traffic comprises mostly of motorized (mainly two wheelers and three wheelers) as well as non- motorized (comprising of cycle rickshaws and bicycles) vehicles. The main reason for congestion in the city is unregulated movement of cycle rickshaws followed by two wheelers and three wheelers. The concentration of SPM at major road crossings varies between 305.65 µg/m^{3}to 1165.35 µg/m^3. It is evident from the Table 2.7 that locations like Bhagwan crossing (1165.35 µg/m^3), Collectorate crossing (1152.35 µg/m^3), Itmad-Ud-Daula (1145.05 µg/m^3), Rambagh (1042.6 µg/m^3), Purani Mandi (1023.47 µg/m^3) and Sikandra crossings (1005.75 µg/m^3) have high SPM. It may be due to heavy traffic density (4723 vehicle/hr to 1157 vehicle/hr) in these areas during peak and non-peak hours of the day

as well poor condition roads. Some of the roads also pass through commercial and densely populated area of the city. Further, roads are very narrow (5 m -9 m) in these areas. It causes slow movement of traffic and also increases emissions from automobiles in these areas. It is found that at Teri Bagiya (305.65 µg/m^3), Nagar Nigam Chauraha (392.65 µg/m^3), Kamala Nagar (455.08 µg/m^3), St. Johns Crossings (492.29 µg/m^3) etc. have low level of SPM concentration. It is because of their existence in the newly developed residential areas and has low traffic densities (1454 vehicle/hr to 2155 vehicle/hr). Besides this, the width of the road is sufficiently and comparatively in good (Fig. 2.2 A).

Temporal Study of Air Pollutants

National Environmental Engineering Research Institute (NEERI) has formulated air quality exposure index to assess the combined impact of SPM, SO_2 and oxides of nitrogen (NO_X) concentration on the environment.

Table 2.10: Air Pollutants Load (Tonnes / Day)

Sl. No.	Source	SPM	SO_2	NO_X	HC	CO	Total
1.	Domestic	2.38	0.05	1.12	0.19	0.23	3.97
2.	DG sets	0.24	0.09	6.18	0.03	0.04	6.58
3.	Industrial	29.14	1.46	0.96	0.06	0.13	31.75
4.	Vehicular	0.63	0.35	3.67	4.34	7.21	16.20
Total		32.39	1.95	11.93	4.62	7.61	58.50

Source: *CPCB, 2004*

Note: *DG Set- Diesel Generator Set*

The total load of air pollutants in Agra from domestic sources, diesel generator sets, industrial sources, Petha units and vehicular sources represented by SPM, SO_2, NO_X and CO is nearly 58.5 tonnes /day (Table 2.10). SPM emission from industrial and domestic sources is an important parameter as carbon content of these emissions may have harmful effects on Taj Mahal. Silica content of SPM from natural sources is also important, as this causes abrasion of marble surface. SO_2 and H_2S are also important, as these are highly corrosive to marble. Central Pollution Control Board (CPCB) and Uttar Pradesh State Pollution Control Board (UPPCB) have established air quality monitoring stations at Taj Mahal, Itmad-Ud-Daula, Rambagh,

Nunhai and the Archaeological Survey of India (ASI). At the two locations in Agra, one inside the Taj Mahal and the other at Sikandra, air pollution levels are being monitored throughout the year. The annual ambient air quality for the period 2001-2008, has been given in the Table 2.11.

Table 2.11: Ambient Air Quality in Agra (2001-2008)

Location	Year	SO_2			NO_X			SPM			RSPM		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Taj Mahal	2001-02	9.8	3.4	7.0	48.7	7.0	28.0	680	39.6	490	402	78.0	200
	2002-03	8.0	3.5	4.0	40.0	9.0	27.1	910	40.0	500	380	40.0	205
	2003-04	10.8	5.6	5.0	29.5	4.6	10.0	590	42.0	309	341	105.0	221
	2004-05	14.2	4.3	9.0	64.2	5.5	22.0	850	30.4	306	399.4	109.0	225
	2005-06	12.6	3.0	6.0	39.7	8.5	20.0	799	80.5	316	282	101.0	147
	2006-07	10.0	6.0	6.0	64.2	6.5	23.0	678	42.0	296	312	62.0	140
	2007-08	11.0	8.0	6.0	64.0	12.0	18.0	712	52.0	305	352.4	79.0	180
Itmad-Ud-Daula	2001-02	12.2	6.4	5.3	59.0	10.5	29.0	649	95.0	389	399	51.5	191
	2002-03	8.0	3.9	7.0	42.5	11.0	26.9	795	180.0	478	450	45.0	202
	2003-04	7.9	3.8	6.0	49.6	7.4	26.0	739	145.0	419	527	68.0	295
	2004-05	50.9	4.3	10.0	38.4	15.6	25.0	789	88.0	416	387	74.0	186
	2005-06	9.3	4.2	7.0	35.0	9.0	24.0	819	64.0	401	478	49.0	214
	2006-07	8.0	3.0	5.0	59.4	14.1	27.0	564	55.0	377	349	75.6	103
	2007-08	8.0	4.0	6.0	44.0	15.0	26.0	650	100.0	383	510	55.0	183
Nunhai	2001-02	29.0	6.7	6.0	96.4	7.8	32.8	799	105.0	481	421	611.0	210
	2002-03	9.0	4.0	6.8	52.5	18.0	24.6	1100	107.0	608	495	50.0	215
	2003-04	20.5	6.0	6.0	79.8	6.5	27.0	1005	69.0	475	408	64.0	282
	2004-05	40.9	57.0	11.0	82.0	7.0	27.2	899	99.0	407	412	78.0	268

	2005-06	22.0	6.2	7.0	73.0	4.0	26.4	668	102.0	337	399	100.0	306
	2006-07	19.0	4.0	5.0	87.4	6.0	30.0	801	105.0	484	391	90.0	274
	2007-08	18.0.	4.0	7.0	55.0	15.0	28.0	850	215.0	543	360	85.0	216
Rambagh	2001-02	8.4	4.1	5.3	49.2	12.3	27.8	775	170.0	412	295	41.5	199
	2002-03	14.2	3.9	5.1	45.0	17.5	26.4	989	85.0	414	375	50.0	201
	2003-04	16.2	3.0	6.0	49.3	9.4	23.0	784	49.0	341	592	62.0	304
	2004-05	16.9	3.2	8.0	37.8	5.4	25.0	712	82.0	391	329	49.0	185
	2005-06	18.0	2.97	7.0	39.4	4.3	25.0	801	79.0	431	432	72.0	278
	2006-07	12.2	3.0	5.0	44.2	7.7	25.0	842	95.0	439	382	89.0	203
	2007-08	10.0	4.0	6.0	36.1	4.5	27.0	700	190.0	399	265	105.0	165

Source: *CPCB, New Delhi, UPPCB, Lucknow*

Note: Units *in µg/m^3; Max=Maximum; Min=Minimum; Avg=Average Value (12Month); SO_2=Sulphur Dioxide;* Nox=*Oxides of Nitrogen; SPM=Suspended Particulate Matter; RSPM=Repairable Suspended Particulate Matter*

Monthly Variation of Air Pollution

Dispersion of air pollution is highly influenced by meteorological conditions. The dilution of pollutants depends upon mainly total rainfall and frequency of rainfall. Wind velocity determines how rapidly contaminants will advance and disperse in the city. Movements of pollutants in Agra city are governed by the general air flow of the region but multi-storey buildings and pollutants modify the air flow in and around the city. Diffusion of pollutants also depends upon the vertical temperature distribution in the lower layers of the atmosphere. Climate of Agra is semi-arid. May and June are the hottest months of the year and dust storms from Rajasthan desert and hot winds are present during the summer. Agra is a fast growing commercial, industrial and trading centre of western UP as well as of North India.

Table 2.12: Monthly Concentration of Pollutants in Agra (2008-09)

Month	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
SPM												

Taj Mahal	380	380	150	110	100	150	350	490	395	380	310	390
Itmad-Ud Daula	490	425	200	100	150	245	450	625	234	450	425	524
Rambagh	445	515	210	195	275	370	390	500	405	390	400	700
Nunhai	550	380	400	290	215	290	470	780	750	775	719	850
RSPM												
Taj Mahal	140	150	60	45	40	60	175	290	260	165	140	195
Itmad-Ud-Daula	190	165	60	48	60	75	200	340	495	245	350	360
Rambagh	190	210	90	75	100	100	140	290	210	175	200	230
Nunhai	270	145	115	90	75	105	210	308	248	275	250	375
SO_2												
Taj Mahal	6	5	9	6	4	5	6	6	12	8	8	7
Itmad-Ud-Daula	8	7	6	5	4	4	5	4	6	7	6	6
Rambagh	6	5	4	6	4	4	5	4	6	7	6	6
Nunhai	9	6	6	4	4	5	4	5	10	4	4	5
NO_2												
Taj Mahal	25	22	12	11	11	12	22	35	28	18	19	21
Itmad-Ud-Daula	29	22	19	15	21	22	33	42	39	38	31	29
Rambagh	25	28	19	18	18	20	30	35	25	22	25	26
Nunhai	34	45	32	24	25	33	35	52	55	48	37	38

Source: *CPCB, New Delhi, Note: Units in µg/m^3*

Table 2.12 reflect that concentration of air pollutants was recorded lowest in rainy season because in this season process of wash out of pollutants occurs effectively. In rainy season average rainfall in Agra is about 686 mm, the concentration of air pollutants in the month of July is lowest *i.e* SPM (100 µg/m^3) at Itmad-Ud-Daula, RSPM (45 µg/m$^{3)}$ at Taj Mahal, SO_2 (5 µg/m^3) at Itmad-Ud-Daula, NO_2 (11 µg/m^3) at Taj Mahal (Fig. 2.6). Winter season show high concentration of gaseous pollutants like SO_2 and NO_2. It is mainly due to less rainfall, calm wind speed and clean sky conditions. Highest concentration of SO_2 (12 µg/m^3) and NO_X (55 µg/m^3) is recorded at Taj Mahal (historical monuments cum commercial)

and Nunhai (industrial area) in the month of November-December. Further, the data reveals that summer season shows moderately low concentration of SO_2 and NO_2. Dispersion of air pollutants is quite high in summer season due to high wind speed from Rajasthan desert. SPM and RSPM concentration are monitored as highest in summer season i.e. 850 µg /m^3 and 375 µg /m^3 in the month of March at Nunhai industrial area.

Conclusion

Air pollution may affect human health in many ways with both short-term (e.g. irritation to eyes, nose and throat, and upper respiratory infections such as bronchitis and pneumonia) and long-term (chronic respiratory diseases, lung cancer, heart disease, and even damage to the brain, nerves, liver, or kidneys) effects. Different groups of individuals are affected by air pollution in different ways. Some individuals are much more sensitive to pollutants than others. Young children and elderly people often suffer more from the ill effects of air pollution. People with health problems such as asthma, heart and lung disease will suffer more when the air is polluted in their locality. The extent to which an individual is harmed by air pollution usually depends on the total exposure to toxic gases, i.e., the duration of exposure and the concentration of chemicals must be taken into account. "The main factors responsible for day to day deterioration in urban air quality are growing industrialization, increasing vehicular population and burning of fossil fuels. According to a study on effect of pollution on human health by K.E.M. Hospital, Mumbai during the last twenty years the effect of air pollution has been found more pronounced (Kamat, 1997). In recent decades the problem of urban air pollution has increased across Indian cities at an alarming rate due to traffic congestion, poor housing, poor sanitation and drainage and garbage accumulation. Increased level of air pollutants has caused significant damage to human health especially children. According to a study, 84,000 deaths were directly attributable to outdoor air pollution in Indian cities (WHO, 1996). At the same time, indoor air pollution accounted for 496,000 deaths in villages and 93,000 deaths in cities (WHO, 1997). About 51,779 persons die every year in India due to high level of air pollution. Besides, 26 million are hospitalized every year causing burden on government's exchequer In Delhi alone 9,859 children die prematurely every year due to poor quality of air. Kolkata (10,647), Mumbai (7,023), Kanpur (3,639) and Ahmadabad (3,006) and other major cities account for nearly 66 per cent of the total pre-mature deaths in India.

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