Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 6, Issue 9; October-December, 2019, pp. 561-567

http://www.krishisanskriti.org/Publication.html

Differential Impact of Air Pollution on Different Socio Economic Classes: A Case Study of Delhi Households

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Abstract—*The capital city of Delhi has been suffering from very high pollution levels for the past few years, giving it the dubious distinction of being the most polluted city in the world. The spike in pollution levels particularly in the winter season due to additional smoke from neighbouring Punjab and Haryana due to seasonal stubble burning have made the city a gas chamber raising serious health concerns for its residents .The level of exposure to air pollution is higher among low socio economic communities living in Delhi . They are more sensitive and susceptible to air pollution compared to individuals with high socio economic status .Individuals belonging to high income class can avoid some of the detrimental effects of air pollution by incurring averting expenditure such as use of an air purifier, high quality masks or rolling up the windows of their air conditioned cars. Additionally, poor living conditions, material deprivation, low intake of nutrition, long hours spent outside and psychological stress of their everyday life makes them more prone to the health impact of air pollution. Being of low educational background, they usually lack the knowledge of health and environment pollution as well as health impact of air pollution. They are therefore more likely to have lower level of awareness of self protection and may not indulge in pollution averting expenditure. Many studies now confirm that the tangible benefits from upgrading the air quality in urban areas go more to the poor rather than the rich. This study through a primary survey of households belonging to different income groups in four different parts of Delhi over different seasons attempts to highlight the differential impact of air pollution so that a targeted policy action can be taken for maximum mitigation of negative impact of air pollution in the capital city.*

1. INTRODUCTION

Climate change is an emerging problem facing the world today. The rising air pollution is a major challenge for all growing economies of the world. The state-oriented policy in these economies has to be designed to control air pollution and the decarbonize their energy sources so as to sustain the steadily deteriorating environment.

The development and growth of an economy is directly linked with air pollution and emissions. India is today a growing economy with a GDP growth rate of about 7 per year (2018-2019). The environmental risks faced by India are wide ranging and are driven by considerations of both economic prosperity and future poverty. The fast pace of growth has put a strain on the environment leading to increase in all forms of pollution-land, air and water. According to a report[1] prepared by the World Bank at the request of the country's Environment Ministry, released on July 2013, environmental degradation costs India $80 billion per year or 5.7 per cent of its economy. The report focuses on particle pollution (PM10) from the burning of fossil fuels which has serious consequences on health amounting to about 3 per cent of India's GDP inclusive of losses due to lack of access to clean water, sanitation and hygiene. Of this, outdoor air pollution is the biggest culprit accounting for 1.3 per cent of share of GDP. In yet another report[2] released in 2018, India ranks 177 out of 180 in Environmental Performance Index (EPI) due to poor performance in the environmental policy and deaths due to air pollution. It said that the deaths attributed to ultra fine PM2.5 particles have risen tremendously in India over the past decade and are estimated at 1,640,113 annually in India (Institute for Health Metrics and Evaluation, 2017).

Air pollution has been observed as a major threat to human capital with serious consequences on growth and development. Economics seeks to put of value on the effect of this change in the environment (here, air quality) on human welfare.

[1] *Diagnostic Assessment of Select Environmental Challenges in India*: World Bank, July 17, 2013: The report is first ever national level economic assessment of environmental degradation in India. It analyzes the physical and monetary losses of environmental health and natural resources; the trade offs between economic growth and environmental sustainability
[2]The biennial report released by Yale and Columbia Universities was released during The World Economic Forum in Davos, Switzerland
The 10[th] EPI report ranks 180 countries on 24 performance indicators across 10 categories covering environmental health and ecosystem vitality

Environmental quality is an important determinant of human health and longevity. An ideal environment is one in which people are free from illness or any kind of disability or discomfort. This environmental quality is deteriorated if human activities release substances into the atmosphere causing different types of pollution. Air pollution is one of the outcome of the release of chemicals, particulate matter and

poisonous gases into the atmosphere causing harm or discomfort to the humans.

Environmental pollution affects human health and well-being in several ways. *Medical expenses* associated with treatment costs of pollution-induced diseases, *lost wages*, *defensive expenditures* to prevent the occurrence of pollution illnesses, *disutility* arising from the illness due to lost opportunities for leisure and *changes in life expectancy* due to illness on exposure to pollution are all economically quantifiable aspects of environmental health. Household members are exposed to different levels of ambient air pollution at home, at office, at school and while travelling.

In the current times, economists rely on *Endogenous Growth Model* which considers *human capital* as a major factor of growth. Since health is an important parameter of human capital, anything which adversely affects health will have a negative impact on human capital. The growth prospects of any economy takes into account the health status of its individuals to maintain a potential level of human capital to attain the desired economic growth rate.

The interdependence and interlinkages between the environment and economics calls for an evaluation of the environmental consequences of any human activity to promote economic development. The economic activities of production and consumption draw heavily on the environment's role as a resource supplier and as a waste assimilator resulting in the impairment of earth's life support system. Hence, placing a value on environmental services is important. Such evaluations signal the growing scarcity of the environmental resources and is largely directed to measure the costs to individuals and the society at large. A valuation of benefits vis-à-vis costs helps in any kind of decision making on projects involving a conflict between development and conservation.

2. RATIONALE OF THE STUDY

'Air Pollution' is contamination of atmosphere by substances that directly or indirectly adversely affect human health or welfare. It is now an established fact that high concentrations of lower atmospheric pollution (e.g. ozone, lead and particulate matter) poses a serious threat to human health. The threats to human health are due to morbidity and mortality problems. Prolonged exposure to air pollution may lead to *asthma, allergy, lung diseases, chronic bronchitis, COPD, heart damage* and even *lung cancer*. Air toxics such *as benzene, toluene, dioxin, lead* and *mercury* cause serious health problems. There is now clear evidence which supports that long-term exposure to traffic related air pollution also affects brain functions and even cognitive and learning abilities of children. In addition, there is overwhelming evidence that air pollution leads to increased rate of heart attacks, hardened arteries and numerous cardiovascular diseases.

Pollution not only has negative physical impact on environment but also has economic costs arising through the *loss in productivity*, *loss in working days* due to illness, *treatment costs for illness* and finally *loss of wages*. It is a challenge which not only threatens basic human welfare, but also damages natural and physical capital thereby constraining economic growth. The intangible costs include the patient's level of pain and suffering due to the disease and limitations imposed by this pain and suffering on the latter's quality of life.

Thus, environmental pollution that impairs human health can reduce people's well-being through at least the following five channels: (1) medical expenses associated with treating pollution-induced diseases, including the opportunity cost of time spent in obtaining treatment; (2) lost wages; (3) defensive or averting expenditures associated with attempts to prevent pollution induced disease; (4) disutility associated with the symptoms and lost opportunities for leisure activities; and (5) changes in life expectancy or risk of premature death.

Changes in the life support capacity of the environment brought about by reducing the pollution of air can lead to decreases in the incidence of disease, reduced impairment of activities, or perhaps increased life expectancy.

If the air quality is improved, and individual benefits from being able to reduce his medical expenditures, the lost wages and the opportunities for leisure that are associated with defending against the health impacts of air pollution.

Very few studies have looked into the economic aspects of health cost due to air pollution in the case of India. Thus, there is a need to establish economic relationship between health cost and air pollution. The information on economic dimensions of ill health is of crucial importance for the stakeholders in designing the most appropriate and effective policy initiatives to mitigate the adverse outcomes of ill health. Governments have to decide on a wide array of competing development goals. Monetizing the costs of pollution can help them in allocating scarce resources more efficiently to better the lives of their citizens. Studies on economic costs of air pollution also aid in cost benefit analysis of various policies to combat pollution thereby encouraging cost effective air quality management system. This study makes a modest attempt to study the economic impact of air pollution on deterioration on different socio-economic classes living in Delhi .

3. ECONOMIC COST OF AIR POLLUTION

The rapid process of urbanization and industrialization in developing countries has resulted in the degradation of air quality. However, accompanying this phenomenon has been the growing realization that economic development and environmental management are mutually supporting goals.

The people who live longer would be available to contribute to India's economy for more years. Furthermore, cleaner air

makes people more productive due to reduced rates of sickness. Air pollution retards growth by causing people to die prematurely. There is an opportunity to choose longer, healthier and more productive lives for hundreds of millions of Indians.

An important aspect of the air pollution is to study the differential effects of air pollution on different socio-economic classes of population. The equity in the health effects of air pollution in an urban society could exist due to differences in exposure, susceptibility and coping capacity of various socio-economic classes.

The reasons of these differences may be due to poor living conditions, material deprivation, pre existing vulnerable health status, hereditary predisposition and apprehension (psychosocial influence). Moreover, due to low levels of social, financial and infrastructural facilities the individuals with low socio-economic status have lower adaptive or defensive capabilities to combat the adverse consequences of air pollution. The exposure to air pollution is high for the low income groups due to unhealthy living conditions, exposure to busy road traffic and long hours spent outside. The impact gets for the aggravated due to higher indoor pollution on account of use of poor fuel for cooking appliances and occupational exposure due to unorganised sector job profile such as in the construction industry and finally higher exposure due to lower educational status, family background and deprivation of basic needs.

4. COST TO THE HOUSEHOLD

Pollution harms the individual's health and well-being by lowering their enjoyment of life (for instance, smog reduces visibility, ruining the enjoyment of otherwise scenic views), makes them sick (morbidity) and also causes death (mortality) in extreme cases. Medical treatment, visits to the hospital, lost time at work- all these are a burden on household's income. There is significant evidence that pollution poses substantial cost on households. These can be categorized as:

Direct welfare or well-being cost

Income cost

Wealth cost

Direct welfare costs: These are basically the medical cost that the individual has to incur due to illness caused by pollution. Hospital costs, diagnostic tests, medications- all are direct costs to households from their pockets. Illness cause people to miss work, reducing their personal incomes and the incomes of the businesses they work for. Friends and family may also miss work for the sick relatives what some call the *caregivers cost*.

This impact of pollution is related to the burden imposed on health and other aspects of human well-being that are not associated with *economic activities.*

Direct costs to human well-being include suffering due to premature death (mortality) and increased illness (morbidity) caused by pollution as well as the costs associated with other non -health losses of life satisfaction; for instance, lost enjoyment of recreational opportunities due to air pollution.

Income costs: These costs impact the income and consumption of market goods and services by the individual. They are in the form of either reduced incomes due to work-days lost or increased expenditure (or both) for individuals. Individuals who fall sick due to pollution are either not able to go to work or their productivity suffers with repercussions on not only their incomes but also on income of the economy. The increased expenditure on consumption may be in the form of *pollution-averting* behavior wherein the individual or the household spends on air- purifiers, masks, travelling by air-conditioned transport and so on.

Wealth costs: The value of an asset such as house or property owned by an individual may depreciate because of air pollution thereby affecting the future income and expenditure of the household. For instance, peeling of painted surfaces, corrosion of metals and weakening of plastics and stones. Pollutants cause materials to break down sooner than they would otherwise leading to additional costs of maintenance (such as more frequent painting and maintenance) and reduced lifespan of structures.

The main feature which distinguishes *direct* welfare costs from *income* and *welfare* costs is that the former need not involve the market. Pollution causes human mortality, morbidity and other loss of welfare- all without any mediation by the market. That is why, they are termed as "direct" costs.

It is to be noted that the costs in these three categories are not directly comparable and should not be added together. Therefore, no overall "cost of pollution" can be computed as such.

Due to no involvement of market in the direct welfare costs, there are usually no market prices available to value them. They are therefore not directly comparable with *income* or *wealth* costs which are always valued using market prices. The absence of market prices has forced Economists to use different techniques in their valuation. Most often, it involves asking individuals to state directly how they value different costs and benefits. (Stated Preference Approach). For example, asking people how much they are willing to pay for pollution free residential zone or for good health.

Although the cost of loss of human life is immeasurable in any actual instance, it is usually measured in context of value of a "*Statistical"* life in monetary terms. Economists determine this value by considering the "Willingness to *Pay"* (WTP) of individuals to avoid small changes in the risk of dying (premature death). The resulting value does not actually represent the value of an individual's life (which is immeasurable) but rather an estimate of the collective

willingness to pay to avoid the death of a representative individual due to pollution.

5. IMPACT OF SOCIO-ECONOMIC STATUS

Many studies have found that people with lower socio-economic status experience a higher health risk from air pollution while people with middle or high socio-economic status barely had health risk since they had more ways to avoid pollution. Moreover, as the severity of air pollution increases health disparities among people with different social-economic status increases. The reasons that explain stronger effects of air pollution among people belonging to low socio-economic class are many fold:

Differential Exposure

The level of exposure to air pollution is higher among people living in low socioeconomic communities. Schoolman and Ma Found that townships and areas with higher proportion of of rural migrants were exposed to higher levels of air pollution.

Differential Susceptibility

Individuals with low socioeconomic status are more sensitive and susceptible to air pollution compared to individuals with high socio-economic status. This susceptibility is caused by health related social, behavioural and psychological factors such as poor health status (such as diabetes, high blood pressure and obesity), Addictions such as smoking, exposure to secondhand smoking low intake of nutrition, genetic factors and even psychological stress. Moreover, people with low socio-economic status have significantly less access to good quality medical services than those belonging to higher socio-economic status. Additionally, under the same level of air pollution, people with low economic status are more exposed to air pollution due to outdoor work environment compared to indoor work environment which also depends on the type of occupation.

6. REVIEW OF LITERATURE

The tangible benefits from upgrading the air quality of urban areas go to the poor rather than the rich. According to a study by Asch and Joseph (1978), who investigated both inter- and intra-city variations in air quality in the U.S states, a higher exposure to particulates is associated with cities characterized by low income and hence, low education, low property value, and crowded population. Using generalized linear models (GLMs), Jerrett et al. (2004) showed that air pollution was related to expansive deaths in intra-urban zones of low socioeconomic profile. Furthermore, low education and high manufacturing employment in the zones substantially enhanced mortality impacts of air pollution exposure. A study by Pratt et al. (2015) studied the inequities in exposure to air pollution from traffic and the related risk in the state of Minnesota, America. They found that the risks and exposures were differentially larger than expected for ethnic minorities and low socio economic population. In similar studies , Fecht et al. (2015) examined inequities of exposure to air pollution in England and the Netherlands at all three levels namely country, city and regional levels. The results of the study showed a greater concentration of air pollution in those areas of the two countries which had more than 20 per cent non-white population and the most deprived and poor neighborhoods in England. In a related study in Africa Rooney et al. (2012) examined the spatial patterns of particulate pollution and its sources in four neighborhoods of varying socio-economic groups in Accra using mixed-effects regression model. It found that socio-economic status was inversely associated with both PM2.5 and PM10 levels. In one of the A studies highlighting inequity in air-pollution , Fan, Lam and Yu (2012) tried to examine the spatial variations in urban population of Hongkong by analyzing the relationship between socio-economic status and exposure to vehicular pollution. The results of the study corraborated that there was more inequality in private housing lands than their public counterparts. Also, older and low socio-economic groups faced relatively greater exposure to air pollution as compared to higher socio-economic status groups. However, when all residents are clubbed, results showed no status prejudice in air pollution exposure which can be attributed to the housing mechanism in Hong Kong, where the poor live in government-provided housing with relatively good air quality. There are not too many studies on the inequity impact of air pollution in India. Most studies look at the health consequences and analysis of cost and benefits of improved health from a reduction in air pollution. In a study of households of Delhi, Cropper et al. (1997) estimated a dose-response function of health status to pollution levels. Results showed that more than two per cent of non-traumatic deaths in Delhi were due to increased pollution levels (TSPM) and that the relationship was significant for children and adults. Kumar and Rao (2001) studied the economic benefits of improved air quality in Haryana and found that a representative household has willingness to pay (WTP) of Rs. 12 to Rs. 53 per month for reducing particulate matter to the level prescribed by WHO standards. Using health production model , a study by Murty et al. (2003) conducted in Delhi and Kolkata found the annual health benefits from reducing air pollution levels to safe levels in the urban areas of Delhi and Kolkata to be Rs. 4896.6 million and Rs. 2999.7 million, respectively . In yet another study by Usha Gupta (2006) conducted in the city of Kanpur using the household health production model, the economic gains from reduction in air pollution were examined and results concluded that a typical resident of Kanpur would annually save Rs. 165, if pollution was reduced to standard levels . On the whole, population of Kanpur would gain Rs. 213 million annually. In one of the rare studies of its kind, Garg (2011) analyzed the equity aspects of air pollution reduction and found that the health effects of air pollution are more detrimental to the poor. The research study had quantified mortality and morbidity due to pollution for various socio-economic groups in Delhi with spatial data on

concentrations of PM10 and socio-economic status of different households . It concluded that the health benefits from better air quality are differentially favoured towards the poor. A study by Makri and Stilianakis (2008) demonstrates the vulnerability to air pollution and its health consequences through risk assessment analysis . According to this study the population characteristics have socio-economic parameters that increase the vulnerability, exposure, susceptibility and coping capacity of different groups. A study by Kathuria and Khan (2007) examined the relation between air pollution exposure and socio-economic characteristics. It used a two-step methodology for computing a household-specific exposure index for 347 houses in close proximity to pollution monitoring station in Delhi. The study examined the relationship of air pollution exposure with socioeconomic and demographic characteristics using the technique of multivariate regression. The results showed that economically weaker sections are more exposed to air pollution than their counterparts. A more recent study by Foster and Kumar (2011) in Delhi found that people who remained outdoors for long hours had relatively stronger health impacts of air pollution. The study also pointed out betterment in their health status following improvements in ecology, economy and society through strict regulation of air quality policies. A meta-analysis by Hajat, Hsia and Neill (2015) made similar conclusions.

7. METHODOLOGY OF THE STUDY

Data about the expenditure on respiratory illness and socio–economic characteristics of households are obtained through household survey in four different parts of Delhi namely Seelampur (East Delhi),Vasant Kunj (South Delhi), Wazirpur and Ashok Vihar (North Delhi). A sample of 50 households in each area was surveyed over four different times of the year.

Since air pollution directly effects respiratory health, the expenditure on illness in the present study focuses on respiratory illness.

There are seven monitoring stations in Delhi providing regular monthly data on air pollution concentrations of SPM (PM10 and PM2.5), and NO_2 and SO_2. However, since PM2.5 is the prominent pollutant in case of Delhi, data on PM2.5 was collected from the nearest CPCB station to all four localities. In order to make comparisons between different income groups, samples were drawn from both high-income group area (Ashok Vihar) and low-income group area (Wazirpur) in North Delhi.

Time period of study

. Quarter 1: Survey I Round in January 2016 (data obtained from October 2015 – December 2015)

. Quarter 2: Survey II Round in April 2016 (data obtained from January 2016 – March 2016)

. Quarter 3: Survey III Round in July 2016 (data obtained from April 2016 – June 2016)

. Quarter 4: Survey IV Round in October 2016 (data obtained from July 2016 – September 2016).

7.1 Data collection

Data about health expenditure was collected for a recall period of three months. Information about the health history and respiratory health stock of the individuals was obtained through a well-designed questionnaire. The detailed data collected consists of *days of sickness, number of visits to the doctor, expenditure on medicines, doctor fees, travel cost* and *diagnostic tests*. Information was also collected on health-insurance and the household opinion on various policy measures to reduce air pollution in the national capital Delhi. A *five-point Likert scale* was used for the purpose.

Information about the demographic characteristics of households such as family size, age and sex composition of the family, the education level of the family members and the occupation of the respondent was also collected.

7.2 Establishing relationship among variables

The impact of air pollution results in changes in the health status (number of sick days) of an individual. There are various factors which determine the health status of individuals. These factors can be characterized as: *age; income; gender; education; distance travelled; transportation; health stock (respiratory) and outdoor pollution.*

Construction Variables

i. Age: The households were divided into four different age groups in order to study the economic impact of air pollution on the more vulnerable age groups, particularly the children and the old. The age groups are:

Less than 15 yrs

15 – 30 yrs

30 – 50 yrs

More than 50 yrs.

ii. Income: Annual income of the household was recorded in the questionnaire. The various income levels were categorized as:

Less than 20,000

20,000 – 1,00,000

1,00,000 – 2,00,000

Greater than 2,00,000

iii. Education: The education levels are recorded in the questionnaire under the following categories:

Below secondary and Not Educated

Undergraduate and Senior secondary

Graduate

Masters or professionals (M.B.A; B.E; B.Tech; M. Tech; B.Arch; C.A

iv. Occupation (Dummy): This parameter was categorized in to three different types.

Type I: Helper, Housewives, Retired People, Caretaker or Infants (*Minimum Exposure*)

Type II: Businessmen, Shopkeepers, Barber, Engineer, Students, Music Teacher, Clerks, Investment advisor, Advocate, Banker, Supervisor, Tailor, Teacher, Government Service, Designer, Self-Occupied (*Limited Exposure*)

Type III: Auto Driver, Salesmen, Washermen, Rickshawpuller, Cobbler, Tinpainter, Labourer, Factory worker (*Maximum Exposure*)

v. Distance Travelled (Dummy): The distance travelled by the respondent was categorized as: m

More than 35 kms

10 to 35 Kms

5 to 10 Kms

Less than 5 Kms

vi. Transportation (Dummy): The transport used by the respondent was classified as:

Two-Wheeler; On Foot; Diesel Car; Cycle

Petrol/CNG Car

Bus

Metro, No commute

***vii.* Respiratory Health Stock**: This takes stock of respiratory disorders which an individual experiences due to air pollution. The various categories of respiratory health stock are as follows:

Bronchitis, Asthma.

Chest Tightness, Shortness of Breath, Sinusitis.

Either of above, Cold and Cough.

None of the above

viii. Gender (Dummy): This variable indicates whether the individual is a male or female. Since the variable takes only binary value, it is defined as gender dummy variable where, Male = 0; Female = 1

***ix.* Outdoor pollution**: The outdoor pollution is reflected by PM 2.5 (Data obtained from nearest CPCB Monitoring Station).

Dependent Variables

Mitigation Expenditure: It captures the expenditure undertaken on account of illness (here due to respiratory ailment). The medical expenditure is determined by the factors like age; gender; income; education; occupation; mode of transport and distance travelled.

Number of sick days: It is determined as an indicator of health status of an individual. As an individual gets exposed to more pollution, his expected number of sick days is going to increase. In the present study, sick days is assumed to be days on which the respondent was either bedridden due to his respiratory ailment or because of which he or she could not carry out daily routine activities including going to work. This information is obtained by asking the number of sick days in the last three months from the respondent. (*Refer to questionnaire in the appendix*).

Total Economic Cost: This is obtained as the sum of total mitigation cost and wage loss on account of illness. The information about wage loss on account of illness was collected in the questionnaire.

Total Economic Cost = Total Mitigation Cost or Medical Expenses + Wage Loss on account of Illness.

7.3 Sample Profile

The snowball method of sampling was used in the study. It is *a non - probability* sampling technique where the existing study subjects provide references of other subjects from among their acquaintances. Initially, some households were selected based on *Convenience sampling* in the four areas of Delhi namely *Seelampur (East Delhi), Vasant Kunj (South Delhi), Ashok Vihar* and *Wazirpur (North Delhi).* Subsequently, snowball sampling was used to cover more households. Once the sample households were decided, the same group of households (cohort) were studied over four different times of the year in order to estimate the annual economic cost to them due to air pollution. A *cohort-based* study enables us to show long-term, cumulative impact of air pollution. It will present a more comprehensive picture of health risks associated with air pollution and its economic impact on a household in the National capital territory of Delhi.

8. RESULT ANALYSIS

ANOVA is highly significant (with a value of .000) .Annual income status is statistically significant at 1%. Total cost increases with income because as a person's spending capacity increases he incurs higher costs on his health maybe due to better quality of health services or more preventive and expensive diagnostic tests. Annual income is also positively correlated with mitigating expenditure showing higher medical expenditure as the income status becomes higher. This further reinforces that the higher income groups are able to spend more on medical expenses to not only get better

quality healthcare but also to prevent various diseases through early detection enabled by diagnostic tests.

9. CONCLUSION

A very high percentage of people living in Delhi and other cities of India are increasingly exposed to dangerous levels of ambient air pollution. The people living in slum areas of the capital city are more vulnerable to the detrimental effects of air pollution. To tackle this, pollution control would need to be at the top of the agenda for the government. However, such expenditure often competes with other budgetary priorities and policy objectives. The study concludes that the gains from pollution reduction in Delhi will benefit the poor income households more than high income households.

Given the current economic and energy paradigm and the rapidly urbanizing world which exposes the population to increasing air pollution, mitigating the damage cost in the future remains a challenge. The reduction in current levels of economic damage in Delhi will require successful implementation of policies that are environmentally sustainable. The opportunities exist for better air monitoring and timely public alerts in the capital city and sustainable development can be achieved by promoting the use of cleaner fuels and making more stringent vehicle emission standards.

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List and number all bibliographical references in 9- point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example [2-4], [2, 5], and [1].

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