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Transport and Ambience Air Quality in Metro Cities of India

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Abstract
Increasing Vehicular population and deteriorating quality of air is the by-product of rapid growth of population and haphazard urbanization in India. The urban population in India has increased significantly from 62 million in 1951 to 285 million in 2001 and is estimated to grow to 540 million by the year 2021. In terms of percentage of total population, the urban population has gone up from 17% in 1951 to 29% in 2001 and is expected to increase up to around 37% by the year 2021. About 55 million vehicles were playing on Indian roads in 2001. The annual growth rate of motor vehicle population in India has been about 10% during the decade (1991-2001), It is seen that two wheelers are growing faster than cars. The basic problem is not the number of vehicles in the country but their concentration in a few selected cities, particularly in metropolitan cities. It is alarming to note that 32 percent of all vehicles are plying in metropolitan cities alone; these cities constitute about 11 percent of country's total urban population. During the year 2000, more than 6.3 million vehicles were plying in mega cities, which constitute more than 13 percent of all motor vehicles in the country. Mumbai is carrying the highest vehicles compared with other mega cities. Cities like Bangalore, Hyderabad, Jaipur, Nagpur, Pune show a vehicle growth higher than the mega cities like Delhi, Kolkata etc., presently.
Undoubtedly on one hand transport sector plays a significant role in the overall development of a nation's economy, but on the other this sector accounts for a substantial and growing proportion of air pollution also. The urban expansion, industrialization, lack of services, energy and transport demands are leading to a vicious cycle of pollution.
The main aim of this paper is to analyze air pollution caused by increasing number of vehicles and its effect on the environment at present and in future by projecting the number of vehicles and emission load. It also deals with the planning measures that should be adopted in India to solve the problem of increasing vehicular pollution.
Keywords: Transportation, Environment, Pollutants, Emission, Development

Introduction

According to the Inter-governmental Panel on Climate Change (IPCC), the main sources of emission are energy (26%), transport (18%), industry (19%) and buildings (10%) are the main sources of emissions. The road traffic accounts for about 80% of the passenger traffic and 60% of the goods. For vehicular motors emits various pollutants, such as carbon monoxide, nitric-oxide, carbon dioxide and several organic compounds which are responsible for the deterioration of the environment. In developing countries like India especially, increasing demand for private vehicles is outpacing the supply of transport infrastructure – including both road networks and public transit networks. The result is growing congestion and air pollution (Pundir, 1989; Saranthan, 1987).
The transport sector in India consumes about 16.9% fossil fuel based energy sources. The aim of this paper is to focus on the state wise emissions of variety of pollutants and asses the quality of air, using region specific mass emission factors for each type of vehicles (Kamalakar, 1991).

Global air pollution from motor vehicle emissions is growing at an alarming rate because of rapid urbanization and increasing use of motor transportation in the third world cities. Lax environmental protection laws and policies, and poor maintenance of vehicles are exacerbating this situation (Saranthan, 1987). The atmospheric pollutants associated with motor vehicles such as carbon dioxide, nitrous oxide, sulphur dioxide, particulate matter and lead often exceed World Health Organization (WHO) guidelines in many large cities of the Third World (like Mexico City, Sao Paulo, Delhi, Mumbai, Lagos, Bangkok, Jakarta, Manila, Seoul, Ankara, Cairo, Tehran, Belgrade, and Istanbul). Although inspection and maintenance programs to reduce emissions are an integral element of air pollution control programs in many industrialized countries, the same is not true for developing countries (Horowitz, 1982). On one hand transport plays a significant role in the overall development of a nation's economy, but on the other this sector accounts for a substantial and growing proportion of air pollution in cities. Public transport systems have not been able to keep pace with the rapid and substantial increases in demand over the past few decades. Bus services in particular have deteriorated and their relative output has been further reduced as passengers have turned to personalized modes and intermediate public transport such as three-wheelers and taxis, adding to traffic congestion. For vehicular motors emits various pollutants, such as carbon monoxide, nitric-oxide, carbon dioxide and several organic compounds. Some of these

pollutants concur in several physio-chemical phenomena that take place in the air, thus contributing to the formation of other pollutants (ibid). Many of these pollutants have injurious effects on human health, vegetation an materials, besides contributing to altering the atmospheric characteristics (Seinfled, 1986). Another point of importance is that these pollutants are basically greenhouse gases which have the property of increasing the amount of counter radiation by the atmosphere. This sector is a major consumer of petroleum fuels, for almost half of the total consumption of petroleum products in India is attributed to this sector mostly in the form of high speed diesel and motor spirit.

Study Area

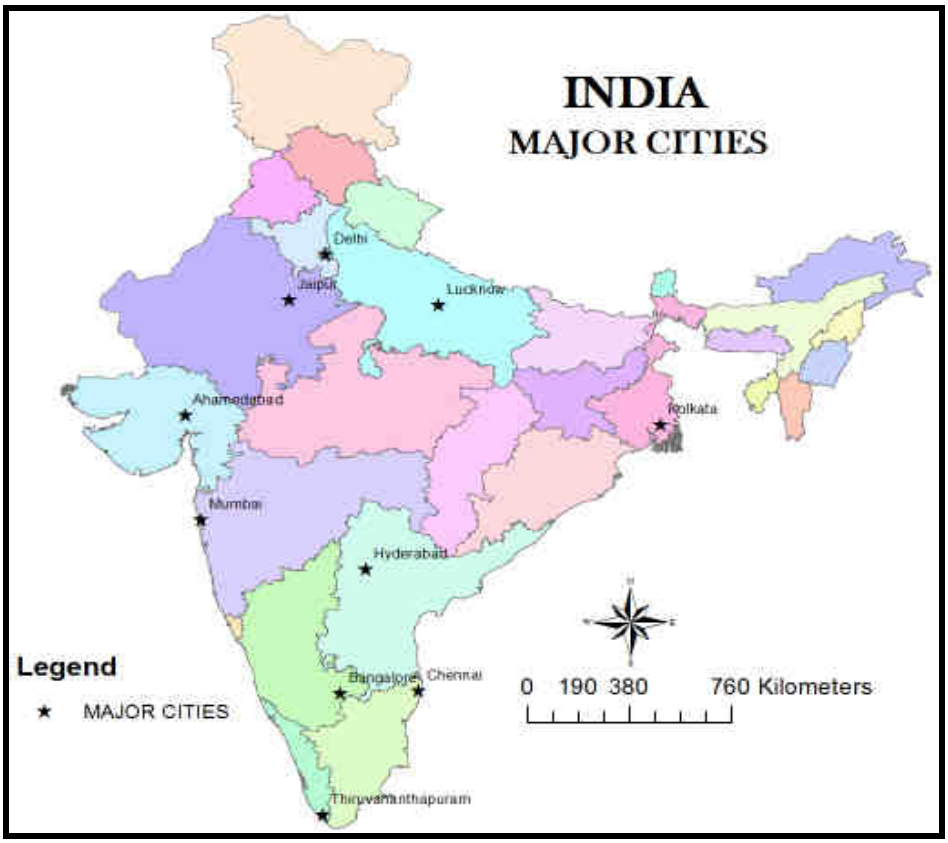

Figure 1. Map of Metro Cities of India

Growth in Transport Sector in Metro Cities of India – A Historical Perspective

Urban growth in India is quite alarming. Less than 60 million at the time of Independence about five decades ago, the urban population has more increased about five times since then, and has reached 288 million by the turn of the century. The urban population is concentrated in 35 million cities and 3 mega cities according to 2001 census. Though this trend is commonly found in most developing countries, in the process of adjustment from an agricultural to an industrial economy, it has become a problem in India because of its rapidity in relation to local experience in urban development. The continued expansion of large urban areas poses the risk of physical, economic and social breakdowns with serious political consequences. The major metropolitan cities in the country are colonial creation rather than the product of indigenous economic development. The major threat to the human environment today is closely linked with the way in which the cities in India are built (Fernades, 1992). For example Delhi's population has multiplied ten times since independence, its land consumption is still greater. Large cities of the country require high energy inputs to remain viable. In turn, high energy consumption is causing ecological change in these cities.

The continuous stream of migrants from rural areas to metro cities creates various types of problems. Some of the problems like housing is solved by growth of innumerable slums, unemployment by increasing rates of crime, sanitation and waste disposal by usage of any open space, side of roads, vacant plots etc. Beside all these, increasing air pollution in large metro cities is a cause of rising concern among scientists, politicians, planners and even common man. To satisfy the transportation requirements of commuters in metro cities of India there has been a continuous growth of vehicles of all types. But the network of roads in these cities are unable to bear with the rising vehicular population. This is mainly because of narrow roads, lack of space for further road widening, improper planning etc. The net result is that of traffic jams, congestion, increasing air pollution etc

(Hussain, 1992).

The data of the number of vehicles in metropolitan cities in 1995 is given in Table 1. It is vividly clear from Table 1 that larger cities have large number of vehicles. Large number of vehicles are found in the metropolitan Delhi followed by Bangalore where total registered vehicles are 796,000. The following table depicts the data of vehicular population in metro cities of India.

Table 1: Growth Trend in Vehicle Population (in Thousands)

City Name	1995	1996	1997	1998	1999	2000	Annual Growth Rate (1995-'00) (%)
Ahmedabad	510	572	631	686	739	799	9
Bangalore	796	900	972	1130	1332	1550	14
Chennai	768	812	890	975	1056	1150	8
Delhi	2432	2630	2848	3033	3277	3423	7
Hyderabad	557	764	769	887	951	991	12
Jaipur	368	405	449	492	542	598	10
Kolkata	561	588	588	664	702	799	7
Mumbai	667	724	797	860	911	970	8
Nagpur	198	213	239	270	298	331	11
Pune	358	412	468	527	568	593	11

Source: Ministry of Road Transport and Highways & RTOs

Due to increasing standard of living and greater purchasing power of people it had been found that 90.8 percent of the total vehicles is accounted by two, three and four wheelers, and buses

Increasing Vehicular Population in Metro Cities of India

The number of metropolitan cities with a population exceeding one million has increased from 5 in 1951 to 23 in 1991. This is expected to increase further to 51 by the year 2021. The unprecedented rise in vehicle population has hit the cities hard. Most city authorities today are scampering about to keep traffic flowing. A large and efficiently managed public transport system would be the ultimate solution for reducing air pollution by reducing growth of private vehicles on the roads (Ranganathan, 1990).

The major road network in most of the cities even now is characterized by narrow carriageways, poor surface quality, absence or inadequacy of footpaths. In some cities, a large proportion of road length has right-of-way (ROW) less than 10 meters. Most of the road network has not been provided with footpaths. Even the available limited road capacity is reduced by way of on-street parking and encroachments. Surveys have shown that about 30 percent of a carriageway of major roads in Indian cities are encroached (Sibal and Sachdeva, 2001).

Increasing Vehicular Emissions in Indian Cities

Vehicular emissions depend on two basic factors - transport demand in terms of vehicle km for each vehicle category and emission rates for different pollutants. The former depends upon the modal share and the latter upon vehicle technology, speed, age/condition and road conditions. Emission factors for different types of vehicles, under typical conditions obtaining in Indian cities are given in Table 2.

Existing estimated daily vehicular emissions based up on generalized UT characteristics in cities of various sizes in India by different modes are presented in Table 2. It is seen that over 95 percent of total emissions pertain to Carbon mono-oxide (CO) and hydrocarbons (HC) which are largely emitted by personalized modes of transport i.e. two wheelers and cars. Contribution of these personalized modes is as high as 84 - 91 percent in total emissions in cities of various sizes. Two wheelers constitute nearly 60-70% of registered vehicles in most of the cities. Buses contribute only around 2 percent in total emissions (Sibal and Sachdeva, 2001).

With deteriorating level of mass transport services and increasing use of personalized motor vehicles, vehicular pollution is assuming serious dimensions in most of the cities.

Table 2: Category wise Fuel Consumption/ day (in Kilo Liters)

City Category	Car	TW	AR	Bus	Total
1	36	8	5	6	55
2	603	414	362	280	1,659
3	1,003	1,058	602	376	3,039
4	436	393	393	140	1,362
5	921	901	553	833	3,208
6	4,782	1,605	2,869	7,442	16,697

Table 3: Category wise Emissions/day (in Tons)

City Category	Car	TW	AR	Bus	Total
1	6	3	0	0	10
2	90	133	24	21	268
3	158	342	125	27	652
4	64	127	37	9	238
5	143	300	143	60	647
6	556	365	451	375	1747

AR

Conclusion

Based on the above tables the following conclusions could be made. The majority of the fuel consumption by vehicles for all cities in Category 1 to 5 is contributed by cars and two-wheelers and they account to approximately 65 percent to 90 percent of the total emissions produced by all modes of transport. In Category 6 cities, although cars and two-wheelers consume less than fifty percent of the total fuel consumption by all modes, the total emission produced by these two modes is more than 60 percent. This is due to high level of congestion in these cities resulting in slow speeds and thus higher emissions. In Category 5 and 6 cities, Intermediate Public Transport vehicles account to 18 to 23 percent of the fuel consumption, respectively while they contribute to approximately quarter of the total emissions by all vehicles. It could be concluded that cars and two-wheelers are the major contributors to the total emissions produced by all vehicles in all cities. In Category 5 and 6 cities IPT vehicles also contribute significantly to total emission levels. It is evident that more public transport vehicles would decrease the total emission produced on the road. The public transport system is the most effective way to reduce the number of vehicles as well as the total emissions on the road. This is also the only way to a more equitable allocation of road space with people, rather than vehicles. The effects of incorporating adequate public transport (ranging from 30 to 70 percent) in 87 urban centers in India in the future year (2021) clearly illustrate the above.

Planning Measures

The following measures should be taken for sustainable development in general and metrocities in particular.

A. We should check the heavy migration from the countryside - Bihar, West Bengal, Orissa, UP and Jammu and Kashmir etc., who are coming to the urban centres in search of their livelihood and security by providing them suitable jobs and by making agriculture scientific oriented in the country sides. And maximum stress should be put on small scale industries and agro-based industries. By giving the guarantee of safety of life and property, the heavy influx from the disturbed areas may be stopped.

B. Decentralization of industrial and commercial units, government, semi-government offices to the satellite towns or to the rural areas can help in reducing migration to the city centres and at the same time reducing air pollution to a greate extent.

C. There has been a phenomenal growth in the number of personalised vehicles. So in the case of metropolitan cities, where the demand is large, particularly in the peak hours, the MRTs .(mass rapid transport system) should be introduced. More flyovers at busy traffic intersections can also help in reducing the pollution to some extent. The success of the sub-urban rail network in Mumbai, Kolkata and Delhi metro are

encouraging precedents in this direction. Now Jaipur too follows suit. The railways are seven to eight times more fuel efficient than road transportation. Such a system should also be introduced in other metros which would not only help in conservation of fuel, but to check air pollution also.

D. As compared to the international average, the same capacity vehicle in India consumes about eight to fifteen percent more fuel resulting inmore pollution which can be avoided by making light bus bodies, use of steel-belated radical tires, electronic control devices and time to time testing of emission level.

E. Last, but not the least illegal migrants from Bangladesh and Myanmar should be stopped immediately lest the cities lose all sense of identities and furthering environmental degradation.

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