

Sustainable Public Transportation: A Study of Policies and Practices in Indian Cities

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Abstract:

The current paper aims at understanding the policies and practices adopted and implemented by Indian cities to achieve sustainable transportation systems. The paper tries to study the trends in urbanization, motorization and its impact on environment. It also explores policy making by the government to address the issue of sustainable public transportation and its implementation as well as innovative practices adopted by various cities in India. The paper is based on secondary research and literature review of the recent trends and research in the emerging field of sustainable transportation systems. It is expected that the current paper will lead to the understanding of the issue of sustainable public transportation and its impact on environment, It will provide direction and guidelines for policy makers and public transportation bodies to design and manage their transportation systems in a way that will lead to more efficiency and effectiveness in their operations without creating adverse impact on the environment.

Keywords

Sustainable Transportation Systems, Urban Public Transport, Innovative Transportation Systems

Introduction:

One of the most important components of urban development is transportation. There is a growth in demand for transportation due to the growth in business, trade and urbanization all over the world. The problem of transportation problems arise mainly due to the growing demand and the inadequacy of the supply of transport facilities. This mismatch between capacity or supply of transport facilities and the increasing demand from people causes an unsustainable condition. Traffic congestion, travel delays and dissatisfaction amongst the travelers are all the results of this imbalance. These are accompanied by environmental problems like air and noise pollution with high vehicular emissions and excessive fuel consumption. The concept of sustainability thus arises from the need of having a transportation system which would efficiently cater to the needs and travel demands of citizens, without causing any negative impact on the environment.

Sustainability is the buzz word in transportation planning and policy. It can be broadly defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their needs. In the context of transportation, sustainability would mean developing better transportation systems, options and expectations consistent with the objective of securing future social and economic development within a sustainable environment that ensures community well-being. Transport sustainability can be achieved through measures pertaining to transportation system management, energy management, capacity management and environmental management. It is also important for developing countries from the perspective of climate change and reducing emissions and carbon footprint. According to the European Union Council of Ministers of Transport ‘A sustainable transportation system is one that: (i) Allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations. (ii) Is affordable, operates fairly and efficiently, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development. (iii) Limits emissions and waste within the planet’s ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimizing the impact on the use of land and the generation of noise.

Materials and Methods

The present paper is based on the review of available literature on the subject of sustainable transportation. The data for the study was collected from the secondary sources in form of published research papers and articles related to the subject. The researcher also referred the policy documents on transportation and urbanization published by the government of India and research reports on the subject prepared and published by various national and international bodies and agencies.

Need for sustainable transport systems: The need for sustainable transportation system arises due to the following factors.

i) Urbanization: An urban area is an area with an increased density of human-created structures in comparison to the areas surrounding it. Urban areas may be cities, towns or conurbations, but the term is not commonly extended to rural settlements such as villages and hamlets. The definition of 'urban' varies from nation to nation. The definition of 'urban' in the Indian context is: 'The towns (places with municipal corporation, municipal area committee, town committee, notified area committee or cantonment board), all places having 5000 or more inhabitants, a density of not less than 400 per square kilometer, pronounced urban characteristics and at least three fourths of the adult male population employed in pursuits other than agriculture, are treated as urban areas'. According to India Census (2011), urban population in the country is 377 million. On an international scale, India has witnessed fastest urbanization rates during last decade or two in the developing world. India's urban population increased from 17.3 percent in 1971 to 23.3 percent in 1981, 27.78 percent in 2001 and expected to increase 38% in 2026. The 2011 Census figures reveal that over 31 per cent of the country's population is presently living in urban areas. This of course is lower than that for China, Indonesia, Mexico or Brazil.

ii) Motorization: Indian cities have registered an astronomical growth in registered motor vehicles in the last decade (Figure 1). Booming economy, aspirations to own a car, unmatched public transport (with respect to demand, comfort or both), the government's encouraging policies (open car market, easy loan schemes), etc. are a few reasons for increasing motorization at a rapid rate. The estimates of vehicular growth are unimaginable and threatening. For example, Table 1 shows that cars and SUVs will increase 13-fold in 2035 with respect to 2005 statistics under the do-nothing scenario. Unfortunately, a similar growth has not been observed for bus fleets of major transport undertakings in India.

Impact of transportation on environment

If we consider the current state of sector-wise carbon emissions (Figure 2), it can be observed that the transport sector has a major share of 26% of total carbon emissions as compared to other sectors, such as energy, manufacturing, residential, commercial, etc. Also, within the emissions from the transport sector, road transport has a major share of 65% as compared to rail, air and water transport. Certainly, these facts are closely related to the present trends of urbanization, motorization and modal share. The major share of fuel consumption as well as emissions is by cars and two-wheelers as compared to buses, except for cities of Category 6, i.e. more than 8 million population, where the fuel consumption is higher for buses but still the emission is less compared to cars. According to an Asian Development Bank report, transport-related CO₂ emissions from developing countries will contribute in increasing proportion to global CO₂ emissions unless mitigating measures are implemented soon. Thus most of the Indian cities today are typically characterized by high-density urban areas, absence of proper control on land-use, lack of proper roads and parking facilities, poor public transport, lack of road-user discipline, etc. This level and type of urbanization in India has caused many problems, especially with regard to its impact on the demand for infrastructure facilities. Urban transport systems have come under heavy strain and this has adversely affected the quality of life of the urban dwellers.

Policy initiatives of government

Realizing the magnitude of the problem, the central and state governments have taken up some major initiatives in the recent past to achieve sustainability in transport, some of which are as below.

National Urban Transport Policy 2006: In 2006, the Ministry of Urban Development, Government of India issued the National Urban Transport Policy (NUTP) document, which lays emphasis on moving people rather than vehicles. The following are the objectives of the policy.

- 1) Incorporating urban transport as an important parameter at the planning stage rather than being a consequential requirement
- 2) Reduced travel demand – better integration of land-use and transport planning
- 3) Equitable allocation of road space
- 4) Improved public transport
- 5) Introducing intelligent transportation system (ITS)
- 6) Facilities for use of non-motorized vehicles
- 7) Capacity building – individual and institutional
- 8) Use of cleaner technology
- 9) Innovative financing mechanism
- 10) Greater involvement of private sector
- 11) Better awareness

The NUTP has now become the guiding document for all urban transport improvements in Indian cities.

Jawaharlal Nehru National Urban Renewal Mission (JnNURM)

JnNURM has been recently launched by the central government to provide financial assistance to 63 mission cities for various urban development projects including urban transport. It is a reform-based mission. The statement of the vision is ‘Reform-driven fast track planned development of identified cities with focus on efficiency in urban infrastructure/services delivery mechanism, community participation and accountability of urban local bodies (ULBs) towards citizens’. The central government made it mandatory for all urban transport-related proposals to be in consonance with NUTP, for them to be eligible for funding under JnNURM.

Overview of JnNURM

The selection of cities is primarily based on the population of the cities and the other state capitals and cities with religious or historic importance. Sixty-three cities were selected based on the above criteria and their classification is as follows. The numbers in the brackets indicates, the number of cities falling under that category.

- Cities/Urban areas (UAs) with 4 m + population 2001 census (7)
- Cities/UAs with 1 m + but less than 4 m population according to 2001 census (28)
- Selected cities/UAs (state capitals and other cities/ UA of religious/historic and tourist importance) (28).
- This scheme covers 63 cities/UAs with a population more than 150 million to be benefited.
- The expected order of investment is around Rs 1000 billion in seven years.
- Thrust areas
 - Water supply
 - Sewerage
 - Solid waste management
 - Drainage including preservation of water bodies
 - Urban transport
 - Inner city renewal
 - Development of heritage area
 - Provision of basic services to the urban poor.

As many as 63 cities across India, demonstrating vision and creativity have introduced innovative measures in urban planning, management and governance following central government policy innovations such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM) of 2005. These innovations have triggered some changes, but sidestepped the existing planning processes that seem too complicated to be amenable for any change (GoI, 2005). This reform based mission is meant for extending Central Financial Assistance (CFA) to Urban Local Bodies and includes betterment of urban transport planning and management through

- 1) Comprehensive Mobility Plan (CMP),
- 2) Unified Mass Transit Authority (UMTA),
- 3) Dedicated Urban Transport Fund at state and city level,
- 4) Transit Oriented Development Policy, Parking Policy and Advertisement Policy,
- 5) City specific Special Purpose Vehicle for managing public transport,
- 6) Traffic Information and Management Control Centre, etc.
- 7) Use of ITS and integration of multi-modal systems,
- 8) Bus prioritization at intersections, dedicated/ demarcated lanes for buses,
- 9) Designate a nodal department for urban transport and

10) Mechanism for periodic revision of public transport fares (Lohia, 2011).

Integration of transport and land use planning is a key suggestion of the National Urban Transport Policy adopted in 2006, and Transit-oriented Development is gradually becoming a strategic point of focus in several key cities such as Delhi. In fact, urban transport is witnessing quite some innovation but mobility is a serious challenge in most Indian cities and towns mainly due to inadequate transport infrastructure, unbalanced modal split heavily favoring private transport and little integration between land use and transport planning. Private transport is increasing by leaps and bounds every day but roadways remain the same or at best increase marginally (Suri, 2011). Improvement in public transport is becoming increasingly common characterized by innovative planning combined with the use of modern technology in major metropolitan cities of India. For instance, all modes of public transport, including Bus Rapid Transit system (BRTS) and metro rail are resorting the use of Compressed Natural Gas (CNG). Public service vehicles in the National Capital Territory run on CNG for over a decade now. This policy introduced in 2001-02 under the directives of the Supreme Court of India; is implemented now effectively and as a result the capital became relatively free of diesel smoke. For example, between 2000 and 2008 carbon emissions in the metropolis had plummeted by 72% while SO₂ emissions decreased by 57%, though 3500 buses, 12,000 taxis, 65,000 auto rickshaws and 5000 mini buses are plying in and around the mega city solely due to the use of CNG (Hohne & Burck., 2009). Buses serve as the most important mode of public transport across all cities. Bus Rapid Transit System Projects for 437 km (Pune-101.77 km, Pimpri Chinchwad-42.22 km, Indore-11.45 km, Bhopal-21.71 km, Ahmedabad-88.50 km, Jaipur-39.45 km, Vijayawada-15.50 km, Visakhapatnam- 42.80 km, Rajkot-29.00 km, Surat-29.90 km and Kolkata-15.00 km) were sanctioned to 10 mission cities in the country at a total cost of US \$ 1085 million (@US \$ 2.4 million per km). Urban Ministry is supporting Metro Rail projects to serve high demand corridors in bigger cities such as Delhi (117.00 km), Mumbai (62.89 km), Bangalore (42.30 km), Kolkata (14.67 km), Chennai (46.50 km), Hyderabad (71.00 km) and Kochi (25.30 km) (GoI, 2011a).

Problems in achieving sustainable transportation

In spite of these and many other initiatives by the central and state governments, the improvements are still not encouraging, as evident from the trends presented in the earlier section. There are many problems and issues that need to be addressed in order to make these efforts successful in achieving sustainability in transportation for Indian cities. The same is discussed under various categories in subsequent sub-sections.

Transport planning and modeling: One of the reasons for unregulated urban growth and sprawl in India is the lack of integration of land-use and transportation planning. For saturated and dense urban areas of Indian cities, questions such as ‘what ceiling would be appropriate to restrain the land-use considering the holding capacity of transport infrastructure?’ are often important to answer. The current floor space index of 1.6 in urban centers of India compared to indices ranging from 5 to 15 in other Asian city centres actually encourages car-centric development. This is one of the reasons for the sprawl and dispersion of development activities. Also, traditional four-stage demand modeling process is the main modeling technique employed in India for all transportation planning processes. There is no/little use and understanding of other modeling techniques like activity-based modeling, etc. Traditional demand modeling techniques which adopt trip-based approach and uses ‘trips’ as the basic unit of analysis have limitations of dealing with behavioural issues, for instance, modeling multistep tours, etc. Further, effective use of discrete modal choice models is required to predict the modal shares of NMT, IPT, etc. better, which are often ignored in the Indian context. It is also necessary to represent the realistic behaviour in travel demand modeling particularly because of increasing interests in evaluating the short/ medium-term strategies than long-term capital-intensive strategies. This is essential to understand the behaviour of people against demand management policies such as congestion pricing, staggering of work schedules, etc. In planning and policy making there is need to clearly understand the effective approaches for framing urban transport strategies for Indian cities. So far, problem oriented or bottom-up approach is adopted in all transportation studies and strategies in India, whereas top-down approach is seldom adopted or even considered.

Non-motorized transport: One of the basic reasons for the lack of proper infrastructure for pedestrians and bicyclists in India is the lack of understanding of the mobility role that each of these modes (as main mode or access/egress mode) can play for Indian cities of different size (physical and population), and shapes. Accordingly, the planning focus and infrastructure provisions will differ. Also, comparing the Central business district (CBD) areas of many European cities with Indian cities, it can be observed that while in European cities, CBDs are mostly pedestrian/bi-cyclists zones and/or public transport only zones; in Indian cities they are the most congested/polluted

parts and NMT unfriendly because the private vehicles are allowed to enter a CBD and it is perceived as good for businesses located inside a CBD. One of the important reasons for this situation is the lack of sound approaches to study the impact of NMT and/or PT zones on the overall mobility within and outside a CBD, and on the businesses in general. Another common issue with respect to pedestrian facilities in India is the encroachment of footpaths by hawkers/vendors. They are desirable to the road users and pedestrians because the services provided by them are cheap and convenient to them. However, the same hawkers/ vendors cause inconvenience to them while using walkways for their movement. This contradictory perception of people changes according to their needs and class. Therefore, given the heterogeneous structure of our society and urban areas, street vendors are not only necessary but also inevitable, as they provide services to all commuters with cheap and easily available goods. They have also been a characteristic feature of Indian cities and towns from time immemorial. The reasons for the present trends of motorization can be listed in two categories: general reasons such as urban sprawl, decentralization, lack of public transportation services, poor level of service offered by public transport, lack of efficiency of bus mode in congested traffic, introduction of small and low-cost automobiles etc.; and socio-economic reasons such as increase in income levels, easily available and attractive credit and financial schemes, increase in number of cars owned per household, rise in middle class aspirations to own a vehicle, etc. An affordable public transport with a desired minimum level of service would always attract ridership in Indian cities; however, the majority of public transport riders in Indian cities are captive riders. This is the major reason behind the increasing trend of motorization because, as soon as the captive rider turns into a choice rider, public transport becomes the less-preferred mode. In order to make sustainable in Indian cities, one of the important requirements is a good networked public transportation system with time-bound schedules, reliable services, comfort, competitive travel times and affordable prices. These features will improve the generalized cost of travel by PT modes and will make mass transit attractive and will thus bring about a shift from individual mode to public transport. Many Indian cities are now introducing multi-modal mass transit systems which need good integration to be able to effectively serve the overall mobility needs of the city. Inter- and intra-connectivity between modes such as public versus public and public versus private needs to be ensured for an efficient transport system. The other important requirement includes good pre-trip planning system for PT users to plan their trips based on certain needs and criteria.

Results and Discussions

Implementing a sustainable transportation system: Pardo (2010) had suggested four measures for sustainable urban transport, namely, 1) public transport, 2) subway and light-rail system, 3) metro and urban light-rail system and 4) non-motorized transport.

Public Transport: This measure implies the development of high quality public transport systems, which include mass transit systems. A specific public transport mode called Bus Rapid Transit (BRT) has been generally favored in recent years due to its moderate cost of implementation, relatively short implementation time, high quality of service, and capacity to move large numbers of passengers once it is implemented. Subway and light-rail systems are other means of rapid, cost-effective and environmentally benign urban passenger transport. For example, 116 cities, located mostly in the industrialized countries, operate their own metro systems, which are used by an estimated 155 million passengers each day. In addition, there are about 400 light rail systems worldwide, while over 200 new systems are being planned. Many megacities in developing countries are also investing in the construction, modernization and expansion of urban light-rail systems. Sustainable Urban Transport Metro and urban light-rail systems are costly to construct and to maintain but can provide significant long-term economic, social and environmental benefits. Various studies analyzing investment in urban public transport infrastructure and services have shown that in the long term the sum of public benefits by far exceed the investment costs. Urban public transport systems are more attractive for commuters and more economically viable for operators if they offer the option to travel from any point in the city to any other point. This can be achieved through the expansion of network as well as through intermodal connections.

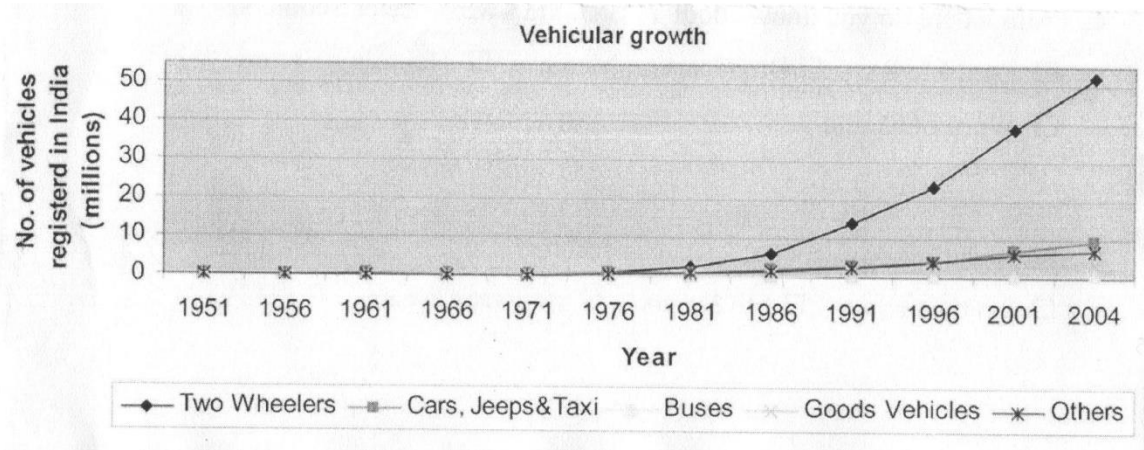
Subway and light-rail systems: This is a means of rapid, cost-effective and environmentally benign urban passenger transport. For example, 116 cities located mostly in industrialized countries operate their own metro systems, which are used by an estimated 155 million passengers each day. In addition, there are about 400 rail systems worldwide while over 200 new systems are being planned. Many megacities in developing countries are also investing in the construction, modernization and expansion of urban light-rail systems.

Metro and urban light-rail systems: This system is costly to construct and maintain but can provide significant long-term economic, social and environmental benefits. Various studies analyzing investment in urban public transport infrastructure and services have shown that in the long term the sum of public benefits by far exceed the investment costs. Urban public transport systems are more attractive for commuters and more economically viable for operators if they offer the option to travel from any point in the city to any other point. This can be achieved through the expansion of network as well as through intermodal connections.

Non-motorized transport: Also called “Active Transport”, it essentially refers to walking and cycling (and all other modes that have wheels but no engine such as pedicabs and freight tricycles), as well as related infrastructure, policies and education. All these transport modes have been greatly promoted in recent years due to lot of short and long term benefits in reducing greenhouse gas emissions and for ensuring healthy environment. Urban planning practices shall be geared up to reflect a new awareness and to integrate environmental, health, economic and social concerns of the 21st century (UN-Habitat, 2013). The key challenges in many cities of developing countries and emerging economies are lack of awareness about the wide benefits of non-motorized infrastructure and scarce financial resources for the implementation of necessary projects. Sustainable urban mobility practices from various internationally acknowledged case studies mention that auto- free zones, bikeway, bike-sharing, bus rapid transit, carpooling, car-sharing, congestion charge, demand-responsive public transport, flyover/overpass, integrated planning and pedestrian ways play an important role in integrated environmental, health, economic and social concerns during the preparation of mobility plans for a city or a town.

Conclusions: Thus sustainable transportation systems are the need of the hour in order to reduce the harmful impact of emissions and carbon footprint and to provide an efficient transportation option for the citizens. The use of non congenital fuels, subways, metro trains and bus rapid transit systems can ease the congestion of the traffic in the major towns and discourage the use of personal vehicles leading to the reduction of ownership as well as frequency of travel over a period of time.

Table: 1



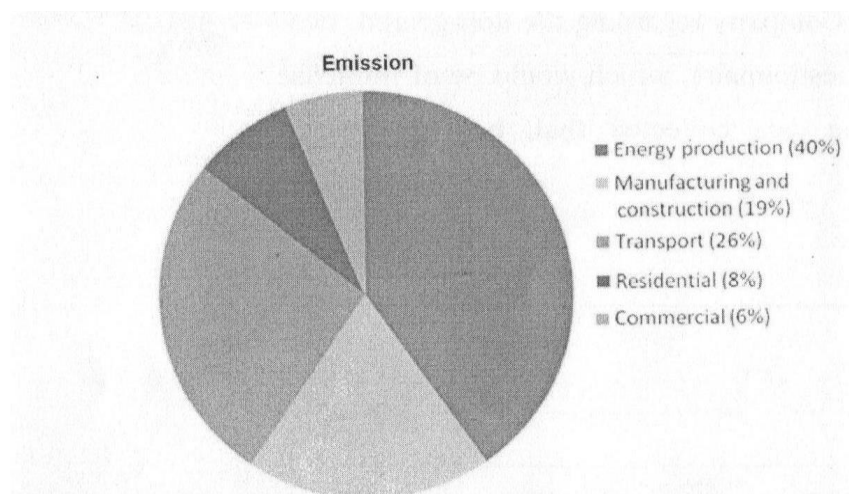
(Growth of motor vehicle fleet by type from 1951 -2001 in millions, source: Ministry of Road Transport and Highways, 2004)

Table: 1 Forecast of vehicle population in India (in millions)

Population	2005	2008	2015	2025	2035
2-W	35.8	46.1	87.7	174.1	236.4
3-W	2.3	3.0	5.3	8.8	13.1
HCV	2.4	2.9	4.6	9.1	16.2
LCV	2.4	3.2	5.7	12.5	26.9
Car, SUV	6.2	8.8	18.0	41.6	80.1
Grand total	49.1	63.9	121.3	246.1	372.7

(Note: 2 -W, Two wheeler, 3-W, Three wheeler, HCV, Heavy commercial vehicle, LCV, Light commercial Vehicle, SUV, Sports utility vehicle, Source: Lohia)

Figure: 2 Sector wise carbon emissions



(Source: IEA, 2000.)

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