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The Urban Transport Crisis in Emerging Economies

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Chapter 5
India

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Capital city	Land area	Total population	Urban population	GDP per capita	Passenger cars
New Delhi	3,287,590 sq. km	1,300 million	32% (401 million)	$1,499	11 / 1,000 people

Data source: World Bank
Maps source: d-maps.com

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1 Introduction

Despite having a number of extremely large cities and rapid rates of urbanization, India is a predominantly rural country: its hundred most populated cities account for only 16 % of the total population (IIHS 2012). The driving forces of India's urbanization are diverse and include natural population growth, rural-urban migration, and changes in municipal boundaries and area reclassification (Gogoi 2013; Gupta 2014). Recent estimates indicate that most Indian cities will double their population and built-up area by 2030, and quadruple their mobility demand (CSTEP and IUT 2014; McKinsey Global Institute 2010; Swamy 2012).

In economic terms, urbanization has had positive impacts: the hundred most populated cities contribute 43 % of the total GDP (IIHS 2012). However, the sheer number of people now living in urban areas poses transportation problems of an unrivalled magnitude. Current motorization rates surpass both the population growth rate and the urbanization rate. However, growing motorization has not translated into increased accessibility. Sprawling development patterns (both in slums and planned settlements) have severed linkages between residential, employment, recreational, educational, medical, and other activities. Traveling is becoming increasingly difficult in terms of comfort, safety, cost, and time. This is adversely impacting the economic efficiency of Indian cities, as well as the health and well-being of urban Indians. With almost one-third of India's urban population below the poverty line, the mobility problems of the poor, who cannot afford private transport and cannot access public transport, are of special concern. As Indian cities continue to sprawl, the poor are forced to travel increasingly long distances by foot or cycle (Nair 2015).

The chief factors that stand in the way of resolving urban transport problems are institutional, including a weak administrative framework, limited planning capacity, and the lack of integrated land use and transport (IIHS 2015). Despite several ambitious programs launched by the national government, local governments have been unable to transform the face of transport in their cities (Mahadevia et al 2013). In this context, this chapter reviews urban transport trends, problems, and potential solutions in urban India.

2 Urban Land Use Patterns and Spatial Structure

Historically, Indian cities were based around pedestrian movement; most people worked within a small radius of their home (Fazal 2012). Today, most of the larger cities include an old district in their core, which retains small town characteristics

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(narrow, congested streets and intermingled activities) but this is often just a small part of the total urban area. Large cities are also marked by the presence of informal settlements, which are scattered throughout the built tissue, including the periphery (so-called "resettlement areas"). There are also various types of planned residential colonies built by the public, private, or cooperative sectors. Planned commercial districts are spatially dispersed in a polycentric fashion. Industries are concentrated near traditional commercial zones but are also located within newly developed industrial parks in the urban outskirts. Within urban areas, there is no clear demarcation of different activities. Delhi is a classic example: the poor live in informal settlements within the central commercial areas and in the periphery; the elites are concentrated in centrally located, as well as peripheral, planned districts; and the middle classes are dispersed all over the city (Tiwari 2001).

Indian cities have been described as having "high density, low-rise, low accommodation." The level of space consumption per capita is low by international standards. In Mumbai, for example, a typical middle-class family occupies 5 m^2 per capita, compared to 55 m^2 per capita in Manhattan (Patel 2011). In the last decades, population densities in the cores of the ten largest Indian cities have declined further (IIHS 2012). Not only has the public sector tolerated peripheral growth and urban sprawl, it has actually (unintendedly) encouraged it through specific policies designed to decongest city centers. The so-called Floor Space Index[1] has been restricted to 1.6 as compared to 5–15 in other Asian city centers. In peripheral developments a higher Floor Space Index is allowed than in the centers. Thus, policy has induced firms to decentralize—a trend seen in Kolkata, Bengaluru, Chennai, and Hyderabad (Bertraud 2002).

On the edges of Bengaluru and Chennai, a number of "Special Economic Zones" and "technology parks" have appeared. In Special Economic Zones special economic laws apply, with the goal of attracting foreign investments (Topno 2005). New residential districts have grown around these new employment centers but the housing here is not always affordable for workers. In addition, haphazard and speculative developments have mushroomed along the major road corridors that connect the inner cities to the surrounding areas. Within the larger regional system, these typically fall outside municipal jurisdictions (the Urban Local Bodies) and are therefore uncontrolled (IIHS 2012; Ahluwalia 2015). In a context of growing motorization and poor public and nonmotorized transportation planning, these development patterns have led to major traffic congestion problems (Batra 2009; Mohanty 2014).

3 Trends in Transport Use and Mobility

3.1 Automobility

In 2012, there were 160 million motor vehicles registered in India (MoRTH, GoI 2013). While motorization remains low by international standards (11 cars per 1000 people), the number of registered motor vehicles grew 26-fold between 1981 and

[1] The Floor Space Index is the total developed area, including all the floor areas in a multi-storey building.

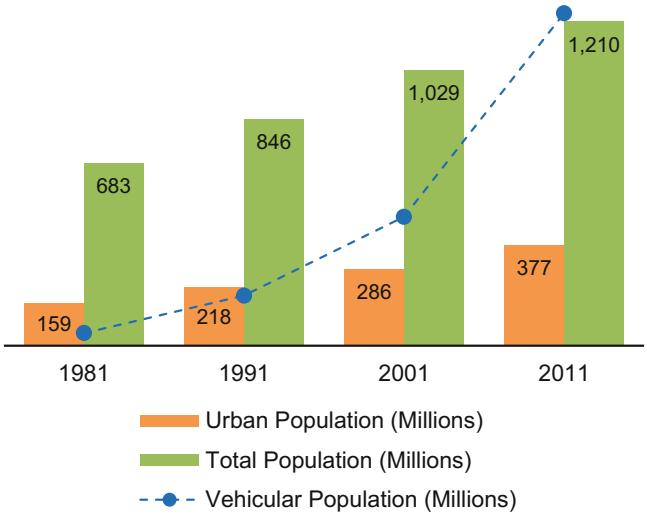

Fig. 5.1 Population, urbanization, and motorization in India (1981–2011). *Source*: Registrar General (2011)

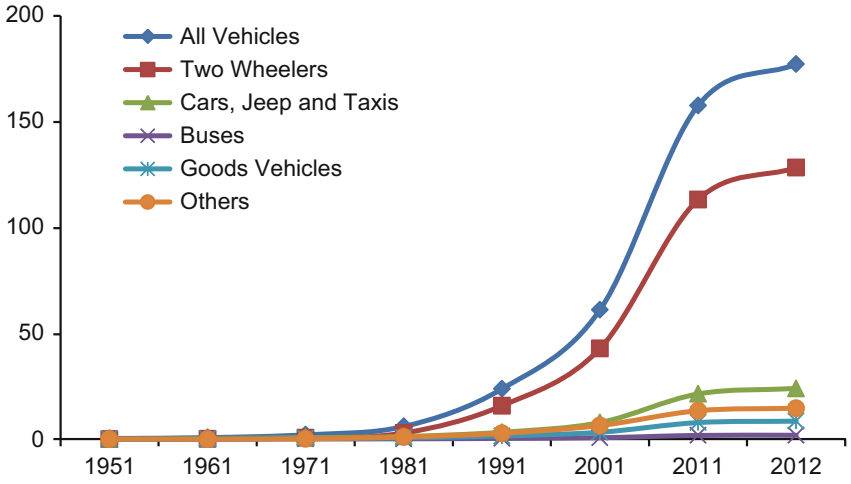

Fig. 5.2 Trends in registered vehicles in India. *Source*: (MoRTH, GoI 2013)

2011, while the overall population and the urban population during the same period grew by factors of 1.8 and 2.4, respectively (Figs. 5.1 and 5.2) (Registrar General 2011). By some estimates, the number of motorized vehicles will quadruple by 2030 (Ghate and Sundar 2013).

There are various reasons behind this exponential increase in motorized vehicle ownership, in addition to India's rapid economic growth. The deregulation of the automobile sector has given impetus to domestic vehicle production, incentivizing the entry into the market of numerous manufacturers (including affordable and fuel

Table 5.1 Travel patterns in Indian cities

City category	Population range (million)	Motorized trip length (km) (2007)	Motorized trip length (km) (2011)	Motorized trip rate (2007)	Motorized trip rate (2011)
1	<0.5	1–3.5	3.5–4.5	0.7–0.7	0.7–1.6
2	0.5–1	2–3.5	3.5–7	0.8–1	0.4–1.6
3	1–2	4–6	6–14	0.9–1	0.9–3.5
4	2–4	4–8	5.5–8	1–1.2	1–1.3
5	4–8	7–10	8–11.5	1.2–1.4	1.2–1.5
6	>8	9–13	11–16	1.2–1.4	1.3–1.4

Note: A larger number of cities were sampled in 2011 than in other years
Source: MoUD (2008) and CSTEP and IUT (2014)

Table 5.2 Modal split in Indian cities (as a percentage of total trips)

Population (million)	Walk	Mass transit	Paratransit		Car	Two-wheeler	Bicycle
			Fast	Slow			
0.1–0.25	37	16	10	20	3	24	26
0.25–0.5	38	21	9	17	3	30	21
0.5–1	31	25	8	12	10	29	16
1–2	30	31	6	8	3	40	12
2–5	29	42	5	3	5	29	16
>5	28	63	3	4	6	15	9

Source: Singh (2009)

efficient cars and motorized two-wheelers). Easy access to auto finance and low insurance rates have also fueled car ownership.

Travel data for Indian cities show that people are now making more trips (both in total and by car), and their trips are longer (Tables 5.1 and 5.2). However, people in the informal sectors display different travel behavior. Among these groups, especially in smaller cities, walking and cycling trips account for 40–80 % of the commuter trips despite inadequate and unsafe conditions for nonmotorized travel (Tiwari 2002; Kunieda and Gauthier 2007). For the poor, this is often the only option, as public transport fares are too expensive for much of this group: approximately half of the urban slums residents spend nearly one-third of their family income on public transport (Tiwari 2007). The main public transport patrons are individuals employed in the formal sector, who can afford motorized travel.

Public transport development has not kept pace with the increase in travel demand, compelling people to turn to either cars or informal paratransit (MoUD 2008). Only older and larger cities, such as Kolkata and Mumbai, in which the rate of population growth has abated, and mass transit systems (bus, rail, ferry) have been established, have had lower rates of car use increase, in comparison to smaller and faster growing cities with inadequate public transport systems (Fig. 5.3). Public

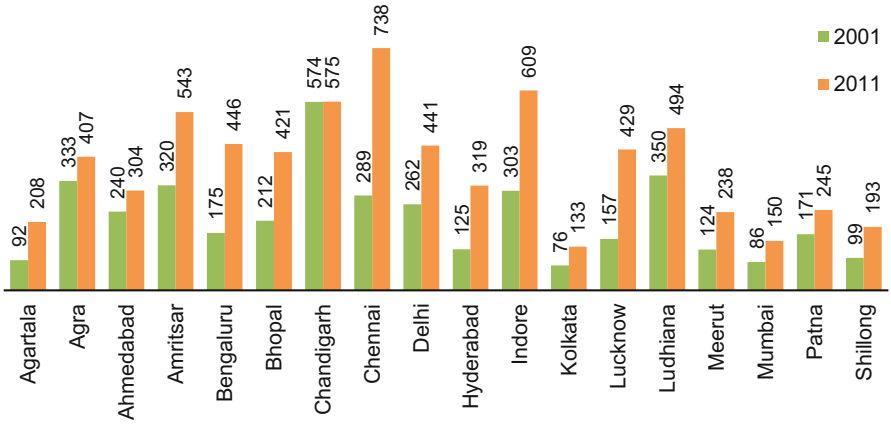

Fig. 5.3 Motorization trends (vehicles/1000 people) in select Indian cities. *Source*: MoRTH, GoI (2013), and Registrar General (2011)

transport remains the predominant mode of travel in these megacities. In cities with fewer than five million inhabitants, cars and two-wheelers constitute a significant share of vehicles on the road.

The heterogeneity of traffic on Indian roads adds another dimension to urban and transport challenges. A mixture of vehicles with widely varying sizes, speeds, occupancy, and heights share the same road space without segregation (Figs. 5.4 and 5.5). Traffic control and management is primitive or nonexistent, often without even the most basic street signage. In this context, traffic congestion and chaos reign (Pucher et al. 2005).

In almost all cities in India, the typical government response to easing congestion has been the construction of additional road infrastructure—ring roads, signal-free corridors, and flyovers (equipped with pedestrian overpasses in some cases)—or the expansion of existing infrastructure. In a vicious circle, these interventions have created more urban sprawl and produced some extremely unlivable and unsustainable urban spaces and structures (Gogoi 2013; Gupta 2014). In Bengaluru, for example, recent road construction projects not only did not alleviate traffic but resulted in a higher congestion index, with bottlenecks merely shifted around the city (Directorate of Urban Land Transport 2011).

The reasons behind these investment choices are political. While much of the population is so poor that it cannot afford motorized transport and has to spend hours of walking and cycling for travel, government policies have focused on serving the needs of an elite minority. The concentration of wealth and power is among an economic and political elite that has distorted transport policies in India (Pucher et al. 2005).

Fig. 5.4 Heterogeneous traffic in Guwahati (2009). Photo by author

Fig. 5.5 Heterogeneous traffic in Ranchi. *Source*: (ITDP 2015), Creative Commons Attribution 3.0 License)

3.2 Public Transport

Public bus transport accounts for a majority of all public transport use in India although this mode has been losing ground in recent years (Indian Institute for Human Settlements 2015). While the absolute number of public transport buses per capita has no doubt increased in cites, the share of buses as a percentage of registered vehicles has declined from 11 % in 1951 to a mere 1 % in 2012. Bus ridership levels vary widely by city, as do ridership trends. For example, between 2006 and

2011, Delhi and Chennai experienced an increase in bus ridership of 91 % and 36 %, respectively, while Mumbai saw a decrease of 26 % (MoRTH, GoI 2014). Despite ridership gains in a few large cities, the poor financial performance of bus enterprises has limited the ability of operators to improve services, which, in turn, has driven passengers towards other modes. Almost everywhere, informal operators (two-wheelers, rickshaws, and the like) have stepped into the market to fill major service gaps. The local economies are such that the unit operating cost for two-wheelers is lower than the fares charged by public transit operators. This makes paratransit an attractive option compared to formal buses (Centre for Science and Environment 2012).

Other than bus-based public transport services, two types of urban rail systems operate in Indian cities: urban (metros) and suburban. The impact of metro services has been mixed. For example, in Delhi and Kolkata, the ridership is high is some routes, mainly due to the dense and linear form of these cities. However, the presence of metros has not contained motorization (CSTEP and IUT 2014). Suburban rail is found in some cities, including Mumbai, Kolkata, Chennai, and Hyderabad, but is often considered as a low priority, and therefore is not well leveraged and integrated with the urban systems. Another lacuna that hinders rail ridership is a lack of connectivity at the start and end of a journey (the "first and last mile") for many potential passengers. Paratransit has emerged partly to address this gap (Fig. 5.6).

Fig. 5.6 Public transport in Kolkata. Photo by Arne Hückelheim (CC BY-SA 3.0)

3.3 Paratransit

Paratransit in Indian cities—also referred locally as "intermediate public transport"—is mostly informal. It includes rickshaws (auto, cycle, and manual) and casual carpooling systems (Fig. 5.7). Rickshaws operate in one of two ways. They are either hired for door-to-door trips (in the same way as taxis) or they operate along fixed routes and charge fixed fares (the same way as buses). Nearly 75 % of the global auto-rickshaw population is found in India and an estimated 2–7 million cycle-rickshaws circulate in Indian cities (IDFC 2012; Mani and Pant 2012).

Paratransit is ubiquitous in smaller cities and towns in which the population thresholds are too low, the trip distances are too short, and the activity centers too scattered to justify the introduction of formal urban bus systems. In larger cities, paratransit both competes with and complements (i.e., feeds) mass transit services. Paratransit provides first and last mile connectivity for passengers who live at a distance from stations. Rickshaws are preferred by some users over mass transit for whole trips because these vehicles are widely available, flexible, cheap, and can easily maneuver through narrow streets and congested urban conditions.

While providing a valuable service, paratransit also poses many challenges, in terms of passenger and driver comfort and safety, and environmental pollution (IDFC 2012). The regulatory environment in which rickshaws operate is problematic; some of the legislation is very restrictive; some is highly ambiguous. In theory, motorized rickshaws are regulated by a national government act and associated laws adopted by state governments while nonmotorized rickshaws are governed by the respective state acts. However, local governments often set their own quotas for issuing paratransit permits, thus laying the ground for negotiation and corruption.

Fig. 5.7 Cycle-rickshaw in old Delhi. *Source*: Bialek (2011). GNU Free Documentation License, Version 1.2 or any later version

More recently, app-based taxi services are becoming popular, especially in larger cities such as Kolkata, Mumbai, and Bengaluru. These services are quite competitive in terms of cost compared to private cars. As a new phenomenon, their long-term impact on urban transport is uncertain but their use is set to increase (Thakkar and Chanchani 2015).

4 Urban Transport Problems

4.1 Congestion and Parking

Traffic congestion levels are huge in Indian cities and vehicular speeds are as low as 15 km/h during peak periods (Directorate of Urban Land Transport 2011; MoUD 2008). Delays cost millions of dollars to the nation (Institute for Competitiveness, India 2012). To speed up their journey and bypass others, motorists avail themselves of any possible shortcuts, even driving on sidewalks (Fig. 5.8). In a context where only 30 % of the urban roads have sidewalks, this behavior is extremely detrimental to pedestrian safety and comfort (Bhatt and Mehta 2013).

Adding to the congestion is a severe shortage of parking spaces, both on- and off-street (Rye 2010). In some cities (e.g., Madurai, Agra, Pune, and Surat), nearly 60 % of the road length is blocked by on-street parking. In the densest cities such as Mumbai, Kolkata, Chennai, and Delhi, a parking place occupies more space than a low-income family of four (Gauthier 2012). The parking shortage is a product of irrational parking pricing, combined with poorly enforced parking policies.

Fig. 5.8 Sidewalks encroached by motorcycles. Photo by CSTEP

However, lax land use planning is also responsible, which has permitted the development of monofunctional lots, inaccessible by public transport (Chanchani and Rajkotia 2011; Roychowdhury 2013).

4.2 Health and Safety

Transport affects the health and safety of urban residents by exposing them to pollution and dangers on the roads. Large Indian cities (population more than one million) contribute nearly one-quarter (23 %) of the total road accidents. Pedestrians, cyclists, and motorcyclists constitute a majority of urban road fatalities (up to 80 % in Mumbai); riders of motorized two-wheelers alone represent 29 % of all fatalities (MoRTH 2012). Pedestrian deaths are higher in the urban outskirts while injuries are more prevalent in inner cities (Tiwari 2011). In addition to road fatalities, there are hundreds of fatalities every year at railroad crossing gates as safety guidelines are unenforced (Kumar and Bindra 2013). There is large variation in the fatality risk across urban regions (ranging from 3.2 deaths per 100,000 people in Kolkata to 34.4 per 100,000 people in Vishakhapatnam), which is reportedly related to urban density (Singh 2012).

Air pollution levels in urban areas are among the highest in the world. While SO_2 and NO_2 levels comply with (low) local standards, particulate levels (both respirable and non-respirable) in most cities are alarming (Central Pollution Control Board 2012).[2] Delhi is one of the most polluted cities in the world with a $PM_{2.5}$ level of 153 μg/m^3 (Mathiesen 2015). High pollution levels are quickly becoming a concern for smaller cities too. Cities with fewer than four million inhabitants contribute almost half (47 %) of the total emissions (CSTEP and IUT 2014; Mathiesen 2015). Greenhouse Gas (GHG) emissions (the primary causes of global warming) are also growing. The transport sector contributes about 7.5 % of CO_2 emissions in India and this share has been increasing over time (Ministry of Environment and Forests 2010). Within cities, cars and two-wheelers (motorcycles and scooters) contribute 60–90 % of the GHG emissions while accounting for less than one-third of all trips (Central Pollution Control Board 2008; Indian Institute for Human Settlements 2012). The most important causes of high emissions from transport are the age old and the inefficient engines of the motorized two- and three-wheeler fleet as well as illegally adulterated fuel with kerosene and lubricating oil (Pucher et al. 2005). Most of the recent progress in reducing air pollution has resulted from regulations requiring cleaner fuels (see Sect. 6.5).

[2] Local air quality standards are set in the National Ambient Air Quality Standard, produced by the Central Pollution Control Board. These standards are generally less stringent than the World Health Organization standards.

4.3 Equity

The lack of accessibility to jobs and services affects the livelihood of the Indian urban poor (one-third of the population) directly or indirectly. The poor in Indian cities cannot afford private motorized transport and are reliant on nonmotorized, informal, or public transport (World Bank 2005). However, informal settlements in core areas are generally inaccessible by public transport. Public transport might be available to slum dwellers in peripheral areas but the fares are often too high for these residents (Rathi et al. 2013). The problem of overall low per capita incomes in India is compounded by extreme income inequality.

Poor women are significantly less mobile than poor men. Urban transport-related security of women is a very salient issue in India. Many cases of sexual harassment and violence against women occur while they are using public transport or even while walking on public streets. A range of interventions have taken place to tackle the issue, including the employment of female taxi drivers (Mumbai) and female conductors (Bengaluru, Hyderabad), the installation of Closed-Circuit Television Cameras (CCTVs) in public transport vehicles and stations (Ahmedabad), and the design of smartphone apps which assign safety scores to public spaces (e.g., Safetipin). However, the problems have not gone away. More efforts in a more coordinated manner still need to be made by the police, transport agencies, and gender advocacy organizations (Khan 2015; Mahadevia et al. 2013).

In the case of the differently abled, the physical design of transport infrastructure (e.g., unsafe road crossings, crowded buses, missing handrails in buses, high steps in bus stops and vehicles, lack of reserved seats in public transport) represents another major barrier to their autonomous mobility. However, cultural constraints inhibit their full participation in public life too. People with disabilities are often confined to their homes. To overcome some of these problems, flexible door-to-door modes, such as rickshaws, are preferred over fixed route modes, such as rail and even Bus Rapid Transport (BRT) (Kunieda and Gauthier 2007; Mahadevia et al. 2013).

4.4 Oil Security

India is a net fuel importer and the country consumes 65 Mt of diesel and 15 Mt gasoline annually (diesel is preferred due to its cheaper consumer price). The transport sector is responsible for 70 % and almost 100 % of this consumption, respectively (Nielsen 2013). A steep increase in fuel consumption, due to growing motorization, has drained the country's foreign exchange reserves. The fuel import bill has increased more than 100-fold between 1981 and 2012, from $883 million to almost $123 billion (Ministry of Petroleum and Natural Gas 2011). This raises major energy security concerns as a result (CSTEP and IUT 2014). Estimates for 2016 indicate that the import bill is likely to decrease to $73 billion, due primarily to fluctuations in international oil prices and exchange rates, rather than a reduction in consumption (Press Trust of India (PTI) 2015).

5 Urban Transport Governance, Decision-Making, and Financing

India's urban transport governance is plagued by institutional fragmentation, low levels of institutional coordination, limited planning capacity, lack of public participation, and restricted scope for land use and transport integration.

5.1 Institutional Setup and Capacity

Urban transport planning in India has been characterized as a "constitutional and institutional orphan" (Working Group on Urban Transport 2012). The responsibilities for policies, planning, investment, operations, and management are scattered among a myriad of national, state, and local governmental organizations (Table 5.3). These organizations work along administrative and sectorial lines in an uncoordinated rather than holistic manner (Vaidyanathan and King 2011).

Table 5.3 Transport-related government organizations and their functions

Organization	Function
Urban transport planning	
Ministry of Urban Development	Overall responsibility for urban transport policy and planning
Development Authorities with state governments	Allocate land uses (relevant law: State Development Act)
Road transport	
Departments of Transport Development within state governments	License and inspect vehicles, issue permits, set motor vehicle tax rates (relevant law: Motor Vehicle Act of 1988)
State Transport Undertakings	Operate bus services (relevant law: Road Transport Corporations Act of 1950)
Ministry of Road Transport and Highways	Administers the Motor Vehicle Act of 1988 and determines vehicle and emission standards
Infrastructure and traffic	
Public Works Departments within state governments	Build and maintain state roads
Ministry of Road Transport and Highways	Build and maintain national highways
Municipalities	Build and maintain local roads, road signage, and traffic lights; license and control of nonmotorized vehicles; clear road encroachments; allocate land uses
Police	Enforces traffic laws
Ministry of Petroleum and Natural Gas	Regulates prices and quality of fuels
Departments of Environment within state governments	Monitor air quality

India's top-down, centralized planning style—a combination of Soviet-era and British colonial legacies—makes the governance of urban transport issues complex and difficult. In the past, Soviet-style 5-year plans were prepared, primarily concerned with state and national level development; urban development was not a focus area. More recently, multiple laws have been adopted, which mandate a decentralization reform in urban transportation planning, with local civic groups in charge of city-based projects. However, few genuine efforts have been made in this direction (Vaidyanathan and King 2011). As for urban planning and development, this is mainly rooted in the Town and Country Planning Act of the United Kingdom of 1947, based on a detailed zoning plan. However, this British style "command and control approach" is inappropriate for India's urban context since it lacks sufficient flexibility needed for dealing with the fast changing dynamics of Indian cities. Moreover, it undermines the role of market forces in determining the scale and location of economic activities and does not respond to the needs of a majority of workers (59 %) who are employed in the informal sector (Ahluwalia 2015; Chen and Raveendran 2014).

As for urban transportation, local authorities still have very little decision-making powers in this matter. They are not legislatively or financially empowered to plan and act. Decisions lay with state governments, which are far removed from the concerns of particular cities. Urban residents are thus very disconnected from transport governance. They do not, for example, have a forum in which to share information or advocate solutions (NTDPC 2013). In larger cities, transport governance is particularly problematic, not only due to the scale of issues and a lack of citizen input, but also because larger cities often include rail transport infrastructure and services within their territory and rail is typically overseen by national and state agencies. This creates a major scope for conflicts and inefficiencies.

In addition to centralization and institutional coordination issues, weak transportation planning capacity at the state and local levels presents a major barrier to dealing with transport issues and urban systems (HPEC 2011). Recently, for example, the national government required cities to compile Comprehensive Mobility Plans covering their territorial jurisdictions. Analysis of these plans indicated compilations of urban transport project proposals without rigorous cost–benefit analyses of alternatives. Major issues in Indian cities such as pedestrian transport, public transport accessibility, and the needs of vulnerable and low-income groups were typically neglected (Chotani 2010; The Energy and Resources Institute (TERI) 2011). While the plans succeeded in generating a substantial amount of transport-related data, this effort was mainly in vain because limited funding was provided for implementation. In some cases, these plans were in contradiction with the plans prepared by higher levels of government. In Bengaluru, for example, the Structure Plan (2011) and the Regional Master Plan (2015) were not aligned to each other and, consequently, there were gaps or duplications and incoherent investment decisions (Rathi and Bhattacharya 2014).

5.2 Financing

In 2005, the Indian national government launched the Jawaharlal Nehru National Urban Renewal Mission, a 7-year program (2005–2012) which made $20 billion available for urban infrastructure investments. One year later (in 2006), the National Urban Transport Policy was adopted, which defined the priorities for investments in urban transport. At least at a rhetorical level, public transport and nonmotorized modes were prioritized over personal motor vehicles. These two programs offered significant financial impetus to city administrations, and also enticed states to reform certain institutional aspects of urban transport.

Since then, the Jawaharlal Nehru National Urban Renewal Mission funds have been used to build new mass transit systems (metro and BRT) in many cities, and to procure thousands of higher quality urban buses, including features such as digital passenger information displays and Closed Circuit Television Cameras (CCTV). Bus purchases were not part of the original purpose of the Mission funds. However, a decision was made to include them after 2009 in order to provide an economic stimulus to the local bus-building industry. In fact, certain government-mandated specifications for buses clearly benefited these companies.

Meanwhile, Indian metro systems have been financed through a variety of other sources, including soft loans from the Japan International Cooperation Agency, as well as Mission funds (Goel and Tiwari 2014). Mechanisms such as Public–Private Partnerships (PPPs) for the construction, operation, and maintenance of urban infrastructure are relatively new. Rather than easing the burden of cities, PPPs have often led to disputes and a large "viability gap" of public funding, further straining urban transport operations and management. Taking advantage of the fact that the public sector lacks experience in designing PPP contracts and assessing risks, private companies participating in PPPs have often manipulated ridership figures for their own gain. Examples include the Delhi Airport Express Metro and the Hyderabad Metro. The current ridership of the Delhi Metro—the world's 12th largest system in terms of length and number of stations (190 km long)—is reported to be 2.6 million passengers per day, although the original feasibility study projected a daily ridership of 3.1 million passengers for a 65 km system (Goel and Tiwari 2014).

The costs of many metro projects have been very high relative to India's GDP per capita (Table 5.4). However, metro projects have frequently been preferred over the enhancement of bus systems. It is not clear why, as the process of decision-making regarding mass transit technology is not transparent. In the case of the Bengaluru Metro, the environmental impact assessment mentions that a metro system was decided upon after "several alternatives" were assessed and compared but none of these was ever documented. In the case of the Hyderabad Metro, allegations were made that the decision to award the contract was made well before the tendering process had begun, showing collusion at the highest level, promoting "big-ticket projects" (Ramachandraiah 2009; Vaidyanathan et al. 2013). A preferential treatment of rail over bus systems is also reflected in taxes incurred by the respective operators (Table 5.5). While bus operators are overloaded by taxes, rail operators are exempted from most taxation.

Table 5.4 Urban rail transport investments

Project	Total (million)
Delhi Metro Phases I & II	$590
Kolkata Metro (Pre-Jawaharlal Nehru National Urban Renewal Mission)	$40
Kolkata Metro East-West Corridor	$90
Bengaluru Metro	$160
Chennai Metro	$296
Public–Private Partnerships	
Delhi Airport Express Link	$80
Mumbai Metro Phase I	$510
Hyderabad Metro	$330
Gurgaon Metro	$22

Source: Goel and Tiwari (2014)

Table 5.5 Comparison of taxes incurred by bus operators and rail operators in Delhi

Delhi Transport Corporation (bus operator)	Delhi Metro Rail Corporation (rail operator)
1. Wealth tax	1. Wealth tax
2. Taxes on acquisition of immovable property	Exempt from
(a) Tax on acquisition of land (state)	(a) Property tax
(b) Property tax (municipal)	(b) Sales tax
3. Taxes on acquisition of buses	(c) Works' contract tax
(a) Value-added tax (state)	(d) Income tax
(b) Central excise (national)	(e) Capital gains tax
(c) Customs duty for imports (national)	(f) Customs
(d) Octroi (municipal)	(g) Excise
(e) Entry tax (state)	
4. Taxes related to operations	
(a) Excise duty on consumables (national)	
(b) Value-added tax on consumables (state)	
(c) Excise and value-added tax on spare parts	
5. Tax on use of vehicles for passenger transport	
(a) Motor vehicle tax (state)	
6. Advertisement tax (municipal)	

Source: Kharola and Tiwari (2008)

A review of public taxation and expenditures for transport indicates that private cars and rail systems are favored. Notwithstanding a pro-bus and pro-cycling rhetoric, the Jawaharlal Nehru National Urban Renewal Mission allocated a majority of funding (more than 70 %) for road widening projects and the construction of flyovers while funding for nonmotorized transport infrastructure was minimal (IIHS 2015). In some cases, buses are taxed more than personal vehicles. For example, in the State of Karnataka, all automobile taxes amount to just 5 % of the taxes paid by the local bus corporation. Clearly, the stated principles and fiscal strategies of the National Urban Transport Policy have been inconsistent.

6 Proposed Urban Transport Solutions and Implementation Issues

Many of the recent interventions in urban transport are a result of support from the Jawaharlal Nehru National Urban Renewal Mission funds, although sometimes only loosely based on the principles set forth in the National Urban Transport Policy principles, as mentioned above. Currently, the Jawaharlal Nehru National Urban Renewal Mission is being phased out without having succeeded in abating motorization rates. Its main achievements are reviewed below.[3]

6.1 Institutional Coordination and Capacity Building

India lacks cooperation among different transport agencies, departments, and ministries as well as overall coordination of transport and land use policies, as noted above. In order to improve these issues, the National Urban Transport Policy proposed the establishment of Urban Metropolitan Transport Agencies in all cities with more than one million inhabitants. These agencies would be backed by legislation and funding for urban transport projects and policies would be routed through them. At present, there are only eight or ten such agencies in existence. Discussions regarding the formation of many others are underway across India but the implementation time frame is unclear. The existing agencies act more like committees within existing organizations than as independent planning institutions (Mohan 2014). For example, in Bengaluru, a Directorate of Urban Land Transport was created with a mandate to coordinate land-based transportation projects but in reality it merely handles administrative protocols and bureaucratic hurdles; it has neither funding nor regulatory powers to intervene in transport matters (Vaidyanathan and King 2011). Only the Hyderabad Urban Metropolitan Transport Agency has, to a certain extent, achieved its original mission (Mohan 2014).

One reason why fully fledged institutional reform has not taken place is that local governments have low planning capacity and insufficient professionals trained in the new sustainability paradigm. Dated higher education curricula and India's severe brain drain are partly responsible for this outcome. To promote better practices and train professionals on the job, the national government has provided financial assistance for training sessions and awareness-raising campaigns (e.g., air pollution). Centers of Excellence in Urban Transport sponsored by the Ministry of Urban Development have also been set up within universities.

[3] Recognizing the overwhelming urban transport problems still facing Indian cities, the national government is planning on launching several successor programs, which are more ambitious than the Mission. These include: the Smart Cities Mission; the Atal Mission for Rejuvenation and Urban Transformation; and the Heritage City Development and Augmentation Yojana.

These offer postgraduate degrees in urban transport planning and management, conduct research, organize conferences and workshops, and provide technical assistance to the government itself. However, much more can still be done in terms of capacity building.

6.2 Improving Public Transport

The selective privatization of bus services in several Indian cities, with Delhi, Kolkata, Bengaluru, and Hyderabad leading the way, has led to higher productivity, lower costs, more passengers per bus, and higher revenues per bus km of service. However, experience to date has shown the crucial need for public regulation of safety, route and schedule coordination, and service quality (Pucher et al. 2005). In addition to privatization, the Jawaharlal Nehru National Urban Renewal Mission funds have been used to procure modern buses replacing old, dangerous vehicles, as noted above, as well as to initiate BRT systems in 12 cities.

The Delhi BRT was one of the nation's first "full" BRTs. While it has clear institutional responsibilities and a thoughtful and inclusive design, this BRT has faced many operational challenges, as well as stiff opposition from car-owning elite. It has been widely lambasted in the press as an abject failure, with public-interest litigation leading to a court-ordered shutdown of the system. Today it continues to face public relations obstacles. Despite high ridership, it has failed to be extended beyond its initial pilot length. In contrast, the Ahmedabad BRT (Fig. 5.6), which was launched little more than a year later, is now internationally lauded as a success story, receiving multiple national and international awards. Implemented much faster than Delhi, it also benefited from thorough design, clearly assigned organizational responsibilities, and strong political backing. Today the system is well received by city residents, extending to nearly 90 km and serving 132,000 passengers daily, while also recovering its operating costs. The differences between the two systems have been attributed to the different planning approaches and timing. While Delhi's plan-making was long, technically focused, and sequential, Ahmedabad's was shorter, more politically oriented, pragmatic, and incremental, with more opportunities for feedback and adjustments (Rizvi and Sclar 2014; TNN 2016). Nevertheless, even Ahmedabad's BRT has failed to increase the public transport modal share (TNN 2016). Other BRT projects have been plagued by fragmented planning, operational inefficiencies, political struggles, land acquisition disputes, cost overruns, and slum rehabilitation issues. In all cities which have attempted BRT implementation, these systems have not been perceived as a backbone of the urban transport system but rather as a secondary system. BRTs in Pune, Indore, and Jaipur have been dismantled in order to be replaced by high cost metro systems (Mahadevia et al. 2013).

6.3 Prioritizing Nonmotorized Transport

One of the most crucial needs in Indian cities is the provision of improved rights of way for pedestrians and cyclists. These nonmotorized travelers, who account for about half of all trips made and are among the most vulnerable roadway users, have been largely ignored by policy makers. In a context of narrow roads, densely built central cities, and lack of funding, it is very rare to find any special provisions for pedestrians and cyclists. As a rare exception, in the planned city of Chandigarh, 160 km of cycle paths were built between 2001 and 2003 (Chhabra 2002). On some arterial routes, special pedestrian paths were also constructed. While scarce roadway space hinders nonmotorized transport, the real problem lies with government priorities that favor motorized traffic. Since the powerful elite are more likely to drive private cars, they have strongly favored road projects over improvements for pedestrians and cyclists (Pucher et al. 2005).

Earlier drafts of the National Urban Transport Policy promised 50 % national government financing of both cycle tracks and pedestrian paths in large cities. In the first stage, it would finance 50 km of cycle tracks in all cities with at least a million residents, and 100 km of cycle tracks for all cities with at least three million residents (Pucher et al. 2005). In reality, the financial allocation patterns heretofore adopted have not supported the main objectives of the National Urban Transport Policy. Chennai, Delhi, Hyderabad, and Pune have spent less than 20 % of their Jawaharlal Nehru National Urban Renewal Mission funds on nonmotorized transport infrastructure (IIHS 2015; Joshi and Joseph 2015).

More recently, various bottom-up cycling initiatives have emerged, led by higher-income cycling enthusiasts. Examples include bicycle sharing schemes such as Cycle Chalao (Mumbai) and Namma Cycle (Bengaluru), albeit with limited coverage and ridership. Other cities including Bhubaneswar, Mysore, Jaipur, Rajkot, Vadodara, and Ahmedabad are following suit (Kumar 2013; Rohith 2013). However, utilitarian cycling in many cities suffers from serious neglect in public policies and projects (Joshi and Joseph 2015).

6.4 Traffic and Travel Demand Management

Better traffic management in all Indian cities is crucial in order to mitigate some of the current traffic problems. Most medium-size and small Indian cities (with the exception of the planned city of Chandigarh) lack even basic provisions such as road signage, traffic signals, lane markings, and other regulatory signage. The traffic regulations that currently exist are not well known due to lack of driver training. Moreover, regulations are rarely enforced by the police. In traffic disputes, the police often favor motorists, even if they are at fault, since they are more affluent than nonmotorized travelers (Pucher et al. 2005). India's largest cities have

benefited from modest improvements in traffic management through the introduction of more advanced technology and stricter enforcement of traffic regulations (Pucher et al. 2005). In Delhi, for example, the local government has recently initiated a pilot to restrict the use of private cars based on license plate numbers. The experiment exempts women, cars using compressed natural gas, and those belonging to senior government officials and judges, as well as two-wheelers (which constitute the majority of the vehicles on Delhi roads). The pilot has eased congestion but its impact on air pollution has been rather limited (Najar 2015, 2016).

6.5 Fuel Standards

Over recent decades, the Indian government has introduced a series of regulations to limit pollution from private cars, buses, and trucks. Between 1991 and 2000, national regulations for new vehicle emissions reduced allowable levels of carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx) (Pucher et al. 2005). Lead in fuels has been phased out and the permissible levels of sulfur and benzene in fuels have been reduced. In the late 1990s, Delhi was forced to adopt the rather drastic policy of requiring all buses, taxis, and trucks to convert from petrol and diesel to compressed natural gas (CNG) within a period of a few years. By mid-2000s, the city was winning awards for its bold efforts to curb air pollution and support alternative fuel initiatives (Solomon 2003). However, in the absence of substantial reductions in travel, Delhi's success was short-lived and air pollution is acute.

In 2014, the Bureau of Energy Efficiency introduced fuel economy standards for passenger cars (Ministry of Power, GoI 2015), requiring all car manufacturers to attain a fleet average of 54.5 miles per gallon by 2025 (Gordon-Bloomfield 2015) However, to an extent this is in conflict with existing fuel policies, which are focused on fuel quality and emissions rather than fuel economy. Some preliminary steps have been taken toward the adoption of electric vehicles. A National Electric Mobility Mission Plan and a Faster Adoption & Manufacture of Electric Vehicles Policy have been instituted by the national government. The current policy climate in India focuses mainly on electric buses. However, a better understanding of the technology and policy landscape is required by the administrative bodies in charge of policy implementation, such as the State Road Transport Undertakings, as well as more robust assessment methods for evaluating costs and benefits.

Phasing out or converting the most polluting motor vehicles has proven difficult. The highly polluting two-stroke engines of motorcycles, scooters, and auto-rickshaws pose serious environmental problems since these vehicles are more affordable than private cars and have been growing very rapidly in number. Although unpopular across society, it seems necessary to mandate all new motorized two- and three-wheelers to have much cleaner engine technology (Pucher et al. 2005).

7 Conclusion

Urbanization, growing incomes, changing lifestyles, and urban sprawl have intensified the travel demand in India. This has serious environmental, economic, and social implications for Indian cities. Private vehicles offer unparalleled convenience, and with the increased purchasing power of the middle class, the car and two-wheeler fleet has skyrocketed. Public transport has failed to remain competitive, which has increased the attractiveness of private mobility solutions, including informal modes. The mass of motorized vehicles competing for space on narrow roads has overshadowed nonmotorized modes. Longer walking and cycling trips lengths, coupled with the great risk of traffic accidents, have reduced the space and opportunity for pedestrians and cyclists. The urban poor are especially disadvantaged in this situation.

The current state of affairs is unsustainable and there are various obstacles to implementing policies to deal with India's urban transport problems. Among these, financial and political barriers are crucial. Budget problems at every level of government—national, state, and local—severely limit the extent to which experienced professionals can be engaged in public institutions and public subsidies can be provided for measures in favor of urban sustainability. The urgency of improvements often leads to ad hoc public initiatives that are not aligned with long-term visions. Increased participation by the private sector in the bus and rail sectors might ease public budget pressures but experience to date with PPP models has not been encouraging. Another formidable obstacle to improved transport policies is the political influence of the automobile and highway lobbies in India, as well as affluent Indians, who benefit the most from increased adaptations of transport policies to their car-oriented lifestyles (Pucher et al. 2005).

A more sustainable way forward is to promote a more integrated approach to urban transportation planning. A paradigm based on measuring the outcomes rather than the feasibility of proposed solutions is needed. This requires an enabling framework, derived from a robust, integrated, and participatory institutional framework. Different sectoral ministries, including the Ministry of Road Transport and Highways and the Ministry of Urban Development, need to develop a shared agenda for urban transport. Urban transportation planning needs to be placed centrally within the context of India's development goals. A multipronged approach is needed in each sector, as well an understanding of the inter-sectoral impacts of decisions related to urban transport. Local government needs to be empowered to act through legislative authority, financial independence, and professional capacity. Its aim should be to reduce the number of cars on the road, prioritize pedestrians and cyclists, enhance public transit systems (BRT and/or rail, based on a rigorous assessment of alternatives), manage traffic efficiently, encourage the use of cleaner fuels and vehicles, and stir new development toward transit nodes and corridors, thereby curbing energy use, emissions, and congestion.

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