JSDC

Effects of Air Pollution on Public Health: The case of Vital Traffic Junctions under Kolkata Municipal Corporation

Anwesha Chakraborty
Calcutta University, West Bengal, India

ABSTRACT

The growing menace of air pollution is one of the crucial environmental issues in modern era across the world. This is a silent killer of the physical as well as mental health of human being. The existing findings in Indian context show that, Kolkata is amongst the polluted city primarily because of high population base and growing surface traffic. In the light of this, the present study addresses the main source of air pollution viz. the traffic air pollution and its likely impact upon the occupationally exposed people who spends more than eight hours on few selected busy traffic intersections of the city. Primary data were collected during the daytime of the city which includes the busiest road crossings, commercial and residential areas from different parts of the city. The targeted group for each survey includes traffic police, garage mechanics, public transport-drivers, salesmen, hawkers and shopkeepers. The finding shows that Ultadanga crossing from north-eastern parts, Shyambazar-V point crossing from northern parts and Behala- Chowrasta crossing from southern parts is more polluted traffic points in comparison to other locations of the city. These intersections have also recorded more cases of air borne diseases compared to other locations. The study broadly observes six major health disorders caused by air pollution in the survey period 2012 and 2013.

<u>*Author Details and Affiliations*</u>
The author is a Research Scholar at Calcutta University and can be contacted at <u>chakraborty.anwesha23@gmail.com</u>

Introduction

The air pollution is the changes in the physical, chemical and biological properties in the air. The changes in the air due to number of natural and/or anthropogenic activities may cause adverse effects on human health. This is a major health hazard across the world and the largest single environmental health risk in the recent years. The health related diseases in the developing countries are increasing over the years. Air Pollution in developing world is closely related with rapid economic and social development. The main change in the air composition in the developing countries is mainly by the human created air pollution which includes increased industrialisation, urbanization, rapid increase of population and transportation. The increased concentration of these activities in and near the urban areas causes severe pollution to the air and ultimately affecting to the human health. The effect ranges from minor upper respiratory irritation to chronic respiratory and heart disease, lung cancer, acute respiratory infections across the age group. The World Health Organisation in its latest release reports that in the year 2012 about 7 million people died as a result of exposure to air pollution. It further says- one in eight of total global deaths are caused by the air related diseases.

The growing trend of the metro cities leads to the heavy movements of traffic, aircraft and several constructional projects. Kolkata is not an exception of this. Over time it is becoming overcrowded, busy and polluted even though certain measures have been taken to curb it. But the growing numbers of population along with the congested roads and large

public transportation system, the emitted air from public transport are adding more to the problem. The air emitted from diesel run engine as well as petrol run engine during operation of public transport plays a vital role in generating the traffic air pollution in the city (Agarwal, 2005).

In the light of the above, the present paper systematically studies the effect of air pollution on the public health in some vital intersection of Kolkata Municipality Corporation (KMC). The study is structured as follows. The second section briefly underlines the presence of different pollutants in the air. The third section shows the air pollution health related hazards on the human body. The fourth section defines the justification of the selection of the study area. The fifth section shows the emission standard of different air pollutant in the Kolkata city. The sixth section describes the participants and the location of the survey. The seventh section analyses the findings based on the primary data. And the last section concludes the findings.

Pollutants in the Air

There are various pollutants in the air, namely gaseous pollutants, heavy metals, volatile organic components, toxics and suspended particulate matters, which all together are responsible for air pollution in a region. An insight into the subcategory of the above stated pollutants shows that the increase in the ammonia, nitrogen dioxide, ozone, sulphur dioxide, nitrogen monoxide, carbon monoxide, arsenic, lead, nickel, benzene, $PM_{2.5}$ and PM_{10} (Badami, 2005) leads to the pollution in the air. The World Health Organization (WHO) shows that each and every pollutant particles have specific emission level. The major air quality guidance as per the WTO guidance is given in table 1. Any increase in the composition of these components leads to the pollution in the air.

Air Pollution Related Health Hazards

The concentration of air pollutants in different Indian cities have been measured by various institutions and organizations. However, the effect of these pollutants on public health is hardly studied by any organisation. Cropper et. al. (1997) stated air pollution related health data is very scanty and the proper investigation on public health is almost lacking. Looking at this shortcoming, the present study attempts to find the effect of air pollution on the public health due to high emission levels. Though the survey covers a limited time of two years, viz.

2012 and 2013, but it leaves a broad overview on the hazardous effect of air pollution on the public health in the Kolkata Municipality Corporations (KMC).

It is evident that air pollution does cause many functional disorders in the organs of human body. Mainly, it hampers the respiratory and lung function by several magnitudes of the human body. Before we get into the detail of the above mentioned objectives, the following list provides some basic information on the major functional disorder of the human body caused by the air pollution.

Respiratory Disorder- Respiratory disorders are more common diseases which takes place on public health easily due to high concentration of air pollutants. Sinusitis, running or stuffy nose, sneezing, sore throat, common cold and fever considered as upper respiratory disorders and dry cough, cough with phlegm (wet cough), chest discomfort and pain, shortness of breath and wheezing breath as lower respiratory disorders. Other than these, many different respiratory diseases viz. prevalence of asthma, prevalence of other symptoms like headache, eye irritation, skin irritation or dryness on public health have also been noticed due to high emission of air pollutants like SO_2, NO_2, O_3, heavy metals namely arsenic, nickel, vanadium, on those who are occupationally exposed in highly air polluted places in the city (WHO, 2010).

Cardiovascular Disorders- Cardiovascular disorders take place on human health through various air pollutant agents like CO, heavy metals i.e. mercury, nickel, arsenic and mice. Different CVD problems namely increase prevalence of hypertension, activation of blood platelets (giant platelet activation, leukocyte cardiovascular risk, oxidized low density lipoprotein in blood, anti-cardio-lipin antibodies in blood serum may also increase the risk in CVD system in human body).

Nervous Disorder- Many air pollution does directly affect the human nervous system. Mainly the air pollution agents like heavy metals i.e. lead, mercury, arsenic and dioxins may increase the depression level among occupational exposed people in high air polluted zones. These also do effects on blood neurotransmitter levels in several forms.

Urinary Disorder- Urinary System disorder sometimes may takes place on human body due to high emissions of pollutants like heavy metals.

Digestive Disorder -Digestive Power sometimes affected by air pollution agents. Mainly dioxins does effect on digestive system of human health.

Lung Diseases and Lung Cancer - Excess AgNOR in

Pregnancy Problem- Damage of fetus during pregnancy can also recorded on women due to long time exposure of high air polluted zones. Heavy metals like lead also effects on the growth of fetus due to emission of air pollution. These can be the

Figure-1: Location Map of the Study Area
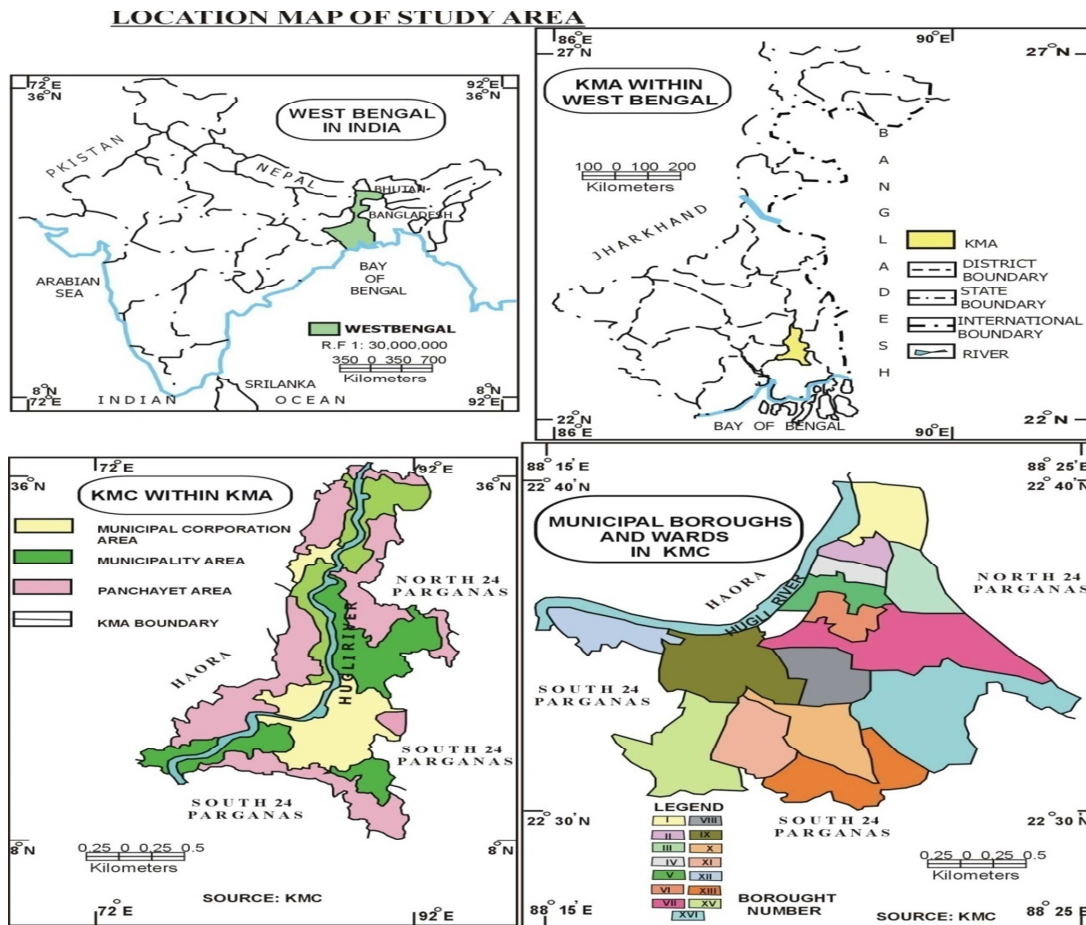
buccal epithelial cells indicates increase in ribosome biosynthesis which is responsible factor for up-regulation of akt signal transduction. This may be the causes of metaplasia, dysplasia and finally increase the cancer risk in lungs of human body and also other lung diseases.

Malfunctioning of Cellular System and DNA Function - Malfunctioning of cellular function and DNA function can also hampered due to high emission level of air pollution. Mostly heavy metals mainly lead may affects the malfunctioning of cellular system as well as on DNA function in human body.

promoting oxidative stress in human health. Which is harmful for cellular lipids, proteins and nuclear or mitochondrial-DNA. Oxidative Stress is also responsible for degenerative diseases namely atherosclerosis, heart attacks, stoke, chronic inflammatory diseases (rheumatoid arthritis), cataract, central nervous system disorders, age related disorder and finally the cancer risk of human body.

Justification of Selection the Study Area

Kolkata city has been selected as the study area in the present context due to several relevant factors. This includes the high traffic volume, the increased construction works, the growing population etc. In

this pretext some of the major road intersections, commercial and residential places of high traffic volume are selected for the present purpose. The location of these selected study sites are shown in figure 1.

The prime reason for selecting these intersections as the vital places of pollution is based on the several established facts in line with the World Bank Statistics, WHO guidelines and few existing studies/reports. In addition to the above cited factors other reasons for the selection of the locations are given in the following broad points.

- According to World Bank Statistics (2010), in terms of suspended particulate matter emission level, Kolkata city stands 3rd position in the world in comparison to other world cities. This categorization is mentioned in table 2.

- 4.2. Decades old and polluting vehicles have clogged the city's roads and emit dark noxious fumes. Kolkata is also known to be a diesel capital in the country due to maximum diesel run vehicles are plying on the city street. This contributes to the increase in air pollution level in the region.

- As per the report of Central pollution Control Board (CPCB) and WBPCB, maximum quantity of energy emissions, mainly emissions of CO_2 energy have been noticed in the city. High rate of suspended matter increases have been noticed day by day.

- Number of personal cars and two-wheelers in the last couple of decades are also increased. This could be one of the major factors for creating traffic chaotic situations all over the city road.

Emission Standard of Different Air pollutant in Kolkata city

The official statistics of the level of air pollution is reported by majority of the countries in the world. In Indian context, it is the CPCB that provides the emission statistics as per the Indian standard. The classification as reported by the CPCB is given in table 3.

Like Central Pollution Control Board, every state has its own pollution measuring organization. These organizations act as decision making supreme committee in state levels. In West Bengal, West Bengal Pollution Control Board (WBPCB) provides the year wise air pollution data as reported by the end of 2013 is presented in table 4.

Data Sources and the Survey Spots

Occupationally exposed people are chosen for the participants of the survey. Here, mostly the air pollution exposed groups include the traffic police, public transport drivers, street hawkers, salesmen, shop keepers, garage mechanics and office passengers. The major traffic intersections such as Rabindra Varati University, Dunlop Bridge, Shyambazar-V point crossing from northern parts of the city, Ultadanga crossing from north-eastern part, Moulali crossing, Minto Perk-Sarat Bose road crossing and Victoria Memorial from central parts of the city and Baishnabghata residential area, Behala-Chowrasta crossing from south-eastern parts of the city have been selected in line with pre-selected survey sites by West Bengal Pollution Control Board.

The respondents, those are occupationally exposed by air pollution were randomly selected from these survey points. A total of 450 people are randomly picked in two consecutive survey years i.e. 2012 and 2013. In other words, a total of 225 occupationally exposed people are selected for each year. Mainly the participants were included from a non-smoking healthy background in the age group of 14 to 56 years. The entire survey periods have been classified into two seasons' viz. the winter and the summer. The month of January is considered for the summer season and the month of June is taken for the summer season. Peak diurnal office hours in a day have been chosen for survey timings.

Findings and Analysis

If we thoroughly follow the nature of air pollution for the year 2012 and 2013, it is observed from the data that there is no significant change in the air quality level in both the years. However, the emission level during this period is observed higher over the prescribed National Air Quality Standard. This can be treated as a danger sign for the public health of the concerned areas, particularly for those who are exposed to such high air pollution level due to their occupational compulsion.

The present survey in the selected sites reveals the existence of seven types of health related diseases among the respondents. These diseases are namely

As per the survey, among the respondent it has been found that traffic police are the most affected by air borne health diseases. This is followed by public

Figure 2: Percentage Share of Air Borne Diseases in the Year 2012.
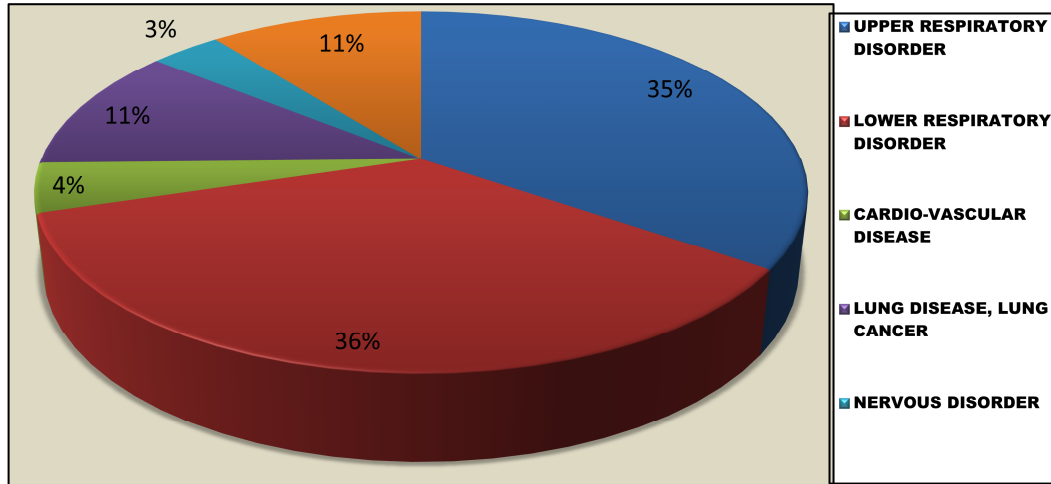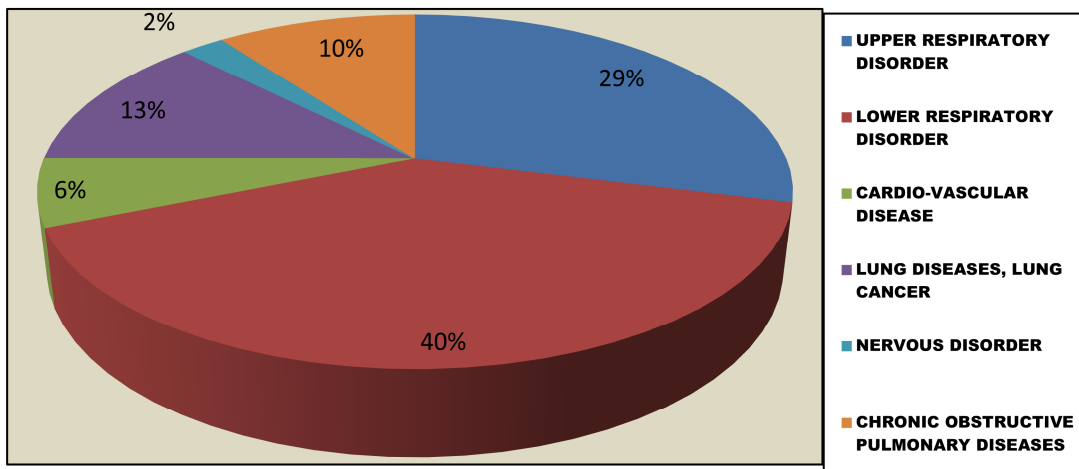

Figure 3: Percentage share of air borne diseases in the year 2013.

upper respiratory disorder, lower respiratory disorder, cardiovascular diseases, nervous system disorder, lung diseases-lung cancer and also other pulmonary cardiac diseases. The share of the airborne diseases in both the year 2012 and 2013 is given in figure 2 and 3. It is evident from the figure that more than two third of the affected population falls in the category of respiratory disorder. On the other hand, in both the survey period the people affected with the nervous disorder is the lowest preceded by Cardio Vascular diseases? However, people exposed to the Cardio Vascular diseases have increased in the year 2013 over the preceding year.

transport drivers, garage mechanics, road side hawkers, shopkeepers and salesmen. On the other hand, the office employees located in that locality are the least affected compared to other professionals. An insight into the findings of the air borne diseases reveals that traffic policemen are mostly affected by lung diseases. Even a very few lung cancer problems have also been reported among the traffic policemen working in that locality. Public transport drivers and garage mechanics are also affected by lung related diseases due to long time exposure into the polluted air.

Among all respiratory symptoms, upper respiratory symptoms namely sinusitis, running or stuffy nose, sneezing, sore throat and common cold and fever are more common among the children communities. On the other hand, elderly people are badly affected by lower respiratory disorders than younger participants. A comparison among different survey sites shows that, Behala-Chowrasta located in the south Kolkata has reported the highest numbers of air borne diseases affected people followed by Ultadanga crossing (north-eastern Kolkata) and shyambazar 'V' point (northern Kolkata). This is mainly because of the heavy traffic in the locality as it is a prime junction for several bus and auto routes. Similarly, many other construction activities such as the metro-railways and drainage related works could be the reason for high air pollution in the locality which leads to high air borne diseases in Behala-Chowrasta location.

Conclusion

The present study in the light of the growing pollution in the Kolkata city reveals some interesting facts. Though few existing reports and studies have given an insight to the level of air pollution, but the present study, based on the cross sectional data revels that the air pollution level during peak and non-peak hours of the day and night time is the highest during the winter season that the summer season. As seen, the total traffic volume is always higher in southern parts of the city that the northern parts, mainly the Behala-Chowrasta, considered as one of the highest traffic congested place in the city.

Exposure to high air pollution level does effect on human health which is the key finding of present paper during the year 2012-2013. From our findings seven major health disorders have been noticed on public health due to high air pollution level in the city during this period. The year 2013 shows a higher air borne diseases that includes primarily the higher respiratory disorders, cardio-vascular diseases and lung diseases over the year 2012. However, in cases of lower respiratory disorder, nervous disorder and other related diseases shows a decline in the year 2013 over the same period last year.

Works Cited

Abbey, D.E., Hwang, B.L., Burchette, R.J., Vancuren,T. and Mills, P.K. 1995: Estimated long-term ambient concentrations of PM_{10} and development of respiratory symptoms in a non-smoking population: *Arch Environ Health*, vol.50, no.2, pp. 139-152.

Abbey, D.E., Burchette. R.J., Knutsen, S.F., Mac Donne,l W.F., Lebowitz, M.D. and Enright T.L. 1998: Long-term particulate and other air pollutants and lung function in non-smokers: *American Journal of Respiratory and Critical Care Medicine* , vol.158, no.1. pp 289-298.

Agarwal, A.K, 2005: Air Pollution: Anmol Publication, New Delhi.

Asian Development Bank, 2005: Strengthening environmental management at the state level (cluster), component E-Strengthening environmental management at West Bengal Pollution Control Board: Final Report, *Air Quality Management*, vol.5, TA No. 3423.

Badami, M.G. 2005: Transport and urban air pollution in India: *Environmental Management*, vol. 36, no.2, pp. 195-204

Badman, D.G. and Jaffe, E.R. 1996: Blood and air pollution; state of knowledge and research needs: Otolaryngol, Head Neck Surg, pp 114-205.

Basu, C., Ray, M.R. and Lahiri, T. 2001: Traffic-related air pollution in Calcutta associated with increased respiratory symptoms and impaired alveolar macrophage activity: *Journal of Environmental Pollution*, vol.8, pp. 187-195.

Bellinger, D.C. 2005: Teratogen update: lead and pregnancy: *Birth Defects Research Part A: Clinical and Molecular Teratology*, vol. 73, no.6, pp. 409–442.

Brunekreef, B. and Holgate, S.T. 2002: Air pollution and health: The *Lancet*, vol.360, no.9341, pp. 1233-1242.

Brunekreef, B., Janssen N.A., de Hartog, J., Harssema, H., Knape, M. van and Vliet P.1997: Air pollution from truck traffic and lung function in children living near motorways: *Epidemiology*, vol.8, pp. 298-303.

Chauhan, A., Chatterjee, A, and Johnston S.L. 2005: Acute Respiratory Infections: In Effects of Air Pollution on Children's Health and Development, A review of the evidence: World Health Organization, Special Programme on Health and Environment,

European Centre for Environment and Health, pp. 44-69.

Cropper, M.L., Simon, N.B., Alberini, A. and Sharma, P.K. 1997: The health effects of air pollution in Delhi: Policy Research Working Paper.1860. *The World Bank Development Research Group.*

Hoffman, B., Moebus, S., Stang, A., Beck, E.M., Dragano, N., Mohlenkamp, S., Schmermund, A., Memmesheimer, M., Mann, K., Krbel, R. and Jockel, K.H. 2006: Residence close to high traffic and prevalence of coronary heart disease: *European Heart Journal* 27: pp. 2696-2702.

Huang, Y.C. and Gtio, A.J. 2006: Vascular effects of ambient pollutant particles and metals: *Current Vascular Pharmacology*, vol.4, no.3, pp. 199.

Katsouyammi, K. 2003: Ambient air pollution and health: *British Medical Bulletin:* vol. 68, no.1, pp. 143.

Kumar, R., Sharma, S.K., Thakur, J.S., Lakshmi, P.V., Sharma, M.K. and Singh, T. 2010: Association of air pollution and mortality in the Ludhiana city of India: a time-series study: *Indian Journal of Public Health*, vol. 54, pp. 98-103.

Kunzli, N. and Tager, I.B. 2005: Air pollution: from lung to heart, *Swiss Medical Weekly*. vol.135, no 47-48, pp. 697-702.

Maynard, D., Coull, B.A, Gryparis, A., and Schwartz, J. 2007: Mortality risk associated with short term exposure to traffic particles and sulfates: *Environ Health Prospect,* vol. 115, pp. 751-755.

Menzel, D.B. 1994: The toxicity of air pollution in experimental animals and humans: the role of oxidative stress: Toxicology Letter, vol.72, no.1-3, pp. 269-277.

Mrinal, K. Ghose et al 2005. Assessment of the status of urban air pollution and its impact on human health in the city of Kolkata: *Environmental Monitoring and Assessment*, vol.108, no. 1-3, pp. 151-167

The World Bank 2005: For a breath of fresh air, ten years of progress and challenges in urban air quality management in India (1993-2002): *Environment and Social Development Unit South Asia Region*, The World Bank.

Schwartz, J.2001: Air pollution and blood makers of cardiovascular risk: *Environmental Health Perspectives* vol. 109, no.3, pp. 405-409.

Uysal, N. and Schapira, R.M.,2003: Effects of ozone on lung function and lung diseases: *Current Opinion* in *Pulmonary Medicine:* vol.9, no.2.pp 144-150

Vichit-Vadakan, N., Vajanapoom, N. and Ostro B. 2010: Estimating the effect of air pollution on mortality in Bangkok, Thailand. Research Report: *Health Effects Institute: Part 3, No.*154, pp. 231-276..

Tables Used

Table 1. Air Quality Guideline by World Health Organization

POLLUTANT	AVERAGE TIME	AIR QUALITY GUIDELINE VALUE($\mu g/m^3$)
PARTICULATE MATTER		
$PM_{2.5}$	1 YEAR	10
	24 HOURS	25
PM_{10}	1 YEAR	20
	24 HOURS	50
OZONE	8 HOURS, DAILY	100
NITROGEN DIOXIDE	1YEAR	40
	1 HOUR	200
SULFUR DIOXIDE	1YEAR	20
	1 HOUR	500

Source: WHO air quality guidelines global update 2005, Report on a working meeting, Blonn,World Health Organization,Germany

Table 2. Emission Level of Air Pollutants by World Bank

PARTICULATE MATTER $\mu g/m^3$(2004)	NAME OF CITIES
168	Cairo, Egypt
150	Delhi, India
128	Kolkata, India
125	Tianjin, China
123	Chongqing, China
109	Kanpur, India
109	Lucknow, India
104	Jakarta, Indonesia
101	Shenyang, China

Source: World Bank Statistics, 2010

Table 3. NATIONAL AMBIENT AIR QUALITY STANDARD (NAAQS)

POLLUTANT	TIME WEIGHTED AVERAGE	CONCENTRATION IN AMBIENT AIR ($\mu g/m^{3)}$)		
		SENSATIVE AREA	INDUSTRIAL AREAS	RESIDENTIAL, RURAL AND OTHER AREAS
SULFUR DIOXIDE	ANNUAL	15	80	60
	24 HOURS	30	120	80
NITROGEN DIOXIDE	ANNUAL	15	80	60
	24 HOURS	30	120	80
SUSPENCED PARTICULATE MATTER	ANNUAL	70	360	140
	24 HOURS	100	500	200
PM_{10}	ANNUAL	50	120	60
	24 HOURS	75	150	100
LEAD	ANNUAL	0.50	1.0	0.75
	24 HOURS	NIL	NIL	NIL
CARBON MONOXIDE	24 HOURS	0.75	1.5	1.0
	8 HOURS	1.0	1.0	2.0
	1 HOUR	2.0	2.0	4.0
AMONIA	ANNUAL	NIL	400	NIL
	24 HOURS	NIL	100	NIL

Source: National Ambient Air Quality Monitoring Series: NAAMQS/9/1996-97, Central Pollution Control Board, Government of India

Table 4. Air Quality Guidelines by West Bengal Pollution Control Board

DATE	O_3	SO_2	NO_2	$PM_{2.5}$	PM_{10}	Lead	CO	Ammonia
30-06-2012	100(8 hr)	80(D)	80(D)	Nil	100(D)	Nil	2.0(8 hr)	Nil
	180(1 hour)	50(A)	40(A)	Nil	60(A)	Nil	4.0(hr)	Nil
31-12-2012	80(D)	80(D)	80(D)	60(D)	100(D)	1.0(D)	2.0(8 hr)	400(D)
	40(A)	50(A)	40(A)	40(A)	60(A)	0.5(A)	4.0(hr)	100(A)
30-06-2013	100(8 hr)	80(D)	80(D)	Nil	100(D)	Nil	2.0(8 hr)	Nil
	180(1 hour)	50(A)	40(A)	Nil	60(A)	Nil	4.0(hr)	Nil
31-12-2013	100(8 hr)	80(D)	80(D)	Nil	100(D)	Nil	2.0(8 hr)	Nil
	180(1 hour)	50(A)	40(A)	Nil	60(A)	Nil	4.0(hr)	Nil

Source: West Bengal Pollution Control Board, 2014