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Lessons learned from the experience of Indian policies towards sustainable transport systems

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Abstract

Indian transportation sector faces the severe challenges in the account of the limited expansion of relevant infrastructure, lack of integration among major transport systems like railways and roadways, and multiple institutions deal with these systems with different mandates. Thus the sector needs the multi-pronged approach to address the challenges in sustainable development. To derive such strategies, this paper assesses India's evolution of transport policies, identifies the gap between demand and supply related infrastructure, and presents good governance framework to deliver, mainly at the national level. Based on secondary data sources, like census of India, relevant ministries documents, and existing policies and programs, this study reveals that Indian transport system is in the emerging state and it requires demand-based policies to improve overall transport quality in India. This paper concludes with policy recommendations for guiding sustainable transportation system in India.

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1. Introduction

This paper attempts to understand India's transport systems from sustainability perspectives. The current transport patterns shows that the Indian transport systems remain unsustainable on various aspects. This paper deals with the existing transport policies in India and its impact on transport sustainability. It highlights the various lessons that India can draw from its existing transport policies and take appropriate measures to make the overall transport systems sustainable in the longer run. To meet the needs of the rapidly growing population, infrastructural

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development is one of the keys to transport sustainability. A highly competitive transport system plays a vital role in sustaining the economic growth of a country. In India, the transport system has played an important role in fulfilling the needs of passenger and freight movements. However, transport demand and supply do not match the current infrastructure and therefore it is affecting the economy as well as the environment at large. Most of the developing countries, including India have several common contributing factors to the severity of the transport problems. In recent time, the rapid growth in urbanization and vehicle population shows serious effect on human life and environment (Shrivastava et al., 2013). Moreover, the Indian transport system is insignificant in comparison to the country's geographic features. In India, the transport system comprises a number of distinct modes and services, notably railways, roadways, ports, inland water transport, coastal shipping, airports, and airlines, but railways and roadways are the dominant means of transport.

India's transport policies are drafted and implemented at national as well as state level. India consists of 29 states and 7 Union Territories (UT). Apart from national level, every province has their own priorities in formulating transport policies based on their needs and financial capability to meet the demand of freight and passengers. Despite these transport policies, India is largely facing transport challenges, which varies from one state to another and rural to urban on various grounds. Most of the Indian metropolitan cities are facing unsustainable trends in the transport sector due to an enormous increase in energy use, air pollution, traffic congestion, noise pollution and accidents (Pucher et al., 2005). One of the barriers to sustainable transportation is rapid urbanization in India. India urbanized slowly in pre-independence era, but steady in post-independence era, particularly after economic reforms in the 1990s. In 1901 only 11.4% of Indians were living in urban areas, while it reached to 28.53% in 2001 and 31.16% in 2011 (Census of India, 2011). By 2030, about 40.76% of country's population is expected to reside in urban areas (United Nations, 2007). The rapid motorization is another contributing factor for unsustainable transport patterns. The vehicles have grown exponential, particularly personalized transport vehicles. Some other key challenges for Indian transportation are slow expansion of rail network, capacity constraints, inadequate and unplanned investments, narrow road lane, mixing of traffic – sharing of bus, car, truck and two-wheelers on the same lane, poor quality of services, inefficient port structure, inadequate urban transport, and lack of reform in railway.

In this paper, an attempt has been made to understand the various key components of unsustainable transport systems in India. In policies perspectives, we ask how and why Indian transport systems are still following unsustainable transport patterns. In this paper, government policies and their outcomes are reviewed to understand on-going unsustainable transport patterns. Finally, this paper exposes the various lessons that India can learn from its past experiences to enhance sustainability in the transport sector. The study reviews past and present transport trends and focuses on future transport trends at the macro level. An attempt has been made to understand the nature and changing dynamics of the transport sector. It also examines the evolution and growth of the transport industry viz. bicycles, two-wheelers, four-wheelers, and commercial vehicles. This study presents transport system impact on the environment and sustainable development, employing historical context of transport policies, including relevant acts, rules, and regulations, and assesses the evolution of governance framework. This paper also attempts to understand the gap between transportation-related planning and its implementation. At the outset, implementation deficit seems to be either output of poor governance framework or lack of evidence-based transportation planning, which will be explored using various data sources, mostly available in public domain.

The next section presents an overview of Indian transport; third section reviews literature, mainly relevant policies. The fourth section highlights various reasons and components of unsustainable patterns such as urbanization, motorization, infrastructure and environmental degradation. The last section concludes with policy-relevant lessons learned from the past experiences.

2. An overview of Indian transport

An efficient transport system is crucial for the overall socio-economic development of any country. The transport network of India is one of the large-scale networks in the world. The transport sector shared 2 percent of the GDP of the entire infrastructure funding in 1995-1999, which further increased to 2.6 percent between 2007 and 2011. Near

about twenty percent of the national highways are four lanes that carry traffic of around 40 percent. One-third of the village population still lacks proper all-weather roads. The railway networks still operate at considerable slower speeds owing to poor maintenance and the entire railways have been facing inadequate financial support to sustain themselves. Safety and security in the transport sector is also a rising concern. For instance, fatalities registered by road are 146,000 and 710 by rail alone in 2015.

Table 1. Indian roadways and railways, and fatalities in 2015

	Roads	Rails
Network (km)	5,232,584	115,000
Passenger (million passenger – km)	8,671,295	1,135,718
Freight (million tons – km)	1,495,678	685,925
Fatalities	146,133	710

Source: (MORTH, 2016, MOSPI, 2016)

A half-century back India had only 0.4 million km of roads and now with 5.2 million km offers one of the largest road networks in the world. The road network has expanded tremendously, about 13 times, in a span of nearly 65 years, but considerably with slower annual growth rate. Roadways still comprise the most used means of transportation. The length of roadways has expanded at the rate of 39.02% with the passenger by road increasing at 163% and freight by road at 135%. The demand has been raised with time and road nevertheless still forms the dominant mode of transportation. In the year 2015, the Indian roadway network enabled transportation to 88% of the country's passenger with a growth of 9.12% per km per million passengers and 65.5% of its freight at 6.08% growth rate in freight by road.

Freight and passengers movements by roads are continuously increasing as it is the dominant mode of transportation in the rural as well as in the urban areas of India. The total passengers by roads (million passenger-km) were recorded as 2.4 million in 2001 and it surpassed 8.6 million in 2015. It has grown by 3.6 times in a mere 15 years while during the same time period, the freight by road (million tons -km) was recorded as 515,000 and 1,495,678 respectively with 2.9 times. Ironically, the growth in the surface length of road has been only recorded as 1.5 times (World Bank, 2016b).

The Indian Railways consist of 12,617 passenger trains and 7,421 freight trains operating daily through 7,172 stations and carrying 23 million travelers and 3 million tons of freight (MOSPI, 2016). This massive network of trains and railways is considered the largest railway systems in the world which are managed by a single entity. Railways are the most sought mode of transportation for long-distance goods and people travel. It is energy efficient and economic medium of transportation. The government of India (GoI) has made several attempts to design easy and convenient investing policies for the railway infrastructure. The Government has allowed Foreign Direct Investment (FDI) in railways for further infrastructure development projects (Government of India, 2017). Indian Railways are one of the world's largest railway networks comprising 115,000 km of track length over a route of 66,687 km.

Railway route length has grown slower than the rail passenger growth rate. A slow growth in railway route length has been noticed over the years and it has grown from 63,028 in 2001 to 66,030 km in 2015. So, it has grown at a rate of 4.76% in 15 years while the passengers by rail have grown from 490,900 (million passenger-km) in 2001 to 1,135,718 in 2015. Freight by train has grown from 333,200 million ton-km to 685,925 million ton-km between 2001 and 2015. So, in comparison to 4.76% growth in railway route length, passengers have increased by 131% and freight by 106% in the same time period (OECD, 2016).

3. Review on Indian transport policies

India is in a transition stage from developing to developed economies. India could not have achieved this economic growth without boosting its secondary and tertiary sectors of the economy, i.e., the industrial and service sectors. Interestingly, most of the secondary and tertiary activities are taking place in the urban centers and therefore cities growth are utmost important for the overall economic development of India. India's urban population is rapidly increasing and currently, the urban population is over 33%. India's urban population-growth trajectory is expected to grow further in next three to four decades. In the last two decade, the GoI has come with various policies to overcome with transport challenges. Not only the central government but also state governments have taken various precautionary measures to ensure sustainable transport pattern. Despite these attempts, India's transport remains unsustainable. Some of the key policies and its outcomes are discussed below.

One of the important decisions taken by the GoI for transport sustainability is the formation of the National Road Transport Policy (NRTP) with a motive to offer modern, energy efficient and environment-friendly road transport policies in India. Some of the key objectives of NRTP are to promote road infrastructure for mobility of passengers and freight to sustain a high growth rate of GDP, to offer an adequate supply of public transport and requisite quality of service, and to improve quality and productivity level of goods transportation and infrastructure. It also endorses road safety, traffic management, and post-accident trauma care facilities. The ultimate goal is to promote sustainability in the road transport with special emphasis on energy efficiency, environmental conservation, and social impact. It emphasizes on increasing use of modern technology and research in road transport development; and strengthens database collection and management system to assist in continued policy and performance evaluation.

Despite policy and vision, the government could not implement all suggestions made by NRTP and therefore transport sector continue to degrade over the period of time. To improve the transport condition in India, different committees, organization and institutions were set up by the government and they made recommendations for the various policies from time to time. The existing problems with the Indian transport system are not much about good or bad policies but it is more connected with the policy implementation. There is a vast gap between formation and implementation of policy and currently, India lacks in the implementation. Below, some of the recent major policies are discussed under the framework of four challenges mentioned in the introductory section and an attempt has been made to justify why these policies were not very successful.

Table 2. List of key transport policies in India

Policies	Urbanization	Motorization	Infrastructure	Environment
Air (Prevention and Control of Pollution) Act, 1981 (ENVFOR, 1981)	NA	NA	NA	Set vehicle emission standard
Motor Vehicle Act, 1988 (GoI, 1988)	NA	Motor vehicle registration, vehicle control through permits, license of drivers, etc.,	NA	NA
Integrated Transport Policy, 2001 (Planning Commission, 2001)	Mass transit system,	NA	Improve infrastructure, encourage private sector participation	NA
National Urban Transport Policy, 2006 (MOUD, 2006)	Improve urban transport,	Encourage private	Better infrastructure	Strict environmental

	integrated land use, city planning	transport, sustainable transport	for road safety	norms, reduce pollution level,
National Urban Transport Policy, 2014 (MOUD, 2014)	Integrated land use and transport planning, CMP, TDM	Control private vehicles, plans for freight movement	Expansion of road network, equitable allocation of road space, universal accessibility, parking, MRT	Promote NMT, reduce emission level, control noise pollution
Road Transport and Safety Bill, 2014 (MORTH, 2014)	Urban planning, city safety, and traffic management program	Road safety, vehicle regulation, setting vehicle safety standards, unified driving license and vehicle regulation system, punishment for traffic law violators	Parking places and halting stations, road infrastructure development	Alternative vehicle fuel
Make in India, 2014 (Make in India, 2014)	100 smart cities programs	NA	Investment in railway, roads and highways, aviation industry, modernization of ports and shipping, FDI, GST on logistics	NA
India Transport Report: Moving India to 2032 (Planning Commission, 2014)	Improve urban transport, emphasis on public transport	Raising safety standards, discourage private vehicle	Investment on transport structure development	Emission controlling measures, NMT,
Green Urban Mobility Scheme, 2017 (MOHUA, 2017)	Sustainable urban mobility, strategies for urban freight movement, TDM	Promote public transport	Safe pedestrian pathways, cycling track, public bike sharing	Sustainable vehicle and fuels, reduction in GHG emission
National Policy on Transit Oriented Development, 2017 (MOUD, 2017)	Rapid transit stations, promote public transport	Reduce private vehicles	New metro rail policy,	Promote NMT
Motor Vehicles (Amendment) Bill, 2017 (MORTH, 2017)	Children, women and senior citizen safety,	Reduce accident rates, hefty penalty to law violators, third party insurance	Infrastructure development for smooth mobility	Environmental protection

3.1. Air (Prevention and Control of Pollution) Act, 1981

This Act gives an authority to set vehicular emission standards across India and it was amended in 1987. As per this law, Indian State's Pollution Control Board (SPCB) may decide emission standards in consensus with Central Pollution Control Board (CPCB). However, the ultimate authority responsible for setting vehicular emission standards is MORTH because it controls Motor Vehicles Act, 1989. Moreover, MORTH responsibility lies in setting-up norms for emission standards while states and municipalities are responsible for its implementation.

3.2. Motor Vehicle Act, 1988

This act consolidates and amends the law relating to motor vehicles in India. It offers legislative provision to licensing of drivers, vehicle registration, motor vehicle control through permits, traffic regulations. It also describes different penalty provisions for law offenders. The motive of this act is to have database of vehicle registration and policy guidelines for motor vehicle license obtaining as well as defining penalties for traffic law offenders.

3.3. Integrated Transport Policy, 2001

The main objective of the integrated transport policy is to make all the transport systems parallel and enable a spirit of competition among the public transport systems. So, the transportation system can become efficient, sustainable, safe and regionally balanced. The Government also planned to introduce a competitive transportation within the framework of each mode on a "level playing field". Such policies were hopeful to achieve a comparative advantage and economic efficiency that would affect the cost system and thereby the transportation systems can be more efficient and sustainable. The policy experimented in a few metro cities but it did not succeed as per the expectation. To achieve transport policy, 2001, the government of India needed to sanction three-fold more financial funding to transport sector until 2010 but due to financial constraints, it never happened.

3.4. National Urban Transport Policy, 2006

The Ministry of Urban Transport formulated India's National Urban Transport Policy in 2006 with the prime objective to assure safety, affordability, speed, comfort, reliability and sustained mobility to the increasing city residents to increasing jobs, education and daily needs. The agency planned to achieve this by including urban transportation as the prime factor of urban planning that called for the integrated land development and transport planning in all cities so as to make the traveling distance smaller and smaller. The objective was to make businesses easier by enabling them to transport easily, increasing mobility between various factors of production thereby promoting an equitable allocation of roadways and people in spite of vehicles as the prime focus.

3.5. National Urban Transport Policy, 2014

This policy advocates integrated land use and transport planning. To improve overall urban transport systems, this policy strongly recommend to control the use of private vehicles and at the same time emphasize the modernization of public transport systems. Some other recommendation includes expansion of road network, equitable allocation of road space, universal accessibility to all, proper development of mass rapid transit system and further emphasize on adequate parking facilities. From environmental perspectives, it endorses the NMT and reduction of environmental and noise pollution.

3.6. Road Transport and Safety Bill, 2014

This bill is currently in draft stage with the main objective of implementing a system that is safe, fast and cost-effective and inclusive mobility of people and freight under the banner of "Make in India" initiative. This bill is actually being drafted with a goal of making transportation scientifically advanced and well-planned framework to assure the safety of all road users in India and at the same time making the roadways cost-effective, sustainable and

inclusive for the mobility of passengers and freight. The simultaneous engagement of various parameters is crucial to the sustainable and self-generating socio-economic system that promotes innovation and aptly uses the latest technologies. This bill also emphasizes on the establishment of vehicle regulation and road safety authority and endorsement of environment-friendly fuels in the vehicles. As per the bill, a hefty penalty will be implemented against traffic law violators but still, there are many conceptual things which are not very clear. Due to some political and economic reasons, Tamil Nadu government has strongly opposed to this bill and asked for some changes and apart from it, in 2015 various transport unions went on to protest against this bill.

3.7. Make in India, 2014

Goods and Service Tax (GST) is recently implemented in the logistics industry and GST is an integral part of GoI initiative “Make in India” program. The logistics industry plays a very important part in the country’s economic growth. However, the Indian logistics industry was poorly regulated and therefore the implementation of GST could boost the entire industry. Prior to GST implementation, logistics industry was facing some severe challenges as such as paying the central sales tax (CST) as well as the state entry taxes i.e. the goods cannot move freely from one state to other. Under the GST, the goal is “one nation one tax”. India has implemented the Goods and Services Tax from July 2017. It is aimed to remove the various hindrances in taxation and promote a unified taxation system imposed throughout the country enabling easy movement of goods from one state to the other. It is predicted by the Ministry of Roadways and Highways that the logistics sector will gain the most from GST reforms as the cost will fall almost by 20% and also easy taxation enables time reduction in transits. The implementation of GST would help in boosting trade but the policymakers have ignored the fact that first of all government needs to improve road networking and more importantly connectivity. So, the benefit of GST can only be accomplished if the road has adequate network and connectivity are achieved.

3.8. India Transport Report: Moving India to 2032 (2014)

The government set up the National Transport Development Policy Committee (NTPDC) in 2010 to develop a safe, easy and comfortable and sustainable long-term transport policy. The committee has suggested various measures to make the Indian transportation feasible and cost-effective as well as safer. The government has considered its proposals but there is no word on any near plans to implement. The policies offered by NTPDC will help improving overall transport systems of India. However, it has missed certain key elements of transportation as such as required measures to undone the damage was done by the inefficient transport systems in the past. It only offers solutions for the future but merely has discussed on-going transport systems.

3.9. Green Urban Mobility’ Scheme, 2017

One of the latest schemes to reduce carbon emissions and improve travel infrastructure in cities by enabling last mile connectivity through non-motorized transport like pedestrian pathways and bicycle sharing. The scheme is under planning phase and it is expected to be implemented soon throughout the nation. One of the main characteristics of this scheme is to promote “Green Urban Mobility Scheme” in 103 cities for transportation so as to promote hybrid/electric vehicles. Various components of the project include setting up of footpaths, cycle tracks, public bike sharing, bus rapid transit (BRT) systems, intelligent transport system, non-fossil fuels for public transport and urban freight management and innovating financing for transport systems. With an intention to reduce the carbon emissions the government plans to promote the use of non-motorized vehicles.

3.10. National Policy on Transit Oriented Development, 2017

The Central government has approved Transit Oriented Development (TOD) and it will help in building the new Metro Rail policy. The idea is to design a new Metro Rail policy, wherein the opportunity for innovative finance, such as land value capture, transit-oriented development for new Metro Rail projects can be enabled. Therefore, this new national policy which comes under the Ministry of Housing and Urban Affairs focuses on implementing TOD-

style urban development within a 500-800 m influence area around rapid transit stations. The main goal of this initiative is to promote the use of public transport by developing high-density zones in the influence area by providing all the basic needs of work/ job, shopping, public amenities, entertainment in the influence zone with mixed land-use development, reducing the need for travel. It also aims at reducing the private vehicle ownership, traffic, and associated parking demand. This policy assures a dense road network within the development area for safe and easy movement and connectivity of non-motorized transport (NMT). In this policy, special emphasis has been given to the development of a safe society with special attention to the safety of women, children, senior citizen and differently abled. So, it will help in developing inclusive habitat in the influence area so that the people dependent on public transport can live in the livable communities within walking distance of stations. Also, measures are promised to be taken for reducing carbon footprints by shifting towards environmentally friendly travel options.

3.11. Motor Vehicles Act (Amendment Bill, 2017)

The motor vehicles (amendment) bill, 2017 is an upgraded version of the motor vehicles Act 1988. Currently, this bill has been passed in the Lok Sabha and now it requires approval from Rajya Sabha and then a nod from President of India to make it as law. This bill is revolutionary in many ways as it will help in improving the rate of accidents in India. It recommends strong punishment for traffic violators, poor quality vehicle manufacturing companies while endorses an integrated approach of transport and land use planning, infrastructural development for smooth mobility, and environmental protection.

4. Challenges of sustainable transport in India

There are several factors for unsustainable transport pattern in India but the key of them are urbanization, motorization, poor infrastructure, and environmental degradation. In this section, we are evaluating these challenges with Indian transport policies. Based on secondary data and review, each policy compliments each other directly or indirectly.

4.1. Urbanization

Though urbanization is a slow process and in India, the rate of urbanization was slow until the 1970s. Post industrialization and economic reforms, urbanization accelerated but unevenly took place in the country. The recent census reveals in absolute term, the population of the urban areas has increased more than the rural areas. Higher economic growth, rural-urban classification, better educational and health centers, employment opportunities including the industrial revolution have been responsible for the massive burst of population in the cities. The city infrastructure has been advancing at a remarkable rate since the nineties. The private sector is growing at a rate considerable than ever. The eleventh five-year plans aimed at increasing the economic opportunities in the cities, thus attracting more people towards the cities. Due to the urbanization, the number of towns, statutory towns, and census towns have increased by 34%, 6%, and 65% respectively between 2001 and 2011. During the same period, the number of the villages has merely increased by 0.35% (Census, 2011).

In terms of urban mobility, transport policies should be aimed at stimulating the use of inclusive transport to enhance the urban transport systems (Ahmad and de Oliveira, 2016). In 1991 the Government of India launched various measures to increase the economic growth that led to increases in urbanization. The steps thus are taken to promote economic activity primarily involved the government letting relaxations for the businesses that led to many entrepreneurs leaping in to participate in the ever-changing economic environment. As a result of this, the economic growth reached about 8 percent per annum in the early 2000s which were a considerable growth when compares to 3 percent growth rate in the 1980s. The new measures exposed the Government to a new horizon of growth, development, and urbanization. The recently discovered focus on the urbanization of its cities revived various policies and that eventually resulted in urban areas contributing to 65 percent of the GDP. Initially, the impact of urbanization on Indian GDP was very visible but a decade later in the twelfth five-year plan (2012-2017), the

urbanizations posed some of the gravest challenges such as inadequate infrastructure, overpopulated cities, a transportation crisis, and environmental degradation.

Table 3. Urban and rural population distribution and decennial growth rate in India (%) (1951-2011)

Census Year	1951	1961	1971	1981	1991	2001	2011
Urban population (million)	62.44	78.94	109.11	159.46	217.57	286.12	377.11
Urban population (%)	17.29	17.97	18.24	23.33	25.72	27.78	31.16
Urban population decennial growth rate (%)	41.40	26.41	38.23	46.14	36.44	31.51	31.80
Rural population (million)	298.64	360.30	439.04	523.87	628.85	742.62	833.46
Rural population (%)	82.71	82.03	81.76	76.66	74.28	72.22	68.84
Rural population decennial growth rate (%)	8.80	20.64	21.86	19.32	20.04	18.09	12.23

Source: (Census, 2011)

The gap between urban and rural population is growing. Table 3 and Fig.1 show urban population growth rate is higher than the rural population growth rate and overtime though growth rate is declining but still urban population growth rate has increased between 2001 and 2011. For instance, in 2000 the growth rate of rural and urban population was 1.4 percent and 2.5 percent respectively. However, the trend of urban population has further increased in 2016 and it is recorded as 2.3 percent but rural population growth has further declined and from 1.4 percent, it has come down to 0.5 percent.

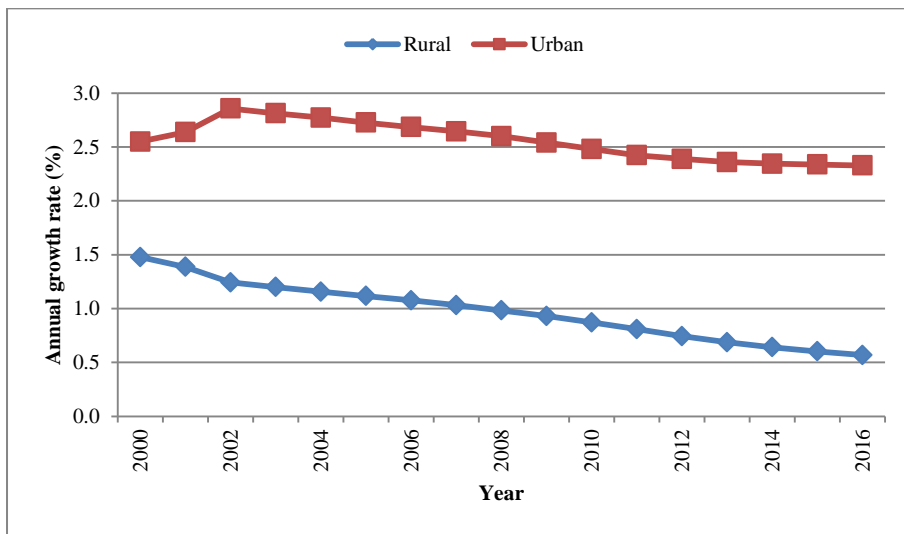


Fig. 1. Urban and Rural population growth trend (2000-2016) (World Bank, 2017)

The manufacturing and services industries are mostly concentrated around the major urban centers and to meet their needs, highly efficient urban transport system is required for the mobility of workers as well as logistics. The metropolitan cities like Delhi, Mumbai, Bengaluru, and Chennai have attracted considerable investments to establish and improve various industries. In the past few years, the urban transport systems have been struggling to keep balance with the increasing loads due to massive growth in industries. After realizing the urgent need for the transformation of urban transport systems, the government of India appointed High Powered Expert Committee (HPEC) for estimating the investment requirements for urban infrastructure services. After a study, the Committee came with many recommendations in 2009-10 to deal with the challenges of urbanization. HPEC report suggests

that the challenge of urbanization can be addressed through a combination of increased investment, strengthening the framework for governance and financing, and a comprehensive capacity building program at all levels of government. The Committee has projected huge investment into transport sector and it would be interesting to see how governments cope with it.

Table 4. Recommendation of HPEC for Infrastructural Development in Transport Sector

Sector	Investment from all sources (in INR 10 million) over 20 year period	Percentage share of investment in urban sector
Urban Roads	1,728,941	55.8
Urban Transport	449,426	14.5
Traffic support infrastructure	97,985	3.2
Street lighting	18,580	0.6
Total	2,294,932	74.1

Source: (Planning Commission, 2010)

From policy perspectives, various policies such as Integrated Transport Policy (2001), National Urban Transport Policy (2006 & 2014), Green Urban Mobility Scheme (2017), National Policy on Transit Oriented Development (2017), and government initiative for public-private partnership have advocated for urban transport improvement and these policies have offered numerous recommendations. Recommendations made in these policies are safety, affordability, regionally balanced transport systems, endorsement of public transportation, discourage in the use of private vehicles, promoting hybrid/electric vehicles against diesel and petrol, and policies for metro rail.

Despite these policies and recommendations, the majority of Indian metropolitan cities are facing severe transport challenges as such as congestion, shortage of parking, an increase in the number of the private mode of transport, decrease in the number of public transport vehicles. If the government had implemented these policies such as efficiency, safety, sustainability and regionally balanced then people would not have opted for the privatized mode of transport. For instance, data demonstrate that the annual growth in the registration of 2-wheelers is 10.67%, car/jeep/taxi 10.05% and bus growth rate is mere 4.45% in 2014 (MRTD, 2016). Among these policies, safety is another key aspect. Unfortunately, urban roads are the most dangerous in the country. Based on the data, the number of road fatalities and road accidents are continuously growing. For instance, the number of road fatalities (30 days) recorded in 2000 was 78,911 and it reached 146,133 in 2015. Despite policy recommendations, the number of road fatalities has grown by 1.85 times in mere one and half decades. Similarly, the number of road accidents has been gone up by 1.28 times from 391,449 in 2000 to 501,423 in 2015. Based on these outcomes it is clear that these policies have not been successfully implemented.

4.2. Motorization

Road transport plays a vital role in economic development, trade, and social integration as it boosts service for both passengers as well as freight movement. Higher transport costs lead to the exploitation of trade and market, while efficient and feasible transport systems help in promoting economic development. In India, motorization patterns vary widely in urban and rural areas. Most of the metropolitan cities are overcrowded with the vehicle growths. The total number of registered vehicles in 1951 was 0.3 million, while in 2001 it was 55 million and it surpassed 142 million by 2011 (Economic Survey, 2014-15). Further, it has crossed 210 million by the end of 2015 and out of these vehicles, 73% are two-wheelers only (MOSPI, 2016b). It has grown at a compound annual growth rate of almost 11% between 1951 and 2011. The share of public transport commuters and non-motorized transport has decreased and the use of the private vehicles has rapidly increased. The rapid increase in the number of privately owned vehicles, increasing in the number and length of trips are the outcome of ineffective urban planning strategy (Sharma et al., 2011).

Table 5. Number of registered motor vehicles and growth rate in India, 2000-2015

Year	All vehicles (thousand)	Growth rate (%)	2-Wheelers (thousand)	Growth rate (%)	Cars/jeep/taxi (thousand)	Growth rate (%)	Buses (thousand)	Growth rate (%)	Goods vehicles (thousand)	Growth rate (%)
2000	48857	12.56	34118	13.01	6143	14.90	562	12.81	2715	8.58
2001	54991	17.15	38556	7.85	7058	7.86	634	0.16	2948	0.88
2002	58924	13.72	41581	14.28	7613	12.95	635	13.54	2974	17.42
2003	67007	8.52	47519	9.27	8599	9.91	721	6.52	3492	7.36
2004	72718	12.08	51922	13.24	9451	9.19	768	16.15	3749	7.52
2005	81499	9.96	58799	10.11	10320	11.69	892	11.21	4031	10.05
2006	89618	7.91	64743	6.77	11526	9.74	992	36.09	4436	15.40
2007	96707	8.94	69129	8.98	12649	10.29	1350	5.70	5119	9.42
2008	105353	9.11	75336	9.38	13950	9.77	1427	4.13	5601	7.86
2009	114951	11.13	82402	11.16	15313	11.73	1486	2.76	6041	6.47
2010	127746	11.05	91598	11.21	17109	12.40	1527	5.04	6432	9.83
2011	141866	12.42	101865	13.31	19231	12.15	1604	4.55	7064	8.41
2012	159491	10.38	115419	10.75	21568	11.54	1677	8.17	7658	8.47
2013	176044	8.33	127830	9.06	24056	8.07	1814	4.02	8307	4.71
2014	190704	10.13	139410	10.68	25998	10.05	1887	4.45	8698	7.43
2015	210023		154298		28611		1971		9344	

Source: (MOSPI, 2016)

In 1951, the percentage of vehicle registration for two-wheeler, car/jeep/taxi, bus, goods vehicle, and other vehicles was 9%, 52%, 11%, 27%, and 1% respectively. However, the vehicle registration trend rapidly changed in the next six decades and now, the two-wheelers has gone more than 8 fold from 1951. Apart from two-wheelers, all other types of vehicle registration share have declined. For instance, the share of the bus was 11% in 1951 but it declined to 1% in 2011. Interestingly, the share of car/jeep/taxi has declined from 52% to 14% and goods vehicle from 27% to a mere 4% from 1951 to 2015. Based on the data, the decline in the registered buses and an increase in the two-wheeler are very much evident. Arguably, poor public transport has forced people to opt for two-wheelers to achieve their transport needs. The number of two-wheelers per thousand populations has gone to 118 per thousand populations in 2015 in comparison to 36 in 2001. Below Fig 2, demonstrates modal share home to/work in India districts in 2011. In any specific district, sum of all these mode types of transportation make total share (100%). In this figure, different modal share for transport vehicle has been shown on Indian map. Each map demonstrates different mode and district wise transport patterns. However, Fig 3 highlights the road accidents in India by the mode of transport and ironically two-wheelers share is the highest with 21 percent.

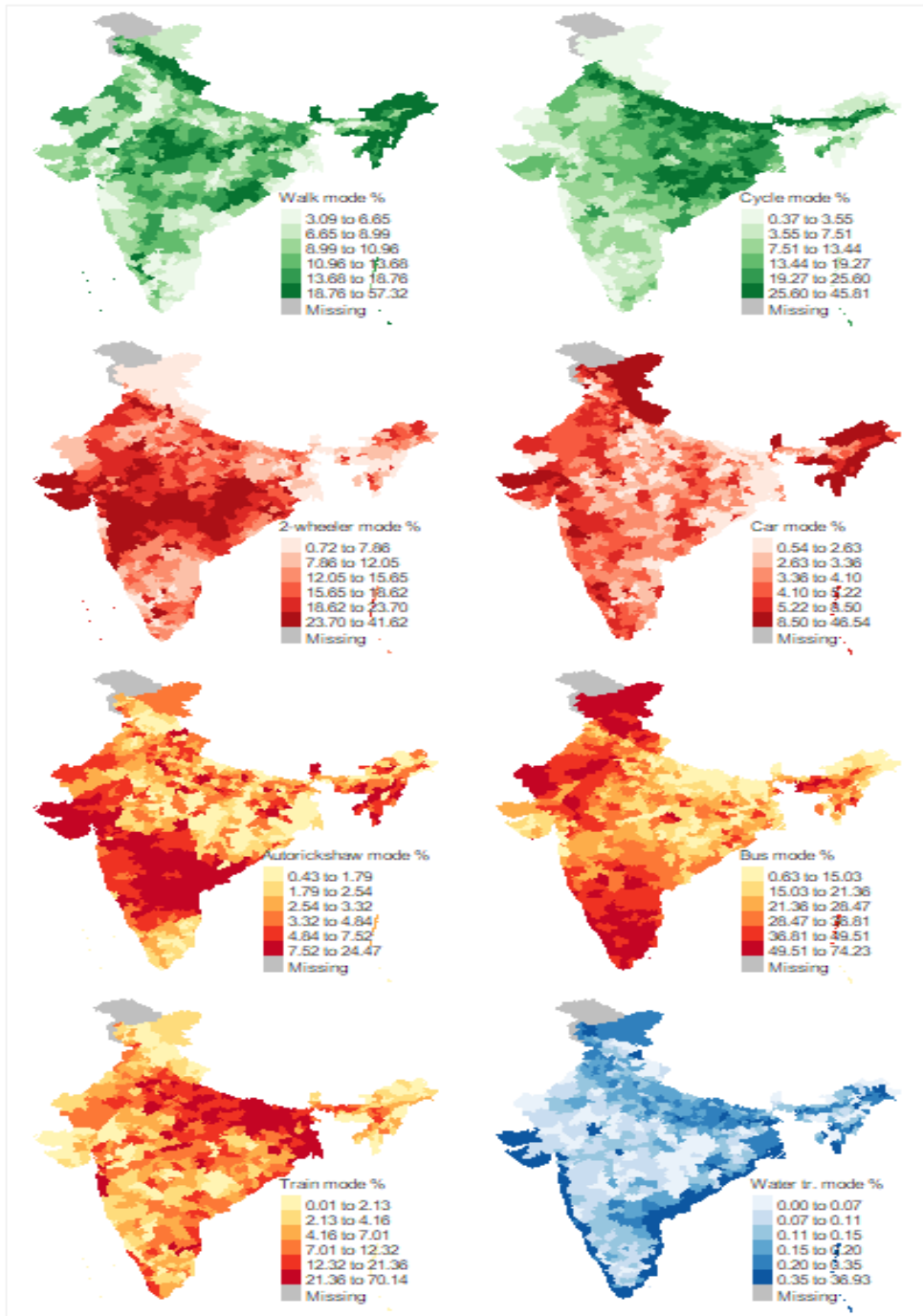


Fig. 2: Distance weighted transport mode share home to/from work in India districts, 2011 (Census of India, 2011).

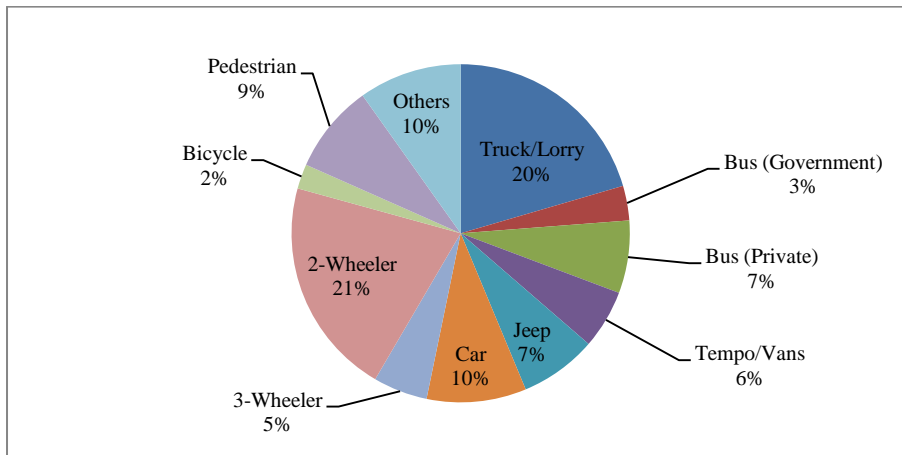


Fig. 3. India road accident deaths by mode of transport (2001-2014)

The benefits of motorization are great, but its sequences are dangerous too. Increase in the number of privately registered motor vehicles leads to more pollution, more energy consumption, congestion and more importantly undermining of public transport services. These issues are so serious in nature that policymakers came with so many policies and recommendation in last three years, i.e., Motor Vehicles Act (1988), National Urban Transport Policy (2014), Road Transport and Safety Bill (2014), National Policy on Transit Oriented Development (2017), the Motor Vehicles (Amendment) Bill (2017). All these policies encourage the use of public transport and therefore they recommend affordable fare system. One of these policies recommends metro rail schemes and comfortable and sustainable long-term transport plans. While, some of the other policies focuses on overall improvement in the transport sector by considering key facts such as safety, efficiency, sustainability, and mobility.

However, there is a huge difference in policy formation and its implementation. The above policies rightly advocate for the affordable fare but the government has not taken this recommendation seriously. For instance, the majority of commuters on public transport belong to middle and low economic class. In 2017, DMRC increases Delhi metro fare twice in a row and as a consequence ridership declined by 15% (around 0.3 million) within three months. Such a decline in the share of metro rail due to a hike in fare will lead to an increase in the number of 2-wheelers use. Another motorization fear lies in the growing GDP of India. For instance, India's GDP per capita in 2001 was \$447 and vehicle per thousand population was 53 and in 2015 GDP per capita reached to \$1,613 and vehicle per thousand population was recorded as 167. The rising income level is expected to slightly reduce the ownership of two-wheelers and a drastic increase in car ownership. Interestingly, the total vehicle per thousand populations will increase with increasing GDP. In India, a personal vehicle is not only used for unmatched flexibility, convenience, and freedom but for many, it represents status symbols.

The rapid motorization is the one of the key reasons for the policies failure. Apart from unchecked population growth, poor public transport has resulted in the increase in the use of private vehicles across India. It has also resulted in a rising number of road fatalities. Based on the report from TRW, the urban roads are more dangerous than the rural roads. The number of road accidents has taken place in some of the big cities are Chennai (7,468), Delhi (7,375), Bengaluru (5,323), Indore (5,143), Kolkata (4,104), and Mumbai (3,379). Also, data reveal that people died in road accident in 2016 is higher than the people killed in 2015 (MORTH, 2017). The rapid growth in the vehicle is also causing scarcity of parking space. The shortage of parking space is more severe in the cities and metropolitan areas and if authorities do not take this issue seriously then this could be one of the biggest challenges in the coming decades.

4.3. Infrastructure

This study reveals that there are many issues associated with infrastructure development in India and some of the major issues include financing of infrastructure, land acquisition and environmental clearances, private sector participation etc. The Government of India had been making numerous efforts to develop the entire transport system from time to time. The Indian transport system lacks greatly when compared to the transport systems of developed nations. Even there is a disparity not within urban and rural India in terms of infrastructure but also in between cities and metropolitan cities. Normally, infrastructure related to public transport in small cities is financially inefficient and uncompetitive comparing with metropolitan cities (Badami and Haider, 2007). The Government is aiming to promote corporate investments in roadways. At the same time, it is working to design policies that are business oriented and properly balance profits with efficient project implementation. The fig. 4 (a & b) demonstrates the changing trends in roadways and railways from 2001 to 2015.

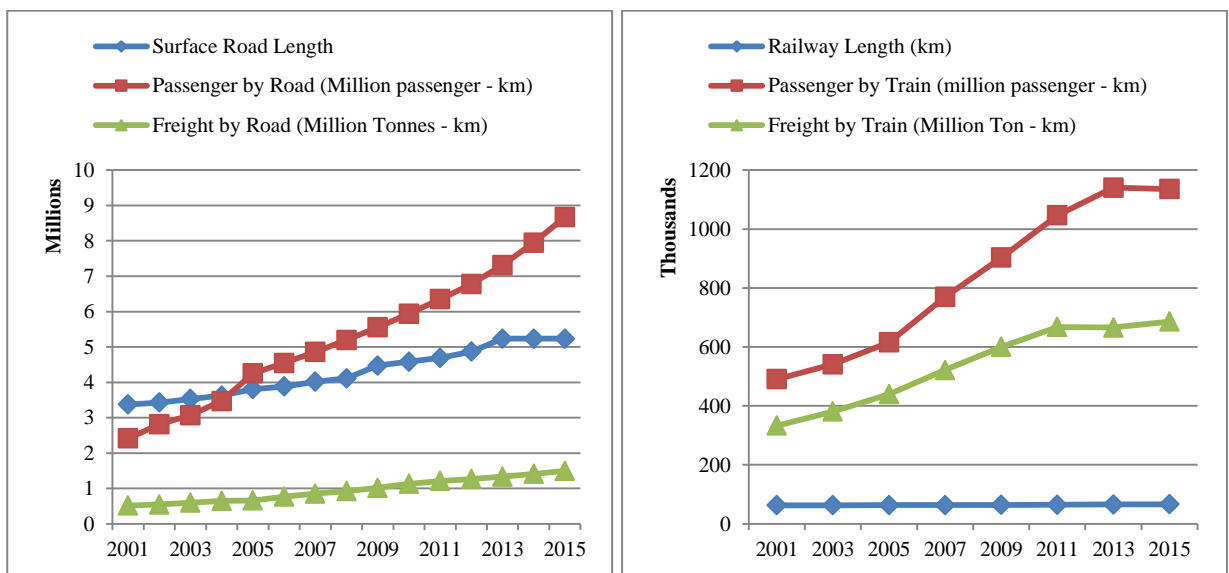


Fig. 4. (a). Changing roadways trends (2001-2015), (b). Changing railways trends (2001-2015)

The government of India is making various efforts to increase the overall budget for the transport sector. Indeed, the sanctioned amount is not enough to make transport system efficient and competitive. The fund allocated in the union budget for the transport sector in 2017-18 is shown in Table 6.

Table 6. Budget Allocation for Transport sector (2017-18)

Sectors	Amount
Road Sector	
Roads and Bridges	405.92
National Highways Authority of India	238.92
Research Training and Studies and Other Road Safety Schemes	2.50
Rail Sector	
Grants to Delhi Metro Rail Corporation	1.50
Metro Projects	178.10
Indian Railways	550.00

Urban Rejuvenation Mission	
AMRUT – Atal Mission for Rejuvenation and Urban Transformation & Smart Cities	90.00
Electric Vehicles and Testing Facility	
Scheme for Faster Adoption and Manufacturing of (Hybrid and Electric) Electric Vehicle in India – (FAME – India)	1.75
National Automotive Testing and Research and Development Infrastructure Project (NATRIP)	4.85
Capacity Building	
Transport Planning and Capacity Building in Urban Transport	0.40
Water Transport	
Grants to Inland Water Transport Authority of India	3.03

Source: (Union Budget, 2017-18)

The union budget allocated for transportation seems very promising but still, it remains a question that whether this fund will be utilized within the time frame. In India, one of the key challenges for infrastructure development is a slow process of obtaining clearance from the environment, forest and wildlife departments. Sometimes, these authorities take even more than three years and as consequence, many projects get delayed. So, government and other responsible authorities should emphasis on issuing clearance within the given time frame. Table 7, shows the time taken in obtaining clearance including transport infrastructure and Table 8 highlights the various reasons for the project delays. While Table 9 shows some examples of project delays due to carelessness of the clearance issuing authority and sometimes for the other reasons.

Table 7. Time taken in obtaining clearance

Clearance required	Statutory Authority	Time Taken
Environment	Ministry of Environment and Forest	12-15 months
Forest	Ministry of Environment and Forest	1-2 years
Wildlife	National Board of Wildlife and Supreme Court of India	More than 3 years

Source: compiled from various sources

The below table demonstrates the reasons and delay period:

Table 8. Delay in projects and its reasons

Project	Amount (\$ Million)	Delayed	Implementation Issues
National Highways	245	1 Year	Change in scope, land acquisition problems and administration delays
Surat-Manor Tollway	165	2 Years	Contractor problem and increase in the scope of works, rising number of traffic accidents
Western Transport Corridor	240 (reduced to 191.5)	2.5 Years	Poor performance by the contractors, replacement of contractor
Road improvement	198	4 Years	Project/management issues during the implementation
Railways	190	6 Years	Slow implementation by IR
Railways Sector Improvement	313	ongoing	Procurement problems

Table 9. Targets vs. achievements for road construction (National Highways)

Year	Target (km)	Achievement (km)	Achievement (in %)
2014-15	6300	4410	70%
2015-16	10950	6061	55%

2016-17	15000	8231	55%
2017-18	15000	4942*	57.6%*

*Data available till November 2018

There are many policies dealing in transport infrastructure, i.e., Integrated Transport Policy (2001), India's National Urban Transport Policy (2006 & 2014), Green Urban Mobility Scheme (2017), Motor Vehicles (Amendment) Bill (2017). The basic argument of these policies is to develop an adequate and sustainable transport infrastructure. To achieve sustainable infrastructure, policies recommend accessibility, mobility, safety, and encouraging public-private partnership. Despite the recommendation of sustainable transport approach, the government has not done enough on the ground level.

For example, the concept of Bus Rapid Transit (BRT) system was first time introduced in 2006 in Pune and then followed by Delhi (2008), Ahmedabad (2009), Jaipur (2010) and then in other cities of India. The BRT achieved great success in a few cities while it remained irrelevant to many big cities including Delhi. For instance, with an investment of INR 115 crore, Delhi BRTS corridor came in operation but in a longer run, it emerged as a complete failure. The process of Delhi BRT was not only a huge financial investment but hardships faced by the commuters during its construction. So, many things can be learned from Delhi BRT experience and especially the fact that the number of accidents increased in the case of Delhi due to poor construction and design. Finally, due to the poor infrastructure and design, the Delhi government dismantled the system in 2016. Now, many other cities are in the process of developing their own BRT and while some cities are planning to initiate this project. There are many aspects of lessons can be learned from Delhi BRT and do the needful to make it more user-friendly.

Another important concern is rising in the number of road accidents due to poor infrastructure. Despite recommendations made by the policymakers that India needs to promote non-motorized transport, still enough has not been done for pedestrians and cyclists. In general, the infrastructure for pedestrian and cyclist is very poor across the country. This is why the most affected by the poor infrastructure are those pedestrians and cyclist who while walking/riding have to face the obstruction of broken pavements and sidewalks/side roads, risky road crosses, and flooding during the monsoon season. Bicycles were once the major mode of urban transportation and are now being sidelined by the ever-growing motorbikes and vehicles. These two groups are responsible for ten percent of all traffic accidents. The secondary and tertiary roadways receive very little focus and investments mostly in the rural areas.

Table 10. India road accident deaths by mode of transport (2001-2014)

Mode	Percentage	Mode	Percentage	Mode	Percentage
Truck/Lorry	20	Bus (Government)	3	Tempo/Vans	6
Car	10	Bus (Private)	7	Jeep	7
3-wheelers	5	2-wheelers	21	Bicycle	2
Pedestrian	9	Others	10		

From past experience, one thing is clear that the government is not utilizing its funding in a smart way and some of the steps clearly show a lack of optimism. The Delhi BRT was built in INR 115 crore and yet it was a complete nightmare. So, the learning lesson is that India is a big country and one state transport policy may not suit to others. For example, Ahmedabad or Pune BRT was great success but Delhi's flopped. In the case of Delhi BRT, planning and designing were very poor and therefore in future, a different aspect of infrastructure shall be considered before coming to any final conclusion.

4.4. Environmental degradation

The majority of Indian vehicles rely on oil products like petrol and diesel. However, the CO₂ emission from the transport sector is rapidly increasing and as an alternative to petrol and diesel, CNG and electricity are introduced. Moreover, CNG is available only in major cities and electric vehicles are the newly developing trend in India. For

instance, Delhi has made mandatory use of CNG for public transportation but this trend is not common in most of the other states. In 2015, road transport accounted for most of the CO₂ emissions from fuel use.

The growing tendency of vehicle ownership is leading towards congestion on the road and as a result, the CO₂ emission is increasing from transport. Personal motorization imposes enormous costs, especially in cities. Since motorized transportation is the only sector globally which consume the maximum amount of petroleum and therefore it also raises the question of energy security. Currently, in India transportation is one of the key sources of greenhouse gas (GHG) emissions. The CO₂ emission from transport sector is still not under the control. Despite policies, vehicles emission level is not properly checked by the concern authorities and as a result, environment is rapidly degrading (Fig. 5).

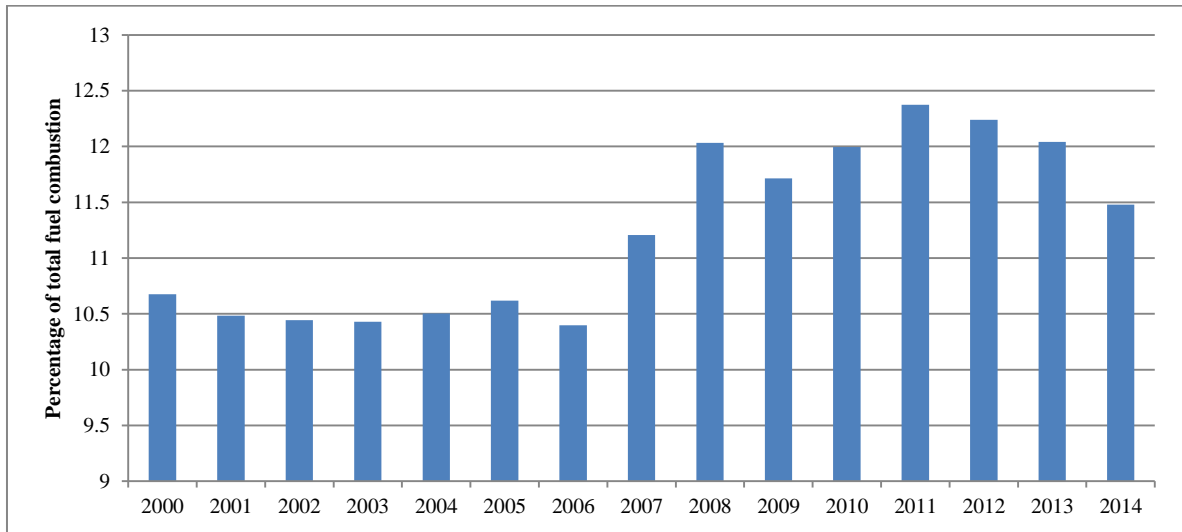


Fig. 5. CO₂ emissions from transport (% of total fuel combustion) (World Bank, 2016a)

From policies perspective, the government has given special emphasis on environmental issues. Several policies have been implemented to improve environmental conditions in India. The implementation of Air (Prevention and Control of Pollution) Act, 1981 is fully devoted to reforming transport industry and it has made strong recommendations on the pollution emission level from vehicles. However, despite this Act, the level of CO₂ emission is beyond the control limit which signifies that policies are not fully implemented on the ground level.

Other policies such as Integrated Transport Policy (2001), National Urban Transport Policy (2006 & 2014), Road Transport and Safety Bill (2014), Green Urban Mobility Scheme (2017), National Policy on Transit Oriented Development (2017), and Motor Vehicles (Amendment) Bill (2017) have made strong recommendations on improving transport sector to keep environment healthy. Some of their key recommendations suggest emphasizing on improving public transport systems, reducing the use of private vehicles, moving from consumption of tradition fuels towards hybrid and electric vehicles, promoting NMT, improve pedestrian and cyclists paths and so on. Based on these recommendations, the GoI has started working on it but the situation has not changed. An All India Study conducted by Nielsen (India) Pvt. Ltd. for Petroleum Planning and Analysis Cell (PPAC), an attached office of the Ministry of Petroleum and Natural Gas to estimate the share of petrol and diesel consumption among the different segments within the transport and non-transport sector sold through retail outlets of Public Sector Undertaking (PSU), Oil Marketing Companies (OMC) on state-wise, zone-wise and all India basis. The report suggests that 70% of diesel and 99.6% petrol are alone consumed by the transport sector in India. From petroleum perspective, 61.42% is alone consumed by the 2-wheelers while 34.33% by the cars and 2.34% followed by the 3-wheelers, 1.51% by SUVs and 0.39%. In case of diesel (retail sale), the highest consumption of 32.54% is by HCV/LCV and followed

by private and commercial cars and utility vehicles (UVs) 25.52%, buses 8.26%, 3-wheelers-passengers/Goods 7.36%.

4.5. Others

Accident, traffic congestion, noise pollution are some other examples of Indian transport inefficiencies. The growing road fatalities as mentioned earlier are a serious concern for the authorities. Also, the trend in railway casualties is growing year after year (Fig. 6) and policies implemented by the Ministry of Railways to control accidents do not seem very promising. In fact, motorization, urbanization, poor infrastructure is complementing to road congestion, environmental pollution, and fatalities.

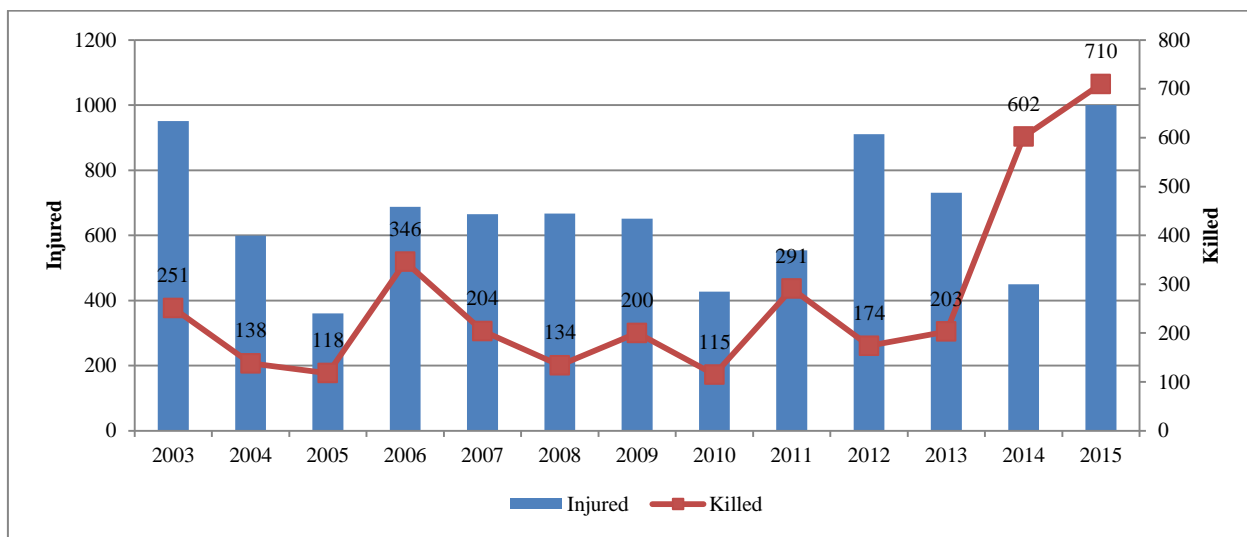


Fig. 6. Casualties in rail accidents (2003-2015) (MOSPI, 2016)

5. Conclusion

India is rapidly growing in terms of population and to meet the needs of the rapidly growing population, infrastructural development is key for economic sustainability. Also, efficient transport systems play a vital role in sustaining economic growth. Currently, Indian transport systems look unsustainable because of four reasons i.e., urbanization, motorization, poor infrastructure and environmental degradation. In the last a few decades, urbanization has rapidly taken place. Currently, 32.8% of the Indian population lives in cities and as per the UN State of the World Population report, urban population will surpass 40% by 2030. To match the need of the growing population (rural and urban), the government of India has implemented various transport policies. However, these transport policies are not successfully implemented and therefore there is a mismatch between transport demand and supply across the country and cities in particular.

Motorization: The motorization is rapidly taking place in India. Currently, more than 210 million registered vehicles exist in India. In 2015, the share of 2-wheelers was 73.47%, car/jeep/taxi 13.62%, bus 0.94%, good vehicles 4.45% and others 7.52%. The highest growth is registered with the privatized mode of transport. Ironically, the share of 2-wheelers has gone more than 8 fold from 1951 to 2015 and it alone contributes one-third of total vehicles. Also, the share of bus is rapidly decreasing over the years. For instance, the share of the bus was 1.15% in 2000 and in 2015; it has fallen to 0.94%. There are so many benefits of private vehicles such as convenient, flexible

and better accessibility but its consequences are dangerous too. The rise in the private mode of transport leads to more pollution, more energy consumption, congestion, and environmental degradation. Many studies suggest that transportation is one of the key sources of greenhouse gas emissions in India. The larger question is why private vehicles have increased so fast? There are two reasons: population growth; and inadequate public transport systems.

Urbanization: Urbanization represents the transformation of a given area from several perspectives, demographics, economic, social as well as technological from a relatively less advanced to highly advanced technological area. In the 1990s, the government of India launched various economic schemes and due to better transport connectivity in urban areas, urban centers benefitted more from schemes. People from rural India started migrating to urban areas in search of better employment and educational opportunities. As a result, most of the cities are overpopulated and the public transport system is unable to match the demand and supply. Hence, people are forced to have their own vehicle for their convenience. Now, the overpopulated cities with the overpopulated vehicle are creating basic problems like congestion, environmental degradation, and road accidents.

Infrastructure: Due to financial constraints, the government of India could not offer adequate infrastructure. With the help of PPP, the government of India has been able to accomplish the desired infrastructure. Most of the Indian cities are developed unplanned and therefore now it is little challenging to design infrastructure as per the current needs. The World Bank has suggested that India need to invest much more than the current budget in the transport sector. There is two main problems with infrastructure development in India; (1) time-consuming in clearance from environment/forest/wildlife authority and (2) project delay. Most of the projects are delayed because of too much time consumption in issuing clearance certificate by the concern authorities. For instance, Ministry of Environment and Forest often takes 2 years in issuing clearance certificate and ironically the National Board of Wildlife and Supreme Court of India even take more than three years in proving clearance certificates.

Environmental degradation: The majority of Indian vehicles rely on oil products like petrol and diesel. Therefore, the CO₂ emission from the transport sector is rapidly increasing. The alternative of petrol and diesel is limited to big cities. For example, in Delhi, all public transportations are using CNG. The data presented by the World Bank shows that the CO₂ emissions from transport are rapidly increasing. An All India Study conducted by Nielsen (India) Pvt. Ltd. for Petroleum Planning and Analysis Cell (PPAC) suggests that 70% of diesel and 99.6% petrol are alone consumed by the transport sector in India. Out of total diesel (retail sale), the highest consumption of 32.54% is by HCV/LCV and followed by private and commercial cars and utility vehicles (UVs) 25.52%, buses 8.26%, 3-wheelers-passengers/Goods 7.36%. Moreover, in the case of petrol, 61.42% is alone consumed by the 2-wheelers while 34.33% by the cars and 2.34% followed by the 3-wheelers, 1.51% by SUVs and 0.39%.

Lessons Learned from Policies: The government of India is regulating its transportation policies from time to time. However, there is nothing wrong with most of the policies but the serious issue is about its implementation. In 2001, the government of India implemented "Integrated Transport Policy" with a motive of making all transport systems parallel and enable a spirit of competition among the public transport systems. So, the transportation system can become efficient, sustainable, safe and regionally balanced. Despite this policy, data reveals that there is still no control accidents, regionally transport system remained imbalance. Even the vehicle population growth continues to rise and no parameters of sustainable transportation have been seen under the control. However, the guidelines offered in this policy are still relevant if policies are implemented in reality.

In another policy "India's National Urban Transport Policy 2006", the guidelines suggest offering safe, affordable, speedy, comfortable and reliable mobility. However, despite this policy, the government raises public transport fare. For instance, in 2017, DMRC increase Delhi metro fare twice in a row and as a consequence ridership declined by 15% (around 0.3 million) within three months. India's national urban transport policies have given special emphasis on fare affordability but still, this policy has not been implemented to improve the urban transport systems. So, most of the policies and guidelines issued by the transport authorities or the government organization are only limited to policies and real effort has not been made to implement on the ground level. India needs to learn from its previous mistakes and try to improvise it in the future for the better outcome. If these policies are not implemented in the

reality then India will continue to face severe transport problems as increase in private mode of vehicles, congestion, more energy consumption, and environmental degradation and so on. The National Urban Transport Policy (2014) has strongly recommended improving public transport (accessibility, connectivity, safety to assure a reduction in the use of private vehicles. But data clearly demonstrate that the numbers of buses are continuously decreasing and the use of private vehicles is rapidly increasing. So, in this high time government need to seriously implement these policies otherwise outcome could be dangerous in future.

The Road Transport Bill (2014) recommends safety and security of the commuters. But data demonstrates that the total death in road accidents is higher in 2016 in comparison to 2015. These road safety rules should be implemented on a serious note and special emphasis should also be given to pedestrians and cyclists. If all policies are seriously implemented then India's transport system can become sustainable in the longer run.

References

- AHMAD, S. & DE OLIVEIRA, J. A. P. 2016. Determinants of urban mobility in India: Lessons for promoting sustainable and inclusive urban transportation in developing countries. *Transport Policy*, 50, 106-114.
- BADAMI, M. G. & HAIDER, M. 2007. An analysis of public bus transit performance in Indian cities. *Transportation Research Part A: Policy and Practice*, 41, 961-981.
- CENSUS 2011. Office of Registrar General and Census Commissioner. *Ministry of Home Affairs*.
- CENSUS OF INDIA 2011. B-28 'Other Workers' by distance from residence to place of work and mode of travel to place of work. Office of the Registrar General & Census Commissioner, India.
- ENVFOR 1981. THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981. *Ministry of Environment, Forest and Climate Change, Government of India*.
- GOI 1988. THE MOTOR VEHICLES ACT, 1988.
- GOVERNMENT OF INDIA 2017. FDI in Railways. Delhi: Press Information Bureau.
- MAKE IN INDIA 2014. Make in India - New Initiatives.
- MOHUA 2017. Green Urban Mobility Scheme, 2017.
- MORTH 2014. Road Transport and Safety Bill, 2014.
- MORTH 2016. Road Network by Categories from 1950-51 to 2014-2015.
- MORTH 2017. The Motor Vehicles (AMENDMENT) Bill, 2017.
- MOSPI 2016. Indian Railways - Statistical Year Book India 2016.
- MOUD 2006. National Urban Transport Policy, 2006.
- MOUD 2014. National Urban Transport Policy, 2014
- MOUD 2017. National Policy on Transit Oriented Development, 2017.
- OECD 2016. Passenger Transport, Freight Transport. *OECD DATA*.
- PLANNING COMMISSION 2001. Integrated Transport Policy.
- PLANNING COMMISSION 2010. Estimates Of Urban Transport Investments By High Powered Expert Committee (HPEC).
- PLANNING COMMISSION 2014. India Transport Report, Moving India To 2032.
- PUCHER, J., KORATTYSWAROPAM, N., MITTAL, N. & ITTYERAH, N. 2005. Urban transport crisis in India. *Transport Policy*, 12, 185-198.
- SHARMA, R. D., JAIN, S. & SINGH, K. 2011. Growth rate of motor vehicles in India-impact of demographic and economic development. *Journal of economic and social studies*, 1, 137.
- SHRIVASTAVA, R., NEETA, S. & GEETA, G. 2013. Air pollution due to road transportation in India: A review on assessment and reduction strategies. *Review Paper (NS-2), Journal of Environmental Research and Development*, 8.
- UNITED NATIONS 2007. UNFPA state of world population 2007, Unleashing the Potential of Urban Growth.
- WORLD BANK 2016a. CO2 emissions from transport (% of total fuel combustion).
- WORLD BANK 2016b. Railways, passengers carried (million passenger-km), Railways, goods transported (million ton-km).
- WORLD BANK 2017. Urban population (% of total).