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High Speed Railways: A Sustainable Option for Indian Urban Transport

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ABSTRACT

This paper is aimed at understanding the critical issues like urbanization, population growth, transport demand, growth of vehicles, and air pollution in Urban India. The trends in urban growth are discussed along with the impact of high urban population growth rates on various facets like transport demand, GDP, and its impact on the urban society's wellbeing. Rapid motorization and urbanization can bring many issues that can endanger the sustainability of Indian cities. This paper reviews the existing urban environmental problems, poor transport system and increasing accidents rate and suggests that High speed railways will be an efficient, economical and environmentally friendly transportation system which can make urban India more sustainable.

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Introduction

It wouldn't sound hyping to call The Indian Railways as the life line of our nation and to consider it a strong symbol of national integration in our land of diverse cultural heritage. Since its inception in 1853 as a colonial organization with a 13-km track length, Indian Railways (IR) has grown to its present size of over 65,000 kilometers across the length and breadth of the country. It is the 3rd largest railway network in the world, transporting over 23 million passengers daily and 2.65 million tonnes of freight daily (2012). Train travel is of high importance for the evolving middle class as it is a cheap and easy source of commuting through different parts of the country. Transport demand in most of the Indian cities has increased substantially due to increase in population and as well as urbanization lead to acute road congestion, rising air pollution and a high level of accidents risk are faced by urbanities of India. The use of more number of personalized vehicles has led to depletion of conventional energy sources and environmental pollution problems. Speed is a priority for the railways at the moment. At a time when the world has reached a speed of 330 kmph, India could achieve only about 130 kmph. IR being one of the largest rail networks in the world but does not have any high-speed rail lines capable of supporting speeds of 200 km/h (124 mph) or more. Global warming and climatic change due to vehicular emissions are major concerns before the world today which can be reduced to greater extent by provision of high speed railways.

Urbanization

Urbanization is a global phenomenon. India is one of the largest developing countries and world's second populous country having a population of 1.21 billion (Census 2011), accounting for nearly 18% of the world's population. According to the 2011 Census, urbanization in India has increased faster than expected. Indian urban population is also growing at a fast rate of 3% per year. Indian urban population has increased more than fourteen times from 26 million in 1901 to 377 million

(2011) and expected to reach 473 million by 2021. In terms of percentage of total population the urban population has increased from 11.4% in 1901 to 31.8% in 2011 and expected to reach 35% by the year 2021. Table 1 shows the pattern, trends of urbanization and no of towns in India during 1901 to 2011.

Table 1. Trends of Urbanization in India

Census Year	No. of Towns	Urban Population (in million)	Percentage Urban population
1911	1908	25.9	10.3
1921	2048	28.1	11.2
1931	2220	33.5	12.0
1941	2422	44.2	13.8
1951	3060	62.4	17.3
1961	2700	78.9	18.0
1971	3126	109.1	19.9
1981	4029	159.5	23.3
1991	4689	217.6	25.7
2001	5161	284.53	27.8
2011	7935	377.11	31.2

Most Indian cities are experiencing rapid urbanization and a majority of the country's population is expected to live in cities within a span of next two decades. In addition to increase in population the number of towns has increased during the last decade, contributing significantly to the speeding up of urbanization. There was only one million plus city (Kolkata) in India in 1901. The number of metropolitan cities- those with a million plus population has increased sharply over this period from 35 in 2001 to 53 in 2011, (Census of India, 2011) and expected to reach 85 by 2051. There are 6 mega cities three with population in excess of 10 million & three with population above 5 million. Cities with population in excess of 10 million will increase from 3 to 15 cities by 2051. Presently India has 475 urban agglomerations three of which has population over 10 million. Table 2 gives the top five urban agglomerations in terms of population.

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Table 2. Urban population of Indian Cities

Sl.No	Cities	Population (Millions)
1	Greater Mumbai	18.4
2	Delhi	16.3
3	Kolkata	14.1
4	Chennai	8.70
5	Chennai	8.50

GDP

Cities and towns play a vital role in promoting economic growth and prosperity. Cities are centers of economic activity and wealth generators. In India, urban areas contribute more than 60% of national economy in 2001 expected to increase to 75% by 2021. In the last two decades, the Indian economy has witnessed a remarkable growth. Indian GDP is growing at about 9% as against the world average of 5.5%. Rapid urbanization, growing economy, rising level of educated work force and higher levels of income have caused growth in inter-city travel. Effective, comfortable, safe, fast and affordable urban transport systems not only increase the commercial and labor market efficiency of cities, but also increase access to amenities, improve general mobility and add to quality of life there by making cities livable and workable. Unfortunately, public transport systems in Indian cities have not been able to keep pace with the rapid and substantial increase in travel demand. The available public transport services are overcrowded particularly during peak hours and involve long waiting periods. As a result, there is a massive shift towards personalized transport. Rising income of people is one of the most important reasons for the shift towards personalized mode leads to exponential growth in vehicle ownership. In addition speed, convenience, flexibility and availability favors adaptation of private mode of transport.

Traffic

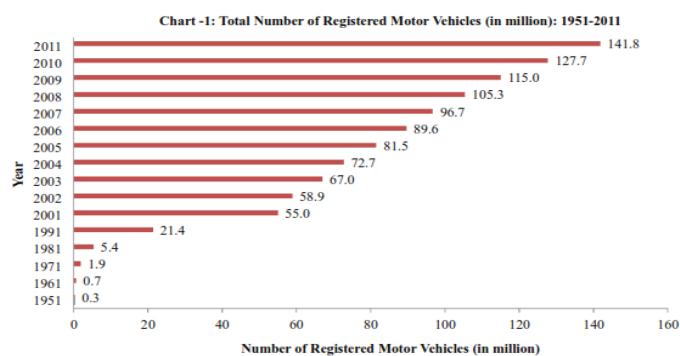
Transport development is very essential component for the growth of any city. Rapid increase in population along with urbanization has triggered a growing demand for inter city traffic between metropolitan cities and 2nd and 3rd tier cities. Travel demand of urban population increased over the years substantially. Highway and air transportation system congestion are growing fast, and a transportation network developed to meet the needs of an age in which there was less travel and movement of materials, is ill-suited to today's needs. The increasing movement of people and products at the local, regional, national, and international levels has placed extreme demands on transportation system, especially in the Indian cities are growing at an unforeseen rate. Fig1. Shows the growth of urban travel demand in India between the years 1994 to 2021.

**Fig1. Growth of Urban Travel Demand in India**

Indian railway has also witnessed much higher demand for both passenger and freight traffic. The demand for public transport is expected to grow around 10% a year over the last decade and projected to increase in passenger traffic by 30 to 40% and increase in goods traffic by 80 to 100% in next 20 years. As per the latest UN report 1million people are moving to urban areas each week. It is estimated that about 2/3rd of the world population will be living in cities by 2050. Studies made by a group of consultancy firms suggest that the annual demand for the railway line would be around 1.1 million passengers which are expected to increase from 8.9 billion in 2012-13 to 11.7 billion by 2016-17. The annual growth in passenger-km is expected to be around 10.8%, rising from 1195 billion in 2012-13 to 1760.4 billion by 2016-17. In order to meet the traffic demand high-speed trains have been introduced by the developed countries where as India, with more than 20 million passengers is still using the slow moving trains as the main means of transport. Public transport systems in cities have not been able to keep pace with the rapid and substantial increases in demand over the past few years.

Growth of Vehicles

The rapid growth in economy and urbanization has also resulted in a tremendous increase in the number of motor vehicles and in some cities this has doubled in the last decade. The delays, low speeds and high travel times by public transport have lead to the exponential growth in vehicle ownership. Increasing motorization is due to rising incomes, aspirations and easy financing. As per the reports of Ministry of Road Transport & Highways, Government of India, the annual rate of growth of motor vehicle population has been increased around 10% during last decade. The total number of registered vehicles has been increased from 0.3 million in 1951 to 142 million in 2011 and expected to increase to 500 to 600 million by 2030. In terms of volume two wheelers dominate the market with nearly 80% share, followed by four wheelers with 13% and commercial vehicles with 7 % of the share. The report of MOUD(2008) shows that the share of personal modes especially of two wheelers has gone up at 12% per annum in the past two decades, while the public transport share has generally dwindled. It is alarming to note that 32 percent of these vehicles are plying in metropolitan cities alone which constitute about 11 percent of the total population.



Source: Offices of State Transport Commissioners/UT Administrations.

Fig 2. Growth of Vehicles in India between 1951 to 2011 Road congestion

Major urban centers are severely congested due to the dramatic growth in vehicle ownership in the last decade. The growth of vehicular traffic on roads has been far greater than the growth in road network. Indian roads are reaching a saturation point in utilizing the existing capacities leading to congestion

and further contributing to air pollution load. Congestion is an outcome of twin factors such as growth in number of vehicles on road and limitations to expansion of road space. The road space in cities is grossly insufficient due to the use of personal mode of transport. Growing traffic and limited road space reduced the peak-hour speeds to 5 to 10 km/h in the central areas of many major cities leads to an increase in the fuel consumption and increase in three major air pollutants (nitrogen oxides, hydrocarbons and carbon monoxide) with the reduction in motor vehicle speeds. In addition, billion of man hours are lost with people stuck in traffic. Table 3 shows effect of congestion on air pollution.

Table 3. Pollution Rate and Congestion Effect of Private and Public Transport Vehicles

Type of Vehicle	Average Passenger per vehicle	Pollution load in gm/pass.-km	Congestion effect in PCU/Pass
Two-stroke two-wheeler petrol engine	2	7.13	0.375
Four-stroke two-wheeler petrol engine	2	4.76	0.375
Car with catalytic converter petrol engine	4	0.93	0.25
Bus with diesel engine	40	1	0.075

Note: PCU = Passenger Car Unit where 1 car = 1 PCU, 1 bus = 2.5 PCU, 1 scooter = 0.75 PCU, etc.

Road Accidents

In all over the world, more than half a million people die each year in road accidents and up to two-thirds of traffic accident injuries are suffered by pedestrians. India has the highest number of road accidents deaths in the world - over 1,35,000 in 2012 alone. On an average, 15 people die and 60 are seriously injured every hour in road accidents in India. With the increase in number of vehicles and urbanization in the country, the number of road accidents has surged. Road traffic injuries (RTI) and fatalities have emerged as a major public health concern; with RTI have becoming one of the leading causes of deaths, disabilities and hospitalizations which impose severe socio-economic costs across the world. There were close to 5 lakh road accidents in India during the year 2011. Table 5 gives data on road accidents in India between the years 2002 to 2011.

Table 4. Number of Road Accidents and Number of Persons Involved: 2002 to 2011

(Ref. Ministry of Road Transport and Highways Transport Research Wing)

year	Number of Accidents		Number of Persons Affected		Accident severity No. of persons Killed per 100 Accidents
	Total	Fatal	Killed	Injured	
2002	4,07,497	73,650	84,674	4,08,711	20.8
2003	4,06,726	73,589	85,998	4,35,122	21.1
2004	4,29,910	79,357	92,618	4,64,521	21.5
2005	4,39,255	83,491	94,968	4,65,282	21.6
2006	4,60,920	93,917	1,05,749	4,96,481	22.9
2007	4,79,216	1,01,161	1,14,444	5,13,340	23.9
2008	4,84,704	1,06,591	1,19,860	5,23,193	24.7
2009	4,86,384	1,10,993	1,25,660	5,15,458	25.8
2010	4,99,628	1,19,558	1,34,513	5,27,512	26.9
2011	4,97,686	1,21,618	1,42,485	5,11,394	28.6

From the above table it is clear that the number of road accidents is increasing substantially over the years due to motorization and urbanization. The motorized vehicles are responsible for the total road accidents in India. Amongst the vehicle categories, two-wheelers accounted for the highest share in total road accidents. Figure 3 gives data on road accident deaths in India between the years 2007 to 2012. Further, the figure indicates that the number of road accident deaths in India is also increasing with an increase in number of vehicles along with urbanization.



Fig 3. Road Accident Deaths in India between 2007 to 2011 Fuel Demand

Fuel crisis is one of the major crises to be managed in the years to come. The strongly increasing population, urbanization and GDP as well as motorization in India imposed tremendous pressures on the Fuel. It is expected that the Indian growth will reach a Fuel consumption of 4 times the current value in 2030. Fuel demand for sustaining urban transport has grown several folds in last decade and this rate is escalating further and putting additional pressure on the foreign exchequer. According to US Energy Information Administration, India's Transport energy use will grow at about 5.5 percent a year – significantly higher than the world average of 1.4 percent per year, more than quadrupling the total energy use from the road transport in 2035. By 2050, world population will be approximately 8–10 billion with 80 per cent people living in urban areas. Their average income will be in the range of US\$15–US\$25,000 per annum. The per capita energy demand in 2050 will be 2–3 times that of the present level (India infrastructure report 2006). At present, India imports about 71% of its oil requirements and its overall energy import dependency is likely to increase to over 90% by 2030 (TERI 2006). As per information available from CIA's World Fact, 2008 with an oil consumption of 2,438,000 barrels per day, India stands 6th amongst top ten oil consuming countries of the world. Further, as per PCRA (Pollution Conservation Research Association), the transport sector alone consumes more than 50% of the total oil consumption in the country. The combined effects of vehicle-growth and fuel-economy scenarios, together with the change in annual vehicle usage, result in a projected demand in 2035. Table 5. Gives Fuel Consumption of road vehicles in India between the years 2005 to 2035. From the above table it is clear that India's fuel consumption in 2035 will be over six times that in 2005.

Table 5. Total on road Vehicle Fuel Consumption

Year	2005	2008	2015	2025	2035
Million Tons of Oil	58	73	115	221	371

Air Pollution

Road traffic is the major source of air pollution in most urban areas. It causes deterioration of urban air quality and its

interaction with the environment causes a perceivable discomfort in daily life. In current situation vehicles contributes 60%-70% of the total emission in urban areas. The increase in traffic along with inadequate infrastructure facilities is responsible for higher emissions of local pollutants and GHGs in several Indian cities. The transport sector is contributing to over 9 percent of India's total greenhouse gas (GHG) emissions accountable for about 50% of the emissions of nitrogen oxide and 90% of the carbon monoxide. Vehicles in major metropolitan cities are estimated to account for 70% of CO, 50% of HC, 30-40% of NO_x, 30% of SPM and 10% of SO₂ of the total pollution load of these cities, of which two-thirds is contributed by two wheelers alone. Out of 127 cities monitored under "The National Air Quality Monitoring Programme", only 3 cities have low air pollution and 101 cities report at least one pollutant exceeding the annual average air quality standard (CPCB,2009). According to a study by TERI, around 72 per cent of total emissions are caused by vehicles on road.

India need high speed railways

Development of cheap and efficient and environmental friendly means of urban transport is necessary for the progress of large cities in developing country like India are tremendously essential in order to maintain future quality of life. High speed railways may be an environmentally sustainable transport system for urban India.

As per UIC definition, trains running at speed of 200 kmph on upgraded track and 250 kmph or faster on new track are called High Speed Trains. Table 6. Gives world scenario of high speed rails IR has one of the largest rail networks in the world but does not have any high-speed rail lines capable of supporting speeds of 200 km/h (124 mph) or more was reckoned with introduction of Rajdhani Express and then later days introduction of Shatabdi express. At a time when the world has reached a speed of 330 kmph, the best that India could achieve has been a little over 130 kmph. Speed is a priority at the moment and High Speed Railways (HSR) are need of the hour.

Table 6. World Scenario of high speed railways

USA:	Amtrak's Acela (245 km/h= 150 mph) California High Speed (320 km/h=200 mph)
Sweden:	Arlanda Express (200 km/h=125 mph)
Spain:	Renfe's Alaris Tilting Trains (220 Km/h=135 mph)
Italy:	High Speed Train ETR 500 (300 km/h=190 mph)
Finland:	RHK's Pendolino (200 km/h = 135 mph)
Florida	Overland Express FOX (32- km/h =200 mph)
Norway	The Gardermoen line (210 km/h =130 mph)
Germany	Inter City Express ICE (300 km/h = 190 mph)
Japan	JR Central's Shinkansen (270 km/h =170 mph)
Australia	High Speed Railway (320 km/h =200 mph)
Switzerland:	Tilting High Speed Trains (200 km/h = 125 mph)
Taiwan:	High Speed Rail Administration (300 km/h = 186 mph)
France:	SNCF's TGV Train Grande Vitesse (300 km/h = 186 mph)
Korea	Korean National Railroad's TGV (300 km/h = 186 mph)
UK	Rail track's West Coast Main Line (225 km/h = 135 mph)
China	High Speed (250 Km/h = 155 mph)

High-speed railway (HSR) is a powerful symbol of a nation's transportation network competes with road and air modes of transport system. HSR is an efficient means of

transportation fulfils the demand gap for faster intercity and inter-regional movement of passenger and freight volume by improved operational efficiency, and reduced travel time. HRS being a speedy, comfort and reliable transport system boost uniform development of the country creating more business, jobs in tier II cities minimizes migration to megacities. HSR is a latest technology helps to build national image at international level. High speed railways has the advantage over automobiles in that it can move passengers at speeds far faster than those possible by car, apart from avoiding congestion. Maximum speed of cars has stabilized and speed are limited to 110-130 most of the world highways kmph while the journey times have even increased due to congestion on the roads while the speed of HSR are Speed 300 km/h or more. High speed railways have by far the highest capacity per unit land they use. HSR systems need 30% less land requirement in comparison to expressways for same carrying capacity and more beneficial from the sustainability point of view because it saves land. A two line HSR is equivalent to eight lane highways for carrying capacity for passenger transport thus allows more passengers per hour. High Speed Railway is a new way to transport people and freight, reducing consumption of our limited energy resources and working for a greener, cleaner planet. HSR is highly energy-efficient as the energy consumption is one third less than private cars and 5 times less than airplanes. As a result, HSR is more beneficial from the sustainability point of view because it saves fragile energy of the nation. HRS emits very low carbon dioxide compare to cars and airplanes reduce greenhouse gases and help to achieve carbon foot prints. Transport is a driver of economic and social development worldwide. The economic growth of nations and the competitiveness of cities depend on a capacity to transport not only goods but people. High speed railways can add 1.5 to 2% to national GDP and can play a role in achieving a more balanced and sustainable way in the development of towns and cities, opening up opportunities for growth across a wider, inter-connected, region, with the benefit of taking the pressure of the larger cities to absorb additional burgeoning populations. High speed railway services are already running in many countries of the world should be considered as a window of opportunity to enhance the productivity of the Indian Railways in terms of economy, efficiency, safety and quality. High speed railway is sustainable transport has become more relevant in present scenario of global warming and environmental concerns, as it is faster and more convenient than other modes of transport system.

Conclusions

On the basis of the above study it can be concluded that urbanization is taking place at fast rate in India. Growing prosperity, urbanization and industrialization has caused tremendous increase in transport demand in most of the Indian cities. The modern lifestyle demands a speedy, comfort and affordable mode of transport. The existing systems are slow leading to congestion and deterioration of quality life. HSR system is smart mode which can transport a large number of people in shorter time which help in making economy more dynamic and efficient. India being fast developing country should identify high speed rails as "immediate needs". The introduction of high speed railways in India, not only fulfill the rapid demand growth in inter-city passenger segment travel; but also curtail over dependence of on imported fossil fuel make India more sustainable. HSR have the highest performance of safety, as compared to any other mode of mass transportation

system. High speed railway is an economical environmentally friendly public transport services integrate small towns and cities to make India more sustainable. High Speed Railway mitigates the negative climate, noise, air pollution, congestion and economic impacts of rising urban transport volumes and energy consumption and will be a sustainable solution for Indian urban transport.

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