



International Journal of Architecture and Planning

Publisher's Home Page: <https://www.svedbergopen.com/>



Research Paper

Open Access

Sustainable and Effective Mode of Non Motorized Transport System for Patna City

Pranay Kumar¹, Manpreet Singh Saini², and Prakash Mahto^{3*}

¹Masters of Urban and Regional Planning, Lovely Professional University, Punjab 144001, India. E-mail: pranaysingh1410@gmail.com

²Assistant Professor, Department of Urban Planning, School of Architecture and Design, Lovely Professional University, Punjab 144001, India. E-mail: manpreet.25200@lpu.co.in

³Assistant Professor, Department of Urban Planning, School of Architecture and Design, Lovely Professional University, Punjab 144001, India. E-mail: prakash.25173@lpu.co.in

Article Info

Volume 2, Issue 1, March 2022

Received : 12 October 2021

Accepted : 17 February 2022

Published : 05 March 2022

doi: [10.51483/IJARP.2.1.2022.37-43](https://doi.org/10.51483/IJARP.2.1.2022.37-43)

Abstract

The demand for a growing population leads to urbanization, which also makes the growth of transportation in the urban areas. Non-motorized transport plays a crucial role in urban transportation planning. Non-motorized transport serves as a feeder for motorized transportation that requires proper planning. Being the capital city of Bihar, Patna is growing spatially which impacts the growth of transportation. Therefore, the success of public transport relies on dependency on non-motorized transport that acts as a feeder to public transport stops/terminals. Patna noticed a decrease from 13% in 1996 to 4.8% in 2008 (CMP 2009) in public transport due to lack of infrastructure and poor planning of non-motorized transport. The objective of this research is to discuss issues, as well as the current non-motorized status, and highlights the measures to improve in the neighborhood of Patna.

Keywords: Non-motorized transport, Sustainable mobility, Pedestrian

© 2022 Pranay Kumar et al.. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

1. Introduction

India's growing population and urbanization are leading to an increase in the registration of motor vehicles. Because of the growing dependency on motorized vehicles, the movement of motorized vehicles in cities and towns is also rising (Vedant, 2014). The number of people who have privately owned vehicles appears to harm other road users, particularly pedestrians, non-motorized users, and public transportation users. In the context of India, the population coverage of non-motorized transport in Delhi has decreased in recent years, from 59% in 1980 to 39% in 2005 (Deepty and Geetam, 2016). And only the Lower Income Group (LIG) uses non-motorized transport for daily transportation. Low-income families rely on these modes to get to work, school, and other necessities. If non-motorized transportation is raised by 1% over motorized transportation in India, it will certainly benefit people by improving their health and saving up in

* Corresponding author: Prakash Mahto, Assistant Professor, Department of Urban Planning, School of Architecture and Design, Lovely Professional University, Punjab 144001, India. E-mail: prakash.25173@lpu.co.in

2788-5046/© 2022. Pranay Kumar et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

their daily expenditure. Non-motorized transportation has health benefits, but the use of non-motorized transport is getting declined overtime the period because of rising income and the poor availability of infrastructure which is not appropriate to entertain. Often the users are also chained to non-motorized transport, they can't afford other modes to rely on. After which to commuting across larger distances, some users rely on walking and bicycle (Mohan and Tiwari, 2000).

2. India Transport Scenario

With the increase in urban population and people's traveling demand in India, most metropolitan cities in India have seen a threefold increase in vehicles in the last 23 years. The demand for intercity travel will increase by 4.3 times between 2010 and 2050. This demand will be satisfied through road-based transportation, as is standard practice (Dhar et al., 2015). From the previous few years, total road space availability for motorized vehicles has fallen from 0.18 km per vehicle to 0.01 km per vehicle (NTDCP Final Report, 2014). In a metropolitan region like Mumbai, the accessibility, mobility, and travel demand of 80% of the population is met by public transportation, whereas only 20% of the population uses two-wheeler/NMT cars (Das and Parikh, 2004). Many communities have not been able to meet the demand for transportation. The fundamental reason for this is current modal split imbalances in Indian cities, as well as inadequate transportation infrastructure and its inefficient utilization (Jain et al., 2010).

3. The Sustainable Mode Of Transportation – Non-Motorized Transport

In comparison to motorized transportation, non-motorized transportation uses very low-cost infrastructure. Non-motorized transportation stands for “non-polluting” or “environmentally friendly” mode of transportation (Luthra, 2002). Users of non-motorized transportation modes do not incur the same significant costs as users of motorized modes. Non-motorized transportation is a population-healthy mode, or it is beneficial to people's health (Harcharan Singh, 2018). The non-motorized transport modes played a significant impact in India's large and medium cities. In Delhi, 51% of excursions were made on foot, while 46% in Ahmadabad, 42% in Lucknow, 34% in Madurai, and 38% in Cochin were made on foot. The non-motorized transportation percentage of vehicle journeys varied greatly: 49% in Lucknow, 26% in Ahmedabad, 19% in Madurai, 8% in Delhi, and 5% in Cochin. In the medium-sized cities of Patna and Jaipur, pedestrian trips accounted for 35.5% and 39.5%, respectively, while bicycles and rickshaws accounted for 31.1% and 29.2% (CRRRI Reports, 1986-1988). Except in Chennai and Patna, a trend study in seven Indian cities shows that the modal share of NMT has been dropping since the 1980s (Figure 1). Excursions on bicycles and trips on foot follow different patterns.

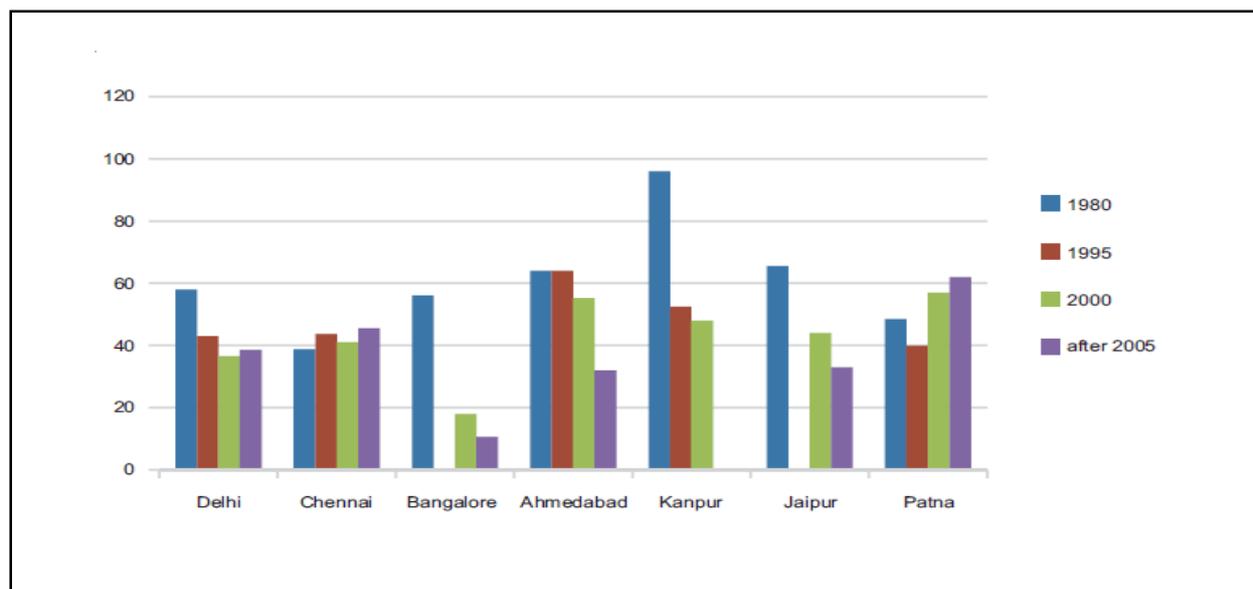


Figure 1: Trends in Modal Share of NMT (Walking and Bicycle) since the 1980s

Source: Compiled from various sources – Delhi Metro Rail Corporation 2011; Leather et al. (2011); Itrans (2009); Cept University (2008); Rites (2008); State Level Committee on Road Connectivity & Traffic Improvements (2008); Tiwari and Jain (2008); Wilbur Smith Associates (2008); Rites (2007); Department of Urban Development (2006); Tiwari (2001); Rites (1998a); Replogle (1992); Maunder and Four acres (1989); Pendakur (1988)

Since 1990, the bicycle modal share in Chennai has stayed steady, whereas the proportion of bicycles in Patna has increased. Since 2000, the rate of increase has slowed (Modal share after 2005 refers to different periods as – Delhi (2007), Chennai (2005), Bangalore (2007), Ahmedabad (2008), Jaipur (2011), and Patna (2009)).

4. Non-Motorized Transport Demand Factors

The demand for NMT is rising due to many factors, having a comprehensive approach of benefitting the environment and local community or neighborhood. Some of the factors are listed below (Anand, 2000):

- Topography: In flat locations, cycling, rickshaws, and pedestrian activities are more prevalent than in steep areas.
- Landuse and Urban Activities: NMTs are generally utilized for short-distance journeys in the local area. As a result, the distance between origin and destination (for example, houses and schools, homes and shops) has a significant impact on demand, particularly among the young and elderly.
- The nature of the local community: In a community with a large proportion of young people, cycling, rickshaws, and walking are more likely to occur.
- Quality of Service: If high-quality pedestrian and cyclist facilities are available, demand is likely to rise.
- Safety and Security: Pedestrians and bikers must believe that the facilities are safe and secure. This entails a lack of conflict with motor vehicles, a low risk of personal attack, and a low chance of stumbling. There is also the security of a parked bicycle at the journey’s destination for cyclists.

5. Study Area

Patna City is an important administrative and educational center on the Ganga’s south bank in Bihar. According to the 2011 census, Patna had a population of 20.46 lakh people. Patna Municipal Corporation (PMC) is the state’s largest corporation, accounting for 44.1% of the population of the state’s seven companies and 20% of the state’s total urban population. The PMC has a population density of 137.40 people per hectare (pph). The tertiary sector of the Patna Urban Area’s economy is dominated by commerce, administration, urban services, and community facilities such as health, education, and recreation (Secondary Data, PMC).

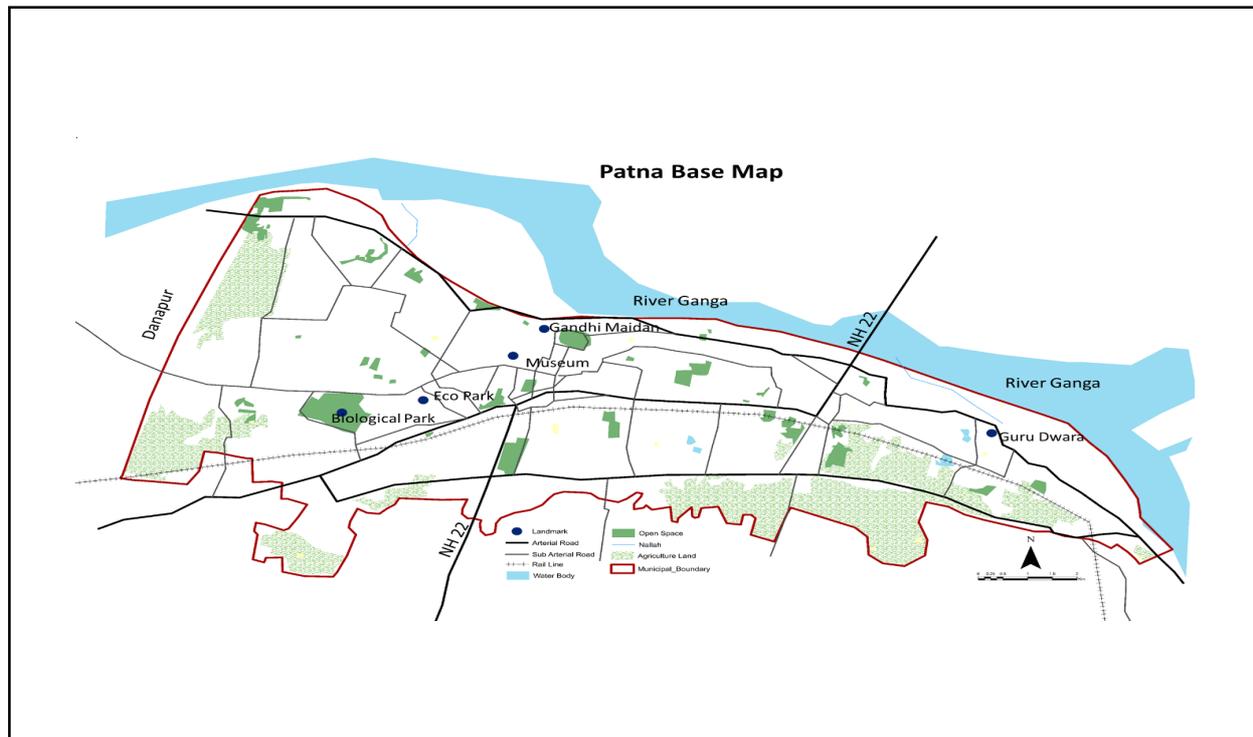


Figure 2: Patna Municipal Area and Study Area

The study area (Figure 2), is identified at a scale of the neighborhood in the municipal area of Patna. It lies under zone number 1 and comes in ward no 27, with a population density of up to 300 persons per hectare. The study is identified based on the existing character, land use, and the urban activity of the area. It consists of mixed land use, with a high density of commercial, residential and educational. The identified area is also having the character and identity of old Patna city, as the growth of the city started happening from the side of the river. The area is rich in high congestion and encroachment. The area is having major educational (NIT Patna, Patna University, Law College, Dental College, etc., and hospital (PMCH), and a high density of commercial land use and activities.

6. Data Collection

Every neighborhood has its own mix of socioeconomic factors. The regional distribution of work and housing options, as well as the transportation services that are appropriate for each of these socioeconomic classes, differ significantly. The household survey used a stratified random sampling technique to assess activity patterns. There are two components to the questionnaire form. The first section (Table 1) comprises the household's socioeconomic factors, while the second section (Table 2) offers individual travel information. The analysis was carried out at the household level, with the mode-wise share of travels for work, education, and other purposes estimated for each group of households (Table 3). The modal divide has also been determined, both in terms of purpose and mode.

Sample Size: Total population of ward 27 is 18, 885. As per random sampling method over 500 households were taken under primary survey in order to derive the modal split scenario in the neighborhood. The purpose and mode were undertaken in order to proceed with further analysis.

Veh. Ownership (%)	Household's Monthly Income (₹)				
	<10,000	10,001 – 20,000	20,001 – 30,000	30,001 – 40,000	>40,001
No Vehicle	36.89	20.56	6.55	0	0
Cycle	41.66	22.29	35.62	12.6	10.53
MTW	21.45	33.11	39.71	27.59	29.2
Car	-	-	5.3	10.2	21.78
Cycle + Car	-	24.04	12.82	15.81	5.64
Cycle + MTW	-	-	-	8.9	10.2
MTW + Car	-	-	-	7.8	12.04
Cycle + MTW + Car	-	-	-	17.1	10.61
Total	100	100	100	100	100

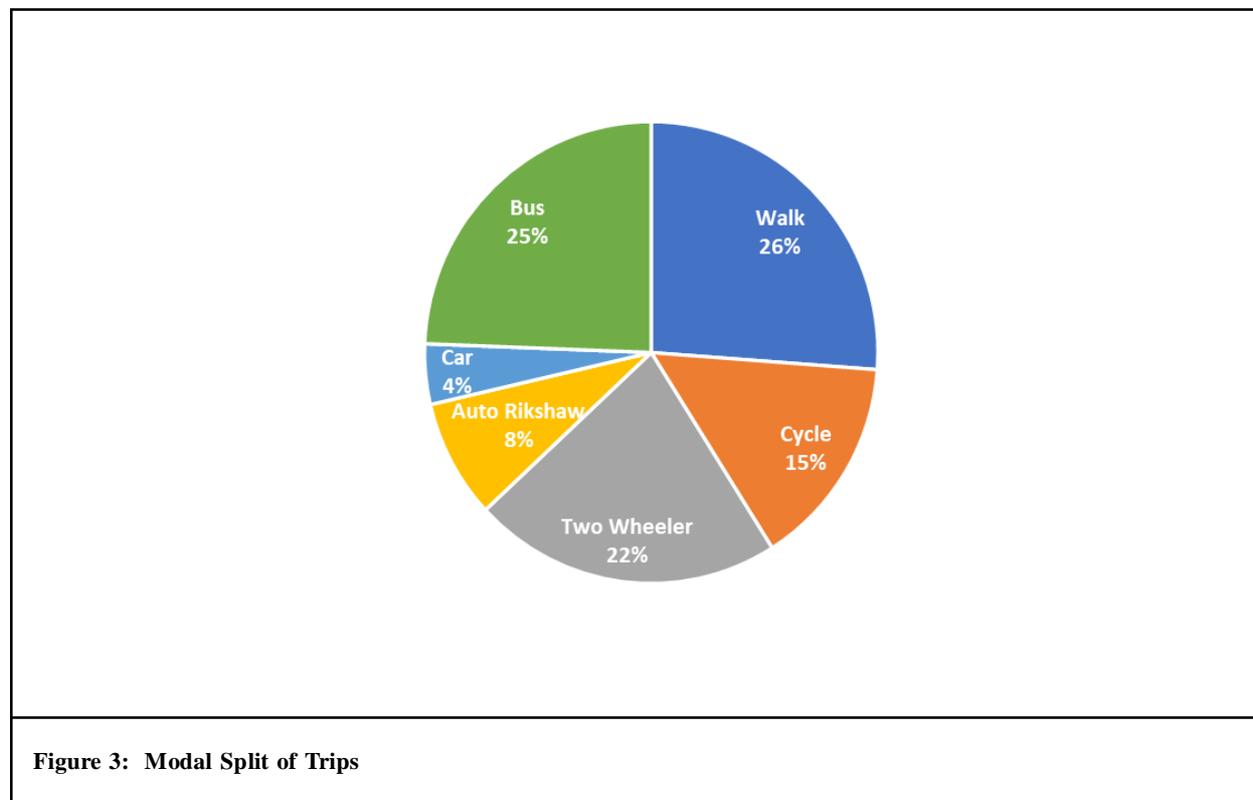
Note: WT: Work Trip, ET: Education Trip, OT: Other Trip, TT: Total Trips.

Mode	Trip Type			
	WT/Household	ET/Household	OT/Household	TT/Household
Walk	0.480459	0.62	0.178	1.548
Cycle	0.532588	0.33	0.077	0.879
Two Wheeler	0.725658	0.15	0.211	1.302
Auto Rickshaw	0.132556	0.3	0.089	0.492
Car	0.129662	0.06	0.065	0.25
Bus	0.635544	0.65	0.256	1.442
Total	2.636467	2.11	0.876	5.913

Note: WT: Work Trip, ET: Education Trip, OT: Other Trip, TT: Total Trips.

Table 3: Percent of Trips as per the Mode and Purpose				
Mode	WT (%)	ET (%)	OT (%)	Total Trips (%)
Walk	18.2235924	29.38389	20.31963	26.1796
Cycle	20.2008218	15.63981	8.789954	14.86555
Two Wheeler	27.5238795	7.109005	24.08676	22.01928
Auto Rickshaw	5.02778908	14.21801	10.15982	8.320649
Car	4.91802097	2.843602	7.420091	4.227972
Bus	24.1058963	30.80569	29.22374	24.38694
Total	100	100	100	100

Note: WT: Work Trip, ET: Education Trip, OT: Other Trip, TT: Total Trips.



The modal split comparison (Figure 3) shows the percent of mode for various purposes. As the ownership and the use of motorized two-wheelers has grown, cycling has become less popular. According to the study, 26% of people walk and 15% of people cycle. According to the primary study, non-motorized modes of transportation account for approx. half of all trips 41% and private vehicles and public transportation account for roughly equal shares 26% and 25%, respectively.

7. Recommendation

The weaker parts of the urban population who depend on nonmotorized modes of transportation are also more prone to road accidents, as pedestrian and cyclists constitute the majority of those killed or injured in city vehicle accidents. The following measures are suggested to improve the current state of NMT modes: In traffic and transportation management, these modes should be treated as preferred means of transportation. It should be easy and convenient to walk or ride a bicycle thanks to transportation and traffic management. The separation of road space into footpaths, bike paths, and motor routes, as well as suitable provision for NMT movement over road crossings and intersections, are the most important needs. NMT should have direct, safe, and comfortable movement thanks to traffic signaling and other safeguards. A good transportation model that can prepare for a mix of mass transit and NMT can result in a better

city. Motorized transportation has significant external, social, and strategic costs when compared to NMT. These costs include the obvious expenses of pollution and environmental damage, as well as the costs of accidents, congestion, infrastructure, and land.

8. Conclusion

By enhancing non-polluting mobility in metropolitan settings as a sustainable mode of transportation, people's movement behavior through motorized cars is reduced and non-motorized vehicle mobility increases. With the development of alternate transportation modes, the increase and usage of motorized cars must be curtailed. Non-motorized vehicles can help bridge the gap between walking and driving. Pedestrians are the city's most underappreciated road users. The use of non-motorized forms of transportation, and the bicycles should be encouraged by providing appropriate infrastructure for their safe and efficient passage across high-density corridors.

References

- Advani M. and Tiwari, G. (2006a). [Bicycle – As a Feeder Mode for Bus Service](#). In [Velo Mondial Conference: Third Global Cycling Planning Conference](#).
- Anand, Y.P. (2000). [Non Motorized Transport in Urban India: An Overview](#). *Urban Transport Journal*, 6(7), 69-79.
- Bihar Urban Development, A. (2006). [City Development Plan for Patna under JNNURM](#). Jawaharlal Nehru National Urban Renewal Mission, Ministry of Urban Development.
- Central Road Research Institute Reports. (CRRI). (1986-1988).
- Cept University. (2008). [Ahmedabad System Plan: Phase-II, Volume II: Detailed Project Report](#). Ahmedabad Municipal Corporation, Ahmedabad.
- Das, A. and Parikh, J. (2004). [Transport Scenarios in Two Metropolitan Cities in India: Delhi and Mumbai](#). *Energy Conversion and Management*, 45 (15-16), 2603-2625.
- Deepty. and Geetam (2013). [UNEP – Promoting Low Carbon Transport in India](#).
- Deepty, Jain. and Geetam, Tiwari. (2016). [Impact of Non-Motorized Transport and Public Transport Infrastructure on Travel Behavior, Energy Consumption and CO₂ Emissions – Delhi, Pune and Patna](#).
- Delhi Metro Rail Corporation. (2011). [Detailed Project Report- Jaipur Metro \(Phase-I\)](#). Jaipur Development Authority.
- Delhi Pedestrian Design Guidelines. (2009). www.uttipeec.nic.in/PedestrianGuidelines-30Nov09-UTTPEC-DDA.pdf
- Dhar et al. (2015). [UNEP – Low Carbon Scenario for Transport in India](#). *Energy Policy*, 81, 186-198.
- Dinesh, Mohan. and Geetam, Tiwari. (2000). [Sustainable Transport System – Linkages Between Environmental Issues, Public Transport, Non Motorised Transport and Safety](#). *Economic and Political Weekly*, 34(25), 1589-1596.
- Harcharan, Singh. (2018). [Sustainable Urban Neighbourhood With Effective Non-Motorised Transportation](#). 544 (277-291).
- Islam, Ghonimi. and Hassan, El Zamly. (2017). [Sustainable Urban mobility: Assessing Different Neighbourhood Models in Greater Cairo Region, Egypt](#).
- Itrans. (2009). [Comprehensive Mobility Plan, Patna](#). Bihar Rajya Pul Nirman Nigam Ltd.
- Jain, H., Tiwari, G and Zuidgeest, M. (2010). [Evaluating Bicyclists Comfort and Safety Perception](#), World Conference On Transportation Research (WCTR), Lisbon, July 11-15, 2010.
- Leather, J., Fabian, H., Gota, S. and Mejia, A. (2011). [Walkability and Pedestrian Facilities in Asian Cities: State and Issues](#). ADB Sustainable Development Working Paper Series, 17.
- Luthra, A. (2002). [Sustainable Transport Policy for Medium and Small Cities of India](#), Proceedings of National Conference on Transportation Systems, I.I.T., New Delhi.
- Maunder, D.A.C. and Four acre, P.R. (1989). [Non-motorized Transport in Third World Countries](#). Institute of British Geographers Annual conference on Managing our Environment, 3-6 January 1989. Coventry, Transport Research Laboratory.
- NMT Policy of India. (2013). [Federal Ministry of Economic Cooperation and Development \(PDF\)](#).

- Pendakur, V.S. (1988). *Non-motorised urban transport in India*, In Transportation Research Board, 67th Annual Meeting, Washington, DC.
- Promoting NMT in Asian Cities. [Policymakers Toolbox \(pdf\)](#).
- Report. (2014). [National Transport Development Policy Committee](#). Government of India.
- Review of Urban Transport in India. (2014). [Institute of Urban Transport \(India\)](#).
- Rites. (1998a). *Traffic Characteristics in Indian Cities*. Ministry of Urban Development, Government of India.
- Rites. (2007). *Comprehensive Traffic and Transportation Study for Bangalore City*.
- Rites. (2008). *Delhi survey 2005-2006*.
- Roychowdhury and Rahul et al. (2013). [Non-Motorized Transportation \(PDF\)](#).
- Siddharthkumar, Lukhi, B.B. and Bhatt, Himanshu, J. Padhya. (2021). [Comprehension of NMT in Delhi Master Plan 2021 \(pdf\)](#).
- Sinha, H.K., Sinha, P. and Sinha, J.N.P. (1995). Transportation in Midsized City with Special Reference to Patna: Obvious Problems and Possible Solutions. Proceedings International Conference on New Horizons in Roads and Road Transport (ICORT-95), University of Roorkee.
- [Slideshare.net/Sherchan92/neighbourhood-planning-6016360](#).
- State Level Committee on Road Connectivity & Traffic Improvements. (2008). *Highlights and Recommendations of The State Level Committee on Road Connectivity & Traffic Improvements in Chennai*. Chennai Metropolitan Development Authority, Chennai.
- Tiwari, G. (2002). Urban Transport Priorities: Meeting the Challenge of Socio-Economic Diversity in Cities, A Case Study of Delhi, India. *Cities*, 19(2), 95-103.
- Tiwari, G. and Jain, H. (2008). Bicycles in Urban India. *IUT Journal*, 59-68.
- Vedant, S. Goyal. (2014). [Planning For Non-Motorized Transport In Urban Areas, National Capacity Building Workshop for Sustainable and Inclusive Development, August 12-13, 2014, Dhaka, Bangladesh](#)
- Wilbur Smith Associates. (2008). [Study on traffic and transportation: Policies and strategies in urban areas in India. Ministry of Urban Development.](#)