

Evaluation of Growth of Motor Vehicles Fleet and Ambience Air Quality in India

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Abstract

Increasing Vehicular population and deteriorating quality of air is the by-product of rapid growth of population in India. 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. 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. 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.

Keywords- *Transport, Quality of air, Industrialization, Development, Greenhouse gas (GHG)*

Introduction

India is the seventh largest country in the world covering an area of 3.5 million square kilometres and has a population of 1.2 billion. 30% of India's population lives in urban areas and the rate of urbanization is growing steadily due to push/pull effects of employment opportunities and declining viability of rural agriculture (Guttikunda and Jawahar, 2012). As India's capital, Delhi has grown across all sectors - industry, transport, and housing, all of which have contributed to an increase in city's air pollution problems (Horowitz, 1982; Narain, 2006). The basic infrastructures required for the region's economic growth are roads, railways, water and air connectivity. Road transport is vital to the economic prosperity and social integration of the country including the development of rural areas. Road transport provides indispensable mobility for all citizens and goods. Transport fulfils a major role in the Indian economy involving a wide range of industries and services from vehicle manufacturers and suppliers to infrastructure builders, services, energy providers, public authorities, insurance and many others. Transport predominantly relies on a single fossil resource, petroleum that supplies 95% of the total energy used by world transport. With the increase in economic activities, the dependence of fossil fuel based energy sources and consequent greenhouse gas (GHG) emissions have increased rapidly in recent times which in turn are responsible for Global warming and Climate Change. In 2004, transport was responsible for 23% of world energy-related GHG emissions with about three quarters coming from road vehicles. Over the past decade, transport's GHG emissions have increased at a faster rate than any other energy using sector. Transport activity is expected to grow robustly over the next several decades (Kamalakar, 1991).

Unless there is a major shift away from current patterns of energy use, world transport energy use is projected to increase at the rate of about 2% per year, with the highest rates of growth in the emerging economies, and total transport energy use and carbon emissions is projected to be about 80% higher than current levels by 2030 (Tahir and Mary, 1992).

The global warming issue in transport will have to be addressed in the context of the broader goal of sustainable development. GHG emission reduction will be only one of several key issues in transport during the coming decades and will not be the foremost issue in many areas. The majority of GHG emissions from transportation are CO₂ emissions resulting from the combustion of petroleum-based products, like gasoline, in internal combustion engines. India's auto sector accounts for about 18 per cent of the total CO₂ emissions in the country. Relative CO₂ emissions from transport have risen rapidly in recent years. Road transport is the largest contributor to global warming. It is known that Transport is a key factor to social, regional and economic cohesion. However, the impact of road transport on the environment and health remains a major challenge in many aspects. Transport sector accounts for a share of 6.4 percent in India's Gross Domestic Product (GDP) (Hussain and Mary, 1992).

The economic growth, increasing disposable income, and increasing urbanization is creating greater demand for transport and the number of vehicles on India's road system is growing rapidly. India like many other countries in Asia has experienced high annual growth rate in excess of 10%. This is equivalent to doubling vehicle fleets in about seven years. This factor coupled with high proportion of two motorized vehicles and the relatively young age of the majority of the population, all make India's road safety challenging problem. Energy consumption also varies with the modes of transport and public transport system has least average energy consumption per passenger kilometre.

Various energy sources used in this sector are coal, diesel, petroleum (gasoline) and electricity. Road, rail and air are responsible for emission of 80%, 13% and 6% respectively. Vehicular emissions account for about 60% of the GHG's from various activities in India. With a rising income and greater need for mobility the personalized mode of transport is likely to grow in importance in the coming years. The proliferation in the personalized mode of transport has serious implications for traffic congestion, energy efficiency and pollution. Lax environmental protection laws and policies, and poor maintenance of vehicles are exacerbating this situation (Seinfeld, 1986; Guttikunda and Jawahar, 2012).

Transport Scenario in India

India became the fifth largest motor vehicle/car manufacturer in the world in 2011. Indian auto manufacturers produced a record 14.82 million motor vehicles in 2010. 3.54 m (million) cars and commercial vehicles were produced in 2010 out of which 3.05 m were cars. Domestic passenger vehicle sales hit a new record in 2009-10 (Apr-Mar) when over 1.95 million vehicles were sold.

India is the largest manufacturer of three-wheelers (444,000 in 2009-10) and the eighth largest commercial vehicle (0.53 m in 2009-10) (Sibal and Sachdeva 2001).

India is also the largest tractor manufacturing country (around 1/3 of global output) having produced around 370,000 units in 2009-10. 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. Road surface quality is generally poor. 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 is encroached (ibid).

Growth in Number of Registered Motor Vehicles

India had 89.6 million registered motor vehicles at the end of fiscal year 2005-06. Personalized mode (constituting mainly two wheelers and cars) accounted for more than four fifth of the motor vehicles in the country compared to their share of little over three-fifth in 1951 (Figure-1).

Further break up of motor vehicle population reflects preponderance of two wheelers with a share of more than 72 percent in total vehicle population. In contrast to personalized mode, the share of buses in total registered vehicles has declined from 11.1% in 1951 to 1.1 during 2006. The share of buses in the vehicle population at about 1 percent possibly indicates the slow growth in public transport (Hussain and Mary, 1991).

The growth in number of registered vehicles amongst different categories of vehicles during the period (1991 to 2006) which coincides with era of significant economic reforms shows compound annual growth rate (CAGR) of about 10% in total vehicle registrations with variation across vehicle categories. Personalized category of motor vehicles, viz., two-wheelers and cars grew at a CAGR 10.6% and 9.5% respectively which was higher compared to growth in buses (7.6% per annum) and goods vehicles (8.2% per annum). The higher growth in personalized motor vehicles reflects rising disposable income; easing of supply side restraints (lifting of licensing, Quantitative Restrictions etc.); and availability of more convenient financing options. In contrast, slower growth in goods vehicle category to some extent shows changes in structure of economy and shift from commodity producing sector (agriculture and industry) towards services which are far less material intensive together with higher input costs (tyres etc.) and a plethora of regulations (ibid).

Growth in terms of CAGR of registered vehicles amongst the States and Union Territories for the quinquennium ending 2006 (2001-2006) shows that total vehicle population in terms of registration grew at 10.3 %. Several States exceeded the all-India growth rate and clocked CAGR of over 11%. These States include Andhra Pradesh, Assam, Chhattisgarh, Karnataka, Kerala, Orissa, Sikkim, Tamil Nadu, Tripura and Uttarakhand (Pundir, 1989).

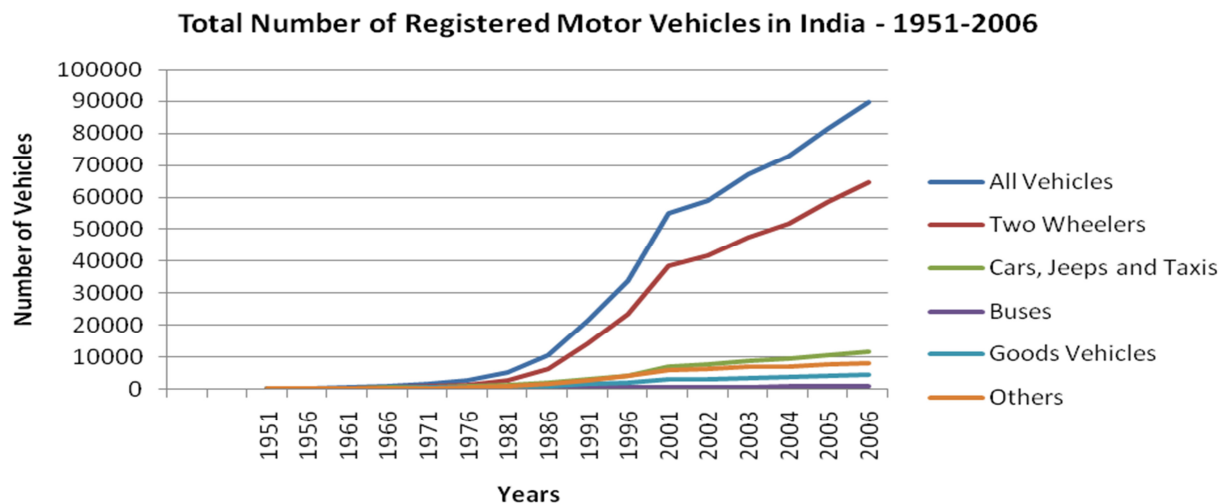


Fig. 1: Time series of vehicle registration in India.

Source: Road Transport Year Book (2006/07)

Way back in 1951, less than four years after Independence the number of registered vehicles registered in India was just 306 thousand of which around 50 % was accounted by cars, jeeps and taxis. Slowly, but steadily the number started increasing and doubled in a decade in 1961 (665 thousand total vehicles) and then there is steep incline and by the passing of another decade the number tripled to 1865 in the year 1971 (RTYB, 2006/7).

The increase in two wheelers is all the more evident with just 27 thousand in 1951 to 576 thousand by 1971. With the passing of another decade what we observe is that the total number of vehicles has shot to 5391 thousand vehicles. It means that the number of vehicles has increased sixteen times. And this number doubled in just five years in 1986 and by 1991 it was a whopping 21 million. Therefore, from the chart it is very much evident that India has evolved from days of the bullock carts and the horse cart (tonga) to cars of every make and two wheelers of every style plying Indian roads with speed for as of the traffic jams have just begun in some congested parts of the old sections of metro cities and other cities and towns. 21 million in 1991 and by 2002 the number has almost tripled (58 million) (Ranganathan, 1990).

From 1976 onwards the number of two wheelers has increased much more than cars, jeeps and taxis. This clearly shows that Indians are becoming more and more independent and a chunk of them are no longer that much dependent on public transport as compared to the earlier times. And by 2002 the number of two wheelers is more than 41 million. Cars etc accounted for 76 lakhs in the same year. Let us see what happens as time passes on. By 2006 the number of total vehicles has increased to 90 million and two wheelers accounted for around 65 million and cars 12 million. Even for other vehicles the rise in numbers is phenomenal as can be seen from the diagram. Thus it is very clear that innumerable problems will crop up with the rise in the numbers such as increasing pollution deteriorating environment of India. The time and energy wasted in traffic jams too of millions of people is also an inevitable problem. Development has a price and we all pay for it in more than one way (Ranganathan, 1990; Hussain, 1992).

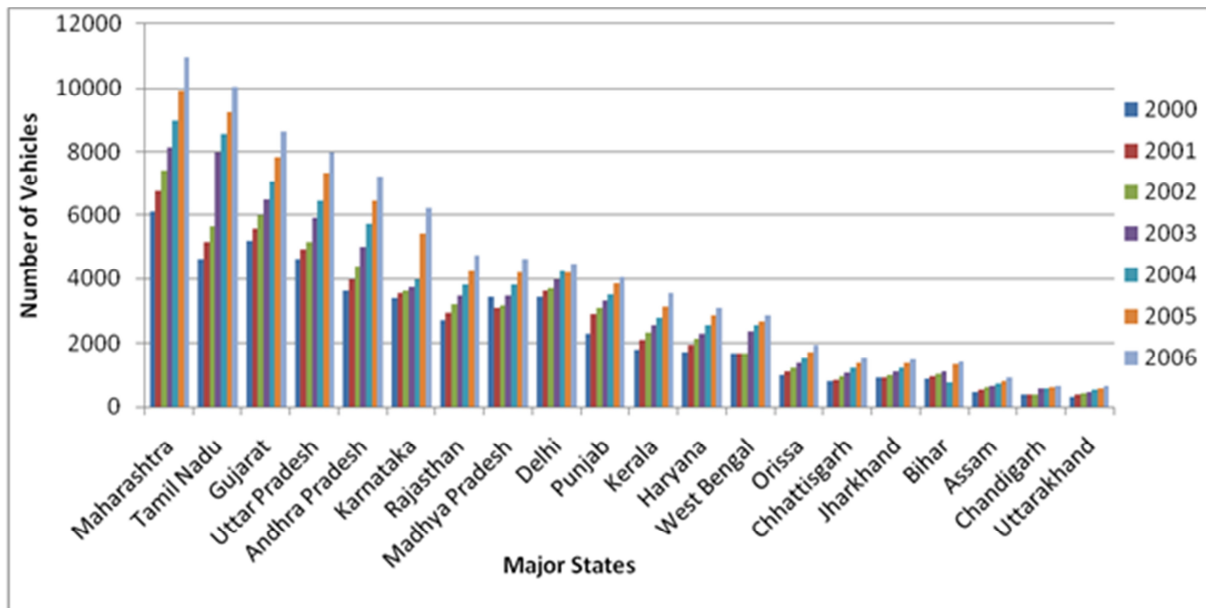
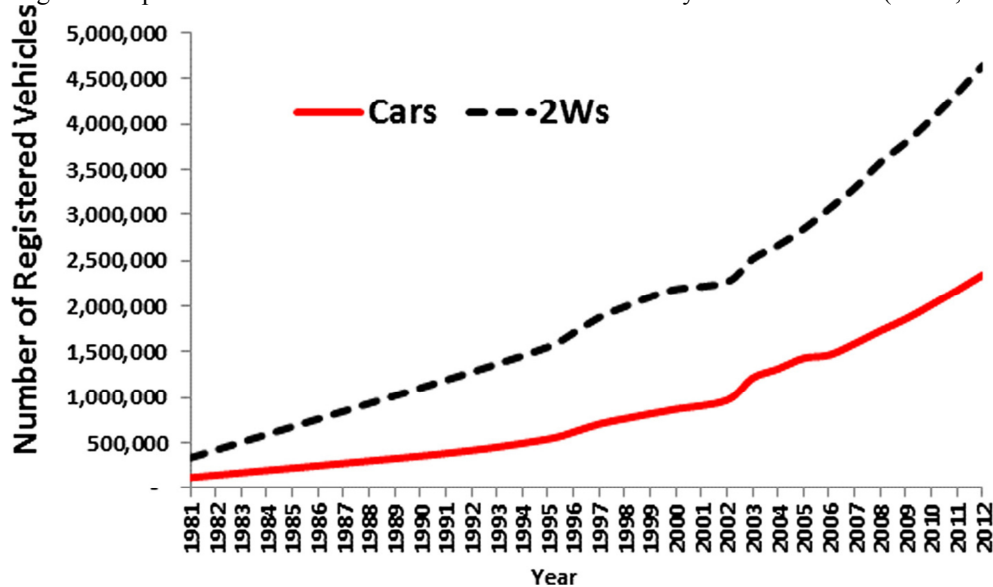


Fig. 2: Total Registered Motor Vehicles in India (State-Wise) (In thousands)

Source: Road Transport Year Book (2006-07)

The total registered motor vehicles in India (State-Wise) for the years 2000 to 2006 have been given in Figure 2. From this Figure, we can see that among the states the maximum number of motor vehicles is accounted by Maharashtra (ranging from 6 million in 2000 to 11 million in 2006) for all the years followed closely by Gujarat, Uttar Pradesh and Tamil Nadu (RTYB, 2006/7). The middle rung states are Andhra Pradesh, Karnataka and Madhya Pradesh. Among the north eastern states development in terms of vehicular population seems to be highest in Assam followed by Nagaland and Manipur. Among the northern states the highest position is that of Rajasthan followed by Punjab and Haryana (ibid).

Among the Union Territories it is obviously the national capital Delhi that had an all-time high of 34 lakhs in 2000 to 44 lakhs in 2006 (Figure 2). The high growth rate of population and high rate of migration has indeed put an imprint on the vehicular population too. It is most surprising how Delhi manages to go on and on. Among the other Union Territories the highest position in terms of vehicular population is held by Chandigarh followed by Puducherry (Pondicherry). Among the road vehicles, the most prominent are cars and two wheelers. The following chart depicts the trend of these two road vehicles from the year 1981 to 2012 (Rahul, *et al*, 2014)



Source: Rahul *et al* (2014)

Table-1. Emission factors for road vehicles (g km^{-1})

mitted	Bus	Omni buses	Two wheelers	Light motor vehicles (Passenger)	Cars and jeeps	Taxi	Trucks and lorries	Light motor vehicles (Goods)	Trailers and tractors	
CO ₂	515.2	515.2	26.6	60.3	223.6	208.3	515.2	515.2	515.2	343.87
CO	3.6	3.6	2.2	5.1	1.98	0.9	3.6	5.1	5.1	3.86
NO _x	12	12	0.19	1.28	0.2	0.5	6.3	1.28	1.28	3.89
CH ₄	0.09	0.09	0.18	0.18	0.17	0.01	0.09	0.09	0.09	0.11
SO ₂	1.42	1.42	0.013	0.029	0.053 ^b	10.3 ^c	1.42	1.42	1.42	1.94
PM	0.56	0.56	0.05	0.2	0.03	0.07	0.28	0.2	0.2	0.24
HC	0.87	0.87	1.42	0.14	0.25	0.13	0.87	0.14	0.14	0.54

b Indian Institute of Petroleum(IIP), Automotive Research Association of India (ARAI)used in UNEP, 1999
 c Mittal and Sharma 2003

Table -2. Emissions from different vehicle types of India (As of 2010)

Categories	CO ₂	CO	NO _x	CH ₄	SO ₂	PM	HC
Bus	28748.16	207.26	679.73	5.02	79.24	31.36	51.72
Omni buses	8508.42	60.94	200.53	1.49	23.45	9.28	15.11
Two wheelers	8701.08	719.64	62.15	58.88	4.25	16.36	464.49
Light motor vehicles (Passenger)	4378.10	370.29	92.93	13.07	2.11	14.52	10.16
Cars and jeeps	23901.22	212.30	22.14	18.17	5.67	3.22	28.01
Taxi	2367.08	10.23	5.68	0.11	117.05	0.80	1.48
Trucks and lorries	70288.92	491.15	859.51	12.28	193.73	38.20	118.69
Light motor vehicles (Goods)	44654.58	442.04	110.94	7.80	123.08	17.33	12.13
Trailers and tractors	46563.85	460.94	115.69	8.13	128.34	18.08	12.65

Total emission from Indian transport by states (for 2010)

Recommendations

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

- 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.
- 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 great extent.
- 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.
- As compared to the international average, the same capacity vehicle in India consumes about eight to fifteen percent more fuel resulting in more pollution which can be avoided by making light bus bodies, use of steel-

belated radical tyres, electronic control devices and time to time testing of emission level.

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

References

- Sarath Guttikunda and Puja Jawahar, (2012) Emissions, Pollution & Health Impacts; Road Transport in India 2010-30
- Fernades, B.G. (1992). 'Solvaging big cities' in Hindustan Times, March 18.
- Horowitz, J. M. (1982) Air Quality Analysis for Urban Transportation Planning MIT Press, Cambridge.
- Hussain T. and T. Mary (1991) 'Deteriorating Urban Environment with increasing vehicular population' Link News Weekly Dec. 22.
- Hussain, T. and T. Mary (1992) 'Energy Crisis, vis-a-vis transport sector' Link News Weekly March 1.
- Hussain, T. (1992) 'Vehicular Pollution vis-a-vis Environment' in Environmental Management and Sustainable Development. Department of Geography, Jamia Millia Islamia, New Delhi.
- Kamalakar J.A. (1991) 'A Study of Air Pollution in Union Territory of Delhi' Ecology Vol. 5 (No.9) February.
- Pundir, B.P. (1989) 'Vehicle Air Pollution in India' Ecology Vol. 4 (No.7) December.
- Ranganathan, S. (1990) 'A sustainable India' Ecology VI. 1 (No. 12) May. Saranathan, TR. (1987) 'Automobile Pollution' Ecology Vol. 1 (No. 12) May.
- Seinfeld, J. H. (1986) Atmospheric Chemistry and Physics of air pollution John Wiley, New York. (1992) 'Environmental Pollution' Civil Services Chronicle, March.
- Sibal, V. and Sachdeva Y. (2001). Urban Transport Scenario in India and its Linkages with Energy and Environment, Urban . Transport Journal, Vol. 2, No.1, March.
- Narain, U., Bell, R.G., 2006. Who changed Delhi's air? Econ. Political Wkly., 1584–1588.
- Rahul Goel, Sarath K. Guttikunda, Dinesh Mohan, and Geetam Tiwari (2014) Benchmarking vehicle and passenger travel characteristics in Delhi for on-road emissions analysis. Elsevier www.elsevier.com/locate/tbs.
- RTYB (Road Transport Year Book) (2006/07). Annual report, India.

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