

Sustainable Urban Mobility in Southern Asia

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List of acronyms

BRT	bus rapid transit
CCTV	closed circuit television
CNG	compressed natural gas
GDP	gross domestic product
GIS	geographical information systems
ICT	intelligent communication systems
MRTS	metro rail transport systems
NMT	non-motorized transport

1. The Crisis of Sustainability in Urban Transport

With rapidly rising populations and the concomitant growing transport demand, urban areas in South Asia today face an unprecedented transport and mobility challenge. Poor access to transport infrastructure and services leaves hundreds of millions of people in the region without access to basic social and economic services. This report reviews the intra-urban transport trends, conditions, issues and policies in Southern Asian countries, namely India, Pakistan, Sri Lanka, Bangladesh, Nepal, Afghanistan, Iran, Maldives and Bhutan. These countries together make up about one fourth of world's population (1,653 million) and cover about 6.3 million square kilometres of area. Except Iran and Maldives, the per capita incomes of the other 7 South Asian countries fall in the low income and lower middle class brackets. South Asia is home to nearly 36 per cent (about 596 million) of the world's poor, who live on less than US\$1.25 a day (in 2005).¹ Maldives and Bangladesh have a high density of population whereas India, Pakistan, Nepal and Sri Lanka show a modest density pattern.

In the nine South Asian countries reviewed here, there are 52 large urban centres (million plus cities), of which 47 alone are in India. Most of the transport infrastructure and motor vehicles (see Box 1) are concentrated in these large cities, which are considered as symbols of progress and prosperity. Thousands of other cities and smaller towns do not have any organized public transport, and the masses mainly depend on informal or non-motorized modes of transport which are usually considered as symbols of poverty. Invariably pedestrians, cycles and other non-motorized vehicles lack dedicated, safe right of way. Public transport, wherever available, is inefficient, overcrowded and is largely seen as a transport mode for the poor. At the same time, those that have the means are increasingly resorting to fossil fuel powered private vehicles, which are witnessing a rapid increase of 6 to 10 per cent per annum. This further perpetuates inequalities in mobility, but also social and economic inequities. With massive urban growth and sprawl, large populations in peri-urban areas especially face transport poverty.

Table 1. Basic characteristics of South Asian countries

Country	Area (km ²)	Population (million)	Density (population per km ²)	GDP (US\$ million)	GDP per capita (2009)	Capital
Afghanistan	647,000	34	52	14,044	486	Kabul
Bangladesh	147,570	162	1,099	94,505	573	Dhaka
Bhutan	38,394	0.7	18	1,269	1,880	Thimpu
India	3,287,240	1,198	365	1,235,975	1,030	New Delhi
Iran	1,648,195	70	40	330,461	4,459	Tehran
Maldives	298	0.4	1,330	1,357	3,932	Male
Nepal	147,181	29	200	12,615	451	Kathmandu
Pakistan	803,940	181	225	166,515	1,016	Islamabad
Sri Lanka	65,610	20	309	41,323	2,041	Sri Jayawardenapura Kotte
Total	6,285,724	1,653	263.04			

Sources: http://en.wikipedia.org/wiki/South_Asia, last accessed 7 July 2010.

1. World Bank, 2009a.

Box 1. Transport Infrastructure in South Asian countries

The road length per 1000 km of area varies from 30 km (Nepal) to 1422 km (Sri Lanka) which indicates inadequacy of road infrastructure vis-a-vis growing traffic. Afghanistan (population 34 million) has one of the lowest road density (53.3 km of road length per 1000 sq km of land area) and almost no public transport system. Huge portions of Afghanistan's inhabitants remain physically cut-off. The country faces a very poor transport infrastructure, war – damaged roads deteriorating due to lack of maintenance. The Government and transport departments often face the problems of capacity and unreliable funding for the transport system.

The transport system of Bangladesh (population 162 million) consists of roads, railways, inland waterways, two sea ports, maritime shipping and civil aviation catering for both domestic and international traffic. Presently there are about 21,000 km of paved urban roads, 2,706 kilometres of railways (884 km Broad Gauge; and 1822 km Meter Gauge); 3,800 to 6000 km of perennial waterways and 2 international (Dhaka and Chittagong) and 8 domestic airports. Bangladesh witnessed rapid growth of transport vehicles (852,476), with an overall annual growth rate of nearly 8.2 per cent for freight transport and 8.4 per cent for passenger transport. However, the transport intensity of the Bangladesh is considerably lower than that of many South Asian countries. Bhutan (population 697,000) has only 33,241 vehicles, mainly private, and its urban road network has a length of only 2038 km. Whereas, Iran (population 70 million) stands out for its highest per capita GDP in South Asia. It has 7 million motor vehicles and about 1.78 million km of roads.

The Republic of Maldives, with a population of 300,000, consists of about 1200 small, low-lying coral islands in the Indian Ocean, of which only 198 are inhabited and many have fewer than 200 people. Tourism and commercial fisheries are the leading sectors of the economy. Maldives has an extremely low population density and paved roads – 60 km in Male, and 14 km each on the Laamu and Addu Atolls, mainly of compacted coral. Nepal (population 29.3 million), has about half million vehicles. It has a total road network (2007), of 17,282 km. The poor condition of the road network and difficult remote hill and mountainous topography affect the country's transport development due to high costs and the lack of connectivity.

In Pakistan, (population 180 million), there are about 7 million motor vehicles and 260,000 km of roads which include about 10,525 km of highway/main roads. The transport services sector contributes 11.1 per cent of the GDP (excluding manufacturing) and employs 2.4 million labour force or 5.7 per cent of total labour force. Road transport accounts for 91 per cent of passenger traffic and 96 per cent of freight traffic. The main source of investment in the transport infrastructure is the public sector development programmes, which is heavily tilted towards big projects – highways, expressways, bridges. With an annual growth rate of 7 per cent for passenger traffic and 6 per cent for freight traffic, road transportation is the fastest growing sub-sector, absorbing a large number of workers and generating huge number of micro/small enterprises. Sri Lanka (population 20 million) has 2.52 million vehicles and 27,500 km of main roads/highways. It has been witnessing a rapid growth of private vehicles, parallel to its economic growth.

Sources: ADB, 2010; UNESCO, 2010; World Bank 2010.

The impact of urban transport on the environment in the regions of South Asia is also visible. Due to large scale suburban growth, the integrity of land use and transport has become disjointed, which makes them environmentally unsustainable. Automobile use in Asian cities during 1980–1990 grew by 67 per cent (against 12 to 29 per cent in US/Europe).² As per ICLEI³ transport in 54 South Asian cities contributes 24 per cent of carbon emissions, whereas in Delhi, suspended particulate matter from transport had been as high as 72 per cent in 2001.⁴ Urban transport in the region is further marred by a number of social challenges. In many cities, transport related accidents are alarmingly high and frequent. Eve teasing, crimes

2. Newman and Kenworthy, 1999.

3. ICLEI, 2009.

4. CRRI, 2002.

and exclusion of the disabled characterize the public transport which is also the target of strikes and vandalism.

Table 2. Urban transport indicators in South Asian countries

Indicator	Afghanistan	Bangladesh	Bhutan	India	Iran	Maldives	Nepal	Pakistan	Sri Lanka
No. of motor vehicles (x1000)	N/A	852	33	72,700	7,000	N/A	502	7,000	2,527
Motor vehicle ownership (% households)	N/A	N/A	N/A	14.2	N/A	N/A	6.27	30.6	4.1
Road length (x1000km)	35	271	4	3,516	178	N/A	17	260	92
Main roads (x1000km)	3	21	2	666	N/A	N/A	10	11	27
Road length /1000 people	1.1	1.9	6.5	3	N/A	N/A	0.67	N/A	4.7
Road density (km/1000m ²)	53	2,079	93	1,115	N/A	N/A	30	335	1,422
Road goods transport/year (million tonnes)	N/A	N/A	N/A	1,559	N/A	N/A	0.013	107,000	5,300
Road passengers (thousands /1000km/year)	N/A	N/A	N/A	N/A	N/A	N/A	0.026	208,000	66,900
Road accident fatalities/10,000 vehicles/year	N/A	85.6	21.4	12.7	N/A	N/A	24.9	6	9.1

Sources: ADB, 2010; UNESCO, 2010; World Bank 2010.

Urban transport in South Asian countries is a means of livelihood for the poor. Through appropriate policy interventions it can be an important tool of social transformation and poverty alleviation. It accounts for major public sector investments, and attracts huge private sector resources. Public-private partnerships and other instruments are being increasingly adopted for public transport and infrastructure development with mixed results.

With cities emerging as the centre of economic growth, there has also been a sharp growth of goods transport demand. Yet, the sector faces several barriers and challenges, such as poor infrastructure, polluting, overloaded and dangerous vehicles, lack of freight centres/terminals and widespread mismanagement. There are high differentials in goods transport logistics and still the bulk of urban goods traffic is handled by non-motorized transport along with head-loading.

This report examines the state of urban transport in the Southern Asia region by reviewing the trends and conditions of various transport modes (non-motorized, public, informal, private motorized and goods transport) as well as the extent of integration between transport and land-use planning. It also examines the social, economic, environmental and institutional dimensions of sustainability with respect to urban transport before considering the way forward in policy terms.

2. Non-Motorized Transport

2.1. Overview

Non-motorized transport (NMT) includes public modes like rickshaws, pedicabs, rehri, thela (push cart), buggy/tonga (animal-drawn carts), inland boats and ferry and private ones (walking, bicycles, roller-skates/ skateboards, etc). In South Asian cities about 40 types of vehicles ply the roads, and about half of them are NMTs, which is the dominant transport mode for the poor. Varying from 17 to 60 per cent, people in South Asian cities use various modes of non- motorized transport (see Table 3). NMTs are low investment, economical, non-polluting, need minimal space and no fuels.

Table 3. Modal split in some South Asian cities

Cities	Total trips (%)		
	Private transport	Public transport	Non-motorized transport
Lahore	24	16	60
Karachi	27	23	50
Delhi	18	40	42
Mumbai	18	60	22
Kolkata	5	78	17

Note: The above table does not categorize informal motorized transport separately, which presumably is included under private and public transport.

Sources: TEPA and JICA, 1992; Malik, 2004; World Bank, 2002.

In South Asian cities, indigenous models of cycle and rickshaw have been developed and retrofitted for vending, transporting school children, goods, garbage and to provide many day to day services. As such, in spite of frequent strikes, non-availability of diesel/petrol and traffic jams, cities in the region continues to function. For most users, NMTs are the means of lifecycle and livelihood, which provide cheap mobility independent of fossil fuel. Almost every city in South Asia (except those located in hilly areas or extreme climate) is regularly served by a variety of NMTs, such as bicycle, *thela*, tricycle and carts which provide doorstep services and consumer goods. Hawkers using NMTs also serve as the eyes on the streets and their presence contributes to crime reduction.

Cities like Dhaka, Delhi, Bangalore, Karachi, Lahore, Kathmandu, Colombo, Kolkata, etc. are the hubs of development where NMTs compliment motorized public transport as feeder services, besides providing complete trips and essential services. More than half of passenger and goods trips, especially in the congested cities are by walking, cycle and rickshaw, and reach the inner city areas where formal motorized transport does not or cannot reach. However, most NMT trips are over short distances (0.5 to 3 km) or serve as last mile/feeder trips. It is estimated that although in Delhi non-motorized transport accounted for 42 per cent of trips (of a total of 15 million trips in 2008), these covered only 6.3 million km per day, as compared to 166.7 million vehicle kilometre travelled by vehicular modes (see Table 4).

2.2. Trends and conditions

As highlighted above, a significant proportion of people in South Asia cities depend on NMT. A 2008 study of 30 Indian cities for instance showed that almost 40 per cent of all trips in

urban areas involved no motorized vehicles at all – 28 per cent walked and 11 per cent cycled. The proportion was sharply higher in smaller towns since distances are usually short and the roads less congested. However, in bigger cities, the proportion of people using public transport was high, and consequently commuters walked the last mile. For instance, in cities with a population of more than 5 million, 8 per cent cycled and 44 per cent used public transport.⁵ Surveys in Dhaka, Lahore, Karachi and other cities in South Asia reveal that over 60 per cent of all link trips involve walking, followed by cycles and rickshaws (13 per cent). Of the motorized trips, 10–15 per cent also involve a walking component.

Box 2. Delhi – How people move

- 34% of the population takes walk-only trips for daily commuting.
- 16% of the trips by public transport involve more than a kilometre walk.
- 40% of total road length has no sidewalk, while available sidewalks lack quality in terms of surface, width and geometrics.
- 58% of the disabled found ramps difficult to negotiate.
- 45% of the elderly found steps and ramps daunting.
- 20% had trouble with uneven, narrow sidewalks.

Source: Aggarwal, 2009.

The bicycle is a popular mode of NMT among the low income segments in South Asian cities, and is used not only for commuting but also for livelihoods, such as for the delivery of goods like newspapers, milk, etc. However, in terms of percentage share of trips, there has been a drastic reduction in cycle trips against the phenomenal growth of light- motor vehicles (cars and two wheelers). In Delhi bicycle trips declined from 17 per cent in 1981 to 7 per cent in 1994.⁶

The bicycle has further evolved into the three wheeled rickshaw as a popular type of NMT in South Asian cities. It is found all over in Bangladesh, India, Pakistan, and to some extent in other countries like Sri Lanka, Bhutan, Nepal and Afghanistan. Cycle rickshaw pulling is often the first job for many rural migrants in cities. Cycle rickshaws cater for quite a significant proportion of trips in South Asian cities, for example, 13 per cent in Dhaka, and between 5 and 10 per cent in Indian cities (Kolkata, Chennai, Delhi and Hyderabad). In Dhaka 20 per cent of the population, that is about 2.5 million, rely on rickshaw pulling for their livelihood, directly or indirectly.⁷ The percentage of trips made via rickshaws is higher in smaller cities that do not have public transport and with traditional narrow streets inaccessible to buses.

Apart from the passenger traffic, rickshaws have been developed as mobile carts selling perishable and goods for daily use. They are also retrofitted as vans ferrying children to school. In spite of frequent harassment by local officials, rickshaws continue to remain a popular, easily available and cheap mode of transport for travel within a crowded locality, both for passengers and cargo. The amount of luggage they can carry versus the amount of space they occupy is comparatively high. Rickshaws also provide much needed transport to people living in the old, congested areas, urbanized villages, illegal colonies or peri-urban localities and provide connectivity to physically separated neighbourhoods.

5. Wilbur Smith Associates, 2008.

6. Government of India, 2006.

7. Wipperman and Sowula, 2007.

In many South Asian cities, the bulk of goods are transferred, handled and distributed by manual hand carts (thela in India and Pakistan), wheel barrow or animal driven vehicles. The hand cart, donkey cart, rickshaw cart (locally known as the *Reyri*), are visible in every city in India, Bangladesh, Nepal and Pakistan. As people are poor, they use this form of transport to shift cargo within a city and also for mobile vending. The cargo they carry ranges widely- milk, soft drinks, fruits and vegetables, food products, garbage, textiles, building materials, machinery and industrial products. A classic example is that of tiffin supplies in Mumbai, where everyday about 200,000 lunch boxes are delivered, which are transported mainly on hand carts, local rail network, bicycles and also carried on head (Box 3). In the Indian slums, where water is supplied by public taps, women carry 50 to 100 litres of water every day over an average distance of half a kilometre.⁸

Box 3. Dabbawala – Lunchbox delivery system in Mumbai

In Mumbai more than 200,000 lunches get moved every day by an estimated 4,500 to 5,000 dabbawalas, with an extremely small nominal fee and with utmost punctuality. Although the service remains essentially low-tech, with the barefoot delivery men as the prime movers, the *dabbawalas* (tiffin carrier) have started booking through SMS. A website, mydabbawala.com, has also been added which facilitates for on-line booking. The success of the system depends on teamwork and time management and their indigenous logistics. A simple colour coding system doubles as an ID system for the destination and recipient. *Dabbawalas* carry a wooden crate for the *tiffins* on their cycle, sometimes on their head and sometimes in local trains. The objective is delivery in time and at the right place which is achieved by the *dabbawalas* by a combination of their own transport mode-cycle, barefoot, wheel barrow, head loading, push cart or by train.



Cycles, wheelbarrows and pushcarts transport about 200,000 lunchboxes in Mumbai everyday

Sources: <http://www.google.co.in/imgres?imgurl=http://topnews.in/law/files/Dabbawala.jpg>, http://www.flickr.com/photos/bs_rajawat/2738330320/; pitchyourtalent.wordpress.com; http://www.google.com/imgres?imgurl=http://pitchyourtalent.files.wordpress.com/2011/06/12379983573441.jpg&imgrefurl=http://pitchyourtalent.wordpress.com/&usq=__A64GVhjk55EXw2lOmZGh-yApU6o=&h=370&w=500&sz=40&hl=en&start=1&zoom=1&tbnid=FUmDWg50Ixm6fM:&tbnh=121&tbnw=161&ei=7iwETvbbCoKyrAevke26DA&prev=/search%3Fq%3Ddabbawala%26tbnh%3D118%26tbnw%3D160%26hl%3Den%26gbv%3D2%26biw%3D1280%26bih%3D572%26tbs%3Dsimg:CAQSEglK9hzyR3gOQSEnNkkOxzhfsw%26tbm%3Disch&itbs=1&iact=hc&vpx=116&vpy=111&dur=15616&hovh=193&hovw=261&tx=129&ty=155&page=1&ved=1t:722,r:0,s:0&biw=1280&bih=572; <http://www.google.co.in/imgres?imgurl=http://photos.merineews.com/upload/image>

8. NIUA, 2002.

2.3. Challenges and impacts

A major challenge for NMT in South Asian cities is that dedicated corridors for this mode of transport are largely absent. Where such corridors exist they are either encroached upon or used for perennial widening of carriageways for increasing motorized traffic. In Delhi, trip studies indicate that although half of trips are by walking, but 40 per cent of the roads have no sidewalks.⁹ Nearly half of the fatal accidents involve pedestrians and children under ten years who are the most vulnerable. 50 per cent of people don't use foot-bridge since it involves climbing, descending and long detour. Surveys indicate that cars often do not slow down at marked midblock/zebra crossings.¹⁰ In Kathmandu about 90 to 95 per cent of road stretches do not have facilities for persons with disabilities. Poor lighting, absence of footpaths, overcrowded or deserted streets make walking unsafe for women, especially during the night. For instance, women find it difficult to use bicycles due to fear of harassment, hooting or personal security.

Although, NMTs, such as cycles have many advantages such as affordability and minimizing the environmental impacts of urban transport, they often carry a poverty stigma and are marginalized. Furthermore, among professionals, traffic police and transport authorities a common perception prevails that improvements in traffic flows can be achieved by banning slow moving rickshaws. Such efforts in some cities like, Dhaka, (Mirpur Road) did not lead to much improvement in the mobility of public transport, but only of private motorized transport reducing their travel time by about 30 per cent per trip, while some segments of the population, particularly women, who relied on rickshaws for short distance trips were adversely affected.¹¹ With the ever growing numbers of motorized vehicles and in effort to expedite the movement of traffic, many cities are also abandoning or banning the use of manual, animal driven carts and tricycles in favour of standard motorized passenger and goods transport.

Apart from official apathy and hostility, rickshaws face the challenges of legitimacy, safety, efficiency, health and comfort. The rickshaw-puller undergoes severe health problems (due to the continuous strain on his wrist and lungs) and frequent accidents. School children on rickshaws are vulnerable to accidents and overturning due to imbalanced loading.

Air pollution around the Taj Mahal, Agra, sparked a renaissance in cycle rickshaws. Local agencies and the Institute of Transportation and Development Policy designed, lightweight rickshaws that were more convenient, safer and increased the earnings of the owners. In Mirzapur and several other cities cycle rickshaws are being used by a municipal agency for part of the collection of household refuse and street waste.

In general, with tremendous competition for space and speed, cyclist and pedestrians are losing out. Public finance is hardly earmarked for NMTs and related facilities and infrastructure. Although NMTs sustain and compliment the public transport system as a key feeder service, these are seldom integrated with it. The media regularly reports on the success and achievements of the automobile industry (cars and two wheelers), bus rapid transit (BRT), Metro Rail Transit (MRT), etc., but hardly gives any coverage on the NMTs.

9. Aggarwal, 2009.

10. CAI, 2010.

11. World Bank, 2008.

3. Public Transport

3.1. Overview

In South Asian countries, public transport is a major area of public policy which impacts urban growth and its sustainability. Urban public transport is mainly comprised of buses, while rail-based public transport exists primarily at the intercity level. Some cities have supplemented the intercity railway by urban rail network (like Mumbai), and few cities have recently embarked upon BRT, Metro, Light rail and other forms of multimodal public transport systems. Public transport systems are usually complemented by taxies, autos and NMTs, and the percentage of public transport trips is higher in the countries having fewer private vehicles per 1000 population, which indicates an inverse correlation between proportion of private vehicles and proportion of public transport journey. For instance, Tehran with 146 private motor vehicles and 0.1 taxis per 1,000 population has only 18.7 per cent trips by public transport. In Mumbai 41 per cent of trips are by public transport, while it has 53.4 private vehicles and 10 taxies per thousand population.¹²

3.2. Trends and conditions

It is estimated that in several megacities like Delhi, Mumbai, Kolkata and Bangalore, the buses, which are generally 1 to 2 per cent of the total number of vehicles, cater for around one third to 62 per cent of the total vehicular trips demands.¹³ Public transport is largely seen as the transport mode for the poorer sections of the community, who cannot afford to own/use personal transport. The buses usually lack dedicated right of way and aspects like frequency, inter-modal integration, development of parking and infrastructure are not given due attention. In cities with majority of population who are poor, public transport is often subsidized. In many cities, private operators are licensed to run buses. However, wherever private buses operate, they tend to choose the profit making routes and are usually overloaded and unsafe. An extreme example is that of Kabul where approximately 900 buses and minibuses of registered private companies provide public transport, which carry about 80 per cent of all vehicle trips.¹⁴ The availability of public buses is irregular and limited. The private buses tend to take over the profitable part of the transport business while the government is left with the lack with the task to uphold a costly service. In Kathmandu, Nepal about 95 per cent of buses are owned and operated by the private sector, which are licensed by the public transport authority. Less than six year old vehicles are allowed to operate on long distance night services whereas vehicles aged between 6 and 10 years (some in excess of 20 years) operate as urban local buses. Bus accidents result in 71 per cent of total injuries and 63 per cent of fatalities.¹⁵ Pedestrians are the worst sufferers of traffic accidents. The studies of Kathmandu (which is also typical of many South Asian cities) reveal that likely causes of accidents are usually the traffic rule violations, overloading, speeding and reckless driving, the over-aged buses and other vehicles, poor maintenance of roads, poor road geometry, potholes, encroachments, carriageway parking, lack of designated pedestrian crossings, poor lighting, lack of traffic regulations/enforcement, etc. are common reasons for accidents and poor public transport service.¹⁶

12. Kenworthy, 2011.

13. Ministry of Urban Development, Government of India, 2009.

14. World Bank, 2004.

15. Maunder et al, 1999.

16. Maunder et al, 1999.

The public transport system in Pakistani cities consists of buses and wagons. The government authorities have been struggling to improve bus systems and also to introduce rail-based public transport. Initially, it was declared that railways should be the backbone of urban transport in Pakistan, but this policy did not last long due to the non-availability of finance. In 2005, the Government of the Punjab, Transport Department, recommended a rail-based four-line network called the Lahore Rapid Mass Transit System. The Karachi Strategic Development Plan, 2020 proposed to revive and extend the Karachi Circular Railway, construct BRT, and introduce Light Rail Transit by the City District Government.¹⁷ The Punjab government also initiated bus-franchising schemes that offered exclusive rights to private transport operators on selected routes. However, after operating for a few years, franchised services in many cities (Lahore, Karachi, Rawalpindi, Islamabad, etc.) were closed down due to a lack of investments from the private sector and the inability of the public sector to resolve the conflicts that arose in its operation. Apart from financial and management problems, the failure of franchised bus services is also attributed to buses being the favourite targets of attacks and vandalism during frequent strikes and violence, and perceptions that the bus is unsafe for women and girls due to eve-teasing, harassment, necklace snatching and pick-pocketing. As a result, the city authorities allowed 20,000 privately-owned buses and minibuses to provide public transport services in Karachi. These are regulated and the passengers routinely hang out from doors and windows on unreliable, unsafe, dirty and

Table 4. Modal split in Delhi (2006-10)

Mode	No. of Vehicles	Vehicle km travelled		Trips (%)	Emissions*
		Million km/day	(%)		Tonnes/day
Private	5,526,000	123.0	73.0	31.0	500 (90%)
Cars	1,805,000	68.0	40.0	10.0	280
Scooters/motor cycles	3,721,000	55.0	33.0	21.0	220
Public		43.7	27.0	69.0	53 (10%)
3-Wheelers/Auto	76,000	19.6	12.0	3.0	6
Taxi	28,000	0.6	0.4	0.1	2
Buses**	46,000	13.0	8.0	62.0	15
Goods Vehicles	158,500	6.0	3.6	–	30
Metro (Electric)	186 km	4.5	3.0	3.9	N/A
Total	5,866,000	166.7	100.0	100.0	553

* Comprising carbon monoxide/carbon dioxide (60%), halocarbons (20%), nitrous oxides (15%), particulate matter and others (5%).

** Include public, school, company, chartered, private and inter-state buses. All buses, taxies and auto-rickshaws in Delhi run on compressed natural gas (CNG) fuel. Figures for NMT not available, however rough estimates give a total of 6.3 million km travel per day.

Sources: Kayitha et al, 2010; Bhandari et al, 2010; Jain, 2011; Government of Delhi, undated; www.transport.delhigovt.nic.in.

17. City District Government, Karachi, 2007.

inconvenient buses.¹⁸ The continuous decline in the quality of public transport implies a perception that it is the mode of transport for the poor.

In Colombo, Sri Lanka, authorities allowed private bus and minibus services to supplement the publicly owned Central Transport Board services free of fare and route regulation. Tariffs did not rise significantly, because of the Central Transport Board's very low fares with whom the private operators were competing. However, private buses operate only on high density routes and usually during rush hours.

Out of 5161 cities/towns in India only about 100 cities have a public transport system. State (or City) Transport Undertakings are responsible for the operation of city buses. Due to poor returns and subsidies, government run bus fleets have been declining and private operators are being licensed to supplement bus operations to meet the growing demand.

An estimated 62 per cent of the commuting trips in Delhi are made by buses, which constitute less than one per cent of the total motorized vehicles. CNG bus fleet in Delhi comprises 46,000 buses (including public, private, school, company, chartered and inter-state), covering a road network of 31,200 km, running about 13 million km per day and transporting nearly 6 million passengers per day. It is interesting to note that private modes carry 31 per cent of vehicular trips, and are responsible for 90 per cent of emissions, while CNG powered buses carry 62 per cent of trips and emit less than 4 per cent of pollutants. The reduction in pollution from buses, taxis and three-wheelers had been mainly due to the

Figure 1. Delhi Metro network (2010)

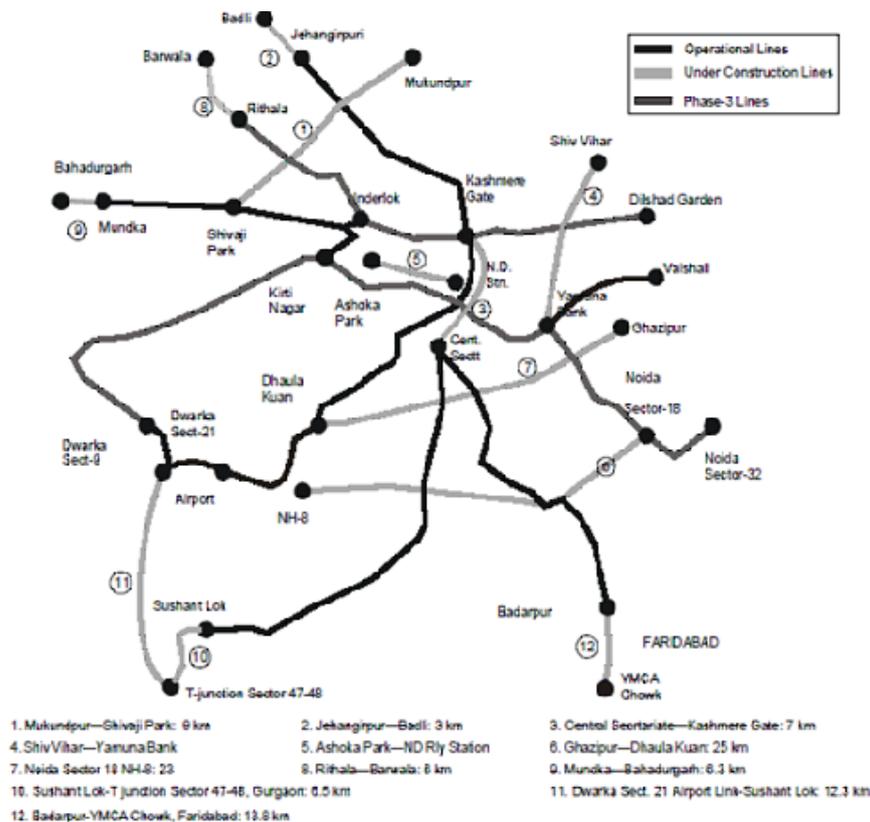


Fig. 21.1 Metro network in Delhi(2010).

Source: www.delhimetrorail.com/index.htm.

18. City District Government, Karachi, 2007.

Supreme Court of India order (1998) and its regular monitoring, together with government incentives and investments for public transport. Other major reasons have been existence of a legal master plan, a dedicated organizational set up, mega event like Commonwealth Games (2010) and a sustained pressure of the professionals and media.

In recent times some of the metropolitan cities in India have embarked upon multi-modal transport schemes comprising of integrated road/BRT and metro/Light Rail systems. Most of the funding for these is given by the Central Government under Jawaharlal Nehru National Urban Renewal Mission, and during the last five years, BRT corridors have been developed in several cities including Indore, Ahmedabad, Surat, Rajkot, Hyderabad, Bangalore and Delhi. Delhi Government plans to build 26 BRT corridors, covering a total length of 310 km by 2020. One of the BRT corridors has been completed and operational since 2008. The experience of Delhi BRTs indicates that it can be quickly built utilizing existing road networks and at a fraction of the cost of metro rail systems. It can double the average bus speed, from normally 10–12 km per hour to 20–25 km per hour, thus enhancing the bus service efficiency without additional buses. Along with BRT, dedicated corridors have been developed for pedestrians and bicyclists. The BRT lane also provides an undisturbed corridor for emergency vehicles like police, ambulances and the fire brigade. However, the allocation of existing lanes for BRT has caused traffic congestion and invited severe criticism from car users and the media.

Metro Rail Transport Systems have been introduced in Delhi (Figure 1 and Box 4), while these are being planned in Jaipur, Chennai, Mumbai, Hyderabad, Bangalore, etc.

Box 4. Delhi Metro

Sanctioned by the Union Cabinet in September 1996, work on Delhi Metro (Phase I) commenced in April 1998, after the setting up of the Delhi Metro Rail Corporation Ltd., the implementing agency for the project. The Metro Rail network for the entire city has been identified in four phases, which comprise of underground, elevated and surface corridors aggregating to approximately 415 km., and is expected to carry 3–4 million daily passengers with an average trip length of 15 km by 2021:

- Phase one of the network (65 km) is already in operation since 2002;
- Phase two (2006–2011) covering a length of 121 km is nearing completion and is largely in operation;
- Phase three Metro Rail Transport Systems (MRTS) (2011–2016) will cover 120 km; and
- Phase four (2016–2021) will cover 108.8 km length, which is to be completed by the year 2021.

It is expected that about 60% of Delhi's urban areas will be within 15-minute walking distance from the proposed MRTS stations, after full development of the system. Additional areas could come within easy access and connectivity with the Metro Rail through inter-linkages with other transport modes. About 15% of urban area of Delhi is likely to be directly affected, undergoing a dramatic impact and change. Due to the development of economic activities along the Metro Corridors and optimization of connectivity provided by it, the ridership on the Metro has been growing rapidly. It is expected that vehicular trips may progressively shift from road-based transport to Metro Rail Transport Systems, particularly, with reference to the longer trip lengths (greater than 10 km) within the city. About one-fifth of the capital costs of Delhi Metro project have been met by the Central and State Governments each. Japan International Cooperation Agency (JICA) and other subordinate soft loans contributed about half of the capital cost and the remaining costs are covered through fare box collection/integral resources and by property development (6 to 7 %). Given that about 43% of women commuters in Delhi face sexual harassment while using public transport, Delhi metro has reserved a coach for women passengers, besides installing CCTV and deploying women marshalls.

Source: www.delhimetrorail.com/index.htm; JAGORI and GNCTD, 2005.

Table 5. Delhi Metro vis-à-vis global systems

City	Opened	Length 2010 (km)	No. of stations	Daily ridership (millions)
London	1890	402	270	2.74
Paris	1900	199	368	6.00
New York	1904	368	468	4.27
Moscow	1935	292	177	9.00
Delhi	2002	186	130	1–1.50

Source: www.delhimetrorail.com/index.htm; JAGORI and GNCTD, 2005.

3.3. Impacts and challenges

Existing public transportation systems in South Asian cities face several challenges. In the cities where majority of the public transport users are poor, women and children mobility helps them to access to employment, education, healthcare and other basic amenities. As such public transit systems need to not only sustainable but also inclusive. However the provision of public transport system is limited, e.g. only 100 odd large cities out of 5161 cities and towns in India have a formal transport system. Wherever provided, the public transport agencies are struggling to survive and are dependent upon by huge government subsidies. With the growing economies of the cities in South Asia, it is a major challenge to facilitate a shift from cars and motorcycles to public transport. Public transport is also linked with feeder services, parking facilities, financial resources, dedicated corridors and network capacity. Although solutions like underground metro are long range and expensive, innovative models can be developed engaging property development, central/state government and local bodies sharing of investments, soft loans, public private partnership and formation of special purpose vehicle, as has been done in Delhi and Mumbai. However, as the examples of Karachi and some other cities indicate, complete privatization of public transport may not work by itself and its affordability is a big question. Such efforts have ended up being non-viable in terms of safety of passengers, affordable fares and welfare of workers/operators (as in Karachi and Kabul).

Some of the cities in India e.g. Delhi, Mumbai, Ahmedabad, Nashik, Rajkot, Vishakhapatnam, etc. have embarked upon Bus Rapid System also called integrated transit corridor) for improving public transport. The experience indicates several challenges. Improving the vehicle efficiency and transit operations (consistent dwell times and driving practices, regular dispatch, control of the bus intervals along the route), improving fuel efficiency and quality, fleet management systems, using GIS and online supervision as to make public transit operations sustainable and reliable. Establishing a relationship of the public transport system with other modes, such as 2 wheelers, cars, informal transport and NMTs is another challenge. The public transport system also needs a well developed road infrastructure, terminals, workshops, depots and parking space which can not be overlooked.

4. Informal Motorized Transport

4.1. Overview

In many South Asian cities due to the lack of public transport and the inability of the masses to own private vehicles, informal transport provides an indigenous solution to mobility needs. Such transport modes include mini bus, chartered bus, *tuk-tuk*, jeep, taxi, three wheelers, motorcycles, pick up vans, etc. Even tractor trolley, old jeeps, locally assembled vans, retrofitted old military vehicles, powered by indigenous, second hand engines or by irrigation motors are common modes of hired passenger vehicles in smaller towns. In Male (Maldives) and Goa (India) private motorcycles ferry tourists and other passengers on the pillion to beaches, hotels and other destinations.

It is characterized by cost effective, affordable, small vehicle and low performance services, which are privately operated, mostly by small, self employed entrepreneurs who work hard in a competitive marketplace. Informal operators craft new, tailor made services in response to growing transit needs and city expansion. Such innovations include trip chaining, chartered service for offices and schools and pick up services for off peak travel. Their inherent flexibility to changing markets stands in sharp contrast to the rigidities of protected monopolies.

4.2. Trends and conditions

A recent study¹⁹ estimates that in Rajkot (Gujarat) 22 per cent of trips (400,000 passengers per day) are by *Chakda* (3 wheeled, diesel powered auto rickshaw) catering mainly to the urban poor, working class, women and children. They provide point to point service at 2–3 minute frequency at affordable price, competitive to bus fares. In Mumbai three wheeler auto rickshaws grew by 420 per cent during 1991–2005 which is one of the highest in India. Auto rickshaws are a popular mode of travel and are found in almost every city and town (Box 5).

Informal transport is not necessarily unsanctioned. For instance, the 76,000 auto rickshaws operating in Delhi are all licensed. What makes many of them irregular and illegal are usually a) charging customers over and above government regulated fares, b) refusing services to passengers, c) irregular parking, d) plying without pollution control certificates or with non-CNG fuels, and e) operating auto unlicensed or outdated license. Traffic police in Delhi allege that many unlicensed auto-rickshaws (as much as another 30,000 to 40,000) are in operation within the city. Surveys show that three wheeler autos in Delhi travel 19.6 million km per day (as compared to 13 million km per day by buses) which is 12 per cent of total motorized travel.²⁰

Informal transport provides much needed mobility and services, jobs or vending options to the poor whose livelihoods depend upon reaching their desired destinations early to procure jobs, markets or the customers. Women make up the majority of the users of informal transport, such as mini bus, vans, three wheelers etc. These also connect the peri-urban and congested neighbourhoods that are otherwise inaccessible or are not served by buses.

In India and some other countries motorized tri-cycles are being extensively used for hauling small loads, which require frequent delivery stops. It is estimated that 3 wheeler vans and pickups cater for about 60 per cent of intra-city goods movement in Delhi. As compared to small trucks, the rickshaw trailers are substantially cheaper, and can deliver as much as a 5-

19. Arora et al, 2010.

20. Kayitha et al, 2010.

ton truck in a day by multiple trips.²¹ Courier services, perishables, such as milk, vegetables, fruits, groceries and other short-haul deliveries are increasingly being made by auto-rickshaws, vans or tricycles, where public authorities do not allow trucks/public carriers during day time and also during frequent VVIP visits, processions, ceremonies, etc.

During the 2010 Commonwealth Games in Delhi, the movement of trucks was almost banned for three weeks and people were wondering whether they will get their daily supplies of fresh fruits and vegetables, milk, bread, vegetables, newspaper, laundry, grocery, soft drinks, water, etc. It was a surprise that in spite of almost no trucks, the supplies were almost normal. Credit goes mainly to informal goods transport- that is motorized three wheelers, trailers, etc. which regularly delivered the bulk of the daily supplies of fruits and vegetables (3600 million tonnes) and many other items of daily consumption.

The informal carriers and goods services have developed their own informal indigenous logistics. They often work on the principle of relay race and area-wide trip chains link various transport nodes-railway stations, bus terminals, truck terminals, wholesale markets of grains, fruits and vegetables, etc., milk production centres with the retail markets, street vendors and operators and satisfy escalating demands for transport and goods movement. Although competitive and affordable, low fares preclude service improvements. Informal transport provides employment for hundreds of thousands of unskilled, young men, estimated at about 15 per cent of total employment in the transport sector. In Dhaka, Bangladesh the figure is close to 30 per cent.²²

Box 5. Auto rickshaw – the taxi of the middle class

An auto rickshaw or three-wheeler (*tuk-tuk*, trishaw, auto, rickshaw, autorick, Chakda, *vikram*, *tempo*, *bajaj*, tricycle or baby taxi in popular parlance) is a popular mode of transport for private as well as public use. It is a motorized version of the traditional rickshaw or velotaxi, a three-wheeled automobile operated by a single individual. Auto rickshaws can be found in many countries such as Bangladesh, Cambodia, India, Laos, the Philippines, Pakistan, Sri Lanka, and Thailand, as well as in Guatemala, Ethiopia, Sudan and Egypt. In many cities in India and Pakistan, there are also motorcycle rickshaws, usually called *phat-phati*, *chand gari* (moon car) or *qingqi* (after the Chinese company). A major proportion of road passenger transport in Afghanistan is carried out by small and intermediate size vans and auto-rickshaws. Being low cost (about one-fourth of a taxi) and popular among commuters because of low fares (about half of taxi), auto rickshaws are growing at 10 to 20 per cent per year in many cities. These are also a source of employment, providing about 10 to 15 per cent of total jobs in the urban sector. As the two-stroke engines which power auto rickshaws release greater emissions than most other modes, governments (particularly in India and Pakistan) have begun replacing older models by CNG powered auto rickshaws, which are less noisy, less polluting and more comfortable.

Source: http://en.wikipedia.org/wiki/Cycle_rickshaw; UN-Habitat, 2000; and author.

4.3. Impacts and challenges

Informal motorized transport faces several operational and financial problems. The sector is often blamed for aggressive and unruly driving, overcharging and poaching passengers, serious accidents, noise, congestion, lack of vehicle standards and services and unregulated, disorderly operations. In smaller cities, during the late evening, women fear to travel alone using informal transport. Informal transport is also suspected of involvement in illicit

21. Replogle, 1993.

22. Hoque et al, 2005.

activities, crimes and corruption. Many drivers claim that they have to regularly pay bribes to traffic police and officials for the right to operate. They are accused of causing air pollution which is attributed mainly to two stroke engines and use of low quality fuel. In July 1998, the Supreme Court of India ordered the Delhi Government to implement CNG or LPG fuel for all 3 wheeler autos, taxis and bus fleet aiming at improving Delhi's air quality. The government is also pushing for four stroke engines to replace two stroke versions. Pakistan has passed a similar law prohibiting diesel petrol driven auto rickshaws in certain cities, which are being replaced by CNG auto rickshaws. In January 2007, the Sri Lankan government banned two stroke auto-rickshaws to reduce air pollution. As a result now direct injection and four stroke engines are being used in auto rickshaws.

The informal transport sector is riddled with numerous challenges, including lack of parking space and road right of way, harassment by traffic police and transport officials, poor vehicle safety and fitness standards, lack of insurance, etc. The predisposition among motoring class and transportation officials is to expedite automobile flows, and they usually fail to appreciate the importance of informal transport. This mindset together with the pressures from customers and automobile industry add to the marginalization of informal transport. There is absence of any kind of normative policy framework for informal motorized transport services, which fill the void left by public transport and is a part of overall city transport. There are hardly any earmarked parking areas and other facilities for informal transport, as a result there is harassment and rent/bribe seeking by concerned officials. Being informal or quasi illegal, the informal vehicles do not get bank loan, and therefore go for second hand, recycled vehicles with poor performance and emission standards. Also informal vehicle repair/service workshops along with cheap or spurious parts markets thrive all over. For example Delhi in 2001 had 60,000 transport related shops and repair facility, of which one-third were illegal or informal, who were not eligible for bank loans and space in planned areas. Keeping in view the service rendered by informal shops and workshops, Delhi Master Plan now mandates a reservation of 10 per cent space and about one-third of planned commercial units for the informal sector.²³ While the informal transport sector is regularly a target of criticism and punishments, there are hardly any programs for their integration into the formal sector by way of education, training and financial assistance. An exception was during the Delhi Commonwealth Games, October 2010, when auto drivers were given training in driving behaviour, etiquettes and also financial assistance to paint and retrofit their vehicles.

23. Delhi Development Authority, 2007.

5. Private Motorized Transport

5.1. Overview

During the last decades there has been unprecedented urbanization and enhanced mobility demand in South Asian countries amidst policies of economic liberalization and privatization. In many cities private vehicles are growing annually at 7 to 10 per cent. Iran and Maldives have a high private vehicle ownership rates, and in other South Asian countries such as, India, Pakistan, Nepal and Sri Lanka, private vehicles are growing 2 to 3 times the population growth rates.²⁴

The increasing volume of private motorized transport in the South Asian cities is imposing large economic, social and environmental costs. With the increasing frequency and speed of travel, there has been a skewed growth and urban sprawl, together with a rapid rise in congestion, pollution, greenhouse gas emissions, noise and accidents.

5.2. Trends and conditions

A significant proportion of privately owned vehicles in South Asian cities comprise of two wheelers which are three to six times the number of cars except in Iran.

- Tehran has 95.1 cars and 51.5 motorcycle/two wheelers per 1000 persons whereas Male (Maldives) has 10 cars and 200 two wheelers per 1000 persons.
- Private modes (9.3 per cent of total vehicular trips) in Mumbai cover 212 car and 214 motorcycle passenger km per capita.
- The proportion of total daily trips by motorized private modes is as high as 51 per cent in Tehran covering 1385 car passenger km per capita and 331 motorcycle passenger km per capita.
- In Chennai private modes (14 per cent of total trips) cover 129 car and 375 motorcycle passenger km per capita.
- Mumbai has 21.2 cars and 32.2 two wheeler, and Chennai has 22 cars and 100 two wheelers per 1000 persons.
- In Bangalore two-wheelers growing at 9.5 per cent constitute 74 per cent of motorized vehicles and are used for 31 per cent of journeys.²⁵

Two wheelers are less expensive to buy (about one-tenth of car price), less expensive in fuel consumption terms (about one-fifth of running a car), require a fraction (one-sixth) of parking space as compared to a car and can negotiate faster through congested streets.

According to a survey²⁶ in Dhaka there are 240,000 private motor vehicles, which means about 30 vehicles per 1000 inhabitants. In 2004, only 3 per cent of trips were made by cars and 17 per cent by two wheelers. Almost 80 per cent of trips in Dhaka were undertaken by walking, rickshaw or bus. However, private automobiles occupy nearly 70 per cent of Dhaka's road space, while serving only 20 per cent of the commuters, whereas public transit, non-motorized vehicles and pedestrians take up 30 per cent of space, while moving 80 per cent of the people. This means traffic congestion is caused mainly by low-occupancy personal vehicles.

24. World Bank, 2010.

25. Barter, 1999 (Bangalore); Kenworthy 2011 (other cities).

26. GOB, 2004.

A study on 'Urban Transportation and Environment in Kathmandu Valley, Nepal', (2006), indicates that from nearly one billion passenger-km in Kathmandu in 1989, motorized travel demand increased 8.7-fold during 1989–2004, and is projected to increase further to 27 billion passenger-km by 2025. Private cars and motorcycles make up 71 per cent of the total number of vehicles, meet 41 per cent of the total travel demand and consume 53 per cent of the total energy. Buses and minibuses comprise only 1.4 per cent of the total number of vehicles, meet 37 per cent of the travel demand and consume 13 per cent of the total energy. As compared to a bus, minibuses use 20 per cent more energy per person, motorcycles use twice and private cars use 6.5 times.²⁷

India has around 100 million vehicles comprising nearly 70 per cent private vehicles (about 10 per cent cars and 60 per cent two wheelers). During the last 40 years, oil consumption increased by 900 per cent at an average annual growth of 20 to 25 per cent. India's urban road network (670,000 km) fails to cope up with the increasing traffic.²⁸ The contribution of cars and two-wheelers to traffic is significant providing about 70 to 75 per cent of vehicle kilometres travelled, in terms of proportion of total travel lengths undertaken. For example, in Delhi vehicle kilometres travelled by private motorized transport was 123 million kilometres per day in 2009 (see Table 2) as compared to 13 million kilometres per day by public buses.²⁹

In South Asian cities private motorized vehicles, especially two-wheelers are no more just a status symbol, but a symbol of youth, freedom and success. Private vehicle ownership is largely male dominated and women's access is restricted. However, in large cities women's employment patterns are transforming car ownership and use. Car parking is emerging as a major issue as it involves using public space for private purposes that means subsidies to car owners in providing various other externalities, like roads, flyovers, etc at public expense.

Cars have been commonly used on pool basis to ferry school children and car sharing by office goers is also catching up in large cities. The Government of Delhi (Transport Department) has recently started a 'mega car pool scheme' (2011) that facilitates sharing a car ride which can be requisitioned on mobile phone on credit/exchange basis from a car registered under the scheme.

5.3. Impacts and challenges

Foremost among the impacts of motorization in South Asia is the conversion and subsequent loss of agricultural and natural land areas. Extensive urbanization and primacy of metropolitan cities through the transformation of agricultural land has led to an increase in traffic congestion, demand for roads and parking, consumer costs, accidents and energy consumption. This is evident in extensive suburban townships around almost all the metropolitan cities such as Mumbai, Delhi, Kolkata, Chennai, Dhaka, Karachi, Lahore, etc. Around Mumbai, 7 new towns have come up within a radius of 50 km from the old city. Around Delhi, new urban centres which have emerged within 20 to 50 km radius and are contiguous to Delhi include Gurgaon, Manesar, Kondli, NOIDA, Greater NOIDA, Ghaziabad, Faridabad, etc. Around Kolkata new city developments, such as Salt Lake City, Jadavpur, Rajarhat, have emerged within 20 to 40 km radius from the mainland. With such sprawl, both the number of private vehicles and trips length are increasing. The poor who cannot afford private transport are adversely affected as they have to resort to informal motorized transport

27. Dhakal, 2006.

28. Ministry of Road Transport and Highways, 2009.

29. Kayitha et al, 2010.

in the absence of efficient public transport, which means more money and time spent in commuting. As a consequence the gap between private vehicle owners, i.e. high mobility citizens and low income groups with restricted mobility is widening, both in economic and social terms.

The fast-growth of private vehicles is seen as a most intractable source of carbon emissions. Its implications are evident as the Delhi study shows that 73 per cent of total motorized transport, i.e. private vehicles, carry 31 per cent of vehicular trips and are responsible for 90 per cent of emissions. Recent empirical data, however indicates that pollution loads are reducing, largely due to vehicular technology in terms of emission norms (such as Bharat Stage Bharat Stage II and Bharat Stage Bharat Stage III/Euro norms), and the use of CNG and LPG. The pollution loads in Delhi, as compared to 2002 significantly reduced in 2009, by 37 per cent for Carbon Monoxide (264.55 tonnes per day), 31 per cent for Halocarbons (127.54 tonnes/day), 25 per cent for Nitrogen Oxide (82.53 tonnes per day) and particulate matter by 23 per cent (9.81 tonnes/day).³⁰ However, the potential gains of stringent emission control and public transit system are yet to fully realised which faces several barriers, such as increasing volume of vehicles and idling due to congestion on roads. Besides engine norms and fuel policy, it is necessary to reduce the vehicle kilometres travelled and trip length by travel demand management, land use and transport synergy, car pooling and integrating public-private modes of urban transport. Besides emissions environmental footprints of private motor vehicle also include the amount of resources (including embedded energy) used in their production, amount of waste produced by its disposal, and continued use of fossil fuels. The electric car is being promoted through the government subsidies (India), however, the production of thermal energy is still a large producer of carbon emissions.

There are significant challenges to enhancing the role of public transport as an alternative to private motorized vehicles in South Asian cities. Even in cities with reasonably good and subsidized public transport, private motorized transport remains popular as it provides door to door, just in time, quick, convenient and safer travel. Private motor vehicles as compared to public transport are being increasingly used for longer trip lengths as the users try to balance between the fuel price and time gain.

30. Kayitha et al, 2010.

6. Goods Transport

6.1. Overview

Besides the movement of people, transportation involves the transfer of the goods from one location to another. The delivery and collection of the goods is a necessary component of urban living, and the economic and social sustainability of an urban area is dependent on an effective, efficient, affordable and safe transport of the goods. Historically many cities in the Indian sub-continent grew up as market towns (Mandi) for the transfer of rural agricultural produce or as distribution centres for industrial production, exports and imports. Almost every city has specific wholesale market areas for fruits and vegetables, grains, edible oils, sugar and spices, fodder, cotton, etc., usually found along the highways or adjacent to transport nodes (railway station, bus terminal, etc.). However, with the passage of time, population growth and congestion, most of the wholesale markets and warehousing areas in inner city have become unable to cater to the increasing demands of trade, warehousing, parking, traffic and related infrastructure.

6.2. Trends and conditions

The effects of globalization, industrialization and consumerism are visible in South Asia and the importance of cities as centres of transfer of goods keeps growing. This is manifested by emerging variety of modes for goods transport-air, container, railways, trucks, pickup vans, trailers, maritime, ropeways, pipelines, etc., co-existing with non-motorized *thela*, *rehri*, cycle rickshaw, head loading, animal powered cart, etc. Surveys in Delhi reveal that for every truck, there are about 5 feeder informal motorized goods vehicles, 5 non-motorized vehicles and 5 to 10 head-loaders.³¹ As such goods transport is a major generator of business and employment and contributes to poverty alleviation. Deficient logistics and poor goods transport can be major drag on the economy and social change.

Depending upon the nature of goods, market demand and the availability of the infrastructure, there are high differentials in goods transport logistics and volumes in the regions. The road network in South Asian countries caters for the bulk of inland goods transport (roughly two-thirds), while the role of railways, shipping and air are gradually picking up. Bottlenecks are encountered in infrastructure and services for goods transport - poor condition of roads, lack of connectivity between the national, regional and local road networks and unreliable and costly road transport services. The unrealized potential of rail, ports and maritime/inland water freight transport puts excessive pressures on road transport.

Bhutan's Transport Policy envisages exploring, planning, developing and implementing alternative modes of urban freight transport such as railways, ropeways and water transport. It aims to establish a comprehensive land freight transport information system; set-up uniform regulations on axle load, construction standards, vehicle and driver requirements; transportation of hazardous materials and guidelines to ensure safety and security of freight transport. The policy encourages containerized cargo and periodical consultations by the government with the public and private sector operators, stakeholders and users in order to promote interactive participation towards the establishment of an acceptable and effective land freight transportation system.

India's 11th Five Year Plan (2007–2012), emphasizes the strengthening of dedicated rail freight corridor linking India's major cities, ports and industrial areas. It also underlines the

31. Jain, 2009, citing Delhi Development Authority.

need to expedite the completion of Golden Quadrilateral that is Express Highways connecting the major cities, free trade, special economic zones, ports, etc. Multi-modal containerization of cargo is being encouraged, which is growing at a rate of over 20 per cent a year, by establishment of the Container Corporation of India. India's National Urban Transport Policy (2006) supports a greater role for the private sector, businesses and industry in goods transport and encourages public-private partnerships. It recommends staggering of time for freight traffic movement and the use off-peak passenger traffic times, i.e. late night hours for freight transport. It also suggests the development of bye-passes and truck terminals to facilitate the movement of goods vehicles in the urban periphery for which financial support is given by the Central government.

The use of Information Technology and Intelligent Communication Systems in goods movement is vital for its efficiency, economy and speed. The webkit, a computerized system developed by Japan Trucking Association, provides goods transport companies and shippers with information on cargos awaiting trucks, and trucks seeking cargos. To assist small and medium truckers in promoting joint truck allocation, the network collects and exchanges information on the trucks awaiting cargos and the cargos awaiting trucks, which is put into operation for greater transport efficiency. Computerized network system together with GPS and radio tagging are being increasingly used for handle cargo in the ports, freight and truck terminals in India (Mumbai, Kolkata, Bangalore, Pune). However feeder services for further transfer of goods are still to be web linked, which by and large continue to be indigenous and informal,

6.3. Impacts and challenges

Depending upon the varying nature, every ton of cargo transport earns US\$100–200 for Iran's Government and creates 30 to 50 jobs.³² The situation is similar in most other countries in South Asia. In this context, whereas passenger public transport invariably needs subsidies, goods transport yields income for the government. In spite of this, the goods transport infrastructure and facilities do not receive the attention they deserve and are often poor and deficient.

There is a lack of co-ordinated urban freight policy and co-operation among various transport systems (railways, shipping, air, highways, urban, etc.), city departments, local organizations, private sector and others. Conflicts exist between goods movement and urban passenger transport in term of emissions, congestion, accident and damage of roads due to heavy goods vehicles. The spatial needs for goods handling and freight terminals, warehousing, markets, etc, and integration of various transport modes (formal and informal) are not given due priority in urban planning.

The goods transport sector lacks basic infrastructure, such as goods terminals, parking facilities, freight centres, etc. It faces various bottlenecks, such as many barriers, checks and taxes, restricted road width, poor road maintenance, danger and delays due to railway level crossings/barriers, etc. The poor condition of roads is exacerbated by an outdated freight vehicle fleet. Accidents are frequent due to poor driving, overloading of goods vehicles and due to mixed traffic. With the dominance of highways oriented goods transport policy and plans, the informal goods transport and NMTs are excluded from design of roads, terminals, etc and are seen as intruders. The marginalization of NMTs serving as feeder services for goods transport delivery within urban areas, makes the goods transport sector vulnerable to corruption.

32. <http://iran-daily.com/1386/2865/html/ecnomy.htm>.

The most significant environmental issues related to urban goods transport in South Asian cities (with some exceptions) by and large are road based air pollution (emission, dust, suspended particulate matter, noise, etc.) and energy use. There have been debates whether rail is a more sustainable mode and can be used more extensively for the movement of goods. According to an Indian Railway Board and World Bank study, as compared to roads and trucks, the railways are about five times more energy-efficient (Table 6). However, the government of India as a policy deals with the railways as an intercity transport and not for intra-urban transport. In this scenario city government in Navi Mumbai has taken the initiative and tied up with railways for development of goods terminals/nodes and railway tracks by sharing of costs for intra-urban transport. While India has 12 major ports, 140 minor ports, 14,500 km of navigable rivers and canals, the inland water transport potential is grossly underutilized, largely due to a lack of interconnected logistics, infrastructure facilities, markets and feeder transport systems.

Table 6. Comparison of energy efficiency of railways and roads

Mode	Energy needed (BTU/tonne km)
Electric train	84.60
Diesel train	225.50
Steam train	3576.90
Diesel trucks	1587.30

Source: World Bank and Indian Railway Board Study, 1998.

The lack of linkages between the supply chains at urban and regional levels, and frequent barriers add to cargo delivery and logistic costs in South Asian countries. With increasing demands for frequent and just-in-time delivery on the one hand and the inadequacies and restrictions of goods transport spatial infrastructure and environmental demands on the other, the need of computerized handling and optimum consolidation of goods delivery becomes indispensable. This would optimize the efficient utilization of the transport system, thereby reducing vehicle trips, increasing efficiency and decreasing financial and environmental costs. A useful measure for improving consolidation is the establishment of a network of freight centre, where freight is radio-tagged, sorted out and consolidated at the stages of collection and delivery. Measures such as selective time-sharing and multiple use of infrastructure, introducing environmental zones, computerized logistics for pricing, security, safe handling, CCTV to check vandalism and traffic management strategies for smooth flow of freight traffic in urban areas, can improve goods transportation.

7. Integrated Land Use and Transport Planning

7.1. Overview

In many traditional cities, particularly in South Asia, urban growth has been encouraged by the expansion of transport infrastructure, such as a railway station, highway or bus terminal. The propensity of urban growth has always been high adjacent to transport nodes-like a railway station or a bus stand. The presence of mixed land use, high population and employment density along transport nodes and corridors manifested a close relationship between transport and land use. However, with the increasing ownership of private motorized vehicles, during the recent decades there had been an amorphous pattern of urban growth resulting into ever increasing transport demand. It is now being realised that the integrity of land use and transport planning is essential for urban sustainability.

7.2. Trends and conditions

The core of many South Asian cities are still walkable (e.g. Delhi, Mumbai, Jaipur, Agra, Lahore, Karachi, Dhaka, Colombo, Kathmandu), which makes it possible for the average citizen to save cost and time on vehicular transport for day to day activities. Street life, public places, pedestrianisation are special features of South Asian cities which make them dynamic and vibrant.

With the passage of time, modern planning have adopted low density, low-rise and single-use zoning. Urban sprawl and the separation of land use from transportation planning generated higher volumes of vehicular transport, longer trips, higher consumption of fuels and rising levels of congestion, emissions, pollution and road accidents. These have made the cities unsustainable. However, a few attempts have been made towards integrated land use and transport planning and the examples of Islamabad (Pakistan), Dhaka (Bangladesh), New Mumbai and New Delhi can be cited.

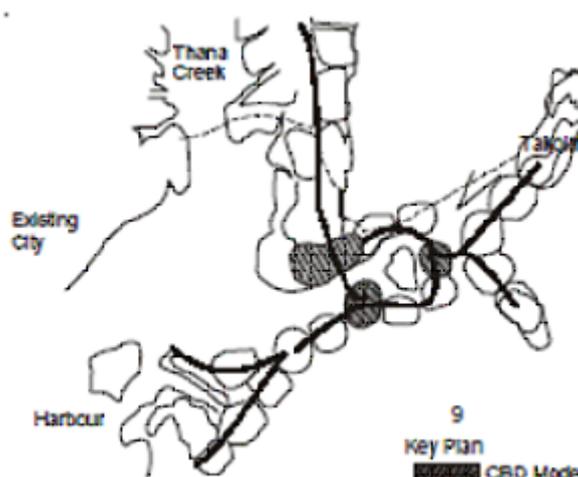
Islamabad, the new capital of Pakistan was designed by C.A. Doxiadis based on transport and land use dynamics. The spinal form of the city centre evolves along with growth of the city. The residential sectors flank the evolving Dynamic Development Centre, which allows walkability and viability of public transport.

The Government of the People's Republic of Bangladesh developed a Strategic Transport Plan for Greater Dhaka (2004–2024), with the primary objective of integrating land use for the future growth of Dhaka Metropolitan Area with transport system. The Strategic Transport Plan project identified fifteen key issues which influence the urban settlement and economic growth based on transport pattern. The basic objective of Strategic Transport Plan is to integrate land use with transport planning so as to reduce of transport demand and facilitate sustainable, equitable, safe and comfortable mobility for everyone. It envisaged an urban form which is walkable and conserves the need for transport, thus reducing the dependence on motorized vehicles.

Planned in early 1970s by Charles Correa the spatial configuration of New Bombay is derived from its traffic and transport structure, comprising road-cum-rail corridors. These are the backbone of a series of new cities which are planned and served by public transport. The central business districts have been planned at the junction of three linear rail spines and regional road transport networks. The plan seeks to use rail network for reducing traffic load on the roads and to achieve better environmental and economic sustainability

The Master Plan for Delhi 2021 envisages the restructuring of about 500m belt along the metro corridors, highways and transport nodes with incentives of higher Floor Area Ratio and mixed land use.³³ The concept of linear ‘facility corridors’ all along metro/ public transport networks envisages high intensity development of work centres, educational, healthcare and

Figure 2. Concept plan of New Bombay



Source: Khan, 1987.

other public facilities so as to strengthen the relationship with mobility (public transport), pedestrians, cycles, etc. It aims at dispersal of traffic towards achieving a sustainable volume/capacity ratio. The Plan encourages compact, dense and smart growth and projects the concepts of ‘synergy between public transport corridors and land use,’ ‘urban restructuring along major arterials’ and ‘metro network,’ influence zone’ ‘densification’ and ‘mixed land use’. The experience of Delhi indicates that a speedy, comfortable and affordable public transport can attract private motorised users to public transport. Central Road Research Institute (CRRI) surveys (2009) estimated that about 29,000 car owners and 28,000 two wheelers/three wheeler commuters shifted to metro during 2009. The shift was attributed to traffic jams (23 per cent), parking problem (5 per cent), speed (17 per cent) and 24 per cent for safer, comfortable journey.³⁴ On the other hand, there is also a shift of about 200,000 to 300,000 commuters per year from public to private transport, which points towards enhancing the potential of public transport by linking it with land use, along with a series of complimentary actions, as given below:

- Preparation and operationalization of an integrated and complementary multi-modal transportation plan comprising the road, rail and metro networks, so that work centres/residences are within a walkable distance.
- The multimodal system has to be integrated with facilities for pedestrians, bicyclists, disabled persons and Intelligent Transport System enabled taxis and three-wheeler scooter rickshaws.
- Optimal development of the existing road network by removing impediments to the smooth and safe flow of buses and non-motorized transport.
- Expansion and restructuring of the existing road, rail and metro network and creating alternative networks to promote use of public transport.

33. DDA, 2007.

34. CRRI, 2009.

- Integration between the bus, rail and metro-system to provide seamless multi-modal transport, through the provision of additional stations, park and ride facilities and introduction of single multi-modal ticketing. The multimodal public transport system to be based on comparative cost-effectiveness analysis for the judicious use of public funds.
- Planning and development of goods transport and transport terminals (air, railways, container depots, freight complexes, warehousing and wholesale markets) and influence areas around them to be based on the principle of decentralization in a regional framework and towards the urban periphery, linked with railways, highways and metro network, together with feeder services.
- Development of a comprehensive parking policy including measures for linking new vehicle registration with owner parking facilities
- Bicycle/cycle-rickshaw to be promoted for short and medium trip lengths, together with enhanced facilities for pedestrians with street furniture, signage and landscaping.
- A major consideration in mobility planning and space design is that people with disability, older persons and people in wheel chairs could move safely in the city. This requires that:
 - Paths and pavements shall be flat, uniform, slip-free and free from obstacles.
 - Orientation points and guide routes may be provided for visually disabled people.
 - Information and warning signs must be understandable, clear and well lit.
 - Provisions for the physically challenged should be made to overcome curb height, rain water gratings and other barriers. Parking spaces close to the entrance should be reserved for physically challenged. Public transport shall be designed for easy access by wheelchair users.
- Exclusive parking bays to be provided near major intersections for parking of mobile repair vans, Police Control Room/Vans, ambulances, cranes, fire tenders and other public utility vehicles.
- Safety of road users shall be a prime consideration while planning transport infrastructure. The aspects of licensing, registration and training of transport operators/drivers are important elements in traffic safety. Appropriate road signage and markings help in traffic safety.

7.3. Impacts and challenges

High growth of automobile use in Asian cities (67 per cent during 1980–1990)³⁵ is a result of several factors, e.g. urbanization and sprawl, lack of public transport, low density and high single use zoning. The conventional ‘end of piped’ technological solutions have not worked. More fundamental challenge is to curtail the need of travel by integrating urban transport and land use planning and a compact urban form that configures a hierarchical symbiosis of work centres and mixed land use based on the public transportation and walkability. There are several challenges and implications in its implementation on ground. Most of the cities in South Asia face the challenge of massive unplanned, informal growth where bulk of the poor live and work and face transport poverty. There are multiple layers in governance and verticals of stakeholders and gaps exist in their coordination. The issues of processes and

35. Newman and Kenworthy, 1999.

procedures, domains and jurisdiction, public participation, converting policy into a legally enforceable framework are the major challenges in integrating unplanned, informal areas and urban expansion with public transport. For the integrity of land use and urban transport, the planning and implementation capacity at local level needs to be reinforced.

8. Social Sustainability of Urban Transport

8.1. Overview

In South Asia, the pace of urban transport is lagging behind its massive urban growth, due to which the potential advantages of city life are not accessible to poor. It is well realized that accessibility acts as a powerful tool that enables spatial inclusion and social sustainability. At the policy level every government in South Asia is committed to social equity and poverty alleviation. However, in practice, mobility related exclusion is widespread, which impacts access to employment, education, healthcare, goods and services. There is widespread deprivation in terms of access to affordable transport further accentuated by gender and age.

8.2. Trends and conditions

Transport planning and decision-making are not gender sensitive, resulting in policies and investments inappropriate to the differentiated needs of women and children. In South Asian cities where eve teasing and pushing women in crowded public buses are common. In Dhaka, during the 1980s five per cent seats on buses were reserved for women, which were subsequently withdrawn. An evaluation of Bangladesh Road Transport Corporation buses in Dhaka revealed that women's dignity and security are at risk travelling on crowded buses as they face the dangers of physical touching and gross misbehaviour.³⁶ To avoid such conditions of travel, women either have to walk long distances or pay high fares in hiring rickshaws. This constrains women's access to work, education and necessary social services.

Transport systems in many cities are often insensitive to the needs of the disabled thereby creating an additional factor of exclusion. The design and operation of vehicles and transport infrastructure (roads, footpaths, parking, signage, bus stand, terminals and passenger facilities) ignore the needs of the disabled/special users, who constitute about 1 per cent of the population. Furthermore, different age groups require specific transport services and face particular constraints.

Safety is also a concern with regards to transport in South Asian cities. Some cities have the highest road accidents among the major cities globally. India has over 114,000 road deaths each year.³⁷ Bangladesh, with relatively low motorization, has the worst fatality rate in the region with 85.6 fatalities per 10,000 vehicles. It is followed by Nepal (24.3), India (20.3), Pakistan (18.7) and Sri Lanka (15.5).³⁸ In Bhutan, the fatality rate is reported at 21 deaths per 10,000 vehicles. In Iran, over 30,000 people die annually in road traffic crashes, amounting to a death rate of 44 per 10,000. Transport officials say 46.8 per cent of car accidents take place in cities, and the rest outside Fig 3. In urban areas of Bangladesh, like Dhaka, pedestrians represent up to 70 per cent of the total road accidents and fatalities. The share of pedestrian deaths is also alarming in Pakistan (50 per cent) and Sri Lanka (45 per cent). There has been a spurt in accidents in relation to the indiscriminate privatization of city bus services, where the sole basis of licensing regime is solely the lowest tender. City bus transport in Delhi was opened up to private buses in 1992. The private blue line buses were mostly old, noisy overloaded and unsafe. Surveys showed that 90 per cent drivers had no formal training and half worked between 12 to 16 hours. Private buses constituted just 0.15 per cent of registered vehicles in the city but were involved in 11 per cent of accidents (amounting to an average of 3 collisions per day). The surveys attribute about 80 per cent of accidents due to poor, rash

36. Lennat and Thynell, 2004.

37. WRS, 2009.

38. Koptis and Cropper, 2003.

driving racing to pick up passengers from the bus stops.³⁹ As such, unless care and safeguards are taken, privatization increases the vulnerability of marginalized groups.

Driving behaviour is usually characterized by frequent flouting of traffic rules and regulations, aggressive, high speed driving and overtaking, freedom of parking on roads and excessive horn blowing. This not only leads to frequent accidents, but also quarrels and crimes on roads. The alarming scale of traffic injuries and casualties in the South Asian countries leads to significant economic and social costs. Injury, deaths and other health consequences are especially severe amongst the 'vulnerable road users', i.e. pedestrians, cyclists, women and children, etc. In South Asian cities, road safety audits are seldom undertaken. The multiplicity of modes of transport, low level of education of drivers, lack of enforcement of traffic road safety laws (many of which are outdated) and incompatible drivers' behaviour make the problem extremely complex. Only few countries have updated road safety laws that address critical risk factors for road traffic such as mandatory road safety audit, provision of safe and accessible pedestrian crossings and walkways, railing, road lighting, signage and markings, drainage and road maintenance, besides laws relating to speed, drunk driving and non-use of protection measures (helmets, seat-belts and child-restraints).

Various policy initiatives have been taken by South Asian countries to deal with the social sustainability of transport. These include the following:

- In many South Asian cities e.g. Colombo, Kathmandu, Lahore, Karachi, Dhaka, Mumbai, Chennai, etc. seats are reserved for girls and women in buses. In Delhi special buses are run for the students on monthly pass basis, which is highly subsidized. Delhi metro and suburban trains also have reserved coaches for women. This has improved the situation. However this policy needs a more sustained implementation and is yet to cover informal transport modes (such as mini-bus, taxies and three wheelers) which are vulnerable modes for women.
- During last decade, almost every South Asian country have enacted and enforced law for making public transport and terminals accessible and barrier free. These measures include mandatory bye-laws, planning and development of dedicated and barrier free corridors for pedestrians, wheel chair users and cyclists with provision of railing, crash barriers, signage, zebra (Pelican crossings), lighting, etc. However there are gaps between mandate and its implementation.
- Road safety laws have been revisited with stricter enforcement of speed, vehicle condition, emission norms driving regulations and mandatory use of protection/ safety gear, etc. besides other measures. However, most of the road safety laws are driver centric and leave out public work agencies responsible for road safety (such as sidewalks, pedestrian crossings, speed breakers, road signage, markings, drainage, traffic lights, etc)

8.3. Impacts and challenges

In South Asia the advent of faster modes of transportation has changes the urban pattern and spatial organization of cities and vice versa. Besides the booming real estate and urban sprawl, growth of slums and shanty towns pose the challenges of accessibility and the survival and livelihoods for the poor inhabitants. To incorporate their needs in urban transport policy and programs is a major challenge. In this regard the transport policy makers/planners

39. Ramasaamy and Satyaramchander, 1998.

and departments need to consider transport and mobility as human right. This poses the challenge of equity in allocation of road space for public transport and informal roads and also safeguarding dignity and security of vulnerable users, especially the women. Participatory planning and social audit help in giving voice to relevant stakeholders and community. Social Audits and Social Impact Assessments are necessary to ensure spatial and access equity and to provide safe, inclusive and barrier free transport, together with dedicated facilities for pedestrians, cycles and other NMTs. The role of media is important in creating awareness among the public, authorities and transport operators with regard to critical urban transport issues, such as safeguarding women, traffic safety and calming, pedestrian facilities, driving behaviour, public participation in urban transport planning and decision making, etc.

9. Urban Transport and the Environment

9.1. Overview

Motorization in South Asia is contributing to an increase in transportation energy intensity and consumption of fossil fuels. The impacts of oil-based transport energy on the natural environment (energy and mineral extraction and use, hydrological cycle and water quality effects, consumption of agricultural land and natural habitats through urban sprawl, air pollution, etc.) and the built environment (noise, pollution, traffic accidents, community severance) are significant. In several cities of South Asia e.g. Delhi 72 per cent of emissions (suspended particulate matter) are due to motorized vehicles (2002).⁴⁰ The International Council of Local Environmental Initiatives (ICLEI) states that on average 24 per cent emissions are from urban transport. These are likely to rise steadily due to growing city size, rising incomes, motorization and due to inefficient engines and fuel use.⁴¹

9.2. Trends and conditions

In Iran pollution from vehicles in large cities is a serious problem. It is estimated that four thousand people die from air pollution-related diseases each year in Tehran.⁴² To reduce demand for refined fuels and to lower air pollution, the government is seeking to introduce compressed natural gas vehicles.

Dhaka has become one of the most polluted cities in the world. The environment of the city has been deteriorating rapidly during the last years. Complaints about headache, eye and skin irritation as well as breathing problems are common among the residents of the city. The situation is expected to worsen further with population increase, its mobility and economic development, particularly for the children and the elderly people. In Dhaka, the concentration of oxides of nitrogen, oxides of sulphur, carbon monoxide and suspended particulate matter are 500, 1200, 7500 and 2500 $\mu\text{g}/\text{m}^3$ respectively which far exceed the acceptable limits set by WHO. The car is the principal contributor of sulphur, nitrogen and carbon monoxide emissions in the city. The contributions from buses and trucks are significant in the case of sulphur and nitrogen emissions. Auto-rickshaws and 2-wheelers contribute significantly to sulphur and carbon monoxide emissions.⁴³ According to the Department of Environment and the Bangladesh Road Transport Authority, more than 90 per cent of the vehicles in Dhaka are faulty and emit smoke far exceeding the prescribed limit. The Bangladesh Atomic Committee reports that automobiles in Dhaka emit 100 kg lead, 3.5 tonnes suspended particulate matter, 1.5 tonnes sulphur dioxide, 14 tonnes hydrocarbon and 60 tonnes carbon monoxide yearly.⁴⁴ To make the city environmentally sustainable and to cleanse the air, initiatives are being taken to assess the level of air pollution and develop transport policy, technology and institutional reforms and mandatory use of cleaner fuels to control the emissions from motorized transport.

Emissions vary widely as per the mode, which is as high as 4.5 metric tonnes per capita for those using private motorized transport, which are predicted to double within next 10 years, if private motorized travel continues to grow at the present pace of 8 to 10 per cent per year and mitigation measures are not initiated. Studies show that to transport one ton of cargo

40. CRRI, 2002.

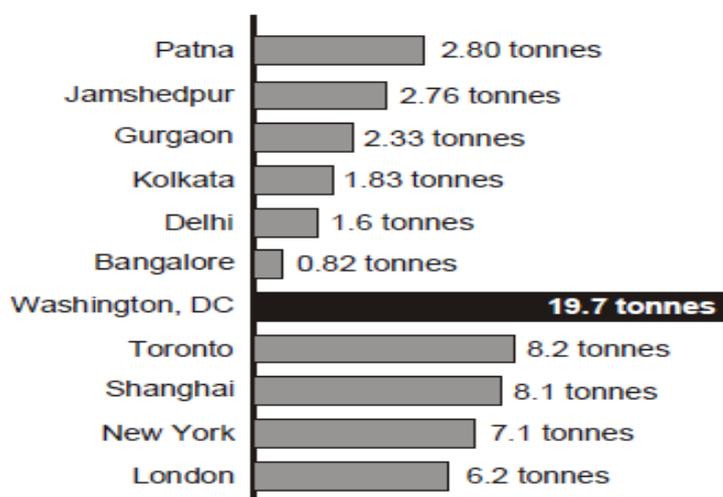
41. ICLEI, 2009.

42. Verdinejad, undated.

43. Hoque et al, 2005.

44. Ferdous, 1997, cited in <http://www.sos-arsenic.net/english/environment/1.html>.

Figure 3. Per capita greenhouse gas/carbon emissions in selected cities in India as compared to some cities across the world (2007–2008)



Source: http://www.usclimatenetwork.org/resource-database/unfccc_wri_submissions.pdf.

per kilometre, road transportation needs 4 to 5 times the energy that is needed by a train. The energy used by a car to carry a passenger over one kilometre is 3 to 4 times that of a bus.⁴⁵

Greenhouse gas emissions per passenger of public transport (bus, rail and trams) is about one-twelfth that of a car (Table 7). Although NMTs (including walking) are ideal from the point of view of emissions, in terms of kilometres travelled, these cover only 1 to 2 per cent of the total vehicle kilometres travelled, even if the proportion of trips are as high as 40 to 50 per cent, as in Delhi and other megacities.

Table 7. Typical greenhouse gas emissions

Activity	Tonnes per capita per year
Bus, rail, trams	0.1
Car	1.2
Air travel	1.8
Other direct emissions	0.6

Source: Goodall, 2007.

Various policy initiatives have been taken by South Asian countries to deal with the environmental sustainability of transport. These mainly cover:

- improving the environmental efficiency of vehicles, such as engine/performance,
- fuel type and quality, introducing low pollution fuels,
- improving emissions and environmental regulations,
- improving the quality of road infrastructure and public transport.

45. Goodall, 2007; Verdinejad, undated.

In Mumbai, Delhi and other cities in India, air quality improvement efforts include adopting CNG, LPG and other cleaner fuels, improving engine standards for fuel efficiency and standards, vehicle and road maintenance, strengthening of public transport (BRT, Metro, etc.). Likewise in Pakistani cities, Colombo (Sri Lanka) and Bangladesh (Dhaka) the implementation of initiatives such as CNG technology, mandatory replacement of two stroke engine, vehicle pollution checks, traffic reforms, etc. have been attempted.

The Strategic Action Plan of Maldives (2009–2013) includes the establishment of a nationwide transport system and aspires to become the first carbon-neutral country in the world within a decade. A study on Urban Transportation and Environment in Kathmandu Valley, Nepal, emphasizes the need for developing a comprehensive policy accompanied by a set of practical countermeasures which cover all major components of the activity-structure-intensity-fuel framework. It underscores that small, pro-active and upstream countermeasures such as managing travel demand, promoting a modal shift towards public transportation and progressive tightening of emission standards will reduce the pressure and mitigate emission. It is estimated that such a package will reduce carbon dioxide emissions by 20 per cent and energy use by 18 per cent.⁴⁶

Empirical data indicates that vehicular pollution loads have significantly reduced in various cities (like Delhi), with improved engines and fuels (see Chapter 5), in terms of emissions per vehicle kilometre travelled by cars and 4 stroke two-three wheelers. But the problem is mainly with the exponential growth of vehicles, travel demand and urban sprawl. Therefore, the challenge is to reduce the vehicle kilometre travelled and trip length by travel demand management, land use policy and by complementarily and integrity of various modes of transport.

9.3. Impacts and challenges

In most South Asian cities the sustainability of surface transport system is constrained by three distinct sets of factors. These are:

- physical (e.g., conversion of agriculture/forest for urban use and transport network, environmental impacts, periodic flooding, poor soil condition, siltation and erosion of rivers, etc.);
- low investments in public transport systems; and
- inadequate institutional framework (number of ministries, transport sector parastatals and lack of co-ordination and autonomy of transport parastatals).

The environmental dimension of transport projects often remains disjointed. In practice it means vehicle and fuel centric environmental controls, such as checking of ‘pollution, control certificate’ of vehicles and fuels. In most of the cities there is hardly a comprehensive and legally enforceable system to evaluate and obviate the impacts of urban growth and transportation infrastructure projects (like expressways, flyovers, etc.). The production and ownership of private motorized vehicles are being promoted with government support by the automobile industry, media and aggressive marketing, as well as due to poor alternatives to travel and transport goods. Overemphasis upon transportation hardware such as more and wider roads, grade separators, fuels, engine efficiency and reduction of energy use, have marginalized the software of environmental sustainability of transport, such as promoting walkable city, mixed land use, higher density, compact and smart growth, which reduce the demand to travel. Planning interventions and non-invasive, non-structural solutions such as

46. Dhakal, 2006.

promoting transport and land use integrity and a walkable city structure are hardly adopted in practice. Popular solutions like widening of roads, construction of flyovers/grade separators and mega transport terminals are pursued by transport organizations and political leadership, who consider these as a matter of prestige and professional achievement. However, these often prove to be short term and sometimes even worsen the situation.

Integrity between transport and urban planning, along with transport demand management, transportation mode and technology choice are crucial factors in transport sustainability. It implies a change in perspective as public transport and NMTs are usually seen as the mode for the not so well off section of the community, who cannot afford to own/use personal transport. To change this perception public transport and NMTs have to be reinvented as in the case of Dhaka where Volvo buses were introduced. Luxury air-conditioned buses have also been introduced for city transport in some Indian cities, such as Delhi, Mumbai and Bangalore, etc., which helped in changing the perceptions of public transport. In Agra, state of the art designer rickshaws made them prestigious for the users besides being more efficient, less polluting and more comfortable.

Apart from aspects like reliability, frequency, inter-modal integration and single ticketing systems, the quality of public transport would need to be significantly upgraded, inter-alia, keeping in view the elements of clean and non-carbon (green) fuels and traffic calming. This way a reduction in use of fossil fuels and resulting pollution control is linked with public transport sustainability, efficiency and performance. Some cities in India (Indore, Ahmadabad, Delhi, etc.) have recently adopted Clean Development Mechanism protocols, performance standards and IT based traffic management and passenger information systems for public transport, which can be evaluated and adapted more widely.

10. The Economics of Sustainable Urban Transport

Urban transport in South Asian countries accounts for major public sector budget outlays, and several regulatory and financial instruments have been developed for its financing and long-term maintenance. In order to mobilize private sector resources new partnerships, Special Purpose Vehicles and other instruments have been evolved, together with various incentives.

There has been unprecedented motorization with a skewed growth of private motorized transport, while public transport services are being privatized with increasing costs and fares, thus excluding the poor. Among various initiatives of privatization of public transport services, only very few could be sustained, due to either heavy subsidies from the governments or after being allowed laissez faire fare policies. For example, under the stage carrier kilometre scheme in New Delhi, (1992) private buses were allowed to run, along with state buses on various routes in designated zones. Although the private operators were able to make profits, in contrast to the ever losing (and subsidized) state bus service, privatization could not be sustained due to various reasons, such as frequent involvement of private buses in serious, fatal accidents, frequent traffic violations, penalties for dangerous, rash driving and overloading, allegations of crimes and corruption, and also the government's refusal to increase subsidies or to allow increase in fares.

In Pakistan, various programs for strengthening the sustainability of public transport have been initiated. These include the provision of multimodal urban transport which covers both roads and railways. However, the success of privatization and partnerships in urban transport had been limited, largely due to the financing and capacity constraints of local governments. In various cities (Lahore, Karachi, etc.) the public-private partnership in public transport failed and highly subsidized, loosing public sector buses run in minority along with overcrowded private buses and mini-buses, which are in majority.

The Government of Nepal's Interim Three Year Plan (2007–2010) emphasizes the role of public private partnerships for road infrastructure and public transport. Seeking to rectify the limitations inherent in the transport sector, the Government of Sri Lanka made attempts at consolidating responsibilities and streamlining financing, planning and operational processes via a comprehensive transport policy and intermodal coordination. It aims to coordinate the budgets and action plans of nine ministries who have divided responsibilities for investments and implementation of transport infrastructure projects. Over the last 10 years, in Sri Lanka, budget allocations to the transport sector increased by an average rate of 7.3 per cent per year.⁴⁷ Capital expenditures are predominantly financed with international development assistance comprising loans and grants, which also require government counterpart funds.

The Indian government announced several incentives to increase the role of the private sector in urban transport and road infrastructure. The Expert Group on Commercialization of Infrastructure Policy Reforms underlined the need for greater commercialization of urban transport infrastructure along with the promotion of public-private partnerships. The National Urban Transport Policy⁴⁸ aims to strengthen the economic sustainability of public transport by giving financial assistance to all state capitals and cities with a population of more than one million for high capacity public transport systems through the Special Purpose Vehicle mechanism:

- By providing 50 per cent of the cost of preparing city transport plans and detailed projects.

47. ADB, 2007.

48. Government of India, 2006.

- Viability Gap Funding to the extent of 30 per cent of the total capital cost
- By offering 50 per cent of project capital cost whenever projects are to be financed through public-private partnerships.

The Government has proposed a Rs.50 billion National Transport Revolving Fund for the Metro Rail Transit Systems in various metro cities in India for attracting private investors. Funds are also earmarked for sustainable public transport, which support appropriate fare regulation, pricing control and modal shift from private transport.

Under the National Urban Transport Policy financed public transport schemes, Indore, Ahmedabad, Bangalore, Rajkot, Nashik, Surat, Delhi and some other cities have developed public-private partnership models to operate urban bus services. These are accompanied by several financial and institutional reforms, corporate initiatives and differentiated public transport services. The subsidies in the form of use of public transport infrastructure, tax concessions, etc. have brought forward the private sector in urban public transport.

In Ahmedabad, 48.8 km of BRT corridor has been developed at an average cost of Rs.1.60 million per kilometre. Fifty per cent of the investment for this was borne by the Ahmedabad Municipal Corporation, 35 per cent by the central government and 15 per cent by the State Government of Gujarat. The financing of rolling stock and operations are based on public-private partnerships. It is claimed that by marginal investments in dedicated corridor developments for buses, the speed and delivery of each bus has been doubled.

The Indore City Transport Services Ltd. structured a public-private partnership model for urban bus services. The investment in the urban bus transport system was shared between Indore City Transport Services Ltd, private operators and service providers. Broadly, the cost of common infrastructure like bus stops, bus depot terminal and office space was borne by the Indore City Transport Services Ltd, and the investment in the rolling stock by the private bus operators. The contractual arrangement between the Indore City Transport Services Ltd and the bus operators was based on a franchise arrangement, by way of competitive tendering process. The contract between the successful bidder and the Indore City Transport Services Ltd for tenure of five years is based on the following conditions:

- The operator would pay a fixed monthly premium to the Indore City Transport Services Ltd for the right of plying the buses on selected routes and for using the shared infrastructure.
- The operation and maintenance cost, daily running costs, and other costs of operating the service will be borne by the bus operator. The operator's share of revenue comprises the following.
 - Entire fare box collections.
 - 60 per cent of the revenue from sale of advertising rights.
 - 80 per cent of the revenue from sale of monthly passes.
- The operator will comply with the performance and maintenance standards issued by the Indore City Transport Services Ltd.
- The fare collected from the passengers would be based on tariffs prescribed by Indore City Transport Services Ltd.

The performance parameters for the private entities prescribed by Indore City Transport Services Ltd include:

- Technical specifications for rolling stock; standards for bus, pollution check, fuel, etc.

- Specifications and standards for operations of buses, numbers, frequency, trips timings, maintenance, etc.
- Specifications for the operating staff and their code of conduct
- Standards for support services, geographical information systems (GIS), and passenger information systems (PIS), for monitoring the performance of services and adherence to defined routes, fares and the specifications.

The Indore City Transport Services Ltd involved private parties for BRT corridor retrofitting and maintenance which includes sidewalks, cycle tracks, bus stops, etc, and for the provision of support services like advertising, selling bus passes and installing and operating geographical information systems or passenger information systems in the buses. The public-private partnership model also covered 100 taxis which are accessible through a 24×7 call centre. The experience of the last four years of public-private partnerships indicates an improved ridership on buses (to an extent of 30 to 40 per cent), together with a more reliable, efficient and comfortable service. The experience indicates that the involvement of the private sector in urban public transport in bringing in additional resources was fraught with several problems, such as high costs, low profits and long gestation periods. Therefore, to attract the private sector, the governments participate in their equity and provide certain concessions/benefits such as the provision of interest free/low interest subordinate debt, tax holiday, incentives for property development, sharing of advertisement income, etc.

In order to obviate the high cost of land acquisition for widening of urban roads, the tool of using land for commercial activities (such as hotel, offices, shopping, etc.) and enhanced Floor Space Index also known as Floor Area Ratio, have been used. In Hyderabad, a massive road widening programme has been taken up, whereby the land owners are incentivised to surrender their lands for road widening free of cost, against the benefits of relaxation of zoning and building rules and allocation of extra Floor Space Index against the surrendered land. The Hyderabad Municipal Corporation rebuilds the demolished compound walls and structures affected due to land surrender or pays compensation. If there is no scope for going vertical, the land owner has a choice to avail Transferable Development Rights for using the Floor Space Index elsewhere or sell it. Wherever necessary, non-residential use (commercial/institutional) is permitted to induce landowners to part with their portion of land.

New Mumbai has experimented with selling air-rights to private sector over railway terminals for part financing of the development of transport nodes. Other methods which have been adopted for making urban transport projects financially viable include land bundling, betterment charges, generating international funding, issue of bonds for mass transport projects, excess condemnation for construction of highways/public transport corridors/terminals; passenger/vehicle tax; leasing of urban road, etc. An innovative method which has been adopted in Delhi is the diversion of part of the excise duty levied on hard liquor, and levies on petrol and diesel for financing urban transport projects. The Delhi Tourism and Transport Development Corporation, Delhi State Industrial and Infrastructure Development Corporation and Delhi Integrated Multi-modal Transport Services Ltd. have been constituted by Delhi Government as self-financing special purpose vehicles, who invest in urban transport infrastructure, mainly by combining resources through levies, excise duty, Centre and State Government plan funds and by way of public-private partnerships. The experience indicates that property/land development can offset only a part of the capital investments of large transport projects (like metro, terminals, railways, BRT, etc) and these still need budgetary support and soft loans from the Central/State/Local governments. However, transport investments cannot be and should not be evaluated in segments, but as a part of the whole transport system. While doing so, it is important to keep in view that urban transport is a

powerful tool for poverty reduction, social inclusion, gender equity and empowerment. When viewed in this perspective the focus and priorities shift from mega and high investment transport projects to smaller actions which are more relevant for the common man, like the provision of sidewalks (90 per cent Indian roads do not have them), signage, road markings, drainage, better bus stops, public urinals, removal of roadside encroachments, and bringing the informal motorized transport and NMTs in the urban mainstream by improving the facilities, norms and micro-financing.

A unique characteristic of urban transport in South Asian cities is the substantial component of informal, non-motorized modes, which provide services at affordable costs. These are often outside the spatial and financial support framework of the government. Certain innovative initiatives, such as micro-loans, promoting co-operatives and community partnerships can be of great help in making the small, informal transport modes more viable, safe and sustainable.

11. Urban Transport Institutions and Governance

Urban transport in South Asian cities concurrently involves the centre, state and local/city governments, quasi-government, private sector, transport operators and citizens' groups. Besides the hard institutions, the soft institutions (i.e. media, local community, educational/research institutes, etc.) also play an important role. With growing transport and mobility demand, urban transport institutions in South Asian countries face numerous challenges, such as:

- being under-resourced and lacking in overall capacity to plan, execute, maintain and deliver affordable and sustainable transport;
- fragmented policy formulation and implementation, lack of co-operation among multiple ministries and transport agencies;
- lack of finances for transport infrastructure and urban public transport, which require institutional/ governmental support, concessions/subsidies, etc.;
- the institutional and procedural constraints that impede efficient delivery of transport infrastructure and services;
- lack of a unified legal and enforcement framework;
- lack of financial procedures, accounting and audit systems;
- lack of comprehensive information systems, disclosure and public participation, leading to corruption.

Most of the organized institutions are created and geared to deal with formal traffic and transport and the informal modes and NMTs are left to fend for themselves, although they normally constitute half of the total trips. In most of the cities (except metropolitan centres), there are no integrated mobility and accessibility plans. Traffic and transport planning is often piecemeal, ad hoc and is left to traffic police and regional transport offices. The continuance of the vertical command structure leaves out the scope of horizontalization among the transport infrastructure providers, operators and regulatory bodies, (traffic police, etc.).

Various initiatives and policy responses have been undertaken by South Asian countries/cities to deal with the institutional deficit, issues and challenges of urban transport. In India, the National Urban Transport Policy (2006) supports the capacity building programs, coordination of transport planning and operations for which the establishment of Unified Metropolitan Transport Authorities is being implemented in a million plus cities. These have been set up in Delhi, Mumbai, Jaipur, Chennai, Bangalore and Hyderabad. Notable initiatives include the following:

- Gender Assessment study for Haryana State Road Project
- Engaging railways in dedicated Industrial/Freight Corridors and urban transport
- Establishment of Special Purpose Vehicle for specific execution and financing of urban public transport and infrastructure projects (see chapter 10)
- Procedures and supports for private sector participation in designing and managing various transport related transactions; such as ICT, GPS, land acquisition and resettlement and road construction;
- Involvement of citizen's groups and non-governmental organizations in traffic regulation.

The Right to Information Act (2005) and the Development of Governance and Accountability Action Plan are some of the initiatives to ensure transparency in public financed transport projects. These include:

- Guidance notes and standards, operating procedures and regulatory framework to implement quality road development programs, public-private partnerships, contracting out, double entry accounting, toll roads, bridges, etc.
- Development of benchmarks and indicators to measure the performance of the road construction and urban public transport
- Disclosure policy, website development and information management system
- Complaints handling system; citizen oversight/civil society involvement, mechanisms for dealing with public comments, suggestions and grievances.
- Preventive and penal actions for mitigating collusion in procurement and payment fraud
- Mitigation measures to enhance transparency in contracts/public-private partnerships, civil society audit and social, economic and environmental impact assessment during implementation phase.

The Policy Statement of the Afghanistan Government recommends that road transport should be deregulated to stimulate public-private partnerships and standards should be formulated with regard to accessibility. It envisages establishing an institutional framework which can effectively identify and put in place resources to implement policies so as to improve the accessibility. It seeks to enhance road assets management, and improve the maintenance, planning and execution of transport projects. To mainstream gender in urban transport, the policy stipulates gender assessment of projects to advance women's empowerment. Bangladesh has evolved a National Transport Strategy that reorganizes the role of non-government transport related institutions, together with capacity building for a more professional approach towards transport planning and management. Pakistan has undertaken several initiatives for restructuring its transport organizations and governance. For better transparency, it has adopted assessment of the operating environment for institutions, contractors and consultants. Pakistan has also taken up the enhancement of the capacity for implementing transport infrastructure projects.

Transport infrastructure sector in some countries, viz. India, Pakistan and Sri Lanka involves between 10–20 per cent of a country's budget, which constitutes major public sector expenditure. Corruption in transport projects can account for as much as 5–20 per cent of transaction costs. This means that strengthening governance and, transparency in procedures together with capacity improvement in the transport sector could potentially save 10–40 per cent of overall spending in the sector. The National Urban Transport Policy (India) suggests rebalancing of investments in favour of public transit, walking and cycling and away from road capacity enhancement projects in urban areas.⁴⁹ The Planning Commission (Government of India) underlines the need of procedural reforms, such as undertaking operational risk assessment, supporting the adoption and application of e-procurement, reforms in accountability and transparency, anti-corruption procedures and protocols, disclosure of information, facilitating civil society oversight and developing a credible system to handle public comments, suggestions and grievances.⁵⁰ Such few innovative practices have been adopted in Ahmedabad, Indore and some other cities which provide useful lessons in the performance of urban transport institutions and enhancing governance.

It is being increasingly realized that the gap between planning and implementation can not be bridged without the institutional reorganization, capacity building and streamlining of the procedures, including review of overall mandates, roles, and functions of existing

49. Government of India, 2006.

50. Government of India Planning Commission, 2007.

institutions. As such the establishment of a citywide unified urban transport agency, which also recognizes and promotes the NMTs and non-transport (walking, e-governance, etc) has been initiated in Delhi, Bangalore, Hyderabad and some other cities. A major task of unified transport agency is to promote a more professional approach to transport planning. Its other priorities are streamlining of public-private partnership procedures, updating legal framework, driving license and safety procedures, working out norms and standard operating procedures. As urban mobility concern every citizen, the Unified Transport Agency provides a platform for online and personal participation of citizen groups, media, education and training institutions in the development of public oriented policies, plans, priorities and services. The States/city governments in India are increasingly adopting disclosure policy and accounting procedures to achieve better value of public funds. However, the process of social audit of urban transport projects to ensure creation of an equitable gender sensitive, accessible mobility is still missing, and the concerns specific to South Asian cities such as protecting women's dignity in public transport, role of NMTs, traffic calming, etc. are not given due importance. A composite governance framework needs to be evolved putting together bits and pieces.

To improve the delivery and reduce the risk of corruption, few institutional and governance reforms, such as right to information, social audits, road public expenditure reviews, anti-graft initiatives and project specific fiduciary management measures have been effective. These can be clustered into national policies and reforms, such as, procurement, third party monitoring, road users voice in agency performance monitoring, civil society involvement, optimizing value for money, etc for a more affordable, safer and sustainable delivery of transport infrastructure and services.

12. Towards Sustainable Urban Transport

12.1. Conditions

South Asia is characterized by its massive, widespread poverty having about 36 per cent (596 million) of the population below the poverty line. As a result, widespread transport poverty exists, which in turn creates a vicious cycle of economic and social deprivation. Poor transport infrastructure and services leave hundreds of millions of people in South Asian countries without access to basic social and economic services. Most of the cities, except the metropolitan/capital cities in South Asia, do not have regular public transport and wherever available, it is inefficient, overcrowded and is largely seen as a transport mode for the poor. More than half of the urban population walk or travel by non-motorized transport or informal motorized transport which sustain and service the cities both ways- for movement of people and also goods. With rapid economic growth and urbanization, there has been a runaway growth of private cars/two wheelers, which is widening the gulf between automobile owners and the rest. Poverty stigma is attached to the NMTs, public transport and informal modes, which is reflected by a continuous downslide in their use. These provide not just mobility but livelihoods to the poor. Cycle rickshaws, which cater to a significant proportion of trips (13 per cent in Dhaka, and between 5 and 10 per cent in Kolkata, Chennai, Delhi and Hyderabad) are struggling for survival. Among the traffic and transport officials the perception prevails that improvements in traffic flows can be achieved by banning slow moving traffic, like the push cart, rickshaws, etc. and by reducing the volume of cyclists, goods vehicles or pedestrians.

Although informal transport services tend to bridge the voids left by formal public transport operators, these are riddled with numerous challenges, such as lack of space on roads and for parking, harassment by traffic and transport officials, poor vehicle safety and fitness standards, lack of insurance, etc. In South Asian cities, there is an absence of normative policy frameworks for informal transport services.

In South Asia, only very few cities have a public transport system. For example, in India out of 5161 cities/towns in India only about 100 cities have public transport (usually bus service). An estimated 62 per cent of the commuting trips in Delhi are made by 46,000 CNG powered buses, which are less than one per cent of the total motorized vehicles, running about 13 million km (8 per cent of the total motorized distances travelled) and transporting nearly 6 million passengers per day (62 per cent of trips made). On the other hand private modes (cars plus motorcycles) carry 31 per cent of motorized vehicular trips covering 73 per cent of the total motorized distances travelled, and are responsible for 90 per cent of emissions against 4 per cent emission from the buses. However, the roles of car and two-wheelers cannot be undermined, which contribute very significantly in terms of vehicle kilometre travel. In cities like Delhi private automobiles (cars and 2 wheelers) cover 123 million vehicle kilometres per day as compared to 13 million vehicles kilometres per day by public buses.

With a rapid growth of suburban and peri-urban areas, the South Asian cities are witnessing a rapid pace of motorization According to Wilbur Smith & Associates (WSA) and Ministry of Urban Development (MOUD) study (2008), of 30 Indian cities during 1994–2007 the share of motorized vehicles grew at the rate of 12 per cent per annum, i.e. almost 2 to 3 times the population growth.⁵¹ In India the growth of motorized vehicles over a period of 1990–2001 had been 775 per cent.⁵² The gap between private vehicle owners and low income

51. Wilbur Smith Associates, 2008.

52. Government of India, 2006.

groups with restricted mobility is widening. The fast-growth of private vehicles is also a most intractable source of carbon emissions and loss of agricultural and natural land areas, leading to increase in traffic congestion, demand for roads and parking, increasing travel and transport costs, increasing energy consumption and emissions and more accidents.

With the growing economy, the cities in South Asia are emerging as the hubs of transfer of goods. Bulk of inland goods transport (roughly two-thirds) is by roads, while the roles of railways, shipping and air are marginal. NMTs and informal modes provide bulk of the transport and feeder services for regional goods transport. However, poor condition of roads, lack of seamless connectivity, conflicts between goods and passenger transport, congestion, accidents and emissions are some of the major challenges. Goods transport also suffers from the want of space for freight terminals, warehousing, markets, and transport centres. Informal goods transport and NMTs are hardly included in the formal logistic chains, design of roads, terminals, etc. Road based freight transport is highly fossil fuel dependent and there is a need to explore various alternatives, such as NMTs, railways, ropeways, pipelines and maritime transport.

12.2. Social sustainability

In the context of South Asian cities, mobility acts as a powerful tool of poverty alleviation, social inclusion and sustainability. For the majority of people mobility is relevant in meeting their basic needs (livelihood, jobs, economic growth, safety and security). Every government in South Asia is committed to social equity and poverty alleviation, which are contingent upon the provision of inclusive and sustainable transport. In many cities public transport and NMTs are seen as the mode for the poor. To change this perception public transport and NMTs have to be given space and made safer, more efficient and less polluting. Such measures will be of direct benefit to women, children and other vulnerable users, in terms of protecting their modesty and health, reduction in traffic related insecurity and accidents, reducing their time poverty and increasing their employability and productivity. A peculiar problem of traffic in South Asia is aggressive driving behaviour, leading to high levels of accidents, dangers and noise. Traffic calming measures are necessary together with reviewing the driving license procedures, road safety audit and better enforcement. Social Audit and Social Impact Assessment of urban transport projects can be the effective tools of civil society participation and to ensure gender dignity and equity, safe, inclusive and barrier free transport. It will also ensure the provision of dedicated facilities for pedestrians, cycles and other NMTs. Participatory social audit of urban transport projects would help in empowerment of the society and give voice to relevant stakeholders, especially the pedestrians, NMT users, elderly, women and children.

12.3. Environmental sustainability

In many South Asian cities motorized urban transport on an average contributes one-fourth of carbon emissions and suspended particulate matter goes as high as 72 per cent in some mega cities like Delhi. The impacts of oil-based transport energy on the natural environment (energy and mineral extraction and use, hydrological cycle and water quality effects, consumption of agricultural land and natural habitats through urban sprawl, air pollution, etc.) and the built environment (noise, pollution, accidents, community severance) are significant. In some South Asian cities various technological/vehicles improvements and use of cleaner fuels have yielded positive results by reduction of air pollution. However, the gains tend to be neutralised by rapid increase in number of vehicles, volume of traffic and trip lengths. This implies looking at the city form, land use policy and integrity between transport and urban

planning, along with transport demand management, as the critical factors of environmental sustainability. There is need to develop a new perspective of urban planning for achieving better land use –transport integration and urban restructuring for a compact, walkable and smart growth.

12.4. Economic sustainability

Urban transport in South Asian countries accounts for major public sector budget outlays. The pressures of increased land values, urban accessibility, expanding population, globalization of commerce and the locational preferences demand efficient and optimum connectivity and mobility. In order to mobilize private sector resources, Special Purpose Vehicles and other instruments have been developed, together with incentives to promote public-private partnerships. The experience indicates that property/land development can offset only a part of the investments of the public transport projects (like metro, terminals, railways, BRT, etc) and these still need budgetary support and soft loans from the governments. However, transport investments cannot be and should not be evaluated in segments, but as a part of the whole transport system and overall urban development. While doing so, it is important to keep in view that urban transport is a powerful tool for economic growth, poverty reduction, social inclusion, gender equity and empowerment. When viewed in this perspective the focus and priorities shift from mega-projects to local, smaller actions, like promoting NMTs, informal motorized transport and walking, provision of sidewalks (90 per cent of roads in India and other South Asian cities do not have them), signage, road markings, drainage, better bus stops, removing roadside encroachments and improving the facilities for informal transport and NMTs. NMTs and informal transport are the characteristics of South Asian cities, which can be legalised and supported by a normative and regulatory framework, micro-loans, community and cooperative partnerships together with dedicated provisions as part of mainstream urban transport.

12.5. Institutional sustainability

Urban transport concurrently involves the centre, state and local city governments, besides quasi-government, private sector, operators and non-government actors. Soft institutions i.e. media, citizens groups, local community, educational/research institutes, etc. also play an important role. In a multiple layered set up of governance, gaps exist in the convergence of urban transport policies and programs with economic, political and technocratic objectives. There are issues of unplanned, informal settlements where bulk of the poor live and work and face transport poverty. For inclusive transport strategies the issue of institutional and governance sustainability is vital. This would help in better focus upon the day to day concerns of the users, such as road safety and maintenance, quality and punctuality of public transport service, safe mobility of women, children and the vulnerable sections, affordable fares, relieving the pollution and congestion, checking corruption and providing timely traffic/transport information to the users, etc. Most of the organized institutions are created and geared to deal only with formal traffic and transport, while the informal modes of transport and NMTs, which constitute about half of the total trips are relegated to fend for themselves. In most of the cities (except some metropolitan centres), there is no organization for traffic and transport planning, which is often relegated to traffic police and regional transport office. Governance systems often function on a vertical command structure, and hardly any attention is given to horizontalization among the transport infrastructure providers, operators and regulatory bodies, (traffic police, etc.). A visible gap, which needs to be bridged is the establishment of citywide unified urban transport agency, which promotes NMTs, walking, e-

governance, and provides a more professional approach to transport planning. A citywide unified transport platform can also help in reviewing of the driver's licensing procedures and safety audits. A major area of improvement in transport planning and development pertains to working out norms and parameters and standard operating procedures. To harness the private sector resources in urban transport, streamlining of public-private partnership procedures, updating the legal framework, reviewing the procedures of environmental, social and economic impact assessment and social audit, disclosure policy and reviewing of accounting procedures are the pre-requisites. Participation of citizen groups, transport cooperatives, media, educational and training institutions in traffic and transport planning and operations can help in evolving the policies, plans and priorities which can be people centric and local.

This calls for a review of the prevailing urban transport policies and practices in the countries of South Asia, with the object of making it inclusive by integrating social, environmental, economic and governance pillars of sustainability.

List of References

- ADB (Asian Development Bank) (2010) *Basic Statistics 2010*, Manila
- ADB (2007) Sri Lanka Country Program Evaluation, Transport Sector, Manila
- Aggarwal, A. (2009) ‘Samarthayam, Guidelines for Inclusive Pedestrian Facilities’, Report for Indian Road Congress, New Delhi
- Arora, A., M. Jarnhammer and J. Fazan (2010) ‘Green and pro-poor?, The role of informal transport in India’, Background paper for the conference, ‘The Environment of the Poor’, 24–26 November, New Delhi
- Barter P.A. (1999) *An International Comparative Perspective on Urban Transport and Urban Form in Pacific Asia: The Challenge of Rapid Motorisation in Dense Cities*, PhD Thesis, Institute for Sustainability and Technology Policy, Murdoch University, Australia
- Bhandari, K., A. Shukla, S. Gangopadhyaya and Y. Hayashi (2010) *Environmental Implication and Passenger Mobility in Delhi*, Paper presented in Transect Conference, April, New Delhi
- CAI Asia (Clean Air Initiative) (2010) ‘Walkability in Asia’, cleanairinitiative.org/portal, last accessed 21 June 2011
- Central Pollution Control Board, India (undated) ‘Latest’ <http://www.cpcb.nic.in/>
- City District Government, Karachi (2007) *Karachi Strategic Development 2020*, City District Government Karachi
- CRRI (Central Roads Research Institute) (2002) ‘Urban Road Traffic and Air Pollution (URTRAP)’, Final Report, Submitted to Society for Indian Automobile Manufacturer, New Delhi
- CRRI (2009) ‘A study of daily vehicles off the road due to metro in Delhi’, CRRI, New Delhi
- DDA (Delhi Development Authority) (2007) *Master Plan for Delhi, 2021*, Government of India, New Delhi
- Dhakal, S. (2006) *Urban Transportation and the Environment in Kathmandu Valley, Nepal: Integrating global carbon concerns into local air pollution management*, IGES, Japan
- Doxiadis, C. (1965) ‘Islamabad, the creation of a new capital’, *Town Planning Review* **36**(1): 1–28
- GOB (Government of the People’s Republic of Bangladesh) (2004) *Strategic Transport Plan (STP) for Greater Dhaka (2004–2024)*, GOB, Dhaka
- Goodall, C. (2007) *How to Live a Low Carbon Life*, Earthscan, London
- Government of Delhi (undated) ‘Introduction’ www.transport.delhigovt.nic.in, last accessed 5 May 2011
- Government of India (2006) *National Urban Transport Policy*, Ministry of Urban Development, New Delhi
- Government of India (2008) *The Gazette of India Notification*, Unified Traffic and Transportation Infrastructure (Planning and Engineering) Centre, Regulations, New Delhi
- Government of India (2009) *White paper on Indian Railways*, New Delhi
- Government of India, Planning Commission (2007) ‘XIth five year plan (2007–2012)’ New Delhi, India
- Government of Maldives (2009) ‘Strategic plan of Maldives 2009–2013’, Male, Maldives
- Government of Nepal (2007) ‘Interim three year plan (2007–2010)’, Kathmandu

- Hoque, M.M., B. Khondokar and M.J.B. Alam (2005) 'Urban transport issues and improvement options in Bangladesh', Proceedings of Canadian Transport Research Forum (CTRF) Conference, Toronto, Canada
- ICLEI (International Council of Local Environmental Initiatives) (2009) *Energy and Carbon Emissions Profiles of 54 South Asian Cities*, New Delhi
- JAGORI (Women's Training, Documentation and Communication Centre) and GNCTD (Government of the National Capital Territory of Delhi) (2005) *Surveys on Gender and vulnerabilities in Delhi*, New Delhi
- Jain, A.K. (2009) *Urban Transport Planning and Management*, APH Publishing, New Delhi
- Jain, A.K. (2011) *Sustainable Urban Transport and Systems- Planning, Design and Engineering*, Khanna Publishers, New Delhi
- Kayitha, R., M. Errampalli, S.Velmurugan and S. Gangopadhyay (2010) 'Impact of vehicular emission norms on vehicular pollution loads in Delhi' 24th ARRB Conference – Building on 50 years of road and transport research, Melbourne, Australia 2010, CD-ROM
- Kenworthy, J. (2011) 'An international comparative perspective on fast rising motorization and automobile dependence', in H.T. Dimitriou and R. Gakenheimer (eds) *Urban Transport in the Developing World: Perspectives from the First Decade of the New Millennium*, Edward Elgar, Cheltenham
- Khan, H.-H. (1987) *Charles Correa Architect in India*, Mimar Book, Butterworth architecture
- Koptis, E. and M. Cropper (2003) 'Traffic fatalities and economic growth', Policy Research Working Paper No. 3035, World Bank, Washington, DC
- Kumarage, A. S., (2007) 'Impacts of transportation infrastructure and services on urban poverty and land development in Colombo', *Global Urban Development Magazine*, 3(1): 46–57
- Lennat, O. and M. Thynell (2004) *Bangladesh Road Transport Corporation (BRTC) Bus Project in Dhaka*, SIDA Evaluation 06/38, 2004, SIDA, Sweden
- Malik, Z. (2004) 'Mass transit in Karachi: Moving in a right direction, Islamabad', Presentation in Chartered Institute of Logistics and Transport, Pakistan Annual Seminar, Karachi Mass Transit Cell, City District Government, Karachi
- Maunder, D. A.C., T.C. Pearce, D.M. Babu and N.B. Nyachhyon (1999) 'The safety of public transport services in Nepal and India in an environment of deregulation and privatization', Transport Research Laboratory
- Ministry of Health and Medical Education, Death Registration System in 2005 (In Persian), Tehran, Iran
- Ministry of Road Transport and Highways (2009) *Road Transport Year Book*, Government of India, New Delhi
- Ministry of Urban Development, Government of India (2009) Transforming city bus transport in India through financial assistance under Jawaharlal Nehru National Urban Renewal Mission (JnNURM)', New Delhi
- Naghavi, M., S. Shahraz, K. Bhalla, N. Jafari, F. Pourmalek, D. Bartels, J. Abraham and M. E. Motlagh (2009) 'Adverse health outcomes of road traffic injuries in Iran after rapid motorization', *Archives of Iranian Medicine* 12(3): 284–294
- Newman, P. and J.R. Kenworthy (1999) *Sustainability and Cities, Overcoming Automobile Dependence*, Island Press, Washington, DC
- NIUA (National Institute of Urban Affairs) (2002) 'Small Scale Private Water Providers', (a study for ADB), New Delhi

- Ramasaamy, N. and A. Satyaramchander (1998) 'Lessons from private bus operation in Delhi', *Indian Journal of Transport Management* **22**(7)
- Replogle, M. (1993) 'Bicycle and cycle rickshaws in Asian cities', 6th Conference on Urban Transport in Developing Countries, CODATU VI, Tunis, 1993
- RITES Ltd and TERI (2010) 'Traffic and transport demand study for NCT of Delhi', Unpublished Report, Delhi Integrated Multi-modal Transport Services Ltd. (DIMMTS), New Delhi
- TEPA (Traffic Engineering and Transport Planning Agency) and JICA (Japan International Cooperation Agency) (1992) *Comprehensive Study on Transportation System in Lahore*, TEPA, Lahore
- UN (United Nations) (2008) *World Urbanization Prospects: The 2007 Revision Population Database*, United Nations Population Database, <http://esa.un.org/unup>, last accessed 11 August 2010
- UN Habitat (2000) *Informal Transport in Developing World*, UN-Habitat, Nairobi
- UNESCO (2010) Institute for Statistics Data Centre, http://unstats.un.org/unsd/demographic/sources/census/2010_PHC/default.htm
- Verienejad, F. (not dated) 'A review of Iran's transportation history and its recent energy demand issues', <http://www.verdinejad.com/VisitorPages/show.aspx?IsDetailList=true&ItemID=15244,8&language=en>, last accessed 21 June 2011
- Vuchic, R.V. (1981) *Urban Public Transport System and Technology*, Prentice Hall, Eaglewood Cliffs, New Jersey
- Wikipedia (undated) 'Cycle rickshaw' http://en.wikipedia.org/wiki/Cycle_rickshaw, last accessed 21 June 2011
- Wilbur Smith Associates (2008) *Study on Traffic and Transportation Policies and Strategies in Urban Areas in India*, Ministry of Urban Development, New Delhi
- Wipperman, T. and T. Sowula (2007) 'The rationalization of non-motorized public transport in Bangladesh', The Progress Bangladesh, http://www.progressivebangladesh.org/index.php?option=com_content&task=view&id=74&Itemid=26
- World Bank (2002) *India's Transport Sector, the Challenges Ahead*, Washington, DC
- World Bank (2004) *Action Plan Road Traffic and Transport, (Afghanistan)*, Washington, DC
- World Bank (2008) *Dhaka Case Project*, Washington, DC
- World Bank (2009) *Transport Strategy Brief for South Asia Region*, Washington, DC
- World Bank (2009a) *World Development Indicators database*, Washington, DC
- World Bank (2010) *Transport Challenges in South Asia*, Washington, DC
- World Bank and Indian Railway Board (1998) 'Study on reforms for Indian railways', New Delhi