

The Impact Study Of Vehicular Pollution On Environment

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Abstract- *The rapid development in urban India has resulted in a tremendous increase in the number of motor vehicles. In some cities, this has doubled in the last decade. Rapid urbanization and growth of motor vehicles impose a serious effect on human life and the environment in recent years. Motor vehicles are a significant source of urban air pollution and are increasingly important contributors of anthropogenic carbon dioxide and other greenhouse gases. Transport sector contributes a major sector, contributing 90% of total emissions. Air pollution is a serious environmental health threat to humans. Adverse effects range from nausea, difficulty in breathing and skin irritations, birth defects, immunosuppression and cancer. All these situations indicate that air pollution becoming a major problem in Indian context and there is an essential need to build up healthy environment and increase the level of research around the world.*

The document presents a review of the vehicular emission problems in Indian cities, the various developments that have taken place in the past including the studies conducted for assessment of the air quality in cities, the legislation and standards adopted for the control of vehicle emissions, the role of the various concerned agencies, the steps taken for improvement in the quality of the automotive fuel, the overall impact of these measures and the future strategy to be adopted for vehicular emission reduction and related issues.

Keywords- Vehicular Pollution, Air Pollution, Environment, Greenhouse Gases, Carbon Dioxide, Ozone, Pollutant

I. INTRODUCTION

Air pollution is one of the serious environmental concern of the urban Asian cities including India where majority of the population is exposed to poor air quality. The health related problems such as respiratory diseases, risk of developing cancers and other serious ailments etc. due to poor air quality are known and well documented. Besides the health affects, air pollution also contributes to tremendous economic losses, especially in the sense of financial resources that are required for giving medical assistance to the affected people. The poor are often the most affected segment of the

population as they do not have adequate measures to protect themselves from air pollution.

Most of the Indian Cities are also experiencing rapid urbanization and the majority of the country's population is expected to be living in cities within a span of next two decades. Since poor ambient air quality is largely an urban problem this will directly affect millions of the dwellers in the cities.

The rapid urbanization in India has also resulted in a tremendous increase the number of motor vehicles. The vehicle fleets have even doubled in some cities in the last one decade. This increased mobility, however, come with a high price. As the number of vehicles continues to grow and the consequent congestion increases, vehicles are now becoming the main source of air pollution in urban India. Although, the air quality can be improved through a combination of technical and non-technical measures, legislative reforms, institutional approaches and market-based instruments, there are certain unique challenges which the country has to face in tackling the problem of urban air pollution. These include, the transport features which are different from the developed countries particularly in terms of the types of vehicles commonly used, the manner in which the road network is operated and sharing of the limited space by pedestrians and non-motorized modes with modern vehicles in Indian cities. Vehicles in India are often much older and usually comprise technologies considered as out-dated in the developed world. The institutions responsible for managing urban air quality are also not as well developed as those in the developed countries. The country has however taken a number of measures for the improvement of the air quality in cities. These include, right from the improvement in the fuel quality, formulation of necessary legislation and enforcement of vehicle emission standards, improved traffic planning and management etc. The non-technical measures taken include, awareness raising regarding the possible economic and health impacts of air pollution and available measures for improving air quality, increasing use of cleaner fuels and purchase of vehicles with advance emission control devices, increasing institutional framework and capacity building for the monitoring of vehicle emissions.

1.1 Vehicular Pollution:

Vehicular pollution is the introduction of harmful material into the environment by motor vehicles. These materials, known as pollutants, have several bad effects on human health and the ecosystem. Transportation is a major source of air pollution in many countries around the world due to the high number of vehicles that are available on the roads today. An increase in purchasing power means that more people can now afford cars and this is bad for the environment. Vehicular pollution has grown at an alarming rate due to growing urbanisation in India. The air pollution from vehicles in urban areas, particularly in big cities, has become a serious problem. The pollution from vehicles has begun to tell through symptoms like cough, headache, nausea, irritation of eyes, various bronchial and visibility problems.

1.2 Vehicular Pollution in India:

Air pollution is one of the serious environmental concerns of the urban cities where majority of the population is exposed to poor air quality. The rapid urbanization in India has resulted in a tremendous increase in the number of motor vehicles. As the number of vehicles continues to grow and the consequent congestion increases, vehicles are now becoming the main source of air pollution in urban India. The country has taken a number of measures for the improvement of the air quality in cities. These include, the improvement in the fuel quality, formulation of necessary legislation and enforcement of vehicle emission standards, improved traffic planning and management, etc.

1.3 Vehicular pollutants:

Automotive vehicles emit several pollutants depending upon the quality of the fuel they consume and engine efficiency. The release of pollutants from vehicles also include fugitive emissions of the fuel and the source and level of these emissions depending upon the vehicle type, its maintenance, etc. The major pollutants released as vehicle/fuel emissions are, carbon monoxide (CO), nitrogen oxides (NO_x), photochemical oxidants, air toxics, namely benzene (C₆H₆), aldehydes, 1,3 butadiene (C₄H₆), lead (Pb), particulate matter (PM), hydrocarbon (HC), oxides of sulphur (SO₂) and polycyclic aromatic hydrocarbons (PAHs). While the predominant pollutants in petrol/gasoline driven vehicles are hydrocarbons and carbon monoxide, the predominant pollutants from the diesel based vehicles are Oxides of nitrogen and particulates.

1.4 Ingredients of Vehicular Pollution:

Ozone- The primary ingredient in urban smog, ozone is created when hydrocarbons and nitrogen oxides—both of which are chemicals released by automobile fuel *combustion*—react with sunlight. Though beneficial in the upper atmosphere, at the ground level ozone can irritate the respiratory system, causing coughing, choking, and reduced lung capacity.

Particulate matter- These particles of soot, metals, and pollengive smog its murky color. Among vehicular pollution, fine particles pose the most serious threat to human health by penetrating deep into lungs.

Nitrogen oxides- These vehicular pollutants can cause lung irritation and weaken the body's defenses against respiratory infections such as pneumonia and influenza. In addition, they assist in the formation of ozone and particulate matter.

Carbon monoxide- This odorless, colorless gas is formed by the combustion of fossil fuels such as gasoline. Cars and trucks are the source of nearly two-thirds of this pollutant. When inhaled, CO blocks the transport of oxygen to the brain, heart, and other vital organs in the human body. Newborn children and people with chronic illnesses are especially susceptible to the effects of CO.

Sulfur dioxide- Motor vehicles create this pollutant by burning sulfur-containing fuels, especially diesel. It can react in the atmosphere to form fine particles and can pose a health risk to young children and asthmatics.

Hazardous air pollutants- These chemical compounds, which are emitted by cars, trucks, refineries, gas pumps, and related sources.

II. VEHICULAR POLLUTION PROBLEMS IN INDIA

Motor vehicles have been closely identified with increasing air pollution levels in urban centers of the world. Besides substantial Carbon Dioxide (CO₂) emissions, significant quantities of Carbon Monoxide (CO), Hydrocarbon (HC), Nitrogen Oxide (NO_x), Suspended Particulate Matter (SPM) and other air toxins are emitted from these motor vehicles in the atmosphere, causing serious environmental and health impacts. Like many other parts of the world, air pollution from motor vehicles is one of the most serious and rapidly growing problems in urban centers of India. The problem of air pollution has assumed serious proportions in some of the major metropolitan cities of India and vehicular emissions have been identified as one of the major contributors in the deteriorating air quality in these urban

centers. The problem has further been compounded by the concentration of large number of vehicles and comparatively high motor vehicles to population ratios in these cities.

Reasons for increasing vehicular pollution problems in urban India are as below;

- High vehicle density in Indian urban centers.
- Older vehicles predominant in vehicle vintage
- Predominance of private vehicles especially cars and two wheelers, owing to unsatisfactory public transport system, thereby causing higher idling emissions and traffic congestion.
- Absence of adequate land use planning in development of urban areas, thereby causing more vehicle travel and fuel consumption
- Inadequate inspection & maintenance facilities.
- Adulteration of fuel & fuel products
- Improper traffic management system & road conditions
- High levels of pollution at traffic intersections

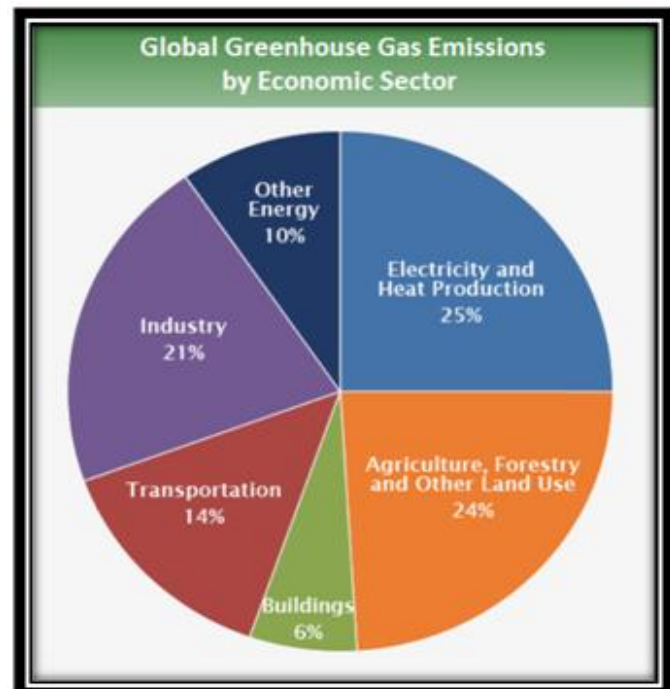
III. VEHICULAR POLLUTION AND CLIMATE CHANGE

The world average temperature has risen by about 1 F° over the past century. It is widely accepted that the global warming is related to anthropogenic Green House Gases (GHGs). GHGs include, the common gases namely, carbon dioxide and water vapor, and rarer gases such as nitrous oxide, methane and chlorofluorocarbons (CFCs) whose properties relate to the transmission or reflection of different types of solar radiations. The increase in such gases in the atmosphere is a result of the burning of fossil fuels, emission of pollutants into the atmosphere by power plants and vehicle engines, etc. Of all human activities, driving motor vehicles produces the most intensive CO₂ emissions and other toxic gases per capita. A single tank of gasoline releases 140 ~180 kilograms of CO₂. Over 25% of transportation-related GHG emissions originate from urban passenger travel (Yang M. 1998). Unsustainable trends in urban transportation have already manifested in frequent congestions, periodic gridlock and evidence linking respiratory illnesses and deaths to poor air quality.

IV. GLOBAL EMISSIONS OF GHG'S FROM TRANSPORT SECTOR

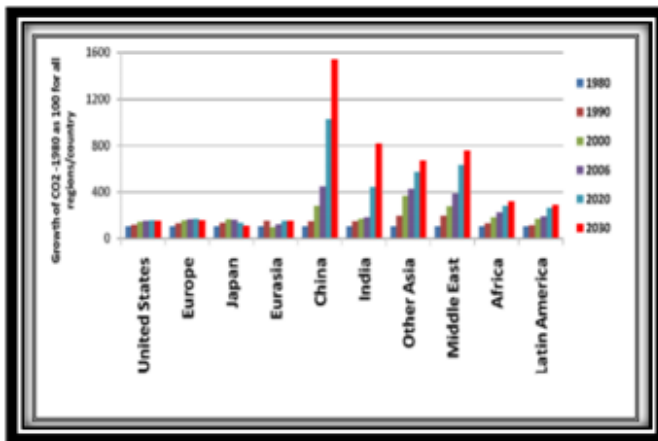
Transport sector contributes around 14% towards the global emissions of green house gases. Carbon dioxide represents the largest proportion of basket of greenhouse gas

emissions. During, the past three decades, carbon dioxide emissions from transport have increased faster than those from all other sectors and are projected to increase more rapidly in future. The Road transport alone emits around 16% of the global CO₂ emissions (Source: OICA). From 1990 to 2004, carbon dioxide emissions from the world's transport sector have increased by 36.5%. For the same period, road transport emissions have increased by 29% in industrialized countries and 61% in the other countries (IEA, 2006). The global emissions of GHG's from different sectors have been shown in figure 1.0. shipping & Railways sector emissions of CO₂ from transport sector are about 11%, 9% & 2% respectively.



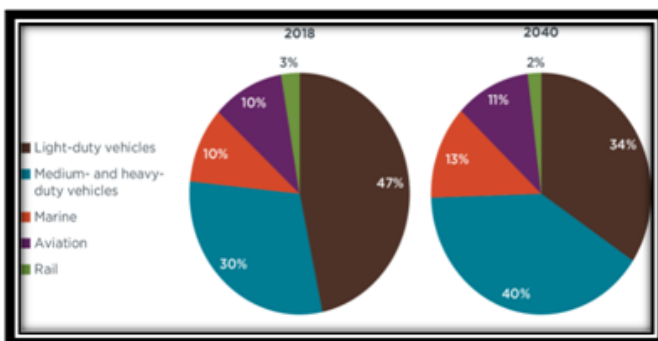
(Figure 1.0 : Global emissions of GHG's from different sectors)

The CO₂ emissions in the major developed and developing countries around the world during 1980 to 2030 is shown in figure 1.1. The figure shows that the global CO₂ emissions are going to get stabilized in the developed countries in the near future, the CO₂ are likely to increase in the developing countries owing to its due economic growth as well rising human population. However, in terms of per capita emissions the emissions from developing countries alike developed countries, are also expected to stabilize in the near future.



(Figure 1.1 : CO2 emissions Transport sector 1980 - 2030
Source: Modified from IEA 2008, World Energy Outlook)

The mode wise distribution of CO₂ emissions amongst transport section (See figure 1.2), reveals that road transport contributes major share of around 73% towards total CO₂ emissions from transport sector. Aviation, International



(Figure 1.2 : Global GHG's emissions from Transport sector (Mode-Wise)

V. VEHICULAR EMISSIONS LOAD IN INDIA

In India, the number of motor vehicles has grown from 0.3 million in 1951 to approximately 50 million in 2000, of which, two wheelers (mainly driven by two stroke engines) accounts for 70% of the total vehicular population. Two wheelers, combined with cars (four wheelers, excluding taxis) (personal mode of transportation) account for approximately four fifth of the total vehicular population. The problem has been further compounded by steady increase in urban population (from approximately 17% to 28% during 1951-2001; Sharma; 2001 and larger concentration of vehicles in these urban cities specially in four major metros namely, Delhi, Mumbai, Chennai and Kolkatta which account for more than 15% of the total vehicular population of the whole country, whereas, more than 40 other metropolitan cities (with human population more than 1million) accounted for 35% of the vehicular population of the country. Further, 25% of the

total energy (of which 98% comes from oil) is consumed by road sector only. Vehicles in major metropolitan cities are estimated to account for 70% of CO, 50% of HC, 30-40% of NO_x, 30% of SPM and 10% of SO₂ of the total pollution load of these cities, of which two third is contributed by two wheelers alone. These high level of pollutants are mainly responsible for respiratory and other air pollution related ailments including lung cancer, asthma etc., which is significantly higher than the national average (CSE, 2001; CPCB, 2002).

VI. POLLUTION LOAD FROM ROAD TRAFFIC IN VARIOUS MEGA CITIES

The vehicle pollution load as estimated through a joint study conducted by Central Road Research Institute (CRRI), National Environmental Engineering Research Institute (NEERI) & Indian Institute of Petroleum (IIP) in the year 2002 for four key pollutants (i.e. CO, NO_x, HC and PM) in eight mega cities namely Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Kanpur & Agra are given in Table 1.1. This is attributable to the highest number of automobiles operating in Delhi. From the table it can be seen that Delhi has the maximum vehicle pollution load compared to any other city in the country.

VII. SERIOUS EFFECTS OF VEHICULAR POLLUTION

1. Global Warming:

One of the leading effects of vehicular pollution is global warming. Vehicular pollution results in the emission of greenhouse gases into the atmosphere, which results in the depletion of the ozone layer and an increase in atmospheric temperature, leading to global warming.

As a result, it contributes to adverse weather such as heavy rains, flooding, and extremely high or cold temperatures linked to the loss of lives, destruction of property, damage to the soils, and sometimes even adversely impacting agriculture.

2. Poor Air Quality:

Vehicular pollution has destroyed the air so much that in some countries, people have to wear face masks, to reduce the number of harmful substances inhaled. In the US particularly, vehicles produce about a third of the nation's air pollution.

It makes living in such cities uncomfortable, having to walk around with a mask all day, let alone the fact that there

are possibilities of developing health complications. The air in such areas is filled with various kinds of pollutants, which greatly reduce the air quality index.

3. Reduced Visibility:

Vehicles produce a lot of emissions, and can at times make visibility a problem, especially if an old vehicle or a truck carrying a lot of loads drives by. Such vehicles produce a lot of smoke, which hampers visibility making one unable to see what is in front. This means that if you were driving behind such a vehicle, visibility would be affected, even if it is for a few seconds.

In heavily polluted cities with many vehicles producing such smoke, visibility becomes a huge problem. The matter is worsened when there is fog, which results in the formation of smog (a mixture of smoke and fog).

4. Health Issues and Complications:

Pollutants from vehicular pollution can result in lung infections, complications, and even various types of cancers. The hydrocarbons are not good for human health and they can also cause heart disease, damage the central nervous system, make breathing difficult, aggravate asthma and if left unchecked, they could result in premature death.

Approximately 5,000 people die every year because of lung cancers and heart attacks caused by vehicle exhaust fumes. Treating these diseases also requires a lot of money and causes a lot of emotional pain to the relatives of a patient.

The spillage of oil further affects plants, animals and marine life. The health of a nation could also be at risk, especially if the economy will stall after the ability of people to work and generate income is affected.

5. It Results in Acid Rain:

One of the gases produced by vehicles is nitrogen oxide and it contributes to the formation of highly corrosive smog which results in the rusting of vehicles and the corrosion of structures.

When the nitrogen oxide dissolves in rain, acid rain is produced, which can significantly reduce the lifespan of buildings made by limestone and marble if they come into direct contact. Besides, any water harvested from this type of rain is not fit for human and animal consumption and can cause stunted growth in plants.

6. It Affects Tourism:

Because of the adverse effects of vehicular pollution, especially the formation of smog, tourism ends up being affected. Most people are not willing to visit cities or countries that are not going to be good for their health or knowing that their visit could lead their premature death. The decrease in tourism results in the loss of foreign exchange income.

VIII. SOLUTIONS TO VEHICULAR POLLUTION

1. Drive Less:

We are desperately dependent on fossil fuels and the number of vehicles on the roads will continue to increase. We can only try and reduce vehicular emissions by doing our parts, and one of the easiest things to do is drive less and choose alternatives such as walking, using the train or public transportation, and even using a bike. Carpooling is another way to drive less, where people from the same neighborhood or the same area can share one vehicle instead of each using their own.

2. Governmental intervention:

Most city governments can take action to lower vehicular pollution, seeing that more emissions are produced by vehicles in urban areas because of traffic and the fact that people have to drive slowly in towns. The necessary daily commute to work further worsens the problem of vehicular pollution.

To address the issue, city governments or municipalities can order that no vehicles enter the central business district and instead, they be parked on the outskirts. To overcome the shortage, bus rapid transit systems should be improved, as well as trains that operate within the cities. This would eliminate traffic jams, and lower vehicular pollution in urban cities.

3. Invest in zero-emission vehicles:

Not all vehicles today are relying on fossil fuels for locomotion. Electric vehicles have moved away from burning fuel and use electrochemical processes to produce the energy required for a vehicle to move. The by-product of fuel-cell vehicles is water and that is why these types of cars are known as zero-emission vehicles.

They store energy in an onboard battery and emit nothing from their tailpipe. More research needs to be invested in electric cars because as of now, they cannot handle difficult

tasks such as ferrying heavy loads. There also exist hybrid-electric vehicles that use both a gasoline engine and an electric motor plus battery. They are a bit expensive, but eventually, they save at the gasoline pump.

4. Burn Fewer Fuels:

The key to burning fewer fuels is making vehicles more efficient. Governments need to set fuel-economy standards for all passenger vehicles, including the advocacy for the use of technologies that help cars and trucks to further on a gallon of gasoline.

Most pickup, SUVs and minivans, on average travel less distance on a gallon of gas than they did decades ago. If this is implemented, it can help reduce the number of dangerous gases that are emitted into the atmosphere.

5. Having in Place Pollution Control Technologies:

Some jurisdictions require the use of technologies that dramatically reduce the amount of smog-formation pollution and carbon gases coming from vehicles. For diesel vehicles, 'two-way' catalysts and engine controls reduce hydrocarbons and carbon monoxide emitted, although they still emit a lot of nitrogen oxide and toxic particulate matter.

For gasoline vehicles, 'three-way' catalysts, precise engine and fuel controls, as well as evaporative emission controls, reduce smog-forming emissions from new vehicles by a factor of ten. New technologies can identify emission-equipment control failures, as well as, help reduce the gross pollution problem.

6. Civic Education:

Many people know about the effects of these emissions but play ignorant, while some simply do not know about them. Civic education, especially on the short-term and long-term effects of vehicular pollution on our lives and the planet in general, could open up eyes and help people make sane decisions.

It is a task that should be imposed upon every individual, government, non-governmental institutions and various other institutions all over the world, and they could awaken the society to the realities of pollution, its effects and how to reduce it. A sense of responsibility should be cultivated in each person so that they grow a desire and willingness to do the right thing.

7. Discarding Old Vehicles:

Old vehicles are responsible for more vehicular pollution because their transmission systems are outdated. They also cause accidents on the roads because of their many complications and getting rid of them for newer models serves as the most sensible and practical alternative or solution. Newer vehicles use new technologies and pollute the environment less than their older counterparts.

8. Control the formation of nitrogen oxide by investing in novel designs:

some changes can be done to the vehicle's operation parameters or designing them in a way that it lowers the high temperature of the combustion system, which produces the dangerous gas. Some high tech devices could also be used to reduce the formation and emission of the nitrogen oxide in combustion chambers.

IX. EVOLUTION OF VEHICULAR POLLUTION CONTROL MEASURES TAKEN IN INDIA

For containing vehicular pollution, the Government has taken important initiatives in recent years. The Union Government and the Provincial Governments in India have been emphasizing the need for planning and developing strategies to implement mitigation measures to maintain the urban air quality and make the cities cleaner and greener for achieving better air quality and good health for its citizens. Over the past decade or so, the government has brought in statutes aimed at regulating and monitoring industrial and vehicular pollution across the country.

9.1 Awareness Raising:

Public awareness and participation is a key to bringing about policy change. Widespread environmental education promotes understanding of linkages between pollution and health and encourages public involvement. Raising mass awareness among general public has been perceived as one of the major tool in the success of our vehicular pollution control policy framework. Private sector participation through innovative schemes like accepting delivery only from trucks that meet emission standards, Adopt a street campaigns, and air quality monitoring displays should be encouraged / strengthened. Media can also participate in awareness raising by disseminating air pollution related data.

9.2 Developing fuel economy standards:

Adopting fuel economy standards will not only help check the growing consumption of petrol and diesel, it will

also reduce the transport sector's contribution to accumulation of CO₂, not to speak of conventional air pollutants such as particulate matter, oxides of nitrogen and hydrocarbons. The less fuel burned/consumed per km travelled, the less will be the emissions.

The International Council on Clean Technology (ICCT) is working to improve the environmental performance and efficiency of cars, trucks, buses and transportation systems in order to protect and improve public health, the environment, and quality of life. The Japan has increased stringency of its fuel economy standards. In India, the Petroleum Conservation and Research Association (PCRA), an autonomous research body under the Union ministry of petroleum and natural gas, has signed a memorandum of understanding with the Bureau of Energy Efficiency to develop fuel economy standards under the Energy Conservation Act, 2001. The fuel efficiency standard is applicable for all types of vehicles, including cars, trucks and buses. According to government projections, the country could save up to \$36 billion if fuel efficiency is improved by 50% by 2030 in all sectors. A committee of experts is now being set up by PCRA to set target values.

TABLE 1.0
EFFECT OF DIFFERENT POLLUTANTS ON
ENVIRONMENT AND HUMAN HEALTH.

Pollutants	Effect on Environment	Effect on human health
Carbon Monoxide (CO)	N.A.	Harmful for cardiovascular system, central nervous system, pregnant women, and young children. Causes nausea, headaches and drowsiness.
Nitrogen Oxides (NOx)	Causes acid rain. Harmful for fertilization of soil.	Affects respiratory system. Increases vulnerability to infections and lung disease. Causes irritations in noses and eyes.
Sulphur Oxides (SO)	Causes acid rain. Reduces visibility.	Harmful for lungs.
Particulate Matter	Reduces visibility. Creates dirty locality due to dusts.	Causes irritation in lungs and long term disorder. Alters immune system.
Lead	N.A.	Causes damage to brain, lower IQ in children and death.

Table 1.1
Estimated Pollution Load in the cities (2002)

City	Pollution Load in Metric tones per day			
	CO	NOx	HC	PM
Delhi	421.84	110.45	184.37	12.77
Mumbai	189.55	46.37	89.93	10.58
Kolkata	137.50	54.09	47.63	10.80
Chennai	177.00	27.30	95.64	7.29
Bangalore	207.04	29.72	117.37	8.11
Hyderabad	163.95	36.89	90.09	8.00
Kanpur	28.73	7.25	11.70	1.91
Agra	17.93	3.30	10.28	0.91

IX. CONCLUSION

In this age of rapid advancement air pollution due to automobiles has become a critical concern for the environment. Today, in almost every country the majority of population is exposed to the poor quality of environment. The human beings have become vulnerable to different disease starting from a headache to serious diseases such as lungs cancer. This indirectly leads to the economic loss of a country as financial resources are need to be spent for providing required medical facilities to the affected public.

The pollution from motor vehicles can be minimized by using new as well as innovative technology, alternate fuels and government policies. These methods need to be used in a proper way to improve the condition of the environment significantly. The present study helps the automobile manufacturers for a better sustainable environment.

It's often been said that we only have one earth and we should do everything to protect it. One cannot afford to sit on the sidelines and watch because when it comes to pollution, everyone is affected, even the ones that did not contribute to it. Vehicle transportation is one of the leading causes of air pollution the world over. The good thing is that something can actually be done about it. It begins with individual responsibility in having a cleaner planet. When people change their mindsets and become more proactive, a lot of good things can be achieved. In the same manner, vehicle pollution can also be reduced and managed.

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