URBANIZATION AND URBAN TRANSPORT IN INDIA: THE SKETCH FOR A POLICY

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Abstract

Cities play a vital role in generating economic growth and prosperity. The sustainable development of cities largely depends upon their physical, social and institutional infrastructure. In this context, the importance of transport infrastructure is paramount. To facilitate this, what is required is a sound urban transport policy.

The urban population in India has increased significantly from 62 million in 1951 to 285 million in 2001 and is estimated to grow to around 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. Consequently, the number and size of cities have also increased considerably. Although circumstances differ considerably across cities in India, certain basic trends which determine transport demand (such as substantial increase in urban population, household incomes, and industrial and commercial activities) are the same. These changes have placed heavy demands on urban transport systems, a demand that many Indian cities have been unable to meet.

The paper attempts to highlight the need for a cogent urban transport policy without which there will be ad hoc interventions. Such interventions, apart from not adding up to a comprehensive approach, will result in greater confusion. Furthermore, it emphasizes that if there is no worthwhile public transport, it will still need to be reinvented to promote a better quality of life. The need of the hour is formulation of an urban transport strategy that is both pragmatic and holistic in its approach.

1. THE PRESENT CONTEXT

The making of transport policy is a tricky affair. Transport being essentially a derived activity its conceptualization and articulation depends upon a variety of social and economic issues and longer-term goals. India has however attempted twice to evolve a transport policy: the first in 1966 when the dreams of independence were still alive and the second in 1980 under the shadow of zooming oil prices. In a typically oriental fashion, on both occasions, the policies were accepted in toto by the government and subsequently subjected to studied neglect. The silver lining however was the establishment of State Transport Undertakings (STUs) which in the 1960s and the 1970s did an enormous service in linking up towns and villages across the country, particularly in the western and the southern parts. Even though the service may leave much to be desired in terms of quality, STUs' importance lies in the fact that unlike in most other developing countries one can reach almost every village in India by bus.

Urban areas in India, which include a wide range of mega cities, cities, towns etc. are not all that lucky in terms of intra-city transportation. Transport in this context has been a victim of ignorance, neglect and confusion – or all these at once. This is perhaps due to the fact that the majority of the urban population were relatively recent migrants and have yet to develop a sense of belonging in order to influence policies. Whatever influence the public had was not so much for improving the quality of transport but in reducing the fares which further added to inadequacy and inefficiency. There is an absence of policy in urban areas. Indeed policies are most needed here in view of the complexities in urban infrastructure and the need for greater integration in providing, maintaining and managing urban public utilities. The political and bureaucratic set up has done little to introduce professionalism without which the planning and regulatory measures can only be inadequate, inefficient and at the most half-baked. It is essentially for these reasons that new threats are emerging in the shape of congestion and pollution. In other words, whatever the transport system, people will move, but the modes they choose and the manner in which they travel will tend to be unsafe and inefficient without careful articulation and planning. This paper argues for greater attention to policy making and its implementation.

Economic efficiency of cities and well-being of urban inhabitants are directly influenced by mobility or the lack of it. The increasing rate of urbanization and city size already put the urban transport system under great stress. The urban population in India has increased significantly from 62 million in 1951 to 285 million in 2001 and is estimated to be around 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. Consequently, 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 to 51 by the year 2021. These changes have exacerbated the demand for transport – a demand that many Indian cities have not been able to meet. The main reason for this is the prevailing imbalance in modal split besides inadequate transport infrastructure and its sub-optimal use. Given the current urban transport scenario in India, transport policy should aim at improving the economic efficiency of cities and well-being of urban inhabitants. Adequate transport policy should assist in alleviating endemic traffic congestion which causes significant disruption to business and commercial activities. Furthermore, policy should aim at reducing social costs of accidents and pollution.

Although mobility and accessibility have increased tremendously in the urban areas, there are severe problems such as delay, congestion, accidents, air and noise pollution, energy wastage, etc. 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 which has had its

impact on quality as well. It is often thought to be inegalitarian to provide special services such as air-conditioned buses, express buses, and premium or guaranteed seats in return for higher fares. In other words, variety is usually curbed. Experience shows that the public welcomes a wide choice of transport, but despite the clear need for greater variety in public transport, there is a tendency in established monolithic corporations to offer very limited choice.

The city cannot afford to cater only to the private cars and two-wheelers and there has to be a general recognition that without public transport cities would be even less viable. Much needs to be done if public transport is to play a significant role in the life of a city. Measures need to be taken in the short-run to enhance the quality of public transport service and to impose constraints on the use of private vehicles in cities. In the long-run, there needs to be effective land use planning and the introduction of new transit systems to keep the city moving. It must not be forgotten that cities are the major contributors to economic growth and movement in and between cities is crucial for improved quality of life.

2. URBANIZATION PATTERN IN INDIA

India's urban population is growing at an average rate of around 3 percent per annum. It has almost doubled during the period between 1981 and 2001 from 160 million to 285 million (Figure 1). The average rate of growth of the urban population is not expected to change significantly during the next twenty years. Assuming a decadal increase of around 37%, India's urban population is expected to be around 540 million during 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 (Figure 2). Consequently, the number and size of cities have also increased considerably.

Figure 1 is here
Figure 2 is here

During the 1990s, 68 million people joined the ranks of urban dwellers – which implies a slower decadal growth of 31 percent when compared to the growth of 36 percent during the 1980s. Although urbanization has slowed down in India during the 1990s, the number of metropolitan cities – those with a million plus population – has increased over this period. From 23 in 1991, the number of metropolitan cities rose to 35 according to the Census of India, 2001. India's metropolises grew rapidly during the 1990s with Surat registering the fastest growth of 85.1 percent followed by Faridabad (70.8 percent), Nashik (58.8 percent), Patna (55.3 percent), Jaipur (53.1 percent), Delhi (51.9 percent), Pune (50.6 percent), and Indore (47.8 percent) *(2)*. The overall decadal growth rate of the 35 metropolises worked out to be around 34 percent, which is higher than urban India's growth of 31 percent. India's big cities now account for a larger share of total urban population – a trend that has been observed since Independence. In 2001, the share of metropolitan cities was 37.8 percent, up from 32.5 percent in 1991 and 26.4 percent in 1981.

The pattern of urbanization has many distinguishing characteristics. There is a great variation across states. The range is from around 8% for Himachal Pradesh to around 35% for Maharashtra *(3)*. Many factors contribute to this variation. Transport is one of them. It is interesting to note that the level of economic development is higher in those states where the urbanization level is high indicating a positive correlation between urbanization and economic development.

The distribution of urban population by city size widely varies and is skewed towards larger cities. One specific feature of India's urbanization is the increasing metropolitanization, that is, growth in the number and size of cities with a million plus population. The trends indicate the continued urbanization and metropolitaniztion in the years to come.

3. URBANIZATION – INEVITABLE AND DESIRABLE

The urbanization pattern and trends raise a number of issues. There is a debate as to whether it is an index of development or distress. The very process of urbanization has often been considered as something undesirable. While the objections used to be on social and moral grounds, the criticism lately is more on economic grounds such as provision of requisite infrastructure and civic amenities at rapidly escalating per capita costs. Despite all the objections, the rate of urbanization has not even slowed, not to speak of its being halted. A certain inevitability about the process is being accepted steadily. It is felt that urbanization is necessary for the benefits of sharing modern technology for the growth and development of the entire national economy. In India, urban areas contribute nearly 60 percent of the national income. It is expected that they will assume greater economic importance in the coming years.

Until recently policies towards urban areas have often been apologetic. The focus has been on rural areas where the poorest of the poor were said to live, and from where, it was argued, agriculture-led growth must emanate. It was also argued that cities should be restricted in size, and action to tackle their problems should be limited to avoid increasing their attraction. This strategy was directed to limit migration towards cities and thereby promoting growth and balanced development of the country. Several facts revealed the weaknesses of this approach, which lead to a reappraisal of the strategy. It is clear that the ambiguity, which often underpinned discussion on urban policy, is presently undergoing rapid change towards a new and positive stance.

4. URBAN TRANSPORT AND CITY EFFICIENCY

Many cities in India have grown at an unprecedented rate in recent years, and this growth is expected to continue in the foreseeable future. In 1951 only five cities in India had populations in excess of 1 million: Kolkata (4.67 million), Mumbai (2.97 million), Delhi (1.43 million), Chennai (1.54 million), and Hyderabad (1.13 million). By 2001, however, there are 35 cities in India whose populations topped 1 million, and by the end of the year 2021 there are expected to be at least fifty.

Fast-growing cities in India have nurtured business and industry and have provided jobs and higher incomes to many migrants from rural areas. Thus, it is important that cities function efficiently – that their resources are used to maximize the cities' contribution to national income. City efficiency largely depends upon the effectiveness of its transport systems, i.e., efficacy with which people and goods are moved throughout the city. Poor transport systems stifle economic growth and development, and the net effect may be a loss of competitiveness in both domestic as well as international markets.

Although Indian cities have lower vehicle ownership rate (number of vehicles per capita) than their counterparts in developed countries, they suffer from worse congestion than cities in industrialized countries. In Kolkata, for example, the average speed during peak hours in CBD area goes down as low as 7 km per hour. This indicates both the amount of time and energy that are wasted and the scale of opportunity for improvement.

Spending on transport is too often influenced by a notion of political prestige than by rational calculations of economic growth. Most Indian cities spend too much on politically attractive but costly facilities, such as elevated roadways and mass rail transit systems, instead of making modest labor-intensive road improvements, extending city streets, and promoting low-cost bus operations. Since, according to a World Bank Study *(4)*, rail subways can cost as much as $100 million per kilometer, the money spent building just a few meters of subway could be used instead to construct or upgrade several miles of streets.

Transport demand in most of the Indian cities has increased substantially due to an increase in population as a result of both natural birth rates and migration from rural areas and smaller towns. Availability of motorized transport, increases in household income, and increases in commercial and industrial activities have further added to it. In many cases, demand has outstripped road capacity. Congestion and delays in both passenger and commercial traffic are widespread in Indian cities and indicate the seriousness of their transport problems. As a result, costs – particularly fuel costs – increase substantially, affecting commerce and industry. A high level of pollution is another

undesirable feature of overloaded streets. The result has been a serious decline in productivity and city efficiency, a drain on city and national budget, and a strain on urban institutions. The transport crisis also takes a human toll. Statistics indicate that traffic accidents are a primary cause of accidental deaths in the Indian cities.

5. CURRENT URBAN TRANSPORT SCENARIO IN INDIA

On average, during peak hours in Mumbai, the actual occupancy in a suburban train is in excess of 4000 passengers, which have maximum desirable capacity of 2600 passengers *(5)*. Most of the Indian cities have more or less similar traffic congestion. Estimates for the metropolitan cities show that approximately 80 million trips will need to be catered to per day, whereas only 37 million trips are being provided by the available rail and bus mass transport facilities *(6)*. Furthermore, according to a World Bank study *(4)*, for every extra one million people in a developing city an extra 3.5 to 4 million public transport trips per day are generated. Considering the population growth in most Indian cities, the urban transport infrastructure thus needs to be increased manifold in the decade or so, if the gap in the demand and supply has to be eliminated.

5.1. Vehicular growth

According to Motor Transport Statistics *(7)*, the annual rate of growth of motor vehicles in India was around 11 percent during the last decade (see also Figure 3). In 1987 there were 12.6 million vehicles. 10 years later, in 1997, this number had increased threefold to 37.2 million. Vehicle population is estimated to be over 50 million by 2001. The basic problem is not the number of vehicles in the country but their over-concentration in a few selected cities, particularly in metropolitan cities. If one compares the vehicle as well as car ownership rate across countries, India fares poorly vis-à-vis even most developing countries. India, where more than 15% of the world's human population lives, constitutes just 5% of the world's motor vehicle population. As far as cars are concerned, its share is even less than 1%.

Figure 3 is here

A majority of motor vehicles in India are concentrated in urban centres and it is alarming to note that 32% of these vehicles are plying in metropolitan cities alone, which constitute just around 11% of the total population. It is interesting to note that Delhi, which contains around 1.4% of the Indian population, accounts for more than 7% of all motor vehicles in the country. There are already more than 2.6 million registered motor vehicles in Delhi and about 600 vehicles are being registered everyday.

Traffic composition in India is of a mixed nature. There is a wide variety of about a dozen types of both slow and fast-moving vehicles. The modal split indicates that in 1977, about 39% of total vehicles were two-wheelers, which increased to 69% in a span of just two decades (see also Figure 4). The share of two-wheelers is likely to increase to about 75% by the year 2005.

Figure 4 is here

The share of buses is negligible in most Indian cities when compared to two-wheelers and cars. For example, two-wheelers and cars together constitute more than 91% in Kanpur, 88% in Hyderabad, and 86% in Nagpur whereas buses constitute 0.5, 0.5, and 0.4 percent respectively *(6)*. There has been a decline in the percentage share of buses from 11.1 percent in 1951 to 1.3 percent in 1997 for the whole country.

In the absence of an adequate and efficient public transport system, a large number of private and para-transit modes have entered into the market to meet the travel demand. Such a proliferation of vehicles results in acute congestion, inordinate delays, serious accidents, high-energy consumption particularly of fossil fuels, and intense pollution of the environment.

5.2. Travel demand

The level of urban travel demand in India is increasing substantially over the years. Three factors contribute to this. The first is the increase in population. The urbanization process has indicated that the population size of an urban area doubles in about two decades. The second factor is the mobility rate, that is, the average number of trips per person per day. The mobility rate in urban India is continuously increasing over the years. For example, in Delhi, the average number of trips per person per day has increased from 0.49 during 1969 to 1.10 during 2001 (Table 1). The trip rates for Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Ahmedabad, and Pune are 1.26, 1.26, 1.22, 1.05, 1.20, 1.57, and 1.48 respectively *(8)*. The third factor contributing to travel demand is the increase in trip length due to an increase in the physical expansion of the city. For example, the average trip length in Delhi has increased from 5.4 km in 1969 to about 13.5 km in 2001 *(8)*. The average trip length on Delhi Transport Corporation (DTC) buses has increased from 6.4 km in 1972 to nearly 18.0 km at present. Currently, it is estimated that the average trip length of four mega cities varies from 12.7 to 13.5 km. There is also a change in the pattern of trip distribution; more and more trips are being made in urban areas for work, followed by education. For example, more than 60% of the total trips in Mumbai are meant for work and around 31% for education *(8)*.

Table 1 is here

The serious consequence of such development is a steep rise in demand for transport in almost all the cities in India. Tata Energy Research Institute (TERI), New Delhi, estimates this to increase from 335 Billion Passenger-Kilometers (BPKm) in 1991 to 1905 BPKm by 2001 for seventeen selected towns in its study. RITES have estimated 462 million passengers trips per day (mptd) by 2016, for the class I cities (100,000 plus population) alone. The annual growth of travel demand is increasing at the rate of 2.2% in Kolkata, 4.6% in Mumbai, 9.5% in Delhi, and 6.9% in Chennai *(8)*.

Table 2 presents desired shares of mass transport in Indian cities on the basis of their population levels. While the share of mass transport is well below the desired range, the share of personalized transport and para transit is already above the optimal range (Table 3). What is worse is that the modal split appears to be moving in the wrong direction. For example, the share of mass transit in Delhi has stayed at the same low and unacceptable level for the last two decades (Table 4). Since its population is more than 10 million, mass transport should serve at least 75% of the total travel demand rather than the existing level of 62%. In Lucknow, which has a population of about 2 million, bus transport plays a negligible role in providing mobility to urban dwellers (Table 5). The modal split in Class I cities of India during the year 1994 is presented in Table 3. This table also shows that the share of mass transit in the cities is much less than the desired level. Intermediate Public Transport (IPT) modes play a significant role in meeting transport demand in small and medium size cities in the absence of an adequate mass transport system. The share of trips made by personalized modes, particularly two-wheelers is very high in virtually all the cities. The percentage of trips by bicycle is seen to decrease with the increase in city size. The prevailing imbalance in modal split, that is, inadequate mass transit, decline in walking and bicycle trips, rise in the use of para transit and personalized transport leads to congestion, energy wastage, accidents as well as air pollution.

Table 2, 3, 4, and 5 are here

5.3. Existing transport infrastructure

The area occupied by roads and streets in Class – I cities in India is only 16.1 percent of the total developed area while the corresponding figure for the USA is 28.19 percent. Figure 5 presents the allocation of urban space for transportation in selected city centers. It is interesting to note that even

in Mumbai, the commercial capital of India, the percentage of space used for transportation is far less when viewed in comparison to its counterparts in the developed world. In general, the road space in Indian cities is grossly insufficient. To make the situation worse, most of the major roads and junctions in Indian cities are heavily encroached upon by parked vehicles, roadside hawkers, and pavement dwellers. As a consequence of these factors, the already deficient space for the movement of vehicles is further reduced.

Figure 5 is here

The present urban rail services in India are extremely limited. Only three cities i.e., Mumbai, Kolkata, and Chennai are served by suburban rail systems. The rail services in these three main cities together carry more than 7 million trips per day. Interestingly, the Mumbai Suburban Rail System alone carries about 5.5 million trips per day. Delhi with a population of about 12.7 million is the only mega city in India, which does not have an urban rail system. It is hoped that the Delhi Metro which is under construction will adequately integrate with other modes and help in better circulation. A few other cities also have limited suburban rail systems but these hardly meet any urban transport demand.

Few of the metropolitan cities are served by well-organized bus services. Services are mostly run by STUs. Private bus services operate mainly in Delhi and Kolkata. All passenger buses use the standard truck engine and chassis and hence are not most economical for city use. There are virtually no buses in India specifically designed for urban conditions. Qualitatively, the available urban mass transport services are overcrowded, unreliable, and involve long waiting periods. Over-crowding in the public transport system is more pronounced in large cities where buses, which are supposed to carry 50-60 passengers generally, carry double of their capacity during peak hours. As a result, there is a massive shift to personalized transport, especially two-wheelers and also a proliferation of various types of IPT modes, i.e. three-wheelers and mini-buses. Buses are still the best answer to provide mobility in Indian cities. It is regrettable that bus systems are neglected and allowed to decline due to uneconomic fares and outdated technologies.

6. ROAD SAFETY IN INDIA

Many developing countries including India have serious road accident problems. Fatality rates are quite high in comparison with developed countries. While in Europe and North America the situation is generally improving, many developing countries face a worsening situation. A large number of deaths in the developing world are due to road accidents. Apart from the humanitarian aspects of the problem, road accidents cost countries of the developing world at least one percent of their Gross National Product (GNP) each year – sums they can ill-afford to lose *(11)*. The nature of the problem in developing countries is in many ways different from that in the industrialized world. The proportion of commercial and public service vehicles involved in road accidents is often much greater. Pedestrians and cyclists are often the most vulnerable. Given the fact that the poorest of the poor in urban India cannot even afford to use public transport, they resort to cycling or walking. Since cyclists and pedestrians are the prime victims of road accidents, there must be a serious attempt to either make public transport available to them through targeted subsidization or to make the road safer to cycle and walk.

There is an alarming increase in accidental deaths on Indian roads. Figure 6 presents the rate of road accidental deaths in India from the year 1991 to 1998. The fatality risk (defined as, road accidental deaths per million population) in India is increasing over the years, from 67 in 1991 to 79 in 1998. During the same period, road accidental deaths have increased at a rate of 4.44 percent per annum while the population of the country has increased by only 1.92 percent per annum. Although the fatality rate (defined as the number of fatalities per 10,000 vehicles) in India is declining over the years, it is still quite high in comparison to the developed world.

Figure 6 is here

Road accidental deaths in cities are relatively higher than the Indian average e.g., four mega cities of India constitute around 5.4% of all road accident related fatalities, whereas only 4.4% of the Indian population live there. Table 6 presents road accidental casualties in selected metropolitan cities in India. Analysis shows that from 1990 to 1997, the number of fatalities in selected Indian cities increased at the rate of 4.1% per annum, which is quite high by any standard. There are more than 6 deaths due to road accidents every day in Delhi alone. Except Kolkata and Mumbai, all sample cities are showing very high growth rate in fatalities over the sample period. The accident severity index (defined as number of fatalities per 100 accidents) is also very high for all the sample cities other than Ahmedabad, Bangalore, Kolkata, and Mumbai.

Table 6 is he re

7. ENVIRONMENTAL IMPACT OF URBAN TRANSPORT

Transport sector is the major contributor to air pollution in urban India. Emissions from motor vehicles pollute the air, which, in turn, affects the health of people who are living in the city. The problem of air pollution in Indian cities can be gauged from the fact that more than 2% of the people in the prime of their life (15 to 45 years) die prematurely in Delhi every year due to breathing and heart-related disorders caused by polluted air. A study of metropolitan cities of India showed that the health costs of air pollution of these cities for 1991-92, which involved 40,351 premature deaths, ranged between US $170 million and US $1615 million on account of such deaths alone. The estimate of damage rises to anywhere in the range of US $517 million to US $2102 million when we consider the effects in terms of higher mortality and morbidity together. The three mega cities (Mumbai, Kolkata, and Delhi) of India accounted for 40% of such deaths. *(14).*

There is a direct relationship between transport system and air pollution in a city. Vehicular emissions depend on vehicle-km, vehicle speed, age of vehicle, and of course emission rate of different vehicle categories. Table 7 presents emission factors for different types of vehicles, under typical conditions, in Indian cities. One can see that the emission rate, defined as quantity of pollutants emitted per vehicle-km, pertaining to carbon monoxide (CO) and hydrocarbons (HC) is very high for personalized modes (e.g., cars and two-wheelers) and para transit modes (e.g., three-wheelers) in comparison to buses, trucks, and LCVs. With the deteriorating level of mass transport services and the increasing use of personalized motor vehicles, vehicular emission is assuming serious dimensions in most Indian cities (see also Table 8).

Table 7 and 8 are here

Traditionally, industries have been blamed for causing air pollution. However, this dubious distinction has now gone to automobiles. According to studies by Central Pollution Control Board (CPCB), 76.2% of CO, 96.9% of hydrocarbons, and 48.6% of NO_x are caused by emissions from the transport sector in Delhi. Air pollution due to vehicles in Delhi is expected to rise from 63% in 1990-91 to 72% in 2000-01 (Figure 7). According to a study by Vatavaran, an NGO, during 1998, 98% of tempos and trucks, 94% of buses, 82% of taxis, 66% of two-wheelers, and 52% of cars in Delhi were found to have emission levels above the permissible limit. The ambient air pollution in terms of Suspended Particulate Matter (SPM) in all metropolitan cities in India exceeds the limit set by World Health Organization (WHO) *(18)*. For example, in Delhi, the average annual emission of SPM is 543 microgrammes per cubic meter while the WHO standard is 75. In the case of Kolkata and Mumbai, the corresponding figures are 394 and 226 respectively. If no action is taken, the air quality of large cities in India is likely to deteriorate by a factor of 3 in the next 10 to 15 years *(19).*

Figure 7 is here

The average peak hour speed in Indian cities is far less than the optimum one. According to Centre for Science and Environment (CSE), the quantity of all the three major air pollutants (namely CO, hydrocarbons, and nitrogen oxides) drastically increases with a reduction in motor vehicle speeds. For example, at a speed of 75 km/h, emission of CO is 6.4 g/veh.-km, which increases fivefold to 33.0 g/veh.-km at a speed of 10 km/h. Similarly, emission of hydrocarbons, at the same speeds, increases by 4.8 times from 0.93 to 4.47 gm/veh.-km. Thus, traffic congestion not only decreases the vehicle speed but also increases the pollution level.

It is difficult to ignore what is happening in Delhi. There is a raging debate between diesel and compressed natural gas. The protagonists and antagonists have taken sides and "shot everyone who tried to moderate the discussion". Based on the argument presented before it, the Supreme Court ordered that all public transport vehicles should use compressed natural gas within a given time frame. This however leaves the engines of cars, two-wheelers, and three-wheelers very much outside the discussion. The buses which are presently operating in Delhi constitute only one percent of vehicles and in any case the per pass.-km pollution generated by buses can only be much lower than the other personal and para-transit modes. It is still debatable whether buses should have been targeted in the first cut.

The point is that the confusion has occurred because of the absence of transport policy in urban areas which would have addressed issues of modal split and desirability of supporting certain modes in preference to others. Which fuel and at what quality should have been a secondary issue. The latter became the primary issue by default. This is clear proof that absence of policy will have bizarre and irreversible consequences.

8. ENERGY CONSUMPTION IN THE TRANSPORT SECTOR

In general, energy consumed in the urban transport sector are petroleum products, mainly gasoline and High Speed Diesel (HSD). The energy consumption in urban transport largely depends on the modal split as well as the speed of the vehicle. On average, energy consumption per pass.-km is the least by bus and the highest by car among different modes of road-based passenger transport (last column of Table 9). Estimated energy consumption in urban India during 1994 is presented in Table 10. One can see that buses, which carry around 50% of motorized urban passenger traffic, consume far less energy as compared to cars, jeeps, and two-wheelers, which carry around 40% of this traffic. On average, a car consumes nearly six times more energy than an average bus, while two-wheelers consume about 2.5 times and three-wheelers 4.7 times more energy (last column of Table 9). In terms of fuel cost per pass.-km, a two-wheeler is 6.8 times, a three-wheeler 7.0 times, and a car is 11.8 times costlier than a bus. Furthermore, a car occupies over 38 times more road space in comparison to a bus to provide the same level of passenger mobility (in terms of pass.-kms). The corresponding figures for two- and three-wheelers are 54 and 15 respectively. This shows that bus transportation is not only favorable in terms of environmental consideration but also in terms of energy efficiency and best possible use of scarce road space.

Table 9 and 10 are here

9. NEED FOR AN URBAN TRANSPORT POLICY

Urban transportation is the single most important component instrumental in shaping urban development and urban living. While urban areas may be viewed as engines of growth, urban transport is, figuratively and literally, the wheel of that engine. The test of urban governance depends upon the quality of life the city or town offers *(20)*. Since transport is one of the prime determinants of quality of life, it is for the government to articulate the need for mobility and facilitate it through an appropriate mechanism. In fact, the efficiency of cities greatly depends on the development of

transport systems, as urban transport is a catalyst for overall development. However, the cities in India suffer from the absence of a cogent urban transport policy.

Urban transportation problems in India are manifest in the form of congestion, delay, accidents, energy wastage, and pollution. All these have very heavy economic, social, and environmental costs. The need of the hour is therefore a sound urban transport policy. The major thrust of such an urban transport policy should include integrated planning, an optimum share between public and private modes, the choice of relevant technology for public transport systems, optimal use and management of available resources, restructuring of monetary and fiscal policy to encourage and promote public transport, and establishment of institutional arrangements, at all levels of governance, particularly at the city level, for planning, development, operation, management, and coordination of urban transport systems.

Much of the confusion in these matters is due to a lack of professional expertise. There is no transport undertaking in India, which employs qualified transport planners, and the transport planners employed in municipalities and municipal corporations are placed at a hierarchial level where they can have little or no influence. There are over a dozen institutions which are bringing out qualified transport professionals in India. Having no job market within, it is no surprise that Indian transport planners are active in most developed countries from Seattle to Sydney. It is unfortunate that they have only marginal influence in policy formulation within the country.

10. POLICY MEASURES

Transport systems in most of the Indian cities are under the pressure of economic growth on the one hand and under-investment on the other. Resolving this is therefore the highest priority of urban authorities. An integrated transport strategy, which should be socially, economically, and environmentally acceptable, has to be evolved and implemented.

Urban transport plans should especially emphasize public transport systems. As far as public transport systems in Indian cities are concerned, dedicated city bus services are known to operate in 17 cities only and the rail transit exists only in three cities (i.e., Mumbai, Chennai, and Kolkata) out of 35 cities with populations in excess of one million. Very few urban bus transport systems in India have been able to keep pace with the very rapid and substantial increases in travel demand of the past few years. Bus services have deteriorated over the years, and their efficiency and quality have further been reduced. As a result, passengers have turned to personalized modes and IPTs.

Considering the financial health of various levels of governments (central, state, and local governments) and investment requirement to improve the rail-based mass transport systems, it is evident that bus transport will have to play a more important role in providing the passenger transport services not only in mega cities but also in most of the metropolitan and class I cities in India. Bus transport is favorable over its other counterparts not only for reasons of energy efficiency but also from an environmental point of view. There is a need to maximize its potential by encouraging promotional measures.

There is a need for a great variety of modes of public transport. Given the opportunity, people reveal widely divergent transport preferences, but in many places city authorities favor a basic standard of bus services provided by closely controlled large undertakings. This approach is often justified by certain misconceptions. First, it is said that there are great economies of scale in the size of the firms providing bus services. Second, it is often thought to be inegalitarian to provide special services such as premium or guaranteed seats or express buses in return for higher fares. In other words, variety is usually curbed. The economies of scale argument, however, has been discredited by both empirical evidence and experience (see, for example, *(21)* and *(22)*). The

management and labor problems of large undertakings have revealed the diseconomies of large-scale operations. Since the monopolies often produce only low quality service, people who are willing to pay for something better are forced to opt for other modes. Government regulation and control have exacerbated the poor operational and financial performance of the monopolies. As costs rise, for example, transport systems come under financial pressure to increase fares, but politicians are under contrary pressure to keep fares at existing levels. Unless the system is subsidized, it will then have to eliminate some of its less profitable services. Once again, however, politicians will be inclined to yield to pressure from those whose services are threatened and to insist on maintaining money-losing operations. The answer, however, is not to withdraw public transport services but to regulate them, if necessary, with carefully targeted subsidies.

With few exceptions, publicly owned transport undertakings operate at higher unit costs than comparable transport operations controlled by the private sector. Kolkata provides an opportunity to make a direct comparison between privately owned and publicly owned bus systems. Public buses are operated by the Calcutta State Transport Corporation (CSTC), with a fleet size of over 1,200 buses and a staffing ratio per operational bus of around 16. CSTC has also been plagued by fare evasion estimated at more than 15 percent of revenue. As a result of low productivity and fare evasion, the system requires a huge subsidy since revenues cover only about half of the operating costs. On the other side, there are around 1,800 private buses in the city. These buses are operated mainly by small companies or individual owners grouped into a number of route associations. Fares for private and public bus services are the same. Despite the similarity in fare rates, private operators have been able to survive financially without any subsidy. Their success is attributed to very high productivity, which is reflected in low staffing ratios and high fleet availability. Although the quality of both private and public bus service is below the desired level, the private operators are able to provide more frequent service. This is because the route associations regulate the services and apply fines when buses run behind schedule. The private bus companies in Kolkata, which hold almost two-thirds of the market, play a major role in meeting the demand and thus substantially reduce the financial burden on the State Government. Without the profit motive and the staff accountability that exist in the private sector, publicly owned transport undertakings have little incentive to strive for cost effectiveness, to compete for revenues, or to sustain the high degree of effort necessary to overcome the various day-to-day problems.

Furthermore, public transport undertakings often lack the flexibility of organization, the ability to hire and fire staff, or the financial discretion needed to adapt to changing conditions. In such circumstances, a policy, which encourages private participation in the provision of bus services, should be welcomed. One should note that under competition, operators tend to become more responsive to customers' needs and more innovative in finding ways to cut costs. Moreover, the alleged disadvantages of competition seldom are found to be real problems and, if they do arise, can usually be overcome by minimal regulatory intervention. If bus movements cause congestion, for example, it can be dealt with by strengthening police enforcement of traffic rules. Similarly, inspection of buses and driving tests for drivers can be introduced to improve safety.

Considering the forecasts of rapid growth in urban travel demand, the need for bus services can be expected to intensify greatly in the years to come. If the private and the public sectors play their appropriate roles, most Indian cities will have the opportunity to develop vigorous and viable public transport systems. Because of rapid growth in travel demand, considerable expansion of public transport systems in most cities will be an absolute necessity. If a knowledge-based regulatory and planning authority for public transport is installed in every city, there can be a healthy coordination of private and public sectors, complementary rather than uneconomically competing with one another.

In general, Indian cities have not made much progress in implementing the demand side management measures, such as congestion pricing, restraints on parking etc. Although policy measures that involve restraining the use of private cars and two-wheelers are likely to be unpopular, a gradualist approach of progressively introducing restraints on road use, while at the same time

improving public transport, is more likely to lead to greater acceptance. It is believed that improved public transport and more efficient management of demand would help to combat the trend away from public transport vehicles towards greater use of personalized modes. The central government should assist local governments for effective implementation of such measures. In fact, there is a pressing need to strengthen institutions in the transport sector. More often than not, the institutions responsible for urban transport generally lack the executive, financial, and technical skills to cope with existing situations, let alone emerging transport problems. Central government should provide training and technical assistance to local governments to prepare and implement sound policies and programs.

Furthermore, an urban transport policy should encourage the need for developing 'green' modes like bicycling, walking, through a provision of pedestrian paths and cycle tracks especially in new development areas of larger cities and small and medium towns which should be integrated with the transport network. The application of Transport System Management (TSM) strategy such as one-way systems, improvement of signals, traffic engineering improvement measures for road network, intersections, bus priority lanes, and suitable policies and development of intermediate passenger transport as a short-term measure should be introduced in all cities especially in metropolitan cities so that the existing road capacity and road user safety is increased. Road infrastructure improvement measures like new road alignments, a hierarchy of roads, a provision of service roads, by-passes, ring roads, bus bays, wide medians, intersection improvements, construction and repair of footpaths and roads, removal of encroachments, good surface drainage etc. should also be introduced at least in metropolitan cities. These can be considered as short- and medium-term measures. Very old vehicles in the city should be phased out and lead free fuel for all vehicles should be introduced as soon as possible.

Besides short- and medium-term measures, there is a need to have long-term measures as well, involving technology upgrades and introduction of a high speed, high capacity public transport system particularly along high-density traffic corridors. Use of electric traction should be encouraged as far as possible. One should note that capital-intensive projects should be considered if and only if it is absolutely necessary. In many cases, instead of building underground railways or elevated highways, the government would have done better to have increased the capacity of existing bus services through bus priority measures, such as exclusive busways and better road access. In some cases, of course, capital-intensive investments, such as elevated highways or rapid rail systems, may be the best approach. However, there should be careful appraisal of all capital-intensive projects before implementing them. In addition, there should be a determined effort to develop alternative pollution free fuels in the long run. Caution should be exercised in building flyovers within the CBDs. Flyovers are not essentially an answer to present-day traffic congestion and unless coupled with effective dispersal of activities can cause further chaos because of their irreversibility. Further, since flyovers do not allow buses to use them, there is the danger of increased private vehicle use going against the grain of efficient transport planning.

All these measures suggested above would require a policy framework encompassing regulatory, pricing, and taxation mechanisms. They would have to be reinforced with effective enforcement to encourage the use of clean vehicles and fuels, restrict the use of polluting vehicles and fuels, and modify travel behavior and transport demand using regulatory and pricing instruments.

In a nutshell, transport strategy should support the following objectives:

- Provide and promote sustainable high quality links for people, goods, and services to, from and within the city to benefit economic growth, and the urban fabric and environmental quality of city;
- Improve the efficiency, effectiveness, and reliability of city's transport systems;
- Integrate transport, spatial, and economic development policies, to ensure sustainable access for people and goods;

- Planning development in a way which reduces the need to travel by personalized modes and increase of public transport system;
- Reduction of consumption of scarce energy resources and pollution for ensuring a healthy living environment;
- Improvement of public transport system and its efficiency;
- Improve travel choice and quality;
- Promote transport services and patterns of movement that will contribute to improvements in air quality, reduction in greenhouse gas emissions, and enable visual amenity;
- Optimization of existing transport infrastructure and give precedence to low cost and affordable technology, at least as a short-term measure, especially bus technology.
- Promote the health of the people by encouraging more walking and cycling; and
- Ensure that the development of the transport system contributes to the protection and enhancement of the natural and built environment.

11. SUMMARY AND CONCLUDING REMARKS

Among various factors affecting the quality of life and safety in a city, the transport system is among the most important. It has a direct correlation with air quality and safety. The urban transport situation in large cities in India is deteriorating. The deterioration is faster in metropolitan cities where there is an excessive concentration of vehicles. Commuters in these cities are faced with acute road congestion, energy wastage, rising air pollution, and a high rate of accident risk. It is no longer safe to walk on the road or to ride a bicycle. Mass transport is scarce, overcrowded, unreliable, and involves long walking periods. Considering the population growth in most Indian cities, the urban transport infrastructure thus needs to be increased manifold over the next few years, if the gap in the demand and supply has to be eliminated.

The vehicle operating speed on many roads in metropolitan cities has declined, ranging from 15% to 50% over the last two-decades. The development of roads and infrastructural facilities has not kept pace with the growth of motor vehicles. The transport crisis faced by most of the metropolitan cities in India harms business efficiency, threatens to undermine the city's competitive position, and worsen the people's quality of life. Without vigorous action, all of these problems would intensify, as rising population over the coming decades and the goal of growing economic prosperity put more pressure on the system. Achieving this requires not only overcoming chronic under-investment, but also a complete overhaul of public transport management. It is high time the decision-makers take necessary action to make cities viable.

The complexities of urban transport cannot be resolved without a concise and cogent policy. Urban areas, whether mega-cities, cities or towns, have grown and are growing. The demands they are making have remained largely unmet. The deteriorating quality of public transport is driving people to personalized transport, most of which are fuel-inefficient, congesting and unsafe. While it is not the intention of this paper to make a case against large capital intensive metro systems, the realities demand solutions which are within reach. Buses as a mode of public transport, have a potential which is yet to be fully exploited. Given the priority that they deserve, buses can ensure safety, act against pollution and promote mobility for the poor and the not so poor.

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TABLE 1. Average number of trips per person per day in Delhi

Purpose	1969	1981	2001 (Estimated)
Work	0.29	0.35	0.45
Education	0.08	0.10	0.15
Others	0.12	0.27	0.50
All purpose	0.49	0.72	1.10

Source: *(3).*

TABLE 2. Desirable modal split for Indian cities of various sizes (as a %age of total trips by mechanical modes)

City size range (pop. In million)	Mass transport	Bicycle	Other modes
0.1 – 0.5	30 – 40	30 – 40	25 – 35
0.5 – 1.0	40 – 50	25 – 35	20 – 30
1.0 – 2.0	50 – 60	20 –30	15 – 25
2.0 – 5.0	60 – 70	15 – 25	10 – 20
5.0 plus	70 – 85	15 – 20	10 – 15

Source: *(6).*

TABLE 3. Existing modal split in Indian cities during 1994 (in %age)

City population (in million)	Walk	Mass transport	IPT Fast	IPT Slow	Car	Two wheeler	Bicycle	Total
0.10 – 0.25	37.1	16.4	10.4	20.1	3.3	24.1	25.7	100.0
0.25 – 0.50	37.8	20.6	8.9	17.2	2.6	29.8	20.9	100.0
0.50 – 1.0	30.7	25.4	8.2	12.0	9.5	29.1	15.9	100.0
1.0 – 2.0	29.6	30.6	6.4	8.1	3.3	39.6	12.1	100.0
2.0 – 5.0	28.7	42.3	4.9	3.0	5.0	28.9	15.9	100.0
5.0 plus	28.4	62.8	3.3	3.7	6.1	14.8	9.4	100.0

Source: *(6).*

TABLE 4. Modal split trend in Delhi

Mode	Modal split (in percent)			
	1969	1981	1986	1994
Bus	41	62	62	62.0
Car	59	38	38	6.9
Two-wheeler				17.6
Bicycle				6.6
Cycle rickshaw				3.5
Others				3.4

Source: *(9).*

TABLE 5. Modal split trend in Lucknow

Mode	Modal split (in percent)		
	1963-64	1984-85	1997-98
Bus	2.6	3.4	4.3
Car	1.1	1.3	3.4
Two-wheeler	0.8	8.2	26.7
Tempo	-	4.6	9.2
Bicycle	26.3	30.1	23.4
Cycle rickshaw	2.8	16.8	14.9
Other vehicles	0.2	2.7	0.4
Walk	66.3	33.0	17.7

Source: *(9).*
Note: (-) indicates unavailability of data.

TABLE 6. Road accidental casualties in selected metropolitan cities in India

Metropolitan cities	1990			1997		
	Fatalities	Accidents	ASI*	Fatalities	Accidents	ASI*
Ahmedabad	195	2873	7	239	3229	7
Bangalore	562	6729	8	704	8722	8
Chennai	507	5877	9	749	5171	14
Delhi	1670	7697	22	2342	10957	21
Hyderabad	276	1412	20	377	2108	18
Jaipur	235	1062	22	303	2022	15
Kolkata	463	10911	4	471	10260	5
Mumbai	400	25331	2	401	27421	1
Nagpur	166	1139	15	387	1496	26
Pune	275	1387	20	320	2687	12

Source: *(13).*

* ASI is accident severity index (defined as, number of fatalities per 100 accidents)

TABLE 7. Emission rate of different vehicles in a typical Indian city (in gms/km)

Vehicle	CO	HC	NO_x	SO_2	Pb	TSP
Two-wheeler	8.30	5.18	-	0.013	0.004	-
Car	24.03	3.57	1.57	0.053	0.012	-
Three-wheeler	12.25	7.77	-	0.029	0.009	-
Bus	4.38	1.33	8.28	1.441	-	0.275
Truck	3.43	1.33	6.48	1.127	-	0.450
LCV	1.30	0.50	2.50	0.400	-	0.100

Source: *(15).*

Note: (-) indicates negligible quantity.

TABLE 8. Estimated vehicular emission load in selected metropolitan cities in India

Name of the city	Vehicular pollution load (tonnes per day)					
	Particulates	Sulphur dioxide	Oxide of the Nitrogen	Hydrocarbons	Carbon monoxide	Total
Delhi	10.30	8.96	126.46	249.57	651.01	1046.30
Mumbai	5.59	4.03	70.82	108.21	469.92	659.57
Banglore	2.62	1.76	26.22	78.51	195.36	304.47
Kolkata	3.25	3.65	54.69	43.88	188.24	239.71
Ahmedabad	2.95	2.89	40.00	67.75	179.14	292.71
Pune	2.39	1.28	16.20	73.20	162.24	255.31
Chennai	2.34	2.02	28.21	50.46	143.22	226.25
Hyderabad	1.94	1.56	16.84	56.33	126.17	202.84
Jaipur	1.18	1.25	15.29	20.99	51.28	88.99
Kanpur	1.06	1.08	13.37	22.24	48.42	86.17
Lucknow	1.14	0.95	9.68	22.50	49.22	83.49
Nagpur	0.55	0.41	5.10	16.32	34.99	57.37
Grand total	35.31	29.84	422.88	809.96	2299.21	3597.20

Source: *(16).*

TABLE 9. Energy efficiency of various modes of passenger transport

Mode	Fuel type	Fuel efficiency (Km/litre)	Operating energy intensity (litre/PKm)	Relative energy efficiency
Bus	Diesel	4.30	0.006	1.00
Two-wheeler	Petrol	44.40	0.015	2.50
Three-wheeler	Petrol	20.00	0.028	4.70
Car	Petrol	10.90	0.038	6.30

Source: *(15).*

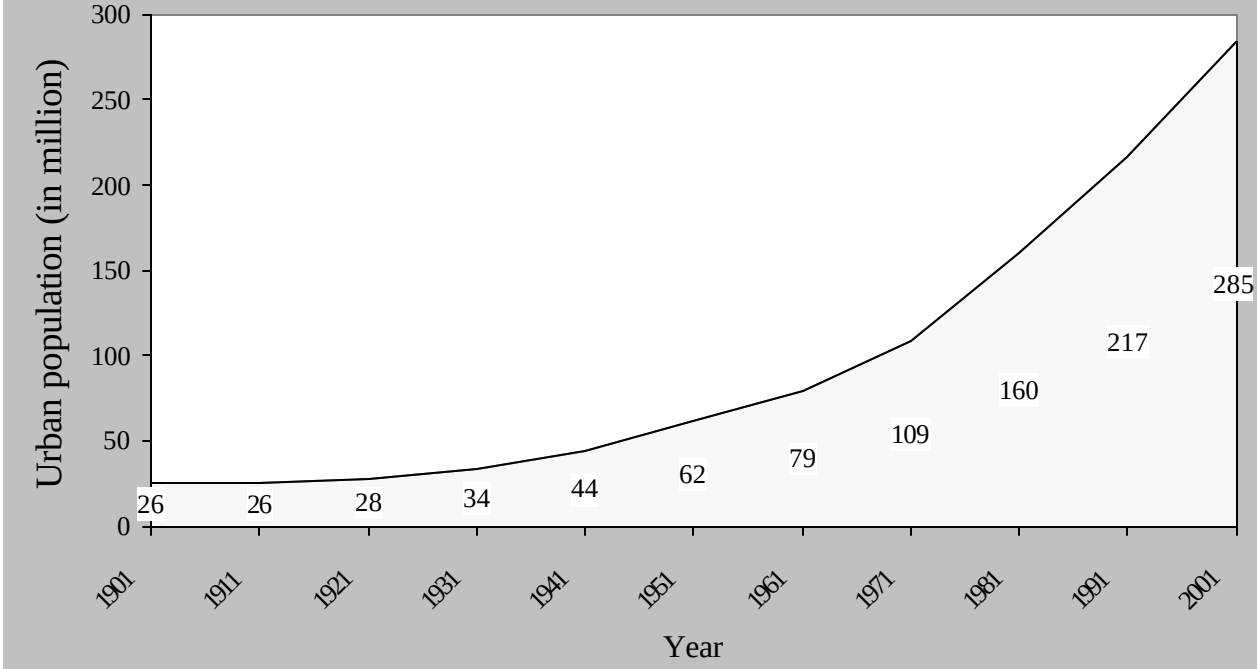
TABLE 10. Estimated annual energy consumption in urban India during 1994

City size (Pop. in million)	No. of cities	Annual fuel consumption (in thousand tons)						
		2-wheelers	Cars/ Jeeps	3-wheelers	Buses	Trucks	Rail	Total
0.1 – 0.5	281	567	325	74	546	857	-	2369
0.5 – 1.0	34	215	198	52	230	405	-	1100
1.0 – 2.0	15	402	150	41	162	203	-	958
2.0 – 5.0	5	272	130	31	147	87	-	667
5.0 plus	5	403	373	51	528	213	6	1574
Total	340	1859	1176	249	1613	1765	6	6668

Source: *(6).*

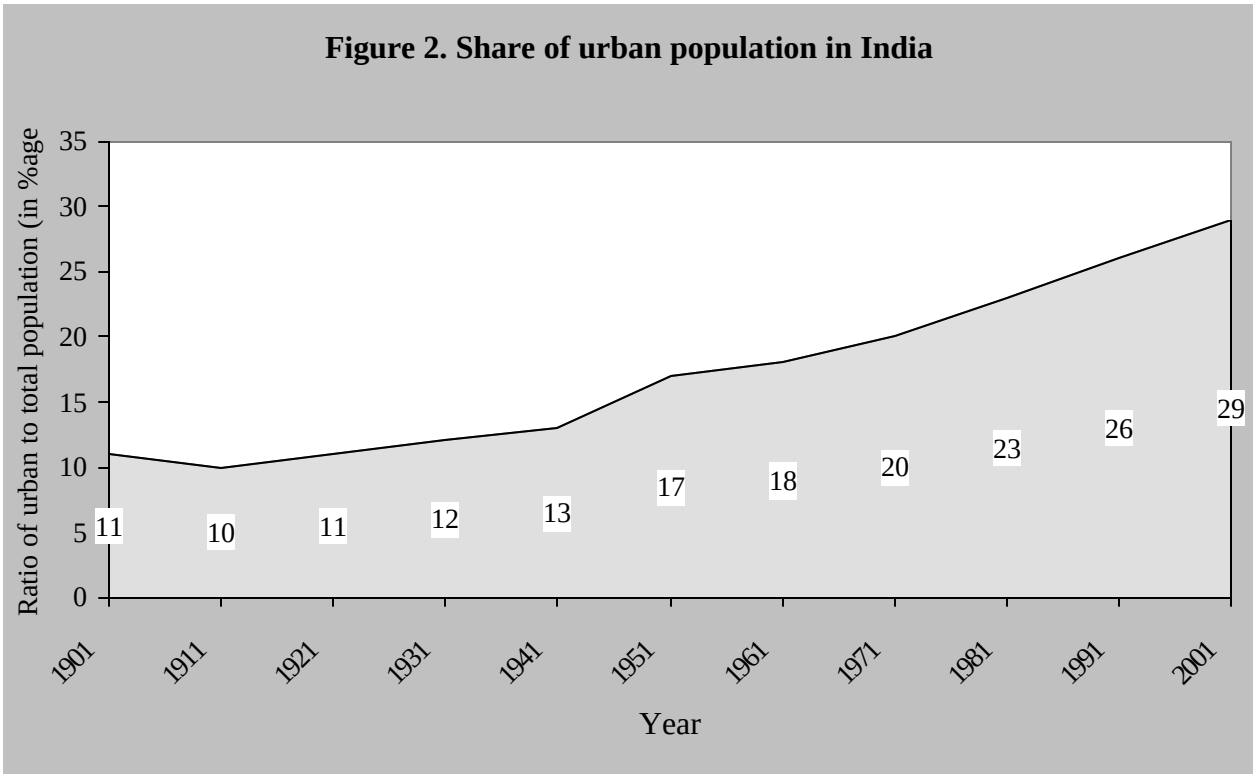
Note: (-) indicates unavailability of data.

Figure 1. Urban population in India



Sources: *(1)* and *(2)*.

Figure 2. Share of urban population in India



Sources: *(1)* and *(2).*

Figure 3. Motor vehicle population in India; 1951 to 1997

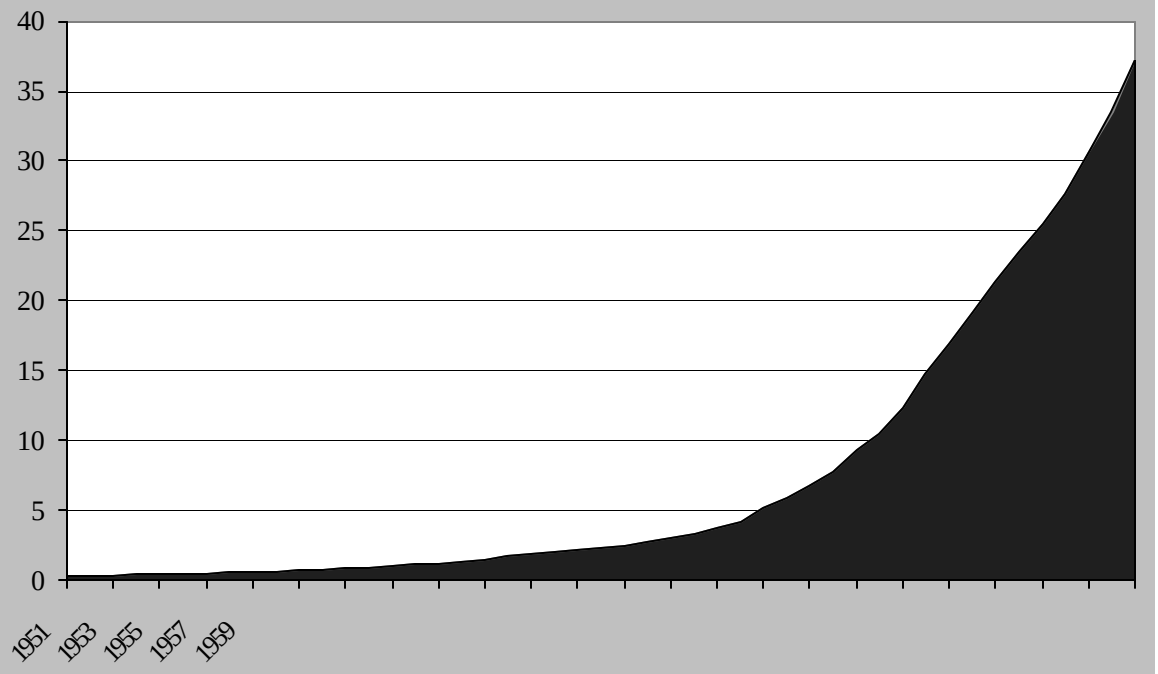
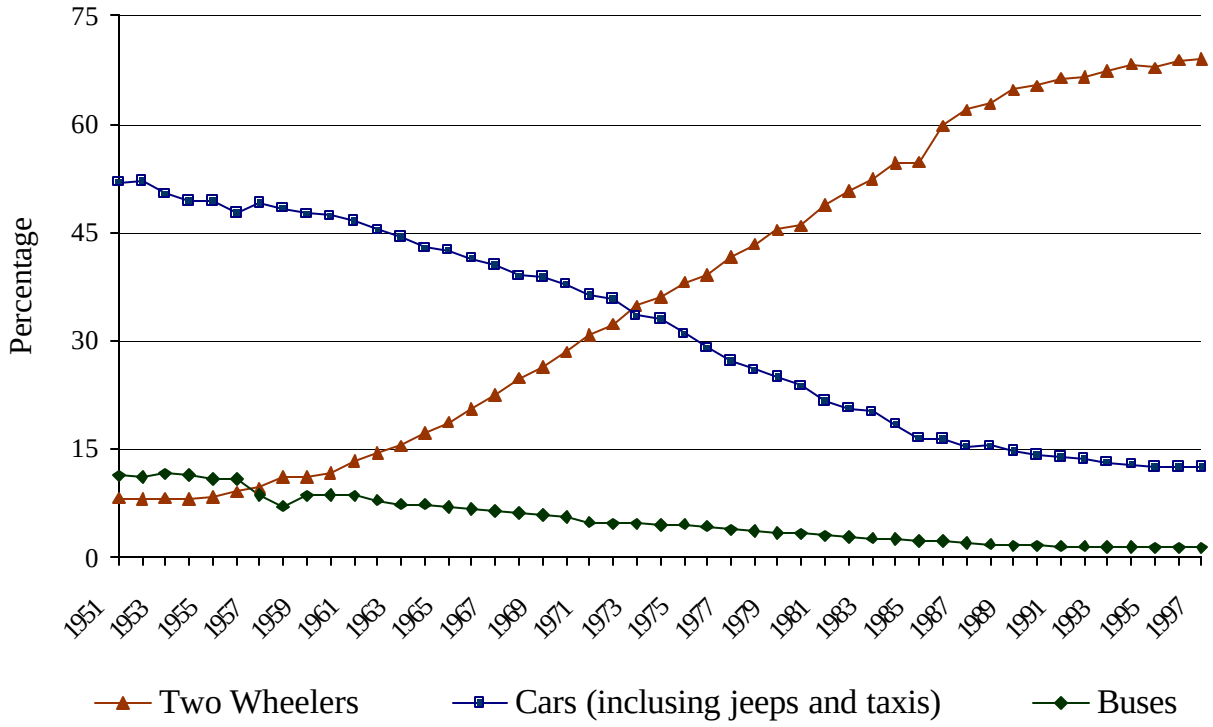
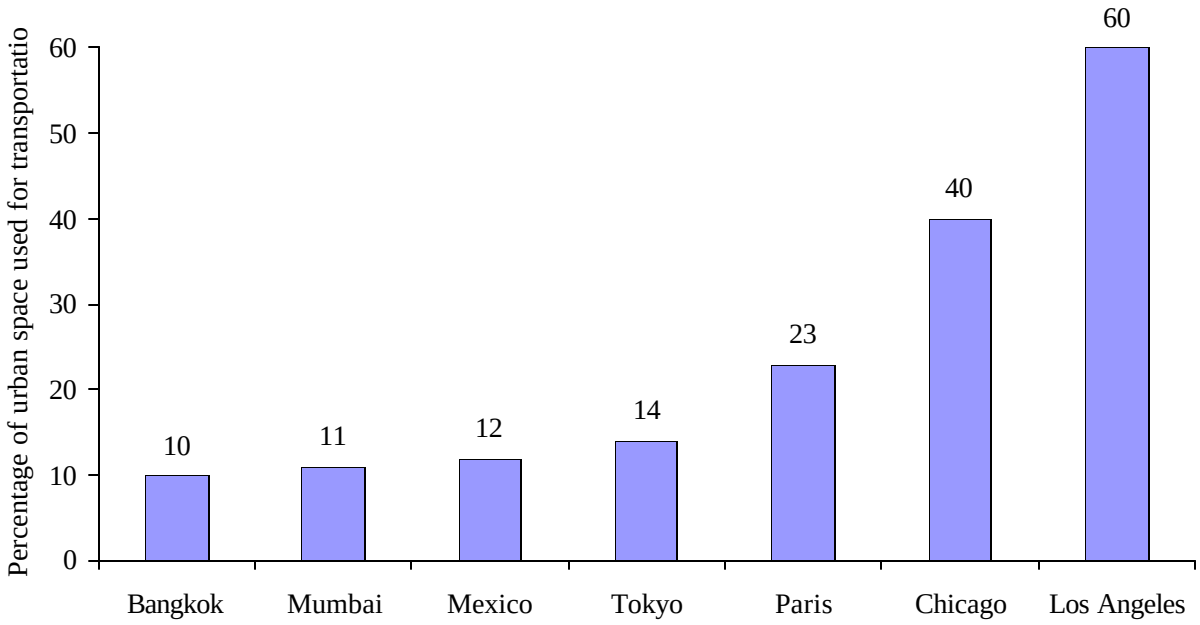


Figure 4. Share of two wheelers, cars, and buses in total motor vehicle population in India



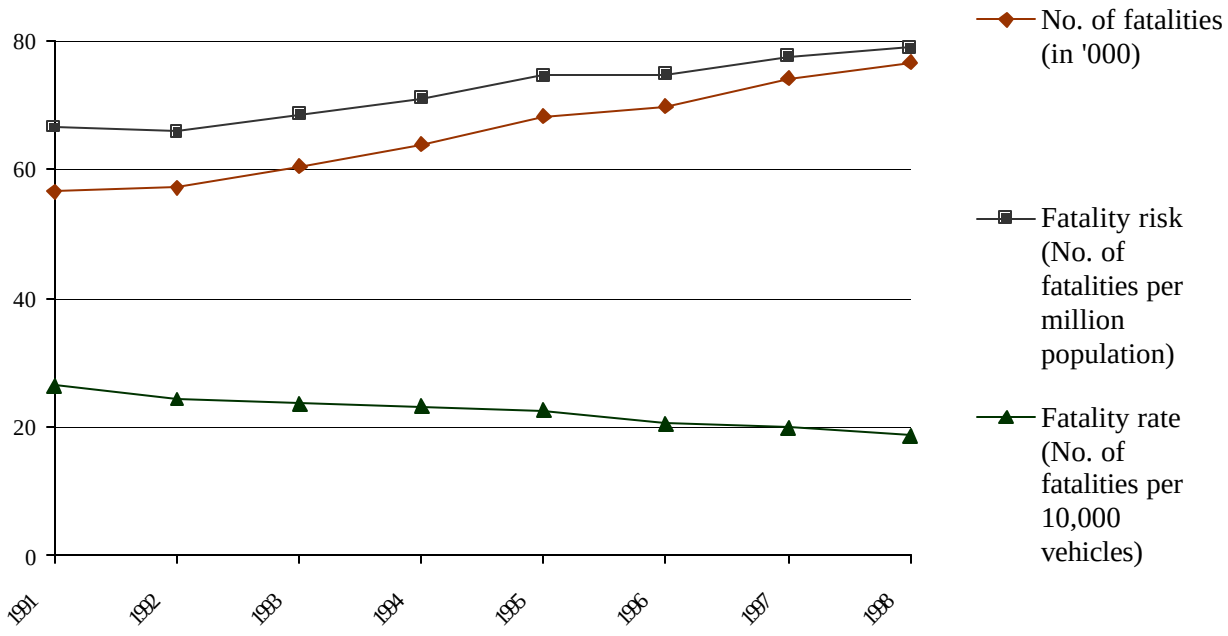
Source: *(7)*

Figure 5. Allocation of urban space for transportation in city centres



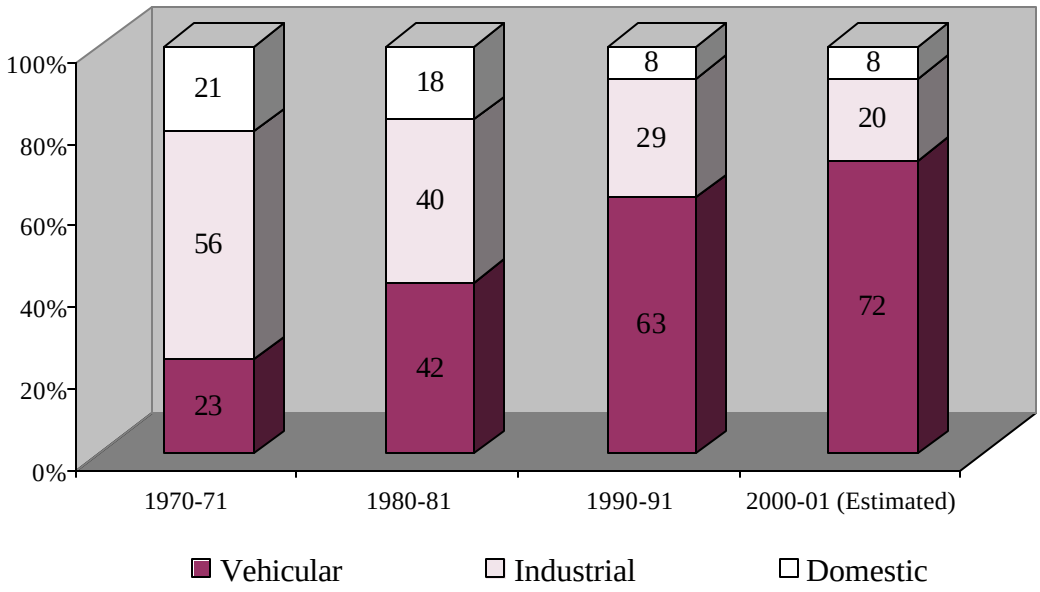
Source: *(10)*

Figure 6. Rate of road accidental deaths in India



Source: *(12)*

Figure 7. Air pollution in Delhi by sources



Source: *(17)*