



## STATUS OF VEHICULAR POLLUTION IN NCT OF DELHI

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**Abstract:** *The present study is made to attempt the role of motor-vehicle in generation of air pollution in Delhi. The present study covers the period from 2000 to 2009. The necessary data were collected from secondary sources and further, analyzed with the help of simple statistical tools and techniques. After analyze the data we found that the share of motor-vehicle has increase from 64-70 percent from 1990-2009. The rapid urbanization in India has also resulted in a tremendous increase in the number of motor vehicles. The vehicle fleets have even doubled in some cities in the last one decade. About 60 lakh vehicular counts in 2009 in the environment report of Delhi, and out of these 81% private vehicles, Auto 13%, Buses and Goods vehicles are about 4% and 2% respectively. In Delhi fuel consumption like MS, HSD and CNG are more consumed other than Mumbai, Kolkata and Chennai. Here, HSD is about 561105 MT. more consumed than Mumbai and MS is 261033 MT. and 470183 MT. more consumed than Mumbai and Kolkata respectively. And 414316 MT. more than Chennai. While CNG is only used in Delhi and Mumbai. So Delhi is on the top in fuel consumption, which is the main cause of vehicular pollution. The present study has interesting finding that the pollutants like CO, HC, NO<sub>x</sub> and PM are decrease in 2009. In 2002 CO emission is 421.84 tons/day but it decrease in 2009, it is 264.55, and same trend found in the emission of HC, NO<sub>x</sub> and PM. The main reason behind this trend implementation of BS-II and BS-III and proportion of vehicles increased which using to CNG, in taking place. Therefore the Government of Delhi should continues implementation the BS-II and BS-III along with 4-Stroke in two wheelers and Autos. It is the best options to removal the contribution of motor-vehicles in total air pollution in Delhi in future.*

**Keywords:** *Urbanization, Air Pollution, CNG, CO, PM, SO<sub>2</sub>, NO<sub>x</sub>*

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## **INTRODUCTION**

India's rapidly growing population, along with a move towards urbanization and industrialization, has placed significant pressure on India's infrastructure and its natural resources. Deforestation, soil erosion, water pollution, and land degradation continue to worsen and are hindering economic development in rural India, while the rapid industrialization in India's growing metropolises are straining the limits of municipal services and causing serious air pollution problems. The air quality has been threatened to alarming levels in several cities throughout the world. The World Health Organization (WHO) estimates that as many as 1.4 billion urban residents in the world breathe air exceeding the WHO air quality guidelines. The health consequences of exposure to dirty air is around 2.0 to 5.7 laces representing about 1.4 to 1.1 percent of total annual deaths. The adverse effects of air pollution are more pronounced in the developing countries (WHO, 1997). The main issue here to be discussed is the extent of the air pollution, the problems that it has caused, and the actions that have been put in place as possible and successful solutions.

Air pollution is one of India's most severe environmental problems. Sources of air pollution come in several forms, including vehicle emissions and untreated industrial smoke. Industrialization and urbanization have resulted in a huge deterioration of India's air quality. Continued urbanization has exacerbated the problem of rapid industrialization, as more and more people are affected and cities are unable to implement adequate pollution control mechanisms. Currently, in India, air pollution is widespread in urban areas where vehicles are the major contributors and in a few other areas with high concentration of industries and thermal power plants.

In present study we are discussing about Delhi. Delhi is the most densely populated and urbanized city of India. The annual growth rate in population during the last decade (1991-2001) was 3.85. Delhi is also a commercial hub, providing employment opportunities and accelerating the pace of urbanization, resulting increase in air pollution. Delhi the capital city of India, is one of the 10 most polluted cities of the world and the third most populated city in India with 13.8 million inhabitants spread over 1483 km<sup>2</sup> (Aneja et al., 2001). The transportation network in Delhi is predominantly road based with 1284 km of road per 100 km<sup>2</sup>. The steep increase in vehicular population has resulted in corresponding increase in pollutants emitted by these vehicles. The main source, contributing to the deterioration of



air quality in Delhi, is vehicular transport, which is responsible for almost 70% of the total air pollution load in the city. Vehicular pollution in Delhi has increased phenomenally from 2.3 million in 1975 (MOEF, 1997) to 4.2 million in 2004, which has been estimated 7.2 million in 2016 on the basis of transport data obtained from Transport Department, 2004. Vehicular pollution is based on the quality and quantity of the fuel. Presently, more than 1300 tonnes of pollutants are emitted by the vehicles playing in Delhi. However, Delhi had 6 lakh vehicles in 1982 that became 20 lakh in 1992, 35 lakh in 2001 and 60 lakh in 2009 accounting for about 60% of total pollutants being generated in Delhi (Goyal, 2010). So, the population is increasing by the time and vehicular pollution is also continuing over the time.

### **STUDY AREA**

The Territory of Delhi (NCT) is the second largest metropolis in India and it is the sixth largest metropolis in the world by population. It has 9 districts, 27 tehsils, 62 towns and 165 villages (Acc. to 2001 census). Delhi is located in North India between the latitude of 28°24'17" to 28° 53' 00" North and longitude of 76°50 '24" to 77°20' 37" East. The area of the National Capital Territory of Delhi is 1483 sq. km. (0.4 percent of total geographical area of India). The Union Territory Delhi is encircled by Uttar Pradesh in the East, Haryana on the North, West and South.

### **AIMS AND OBJECTIVES**

The purpose of the current study is to understand and analyze the air pollution in Delhi. The current study has the following objectives:

1. To study the air pollution problem in Delhi.
2. To assess the problem of vehicular pollution in NCT of Delhi.
3. To review the existing legislation and norms for the vehicular pollution.

### **DATA BASE AND METHODOLOGY**

The present study is descriptive in nature. The facts and figures were obtained from secondary sources. The secondary data were collected from annual reports and research studies in this regard. The data were collected from, Central Pollution Control Board, Central Road Research Institute, The Energy and Research Institute, Ministry of Environment and Forest Reports and many others Government and Non- Government publications. Further collected data has been transcribed into long sheets for going suitable form, tables have



been formulated and analysed using simple statistical techniques such as average, percentage, mean and etc. Moreover the results are presented in tables and geographical manners.

### **AIR POLLUTION PROBLEM IN DELHI**

Air Pollution is a complex as it contains so many known and unknown parameters. The pollutants are added to the environmental through various known and unknown natural processes as well as anthropogenic sources viz. industrial process, auto exhaust and domestic sources. According to the white paper on the pollution prepared by Ministry of Environment and Forests(MOEF), Government of India, the ambient air quality data of Delhi shows very high values of suspended particles which have been beyond the permissible limits from last several years continuously. In Delhi domestic, industrial and vehicular pollution is count, the industrial pollution is less down after the shiftment of industries but it is the vehicular pollution, both diesel and well petrol-induced, which continues to be the major problem for the capital, which has the highest number of automobiles in the country. With the number of vehicles, especially two wheelers, increasing at an unprecedented rate, vehicular pollution has become a major contributor to deteriorating air quality in Delhi. According to White paper (MOEF), vehicular pollution contributes to 64% of the total pollution in Delhi in 1991 and 70% in 2000-2001.

The monitoring stations of CPCB, which are monitoring regularly, are located at Ashok Vihar, Shazadabagh, Siri Fort, Janakpuri, Nizzamauddin, and Shahdra. The ambient air quality data indicates high values of PM, SO<sub>2</sub>, CO and NO<sub>x</sub>. The given table 1 shows the emission load contribution from different vehicles in year 2000, this table indicates that 2-stroke 2 wheelers emit the maximum pollutants and trucks and PCG also contribute a huge number of pollutants in the air. But after the uses of BS-II and BS-III along with 4-Stroke in Two Wheelers and Autos and use of CNG as alternate fuel for buses, taxis and three wheelers appears to be one of the most promising options capable of reducing the air pollutants in Delhi.



**Table: 1**

**Emission Load Contribution from different Vehicles in Year 2000 in Delhi**

Types Load Th.t	CO (292.6)	HC (112.6)	NO <sub>x</sub> (63)	PM (14.4)
BUS	1	1	23	15
LCV	7	1	10	14
MUVG	1	1	1	<1
MUVD	3	<1	6	13
PCG	36	17	35	6
PCD	<1	<1	<1	1
TAXIS	<1	<1	1	1
TRUCKS	4	2	22	21
3W	8	L13	<1	4
4S/2W	2	2	1	1
2S/2W	38	63	1	24

Source: CPCB, New Delhi (2000)

**NOTE:** CO (Carbon Monoxide), HC (Hydrocarbons), NO<sub>x</sub> (Nitrogen Oxide), PM (Particulate matter)

### **VEHICULAR POLLUTION PROBLEMS IN INDIA**

Motor vehicles have been closely identified with increasing air pollution levels in urban centers of the world. Besides substantial CO<sub>2</sub> emissions, significant quantities of CO, HC, NO<sub>x</sub>, PM 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 (WHO, 1997). 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
- Absence of effective mass rapid transport system & intra-city railway networks
- High population exodus to the urban centers.
- Increasing number Skyrocketing buildings in the urban areas causes stagnation of the vehicular emissions to the ground level and unable its proper dispersion. (Status of Vehicular Pollution Control Programme in India, CPCB, 2010)

### **GROWTH OF MOTOR VEHICLES IN INDIA**

The rapid increase in urban population has resulted in unplanned urban development, increase in consumption pattern and higher demands for transport, energy, other infrastructure, thereby leading to pollution problems. It is the vehicular pollution, both diesel and well petrol-induced, which continuous to be the major problem for the Indian cities, which has the highest number of automobiles in the country. Vehicular emission constitutes a very important component in air pollution in Indian cities which emit air pollutants at a very low height. In Indian cities there are vehicles continuously increasing on the roads. 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 and larger concentration of vehicles in these urban cities specially in four major metros namely, Delhi, Mumbai, Chennai and Kolkata 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 1 million) accounted for 35% of the vehicular population of the country (CPCB). The total number of vehicles in major Indian

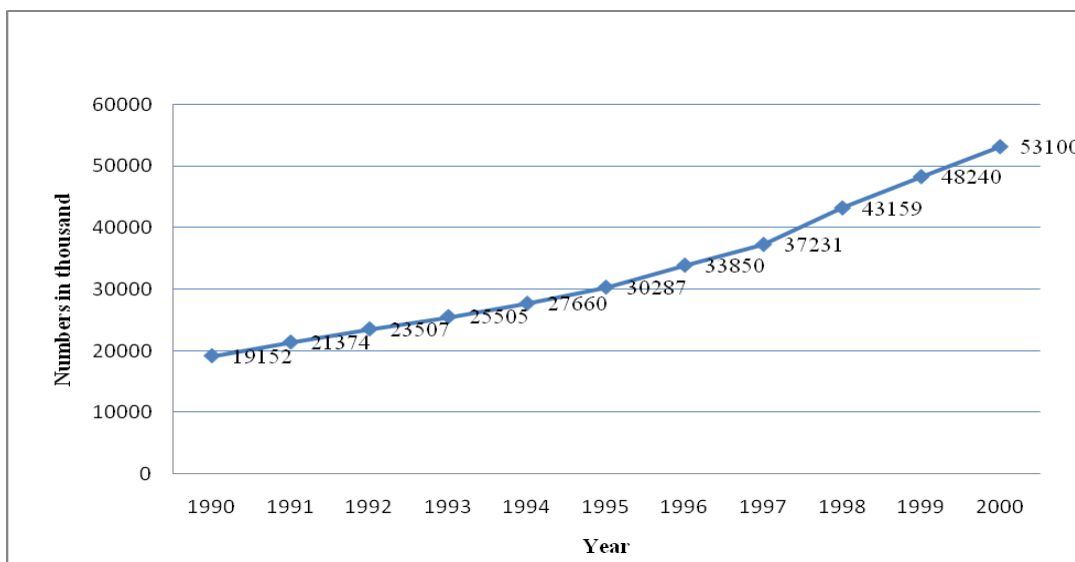


cities in 1990 is 19152 thousands, 30287 thousands in 1995 and 53100 thousands in 2000. And now about 80000 to 85000 thousands of vehicles exist in major Indian cities Figure 1.

Figure: 1

### GROWTH OF MOTOR VEHICLES IN INDIA

Source: Sengupta (CPCB), 2001



### Fuel Consumption in Metro Cities

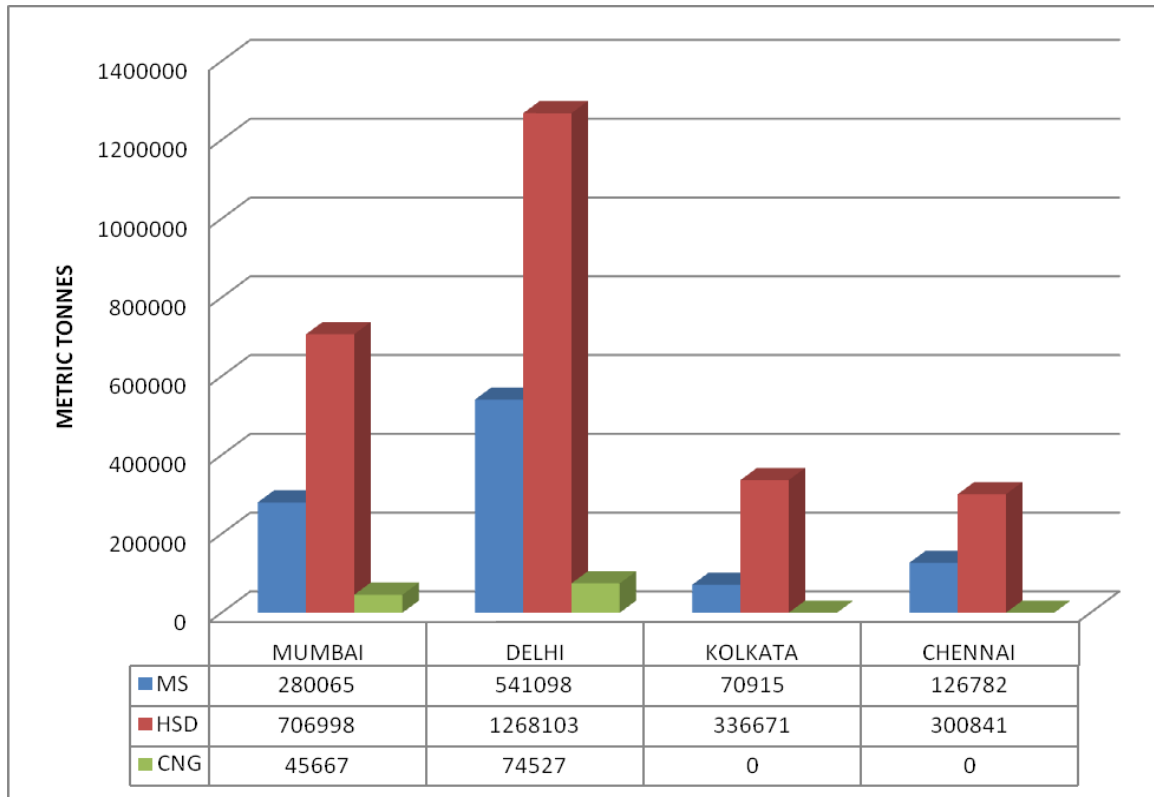
India is a developing country, its population and economy is very fastly growing and now it takes second position in the world. The per capita income of India is 46492 Rs. and 116886 Rs. of Delhi (2009-10), and it is increasing year by year. The rapid urbanization in India has also resulted in a tremendous 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. Figure 2. Shown the fuel consumption of mega cities of India, these are Mumbai, Delhi, Kolkata and Chennai. This figure shows that in Delhi MS, (An alternative (British) name for gasoline) HSD (High Speed Diesel) and CNG (Compressed Natural Gas) are more consumed other than rest of three cities. In Delhi HSD is about 561105 MT. more consumed than Mumbai and MS is 261033 MT. and 470183 MT. more consumed than Mumbai and Kolkata respectively and 414316 MT. more than the Chennai, while, CNG is used only in two major cities i.e., Delhi and Mumbai. After the uses of CNG and LPG in motor-vehicles in Delhi



the city is most polluted in all Indian cities. The major reason behind the higher fuel consumption in Delhi is, high per capita income, higher living standard.

Figure: 2

Fuel Consumption in metro cities (1999-2000)



Source: Sengupta (CPCB), 2001

### Vehicular Fleet in Delhi

In Delhi, every year a huge number of vehicles registered. Motor-vehicles are major sources of air pollution in Delhi. Delhi itself account for about 8% of the total vehicles in India. In 2000-01 about 35 lakh vehicles registered, and this number is raised about 60 lakh in 2008-09 Table 2. So we can say that vehicular fleet is continuously raising about 10 to 15 lakh vehicles over the year. In NCT of Delhi year 2009, 31% cars and jeeps registered, 63% motor cycles and scooters registered and 1% each taxis, buses and goods vehicles registered Figure 3. So this figure shows that motor cycles and scooters and cars and jeeps are more in Delhi. Delhi has maximum vehicular emission loads because of their huge traffic. The number of registered vehicle in Delhi has been increased from 34567579 in 2001 to 6011731 in 2008-09 (GNCTD, 2009). In ratio of various registered vehicles (i.e. cars and jeeps, motor cycles and scooters, auto rickshaws, taxis, buses and goods vehicles etc.) of total vehicles was





26.63, 64.53, 2.51, 0.53, 1.2 and 4.5 percent in 2001. In 2009 the ratio of cars jeeps and motorcycles and scooter ratio has been increased to 30.92 to 63 percent while the other type of vehicles.

**Table: 2**

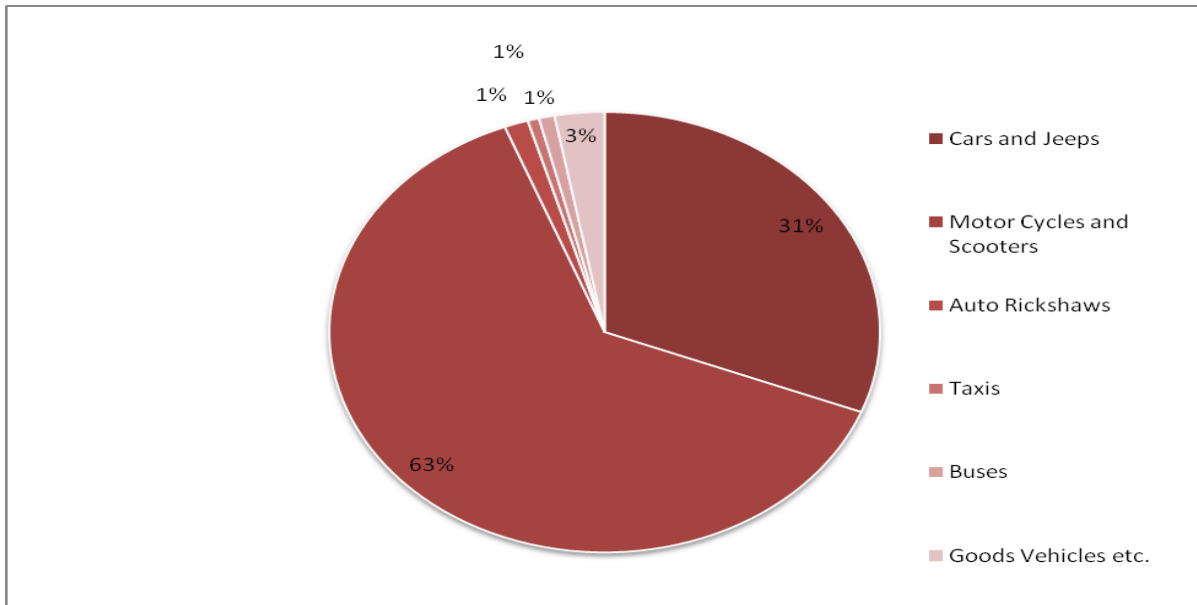
**Total Registered Vehicles in Delhi during 2000-2008**

Name of the Vehicle	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Cars and Jeeps	920723	968894	1214693	1314672	1431638	1466641	1589872	1729695	1859370
Motor Cycles and Scooters	2230534	2265955	2517788	2665750	2844004	3062536	3299838	3578199	3797943
Auto Rickshaws	86985	86985	49538	52905	53656	73644	74189	75297	83948
Taxis	18362	20628	9936	11495	13511	20693	24958	30704	40072
Buses	41483	47578	18731	21962	24235	43500	46581	52763	55148
Goods Vehicles etc.	158492	161650	129723	135671	140982	141996	149972	160726	175250
Total	3456579	3551690	3940409	4202455	4508026	4809010	5185410	5627384	6011731

**Source:** State of Environment Report Delhi (2010), Govt. of Delhi

Figure: 3

Distribution of Registered Vehicles in Delhi (2008-09)



**Source:** State of Environment Report Delhi (2010), Govt. of Delhi

In Delhi, daily 81 per cent are private vehicles, 13 per cent auto, buses and goods vehicles are about 4 per cent and 2 per cent respectively (CRRI, 2009). The given Table 3, shows that the estimated daily traffic loads on Delhi Road Network. In this table we have seen that cars 38.7 per cent in 2002 and about 45.1 per cent in 2009, about 7 per cent rise in the period of 2002-2009. Two wheelers load decreased in this period about 6.4 per cent, and autos, goods vehicles load increased about 1-2 per cent. But bushes have been decreased 3.6 per cent to 1.8 per cent in the same period. This is mainly due to higher per capita income, living standard, lenient loan policy and cheaper vehicle credit provided by government and private banks. One important thing is also responsible for this increasing load of traffic is shortage of public transport and Government policy.



**Table: 3**  
**Estimated Daily Traffic Load on Delhi Road Network**

Estimated Daily Traffic Load on Delhi Road Network			
Sr. No.	Vehicle Type	Vehicle-Kms/day(in Lakh)	
		Urtrap2002 study (CRRI,2002)	Present Study 2009
1	Cars	306.89 (38 .7%)	678.5 (45 .1%)
2	Two Wheelers	338.23 (42 .7%)	546.57 (36 .3%)
3	Autos	93.57 (11 .8%)	196.04 (13 .0%)
4	Goods Vehicles	25.14 (3 .2%)	57.32 (3 .8%)
5	Buses	28.51 (3 .6%)	27.17 (1 .8%)
6	Total	792.34 (100 .0%)	1505.6 (100 .0%)

**Source:** Sitaramanjaneyulu (CRRI), New Delhi, 2010

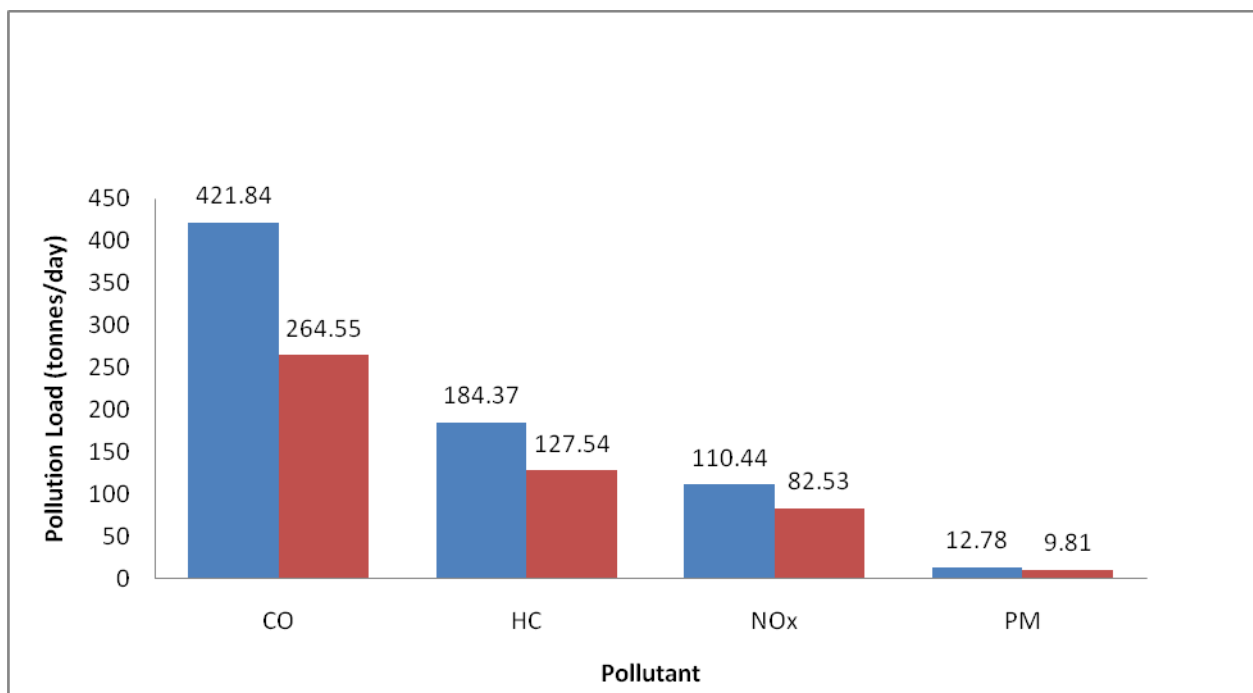
#### **Pollution Loads by Vehicles in Delhi**

The given Figure 4 indicates that the pollutants like CO, HC, NO<sub>x</sub>, and Pm decreased in 2009. In 2002 CO emission was 421.84 tons/day but it decreased in 2009 and it is 264.55, about 30-35 % less than 2009. And same trends found in the emission of HC, NO<sub>x</sub>, and PM. These reduction can be attributed to vehicular technology (BS-II and BS-III along with 4-Stroke in Two Wheelers and Autos) and Use of CNG as alternate fuel for buses, taxis and three wheelers appears to be one of the most promising options capable of reducing HC emissions by about 32%. This will also reduce emissions of PM and CO by about 16% and 14% respectively.

In Delhi, about 66% vehicles of total VKT, contributed 78% CO, 53% HC, 34%NO<sub>x</sub>, and 46% PM. Diesel fuel used VKT is 18% of total VKT, contributed 16% CO, 4% HC, 34% NO<sub>x</sub>, and 47% PM. And CNG fuel used VKT is 16% of total VKT, contributed 6% CO, 43% HC, 21% NO<sub>x</sub>, and 7% PM. So we can say that the Petrol vehicles are more pollutants emits into the air.

Figure: 4

Estimated Pollution Loads in URTRAP Study (2002) and Present Study (2009)



Source: Sitaramanjaneyulu (CRRI), New Delhi, 2010

### Control of Vehicular Pollution

The various measures taken by government to mitigate emission from transport sector are as follows:

**Stringent emission norms:** The mass emission standards for new vehicles had been first notified in the year 1991 in India. Stringent emission norms along with fuel quality specifications were laid down in 1996 and 2000. Euro I norms are applicable from (April 2000 and Euro II) norms will be applicable all over India from 1 April 2005. However, in the case of the NCR, the norms were brought forward to 1 June 1999 and 1 April 2000 for Euro I and Euro II, respectively.

**Inspection and Maintenance:** The first and most important step towards emission control for the large in-use fleet of vehicles is the formulation of an inspection and maintenance system. It is possible to reduce 30-40% pollution loads generated by vehicles (CPCB, 2000c). In India, the existing mechanism of I&M is inadequate. Thus, there is a great need of establish effective periodic I&M programmes. Since vehicles contribute significantly to the total air pollution load in Delhi, vehicular pollution control deserves top priority. A practical strategy should be devised that reduces both emissions and congestion, using a mixed set of



instruments which are dictated by command and control, and/or the market based principles. Some of are as follows:

- Augmentation of public transport system.
- Mass Rapid Transports System may be considered for the fast expanding in the city.
- Traffic planning and management.
- Taxes on fuels, vehicles the revenue so generated could be used for pollution control measures.
- Further tightening of emission norms and fuel quality specifications.
- Greater promotion and use of alternative fuels such as CNG/LPG/Propane/Battery operated vehicles.
- Replacement of two-stroke engines.
- Strengthening of Inspection and Maintenance system.
- Govt. should run the awareness programme for reducing the Air Pollution from vehicles.

(State of the Environment Report, 2006)

### Legislative and Implementing Agencies

The environmental legislation concerning vehicular pollution and the implementation authorities are as follows:

Legislation / Act	Authority	Responsibility/ Notifications
<p>The Environment (Protection) Act, 1986, amended 1991</p> <ul style="list-style-type: none"> <li>• Environmental (Protection) Rules, 1986 (amended in 1999, 2001, 2002, 2002, 2003, 2004)</li> </ul>	Ministry of Environment & Forests	<p>Notification of standards for emission or discharge of environmental pollutants from the industries, operations or process. The notified standards related to vehicular are as follows:</p> <ul style="list-style-type: none"> <li>✓ Specification of Motors Gasoline for emission related parameters</li> <li>✓ Specification of Diesel for emission related parameters</li> <li>✓ Specifications of two- stroke engine oil</li> <li>✓ Standard for emission smoke, vapour etc from motor vehicles</li> <li>✓ Noise limits for Automobiles at the manufacturing stage</li> </ul>
The Central Motor Vehicles	Ministry of	Makes rules regulating construction,



<p>Act, 1988</p> <ul style="list-style-type: none"><li>• The Central Motor Vehicles Rules, 1989 (Second amendment 2009)</li></ul>	<p>Road Transport and Highways</p>	<p>equipment and maintenance of motor vehicles and trailers as per section 110 of Motor Vehicle Act. The notified emission standards related to vehicular are as follows:</p> <ul style="list-style-type: none"><li>✓ Relating to Emission of smoke and vapour from agricultural tractors driven by diesel engines</li><li>✓ Relating to Diesel vehicles with original equipment fitment - Replacement of in-use diesel engine by new LPG engine - Applicable emissions norms</li><li>✓ Relating to Diesel driven Agricultural tractor for standards of gaseous pollutants</li><li>✓ Relating to idling emissions standards for petrol / CNG/LPG driven vehicles</li><li>✓ Mass emission standards Bharat Stage III for four wheeled vehicles in NCR &amp; other cities</li><li>✓ Mass emission standards Bharat Stage III for two and three wheelers manufactured on and from 1<sup>st</sup> April, 2010.</li><li>✓ Mass emission standards Bharat Stage IV for M and N category vehicles</li></ul>
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### Policy Gaps

- Prevention based environmental policy needs to be strengthened. Issues such as cleaner technology and land use planning incorporating environmental considerations need to be given priority.
- Effectiveness and impact of various policy measures not assessed.
- No separate transport policy exists at the national and state transport.
- No well defined policy to promote private participation in public transport.
- Lack of coordination between various governments agencies to improve transport services.
- Lack of people awareness



## **CONCLUSION**

The problem of general pollution and air pollution is particular is the burning issue in the world along with India. There is nodoubt, across the globe including India the concentration of pollution has been high in metropolitan cities as compared to other place. In this context, many studies has been conducted and argued that the vehicles are the major source in contribution of total air pollution in metropolitan cities. In this line, the present study is made to attempt the role of motor-vehicles in the generation of problem of general pollution and air pollution is particular in Delhi. Through this study, we found that the contribution of motor-vehicles is 64 per cent of the total pollution in Delhi in 1991 and went 70 per cent in 2000-2001. The registered number of motor-vehicles in the city has been increased from 35 to 61 lakh in same period. Further, the CO emission has decreased 421.84 tons/day to 264.55 between 2002 to 2009. It is less 35 per cent as compared to 2002. The reasons beside this declined trends are implementation of the BS-II and BS-III along with 4-Stroke in Two Wheelers and Autos, increased the number of vehicles which operate with CNG. But after all things vehicular load on the road are increasing year by year. In 2000-01 about 35 lakhs registered vehicles exist in Delhi, but in 2008-09 this number is 60 lakh more than 25 lakhs from 2000-01. On the basis of above analysis we suggest that the Government of Delhi boost the habit of using public transportation among peoples and strictly implement the motor-vehicle norms for reduce the level of general pollution and air pollution in particular in the city.

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